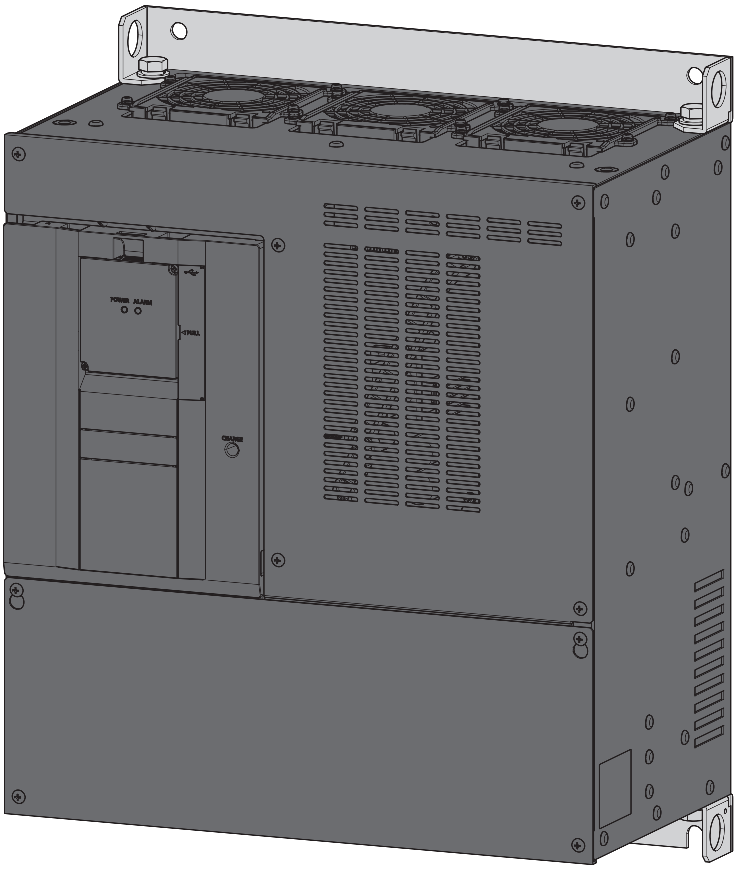
INVERTER
FR-F800
FR-F860 (600V CLASS SPECIFICATION INVERTER)
INSTRUCTION MANUAL (DETAILED)

Inverter for fans and pumps

FR-F860-00027 to 00450-N6
FR-F860-00680 to 04420
FR-F862-05450 to 08500



Safety Instructions

Thank you for choosing this Mitsubishi Electric inverter.

This Instruction Manual provides instructions for advanced use of the FR-F860 series inverters.

Incorrect handling might cause an unexpected fault. Before using this inverter, always carefully read this Instruction Manual and the Instruction Manual (Startup) packed with the product to use this product correctly.

Do not attempt to install, operate, maintain or inspect the product until you have read through this Instruction Manual and appended documents carefully and can use the equipment correctly. Do not use this product until you have a full knowledge of the equipment, safety information and instructions.

Installation, operation, maintenance and inspection must be performed by qualified personnel. Here, an expert means a person who meets all the conditions below.

- A person who took a proper engineering training. Such training may be available at your local Mitsubishi Electric office. Contact your local sales office for schedules and locations.
- A person who can access operating manuals for the protective devices (e.g. light curtain) connected to the safety control system. A person who has read and familiarized himself/herself with the manuals.

In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION"

⚠WARNING	**Incorrect handling may cause hazardous conditions, resulting in death or severe injury.**
⚠CAUTION	**Incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause only material damage.**

Note that even the ⚠ **CAUTION** level may even lead to a serious consequence according to conditions. Be sure to follow the instructions of both levels as they are critical to personal safety.

Electric Shock Prevention

⚠WARNING

- While the inverter power is ON, do not remove the front cover or the wiring cover. Do not run the inverter with the front cover or the wiring cover removed, as accidental contact with exposed high-voltage terminals and internal components may occur, resulting in an electrical shock.
- Even if power is OFF, do not remove the front cover except for wiring or periodic inspection. You may accidentally touch the charged inverter circuits and get an electric shock.
- Before wiring or inspection, the power lamp must be switched OFF. Any person who is involved in wiring or inspection shall wait for at least 10 minutes after the power supply has been switched OFF and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power OFF, and it is dangerous.
- This inverter must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical code (NEC section 250, IEC 61140 class 1 and other applicable standards).
- Any person who is involved in wiring or inspection of this equipment shall be fully competent to do the work.
- The inverter must be installed before wiring. Otherwise you may get an electric shock or be injured.
- Setting dial and key operations must be performed with dry hands to prevent an electric shock. Otherwise you may get an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Doing so may cause an electric shock.
- Do not change the cooling fan while power is ON. It is dangerous to change the cooling fan while power is ON.
- Do not touch the printed circuit board or handle the cables with wet hands. Doing so may cause an electric shock.
- When measuring the main circuit capacitor capacity, the DC voltage is applied to the motor for 1s at powering OFF. Never touch the motor terminal, etc. right after powering OFF to prevent an electric shock.
- A PM motor is a synchronous motor with high-performance magnets embedded in the rotor. Motor terminals holds high-voltage while the motor is running even after the inverter power is turned OFF. Before wiring or inspection, the motor must be confirmed to be stopped. In an application, such as fan and blower, where the motor is driven by the load, a low-voltage manual motor starter must be connected at the inverter's output side, and wiring and inspection must be performed while the motor starter is open. Otherwise you may get an electric shock.

Fire Prevention

⚠CAUTION

- Inverter must be installed on a nonflammable wall without holes (so that nobody touches the inverter heat sink on the rear side, etc.). Mounting it to or near flammable material may cause a fire.
- If the inverter has become faulty, the inverter power must be switched OFF. A continuous flow of large current may cause a fire.
- Do not connect a resistor directly to the DC terminals P/+ and N/-. Doing so could cause a fire.
- Be sure to perform daily and periodic inspections as specified in the Instruction Manual. If a product is used without any inspection, a burst, breakage, or a fire may occur.

Injury Prevention

⚠CAUTION

- The voltage applied to each terminal must be the ones specified in the Instruction Manual. Otherwise an explosion or damage may occur.
- The cables must be connected to the correct terminals. Otherwise an explosion or damage may occur.
- The polarity (+ and -) must be correct. Otherwise an explosion or damage may occur.
- While power is ON or for some time after power-OFF, do not touch the inverter as it will be extremely hot. Touching these devices may cause a burn.

Additional Instructions

The following instructions must be also followed. If the product is handled incorrectly, it may cause unexpected fault, an injury, or an electric shock.

⚠CAUTION

Transportation and installation

- Any person who is opening a package using a sharp object, such as a knife and cutter, must wear gloves to prevent injuries caused by the edge of the sharp object.
- The product must be transported in correct method that corresponds to the weight. Failure to do so may lead to injuries.
- Do not stand or rest heavy objects on the product.
- Do not stack the boxes containing inverters higher than the number recommended.
- When carrying the inverter, do not hold it by the front cover; it may fall off or fail.
- During installation, caution must be taken not to drop the inverter as doing so may cause injuries.
- The product must be installed on the surface that withstands the weight of the inverter.
- Do not install the product on a hot surface.
- The mounting orientation of the inverter must be correct.
- The inverter must be installed on a strong surface securely with screws so that it will not drop.
- Do not install or operate the inverter if it is damaged or has parts missing.
- Foreign conductive objects must be prevented from entering the inverter. That includes screws and metal fragments or other flammable substance such as oil.
- As the inverter is a precision instrument, do not drop or subject it to impact.
- For the FR-F860-00090 or lower, the surrounding air temperature must be -10 to +30°C for the SLD rating (-10 to +40°C for the LD rating) (non-freezing). Otherwise the inverter may be damaged.
- For the FR-F860-00170 to 01080, the surrounding air temperature must be -10 to +40°C (non-freezing). Otherwise the inverter may be damaged.
- For the FR-F860-01440 or higher, the surrounding air temperature must be -10 to +40°C for the SLD rating (-10 to +50°C for the LD rating) (non-freezing). Otherwise the inverter may be damaged.
- The ambient humidity must be 95%RH or less (non-condensing). Otherwise the inverter may be damaged. (Refer to page 31 for details.)

⚠CAUTION

Transportation and installation

- The storage temperature (applicable for a short time, e.g. during transit) must be between -20 and +65°C. Otherwise the inverter may be damaged.
- The inverter must be used indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.) Otherwise the inverter may be damaged.
- This product must be used at an altitude of 2500 m or less, with 5.9 m/s^2 or less vibration[*1] at 10 to 55 Hz (directions of X, Y, Z axes). Otherwise the inverter may be damaged. (For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.)
- If halogen-based materials (fluorine, chlorine, bromine, iodine, etc.) infiltrate into a Mitsubishi Electric product, the product will be damaged. Halogen-based materials are often included in fumigant, which is used to sterilize or disinfest wooden packages. When packaging, prevent residual fumigant components from being infiltrated into Mitsubishi Electric products, or use an alternative sterilization or disinfection method (heat disinfection, etc.) for packaging. Sterilization of disinfection of wooden package should also be performed before packaging the product.

Wiring

- Do not install a power factor correction capacitor or surge suppressor/capacitor type filter on the inverter output side. These devices on the inverter output side may be overheated or burn out.
- The output side terminals (terminals U, V, and W) must be connected correctly. Otherwise the motor will rotate inversely.
- PM motor terminals (U, V, W) hold high-voltage while the PM motor is running even after the power is turned OFF. Before wiring, the PM motor must be confirmed to be stopped. Otherwise you may get an electric shock.
- Never connect a PM motor to the commercial power supply. Applying the commercial power supply to input terminals (U, V, W) of a PM motor will burn the PM motor. The PM motor must be connected with the output terminals (U, V, W) of the inverter.

Test operation

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

*1 2.9 m/s2 or less for the FR-F860-02890 or higher.

⚠WARNING

Usage

- Stay away from the equipment after using the retry function in this product as the equipment will restart suddenly after the output shutoff of this product.
- Since pressing the STOP/RESET key may not stop output depending on the function setting status, separate circuit and switch that make an emergency stop (power OFF, mechanical brake operation for emergency stop, etc.) must be provided.
- OFF status of the start signal must be confirmed before resetting the inverter fault. Resetting inverter fault with the start signal ON restarts the motor suddenly.
- Do not use a PM motor for an application where the PM motor is driven by its load and runs at a speed higher than the maximum motor speed.
- Use this inverter only with three-phase induction motors or with a PM motor. Connection of any other electrical equipment to the inverter output may damage the equipment.
- Do not modify the equipment.
- Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the product.

⚠CAUTION

Usage

- 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. Doing so may shorten the life of this product.
- The effect of electromagnetic interference must be reduced by using a noise filter or by other means. Otherwise nearby electronic equipment may be affected.
- Appropriate measures must be taken to suppress harmonics. Otherwise power supply harmonics from the inverter may heat/damage the power factor correction capacitor and generator.
- When driving a 600 V class motor by the inverter, the motor must be an insulation-enhanced motor or measures must be taken to suppress surge voltage. Surge voltage attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all parameter clear is performed, the required parameters must be set again before starting operations because all parameters return to their initial values.
- The inverter can be easily set for high-speed operation. Before changing its setting, the performances of the motor and machine must be fully examined.
- Stop status cannot be hold by the inverter's brake function. In addition to the inverter’s brake function, a holding device must be installed to ensure safety.
- Before running an inverter which had been stored for a long period, inspection and test operation must be performed.
- Static electricity in your body must be discharged before you touch the product.
- Only one PM motor can be connected to an inverter.
- A PM motor must be used under PM motor control. Do not use a synchronous motor, induction motor, or synchronous induction motor.
- Do not connect a PM motor in the induction motor control settings (initial settings). Do not use an induction motor in the PM motor control settings. It will cause a failure.
- In the system with a PM motor, the inverter power must be turned ON before closing the contacts of the contactor at the output side.
- To maintain the security (confidentiality, integrity, and availability) of the inverter and the system against unauthorized access, DoS*2 attacks, computer viruses, and other cyberattacks from external devices via network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions. We shall have no responsibility or liability for any problems involving inverter trouble and system trouble by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.
- When the emergency drive operation is performed, the operation is continued or the retry is repeated even when a fault occurs, which may damage or burn the inverter and motor. Before restarting the normal operation after using the emergency drive function, make sure that the inverter and motor have no fault.

*2 DoS: A denial-of-service (DoS) attack disrupts services by overloading systems or exploiting vulnerabilities, resulting in a denial-of-service (DoS) state.

⚠CAUTION

Emergency stop

- A safety backup such as an emergency brake must be provided for devices or equipment in a system to prevent hazardous conditions in case of failure of this product or an external device controlling this product.
- When the breaker on the inverter input side trips, the wiring must be checked for fault (short circuit), and internal parts of the inverter for a damage, etc. The cause of the trip must be identified and removed before turning ON the power of the breaker.
- When a protective function activates, take an appropriate corrective action, then reset the inverter, and resume the operation.

Maintenance, inspection and parts replacement

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

Disposal

- The inverter must be treated as industrial waste.

General instruction

- For clarity, illustrations in this Instruction Manual may be drawn with covers or safety guards removed. Ensure all covers and safety guards are properly installed prior to starting operation. For details on the PM motor, refer to the Instruction Manual of the PM motor.

MEMO

CHAPTER 1 INTRODUCTION

1 INTRODUCTION

The contents described in this chapter must be read before using this product.
Always read the instructions before using the equipment.
For the INTRODUCTION of the separated converter type, refer to the FR-F802 (Separated Converter Type) Instruction Manual (Hardware).

◆ Abbreviations

Item	Description
DU	Operation panel (FR-LU08)
Operation panel	Operation panel (FR-LU08)
Parameter unit	Parameter unit (FR-PU07)
PU	Operation panel and parameter unit
Inverter	Mitsubishi Electric inverter FR-F860 series
Pr.	Parameter number (Number assigned to function)
PU operation	Operation using the PU (operation panel/parameter unit)
External operation	Operation using the control circuit signals
Combined operation	Combined operation using the PU (operation panel/parameter unit) and External operation

◆ Trademarks

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- Other company and product names herein are the trademarks and registered trademarks of their respective owners.

◆ Notes on descriptions in this Instruction Manual

- Connection diagrams in this Instruction Manual appear with the control logic of the input terminals as sink logic, unless otherwise specified. (For the control logic, refer to page 54.)

1.1 Product checking and accessories

Unpack the product and check the rating plate and the capacity plate of the inverter to ensure that the model agrees with the order and the product is intact.

◆ Inverter model

- FR-F860-00450 or lower

FR - F8 6 0 - 00027 - E3 - N6

Symbol	Voltage class
6	600 V class

Symbol	Description
00027 to 00450	Inverter SLD rated current (A)

Symbol	Type
E3	CA3

Symbol	Circuit board coating (conforming to IEC 60721-3-3: 1994 3C2/3S2)	Plated conductor	UL Type 1 certification
N6	With	Without	With

- FR-F860-00680 or higher

Symbol	Structure, functionality
0	Standard model
2	Separated converter type

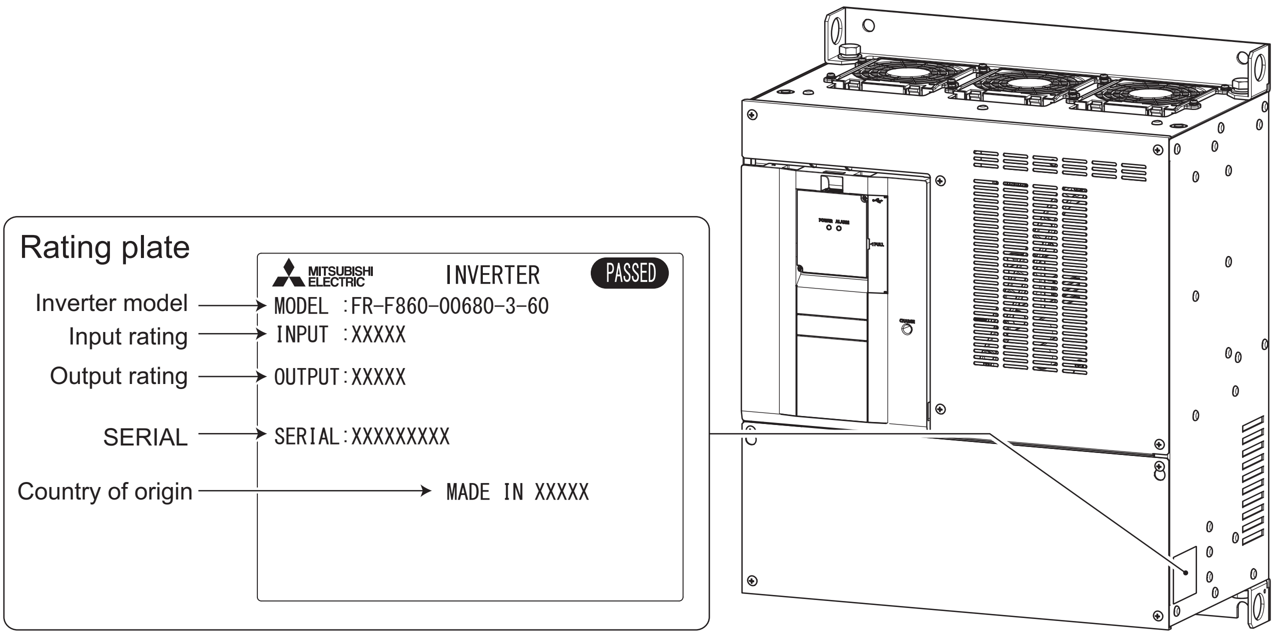
Symbol	Type
3	CA3

FR - F8 6 0 - 00680 - 3 - 60

Symbol	Voltage class
6	600 V class

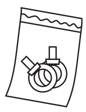
Symbol	Description
00680 to 08500	Inverter SLD rated current (A)

Symbol	Circuit board coating (conforming to IEC 60721-3-3: 1994 3C2/3S2)	Plated conductor
60	With	Without
06	With	With



◆ Accessory

- Eyebolt for hanging the inverter



Capacity	Eyebolt Size	Quantity
FR-F860-02890, 03360	M10	2
FR-F860-04420	M12	2

◆ How to read the SERIAL number

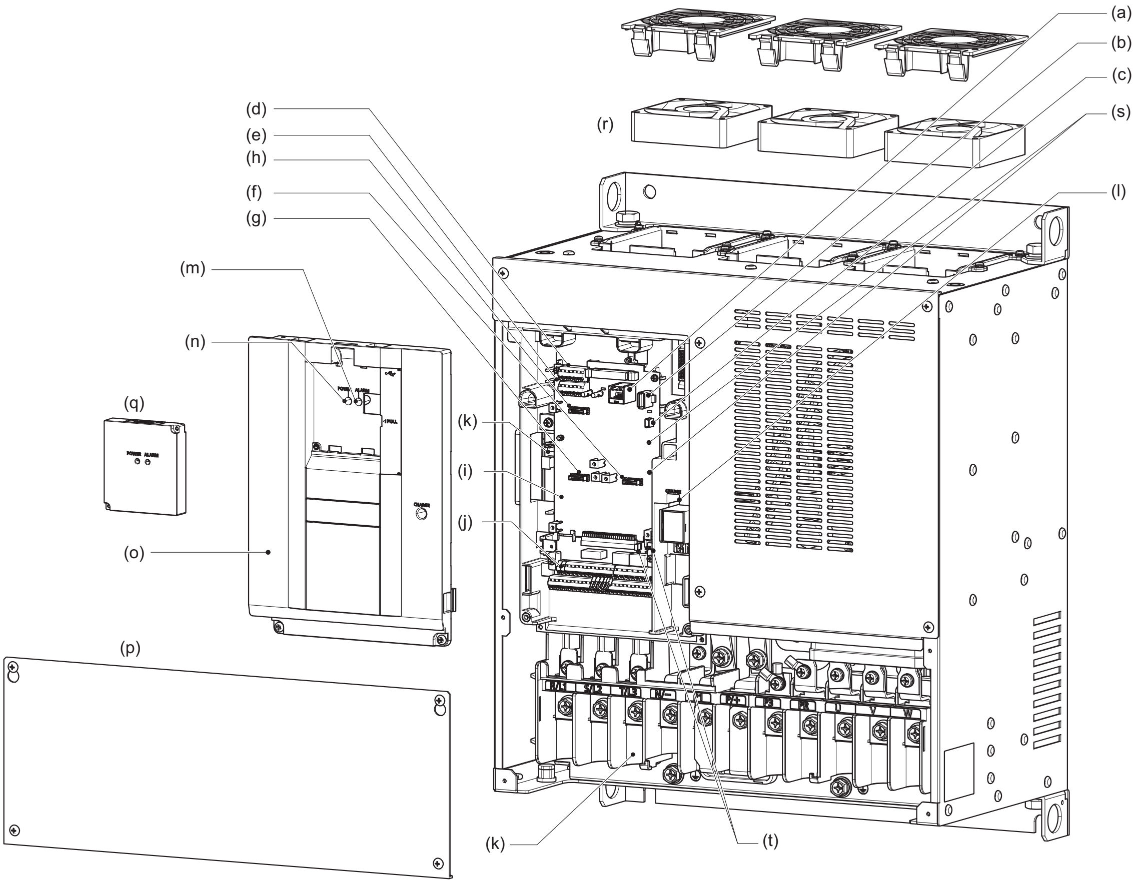
Rating plate example

□ ○ ○ ○○○○○○
Symbol Year Month Control number
SERIAL

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

1.2 Component names

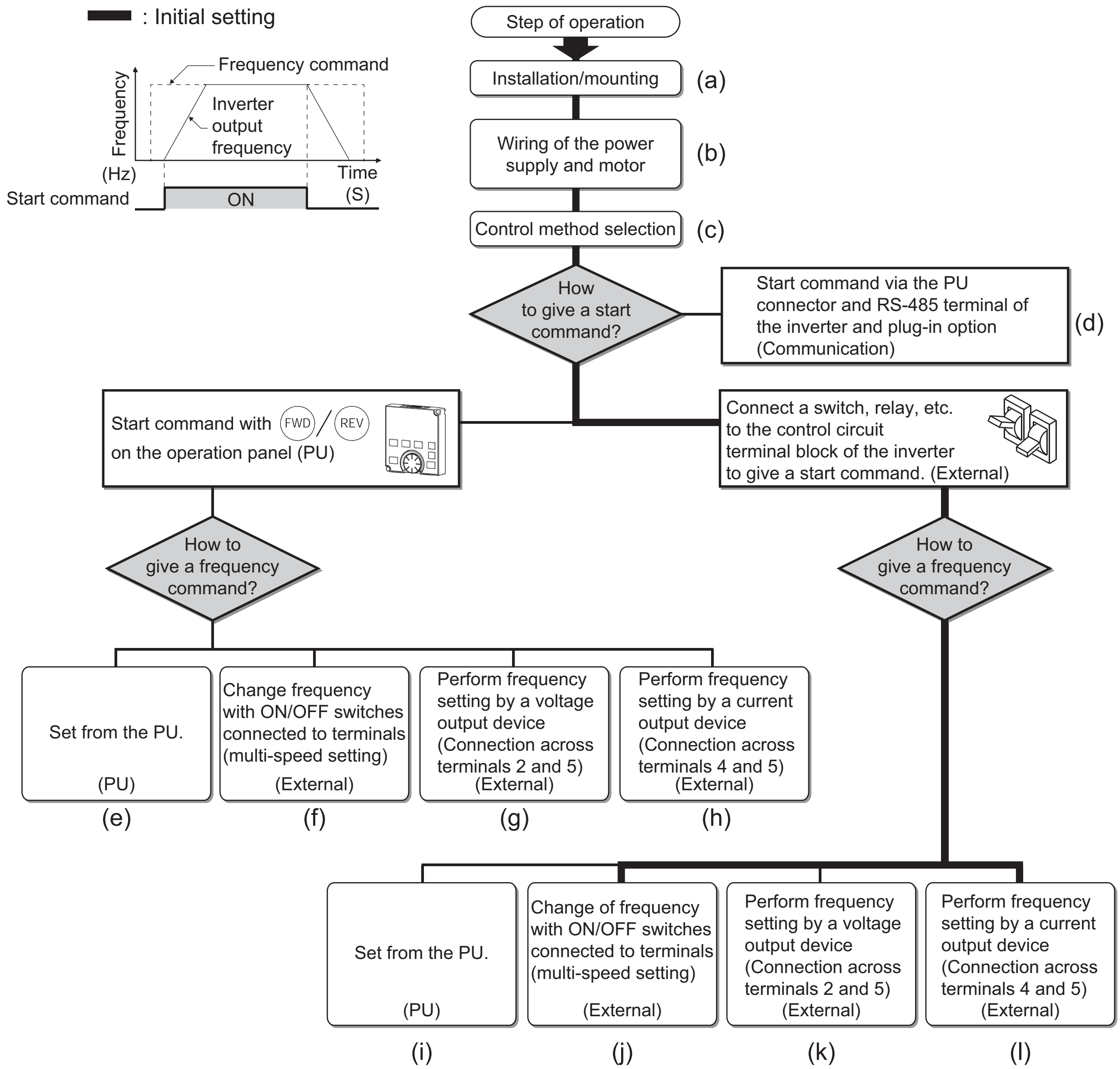
Component names are shown below.



Symbol	Name	Description	Refer to page
(a)	PU connector	Connects the operation panel or the parameter unit. This connector also enables the RS-485 communication.	65
(b)	USB A connector	Connects a USB memory device.	67
(c)	USB mini B connector	Connects a personal computer and enables communication with FR Configurator2.	67
(d)	RS-485 terminals	Enables RS-485, MODBUS RTU communication and BACnet communication.	68
(e)	Terminating resistor selection switch (SW1)	Select whether or not to use the terminating resistor for RS-485 communication.	68
(f)	Plug-in option connector 1	Connects a plug-in option or a communication option.	Instruction Manual of the option
(g)	Plug-in option connector 2		
(h)	Plug-in option connector 3		
(i)	Voltage/current input switch (SW2)	Selects between voltage and current for the terminal 2 and 4 inputs.	318
(j)	Control circuit terminal block	Connects cables for the control circuit.	50
(k)	Main circuit terminal block	Connects cables for the main circuit.	41
(l)	Charge lamp	Stays ON while the power is supplied to the main circuit.	42
(m)	Alarm lamp	Turns ON when the protective function of the inverter is activated.	42
(n)	Power lamp	Stays ON while the power is supplied to the control circuit (R1/L11, S1/L21).	42
(o)	Front cover (upper side)	Remove this cover for the installation of the product, installation of a plug-in (communication) option, RS-485 terminal wiring, switching of the voltage/current input switch, etc.	28
(p)	Front cover (lower side)	Remove this cover for wiring.	28
(q)	Accessory cover	Remove this cover for using the PU connector.	65
(r)	Cooling fan	Cools the inverter. (FR-F860-00061 or higher.)	601
(s)	Switches for manufacturer setting (SW3 and SW4)	Do not change the initial setting (OFF OFF ON).	—

Symbol	Name	Description	Refer to page
(t)	Control logic switchover jumper connector	Changes the control logic of input signals as necessary.	54

1.3 Operation steps



Symbol	Overview	Refer to page
(a)	Install the inverter.	31
(b)	Perform wiring for the power supply and the motor.	42
(c)	Select the control method (V/F control, Advanced magnetic flux vector control, or PM motor control).	145
(d)	Input the start command via communication.	473
(e)	The PU gives both start and frequency commands. (PU operation mode)	90
(f)	The PU gives a start command, and inputs to terminal RH, RM, and RL give a frequency command. (External/PU combined operation mode 2)	91
(g)	The PU gives a start command, and voltage input to terminal 2 gives a frequency command. (External/PU combined operation mode 2)	92
(h)	The PU gives a start command, and current input to terminal 4 gives a frequency command. (External/PU combined operation mode 2)	94
(i)	Inputs to terminal STF and STR give a start command, and the PU gives a frequency command. (External/PU combined operation mode 1)	96
(j)	Inputs to terminal STF and STR give a start command, and inputs to terminal RH, RM, and RL give a frequency command. (External operation mode)	98
(k)	Inputs to terminal STF and STR give a start command, and voltage input to terminal 2 gives a frequency command. (External operation mode)	99
(l)	Inputs to terminal STF and STR give a start command, and current input to terminal 4 gives a frequency command. (External operation mode)	102

1.4 About the related manuals

The manuals related to FR-F860 are shown below.

Name	Manual number
FR-F860 Instruction Manual (Startup)	IB-0600690ENG
FR-F862 (Separated Converter Type) Instruction Manual (Hardware)	IB-0600689ENG
FR-CC2-C (Converter unit) Instruction Manual	IB-0600572ENG
FR Configurator2 Instruction Manual	IB-0600516ENG
PLC function programming manual	IB-0600492ENG

MEMO

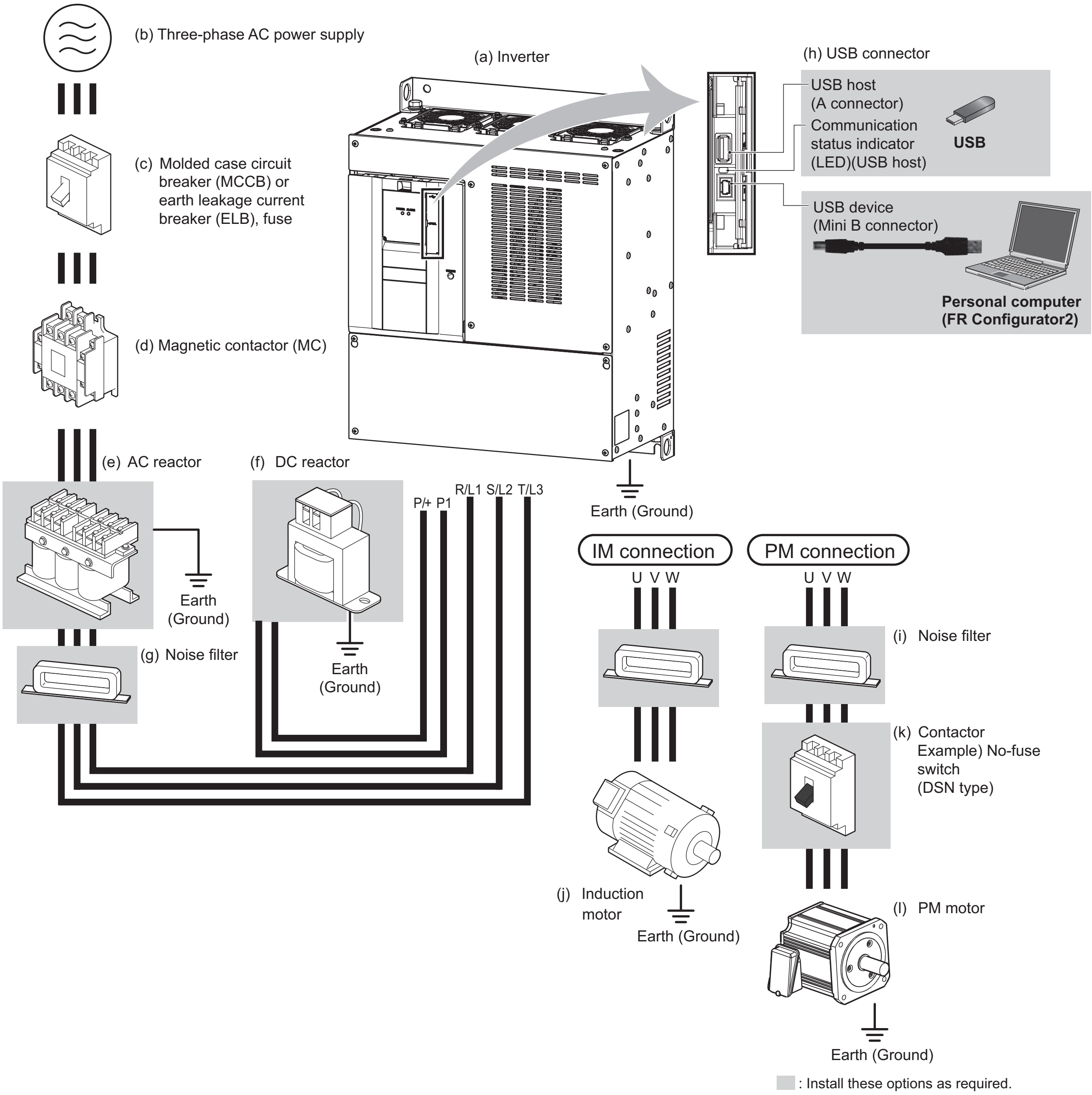
CHAPTER 2 INSTALLATION AND WIRING

2 INSTALLATION AND WIRING

This chapter explains the installation and the wiring of this product.
Always read the instructions before using the equipment.
For the INSTALLATION AND WIRING of the separated converter type, refer to the FR-F862 (Separated Converter Type) Instruction Manual (Hardware).

2.1 Peripheral devices

2.1.1 Inverter and peripheral devices



Symbol	Name	Overview	Refer to page
(a)	Inverter (FR-F860)	The life of the inverter is influenced by the surrounding air temperature. The surrounding air temperature should be as low as possible within the permissible range. This must be noted especially when the inverter is installed in an enclosure. Incorrect wiring may lead to damage of the inverter. The control signal lines must be kept fully away from the main circuit lines to protect them from noise.	31, 39
(b)	Three-phase AC power supply	Must be within the permissible power supply specifications of the inverter.	612
(c)	Molded case circuit breaker (MCCB), earth leakage circuit breaker (ELB), or fuse	Must be selected carefully since an inrush current flows in the inverter at power ON.	26
(d)	Magnetic contactor (MC)	Install this to ensure safety. Do not use this to start and stop the inverter. Doing so will shorten the life of the inverter.	77
(e)	AC reactor	Install this to suppress harmonics and to improve the power factor. An AC reactor is required when installing the inverter near a large power supply system (1000 kVA or more). Under such condition, the inverter may be damaged if you do not use a reactor. Select a reactor according to the applied motor capacity.	76
(f)	DC reactor	Install this to suppress harmonics and to improve the power factor. Select a reactor according to the applicable motor capacity. For the FR-F860-01080 or higher, or a motor with a capacity of 75 kW or higher, always connect a DC reactor. When using the DC reactor with the FR-F860-00680 or lower, remove the jumper across terminals P/+ and P1 before connecting the DC reactor to the inverter.	76
(g)	Noise filter	Suppresses the noise radiated from the power supply side of the inverter.	73
(h)	USB connection	A USB (Ver. 1.1) cable connects the inverter with a personal computer. A USB memory device enables parameter copies and the trace function.	67
(i)	Noise filter	Install this to reduce the electromagnetic noise generated from the inverter. The noise filter is effective in the range from about 0.5 MHz to 5 MHz. A wire should be wound four turns at maximum.	73
(j)	Induction motor	Connect a squirrel-cage induction motor.	—
(k)	Contactor Example) No-fuse switch (DSN type)	Connect this for an application where a PM motor is driven by the load even while the inverter power is OFF. Do not open or close the contactor while the inverter is running (outputting).	—
(l)	PM motor	A PM motor can be used. A PM motor cannot be driven by the commercial power supply.	—

NOTE

- To prevent an electric shock, always earth (ground) the motor and inverter.
- Do not install a power factor correction capacitor or surge suppressor or capacitor type filter on the inverter's output side. Doing so will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices is connected, immediately remove it. When installing a molded case circuit breaker on the output side of the inverter, contact the manufacturer of the molded case circuit breaker.
- Electromagnetic wave interference

The input/output (main circuit) of the inverter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter. Refer to page 73 for countermeasures.

- For details of options and peripheral devices, refer to the respective Instruction Manual.
- A PM motor cannot be driven by the commercial power supply.
- A PM motor is a motor with permanent magnets embedded inside. High voltage is generated at the motor terminals while the motor is running. Before closing the contactor at the output side, make sure that the inverter power is ON and the motor is stopped.

2.1.2 Peripheral devices

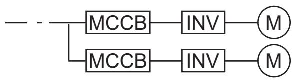
Check the model of the inverter you purchased. Appropriate peripheral devices must be selected according to the capacity. Refer to the table below to prepare appropriate peripheral devices.

◆ SLD rating (Pr.570 Multiple rating setting = "0")

Motor output (kW)*1	Applicable inverter model	Molded case circuit breaker (MCCB)*2 or earth leakage circuit breaker (ELB) (NF, NV type)		Input-side magnetic contactor*3	
		Power factor improving (AC or DC) reactor		Power factor improving (AC or DC) reactor	
		Without	With	Without	With
1.5	FR-F860-00027	10 A	5 A	5 A	3 A
3.7	FR-F860-00061	15 A	10 A	11 A	7 A
5.5	FR-F860-00090	30 A	15 A	16 A	9 A
11	FR-F860-00170	50 A	30 A	27 A	17 A
22	FR-F860-00320	60 A	50 A	43 A	33 A
30	FR-F860-00450	100 A	60 A	61 A	47 A
45	FR-F860-00680	125 A	100 A	88 A	68 A
75	FR-F860-01080	—	150 A	—	133 A
110	FR-F860-01440	—	175 A	—	135 A
110	FR-F860-01670	—	225 A	—	160 A
185	FR-F860-02430	—	300 A	—	231 A
220	FR-F860-02890	—	350 A	—	266 A
260	FR-F860-03360	—	400 A	—	316 A
335	FR-F860-04420	—	500 A	—	414 A

*1 Assumes the use of a 4-pole standard motor with the power supply voltage of 575 VAC 50 Hz.

*2 Select an MCCB according to the power supply capacity.
Install one MCCB per inverter.
For the use in the United States or Canada, refer to "Instructions for UL and cUL" in the Instruction Manual (Startup) or Instruction Manual (Hardware) to select an appropriate fuse or MCCB.



*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 stops during motor driving, the electrical durability is 25 times.
If using an MC for emergency stop during motor driving, select an MC regarding the inverter input side current as JEM 1038-AC-3 class rated current. When using an MC on the inverter output side for commercial-power supply operation switching using a general-purpose motor, select an MC regarding the rated motor current as JEM 1038-AC-3 class rated current.

NOTE

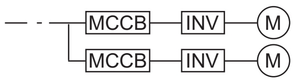
- When the inverter capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the inverter model, and select cables and reactors according to the motor output.
- When the breaker on the inverter's input side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter etc. The cause of the trip must be identified and removed before turning ON the power of the breaker.

◆ LD rating (Pr.570 Multiple rating setting = "1")

Motor output (kW)*1	Applicable inverter model	Molded case circuit breaker (MCCB)*2 or earth leakage circuit breaker (ELB) (NF, NV type)		Input-side magnetic contactor*3	
		Power factor improving (AC or DC) reactor		Power factor improving (AC or DC) reactor	
		Without	With	Without	With
1.12	FR-F860-00027	10 A	5 A	5 A	3 A
2.2	FR-F860-00061	15 A	10 A	11 A	6 A
3.7	FR-F860-00090	20 A	15 A	14 A	9 A
7.5	FR-F860-00170	50 A	30 A	25 A	16 A
18.5	FR-F860-00320	60 A	40 A	36 A	27 A
30	FR-F860-00450	100 A	60 A	55 A	41 A
45	FR-F860-00680	125 A	100 A	79 A	63 A
75	FR-F860-01080	—	125 A	—	98 A
90	FR-F860-01440	—	175 A	—	127 A
110	FR-F860-01670	—	200 A	—	146 A
150	FR-F860-02430	—	300 A	—	192 A
185	FR-F860-02890	—	350 A	—	234 A
220	FR-F860-03360	—	400 A	—	282 A
300	FR-F860-04420	—	500 A	—	373 A

*1 Assumes the use of a 4-pole standard motor with the power supply voltage of 575 VAC 50 Hz.

*2 Select an MCCB according to the power supply capacity.
Install one MCCB per inverter.
For the use in the United States or Canada, refer to "Instructions for UL and cUL" in the Instruction Manual (Startup) or Instruction Manual (Hardware) to select an appropriate fuse or MCCB.



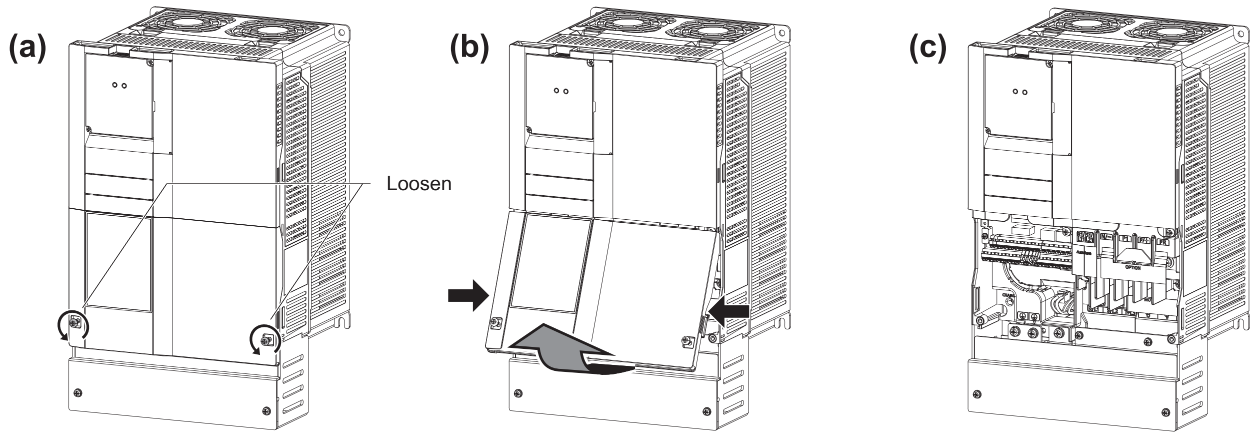
*3 Magnetic contactor is selected based on the AC-1 class. The electrical durability of magnetic contactor is 500,000 times. When the magnetic contactor is used for emergency stops during motor driving, the electrical durability is 25 times.
If using an MC for emergency stop during motor driving, select an MC regarding the inverter input side current as JEM 1038-AC-3 class rated current. When using an MC on the inverter output side for commercial-power supply operation switching using a general-purpose motor, select an MC regarding the rated motor current as JEM 1038-AC-3 class rated current.

NOTE

- When the inverter capacity is larger than the motor capacity, select an MCCB and a magnetic contactor according to the inverter model, and select cables and reactors according to the motor output.
- When the breaker on the inverter's input side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter etc. The cause of the trip must be identified and removed before turning ON the power of the breaker.

2.2 Removal and reinstallation of the front covers

◆ Removal of the front cover (lower side) (FR-F860-00450 or lower)

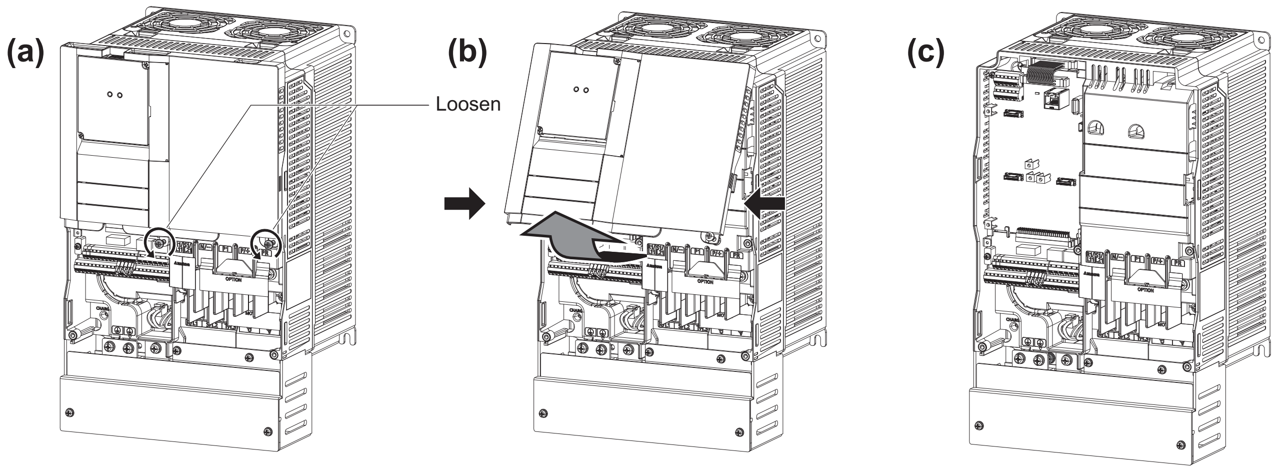


(a) Loosen the screws on the front cover (lower side). (These screws cannot be removed.)

(b) While holding the areas around the installation hooks on the sides of the front cover (lower side), pull out the front cover (lower side) using its upper side as a support.

(c) With the front cover (lower side) removed, wiring of the main circuit terminals and control circuit terminals can be performed.

◆ Removal of the front cover (upper side) (FR-F860-00450 or lower)



(a) With the front cover (lower side) removed, loosen the mounting screw(s) on the front cover (upper side). (The screw(s) cannot be removed.)
(FR-F860-00170 to 00450 have two mounting screws.)

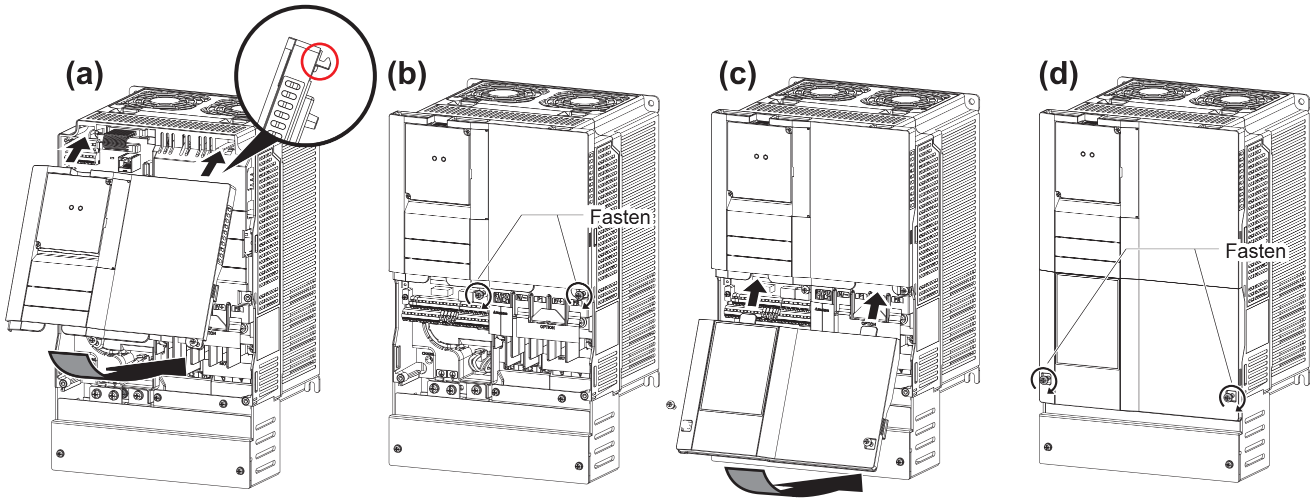
(b) While holding the areas around the installation hooks on the sides of the front cover (upper side), pull out the cover using its upper side as a support.

(c) With the front cover (upper side) removed, wiring of the RS-485 terminals and installation of the plug-in option can be performed.

NOTE

- For the procedures regarding removing the wiring cover and punching out the knockout holes, refer to the Instruction Manual (Startup).

◆ Reinstallation of the front covers (FR-F860-00450 or lower)



(a) Insert the upper hooks of the front cover (upper side) into the sockets of the inverter.
Securely install the front cover (upper side) to the inverter by fixing the hooks on the sides of the cover into place.

(b) Tighten the mounting screw(s) at the lower part of the front cover (upper side).
(FR-F860-00170 to 00450 have two mounting screws.)

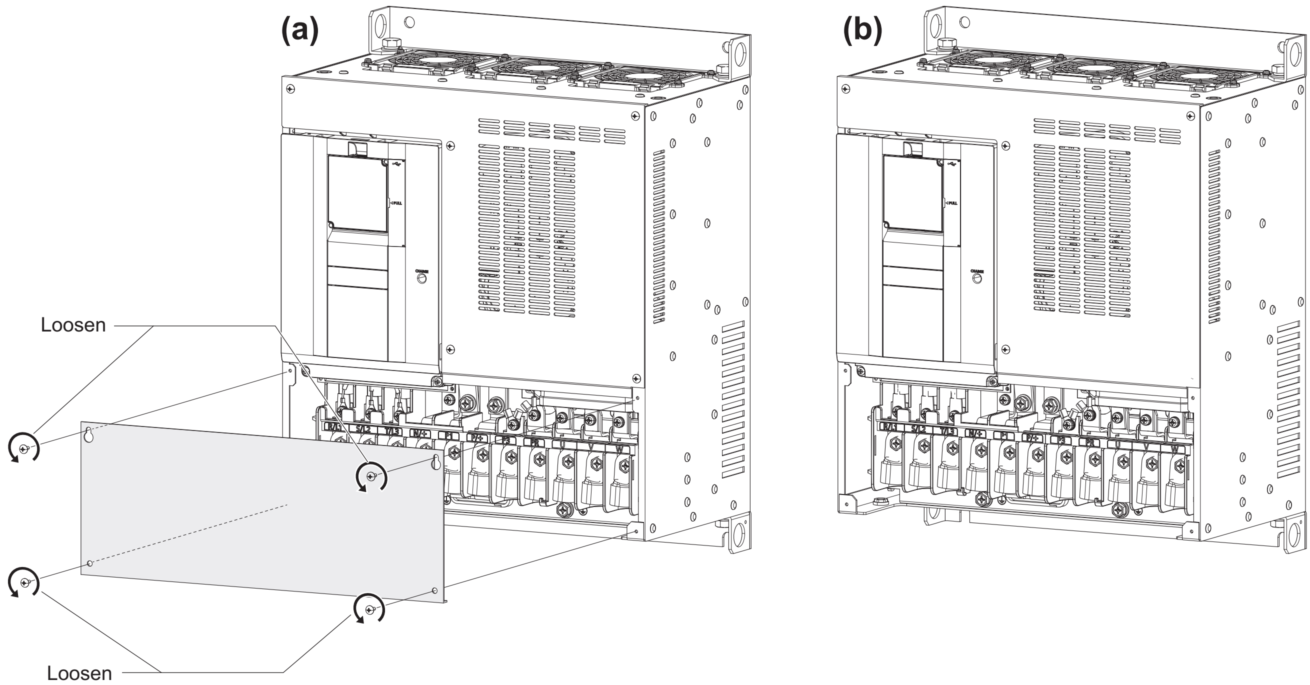
(c) Install the front cover (lower side) by inserting the upper hook into the socket of the front cover (upper side).

(d) Tighten the mounting screws at the lower part of the front cover (lower side).

NOTE

- When installing the front cover (upper side), fit the connector of the operation panel securely along the guides of the PU connector.

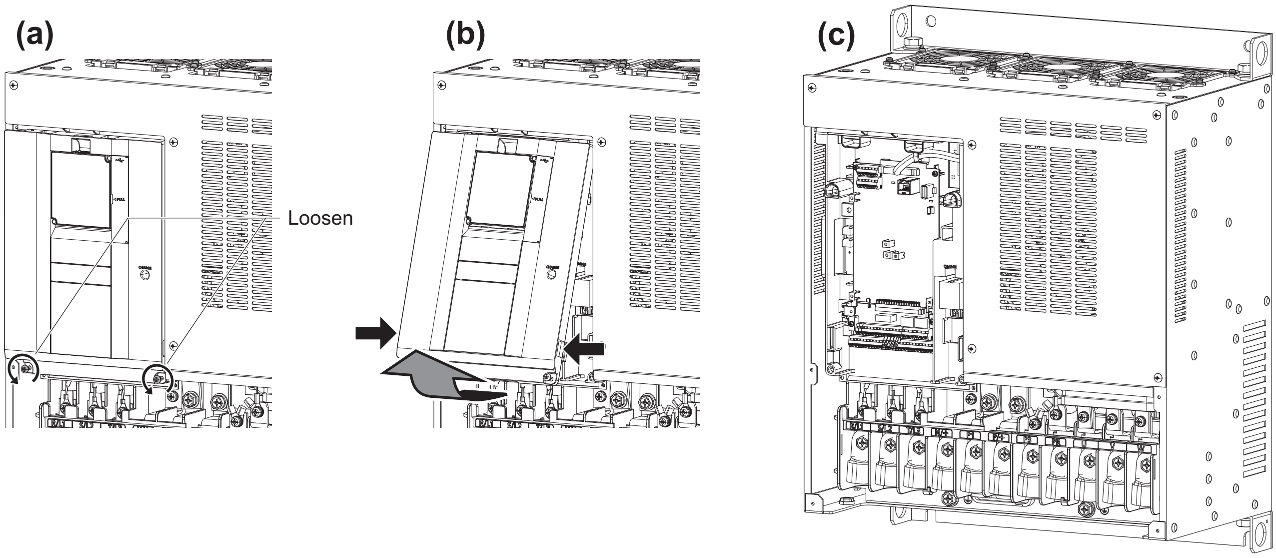
◆ Removal of the front cover (lower side) (FR-F860-00680 or higher)



(a) When the mounting screws are removed, the front cover (lower side) can be removed.

(b) With the front cover (lower side) removed, wiring of the main circuit terminals can be performed.

◆ Removal of the front cover (upper side) (FR-F860-00680 or higher)

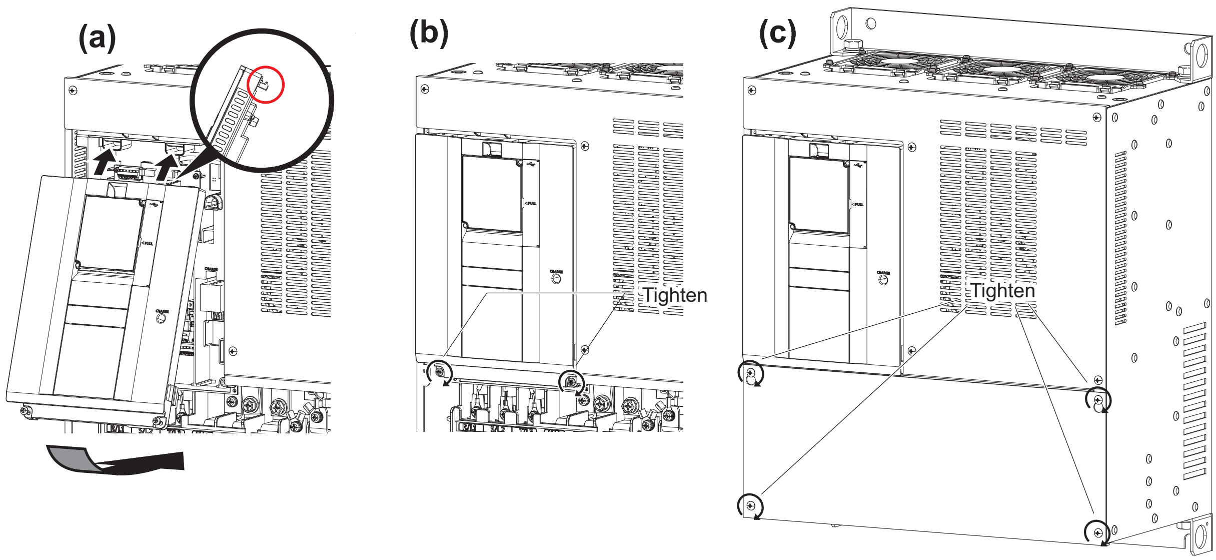


(a) With the front cover (lower side) removed, loosen the mounting screws on the front cover (upper side). (These screws cannot be removed.)

(b) Holding the areas around the installation hooks on the sides of the front cover (upper side), pull out the cover using its upper side as a support.

(c) With the front cover (upper side) removed, wiring of the RS-485 terminals and installation of the plug-in option can be performed.

◆ Reinstallation of the front covers (FR-F860-00680 or higher)



(a) Insert the upper hooks of the front cover (upper side) into the sockets of the inverter.
Securely install the front cover (upper side) to the inverter by fixing the hooks on the sides of the cover into place.

(b) Tighten the mounting screw(s) at the lower part of the front cover (upper side).

(c) Fasten the front cover (lower side) with the mounting screws.

NOTE

- Fully make sure that the front covers are installed securely. Always tighten the mounting screws of the front covers.

2.3 Installation of the inverter and enclosure design

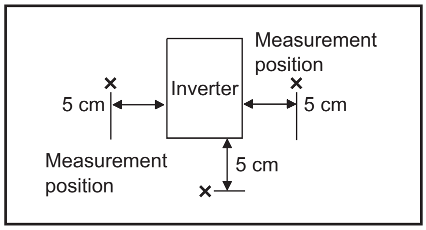
When designing or manufacturing an inverter enclosure, determine the structure, size, and device layout of the enclosure by fully considering the conditions such as heat generation of the contained devices and the operating environment. An inverter unit uses many semiconductor devices. To ensure higher reliability and long period of operation, operate the inverter in the ambient environment that completely satisfies the equipment specifications.

2

2.3.1 Inverter installation environment

The following table lists the standard specifications of the inverter installation environment. Using the inverter in an environment that does not satisfy the conditions deteriorates the performance, shortens the life, and causes a failure. Refer to the following points, and take adequate measures.

◆ Standard environmental specifications of the inverter

Item		Description	
Surrounding air temperature [*4]	FR-F860-00090 or lower	-10°C to +40°C (non-freezing) (LD rating) -10°C to +30°C (non-freezing) (SLD rating)	Enclosure[*5] 
	FR-F860-00170 to 01080	-10°C to +40°C (non-freezing)	
	FR-F860-01440 or higher	-10°C to +50°C (non-freezing) (LD rating) -10°C to +40°C (non-freezing) (SLD rating)	
Ambient humidity		95% 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 2500 m.[*2]	
Vibration		5.9 m/s^2 or less[*3] at 10 to 55 Hz (directions of X, Y, Z axes)	

*1 Temperature applicable for a short time, e.g. in transit.
*2 For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.
*3 2.9 m/s^2 or less for the FR-F860-02890 or higher.
*4 Surrounding air temperature is a temperature measured at a measurement position in an enclosure.
Ambient temperature is a temperature outside an enclosure.
*5 The FR-F860-00680 or higher inverter is intended for installation in an enclosure.

◆ Temperature

For the FR-F860-00090 or lower, the permissible surrounding air temperature of the inverter is between -10°C and +40°C (LD rating) or between -10°C and +30°C (SLD rating). For the FR-F860-00170 to 01080, the permissible surrounding air temperature of the inverter is between -10°C and +40°C. For the FR-F860-01440 or higher, the permissible surrounding air temperature of the inverter is between -10°C and +50°C (LD rating) or between -10°C and +40°C (SLD rating). 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 to keep the surrounding air temperature of the inverter within the specified range.

■ Measures against high temperature

- Use a forced ventilation system or similar cooling system. (Refer to page 34.)
- Install the enclosure in an air-conditioned electric 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.

NOTE

- For the amount of heat generated by the inverter unit, refer to page 33.

◆ Humidity

Operate the inverter within the ambient air humidity of usually 45 to 95%. Too high humidity will pose problems of reduced insulation and metal corrosion. On the other hand, too low humidity may cause a spatial electrical breakdown.

The insulation distance defined in JEM 1103 "Control Equipment Insulator" is humidity of 45 to 85%.

■ Measures against high humidity

- Make the enclosure enclosed, and provide it with a hygroscopic agent.
- Provide dry air into the enclosure from outside.
- Provide a space heater in the enclosure.

■ Measures against low humidity

Air with proper humidity can be blown into the enclosure from outside. Also when installing or inspecting the unit, discharge your body (static electricity) beforehand, and keep your body away from the parts and patterns.

■ Measures against condensation

Condensation may occur if frequent operation stops change the in-enclosure temperature suddenly or if the outside air temperature changes suddenly.

Condensation causes such faults as reduced insulation and corrosion.

- Take the measures against high humidity in (a).
- 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 contacts, reduced insulation and cooling effect due to the moisture-absorbed accumulated dust and dirt, and in-enclosure temperature rise due to a clogged filter. In an 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.

Countermeasure

- Place the inverter in a totally enclosed enclosure.

Take measures if the in-enclosure temperature rises. (Refer to page 34.)

- Purge air.

Pump clean air from outside to make the in-enclosure air 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 given in the previous paragraph.

◆ 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.

◆ High altitude

Use the inverter at an altitude of within 2500 m. For use at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.

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 5.9 m/s^2 (2.9 m/s^2 or less for the FR-F860-02890 or higher) at 10 to 55 Hz frequency and 1 mm amplitude for the directions of X, Y, Z axes. Applying vibration and impacts for a long time may loosen the structures and cause poor contacts of connectors, even if those vibration and impacts are within the specified values.

Especially when impacts are applied repeatedly, caution must be taken because such impacts may break the installation feet.

Countermeasure

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

2.3.2 Amount of heat generated by the inverter

◆ Regarding the amount of heat generated in the FR-F860 series inverter

The amount of heat generated by the FR-F860 series inverter is shown in the following tables.

Voltage	Inverter model	Amount of heat generated (W)	
		SLD	LD
600 V class	FR-F860-00680	980	880
	FR-F860-01080	1450	1300
	FR-F860-01440	2000	1800
	FR-F860-01670	2400	2200
	FR-F860-02430	3400	3100
	FR-F860-02890	3600	3200
	FR-F860-03360	4300	3900
	FR-F860-04420	5500	5000

NOTE

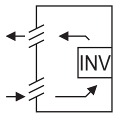
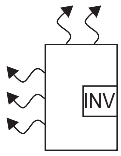
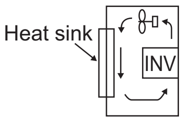
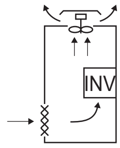
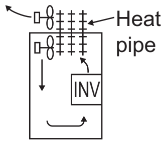
- The amount of heat generated shown assumes that the output current is inverter rated current, power supply voltage is 575 V, and carrier frequency is 2 kHz.

2.3.3 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.

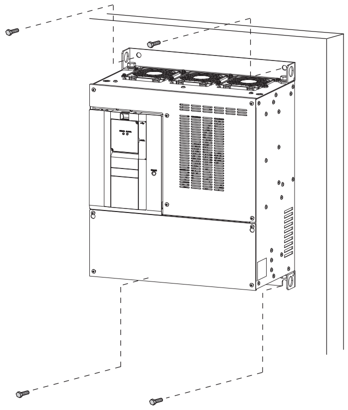
The cooling systems are classified as follows in terms of the cooling calculation method.

- Cooling by natural heat dissipation from the enclosure surface (totally enclosed type)
- Cooling by heat sink (aluminum 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	Natural ventilation enclosed type / open type		This system is low in cost and generally used, but the enclosure size increases as the inverter capacity increases. This system is for relatively small capacities.
	Natural ventilation (totally enclosed type)		Being a totally enclosed type, this system is the most appropriate for hostile environment having dust, dirt, oil mist, etc. The enclosure size increases depending on the inverter capacity.
Forced air	Heat sink cooling		This system has restrictions on the heat sink mounting position and area. This system is for relatively small capacities.
	Forced ventilation		This system is for general indoor installation. This is appropriate for enclosure downsizing and cost reduction, and often used.
	Heat pipe		This is a totally enclosed for enclosure downsizing.

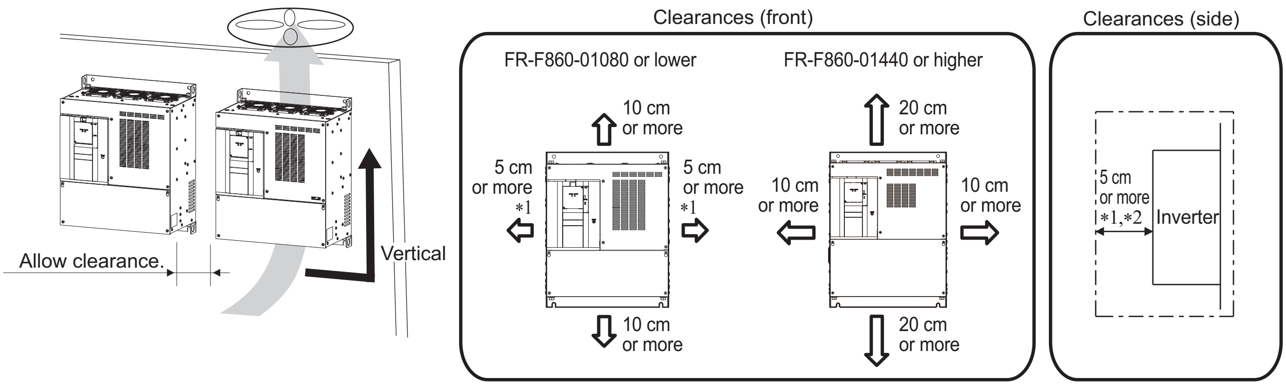
2.3.4 Inverter installation

◆ Inverter placement



Fix six positions for the FR-F860-02890 or higher.

- Install the inverter on a strong surface securely with screws.
- Leave enough clearances and take cooling measures.
- Avoid places where the inverter is subjected to direct sunlight, high temperature and high humidity.
- Install the inverter on a nonflammable wall surface.
- When encasing multiple inverters, install them in parallel as a cooling measure.
- For heat dissipation and maintenance, keep clearance between the inverter and the other devices or enclosure surface. The clearance below the inverter is required as a wiring space, and the clearance above the inverter is required as a heat dissipation space.
- When designing or building an enclosure for the inverter, carefully consider influencing factors such as heat generation of the contained devices and the operating environment.



*1 For the FR-F860-00090 or lower, allow 1 cm or more clearance.

*2 For replacing the cooling fan of the FR-F860-02890 or higher, 30 cm of space is necessary in front of the inverter. Refer to page 601 for fan replacement.

◆ Installation orientation of the inverter

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

◆ Above the inverter

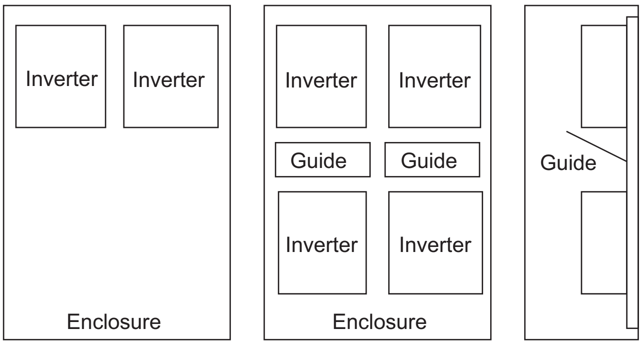
Heat is blown up from inside the inverter by the small fan built in the unit. Any equipment placed above the inverter should be heat resistant.

◆ Arrangement of multiple inverters

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

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

- Arrangement of multiple inverters

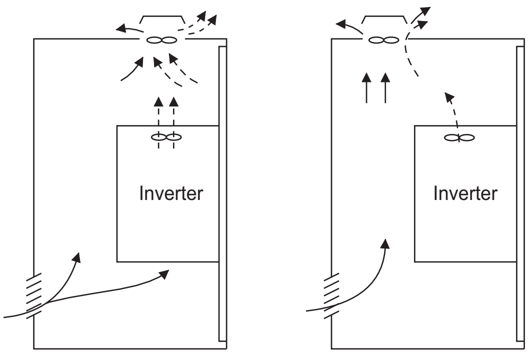


(a) Horizontal arrangement (b) Vertical arrangement

◆ Arrangement of the ventilation fan and inverter

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

- Arrangement of the ventilation fan and inverter



<Good example> <Bad example>

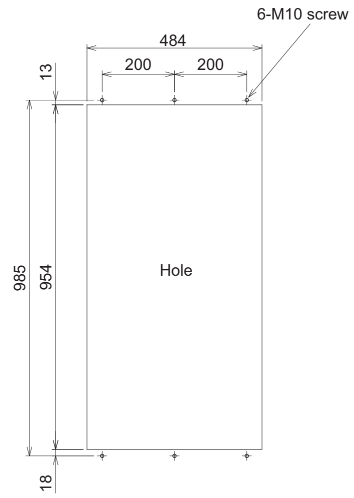
2.3.5 Protruding the heat sink through a panel

When encasing the inverter of the FR-F860-02890 or higher to an enclosure, the heat generated in the enclosure can be greatly reduced by protruding the heat sink of the inverter.
When installing the inverter in a compact enclosure, etc., this installation method is recommended.

◆ Panel cutting

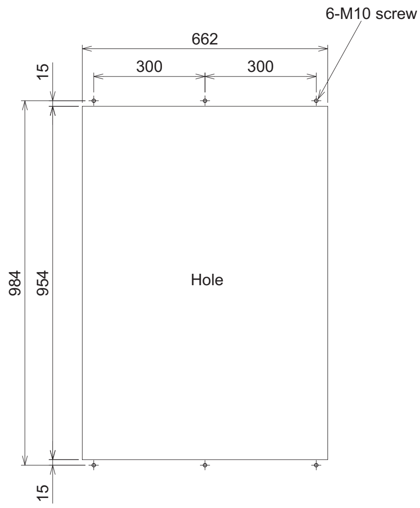
Cut the panel of the enclosure according to the inverter capacity.

FR-F860-02890
FR-F860-03360



(Unit: mm)

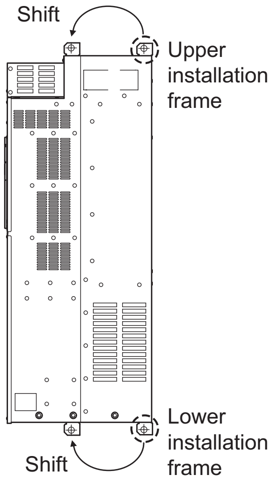
FR-F860-04420



(Unit: mm)

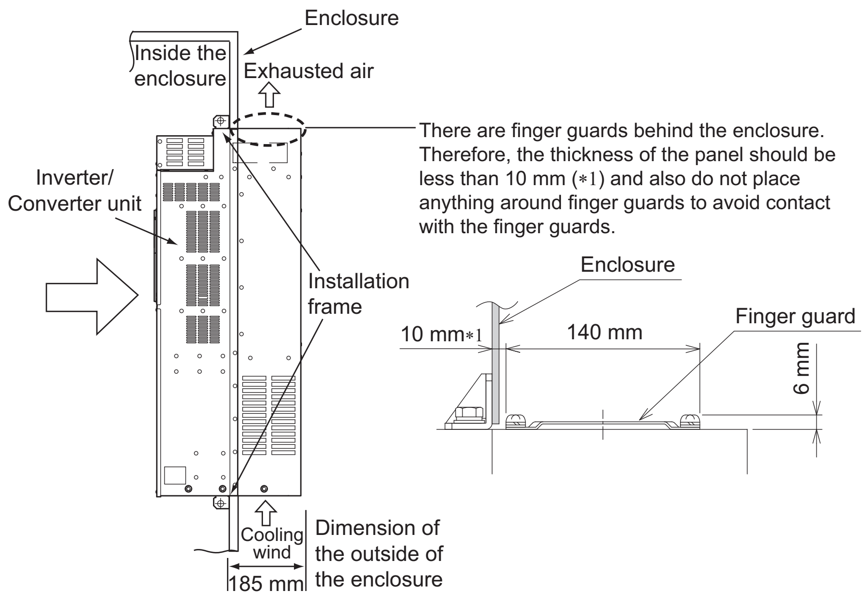
◆ Shift and removal of a rear side installation frame

One installation frame is attached to each of the upper and lower parts of the inverter. Change the position of the rear side installation frame on the upper and lower sides of the inverter to the front side as shown on the right. When changing the installation frames, make sure that the installation orientation is correct.



◆ Installation of the inverter

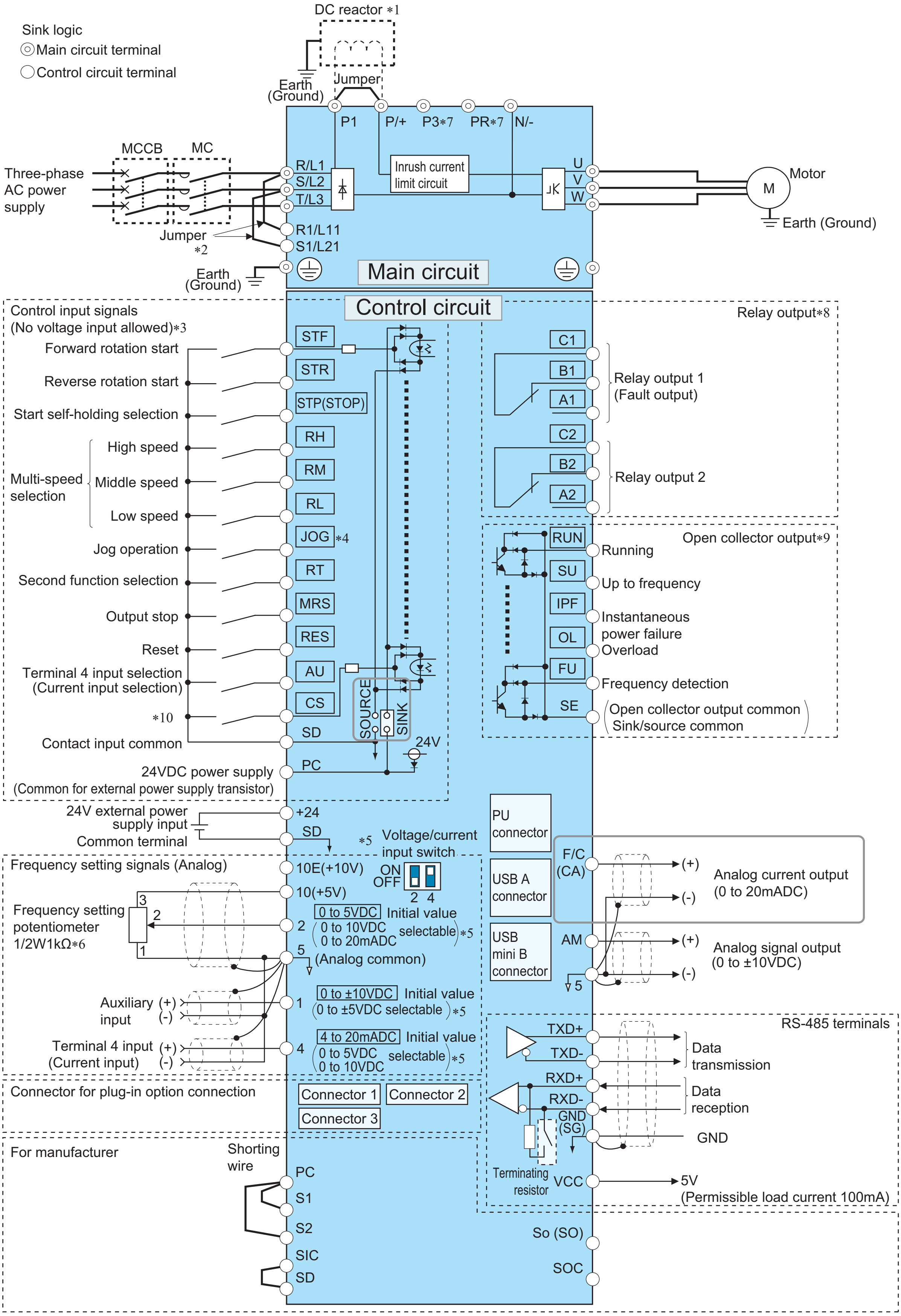
Push the inverter heat sink portion outside the enclosure and fix the enclosure and inverter with upper and lower installation frame.



NOTE

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

2.4 Terminal connection diagrams



*1 For the FR-F860-01080 or higher, or whenever a 75 kW or higher motor is used, always connect a DC reactor. (To select a DC reactor, refer to page 69, and select one according to the applicable motor capacity.)
When connecting a DC reactor, if a jumper is installed across terminals P1 and P/+, remove the jumper before installing the DC reactor. (The jumper is not installed for the FR-F860-01440 or higher.)
*2 When using separate power supply for the control circuit, remove the jumper between R1/L11 and S1/L21.
*3 The function of these terminals can be changed with the input terminal assignment **(Pr.178 to Pr.189)**. (Refer to page 343.)
*4 Terminal JOG is also used as the pulse train input terminal. Use **Pr.291** to choose JOG or pulse.
*5 Terminal input specifications can be changed by analog input specification switchover **(Pr.73, Pr.267)**. To input a voltage, set the voltage/current input switch OFF. To input a current, set the voltage/current input switch ON. Terminals 10 and 2 are also used as a PTC input terminal. **(Pr.561)** (Refer to page 230.)
*6 It is recommended to use 2 W 1 kΩ when the frequency setting signal is changed frequently.
*7 Do not use terminals PR and P3. (Terminals PR and P3 are equipped in FR-F860-01080 or lower)
*8 The function of these terminals can be changed with the output terminal assignment **(Pr.195, Pr.196)**. (Refer to page 297.)
*9 The function of these terminals can be changed with the output terminal assignment **(Pr.190 to Pr.194)**. (Refer to page 297.)
*10 No function is assigned in the initial status. Assign the function using **Pr.186 CS terminal function selection**. (Refer to page 343.)

NOTE

- To prevent a malfunction due to noise, keep the signal cables 10 cm or more away from the power cables. Also, separate the main circuit cables at the input side from the main circuit cables at the output side.
- After wiring, wire offcuts must not be left in the inverter. Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.
- Set the voltage/current input switch correctly. Incorrect setting may cause a fault, failure or malfunction.
- The terminals S1, S2, SIC, So (SO), and SOC are for manufacturer setting. Do not connect anything to these. Doing so may cause an inverter failure. Do not remove the shorting wires across the terminals S1 and PC, the terminals S2 and PC, and the terminals SIC and SD. Removing either shorting wire disables the inverter operation.

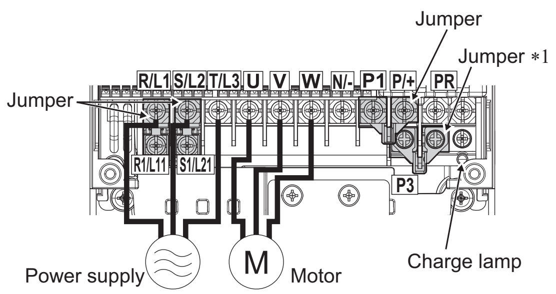
2.5 Main circuit terminals

2.5.1 Details on the main circuit terminals

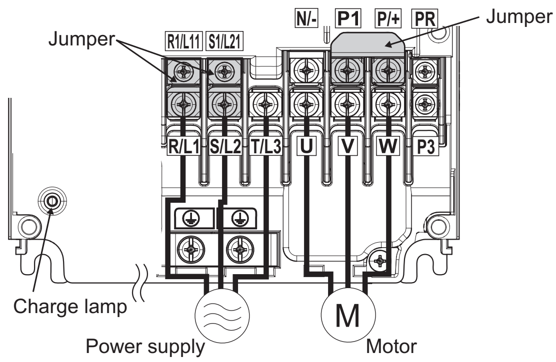
Terminal symbol	Terminal name	Terminal function description	Refer to page
R/L1, S/L2, T/L3	AC power input	Connect these terminals to the commercial power supply.	—
U, V, W	Inverter output	Connect these terminals to a three-phase squirrel cage motor or a PM motor.	—
R1/L11, S1/L21	Power supply for the control circuit	Connected to the AC power supply terminals R/L1 and S/L2. To retain the fault display and fault output, remove the jumpers across terminals R/L1 and R1/L11 and across S/L2 and S1/L21, and supply external power to these terminals. The power capacity necessary when separate power is supplied from R1/L11 and S1/L21 differs according to the inverter capacity. FR-F860-00170 or lower 60 VA FR-F860-00320 or higher 80 VA	60
P/+, N/-	DC terminal	Connect these terminals to the DC power supply for DC feeding.	—
P/+, P1	DC reactor connection FR-F860-00680 or lower	Remove the jumper across terminals P/+ and P1, and connect a DC reactor. When a DC reactor is not connected, the jumper across terminals P/+ and P1 should not be removed.	69
	DC reactor connection FR-F860-01080 or higher	Always connect a DC reactor. (The jumper is not installed for the FR-F860-01440 or higher.)	
P3, PR	Do not use terminals P3 and PR. The terminal PR is equipped in the FR-F860-01080 or lower. The terminal P3 is equipped in the FR-F860-00027 to 00170 and FR-F860-00450 to 01080.		—
⏚	Earth (ground)	For earthing (grounding) the inverter chassis. This must be earthed (grounded).	49

2.5.2 Terminal layout of the main circuit terminals, wiring of power supply and the motor

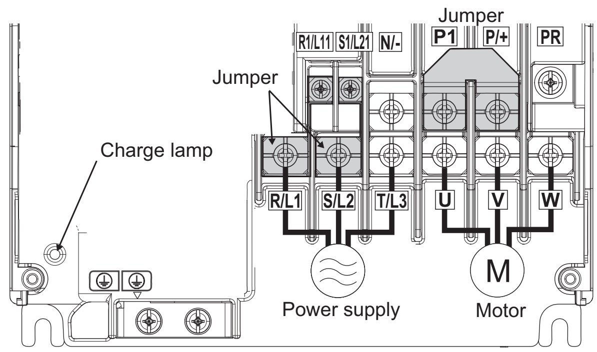
FR-F860-00027 to 00090



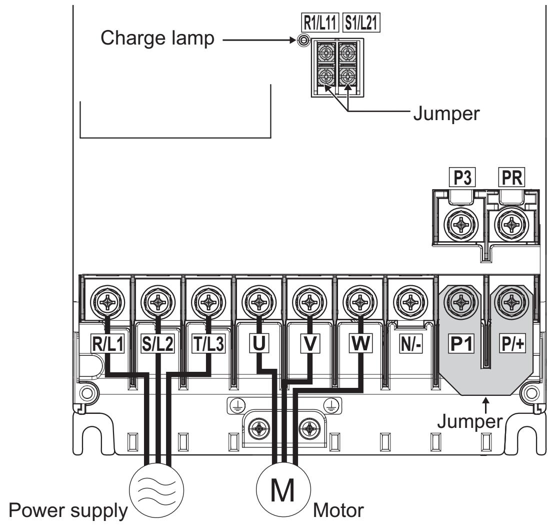
FR-F860-00170



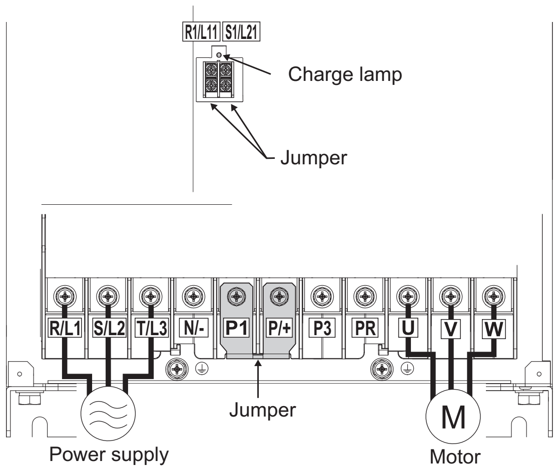
FR-F860-00320



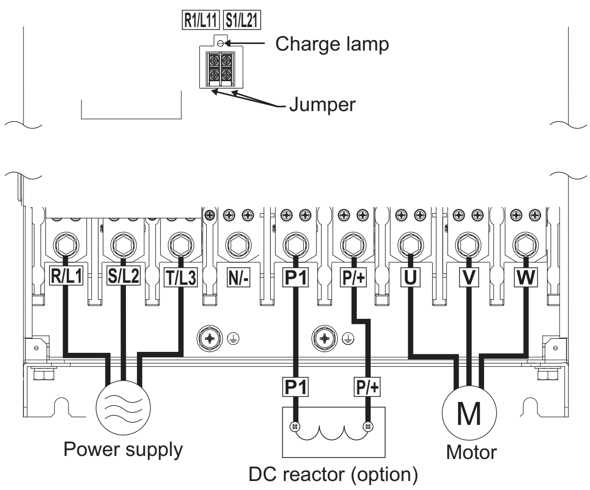
FR-F860-00450



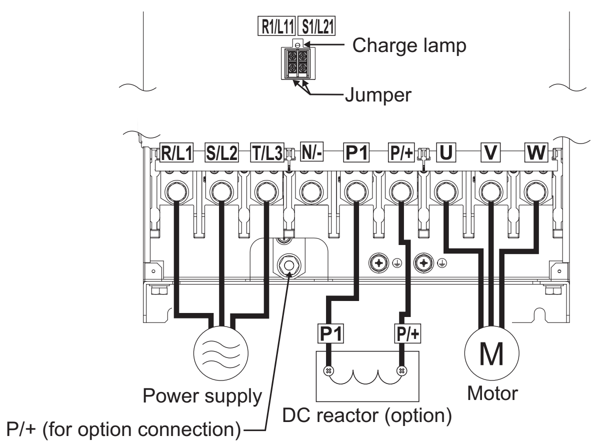
FR-F860-00680, 01080[*3]



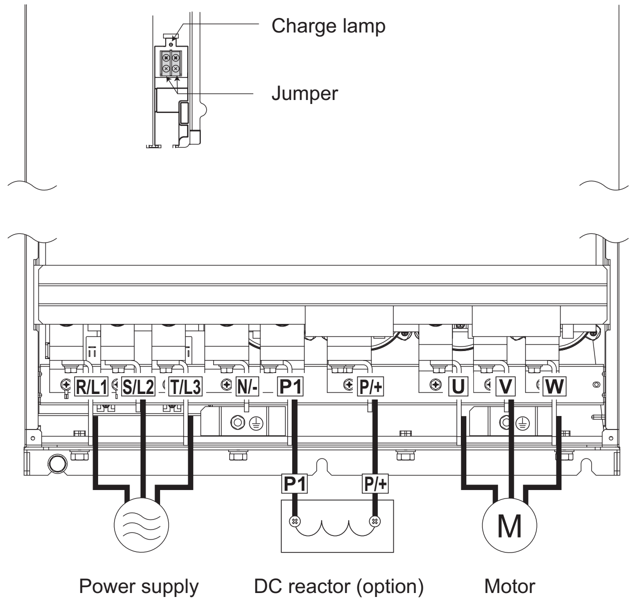
FR-F860-01440 to 02430



FR-F860-02890, 03360*2



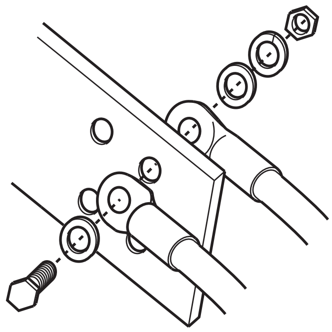
FR-F860-04420



*1 Do not remove the jumper from terminal P3.
*2 When an option other than the DC reactor must be connected to terminal P/+, use terminal P/+ (for option connection).
*3 For the FR-F860-01080, a jumper is not installed across the terminals P1 and P/+. Always connect a DC reactor (FR-HEL), which is available as an option, across the terminals P1 and P/+.

NOTE

- Make sure the power cables are connected to the R/L1, S/L2, and T/L3. (Phase need not be matched.) Never connect the power cable to the U, V, and W of the inverter. Doing so will damage the inverter.
- Connect the motor to U, V, and W. The phase need to be matched.
- When wiring the inverter main circuit conductor of the FR-F860-04420 or higher, 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 on the right.) For wiring, use bolts (nuts) provided with the inverter.



2.5.3 Applicable cables and the wiring length

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

If the wiring distance is long between the inverter and motor, the voltage drop in the main circuit wires will cause the motor torque to decrease especially at a low speed.

The following table indicates a selection example for the wiring length of 20 m.

◆ SLD rating (Pr.570 Multiple rating setting = "0")

- 600 V class (575 V input power supply, without a power factor improving AC or DC reactor)

Applicable inverter model FR-F860-[ ]	Terminal screw size*2	Tightening torque N•m	Crimping terminal				Cable gauge*1			
							HIV cables, etc. (mm^2)			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2
00170	M4	1.5	3.5-4	2-4	3.5-4	3.5-4	3.5	2	3.5	3.5
00320	M5	2.5	8-5	5.5-5	8-5	5.5-5	8	5.5	8	5.5
00450	M6	4.4	14-6	14-6	14-6	14-6	14	14	14	14
00680	M8	7.8	22-8	22-8	22-8	22-8	22	22	22	22
01080	M8	7.8	—	—	—	—	—	—	—	—
01440	M10	26.5	—	—	—	—	—	—	—	—
01670	M10	26.5	—	—	—	—	—	—	—	—
02430	M10	26.5	—	—	—	—	—	—	—	—
02890	M12(M10)	46	—	—	—	—	—	—	—	—
03360	M12(M10)	46	—	—	—	—	—	—	—	—
04420	M12(M10)	46	—	—	—	—	—	—	—	—

Applicable inverter model FR-F860-[ ]	Terminal screw size*2	Tightening torque N•m	Crimping terminal				Cable gauge*1			
							AWG/MCM			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	14	14	14	14
00170	M4	1.5	3.5-4	2-4	3.5-4	3.5-4	10	14	10	12
00320	M5	2.5	8-5	5.5-5	8-5	5.5-5	8	10	8	10
00450	M6	4.4	14-6	14-6	14-6	14-6	4	6	4	6
00680	M8	7.8	22-8	22-8	22-8	22-8	2	4	2	4
01080	M8	7.8	—	—	—	—	—	—	—	—
01440	M10	26.5	—	—	—	—	—	—	—	—
01670	M10	26.5	—	—	—	—	—	—	—	—
02430	M10	26.5	—	—	—	—	—	—	—	—
02890	M12(M10)	46	—	—	—	—	—	—	—	—
03360	M12(M10)	46	—	—	—	—	—	—	—	—
04420	M12(M10)	46	—	—	—	—	—	—	—	—

• 600 V class (575 V input power supply, with a power factor improving AC or DC reactor)

Applicable inverter model FR-F860-[ ]	Terminal screw size*2	Tightening torque N•m	Crimping terminal				Cable gauge*1 HIV cables, etc. (mm²)			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2
00170	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2
00320	M5	2.5	5.5-5	5.5-5	8-5	5.5-5	5.5	5.5	8	5.5
00450	M6	4.4	14-6	14-6	14-6	14-6	14	14	14	14
00680	M8	7.8	22-8	22-8	22-8	22-8	22	22	22	22
01080	M8	7.8	38-8	38-8	38-8	22-8	38	38	38	22
01440	M10	26.5	60-10	60-10	60-10	38-10	60	60	60	38
01670	M10	26.5	60-10	60-10	60-10	38-10	60	60	60	38
02430	M10	26.5	80-10	80-10	80-10	38-10	80	80	80	38
02890	M12(M10)	46	100-12	100-12	100-12	38-10	100	100	100	38
03360	M12(M10)	46	125-12	125-12	125-12	38-10	125	125	125	38
04420	M12(M10)	46	2×80-12	2×80-12	2×80-12	60-10	2×80	2×80	2×80	60

Applicable inverter model FR-F860-[ ]	Terminal screw size*2	Tightening torque N•m	Crimping terminal				Cable gauge*1 AWG/MCM			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	14	14	14	14
00170	M4	1.5	2-4	2-4	2-4	2-4	14	14	14	14
00320	M5	2.5	5.5-5	5.5-5	8-5	5.5-5	10	10	8	10
00450	M6	4.4	14-6	14-6	14-6	14-6	6	6	4	6
00680	M8	7.8	22-8	22-8	22-8	22-8	4	4	2	4
01080	M8	7.8	38-8	38-8	38-8	22-8	1	1	1/0	4
01440	M10	26.5	60-10	60-10	60-10	38-10	1/0	1/0	1/0	1
01670	M10	26.5	60-10	60-10	60-10	38-10	2/0	2/0	2/0	1
02430	M10	26.5	80-10	80-10	80-10	38-10	4/0	250	4/0	1
02890	M12(M10)	46	100-12	100-12	100-12	38-10	250	300	250	1
03360	M12(M10)	46	125-12	125-12	125-12	38-10	2×2/0	2×2/0	2×2/0	1
04420	M12(M10)	46	2×80-12	2×80-12	2×80-12	60-10	2×4/0	2×250	2×4/0	1/0

*1 The cables used should be 75°C copper cables. (For the use in the United States or Canada, refer to "Instructions for UL and cUL" in the Instruction Manual (Startup) or Instruction Manual (Hardware).)

*2 The terminal screw size indicates the size of terminal screw for R/L1, S/L2, T/L3, U, V, W, PR, P/+, N/-, P1, P3, and the screw for earthing (grounding), and P/+ for option connection. A screw for earthing (grounding) of the FR-F860-02890 or higher is indicated in ( ).

◆ LD rating (Pr.570 Multiple rating setting = "1")

- 600 V class (575 V input power supply, without a power factor improving AC or DC reactor)

Applicable inverter model FR-F860-[ ]	Terminal screw size*2	Tightening torque N•m	Crimping terminal				Cable gauge*1 HIV cables, etc. (mm^2)			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2
00170	M4	1.5	3.5-4	2-4	3.5-4	3.5-4	3.5	2	3.5	3.5
00320	M5	2.5	8-5	5.5-5	8-5	5.5-5	8	5.5	8	5.5
00450	M6	4.4	14-6	14-6	14-6	14-6	14	14	14	14
00680	M8	7.8	22-8	22-8	22-8	22-8	22	22	22	22
01080	M8	7.8	—	—	—	—	—	—	—	—
01440	M10	26.5	—	—	—	—	—	—	—	—
01670	M10	26.5	—	—	—	—	—	—	—	—
02430	M10	26.5	—	—	—	—	—	—	—	—
02890	M12(M10)	46	—	—	—	—	—	—	—	—
03360	M12(M10)	46	—	—	—	—	—	—	—	—
04420	M12(M10)	46	—	—	—	—	—	—	—	—

Applicable inverter model FR-F860-[ ]	Terminal screw size*2	Tightening torque N•m	Crimping terminal				Cable gauge*1 AWG/MCM			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	14	14	14	14
00170	M4	1.5	3.5-4	2-4	3.5-4	3.5-4	10	14	10	12
00320	M5	2.5	8-5	5.5-5	8-5	5.5-5	8	10	8	10
00450	M6	4.4	14-6	14-6	14-6	14-6	4	6	4	6
00680	M8	7.8	22-8	22-8	22-8	22-8	2	4	2	4
01080	M8	7.8	—	—	—	—	—	—	—	—
01440	M10	26.5	—	—	—	—	—	—	—	—
01670	M10	26.5	—	—	—	—	—	—	—	—
02430	M10	26.5	—	—	—	—	—	—	—	—
02890	M12(M10)	46	—	—	—	—	—	—	—	—
03360	M12(M10)	46	—	—	—	—	—	—	—	—
04420	M12(M10)	46	—	—	—	—	—	—	—	—

• 600 V class (575 V input power supply, with a power factor improving AC or DC reactor)

Applicable inverter model FR-F860-[ ]	Terminal screw size*2	Tightening torque N•m	Crimping terminal				Cable gauge*1 HIV cables, etc. (mm^2)			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2
00170	M4	1.5	2-4	2-4	2-4	2-4	2	2	2	2
00320	M5	2.5	5.5-5	5.5-5	8-5	5.5-5	5.5	5.5	8	5.5
00450	M6	4.4	8-6	14-6	8-6	5.5-6	8	14	8	5.5
00680	M8	7.8	22-8	22-8	22-8	22-8	22	22	22	22
01080	M8	7.8	38-8	38-8	38-8	22-8	38	38	38	22
01440	M10	26.5	60-10	60-10	60-10	38-10	60	60	60	38
01670	M10	26.5	60-10	60-10	60-10	38-10	60	60	60	38
02430	M10	26.5	80-10	80-10	80-10	38-10	80	80	80	38
02890	M12(M10)	46	100-12	100-12	100-12	38-10	100	100	100	38
03360	M12(M10)	46	125-12	125-12	125-12	38-10	125	125	125	38
04420	M12(M10)	46	2×80-12	2×80-12	2×80-12	60-10	2×80	2×80	2×80	60

Applicable inverter model FR-F860-[ ]	Terminal screw size*2	Tightening torque N•m	Crimping terminal				Cable gauge*1 AWG/MCM			
			R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable	R/L1, S/L2, T/L3	U, V, W	P/+, P1	Earthing (grounding) cable
00027 to 00090	M4	1.5	2-4	2-4	2-4	2-4	14	14	14	14
00170	M4	1.5	2-4	2-4	2-4	2-4	14	14	14	14
00320	M5	2.5	5.5-5	5.5-5	8-5	5.5-5	10	10	8	10
00450	M6	4.4	8-6	14-6	8-6	5.5-6	8	6	8	10
00680	M8	7.8	22-8	22-8	22-8	22-8	4	4	2	4
01080	M8	7.8	38-8	38-8	38-8	22-8	2	2	1/0	4
01440	M10	26.5	60-10	60-10	60-10	38-10	1/0	1/0	1/0	1
01670	M10	26.5	60-10	60-10	60-10	38-10	2/0	2/0	2/0	1
02430	M10	26.5	80-10	80-10	80-10	38-10	4/0	250	4/0	1
02890	M12(M10)	46	100-12	100-12	100-12	38-10	250	300	250	1
03360	M12(M10)	46	125-12	125-12	125-12	38-10	2×2/0	2×3/0	2×2/0	1
04420	M12(M10)	46	2×80-12	2×80-12	2×80-12	60-10	2×4/0	2×250	2×4/0	1/0

*1 The cables used should be 75°C copper cables. (For the use in the United States or Canada, refer to "Instructions for UL and cUL" in the Instruction Manual (Startup) or Instruction Manual (Hardware).)

*2 The terminal screw size indicates the size of terminal screw for R/L1, S/L2, T/L3, U, V, W, PR, P/+, N/-, P1, P3, and the screw for earthing (grounding), and P/+ for option connection. A screw for earthing (grounding) of the FR-F860-02890 or higher is indicated in ( ).

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

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

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

NOTE

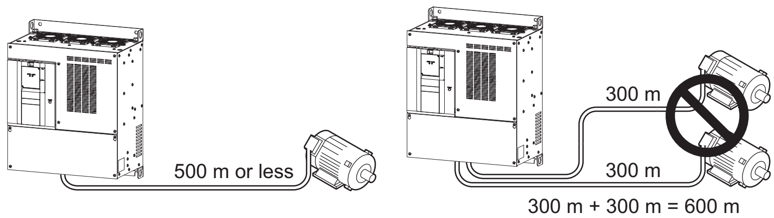
• Tighten the terminal screw to the specified torque. A screw that has been tightened too loosely can cause a short circuit or malfunction. A screw that has been tightened too tightly can cause a short circuit or malfunction due to the unit breakage.
• Use crimping terminals with insulation sleeves to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

◆ Total wiring length

■ With induction motor

Connect one or more induction motors within the total wiring length shown in the following table. (The wiring length should be 100 m or shorter under vector control.)

Total wiring length (FR-F860-00680 or higher)



- When fast response current limit is enabled (**Pr.156** = "0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, or 30"), the wiring length should be within the value in the table below.

Pr.72 setting (carrier frequency)	FR-F860-00027	FR-F860-00061	FR-F860-00090	FR-F860-00170	FR-F860-00320 or higher
2 (2 kHz) or less	100 m	200 m	300 m	500 m	500 m
3 (3 kHz) or more	100 m	100 m	200 m	400 m	500 m

- When fast response current limit is disabled (**Pr.156** = "1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, or 31"), the wiring length should be within the value in the table below.

FR-F860-00027	FR-F860-00061	FR-F860-00090	FR-F860-00170 or higher
100 m	300 m	500 m	500 m

- Use a "600 V class inverter-driven insulation-enhanced motor" and set frequency in **Pr.72 PWM frequency selection** according to wiring length.

Wiring length 50 m or shorter	Wiring length 50 to 100 m	Wiring length longer than 100 m
15 (14.5 kHz) or lower	9 (9 kHz) or lower	4 (4 kHz) or lower

■ With PM motor

The wiring length should be 100 m or shorter when connecting a PM motor.

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

When the wiring length exceeds 50 m for a 600 V class motor driven by an inverter under PM motor control, set "9" (6 kHz) or less in **Pr.72 PWM frequency selection**.

NOTE

- Especially for long-distance wiring, the inverter may be affected by a charging current caused by stray capacitance of the wiring, leading to an activation of the overcurrent protection, malfunction of the fast-response current limit operation, or even to an inverter failure. It may also cause a malfunction or fault of the equipment connected ON the inverter output side. If the fast-response current limit function malfunctions, disable this function. (Refer to **Pr.156 Stall prevention operation selection** on page 257.)
- Refer to page 79 to drive a 600 V class motor by an inverter.

2.5.4 Earthing (grounding) precautions

- Always earth (ground) the motor and inverter.

◆ Purpose of earthing (grounding)

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

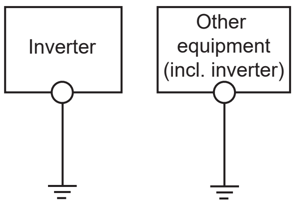
An electrical circuit is usually insulated by an insulating material and encased. However, it is impossible to manufacture an insulating material that can shut off a leakage current completely, and actually, a slight current flows into the case. The purpose of earthing (grounding) the case of an electrical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

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

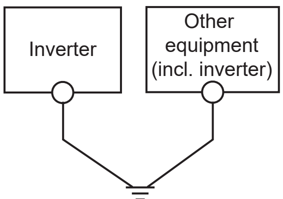
◆ Earthing (grounding) methods and earthing (grounding) work

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

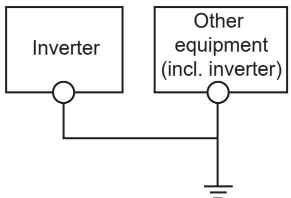
- Whenever possible, use the independent earthing (grounding) for the inverter. If independent earthing (grounding) (I) is not available, use (II) common earthing (grounding) in the figure below where the inverter is connected with the other equipment at an earthing (grounding) point. Do not use the other equipment's earthing (grounding) cable to earth (ground) the inverter as shown in (III). A leakage current containing many high frequency components flows into the earthing (grounding) cables of the inverter and peripheral devices. Because of this, the inverter must be earthed (grounded) separately from EMI-sensitive devices. In a high building, it may be effective to use the EMI prevention type earthing (grounding) connecting to an iron structure frame, and electric shock prevention type earthing (grounding) with the independent earthing (grounding) together.
- Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 61140 class 1 and other applicable standards).
- Use the thickest possible earthing (grounding) cable. The size of the earthing (grounding) cable should be the same or larger than the one indicated in the table on page 44.
- The earthing (grounding) point should be as close as possible to the inverter, and the earth (ground) wire length should be as short as possible.
- Run the earthing (grounding) cable as far away as possible from the I/O wiring of equipment sensitive to noises and run them in parallel in the minimum distance.



(I) Separate earthing (grounding): Good



(II) Common (single-point) earthing (grounding): OK



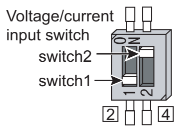
(III) Inadequate common (single-point) earthing (grounding): Bad

2.6 Control circuit

2.6.1 Details on the control circuit terminals

◆ Input signal

Type	Terminal symbol	Common	Terminal name	Terminal function description	Rated specification	Refer to page
Contact input	STF[*1]	SD (sink (negative common)) PC (source (positive common))	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 4.7 kΩ Voltage when contacts are open: 21 to 27 VDC When contacts are short-circuited: 4 to 6 mADC	550
	STR[*1]		Reverse rotation start	Turn ON the STR signal to start reverse rotation and turn it OFF to stop.		
	STP (STOP)[*1]		Start self-holding selection	Turn ON the STP (STOP) signal to self-hold the start signal.		550
	RH, RM, RL[*1]		Multi-speed selection	Multi-speed can be selected according to the combination of RH, RM and RL signals.		226
	JOG[*1]		Jog mode selection	Turn ON the JOG signal to enable JOG operation (initial setting) and turn ON the start signal (STF or STR) to start JOG operation.		224
			Pulse train input	Terminal JOG is also used as a pulse train input terminal. To use as a pulse train input terminal, change the **Pr.291** setting. (maximum input pulse: 100k pulses/s)	Input resistance 2 kΩ When contacts are short-circuited: 8 to 13 mADC	222
	RT[*1]		Second function selection	Turn ON the RT signal to enable the second function. When the second function such as "second torque boost" and "second V/F (base frequency)" is set, turning ON the RT signal enables the selected function.	Input resistance 4.7 kΩ Voltage when contacts are open: 21 to 27 VDC When contacts are short-circuited: 4 to 6 mADC	348
	MRS[*1]		Output stop	Turn ON the MRS signal (2 ms or more) to stop the inverter output. Use this signal to shut off the inverter output when stopping the motor with an electromagnetic brake.		346
	RES[*1]		Reset	Use this signal to reset a fault output provided when a protective function is activated. Turn ON the RES signal for 0.1 s or longer, then turn it OFF. In the initial setting, reset is set always-enabled. By setting **Pr.75**, reset can be set enabled only at fault occurrence. The inverter recovers about 1 s after the reset is released.		162
	AU[*1]		Terminal 4 input selection	The terminal 4 function is available only when the AU signal is turned ON. Turning the AU signal ON makes terminal 2 invalid.		318
	CS[*1]		No function	Use **Pr.186 CS terminal function selection** for function assignment.		—

Type	Terminal symbol	Common	Terminal name	Terminal function description	Rated specification	Refer to page
Frequency setting	10E	5	Frequency setting power supply	When connecting the frequency setting potentiometer at an initial status, connect it to the terminal 10. Change the input specifications of the terminal 2 using **Pr.73** when connecting it to the terminal 10E.	10 VDC ±0.4 V Permissible load current 10 mA	318
	10	5			5 VDC ±0.5 V Permissible load current 10 mA	318
	2	5	Frequency setting (voltage)	Inputting 0 to 5 VDC (or 0 to 10 V, 0 to 20 mA) provides the maximum output frequency at 5 V (10 V, 20 mA) and makes input and output proportional. Use **Pr.73** to switch among input 0 to 5 VDC (initial setting), 0 to 10 VDC, and 0 to 20 mA. Set the voltage/current input switch in the ON position to select current input (0 to 20 mA). *2	For voltage input, input resistance: 10 to 11 kΩ, maximum permissible voltage: 20 VDC.	318
	4	5	Frequency setting (current)	Inputting 4 to 20 mADC (or 0 to 5 V, 0 to 10 V) provides the maximum output frequency at 20 mA and makes input and output proportional. This input signal is valid only when the AU signal is ON (terminal 2 input is invalid). Use **Pr.267** to switch among input 4 to 20 mA (initial setting), 0 to 5 VDC, and 0 to 10 VDC. Set the voltage/current input switch in the OFF position to select voltage input (0 to 5 V/0 to 10 V). *2 Use **Pr.858** to switch terminal functions.	For current input, input resistance: 245±5 Ω, maximum permissible current: 30 mA. 	318
	1	5	Frequency setting auxiliary	Inputting 0 to ±5 VDC or 0 to ±10 VDC adds this signal to terminal 2 or 4 frequency setting signal. Use **Pr.73** to switch between input 0 to ±5 VDC and 0 to ±10 VDC (initial setting). Use **Pr.868** to switch terminal functions.	Input resistance: 10 to 11 kΩ, maximum permissible voltage: ±20 VDC.	318
Thermistor	10 2	—	PTC thermistor input	For receiving PTC thermistor outputs. When PTC thermistor is valid (**Pr.561** ≠ "9999"), the terminal 2 is not available for frequency setting.	Applicable PTC thermistor specification Overheat detection resistance: 0.5 to 30 kW (Set by **Pr.561**)	230
External power supply input	+24	SD	24 V external power supply input	For connecting a 24 V external power supply. If a 24 V external power supply is connected, power is supplied to the control circuit while the main power circuit is OFF.	Input voltage 23 to 25.5 VDC Input current 1.4 A or less	63

*1 The terminal function can be selected by **Pr.178 to Pr.189 (Input terminal function selection)**. (Refer to **page 343**.)

*2 Set **Pr.73, Pr.267**, and the voltage/current input switch correctly, then input an analog signal in accordance with the setting.
Applying a voltage with the voltage/current input switch ON (current input is selected) or a current with the switch OFF (voltage input is selected) could cause component damage of the inverter or analog circuits of output devices. (For the details, refer to **page 318**.)

◆ Output signal

Type	Terminal symbol	Common	Terminal name	Terminal function description		Rated specification	Refer to page
Relay	A1, B1, C1*1	—	Relay output 1 (fault output)	1 changeover contact output that indicates that an inverter's protective function has been activated and the outputs are stopped. Fault: discontinuity across B and C (continuity across A and C), Normal: continuity across Band C (discontinuity across A and C)		Contact capacity 230 VAC 0.3 A (power factor = 0.4) 30 VDC 0.3 A	297
	A2, B2, C2*1	—	Relay output 2	1 changeover contact output			297
Open collector	RUN*1	SE	Inverter running	Switched to LOW when the inverter output frequency is equal to or higher than the starting frequency (initial value 0.5 Hz). Switched to HIGH during stop or DC injection brake operation.		Permissible load 24 VDC (maximum 27 VDC) 0.1 A (The voltage drop is 2.8 V at maximum while the signal is ON.) LOW is when the open collector output transistor is ON (conducted). HIGH is when the transistor is OFF (not conducted).	297
	SU*1	SE	Up to frequency	Switched to LOW when the output frequency is within the set frequency range ±10% (initial value). Switched to HIGH during acceleration/ deceleration and at a stop.	Fault code (4 bits) output. (Refer to page 314.)		305
	OL*1	SE	Overload warning	Switched to LOW when stall prevention is activated by the stall prevention function. Switched to HIGH when stall prevention is canceled.			270
	IPF*1	SE	Instantaneous power failure	Switched to LOW when an instantaneous power failure occurs or when the undervoltage protection is activated.			448
	FU*1	SE	Frequency detection	Switched to LOW when the inverter output frequency is equal to or higher than the preset detection frequency, and to HIGH when it is less than the preset detection frequency.			305
Analog	AM	5	Analog voltage output	Outputs a selected monitored item (such as output frequency) among several monitored items. The signal is not output during an inverter reset. The output signal is proportional to the magnitude of the corresponding monitoring item. Use **Pr.55, Pr.56, and Pr.866** to set full scales for the monitored output frequency, output current, and torque. (Refer to page 284.)	Output item: Output frequency (initial setting)	Output signal 0 to ±10 VDC, Permissible load current 1 mA (load impedance 10 kΩ or more) Resolution 13 bits	284
	CA	5	Analog current output			Load impedance 200 Ω to 450 Ω Output signal 0 to 20 mADC	284

*1 The terminal function can be selected by **Pr.190 to Pr.196 (Output terminal function selection)**. (Refer to **page 343**)

◆ Common terminal

Terminal Symbol	Common	Terminal name	Terminal function description	Rated specification	Refer to page
SD	—	Contact input common (sink)	Common terminal for the contact input terminal (sink logic)	—	—
		External transistor common (source)*1	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the source logic to avoid malfunction by undesirable current.		
		24 VDC power supply common	Common terminal for the 24 VDC power supply (terminal PC, terminal +24). Isolated from terminals 5 and SE.		
PC	—	External transistor common (sink)	Connect this terminal to the power supply common terminal of a transistor output (open collector output) device, such as a programmable controller, in the sink logic to avoid malfunction by undesirable currents.	Power supply voltage range 19.2 to 28.8 VDC Permissible load current 100 mA	55
		Contact input common (source)*1	Common terminal for contact input terminal (source logic).		
	SD	24 VDC power supply	Can be used as a 24 VDC 0.1 A power supply.		
5	—	Frequency setting common	Common terminal for frequency setting signal (terminal 2, 1 or 4) and analog output terminal AM, CA. Do not earth (ground).	—	318
SE	—	Open collector output common	Common terminal for terminals RUN, SU, OL, IPF, FU	—	—

*1 Source logic is initially set.

◆ Communication

Type	Terminal symbol		Terminal name	Terminal function description		Refer to page
RS-485	—		PU connector	With the PU connector, communication can be made through RS-485. (For connection on a 1:1 basis only) Conforming standard: EIA-485 (RS-485) Transmission format: Multidrop link Communication speed: 4800 to 115200 bps Wiring length: 500 m		473
	RS-485 terminals	TXD+	Inverter transmission terminal	The RS-485 terminals enables the communication by RS-485. Conforming standard: EIA-485 (RS-485) Transmission format: Multidrop link Communication speed: 300 to 115200 bps Overall length: 500 m		475
		TXD-				
		RXD+	Inverter reception terminal			
		RXD-				
		GND (SG)	Earthing (grounding)			
USB	—		USB A connector	A connector (receptacle) A USB memory device enables parameter copies and the trace function.	Interface: Conforms to USB 1.1 (USB 2.0 full-speed compatible) Transmission speed: 12 Mbps	67
			USB B connector	Mini B connector (receptacle). By connecting the inverter to a personal computer via this connector, FR Configurator2 installed on the computer can be used for setting the inverter, or monitoring or testing the inverter operation.		67

◆ Terminals for manufacturer setting

Terminal symbol	Terminal function description
S1	The terminals S1, S2, SIC, So (SO), and SOC are for manufacturer setting. Do not connect anything to these. Doing so may cause an inverter failure. Do not remove the shorting wires across the terminals S1 and PC, the terminals S2 and PC, and the terminals SIC and SD. Removing either shorting wire disables the inverter operation.
S2	
SIC	
So (SO)	
SOC	

2.6.2 Control logic (sink/source) change

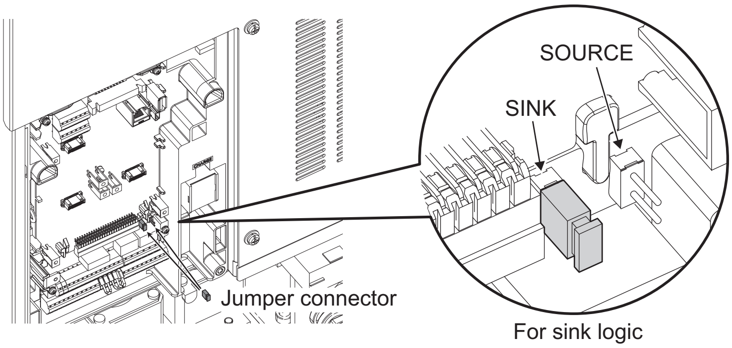
Change the control logic of input signals as necessary.

To change the control logic, change the jumper connector position on the control circuit board.

Connect the jumper connector to the connector pin of the desired control logic.

The control logic of input signals is initially set to the sink logic (SINK).

(The output signals may be used in either the sink or source logic independently of the jumper connector position.)



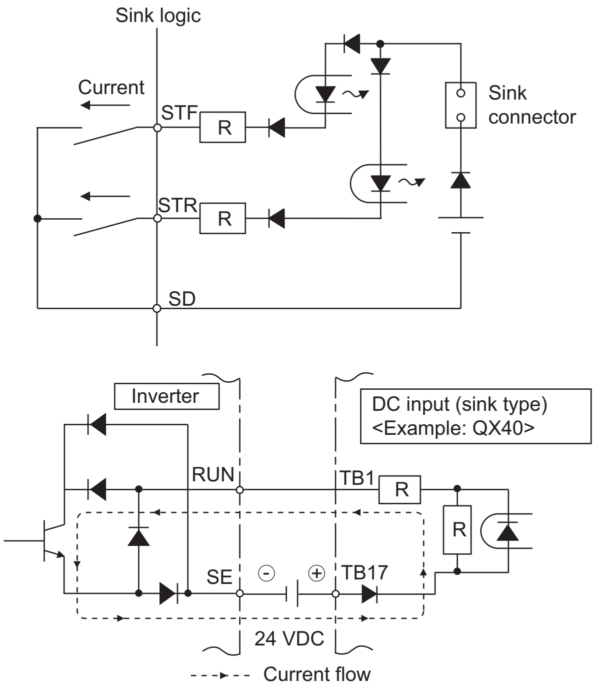
NOTE

- Make sure that the jumper connector is installed correctly.
- Never change the control logic while power is ON.

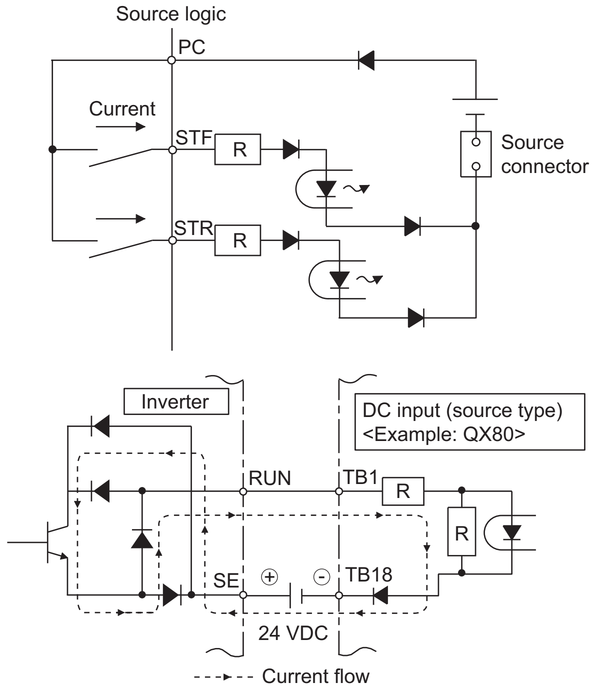
◆ Sink logic and source logic

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

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

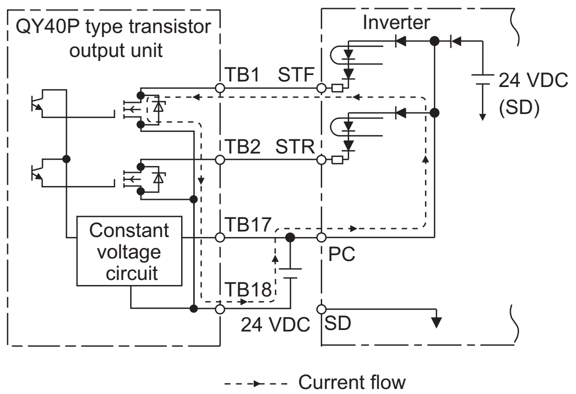


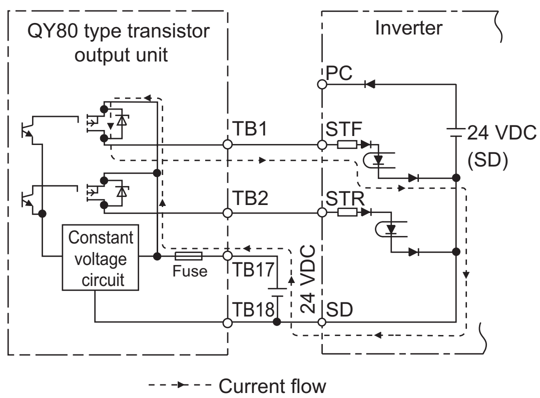
●Current flow concerning the input/output signal when source logic is selected



- When using an external power supply for transistor output

Sink logic	Source logic
Use the terminal PC as a common terminal, and perform wiring as shown below. (Do not connect terminal SD of the inverter with the terminal 0 V of the external power supply. When using terminals PC-SD as a 24 VDC power supply, do not install an external power supply in parallel with the inverter. Doing so may cause a malfunction in the inverter due to undesirable currents.)	Use the terminal SD as a common terminal, and perform wiring as shown below. (Do not connect terminal PC of the inverter with the terminal +24 V of the external power supply. When using terminals PC-SD as a 24 VDC power supply, do not install an external power supply in parallel with the inverter. Doing so may cause a malfunction in the inverter due to undesirable currents.)

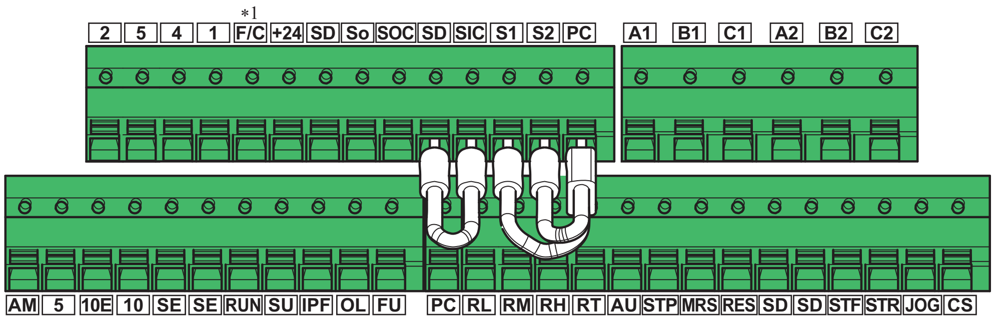




2.6.3 Wiring of control circuit

◆ Control circuit terminal layout

- Recommended cable gauge: 0.3 to 0.75 mm^2



*1 This terminal operates as the terminal CA.

◆ Wiring method

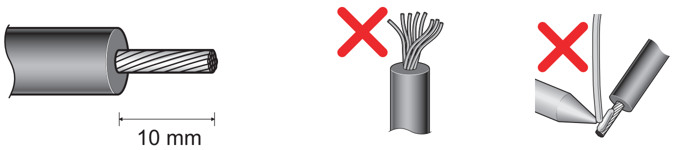
■ Power supply connection

Use crimp terminals and stripped wire for the control circuit wiring. For single wire, the stripped wire can be used without crimp terminal.

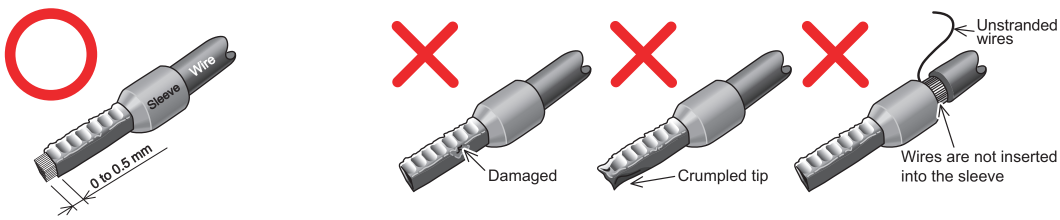
Connect the end of wires (crimp terminal or stranded wire) to the terminal block.

1. Strip the signal wires as shown below. If too much of the wire is stripped, a short circuit may occur with neighboring wires. If not enough of the wire is stripped, wires may become loose and fall out. Twist the stripped end of wires to prevent them from fraying. Do not solder it.

Wire strip length



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



- Crimp terminals commercially available (as of October 2020)

Phoenix Contact Co., Ltd.

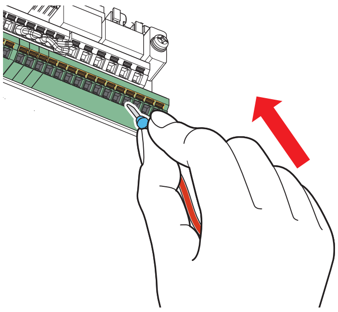
Wire gauge (mm^2)	Ferrule part No.			Crimping tool model No.
	With insulation sleeve	Without insulation sleeve	For UL wire*1	
0.3	AI 0,34-10TQ	—	—	CRIMPFOX 6
0.5	AI 0,5-10WH	—	AI 0,5-10WH-GB	
0.75	AI 0,75-10GY	A 0,75-10	AI 0,75-10GY-GB	
1	AI 1-10RD	A 1-10	AI 1-10RD/1000GB	
1.25, 1.5	AI 1,5-10BK	A 1,5-10	AI 1,5-10BK/1000GB*2	
0.75 (for two wires)	AI-TWIN 2 × 0,75-10GY	—	—	

*1 A ferrule terminal with an insulation sleeve compatible with the MTW wire which has a thick wire insulation.
*2 Applicable to the terminals A1, B1, C1, A2, B2, and C2.

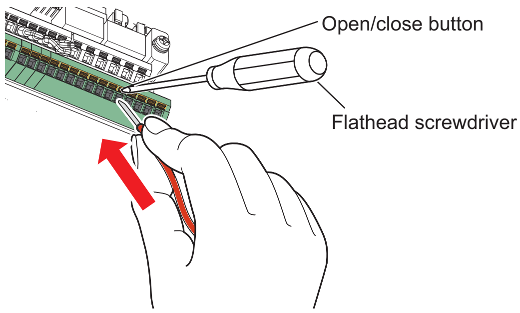
NICHIFU Co., Ltd.

Wire gauge (mm^2)	Crimp terminal part No.	Insulation cap part No.	Crimping tool model No.
0.3 to 0.75	BT 0.75-11	VC 0.75	NH 69

3. Insert the wires into a socket.



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

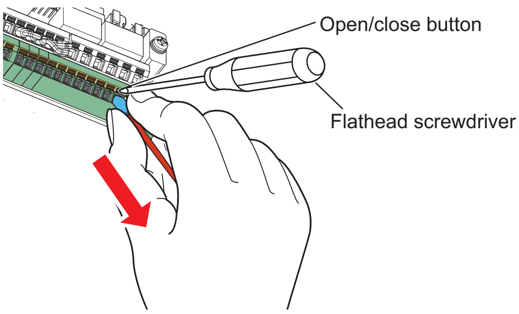


NOTE

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

■ Wire removal

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



NOTE

- Pulling out the wire forcefully without pushing the open/close button all the way down may damage the terminal block.
- Use a small flathead screwdriver (tip thickness: 0.4 mm/tip width: 2.5 mm). If a flathead screwdriver with a narrow tip is used, terminal block may be damaged. Commercially available products (as of October 2020)

Name	Model	Manufacturer
Screwdriver	SZF 0- 0,4 × 2,5	Phoenix Contact Co., Ltd.

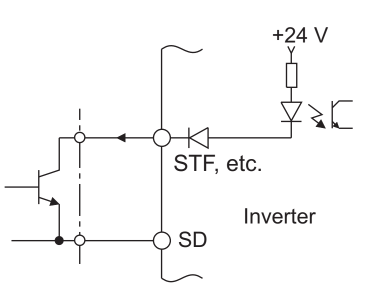
- Place the flathead screwdriver vertical to the open/close button. In case the blade tip slips, it may cause an inverter damage or injury.

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

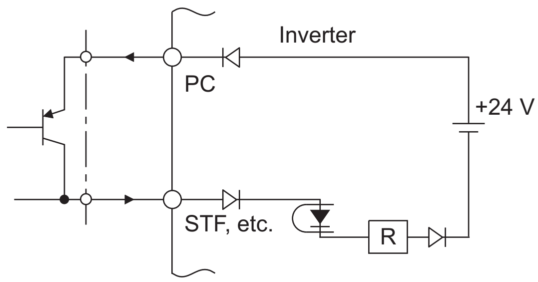
- Terminals SD (sink logic), PC (source logic), 5, and SE are common terminals (0V) for I/O signals. (All common terminals are isolated from each other.) Do not earth (ground) these terminals. Avoid connecting the terminal SD (sink logic) with 5, the terminal PC (source logic) with 5, and the terminal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

◆ Signal inputs by contactless switches

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



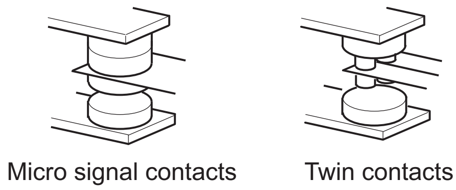
External signal input using transistor
(sink logic)



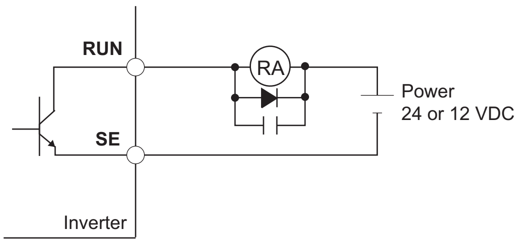
External signal input using transistor
(source logic)

2.6.4 Wiring precautions

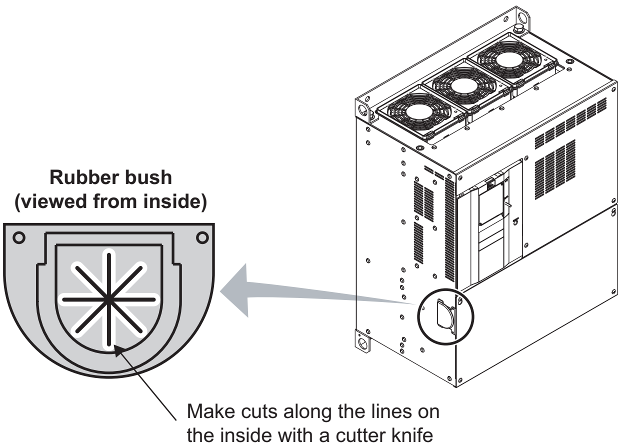
- It is recommended to use a cable of 0.3 to 0.75 mm^2 for the connection to the control circuit terminals.
- The wiring length should be 30 m at the maximum.
- Use two or more parallel micro-signal contacts or twin contacts to prevent contact faults when using contact inputs since the control circuit input signals are micro-currents.



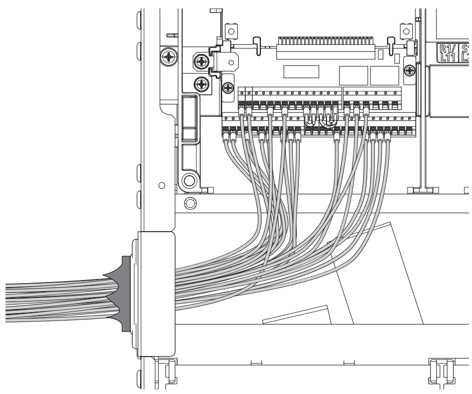
- To suppress EMI, use shielded or twisted cables for the control circuit terminals and run them away from the main and power circuits (including the 200 V relay sequence circuit). For the cables connected to the control circuit terminals, connect their shields to the common terminal of the connected control circuit terminal. When connecting an external power supply to the terminal PC, however, connect the shield of the power supply cable to the negative side of the external power supply. Do not directly earth (ground) the shield to the enclosure, etc.
- Always apply a voltage to the fault output terminals (A1, B1, C1, A2, B2, and C2) via a relay coil, lamp, etc.
- When a relay coil is connected to the output terminals, use one with a surge absorbing function (reflux diode). When the voltage application direction is incorrect, the inverter will be damaged. Pay attention to the diode direction or other precautions to avoid incorrect wiring.



- For the FR-F860-01440 or higher, separate the wiring of the control circuit away from the wiring of the main circuit. Make cuts in rubber bush of the inverter side and lead the wires through.



<Wiring example>



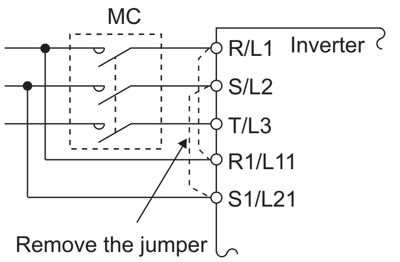
2.6.5 When using separate power supplies for the control circuit and the main circuit

◆ Cable size for the control circuit power supply (terminals R1/L11 and S1/L21)

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

◆ Connection method

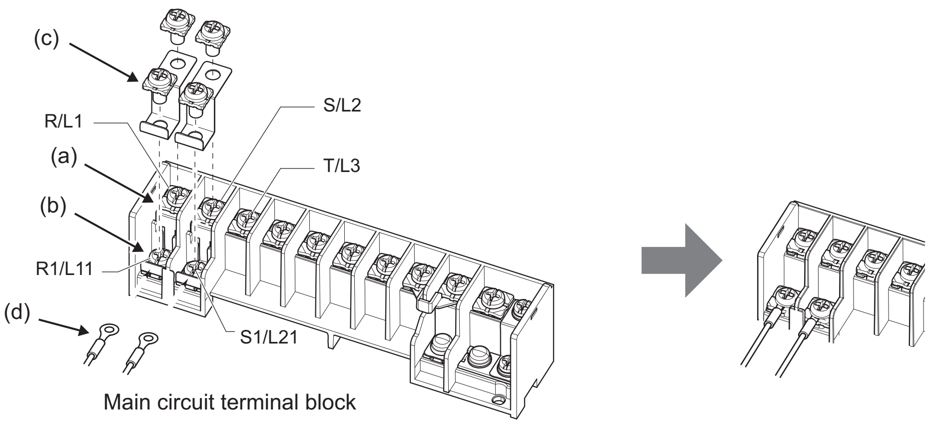
<Connection diagram>



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

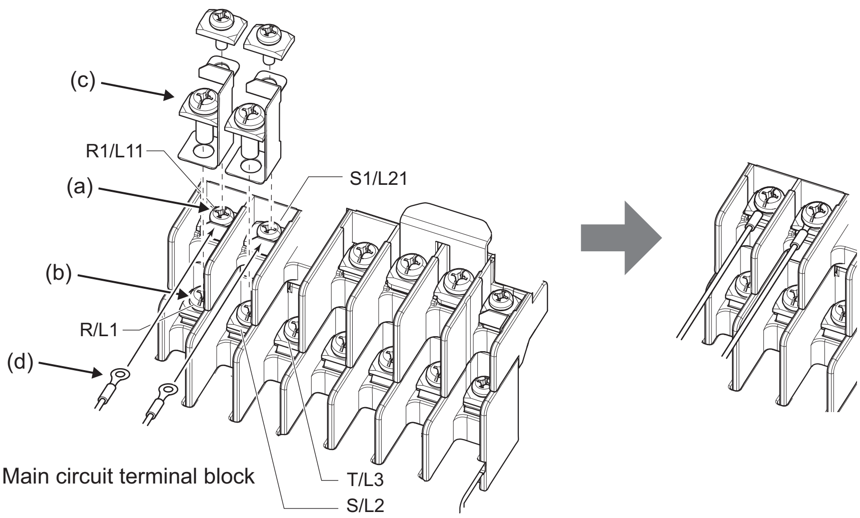
Do not connect the power cable to incorrect terminals. Doing so may damage the inverter.

- FR-F860-00090 or lower



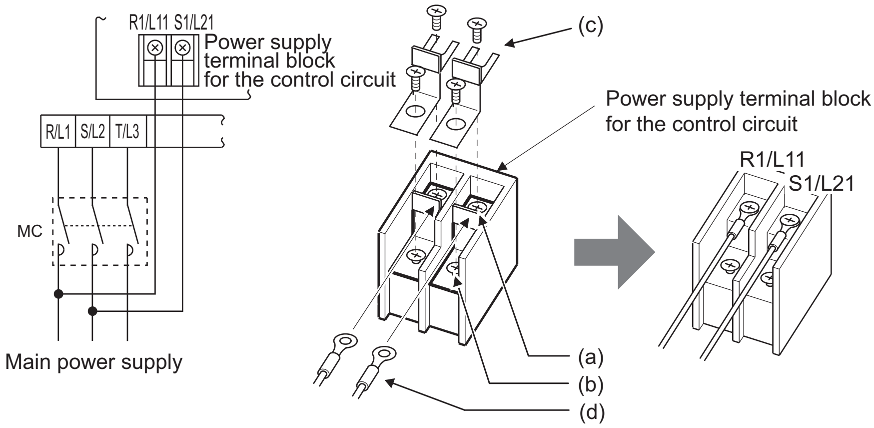
(a) Remove the upper screws.
(b) Remove the lower screws.
(c) Remove the jumper.
(d) Connect the separate power supply cable for the control circuit to the lower terminals (R1/L11, S1/L21).

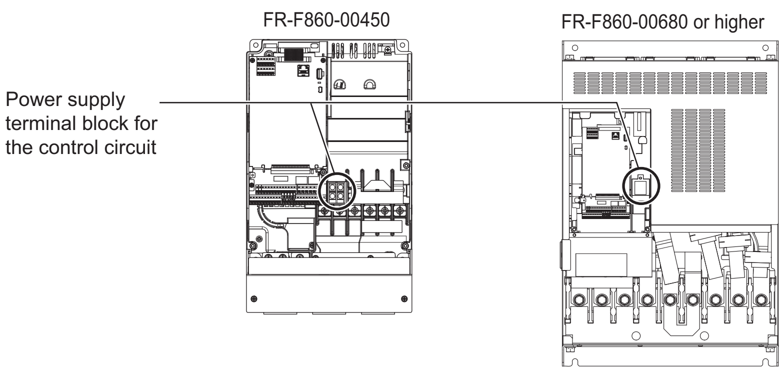
- FR-F860-00170 and 00320



(a) Remove the upper screws.
(b) Remove the lower screws.
(c) Remove the jumper.
(d) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21).

- FR-F860-00450 or higher





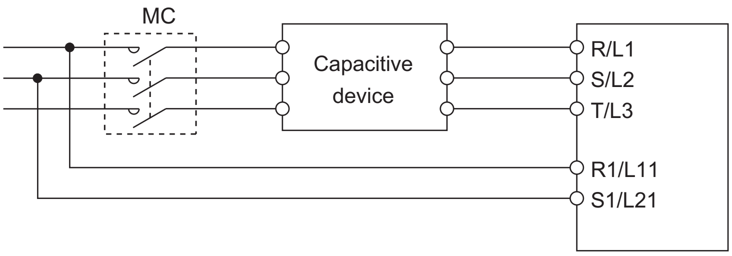
(a) Remove the upper screws.
(b) Remove the lower screws.
(c) Pull the jumper toward you to remove.
(d) Connect the separate power supply cable for the control circuit to the upper terminals (R1/L11, S1/L21).

NOTE

- When using separate power supplies, always remove the jumpers across terminals R/L1 and R1/L11 and across S/L2 and S1/L21. The inverter may be damaged if the jumpers are not removed.
- The voltage should be the same as that of the main control circuit when the control circuit power is supplied from other than the input side of the MC.
- The power capacity necessary when separate power is supplied from R1/L11 and S1/L21 differs according to the inverter capacity.

Inverter	Power supply capacity
FR-F860-00170 or lower	60 VA
FR-F860-00320 or higher	80 VA

- If the main circuit power is switched OFF (for 0.1 s or more) then ON again, the inverter is reset and a fault output will not be held.
- When a power supply is provided for the control circuit separately from the main circuit and a capacitive device (such as an EMC filter or a radio noise filter) is connected, refer to the following diagram.



2.6.6 When supplying 24 V external power to the control circuit

Connect the 24 V external power supply across terminals +24 and SD to turn the I/O terminal ON/OFF operation, keep the operation panel ON, and carry out communication with other devices even at power-OFF state of inverter's main circuit power supply. When the main circuit power supply is turned ON, the power supply source changes from the 24 V external power supply to the main circuit power supply.

◆ Specification of the applicable 24 V external power supply

Item	Rated specification
Input voltage	23 to 25.5 VDC
Input current	1.4 A or less

Commercially available products (as of October 2020)

Model	Product overview	Manufacturer
S8FS-G05024C*1	Specifications: Capacity 50 W, output voltage 24 VDC, output current 2.2 A Installation method: Direct installation, screw type terminal block with cover Input: Single-phase 100 to 240 VAC	OMRON Corporation
S8VK-S06024*1	Specifications: Capacity 60 W, output voltage 24 VDC, output current 2.5 A Installation method: DIN rail, push-in (spring) type terminal block Input: Single-phase 100 to 240 VAC	
S8VK-WA24024*1	Specifications: Capacity 240 W, output voltage 24 VDC, output current 10 A Installation method: DIN rail, push-in (spring) type terminal block Input: Three-phase 200 to 240 VAC	

*1 For the latest information about OMRON power supply, contact OMRON corporation.

◆ Starting and stopping the 24 V external power supply operation

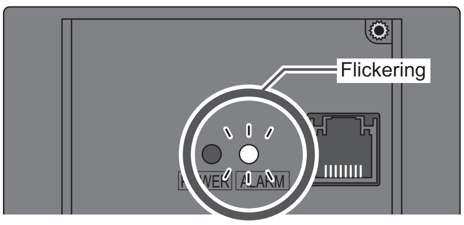
- Supplying 24 V external power while the main circuit power is OFF starts the 24 V external power supply operation. Likewise, turning OFF the main circuit power while supplying 24 V external power starts the 24 V external power supply operation.
- Turning ON the main circuit power stops the 24 V external power supply operation and enables the normal operation.

NOTE

- During the 24 V external power supply operation, the inverter operation is disabled.
- In the initial setting, when the main power supply is turned ON during the 24 V external power supply operation, a reset is performed in the inverter, then the power supply changes to the main circuit power supply. (The reset can be disabled using **Pr.30**. (Refer to page 553.))

◆ Confirming the 24 V external power supply input

- During the 24 V external power supply operation, the alarm lamp flickers.



- During the 24 V external power supply operation, the 24 V external power supply operation signal (EV) is output. To use the EV signal, set "68 (positive logic) or 168 (negative logic)" in one of **Pr.190 to Pr.196 (Output terminal function selection)** to assign function to an output terminal.

◆ Operation while the 24 V external power is supplied

- Fault records and parameters can be read and parameters can be written (when the parameter write is enabled).
- During the 24 V external power supply operation, monitored items and signals related to inputs to main circuit power supply, such as output current, converter output voltage, and IPF signal, are invalid.
- The faults, which have occurred when the main circuit power supply is ON, continue to be output after the power supply is changed to the 24 V external power supply. Perform the inverter reset or turn OFF then ON the power to reset the faults.
- If the power supply changes from the main circuit power supply to the 24 V external power supply while measuring the main circuit capacitor's life, the measurement completes after the power supply changes back to the main circuit power supply (**Pr.259** = "3").
- The output data is retained when "1 or 11" is set in **Pr.495 Remote output selection**.

NOTE

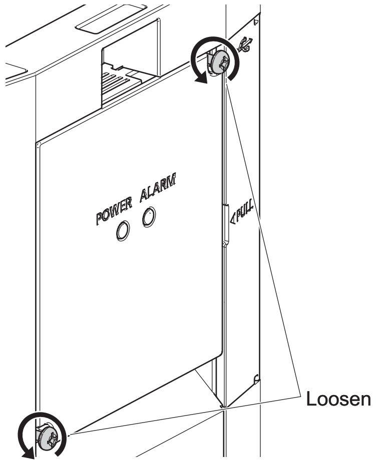
- Inrush current equal to or higher than the 24 V external power supply specification may flow at power-ON. Confirm that the power supply and other devices are not affected by the inrush current and the voltage drop caused by it. Depending on the power supply, the inrush current protection may be activated to disable the power supply. Select the power supply and capacity carefully.
- When the wiring length between the external power supply and the inverter is long, the voltage often drops. Select the appropriate wiring size and length to keep the voltage in the rated input voltage range.
- In a serial connection of several inverters, the current increases when it flows through the inverter wiring near the power supply. The increase of the current causes voltage to drop further. When connecting different inverters to different power supplies, use the inverters after confirming that the input voltage of each inverter is within the rated input voltage range. Depending on the power supply, the inrush current protection may be activated to disable the power supply. Select the power supply and capacity carefully.
- "E.SAF or E.P24" may appear when the start-up time of the 24 V power supply is too long (less than 1.5 V/s) in the 24 V external power supply operation.
- "E.P24" may appear when the 24 V external power supply input voltage is low. Check the external power supply input.
- Do not touch the control circuit terminal block (circuit board) during the 24 V power supply operation (when conducted). Otherwise you may get an electric shock or burn.

2.7 Communication connectors and terminals

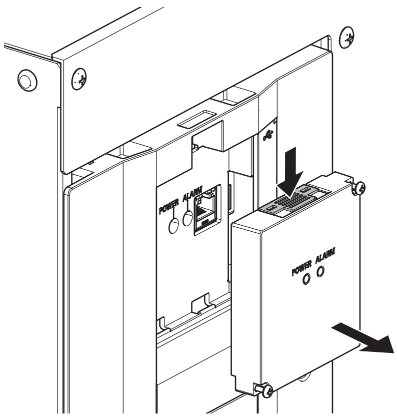
2.7.1 PU connector

◆ Removal and reinstallation of the accessory cover

1. Loosen the two screws on the accessory cover.
(These screws cannot be removed.)



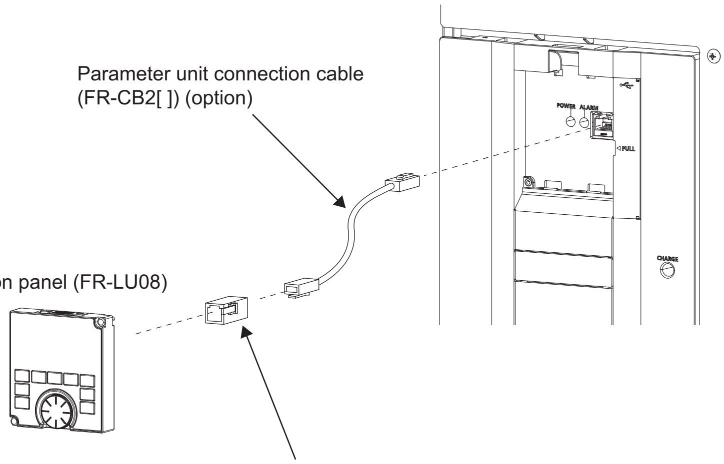
2. Press the upper edge of the accessory cover while pulling out the accessory cover.



To install the accessory cover, fit it securely and tighten the screws. (Tightening torque: 0.40 to 0.45 N·m)

◆ Mounting the operation panel on the enclosure surface

- The operation panel can be used for setting the inverter parameters, monitoring various items, and checking fault indications.
- Having an operation panel on the enclosure surface is convenient. With a connection cable, the operation panel can be mounted to the enclosure surface and connected to the inverter. Use the option FR-CB2[ ], or connectors and cables available on the market. (To mount the operation panel, the optional connector (FR-ADP) is required.) Securely insert one end of the connection cable until the stoppers are fixed.



NOTE

- Refer to the following table when fabricating the cable on the user side. Keep the total cable length within 20 m.

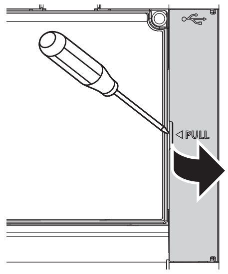
Name	Remarks
Communication cable	Cable compliant with EIA-568 (such as 10BASE-T cable)

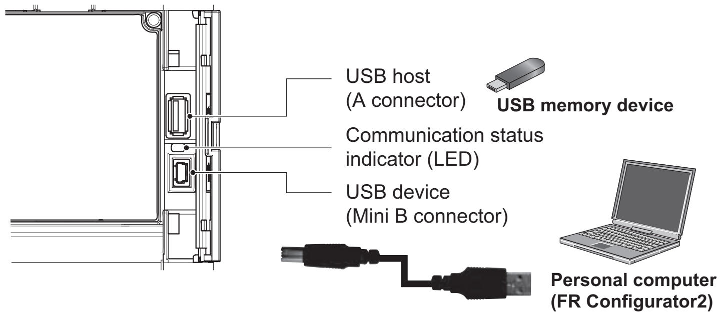
- For details on the FR-LU08, refer to the FR-LU08 Instruction Manual.

◆ Communication operation

- Using the PU connector enables 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 to monitor the inverter or read and write parameters. Communication can be performed with the Mitsubishi inverter protocol (computer link operation). For the details, refer to page 473.

2.7.2 USB connector





◆ USB host communication

Item		Specification
Interface		Conforms to USB 1.1
Transmission speed		12 Mbps
Wiring length		Maximum 5 m
Connector		USB A connector (receptacle)
Compatible USB memory	Format	FAT32
	Capacity	1 GB or more (used in the recorder mode of the trace function)
	Encryption function	Not available

- Different inverter data can be saved in a USB memory device. The USB host communication enables the following functions.

Function	Description	Refer to page
Parameter copy	• Copies the parameter setting from the inverter to the USB memory device. A maximum of 99 parameter setting files can be saved in a USB memory device. • The parameter setting data copied in the USB memory device can be copied to other inverters. This function is useful in backing up the parameter setting or for sharing the parameter setting among multiple inverters. • The parameter setting file can be copied onto a personal computer from the USB memory device and edited using FR Configurator2.	*1
Trace	• The monitored data and output status of the signals can be saved in a USB memory device. • The saved data can be imported to FR Configurator2 to diagnose the operating status of the inverter.	466
PLC function data copy	• This function copies the PLC function project data to a USB memory device when the PLC function is used. • The PLC function project data copied in the USB memory device can be copied to other inverters. • This function is useful in backing up the parameter setting and for allowing multiple inverters to operate by the same sequence programs.	463

*1 Refer to the Instruction Manual of the FR-LU08.

- The operating status of the USB host can be checked on the LED display of the inverter.

LED display status	Operating status
OFF	No USB connection.
ON	The communication is established between the inverter and the USB device.
Flickering rapidly	The USB memory device is being accessed. (Do not remove the USB memory device.)
Flickering slowly	Error in the USB connection.

- When a device such as a USB battery charger is connected to the USB connector and an excessive current (500 mA or more) flows, USB host error (UF warning) is displayed on the operation panel.
- When the UF warning appears, the USB error can be canceled by removing the USB device and setting **Pr.1049** = "1". (The UF warning can also be canceled by resetting the inverter power or resetting with the RES signal.)

NOTE

- Do not connect devices other than a USB memory device to the inverter.
- If a USB device is connected to the inverter via a USB hub, the inverter cannot recognize the USB memory device properly.

◆ USB device communication

The inverter can be connected to a personal computer with a USB (Ver. 1.1) cable.
Parameter setting and monitoring can be performed by using FR Configurator2.

Item	Specification
Interface	Conforms to USB 1.1
Transmission speed	12 Mbps
Wiring length	Maximum 5 m
Connector	USB mini B connector (receptacle)
Power supply	Self-powered

NOTE

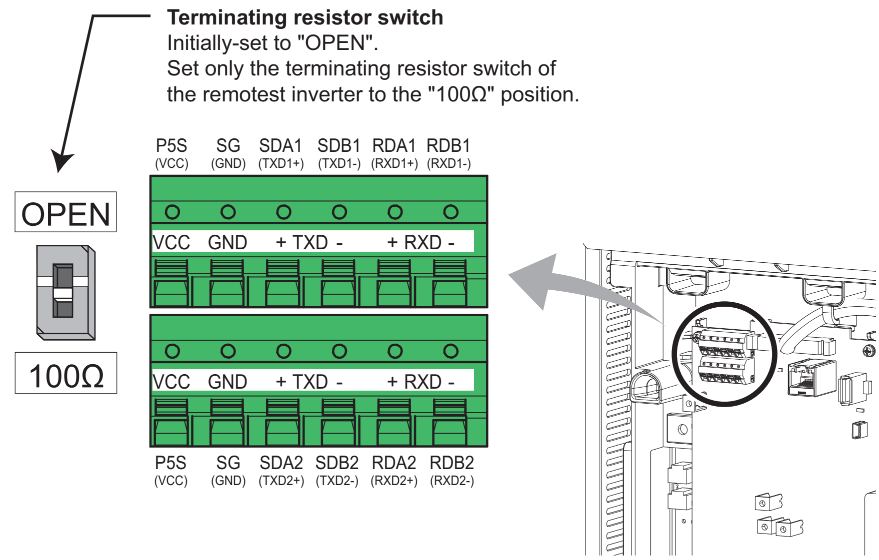
- For details on FR Configurator2, refer to the Instruction Manual of FR Configurator2.

2.7.3 RS-485 terminal block

◆ Communication operation

Item	Specification
Conforming standard	EIA-485 (RS-485)
Transmission format	Multidrop link
Communication speed	Maximum 115200 bps
Overall length	500 m
Connection cable	Twisted pair cable (4 pairs)

The RS-485 terminals enable 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 to monitor the inverter or read and write parameters.
Communication can be performed with the Mitsubishi inverter protocol (computer link operation) and MODBUS RTU protocol. For the details, refer to page 475.



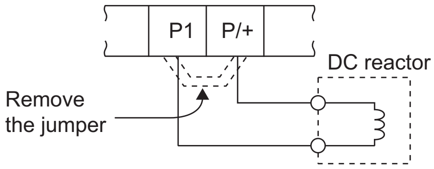
2.8 Connection of stand-alone option units

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

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

2.8.1 Connection of the DC reactor

- When using the DC reactor, connect it across terminals P/+ and P1. In this case, the jumper connected across terminals P/+ and P1 must be removed. Otherwise, the reactor will not be effective. (The jumper is not installed for the FR-F860-01080 or higher.)



- Select a DC reactor according to the applied motor capacity. (Refer to page 612.)
- For the FR-F860-01080 or higher, or whenever a 75 kW or higher motor is used, always connect a DC reactor.
- Select a DC reactor according to the following table.

Motor capacity (kW)	Reactor specifications*1*2	
	Reactor L value (mH)	DC reactor rated current (A)
75	0.616	124
90	0.517	149
110	0.426	182
132	0.351	219
160	0.294	265
185	0.254	307
220	0.214	365
250	0.188	414
280	0.169	464
315	0.150	522

*1 The power supply frequency of 60 Hz is assumed.
*2 Class H or higher insulation is recommended.
Select a DC reactor for which its L value does not fall to 50% or below when the inverter overload current rating is 150% (SLD rating).

NOTE

- The wiring distance must be within 5 m.
- As a reference, the cable gauge for the connection must be equal to or larger than that of the power supply cables (R/L1, S/L2, T/L3) and the earthing (grounding) cable. (Refer to page 44.)

MEMO

CHAPTER 3 PRECAUTIONS FOR USE OF THE INVERTER

3 PRECAUTIONS FOR USE OF THE INVERTER

This chapter explains the precautions for use of this product.
Always read the instructions before using the equipment.
For the PRECAUTIONS FOR USE OF THE INVERTER of the separated converter type, refer to the FR-F862 (Separated Converter Type) Instruction Manual (Hardware).

3.1 Electro-magnetic interference (EMI) and leakage currents

3.1.1 Leakage currents and countermeasures

Capacitance exist between the inverter I/O cables, other cables and earth and in the motor, through which a leakage current flows. Since its value depends on the static capacitance, carrier frequency, etc., low acoustic noise operation at the increased carrier frequency of the inverter will increase the leakage current. Therefore, take the following countermeasures. Select the earth leakage current 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 earthing (grounding) cable, etc. These leakage currents may operate earth leakage circuit breakers and earth leakage relays unnecessarily.

■ Countermeasures

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

NOTE

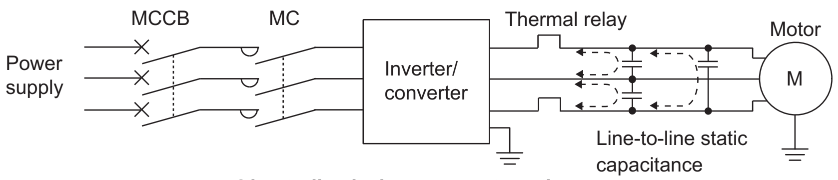
- Long wiring will increase the leakage current.
- High motor capacity will increase the leakage current.

◆ Line-to-line leakage currents

Harmonics of leakage currents flowing in static capacitance between the inverter output cables may operate the external thermal relay unnecessarily. When the wiring length is long (50 m or more) for the 600 V class small-capacity models (FR-F860-00170 or lower), the external thermal relay is likely to operate unnecessarily because the ratio of the leakage current to the rated motor current increases.

■ Line-to-line leakage current example (600 V class)

Motor capacity (kW)	Rated motor current (A)	Leakage current (mA)		Condition
		Wiring length 50 m	Wiring length 100 m	
0.75	1.1	1020	1590	• Motor: 4P • Carrier frequency: 14.5 kHz • Cable: 2 mm^2, 4 cores • Cabtyre cable
1.5	2.0	1110	1680	
2.2	3.2	1200	1770	
3.7	5.2	1320	1890	
5.5	7.8	1470	2040	
7.5	9.9	1605	2175	



Line-to-line leakage currents path

■ Countermeasures

- Use **Pr.9 Electronic thermal O/L relay**.
- If the carrier frequency setting is high, decrease the **Pr.72 PWM frequency selection** setting.

Note that motor noise increases. Selecting **Pr.240 Soft-PWM operation selection** makes the sound inoffensive.
To ensure that the motor is protected against line-to-line leakage currents, it is recommended to use a temperature sensor to directly detect motor temperature.

■ Installation and selection of the molded case circuit breaker

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

3.1.2 Countermeasures against inverter-generated EMI

Some electromagnetic noises enter the inverter to cause the inverter malfunction, and others are radiated by the inverter to cause the peripheral devices to malfunction. Though the inverter is designed to have high immunity performance, it handles low-level signals, so it requires the following basic techniques. Also, since the inverter chops outputs at high carrier frequency, that could generate electromagnetic noises. If these electromagnetic noises cause peripheral devices to malfunction, EMI countermeasures should be taken to suppress noises. These techniques differ slightly depending on EMI 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 shielded twisted pair cables for the detector connecting and control signal cables and connect the sheathes of the shielded cables to terminal SD.
- Ground (Earth) the inverter, motor, etc. at one point.

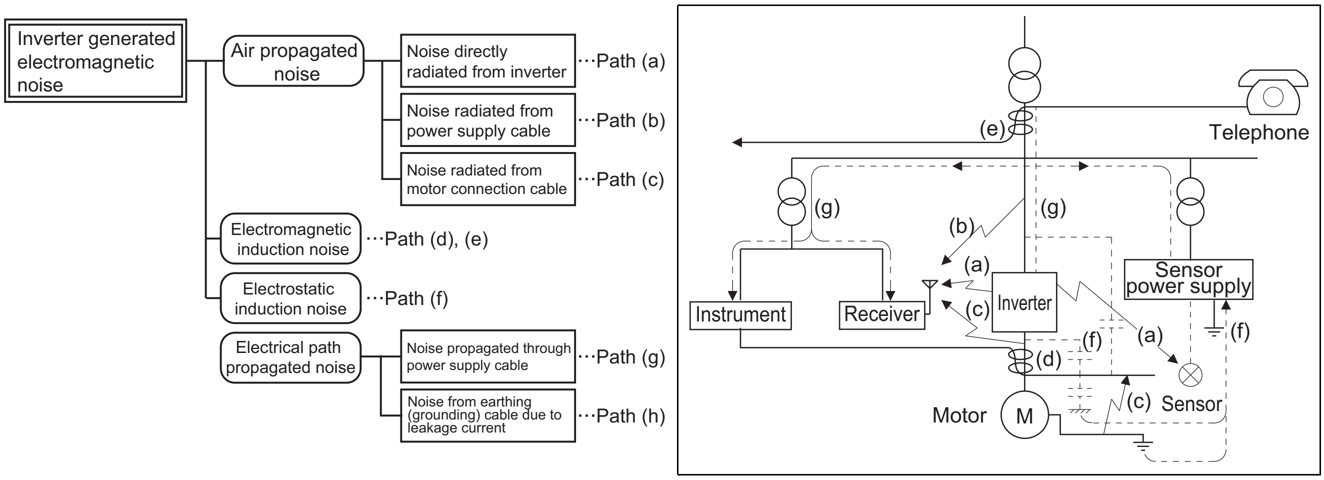
◆ Techniques to reduce electromagnetic noises that enter and cause a malfunction of the inverter (EMI countermeasures)

When devices that generate many electromagnetic noises (which use magnetic contactors, electromagnetic brakes, many relays, for example) are installed near the inverter and the inverter may malfunction due to electromagnetic noises, the following countermeasures must be taken:

- Provide surge suppressors for devices that generate many electromagnetic noises to suppress electromagnetic noises.
- Install data line filters (page 74) to signal cables.
- Ground (Earth) the shields of the detector connection and control signal cables with cable clamp metal.

◆ Techniques to reduce electromagnetic noises that are radiated by the inverter to cause the peripheral devices to malfunction (EMI countermeasures)

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

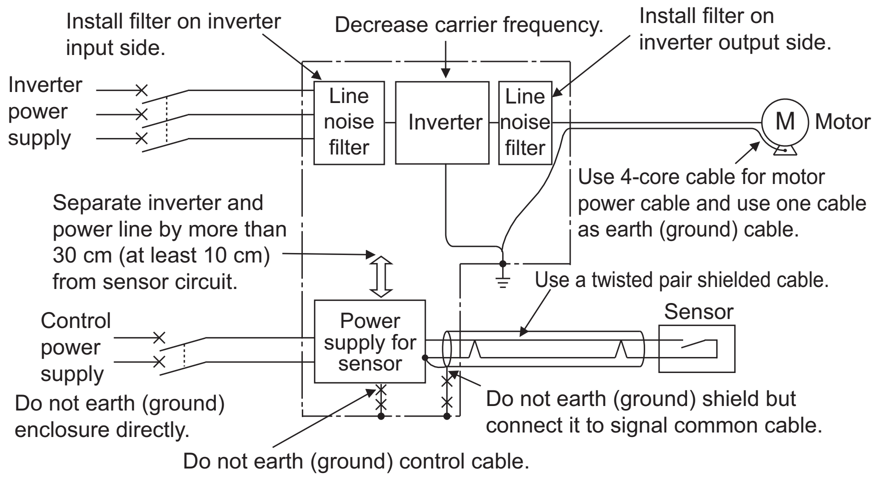


Noise propagation path	Countermeasure
(a)(b)(c)	When devices that handle low-level signals and are liable to malfunction due to electromagnetic noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the inverter or when their signal cables are run near the inverter, the devices may malfunction due to by air-propagated electromagnetic noises. The following countermeasures 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. • Inserting a line noise filter into the output suppresses the radiated noise from the cables. • Use shielded cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
(d)(e)(f)	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 cause malfunction of the devices and the following countermeasures 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 shielded cables as signal cables and power cables and run them in individual metal conduits to produce further effects.
(g)	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 cause malfunction of the devices and the following countermeasures must be taken: • Install the line noise filter to the power cables (output cables) of the inverter.
(h)	When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage currents may flow through the earthing (grounding) cable of the inverter to cause the device to malfunction. In that case, disconnecting the earthing (grounding) cable from the device may stop the malfunction of the device.

◆ Data line filter

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

◆ EMI countermeasure example



3.2 Power supply harmonics

3.2.1 Power supply harmonics

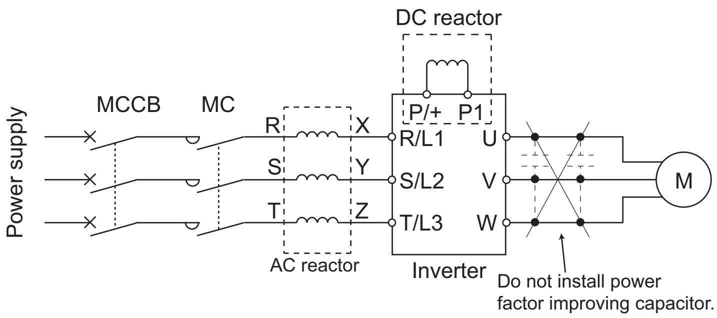
The inverter may generate power supply harmonics from its converter circuit to affect the power generator, power factor correction capacitor etc. Power supply harmonics are different from noise and leakage currents in source, frequency band and transmission path. Take the following countermeasure suppression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

- The differences between harmonics and noises

Item	Harmonics	Noise
Frequency	Normally 40th to 50th degrees or less (3 kHz or less).	High frequency (several 10 kHz to 1 GHz order).
Location	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 the load capacity.	Changes with the current variation ratio. (Gets larger as switching speed increases.)
Affected equipment immunity	Specified by standards per equipment.	Different depending on maker's equipment specifications.
Countermeasure	Provide a reactor.	Increase distance.

- Countermeasures

The harmonic current generated from the inverter to the input side differs according to various conditions such as the wiring impedance, whether a reactor is used or not, and output frequency and output current on the load side.
For the output frequency and output current, we understand that this should be calculated in the conditions under the rated load at the maximum operating frequency.

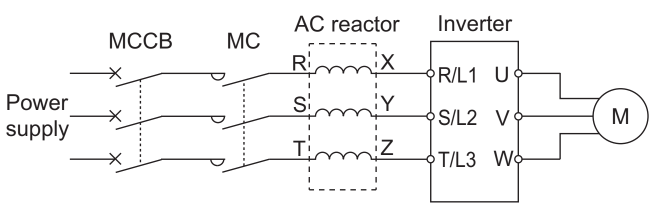


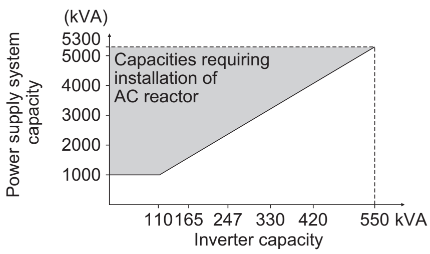
NOTE

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

3.3 Installation of a reactor

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





3.4 Power-OFF and magnetic contactor (MC)

◆ Inverter input side magnetic contactor (MC)

On the inverter input side, it is recommended to provide an MC for the following purposes:
(Refer to page 26 for selection.)

- To disconnect the inverter from the power supply at activation of a protective function or at malfunctioning of the driving system (emergency stop, etc.).
- To prevent any accident due to an automatic restart at power restoration after an inverter stop made by a power failure.
- To separate the inverter from the power supply to ensure safe maintenance and inspection work.

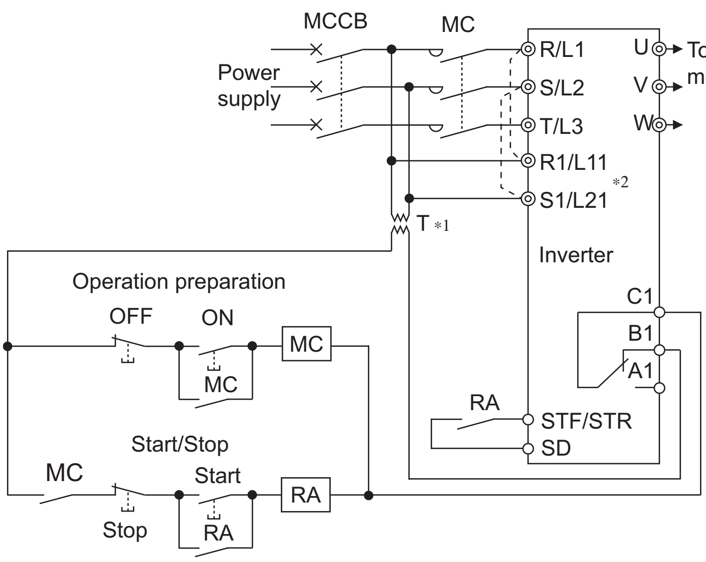
Use the inverter input current as a reference for selection of an MC to perform an emergency stop during operation, and select the MC conforming to JEM 1038-AC-3 class rated operational current.

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 magnetic contactor must be avoided. Turn ON/OFF the inverter start controlling terminals (STF, STR) to run/stop the inverter.

- Inverter start/stop circuit example

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



*1 Install a stepdown transformer.
*2 Connect the power supply terminals R1/L11, S1/L21 of the control circuit to the input 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 and R1/L11 and S/L2 and S1/L21. (Refer to page 60 for removal of the jumper.)

◆ Handling of the magnetic contactor on the inverter's output side

Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop. When the magnetic contactor is turned ON while the inverter is operating, overcurrent protection of the inverter and such will activate. When an MC is provided to switch to a commercial power supply, for example, it is recommended to use the electronic bypass function **Pr.135 to Pr.139** (Refer to page 376). (The commercial power supply operation is not available with PM motors.)

◆ Handling of the manual contactor on the inverter's output side

A PM motor is a synchronous motor with high-performance magnets embedded inside. High-voltage is generated at the motor terminals while the motor is running even after the inverter power is turned OFF. In an application where the PM motor is driven by the load even after the inverter is powered OFF, a low-voltage manual contactor must be connected at the inverter's output side.

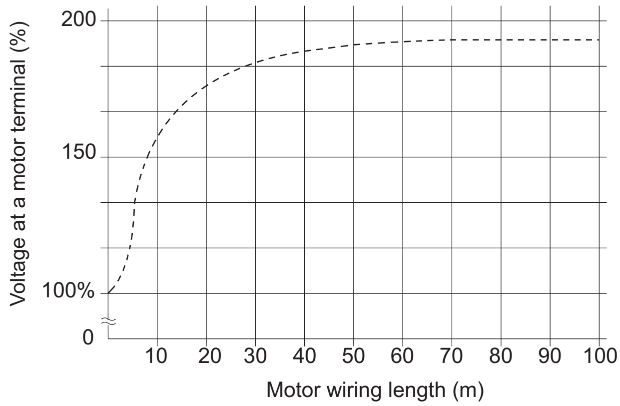
NOTE

- Before wiring or inspection for a PM motor, confirm that the PM motor is stopped. In an application, such as fan and blower, where the motor is driven by the load, a low-voltage manual contactor must be connected at the inverter's output side, and wiring and inspection must be performed while the contactor is open. Otherwise you may get an electric shock.
- Do not open or close the contactor while the inverter is running (outputting).

3.5 Countermeasures against deterioration of the 600 V class motor insulation

In the PWM type inverter, a surge voltage attributable to wiring constants is generated at the motor terminals. Especially for a 600 V class motor, the surge voltage may deteriorate the insulation.

- Surge voltage at a motor terminal by motor wiring length (reference)



When the 600 V class motor is driven by the inverter, consider the following measures:

◆ Measures

- Inverter duty motor

Select an inverter duty motor. Many motor manufacturers sell motors with insulation systems designed to withstand the stress imposed by PWM inverters

- AC reactor

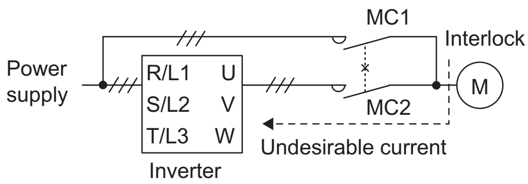
For added protection, install an AC reactor on the inverter output.

3.6 Checklist before starting operation

The FR-F860 series inverter 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 points.

Checkpoint	Countermeasure	Refer to page	Check by user
Crimping terminals are insulated.	Use crimping terminals with insulation sleeves to wire the power supply and the motor.	-	
The wiring between the power supply (R/L1, S/L2, T/L3) and the motor (U, V, W) is correct.	Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.	41	
No wire offcuts are left from the time of wiring.	Wire offcuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in an enclosure etc., take caution not to allow chips and other foreign matter to enter the inverter.	-	
The main circuit cable gauge is correctly selected.	Use an appropriate cable gauge to suppress the voltage drop to 2% or less. If the wiring distance is long between the inverter and motor, the voltage drop in the main circuit will cause the motor torque to decrease especially during the output of a low frequency.	44	
The total wiring length is within the specified length.	Keep the total wiring length within the specified length. In long distance wiring, charging currents due to stray capacitance in the wiring may degrade the fast-response current limit operation or cause the equipment on the inverter's output side to malfunction. Pay attention to the total wiring length.	44	
Countermeasures are taken against EMI.	The input/output (main circuit) of the inverter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter. In such case, activate the noise filter to minimize interference.	73	
Countermeasures are taken against electrical corrosion on the motor bearing.	When a motor is driven by the inverter, axial voltage is generated on the motor shaft, which may cause electrical corrosion of the bearing in rare cases depending on the wiring, load, operating conditions of the motor or specific inverter settings (high carrier frequency). Contact your sales representative to take appropriate countermeasures for the motor. The following shows examples of countermeasures for the inverter. • Decrease the carrier frequency. • Provide a common mode choke on the output side of the inverter.*1	-	
On the inverter's output side, there is no power factor correction capacitor, surge suppressor, or radio noise filter installed.	Such installation will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices is connected, immediately remove it.	-	
When performing an inspection or rewiring on the product that has been energized, the operator has waited long enough after shutting off the power supply.	For a short time after the power-OFF, a high voltage remains in the smoothing capacitor, and it is dangerous. Before performing an inspection or rewiring, wait 10 minutes or longer after the power supply turns OFF, then confirm that the voltage across the main circuit terminals P/+ and N/- of the inverter is low enough using a tester, etc.	-	
The inverter's output side has no short circuit or ground fault occurring.	• A short circuit or ground fault on the inverter's output side may damage the inverter module. • Fully check the insulation resistance of the circuit prior to inverter operation since repeated short circuits caused by peripheral circuit inadequacy or a ground fault caused by wiring inadequacy or reduced motor insulation resistance may damage the inverter module. • Fully check the to-earth (ground) insulation and phase-to-phase insulation of the inverter's output side before power-ON. Especially for an old motor or use in hostile atmosphere, make sure to check the motor insulation resistance, etc.	-	
The circuit is not configured to use the inverter's input-side magnetic contactor to start/stop the inverter frequently.	Since repeated inrush currents at power ON will shorten the life of the converter circuit, frequent starts and stops of the magnetic contactor must be avoided. Turn ON/OFF the inverter's start signals (STF, STR) to run/stop the inverter.	77	

Checkpoint	Countermeasure	Refer to page	Check by user
The voltage applied to the inverter I/O signal circuits is within the specifications.	Application of a voltage higher than the permissible voltage to the inverter I/O signal circuits or opposite polarity may damage the I/O devices. Especially check the wiring to prevent the speed setting potentiometer from being connected incorrectly to short circuit the terminals 10E and 5.	50	
When using the electronic bypass operation, electrical and mechanical interlocks are provided between the electronic bypass contactors MC1 and MC2.	When using a switching circuit as shown below, chattering due to mis-configured sequence or arc generated at switching may allow undesirable current to flow in and damage the inverter. Mis-wiring may also damage the inverter. (The commercial power supply operation is not available with PM motors.)  If switching to the commercial power supply operation while a failure such as an output short circuit has occurred between the magnetic contactor MC2 and the motor, the damage may further spread. If a failure has occurred between the MC2 and the motor, a protection circuit such as using the OH signal input must be provided.	376	
A countermeasure is provided for power restoration after a power failure.	If the machine must not be restarted when power is restored after a power failure, provide an MC 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.	-	
A magnetic contactor (MC) is installed on the inverter's input side.	On the inverter's input side, connect an MC for the following purposes: • To disconnect the inverter from the power supply at activation of a protective function or at malfunctioning of the driving system (emergency stop, etc.). • To prevent any accident due to an automatic restart at power restoration after an inverter stop made by a power failure. • To separate the inverter from the power supply to ensure safe maintenance and inspection work. If using an MC for emergency stop during operation, select an MC regarding the inverter input side current as JEM 1038-AC-3 class rated current.	77	
The magnetic contactor on the inverter's output side is properly handled.	Switch the magnetic contactor between the inverter and motor only when both the inverter and motor are at a stop.	77	
When using a PM motor, a low-voltage manual contactor is installed on the inverter's output side.	When a failure occurs between the MC2 and motor, make sure to provide a protection circuit, such as using the OH signal input. In an application, such as fan and blower, where the motor is driven by the load, a low-voltage manual contactor must be connected at the inverter's output side, and wiring and inspection must be performed while the contactor is open. Otherwise you may get an electric shock.	77	
An EMI countermeasure is provided for the frequency setting signals.	If electromagnetic noise generated from the inverter causes frequency setting signal to fluctuate and the motor rotation speed to be unstable when changing the motor speed with analog signals, the following countermeasures are effective: • Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. • Run signal cables as far away as possible from power cables (inverter I/O cables). • Use shielded cables. • Install a ferrite core on the signal cable.	73	
A countermeasure is provided for an overload operation.	When performing frequent starts/stops by the inverter, rise/fall in the temperature of the transistor element of the inverter will repeat due to a repeated flow of large current, shortening the life from thermal fatigue. Since thermal fatigue is related to the amount of current, the life can be increased by reducing current at locked condition, starting current, etc. Reducing current may extend the service life but may also cause torque shortage, which leads to a start failure. Adding a margin to the current can eliminate such a condition. For an induction motor, use an inverter of a higher capacity (up to two ranks). For a PM motor, use an inverter and PM motor of higher capacities.	-	

Checkpoint	Countermeasure	Refer to page	Check by user
The specifications and rating match the system requirements.	Make sure that the specifications and rating match the system requirements.	612	
Countermeasures are taken against electrical corrosion on the motor bearing.	When a motor is driven by the inverter, axial voltage is generated on the motor shaft, which may cause electrical corrosion of the bearing in rare cases depending on the wiring, load, operating conditions of the motor or specific inverter settings (high carrier frequency). Contact your sales representative to take appropriate countermeasures for the motor. The following shows examples of countermeasures for the inverter. • Decrease the carrier frequency. • Provide a common mode choke*1 on the output side of the inverter.	-	

*1 Recommended common mode choke: FT-3KM F series FINEMET® common mode choke cores manufactured by Hitachi Metals, Ltd. FINEMET is a registered trademark of Hitachi Metals, Ltd.

3.7 Failsafe system which uses the inverter

When a fault is detected by the protective function, the protective function activates and outputs a fault signal. However, a fault signal may not be output at an inverter's fault occurrence when the detection circuit or output circuit fails, etc. Although Mitsubishi Electric assures the best quality products, provide an interlock which uses inverter status output signals to prevent accidents such as damage to the machine when the inverter fails for some reason. Also at the same time consider the system configuration where a failsafe from outside the inverter, without using the inverter, is enabled even if the inverter fails.

3

◆ Interlock method which uses the inverter status output signals

By combining the inverter output signals to provide an interlock as shown below, an inverter failure can be detected.

No.	Interlock method	Check method	Used signals	Refer to page
a	Inverter protective function operation	Operation check of an alarm contact. Circuit error detection by negative logic.	Fault (ALM) signal	304
b	Inverter operating status	Operation ready signal check.	Inverter operation ready (RY) signal	303
c	Inverter running status	Logic check of the start signal and running signal.	Start signal (STF signal, STR signal) Inverter running (RUN) signal	303, 550
d	Inverter running status	Logic check of the start signal and output current.	Start signal (STF signal, STR signal) Output current detection (Y12) signal	307, 550

- When using various signals, assign the functions to **Pr.190 to Pr.196 (Output terminal function selection)** referring to the following table.

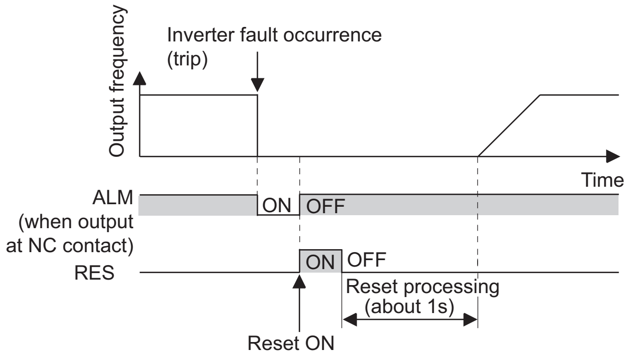
Output signal	Pr.190 to Pr.196 setting	
	Positive logic	Negative logic
ALM	99	199
RY	11	111
RUN	0	100
Y12	12	112

NOTE

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

■ Checking by the output of the inverter fault signal... (a)

When the inverter's protective function activates and the inverter trips, the Fault (ALM) signal is output. (Fault (ALM) signal is assigned to terminal A1B1C1 in the initial setting). With this signal, check that the inverter operates properly. In addition, negative logic can be set. (ON when the inverter is normal, OFF when the fault occurs.)

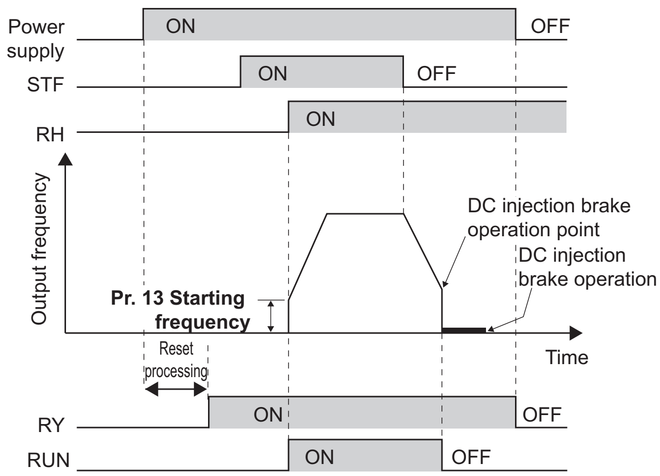


■ Checking the inverter operating status by the inverter operation ready completion signal... (b)

Inverter operation ready (RY) signal is output when the inverter power is ON and the inverter becomes operative. Check if the RY signal is output after powering ON the inverter.

■ Checking the inverter operating status by the start signal input to the inverter and inverter running signal... (c)

The Inverter running (RUN) signal is output when the inverter is running. (RUN signal is assigned to terminal RUN in the initial setting.) Check if RUN signal is being output while inputting a start signal to the inverter. (STF signal is a forward rotation signal, and STR is a reverse rotation signal.) Even after the start signal is turned OFF, the RUN signal is kept output until the inverter makes the motor to decelerate and to stop. For the logic check, configure a sequence considering the inverter's deceleration time.



■ Checking the motor operating status by the start signal input to the inverter and inverter output current detection signal... (d)

The Output current detection (Y12) signal is output when the inverter operates and currents flows into the motor. Check if Y12 signal is being output while inputting a start signal to the inverter. (STF signal is a forward rotation signal, and STR is a reverse rotation signal.) The Y12 signal is initially set to be output at 110% inverter rated current. Adjust the level to around 20% using no load current of the motor as reference with **Pr.150 Output current detection level**. Like the inverter running signal (RUN signal), even after the start signal is turned OFF, the Y12 signal is kept output until the inverter stops the output to a decelerating motor. For the logic check, configure a sequence considering the inverter's deceleration time.

◆ Backup method outside the inverter

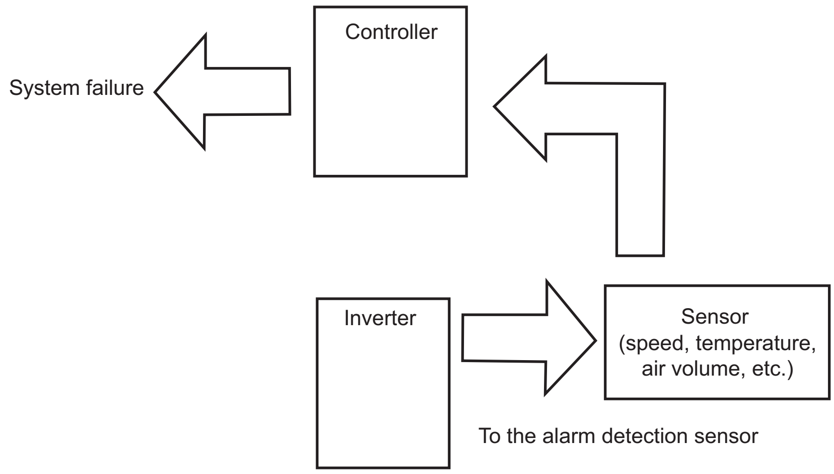
Even if the interlock is provided by the inverter status signal, enough failsafe is not ensured depending on the failure status of the inverter itself. For example, if an inverter CPU fails in a system interlocked with the inverter's fault, start, and RUN signals, no fault signal will be output and the RUN signal will be kept ON because the inverter CPU is down.
Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as performing a check as below according to the level of importance of the system.

■ Start signal and actual operation check

Check the motor running and motor current while the start signal is input to the inverter by comparing the start signal to the inverter and detected speed of the speed detector or detected current of the current detector. Note that the current is flowing through the motor while the motor coasts to stop, even after the inverter's start signal is turned OFF. For the logic check, configure a sequence considering the inverter's deceleration time. In addition, it is recommended to check the three-phase current when using the current detector.

■ Command speed and actual operation check

Check for a gap between the actual speed and commanded speed by comparing the inverter's speed command and the speed detected by the speed detector.



MEMO

CHAPTER 4 BASIC OPERATION

4 BASIC OPERATION

This chapter explains the BASIC OPERATION of this product.
Always read the instructions before using the equipment.

4.1 Frequently-used parameters (simple mode parameters)

Parameters that are frequently used for the FR-F800 series are grouped as simple mode parameters.
When **Pr.160 User group read selection**="9999", only the simple mode parameters are displayed.
The simple mode can be used when the operation panel (FR-LU08) or the parameter unit (FR-PU07) is used.
This section explains about frequently-used parameters.

4.1.1 Simple mode parameter list

For simple variable-speed operation of the inverter, the initial values of the parameters may be used as they are. Set the necessary parameters to meet the load and operational specifications.

Point

• **Pr.160 User group read selection** can narrow down the displayed parameters to only the simple mode parameters. (In the initial setting, all parameters are displayed.) Set **Pr.160 User group read selection** as required. (For the parameter change, refer to the Instruction Manual of the FR-LU08.)

Pr.160 setting	Description
9999	Displays only the simple mode parameters.
0 (initial value)	Displays simple mode + extended parameters.
1	Displays parameters registered in the user group.

Pr.	Pr. group	Name	Unit	Initial value	Range	Application	Refer to page
0	G000	Torque boost	0.1%	3%*1 2%*2 1%*3	0 to 30%	Set this parameter to obtain a higher starting torque under V/F control. Also set this when a loaded motor cannot be driven and the warning [OL] occurs, then the inverter trips with [OC1].	538
1	H400	Maximum frequency	0.01 Hz	120 Hz*4 60 Hz*5	0 to 120 Hz	Sets the upper limit for the output frequency.	253
2	H401	Minimum frequency	0.01 Hz	0Hz	0 to 120 Hz	Sets the lower limit for the output frequency.	253
3	G001	Base frequency	0.01 Hz	60 Hz	0 to 590 Hz	Set this parameter when the rated motor frequency is 50 Hz. Check the rating plate of the motor.	539
4	D301	Multi-speed setting (high speed)	0.01 Hz	60 Hz	0 to 590 Hz	Pre-sets the speeds that will be switched among by terminals.	91, 98, 226
5	D302	Multi-speed setting (middle speed)	0.01 Hz	30 Hz	0 to 590 Hz	Pre-sets the speeds that will be switched among by terminals.	91, 98, 226
6	D303	Multi-speed setting (low speed)	0.01 Hz	10 Hz	0 to 590 Hz	Pre-sets the speeds that will be switched among by terminals.	91, 98, 226
7	F010	Acceleration time	0.1 s	5 s*6 15 s*3	0 to 3600 s	Sets the acceleration time.	190
8	F011	Deceleration time	0.1 s	10 s*6 30 s*3	0 to 3600 s	Sets the deceleration time.	190
9	H000 C103	Electronic thermal O/L relay	0.01 A*4 0.1 A*5	Inverter rated current	0 to 500 A*4 0 to 3600 A*5	Protects the motor from heat. Set the rated motor current.	230
15	D200	Jog frequency	0.01 Hz	5 Hz	0 to 590 Hz	Sets the frequency during JOG operation.	224
16	F002	Jog acceleration/ deceleration time	0.1 s	0.5 s	0 to 3600 s	Sets motor acceleration/deceleration time during JOG operation.	224

Pr.	Pr. group	Name	Unit	Initial value	Range	Application	Refer to page
79	D000	Operation mode selection	1	0	0 to 4, 6, 7	Select the start and frequency command sources.	204
125	T022	Terminal 2 frequency setting gain frequency	0.01 Hz	60 Hz	0 to 590 Hz	Allows the frequency at the maximum potentiometer setting (5 V in the initial setting) to be changed.	101, 328
126	T042	Terminal 4 frequency setting gain frequency	0.01 Hz	60 Hz	0 to 590 Hz	Allows the frequency at the maximum current input (20 mA in the initial setting) to be changed.	103, 328
160	E440	User group read selection	1	0	0, 1, 9999	Restricts the parameters that are read by the operation panel and the parameter unit.	177
934	A630	PID display bias coefficient	0.01	9999	0 to 500, 9999	Adjust the bias value and the gain value that are displayed in relation to PID control.	421
934	A631	PID display bias analog value	0.1%	20%	0 to 300%		
935	A632	PID display gain coefficient	0.01	9999	0 to 500, 9999		
935	A633	PID display gain analog value	0.1%	100%	0 to 300%		
991	E105	PU contrast adjustment	1	58	0 to 63	Contrast adjustment of the operation panel and the parameter unit can be performed.	165
998	E430	PM parameter initialization	1	0	0, 8009, 8109, 9009, 9109	Selects the PM sensorless vector control and set the parameters that are required to drive a PM motor.	151
999	E431	Automatic parameter setting	1	9999	1, 2, 10, 11, 12, 13, 20, 21, 9999	Changes parameter settings as a batch. The target parameters include communication parameters for the Mitsubishi Electric human machine interface (GOT) connection and the parameters for the rated frequency settings of 50 Hz/60 Hz.	173
1136	A670	Second PID display bias coefficient	0.01	9999	0 to 500, 9999	Adjust the bias value and the gain value that are displayed in relation to second PID control.	421
1137	A671	Second PID display bias analog value	0.1%	20%	0 to 300%		
1138	A672	Second PID display gain coefficient	0.01	9999	0 to 500, 9999		
1139	A673	Second PID display gain analog value	0.1%	100%	0 to 300%		

*1 Initial value for the FR-F860-00027.
*2 Initial value for the FR-F860-00061 and FR-F860-00090.
*3 Initial value for the FR-F860-00170 or higher.
*4 For the FR-F860-00680 or lower.
*5 For the FR-F860-01080 or higher.
*6 Initial value for the FR-F860-00090 or lower.

4.2 Basic operation procedure (PU operation)

Select a method to give the frequency command from the list below, and refer to the specified page for its procedure.

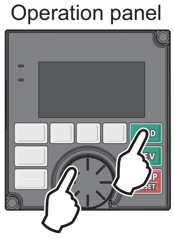
Method to give the frequency command	Refer to page
Setting the frequency on the operation panel in the frequency setting mode	90
Give commands by turning ON/OFF switches wired to inverter's terminals (multi-speed setting)	91
Setting the frequency by inputting voltage signals	92
Setting the frequency by inputting current signals	94

4.2.1 Operating at a set frequency (example: operating at 30 Hz)

Point

• Use the operation panel to give a start command and a frequency command.

Operation panel



The following shows the procedure to operate at 30 Hz.

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Changing the operation mode

Press [PU/EXT] to choose the PU operation mode. [PU] indicator is on.

3. Setting the frequency

Turn the setting dial until the target frequency, "30.00 Hz", appears.

Press [SET] to enter the frequency. "Completed" flickers. After about 3 s of flickering, the indication goes back to "0.00 Hz" (monitor display).

4. Start → acceleration → constant speed

Press [FWD] or [REV] to start running. The frequency value on the indication increases in **Pr.7 Acceleration time**, and "30.00 Hz" appears.
(To change the set frequency, perform the operation in above step 3. The previously set frequency appears.)

5. Deceleration → stop

Press [STOP/RESET] to stop. The frequency value on the indication decreases in **Pr.8 Deceleration time**, and the motor stops rotating with "0.00 Hz" displayed.

Parameters referred to

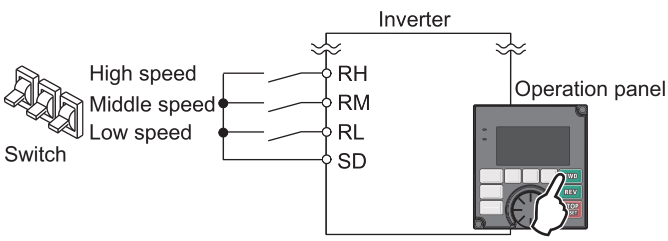
Pr.7 Acceleration time, Pr.8 Deceleration time ☞ page 190
Pr.79 Operation mode selection ☞ page 204

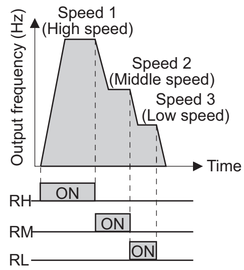
4.2.2 Setting the frequency by switches (multi-speed setting)

Point

• Use the operation panel (FWD or REV) to give a start command.
• Turn ON the RH, RM, or RL signal to give a frequency command. (multi-speed setting)
• Set **Pr.79 Operation mode selection**="4" (External/PU combination operation mode 2).

[Connection diagram]





The following shows the procedure to operate at a low speed (10 Hz).

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Changing the operation mode
Set "4" in **Pr.79**. [PU+E] indicator is on.

3. Setting the frequency
Turn ON the low-speed switch (RL).

4. Start → acceleration → constant speed

Press FWD or REV to start running. The frequency value on the indication increases in **Pr.7 Acceleration time**, and "10.00 Hz" appears.

5. Deceleration → stop

Press STOP RESET to stop. The frequency value on the indication decreases in **Pr.8 Deceleration time**, and the motor stops rotating with "0.00 Hz" displayed. Turn OFF the low-speed switch (RL).

NOTE

- The terminal RH is initially set to 60 Hz. The terminal RM is set to 30 Hz, and the RL is set to 10 Hz. (To change, set **Pr.4, Pr.5, and Pr.6**.)
- In the initial setting, when two or more of multi-speed settings are simultaneously selected, priority is given to the set frequency of the lower signal. For example, when RH and RM signals turn ON, RM signal (**Pr.5**) has a higher priority.
- Maximum of 15-speed operation can be performed.

Parameters referred to

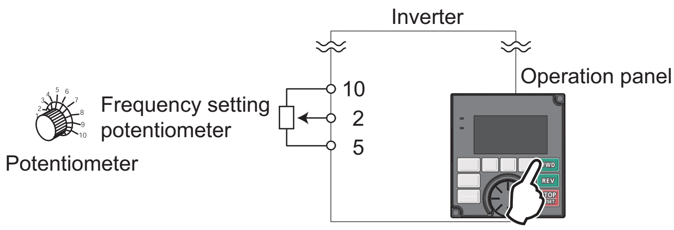
Pr.4 to Pr.6 (multi-speed setting) ☞ page 226
Pr.7 Acceleration time, Pr.8 Deceleration time ☞ page 190
Pr.79 Operation mode selection ☞ page 204

4.2.3 Setting the frequency with analog signals (voltage input)

Point

- Use the operation panel (FWD or REV) to give a start command.
- Use the potentiometer (frequency setting potentiometer) to give a frequency command (by connecting it across terminals 2 and 5 (voltage input)).
- Set **Pr.79 Operation mode selection** = "4" (External/PU combination operation mode 2).

[Connection diagram] (The inverter supplies 5 V power to the frequency setting potentiometer (terminal 10).)



The following shows the procedure to operate at 60 Hz.

Operating procedure

1. Screen at power-ON

   The monitor display appears.

2. Changing the operation mode

   Set "4" in **Pr.79**. [PU+E] indicator is on.

3. Start

   Press FWD or REV. [FWD] or [REV] indicator is on.

4. Acceleration → constant speed

   Turn the potentiometer (frequency setting potentiometer) clockwise slowly to full. The frequency value on the indication increases in **Pr.7 Acceleration time**, and "60.00 Hz" appears.

5. Deceleration

   Turn the potentiometer (frequency setting potentiometer) counterclockwise slowly to full. The frequency value on the indication decreases in **Pr.8 Deceleration time**, and the motor stops rotating with "0.00 Hz" displayed.

6. Stop

   Press STOP RESET. [FWD] or [REV] indicator turns OFF.

NOTE

- To change the frequency (60 Hz) at the maximum voltage input (initial value 5 V), adjust **Pr.125 Terminal 2 frequency setting gain frequency**.
- To change the frequency (0 Hz) at the minimum voltage input (initial value 0 V), adjust the **Pr.902 Terminal 2 frequency setting bias frequency**.
- When terminal 10 is used, the maximum output frequency may fluctuate in a range of ±6 Hz due to fluctuations in the output voltage (5 ±0.5 VDC). Use **Pr.125** or **Pr.903** to adjust the output frequency at the maximum analog input as required. (Refer to page 328.)
- When terminal 10E is used, the maximum output frequency may fluctuate (in a range of ±2 to 3 Hz) due to fluctuations in the output voltage (10 ±0.4 VDC). Use **Pr.125** or **Pr.903** to adjust the output frequency at the maximum analog input as required. (Refer to page 328.)

Parameters referred to

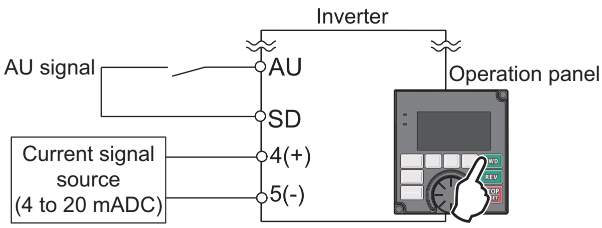
Pr.7 Acceleration time, Pr.8 Deceleration time ☞ page 190
Pr.79 Operation mode selection ☞ page 204
Pr.125 Terminal 2 frequency setting gain frequency ☞ page 328
Pr.902 Terminal 2 frequency setting bias frequency ☞ page 328

4.2.4 Using an analog signal (current input) to give a frequency command

Point

- Use the operation panel (FWD or REV) to give a start command.
- Use the outputs from the current signal source (4 to 20 mA) to give a frequency command (by connecting it across terminals 4 and 5 (current input)).
- Turn ON the AU signal.
- Set **Pr.79 Operation mode selection** ="4" (External/PU combination operation mode 2).

[Connection diagram]



The following shows the procedure to operate at 60 Hz.

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Changing the operation mode
Set "4" in **Pr.79**. [PU+E] indicator is on.

3. Terminal 4 input selection
Turn ON the terminal 4 input selection signal (AU). Input to the terminal 4 is enabled.

4. Start
Press FWD or REV . [FWD] or [REV] indicator is on.

5. Acceleration → constant speed
Input 20 mA. The frequency value on the indication increases in **Pr.7 Acceleration time**, and "60.00 Hz" appears.

6. Deceleration
Input 4 mA or less. The frequency value on the indication decreases in **Pr.8 Deceleration time**, and the motor stops rotating with "0.00 Hz" displayed.

7. Stop
Press STOP RESET . [FWD] or [REV] indicator turns OFF.

NOTE

- **Pr.184 AU terminal function selection** must be set to "4" (AU signal) (initial value).
- To change the frequency (60 Hz) at the maximum current input (initial value 20 mA), adjust **Pr.126 Terminal 4 frequency setting gain frequency**.
- To change the frequency (0 Hz) at the minimum current input (initial value 4 mA), adjust the **Pr.904 Terminal 4 frequency setting bias frequency**.

Parameters referred to

Pr.7 Acceleration time, Pr.8 Deceleration time ☞ page 190

Pr.79 Operation mode selection ☞ page 204

Pr.126 Terminal 4 frequency setting gain frequency ☞ page 328

Pr.184 AU terminal function selection ☞ page 343

Pr.904 Terminal 4 frequency setting bias frequency ☞ page 328

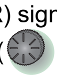
4.3 Basic operation procedure (External operation)

Select a method to give the frequency command from the list below, and refer to the specified page for its procedure.

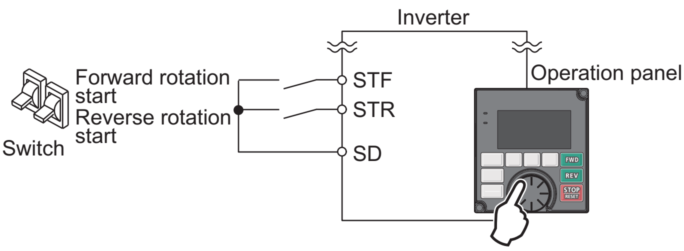
Method to give the frequency command	Refer to page
Setting the frequency on the operation panel in the frequency setting mode	96
Turning ON/OFF switches wired to inverter's terminals (multi-speed setting)	98
Setting the frequency by inputting voltage signals	99
Setting the frequency by inputting current signals	102

4.3.1 Using the frequency set by the operation panel

Point

- Switch ON the STF (STR) signal to give a start command.
- Use the operation panel () to give a start command.
- Set **Pr.79** ="3" (External/PU combined operation mode 1).

[Connection diagram]



The following shows the procedure to operate at 30 Hz.

Operating procedure

1. Changing the operation mode
Set "3" in **Pr.79**. [PU+E] indicator is on.

2. Setting the frequency

Turn  to until the target frequency, "30.00 Hz", appears.

Press [SET] to enter the frequency. "Completed" flickers.

3. Start → acceleration → constant speed
Turn ON the start switch (STF or STR). The frequency value on the indication increases in **Pr.7 Acceleration time**, and "30.00 Hz" appears. [FWD] indicator is on during the forward rotation, and [REV] indicator is on during the reverse rotation. (To change the set frequency, perform the operation in above step 2. The previously set frequency appears.)

4. Deceleration → stop
Turn OFF the start switch (STF or STR). The frequency value on the indication decreases in **Pr.8 Deceleration time**, and the motor stops rotating with "0.00 Hz" displayed.

NOTE

- When both the forward rotation switch (STF) and the reverse rotation switch (STR) are ON, the motor cannot be started. If both are turned ON while the inverter is running, the inverter decelerates to a stop.
- **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.)
- Setting **Pr.79 Operation mode selection**="3" also enables multi-speed operation.
- If stopped using STOP/RESET on the operation panel during the External operation, the inverter enters the PU stop status. ([PS] appears on the operation panel.) To reset the PU stop status, turn OFF the start switch (STF or STR), and then press PU/EXT. (Refer to page 164)

4

Parameters referred to

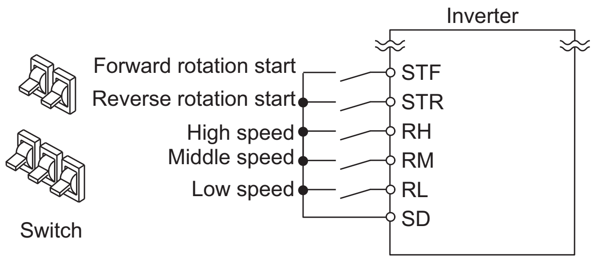
Pr.4 to Pr.6 (multi-speed setting) page 226
Pr.7 Acceleration time, Pr.8 Deceleration time page 190
Pr.178 STF terminal function selection page 343
Pr.179 STR terminal function selection page 343
Pr.79 Operation mode selection page 204

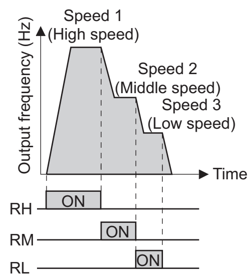
4.3.2 Setting the frequency by switches (multi-speed setting) (Pr.4 to Pr.6)

Point

- Switch ON the STF (STR) signal to give a start command.
- Turn ON the RH, RM, or RL signal to give a frequency command. (Multi-speed setting)

[Connection diagram]





The following shows the procedure to operate at a high-speed (60 Hz).

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Setting the frequency
Turn ON the high-speed switch (RH).

3. Start → acceleration → constant speed
Turn ON the start switch (STF or STR). The frequency value on the indication increases in **Pr.7 Acceleration time**, and "60.00 Hz" appears. [FWD] indicator is on during the forward rotation, and [REV] indicator is on during the reverse rotation.
•When RM is turned ON, 30 Hz is displayed. When RL is turned ON, 10 Hz is displayed.

4. Deceleration → stop
Turn OFF the start switch (STF or STR). The frequency value on the indication decreases in **Pr.8 Deceleration time**, and the motor stops rotating with "0.00 Hz" displayed. [FWD] or [REV] indicator turns OFF. Turn OFF the high-speed switch (RH).

NOTE

- When both the forward rotation switch (STF) and the reverse rotation switch (STR) are ON, the motor cannot be started. If both are turned ON while the inverter is running, the inverter decelerates to a stop.
- The terminal RH is initially set to 60 Hz. The terminal RM is set to 30 Hz, and the RL is set to 10 Hz. (To change, set **Pr.4, Pr.5, and Pr.6**.)
- In the initial setting, when two or more of multi-speed settings are simultaneously selected, priority is given to the set frequency of the lower signal. For example, when RH and RM signals turn ON, RM signal (**Pr.5**) has a higher priority.
- Maximum of 15-speed operation can be performed.

Parameters referred to

Pr.4 to Pr.6 (multi-speed setting) ☞ page 226
Pr.7 Acceleration time, Pr.8 Deceleration time ☞ page 190

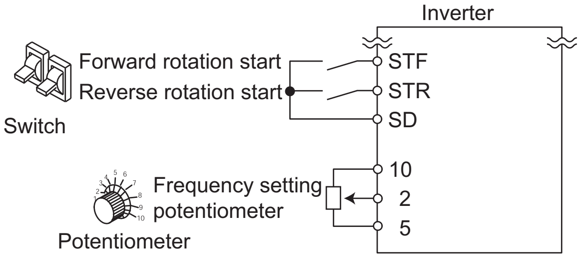
4.3.3 Setting the frequency with analog signals (voltage input)

Point

- Switch ON the STF (STR) signal to give a start command.
- Use the potentiometer (frequency setting potentiometer) to give a frequency command. (by connecting it across terminals 2 and 5 (voltage input)).

[Connection diagram]

(The inverter supplies 5 V power to the frequency setting potentiometer (terminal 10).)



The following shows the procedure to operate at 60 Hz.

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Start
Turn ON the start switch (STF or STR). [STF] or [STR] indicator is on.

3. Acceleration → constant speed
Turn the potentiometer (frequency setting potentiometer) clockwise slowly to full. The frequency value on the indication increases in **Pr.7 Acceleration time**, and "60.00 Hz" appears. [FWD] indicator is on during the forward rotation, and [REV] indicator is on during the reverse rotation.

4. Deceleration
Turn the potentiometer (frequency setting potentiometer) counterclockwise slowly to full. The frequency value on the indication decreases in **Pr.8 Deceleration time**, and the motor stops rotating with "0.00 Hz" displayed. [FWD] or [REV] indicator flickers.

5. Stop
Turn OFF the start switch (STF or STR). [STF] or [STR] indicator turns OFF.

NOTE

- When both the forward rotation switch (STF) and the reverse rotation switch (STR) are ON, the motor cannot be started. If both are turned ON while the inverter is running, the inverter decelerates to a stop.
- **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 terminal 10 is used, the maximum output frequency may fluctuate in a range of ±6 Hz due to fluctuations in the output voltage (5 ±0.5 VDC). Use **Pr.125** or **Pr.903** to adjust the output frequency at the maximum analog input as required. (Refer to page 328.)
- When terminal 10E is used, the maximum output frequency may fluctuate (in a range of ±2 to 3 Hz) due to fluctuations in the output voltage (10 ±0.4 VDC). Use **Pr.125** or **Pr.903** to adjust the output frequency at the maximum analog input as required. (Refer to page 328.)

Parameters referred to

Pr.7 Acceleration time, Pr.8 Deceleration time ☞ page 190
Pr.178 STF terminal function selection ☞ page 343
Pr.179 STR terminal function selection ☞ page 343

4.3.4 Changing the frequency (60 Hz, initial value) at the maximum voltage input (5 V, initial value)

Point

- Change the maximum frequency.

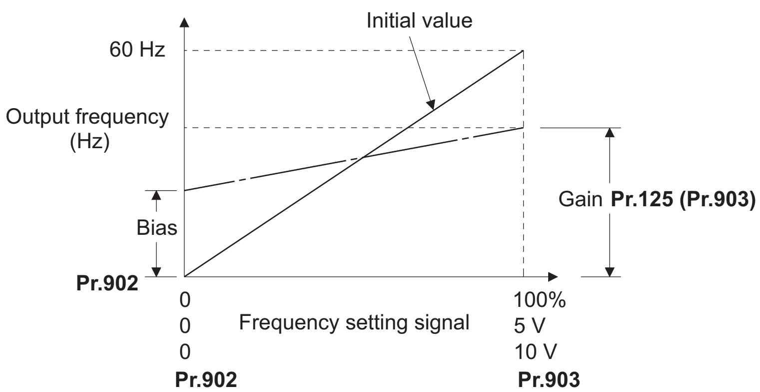
With a 0 to 5 VDC input frequency setting potentiometer, change the frequency at 5 V from 60 Hz (initial value) to 50 Hz. Adjust the setting so that the inverter outputs 50 Hz when 5 V is input. Set "50 Hz" in **Pr.125**.

Operating procedure

1. Changing the maximum frequency
   Set "50.00 Hz" in **Pr.125**.
2. Checking the mode/monitor
   Press MON to change to the monitor / frequency monitor.
3. Start
   Turn ON the start switch (STF or STR), then turn the potentiometer (frequency setting potentiometer) clockwise slowly to full. (Refer to steps 2 and 3 in 4.3.3.)
   Operate at 50 Hz.

NOTE

- To set the frequency at 0 V, use the **Pr.902**.



- Other adjustment methods for the frequency setting voltage gain are the following: adjustment by applying a voltage directly across terminals 2 and 5, and adjustment using a specified point without applying a voltage across terminals 2 and 5.

Parameters referred to

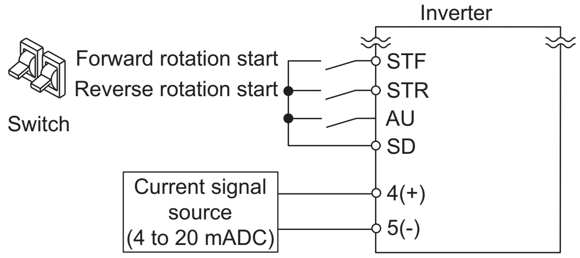
Pr.125 Terminal 2 frequency setting gain frequency ☞ page 328
Pr.902 Terminal 2 frequency setting bias frequency ☞ page 328
Pr.903 Terminal 2 frequency setting gain ☞ page 328

4.3.5 Using an analog signal (current input) to give a frequency command

Point

- Switch ON the STF (STR) signal to give a start command.
- Turn ON the AU signal.
- Set **Pr.79 Operation mode selection**="2" (External operation mode).

[Connection diagram]



The following shows the procedure to operate at 60 Hz.

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Terminal 4 input selection
Turn ON the terminal 4 input selection signal (AU). Input to the terminal 4 is enabled.

3. Start
Turn ON the start switch (STF or STR). [STF] or [STR] indicator is on.

4. Acceleration → constant speed
Input 20 mA. The frequency value on the indication increases in **Pr.7 Acceleration time**, and "60.00 Hz" appears. [FWD] indicator is on during the forward rotation, and [REV] indicator is on during the reverse rotation.

5. Deceleration
Input 4 mA or less. The frequency value on the indication decreases in **Pr.8 Deceleration time**, and the motor stops rotating with "0.00 Hz" displayed. [FWD] or [REV] indicator flickers.

6. Stop
Turn OFF the start switch (STF or STR). [STF] or [STR] indicator turns OFF.

NOTE

- When both the forward rotation switch (STF) and the reverse rotation switch (STR) are ON, the motor cannot be started. If both are turned ON while the inverter is running, the inverter decelerates to a stop.
- **Pr.184 AU terminal function selection** must be set to "4" (AU signal) (initial value).

Parameters referred to

Pr.7 Acceleration time, Pr.8 Deceleration time ☞ page 190
Pr.184 AU terminal function selection ☞ page 343

4.3.6 Changing the frequency (60 Hz, initial value) at the maximum current input (at 20 mA, initial value)

Point

• Change the maximum frequency.

With a 4 to 20 mA input frequency setting potentiometer, change the frequency at 20 mA from 60 Hz (initial value) to 50 Hz. Adjust the setting so that the inverter outputs 50 Hz when 20 mA is input. Set "50 Hz" in **Pr.126**.

Operating procedure

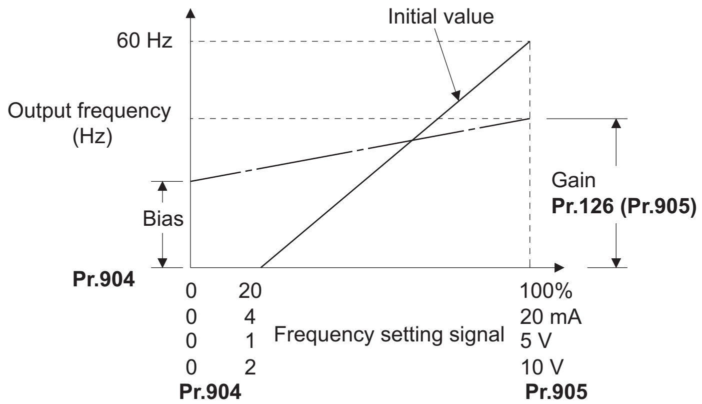
1. Changing the maximum frequency
Set "50.00 Hz" in **Pr.126**.

2. Checking the mode/monitor
Press MON to change to the monitor / frequency monitor.

3. Start
Turn ON the start switch (STF or STR) to input a 20 mA current. (Refer to steps 3 and 4 in 4.3.5.)
Operate at 50 Hz.

NOTE

- To set the frequency at 4 mA, use the **Pr.904**.



- Other adjustment methods for the frequency setting current gain are the following: adjustment by applying a current through terminals 4 and 5, and adjustment using a specified point without applying a current through terminals 4 and 5.

Parameters referred to

Pr.126 Terminal 4 frequency setting gain frequency ☞ page 328
Pr.904 Terminal 4 frequency setting bias frequency ☞ page 328
Pr.905 Terminal 4 frequency setting gain ☞ page 328

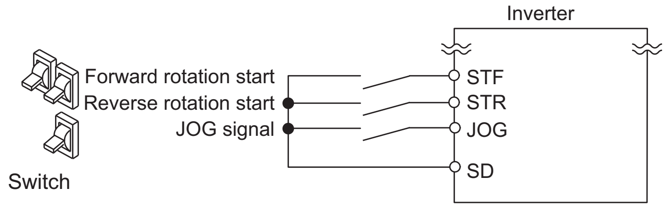
4.4 Basic operation procedure (JOG operation)

4.4.1 Performing JOG operation using external signals

Point

- Perform JOG operation only while the JOG signal is ON.
- Use **Pr.15 Jog frequency** and **Pr.16 Jog acceleration/deceleration time** for the operation.
- Set **Pr.79 Operation mode selection** = "2" (External operation mode).

[Connection diagram]



The following shows the procedure to operate at 5 Hz.

Operating procedure

1. Screen at power-ON
   The monitor display appears.
2. Turning ON the JOG signal
   Turn ON the JOG switch (JOG). The inverter is set ready for the JOG operation.
3. Start → acceleration → constant speed
   Turn ON the start switch (STF or STR). The frequency value on the indication increases in **Pr.16 Jog acceleration/deceleration time**, and "5.00 Hz" appears. [FWD] indicator is on during the forward rotation, and [REV] indicator is on during the reverse rotation.
4. Deceleration → stop
   Turn OFF the start switch (STF or STR). The frequency value on the indication decreases in **Pr.16 Jog acceleration/deceleration time**, and the motor stops rotating with "0.00 Hz" displayed. [FWD] or [REV] indicator turns OFF. Turn OFF the JOG switch (JOG).

NOTE

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

Parameters referred to

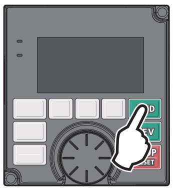
Pr.15 Jog frequency ☞ page 224
Pr.16 Jog acceleration/deceleration time ☞ page 224
Pr.79 Operation mode selection ☞ page 204

4.4.2 JOG operation from the operation panel

Point

- Operate only while FWD or REV is pressed.

Operation panel



The following shows the procedure to operate at 5 Hz.

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Changing the operation mode
Press PU/EXT twice to choose the PUJOG operation mode. [JOG] indicator is on.

3. Start → acceleration → constant speed
Keep pressing FWD or REV. The frequency value on the indication increases in **Pr.16 Jog acceleration/deceleration time**, and "5.00 Hz" appears.

4. Deceleration → stop
Release FWD or REV. The frequency value on the indication decreases in **Pr.16 Jog acceleration/deceleration time**, and the motor stops rotating with "0.00 Hz" displayed.

NOTE

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

Parameters referred to

Pr.15 Jog frequency ☞ page 224
Pr.16 Jog acceleration/deceleration time ☞ page 224

MEMO

CHAPTER 5 PARAMETERS

5 PARAMETERS

This chapter explains the function setting for use of this product.
Always read this instructions before use.
The following marks are used to indicate the controls as below. (Parameters without any mark are valid for all control.)

Mark	Control method	Applied motor
V/F	V/F control	Three-phase induction motor
Magnetic flux	Advanced magnetic flux vector control	
PM	PM sensorless vector control	IPM motor

The setting range and the initial value of parameters differ depending on the structure or functions of the inverter. The following common designations are used for each type of the inverter models.

Inverter model	Common designation
FR-F860	Standard model
FR-F862	Separated converter type

5.1 Parameter List

5.1.1 Parameter list (by parameter number)

For simple variable-speed operation of the inverter, the initial value 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.

NOTE

- *Simple* indicates simple mode parameters. Use **Pr.160 User group read selection** to indicate the simple mode parameters only.
- Parameter setting may be restricted in some operating status. Use **Pr.77 Parameter write selection** to change the setting.
- Refer to page 623 for instruction codes for communication and availability of parameter clear, all clear, and parameter copy of each parameter.

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Basic functions	0	G000	**Torque boost** Simple	0 to 30%	0.1%	3% [*1] 2% [*1] 1% [*1]	538	
	1	H400	**Maximum frequency** Simple	0 to 120 Hz	0.01 Hz	120 Hz [*2] 60 Hz [*3]	253	
	2	H401	**Minimum frequency** Simple	0 to 120 Hz	0.01 Hz	0 Hz	253	
	3	G001	**Base frequency** Simple	0 to 590 Hz	0.01 Hz	60 Hz	539	
	4	D301	**Multi-speed setting (high speed)** Simple	0 to 590 Hz	0.01 Hz	60 Hz	226	
	5	D302	**Multi-speed setting (middle speed)** Simple	0 to 590 Hz	0.01 Hz	30 Hz	226	
	6	D303	**Multi-speed setting (low speed)** Simple	0 to 590 Hz	0.01 Hz	10 Hz	226	
	7	F010	**Acceleration time** Simple	0 to 3600 s	0.1 s	5 s [*4] 15 s [*5]	190	
	8	F011	**Deceleration time** Simple	0 to 3600 s	0.1 s	10 s [*4] 30 s [*5]	190	
	9	H000 C103	**Electronic thermal O/L relay** Simple **Rated motor current** Simple	0 to 500 A 0 to 3600 A	0.01 A [*2] 0.1 A [*3]	Inverter rated current	230, 353, 363	
DC injection brake	10	G100	**DC injection brake operation frequency**	0 to 120 Hz, 9999	0.01 Hz	3 Hz	546	
	11	G101	**DC injection brake operation time**	0 to 10 s, 8888	0.1 s	0.5 s	546	
	12	G110	**DC injection brake operation voltage**	0 to 30%	0.1%	1%	546	
—	13	F102	**Starting frequency**	0 to 60 Hz	0.01 Hz	0.5 Hz	201, 202	
—	14	G003	**Load pattern selection**	0, 1, 12 to 15	1	1	541	
Jog operation	15	D200	**Jog frequency** Simple	0 to 590 Hz	0.01 Hz	5 Hz	224	
	16	F002	**Jog acceleration/ deceleration time** Simple	0 to 3600 s	0.1 s	0.5 s	224	
—	17	T720	**MRS input selection**	0, 2, 4	1	0	346	
—	18	H402	**High speed maximum frequency**	0 to 590 Hz	0.01 Hz	120 Hz [*2] 60 Hz [*3]	253	
—	19	G002	**Base frequency voltage**	0 to 1000 V, 8888, 9999	0.1 V	9999	539	
Acceleration/ deceleration times	20	F000	**Acceleration/ deceleration reference frequency**	1 to 590 Hz	0.01 Hz	60 Hz	190	
	21	F001	**Acceleration/ deceleration time increments**	0, 1	1	0	190	
Stall prevention	22	H500	**Stall prevention operation level**	0 to 400%	0.1%	110%	257	
	23	H610	**Stall prevention operation level compensation factor at double speed**	0 to 200%, 9999	0.1%	9999	257	
Multi-speed setting	24 to 27	D304 to D307	**Multi-speed setting (speed 4 to speed 7)**	0 to 590 Hz, 9999	0.01 Hz	9999	226	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
—	**28**	**D300**	**Multi-speed input compensation selection**	0, 1	1	0	226	
—	**29**	**F100**	**Acceleration/ deceleration pattern selection**	0 to 3, 6	1	0	194	
—	**30**	**E300**	**Regenerative function selection**	0 to 2, 10, 11, 20, 21, 100 to 102, 110, 111, 120, 121 *6	1	0	553	
				2, 10, 11, 102, 110, 111 *7	1	10		
Frequency jump	**31**	**H420**	**Frequency jump 1A**	0 to 590 Hz, 9999	0.01 Hz	9999	255	
	32	**H421**	**Frequency jump 1B**	0 to 590 Hz, 9999	0.01 Hz	9999	255	
	33	**H422**	**Frequency jump 2A**	0 to 590 Hz, 9999	0.01 Hz	9999	255	
	34	**H423**	**Frequency jump 2B**	0 to 590 Hz, 9999	0.01 Hz	9999	255	
	35	**H424**	**Frequency jump 3A**	0 to 590 Hz, 9999	0.01 Hz	9999	255	
	36	**H425**	**Frequency jump 3B**	0 to 590 Hz, 9999	0.01 Hz	9999	255	
—	**37**	**M000**	**Speed display**	0, 1 to 9998	1	0	272	
Frequency detection	**41**	**M441**	**Up-to-frequency sensitivity**	0 to 100%	0.1%	10%	305	
	42	**M442**	**Output frequency detection**	0 to 590 Hz	0.01 Hz	6 Hz	305	
	43	**M443**	**Output frequency detection for reverse rotation**	0 to 590 Hz, 9999	0.01 Hz	9999	305	
Second functions	**44**	**F020**	**Second acceleration/ deceleration time**	0 to 3600 s	0.1 s	5 s	190	
	45	**F021**	**Second deceleration time**	0 to 3600 s, 9999	0.1 s	9999	190	
	46	**G010**	**Second torque boost**	0 to 30%, 9999	0.1%	9999	538	
	47	**G011**	**Second V/F (base frequency)**	0 to 590 Hz, 9999	0.01 Hz	9999	539	
	48	**H600**	**Second stall prevention operation level**	0 to 400%	0.1%	110%	257	
	49	**H601**	**Second stall prevention operation frequency**	0 to 590 Hz, 9999	0.01 Hz	0 Hz	257	
	50	**M444**	**Second output frequency detection**	0 to 590 Hz	0.01 Hz	30 Hz	305	
	51	**H010** **C203**	**Second electronic thermal O/L relay** **Rated second motor current**	0 to 500 A, 9999 *2	0.01 A	9999	230, 353, 363	
				0 to 3600 A, 9999 *3	0.1 A			
Monitor functions	**52**	**M100**	**Operation panel main monitor selection**	0, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98, 100	1	0	274	
	54	**M300**	**CA terminal function selection**	1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52, 53, 61, 62, 67, 69, 70, 85, 87 to 90, 92, 93, 95, 98	1	1	284	
	55	**M040**	**Frequency monitoring reference**	0 to 590 Hz	0.01 Hz	60 Hz	284	
	56	**M041**	**Current monitoring reference**	0 to 500 A *2	0.01 A	Inverter rated current	284	
				0 to 3600 A *3	0.1 A			
Automatic restart	**57**	**A702**	**Restart coasting time**	0, 0.1 to 30 s, 9999	0.1 s	9999	448	
	58	**A703**	**Restart cushion time**	0 to 60 s	0.1 s	1 s	448	
—	**59**	**F101**	**Remote function selection**	0 to 3, 11 to 13	1	0	197	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
—	60	G030	**Energy saving control selection**	0, 4, 9	1	0	543	
—	65	H300	**Retry selection**	0 to 5	1	0	242	
—	66	H611	**Stall prevention operation reduction starting frequency**	0 to 590 Hz	0.01 Hz	60 Hz	257	
Retry	67	H301	**Number of retries at fault occurrence**	0 to 10, 101 to 110	1	0	242	
	68	H302	**Retry waiting time**	0.1 to 600 s	0.1 s	1 s	242	
	69	H303	**Retry count display erase**	0	1	0	242	
—	70	G107	Parameter for manufacturer setting. Do not set.					
—	71	C100	**Applied motor**	0 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094	1	0	145, 351, 353, 363	
—	72	E600	**PWM frequency selection**	0 to 15 *2	1	2	179	
—				0 to 6, 25 *3				
—	73	T000	**Analog input selection**	0 to 7, 10 to 17	1	1	318, 323	
—	74	T002	**Input filter time constant**	0 to 8	1	1	326	
—	75	-	**Reset selection/ disconnected PU detection/PU stop selection**	0 to 3, 14 to 17, 1000 to 1003, 1014 to 1017 *2	1	14	162	
				0 to 3, 14 to 17, 100 to 103, 114 to 117, 1000 to 1003, 1014 to 1017, 1100 to 1103, 1114 to 1117 *3				
		E100	**Reset selection**	0 to 3		0		
		E101	**Disconnected PU detection**	0, 1				
		E102	**PU stop selection**			1		
		E107	**Reset limit**	0 *2	1	0		
				0, 1 *3				
—	76	M510	**Fault code output selection**	0 to 2	1	0	314	
—	77	E400	**Parameter write selection**	0 to 2	1	0	168	
—	78	D020	**Reverse rotation prevention selection**	0 to 2	1	0	221	
—	79	D000	**Operation mode selection** Simple	0 to 4, 6, 7	1	0	204, 213	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Motor constants	**80**	**C101**	**Motor capacity**	0.4 to 55 kW, 9999 *2 0 to 3600 kW, 9999 *3	0.01 kW *2 0.1 kW *3	9999	145, 353, 363	
	81	**C102**	**Number of motor poles**	2, 4, 6, 8, 10, 12, 9999	1	9999	145, 353, 363	
	82	**C125**	**Motor excitation current**	0 to 500 A, 9999 *2 0 to 3600 A, 9999 *3	0.01 A *2 0.1 A *3	9999	353	
	83	**C104**	**Rated motor voltage**	0 to 1000 V	0.1 V	575 V	145, 353, 363	
	84	**C105**	**Rated motor frequency**	10 to 400 Hz, 9999	0.01 Hz	9999	145, 353, 363	
	85	**G201**	**Excitation current break point**	0 to 400 Hz, 9999	0.01 Hz	9999	542	
	86	**G202**	**Excitation current low-speed scaling factor**	0 to 300%, 9999	0.1%	9999	542	
	89	**G932**	**Speed control gain (Advanced magnetic flux vector)**	0 to 200%, 9999	0.1%	9999	149	
	90	**C120**	**Motor constant (R1)**	0 to 50 Ω, 9999 *2 0 to 400 mΩ, 9999 *3	0.001 Ω *2 0.01 mΩ *3	9999	353, 363, 454	
	91	**C121**	**Motor constant (R2)**	0 to 50 Ω, 9999 *2 0 to 400 mΩ, 9999 *3	0.001 Ω *2 0.01 mΩ *3	9999	353	
	92	**C122**	**Motor constant (L1)/d-axis inductance (Ld)**	0 to 6000 mH, 9999 *2 0 to 400 mH, 9999 *3	0.1 mH *2 0.01 mH *3	9999	353, 363	
	93	**C123**	**Motor constant (L2)/q-axis inductance (Lq)**	0 to 6000 mH, 9999 *2 0 to 400 mH, 9999 *3	0.1 mH *2 0.01 mH *3	9999	353, 363	
	94	**C124**	**Motor constant (X)**	0 to 100%, 9999	0.1% *2 0.01% *3	9999	353	
	95	**C111**	**Online auto tuning selection**	0, 1	1	0	371	
	96	**C110**	**Auto tuning setting/ status**	0, 1, 11, 101	1	0	353, 363, 454	
Adjustable 5 points V/F	**100**	**G040**	**V/F1 (first frequency)**	0 to 590 Hz, 9999	0.01 Hz	9999	544	
	101	**G041**	**V/F1 (first frequency voltage)**	0 to 1000 V	0.1 V	0 V	544	
	102	**G042**	**V/F2 (second frequency)**	0 to 590 Hz, 9999	0.01 Hz	9999	544	
	103	**G043**	**V/F2 (second frequency voltage)**	0 to 1000 V	0.1 V	0 V	544	
	104	**G044**	**V/F3 (third frequency)**	0 to 590 Hz, 9999	0.01 Hz	9999	544	
	105	**G045**	**V/F3 (third frequency voltage)**	0 to 1000 V	0.1 V	0 V	544	
	106	**G046**	**V/F4 (fourth frequency)**	0 to 590 Hz, 9999	0.01 Hz	9999	544	
	107	**G047**	**V/F4 (fourth frequency voltage)**	0 to 1000 V	0.1 V	0 V	544	
	108	**G048**	**V/F5 (fifth frequency)**	0 to 590 Hz, 9999	0.01 Hz	9999	544	
	109	**G049**	**V/F5 (fifth frequency voltage)**	0 to 1000 V	0.1 V	0 V	544	
—	**111**	**F031**	**Check valve deceleration time**	0 to 3600 s, 9999	0.1 s	9999	440	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
PU connector communication	117	N020	**PU communication station number**	0 to 31	1	0	483	
	118	N021	**PU communication speed**	48, 96, 192, 384, 576, 768, 1152	1	192	483	
	119	-	**PU communication stop bit length / data length**	0, 1, 10, 11	1	1	483	
		N022	**PU communication data length**	0, 1		0		
		N023	**PU communication stop bit length**	0, 1		1		
	120	N024	**PU communication parity check**	0 to 2	1	2	483	
	121	N025	**Number of PU communication retries**	0 to 10, 9999	1	1	483	
	122	N026	**PU communication check time interval**	0, 0.1 to 999.8 s, 9999	0.1 s	9999	483	
	123	N027	**PU communication waiting time setting**	0 to 150 ms, 9999	1 ms	9999	483	
	124	N028	**PU communication CR/ LF selection**	0 to 2	1	1	483	
—	125	T022	**Terminal 2 frequency setting gain frequency** Simple	0 to 590 Hz	0.01 Hz	60 Hz	328	
—	126	T042	**Terminal 4 frequency setting gain frequency** Simple	0 to 590 Hz	0.01 Hz	60 Hz	328	
PID operation	127	A612	**PID control automatic switchover frequency**	0 to 590 Hz, 9999	0.01 Hz	9999	396	
	128	A610	**PID action selection**	0, 10, 11, 20, 21, 50, 51, 60, 61, 70, 71, 80, 81, 90, 91, 100, 101, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	1	0	396	
	129	A613	**PID proportional band**	0.1 to 1000%, 9999	0.1%	100%	396	
	130	A614	**PID integral time**	0.1 to 3600 s, 9999	0.1 s	1 s	396	
	131	A601	**PID upper limit**	0 to 100%, 9999	0.1%	9999	396	
	132	A602	**PID lower limit**	0 to 100%, 9999	0.1%	9999	396	
	133	A611	**PID action set point**	0 to 100%, 9999	0.01%	9999	396	
	134	A615	**PID differential time**	0.01 to 10 s, 9999	0.01 s	9999	396	
Bypass	135	A000	**Electronic bypass sequence selection**	0, 1	1	0	376	
	136	A001	**MC switchover interlock time**	0 to 100 s	0.1 s	1 s	376	
	137	A002	**Start waiting time**	0 to 100 s	0.1 s	0.5 s	376	
	138	A003	**Bypass selection at a fault**	0, 1	1	0	376	
	139	A004	**Automatic switchover frequency from inverter to bypass operation**	0 to 60 Hz, 9999	0.01 Hz	9999	376	
Backlash measures	140	F200	**Backlash acceleration stopping frequency**	0 to 590 Hz	0.01 Hz	1 Hz	194	
	141	F201	**Backlash acceleration stopping time**	0 to 360 s	0.1 s	0.5 s	194	
	142	F202	**Backlash deceleration stopping frequency**	0 to 590 Hz	0.01 Hz	1 Hz	194	
	143	F203	**Backlash deceleration stopping time**	0 to 360 s	0.1 s	0.5 s	194	
—	144	M002	**Speed setting switchover**	0, 2, 4, 6, 8, 10, 12, 102, 104, 106, 108, 110, 112	1	4	272	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
PU	**145**	**E103**	**PU display language selection**	0 to 7	1	—	165	
—	**147**	**F022**	**Acceleration/ deceleration time switching frequency**	0 to 590 Hz, 9999	0.01 Hz	9999	190	
Current detection	**148**	**H620**	**Stall prevention level at 0 V input**	0 to 400%	0.1%	110%	257	
	149	**H621**	**Stall prevention level at 10 V input**	0 to 400%	0.1%	120%	257	
	150	**M460**	**Output current detection level**	0 to 400%	0.1%	110%	307	
	151	**M461**	**Output current detection signal delay time**	0 to 300 s	0.1 s	0 s	307	
	152	**M462**	**Zero current detection level**	0 to 400%	0.1%	5%	307	
	153	**M463**	**Zero current detection time**	0 to 300 s	0.01 s	0.5 s	307	
—	**154**	**H631**	**Voltage reduction selection during stall prevention operation**	0, 1, 10, 11	1	1	257	
—	**155**	**T730**	**RT signal function validity condition selection**	0, 10	1	0	348	
—	**156**	**H501**	**Stall prevention operation selection**	0 to 31, 100, 101	1	0	257	
—	**157**	**M430**	**OL signal output timer**	0 to 25 s, 9999	0.1 s	0 s	257	
—	**158**	**M301**	**AM terminal function selection**	1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52 to 54, 61, 62, 67, 69, 70, 86 to 96, 98	1	1	284	
—	**159**	**A005**	**Automatic switchover frequency range from bypass to inverter operation**	0 to 10 Hz, 9999	0.01 Hz	9999	376	
—	**160**	**E440**	**User group read selection** Simple	0, 1, 9999	1	9999 0	177	
—	**161**	**E200**	Parameter for manufacturer setting. Do not set.					
Automatic restart functions	**162**	**A700**	**Automatic restart after instantaneous power failure selection**	0 to 3, 10 to 13, 1000 to 1003, 1010 to 1013	1	0	448, 454	
	163	**A704**	**First cushion time for restart**	0 to 20 s	0.1 s	0 s	448	
	164	**A705**	**First cushion voltage for restart**	0 to 100%	0.1%	0%	448	
	165	**A710**	**Stall prevention operation level for restart**	0 to 400%	0.1%	110%	448	
Current detection	**166**	**M433**	**Output current detection signal retention time**	0 to 10 s, 9999	0.1 s	0.1 s	307	
	167	**M464**	**Output current detection operation selection**	0, 1, 10, 11	1	0	307	
—	**168**	**E000**	Parameter for manufacturer setting. Do not set.					
		E080						
—	**169**	**E001**						
		E081						
Cumulative monitor	**170**	**M020**	**Watt-hour meter clear**	0, 10, 9999	1	9999	274	
	171	**M030**	**Operation hour meter clear**	0, 9999	1	9999	274	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
User group	**172**	**E441**	**User group registered display/batch clear**	9999, (0 to 16)	1	0	177	
	173	**E442**	**User group registration**	0 to 1999, 9999	1	9999	177	
	174	**E443**	**User group clear**	0 to 1999, 9999	1	9999	177	
Input terminal function assignment	**178**	**T700**	**STF terminal function selection**	0 to 8, 10 to 14, 16, 18, 24, 25, 28, 33, 37 to 40, 46 to 48, 50, 51, 57, 58, 60, 62, 64 to 67, 70 to 73, 77 to 81, 84, 92, 94 to 98, 128, 129, 9999	1	60	343	
	179	**T701**	**STR terminal function selection**	0 to 8, 10 to 14, 16, 18, 24, 25, 28, 33, 37 to 40, 46 to 48, 50, 51, 57, 58, 61, 62, 64 to 67, 70 to 73, 77 to 81, 84, 92, 94 to 98, 128, 129, 9999	1	61	343	
	180	**T702**	**RL terminal function selection**	0 to 8, 10 to 14, 16, 18, 24, 25, 28, 33, 37 to 40, 46 to 48, 50, 51, 57, 58, 62, 64 to 67, 70 to 73, 77 to 81, 84, 92, 94 to 98, 128, 129, 9999	1	0	343	
	181	**T703**	**RM terminal function selection**		1	1	343	
	182	**T704**	**RH terminal function selection**		1	2	343	
	183	**T705**	**RT terminal function selection**		1	3	343	
	184	**T706**	**AU terminal function selection**		1	4	343	
	185	**T707**	**JOG terminal function selection**		1	5	343	
	186	**T708**	**CS terminal function selection**		1	9999	343	
	187	**T709**	**MRS terminal function selection**		1	24 *6 10 *7	343	
	188	**T710**	**STOP terminal function selection**		1	25	343	
	189	**T711**	**RES terminal function selection**		1	62	343	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Output terminal function assignment	**190**	**M400**	**RUN terminal function selection**	0 to 5, 7, 8, 10 to 19, 23, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 68, 70 to 80, 82, 85, 90 to 96, 98 to 105, 107, 108, 110 to 116, 123, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 168, 170 to 180, 182, 185, 190 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 247, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 347, 9999	1	0	297	
	191	**M401**	**SU terminal function selection**		1	1	297	
	192	**M402**	**IPF terminal function selection**		1	2 *6*7 9999 *7	297	
	193	**M403**	**OL terminal function selection**		1	3	297	
	194	**M404**	**FU terminal function selection**		1	4	297	
	195	**M405**	**ABC1 terminal function selection**	0 to 5, 7, 8, 10 to 19, 23, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 68, 70 to 80, 82, 85, 90, 91, 94 to 96, 98 to 105, 107, 108, 110 to 116, 123, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 168, 170 to 180, 182, 185, 190, 191, 194 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 247, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 347, 9999	1	99	297	
	196	**M406**	**ABC2 terminal function selection**		1	9999	297	
Multi-speed setting	**232 to 239**	**D308 to D315**	**Multi-speed setting (speed 8 to speed 15)**	0 to 590 Hz, 9999	0.01 Hz	9999	226	
—	**240**	**E601**	**Soft-PWM operation selection**	0, 1	1	1	179	
—	**241**	**M043**	**Analog input display unit switchover**	0, 1	1	0	328	
—	**242**	**T021**	**Terminal 1 added compensation amount (terminal 2)**	0 to 100%	0.1%	100%	323	
—	**243**	**T041**	**Terminal 1 added compensation amount (terminal 4)**	0 to 100%	0.1%	75%	323	
—	**244**	**-**	**Cooling fan operation selection**	0, 1, 101 to 105, 1000, 1001, 1101 to 1105	1	1	237	
		H100	**Cooling fan operation selection**	0, 1, 101 to 105	1	1		
		H106	**Cooling fan operation selection during the test operation**	0, 1	1	0		

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Slip compensation	245	G203	**Rated slip**	0 to 50%, 9999	0.01%	9999	563	
	246	G204	**Slip compensation time constant**	0.01 to 10 s	0.01 s	0.5 s	563	
	247	G205	**Constant-power range slip compensation selection**	0, 9999	1	9999	563	
—	248	A006	**Self power management selection**	0 to 2	1	0	385	
—	249	H101	**Earth (ground) fault detection at start**	0 to 2	1	0	238	
—	250	G106	**Stop selection**	0 to 100 s, 1000 to 1100 s, 8888, 9999	0.1 s	9999	550	
—	251	H200	**Output phase loss protection selection**	0, 1	1	1	241	
Frequency compensation function	252	T050	**Override bias**	0 to 200%	0.1%	50%	323	
	253	T051	**Override gain**	0 to 200%	0.1%	150%	323	
—	254	A007	**Main circuit power OFF waiting time**	1 to 3600 s, 9999	1 s	600 s	385	
Life check	255	E700	**Life alarm status display**	(0 to 255)	1	0	182	
	256 *8	E701	**Inrush current limit circuit life display**	(0 to 100%)	1%	100%	182	
	257	E702	**Control circuit capacitor life display**	(0 to 100%)	1%	100%	182	
	258 *8	E703	**Main circuit capacitor life display**	(0 to 100%)	1%	100%	182	
	259 *8	E704	**Main circuit capacitor life measuring**	0, 1, 11	1	0	182	
—	260	E602	**PWM frequency automatic switchover**	0, 1	1	1	179	
Power failure stop	261	A730	**Power failure stop selection**	0 to 2, 11, 12, 21, 22	1	0	458	
	262	A731	**Subtracted frequency at deceleration start**	0 to 20 Hz	0.01 Hz	3 Hz	458	
	263	A732	**Subtraction starting frequency**	0 to 590 Hz, 9999	0.01 Hz	60 Hz	458	
	264	A733	**Power-failure deceleration time 1**	0 to 3600 s	0.1 s	5 s	458	
	265	A734	**Power-failure deceleration time 2**	0 to 3600 s, 9999	0.1 s	9999	458	
	266	A735	**Power failure deceleration time switchover frequency**	0 to 590 Hz	0.01 Hz	60 Hz	458	
—	267	T001	**Terminal 4 input selection**	0 to 2	1	0	318	
—	268	M022	**Monitor decimal digits selection**	0, 1, 9999	1	9999	274	
—	269	E023	Parameter for manufacturer setting. Do not set.					
—	289	M431	**Inverter output terminal filter**	5 to 50 ms, 9999	1 ms	9999	297	
—	290	M044	**Monitor negative output selection**	0 to 7	1	0	274, 284	
—	291	D100	**Pulse train I/O selection**	0, 1	1	0	222, 284	
—	294	A785	**UV avoidance voltage gain**	0 to 200%	0.1%	100%	458	
—	295	E201	Parameter for manufacturer setting. Do not set.					

5

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Password function	**296**	**E410**	**Password lock level**	0 to 6, 99, 100 to 106, 199, 9999	1	9999	170	
	297	**E411**	**Password lock/unlock**	(0 to 5), 1000 to 9998, 9999	1	9999	170	
—	**298**	**A711**	**Frequency search gain**	0 to 32767, 9999	1	9999	353, 454	
—	**299**	**A701**	**Rotation direction detection selection at restarting**	0, 1, 9999	1	9999	448	
PLC	**313** *9	**M410**	**DO0 output selection**	0 to 5, 7, 8, 10 to 19, 23, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 66, 68, 70 to 80, 85 to 96, 98 to 105, 107, 108, 110 to 116, 123, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 166, 168, 170 to 180, 185 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 247 to 250, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 347 to 350, 9999	1	9999	297	
	314 *9	**M411**	**DO1 output selection**		1	9999	297	
	315 *9	**M412**	**DO2 output selection**		1	9999	297	
	316 *9	**M413**	**DO3 output selection**		1	9999	297	
	317 *9	**M414**	**DO4 output selection**		1	9999	297	
	318 *9	**M415**	**DO5 output selection**		1	9999	297	
	319 *9	**M416**	**DO6 output selection**		1	9999	297	
	320 *9	**M420**	**RA1 output selection**	0 to 5, 7, 8, 10 to 19, 23, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 66, 68, 70 to 80, 85 to 91, 94 to 96, 98, 99, 200 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 247 to 250, 9999	1	0	297	
	321 *9	**M421**	**RA2 output selection**		1	1	297	
	322 *9	**M422**	**RA3 output selection**		1	2*6	297	
						9999*7		

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
RS-485 communication	331	N030	**RS-485 communication station number**	0 to 31 (0 to 247)	1	0	483	
	332	N031	**RS-485 communication speed**	3, 6, 12, 24, 48, 96, 192, 384, 576, 768, 1152	1	96	483	
	333	-	**RS-485 communication stop bit length / data length**	0, 1, 10, 11	1	1	483	
		N032	**PU communication data length**	0, 1	1	0		
		N033	**PU communication stop bit length**	0, 1	1	1		
	334	N034	**RS-485 communication parity check selection**	0 to 2	1	2	483	
	335	N035	**RS-485 communication retry count**	0 to 10, 9999	1	1	483	
	336	N036	**RS-485 communication check time interval**	0 to 999.8 s, 9999	0.1 s	0 s	483	
	337	N037	**RS-485 communication waiting time setting**	0 to 150 ms, 9999	1 ms	9999	483	
	338	D010	**Communication operation command source**	0, 1	1	0	214	
	339	D011	**Communication speed command source**	0 to 2	1	0	214	
	340	D001	**Communication startup mode selection**	0 to 2, 10, 12	1	0	213	
	341	N038	**RS-485 communication CR/LF selection**	0 to 2	1	1	483	
	342	N001	**Communication EEPROM write selection**	0, 1	1	0	478	
	343	N080	**Communication error count**	—	1	0	500	
—	374	H800	**Overspeed detection level**	0 to 590 Hz, 9999	0.01 Hz	9999	270	
Pulse train input	384	D101	**Input pulse division scaling factor**	0 to 250	1	0	222	
	385	D110	**Frequency for zero input pulse**	0 to 590 Hz	0.01 Hz	0 Hz	222	
	386	D111	**Frequency for maximum input pulse**	0 to 590 Hz	0.01 Hz	60 Hz	222	
—	390	N054	**% setting reference frequency**	1 to 590 Hz	0.01 Hz	60 Hz	516	
PLC function	414	A800	**PLC function operation selection**	0 to 2, 11, 12	1	0	463	
	415	A801	**Inverter operation lock mode setting**	0, 1	1	0	463	
	416	A802	**Pre-scale function selection**	0 to 5	1	0	463	
	417	A803	**Pre-scale setting value**	0 to 32767	1	1	463	
CC-Link IE	434 *10	N110	**Network number (CC-Link IE)**	0 to 255	1	0	535	
	435 *10	N111	**Station number (CC-Link IE)**	0 to 255	1	0	535	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Second motor constants	450	C200	**Second applied motor**	0, 1, 3 to 6, 13 to 16, 8093, 8094, 9090, 9093, 9094, 9999	1	9999	351	
	453	C201	**Second motor capacity**	0.4 to 55 kW, 9999 *2	0.01 kW *2	9999	353, 363	
				0 to 3600 kW, 9999 *3	0.1 kW *3			
	454	C202	**Number of second motor poles**	2, 4, 6, 8, 10, 12, 9999	1	9999	353, 363	
	455	C225	**Second motor excitation current**	0 to 500 A, 9999 *2	0.01 A *2	9999	353	
				0 to 3600 A, 9999 *3	0.1 A *3			
	456	C204	**Rated second motor voltage**	0 to 1000 V	0.1 V	575 V	353, 363	
	457	C205	**Rated second motor frequency**	10 to 400 Hz, 9999	0.01 Hz	9999	353, 363	
	458	C220	**Second motor constant (R1)**	0 to 50 Ω, 9999 *2	0.001 Ω *2	9999	353, 363, 454	
				0 to 400 mΩ, 9999 *3	0.01 mΩ *3			
	459	C221	**Second motor constant (R2)**	0 to 50 Ω, 9999 *2	0.001 Ω *2	9999	353	
				0 to 400 mΩ, 9999 *3	0.01 mΩ *3			
	460	C222	**Second motor constant (L1) / d-axis inductance (Ld)**	0 to 6000 mH, 9999 *2	0.1 mH *2	9999	353, 363	
				0 to 400 mH, 9999 *3	0.01 mH *3			
	461	C223	**Second motor constant (L2) / q-axis inductance (Lq)**	0 to 6000 mH, 9999 *2	0.1 mH *2	9999	353, 363	
				0 to 400 mH, 9999 *3	0.01 mH *3			
	462	C224	**Second motor constant (X)**	0 to 100%, 9999	0.1% *2	9999	353	
					0.01% *3			
	463	C210	**Second motor auto tuning setting/status**	0, 1, 11, 101	1	0	353, 363, 454	
Remote output	495	M500	**Remote output selection**	0, 1, 10, 11	1	0	310	
	496	M501	**Remote output data 1**	0 to 4095	1	0	310	
	497	M502	**Remote output data 2**	0 to 4095	1	0	310	
—	498	A804	**PLC function flash memory clear**	0 to 9999	1	0	463	
—	502	N013	**Stop mode selection at communication error**	0 to 4	1	0	478	
Maintenance	503	E710	**Maintenance timer 1**	0 (1 to 9998)	1	0	186	
	504	E711	**Maintenance timer 1 warning output set time**	0 to 9998, 9999	1	9999	186	
—	505	M001	**Speed setting reference**	1 to 590 Hz	0.01 Hz	60 Hz	272	
—	506 *8	E705	**Display estimated main circuit capacitor residual life**	(0 to 100%)	1%	100%	182	
—	507	E706	**Display/reset ABC1 relay contact life**	0 to 100%	1%	100%	182	
—	508	E707	**Display/reset ABC2 relay contact life**	0 to 100%	1%	100%	182	
—	514 *8	H324	**Emergency drive dedicated retry waiting time**	0.1 to 600 s, 9999	0.1 s	9999	245	
—	515 *8	H322	**Emergency drive dedicated retry count**	1 to 200, 9999	1	1	245	
—	521	H194	**Output short-circuit detection**	0, 1	1	0	240	
—	522	G105	**Output stop frequency**	0 to 590 Hz, 9999	0.01 Hz	9999	548	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
—	523 *8	H320	**Emergency drive mode selection**	100, 111, 112, 121 to 124, 200, 211, 212, 221 to 224, 300, 311, 312, 321 to 324, 400, 411, 412, 421 to 424, 9999	1	9999	245	
—	524 *8	H321	**Emergency drive running speed**	0 to 590 Hz, 9999	0.01 Hz	9999	245	
—	539	N002	**MODBUS RTU communication check time interval**	0 to 999.8 s, 9999	0.1 s	9999	500	
USB	547	N040	**USB communication station number**	0 to 31	1	0	532	
	548	N041	**USB communication check time interval**	0 to 999.8 s, 9999	0.1 s	9999	532	
Communication	549	N000	**Protocol selection**	0, 1, 2	1	0	478	
	550	D012	**NET mode operation command source selection**	0, 1, 9999	1	9999	214	
	551	D013	**PU mode operation command source selection**	1 to 3, 9999	1	9999	214	
—	552	H429	**Frequency jump range**	0 to 30 Hz, 9999	0.01 Hz	9999	255	
PID control	553	A603	**PID deviation limit**	0 to 100%, 9999	0.1%	9999	396	
	554	A604	**PID signal operation selection**	0 to 7, 10 to 17	1	0	396	
Current average value monitor	555	E720	**Current average time**	0.1 to 1 s	0.1 s	1 s	187	
	556	E721	**Data output mask time**	0 to 20 s	0.1 s	0 s	187	
	557	E722	**Current average value monitor signal output reference current**	0 to 500 A*2	0.01 A *2	Inverter rated current	187	
				0 to 3600 A*3	0.1 A *3			
—	560	A712	**Second frequency search gain**	0 to 32767, 9999	1	9999	353, 454	
—	561	H020	**PTC thermistor protection level**	0.5 to 30 kΩ, 9999	0.01 kΩ	9999	230	
—	563	M021	**Energization time carrying-over times**	(0 to 65535)	1	0	274	
—	564	M031	**Operating time carrying-over times**	(0 to 65535)	1	0	274	
—	565	G301	**Second motor excitation current break point**	0 to 400 Hz, 9999	0.01 Hz	9999	542	
—	566	G302	**Second motor excitation current low-speed scaling factor**	0 to 300%, 9999	0.1%	9999	542	
Second motor constants	569	G942	**Second motor speed control gain**	0 to 200%, 9999	0.1%	9999	149	
Multiple rating	570	E301	**Multiple rating setting**	0, 1	1	0	167	
—	571	F103	**Holding time at a start**	0 to 10 s, 9999	0.1 s	9999	201	
—	573	A680 T052	**4 mA input check selection**	1 to 4, 11 to 14, 21 to 24, 9999	1	9999	338	
—	574	C211	**Second motor online auto tuning**	0, 1	1	0	371	
PID control	575	A621	**Output interruption detection time**	0 to 3600 s, 9999	0.1 s	1 s	396	
	576	A622	**Output interruption detection level**	0 to 590 Hz	0.01 Hz	0 Hz	396	
	577	A623	**Output interruption cancel level**	900 to 1100%	0.1%	1000%	396	

5

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Pump function	**578**	**A400**	**Auxiliary motor operation selection**	0 to 3	1	0	429	
	579	**A401**	**Motor connection function selection**	0 to 3	1	0	429	
	580	**A402**	**MC switchcover interlock time (multi-pump)**	0 to 100 s	0.1 s	1 s	429	
	581	**A403**	**Start waiting time (multi-pump)**	0 to 100 s	0.1 s	1 s	429	
	582	**A404**	**Auxiliary motor connection-time deceleration time**	0 to 3600 s, 9999	0.1 s	1 s	429	
	583	**A405**	**Auxiliary motor disconnection-time acceleration time**	0 to 3600 s, 9999	0.1 s	1 s	429	
	584	**A406**	**Auxiliary motor 1 starting frequency**	0 to 590 Hz	0.01 Hz	60 Hz	429	
	585	**A407**	**Auxiliary motor 2 starting frequency**	0 to 590 Hz	0.01 Hz	60 Hz	429	
	586	**A408**	**Auxiliary motor 3 starting frequency**	0 to 590 Hz	0.01 Hz	60 Hz	429	
	587	**A409**	**Auxiliary motor 1 stopping frequency**	0 to 590 Hz	0.01 Hz	0 Hz	429	
	588	**A410**	**Auxiliary motor 2 stopping frequency**	0 to 590 Hz	0.01 Hz	0 Hz	429	
	589	**A411**	**Auxiliary motor 3 stopping frequency**	0 to 590 Hz	0.01 Hz	0 Hz	429	
	590	**A412**	**Auxiliary motor start detection time**	0 to 3600 s	0.1 s	5 s	429	
	591	**A413**	**Auxiliary motor stop detection time**	0 to 3600 s	0.1 s	5 s	429	
Traverse function	**592**	**A300**	**Traverse function selection**	0 to 2	1	0	389	
	593	**A301**	**Maximum amplitude amount**	0 to 25%	0.1%	10%	389	
	594	**A302**	**Amplitude compensation amount during deceleration**	0 to 50%	0.1%	10%	389	
	595	**A303**	**Amplitude compensation amount during acceleration**	0 to 50%	0.1%	10%	389	
	596	**A304**	**Amplitude acceleration time**	0.1 to 3600 s	0.1 s	5 s	389	
	597	**A305**	**Amplitude deceleration time**	0.1 to 3600 s	0.1 s	5 s	389	
—	**599**	**T721**	**X10 terminal input selection**	0, 1	1	0 *6 1 *7	553	
Electronic thermal O/L relay	**600**	**H001**	**First free thermal reduction frequency 1**	0 to 590 Hz, 9999	0.01 Hz	9999	230	
	601	**H002**	**First free thermal reduction ratio 1**	1 to 100%	1%	100%	230	
	602	**H003**	**First free thermal reduction frequency 2**	0 to 590 Hz, 9999	0.01 Hz	9999	230	
	603	**H004**	**First free thermal reduction ratio 2**	1 to 100%	1%	100%	230	
	604	**H005**	**First free thermal reduction frequency 3**	0 to 590 Hz, 9999	0.01 Hz	9999	230	
—	**606**	**T722**	**Power failure stop external signal input selection**	0, 1	1	1	458	
—	**607**	**H006**	**Motor permissible load level**	110 to 250%	1%	150%	230	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
—	608	H016	**Second motor permissible load level**	110 to 250%, 9999	1%	9999	230	
PID control	609	A624	**PID set point/deviation input selection**	1 to 5	1	2	396	
	610	A625	**PID measured value input selection**	1 to 5, 101 to 105	1	3	396	
—	611	F003	**Acceleration time at a restart**	0 to 3600 s, 9999	0.1 s	9999	448, 454	
—	617	G080	**Reverse rotation excitation current low-speed scaling factor**	0 to 300%, 9999	0.1%	9999	542	
Speed smoothing control	653	G410	**Speed smoothing control**	0 to 200%	0.1%	0%	564	
	654	G411	**Speed smoothing cutoff frequency**	0 to 120 Hz	0.01 Hz	20 Hz	564	
Analog remote output function	655	M530	**Analog remote output selection**	0, 1, 10, 11	1	0	312	
	656	M531	**Analog remote output 1**	800 to 1200%	0.1%	1000%	312	
	657	M532	**Analog remote output 2**	800 to 1200%	0.1%	1000%	312	
	658	M533	**Analog remote output 3**	800 to 1200%	0.1%	1000%	312	
	659	M534	**Analog remote output 4**	800 to 1200%	0.1%	1000%	312	
Increased magnetic excitation deceleration	660	G130	**Increased magnetic excitation deceleration operation selection**	0, 1	1	0	562	
	661	G131	**Magnetic excitation increase rate**	0 to 40%, 9999	0.1%	9999	562	
	662	G132	**Increased magnetic excitation current level**	0 to 300%	0.1%	100%	562	
—	663	M060	**Control circuit temperature signal output level**	0 to 100°C	1°C	0°C	316	
—	665	G125	**Regeneration avoidance frequency gain**	0 to 200%	0.1%	100%	559	
—	668	A786	**Power failure stop frequency gain**	0 to 200%	0.1%	100%	458	
—	675	A805	**User parameter auto storage function selection**	1, 9999	1	9999	463	
—	684	C000	**Tuning data unit switchover**	0, 1	1	0	353, 363	
Maintenance	686	E712	**Maintenance timer 2**	0 (1 to 9998)	1	0	186	
	687	E713	**Maintenance timer 2 warning output set time**	0 to 9998, 9999	1	9999	186	
	688	E714	**Maintenance timer 3**	0 (1 to 9998)	1	0	186	
	689	E715	**Maintenance timer 3 warning output set time**	0 to 9998, 9999	1	9999	186	
Electronic thermal O/L relay	692	H011	**Second free thermal reduction frequency 1**	0 to 590 Hz, 9999	0.01 Hz	9999	230	
	693	H012	**Second free thermal reduction ratio 1**	1 to 100%	1%	100%	230	
	694	H013	**Second free thermal reduction frequency 2**	0 to 590 Hz, 9999	0.01 Hz	9999	230	
	695	H014	**Second free thermal reduction ratio 2**	1 to 100%	1%	100%	230	
	696	H015	**Second free thermal reduction frequency 3**	0 to 590 Hz, 9999	0.01 Hz	9999	230	
—	699	T740	**Input terminal filter**	5 to 50 ms, 9999	1 ms	9999	343	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Motor constants	702	C106	**Maximum motor frequency**	0 to 400 Hz, 9999	0.01 Hz	9999	363	
	706	C130	**Induced voltage constant (phi f)**	0 to 5000 mV/(rad/s), 9999	0.1 mV/(rad/s)	9999	363	
	707	C107	**Motor inertia (integer)**	10 to 999, 9999	1	9999	363	
	711	C131	**Motor Ld decay ratio**	0 to 100%, 9999	0.1%	9999	363	
	712	C132	**Motor Lq decay ratio**	0 to 100%, 9999	0.1%	9999	363	
	717	C182	**Starting resistance tuning compensation**	0 to 200%, 9999	0.1%	9999	363	
	721	C185	**Starting magnetic pole position detection pulse width**	0 to 6000 μs, 10000 to 16000 μs, 9999	1 μs	9999	363	
	724	C108	**Motor inertia (exponent)**	0 to 7, 9999	1	9999	363	
	725	C133	**Motor protection current level**	100 to 500%, 9999	0.1%	9999	363	
BACnet MS/TP protocol	726	N050	**Auto Baudrate/Max Master**	0 to 255	1	255	516	
	727	N051	**Max Info Frames**	1 to 255	1	1	516	
	728	N052	**Device instance number (Upper 3 digits)**	0 to 419 (0 to 418)	1	0	516	
	729	N053	**Device instance number (Lower 4 digits)**	0 to 9999 (0 to 4302)	1	0	516	
Motor constants	738	C230	**Second motor induced voltage constant (phi f)**	0 to 5000 mV/(rad/s), 9999	0.1 mV/(rad/s)	9999	363	
	739	C231	**Second motor Ld decay ratio**	0 to 100%, 9999	0.1%	9999	363	
	740	C232	**Second motor Lq decay ratio**	0 to 100%, 9999	0.1%	9999	363	
	741	C282	**Second starting resistance tuning compensation**	0 to 200%, 9999	0.1%	9999	363	
	742	C285	**Second motor magnetic pole detection pulse width**	0 to 6000 μs, 10000 to 16000 μs, 9999	1 μs	9999	363	
	743	C206	**Second motor maximum frequency**	0 to 400 Hz, 9999	0.01 Hz	9999	363	
	744	C207	**Second motor inertia (integer)**	10 to 999, 9999	1	9999	363	
	745	C208	**Second motor inertia (exponent)**	0 to 7, 9999	1	9999	363	
	746	C233	**Second motor protection current level**	100 to 500%, 9999	0.1%	9999	363	
PID control	753	A650	**Second PID action selection**	0, 10, 11, 20, 21, 50, 51, 60, 61, 70, 71, 80, 81, 90, 91, 100, 101, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	1	0	396	
	754	A652	**Second PID control automatic switchover frequency**	0 to 590 Hz, 9999	0.01 Hz	9999	396	
	755	A651	**Second PID action set point**	0 to 100%, 9999	0.01%	9999	396	
	756	A653	**Second PID proportional band**	0.1 to 1000%, 9999	0.1%	100%	396	
	757	A654	**Second PID integral time**	0.1 to 3600 s, 9999	0.1 s	1 s	396	
	758	A655	**Second PID differential time**	0.01 to 10 s, 9999	0.01 s	9999	396	
	759	A600	**PID unit selection**	0 to 43, 9999	1	9999	421	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
PID pre-charge function	760	A616	**Pre-charge fault selection**	0, 1	1	0	424	
	761	A617	**Pre-charge ending level**	0 to 100%, 9999	0.1%	9999	424	
	762	A618	**Pre-charge ending time**	0 to 3600 s, 9999	0.1 s	9999	424	
	763	A619	**Pre-charge upper detection level**	0 to 100%, 9999	0.1%	9999	424	
	764	A620	**Pre-charge time limit**	0 to 3600 s, 9999	0.1 s	9999	424	
	765	A656	**Second pre-charge fault selection**	0, 1	1	0	424	
	766	A657	**Second pre-charge ending level**	0 to 100%, 9999	0.1%	9999	424	
	767	A658	**Second pre-charge ending time**	0 to 3600 s, 9999	0.1 s	9999	424	
	768	A659	**Second pre-charge upper detection level**	0 to 100%, 9999	0.1%	9999	424	
	769	A660	**Second pre-charge time limit**	0 to 3600 s, 9999	0.1 s	9999	424	
Monitor function	774	M101	**Operation panel monitor selection 1**	1 to 3, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98, 100, 9999	1	9999	274	
	775	M102	**Operation panel monitor selection 2**		1	9999	274	
	776	M103	**Operation panel monitor selection 3**		1	9999	274	
—	777	A681 T053	**4 mA input check operation frequency**	0 to 590 Hz, 9999	0.01 Hz	9999	338	
—	778	A682 T054	**4 mA input check filter**	0 to 10 s	0.01 s	0 s	338	
—	779	N014	**Operation frequency during communication error**	0 to 590 Hz, 9999	0.01 Hz	9999	478	
—	791	F070	**Acceleration time in low-speed range**	0 to 3600 s, 9999	0.1 s	9999	190	
—	792	F071	**Deceleration time in low-speed range**	0 to 3600 s, 9999	0.1 s	9999	190	
—	799	M520	**Pulse increment setting for output power**	0.1, 1, 10, 100, 1000 kWh	0.1 kWh	1 kWh	315	
—	800	G200	**Control method selection**	9, 20, 109, 110	1	20	145	
—	815	H710	**Torque limit level 2**	0 to 400%, 9999	0.1%	9999	190	
Adjustment function	820	G211	**Speed control P gain 1**	0 to 1000%	1%	25%	155	
	821	G212	**Speed control integral time 1**	0 to 20 s	0.001 s	0.333 s	155	
	822	T003	**Speed setting filter 1**	0 to 5 s, 9999	0.001 s	9999	326	
	824	G213	**Torque control P gain 1 (current loop proportional gain)**	0 to 500%	1%	50%	155	
	825	G214	**Torque control integral time 1 (current loop integral time)**	0 to 500 ms	0.1 ms	40 ms	155	
	827	G216	**Torque detection filter 1**	0 to 0.1 s	0.001 s	0 s	158	
	828	G224	Parameter for manufacturer setting. Do not set.					
	830	G311	**Speed control P gain 2**	0 to 1000%, 9999	1%	9999	155	
	831	G312	**Speed control integral time 2**	0 to 20 s, 9999	0.001 s	9999	155	
	832	T005	**Speed setting filter 2**	0 to 5 s, 9999	0.001 s	9999	326	
	834	G313	**Torque control P gain 2 (current loop proportional gain)**	0 to 500%, 9999	1%	9999	155	
	835	G314	**Torque control integral time 2 (current loop integral time)**	0 to 500 ms, 9999	0.1 ms	9999	155	
	837	G316	**Torque detection filter 2**	0 to 0.1 s, 9999	0.001 s	9999	158	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Additional function	849	T007	**Analog input offset adjustment**	0 to 200%	0.1%	100%	326	
	858	T040	**Terminal 4 function assignment**	0, 4, 9999	1	0	257, 322	
	859	C126	**Torque current/Rated PM motor current**	0 to 500 A, 9999 *2	0.01 A *2	9999	353, 363	
				0 to 3600 A, 9999 *3	0.1 A *3			
	860	C226	**Second motor torque current/Rated PM motor current**	0 to 500 A, 9999 *2	0.01 A *2	9999	353, 363	
				0 to 3600 A, 9999 *3	0.1 A *3			
	864	M470	**Torque detection**	0 to 400%	0.1%	150%	309	
Indication function	866	M042	**Torque monitoring reference**	0 to 400%	0.1%	150%	284	
—	867	M321	**AM output filter**	0 to 5 s	0.01 s	0.01 s	288	
—	868	T010	**Terminal 1 function assignment**	0, 4, 9999	1	0	257, 322	
—	869	M334	**Current output filter**	0 to 5 s	0.01 s	0.02 s	288	
—	870	M440	**Speed detection hysteresis**	0 to 5 Hz	0.01 Hz	0 Hz	305	
Protective Functions	872 *7	H201	**Input phase loss protection selection**	0, 1	1	0	241	
	874	H730	**OLT level setting**	0 to 400%	0.1%	110%	257	
Regeneration avoidance function	882	G120	**Regeneration avoidance operation selection**	0 to 2	1	0	559	
	883	G121	**Regeneration avoidance operation level**	300 to 1200 V	0.1 V	940 V	559	
	884	G122	**Regeneration avoidance at deceleration detection sensitivity**	0 to 5	1	0	559	
	885	G123	**Regeneration avoidance compensation frequency limit value**	0 to 590 Hz, 9999	0.01 Hz	6 Hz	559	
	886	G124	**Regeneration avoidance voltage gain**	0 to 200%	0.1%	100%	559	
Free parameters	888	E420	**Free parameter 1**	0 to 9999	1	9999	172	
	889	E421	**Free parameter 2**	0 to 9999	1	9999	172	
—	890	H325	**Internal storage device status indication**	(0 to 511)	1	0	253	
Energy saving monitor	891	M023	**Cumulative power monitor digit shifted times**	0 to 4, 9999	1	9999	274, 291	
	892	M200	**Load factor**	30 to 150%	0.1%	100%	291	
	893	M201	**Energy saving monitor reference (motor capacity)**	0.1 to 55 kW *2	0.01 kW *2	Inverter capacity	291	
				0 to 3600 kW *3	0.1 kW *3			
	894	M202	**Control selection during commercial power-supply operation**	0 to 3	1	0	291	
	895	M203	**Power saving rate reference value**	0, 1, 9999	1	9999	291	
	896	M204	**Power unit cost**	0 to 500, 9999	0.01	9999	291	
	897	M205	**Power saving monitor average time**	0 to 1000 h, 9999	1 h	9999	291	
	898	M206	**Power saving cumulative monitor clear**	0, 1, 10, 9999	1	9999	291	
	899	M207	**Operation time rate (estimated value)**	0 to 100%, 9999	0.1%	9999	291	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Calibration parameters	900	M310	CA terminal calibration	—	—	—	288	
	901	M320	AM terminal calibration	—	—	—	288	
	902	T200	Terminal 2 frequency setting bias frequency	0 to 590 Hz	0.01 Hz	0 Hz	328	
	902	T201	Terminal 2 frequency setting bias	0 to 300%	0.1%	0%	328	
	903	T202	Terminal 2 frequency setting gain frequency	0 to 590 Hz	0.01 Hz	60 Hz	328	
	903 (125)	T203	Terminal 2 frequency setting gain	0 to 300%	0.1%	100%	328	
	904	T400	Terminal 4 frequency setting bias frequency	0 to 590 Hz	0.01 Hz	0 Hz	328	
	904	T401	Terminal 4 frequency setting bias	0 to 300%	0.1%	20%	328	
	905 (126)	T402	Terminal 4 frequency setting gain frequency	0 to 590 Hz	0.01 Hz	60 Hz	328	
	905	T403	Terminal 4 frequency setting gain	0 to 300%	0.1%	100%	328	
	917	T100	Terminal 1 bias frequency (speed)	0 to 590 Hz	0.01 Hz	0 Hz	328	
	917	T101	Terminal 1 bias (speed)	0 to 300%	0.1%	0%	328	
	918	T102	Terminal 1 gain frequency (speed)	0 to 590 Hz	0.01 Hz	60 Hz	328	
	918	T103	Terminal 1 gain (speed)	0 to 300%	0.1%	100%	328	
	919	T110	Terminal 1 bias command (torque)	0 to 400%	0.1%	0%	333	
	919	T111	Terminal 1 bias (torque)	0 to 300%	0.1%	0%	333	
	920	T112	Terminal 1 gain command (torque)	0 to 400%	0.1%	150%	333	
	920	T113	Terminal 1 gain (torque)	0 to 300%	0.1%	100%	333	
	930	M330	Current output bias signal	0 to 100%	0.1%	—	288	
	930	M331	Current output bias current	0 to 100%	0.1%	0%	288	
	931	M332	Current output gain signal	0 to 100%	0.1%	100%	288	
	931	M333	Current output gain current	0 to 100%	0.1%	100%	288	
	932	T410	Terminal 4 bias command (torque)	0 to 400%	0.1%	0%	333	
	932	T411	Terminal 4 bias (torque)	0 to 300%	0.1%	20%	333	
	933	T412	Terminal 4 gain command (torque)	0 to 400%	0.1%	150%	333	
	933	T413	Terminal 4 gain (torque)	0 to 300%	0.1%	100%	333	
	934	A630	PID display bias coefficient Simple	0 to 500, 9999	0.01	9999	421	
	934	A631	PID display bias analog value Simple	0 to 300%	0.1%	20%	421	
	935	A632	PID display gain coefficient Simple	0 to 500, 9999	0.01	9999	421	
	935	A633	PID display gain analog value Simple	0 to 300%	0.1%	100%	421	
—	989	E490	Parameter copy alarm release	10 *2 100 *3	1	10 *2 100 *3	179	
PU	990	E104	PU buzzer control	0, 1	1	1	165	
	991	E105	PU contrast adjustment Simple	0 to 63	1	58	165	
—	992	M104	Parameter for manufacturer setting. Do not set.					
—	997	H103	Fault initiation	0 to 255, 9999	1	9999	240	

5

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
—	**998**	**E430**	**PM parameter initialization** Simple	0, 8009, 8109, 9009, 9109	1	0	151	
—	**999**	**E431**	**Automatic parameter setting** Simple	1, 2, 10, 11, 12, 13, 20, 21, 9999	1	9999	173	
—	**1000**	**E108**	**Direct setting selection**	0 to 2	1	0	166	
—	**1002**	**C150**	**Lq tuning target current adjustment coefficient**	50 to 150%, 9999	0.1%	9999	363	
Clock function	**1006**	**E020**	**Clock (year)**	2000 to 2099	1	2000	160	
	1007	**E021**	**Clock (month, day)**	1/1 to 12/31	1	101	160	
	1008	**E022**	**Clock (hour, minute)**	0:00 to 23:59	1	0	160	
—	**1013** *7	**H323**	**Running speed after emergency drive retry reset**	0 to 590 Hz	0.01 Hz	60 Hz	245	
—	**1015**	**A607**	**Integral stop selection at limited frequency**	0 to 2, 10 to 12	1	0	396	
—	**1016**	**H021**	**PTC thermistor protection detection time**	0 to 60 s	1 s	0	230	
—	**1018**	**M045**	**Monitor with sign selection**	0, 1, 9999	1	9999	274	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Trace function	**1020**	**A900**	**Trace operation selection**	0 to 4	1	0	466	
	1021	**A901**	**Trace mode selection**	0 to 2	1	0	466	
	1022	**A902**	**Sampling cycle**	0 to 9	1	2	466	
	1023	**A903**	**Number of analog channels**	1 to 8	1	4	466	
	1024	**A904**	**Sampling auto start**	0, 1	1	0	466	
	1025	**A905**	**Trigger mode selection**	0 to 4	1	0	466	
	1026	**A906**	**Number of sampling before trigger**	0 to 100%	1%	90%	466	
	1027	**A910**	**Analog source selection (1ch)**	1 to 3, 5 to 14, 17, 18, 20, 23, 24, 34, 40 to 42, 52 to 54, 61, 62, 64, 67 to 69, 81 to 96, 98, 201 to 213, 230 to 232, 237, 238	1	201	466	
	1028	**A911**	**Analog source selection (2ch)**			202	466	
	1029	**A912**	**Analog source selection (3ch)**			203	466	
	1030	**A913**	**Analog source selection (4ch)**			204	466	
	1031	**A914**	**Analog source selection (5ch)**			205	466	
	1032	**A915**	**Analog source selection (6ch)**			206	466	
	1033	**A916**	**Analog source selection (7ch)**			207	466	
	1034	**A917**	**Analog source selection (8ch)**			208	466	
	1035	**A918**	**Analog trigger channel**	1 to 8	1	1	466	
	1036	**A919**	**Analog trigger operation selection**	0, 1	1	0	466	
	1037	**A920**	**Analog trigger level**	600 to 1400	1	1000	466	
	1038	**A930**	**Digital source selection (1ch)**	1 to 255	1	1	466	
	1039	**A931**	**Digital source selection (2ch)**			2	466	
	1040	**A932**	**Digital source selection (3ch)**			3	466	
	1041	**A933**	**Digital source selection (4ch)**			4	466	
	1042	**A934**	**Digital source selection (5ch)**			5	466	
	1043	**A935**	**Digital source selection (6ch)**			6	466	
	1044	**A936**	**Digital source selection (7ch)**			7	466	
	1045	**A937**	**Digital source selection (8ch)**			8	466	
	1046	**A938**	**Digital trigger channel**	1 to 8	1	1	466	
	1047	**A939**	**Digital trigger operation selection**	0, 1	1	0	466	
—	**1048**	**E106**	Parameter for manufacturer setting. Do not set.					
—	**1049**	**E110**	**USB host reset**	0, 1	1	0	166	
—	**1103**	**F040**	**Deceleration time at emergency stop**	0 to 3600 s	0.1 s	5 s	190	
Monitor function	**1106**	**M050**	**Torque monitor filter**	0 to 5 s, 9999	0.01 s	9999	274	
	1107	**M051**	**Running speed monitor filter**	0 to 5 s, 9999	0.01 s	9999	274	
	1108	**M052**	**Excitation current monitor filter**	0 to 5 s, 9999	0.01 s	9999	274	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
PID control	1132	A626	**Pre-charge change increment amount**	0 to 100%, 9999	0.01%	9999	424	
	1133	A666	**Second pre-charge change increment amount**	0 to 100%, 9999	0.01%	9999	424	
	1136	A670	**Second PID display bias coefficient** Simple	0 to 500, 9999	0.01	9999	421	
	1137	A671	**Second PID display bias analog value** Simple	0 to 300%	0.1%	20%	421	
	1138	A672	**Second PID display gain coefficient** Simple	0 to 500, 9999	0.01	9999	421	
	1139	A673	**Second PID display gain analog value** Simple	0 to 300%	0.1%	100%	421	
	1140	A664	**Second PID set point/ deviation input selection**	1 to 5	1	2	396	
	1141	A665	**Second PID measured value input selection**	1 to 5, 101 to 105	1	3	396	
	1142	A640	**Second PID unit selection**	0 to 43, 9999	1	9999	396	
	1143	A641	**Second PID upper limit**	0 to 100%, 9999	0.1%	9999	396	
	1144	A642	**Second PID lower limit**	0 to 100%, 9999	0.1%	9999	396	
	1145	A643	**Second PID deviation limit**	0 to 100%, 9999	0.1%	9999	396	
	1146	A644	**Second PID signal operation selection**	0 to 7, 10 to 17	1	0	396	
	1147	A661	**Second output interruption detection time**	0 to 3600 s, 9999	0.1 s	1	396	
	1148	A662	**Second output interruption detection level**	0 to 590 Hz	0.01 Hz	0 Hz	396	
	1149	A663	**Second output interruption cancel level**	900 to 1100%	0.1%	1000%	396	
PLC function	1150 to 1199	A810 to A859	**PLC function user parameters 1 to 50**	0 to 65535	1	0	463	
PID gain tuning	1211	A690	**PID gain tuning timeout time**	1 to 9999 s	1 s	100 s	415	
	1212	A691	**Step manipulated amount**	900 to 1100%	0.1%	1000%	415	
	1213	A692	**Step response sampling cycle**	0.01 to 600 s	0.01 s	1 s	415	
	1214	A693	**Timeout time after the maximum slope**	1 to 9999 s	1 s	10 s	415	
	1215	A694	**Limit cycle output upper limit**	900 to 1100%	0.1%	1100%	415	
	1216	A695	**Limit cycle output lower limit**	900 to 1100%	0.1%	1000%	415	
	1217	A696	**Limit cycle hysteresis**	0.1 to 10%	0.1%	1%	415	
	1218	A697	**PID gain tuning setting**	0, 100 to 102, 111, 112, 121, 122, 200 to 202, 211, 212, 221, 222	1	0	415	
	1219	A698	**PID gain tuning start/ status**	(0), 1, 8, (9, 90 to 96)	1	0	415	
—	1300 to 1343	N500 to N543	Communication option parameters. For details, refer to the Instruction Manual of the option.					
—	1346	A457	**PID lower limit operation detection time**	0 to 900 s	1 s	9999	396, 440	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
—	1350 to 1359	N550 to N559	Communication option parameters. For details, refer to the Instruction Manual of the option.					
PID control enhanced functions	1361	A440	**Detection time for PID output hold**	0 to 900 s	0.1 s	5 s	440	
	1362	A441	**PID output hold range**	0 to 50%, 9999	0.1%	9999	440	
	1363	A447	**PID priming time**	0 to 360 s, 9999	0.1 s	9999	440	
	1364	A448	**Stirring time during sleep**	0 to 3600 s	0.1 s	15 s	440	
	1365	A449	**Stirring interval time**	0 to 1000 h	0.1 h	0 h	440	
	1366	A627	**Sleep boost level**	0 to 100%, 9999	0.01%	9999	440	
	1367	A628	**Sleep boost waiting time**	0 to 360 s	0.1 s	0 s	440	
	1368	A629	**Output interruption cancel time**	0 to 360 s	0.1 s	0 s	440	
	1369	A446	**Check valve closing completion frequency**	0 to 120 Hz, 9999	0.01 Hz	9999	440	
	1370	A442	**Detection time for PID limiting operation**	0 to 900 s	0.1 s	0 s	396, 429, 440	
	1371	A443	**PID upper/lower limit pre-warning level range**	0 to 50%, 9999	0.1%	9999	440	
	1372	A444	**PID measured value control set point change amount**	0 to 50%	0.01%	5%	440	
	1373	A445	**PID measured value control set point change rate**	0 to 100%	0.01%	0%	440	
	1374	A450	**Auxiliary pressure pump operation starting level**	900 to 1100%	0.1%	1000%	440	
	1375	A451	**Auxiliary pressure pump operation stopping level**	900 to 1100%	0.1%	1000%	440	
	1376	A414	**Auxiliary motor stopping level**	0 to 100%, 9999	0.1%	9999	429	
	1377	A452	**PID input pressure selection**	1 to 3, 9999	1	9999	440	
	1378	A453	**PID input pressure warning level**	0 to 100%	0.1%	20%	440	
	1379	A454	**PID input pressure fault level**	0 to 100%, 9999	0.1%	9999	440	
	1380	A455	**PID input pressure warning set point change amount**	0 to 100%	0.01%	5%	440	
	1381	A456	**PID input pressure fault operation selection**	0, 1	1	0	440	
—	1410	A170	**Starting times lower 4 digits**	0 to 9999	1	0	388	
—	1411	A171	**Starting times upper 4 digits**	0 to 9999	1	0	388	
—	1412	C135	**Motor induced voltage constant (phi f) exponent**	0 to 2, 9999	1	9999	363	
—	1413	C235	**Second motor induced voltage constant (phi f) exponent**	0 to 2, 9999	1	9999	363	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
PID gain tuning	**1460**	**A683**	**PID multistage set point 1**	0 to 100%, 9999	0.01%	9999	396	
	1461	**A684**	**PID multistage set point 2**	0 to 100%, 9999	0.01%	9999	396	
	1462	**A685**	**PID multistage set point 3**	0 to 100%, 9999	0.01%	9999	396	
	1463	**A686**	**PID multistage set point 4**	0 to 100%, 9999	0.01%	9999	396	
	1464	**A687**	**PID multistage set point 5**	0 to 100%, 9999	0.01%	9999	396	
	1465	**A688**	**PID multistage set point 6**	0 to 100%, 9999	0.01%	9999	396	
	1466	**A689**	**PID multistage set point 7**	0 to 100%, 9999	0.01%	9999	396	
Cleaning	**1469**	**A420**	**Number of cleaning times monitor**	0 to 255	1	0	391	
	1470	**A421**	**Number of cleaning times setting**	0 to 255	1	0	391	
	1471	**A422**	**Cleaning trigger selection**	0 to 15	1	0	391	
	1472	**A423**	**Cleaning reverse rotation frequency**	0 to 590 Hz	0.01 Hz	30 Hz	391	
	1473	**A424**	**Cleaning reverse rotation operation time**	0 to 3600 s	0.1 s	5 s	391	
	1474	**A425**	**Cleaning forward rotation frequency**	0 to 590 Hz, 9999	0.01 Hz	9999	391	
	1475	**A426**	**Cleaning forward rotation operation time**	0 to 3600 s, 9999	0.1 s	9999	391	
	1476	**A427**	**Cleaning stop time**	0 to 3600 s	0.1 s	5 s	391	
	1477	**A428**	**Cleaning acceleration time**	0 to 3600 s, 9999	0.1 s	9999	391	
	1478	**A429**	**Cleaning deceleration time**	0 to 3600 s, 9999	0.1 s	9999	391	
	1479	**A430**	**Cleaning time trigger**	0 to 6000 h	0.1 h	0 h	391	

Function	Pr.	Pr. group	Name	Setting range	Minimum setting increments	Initial value	Refer to page	Customer setting
Load characteristics fault detection	**1480**	**H520**	**Load characteristics measurement mode**	0, 1 (2 to 5, 81 to 85)	1	0	265	
	1481	**H521**	**Load characteristics load reference 1**	0 to 400%, 8888, 9999	0.1%	9999	265	
	1482	**H522**	**Load characteristics load reference 2**	0 to 400%, 8888, 9999	0.1%	9999	265	
	1483	**H523**	**Load characteristics load reference 3**	0 to 400%, 8888, 9999	0.1%	9999	265	
	1484	**H524**	**Load characteristics load reference 4**	0 to 400%, 8888, 9999	0.1%	9999	265	
	1485	**H525**	**Load characteristics load reference 5**	0 to 400%, 8888, 9999	0.1%	9999	265	
	1486	**H526**	**Load characteristics maximum frequency**	0 to 590 Hz	0.01 Hz	60 Hz	265	
	1487	**H527**	**Load characteristics minimum frequency**	0 to 590 Hz	0.01 Hz	6 Hz	265	
	1488	**H531**	**Upper limit warning detection width**	0 to 400%, 9999	0.1%	20%	265	
	1489	**H532**	**Lower limit warning detection width**	0 to 400%, 9999	0.1%	20%	265	
	1490	**H533**	**Upper limit fault detection width**	0 to 400%, 9999	0.1%	9999	265	
	1491	**H534**	**Lower limit fault detection width**	0 to 400%, 9999	0.1%	9999	265	
	1492	**H535**	**Load status detection signal delay time / load reference measurement waiting time**	0 to 60 s	0.1 s	1 s	265	
	1499	**E415**	Parameter for manufacturer setting. Do not set.					

*1 Differs according to capacities.
3%: FR-F860-00027
2%: FR-F860-00061, FR-F860-00090
1%: FR-F860-00170 or higher

*2 The setting range or initial value for the FR-F860-00680 or lower.

*3 The setting range or initial value for the FR-F860-01080 or higher.

*4 The initial value for the FR-F860-00090 or lower.

*5 The initial value for the FR-F860-00170 or higher.

*6 The setting range or initial value for the standard model.

*7 The setting range or initial value for the separated converter type.

*8 The setting is available for the standard model only.

*9 The setting is available when the PLC function is enabled.

*10 The setting is available when a compatible plug-in option is installed.

5.1.2 Parameter list (by function group)

◆ E: Environment setting parameters

Parameters that set the inverter operation characteristics.

Pr. group	Pr.	Name	Refer to page
E000	168	Parameter for manufacturer setting. Do not set.	
E001	169	Parameter for manufacturer setting. Do not set.	
E020	1006	Clock (year)	160
E021	1007	Clock (month, day)	160
E022	1008	Clock (hour, minute)	160
E023	269	Parameter for manufacturer setting. Do not set.	
E080	168	Parameter for manufacturer setting. Do not set.	
E081	169	Parameter for manufacturer setting. Do not set.	
E100	75	Reset selection	162
E101	75	Disconnected PU detection	162
E102	75	PU stop selection	162
E103	145	PU display language selection	165
E104	990	PU buzzer control	165
E105	991	PU contrast adjustment Simple	165
E106	1048	Parameter for manufacturer setting. Do not set.	
E107	75	Reset limit	162
E108	1000	Direct setting selection	166
E110	1049	USB host reset	166
E200	161	Parameter for manufacturer setting. Do not set.	
E201	295	Parameter for manufacturer setting. Do not set.	
E300	30	Regenerative function selection	553
E301	570	Multiple rating setting	167
E310	328	Parameter for manufacturer setting. Do not set.	
E400	77	Parameter write selection	168
E410	296	Password lock level	170
E411	297	Password lock/unlock	170
E415	1499	Parameter for manufacturer setting. Do not set.	
E420	888	Free parameter 1	172
E421	889	Free parameter 2	172
E430	998	PM parameter initialization Simple	151
E431	999	Automatic parameter setting Simple	173
E440	160	User group read selection Simple	177
E441	172	User group registered display/ batch clear	177
E442	173	User group registration	177
E443	174	User group clear	177
E490	989	Parameter copy alarm release	179
E600	72	PWM frequency selection	179
E601	240	Soft-PWM operation selection	179
E602	260	PWM frequency automatic switchover	179
E700	255	Life alarm status display	182
E701	256 *1	Inrush current limit circuit life display	182
E702	257	Control circuit capacitor life display	182
E703	258 *1	Main circuit capacitor life display	182
E704	259 *1	Main circuit capacitor life measuring	182
E705	506 *1	Display estimated main circuit capacitor residual life	182
E706	507	Display/reset ABC1 relay contact life	182
E707	508	Display/reset ABC2 relay contact life	182
E710	503	Maintenance timer 1	186
E711	504	Maintenance timer 1 warning output set time	186
E712	686	Maintenance timer 2	186
E713	687	Maintenance timer 2 warning output set time	186
E714	688	Maintenance timer 3	186
E715	689	Maintenance timer 3 warning output set time	186
E720	555	Current average time	187
E721	556	Data output mask time	187
E722	557	Current average value monitor signal output reference current	187

◆ F: Setting of acceleration/deceleration time and acceleration/deceleration pattern

Parameters that set the motor acceleration/deceleration characteristics.

Pr. group	Pr.	Name	Refer to page
F000	20	Acceleration/deceleration reference frequency	190
F001	21	Acceleration/deceleration time increments	190
F002	16	Jog acceleration/deceleration time Simple	224
F003	611	Acceleration time at a restart	448, 454
F010	7	Acceleration time Simple	190
F011	8	Deceleration time Simple	190
F020	44	Second acceleration/deceleration time	190
F021	45	Second deceleration time	190
F022	147	Acceleration/deceleration time switching frequency	190
F031	111	Check valve deceleration time	440
F040	1103	Deceleration time at emergency stop	190
F070	791	Acceleration time in low-speed range	190
F071	792	Deceleration time in low-speed range	190
F100	29	Acceleration/deceleration pattern selection	194
F101	59	Remote function selection	197
F102	13	Starting frequency	201, 202
F103	571	Holding time at a start	201
F200	140	Backlash acceleration stopping frequency	194
F201	141	Backlash acceleration stopping time	194
F202	142	Backlash deceleration stopping frequency	194
F203	143	Backlash deceleration stopping time	194

◆ D: Operation command and frequency command

Parameters that specify the inverter's command source, and parameters that set the motor driving frequency and torque.

Pr. group	Pr.	Name	Refer to page
D000	79	Operation mode selection Simple	204, 213
D001	340	Communication startup mode selection	213
D010	338	Communication operation command source	214
D011	339	Communication speed command source	214
D012	550	NET mode operation command source selection	214
D013	551	PU mode operation command source selection	214
D020	78	Reverse rotation prevention selection	221
D100	291	Pulse train I/O selection	222, 284
D101	384	Input pulse division scaling factor	222
D110	385	Frequency for zero input pulse	222
D111	386	Frequency for maximum input pulse	222
D200	15	Jog frequency Simple	224
D300	28	Multi-speed input compensation selection	226
D301	4	Multi-speed setting (high speed) Simple	226
D302	5	Multi-speed setting (middle speed) Simple	226
D303	6	Multi-speed setting (low speed) Simple	226
D304 to D307	24 to 27	Multi-speed setting (speed 4 to speed 7)	226
D308 to D315	232 to 239	Multi-speed setting (speed 8 to speed 15)	226

◆ H: Protective function parameters

Parameters to protect the motor and the inverter.

Pr. group	Pr.	Name	Refer to page
H000	9	Electronic thermal O/L relay Simple	230, 353, 363
H001	600	First free thermal reduction frequency 1	230
H002	601	First free thermal reduction ratio 1	230
H003	602	First free thermal reduction frequency 2	230
H004	603	First free thermal reduction ratio 2	230
H005	604	First free thermal reduction frequency 3	230
H006	607	Motor permissible load level	230
H010	51	Second electronic thermal O/L relay	230, 353, 363
H011	692	Second free thermal reduction frequency 1	230
H012	693	Second free thermal reduction ratio 1	230
H013	694	Second free thermal reduction frequency 2	230
H014	695	Second free thermal reduction ratio 2	230
H015	696	Second free thermal reduction frequency 3	230

Pr. group	Pr.	Name	Refer to page
H016	608	Second motor permissible load level	230
H020	561	PTC thermistor protection level	230
H021	1016	PTC thermistor protection detection time	230
H100	244	Cooling fan operation selection	237
H101	249	Earth (ground) fault detection at start	238
H103	997	Fault initiation	240
H106	244	Cooling fan operation selection during the test operation	237
H194	521	Output short-circuit detection	240
H200	251	Output phase loss protection selection	241
H201	872 *1	Input phase loss protection selection	241
H300	65	Retry selection	242
H301	67	Number of retries at fault occurrence	242
H302	68	Retry waiting time	242
H303	69	Retry count display erase	242
H320	523 *1	Emergency drive mode selection	245
H321	524 *1	Emergency drive running speed	245
H322	515 *1	Emergency drive dedicated retry count	245
H323	1013 *1	Running speed after emergency drive retry reset	245
H324	514 *1	Emergency drive dedicated retry waiting time	245
H325	890	Internal storage device status indication	253
H400	1	Maximum frequency Simple	253
H401	2	Minimum frequency Simple	253
H402	18	High speed maximum frequency	253
H420	31	Frequency jump 1A	255
H421	32	Frequency jump 1B	255
H422	33	Frequency jump 2A	255
H423	34	Frequency jump 2B	255
H424	35	Frequency jump 3A	255
H425	36	Frequency jump 3B	255
H429	552	Frequency jump range	255
H500	22	Stall prevention operation level (Torque limit level)	257
H501	156	Stall prevention operation selection	257
H520	1480	Load characteristics measurement mode	265
H521	1481	Load characteristics load reference 1	265
H522	1482	Load characteristics load reference 2	265
H523	1483	Load characteristics load reference 3	265
H524	1484	Load characteristics load reference 4	265
H525	1485	Load characteristics load reference 5	265
H526	1486	Load characteristics maximum frequency	265
H527	1487	Load characteristics minimum frequency	265
H531	1488	Upper limit warning detection width	265
H532	1489	Lower limit warning detection width	265
H533	1490	Upper limit fault detection width	265
H534	1491	Lower limit fault detection width	265
H535	1492	Load status detection signal delay time / load reference measurement waiting time	265
H600	48	Second stall prevention operation level	257
H601	49	Second stall prevention operation frequency	257
H610	23	Stall prevention operation level compensation factor at double speed	257
H611	66	Stall prevention operation reduction starting frequency	257
H620	148	Stall prevention level at 0 V input	257
H621	149	Stall prevention level at 10 V input	257
H631	154	Voltage reduction selection during stall prevention operation	257
H710	815	Torque limit level 2	190
H730	874	OLT level setting	257
H800	374	Overspeed detection level	270

◆ M: Monitor display and monitor output signal

Parameters regarding the inverter's operating status. These parameters are used to set the monitors and output signals.

Pr. group	Pr.	Name	Refer to page
M000	37	Speed display	272
M001	505	Speed setting reference	272
M002	144	Speed setting switchover	272
M020	170	Watt-hour meter clear	274
M021	563	Energization time carrying-over times	274
M022	268	Monitor decimal digits selection	274
M023	891	Cumulative power monitor digit shifted times	274, 291
M030	171	Operation hour meter clear	274
M031	564	Operating time carrying-over times	274
M040	55	Frequency monitoring reference	284
M041	56	Current monitoring reference	284
M042	866	Torque monitoring reference	284
M043	241	Analog input display unit switchover	328
M044	290	Monitor negative output selection	274, 284
M045	1018	Monitor with sign selection	274
M050	1106	Torque monitor filter	274
M051	1107	Running speed monitor filter	274
M052	1108	Excitation current monitor filter	274
M060	663	Control circuit temperature signal output level	316
M100	52	Operation panel main monitor selection	274

Pr. group	Pr.	Name	Refer to page
M101	774	Operation panel monitor selection 1	274
M102	775	Operation panel monitor selection 2	274
M103	776	Operation panel monitor selection 3	274
M104	Parameter for manufacturer setting. Do not set.		
M200	892	Load factor	291
M201	893	Energy saving monitor reference (motor capacity)	291
M202	894	Control selection during commercial power-supply operation	291
M203	895	Power saving rate reference value	291
M204	896	Power unit cost	291
M205	897	Power saving monitor average time	291
M206	898	Power saving cumulative monitor clear	291
M207	899	Operation time rate (estimated value)	291
M300	54	CA terminal function selection	284
M301	158	AM terminal function selection	284
M310	900	CA terminal calibration	288
M320	901	AM terminal calibration	288
M321	867	AM output filter	288
M330	930	Current output bias signal	288
M331	930	Current output bias current	288
M332	931	Current output gain signal	288
M333	931	Current output gain current	288
M334	869	Current output filter	288
M400	190	RUN terminal function selection	297
M401	191	SU terminal function selection	297
M402	192	IPF terminal function selection	297
M403	193	OL terminal function selection	297
M404	194	FU terminal function selection	297
M405	195	ABC1 terminal function selection	297
M406	196	ABC2 terminal function selection	297
M410	313*2	DO0 output selection	297
M411	314*2	DO1 output selection	297
M412	315*2	DO2 output selection	297
M413	316*2	DO3 output selection	297
M414	317*2	DO4 output selection	297
M415	318*2	DO5 output selection	297
M416	319*2	DO6 output selection	297
M420	320*2	RA1 output selection	297
M421	321*2	RA2 output selection	297
M422	322*2	RA3 output selection	297
M430	157	OL signal output timer	257
M431	289	Inverter output terminal filter	297
M433	166	Output current detection signal retention time	307
M440	870	Speed detection hysteresis	305
M441	41	Up-to-frequency sensitivity	305
M442	42	Output frequency detection	305
M443	43	Output frequency detection for reverse rotation	305
M444	50	Second output frequency detection	305
M460	150	Output current detection level	307
M461	151	Output current detection signal delay time	307
M462	152	Zero current detection level	307
M463	153	Zero current detection time	307
M464	167	Output current detection operation selection	307
M470	864	Torque detection	309
M500	495	Remote output selection	310
M501	496	Remote output data 1	310
M502	497	Remote output data 2	310
M510	76	Fault code output selection	314
M520	799	Pulse increment setting for output power	315
M530	655	Analog remote output selection	312
M531	656	Analog remote output 1	312
M532	657	Analog remote output 2	312
M533	658	Analog remote output 3	312
M534	659	Analog remote output 4	312

◆ T: Multi-function input terminal parameters

Parameters for the input terminals where inverter commands are received through.

Pr. group	Pr.	Name	Refer to page
T000	73	Analog input selection	318, 323
T001	267	Terminal 4 input selection	318
T002	74	Input filter time constant	326
T003	822	Speed setting filter 1	326
T005	832	Speed setting filter 2	326
T007	849	Analog input offset adjustment	326
T010	868	Terminal 1 function assignment	257, 322
T021	242	Terminal 1 added compensation amount (terminal 2)	323
T022	125	Terminal 2 frequency setting gain frequency Simple	328
T040	858	Terminal 4 function assignment	257, 322
T041	243	Terminal 1 added compensation amount (terminal 4)	323
T042	126	Terminal 4 frequency setting gain frequency Simple	328
T050	252	Override bias	323
T051	253	Override gain	323
T052	573	4 mA input check selection	338
T053	777	4 mA input check operation frequency	338
T054	778	4 mA input check filter	338
T100	917	Terminal 1 bias frequency (speed)	328
T101	917	Terminal 1 bias (speed)	328
T102	918	Terminal 1 gain frequency (speed)	328
T103	918	Terminal 1 gain (speed)	328
T110	919	Terminal 1 bias command (torque)	333

5

Pr. group	Pr.	Name	Refer to page
T111	919	Terminal 1 bias (torque)	333
T112	920	Terminal 1 gain command (torque)	333
T113	920	Terminal 1 gain (torque)	333
T200	902	Terminal 2 frequency setting bias frequency	328
T201	902	Terminal 2 frequency setting bias	328
T202	903 (125)	Terminal 2 frequency setting gain frequency	328
T203	903	Terminal 2 frequency setting gain	328
T400	904	Terminal 4 frequency setting bias frequency	328
T401	904	Terminal 4 frequency setting bias	328
T402	905 (126)	Terminal 4 frequency setting gain frequency	328
T403	905	Terminal 4 frequency setting gain	328
T410	932	Terminal 4 bias command (torque)	333
T411	932	Terminal 4 bias (torque)	333
T412	933	Terminal 4 gain command (torque)	333
T413	933	Terminal 4 gain (torque)	333
T700	178	STF terminal function selection	343
T701	179	STR terminal function selection	343
T702	180	RL terminal function selection	343
T703	181	RM terminal function selection	343
T704	182	RH terminal function selection	343
T705	183	RT terminal function selection	343
T706	184	AU terminal function selection	343
T707	185	JOG terminal function selection	343
T708	186	CS terminal function selection	343
T709	187	MRS terminal function selection	343
T710	188	STOP terminal function selection	343
T711	189	RES terminal function selection	343
T720	17	MRS input selection	346
T721	599	X10 terminal input selection	553
T722	606	Power failure stop external signal input selection	458
T730	155	RT signal function validity condition selection	348
T740	699	Input terminal filter	343

◆ C: Motor constant parameters

Parameters for the applied motor setting.

Pr. group	Pr.	Name	Refer to page
C000	684	Tuning data unit switchover	353, 363
C100	71	Applied motor	351, 353, 363
C101	80	Motor capacity	145, 353, 363
C102	81	Number of motor poles	145, 353, 363
C103	9	Rated motor current Simple	230, 353, 363
C104	83	Rated motor voltage	145, 353, 363
C105	84	Rated motor frequency	145, 353, 363
C106	702	Maximum motor frequency	363
C107	707	Motor inertia (integer)	363
C108	724	Motor inertia (exponent)	363
C110	96	Auto tuning setting/status	353, 363, 454
C111	95	Online auto tuning selection	371
C120	90	Motor constant (R1)	353, 363, 454
C121	91	Motor constant (R2)	353
C122	92	Motor constant (L1)/d-axis inductance (Ld)	353, 363
C123	93	Motor constant (L2)/q-axis inductance (Lq)	353, 363
C124	94	Motor constant (X)	353
C125	82	Motor excitation current	353
C126	859	Torque current/Rated PM motor current	353, 363
C130	706	Induced voltage constant (phi f)	363
C131	711	Motor Ld decay ratio	363
C132	712	Motor Lq decay ratio	363
C133	725	Motor protection current level	363
C135	1412	Motor induced voltage constant (phi f) exponent	363
C150	1002	Lq tuning target current adjustment coefficient	363
C182	717	Starting resistance tuning compensation	363
C185	721	Starting magnetic pole position detection pulse width	363
C200	450	Second applied motor	351
C201	453	Second motor capacity	353, 363
C202	454	Number of second motor poles	353, 363
C203	51	Rated second motor current	230, 353, 363
C204	456	Rated second motor voltage	353, 363
C205	457	Rated second motor frequency	353, 363
C206	743	Second motor maximum frequency	363
C207	744	Second motor inertia (integer)	363
C208	745	Second motor inertia (exponent)	363
C210	463	Second motor auto tuning setting/status	353, 363, 454
C211	574	Second motor online auto tuning	371
C220	458	Second motor constant (R1)	353, 363, 454
C221	459	Second motor constant (R2)	353
C222	460	Second motor constant (L1) / d-axis inductance (Ld)	353, 363

Pr. group	Pr.	Name	Refer to page
C223	461	Second motor constant (L2) / q-axis inductance (Lq)	353, 363
C224	462	Second motor constant (X)	353
C225	455	Second motor excitation current	353
C226	860	Second motor torque current/Rated PM motor current	353, 363
C230	738	Second motor induced voltage constant (phi f)	363
C231	739	Second motor Ld decay ratio	363
C232	740	Second motor Lq decay ratio	363
C233	746	Second motor protection current level	363
C235	1413	Second motor induced voltage constant (phi f) exponent	363
C282	741	Second starting resistance tuning compensation	363
C285	742	Second motor magnetic pole detection pulse width	363

◆ A: Application parameters

Parameters to set a specific application.

Pr. group	Pr.	Name	Refer to page
A000	135	Electronic bypass sequence selection	376
A001	136	MC switchover interlock time	376
A002	137	Start waiting time	376
A003	138	Bypass selection at a fault	376
A004	139	Automatic switchover frequency from inverter to bypass operation	376
A005	159	Automatic switchover frequency range from bypass to inverter operation	376
A006	248	Self power management selection	385
A007	254	Main circuit power OFF waiting time	385
A170	1410	Starting times lower 4 digits	388
A171	1411	Starting times upper 4 digits	388
A300	592	Traverse function selection	389
A301	593	Maximum amplitude amount	389
A302	594	Amplitude compensation amount during deceleration	389
A303	595	Amplitude compensation amount during acceleration	389
A304	596	Amplitude acceleration time	389
A305	597	Amplitude deceleration time	389
A400	578	Auxiliary motor operation selection	429
A401	579	Motor connection function selection	429
A402	580	MC switchcover interlock time (multi-pump)	429
A403	581	Start waiting time (multi-pump)	429
A404	582	Auxiliary motor connection-time deceleration time	429
A405	583	Auxiliary motor disconnection-time acceleration time	429
A406	584	Auxiliary motor 1 starting frequency	429
A407	585	Auxiliary motor 2 starting frequency	429
A408	586	Auxiliary motor 3 starting frequency	429
A409	587	Auxiliary motor 1 stopping frequency	429
A410	588	Auxiliary motor 2 stopping frequency	429
A411	589	Auxiliary motor 3 stopping frequency	429
A412	590	Auxiliary motor start detection time	429
A413	591	Auxiliary motor stop detection time	429
A414	1376	Auxiliary motor stopping level	429
A420	1469	Number of cleaning times monitor	391
A421	1470	Number of cleaning times setting	391
A422	1471	Cleaning trigger selection	391
A423	1472	Cleaning reverse rotation frequency	391
A424	1473	Cleaning reverse rotation operation time	391
A425	1474	Cleaning forward rotation frequency	391
A426	1475	Cleaning forward rotation operation time	391
A427	1476	Cleaning stop time	391
A428	1477	Cleaning acceleration time	391
A429	1478	Cleaning deceleration time	391
A430	1479	Cleaning time trigger	391
A440	1361	Detection time for PID output hold	440
A441	1362	PID output hold range	440
A442	1370	Detection time for PID limiting operation	396, 429, 440
A443	1371	PID upper/lower limit pre-warning level range	440
A444	1372	PID measured value control set point change amount	440
A445	1373	PID measured value control set point change rate	440
A446	1369	Check valve closing completion frequency	440
A447	1363	PID priming time	440
A448	1364	Stirring time during sleep	440
A449	1365	Stirring interval time	440
A450	1374	Auxiliary pressure pump operation starting level	440
A451	1375	Auxiliary pressure pump operation stopping level	440
A452	1377	PID input pressure selection	440
A453	1378	PID input pressure warning level	440
A454	1379	PID input pressure fault level	440
A455	1380	PID input pressure warning set point change amount	440
A456	1381	PID input pressure fault operation selection	440
A457	1346	PID lower limit operation detection time	396, 440
A600	759	PID unit selection	421
A601	131	PID upper limit	396
A602	132	PID lower limit	396
A603	553	PID deviation limit	396
A604	554	PID signal operation selection	396

Pr. group	Pr.	Name	Refer to page
A607	1015	Integral stop selection at limited frequency	396
A610	128	PID action selection	396
A611	133	PID action set point	396
A612	127	PID control automatic switchover frequency	396
A613	129	PID proportional band	396
A614	130	PID integral time	396
A615	134	PID differential time	396
A616	760	Pre-charge fault selection	424
A617	761	Pre-charge ending level	424
A618	762	Pre-charge ending time	424
A619	763	Pre-charge upper detection level	424
A620	764	Pre-charge time limit	424
A621	575	Output interruption detection time	396
A622	576	Output interruption detection level	396
A623	577	Output interruption cancel level	396
A624	609	PID set point/deviation input selection	396
A625	610	PID measured value input selection	396
A626	1132	Pre-charge change increment amount	424
A627	1366	Sleep boost level	440
A628	1367	Sleep boost waiting time	440
A629	1368	Output interruption cancel time	440
A630	934	PID display bias coefficient Simple	421
A631	934	PID display bias analog value Simple	421
A632	935	PID display gain coefficient Simple	421
A633	935	PID display gain analog value Simple	421
A640	1142	Second PID unit selection	396
A641	1143	Second PID upper limit	396
A642	1144	Second PID lower limit	396
A643	1145	Second PID deviation limit	396
A644	1146	Second PID signal operation selection	396
A650	753	Second PID action selection	396
A651	755	Second PID action set point	396
A652	754	Second PID control automatic switchover frequency	396
A653	756	Second PID proportional band	396
A654	757	Second PID integral time	396
A655	758	Second PID differential time	396
A656	765	Second pre-charge fault selection	424
A657	766	Second pre-charge ending level	424
A658	767	Second pre-charge ending time	424
A659	768	Second pre-charge upper detection level	424
A660	769	Second pre-charge time limit	424
A661	1147	Second output interruption detection time	396
A662	1148	Second output interruption detection level	396
A663	1149	Second output interruption cancel level	396

Pr. group	Pr.	Name	Refer to page
A664	1140	Second PID set point/deviation input selection	396
A665	1141	Second PID measured value input selection	396
A666	1133	Second pre-charge change increment amount	424
A670	1136	Second PID display bias coefficient Simple	421
A671	1137	Second PID display bias analog value Simple	421
A672	1138	Second PID display gain coefficient Simple	421
A673	1139	Second PID display gain analog value Simple	421
A680	573	4 mA input check selection	338
A681	777	4 mA input check operation frequency	338
A682	778	4 mA input check filter	338
A683	1460	PID multistage set point 1	396
A684	1461	PID multistage set point 2	396
A685	1462	PID multistage set point 3	396
A686	1463	PID multistage set point 4	396
A687	1464	PID multistage set point 5	396
A688	1465	PID multistage set point 6	396
A689	1466	PID multistage set point 7	396
A690	1211	PID gain tuning timeout time	415
A691	1212	Step manipulated amount	415
A692	1213	Step response sampling cycle	415
A693	1214	Timeout time after the maximum slope	415
A694	1215	Limit cycle output upper limit	415
A695	1216	Limit cycle output lower limit	415
A696	1217	Limit cycle hysteresis	415
A697	1218	PID gain tuning setting	415
A698	1219	PID gain tuning start/status	415
A700	162	Automatic restart after instantaneous power failure selection	448, 454
A701	299	Rotation direction detection selection at restarting	448
A702	57	Restart coasting time	448, 454
A703	58	Restart cushion time	448
A704	163	First cushion time for restart	448
A705	164	First cushion voltage for restart	448
A710	165	Stall prevention operation level for restart	448
A711	298	Frequency search gain	353, 454
A712	560	Second frequency search gain	353, 454
A730	261	Power failure stop selection	458
A731	262	Subtracted frequency at deceleration start	458
A732	263	Subtraction starting frequency	458
A733	264	Power-failure deceleration time 1	458
A734	265	Power-failure deceleration time 2	458
A735	266	Power failure deceleration time switchover frequency	458

Pr. group	Pr.	Name	Refer to page
A785	294	UV avoidance voltage gain	458
A786	668	Power failure stop frequency gain	458
A800	414	PLC function operation selection	463
A801	415	Inverter operation lock mode setting	463
A802	416	Pre-scale function selection	463
A803	417	Pre-scale setting value	463
A804	498	PLC function flash memory clear	463
A805	675	User parameter auto storage function selection	463
A810 to A859	1150 to 1199	PLC function user parameters 1 to 50	463
A900	1020	Trace operation selection	466
A901	1021	Trace mode selection	466
A902	1022	Sampling cycle	466
A903	1023	Number of analog channels	466
A904	1024	Sampling auto start	466
A905	1025	Trigger mode selection	466
A906	1026	Number of sampling before trigger	466
A910	1027	Analog source selection (1ch)	466
A911	1028	Analog source selection (2ch)	466
A912	1029	Analog source selection (3ch)	466
A913	1030	Analog source selection (4ch)	466
A914	1031	Analog source selection (5ch)	466
A915	1032	Analog source selection (6ch)	466
A916	1033	Analog source selection (7ch)	466
A917	1034	Analog source selection (8ch)	466
A918	1035	Analog trigger channel	466
A919	1036	Analog trigger operation selection	466
A920	1037	Analog trigger level	466
A930	1038	Digital source selection (1ch)	466
A931	1039	Digital source selection (2ch)	466
A932	1040	Digital source selection (3ch)	466
A933	1041	Digital source selection (4ch)	466
A934	1042	Digital source selection (5ch)	466
A935	1043	Digital source selection (6ch)	466
A936	1044	Digital source selection (7ch)	466
A937	1045	Digital source selection (8ch)	466
A938	1046	Digital trigger channel	466
A939	1047	Digital trigger operation selection	466

◆ N: Operation via communication and its settings

Parameters for communication operation. These parameters set the communication specifications and operation.

Pr. group	Pr.	Name	Refer to page
N000	549	Protocol selection	478
N001	342	Communication EEPROM write selection	478
N002	539	MODBUS RTU communication check time interval	500
N013	502	Stop mode selection at communication error	478
N014	779	Operation frequency during communication error	478
N020	117	PU communication station number	483
N021	118	PU communication speed	483
N022	119	PU communication data length	483
N023	119	PU communication stop bit length	483
N024	120	PU communication parity check	483
N025	121	Number of PU communication retries	483
N026	122	PU communication check time interval	483
N027	123	PU communication waiting time setting	483
N028	124	PU communication CR/LF selection	483
N030	331	RS-485 communication station number	483
N031	332	RS-485 communication speed	483
N032	333	PU communication data length	483
N033	333	PU communication stop bit length	483
N034	334	RS-485 communication parity check selection	483
N035	335	RS-485 communication retry count	483
N036	336	RS-485 communication check time interval	483
N037	337	RS-485 communication waiting time setting	483
N038	341	RS-485 communication CR/LF selection	483
N040	547	USB communication station number	532
N041	548	USB communication check time interval	532
N050	726	Auto Baudrate/Max Master	516
N051	727	Max Info Frames	516
N052	728	Device instance number (Upper 3 digits)	516
N053	729	Device instance number (Lower 4 digits)	516
N054	390	% setting reference frequency	516
N080	343	Communication error count	500
N500 to N543, N550 to N559	1300 to 1343, 1350 to 1359	Communication option parameters. For details, refer to the Instruction Manual of the option.	

5

◆ G: Control Parameter

Parameters for motor control.

Pr. group	Pr.	Name	Refer to page
G000	0	Torque boost Simple	538
G001	3	Base frequency Simple	539
G002	19	Base frequency voltage	539
G003	14	Load pattern selection	541
G010	46	Second torque boost	538
G011	47	Second V/F (base frequency)	539
G030	60	Energy saving control selection	543
G040	100	V/F1 (first frequency)	544
G041	101	V/F1 (first frequency voltage)	544
G042	102	V/F2 (second frequency)	544
G043	103	V/F2 (second frequency voltage)	544
G044	104	V/F3 (third frequency)	544
G045	105	V/F3 (third frequency voltage)	544
G046	106	V/F4 (fourth frequency)	544
G047	107	V/F4 (fourth frequency voltage)	544
G048	108	V/F5 (fifth frequency)	544
G049	109	V/F5 (fifth frequency voltage)	544
G080	617	Reverse rotation excitation current low-speed scaling factor	542
G100	10	DC injection brake operation frequency	546
G101	11	DC injection brake operation time	546
G105	522	Output stop frequency	548
G106	250	Stop selection	550
G107	70	Parameter for manufacturer setting. Do not set.	
G110	12	DC injection brake operation voltage	546
G120	882	Regeneration avoidance operation selection	559
G121	883	Regeneration avoidance operation level	559
G122	884	Regeneration avoidance at deceleration detection sensitivity	559
G123	885	Regeneration avoidance compensation frequency limit value	559
G124	886	Regeneration avoidance voltage gain	559
G125	665	Regeneration avoidance frequency gain	559
G130	660	Increased magnetic excitation deceleration operation selection	562
G131	661	Magnetic excitation increase rate	562
G132	662	Increased magnetic excitation current level	562
G200	800	Control method selection	145
G201	85	Excitation current break point	542
G202	86	Excitation current low-speed scaling factor	542
G203	245	Rated slip	563
G204	246	Slip compensation time constant	563
G205	247	Constant-power range slip compensation selection	563
G211	820	Speed control P gain 1	155
G212	821	Speed control integral time 1	155
G213	824	Torque control P gain 1 (current loop proportional gain)	155
G214	825	Torque control integral time 1 (current loop integral time)	155
G216	827	Torque detection filter 1	158
G224	828	Parameter for manufacturer setting. Do not set.	
G301	565	Second motor excitation current break point	542
G302	566	Second motor excitation current low-speed scaling factor	542
G311	830	Speed control P gain 2	155
G312	831	Speed control integral time 2	155
G313	834	Torque control P gain 2 (current loop proportional gain)	155
G314	835	Torque control integral time 2 (current loop integral time)	155
G316	837	Torque detection filter 2	158
G410	653	Speed smoothing control	564
G411	654	Speed smoothing cutoff frequency	564
G932	89	Speed control gain (Advanced magnetic flux vector)	149
G942	569	Second motor speed control gain	149

*1 Setting can be made only for the standard model.
*2 The setting is available when the PLC function is enabled.

5.2 Control method

V/F control (initial setting), Advanced magnetic flux vector control, and PM motor control are available with this inverter.

◆ V/F control

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

◆ Advanced magnetic flux vector control

- This control performs vector calculation and divide the inverter's output current into an excitation current and into a torque current. The frequency and the voltage are then compensated to flow the motor current that meets the load torque. This control methods improves the torque generation at a low speed. The output frequency is further compensated (slip compensation) to bring the actual motor speed closer to the commanded speed. This function is useful when the load fluctuates are severe.

5

NOTE

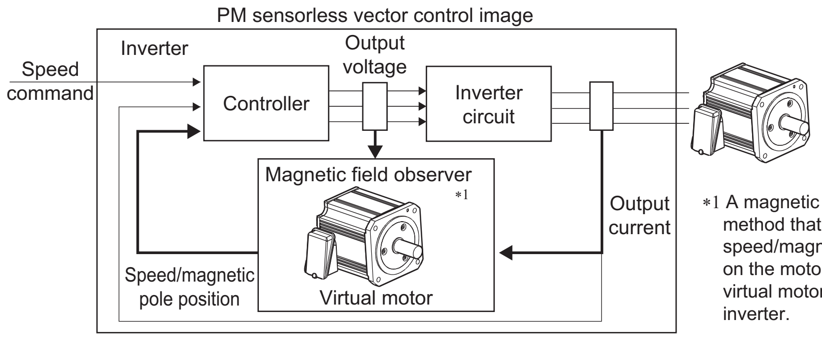
- Advanced magnetic flux vector control requires the following conditions. If the conditions are not satisfied, select V/F control. Otherwise, malfunctions such as insufficient torque, uneven rotation may occur.
- For the motor capacity, the rated motor current should be equal to or less than the inverter rated current. (It must be 0.4 kW or higher.) Using a motor with the rated current substantially lower than the inverter rated current will cause torque ripples, etc. and degrade the speed and torque accuracies. As a reference, select the motor with the rated motor current that is about 40% or higher of the inverter rated current.
- The motor described in the table below is used

Motor	Condition
Standard motor	Offline auto tuning is not required
Constant-torque motor	Offline auto tuning is required
Other motors (other manufacturer's motors)	

- Single-motor operation (one motor to one inverter) is preformed.
- The wiring length from inverter to motor is 30 m or less. (When the wiring length exceeds 30 m, perform offline auto tuning in a wired state.)

◆ PM motor control

- Highly efficient motor control and highly accurate motor speed control can be performed by using the inverter with a PM (permanent magnet embedded) motor, which is more efficient than an induction motor.
- The motor speed is calculated based on the output voltage and current from the inverter. It does not require a speed detector such as an encoder. The inverter drives the PM motor with the least required current when a load is applied in order to achieve the highest motor efficiency.



*1 A magnetic field observer is a control method that calculates the motor speed/magnetic pole position based on the motor voltage and current of a virtual motor which is set up in the inverter.

NOTE

- Perform offline auto tuning when using a PM motor.
- For the motor capacity, the rated motor current should be equal to or less than the inverter rated current. (It must be 0.4 kW or higher.) Using a motor with the rated current substantially lower than the inverter rated current will cause torque ripples, etc. and degrade the speed and torque accuracies. As a reference, select the motor with the rated motor current that is about 40% or higher of the inverter rated current.
- Single-motor operation (one motor to one inverter) is preformed.
- The overall wiring length with the motor is 100 m or less. (Refer to page 48.)

5.2.1 Changing the control method

Set the control method.

V/F control, Advanced magnetic flux vector control, and PM motor control are the control methods available for selection.

- The PM motor test operation can be performed by setting **Pr.800 Control method selection**.

Pr.	Name	Initial value	Setting range	Description
71 **C100**	**Applied motor**	0*1	0 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094	By selecting a standard motor or constant-torque motor, the thermal characteristic and motor constant of each motor are set.
80 **C101**	**Motor capacity**	9999	0.4 to 55 kW*1	Set the applied motor capacity.
			0 to 3600 kW*2	
			9999	V/F control
81 **C102**	**Number of motor poles**	9999	2, 4, 6, 8, 10, 12	Set the number of motor poles.
			9999	V/F control
83 **C104**	**Rated motor voltage**	575 V	0 to 1000 V	Set the rated motor voltage (V).
84 **C105**	**Rated motor frequency**	9999	10 to 400 Hz	Set the rated motor frequency (Hz).
			9999	The setting value of **Pr.3 Base frequency** is used.
800 **G200**	**Control method selection**	20	9	PM motor test operation (Motor is not driven even if it is connected.)
			20	Normal operation (Motor can be driven.)
			109	PM motor test operation (Motor is not driven even if it is connected.) — Fast-response operation
			110	Normal operation (Motor can be driven.) — Fast-response operation

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.

◆ Setting the motor capacity and the number of motor poles (Pr.80, Pr.81)

- Motor specifications (the motor capacity and the number of motor poles) must be set to select Advanced magnetic flux vector control, or PM motor control.
- Set the motor capacity (kW) in **Pr.80 Motor capacity** and set the number of motor poles in **Pr.81 Number of motor poles**.

NOTE

- Setting the number of motor poles in **Pr.81** changes the **Pr.144 Speed setting switchover** setting automatically. (Refer to page 272.)

◆ PM motor control test operation (Pr.800 = "9")

- Test operation in the speed control is available without connecting a motor. The speed calculation changes to track the speed command, and such speed changes can be checked on the operation panel or by outputting it as analog signals to the terminal AM or CA.

NOTE

- Since current is not detected and voltage is not output, monitors related to current and voltage such as output current and output voltage, etc. and output signals do not function.

◆ Selecting the fast-response operation (Pr.800 = "109 or 110")

- Setting **Pr.800** = "109 or 110" selects the fast-response operation. Fast-response operation is available during PM motor control.

Control method	Speed response	
	Fast-response operation Pr.800 = "109 or 110"	Normal-response operation Pr.800 = "9 or 20"
PM motor control	130 Hz at maximum	50 Hz at maximum

NOTE

- Refer to page 179 for the carrier frequency during fast-response operation.
- During fast-response operation, E.THT is likely to occur.

◆ I/O signal operation during the test operation

- During the test operation, the following signals are invalid.

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

- V/F switchover signal (X18)
- Start-time tuning start external input signal (X28)

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

- Electronic thermal O/L relay pre-alarm signal (THP)
- Start time tuning completion signal (Y39)

Parameters referred to

Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

◆ Valid/invalid status of monitor outputs during the test run

○: Valid

×: Invalid (always displays 0)

Δ: Displays accumulated value before the test

—: Not monitored

Types of monitor	DU/PU Monitor display	AM/CA Output	Types of monitor	DU/PU Monitor display	AM/CA Output
Output frequency	○	○	PID deviation	○	○*3
Fault display	○	—	Input terminal status	○	—
Frequency setting value	○	○	Output terminal status	○	—
Running speed	○	○	Option input terminal status	○	—
Converter output voltage	○	○	Option output terminal status	○	—
Electric thermal relay load factor	×*2	×*2	Motor thermal load factor	○*4	○*4
Output current peak value	×*2	×*2	Inverter thermal load factor	○*4	○*4
Converter output voltage peak value	○	○	PTC thermistor value	○	—
Load meter	○	○	PID measured value 2	○	○
Cumulative energization time	○	—	PID input pressure value	○	○
Reference voltage output	—	○	Remote output 1	○	○
Actual operation time	○	—	Remote output 2	○	○
Cumulative power	Δ	—	Remote output 3	○	○
Trace status	○	×	Remote output 4	○	○
Station number (RS-485 terminals)	○	—	PID manipulated amount	○	○*3
Station number (PU connector)	○	—	Second PID set point	○	○
Station number (CC-Link)	○	—	Second PID measured value	○	○
Energy saving effect	○	○	Second PID deviation	○	○*3
Cumulative energy saving	Δ	—	Second PID measured value 2	○	○
PID set point	○	○	Second PID manipulated amount	○	○*3
PID measured value	○	○			

*1 Different output interface (operation panel, parameter unit, terminal CA or terminal AM) can output different monitored items. For details, refer to page 284.

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

*3 The monitored status can be output via the terminal AM only.

*4 When the operation is switched to the test run, accumulated thermal value is reduced by considering the output current is "0".

Parameters referred to

Pr.52 Operation panel main monitor selection ☞ page 274

Pr.158 AM terminal function selection ☞ page 284

◆ Changing the control method with external terminals (RT signal, X18 signal)

- Control method (V/F control, Advanced magnetic flux vector control) can be switched among using external terminals. The control method can be either switched using the Second function selection (RT) signal or the V/F switchover (X18) signal.
- When using the RT signal, set the second motor in **Pr.450 Second applied motor**. Turning ON the RT signal enables the second function, enabling the switchover of the control method.
- When using the X18 signal, turning ON the X18 signal switches the presently-selected control method (Advanced magnetic flux vector control) to the V/F control. At this time, the second functions including electronic thermal characteristic are not changed. Use this method to switch the control method for one motor. (To switch the second functions, use the RT signal.) To input the X18 signal, set "18" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function.

First motor control method	Second motor control method (RT signal-ON)	Pr.450 setting value	Pr.453, Pr.454 setting value
V/F control	V/F control	9999	—
		—	9999*2
	Advanced magnetic flux vector control	Induction motor	Other than 9999
	PM motor control	IPM/SPM motor	
Advanced magnetic flux vector control *1 PM motor control	Same control as the first motor*1	9999	—
	V/F control	—	9999*2
	Advanced magnetic flux vector control	Induction motor	Other than 9999
	PM motor control	IPM/SPM motor	

*1 V/F control is set by turning ON the X18 signal. If the X18 signal is unassigned, RT signal performs the same function; Turning ON the RT signal selects V/F control.

*2 V/F control is set when **Pr.453** or **Pr.454** = "9999".

NOTE

- RT signal is assigned to the terminal RT in the initial status. Set "3" in one of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.
- The RT signal is a second function selection signal. The RT signal also enables other second functions. (Refer to page 348.)
- The control method could be changed by external terminals (RT signal, X18 signal) while the inverter is stopped. If a signal is switched during the operation, the control method changes after the inverter stops.

Parameters referred to

Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.450 Second applied motor ☞ page 351

5.2.2 Selecting the Advanced magnetic flux vector control

Magnetic flux

Point

- To use the Advanced magnetic flux vector control, set the motor capacity, the number of motor poles, and the motor type using **Pr.80** and **Pr.81**.

◆ Advanced magnetic flux vector control

Operating procedure

1. Perform secure wiring. (Refer to page 39.)

2. Make the motor setting. **(Pr.71)**

Motor	Pr.71 setting*1	Remarks
Standard motor	0 (initial value) (3, 4)	
Constant-torque motor	1	Offline auto tuning is required.*2
Other manufacturer's standard motor	0 (3)	Offline auto tuning is required.*2
Other manufacturer's constant-torque motor	1 (13)	Offline auto tuning is required.*2

*1 For the other setting values of **Pr.71**, refer to page 351.
*2 For offline auto tuning, refer to page 353.

3. Set the motor overheat protection. **(Pr.9)** (Refer to page 230)
Set the rated motor current (A) in **Pr.9 Electronic thermal O/L relay**.

4. Setting the motor capacity and the number of motor poles. **(Pr.80, Pr.81)** (Refer to page 145.)
Set the motor capacity (kW) in **Pr.80 Motor capacity**, and set the number of motor poles in **Pr.81 Number of motor poles**. (V/F control is performed when the setting is "9999" (initial value).)

5. Set the rated motor voltage and frequency. **(Pr.83, Pr.84)** (Refer to page 353.)
Set the rated motor voltage (V) in **Pr.83 Rated motor voltage**, and set the rated motor frequency (Hz) in **Pr.84 Rated motor frequency**.

6. Set the operation command. (Refer to page 204.)
Select the start command and speed command.

7. Test run

As required

- Perform offline auto tuning. **(Pr.96)** (Refer to page 353.)
- Select the online auto tuning. **(Pr.95)** (Refer to page 371.)

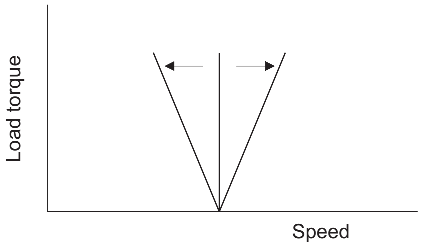
NOTE

- Under this control, rotations are more likely to be uneven than under V/F control. (This control method is not suitable for grinder, wrapping machine, etc., which require even rotation at a low speed.)
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Keeping the motor speed constant when the load fluctuates (speed control gain)

Pr.	Name	Initial value	Setting range	Description
89 **G932**	**Speed control gain (Advanced magnetic flux vector)**	9999	0 to 200%	Makes adjustments to keep the motor speed constant during variable load operation under Advanced magnetic flux vector control. The reference value is 100%.
			9999	The gain set by **Pr.71**. (The gain set in accordance with the motor.)
569 **G942**	**Second motor speed control gain**	9999	0 to 200%	Makes adjustments to keep the second motor speed constant during variable load operation under Advanced magnetic flux vector control. The reference value is 100%.
			9999	The gain set by **Pr.450**. (The gain set in accordance with the motor.)

- Use **Pr.89** to keep the motor speed constant during variable load operation. (This parameter is useful to adjust the motor speed.)



◆ Driving two motors under Advanced magnetic flux vector control

- Turning ON the Second function selection (RT) signal enables the second motor operation.
- Set a second motor in **Pr.450 Second applied motor**. (In the initial setting, "9999 (no second motor)" is selected. Refer to page 351.)

Function	RT signal ON (second motor)	RT signal OFF (first motor)
Applied motor	**Pr.450**	**Pr.71**
Motor capacity	**Pr.453**	**Pr.80**
Number of motor poles	**Pr.454**	**Pr.81**
Speed control gain (Advanced magnetic flux vector)	**Pr.569**	**Pr.89**

NOTE

- The RT signal is a second function selection signal. The RT signal also enables other second functions. (Refer to page 348.) RT signal is assigned to the terminal RT in the initial status. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.71, Pr.450 Applied motor ☞ page 351
Pr.800 Control method selection ☞ page 145

5.2.3 Selecting the PM motor control

◆ Initializing the parameters required for the PM motor control (Pr.998)

- The PM parameter initialization and the offline auto tuning enable the operation with a PM motor.

Pr.	Name	Initial value	Setting range	Description	
998 **E430**	**PM parameter initialization**	0	0	Parameter settings for an induction motor (frequency)	The parameter settings required to drive an induction motor are set.
			8009	The parameters settings required to drive a PM motor are set. (rotations per minute) (after tuning)	The parameters settings required to drive a PM motor are set. (Set **Pr.71 Applied motor** and perform offline auto tuning in advance. (Refer to page 363.))
			8109	The parameters settings required to drive a PM motor are set. (frequency) (after tuning)	
			9009	The parameters settings required to drive an SPM motor are set. (rotations per minute) (after tuning)	The parameters settings required to drive an SPM motor are set. (Set **Pr.71 Applied motor** and perform offline auto tuning in advance. (Refer to page 363.))
			9109	The parameters settings required to drive an SPM motor are set. (frequency) (after tuning)	

- When **Pr.998**="8009 or 9009", the monitor is displayed and the frequency is set using the motor rotations per minute. To use frequency to display or set, set **Pr. 998**="8109 or 9109".
- Set **Pr.998**="0" to change the PM motor control parameter settings to the parameter settings required to drive an induction motor.

NOTE

- Make sure to set **Pr.998** before setting other parameters. If the **Pr.998** setting is changed after setting other parameters, some of those parameters will be initialized too. (Refer to the "List of the target parameters for the motor parameter initialization".)
- To change back to the parameter settings required to drive an induction motor, perform parameter clear or all parameter clear
- If the setting of **Pr.998 PM parameter initialization** is changed between "8009, 9009 (rotations per minute)" ⇔ "8109, 9109 (frequency)", the target parameters are respectively set to their initial values. The purpose of **Pr.998** is not to change the display units. Use **Pr.144 Speed setting switchover** to change the display units between rotations per minute and frequency. **Pr.144** enables switching of display units between rotations per minute and frequency without initializing the parameter settings.
- Example) Changing the **Pr.144** setting between "6" and "106" switches the display units between frequency and rotations per minute.
- The PM parameter initialization (**Pr.998**) changes parameter settings for the first motor. When a PM motor is used as the second motor, parameters for the second motor must be set individually.

◆ PM parameter initialization list

- The parameter settings in the following table are changed to the settings required to perform PM motor control by selecting PM motor control with the IPM parameter initialization mode on the operation panel or with **Pr.998 PM parameter initialization**.
- Performing parameter clear or all parameter clear sets back the parameter settings to the settings required to drive an induction motor.

Pr.	Name	Setting			Setting increments	
		Induction motor	PM motor (rotations per minute)	PM motor (frequency)		
		0 (initial value)	8009, 9009	8109, 9109	8009, 9009	0, 8109, 9109
1	Maximum frequency	120 Hz*1 60 Hz*2	Maximum motor rotations per minute*4	Maximum motor frequency*4	1 r/min	0.01 Hz
4	Multi-speed setting (high speed)	60 Hz	**Pr.84**	**Pr.84**	1 r/min	0.01 Hz
9	Electronic thermal O/L relay	Inverter rated current	—	—	0.01 A*1 0.1 A*2	
13	Starting frequency	0.5 Hz	**Pr.84** ×10%	**Pr.84** ×10%	1 r/min	0.01 Hz
15	Jog frequency	5 Hz	**Pr.84** ×10%	**Pr.84** ×10%	1 r/min	0.01 Hz
18	High speed maximum frequency	120 Hz*1 60 Hz*2	—	—	1 r/min	0.01 Hz
20	Acceleration/deceleration reference frequency	60 Hz	**Pr.84**	**Pr.84**	1 r/min	0.01 Hz
22	Stall prevention operation level	110% *3	Short-time motor torque		0.1%	
37	Speed display	0	0		1	
55	Frequency monitoring reference	60 Hz	**Pr.84**	**Pr.84**	1 r/min	0.01 Hz
56	Current monitoring reference	Inverter rated current	**Pr.859**	**Pr.859**	0.01 A*1 0.1 A*2	
71	Applied motor	0	—	—	1	
80	Motor capacity	9999	—	—	0.01 kW*1 0.1 kW*2	
81	Number of motor poles	9999	—	—	1	
84	Rated motor frequency	9999	—	—	1 r/min	0.01 Hz
125 (903)	Terminal 2 frequency setting gain frequency	60 Hz	**Pr.84**	**Pr.84**	1 r/min	0.01 Hz
126 (905)	Terminal 4 frequency setting gain frequency	60 Hz	**Pr.84**	**Pr.84**	1 r/min	0.01 Hz
144	Speed setting switchover	4	**Pr.81** +100	**Pr.81**	1	
240	Soft-PWM operation selection	1	0		1	
263	Subtraction starting frequency	60 Hz	**Pr.84**	**Pr.84**	1 r/min	0.01 Hz
266	Power failure deceleration time switchover frequency	60 Hz	**Pr.84**	**Pr.84**	1 r/min	0.01 Hz
374	Overspeed detection level	9999	Maximum motor rotations per minute +10 Hz*4*5	Maximum motor frequency +10 Hz*4	1 r/min	0.01 Hz
390	% setting reference frequency	60 Hz	**Pr.84**	**Pr.84**	1 r/min	0.01 Hz
505	Speed setting reference	60 Hz	**Pr.84**	**Pr.84**	0.01 Hz	
557	Current average value monitor signal output reference current	Inverter rated current	**Pr.859**	**Pr.859**	0.01 A*1 0.1 A*2	
870	Speed detection hysteresis	0 Hz	0.5 Hz*5	0.5 Hz	1 r/min	0.01 Hz
885	Regeneration avoidance compensation frequency limit value	6 Hz	**Pr.84** ×10%	**Pr.84** ×10%	1 r/min	0.01 Hz

<table>
<tr><th rowspan="3">Pr.</th><th rowspan="3">Name</th><th colspan="3">Setting</th><th colspan="2" rowspan="2">Setting increments</th></tr>
<tr><th>Induction motor</th><th>PM motor (rotations per minute)</th><th>PM motor (frequency)</th></tr>
<tr><th>0 (initial value)</th><th>8009, 9009</th><th>8109, 9109</th><th>8009, 9009</th><th>0, 8109, 9109</th></tr>
<tr><td rowspan="2">893</td><td rowspan="2">Energy saving monitor reference (motor capacity)</td><td rowspan="2">Inverter capacity</td><td colspan="2" rowspan="2">Motor capacity (Pr.80)</td><td colspan="2">0.01 kW[*1]</td></tr>
<tr><td colspan="2">0.1 kW[*2]</td></tr>
<tr><td>918</td><td>Terminal 1 gain frequency (speed)</td><td>60 Hz</td><td>Pr.84</td><td>Pr.84</td><td>1 r/min</td><td>0.01 Hz</td></tr>
</table>

—: Not changed

*1 Initial value for the FR-F860-00680 or lower.

*2 Initial value for the FR-F860-01080 or higher.

*3 110% for SLD, 120% for LD (Refer to **Pr.570 Multiple rating setting** page 167.)

*4 The **Pr.702 Maximum motor frequency** is used as the maximum motor frequency (rotations per minute). When **Pr.702** ="9999 (initial value)", the **Pr.84 Rated motor frequency** is used as the maximum motor frequency (rotations per minute).

*5 The setting value is converted from frequency to rotations per minute. (The value after the conversion differs according to the number of motor poles.)

NOTE

- If PM parameter initialization is performed in rotations per minute (**Pr.998** = "8009 or 9009"), the parameters not listed in the table and the monitored items are also set and displayed in rotations per minute.

5.3 Speed control under PM motor control

Purpose	Parameter to set			Refer to page
To adjust the gain during PM motor control	Speed control gain adjustment	P.G211 to P.G214, P.G311 to P.G314	Pr.820, Pr.821, Pr.824, Pr.825, Pr.830, Pr.831, Pr.834, Pr.835	155
To stabilize torque feedback signal	Torque detection filter	P.G216, P.G316	Pr.827, Pr.837	158

Speed control performs control so that the speed command and the actual motor rotation speed match.

5.3.1 Setting procedure of PM motor control

PM

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

Operating procedure

1. Set the motor. **(Pr.9, Pr.71, Pr.80, Pr.81, Pr.83, Pr.84)** (Refer to page 351, 363.)
Set "8093 (IPM motor)" or "9093 (SPM motor)" in **Pr.71 Applied motor**. Set **Pr.9 Rated motor current**, **Pr.80 Motor capacity**, **Pr.81 Number of motor poles**, **Pr.83 Rated motor voltage**, and **Pr.84 Rated motor frequency** according to the motor specifications.
(Setting "9999 (initial value)" in **Pr.80** or **Pr.81** selects V/F control.)

2. Perform offline auto tuning for a PM motor. **(Pr.96)** (Refer to page 363.)
Set "1" (offline auto tuning without rotating motor) in **Pr.96**, and perform tuning.

3. Configure the initial setting for the PM motor control using **Pr.998**. (Refer to page 151.)
When the setting for the PM motor is selected in **Pr.998 PM parameter initialization**, the PM motor control is selected.
"8009": Parameter (rotations per minute) settings for a PM motor
"8109": Parameter (frequency) settings for a PM motor
"9009": Parameter (rotations per minute) settings for an SPM motor
"9109": Parameter (frequency) settings for an SPM motor

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

5. Set the operation command. (Refer to page 204.)
Select the start command and speed command.

6. Perform the test operation.

NOTE

- To change to the PM motor control, perform PM parameter initialization at first. If parameter initialization is performed after setting other parameters, some of those parameters will be initialized too. (Refer to page 152 for the parameters that are initialized.)
- Constant-speed operation cannot be performed in the low-speed range of 150 r/min or less.
- During PM motor control, the RUN signal is output about 100 ms after turning ON the start command (STF, STR). The delay is due to the magnetic pole detection.

5.3.2 Performing high-accuracy, fast-response control (gain adjustment for PM motor control)

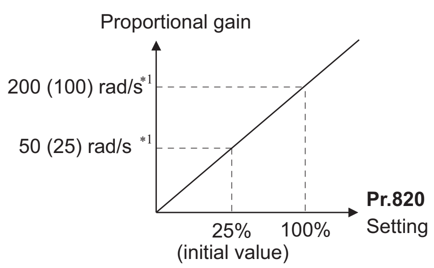
PM

Manual gain adjustment is useful for achieving optimum machine performance or improving unfavorable conditions, such as vibration and acoustic noise during operation with high load inertia or gear backlash.

Pr.	Name	Initial value	Setting range	Description
820 G211	**Speed control P gain 1**	25%	0 to 1000%	The proportional gain during speed control is set. (Setting this parameter higher improves the trackability for speed command changes. It also reduces the speed fluctuation caused by external disturbance.)
821 G212	**Speed control integral time 1**	0.333 s	0 to 20 s	The integral time during speed control is set. (Setting this parameter lower shortens the return time to the original speed when the speed fluctuates due to external disturbance.)
824 G213	**Torque control P gain 1 (current loop proportional gain)**	50%	0 to 500%	The proportional gain of the current controller is set.
825 G214	**Torque control integral time 1 (current loop integral time)**	40 ms	0 to 500 ms	The integral time of the current controller is set.
830 G311	**Speed control P gain 2**	9999	0 to 1000%	Second function of **Pr.820** (valid when RT signal is ON)
			9999	The **Pr.820** setting is applied to the operation.
831 G312	**Speed control integral time 2**	9999	0 to 20 s	Second function of **Pr.821** (valid when RT signal is ON)
			9999	The **Pr.821** setting is applied to the operation.
834 G313	**Torque control P gain 2 (current loop proportional gain)**	9999	0 to 500%	Second function of **Pr.824** (valid when RT signal is ON)
			9999	The **Pr.824** setting is applied to the operation.
835 G314	**Torque control integral time 2 (current loop integral time)**	9999	0 to 500 ms	Second function of **Pr.825** (valid when RT signal is ON)
			9999	The **Pr.825** setting is applied to the operation.

◆ Adjusting the speed control gain manually

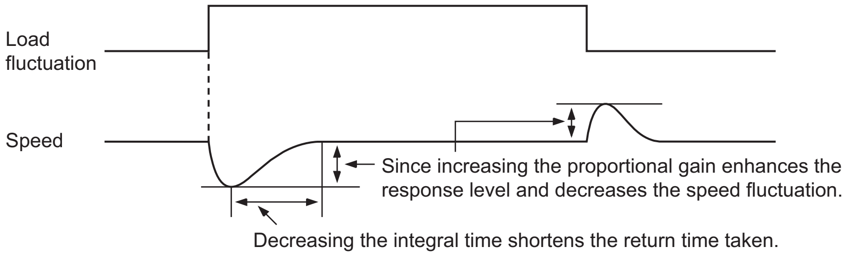
- The speed control gain can be adjusted for the conditions such as abnormal machine vibration, acoustic noise, slow response, and overshoot.
- **Pr.820 Speed control P gain 1**="25% (initial value)" is equivalent to 50 rad/s (speed response of a single motor). (Equivalent to the half the rad/s value with the FR-F860-01080 or higher.) Setting this parameter higher speeds up the response, but setting this too high causes vibration and acoustic noise.
- Setting **Pr.821 Speed control integral time 1** lower shortens the return time to the original speed during speed fluctuation, but setting it too low causes overshoot.



*1 The value in parentheses is applicable with the FR-F860-01080 or higher.

5

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



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

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

- Adjust in the following procedure:

1. Change the **Pr.820** setting while checking the conditions.

2. If it cannot be adjusted well, change **Pr.821** setting, and perform 1) again.

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

NOTE

- **Pr.830 Speed control P gain 2** and **Pr.831 Speed control integral time 2** are valid when terminal RT is ON. In this case, replace them for **Pr.820** and **Pr.821** in the description above.

◆ Gain adjustment of current controllers for the d axis and the q axis

- Use **Pr.824 Torque control P gain 1 (current loop proportional gain)** to adjust the proportional gain of current controllers for the d axis and the q axis. The 100% gain is equivalent to 1000 rad/s. Setting this parameter higher improves the trackability for current command changes. It also reduces the current fluctuation caused by external disturbances.
- Use **Pr.825 Torque control integral time 1 (current loop integral time)** to set the integral time of current controllers for the d axis and the q axis. If the setting value is small, it produces current fluctuation against external disturbances, decreasing time until it returns to original current value.

NOTE

- **Pr.834 Torque control P gain 2 (current loop proportional gain)** and **Pr.835 Torque control integral time 2 (current loop integral time)** are valid when terminal RT is ON. In this case, replace them for **Pr.824** and **Pr.825** in the description above.

5.3.3 Troubleshooting in the speed control

PM

No.	Condition	Cause	Countermeasure
1	Motor does not run at the correct speed. (Command speed and actual speed differ.)	Speed command from the controller is different from the actual speed. The speed command is affected by noise.	• Check that the speed command sent from the controller is correct. (Take EMC measures.) • Set **Pr.72 PWM frequency selection** lower.
		The command speed and the speed recognized by the inverter are different.	• Adjust the bias and gain **(Pr.125, Pr.126, Pr.902 to Pr.905, Pr.917, Pr.918)** of the speed command again.
2	The speed does not accelerate to the command speed.	Torque shortage. The stall prevention operation level is operating.	• Raise the stall prevention operation level. • (Refer to page 257.) • Increase the capacity.
		Only P (proportional) control is performed.	• Speed deviation occurs under P (proportional) control when the load is heavy. Select PI control.
3	Motor speed fluctuates.	Speed command varies.	• Check that the speed command sent from the controller is correct. (Take EMC measures.) • Set **Pr.72** lower. • Set **Pr.822 Speed setting filter 1** higher. (page 326)
		Torque shortage.	• Raise the stall prevention operation level. • (Refer to page 257.)
		Speed control gain is not suitable for the machine. (Resonance occurs.)	• Adjust **Pr.820 Speed control P gain 1** and **Pr.821 Speed control integral time 1**.
4	Hunting (vibration or acoustic noise) occurs in the motor or the machine.	Speed control gain is too high.	• Set **Pr.820** lower and **Pr.821** higher.
		Torque control gain is too high.	• Set **Pr.824 Torque control P gain 1 (current loop proportional gain)** lower.
		Motor wiring is incorrect.	• Check the wiring.
5	Acceleration/ deceleration time is different from the setting.	Torque shortage.	• Raise the stall prevention operation level. • (Refer to page 257.)
		Load inertia is too high.	• Set acceleration/deceleration time suitable for the load.
6	Machine movement is unstable.	Speed control gain is not suitable for the machine.	• Adjust **Pr.820** and **Pr.821**.
		Response is slow because of the inverter's acceleration/deceleration time setting.	• Set the optimum acceleration/deceleration time.
7	Rotation ripple occurs during the low-speed operation.	High carrier frequency is affecting the motor rotation.	• Set **Pr.72** lower.
		Speed control gain is too low.	• Set **Pr.820** higher.

Parameters referred to

Pr.3 Base frequency, Pr.19 Base frequency voltage ☞ page 539
Pr.72 PWM frequency selection ☞ page 179
Pr.80 Motor capacity, Pr.81 Number of motor poles ☞ page 145
Pr.125 Terminal 2 frequency setting gain frequency, Pr.126 Terminal 4 frequency setting gain frequency ☞ page 328
Pr.822 Speed setting filter 1 ☞ page 326

5.3.4 Torque detection filter

PM

Set the time constant of primary delay filter for torque feedback signal.

Speed loop response is reduced. Under ordinary circumstances, therefore, use the initial value as it is.

Pr.	Name	Initial value	Setting range	Description
827 G216	**Torque detection filter 1**	0 s	0	Without filter
			0.001 to 0.1 s	Set the time constant of primary delay filter torque feedback signal.
837 G316	**Torque detection filter 2**	9999	0 to 0.1 s	Second function of **Pr.827** (enabled when RT signal ON)
			9999	Same as **Pr.827** setting

◆ Stabilizing torque detection (Pr.827, Pr.837)

- Current loop response is reduced. Under ordinary circumstances, therefore, use the initial value as it is. If there is torque ripple due to high frequency disturbance, adjust until speed stabilizes by gradually raising the setting. Speed is oppositely destabilized if the setting value is too large.

◆ Employing multiple primary delay filters

- Use **Pr.833, Pr.837** if changing filter according to application. **Pr.833, Pr.837**: Second function selection (RT) signal

NOTE

- The RT signal is a second function selection signal. The RT signal also enables other second functions. (Refer to page 348.)
- The RT signal is assigned to the terminal RT in the initial setting. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.

5.4 (E) Environment setting parameters

Purpose	Parameter to set			Refer to page
To set the time	Real time clock function	P.E020 to P.E022	Pr.1006 to Pr.1008	160
To set a limit for the reset function To shut off output if the operation panel disconnects To force deceleration to a stop on the operation panel	Reset selection/ disconnected PU detection/ PU stop selection/Reset limit	P.E100 to P.E102, P.E107	Pr.75	162
To select the display language of the parameter unit	PU display language selection	P.E103	Pr.145	165
To control the buzzer of the parameter unit and operation panel	PU buzzer control	P.E104	Pr.990	165
To adjust the LCD contrast of the parameter unit	PU contrast adjustment	P.E105	Pr.991	165
To switch the monitor display of the operation panel to the PID set point setting screen by simply turning the setting dial	Direct setting	P.E108	Pr.1000	166
To use the USB memory	USB host reset	P.E110	Pr.1049	166
To use the regeneration unit to increase the motor braking torque	Regenerative brake selection	P.E300	Pr.30	553
To change the overload current rating specification	Multiple rating setting	P.E301	Pr.570	167
To prevent parameter rewriting	Parameter write disable selection	P.E400	Pr.77	168
To restrict parameters with a password	Password function	P.E410, P.E411	Pr.296, Pr.297	170
To use parameters freely	Free parameter	P.E420, P.E421	Pr.888, Pr.889	172
To change parameter settings for a PM motor as a batch	PM parameter initialization	P.E430	Pr.998	151
To set multiple parameters as a batch	Automatic parameter setting	P.E431	Pr.999	173
To display the required parameters	Applicable parameter display and user group function	P.E440 to P.E443	Pr.160, Pr.172 to Pr.174	177
To release the parameter copy warning (CP)	Parameter copy alarm release	P.E490	Pr.989	166
To reduce the motor noise and EMI	PWM carrier frequency changing	P.E600 to P.E602	Pr.72, Pr.240, Pr.260	179
To understand the maintenance time of inverter parts and peripheral device	Inverter parts life display	P.E700 to P.E707	Pr.255 to Pr.259, Pr.506 to Pr.508	182
	Maintenance output function	P.E710 to P.E715	Pr.503, Pr.504, Pr.686 to Pr.689	186
	Current average value monitor signal	P.E720 to P.E722	Pr.555 to Pr.557	187

5.4.1 Real time clock function

The time can be set. The time can only be updated while the inverter power is ON.
The real time clock function is enabled using an optional LCD operation panel (FR-LU08).

Pr.	Name	Initial value	Setting range	Description
1006 **E020**	**Clock (year)**	2000 (year)	2000 to 2099	Set the year.
1007 **E021**	**Clock (month, day)**	101 (January 1)	101 to 131, 201 to 228, (229), 301 to 331, 401 to 430, 501 to 531, 601 to 630, 701 to 731, 801 to 831, 901 to 930, 1001 to 1031, 1101 to 1130, 1201 to 1231	Set the month and day. 1000 and 100 digits: January to December 10 and 1 digits: 1 to end of month (28, 29, 30 or 31) For December 31, set "1231".
1008 **E022**	**Clock (hour, minute)**	0 (00:00)	0 to 59, 100 to 159, 200 to 259, 300 to 359, 400 to 459, 500 to 559, 600 to 659, 700 to 759, 800 to 859, 900 to 959, 1000 to 1059, 1100 to 1159, 1200 to 1259,1300 to 1359, 1400 to 1459, 1500 to 1559, 1600 to 1659, 1700 to 1759, 1800 to 1859,1900 to 1959, 2000 to 2059, 2100 to 2159, 2200 to 2259, 2300 to 2359	Set the hour and minute using the 24-hour clock. 1000 and 100 digits: 0 to 23 hours 10 and 1 digits: 0 to 59 minutes For 23:59, set "2359".

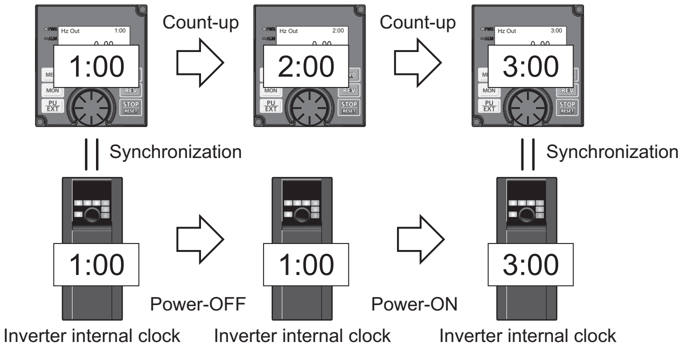
◆ Simple clock function

- When the year, month, day, time and minute are set in the parameters, the inverter counts the date and time. The date and time can be checked by reading the parameters.

NOTE

- The clock's count-up data is saved in the inverter's EEPROM every 10 minutes.
- Because the date and time are cleared after turning OFF the control circuit power supply, the clock function must be reset after turning ON the power supply. Use a separate power supply, such as an external 24 V power supply, for the control circuit of the simple clock function, and supply power continuously to this control circuit.
- In the initial setting, inverter reset is performed if supplying power to the main circuit is started when power is supplied only to the control circuit. Then, the clock information stored in EEPROM is restored. Reset at the start of supplying power to the main circuit can be disabled by setting **Pr.30 Regenerative function selection**. (Refer to page 553)
- The set clock is also used for functions such as fault history.

◆ Real time clock function



- When the FR-LU08 is connected to the inverter, the internal clock of the inverter can be synchronized with the clock of FR-LU08. (Real time clock function)

With a battery (CR1216), the FR-LU08 time count continues even if the main power of the inverter is turned OFF. (The time count of the inverter internal clock does not continue when the inverter power is turned OFF.)

- To adjust the clock of FR-LU08, use the FR-LU08 and set **Pr.1006** to **Pr.1008**.

NOTE

- Time adjustment between the inverter internal clock and the FR-LU08 is performed every one minute.
- When the FR-LU08 clock is initialized after the battery is exhausted for example, the inverter internal clock is valid.

5

5.4.2 Reset selection / disconnected PU detection / PU stop selection

The reset input acceptance, disconnected PU (operation panel/parameter unit) connector detection function and PU stop function (PU stop) can be selected.

Pr.	Name	Initial value	Setting range	Description
75	**Reset selection/disconnected PU detection/PU stop selection**	14	0 to 3, 14 to 17, 1000 to 1003, 1014 to 1017*1	For the initial setting, reset is always enabled, without disconnected PU detection, and with the PU stop function.
			0 to 3, 14 to 17, 100 to 103, 114 to 117, 1000 to 1003, 1014 to 1017, 1100 to 1103, 1114 to 1117*2	
E100	**Reset selection**	0	0	Reset input is always enabled.
			1	Reset input is enabled only when the protective function is activated.
			2	Reset input is enabled only when the start signal is OFF.
			3	Reset input is enabled when the protective function is activated and the start signal is OFF.
E101	**Disconnected PU detection**	0	0	Operation continues even when the PU is disconnected.
			1	The inverter output is shut off when the PU is disconnected.
E102	**PU stop selection**	1	0	Decelerates to a stop when the STOP key is pressed in PU operation mode only.
			1	Decelerates to a stop when the STOP key for PU is pressed in any of the PU, external and communication operation modes.
E107	**Reset limit**	0	0	Reset limit disabled
			1 *2	Reset limit enabled

The parameters above will not return to their initial values even if parameter (all) clear is executed.

*1 The setting range for the FR-F860-00680 or lower.

*2 The setting range for the FR-F860-01080 or higher.

Pr.75 setting	Reset input	Operation after PU disconnection is detected	PU stop function	Reset limit function
0	Always enabled.	Operation continues.	Disabled	Disabled
1	When the protective function is activated.			
2	Always enabled.	Inverter output shutoff		
3	When the protective function is activated.			
14 (initial value)	Always enabled.	Operation continues.	Enabled	
15	When the protective function is activated.			
16	Always enabled.	Inverter output shutoff		
17	When the protective function is activated.			
100	Always enabled.	Operation continues.	Disabled	Enabled*3
101	When the protective function is activated.			
102	Always enabled.	Inverter output shutoff		
103	When the protective function is activated.			
114	Always enabled.	Operation continues.	Enabled	
115	When the protective function is activated.			
116	Always enabled.	Inverter output shutoff		
117	When the protective function is activated.			

Pr.75 setting	Reset input	Operation after PU disconnection is detected	PU stop function	Reset limit function
1000	When the start signal is OFF.	Operation continues.	Disabled	Disabled
1001	When the protective function is activated and the start signal is OFF.			
1002	When the start signal is OFF.	Inverter output shutoff		
1003	When the protective function is activated and the start signal is OFF.			
1014	When the start signal is OFF.	Operation continues.	Enabled	
1015	When the protective function is activated and the start signal is OFF.			
1016	When the start signal is OFF.	Inverter output shutoff		
1017	When the protective function is activated and the start signal is OFF.			
1100	When the start signal is OFF.	Operation continues.	Disabled	Enabled*3
1101	When the protective function is activated and the start signal is OFF.			
1102	When the start signal is OFF.	Inverter output shutoff		
1103	When the protective function is activated and the start signal is OFF.			
1114	When the start signal is OFF.	Operation continues.	Enabled	
1115	When the protective function is activated and the start signal is OFF.			
1116	When the start signal is OFF.	Inverter output shutoff		
1117	When the protective function is activated and the start signal is OFF.			

*3 The setting is available for the FR-F860-01080 or higher.

◆ Reset selection (P.E100)

- While **P.E100** = "1", or **Pr.75** = "1, 3, 15, 17, 101, 103, 115, or 117", the reset command input is enabled (using the RES signal or through communication) only when the protective function is activated.
- While **P.E100** = "2" or **Pr.75** = "1000, 1002, 1014, 1016, 1100, 1102, 1114, or 1116", the reset command input is enabled (using the RES signal or through communication) only when the start signal is OFF.
- While **P.E100** = "3" or **Pr.75** = "1001, 1003, 1015, 1017, 1101, 1103, 1115, or 1117", the reset command input is enabled (using the RES signal or through communication) only when the protective function is activated with the start signal OFF.

NOTE

- When the RES signal 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 is cleared.
- When "reset input always enabled" is selected, the reset key on the PU is enabled only when the protective function is activated.
- The following table shows applicable start commands. (When both the STF and STR signals are ON, the start signal status is OFF.)

Start signal input interface	Applicable start signal
External terminal	X13, X28, JOGF, JOGR, STF, or STR
PU	Forward/reverse rotation command given by pressing the FWD/REV key
Communication	X13, X28, STF, or STR

- During emergency drive operation, reset input is always enabled regardless of the reset selection setting.

◆ Disconnected PU detection (P.E101)

- When the inverter detects that the PU (operation panel/parameter unit) is disconnected from the inverter for 1 second or more while **P.E101** or **Pr.75** is set to shut off the inverter output upon disconnection of the PU, the PU disconnection ("E.PUE") indication is displayed and the inverter output is shut off.

NOTE

- When the PU has been disconnected since before power-ON, the output is not shut off.
- To restart, confirm that the PU is connected and then reset.

- When the inverter detects that the PU is disconnected during PU JOG operation while **P.E101** or **Pr.75** is set to continue the inverter operation even when the PU is disconnected, the inverter decelerates the motor to a stop.
- 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. (The communication is checked according to **Pr.122 PU communication check time interval**.)

◆ PU stop selection (P.E102)

- Stop can be performed by inputting STOP RESET from the PU in any of the operation modes of PU operation, External operation and network operation.
- When stop is performed by the PU stop function, "PS" is displayed on the PU. A fault output is not provided.
- When **P.E102**="0" or **Pr.75**="0 to 3, 100 to 103" is set, deceleration stop using STOP RESET is valid only in the PU operation mode.

NOTE

- When **Pr.551 PU mode operation command source selection**="1" (PU mode RS-485 terminal), deceleration stop is performed even when STOP RESET is input during operation in PU mode via RS-485 communication.

◆ How to restart after stopping with STOP RESET input from the PU during External operation (PU stop (PS) release method)

- PU stop release method for operation panel

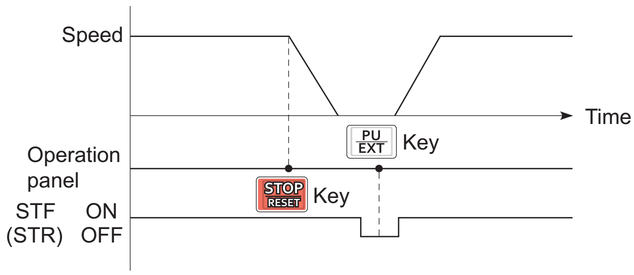
1. After completion of deceleration to a stop, switch OFF the STF and STR signal.

2. Press PU EXT three times. (PS release)
(When **Pr.79 Operation mode selection** = "0 (initial value) or 6")
When **Pr.79** = "2, 3, or 7", PU stop can be released by pressing one time.

- PU stop release method for parameter unit

1. After completion of deceleration to a stop, switch OFF the STF or STR signal.

2. Press EXT. (PS release)



Stop/restart example for External operation

- The motor can be restarted by resetting the power supply or resetting with a RES signal.

NOTE

- Even when **Pr.250 Stop selection** ≠ "9999" is set and coasting stop is selected, deceleration stop and not coasting stop is performed in the PU stop function during External operation.

◆ Reset limit function (P.E107)

- When **P.E107** = "1" or **Pr.75** = any of "100 to 103 and 114 to 117", if an electronic thermal O/L relay or an overcurrent protective function (E.THM, E.THT, E.OC[]) is activated while one of them has been already activated within 3 minutes, the inverter will not accept any reset command (RES signal, etc.) for about 3 minutes from the second activation.
- The reset limit function is available with the FR-F860-01080 or higher.

NOTE

- Resetting the inverter power (turning OFF the control power) will clear the accumulated thermal value.
- When the retry function is set enabled (**Pr.67 Number of retries at fault occurrence** ≠ "0"), the reset limit function is disabled.

⚠ CAUTION

• Do not perform a reset while a start signal is being input. Doing so will cause a sudden start of the motor, which is dangerous.

Parameters referred to

Pr.67 Number of retries at fault occurrence ☞ page 242
Pr.79 Operation mode selection ☞ page 204
Pr.250 Stop selection ☞ page 550
Pr.551 PU mode operation command source selection ☞ page 214

5.4.3 PU display language selection

The display language of the parameter unit (FR-PU07) can be selected.

Pr.	Name	Initial value	Setting range	Description
145 **E103**	**PU display language selection**	—	0	Japanese
			1	English
			2	German
			3	French
			4	Spanish
			5	Italian
			6	Swedish
			7	Finnish

5.4.4 Buzzer control

The PU (operation panel or parameter unit) key sound and buzzer can be turned ON/OFF.

Pr.	Name	Initial value	Setting range	Description
990 **E104**	**PU buzzer control**	1	0	Turns the key sound and buzzer OFF.
			1	Turns the key sound and buzzer ON.

NOTE

- When the buzzer is set to ON, a warning sound will be audible when a fault occurs.

5.4.5 PU contrast adjustment

Contrast adjustment of the LCD of the LCD operation panel (FR-LU08) and the parameter unit (FR-PU07) can be performed. Decreasing the setting value lowers the contrast.

Pr.	Name	Initial value	Setting range	Description
991 **E105**	**PU contrast adjustment**	58	0 to 63	0: Low → 63: High

The above parameter is displayed as a simple mode parameter only when the LCD operation panel (FR-LU08) and the parameter unit (FR-PU07) are connected.

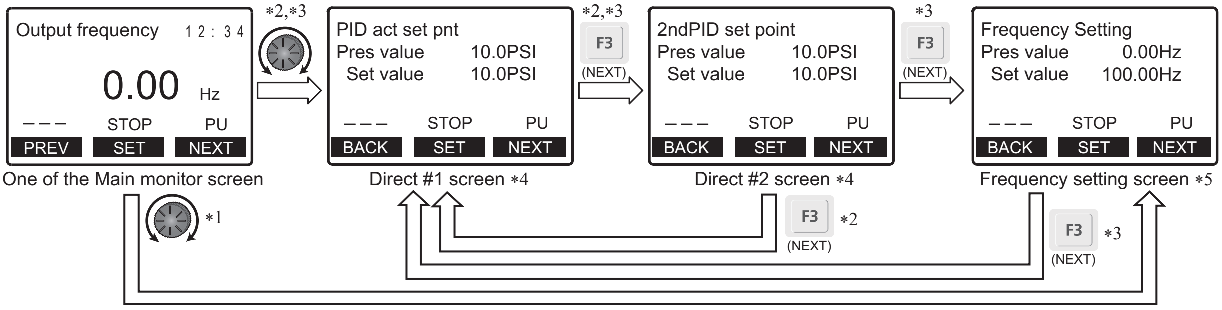
5.4.6 Direct setting

The PID action set point setting screen can be displayed quickly on the monitor.

Pr.	Name	Initial value	Setting range	Description
1000 E108	**Direct setting selection**	0	0	Displays the Frequency setting screen.
			1	Displays the direct (set point setting) screen.
			2	Displays the direct (set point setting) screen and the Frequency setting screen.

- The monitor display can be switched from the Main monitor screen to the set point setting screen for the PID action by simply operation, according to the setting of **Pr.1000 Direct setting selection**. On each setting screen, turn to input a setting value, and press F2 (SET) to confirm the setting.

Example of screen switching and shifting when the PID control is enabled (**Pr.128** ≠ "0")



*1 When **Pr.1000**="0"
*2 When **Pr.1000**="1"
*3 When **Pr.1000**="2"
*4 Not displayed when PID control is disabled (**Pr.128**="0").
*5 Indication of [NEXT] is not displayed when **Pr.1000**="0".

- To switch back the monitor display from the direct screen or the Frequency setting screen to the Main monitor screen, press F1 (BACK).

NOTE

- For the availability of the direct setting for your operation panel, refer to your FR-LU08 Instruction Manual.

Parameters referred to

Pr.128 PID action selection page 396

5.4.7 Resetting USB host errors

When a USB device is connected to the USB connector (connector A), the USB host error can be canceled without performing an inverter reset.

Pr.	Name	Initial value	Setting range	Description
1049 E110	**USB host reset**	0	0	Read only
			1	Resets the USB host.

- Parameter copy and the trace function can be used when a USB device (such as a USB memory) is connected to the USB connector (connector A). (Refer to page 67.)
- When a device such as a USB charger is connected to the USB connector and an excessive current (500 mA or higher) flows, USB host error (UF warning) is displayed on the operation panel.
- If a UF warning occurs, disconnect the USB device and set **Pr.1049**="1" to cancel the USB error. (The UF warning can also be canceled by resetting the inverter power or resetting with the RES signal.)

5.4.8 Multiple rating setting

Two rating types of different rated current and permissible load can be selected. The optimal inverter rating can be chosen in accordance with the application, enabling equipment size to be reduced.

Pr.	Name	Initial value	Setting range	Description (overload current rating, surrounding air temperature)
570 **E301**	**Multiple rating setting**	0	0	SLD rating
			1	LD rating

◆ Overload current rating and surrounding air temperature

- The overload current rating of the inverter can be changed by the **Pr.570** setting.

Pr.570 setting	Rating	Overload current rating	Surrounding air temperature	
			FR-F860-01080 or lower	FR-F860-01440 or higher
0	SLD	110% 60 s, 120% 3 s (inverse-time characteristics)	40°C*1	40°C
1	LD	120% 60 s, 150% 3 s (inverse-time characteristics)	40°C	50°C

*1 30°C for the FR-F860-00090 or lower.

◆ Changing the parameter initial values and setting ranges

- When inverter reset and all parameter clear are performed after setting **Pr.570**, the parameter initial values are changed according to each rating, as shown below.

Pr.	Name	Pr.570 setting		Refer to page
		0	1	
9	Electronic thermal O/L relay	SLD rated current*1	LD rated current*1	230
22	Stall prevention operation level	110%	120%	257
48	Second stall prevention operation level	110%	120%	257
56	Current monitoring reference	SLD rated current*1	LD rated current*1	284
148	Stall prevention level at 0 V input	110%	120%	257
149	Stall prevention level at 10 V input	120%	150%	257
150	Output current detection level	110%	120%	307
165	Stall prevention operation level for restart	110%	120%	448
557	Current average value monitor signal output reference current	SLD rated current*1	LD rated current*1	187
874	OLT level setting	110%	120%	257

*1 The rated current and motor capacity differ depending on the inverter capacity. Refer to the inverter rated specifications (page 612).

NOTE

- When **Pr.570** = "0" (SLD rating), carrier frequency automatic reduction is enabled regardless of the setting in **Pr.260 PWM frequency automatic switchover**.

Parameters referred to

Pr.260 PWM frequency automatic switchover ☞ page 179

5.4.9 Parameter write selection

Whether to enable the writing to various parameters or not can be selected. Use this function to prevent parameter values from being rewritten by misoperation.

Pr.	Name	Initial value	Setting range	Description
77 **E400**	**Parameter write selection**	0	0	Writing is enabled only during stop.
			1	Parameter writing is disabled.
			2	Parameter writing is enabled in any operation mode regardless of the operation status.

- **Pr.77** can be set at any time regardless of the operation mode or operation status. (Setting through communication is unavailable.)

◆ Writing parameters only during stop (Pr.77 = "0" initial value)

- Parameters can be written only during a stop in the PU operation mode.
- The following parameters can always be written regardless of the operation mode or operation status.

Pr.	Name	Pr.	Name
4 to 6	(Multi-speed setting high-speed, middle-speed, low-speed)	551*2	PU mode operation command source selection
22	Stall prevention operation level	555 to 557	(Current average value monitor)
24 to 27	(Multi-speed setting speed 4 to speed 7)	656 to 659	(Analog remote output)
52	Operation panel main monitor selection	663	Control circuit temperature signal output level
54	CA terminal function selection	675	User parameter auto storage function selection
55	Frequency monitoring reference	755 to 758	(Second PID control)
56	Current monitoring reference	759	PID unit selection
72*1	PWM frequency selection	774 to 776	(PU/DU monitor selection)
75	Reset selection/disconnected PU detection/PU stop selection	866	Torque monitoring reference
77	Parameter write selection	888, 889	(Free parameter)
79*2	Operation mode selection	891 to 899	(Energy saving monitor)
129	PID proportional band	900	CA terminal calibration
130	PID integral time	901	AM terminal calibration
133	PID action set point	930	Current output bias signal
134	PID differential time	930	Current output bias current
158	AM terminal function selection	931	Current output gain signal
160	User group read selection	931	Current output gain current
232 to 239	(Multi-speed setting speed 8 to speed 15)	990	PU buzzer control
240*1	Soft-PWM operation selection	991	PU contrast adjustment
241	Analog input display unit switchover	997	Fault initiation
268	Monitor decimal digits selection	998*2	PM parameter initialization
290	Monitor negative output selection	999*2	Automatic parameter setting
296, 297	(Password setting)	1000	Direct setting selection
306	Analog output signal selection	1006	Clock (year)
310	Analog meter voltage output selection	1007	Clock (month, day)
340*2	Communication startup mode selection	1008	Clock (hour, minute)
345, 346	(DeviceNet communication)	1019	Analog meter voltage negative output selection
416, 417	(PLC function)	1142	Second PID unit selection
434, 435	(CC-Link communication)	1150 to 1199	(PLC function user parameters)
496, 497	(Remote output)	1211 to 1219	(PID gain tuning)
498	PLC function flash memory clear	1460 to 1466	(PID multistage set points 1 to 7)
550*2	NET mode operation command source selection	1480 to 1485	(Load characteristics fault detection)

*1 Writing during operation is enabled in PU operation mode, but disabled in External operation mode.
*2 Writing during operation is disabled. To change the parameter setting value, stop the operation.

◆ Disabling parameter write (Pr.77 = "1")

- Parameter write, parameter clear and all parameter clear are disabled. (Parameter read is enabled.)
- The following parameters can be written even if **Pr.77** = "1".

Pr.	Name	Pr.	Name
22	Stall prevention operation level	297	Password lock/unlock
75	Reset selection/disconnected PU detection/PU stop selection	345, 346	(DeviceNet communication)
77	Parameter write selection	496, 497	(Remote output)
79 *1	Operation mode selection	656 to 659	(Analog remote output)
160	User group read selection	805	Torque command value (RAM)
296	Password lock level	997	Fault initiation

*1 Writing during operation is disabled. To change the parameter setting value, stop the operation.

◆ Writing parameters during operation (Pr.77 = "2")

- These parameters can always be written.
- The following parameters cannot be written during operation if **Pr.77** = "2". To change the parameter setting value, stop the operation.

Pr.	Name	Pr.	Name
23	Stall prevention operation level compensation factor at double speed	454	Number of second motor poles
48	Second stall prevention operation level	455	Second motor excitation current
49	Second stall prevention operation frequency	456	Rated second motor voltage
60	Energy saving control selection	457	Rated second motor frequency
66	Stall prevention operation reduction starting frequency	458 to 462	(Second motor constant)
71	Applied motor	463	Second motor auto tuning setting/status
79	Operation mode selection	507, 508	(Display/reset ABC relay contact life)
80	Motor capacity	521	Output short-circuit detection
81	Number of motor poles	541	Frequency command sign selection
82	Motor excitation current	560	Second frequency search gain
83	Rated motor voltage	561	PTC thermistor protection level
84	Rated motor frequency	570	Multiple rating setting
90 to 94	(Motor constant)	574	Second motor online auto tuning
95	Online auto tuning selection	578	Auxiliary motor operation selection
96	Auto tuning setting/status	579	Motor connection function selection
135 to 139	(Electronic bypass sequence parameter)	606	Power failure stop external signal input selection
178 to 196	(Input and output terminal function selection)	660 to 662	(Increased magnetic excitation deceleration)
248	Self power management selection	699	Input terminal filter
254	Main circuit power OFF waiting time	702	Maximum motor frequency
261	Power failure stop selection	706, 707, 711, 712, 717, 721, 724, 725, 1412	(PM motor tuning)
289	Inverter output terminal filter	738 to 746, 1413	(Second PM motor tuning)
291	Pulse train I/O selection	800	Control method selection
298	Frequency search gain	858	Terminal 4 function assignment
313 to 322	(Extended output terminal function selection)	859	Torque current/Rated PM motor current
329	Digital input unit selection	860	Second motor torque current/Rated PM motor current
414	PLC function operation selection	868	Terminal 1 function assignment
415	Inverter operation lock mode setting	998	PM parameter initialization
418	Extension output terminal filter	999	Automatic parameter setting
450	Second applied motor	1002	Lq tuning target current adjustment coefficient
453	Second motor capacity		

5.4.10 Password function

Registering a 4-digit password can restrict parameter reading/writing.

Pr.	Name	Initial value	Setting range	Description
296 **E410**	**Password lock level**	9999	0 to 6, 99, 100 to 106, 199	Select restriction level of parameter reading/ writing when a password is registered.
			9999	No password lock
297 **E411**	**Password lock/unlock**	9999	1000 to 9998	Register a 4-digit password
			(0 to 5) *1	Displays password unlock error count. (Reading only) (Valid when **Pr.296** = "100 to 106, or 199")
			9999 *1	No password lock

The above parameters can be set when **Pr.160 User group read selection** = "0". However, when **Pr.296** ≠ 9999 (password lock is set), **Pr.297** can always be set, regardless of the setting in **Pr.160**.

*1 When **Pr.297** = "0, 9999", writing is always enabled, but setting is disabled. (The display cannot be changed.)

◆ Parameter reading/writing restriction level (Pr.296)

- The level of the reading/writing restriction using the PU/Network (NET) operation mode operation command can be selected with **Pr.296**.

Pr.296 setting	PU operation mode operation command*3		NET operation mode operation command*4			
			RS-485 terminals / PLC function*7		Communication option	
	Read*1	Write*2	Read	Write*2	Read	Write*2
9999	○	○	○	○	○	○
0, 100*6	×	×	×	×	×	×
1, 101	○	×	○	×	○	×
2, 102	○	×	○	○	○	○
3, 103	○	○	○	×	○	×
4, 104	×	×	×	×	○	×
5, 105	×	×	○	○	○	○
6, 106	○	○	×	×	○	×
99 to 199	Only the parameters registered in the user group can be read/written.*5 (For the parameters not registered in the user group, same restriction level as "4, 104" applies.)					

○: Enabled, ×: Disabled

*1 If the parameter reading is restricted by the **Pr.160 User group read selection** setting, those parameters are unavailable for reading even when "○" is indicated.

*2 If the parameter writing is restricted by the **Pr.77 Parameter write selection** setting, those parameters are unavailable for writing even when "○" is indicated.

*3 This restricts parameter access from the command source that can write a parameter under the PU operation mode (initially the operation panel or the parameter unit). (For the PU operation mode command source selection, refer to page 214.)

*4 This restricts parameter access from the command source that can write a parameter under the Network operation mode (initially the RS-485 terminals or a communication option). (For the NET operation mode command source selection, refer to page 214.)

*5 Read/write is enabled only for the simple mode parameters registered in the user group when **Pr.160** = "9999". **Pr.296 and Pr.297** are always read/write enabled whether registered to a user group or not.

*6 If a communication option is installed, an option fault Option fault (E.OPT) occurs, and the inverter output shuts off. (Refer to page 580.)

*7 The PLC function user parameters (**Pr.1150 to Pr.1199**) can be written and read by the PLC function regardless of the **Pr.296** setting.

◆ Registering a password (Pr.296, Pr.297)

- The following section describes how to register a password.

1. Set the parameter reading/writing restriction level. (**Pr.296** ≠ "9999")

Pr.296 setting	Password unlock error restriction	Pr.297 display
0 to 6, 99	No restriction	Always displays 0
100 to 106, 199*1	Restricted at fifth error	Displays the error count (0 to 5)

*1 During **Pr.296** = any of "100 to 106, 199", if password unlock error has occurred 5 times, correct password will not unlock the restriction. All parameter clear can unlock the restriction. (In this case, the parameters are returned to their initial values.)

2. Write a four-digit number (1000 to 9998) in **Pr.297** as a password. (Writing is disabled when **Pr.296**="9999".) When a password is registered, parameter reading/writing is restricted with the restriction level set in **Pr.296** until unlocking.

5

NOTE

- After registering a password, the read value of **Pr.297** is always one of "0 to 5".
- A password restricted parameter cannot be read/written.
- Even if a password is registered, the parameters, which the inverter itself writes, such as inverter parts life are overwritten as needed.
- Even if a password is registered, reading/writing is enabled for **Pr.991 PU contrast adjustment** when the operation panel or the parameter unit (FR-PU07) is connected.

◆ Unlocking a password (Pr.296, Pr.297)

- There are two ways of unlocking the password.
- Enter the password in **Pr.297**. If the password matches, it unlocks. If the password does not match, an error occurs and the password does not unlock. When any of "100 to 106, or 199" is set in **Pr.296** and a password unlock error occurs five times, the restriction will not be unlocked even if the correct password is subsequently input. (Password lock in operation.)
- Perform all parameter clear.

NOTE

- If the password is forgotten, it can be unlocked with all parameter clear, but doing so will also clear the other parameters.
- All parameter clear cannot be performed during the operation.
- When using FR Configurator2 in the PU operation mode, do not set "0, 4, 5, 99, 100, 104, 105, or 199" (parameter read is disabled) in **Pr.296**. Doing so may cause abnormal operation.
- The password unlocking method differs between the operation panel, parameter unit, RS-485 communication and communication option.

	Operation panel/parameter unit	RS-485 communication	Communication option
All parameter clear	○	○	○
Parameter clear	×	×	○

○: Password can be unlocked, ×: Password cannot be unlocked

- For the parameter clear and parameter all clear methods for the communication option and parameter unit, refer to the Instruction Manual of each option. (For the Mitsubishi inverter protocol of RS-485 communication, refer to page 485, and for the MODBUS RTU communication protocol, refer to page 500.)

◆ Parameter operations during password locking/unlocking

Operation		Password unlocked		Password locked	Password lock in operation
		Pr.296 = 9999 **Pr.297 = 9999**	**Pr.296 ≠ 9999** **Pr.297 = 9999**	**Pr.296 ≠ 9999** **Pr.297 = 0 to 4 (read value)**	**Pr.296 = 100 to 106, 199** **Pr.297 = 5 (read value)**
Pr.296	Read	○*1	○	○	○
	Write	○*1	○*1	×	×
Pr.297	Read	○*1	○	○	○
	Write	×	○	○	○*3
Parameter clear execution		○	○	×*4	×*4
All parameter clear execution		○	○	○*2	○*2
Parameter copy execution		○	○	×	×

○: Enabled, ×: Disabled

*1 Reading/writing is disabled if reading is restricted by the **Pr.160** setting. (Reading is available in the Network operation mode regardless of the **Pr.160** setting.)
*2 All parameter clear cannot be performed during the operation.
*3 Correct password will not unlock the restriction.
*4 Parameter clear can only be performed from the communication option.

NOTE

- When **Pr.296** = "4, 5, 104, or 105" (password lock), the setting screen for PU JOG frequency is not displayed in the operation panel or the parameter unit (FR-PU07).
- When the password is being locked, parameter copy using the operation panel, parameter unit and USB memory is not enabled.

Parameters referred to

Pr.77 Parameter write selection page 168
Pr.160 User group read selection page 177
Pr.550 NET mode operation command source selection page 214
Pr.551 PU mode operation command source selection page 214

5.4.11 Free parameter

Any number within the setting range of 0 to 9999 can be input.
For example, these numbers 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.	Name	Initial value	Setting range	Description
888 **E420**	**Free parameter 1**	9999	0 to 9999	Any value can be input. The settings are retained even if the inverter power is turned OFF.
889 **E421**	**Free parameter 2**	9999	0 to 9999	

NOTE

- **Pr.888 and Pr.889** do not influence the operation of the inverter.

5.4.12 Setting multiple parameters as a batch

Parameter settings are changed as a batch. Those include communication parameter settings for the Mitsubishi Electric's human machine interface (GOT) connection and the parameter setting for the rated frequency settings of 50 Hz/60 Hz and acceleration/deceleration time.

<table>
<tr><th>Pr.</th><th>Name</th><th>Initial value</th><th>Setting range</th><th colspan="2">Description</th></tr>
<tr><td rowspan="9">999
E431</td><td rowspan="9">Automatic parameter setting</td><td rowspan="9">9999*1</td><td>1</td><td colspan="2">Standard PID display setting</td></tr>
<tr><td>2</td><td colspan="2">Extended PID display setting</td></tr>
<tr><td>10</td><td>GOT initial setting (PU connector)</td><td rowspan="2">"Controller Type" in GOT: FREQROL 500/700/800, SENSORLESS SERVO</td></tr>
<tr><td>11</td><td>GOT initial setting (RS485 terminals)</td></tr>
<tr><td>12</td><td>GOT initial setting (PU connector)</td><td rowspan="2">"Controller Type" in GOT: FREQROL 800 (Automatic Negotiation)</td></tr>
<tr><td>13</td><td>GOT initial setting (RS-485 terminal)</td></tr>
<tr><td>20</td><td colspan="2">50 Hz rated frequency</td></tr>
<tr><td>21</td><td colspan="2">60 Hz rated frequency</td></tr>
<tr><td>9999</td><td colspan="2">No action</td></tr>
</table>

*1 The read value is always "9999".

◆ Automatic parameter setting (Pr.999)

- Select which parameters to automatically set from the table below, and set them in **Pr.999**. Multiple parameter settings are changed automatically. Refer to page 175 for the list of parameters that are changed automatically.

<table>
<tr><th>Pr.999 Setting</th><th colspan="2">Description</th></tr>
<tr><td>1</td><td colspan="2">Sets the standard monitor indicator setting of PID control.</td></tr>
<tr><td>2</td><td colspan="2">Automatically sets the monitor indicator for PID control.</td></tr>
<tr><td>10</td><td colspan="2">Automatically sets the communication parameters for the GOT connection with a PU connector ("Controller Type" in GOT: FREQROL 500/700/800, SENSORLESS SERVO)</td></tr>
<tr><td>11</td><td colspan="2">Automatically sets the communication parameters for the GOT connection with RS-485 terminals ("Controller Type" in GOT: FREQROL 500/700/800, SENSORLESS SERVO)</td></tr>
<tr><td>12</td><td colspan="2">Automatically sets the communication parameters for the GOT connection with a PU connector ("Controller Type" in GOT: FREQROL 800 (Automatic Negotiation))</td></tr>
<tr><td>13</td><td colspan="2">Automatically sets the communication parameters for the GOT connection with RS-485 terminals ("Controller Type" in GOT: FREQROL 800 (Automatic Negotiation))</td></tr>
<tr><td>20</td><td>50 Hz rated frequency</td><td rowspan="2">Sets the related parameters of the rated frequency according to the power supply frequency</td></tr>
<tr><td>21</td><td>60 Hz rated frequency</td></tr>
</table>

NOTE

- If the automatic setting is performed with **Pr.999** or the automatic parameter setting mode, the settings including the changed parameter settings (changed from the initial setting) will be automatically changed. Before performing the automatic setting, confirm that changing the parameters will not cause any problem.

◆ PID monitor indicator setting (Pr.999 = "1 or 2")

Pr.	Name	Initial value	Pr.999="1"	Pr.999="2"	Refer to page
759	**PID unit selection**	9999	9999	4	421
1142	**Second PID unit selection**	9999	9999	4	
774	**Operation panel monitor selection 1**	9999	9999	52	274
775	**Operation panel monitor selection 2**	9999	9999	53	
776	**Operation panel monitor selection 3**	9999	9999	54	
934	**PID display bias coefficient**	9999	9999	0	421
935	**PID display gain coefficient**	9999	9999	100	
1136	**Second PID display bias coefficient**	9999	9999	0	
1138	**Second PID display gain coefficient**	9999	9999	100	
—	**3-step monitor setting**	—	Disabled	Enabled*1*2*3	—
—	**Direct setting**	—	Disabled	Enabled*3	—
—	**Dedicated parameter list function**	—	Disabled	Enabled*3	—

*1 Enabled when the FR-LU08 (-01) is used.
*2 Enabled when the FR-PU07 is used.
*3 Enabled when the FR-PU07-01 is used.

■ 3-line monitor setting

On the operation panel or parameter unit, the 3-line monitor is used as the first monitor.

■ Direct setting

Pressing the [FUNC] key of the FR-PU07-01 displays the direct setting screen. The PID action set point can be directly set regardless of the operation mode or **Pr.77 Parameter write selection** setting.
Pressing the [FUNC] key on the direct setting screen displays the function menu.

Direct setting	Parameter to be set
Direct setting 1	**Pr.133 PID action set point**
Direct setting 2	**Pr.755 Second PID action set point**

■ Dedicated parameter list function

Pressing the [PrSET] key of the FR-PU07-01 displays the dedicated parameter list. Parameters that need to be set first for the PID extended display setting are listed.

Dedicated parameter list	Parameter to be set
No.1	**Pr.999 Automatic parameter setting**
No.2	**Pr.934 PID display bias coefficient**
No.3	**Pr.935 PID display gain coefficient**

NOTE

- The display of parameters other than the above may be changed due to changes in **Pr.934** or **Pr.935**. Set the PID monitor indicator before changing the settings of other parameters.
- To use the direct setting on the LCD operation panel, set **Pr.1000 Direct setting selection**. (Refer to page 166.)

◆ GOT initial setting (PU connector) (Pr.999 = "10, 12")

Pr.	Name	Initial value	Pr.999="10"	Pr.999="12"	Refer to page
79	**Operation mode selection**	0	1	1	204
118	**PU communication speed**	192	192	1152	483
119	**PU communication stop bit length**	1	10	0	
120	**PU communication parity check**	2	1	1	
121	**Number of PU communication retries**	1	9999	9999	
122	**PU communication check time interval**	9999	9999	9999	
123	**PU communication waiting time setting**	9999	0 ms	0 ms	
124	**PU communication CR/LF selection**	1	1	1	
340	**Communication startup mode selection**	0	0	0	213
414	**PLC function operation selection**	0	—	2*1	463

*1 The setting is changed when **Pr.414** = "0" (initial setting).

■ Initial setting with the GOT2000 series

- When "FREQROL 500/700/800, SENSORLESS SERVO" is selected for "Controller Type" in the GOT setting, set **Pr.999** = "10" to configure the GOT initial setting.
- When "FREQROL 800 (Automatic Negotiation)" is selected for "Controller Type" in the GOT setting, the GOT automatic connection can be used. When "FREQROL 800 (Automatic Negotiation)" is selected for "Controller Type" in the GOT setting and the GOT automatic connection is not used, set **Pr.999** = "12" to configure the GOT initial setting. (Refer to page 533)

■ Initial setting with the GOT1000 series

- Set **Pr.999** = "10" to configure the GOT initial setting.

NOTE

- Always perform an inverter reset after the initial setting.
- For details on connection with GOT, refer to the Instruction Manual of GOT.

◆ GOT initial setting (RS-485 terminals) (Pr.999 = "11, 13")

Pr.	Name	Initial value	Pr.999="11"	Pr.999="13"	Refer to page
79	**Operation mode selection**	0	0	0	204
332	**RS-485 communication speed**	96	192	1152	483
333	**RS-485 communication stop bit length**	1	10	0	
334	**RS-485 communication parity check selection**	2	1	1	
335	**RS-485 communication retry count**	1	9999	9999	
336	**RS-485 communication check time interval**	0 s	9999	9999	
337	**RS-485 communication waiting time setting**	9999	0 ms	0 ms	
340	**Communication startup mode selection**	0	1	1	213
341	**RS-485 communication CR/LF selection**	1	1	1	483
414	**PLC function operation selection**	0	—	2*1	463
549	**Protocol selection**	0	0	0	500

*1 The setting is changed when **Pr.414** = "0" (initial setting).

■ Initial setting with the GOT2000 series

- When "FREQROL 500/700/800, SENSORLESS SERVO" is selected for "Controller Type" in the GOT setting, set **Pr.999** = "11" to configure the GOT initial setting.
- When "FREQROL 800 (Automatic Negotiation)" is selected for "Controller Type" in the GOT setting, the GOT automatic connection can be used. When "FREQROL 800 (Automatic Negotiation)" is selected for "Controller Type" in the GOT setting and the GOT automatic connection is not used, set **Pr.999** = "13" to configure the GOT initial setting. (Refer to page 533)

■ Initial setting with the GOT1000 series

- Set **Pr.999** = "11" to configure the GOT initial setting.

NOTE

- Always perform an inverter reset after the initial setting.
- For details on connection with GOT, refer to the Instruction Manual of GOT.

◆ Rated frequency (Pr.999 = "20 (50 Hz), 21 (60 Hz)")

Pr.	Name	Initial value	Pr.999 = "21"	Pr.999 = "20"	Refer to page
3	**Base frequency**	60 Hz	60 Hz	50 Hz	539
4	**Multi-speed setting (high speed)**	60 Hz	60 Hz	50 Hz	226
20	**Acceleration/deceleration reference frequency**	60 Hz	60 Hz	50 Hz	190
37	**Speed display**	0	0		272
55	**Frequency monitoring reference**	60 Hz	60 Hz	50 Hz	284
66	**Stall prevention operation reduction starting frequency**	60 Hz	60 Hz	50 Hz	257
125 (903)	**Terminal 2 frequency setting gain frequency**	60 Hz	60 Hz	50 Hz	328
126 (905)	**Terminal 4 frequency setting gain frequency**	60 Hz	60 Hz	50 Hz	
263	**Subtraction starting frequency**	60 Hz	60 Hz	50 Hz	389
266	**Power failure deceleration time switchover frequency**	60 Hz	60 Hz	50 Hz	
386	**Frequency for maximum input pulse**	60 Hz	60 Hz	50 Hz	222
390	**% setting reference frequency**	60 Hz	60 Hz	50 Hz	516
505	**Speed setting reference**	60 Hz	60 Hz	50 Hz	272
584	**Auxiliary motor 1 starting frequency**	60 Hz	60 Hz	50 Hz	429
585	**Auxiliary motor 2 starting frequency**	60 Hz	60 Hz	50 Hz	
586	**Auxiliary motor 3 starting frequency**	60 Hz	60 Hz	50 Hz	
918	**Terminal 1 gain frequency (speed)**	60 Hz	60 Hz	50 Hz	328
1013	**Running speed after emergency drive retry reset**	60 Hz	60 Hz	50 Hz	245

5.4.13 Extended parameter display and user group function

This function restricts the parameters that are read by the operation panel and the parameter unit.

Pr.	Name	Initial value	Setting range	Description
160 **E440**	**User group read selection**	0	9999	Only simple mode parameters can be displayed.
			0	Simple mode and extended parameters can be displayed.
			1	Only parameters registered in user groups can be displayed.
172 **E441**	**User group registered display/ batch clear**	0	(0 to 16)	Displays the number of groups that are registered as user groups. (Read-only)
			9999	Batch clear of user group registrations
173 **E442**	**User group registration**	9999*1	0 to 1999, 9999	Sets the parameter number to register for the user group.
174 **E443**	**User group clear**	9999*1	0 to 1999, 9999	Sets the parameter number to clear from the user group.

*1 The read value is always "9999".

◆ Display of simple mode parameters and extended parameters (Pr.160)

- When **Pr.160** = "9999", only the simple mode parameters can be displayed on the operation panel and the parameter unit. (For the simple mode parameters, refer to the parameter list page 108.)
- With the initial value (**Pr.160** = "0"), simple mode parameters and extended parameters can be displayed.

NOTE

- When a plug-in option in installed on the inverter, the option parameters can also be read.
- Every parameter can be read regardless of the **Pr.160** setting when reading parameters via a communication option.
- When reading the parameters using the RS-485 terminals, 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 enabled/disabled
1 (RS-485)	-	Enabled
2 (PU) 3 (USB) 9999 (Automatic determination) (Initial value)	0 (Communication option)	Enabled
	1 (RS-485)	Disabled (All can be read)
	9999 (Automatic determination) (Initial value)	With communication option: Enabled
		Without communication option: Disabled (All can be read)

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

- The user group function is a function for displaying only the parameters required for a setting.
- A maximum of 16 parameters from any of the parameters can be registered in a user group. When **Pr.160** = "1", reading/ writing is enabled only for the parameters registered in user groups. (Parameters not registered in user groups can no longer be read.)
- To register a parameter in a user group, set the parameter number in **Pr.173**.
- To clear a parameter from a user group, set the parameter number in **Pr.174**. To batch clear all the registered parameters, set **Pr.172** = "9999".

◆ Registering a parameter in a user group (Pr.173)

- To register **Pr.3** in a user group

Operating procedure

1. Power ON
Make sure the motor is stopped.

2. Changing the operation mode
Select the PU operation mode.

3. Selecting the parameter number
Read **Pr.173**.

4. Parameter registration
Set "3" in **Pr.173**.
Pr.3 is registered in the user group.

◆ Clearing a parameter from a user group (Pr.174)

- To delete **Pr.3** from a user group

Operating procedure

1. Power ON
Make sure the motor is stopped.

2. Changing the operation mode
Select the PU operation mode.

3. Selecting the parameter number
Read **Pr.174**.

4. Clearing the parameter
Set "3" in **Pr.173**.
Pr.3 is deleted from the user group.

NOTE

- **Pr.77 Parameter write selection, Pr.160, Pr.296 Password lock level, Pr.297 Password lock/unlock and Pr.991 PU contrast adjustment** can always be read regardless of the user group setting.
- **Pr.77, Pr.160, Pr.172 to Pr.174, Pr.296, Pr.297** cannot be registered in a user group.
- When **Pr.174** is read, "9999" is always displayed. "9999" can be written, but it does not function.
- **Pr.172** is disabled if set to a value other than "9999".

Parameters referred to

Pr.77 Parameter write selection ☞ page 168
Pr.296 Password lock level, Pr.297 Password lock/unlock ☞ page 170
Pr.550 NET mode operation command source selection ☞ page 214
Pr.551 PU mode operation command source selection ☞ page 214

5.4.14 Parameter copy alarm release

The parameter copy alarm can be canceled. The parameter copy alarm is generated when parameter copy is performed between the FR-F860-00680 or lower and the FR-F860-01080 or higher.

Pr.	Name	Initial value	Setting range	Description
989 **E490**	**Parameter copy alarm release**	10*1 100*2	10*1	Cancels the alarm of FR-F860-00680 or lower.
			100*2	Cancels the alarm of FR-F860-01080 or higher.

*1 The setting range or initial value for the FR-F860-00680 or lower.
*2 The setting range or initial value for the FR-F860-01080 or higher.

- The setting range of some parameters differ between the FR-F860-00680 or lower and the FR-F860-01080 or higher. When parameter copy is performed between the FR-F860-00680 or lower and the FR-F860-01080 or higher, the parameter copy alarm (CP) is displayed on the operation panel because resetting of some parameters is necessary.
- Use **Pr.989** to cancel the parameter copy alarm. After setting **Pr.989**, perform setting of **Pr.9, Pr.30, Pr.51, Pr.56, Pr.57, Pr.61, Pr.70, Pr.72, Pr.80, Pr.82, Pr.90 to Pr.94, Pr.453, Pr.455, Pr.458 to Pr.462, Pr.557, Pr.859, Pr.860, and Pr.893** again.

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5.4.15 PWM carrier frequency and Soft-PWM control

The motor sound can be changed.

Pr.	Name	Initial value	Setting range	Description
72 **E600**	**PWM frequency selection**	2	0 to 15*1 0 to 6, 25*2	The PWM carrier frequency can be changed. The setting displayed is in [kHz]. Note that 0 indicates 0.7 kHz, and 15 indicates 14.5 kHz. (The setting value "25" is for manufacturer setting. Do not set.)
240 **E601**	**Soft-PWM operation selection**	1	0	Soft-PWM disabled
			1	The soft-PWM is enabled.
260 **E602**	**PWM frequency automatic switchover**	1	0	PWM carrier frequency automatic reduction function disabled (for the LD rating)
			1	PWM carrier frequency automatic reduction function enabled

*1 The setting range for the FR-F860-00680 or lower.
*2 The setting range for the FR-F860-01080 or higher.

◆ Changing the PWM carrier frequency (Pr.72)

- The PWM carrier frequency of the inverter can be changed.
- Changing the PWM carrier frequency can be effective for avoiding the resonance frequency of the mechanical system or motor, as a countermeasure against EMI generated from the inverter, or for reducing leakage current caused by PWM switching.

- Under PM motor control, the following carrier frequencies are used. (To select fast-response operation, refer to **Pr.800 Control method selection** on page 145.)

Pr.72 setting	Carrier frequency (kHz)	
	Normal-response operation	Fast-response mode
0	2	4
1		
2		
3		
4		
5		
6	6[*1]	
7		
8		8
9		
10	10[*1]	
11		
12		12
13		
14	14[*1]	
15		

*1 In the low-speed range (slower than 10% of the rated motor frequency), the carrier frequency is automatically changed to 2 kHz. (For FR-F860-00090 or lower)

NOTE

- In the low-speed range (about 10 Hz or lower), the carrier frequency may be automatically lowered. Motor noise increases, but not to the point of failure.

◆ Soft-PWM control (Pr.240)

- Soft-PWM control is a control method that changes the motor noise from a metallic sound into an inoffensive, complex tone.
- Setting **Pr.240** = "1" will enable the Soft-PWM control.
- To enable the Soft-PWM control for the FR-F860-00680 or lower, set **Pr.72** to "5 kHz or less". To enable it for the FR-F860-01080 or higher, set **Pr.72** to "4 kHz or less".

◆ PWM carrier frequency automatic reduction function (Pr.260)

- Setting **Pr.260** = "1 (initial value)" will enable the PWM carrier frequency auto-reduction function. If a heavy load is continuously applied while the inverter carrier frequency is set to 3 kHz or higher (**Pr.72** ≥ "3"), the carrier frequency is automatically reduced to prevent occurrence of the inverter overload trip (electronic thermal O/L relay function) (E.THT). The carrier frequency is reduced to as low as 2 kHz. (Motor noise increases, but not to the point of failure.)
- When the PWM carrier frequency automatic reduction function is used, the operation with the carrier frequency set to 3 kHz or higher (**Pr.72** ≥ "3") automatically reduces the carrier frequency for heavy-load operation as shown below.

Pr.260 setting	Pr.570 setting	Carrier frequency automatic reduction operation
1	0 (SLD), 1 (LD)	Continuous operation with the 85% or higher inverter rated current reduces the carrier frequency automatically.
0	0 (SLD)	Continuous operation with the 85% or higher inverter rated current reduces the carrier frequency automatically.
	1 (LD)	Without carrier frequency automatic reduction (Perform continuous operation with the carrier frequency set to 2 kHz or lower or with less than 85% of the inverter rated current.)

NOTE

- Reducing the PWM carrier frequency is effective as a countermeasure against EMI from the inverter or for reducing leakage current, but doing so increases the motor noise.
- When the PWM carrier frequency is set to 1 kHz or lower (**Pr.72** ≤ 1), the increase in the harmonic current causes the fast-response current limit to activate before the stall prevention operation, which may result in torque shortage. In this case, disable the fast-response current limit in **Pr.156 Stall prevention operation selection**.
- During fast-response operation, the carrier frequency automatic reduction function is disabled.

Parameters referred to

Pr.156 Stall prevention operation selection ☞ page 257
Pr.570 Multiple rating setting ☞ page 167
Pr.800 Control method selection ☞ page 145

5.4.16 Inverter parts life display

The degree of deterioration of the control circuit capacitor, main circuit capacitor, cooling fan, inrush current limit circuit, and relay contacts of terminals A, B, and C can be diagnosed on the monitor.

When a part approaches the end of its life, an alarm can be output by self diagnosis to prevent a fault.

(Note that the life diagnosis of this function should be used as a guideline only, because with the exception of the main circuit capacitor, the life values are theoretical calculations.)

Pr.	Name	Initial value	Setting range	Description
255 E700	**Life alarm status display**	0	(0 to 255)*1	Displays whether or not the parts of the control circuit capacitor, main circuit capacitor, cooling fan, and inrush current limit circuit have reached the life alarm output level. Read-only.
256 E701 *2	**Inrush current limit circuit life display**	100%	(0 to 100%)	Displays the deterioration degree of the inrush current limit circuit. Read-only.
257 E702	**Control circuit capacitor life display**	100%	(0 to 100%)	Displays the deterioration degree of the control circuit capacitor. Read-only.
258 E703 *2	**Main circuit capacitor life display**	100%	(0 to 100%)	Displays the deterioration degree of the main circuit capacitor. Read-only. The value measured by **Pr.259** is displayed.
259 E704 *2	**Main circuit capacitor life measuring**	0	0, 1(2, 3, 8, 9)	Setting "1" and turning the power supply OFF starts the measurement of the main circuit capacitor life. If the setting value of **Pr.259** becomes "3" after turning the power supply ON again, it means that the measurement is completed. The deterioration degree is read to **Pr.258**.
			11(12, 13, 18, 19)	When "11" is set, turning OFF the power supply starts the measurement of the main circuit capacitor life. If the setting value of **Pr.259** becomes "13" after turning the power supply ON again, it means that the measurement is completed. The degree of deterioration is read to **Pr.258**.
506 E705 *2	**Display estimated main circuit capacitor residual life**	100%	(0 to 100%)	Displays the estimated residual life of the main circuit capacitor. Read-only.
507 E706	**Display/reset ABC1 relay contact life**	100%	0 to 100%	Displays the degree of deterioration of the relay contacts of terminals A1, B1, and C1.
508 E707	**Display/reset ABC2 relay contact life**	100%	0 to 100%	Displays the degree of deterioration of the relay contacts of terminals A2, B2, and C2.

*1 The setting range (read-only) differs depending on the inverter model (standard model or separate converter type).

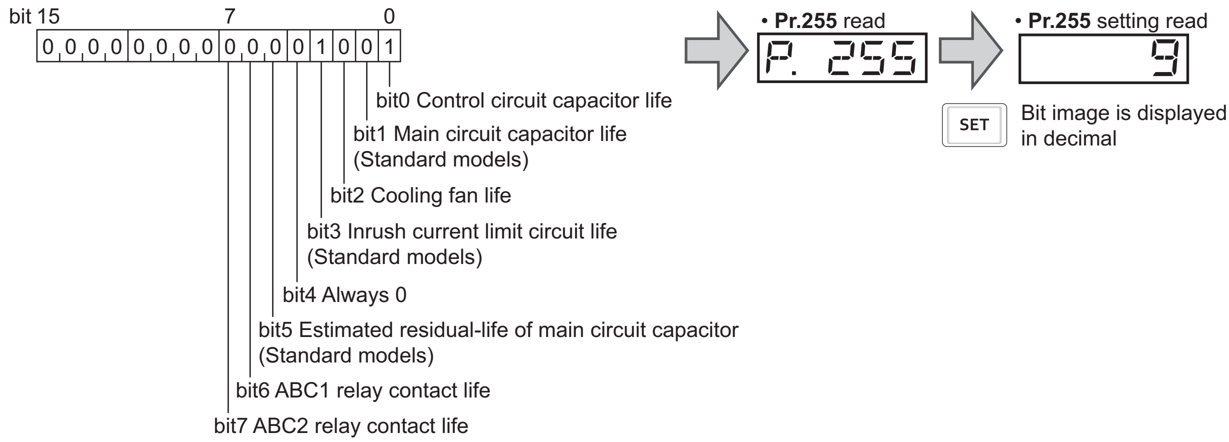
*2 The setting is available only for standard models.

◆ Life alarm display and signal output (Y90 signal, Pr.255)

Point

• In the life diagnosis of the main circuit capacitor, the alarm signal (Y90) is not output unless measurement by turning OFF the power supply is performed.

- Whether or not the parts of the control circuit capacitor, main circuit capacitor, cooling fan, inrush current limit circuit, or relay contacts of terminals A, B, and C have reached the life alarm output level can be checked with **Pr.255 Life alarm status display** and the Life alarm (Y90) signal.



- When the parts have reached the life alarm output level, the corresponding bits of **Pr.255** turns ON. The ON/OFF state of the bits can be checked with **Pr.255**. The following table shows examples.

Pr.255		bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	Remarks
Decimal	Binary									
239	11101111	○	○	○	×	○	○	○	○	All parts have reached alarm output level for standard structure models.
5	101	×	×	×	×	×	○	×	○	Control circuit capacitor and cooling fan have reached alarm output level.
0	0	×	×	×	×	×	×	×	×	No parts have reached alarm output level.

○: Parts reaching alarm output level ×: Parts not reaching alarm output level

- Diagnosable parts differ depending on the type of the inverter.

Part	Applicable inverter	
	Standard model	Separated converter type
Control circuit capacitor	○	○
Main circuit capacitor	○	×
Cooling fan	○	○
Inrush current limit circuit	○	×
Main circuit capacitor (estimated residual life)	○	×
ABC relay contact	○	○

○: Diagnosable, ×: Undiagnosable

- The Life alarm (Y90) signal turns ON when the life alarm output level is reached for either of the following: the control circuit capacitor life, main circuit capacitor life, cooling fan life, inrush current limit circuit life, estimated residual-life of the main circuit capacitor, ABC1 relay contact life, or ABC2 relay contact life.
- For the terminal used for the Y90 signal, set "90" (positive logic) or "190" (negative logic) in any of **Pr.190 to Pr.196 (Output terminal function selection)**.

NOTE

- When using an option (FR-A8AY, FR-A8AR, FR-A8NC, FR-A8NCE, FR-A8NCG), the life can be output separately to the Control circuit capacitor life (Y86) signal, Main circuit capacitor life (Y87) signal, Cooling fan life (Y88) signal, Inrush current limit circuit life (Y89) signal, Estimated residual-life of main circuit capacitor (Y248) signal, ABC1 relay contact life (Y249) signal, and ABC2 relay contact life (Y250) signal.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Life display of the inrush current limit circuit (Pr.256) (Standard models)

- The life of the inrush current limit circuit (relay, contactor and inrush resistor) is displayed in **Pr.256**.
- The number of contact (relay, contactor, thyristor) ON times is counted, and it is counted down from 100% (0 time) every 1%/10,000 times. As soon as 10% (900,000 times) is reached, **Pr.255** bit 3 is turned ON and also a warning is output to the Y90 signal.

◆ Life display of the control circuit capacitor (Pr.257)

- The deterioration degree of the control circuit capacitor is displayed in **Pr.257**.
- In the operating status, the control circuit capacitor life is calculated from the energization time and temperature, and is counted down from 100%. As soon as the control circuit capacitor life falls below 10%, **Pr.255** bit 0 is turned ON and also a warning is output to the Y90 signal

◆ Life display of the main circuit capacitor (Pr.258, Pr.259) (Standard models)

Point

- For accurate life measurement of the main circuit capacitor, wait three hours or longer after turning OFF. The temperature left in the main circuit capacitor affects measurement.

- The deterioration degree of the main circuit capacitor is displayed in **Pr.258**.
- With the main circuit capacitor capacity at factory shipment as 100%, the capacitor life is displayed in **Pr.258** every time measurement is made. When the measured value falls to 85% or lower, **Pr.255** bit 1 is turned ON and also a warning is output to the Y90 signal.
- Measure the capacitor capacity according to the following procedure and check the deterioration degree of the capacitor capacity.

1. Check that the motor is connected and at a stop.
2. Set "1 or 11" (measuring start) in **Pr.259**.
3. Switch the power OFF. The inverter applies DC voltage to the motor to measure the capacitor capacity while the inverter is OFF.
4. After confirming that the power lamp is OFF, turn ON the power again.
5. Check that "3 or 13" (measurement complete) 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, 11	Measurement start	Measurement starts when the power supply is switched OFF. (Only once when **Pr.259** = "1") When **Pr.259** = "11", the measurement starts every time the power supply is turned OFF.
2, 12	During measurement	Only displayed and cannot be set. (When "11" is set in **Pr.259**, "12, 13, 18, or 19" is displayed.)
3, 13	Measurement complete	
8, 18	Forced end	
9, 19	Measurement error	

NOTE

- When the main circuit capacitor life is measured under the following conditions, "forced end" (**Pr.259** = "8 or 18"), or "measurement error" (**Pr.259** = "9 or 19") may occur, or the status may remain in "measurement start" (**Pr.259** = "1 or 11"). To perform measurement, first eliminate the following conditions. Under the following conditions, even if "measurement complete" (**Pr.259** = "3 or 13") is reached, measurement cannot be performed correctly.

  Terminals R1/L11, S1/L21 or DC power supply is connected to terminals P/+ and N/-.
  The power supply is switched ON during measurement.
  The motor is not connected to the inverter.
  The motor is running (coasting).
  The motor capacity is smaller than the inverter capacity by two ranks or more.
  The inverter is tripped or a fault occurred while the power was OFF.
  The inverter output is shut off with the MRS signal.
  The start command is given while measuring.
  The applied motor setting is incorrect.
- Operation environment: surrounding air temperature (annual average of 40°C (free from corrosive gas, flammable gas, oil mist, dust and dirt)). Output current (80% of the inverter rating)
- Since repeated inrush currents at power ON will shorten the life of the converter circuit, frequent starts and stops of the magnetic contactor must be avoided.

5

WARNING

- When measuring the main circuit capacitor capacity (**Pr.259** = "1 or 11"), the DC voltage is applied to the motor for about 1 s at power OFF. Never touch the motor terminal, etc. right after powering OFF to prevent an electric shock.

◆ Life display of the cooling fan

- When the cooling fan approaches the end of its life and a low rotation speed is detected for the cooling fan, the fan alarm (FN) is displayed on the operation panel or the parameter unit. As an alarm display, **Pr.255** bit 2 is turned ON and also a warning is output to the Y90 signal and Alarm (LF) signal.
- For the terminal used for the LF signal, set "98" (positive logic) or "198" (negative logic) in any of **Pr.190 to Pr.196 (Output terminal function selection)**.

NOTE

- When the inverter is mounted with two ore more cooling fans, "FN" is displayed with one or more fans with speed of 50% or less.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.
- For replacement of each part, contact the nearest Mitsubishi Electric FA center.

◆ Estimated residual life display of the main circuit capacitor (Pr.506) (Standard models)

- Even when the power supply cannot be turned OFF, the remaining life of the main circuit capacitor can be estimated without stopping the operation. Note that the remaining life of the main circuit capacitor estimated by this function is theoretical, and should be used as a guideline only.
- The estimated residual life of the main circuit capacitor is displayed in **Pr.506**.
- The remaining life of the main circuit capacitor is calculated from the energization time and the inverter output power (100% = Start of service life). When the remaining life of the main circuit capacitor falls below 10%, bit 5 of **Pr.255 Life alarm status display** turns ON and a warning is output by the Y90 signal.

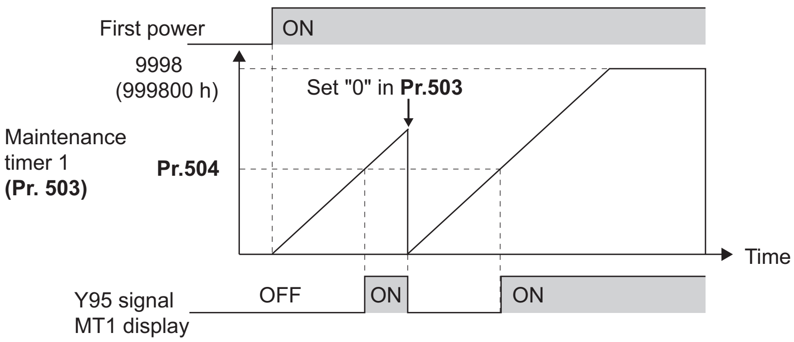
◆ Life display of the relay contacts of terminals A, B, and C (Pr.507, Pr.508)

- The degree of deterioration of the relay contacts of terminals A1, B1, and C1 is displayed in **Pr.507**, and that for terminals A2, B2, and C2 is displayed in **Pr.508**.
- The number of times the contacts of relay turn ON is counted down from 100% (0 time) by 1% (500 times). When the counter reaches 10% (45,000 times), bit 6 or bit 7 of **Pr.255** turns ON and a warning is output by the Y90 signal.
- Any value can be set in **Pr.507** and **Pr.508**. After replacement of the control circuit terminal block or installation of a control terminal option, set **Pr.507** and **Pr.508** again.

5.4.17 Maintenance timer alarm

The Maintenance timer (Y95) signal is output when the inverter's cumulative energization time reaches the time period set with the parameter. MT1, MT2 or MT3 is displayed on the operation panel.
This can be used as a guideline for the maintenance time of peripheral devices.

Pr.	Name	Initial value	Setting range	Description
503 **E710**	**Maintenance timer 1**	0	0 (1 to 9998)	Displays the inverter's cumulative energization time in increments of 100 h (read-only). Writing the setting of "0" clears the cumulative energization time while **Pr.503** = "1 to 9998". (Writing is disabled when **Pr.503** = "0".)
504 **E711**	**Maintenance timer 1 warning output set time**	9999	0 to 9998	Set the time until the Maintenance timer (Y95) signal is output. MT1 is displayed on the operation panel.
			9999	No function
686 **E712**	**Maintenance timer 2**	0	0 (1 to 9998)	The same function as **Pr.503**.
687 **E713**	**Maintenance timer 2 warning output set time**	9999	0 to 9998	The same function as **Pr.504**. MT2 is displayed on the operation panel.
			9999	
688 **E714**	**Maintenance timer 3**	0	0 (1 to 9998)	The same function as **Pr.503**.
689 **E715**	**Maintenance timer 3 warning output set time**	9999	0 to 9998	The same function as **Pr.504**. MT3 is displayed on the operation panel.
			9999	



Operation example of the maintenance timer 1 (**Pr.503, Pr.504**) (with both MT2 and MT3 OFF)

- The cumulative energization time of the inverter is stored in the EEPROM every hour and displayed in **Pr.503 (Pr.686, Pr.688)** in 100 h increments. **Pr.503 (Pr.686, Pr.688)** is clamped at 9998 (999800 h).
- When the value in **Pr.503 (Pr.686, Pr.688)** reaches the time (100 h increments) set in **Pr.504 (Pr.687, Pr.689)**, the Maintenance timer (Y95) signal is output, and also MT1, MT2, or MT3 is displayed on the operation panel.
- For the terminal used for Y95 signal output, assign the function by setting "95 (positive logic)" or "195 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.

NOTE

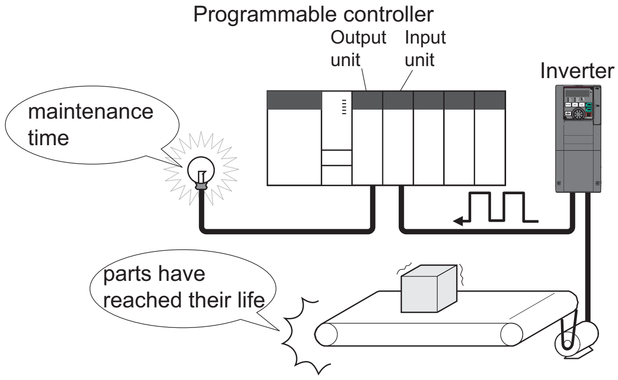
- The Y95 signal turns ON when any of MT1, MT2 or MT3 is activated. It does not turn OFF unless all of MT1, MT2 and MT3 are cleared.
- If all of MT1, MT2 and MT3 are activated, they are displayed in the priority of "MT1 > MT2 > MT3".
- The cumulative energization time is counted every hour. Energization time of less than 1 h is not counted.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

5.4.18 Current average value monitor signal

The output current average value during constant-speed operation and the maintenance timer value are output to the Current average monitor (Y93) signal as a pulse. The output pulse width can be used in a device such as the I/O unit of a programmable controller as a guideline for the maintenance time for mechanical wear, belt stretching, or deterioration of devices with age.
The pulse is repeatedly output during constant-speed operation in cycles of 20 s to the Current average monitor (Y93) signal.

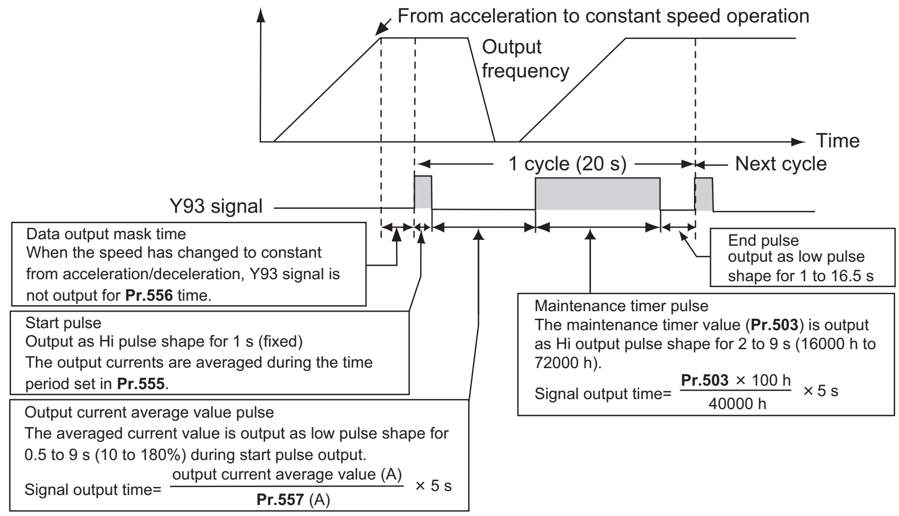


Pr.	Name	Initial value	Setting range	Description
555 **E720**	**Current average time**	1 s	0.1 to 1 s	Set the time for calculating the average current during start pulse output (1 s).
556 **E721**	**Data output mask time**	0 s	0 to 20 s	Set the time for not obtaining (masking) transitional state data.
557 **E722**	**Current average value monitor signal output reference current**	Inverter rated current	0 to 500 A*1 0 to 3600 A*2	Set the reference (100%) for outputting the output current average value signal.

*1 Initial value for the FR-F860-00680 or lower.
*2 Initial value for the FR-F860-01080 and higher.

◆ Operation example

- The pulse output of the Current average monitor (Y93) signal is indicated below.
- For the terminal used for Y93 signal output, assign the function by setting "93 (positive logic)" or "193 (negative logic)" in any of **Pr.190 to Pr.194 (Output terminal function selection)**. (This cannot be assigned by setting in **Pr.195 ABC1 terminal function selection or Pr.196 ABC2 terminal function selection**.)



◆ Pr.556 Data output mask time setting

- Immediately after acceleration/deceleration is shifted to constant-speed operation, the output current is unstable (transitional state). Set the time for not obtaining (masking) transitional state data in **Pr.556**.

◆ Pr.555 Current average time setting

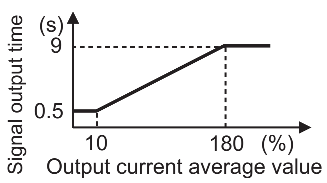
- The output current average is calculated during start pulse (1 s) HIGH output. Set the time for calculating the average current during start pulse output in **Pr.555**.

◆ Pr.557 Current average value monitor signal output reference current setting

- Set the reference (100%) for outputting the output current average value signal. The signal output time is calculated with the following formula.

$$\frac{\text{Output current average value}}{\textbf{Pr.557}\text{ setting value}} \times 5\text{ s} \quad \text{(Output current average value 100\%/5 s)}$$

The output time range is 0.5 to 9 s. When the output current average value is less than 10% of the setting value in **Pr.557**, the output time is 0.5 s, and when it is more than 180%, the output time is 9 s.
For example, when **Pr.557** = "10 A" and the output current average value is 15 A:
15 A/10 A × 5 s = 7.5 s, thus the current average value monitor signal is Low output in 7.5 s intervals.

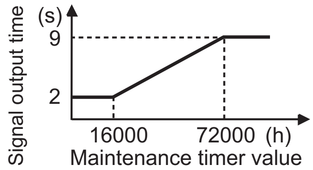


◆ Pr.503 Maintenance timer 1 output

- After LOW output of the output current value is performed, HIGH output of the maintenance timer value is performed. The maintenance timer value output time is calculated with the following formula.

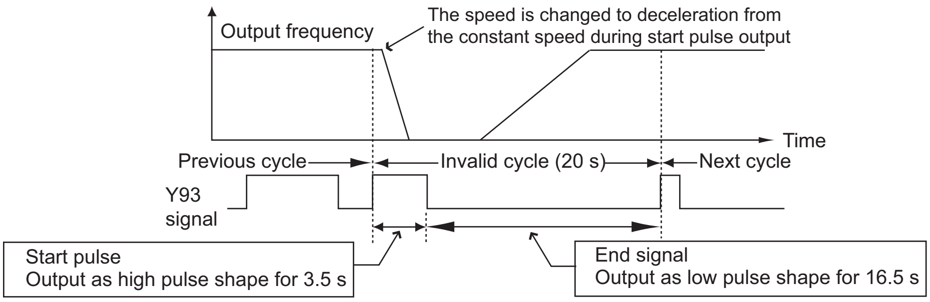
$$\frac{\textbf{Pr.503} \times 100}{40000\text{h}} \times 5\ \text{s} \qquad \text{(Maintenance timer value 100\%/5 s)}$$

The output time range is 2 to 9 s. When **Pr.503** is less than 16000 h, the output time is 2 s, and when it is more than 72000 h, the output time is 9 s.



NOTE

- Masking of the data output and sampling of the output current are not performed during acceleration/deceleration.
- If constant speed changes to acceleration or deceleration during start pulse output, it is judged as invalid data, and HIGH output in 3.5 s intervals is performed for the start pulse and LOW output in 16.5 s intervals is performed for the end signal. After the start pulse output is completed, minimum 1-cycle signal output is performed even if acceleration/deceleration is performed.



- If the output current value (inverter output current monitor) is 0 A at the completion of the 1-cycle signal output, no signal is output until the next constant-speed state.
- Under the following conditions, the Y93 signal is output with Low output in 20 s intervals (no data output).

  When acceleration or deceleration is operating at the completion of the 1-cycle signal output

  When automatic restart after instantaneous power failure (**Pr.57 Restart coasting time** ≠ "9999") is set, and the 1-cycle signal output is completed during the restart operation

  When automatic restart after instantaneous power failure (**Pr.57** ≠ "9999") is set, and the restart operation was being performed at the completion of data output masking
- **Pr.686 Maintenance timer 2** and **Pr.688 Maintenance timer 3** cannot be output.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.57 Restart coasting time ☞ page 448

Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

Pr.503 Maintenance timer 1, Pr.686 Maintenance timer 2, Pr.688 Maintenance timer 3 ☞ page 186

5.5 (F) Setting of acceleration/deceleration time and acceleration/deceleration pattern

Purpose	Parameter to set			Refer to page
To set the motor acceleration/ deceleration time	Acceleration/deceleration time	P.F000 to P.F003, P.F010, P.F011, P.F020 to P.F022, P.F040, P.F070, P.F071, P.H710	Pr.7, Pr.8, Pr.16, Pr.20, Pr.21, Pr.44, Pr.45, Pr.147, Pr.611, Pr.791, Pr.792, Pr.815, Pr.1103	190
To set the acceleration/ deceleration pattern suitable for an application	Acceleration/deceleration pattern and backlash measures	P.F100, P.F200 to P.F203	Pr.29, Pr.140 to Pr.143	194
To command smooth speed transition with terminals	Remote setting function	P.F101	Pr.59	197
To set the starting frequency	Starting frequency and start-time hold	P.F102, P.F103	Pr.13, Pr.571	201, 202

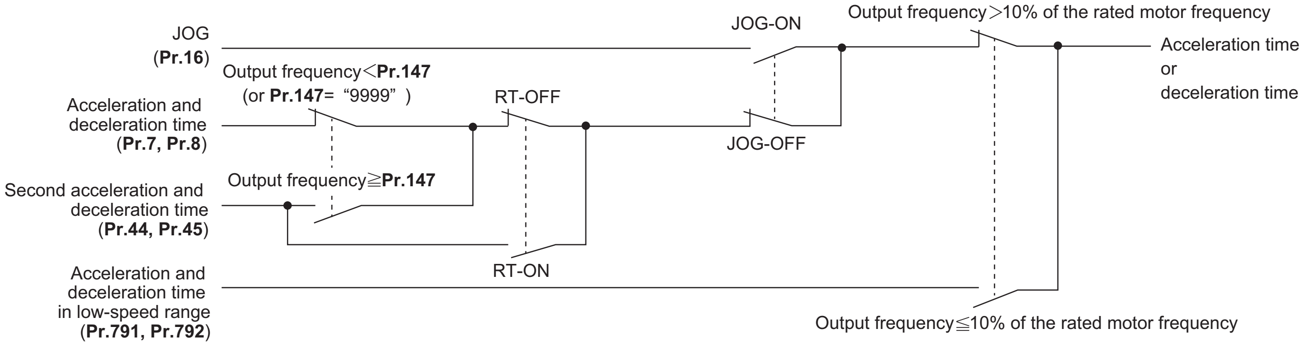
5.5.1 Setting the acceleration and deceleration time

The following parameters are used to set motor acceleration/deceleration time.
Set a larger value for a slower acceleration/deceleration, and a smaller value for a faster acceleration/deceleration.
For the acceleration time at automatic restart after instantaneous power failure, refer to **Pr.611 Acceleration time at a restart** (page 448).

Pr.	Name	Initial value	Setting range	Description
20 F000	**Acceleration/deceleration reference frequency**	60 Hz	1 to 590 Hz	Set the frequency that will be the basis of acceleration/ deceleration time. As acceleration/deceleration time, set the frequency change time from a stop status to **Pr.20**.
21 F001	**Acceleration/deceleration time increments**	0	0	Increment: 0.1 s — Select the increment for the acceleration/deceleration time setting.
			1	Increment: 0.01 s
16 F002	**Jog acceleration/ deceleration time**	0.5 s	0 to 3600 s	Set the acceleration/deceleration time for JOG operation (from stop status to **Pr.20**). Refer to page 224.
611 F003	**Acceleration time at a restart**	9999	0 to 3600 s	Set the acceleration time for restart (from stop status to **Pr.20**).
			9999	Standard acceleration time (for example, **Pr.7**) is applied as the acceleration time at restart. Refer to page 448.
7 F010	**Acceleration time**	5 s[*1]	0 to 3600 s	Set the motor acceleration time (from stop status to **Pr.20**).
		15 s[*2]		
8 F011	**Deceleration time**	10 s[*1]	0 to 3600 s	Set the motor deceleration time (from **Pr.20** to stop status).
		30 s[*2]		
44 F020	**Second acceleration/ deceleration time**	5 s	0 to 3600 s	Set the acceleration/deceleration time when the RT signal is ON.
45 F021	**Second deceleration time**	9999	0 to 3600 s	Set the deceleration time when the RT signal is ON.
			9999	Acceleration time = deceleration time
147 F022	**Acceleration/deceleration time switching frequency**	9999	0 to 590 Hz	Set the frequency where the acceleration/deceleration time switches to the time set in **Pr.44** and **Pr.45**.
			9999	No function
791 F070	**Acceleration time in low-speed range**	9999	0 to 3600 s	Set the acceleration time in a low-speed range (less than 10% of the rated motor frequency).
			9999	The acceleration time set in **Pr.7** is applied. (While RT signal is ON, the second function is enabled.)
792 F071	**Deceleration time in low-speed range**	9999	0 to 3600 s	Set the deceleration time in a low-speed range (less than 10% of the rated motor frequency).
			9999	The deceleration time set in **Pr.8** is applied. (While RT signal is ON, the second function is enabled.)
815 H710	**Torque limit level 2**	9999	0 to 400%	Set the torque limit level at a deceleration by turning ON the X92 signal.
			9999	The torque limit set to **Pr.22** is valid.
1103 F040	**Deceleration time at emergency stop**	5 s	0 to 3600 s	Set the motor deceleration time at a deceleration by turning ON the X92 signal.

*1 Initial value for the FR-F860-00090 or lower.
*2 Initial value for the FR-F860-00170 or higher.

◆ Control block diagram



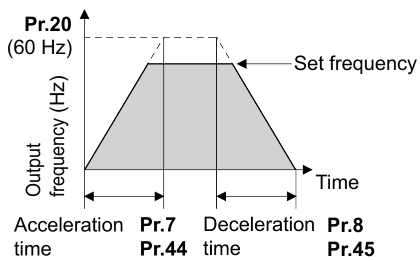
◆ Acceleration time setting (Pr.7, Pr.20)

- Use **Pr.7 Acceleration time** to set the acceleration time required to reach **Pr.20 Acceleration/deceleration reference frequency** from stop status.
- Set the acceleration time according to the following formula.

Acceleration time setting = **Pr.20** × Acceleration time from stop status to maximum frequency / (maximum frequency - **Pr.13**)

- For example, the following calculation is performed to find the setting value for **Pr.7** when increasing the output frequency to the maximum frequency of 50 Hz in 10 s with **Pr.20** = "60 Hz (initial value)" and **Pr.13** = "0.5 Hz".

Pr.7 = 60 Hz × 10 s / (50 Hz - 0.5 Hz) ≒12.1 s



◆ Deceleration time setting (Pr.8, Pr.20)

- Use **Pr.8 Deceleration time** to set the deceleration time required to reach a stop status from to **Pr.20 Acceleration/ deceleration reference frequency**.
- Set the deceleration time according to the following formula.

Deceleration time setting = **Pr.20** × deceleration time from maximum frequency to stop / (maximum frequency - **Pr.10**)

- For example, the following calculation is used to find the setting value for **Pr.8** when increasing the output frequency to the maximum frequency of 50 Hz in 10 s with **Pr.20** = 120 Hz and **Pr.10** = 3 Hz.

Pr.8 = 120 Hz × 10 s / (50 Hz - 3 Hz) ≒25.5 s

NOTE

- If the acceleration/deceleration time is set, the actual motor acceleration/deceleration time cannot be made shorter than the shortest acceleration/deceleration time determined by the mechanical system J (moment of inertia) and motor torque.
- 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.
- Under PM motor control, if the protective function (E.OLT) is activated due to insufficient torque in the low-speed range, set longer acceleration/deceleration times only in the low-speed range in **Pr.791 Acceleration time in low-speed range** and **Pr.792 Deceleration time in low-speed range**.

◆ Changing the minimum increment of the acceleration/deceleration time (Pr.21)

- Use **Pr.21** to set the minimum increment of the acceleration/deceleration time.

Setting value "0" (initial value): minimum increment 0.1 s

Setting value "1": minimum increment 0.01 s

- **Pr.21** setting allows the minimum increment of the following parameters to be changed.

Pr.7, Pr.8, Pr.16, Pr.44, Pr.45, Pr.111, Pr.264, Pr.265, Pr.582, Pr.583, Pr.791, Pr.792, Pr.1103, Pr.1477, Pr.1478

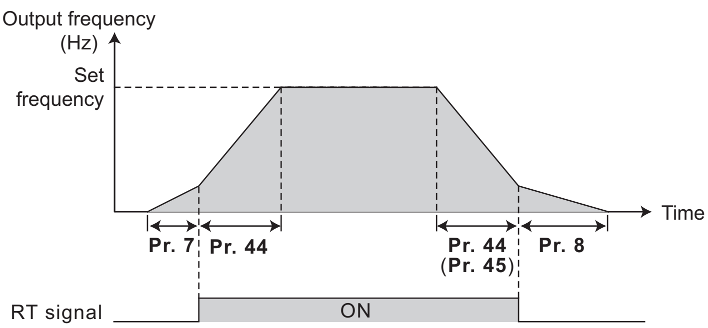
NOTE

- **Pr.21** setting does not affect the minimum increment setting of **Pr.611 Acceleration time at a restart**.
- The parameter can be set in five digits including the numbers below decimal point for the FR-PU07. A "1000" or more value is set in increments of 0.1 s even if **Pr.21** = "1".

◆ Setting multiple acceleration/deceleration times (RT signal, Pr.44, Pr.45, Pr.147)

- **Pr.44 and Pr.45** are valid when the RT signal is ON or when the output frequency is equal to or higher than the frequency set in **Pr.147 Acceleration/deceleration time switching frequency**.
- Even at the frequency lower than the **Pr.147** setting, turning ON the RT signal will switch the acceleration/deceleration time to the second acceleration/deceleration time. The priority of the signals and settings is RT signal > **Pr.147** setting.
- When "9999" is set in **Pr. 45**, the deceleration time becomes equal to the acceleration time (**Pr. 44**).
- If the **Pr.147** setting is equal to or less than the **Pr.10 DC injection brake operation frequency** or the **Pr.13 Starting frequency** setting, the acceleration/deceleration time switches to the **Pr.44 (Pr.45)** when the output frequency reaches or exceeds the **Pr.10 or Pr.13** setting.

Pr.147 setting	Acceleration/deceleration time	Description
9999 (initial value)	**Pr.7, Pr.8**	Acceleration/deceleration time is not automatically changed.
0.00 Hz	**Pr.44, Pr.45**	Second acceleration/deceleration time is applied from the start.
0.01 Hz ≤ **Pr.147** ≤ set frequency	Output frequency < **Pr.147**: **Pr.7, Pr.8** **Pr.147** ≤ output frequency: **Pr.44, Pr.45**	Acceleration/deceleration time is automatically changed.
Set frequency < **Pr.147**	**Pr.7, Pr.8**	Not changed as the frequency has not reached the switchover frequency.

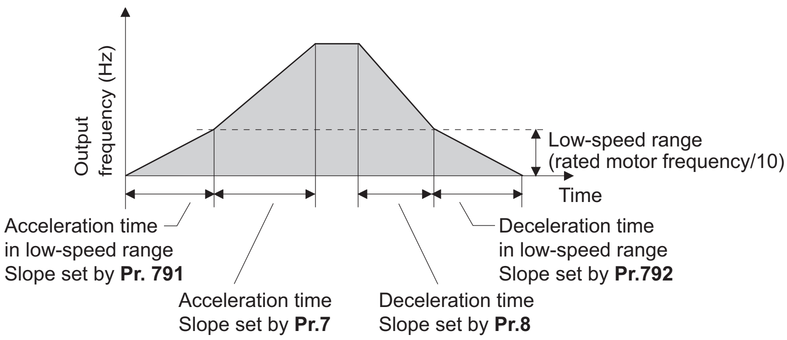


NOTE

- The reference frequency during acceleration/deceleration depends on the **Pr.29 Acceleration/deceleration pattern selection** setting. (Refer to page 194.)
- The RT signal can be assigned to an input terminal by setting **Pr.178 to Pr.189 (Input terminal function selection)**. Changing the terminal assignment may affect other functions. Set parameters after confirming the function of each terminal.
- The RT signal acts as the second function selection signal and makes the other second functions valid. (Refer to page 348.)
- RT signal is assigned to the terminal RT in the initial status. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.

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

- If torque is required in the low-speed range (less than 10% of the rated motor frequency) under PM motor control, set the **Pr.791 Acceleration time in low-speed range** and **Pr.792 Deceleration time in low-speed range** settings higher than the **Pr.7 Acceleration time and Pr.8 Deceleration time** settings so that the mild acceleration/deceleration is performed in the low-speed range. (When RT signal is turned ON, the second acceleration/deceleration time setting is prioritized.)

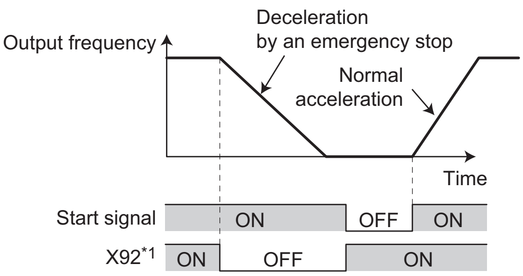


NOTE

- Set **Pr.791** higher than **Pr.7**, and **Pr.792** higher than **Pr.8**. If set as **Pr.791** < **Pr.7**, the operation is performed as **Pr.791** = **Pr.7**. If set as **Pr.792** < **Pr.8**, the operation is performed as **Pr.792** = **Pr.8**.

◆ Emergency stop function (Pr.1103, Pr.815)

- When a fault occurs in the superordinate controller, the motor can be decelerated by the signal input via an external terminal.
- The motor will decelerate to stop according to the settings of **Pr.1103 Deceleration time at emergency stop** and **Pr.815 Torque limit level 2** when the Emergency stop (X92) signal is turned OFF (when the contact is opened).
- To input the X92 signal, set "92" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to a terminal.
- The X92 signal is a normally closed input (NC contact input).
- "PS" is displayed on the operation panel during activation of the emergency stop function.



*1 ON/OFF indicates the input status of the physical terminal.

NOTE

- The X92 signals can be assigned to an input terminal by setting **Pr.178 to Pr.189 (Input terminal function selection)**. Changing the terminal assignment may affect other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.3 Base frequency ☞ page 539
Pr.10 DC injection brake operation frequency ☞ page 546
Pr.29 Acceleration/deceleration pattern selection ☞ page 194
Pr.125, Pr.126 (frequency setting gain frequency) ☞ page 328
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.264 Power-failure deceleration time 1, Pr.265 Power-failure deceleration time 2 ☞ page 458

5.5.2 Acceleration/deceleration pattern

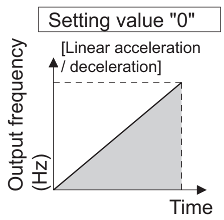
The acceleration/deceleration pattern can be set according to the application.

In addition, the backlash measures that stop acceleration/deceleration by the frequency or time set with parameters at acceleration/deceleration can be set.

Pr.	Name	Initial value	Setting range	Description
29 **F100**	**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 **F200**	**Backlash acceleration stopping frequency**	1 Hz	0 to 590 Hz	Set the stopping frequency and time during backlash measures. Valid by backlash measures (**Pr.29**="3").
141 **F201**	**Backlash acceleration stopping time**	0.5 s	0 to 360 s	
142 **F202**	**Backlash deceleration stopping frequency**	1 Hz	0 to 590 Hz	
143 **F203**	**Backlash deceleration stopping time**	0.5 s	0 to 360 s	

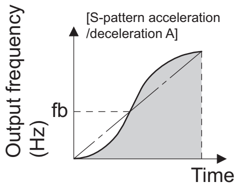
◆ Linear acceleration/deceleration (Pr.29 = "0" initial value)

- When the frequency is changed for acceleration, deceleration, etc. during 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.



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

- Use this when acceleration/deceleration is required for a short time until a high-speed area equal to or higher than the base frequency, such as for the main shaft of the machine.
- The acceleration/deceleration pattern has the **Pr.3 Base frequency** (**Pr.84 Rated motor frequency** under PM motor control) (fb) as the point of inflection in an S-pattern curve, and the acceleration/deceleration time can be set to be suitable for the motor torque reduction in the constant-power operation range at the base frequency (fb) or more.



- Acceleration/deceleration time calculation method when the set frequency is equal to or higher than the base frequency

Acceleration time t = (4/9) × (T/fb^2) × f^2 + (5/9) × T Where T is the acceleration/deceleration time (s), f is the set frequency (Hz), and fb is the base frequency (rated motor frequency)

- Reference (0 Hz to set frequency) of acceleration/deceleration time when **Pr.3** = "60 Hz"

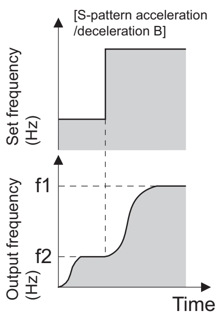
Acceleration/deceleration time (s)	Set frequency (Hz)			
	60	120	200	400
5	5	12	27	102
15	15	35	82	305

NOTE

- For the acceleration/deceleration time setting of the S-pattern acceleration/deceleration A, set the time to **Pr.3** (**Pr.84** under PM motor control) instead of **Pr.20 Acceleration/deceleration reference frequency**.

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

- This is useful for preventing collapsing stacks such as on a conveyor. S-pattern acceleration/deceleration B can reduce the impact during acceleration/deceleration by accelerating/decelerating while maintaining an S-pattern from the present frequency (f2) to the target frequency (f1).

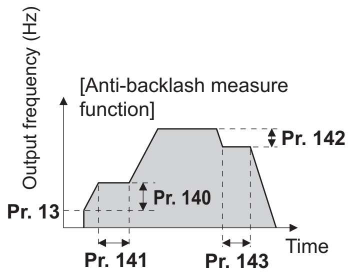


NOTE

- When the RT signal turns ON during acceleration or deceleration with the S-pattern acceleration/deceleration B enabled, a pattern of acceleration or deceleration changes to linear at the moment.

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

- 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**.

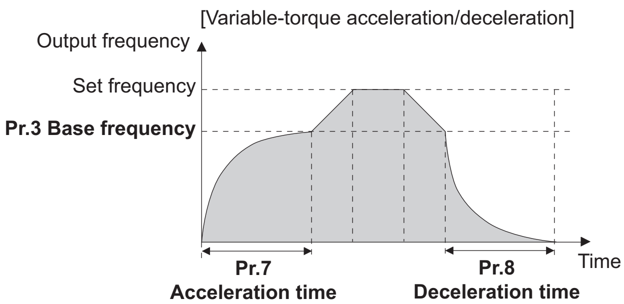


NOTE

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

◆ Variable-torque acceleration/deceleration (Pr.290 = "6")

- This function is suitable to accelerate/decelerate a variable torque load such as a fan and blower in a short time. Linear acceleration/deceleration is performed in the area where the output frequency > base frequency.



NOTE

- When the base frequency is out of the range 45 to 65 Hz, the linear acceleration/deceleration is performed even if **Pr.29** = "6".
- Even if **Pr.14 Load pattern selection** = "1 (variable torque load)", variable torque acceleration/deceleration setting is prioritized and the inverter operates as **Pr.14** = "0 (constant torque load)".
- For the variable torque acceleration/deceleration time setting, set the time period to reach **Pr.3 Base frequency**. (Not the time period to reach **Pr.20 Acceleration/deceleration reference frequency**.)
- The variable torque acceleration/deceleration is disabled during PM motor control. (Linear acceleration/deceleration is performed.)

Parameters referred to

Pr.3 Base frequency ☞ page 539
Pr.7 Acceleration time, Pr.8 Deceleration time, Pr.20 Acceleration/deceleration reference frequency ☞ page 190
Pr.10 DC injection brake operation frequency ☞ page 546
Pr.178 to Pr.182 (Input terminal function selection) ☞ page 343

5.5.3 Remote setting function

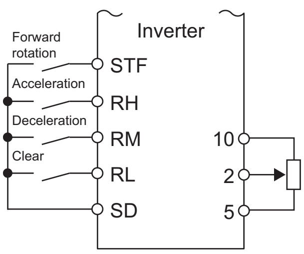
Even if the operation panel is located away from the enclosure, contact signals can be used to perform continuous variable-speed operation, without using analog signals.

Pr.	Name	Initial value	Setting range	Description		
				RH, RM, RL signal function	Frequency setting storage function	Deceleration to the frequency lower than the set frequency
59 **F101**	**Restart cushion time**	0	0	Multi-speed setting	-	Disabled
			1	Remote setting	With	
			2	Remote setting	Without	
			3	Remote setting	Without (Turning STF/STR OFF clears remotely-set frequency.)	
			11	Remote setting	With	Enabled
			12	Remote setting	Without	
			13	Remote setting	Without (Turning STF/STR OFF clears remotely-set frequency.)	

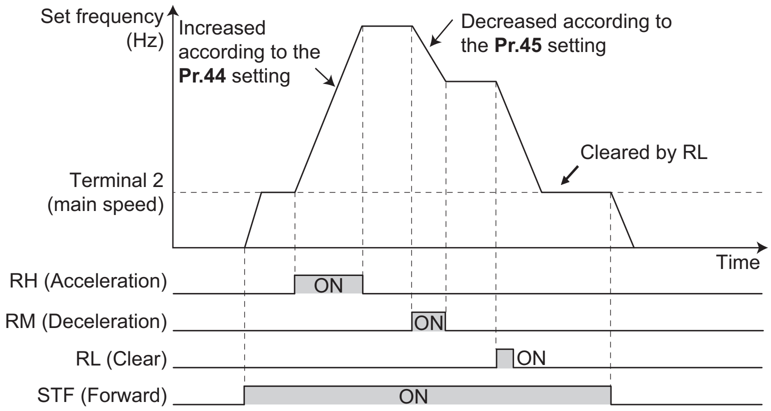
◆ Remote setting function

• When **Pr.59** ≠ "0" (remote setting enabled), the functions of the signals are as shown in the following table.

Signal name	Function	Description
STF/STR	Forward/Reverse	The inverter accelerates the motor in the forward or reverse direction up to the main speed or to the frequency stored by the remote setting function.
RH	Acceleration	The set frequency increases according to the **Pr.44** setting.
RM	Deceleration	The set frequency decreases according to the **Pr.45** setting.
RL	Clear	The set frequency is cleared and the main speed is applied.
Terminal 2 (analog signal)	Main speed	The setting of the main speed is used as a base. The main speed is increased by the RH signal and decreased by the RM signal.



Connection diagram for remote setting



◆ Main speed

• The main speed used in the remote setting corresponds with each of the following operation modes.

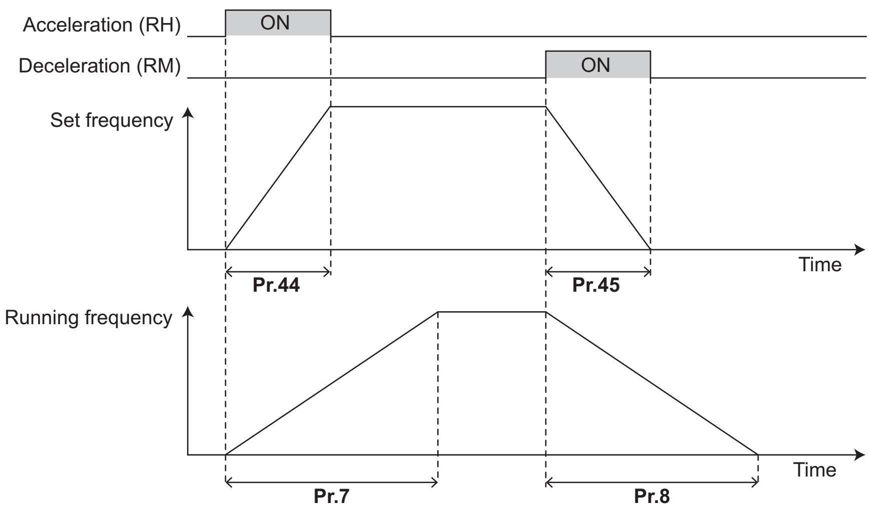
Operation mode	Main speed
PU operation mode / NET operation mode	Digital setting
External operation mode / PU/External combined operation mode 2 (**Pr.79** = "4")	Analog input*1
PU/External combined operation mode 1 (**Pr.79** = "3")	Analog input via terminal 4 (AU signal ON)*1

*1 Set **Pr.28 Multi-speed input compensation selection** to "1" when enabling compensation for input via terminal 1.

◆ Acceleration/deceleration operation

- The running frequency changes as follows when the set frequency is changed by the remote setting function.

Frequency	Time setting	Description
Set frequency	**Pr.44/Pr.45**	The set frequency increases/decreases by remote setting according to the **Pr.44/Pr.45** setting.
Running frequency	**Pr.7/Pr.8**	The running frequency increases/decreases by the set frequency according to the **Pr.7/Pr.8** setting.

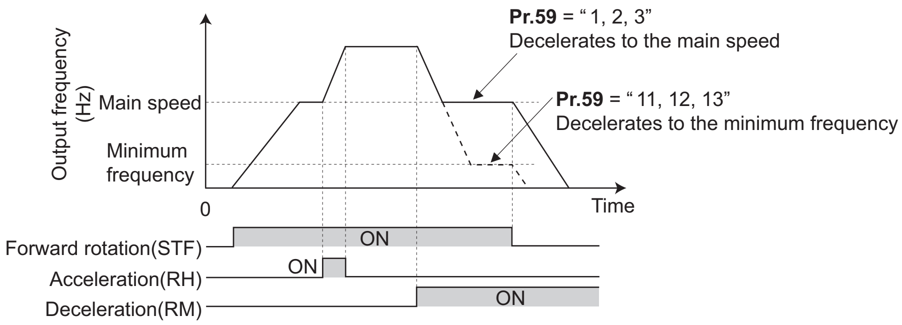


NOTE

- If the time setting of the running frequency is longer than the time setting of the set frequency, the motor accelerates/decelerates according to the time setting of the running frequency.

- Deceleration to the main speed or lower

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).



- Regardless of whether the remote setting is enabled or disabled, the acceleration/deceleration time set for the running frequency can be changed to the second acceleration/deceleration time by turning ON the RT signal.
- The acceleration/deceleration time setting of the set frequency is fixed at the **Pr.44/Pr.45** setting.

◆ Frequency setting storage

- The remotely set frequency is stored, held, or cleared according to the **Pr.59** setting. When the inverter is turned ON again and the operation is resumed, the setting shown in the parentheses will be applied.

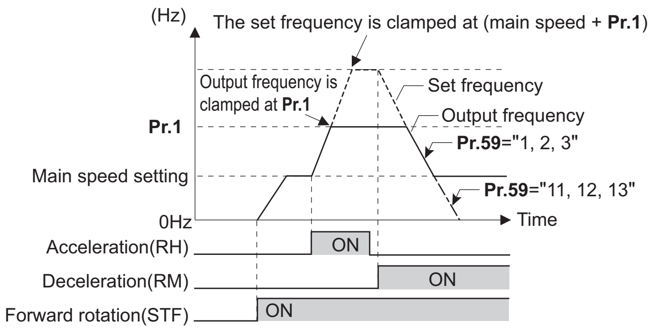
Pr.59 setting	Power OFF	STF/STR signal OFF
1, 11	Stored (stored frequency)	Held (stored frequency)
2, 12	Cleared (main speed)	Held (stored frequency)
3, 13	Cleared (main speed)	Cleared (main speed)

• Storage conditions

The remotely-set frequency is stored at the point when the start signal (STF or STR) turns OFF. The remotely-set frequency is stored every minute after turning OFF (ON) the RH and RM signals together. Every minute, the frequency is overwritten in the EEPROM if the latest frequency is different from the previous one when comparing the two. This cannot be written using the RL signal.

NOTE

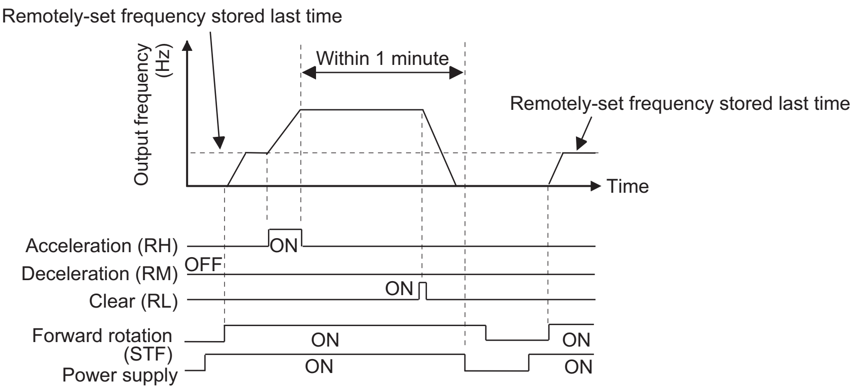
- When switching the start signal from ON to OFF, or changing frequency by the RH or RM signal frequently, set the frequency setting value storage function (write to EEPROM) invalid (**Pr.59** = "2, 3, 12, 13"). If the frequency setting value storage function is valid (**Pr.59** = "1, 11"), the frequency is written to EEPROM frequently, and this will shorten the life of the EEPROM.
- The range of frequency changeable by acceleration signal (RH) and deceleration signal (RM) is 0 to maximum frequency (**Pr.1** or **Pr.18** setting). Note that the maximum value of set frequency is (main speed + maximum frequency).



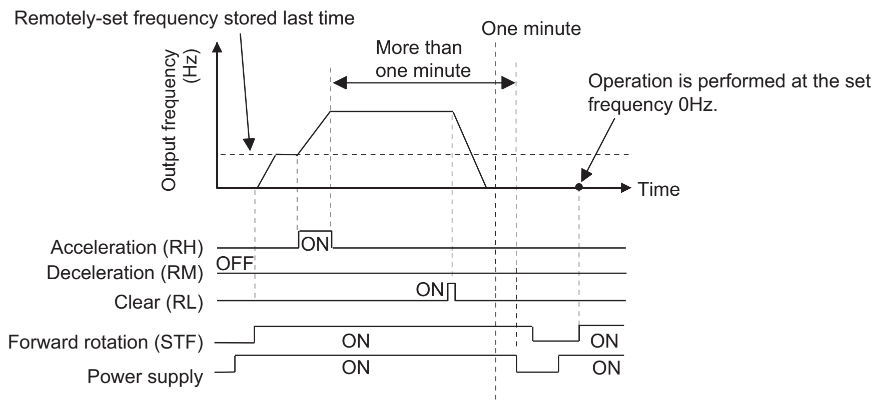
- Even if the start signal (STF or STR) is OFF, turning ON the RH or RM signal varies the preset frequency.
- The RH, RM, or RL signal can be assigned to an input terminal by setting **Pr.178 to Pr.189 (Input terminal function selection)**. Changing the terminal assignment may affect other functions. Set parameters after confirming the function of each terminal.
- The inverter can be used in the Network operation mode.
- The remote setting function is invalid during JOG operation and PID control operation.
- The multi-speed operation function is invalid when remote setting function is selected.

When the setting frequency is "0"

- Even when the remotely-set frequency is cleared by turning ON the RL (clear) signal after turning OFF (ON) 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 turning OFF (ON) both the RH and RM signals.



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



⚠ CAUTION

• When using the remote setting function, set the maximum frequency again according to the machine.

Parameters referred to

Pr.1 Maximum frequency, Pr.18 High speed maximum frequency ☞ page 253

Pr.7 Acceleration time, Pr.8 Deceleration time, Pr.44 Second acceleration/deceleration time, Pr.45 Second deceleration time ☞ page 190

Pr.28 Multi-speed input compensation selection ☞ page 226

Pr.178 to Pr.182 (Input terminal function selection) ☞ page 343

5.5.4 Starting frequency and start-time hold function

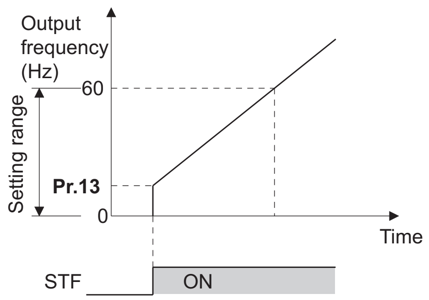
V/F Magnetic flux

It is possible to set the starting frequency and hold the set starting frequency for a certain period of time.
Set these functions when a starting torque is needed or the motor drive at start needs smoothing.

Pr.	Name	Initial value	Setting range	Description
13 **F102**	**Starting frequency**	0.5 Hz	0 to 60 Hz	Set the starting frequency at which the start signal is turned ON.
571 **F103**	**Holding time at a start**	9999	0 to 10 s	Set the holding time of **Pr.13**.
			9999	The holding function at a start is invalid.

◆ Starting frequency setting (Pr.13)

- The frequency at start can be set in the range of 0 to 60 Hz.
- Set the starting frequency at which the start signal is turned ON.

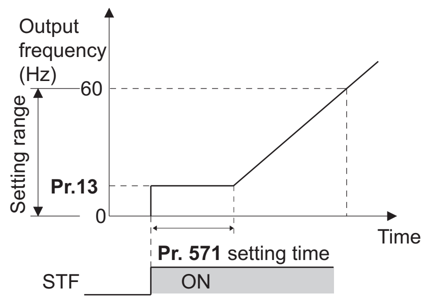


NOTE

- The inverter does not start if the frequency setting signal is less than the value set in **Pr.13**. For example, while **Pr.13** = 5 Hz, the inverter output starts when the frequency setting signal reaches 5 Hz.

◆ Start-time hold function (Pr.571)

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



NOTE

- When **Pr.13** ="0 Hz", the starting frequency is held at 0.01 Hz.
- When the start signal was turned OFF during start-time hold, deceleration is started at that point.
- At switching between forward rotation and reverse rotation, the starting frequency is valid but the start-time hold function is invalid.

⚠ CAUTION

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

Parameters referred to

Pr.2 Minimum frequency ☞ page 253

5.5.5 Minimum motor speed frequency

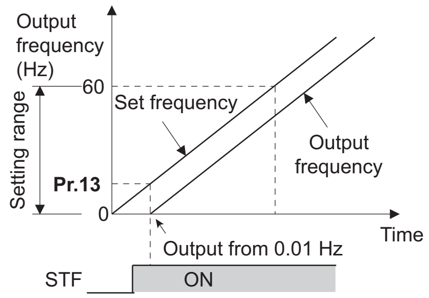
PM

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

Pr.	Name	Initial value	Setting range	Description
13 **F102**	**Starting frequency**	Minimum frequency/ Minimum rotations per minute	0 to 60 Hz	Set the frequency where the motor starts running.

◆ Starting frequency setting (Pr.13)

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



NOTE

- Under induction motor control (under V/F control and Advanced magnetic flux vector control), the output starts at the frequency set in **Pr.13**. Under PM motor control, the output always starts at 0.01 Hz.
- The inverter output does not start when the frequency-setting signal is less than **Pr.13**. For example, while **Pr.13** = "20 Hz", the inverter output starts when the frequency setting signal reaches 20 Hz.

⚠ CAUTION

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

Parameters referred to

Pr.2 Minimum frequency ☞ page 253
Pr.7 Acceleration time ☞ page 190

5.6 (D) Operation command and frequency command

Purpose	Parameter to set			Refer to page
To select the operation mode	Operation mode selection	P.D000	Pr.79	204
To start up in Network operation mode at power-ON	Communication startup mode selection	P.D000, P.D001	Pr.79, Pr.340	213
To select the command source during communication operation	Operation and speed command sources during communication operation, command source selection	P.D010 to P.D013	Pr.338, Pr.339, Pr.550, Pr.551	214
To prevent motor from rotating reversely	Reverse rotation prevention selection	P.D020	Pr.78	221
To set the frequency by pulse train input	Pulse train input	P.D100, P.D101, P.D110, P.D111	Pr.291, Pr.384 to Pr.386	222
To perform JOG operation	JOG operation	P.D200, P.F002	Pr.15, Pr.16	224
To control frequency with combinations of terminals	Multi-speed operation	P.D300 to P.D315	Pr.28, Pr.4 to Pr.6, Pr.24 to Pr.27, Pr.232 to Pr.239	226

5.6.1 Operation mode selection

Select the operation mode of the inverter.

The mode can be changed among operations using external signals (External operation), operation by operation panel or the parameter unit (PU operation), combined operation of PU operation and External operation (External/PU combined operation), and Network operation (when RS-485 terminals or communication option is used).

Pr.	Name	Initial value	Setting range	Description
79 **D000**	**Operation mode selection**	0	0 to 4, 6, 7	Selects the operation mode.

The following table lists valid and invalid commands in each operation mode.

<table>
<tr><th>Pr.79 setting</th><th colspan="3">Description</th><th>Operation panel display</th><th>Refer to page</th></tr>
<tr><td>0
(initial value)</td><td colspan="3">External/PU switchover mode.
The inverter operation mode can be switched between PU and External by pressing PU EXT.
At power ON, the inverter is in the External operation mode.</td><td>PU operation mode
[PU]
External operation mode
[EXT]
NET operation mode
[NET]</td><td>208</td></tr>
<tr><td></td><td>Operation mode</td><td>Frequency command</td><td>Start command</td><td></td><td></td></tr>
<tr><td>1</td><td>PU operation mode fixed</td><td>Operation panel or parameter unit.</td><td>FWD or REV on operation panel or parameter unit</td><td>PU operation mode
[PU]</td><td>208</td></tr>
<tr><td>2</td><td>External operation mode fixed.
The operation can be performed by switching between the External and NET operation modes.</td><td>External signal input (terminal 2 and 4, JOG, multi-speed selection, etc.)</td><td>External signal input (terminal STF, STR)</td><td>External operation mode
[EXT]
NET operation mode
[NET]</td><td>208</td></tr>
<tr><td>3</td><td>External/PU combined operation mode 1</td><td>Operation panel/parameter unit or external signal input (multi-speed setting, terminal 4) *1</td><td>External signal input (terminal STF, STR)</td><td rowspan="2">External/PU combined operation mode
[PU+E]</td><td>209</td></tr>
<tr><td>4</td><td>External/PU combined operation mode 2</td><td>External signal input (terminal 2 and 4, JOG, multi-speed selection, etc.)</td><td>FWD or REV on operation panel or parameter unit</td><td>209</td></tr>
<tr><td>6</td><td colspan="3">Switchover mode
Switching of PU, External, and NET operation modes can be performed during operation.</td><td rowspan="2">PU operation mode
[PU]
External operation mode
[EXT]
NET operation mode
[NET]</td><td>209</td></tr>
<tr><td>7</td><td colspan="3">External operation mode (PU operation interlock)
X12 signal ON: Switchover to PU operation mode enabled (during External operation, output shutoff)
X12 signal OFF: Switchover to PU operation mode disabled</td><td>210</td></tr>
</table>

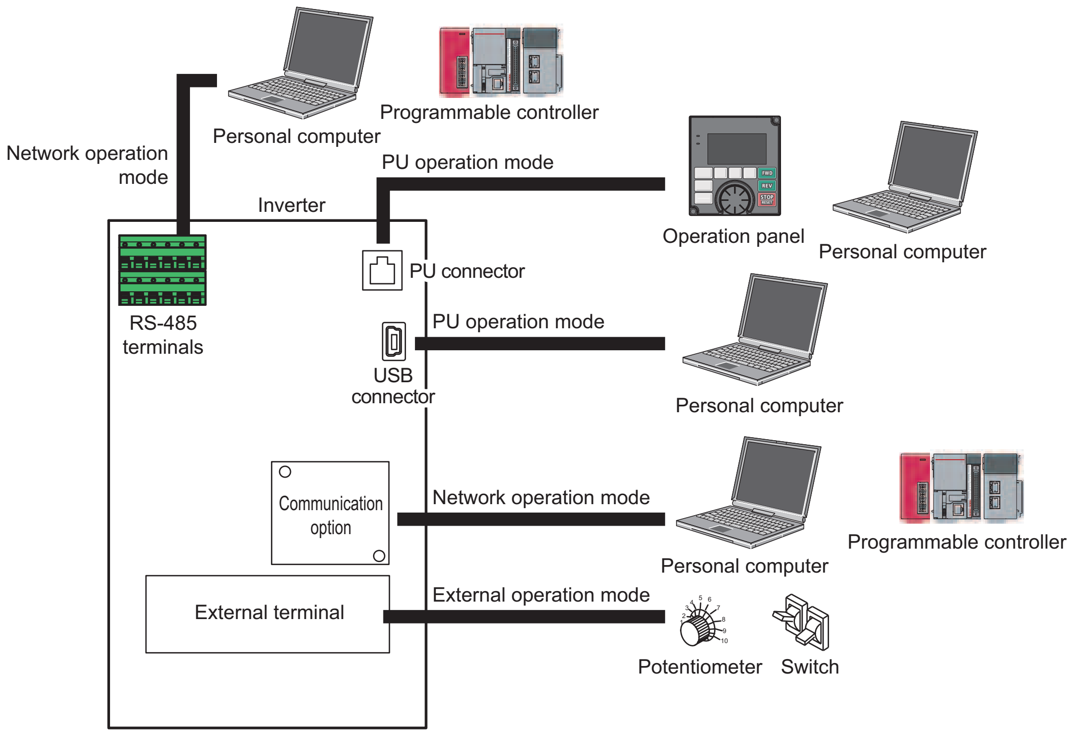
*1 The priority of frequency commands when **Pr.79** = "3" is "multi-speed operation (RL/RM/RH/REX) > PID control (X14) > terminal 4 analog input (AU) > digital input by operation panel".

◆ Operation mode basics

- The operation mode specifies the source of the start command and the frequency command for the inverter.
- Basically, there are following operation modes.

External operation mode	:	For inputting a start command and a frequency command with an external potentiometer and switches which are connected to the control circuit terminal.
PU operation mode	:	For inputting a start command and a frequency command with the operation panel, parameter unit, or the RS-485 communication via PU connector.
Network operation mode (NET operation mode)	:	For inputting a start command and a frequency command using the RS-485 terminals or communication option.

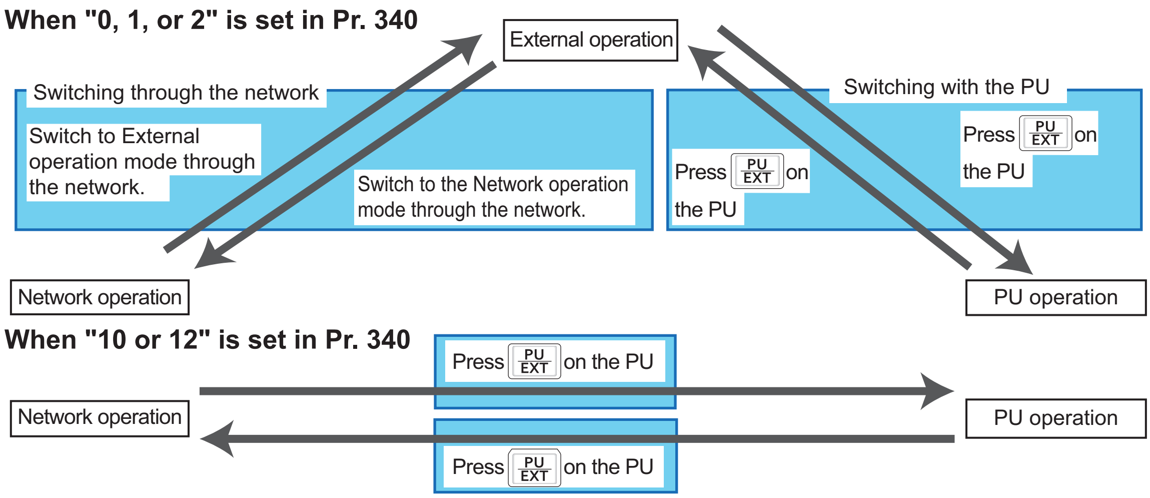
- The operation mode can be selected from the operation panel or with the communication instruction code.



NOTE

- There are two settings of "3" and "4" with PU/External combined operation. The startup method differs according to the setting value.
- In the initial setting, the stop function (PU stop selection) by the operation panel or the parameter unit STOP RESET is effective in modes other than the PU operation mode. (Refer to **Pr.75 Reset selection/disconnected PU detection/PU stop selection** on page 162.)

◆ Operation mode switching method



NOTE

- For details on switching by external terminals, refer to the following pages.

PU operation external interlock signal (X12) ☞ page 210
PU-External operation switchover signal (X16) ☞ page 211
External-NET operation switchover signal (X65), NET-PU operation switchover signal (X66) ☞ page 211
Pr.340 Communication startup mode selection ☞ page 213

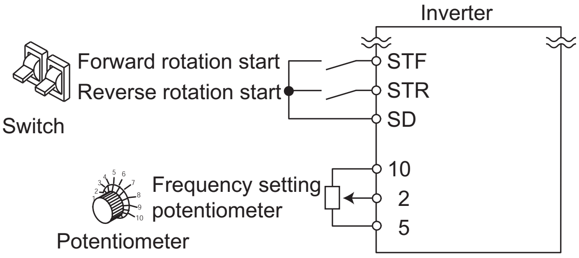
◆ Operation mode selection flow

Referring to the following table, select the basic parameter settings or terminal wiring related to the operation mode.

Start command input method	Frequency setting method	Terminal wiring	Parameter setting	Operation method
External signal input (terminal STF, STR)	External (terminal 2 and 4, JOG, multi-speed, etc.)	STF (forward rotation)/STR (reverse rotation) (Refer to page 550.) Terminal 2 and 4 (analog) RL, RM, RH, JOG, etc.	**Pr.79** = "2" (External operation mode fixed)	• Frequency setting Frequency setting terminal ON • Start command STF(STR)-ON
	PU (digital setting)	STF (forward rotation)/STR (reverse rotation) (Refer to page 550.)	**Pr.79** = "3" (External/PU combined operation 1)	• Frequency setting DU digital setting • Start command STF(STR)-ON
	Communication (RS-485 terminals)	STF (forward rotation)/STR (reverse rotation) (Refer to page 550.) RS-485 terminals (Refer to page 475.)	**Pr.338** = "1" **Pr.340** = "1, 2"	• Frequency setting Transmit a frequency command via communication. • Start command STF(STR)-ON
	Communication (communication option)	Terminals for communication option (Refer to the Instruction Manual of the communication option.)	**Pr.338** = "1" **Pr.340** = "1"	• Frequency setting Transmit a frequency command via communication. • Start command STF(STR)-ON
PU (FWD/REV key)	External (terminal 2 and 4, JOG, multi-speed, etc.)	Terminal 2 and 4 (analog) RL, RM, RH, JOG, etc.	**Pr.79** = "4" (External/PU combined operation 2)	• Frequency setting Frequency setting terminal ON • Start command FWD/REV key ON
	PU (digital setting)	—	**Pr.79** = "1" (PU operation mode fixed)	• Frequency setting Digital setting • Start command FWD/REV key ON
	Communication (RS-485 terminals/ communication option)	N/A		
Communication (RS-485 terminals)	Using external signals (input via terminal 2/4, using the JOG signal, using the multi-speed setting function, etc.)	RS-485 terminals (Refer to page 475.) Terminal 2 and 4 (analog) RL, RM, RH, JOG, etc.	**Pr.339** = "1" **Pr.340** = "1, 2"	• Frequency setting Frequency setting terminal ON • Start command Transmit a start command via communication
	PU (digital setting)	N/A		
	Communication RS-485 terminals	RS-485 terminals (Refer to page 475.)	**Pr.340** = "1, 2"	• Frequency setting Transmit a frequency command via communication. • Start command Transmit a start command via communication
Communication (Communication option)	Using external signals (input via terminal 2/4, using the JOG signal, using the multi-speed setting function, etc.)	Terminals on communication option (Refer to the Instruction Manual of the communication option.) Terminal 2 and 4 (analog) RL, RM, RH, JOG, etc.	**Pr.339** = "1" **Pr.340** = "1"	• Frequency setting Frequency setting terminal ON • Start command Transmit a start command via communication
	PU (digital setting)	N/A		
	Communication (communication option)	Terminals on communication option (Refer to the Instruction Manual of the communication option.)	**Pr.340** = "1"	• Frequency setting Transmit a frequency command via communication. • Start command Transmit a start command via communication

◆ External operation mode (Pr.79 = "0" (initial value), "2")

- Select the External operation mode when the start command and the frequency command are applied from a frequency setting potentiometer, start switch, etc. which are provided externally and connected to the control circuit terminals of the inverter.
- Generally, parameter change cannot be performed in the External operation mode. (Some parameters can be changed. Refer to **Pr.77 Parameter write selection** page 168.)
- When **Pr.79** = "0 or 2", the inverter starts up in the External operation mode at power-ON. (When using the Network operation mode, refer to page 213.)
- When parameter changing is seldom necessary, setting "2" fixes the operation mode to the External operation mode. When frequent parameter changing is necessary, setting "0" (initial value) allows the operation mode to be changed easily to the PU operation mode by pressing PU/EXT of the operation panel. After switching to the PU operation mode, always return to the External operation mode.
- The STF and STR signal are used as a start command, and the voltage to terminal 2 and 4, current signal, multi-speed signal, and JOG signal are used as a frequency command.



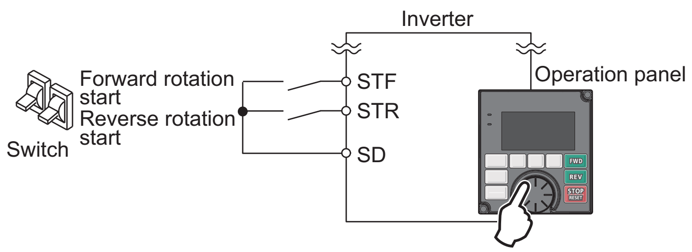
◆ PU operation mode (Pr.79 = "1")

- Select the PU operation mode when applying start and frequency commands by only the key operation of the operation panel or the parameter unit. Also select the PU operation mode when making communication using the PU connector.
- When **Pr.79** ="1", the inverter starts up in the PU operation mode at power-ON. The mode cannot be changed to other operation modes.
- When the PU operation mode is selected, the PU operation mode signal (PU) can be output. For the terminal used for the PU signal, set "10 (positive logic)" or "110 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.

Operation panel

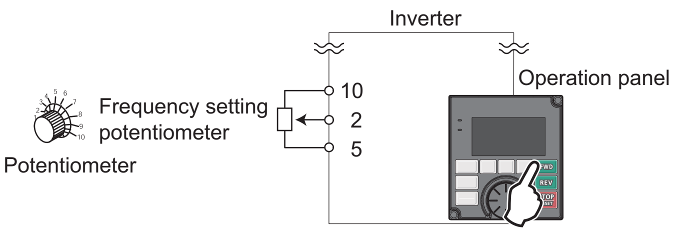
◆ PU/External combined operation mode 1 (Pr.79 = "3")

- Select the PU/External combined operation mode 1 when applying a frequency command from the operation panel or the parameter unit and inputting a start command with the external start switches.
- Set "3" in **Pr.79**. The mode cannot be changed to other operation modes.
- When a frequency is input from the external signal by multi-speed setting, it has a higher priority than the frequency command from the PU. Also, when AU is set to "ON", the command signal is output to the terminal 4.



◆ PU/External combined operation mode 2 (Pr.79 = "4")

- Select the PU/External combined operation mode 2 when applying a frequency command from the external potentiometer, or multi-speed and JOG signals, and inputting a start command by key operation of the operation panel or the parameter unit.
- Set "4" in **Pr.79**. The mode cannot be changed to other operation modes.



◆ Switchover mode (Pr.79 = "6")

- PU, External and Network operation (when RS-485 terminals or communication option is used) can be switched among during operation.

Operation mode switchover	Operation switchover/Operating status
External operation→PU operation	Set to the PU operation mode on the operation panel and the parameter unit. • As the direction of rotation, the direction that was active by External operation is continued. • For the setting frequency, the setting of the potentiometer (frequency command) is continued. (Note, however, that the setting disappears when the power is turned OFF or when the inverter is reset.)
External operation→NET operation	The switchover command to the Network operation mode is transmitted via communication. • As the direction of rotation, the direction that was active by External operation is continued. • The setting by the setting potentiometer (frequency command) is kept. (Note, however, that the setting disappears when the power is turned OFF or when the inverter is reset.)
PU operation→External operation	Press the External operation key on the operation panel and the parameter unit. • The direction of operation is determined by the External operation input signal. • The setting frequency is determined by the external frequency command signal.
PU operation→NET operation	The switchover command to the Network operation mode is transmitted via communication. • For the direction of operation and setting frequency, the status during PU operation is continued.
NET operation→External operation	The switchover command to the External operation mode is transmitted via communication. • The direction of operation is determined by the External operation input signal. • The setting frequency is determined by the external frequency command signal.
NET operation→PU operation	Switch to the PU operation mode on the operation panel and the parameter unit. • For the direction of operation and frequency, the status during Network operation is continued.

◆ PU operation interlock (Pr.79 = "7")

- The operation mode can be forcibly switched to the External operation mode by turning OFF the PU operation interlock (X12) signal. This function prevents the operation mode from being accidentally unswitched from the PU operation mode. If the operation mode left unswitched from the PU operation mode, the inverter does not reply to the commands sent through external commands.
- To input the X12 signal, set "12" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to a terminal. (For details on **Pr.178 to Pr.189**, refer to page 343.)
- Set **Pr.79**="7" (PU operation interlock).
- If the X12 signal is not assigned, the function of the MRS signal is switched to PU operation internal signal from MRS (output stop).

X12 (MRS) signal	Function/Operation	
	Operation mode	**Parameter writing**[*1]
ON	Switching of the operation mode (External, PU, and NET) is enabled. Output is stopped during External operation.	Parameter writing enabled
OFF	Operation mode is forcefully changed to the External operation mode. External operation is enabled. Switching to the PU or NET operation mode from the External operation mode is disabled.	Writing of parameters other than **Pr.79** is disabled.

*1 Depends on the **Pr.77 Parameter write selection** setting and the writing conditions of each parameter. (Refer to page 168.)

- Functions/operations by X12 (MRS) signal ON/OFF

Operating status		X12 (MRS) signal	Operation mode	Operating status	Switching to PU or NET operation mode
Operation mode	**Status**				
PU/NET	during a stop	ON→OFF[*1]	External[*2]	If frequency and start commands are input from external source, the inverter runs by those commands.	Not available
	Running	ON→OFF[*1]			Not available
External	during a stop	OFF→ON	External[*2]	during a stop	Available
		ON→OFF			Not available
	Running	OFF→ON		Running→Output shutoff	Not available
		ON→OFF		Output shutoff→Running	Not available

*1 The mode is switched to the External operation mode regardless of the ON/OFF state of the start signals (STF, STR). Thus, the motor runs under the External operation mode when the X12 (MRS) signal turns OFF with either of STF or STR in an ON state.

*2 When a fault occurs, the inverter can be reset by pressing 

on the operation panel.

NOTE

- The operation mode cannot switched to the PU operation mode with the start signal (STF, STR) in an ON state even if the X12 (MRS) signal is ON.
- If the MRS signal is ON and **Pr.79** is written to a value other than "7" when the MRS signal is used as the PU interlock signal during PU operation mode, the MRS signal will act as a regular MRS function (output stop). Also, when **Pr.79**="7", the MRS signal becomes the PU interlock signal.
- The logic of the signal follows the **Pr.17 MRS input selection** setting also when the MRS signal is used as the PU operation interlock signal. When **Pr.17** ="2", ON and OFF in the above explanation are reversed.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Switching operation mode by external signal (X16 signal)

- When External operation and the operation from the operation panel are used together, the PU operation mode and External operation mode can be switched during a stop (during motor stop, start command OFF) by using the PU-External operation switchover signal (X16).
- When **Pr.79**="0", "6" or "7", switching between the PU operation mode and External operation mode is possible. (When **Pr.79**="6", the switchover can also be made during operation.)
- To input the X16 signal, set "16" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to a terminal.

Pr.79 setting		X16 signal status and operation mode		Remarks
		ON (External)	OFF (PU)	
0 (initial value)		External operation mode	PU operation mode	Switching among the External, PU, and NET operation modes is enabled.
1		PU operation mode		PU operation mode fixed
2		External operation mode		External operation mode fixed. (Switching to NET operation mode is enabled.)
3, 4		External/PU combined operation mode		External/PU combined operation mode fixed
6		External operation mode	PU operation mode	Switching among the External, PU, and NET operation mode is enabled while running.
7	X12 (MRS) ON	External operation mode	PU operation mode	Switching among the External, PU, and NET operation mode is enabled. (In the External operation mode, output shutoff.)
	X12 (MRS) OFF	External operation mode		External operation mode fixed. (Forcibly switched to External operation mode.)

NOTE

- The status of the operation mode follows the **Pr.340 Communication startup mode selection** setting and the ON/OFF state of the X65 and X66 signals. (For details, refer to page 211.)
- The priority among **Pr.79 and Pr.340** and signals is **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. Set parameters after confirming the function of each terminal.

◆ Switching the operation mode by external signals (X65, X66 signals)

- When **Pr.79** ="0, 2 or 6", the PU operation mode and External operation modes can be changed to the Network operation mode during a stop (during motor stop, start command OFF) by the PU/NET operation switchover (X65) signal, the External/NET operation switchover (X66) signal. (When **Pr.79** = "6", switchover is enabled during operation.)
- To switch between the Network operation mode and the PU operation mode

1. Set **Pr.79** = "0 (initial value) or 6".
2. Set **Pr.340 Communication startup mode selection** = "10 or 12".
3. Set "65" in any of **Pr.178 to Pr.189** to assign the PU/NET operation switchover (X65) signal to a terminal.
4. When the X65 signal is ON, the PU operation mode is selected. When the X65 signal is OFF, the Network operation mode is selected.

Pr.340 setting	Pr.79 setting		X65 signal state		Remarks
			ON (PU)	OFF (NET)	
10, 12	0 (initial value)		PU operation mode	NET operation mode	—
	1		PU operation mode		PU operation mode fixed
	2		NET operation mode		NET operation mode fixed
	3, 4		External/PU combined operation mode		External/PU combined operation mode fixed
	6		PU operation mode	NET operation mode	Switching between operation modes is enabled while running.
	7	X12 (MRS) ON	Switching between the External operation mode and PU operation mode is enabled.		Output is shutoff in the External operation mode.
		X12 (MRS) OFF	External operation mode		The operation mode is forcibly switched to the External operation mode.

- To switch between the Network operation mode and the External operation mode

1. Set **Pr.79**="0" (initial value) or "2, "6" or "7". (When **Pr.79** ="7" and the X12 (MRS) signal is ON, the operation mode can be switched.)

2. Set **Pr.340 Communication startup mode selection** ="0" (initial value), "1" or "2".

3. Set "66" in one of **Pr.178 to Pr.189** to assign the NET-External operation switching signal (X66) to a terminal.

4. When the X66 signal is ON, Network operation mode is selected. When the X66 signal is OFF, the External operation mode is selected.

<table>
<tr><th rowspan="2">Pr.340 setting</th><th rowspan="2" colspan="2">Pr.79 setting</th><th colspan="2">X66 signal state</th><th rowspan="2">Remarks</th></tr>
<tr><th>ON (NET)</th><th>OFF (External)</th></tr>
<tr><td rowspan="8">0 (initial value), 1, 2</td><td colspan="2">0 (initial value)</td><td>NET operation mode</td><td>External operation mode</td><td>—</td></tr>
<tr><td colspan="2">1</td><td colspan="2">PU operation mode</td><td>PU operation mode fixed</td></tr>
<tr><td colspan="2">2</td><td>NET operation mode</td><td>External operation mode</td><td>Switching to PU operation mode is disabled.</td></tr>
<tr><td colspan="2">3, 4</td><td colspan="2">External/PU combined operation mode</td><td>External/PU combined operation mode fixed</td></tr>
<tr><td colspan="2">6</td><td>NET operation mode</td><td>External operation mode</td><td>Switching between operation modes is enabled while running.</td></tr>
<tr><td rowspan="2">7</td><td>X12 (MRS) ON</td><td>NET operation mode</td><td>External operation mode</td><td>Output is shutoff in the External operation mode.</td></tr>
<tr><td>X12 (MRS) OFF</td><td colspan="2">External operation mode</td><td>The operation mode is forcibly switched to the External operation mode.</td></tr>
</table>

NOTE

- The priority of **Pr.79** and **Pr.340** and signals is **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. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.15 Jog frequency page 224
Pr.4 to Pr.6, Pr.24 to 27, Pr.232 to Pr.239 multi-speed operation page 226
Pr.75 Reset selection/disconnected PU detection/PU stop selection page 162
Pr.178 to Pr.182 (Input terminal function selection) page 343
Pr.190 to Pr.196 (Output terminal function selection) page 297
Pr.340 Communication startup mode selection page 213
Pr.550 NET mode operation command source selection page 214

5.6.2 Startup in Network operation mode at power-ON

When power is switched ON or when power comes back ON after an instantaneous power failure, the inverter can be started up in the Network operation mode. After the inverter starts up in the Network operation mode, parameter writing and operation can be commanded from programs.

Set this mode when performing communication operation using the RS-485 terminals or a communication option.

Pr.	Name	Initial value	Setting range	Description
79 D000	**Operation mode selection**	0	0 to 4, 6, 7	Selects the operation mode. (Refer to page 204.)
340 D001	**Communication startup mode selection**	0	0	Follows the **Pr.79** setting.
			1, 2	The inverter starts up in the Network operation mode. If an instantaneous power failure occurs when "2" is set, the operating status before the instantaneous power failure is maintained.
			10, 12	The inverter starts up in the Network operation mode. The operation mode can be changed between the PU operation mode and Network operation mode from the operation panel. If an instantaneous power failure occurs when "12" is set, running is continued at the condition before the instantaneous power failure.

◆ Selecting the operation mode for power-ON (Pr.340)

- Depending on the **Pr.79** and **Pr.340** settings, the operation mode at power-ON (reset) changes as described below.

Pr.340 setting	Pr.79 setting	Operation mode at power-ON, at power restoration, or after a reset	Operation mode switching
0 (initial value)	0 (initial value)	External operation mode	Switching among the External, PU, and NET operation modes is enabled.*2
	1	PU operation mode	PU operation mode fixed
	2	External operation mode	Switching between the External and NET operation modes is enabled. Switching to PU operation mode is disabled
	3, 4	External/PU combined operation mode	Operation mode switching is disabled
	6	External operation mode	Switching among the External, PU, and NET operation mode is enabled while running.
	7	X12 (MRS) signal ON External operation mode	Switching among the External, PU, and NET operation modes is enabled.*2
		X12 (MRS) signal OFF External operation mode	External operation mode fixed. (Forcibly switched to External operation mode.)
1, 2*1	0	NET operation mode	Same as **Pr.340**="0" setting
	1	PU operation mode	
	2	NET operation mode	
	3, 4	External/PU combined operation mode	
	6	NET operation mode	
	7	X12 (MRS) signal ON NET operation mode	
		X12 (MRS) signal OFF External operation mode	
10, 12*1	0	NET operation mode	Switching between the PU and NET operation mode is enabled*3
	1	PU operation mode	Same as **Pr.340**="0" setting
	2	NET operation mode	NET operation mode fixed
	3, 4	External/PU combined operation mode	Same as **Pr.340**="0" setting
	6	NET operation mode	Switching between the PU and NET operation mode is enabled while running.*3
	7	External operation mode	Same as **Pr.340**="0" setting

*1 Use **Pr.340**="2 or 12" setting to perform communication with the RS-485 terminals. Even if an instantaneous power failure occurs while **Pr.57 Restart coasting time** ≠ "9999" (with automatic restart after instantaneous power failure), inverter continues operation at the condition before the instantaneous failure.

*2 The operation mode cannot be directly changed between the PU operation mode and Network operation mode.

*3 Switching between the PU and NET operation modes is available with the PU EXT key on the operation panel or the X65 signal.

Parameters referred to

Pr.57 Restart coasting time ☞ page 448
Pr.79 Operation mode selection ☞ page 204

5.6.3 Start command source and frequency command source during communication operation

The start and frequency commands from an external device can be made valid when using the RS-485 terminals or the communication option. The command source in the PU operation mode can also be selected.

Pr.	Name	Initial value	Setting range	Description
338 **D010**	**Communication operation command source**	0	0	Start command source is communication.
			1	Start command source is external.
339 **D011**	**Communication speed command source**	0	0	Frequency command source is communication.
			1	Frequency command source is external.
			2	Frequency command source is external. (When there is no external input, the frequency command via communication is valid, and the frequency command from terminal 2 is invalid.)
550 **D012**	**NET mode operation command source selection**	9999	0	The communication option is the command source when in the NET operation mode.
			1	The RS-485 terminals are the command source when in the NET operation mode.
			9999	Communication option is recognized automatically. Normally, the RS-485 terminals are the command source. When the communication option is mounted, the communication option is the command source.
551 **D013**	**PU mode operation command source selection**	9999	1	The RS-485 terminals are the command source when in the PU operation mode.
			2	The PU connector is the command source when in the PU operation mode.
			3	The USB connector is the command source when in the PU operation mode.
			9999	USB automatic recognition Normally, the PU connector is the command source. When the USB is connected, the USB connector is the command source.

◆ Selection of command source in Network operation mode (Pr.550)

- Either of the RS-485 terminals or the communication option can be specified for the command source in the Network operation mode.
- For example, whether or not the communication option is mounted, set **Pr.550** = "1" to write parameters from or input the start and frequency commands via RS-485 terminals in the Network operation mode.

NOTE

- In the initial setting, "9999" (communication option automatic recognition) is set for **Pr.550**. Thus, if the communication option is mounted, parameters cannot be written or the start and frequency commands cannot be sent by communications that use the RS-485 terminals. (Monitoring or parameter reading can be performed.)

◆ Selection of the command source of the PU operation mode (Pr.551)

- Any of the PU connector, RS-485 terminals, or USB connector can be specified as the command source in the PU operation mode.
- Set **Pr.551**="1" to use communication connected to the RS-485 terminals to write parameters or execute start and frequency commands in the PU operation mode. Set **Pr.551**="3" or "9999" to use the USB connector.

NOTE

- When **Pr.550** ="1" (NET mode RS-485 terminals) and **Pr.551** ="1" (PU mode RS-485 terminals), the PU operation mode has a precedence. For this reason, if the communication option is not mounted, switching to the Network operation mode is not longer possible.
- Changed setting values are enabled at power-ON or inverter reset.

5

Pr.550 setting	Pr.551 setting	Command source				Remarks
		PU connector	USB connector	RS-485 terminals	Communication option	
0	1	×	×	PU operation mode[*1]	NET operation mode[*2]	
	2	PU operation mode	×	×	NET operation mode[*2]	
	3	×	PU operation mode	×	NET operation mode[*2]	
	9999 (initial value)	PU operation mode[*3]	PU operation mode[*3]	×	NET operation mode[*2]	
1	1	×	×	PU operation mode[*1]	×	Switching to NET operation mode disabled
	2	PU operation mode	×	NET operation mode	×	
	3	×	PU operation mode	NET operation mode	×	
	9999 (initial value)	PU operation mode[*3]	PU operation mode[*3]	NET operation mode	×	
9999 (initial value)	1	×	×	PU operation mode[*1]	NET operation mode[*2]	
	2	PU operation mode	×	×	NET operation mode[*2]	With communication option
				NET operation mode	×	Without communication option
	3	×	PU operation mode	×	NET operation mode[*2]	With communication option
				NET operation mode	×	Without communication option
	9999 (initial value)	PU operation mode[*3]	PU operation mode[*3]	×	NET operation mode[*2]	With communication option
				NET operation mode	×	Without communication option

*1 The MODBUS RTU protocol cannot be used in the PU operation mode. To use the MODBUS RTU protocol, set **Pr.551**="2".
*2 If the communication option is not mounted, switching to the Network operation mode is not longer possible.
*3 When **Pr.551**= "9999", the priority of the PU command source is USB connector > PU connector.

◆ Controllability through communication

Command interface	Condition (Pr.551 setting)	Item	Controllability in each operation mode					
			PU operation	External operation	Combined operation mode 1 (Pr.79 = 3)	Combined operation mode 2 (Pr.79 = 4)	NET operation (via RS-485 terminals) *7	NET operation (via option)*8
PU connector*1	2 (PU connector) 9999 (automatic recognition, without USB connection)	Operation (start) command	○	×	×	○	×	
		Operation (stop) command	○	△*4	△*4	○	△*4	
		Frequency setting	○	×	○	×	×	
		Monitor	○	○	○	○	○	
		Parameter writing	○*5	×*6	○*5	○*5	×*6	
		Parameter read	○	○	○	○	○	
		Inverter reset	○	○	○	○	○	
	Other than the above	Operation (start) command	×	×	×	×	×	
		Operation (stop) command	△*4	△*4	△*4	△*4	△*4	
		Frequency setting	×	×	×	×	×	
		Monitor	○	○	○	○	○	
		Parameter writing	×*6	×*6	×*6	×*6	×*6	
		Parameter read	○	○	○	○	○	
		Inverter reset	○	○	○	○	○	
RS-485 terminals	1 (RS-485 terminals)	Operation command (start, stop)	○	×	×	○	×	
		Frequency setting	○	×	○	×	×	
		Monitor	○	○	○	○	○	
		Parameter writing	○*5	×*6	○*5	○*5	×*6	
		Parameter read	○	○	○	○	○	
		Inverter reset	○	○	○	○	○	
	Other than the above	Operation command (start, stop)	×	×	×	×	○*2	×
		Frequency setting	×	×	×	×	○*2	×
		Monitor	○	○	○	○	○	○
		Parameter writing	×*6	×*6	×*6	×*6	○*5	×*6
		Parameter read	○	○	○	○	○	
		Inverter reset	×	×	×	×	○*3	×
USB connector	3 (USB connector) 9999 (automatic recognition, with USB connection)	Operation command (start, stop)	○	×	×	○	×	
		Frequency setting	○	×	○	×	×	
		Monitor	○	○	○	○	○	
		Parameter writing	○*5	×*6	×*6	×*6	×*6	
		Parameter read	○	○	○	○	○	
		Inverter reset	○	○	○	○	○	
	Other than the above	Operation command (start, stop)	×	×	×	×	×	
		Frequency setting	×	×	×	×	×	
		Monitor	○	○	○	○	○	
		Parameter writing	×*6	×*6	×*6	×*6	×*6	
		Parameter read	○	○	○	○	○	
		Inverter reset	○	○	○	○	○	

Command interface	Condition (Pr.551 setting)	Item	Controllability in each operation mode					
			PU operation	External operation	Combined operation mode 1 (Pr.79 = 3)	Combined operation mode 2 (Pr.79 = 4)	NET operation (via RS-485 terminals) *7	NET operation (via option)*8
Option	—	Operation command (start, stop)	×	×	×	×	×	○*2
		Running frequency	×	×	×	×	×	○*2
		Monitor	○	○	○	○	○	○
		Parameter writing	×*6	×*6	×*6	×*6	×*6	○*5
		Parameter read	○	○	○	○	○	○
		Inverter reset	×	×	×	×	×	○*3
External control circuit terminal	—	Inverter reset	○	○	○	○	○	○
		Operation command (start, stop)	×	○	○	×	×*2	
		Frequency setting	×	○	×	○	×*2	

○: Valid ×: Invalid Δ: Partially valid

*1 RS-485 communication via PU connector

*2 Follows the **Pr.338 Communication operation command source** and **Pr.339 Communication speed command source** settings. (Refer to page 214.)

*3 At occurrence of RS-485 communication error, the inverter cannot be reset from the computer.

*4 PU stop is only enabled. PS is displayed on the operation panel during PU stop. Follows the **Pr.75 Reset selection/disconnected PU detection/ PU stop selection** setting. (Refer to page 162.)

*5 Writing of some parameters may be disabled by the **Pr.77 Parameter write selection** setting and the operating condition. (Refer to page 168.)

*6 Some parameters are write-enabled independently of the operation mode and command source presence/absence. Writing is also enabled when **Pr.77**="2". (Refer to page 168.) Parameter clear is disabled.

*7 When **Pr.550 NET mode operation command source selection**="1" (RS-485 terminals enabled), or **Pr.550 NET mode operation command source selection**="9999" with no communication option connected.

*8 When **Pr.550 NET mode operation command source selection**="0" (communication option enabled), or **Pr.550 NET mode operation command source selection**="9999" with communication option connected.

◆ Operation at fault

Fault type	Conditions (Pr.551 setting)	Operation in each operation mode at error occurrences					
		PU operation	External operation	Combined operation mode 1 (Pr.79 =3)	Combined operation mode 2 (Pr.79 =4)	NET operation (via RS-485 terminals)*5	NET operation (via option)*6
Inverter fault	—	Stop					
PU connector disconnection	2 (PU connector) 9999 (automatic recognition)	Stop/continued *1*4					
	Other than 2	Stop/continued *1					
Communication error at PU connector	2 (PU connector)	Stop/ continued *2	Continued		Stop/ continued *2	Continued	
	Other than 2	Continued					
Communication error at RS-485 terminals	1 (RS-485 terminals)	Stop/ continued *2	Continued		Stop/ continued *2	Continued	
	Other than 1	Continued				Stop/continued *2	Continued
Communication error at USB connector	3 (USB connector) 9999 (automatic recognition)	Stop/ continued *2	Continued				
	Other than 3	Continued					
Communication error at communication option	—	Continued					Stop/continued *3

*1 Selectable with **Pr.75 Reset selection/disconnected PU detection/PU stop selection**

*2 Selectable with **Pr.122 PU communication check time interval**, **Pr.336 RS-485 communication check time interval**, and **Pr.548 USB communication check time interval**

*3 Follows the communication option

*4 In the PU JOG operation mode, operation always stops when the PU is disconnected. The operation of PU disconnection (E.PUE) follows the **Pr.75 Reset selection/disconnected PU detection/PU stop selection** setting.

*5 When **Pr.550 NET mode operation command source selection**= "1" (RS-485 terminals enabled), or **Pr.550 NET mode operation command source selection**="9999" with no communication option connected.

*6 When **Pr.550 NET mode operation command source selection**="0" (communication option enabled), or **Pr.550 NET mode operation command source selection**="9999" with communication option connected.

◆ Selection of control source in Network operation mode (Pr.338, Pr.339)

- There are two control sources: the start command source, which controls the signals related to the inverter stand command and function selection, and the speed command source, which controls signals related to frequency setting.
- The table below shows the commands from the external terminals and communication (RS-485 terminals or communication option) in the Network operation mode.

Operation location selection		Pr.338 Communication operation command source			0: NET			1: EXT			Remarks
		Pr.339 Communication speed command source			0: NET	1: EXT	2: EXT	0: NET	1: EXT	2: EXT	
Fixed function (terminal-equivalent function)		Frequency setting through communication			NET	—	NET	NET	—	NET	
		Terminal 2			—	External	—	—	—	—	
		Terminal 4			—	External		—	External		
		Terminal 1			Compensation						
Selectable function	Pr.178 to Pr.189 setting	0	RL	Low-speed operation command/remote setting Clear	NET	External		NET	External		**Pr.59** ="0" (multi-speed) **Pr.59** ≠"0" (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	Automatic restart after instantaneous power failure / flying start function	External / NET			External			External / NET is selected according to **Pr.162** setting. (The emergency electronic bypass is enabled only when the command source is External.)[*1]
		7	OH	External thermal relay input	External						
		8	REX	15-speed selection	NET	External		NET	External		**Pr.59** ="0" (multi-speed)
		10	X10	Inverter run enable signal	External						
		11	X11	FR-CC2 connection, instantaneous power failure detection	External						
		12	X12	PU operation external interlock	External						
		13	X13	External DC injection brake operation start	NET			External			
		14	X14	PID control valid terminal	NET	External		NET	External		
		16	X16	PU/External operation switchover	External						
		18	X18	V/F switchover	NET			External			
		24	MRS	Output stop	Combined			External			**Pr.79** ≠ "7"
				PU operation interlock	External						**Pr.79** = "7" When X12 signal is not assigned.
		25	STP (STOP)	Start self-holding selection	-			External			
		28	X28	Start-time tuning start external input	NET			External			
		33	PWS	Phase synchronization command for bypass switching	External						
		37	X37	Traverse function selection	NET			External			
		38	PDI1	PID multistage set point setting 1	NET	External		NET	External		

5

Operation location selection			Pr.338 Communication operation command source		0: NET			1: EXT			Remarks
			Pr.339 Communication speed command source		0: NET	1: EXT	2: EXT	0: NET	1: EXT	2: EXT	
Selectable function	**Pr.178** to **Pr.189** setting	39	PDI2	PID multistage set point setting 2	NET	External		NET	External		
		40	PDI3	PID multistage set point setting 3	NET	External		NET	External		
		46	TRG	Trace trigger input	Combined			External			
		47	TRC	Trace sampling start/end	Combined			External			
		48	X48	Power failure stop external	External						
		50	SQ	Sequence start	External, NET			External			**Pr.414**= "1": Valid when there is external or network input **Pr.414**= "2": External
		51	X51	Fault clear	Combined			External			
		57	JOGF	JOG forward rotation command	—			External			
		58	JOGR	JOG reverse rotation command	—			External			
		60	STF	Forward rotation command	NET			External			
		61	STR	Reverse rotation command	NET			External			
		62	RES	Inverter reset	External						
		64	X64	During retry	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 P control switchover	NET	External		NET	External		
		73	X73	Second PID P control switchover	NET	External		NET	External		
		77	X77	Pre-charge end command	NET	External		NET	External		
		78	X78	Second pre-charge end command	NET	External		NET	External		
		79	X79	Second PID forward/reverse action switchover	NET	External		NET	External		
		80	X80	Second PID control valid terminal	NET	External		NET	External		
		81	PGT	PID gain tuning start/forced end	NET	External		NET	External		
		84	X84	Emergency drive execution command	Combined						
		92	X92	Emergency stop	External						
		94	X94	Control signal input for main circuit power supply MC	External						
		95	X95	Converter unit fault input	External						
		96	X96	Converter unit fault (E.OHT, E.CPU) input	External						
		97	X97	Cleaning valid	NET			External			
		98	X98	Cleaning trigger	NET			External			
		128	RLF	Low-speed forward rotation command	—			—	External		
		129	RLR	Low-speed reverse rotation command	—			—	External		

*1 When **Pr.77** = "2", **Pr.162** setting can be changed during operation. The new setting is applied after stop. Until the inverter has stopped, the previous setting of the interface for the operation command and the speed command in the Network operation mode is valid.

[Explanation of terms in table]
External (EXT): Commands from external terminal are only valid.
NET: Commands via communication are only valid.
Combined: Command from both external terminal and communication is valid.
—: Command from either of external terminal and communication is invalid.
Compensation: Commands are valid only from external terminal signals when **Pr.28 Multi-speed input compensation selection** = "1".

NOTE

- The command source of communication follows the **Pr.550** and **Pr.551** settings.
- The **Pr.338** and **Pr.339** settings can be changed while the inverter is running when **Pr.77** = "2". Note that the setting change is applied after the inverter has stopped. Until the inverter has stopped, communication operation command source and communication speed command source before the setting change are valid.

◆ Command source switchover via external terminals (X67)

- In the Network operation mode, the start command source and speed command source can be switched over by the command source switchover signal (X67). This can be used to control signal inputs from both the external terminals and via communication.
- For the X67 signal, set "67" to any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to a control terminal.
- When the X67 signal is OFF, the start command source and speed command source are given via control terminals.

X67 signal state	Start command source	Speed command source
Signal not assigned	According to **Pr.338**	According to **Pr.339**
ON		
OFF	Commands from external terminals are only valid.	

NOTE

- The ON/OFF state of the X67 signal is applied only during a stop. When the terminals are switched during operation, the ON/OFF state is applied after a stop.
- When the X67 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. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.28 Multi-speed input compensation selection ☞ page 226
Pr.59 Remote function selection ☞ page 197
Pr.79 Operation mode selection ☞ page 204

5.6.4 Reverse rotation prevention selection

This function can prevent reverse rotation fault resulting from the incorrect input of the start signal.

Pr.	Name	Initial value	Setting range	Description
78 **D020**	**Reverse rotation prevention selection**	0	0	Both forward and reverse rotations allowed
			1	Reverse rotation disabled
			2	Forward rotation disabled

- Set this parameter 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 and of the parameter unit, the start signals (STF, STR signals) via external terminals, and the forward and reverse rotation commands through communication.

5.6.5 Frequency setting via pulse train input

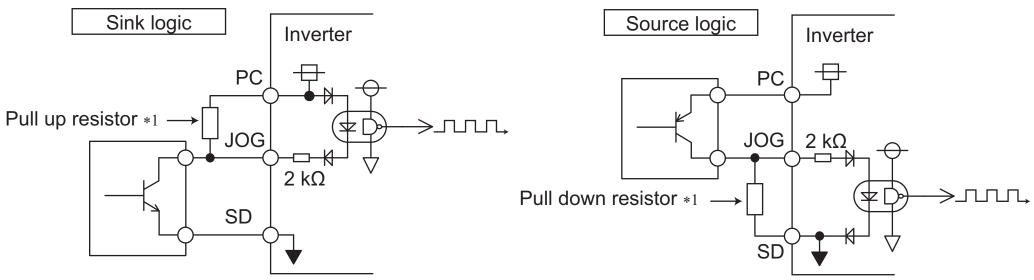
A pulse train input to the terminal JOG can be used to set the inverter's speed command.
Moreover, speed synchronized operation of an inverter can be performed by using the pulse train output together with the terminal JOG.

Pr.	Name	Initial value	Setting range	Description
291 **D100**	**Pulse train I/O selection**	0	0	The JOG signal is assigned to terminal JOG.*1
			1	Pulse train input is assigned to terminal JOG.
384 **D101**	**Input pulse division scaling factor**	0	0	Pulse train input disabled
			1 to 250	Division ratio on the input pulse. The frequency resolution on the input pulse changes according to this setting.
385 **D110**	**Frequency for zero input pulse**	0 Hz	0 to 590 Hz	Sets the frequency when the input pulse is zero (bias).
386 **D101**	**Frequency for maximum input pulse**	60 Hz	0 to 590 Hz	Sets the frequency when the input pulse is maximum (gain).

*1 Function assigned to **Pr.185 JOG terminal function selection**.

◆ Selection of pulse train input (Pr.291)

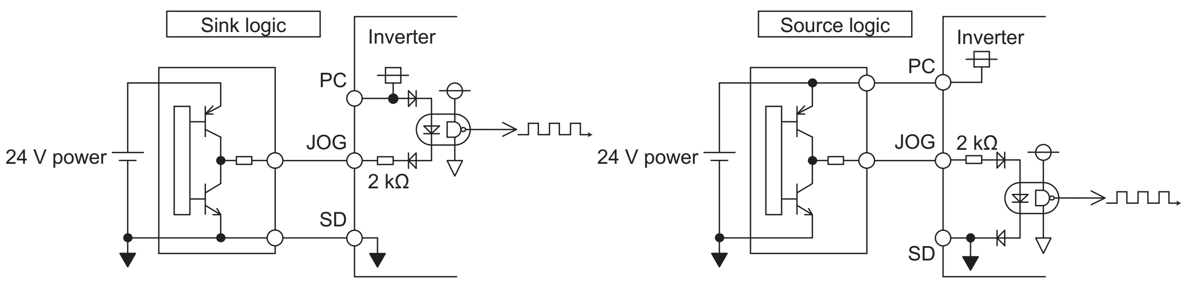
- Setting **Pr.291 Pulse train I/O selection** = "1" and **Pr.384 Input pulse division scaling factor** ≠ "0" changes the function of terminal JOG to a pulse train input so that the frequency can be set to the inverter. In the initial setting, the JOG signal is assigned to terminal JOG. A maximum pulse train of 100k pulses/s can be input.
- Connection with an open collector output system pulse generator



*1 When the wiring length is long with open collector outputs, the influence of stray capacitance causes the pulse to flatten out and prevents the input pulse from being recognized. When the wiring length is long (10 m or longer of shielded twisted pair cable with a recommended cable gauge of 0.75 mm^2), connect the open collector output signal to the power supply by an external pull-up resistor. The table below shows the reference resistance values for wiring length. The stray capacitance of the wiring changes considerably according to how the cable is laid, thus the above wiring lengths are not guaranteed values. When using a pull-up/down resistor, check the permissible power of the resistor and the permissible load current of the output transistor, and use within the permissible range.

Wiring length	Less than 10 m	10 to 50 m	50 to 100 m
Pull-up/down resistor	Not required	1 kΩ	470 Ω
Load current (reference)	10 mA	35 mA	65 mA

- Connection with a complementary output system pulse generator



NOTE

- When pulse train input is selected, the function assigned to terminal JOG by **Pr.185 JOG terminal function selection** is invalid.

◆ Pulse train input specification

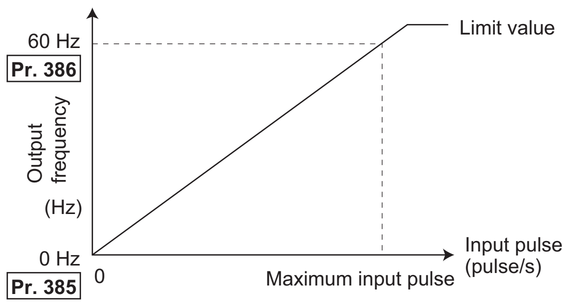
Item		Specification
Supported pulse method		Open collector output. Complementary output. (24 V power supply voltage)
HIGH input level		20 V or more (voltage between JOG and SD)
LOW input level		5 V or less (voltage between JOG and SD)
Maximum input pulse rate		100k pulses/s
Minimum input pulse width		2.5 us
Input resistance/load current		2 kΩ (typ)/10 mA (typ)
Maximum wiring length (reference value)	Open collector output method	10 m (0.75 mm^2/twisted pair)
	Complementary output method	100 m (output resistance 50 Ω)*1
Detection resolution		1/3750

*1 The wiring length of complementary output is dependent on the output wiring specification of the complementary output unit. The stray capacitance of the wiring changes considerably according to how the cable is laid, thus the maximum wiring length is not a guaranteed value.

5

◆ Adjustment of pulse train and frequency (Pr.385, Pr.386)

- The frequency during zero input pulse and maximum input pulse can be set with **Pr.385 Frequency for zero input pulse** and **Pr.386 Frequency for maximum input pulse**, respectively.



*1 Limit value = (**Pr.386** - **Pr.385**) × 1.1 + **Pr.385**

◆ How to calculate the input pulse division scaling factor (Pr.384)

- The maximum number of pulses can be calculated by the following formula with **Pr.384 Input pulse division scaling factor**: Maximum number of pulses (pulse/s) = **Pr.384** × 400 (maximum 100k pulses/s) (number of detectable pulses = 11.45 pulses/s)
- For example, to run the invert at 0 Hz when pulse train input is zero and at 30 Hz when pulse train is 4000 pulses/sec, set the inverter as follows:

Pr.384 = 10 (maximum number of input pulses 4000 pulses/s)

Pr.385 = 0 Hz, **Pr.386** = 30 Hz (pulse train limit value 33 Hz)

NOTE

- The priority of the frequency command by the external signals is "JOG operation > multi-speed operation > terminal 4 analog input". When pulse train input is enabled (**Pr.291** = "1" and **Pr.384** ≠ "0"), terminal 2 analog input becomes invalid.

5.6.6 JOG operation

The frequency and acceleration/deceleration time for JOG operation can be set. JOG operation is possible in both External operation and PU.

JOG operation can be used for conveyor positioning, test run, etc.

Pr.	Name	Initial value	Setting range	Description
15 **D200**	**Jog frequency**	5 Hz	0 to 590 Hz	Sets the frequency during JOG operation.
16 **F002**	**Jog acceleration/ deceleration time**	0.5 s	0 to 3600 s	Sets motor acceleration/deceleration time during JOG operation. For the acceleration/deceleration time, set the time until the frequency[*1] set to **Pr.20 Acceleration/deceleration reference frequency** is reached. The acceleration/deceleration times cannot be set separately.

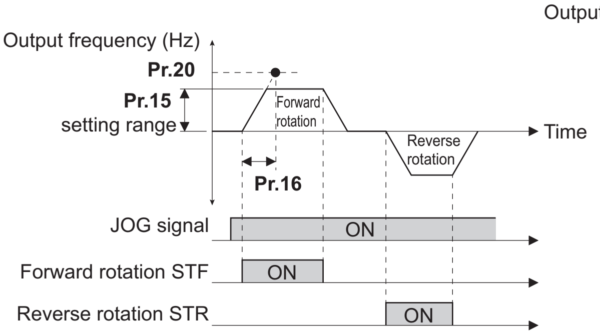
Note that these parameters are categorized as a simple mode parameter when the LCD operation panel or the parameter unit is used.

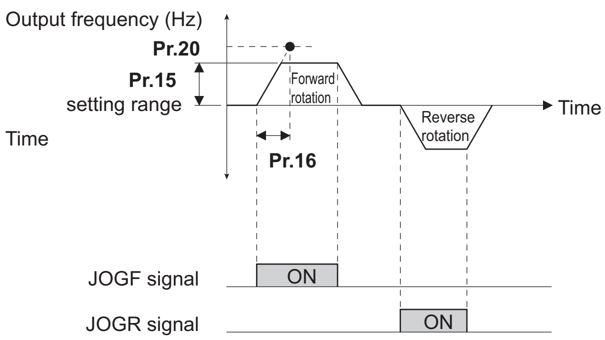
*1 The **Pr.20** initial value is set to 60 Hz.

◆ JOG operation in the External operation

- Operation can be started and stopped by the start signals (STF and STR signals) when the Jog operation selection (JOG) signal is ON. (For the operation method, refer to page 104.)
- While the JOGF or JOGR signal is input, the **Pr.15 Jog frequency** setting is used for operation. The rotation is forward while the JOGF signal is input, and the rotation is reverse while the JOGR signal is input. (Direct JOG function)
- Use **Pr.16 Jog acceleration/deceleration time** to set the acceleration/deceleration time during JOG operation.
- For each signal, refer to the following table and assign the function by **Pr.178 to Pr.189 (Input terminal function selection)**.

Input signal	Pr.178 to Pr.189 settings
JOG	5 (**Pr.185** initial value)
JOGF	57
JOGR	58





◆ JOG operation in PU

- When the operation panel or the parameter unit is in the JOG operation mode, the motor jogs only while the start button is pressed. (For the operation method, refer to page 105.)

NOTE

- The reference frequency of the acceleration/deceleration time differs according to the **Pr.29 Acceleration/deceleration pattern selection** setting. (Refer to page 194.)
- The **Pr.15** setting should be equal to or higher than the **Pr.13 Starting frequency** setting.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.
- During JOG operation, the second acceleration/deceleration cannot be selected with the RT signal. (Other second functions are enabled. (Refer to page 348.))
- When the JOGR or STR signal is input while the JOGF signal is input, the motor is decelerated to stop.
- When the JOGF or STF signal is input while the JOGR signal is input, the motor is decelerated to stop.
- The three-wire type connection is not available for the JOGF and JOGR signals.
- When **Pr.79 Operation mode selection**="4", JOG operation is started by one push of FWD / REV on the operation panel and stopped by STOP RESET.
- This function is invalid when **Pr.79**= "3".
- To perform the JOG operation using the external signals, select the setting of "JOG signal" for the input via terminal JOG in **Pr.291 Pulse train I/O selection**. (Refer to page 222.)

Parameters referred to

Pr.13 Starting frequency ☞ page 201
Pr.20 Acceleration/deceleration reference frequency, Pr.21 Acceleration/deceleration time increments ☞ page 190
Pr.29 Acceleration/deceleration pattern selection ☞ page 194
Pr.79 Operation mode selection ☞ page 204
Pr.178 to Pr.182 (Input terminal function selection) ☞ page 343

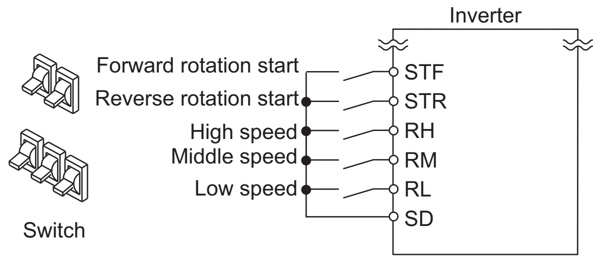
5.6.7 Operation by multi-speed setting

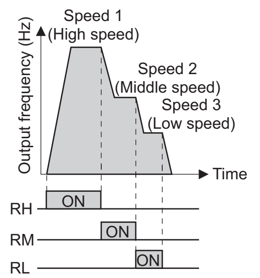
Use these parameters to change among pre-set operation speeds with the terminals. The speeds are pre-set with parameters. Any speed can be selected by simply turning ON/OFF the contact signals (RH, RM, RL, and REX signals).

Pr.	Name	Initial value	Setting range	Description
28 D300	**Multi-speed input compensation selection**	0	0	Without compensation
			1	With compensation
4 D301	**Multi-speed setting (high speed)**	60 Hz	0 to 590 Hz	Sets the frequency when RH is ON.
5 D302	**Multi-speed setting (middle speed)**	30 Hz	0 to 590 Hz	Sets the frequency when RM is ON.
6 D303	**Multi-speed setting (low speed)**	10 Hz	0 to 590 Hz	Sets the frequency when RL is ON.
24 D304	**Multi-speed setting (speed 4)**	9999	0 to 590 Hz, 9999	Frequency from 4th speed to 15th speed can be set according to the combination of the RH, RM, RL and REX signals. 9999: Not selected
25 D305	**Multi-speed setting (speed 5)**			
26 D306	**Multi-speed setting (speed 6)**			
27 D307	**Multi-speed setting (speed 7)**			
232 D308	**Multi-speed setting (speed 8)**			
233 D309	**Multi-speed setting (speed 9)**			
234 D310	**Multi-speed setting (speed 10)**			
235 D311	**Multi-speed setting (speed 11)**			
236 D312	**Multi-speed setting (speed 12)**			
237 D313	**Multi-speed setting (speed 13)**			
238 D314	**Multi-speed setting (speed 14)**			
239 D315	**Multi-speed setting (speed 15)**			

◆ Multi-speed setting (Pr.4 to Pr.6)

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



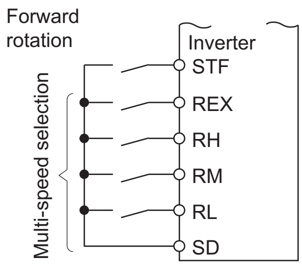


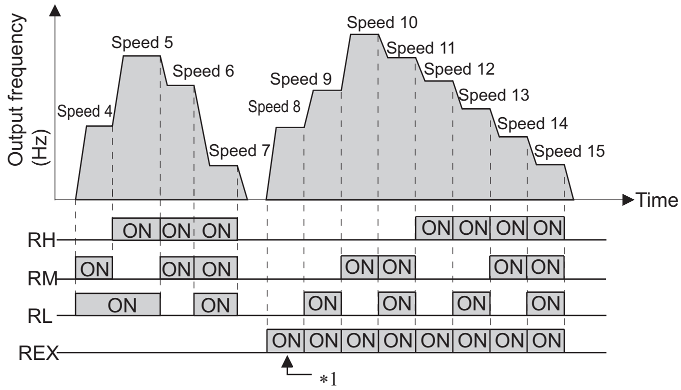
NOTE

- In the initial setting, when two or more of multi-speed settings are simultaneously selected, priority is given to the set frequency of the lower signal. For example, when RH and RM signals turn ON, RM signal (**Pr.5**) has a higher priority.
- The RH, RM and RL signals are assigned to the terminals RH, RM and RL in the initial status. Set "0 (RL)", "1 (RM)", and "2 (RH)" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the signals to other terminals.

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

- The frequency from 4th speed to 15th speed can be set by 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 status, 4th to 15th speeds are invalid.)
- For the terminal used for REX signal input, set "8" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function.

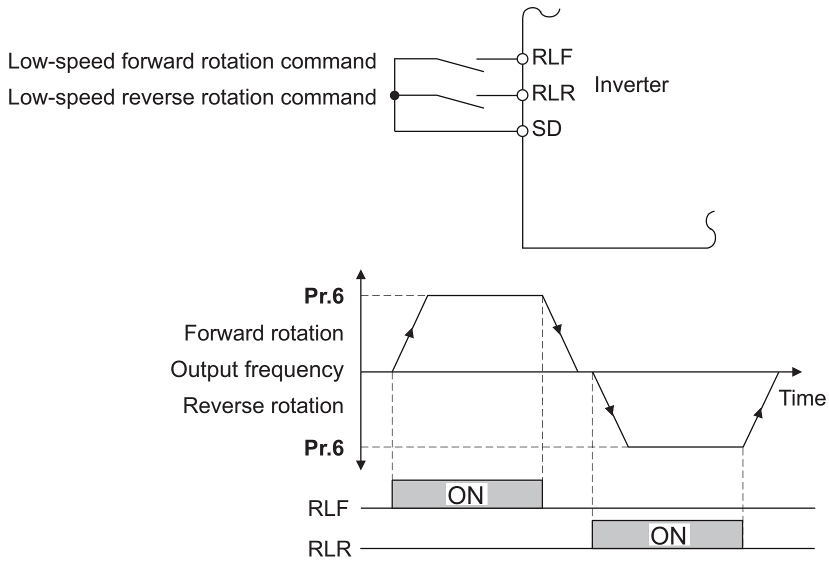




*1 When RH, RM and RL is set to OFF and REX is set to ON when "9999" is set to **Pr.232 Multi-speed setting (speed 8)**, the inverter runs by the frequency set to **Pr.6**.

◆ Direct multi-speed setting

- While the RLF or RLR signal is input, the operation is according to **Pr.6 Multi-speed setting (low speed)**. The rotation is forward while the RLF signal is input, and the rotation is reverse while the RLR signal is input.



NOTE

- The **Pr.6** setting should be equal to or higher than the **Pr.13 Starting frequency** setting.
- To assign the RLF and RLR signals to input terminals, set "128 (RLF)" and "129 (RLR)" in any two parameters from **Pr.178 to Pr.189 (Input terminal function selection)**.
- The direct multi-speed operation is enabled when the inverter operates in External operation mode or External/PU combined operation mode 1.
- When the RLR or STR signal is input while the RLF signal is input, the motor is decelerated to stop.
- When the RLF or STF signal is input while the RLR signal is input, the motor is decelerated to stop.
- When **Pr.59 Remote function selection** ≠ "0", the RLF signal is used as the STF signal, and the RLR signal is used as the STR signal.

◆ Input compensation of multi-speed setting (Pr.28)

- Speed (frequency) compensation can be applied for the multi-speed setting and the remote setting by inputting the frequency setting compensation signal (terminals 1, 2).

NOTE

- The priority of the frequency commands by the external signals are "Jog operation > multi-speed operation > terminal 4 analog input > pulse train input > terminal 2 analog input". (For details on frequency commands by analog input, refer to page 328.)
- Valid in the External operation mode or PU/External combined operation mode (**Pr.79**= "3" or "4").
- Multi-speed parameters can also be set during PU operation or External operation.
- The **Pr.24 to Pr.27** and **Pr.232 to Pr.239** settings have no priority among them.
- When **Pr.59 Remote function selection** ≠ "0", the multi-speed setting is invalid since the RH, RM, and RL signals are for remote setting.
- When performing analog input compensation, set **Pr.28 Multi-speed input compensation selection** to "1".
- Select the terminals (terminals 1, 2) to use for compensation input voltage (0 to ± 5 V, 0 to ± 10 V) at **Pr.73 Analog input selection**.
- When using terminal 1 for compensation input, set **Pr.868 Terminal 1 function assignment** "0" (initial value).
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.15 Jog frequency ☞ page 224
Pr.59 Remote function selection ☞ page 197
Pr.73 Analog input selection ☞ page 318
Pr.79 Operation mode selection ☞ page 204
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.868 Terminal 1 function assignment ☞ page 322

5.7 (H) Protective function parameter

Purpose	Parameter to set			Refer to page
To protect the motor from overheating	Electronic thermal O/L relay	P.H000, P.H006, P.H010, P.H016, P.H020, P.H021	Pr.9, Pr.51, Pr.561, Pr.607, Pr.608, Pr.1016	230
To set the overheat protection characteristics for the motor	Free thermal O/L relay setting	P.H001 to P.H005, P.H011 to P.H015	Pr.600 to Pr.604, Pr.692 to Pr.696	236
To extend the life of the cooling fan	Cooling fan operation selection	P.H100	Pr.244	237
To detect ground fault at start	Ground fault at start enable/ disable	P.H101	Pr.249	238
To initiate an inverter protective function	Fault initiation	P.H103	Pr.997	240
To select the reset operation and fault indication for an output short-circuit	Output short-circuit detection	P.H194	Pr.521	240
To disable the I/O phase loss protective function	I/O phase loss protection selection	P.H200, P.H201	Pr.251, Pr.872	241
To restart using the retry function when the protective function is activated	Retry operation	P.H300 to P.H303	Pr.65, Pr.67 to Pr.69	242
To operate without activating protective functions in case of emergency	Emergency drive	P.H320 to P.H324, P.A001, P.A004, P.A702	Pr.57, Pr.136, Pr.139, Pr.514, Pr.515, Pr.523, Pr.524, Pr.1013	245
To check faulty area in the internal storage device	Internal storage device status indication	P.H325	Pr.890	253
To set the upper and lower limits of the output frequency	Maximum/minimum frequency	P.H400 to P.H402	Pr.1, Pr.2, Pr.18	253
To operate by avoiding resonance points	Frequency jump	P.H420 to P.H425, P.H429	Pr.31 to Pr.36, Pr.552	255
To limit the output current so that the inverter protective function does not activate	Stall prevention	P.H500, P.H501, P.H600, P.H601, P.H610, P.H611, P.H620, P.H621, P.H631, P.M430, P.T010, P.T040	Pr.22, Pr.23, Pr.48, Pr.49, Pr.66, Pr.148, Pr.149, Pr.154, Pr.156, Pr.157, Pr.858, Pr.868	257
To monitor for load faults	Load characteristics fault detection	P.H520 to P.H527, P.H531 to P.H535	Pr.1480 to Pr.1492	265
To set the motor acceleration/ deceleration time	Emergency stop function	P.H710, P.F040	Pr.815, Pr.1103	190
To shut off the output during acceleration	Overspeed detection level	P.H800	Pr.374	270

5

5.7.1 Motor overheat protection (electronic thermal O/L relay)

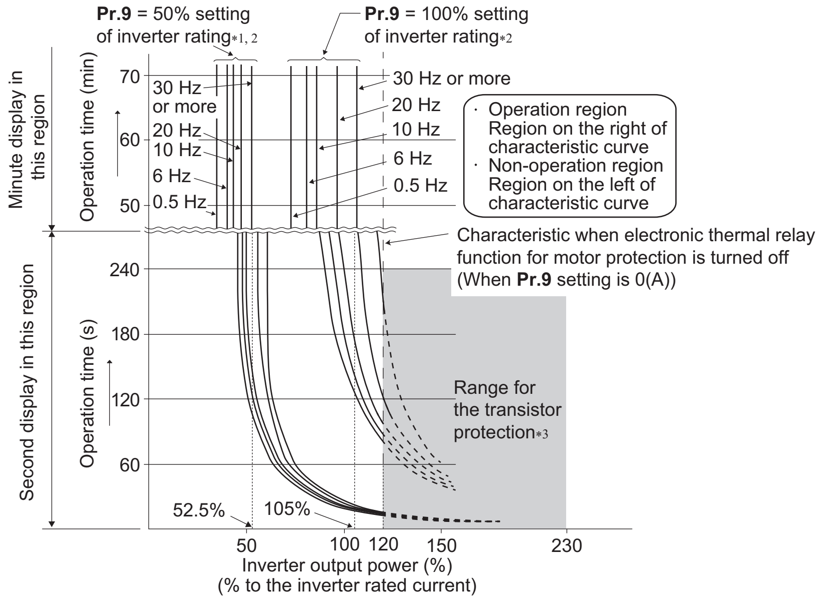
Set the current of the electronic thermal O/L relay function to protect the motor from overheating. Such settings will provide the optimum protective characteristic considering the low cooling capability of the motor during low-speed operation.

Pr.	Name	Initial value	Setting range	Description
9 **H000**	**Electronic thermal O/L relay**	Inverter rated current	0 to 500 A*1	Set the rated motor current.
			0 to 3600 A*2	
600 **H001**	**First free thermal reduction frequency 1**	9999	0 to 590 Hz	The electronic thermal O/L relay operation level can be changed to match the motor temperature characteristics with the combination of these three points (**Pr.600, Pr.601**), (**Pr.602, Pr.603**), (**Pr.604, Pr.9**). 9999: Free thermal O/L relay invalid
			9999	
601 **H002**	**First free thermal reduction ratio 1**	100%	1 to 100%	
			9999	
602 **H003**	**First free thermal reduction frequency 2**	9999	0 to 590 Hz	
			9999	
603 **H004**	**First free thermal reduction ratio 2**	100%	1 to 100%	
			9999	
604 **H005**	**First free thermal reduction frequency 3**	9999	0 to 590 Hz	
			9999	
607 **H006**	**Motor permissible load level**	150%	110 to 250%	Set the permissible load according to the motor characteristics.
51 **H010**	**Second electronic thermal O/L relay**	9999	0 to 500 A*1	Enabled when the RT signal is ON. Set the rated motor current.
			0 to 3600 A*2	
			9999	Second electronic thermal O/L relay invalid
692 **H011**	**Second free thermal reduction frequency 1**	9999	0 to 590 Hz	The electronic thermal O/L relay operation level can be changed to match the second motor temperature characteristics with the combination of these three points (**Pr.692, Pr.693**), (**Pr.694, Pr.695**), (**Pr.696, Pr.51**). 9999: Second free thermal O/L relay invalid
			9999	
693 **H012**	**Second free thermal reduction ratio 1**	100%	1 to 100%	
			9999	
694 **H013**	**Second free thermal reduction frequency 2**	9999	0 to 590 Hz	
			9999	
695 **H014**	**Second free thermal reduction ratio 2**	100%	1 to 100%	
			9999	
696 **H015**	**Second free thermal reduction frequency 3**	9999	0 to 590 Hz	
			9999	
608 **H016**	**Second motor permissible load level**	9999	110 to 250%	Set the permissible load when the RT signal is ON.
			9999	The **Pr.607** setting is applied even when the RT signal is ON.
561 **H020**	**PTC thermistor protection level**	9999	0.5 to 30 kΩ	Set the PTC thermistor protection level (resistance).
			9999	PTC thermistor protection disabled
1016 **H021**	**PTC thermistor protection detection time**	0 s	0 to 60 s	Set the time from when the resistance of the PTC thermistor reaches the protection level until the protective function is activated.

*1 The setting range for FR-F860-00680 or lower. The minimum setting increment is "0.01 A".
*2 The setting range for FR-F860-01080 or higher. The minimum setting increment is "0.1 A".

◆ Electronic thermal O/L relay operation characteristic for induction motor (Pr.9)

- This function detects the overload (overheat) of the motor and trips the inverter by stopping the operation of the transistor at the inverter output side.
- Set the rated current (A) of the motor in **Pr.9**. (If the motor has both 50 Hz and 60 Hz ratings and the **Pr.3 Base frequency** is set to 60 Hz, set to 1.1 times the 60 Hz rated motor current.)
- Set "0" in **Pr.9** to avoid activating the electronic thermal O/L relay function; for example, when using an external thermal relay for the motor. (Note that the output transistor protection of the inverter is activated. (E.THT))



*1 When setting **Pr.9** to a value (current value) of 50% of the inverter rated current

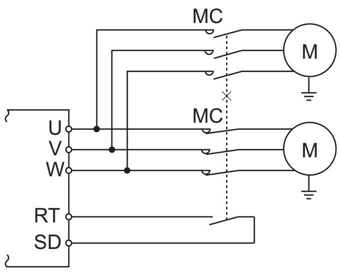
*2 The % value denotes the percentage to the inverter rated current. It is not the percentage to the rated motor current.

*3 Transistor protection is activated depending on the temperature of the heat sink. The protection may be activated even with less than 120% depending on the operating conditions.

NOTE

- The internal accumulated heat value of the electronic thermal relay function is reset to the initial value by the inverter's power reset and reset signal input. Avoid unnecessary reset and power-OFF.
- Install an external thermal relay (OCR) between the inverter and motors to operate several motors, a multi-pole motor or a dedicated motor with one inverter. When setting an external thermal relay, note that the current indicated on the motor rating plate is affected by the line-to-line leakage current. (Refer to page 72.) The cooling effect of the motor drops during low-speed operation. Use a thermal protector or a motor with built-in thermistor.
- The protective characteristic of the electronic thermal O/L relay is degraded when there is a large difference in capacity between the inverter and motor, and when the set value is small. In such case, use an external thermal relay.
- A dedicated motor cannot be protected by an electronic thermal O/L relay. Use an external thermal relay.
- The transistor protection thermal O/L relay is activated early when the **Pr.72 PWM frequency selection** setting is increased.
- When using a PM motor, set the free thermal parameters (**Pr.600** to **Pr.604**) in accordance with the motor characteristic.

◆ Set two types of electronic thermal O/L relays (Pr.51)



- These settings are used when rotating two motors with different rated current separately by a single inverter. (When rotating two motors together, use an external thermal relay.)
- Set the rated motor current for the second motor in **Pr.51**.
- When the RT signal is ON, thermal protection is provided based on the **Pr.51** setting.

Pr.450 Second applied motor	**Pr.9 Electronic thermal O/L relay**	**Pr.51 Second electronic thermal O/L relay**	**RT-OFF**		**RT-ON**	
			No.1 Motor	**No.2 Motor**	**No.1 motor**	**No.2 motor**
9999	0	9999	×	×	×	×
		0	×	×	×	×
		0.01 to 500 (0.1 to 3600)	×	Δ	×	○
9999	Other than 0	9999	○	×	○	×
		0	○	×	Δ	×
		0.01 to 500 (0.1 to 3600)	○	Δ	Δ	○
Other than 9999	0	9999	×	×	×	×
		0	×	×	×	×
		0.01 to 500 (0.1 to 3600)	×	Δ	×	○
Other than 9999	Other than 0	9999	○	Δ	Δ	○
		0	○	×	Δ	×
		0.01 to 500 (0.1 to 3600)	○	Δ	Δ	○

○: Values are accumulated by using the output current.

Δ: Values are accumulated by assuming the output current is "0 A" (cooling processing).

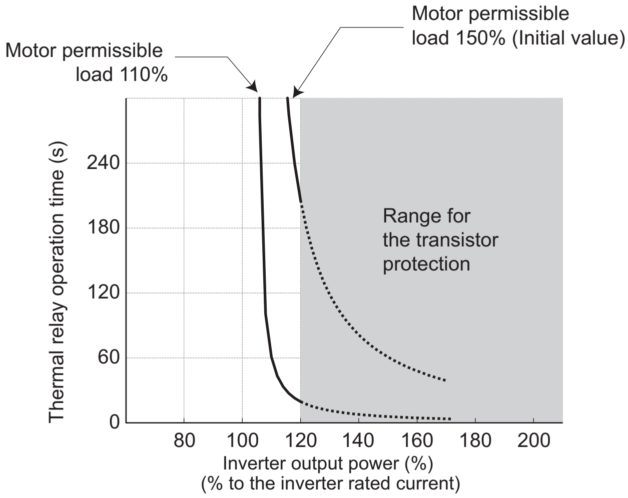
×: Electronic thermal O/L relay does not operate.

NOTE

- The RT signal is a second function selection signal. The RT signal also enables other second functions. (Refer to page 348.)
- The RT signal is assigned to the terminal RT in the initial setting. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)**, to assign the RT signal to another terminal.

◆ Motor permissible load level setting (Pr.607, Pr.608)

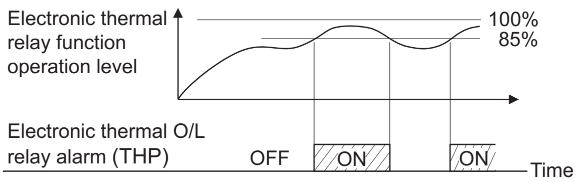
The electronic thermal O/L relay operation characteristic can be changed by setting the permissible load level according to the motor characteristics.



Example of motor permissible load setting (when Pr.9="100% of the inverter rating")

◆ Electronic thermal O/L relay pre-alarm (TH) and warning signal (THP signal)

- If the accumulated electronic thermal value reaches 85% of the **Pr.9** or **Pr.51** setting, electronic thermal O/L relay function pre-alarm (TH) is displayed and the electronic thermal O/L relay pre-alarm (THP) signal is output. If the value reaches 100% of the **Pr.9** setting, the motor thermal protection (E.THM/E.THT) is activated to shut off the inverter output. The inverter output is not shut off with the TH display. The inverter output is not shut off with the warning signal (THP).
- For the terminal used for THP signal output, set "8 (positive logic)" or "108 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.

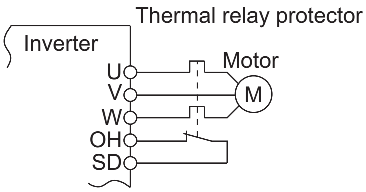


- 100%: Electronic thermal O/L relay activation value

NOTE

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

◆ External thermal relay input (OH signal, E.OHT)



External thermal relay input connection diagram

- The external thermal relay input (OH) signal is used when using an external thermal relay or a thermal protector built into the motor to protect the motor from overheating.
- When the thermal relay function is activated, the external thermal operation (E.OHT) shuts off the inverter output.
- For the terminal used for the OH signal input, set "7" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function.

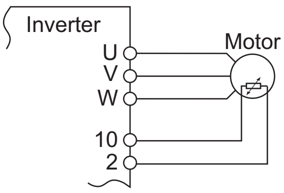
NOTE

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

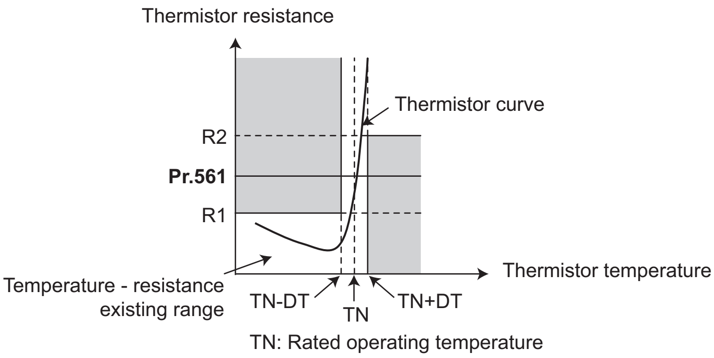
◆ PTC thermistor input (Pr.561, Pr.1016, E.PTC)

This function is used to protect the motor from overheating by inputting outputs from the motor's built-in PTC thermistor to the inverter. It is recommended that a PTC thermistor whose resistance increases most rapidly around the rated activating temperature (TN±DT) is used.

- PTC thermistor input connection diagram

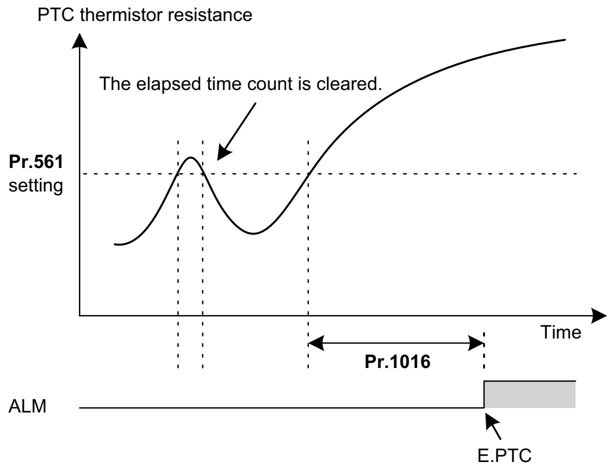


- Example of PTC thermistor characteristics



- Output from the PTC thermistor, which is built into the motor, can be input to the terminals 2 and 10. If the input from the PTC thermistor reaches the resistor value set in **Pr.561 PTC thermistor protection level**, the PTC thermistor operation (E.PTC) shuts off the inverter output.
- To use the PTC thermistor input function, select voltage input (initial setting) for terminal 2 using the voltage/current input selection switch. (For details on the voltage/current input switch assembly, refer to page 318.)
- Confirm the characteristic of the PTC thermistor to be used, and set the resistance for **Pr.561** around the center of the R1 and R2 values shown on the figure above so that it does not deviate from the protective function activating temperature TN. If the **Pr.561** setting becomes too close to R1 or R2, the protective function activating temperature may be too hot (protection is delayed), or too cold (too much protection).
- When the PTC thermistor protection is enabled (**Pr.561** ≠ "9999"), the resistance value for the PTC thermistor can be displayed on the operation panel or via RS-485 communication. (Refer to page 274.)

• When the PTC thermistor protection level setting is used, use **Pr.1016 PTC thermistor protection detection time** to set the time from when the resistance of the PTC thermistor reaches the protection level until the protective function (E.PTC) is activated. If the resistance of the PTC thermistor falls below the protection level within the protection detection time, the elapsed time count is cleared.

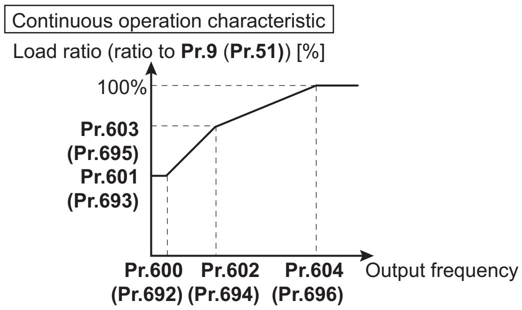


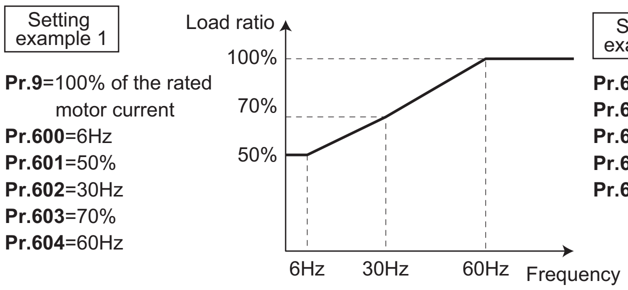
NOTE

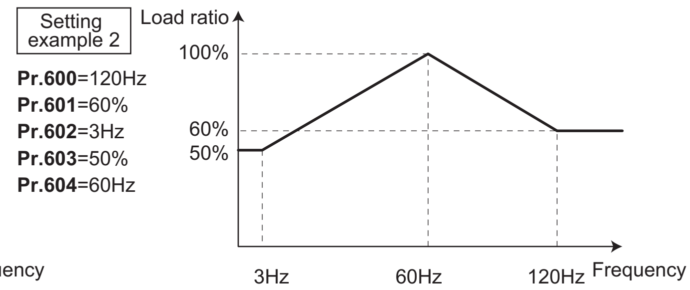
• When using terminal 2 for PTC thermistor input (**Pr.561** ≠ "9999"), the terminal 2 will not operate as an analog frequency command terminal. The PID and dancer control functions assigned to the terminal 2 will be also disabled. Use **Pr.133 PID action set point** to set the set point for the PID function.
• To input power to the PTC thermistor power supply, always use the terminal 10. Do not use any other terminals or an external power supply. Otherwise, the PTC thermistor protection (E.PTC) does not operate properly.
• When E.PTC is activated, the alarm display, "External protection (AU terminal)", may appear on the parameter unit (FR-PU07), but it is not a fault.

◆ Overheat protection to match the characteristic of the motor (Pr.600 to Pr.604, Pr.692 to Pr.696)

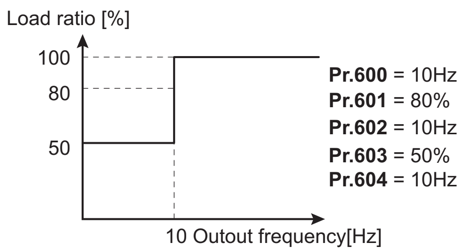
- The activation level of the electronic thermal O/L relay can be varied to match the motor temperature characteristic.
- The electronic thermal O/L relay's activation level can be set using the combination of three points (**Pr.600, Pr.601**), (**Pr.602, Pr.603**), (**Pr.604, Pr.9**). Two or more points are required for setting.
- The electronic thermal O/L relay's activation level can be set to using the combination of three points (**Pr.692, Pr.693**), (**Pr.694, Pr.695**), (**Pr.696, Pr.51**) when the RT signal is ON.







- When setting **Pr.600**, **Pr.602**, **Pr.604** (**Pr.692, Pr.694, Pr.696**) to the same frequency, the following graph's upper level will be applied.



NOTE

- Make sure to set the parameters according to the motor temperature characteristic used.

Parameters referred to

Pr.71 Applied motor ☞ page 351
Pr.72 PWM frequency selection ☞ page 179
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

5.7.2 Cooling fan operation selection

A cooling fan is built into the inverter and its operation can be controlled.

<table>
<tr><th>Pr.</th><th>Name</th><th>Initial value</th><th>Setting range</th><th colspan="2">Description</th></tr>
<tr><td rowspan="6">244</td><td rowspan="6">Cooling fan operation selection</td><td rowspan="6">1</td><td>0</td><td colspan="2">Cooling fan ON/OFF control is disabled. (The cooling fan is always ON at power ON)
The cooling fan operates at power ON.</td></tr>
<tr><td>1</td><td colspan="2">Cooling fan ON/OFF control is enabled.
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.</td></tr>
<tr><td>101 to 105</td><td colspan="2">Cooling fan ON/OFF control is enabled.
Set the cooling fan stop waiting time within 1 to 5 seconds.</td></tr>
<tr><td>1000</td><td>Cooling fan ON/OFF control is disabled. (The cooling fan is always ON at power ON)
The cooling fan operates at power ON.</td><td rowspan="3">The cooling fan can be set to always OFF during PM motor test operation.</td></tr>
<tr><td>1001</td><td>Cooling fan ON/OFF control is enabled.
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.</td></tr>
<tr><td>1101 to 1105</td><td>Cooling fan ON/OFF control is enabled.
Set the cooling fan stop waiting time within 1 to 5 seconds.</td></tr>
<tr><td rowspan="3">H100</td><td rowspan="3">Cooling fan operation selection</td><td rowspan="3">1</td><td>0</td><td colspan="2">Cooling fan ON/OFF control is disabled. (The cooling fan is always ON at power ON)
The cooling fan operates at power ON.</td></tr>
<tr><td>1</td><td colspan="2">Cooling fan ON/OFF control is enabled.
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.</td></tr>
<tr><td>101 to 105</td><td colspan="2">Cooling fan ON/OFF control is enabled.
Set the cooling fan stop waiting time within 1 to 5 seconds.</td></tr>
<tr><td rowspan="2">H106</td><td rowspan="2">Cooling fan operation selection during the test operation</td><td rowspan="2">0</td><td>0</td><td colspan="2">The cooling fan operates according to the H100 setting during PM motor test operation.</td></tr>
<tr><td>1</td><td colspan="2">The cooling fan can be set to always OFF during PM motor test operation.</td></tr>
</table>

◆ Cooling fan always ON (Pr.244 (P.H100) = "0")

- When **Pr.244** = "0", the cooling fan operates at power ON. If the fan stops at this time, fan operation is regarded as faulty, Fan alarm [FN] is displayed on the operation panel, and the fan fault (FAN) and alarm (LF) signals are output.
- For the terminal used for the FAN signal output, set "25 (positive logic)" or "125 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**. For the LF signal, set "98 (positive logic)" or "198 (negative logic)".

◆ Cooling fan operation control (Pr.244 (P.H100) = "1" (initial value), "101 to 105")

- The cooling fan operation is controlled when **Pr.244** = "1". When the inverter is running, the cooling fan operates; and when it is stopped, the cooling fan operates according to the temperature of the inverter heat sink. If the fan stops although it meets the conditions for running, fan operation is regarded as faulty, [FN] is displayed on the operation panel, and the fan signal and LF signals are output.
- To prevent the cooling fan from turning ON and OFF repeatedly during frequent starts/stops (inching), the cooling fan stop waiting time can be set. The waiting time when **Pr.244** = "101 to 105" is **Pr.244**-100 (or 1 s, if the **Pr.244** = "101").

◆ Cooling fan operation command signal (Y206 signal)

- The cooling fan operation command signal (Y206 signal) can be output when the inverter cooling fan meets the conditions for running. The function can be used when the fan installed on the enclosure is synchronized with the inverter cooling fan.
- Y206 signal indicates the operating command condition of the inverter cooling fan depending on the power supply ON/OFF or the **Pr.244** settings. The signal does not indicate the actual operation of the cooling fan. (The signal is output even if the cooling fan is stopped due to a fault.)
- To use the Y206 signal, set "206 (positive logic) or 306 (negative logic)" in one of **Pr.190 to Pr.196 (Output terminal function selection)** to assign function to an output terminal.

◆ Cooling fan operation selection during the test operation (Pr.244 = "1000, 1001, 1101 to 1105" (P.H106 = "1"))

- When **P.H106** = "1" or **Pr.244** = "1000, 1001, or 1101 to 1105", the cooling fan can be set to always OFF during PM motor test operation.

NOTE

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

Parameters referred to

Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

5.7.3 Earth (ground) fault detection at start / restricting reset method for an earth (ground) fault

The reset method for the output side earth (ground) fault overcurrent (E.GF) can be restricted.

- Select whether to enable or disable the earth (ground) fault detection at start. When enabled, the earth (ground) fault detection is performed immediately after a start signal input to the inverter.
- Select whether to restrict the reset method for an earth (ground) fault.

Pr.	Name	Initial value	Setting range	Description	
				Earth (ground) fault	Reset method
249 H101	**Earth (ground) fault detection at start**	0	0	Not detected at start	Not restricted
			1	Detected at start	
			2		Restricted

◆ Selecting whether to perform the earth (ground) fault detection at start

V/F Magnetic flux

- If an earth (ground) fault is detected at start while **Pr.249** = "1 or 2", the output side earth (ground) fault overcurrent (E.GF) is detected and output is shut off. (Refer to page 579)
- Earth (ground) fault detection at start is enabled under V/F control and Advanced magnetic flux vector control.
- When the **Pr.72 PWM frequency selection** setting is high, enable the earth (ground) fault detection at start.

NOTE

- Because the detection is performed at start, output is delayed for approx. 20 ms every start.
- Use **Pr.249** to enable/disable the earth (ground) fault detection at start. During operation, earth (ground) faults are detected regardless of the **Pr.249** setting.

◆ Restricting reset method for an earth (ground) fault

- The reset method when the output is shut off due to the output side earth (ground) fault overcurrent (E.GF) can be restricted. When E.GF occurs while **Pr.249** = "2", E.GF can be reset only by turning OFF the control circuit power.
- This restriction prevents the inverter from being damaged due to repeated reset operations by the other methods such as entering the RES signal.
- When E.GF occurs while **Pr.249** = "2", the output short-circuit detection (ALM4) signal can be output.
- For the terminal used to output the ALM4 signal, set "23" (positive logic) or "123" (negative logic) in any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- If **Pr.249** is set to "2" while the retry function is enabled (**Pr.67** is not set to "0"), no retry is performed even when E.GF occurs.
- If **Pr.249** is set to "2" while the automatic bypass switching after inverter fault is enabled (**Pr.138** is set to "1"), the operation is not switched to the commercial power supply operation even when E.GF occurs.

5

NOTE

- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.
- If E.GF occurs during emergency drive operation when **Pr.249** = "2", the output is shut off.

5.7.4 Initiating a protective function

A fault (protective function) is initiated by setting the parameter.
This function can be used to check how the system operates at activation of a protective function.

Pr.	Name	Initial value	Setting range	Description
997 H103	**Fault initiation**	9999	16 to 253	The setting range is same with the one for fault data codes of the inverter (which can be read through communication). Written data is not stored in EEPROM.
			9999	The read value is always "9999". With this setting, the protective function does not activate.

- To initiate a fault (protective function), set the assigned number of the protective function you want to initiate in **Pr.997**.
- The value set in **Pr.997** is not stored in EEPROM.
- When a protective function activates, the inverter trips, a fault is displayed, and a fault signal (ALM, ALM2) is output.
- The latest fault in the fault history is displayed while the fault initiation function is in operation. After a reset, the fault history goes back to the previous status. (The protective function generated by the fault is not saved in the fault history.)
- Perform inverter reset to cancel the protective function.
- For the selectable parameter by **Pr.997** and the corresponding protective functions, refer to page 570.

NOTE

- If a protective function is already operating, no fault can be activated by **Pr.997**.
- The retry function is disabled when a protective function has been initiated by the fault initiation function.
- If a fault occurs after a protective function has been activated, the protective function indication does not change. The fault is not saved in the fault history either.

5.7.5 Output short-circuit fault

Select the reset operation and fault indication for an output short-circuit.

Pr.	Name	Initial value	Setting range	Description	
				Operation after detection	Reset method
521 H194	**Output short-circuit detection**	0	0	E.OC1 to E.OC3	Not restricted
			1	E.SCF	Restricted

- The fault indication for an output short-circuit (E.OC1 to E.OC3, and E.SCF) can be changed by the **Pr.521** setting.
- When an output short-circuit is detected while **Pr.521** = "1", E.SCF is displayed and the inverter output is shut off. (Refer to page 576)
- When E.SCF occurs while **Pr.521** = "1", E.SCF can be reset only by turning OFF the control circuit power. (E.OC1 to E.OC3 can be reset by any reset method.)
- This restriction prevents the inverter from being damaged due to repeated reset operations by the other methods such as entering the RES signal.
- When E.SCF occurs, the output short-circuit detection (ALM4) signal can be output.
- For the terminal used to output the ALM4 signal, set "23" (positive logic) or "123" (negative logic) in any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- If the automatic bypass switching after inverter fault is enabled (**Pr.138** is set to "1"), the operation is not switched to the commercial power supply operation even when E.SCF occurs.

NOTE

- When short-circuit resistance is large, the current does not reach the short-circuit detection level. In such a case, an output short-circuit cannot be detected.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

5.7.6 I/O phase loss protection selection

The output phase loss protection function, which stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) is lost, can be disabled.
The input phase loss protective function on the inverter input side (R/L1, S/L2, T/L3) can be enabled.

Pr.	Name	Initial value	Setting range	Description
251 **H200**	**Output phase loss protection selection**	1	0	Without output phase loss protection
			1	With output phase loss protection
872 **H201** *1	**Input phase loss protection selection**	0	0	Without input phase loss protection
			1	With input phase loss protection

*1 The setting is available only for standard models.

◆ Output phase loss protection selection (Pr.251)

- When **Pr.251** = "0", output phase loss (E.LF) protection is disabled.

◆ Input phase loss protection selection (Pr.872) (Standard models)

- When **Pr. 872** = "1", input phase loss (E.ILF) protection will be activated if one of three phases is detected to be lost for 1 s continuously.

NOTE

- When several motors are connected, output phase loss cannot be detected even if the wiring to one motor loses phase.
- If an input phase is lost while **Pr.872** = "1" (with input phase loss protection), **Pr.261 Power failure stop selection** ≠ "0" (power failure stop function enabled), the motor decelerates to stop without outputting E.ILF.
- In the case of R/L1, S/L2 phase loss, the input phase loss protection will not operate, and the inverter will trip.
- If an input phase loss continues for a long time, the converter section and capacitor lives of the inverter will be shorter.

Parameters referred to

Pr.261 Power failure stop selection page 458

5

5.7.7 Retry function

This function allows the inverter to reset itself and restart at activation of the protective function (fault indication). The retry generating protective functions can be also selected.

When the automatic restart after instantaneous power failure function is selected (**Pr.57 Restart coasting time** ≠ 9999), the restart operation is also performed after a retry operation as well as after an instantaneous power failure. (Refer to page 448 for the restart operation.)

Pr.	Name	Initial value	Setting range	Description
65 **H300**	**Retry selection**	0	0 to 5	A retry-making fault can be selected. (Refer to the table on the next page.)
67 **H301**	**Number of retries at fault occurrence**	0	0	The retry function disabled.
			1 to 10	Set the number of retries at a fault occurrence. A fault output is not provided during the retry operation.
			101 to 110	Set the number of retries at a fault occurrence. (The setting value minus 100 is the number of retries.) A fault output is provided during the retry operation.
68 **H302**	**Retry waiting time**	1 s	0.1 to 600 s	Set the time delay from when an inverter fault occurs until the retry operation starts.
69 **H303**	**Retry count display erase**	0	0	Setting "0" clears the retry success counter ("retry success" means that the inverter successfully restarts).

◆ Setting the retry function (Pr.67, Pr.68)

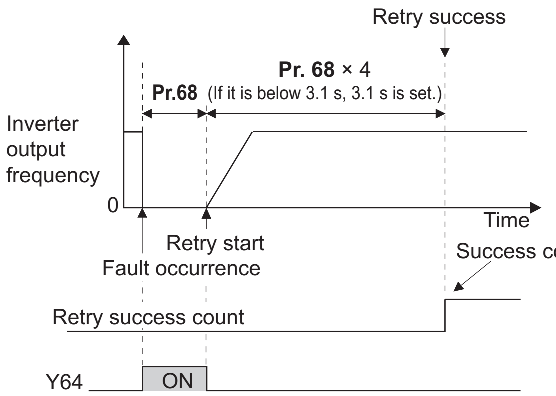
- When the inverter protective function is operating (fault indication), the retry function automatically cancels (resets) the protective function after the time set in **Pr.68**. The retry function then restarts the operation from the starting frequency.
- The retry function is enabled when the **Pr.67** setting is other than "0". For **Pr.67**, set the number of retries at activation of the protective function.

Pr.67 setting	Fault output during retry operation	Retry count
0	—	No retry function
1 to 10	Not provided	1 to 10 times
101 to 110	Provided	1 to 10 times

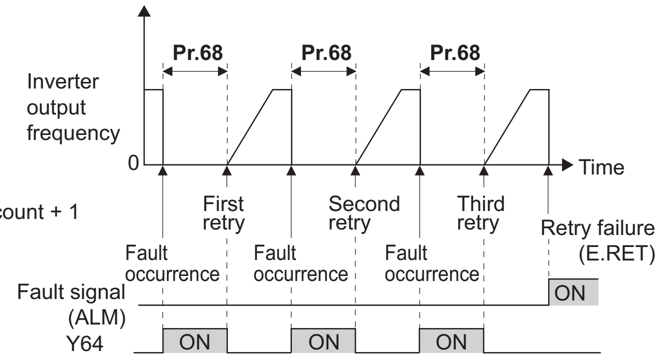
- When retries fail consecutively more than the number of times set in **Pr.67**, a retry count excess (E.RET) occurs, resulting in an inverter retries. (Refer to the retry failure example.)
- Use **Pr.68** to set the waiting time from a protective function activation to a retry in the range of 0.1 to 600 s.
- During retry operation, the during retry (Y64) signal is ON. For the Y64 signal, set "64 (positive logic)" or "164 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.

◆ Retry count check (Pr.69)

- Reading the **Pr.69** value provides the cumulative number of successful restart times made by retries. The cumulative count in **Pr.69** increases by 1 when a retry is successful. Retry is regarded as successful when normal operation continues without a fault for the **Pr.68** setting multiplied by four or longer (3.1 s at the shortest). (When retry is successful, the cumulative number of retry failures is cleared.)
- Writing "0" in **Pr.69** clears the cumulative count.



Retry success example



Retry failure example

5

◆ Selecting retry generating faults (Pr.65)

- Using **Pr.65**, you can select the fault that will cause a retry. No retry will be made for the fault not indicated. (For the fault details, refer to page 570.) l indicates the faults selected for retry.

Retry-making fault	Pr.65 setting					
	0	1	2	3	4	5
E.OC1	●	●		●	●	●
E.OC2	●	●		●	●	
E.OC3	●	●		●	●	●
E.OV1	●		●	●	●	
E.OV2	●		●	●	●	
E.OV3	●		●	●	●	
E.THM	●					
E.THT	●					
E.IPF	●				●	
E.UVT	●				●	
E. BE	●				●	
E. GF	●*1				●*1	
E.OHT	●					
E.OLT	●				●	
E.OPT	●				●	

Retry-making fault	Pr.65 setting					
	0	1	2	3	4	5
E.OP1	●				●	
E. PE	●				●	
E.OS	●				●	
E.PTC	●					
E.CDO	●				●	
E.SER	●				●	
E.USB	●				●	
E.ILF	●				●	
E.PID	●				●	
E.PCH	●				●	
E.SOT	●	●		●	●	●
E.LCI	●				●	
E.LUP	●				●	
E.LDN	●				●	

*1 When **Pr.249 Earth (ground) fault detection at start** = "2", retry is not performed.

NOTE

- Use the retry function only when the operation can be resumed after resetting a protective function activation. Making a retry against the protective function, which is activated by an unknown condition, will lead the inverter and motor to be faulty. Identify what condition the protective function was activated, and eliminate such condition before resuming the operation.
- If the retry function operates during PU operations, the operating conditions (forward/reverse rotation) are stored; and operations resume after retry reset.
- Only the fault details for the first fault that occurred are stored in the fault history.
- The reset by the retry function does not clear the accumulated data of the electronic thermal O/L relay. (This is different from power supply reset or reset by RES signal.)
- When the Parameter storage device fault (control circuit board) (E.PE) is occurring and reading of the retry-function-related parameters is not possible, retry cannot operated.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

⚠ CAUTION

- When the retry function is set enabled, stay away from the motor and machine in the case of an inverter trip. The motor and machine will start suddenly (after the reset time has elapsed) after the inverter trip. When the retry function is set enabled, apply in easily visible places the CAUTION stickers supplied to this product.

Parameters referred to

Pr.57 Restart coasting time ☞ page 448
Pr.249 Earth (ground) fault detection at start ☞ page 238

5.7.8 Emergency drive (Fire mode)

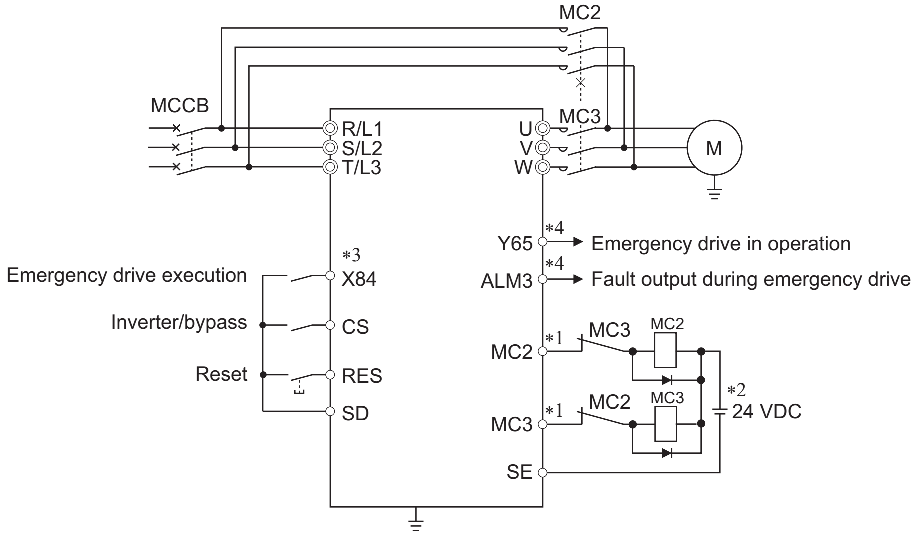
This function is used in case of emergency such as a fire to forcibly continue inverter operation to drive a motor without activating protective functions even if the inverter detects a fault. Using this function may cause damage of the motor or the inverter because driving the motor is given the highest priority. Use this function for emergency operation only. When the inverter is damaged by a fault, the motor operation can be continued by switching to the commercial power supply operation. The emergency drive function is available only for the standard model.

Pr.	Name	Initial value	Setting range	Description
523 **H320**[*1]	**Emergency drive mode selection**	9999	100, 111, 112, 121, 122, 123, 124, 200, 211, 212, 221, 222, 223, 224, 300, 311, 312, 321, 322, 323, 324, 400, 411, 412, 421, 422, 423, 424	Select the operation mode of the emergency drive.
			9999	Emergency drive disabled
524 **H321** [*1*2]	**Emergency drive running speed**	9999	0 to 590 Hz[*3]	Set the running frequency in the fixed frequency mode of the emergency drive. (when the fixed frequency mode is selected in **Pr.523**)
			0 to 100%[*3]	Set the PID set point in the PID control mode of the emergency drive. (when the PID control mode is selected in **Pr.523**)
			9999[*3]	Emergency drive disabled
515 **H322**[*1]	**Emergency drive dedicated retry count**	1	1 to 200	Set the retry count during emergency drive operation.
			9999	Without retry count excess (no restriction on the number of retries)
1013 **H323**[*1]	**Running speed after emergency drive retry reset**	60 Hz	0 to 590 Hz	Set the frequency for operation after a retry when any of E.CPU, E.1 to E.3, E.5 to E.7 occurs during emergency drive operation.
514 **H324**[*1]	**Emergency drive dedicated retry waiting time**	9999	0.1 to 600 s	Set the retry waiting time during emergency drive operation.
			9999	As set in **Pr.68**.
136 **A001**	**MC switchover interlock time**	1 s	0 to 100 s	Set the operation interlock time for MC2 and MC3.
139 **A004**	**Automatic switchover frequency from inverter to bypass operation**	9999	0 to 60 Hz	Set the frequency at which the inverter-driven operation is switched over to the commercial power supply operation when the condition for electronic bypass is established during emergency drive operation.
			9999	Without automatic switchover
57 **A702**	**Restart coasting time**	9999	0	Coasting time differs according to the inverter capacity. (Refer to page 448.)
			0.1 to 30 s	Set the waiting time for the inverter to perform a restart after the power lost by an instantaneous power failure restores.
			9999	No restart

*1 The setting is available only for standard models.
*2 Set **Pr.524** after setting **Pr.523**.
*3 When **Pr.523** = "100, 200, 300, 400", the emergency drive is activated regardless of the **Pr.524** setting.

◆ Connection diagram

- A connection diagram of the emergency drive (commercial mode) is as follows.



*1 Be careful of the capacity of the sequence output terminals. The applied terminals differ by the settings of **Pr.190 to Pr.196 (Output terminal function selection)**.

Output terminal capacity	Output terminal permissible load
Inverter open collector output (RUN, SU, IPF, OL, FU)	24 VDC 0.1 A
Inverter relay output (A1-C1, B1-C1, A2-B2, B2-C2) Relay output option (FR-A8AR)	230 VAC 0.3 A 30 VDC 0.3 A

*2 When connecting a DC power supply, insert a protective diode. When connecting an AC power supply, use relay output terminals of the inverter or contact output terminals of the relay output option (FR-A8AR).

*3 The applied terminals differ by the settings of **Pr.180 to Pr.189 (Input terminal function selection)**.

*4 The applied terminals differ by the settings of **Pr.190 to Pr.196 (Output terminal function selection)**.

NOTE

- Always provide mechanical interlocks for MC2 and MC3.

◆ Emergency drive execution sequence

Point

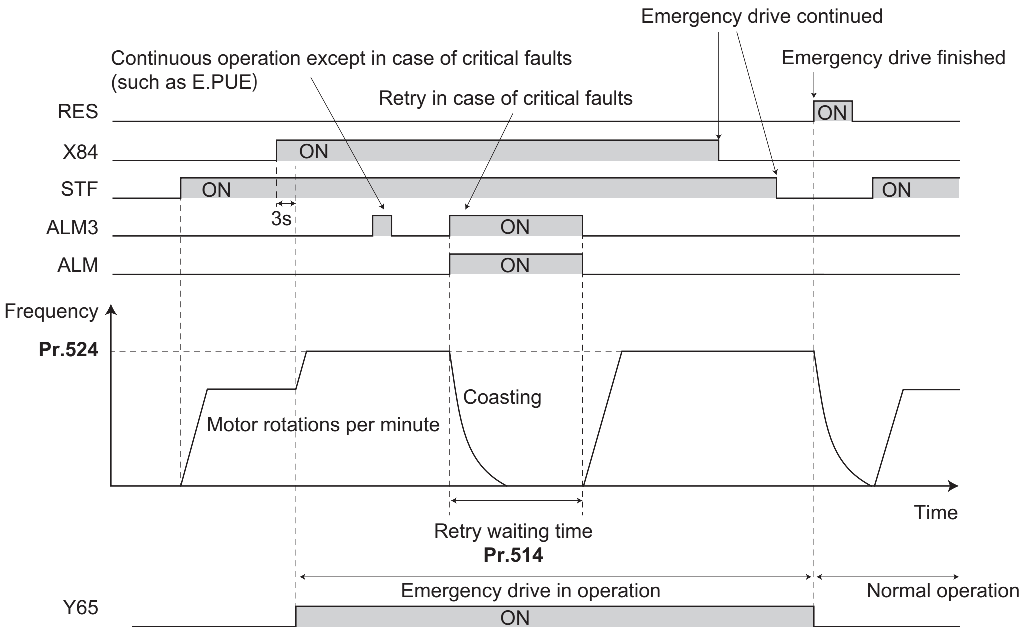
- When X84 signal is ON for 3 s, the emergency drive is executed.
- Y65 signal turns ON during emergency drive operation.
- "ED" appears on the operation panel during emergency drive operation.
- ALM3 signal turns ON when a fault occurs during emergency drive operation.

- To activate the emergency drive, the X84 signal needs to be ON for three seconds while all the following conditions are satisfied.

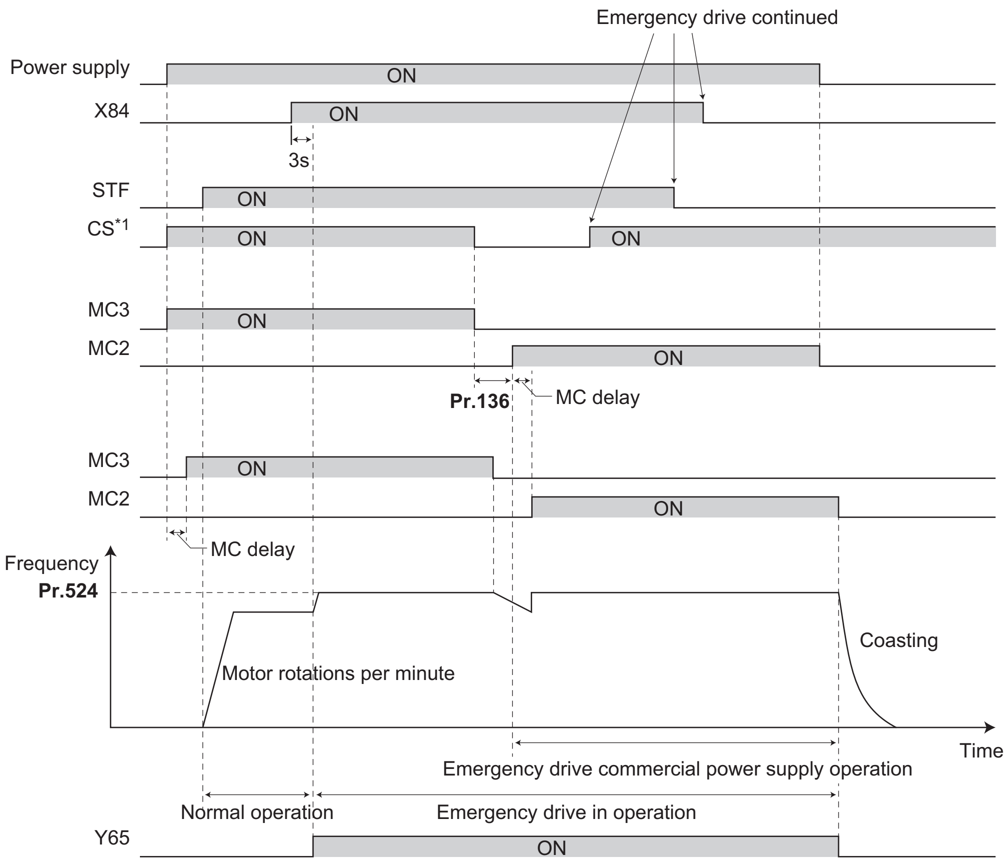
Item	Condition
Emergency drive parameter settings	**Pr.523** ≠ "9999" **Pr.524** ≠ "9999" (Setting is not required when **Pr.523** = "100, 200, 300, or 400".)
Contradictory condition	None of the following conditions are satisfied. • Enabling the electronic bypass sequence function • During offline auto tuning • Supplying power through terminals R1 and S1

- When the "retry" (**Pr.523** = "2[][], 3[][]") is selected, it is recommended to use the automatic restart after instantaneous power failure function at the same time.
- Parameter setting is not available during emergency drive operation.
- To return to the normal operation during emergency drive operation, do the following. (The operation will not be returned to normal only by turning OFF the X84 signal.) Reset the inverter, or turn the power supply OFF. Clear a fault by turning ON the X51 signal while the sequence function is enabled (when the protective function is activated).
- The operation is switched over to the commercial power supply operation in case of the following during emergency drive operation while the commercial mode or the retry / commercial mode is selected. 24 V external power supply operation, power failure status or operation with the power supplied through R1/S1 (except when the DC feeding mode 1 or 2 is selected), undervoltage
- To input the X84 signal, set "84" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function.
- For the terminal used for the Y65 signal output, assign the function by setting "65 (positive logic)" or "165 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**. For the terminal used for the ALM3 signal output, assign the function by setting "66 (positive logic)" or "166 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- The X84 signal input is valid either through the external terminal or via network regardless of the **Pr.338** and **Pr.339** settings (Selection of control source in Network operation mode).
- During emergency drive operation, the operation is performed as **Pr.502 Stop mode selection at communication error** = "0 (initial value)" and communication errors (such as E.SER) do not occur. (A protective function is performed according to its operation during emergency drive operation.)

• The following diagram shows the operation of the emergency drive function (in the retry / output shutoff mode or in the fixed frequency mode (**Pr.523** = "211")).



• The following diagram shows the operation of switching over to the commercial power supply operation during emergency drive operation by using the CS signal (in the commercial mode or in the fixed frequency mode (**Pr.523** = "411")).



*1 Input the CS signal via an external terminal.

◆ Emergency drive operation selection (Pr.523, Pr.524)

- Use **Pr.523 Emergency drive mode selection** to select the emergency drive operation. Set a value in the hundreds place to select the operation when a valid protective function is activated (critical fault) during emergency drive. Set values in the ones and tens places to select the operation method.

Pr.523 setting	Emergency drive operation mode			Description
1□□	Output shutoff mode		Selecting operation when a critical fault occurs during emergency drive operation	Output shutoff at a critical fault occurrence.
2□□	Retry / output shutoff mode			Retry operation at a critical fault occurrence. The output is shut off when a critical fault for which retry is not permitted occurs, or the retry count is exceeded.
3□□[*1]	Retry / commercial mode			Retry operation at a critical fault occurrence. The operation is switched over to the commercial power supply operation when a critical fault for which retry is not permitted occurs, or the retry count is exceeded. While **Pr.515** = "9999", the operation is switched over to the commercial power supply operation when the retry count reaches 200.
4□□[*1]	Commercial mode			The operation is switched over to the commercial power supply operation when a critical fault occurs.
□00	Normal operation mode		Selecting the operation method during emergency drive operation	The operation is performed with the same set frequency and by the same starting command as those in the normal operation. Use this mode to avoid output shutoff due to a fault.
□11	Fixed frequency mode	Forward rotation		The operation is forcibly performed with the frequency set in **Pr.524**. Even when the motor is stopped, the operation is started by the emergency drive execution.
□12		Reverse rotation		
□21	PID control mode	Forward rotation		The operation is performed under PID control using the **Pr.524** setting as a set point. The measured values are input in the method set in **Pr.128**.
□22		Reverse rotation		
□23		Forward rotation (Second PID measured value input)		The operation is performed under PID control using the **Pr.524** setting as a set point. The measured values are input in the method set in **Pr.753**.
□24		Reverse rotation (Second PID measured value input)		
9999	Emergency drive disabled			

*1 Under PM motor control, the operation is not switched over to the commercial power supply operation the output is shut off.

NOTE

- The operation is automatically switched from the PU operation mode or External/PU combined operation mode to the External operation mode when the emergency drive is activated in the fixed frequency mode or in the PID control mode.

◆ Retry operation during emergency drive (Pr.515, Pr.514)

- Set the retry operation during emergency drive operation. Use **Pr.515 Emergency drive dedicated retry count** to set the retry count, and use **Pr.514 Emergency drive dedicated retry waiting time** to set the retry waiting time.
- The ALM signal output conditions depend on the **Pr.67 Number of retries at fault occurrence** setting. (Refer to page 242.)
- For the protective functions (critical faults) for which a retry is performed during emergency drive operation, refer to page 251.

NOTE

- During emergency drive operation, **Pr.65 Retry selection** is not available.

◆ Electronic bypass during emergency drive (Pr.136, Pr.139, Pr.57)

- For selecting the commercial mode (**Pr.523** = "3[][], 4[][]"), setting is required as follows. Set **Pr.136 MC switchover interlock time** and **Pr.139 Automatic switchover frequency from inverter to bypass operation** and assign MC2 and MC3 signals to output terminals. When CS signal is assigned to an input terminal, set **Pr.57 Restart coasting time** ≠ "9999" and input the CS signal through the terminal. (In the initial setting, the CS signal is assigned to the terminal CS.) V/F control or Advanced magnetic flux vector control (Under PM motor control, the operation is not switched over to the commercial power supply operation the output is shut off.)
- During emergency drive operation, the operation is switched over to the commercial power supply operation when any of the following conditions is satisfied. CS signal turns OFF. A critical fault for which retry is not permitted occurs while **Pr.523**="3[][]". A critical fault occurs while **Pr.523**="4[][]".
- While the motor is driven by the inverter during emergency drive operation, if a condition for electronic bypass is satisfied, the output frequency is accelerated/decelerated to the **Pr.139** setting. When the frequency reaches the set frequency, the operation is switched over to the commercial power supply operation. (The operation is immediately switched over to the commercial power supply operation during output shutoff due to a critical fault occurrence.)
- If the parameter for electronic bypass is not set while the commercial mode is set (**Pr.523** = "3[][], 4[][]"), the operation is not switched over to the commercial power supply operation even when a condition for switchover is satisfied, and the output is shut off.
- For the terminals used for the MC2 and MC3 signal output, set "18 (positive logic)" and "19 (positive logic)" in any two of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.
- Operation of magnetic contactor (MC2, MC3)

Magnetic contactor	Installation location	Operation	
		During commercial power supply operation	During inverter operation
MC2	Between power supply and motor	Shorted	Open
MC3	Between inverter output and motor	Open	Shorted

- The input signals are as shown below.

Signal	Function	Operation	MC operation *3	
			MC2	MC3
CS	Inverter/bypass	ON Inverter operation	×	○
		OFF Emergency drive commercial power supply operation *1	○	×
X84	Emergency drive execution	ON Emergency drive execution	—	—
		OFF Normal operation *2	×	○
RES	Operation status reset	ON Reset	×	Invariance
		OFF Normal operation	—	—

*1 If the signal is turned ON after switchover to the emergency drive commercial power supply operation, the operation will not be returned to the inverter-driven operation.
*2 If the signal is turned OFF during the emergency drive operation, the operation will not be returned to normal.
*3 MC operation is as shown below.

Notation	MC operation
○	ON
×	OFF
—	During inverter operation: MC2-OFF, MC3-ON During commercial power supply operation: MC2-ON, MC3-OFF
No change	The operation status before changing the signal state to ON or OFF is held.

NOTE

- During electronic bypass operation while the electronic bypass sequence is enabled (**Pr.135** = "1"), the emergency drive function is not available.

◆ PID control during emergency drive operation

- During emergency drive operation in the PID control mode, the operation is performed under PID control using the **Pr.524** setting as a set point. Input the measured values in the method set in **Pr.128** or **Pr.753**.
- When the PID control mode is selected for emergency drive, the PID action during emergency drive operation is as follows depending on the PID control setting.

Item	PID control action		
	Set point / measured value input setting	Deviation input setting	Without PID control setting
Measured value input selection (**Pr.128**, **Pr.753**)	Held	Terminal 4 input	Terminal 4 input
Forward action / reverse action selection (**Pr.128**, **Pr.753**)	Held	Held	Reverse action
Proportional band (**Pr.129**, **Pr.756**)	Held	Held	100% (initial setting)
Integral time (**Pr.130**, **Pr.757**)	Held	Held	1 s (initial setting)
Differential time (**Pr.134**, **Pr.758**)	Held	Held	Not used (initial setting)
Applied to the frequency / calculation only (**Pr.128**, **Pr.753**)	Applied to the frequency	Applied to the frequency	Applied to the frequency
Other PID-related settings	Held	Held	Held

- While the "retry" (**Pr.523** = "22[], 32[]") is selected in the PID control mode, if a retry occurs at an occurrence of E.CPU, E.1 to E.3, E.5 to E.7 during emergency drive operation, the operation is performed not under PID control but with the fixed frequency. Use **Pr.1013 Running speed after emergency drive retry reset** to set the fixed frequency.

NOTE

- For details of the PID control, refer to page 396.

◆ Operation of protective functions during emergency drive

- Operation of protective functions during emergency drive is as follows.

Protective function	Operation during emergency drive	Protective function	Operation during emergency drive	Protective function	Operation during emergency drive
E.OC1	Retry	E.LF	Disabled	E.P24	Disabled
E.OC2	Retry	E.OHT	Retry	E.CDO	Retry
E.OC3	Retry	E.PTC	Retry	E.IOH	Output shutoff
E.SCF	Output shutoff	E.OPT	Disabled	E.SER	Disabled
E.OV1	Retry	E.OP1	Disabled	E.AIE	Disabled
E.OV2	Retry	E.OP2	Disabled	E.USB	Disabled
E.OV3	Retry	E.OP3	Disabled	E.SAF	Retry*1
E.THT	Retry	E.16	Disabled	E.PBT	Retry*1
E.THM	Retry	E.17	Disabled	E.OS	Disabled
E.FIN	Retry	E.18	Disabled	E.LCI	Disabled
E.IPF	Disabled	E.19	Disabled	E.PCH	Disabled
E.UVT	Disabled	E.20	Disabled	E.PID	Disabled
E.ILF	Disabled	E.PE6	Disabled	E.1	Retry*3
E.OLT	Retry	E.PE	Output shutoff	E.2	Retry*3
E.SOT	Retry	E.PUE	Disabled	E.3	Retry*3
E.LUP	Disabled	E.RET	Output shutoff	E.5	Retry*3
E.LDN	Disabled	E.PE2	Output shutoff	E.6	Retry*1*3
E.BE	Retry*1	E.CPU	Retry	E.7	Retry*1*3
E.GF	Retry*2	E.CTE	Disabled	E.13	Output shutoff

*1 While the switchover to the commercial power supply operation during emergency drive operation is enabled, when the same protective function is activated twice consecutively, the retry is attempted up to twice.
*2 When **Pr.249** = "2", the output is shut off.
*3 In normal operation (**Pr.523** = "200 or 300"), the start signal is turned OFF at the same time the retry function resets the protective function. Input the start signal again to resume the operation.

- The fault output during emergency drive operation is as follows.

Signal	Pr.190 to Pr.196 setting		Description
	Positive logic	Negative logic	
ALM	99	199	Turns ON at the occurrence of a fault that causes the above-mentioned "retry" or "output shutoff" during emergency drive operation.
ALM3	66	166	Output when a fault occurs during emergency drive operation. During emergency drive operation, if a fault that does not activate any protective function occurs, the signal turns ON for 3 s and then turns OFF.

◆ Input signal operation

- During emergency drive operation in the fixed frequency mode or in the PID control mode, input signals unrelated to the emergency drive become invalid with some exceptions.
- The table below shows functions of the signals that do not become invalid during emergency drive operation in the fixed frequency mode or in the PID control mode.

Input signal status	Fixed frequency mode	PID control mode
Valid	OH, TRG, TRC, X51, RES, X70, X71	OH, TRG, TRC, X51, RES, X70, X71
Held	RT, X18, SQ, X84	RT, X18, SQ, X64, X65, X66, X67, X79, X84
Always-ON	—	X14, X77, X78, X80

◆ Emergency drive status monitor

- Set "68" in **Pr.52, Pr.774 to Pr.776, Pr.992** to monitor the status of the emergency drive on the operation panel.
- Description of the status monitor

Operation panel indication	Description		
	Emergency drive setting	Emergency drive operating status	
0	Emergency drive function setting is not available.	—	
1	Electronic bypass during emergency drive operation is disabled.	During normal operation	
2		During emergency drive operation	Operating properly
3			A certain alarm is occurring.[*2]
4			A critical fault is occurring. The operation is being continued by the retry.
5			A critical fault is occurring. The continuous operation is not allowed due to output shutoff.
11	Electronic bypass during emergency drive operation is enabled.	During normal operation	
12		During emergency drive operation	Operating properly
13			A certain alarm is occurring.[*2]
14			A critical fault is occurring. The operation is being continued by the retry.
15			A critical fault is occurring. The continuous operation is not allowed due to output shutoff.
2□[*1]		Electronic bypass is started during emergency drive (during acceleration/deceleration to the switchover frequency).	
3□[*1]		During electronic bypass during emergency drive (waiting during the interlock time).	
4□[*1]		During commercial power supply operation during emergency drive	

*1 The first digit remains the same as the previous numerical value (fault condition).
*2 "A certain alarm" means a protective function disabled during emergency drive shown in the tables on page 251.

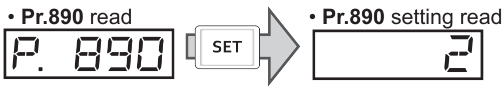
CAUTION

- When the emergency drive operation is performed, the operation is continued or the retry is repeated even when a fault occurs, which may damage or burn the inverter and motor. Before restarting the normal operation after using this function, make sure that the inverter and motor have no fault. Any damage of the inverter or the motor caused by using the emergency drive function is not covered by the warranty even within the guarantee period.

5.7.9 Checking faulty area in the internal storage device

When Internal storage device fault (E.PE6) occurs, faulty area in the internal storage device can be checked by reading **Pr.890**. When the read value of **Pr.890** is "7" or smaller, an inverter reset after All parameter clear can return the operation to normal. (The parameters that had been changed before All parameter clear must be set again.)

Pr.	Name	Initial value	Setting range	Description
890 **H325**	**Internal storage device status indication**	0	(0 to 511)	A faulty area detected by check function can be indicated in the internal storage device.



- Use the read value of **Pr.890** to check the faulty area.
- The following table shows faulty areas indicated by the read value of **Pr.890**. Some read values indicate that there are multiple faulty areas. (For example, the read value "7" indicates that all the areas described in No. 1 to No. 3 are faulty.)

No.	Read value	Description
1	1, 3, 5, 7	Storage area other than the area for parameter settings is faulty (such as area for the set frequency). (When All parameter clear is performed, the set frequency, remotely-set frequency, host name for Ethernet communication, and offline auto tuning data are cleared.)
2	2, 3, 6, 7	Storage area for standard parameter settings is faulty.
3	4, 5, 6, 7	Storage area for communication parameter settings is faulty.
4	8 to 511	Area for manufacturer setting

5.7.10 Limiting the output frequency (maximum/minimum frequency)

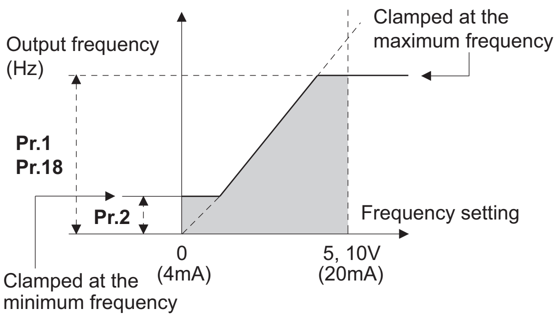
Motor speed can be limited. Clamp the output frequency at the upper and lower limits.

Pr.	Name	Initial value	Setting range	Description
1 **H400**	**Maximum frequency**	120 Hz*1 60 Hz*2	0 to 120 Hz	Set the upper limit of the output frequency.
2 **H401**	**Minimum frequency**	0 Hz	0 to 120 Hz	Set the lower limit of the output frequency.
18 **H402**	**High speed maximum frequency**	120 Hz*1 60 Hz*2	0 to 590 Hz	Set when operating at 120 Hz or higher.

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.

◆ Setting the maximum frequency (Pr.1, Pr.18)

- Set **Pr.1 Maximum frequency** to the upper limit of the output frequency. If the value of the frequency command entered is higher than the setting, the output frequency is clamped at the maximum frequency.
- To operate at a frequency higher than the 120 Hz, adjust the upper output frequency limit with **Pr.18 High speed maximum frequency**. (When setting a frequency in **Pr.18**, the **Pr.1** setting automatically changes to the frequency set in **Pr.18**. Also, when setting a frequency in **Pr.1**, the **Pr.18** setting automatically changes to the frequency set in **Pr.1**.)



◆ Setting the minimum frequency (Pr.2)

- Set **Pr.2 Minimum frequency** to the lower limit of the output frequency.
- If the set frequency is **Pr.2** or less, the output frequency is clamped at **Pr.2** (will not fall below **Pr.2**).

NOTE

- To operate with a frequency higher than 60 Hz using frequency-setting analog signals, change the **Pr.125 (Pr.126) (frequency setting gain) setting**. Simply changing the **Pr.1 and Pr.18** settings does not enable operation at a frequency higher than 60 Hz.
- During PM motor control, the upper and lower limits are for the commanded frequency.
- When **Pr.15 Jog frequency** setting is equal to or less than **Pr.2** setting, the **Pr.15** setting has precedence over the **Pr.2** setting.
- If a jump frequency that exceeds **Pr.1(Pr.18) Maximum frequency** is set for the 3-point frequency jump, the maximum frequency setting is the set frequency. If the set frequency is less than the jump frequency **Pr.2 Minimum frequency**, the jump frequency is the set frequency. (The set frequency can be equal to or lower than the frequency lower limit.) When stall prevention is activated to decrease the output frequency, the output frequency may drop to **Pr.2** or below.

⚠CAUTION

- Note that when **Pr.2** is set to any value equal to or higher than **Pr.13 Starting frequency**, simply turning ON the start signal will run the motor at the frequency set in **Pr.2** even if the command frequency is not input.

Parameters referred to

Pr.13 Starting frequency ☞ page 201, page 202
Pr.15 Jog frequency ☞ page 224
Pr.125 Terminal 2 frequency setting gain frequency, Pr.126 Terminal 4 frequency setting gain frequency ☞ page 328

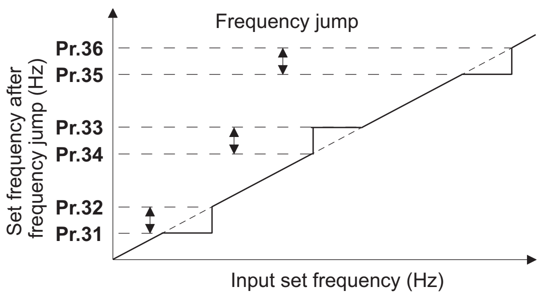
5.7.11 Avoiding the mechanical resonance points (frequency jump)

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

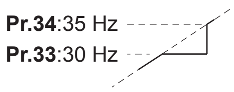
Pr.	Name	Initial value	Setting range	Description
31 **H420**	**Frequency jump 1A**	9999	0 to 590 Hz, 9999	1A to 1B, 2A to 2B, 3A to 3B are frequency jumps. (3-point jump) 9999: Function disabled
32 **H421**	**Frequency jump 1B**			
33 **H422**	**Frequency jump 2A**			
34 **H423**	**Frequency jump 2B**			
35 **H424**	**Frequency jump 3A**			
36 **H425**	**Frequency jump 3B**			
552 **H429**	**Frequency jump range**	9999	0 to 30 Hz	Set the jump range for the frequency jumps (6-point jump).
			9999	3-point jump

◆ 3-point frequency jump (Pr.31 to Pr.36)

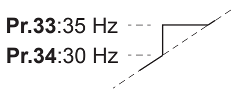
- Up to three areas may be set, with the jump frequencies set to either the top or bottom point of each area.
- The settings of frequency jumps 1A, 2A, 3A are jump points, and operation is performed at these frequencies in the jump areas.



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

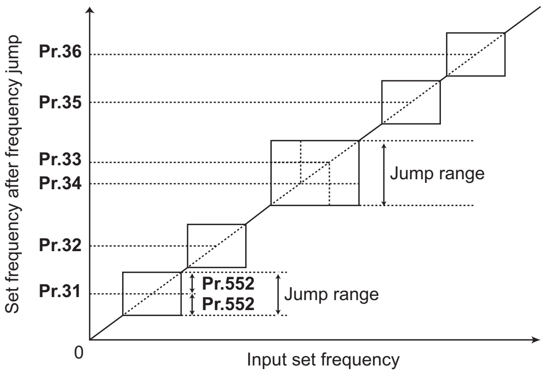


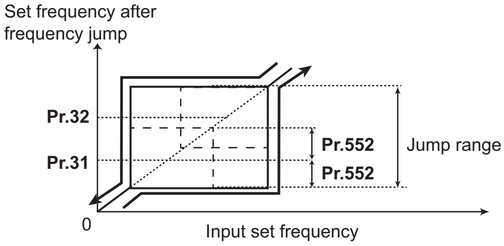
- [Example 2] To jump the frequency to 35 Hz in the range of 30 Hz to 35 Hz, set 35 Hz in **Pr.33** and 30 Hz in **Pr.34**.



◆ 6-point frequency jump (Pr.552)

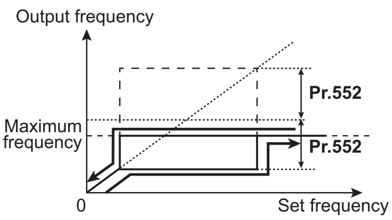
- A total of six jump areas can be set by setting the common jump range for the frequencies set in **Pr.31 to Pr.36**.
- When frequency jump ranges overlap, the lower limit of the lower jump range and the upper limit of the upper jump range are used.
- When the set frequency decreases and falls within the jump range, the upper limit of the jump range is the set frequency. When the set frequency increases and falls within the jump range, the lower limit of the jump range is the set frequency.



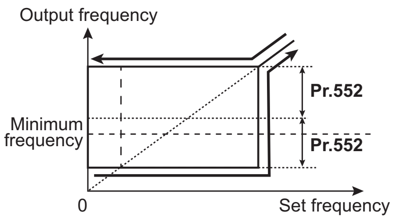


NOTE

- During acceleration/deceleration, the frequency within the set area is valid.
- If the setting ranges of individual groups (1A and 1B, 2A and 2B, 3A and 3B) overlap, write disable error (Er1) will occur.
- Setting **Pr.552** = "0" disables frequency jumps.
- If a jump frequency that exceeds **Pr.1 (Pr.18) Maximum frequency** is set for the 3-point jump, the maximum frequency setting is the set frequency. If the set frequency is less than the jump frequency **Pr.2 Minimum frequency**, the jump frequency is the set frequency. (The set frequency can be equal to or lower than the frequency lower limit.) Example with 6-point frequency jump



Maximum frequency and frequency jump



Minimum frequency and frequency jump

Parameters referred to

Pr.1 Maximum frequency, Pr.18 High speed maximum frequency, Pr.2 Minimum frequency ☞ page 253

5.7.12 Stall prevention operation

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

- Stall prevention

If the output current exceeds the stall prevention operation level, the output frequency of the inverter is automatically changed to reduce the output current.

Also the second stall prevention function can limit the output frequency range in which the stall prevention function is enabled.

- Fast-response current limit

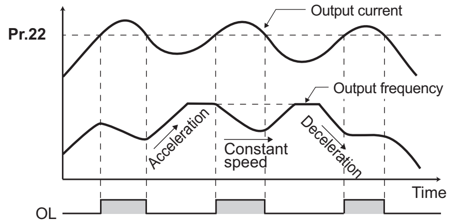
If the current exceeds the limit value, the output of the inverter is shut off to prevent an overcurrent.

Pr.	Name	Initial value	Setting range	Description
22 H500	**Stall prevention operation level**	110%	0	Stall prevention operation disabled.
			0.1 to 400% [*1]	Set the current limit at which the stall prevention operation will start.
156 H501	**Stall prevention operation selection**	0	0 to 31, 100 to 101	Enable/disable the stall prevention operation and the fast-response current limit operation.
48 H600 V/F Magnetic flux	**Second stall prevention operation level**	110%	0	Second stall prevention operation disabled.
			0.1 to 400% [*1]	The stall prevention operation level can be changed using the RT signal.
49 H601 V/F Magnetic flux	**Second stall prevention operation frequency**	0 Hz	0	Second stall prevention operation disabled.
			0.01 to 590 Hz	Set the frequency at which the **Pr.48** stall prevention operation will start.
			9999	**Pr.48** is enabled when RT signal is ON.
23 H610 V/F Magnetic flux	**Stall prevention operation level compensation factor at double speed**	9999	0 to 200%	The stall operation level when running at high speeds above the rated frequency can be reduced.
			9999	Stall prevention operation disabled at double speed.
66 H611 V/F Magnetic flux	**Stall prevention operation reduction starting frequency**	60 Hz	0 to 590 Hz	Set the frequency at which the stall operation level reduction will start.
148 H620 V/F Magnetic flux	**Stall prevention level at 0 V input**	110%	0 to 400% [*1]	The stall prevention operation level can be changed by the analog signal input to the terminal 1 (terminal 4).
149 H621 V/F Magnetic flux	**Stall prevention level at 10 V input**	120%	0 to 400% [*1]	
154 H631 V/F Magnetic flux	**Voltage reduction selection during stall prevention operation**	1	0	Output voltage reduction enabled. / Enable/disable the output voltage reduction during stall prevention operation.
			1	Output voltage reduction disabled.
			10	Output voltage reduction enabled. / Use this setting when the overvoltage protective function (E.OV[ ]) activates during stall prevention operation in an application with large load inertia.
			11	Output voltage reduction disabled.
157 M430	**OL signal output timer**	0 s	0 to 25 s	Set the OL signal output start time when stall prevention is activated.
			9999	No OL signal output.
858 T040	**Terminal 4 function assignment**	0	0, 4, 9999	When set "4", the stall prevention level can be changed with the signal to the terminal 4.
868 T010	**Terminal 1 function assignment**	0	0, 4, 9999	When set "4", the stall prevention level can be changed with the signal to the terminal 1.
874 H730 PM	**OLT level setting**	110%	0 to 400%	A trip can be set for when the stall prevention is activated and the motor stalls. Set the output at which to activate the trip.

*1 The upper limit of stall prevention operation is limited internally to the following. 120% (SLD rating), 150% (LD rating)

◆ Setting the stall prevention operation level (Pr.22)

- For **Pr.22 Stall prevention operation level**, set the ratio of the output current to the inverter's rated current at which the stall prevention operation will be activated. Normally, use this parameter in the initial setting.
- Stall prevention operation stops acceleration (makes deceleration) during acceleration, makes deceleration during constant speed, and stops deceleration during deceleration.
- When the stall prevention operation is performed, the Overload warning (OL) signal is output.



Stall prevention operation example

NOTE

- A continuous overloaded condition may activate a protective function such as motor overload trip (electronic thermal O/L relay function) (E.THM).
- When **Pr.156** has been set to activate the fast response current limit (initial value), the **Pr.22** setting should not be higher than 140%. Such setting will prevent torque generation
- Under PM motor control, the stall prevention operation level is reduced inversely proportional to the output frequency in the constant output range of the rated motor frequency or higher.

◆ Disabling the stall prevention operation and fast-response current limit according to operating conditions (Pr.156)

• Referring to the table below, enable/disable the stall prevention operation and the fast-response current limit operation, and also set the operation at OL signal output.

Pr.156 setting		Fast response current limit ○: enabled ●: disabled	Stall prevention operation selection ○: enabled ●: disabled			OL signal output ○: operation continued ●: operation stopped*1
			Acceleration	Constant speed	Deceleration	
0 (initial value)		○	○	○	○	○
1		●	○	○	○	○
2		○	●	○	○	○
3		●	●	○	○	○
4		○	○	●	○	○
5		●	○	●	○	○
6		○	●	●	○	○
7		●	●	●	○	○
8		○	○	○	●	○
9		●	○	○	●	○
10		○	●	○	●	○
11		●	●	○	●	○
12		○	○	●	●	○
13		●	○	●	●	○
14		○	●	●	●	○
15		●	●	●	●	—*2
100 *3	Power driving	○	○	○	○	○
	Regenerative driving	●	●	●	●	—*2
16		○	○	○	○	●
17		●	○	○	○	●
18		○	●	○	○	●
19		●	●	○	○	●
20		○	○	●	○	●
21		●	○	●	○	●
22		○	●	●	○	●
23		●	●	●	○	●
24		○	○	○	●	●
25		●	○	○	●	●
26		○	●	○	●	●
27		●	●	○	●	●
28		○	○	●	●	●
29		●	○	●	●	●
30		○	●	●	●	●
31		●	●	●	●	—*2
101 *3	Power driving	●	○	○	○	○
	Regenerative driving	●	●	●	●	—*2

*1 When "operation stop at OL signal output" is selected, the inverter stops its operation at the OL signal output (stall prevention stop).
*2 The OL signal and E.OLT are not outputted because fast-response current limit and stall prevention are not operating.
*3 Setting values "100, 101" can be individually set for power driving and regenerative driving. The setting value "101" disables the fast-response current limit during power driving.

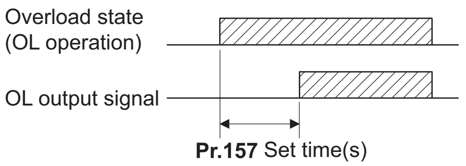
NOTE

• When the load is heavy or the acceleration/deceleration time is short, stall prevention operates and acceleration/deceleration may not be performed according to the time set. In such case, set the **Pr.156** and the stall prevention operation level to the optimum values.
• For lift applications, make settings to disable the fast-response current limit. Otherwise, the torque may be insufficient, causing the load to drop.

◆ Adjusting the stall prevention operation signal output and output timing (OL signal, Pr.157)

- If the output current exceeds the stall prevention operation level and stall prevention is activated, Overload warning (OL) signal will turn ON for 100 ms or more. The output signal turns OFF when the output current falls to the stall prevention operation level or less.
- **Pr.157 OL signal output timer** can set whether to output the OL signal immediately, or to output it after a certain time period.
- This function also operates during regeneration avoidance operation (overvoltage stall).

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

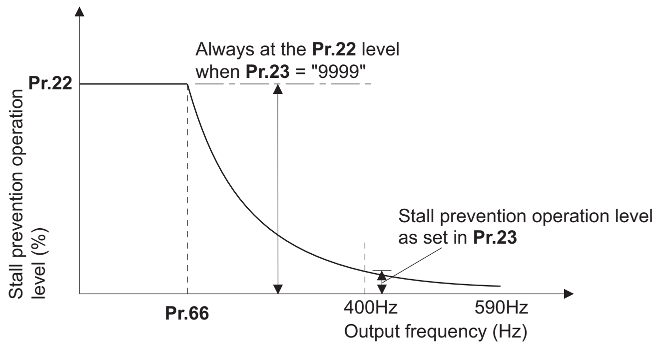


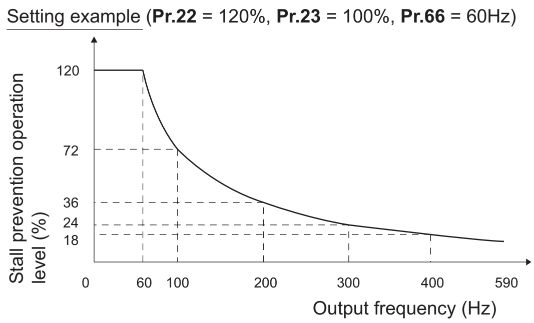
NOTE

- OL signal is assigned to the terminal OL in the initial status. The OL signal can be assigned to other terminals by setting "3 (positive logic) or 103 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- If the stall prevention operation has lowered the output frequency to 0.5 Hz and kept the level for 3 s, the stall prevention stop (E.OLT) is activated to shut off the inverter output.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Setting for stall prevention operation in the high-frequency range (Pr.22, Pr.23, Pr.66)

V/F Magnetic flux





- When operating at the rated motor frequency or higher, acceleration may not be made because the motor current does not increase. Also, when operating in the high-frequency range, the current flowing to the locked motor becomes less than the rated output current of the inverter; and even if the motor is stopped, the protective function will not operate (OL). In a case like this, the stall prevention level can be reduced in the high-frequency range to improve the motor's operating characteristics. This is useful when operating up to the high speed range, such as when using a centrifuge. Normally, set **Pr.66 Stall prevention operation reduction starting frequency** to 60 Hz, and **Pr.23 Stall prevention operation level compensation factor at double speed** to 100%.
- Calculation formula for stall prevention operation level

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

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

- When **Pr.23** ="9999" (initial value), the stall prevention operation level is constant at the **Pr.22** level up to 590 Hz.

◆ Setting multiple stall prevention operation levels (Pr.48, Pr.49)

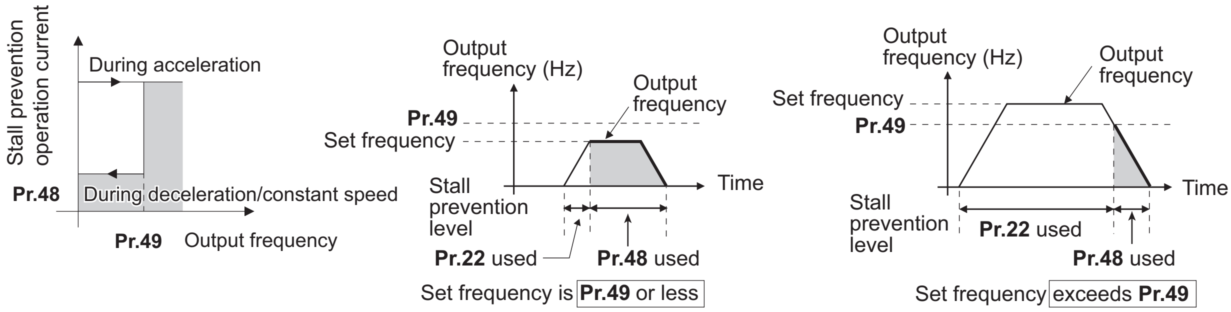
V/F Magnetic flux

- By setting **Pr.49 Second stall prevention operation frequency** = "9999" and turning ON the RT signal, Pr.**48 Second stall prevention operation level** will be enabled.
- For **Pr.48**, set the stall prevention operation level that is effective in the output frequency range between 0 Hz and **Pr.49**. However, the operation level is **Pr.22** during acceleration.
- Stop-on-contact operation can be used by decreasing the **Pr.48** setting and loosening the reduction torque (torque when stopped).

Pr.49 setting	Operation
0 (initial value)	The second stall prevention function disabled.
0.01 Hz to 590 Hz	The second stall prevention function operates according to the frequency.*1
9999*2	The second stall prevention function operates according to the RT signal. RT signal ON: stall level **Pr.48** RT signal OFF: stall level **Pr.22**

*1 For the stall prevention operation level, the smaller of **Pr.22** and **Pr.48** has precedence.

*2 When **Pr.858** = "4 (analog input to terminal 4 for stall prevention operation level)" or **Pr.868** = "4 (analog input to terminal 1 for stall prevention operation level)", turning ON the RT signal will not enable the second stall prevention function. (Input to the terminal 4 or terminal 1 is valid.)



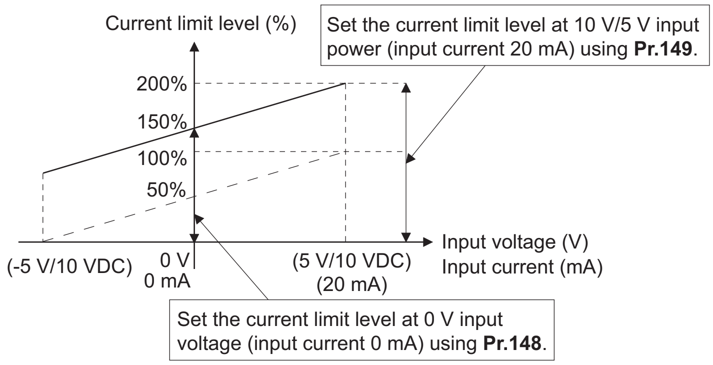
NOTE

- When **Pr.49** ≠ "9999" (level change according to frequency) and **Pr.48** = "0%", the stall prevention function will be disabled at or lower than the frequency set in **Pr.49**.
- The RT signal is assigned to the terminal RT in the initial status. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.
- The RT signal acts as the second function selection signal and makes the other second functions valid. (Refer to page 348.)

◆ Stall prevention operation level setting (analog variable) from terminal 1 (terminal 4) (Pr.148, Pr.149, Pr.858, Pr.868)

V/F Magnetic flux

- To use the terminal 1 (analog voltage input) to set the stall prevention operation level, set **Pr.868 Terminal 1 function assignment** = "4". Then, input a 0 to 5 V (or 0 to 10 V) to the terminal 1. To choose whether 5 V or 10 V, use **Pr.73 Analog input selection**. In the initial status, **Pr.73** = "1 (initial value)" is set to choose 0 to ±10 V input.
- When setting the stall prevention operation level from terminal 4 (analog current input), set **Pr.858 Terminal 4 function assignment** = "4".
- Input 0 to 20 mA into terminal 4. There is no need to turn ON the AU signal.
- Set **Pr.148 Stall prevention level at 0 V input** to the current limit level when input voltage is 0 V (0 mA).
- Set **Pr.149 Stall prevention level at 10 V input** to the current limit level when input voltage is 10 V/5 V (20 mA).



Pr.858 setting	Pr.868 setting	V/F, Advanced magnetic flux vector control	
		Terminal 4 function	Terminal 1 function
0 (initial value)	0 (initial value)	Frequency command (AU signal-ON)	Auxiliary frequency
	4 *1		Stall prevention
	9999		—
4 *2	0 (initial value)	Stall prevention	Auxiliary frequency
	4 *1	— *3	Stall prevention
	9999	Stall prevention	—
9999	—	—	—

*1 When **Pr.868** = "4" (analog stall prevention), the other functions for terminal 1 (auxiliary input, override function, PID control) will be disabled.
*2 When **Pr.858** = "4" (analog stall prevention), PID control and speed commands using terminal 4 will not operate, even if the AU signal turns ON.
*3 When both of **Pr.858 and Pr.868** are set to "4" (stall prevention), terminal 1 functions take priority and terminal 4 has no function.

NOTE

- The fast-response current limit cannot be set.
- To change the stall prevention operation level with the analog signal under PM motor control, set **C16 to C19** or **C38 to C41** to calibrate terminal 1 or terminal 4. (Refer to page 333.)

◆ To further prevent a trip (Pr.154)

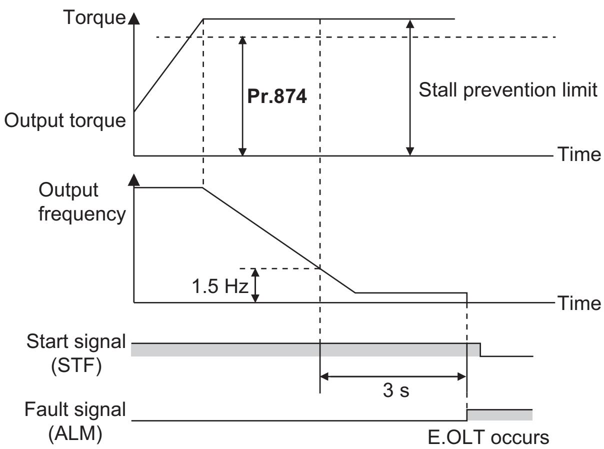
V/F Magnetic flux

- When **Pr.154 Voltage reduction selection during stall prevention operation** = "0, 10", the output voltage is reduced. By making this setting, an overcurrent trip becomes less likely to occur. Use this setting when torque reduction does not pose a problem. (Under V/F control, the output voltage is reduced only during the stall prevention operation is activated.)
- Set **Pr.154** = "10, 11" when the overvoltage protective function (E.OV[ ]) activates during stall prevention operation in an application with large load inertia. Note that turning OFF the start signal (STF/STR) or varying the frequency command during stall prevention operation may delay the acceleration/deceleration start.

Pr.154	E.OC[ ] countermeasure	E.OV[ ] countermeasure
0	Effective	—
1 (initial value)	—	—
10	Effective	Effective
11	—	Effective

◆ Trip during stall prevention operation (Pr.874)

- The inverter can be set to trip at activation of stall prevention and stalling of the motor.
- When a high load is applied and the stall prevention is activated, the motor stalls. At this time, if the rotation speed is lower than 1.5 Hz and the output torque exceeds the level set in **Pr.874 OLT level setting** and such a state continues for 3 s, stall prevention stop (E.OLT) is activated and the inverter output is shut off.



NOTE

- Under V/F control or Advanced magnetic flux vector control, if the output frequency drops to 0.5 Hz due to the stall prevention operation and this state continues for 3 s, a fault indication (E.OLT) appears, and the inverter output is shut off. This operation is activated regardless of the **Pr.874** setting.

⚠CAUTION

- Do not set the stall prevention operation current too low. Doing so will reduce the generated torque.
- Be sure to perform a test run. Stall prevention operation during acceleration may extend the acceleration time. Stall prevention operation during constant-speed operation may cause sudden speed changes. Stall prevention operation during deceleration may extend the deceleration time.

Parameters referred to

Pr.73 Analog input selection ☞ page 318
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297
Pr.858 Terminal 4 function assignment, Pr.868 Terminal 1 function assignment ☞ page 322

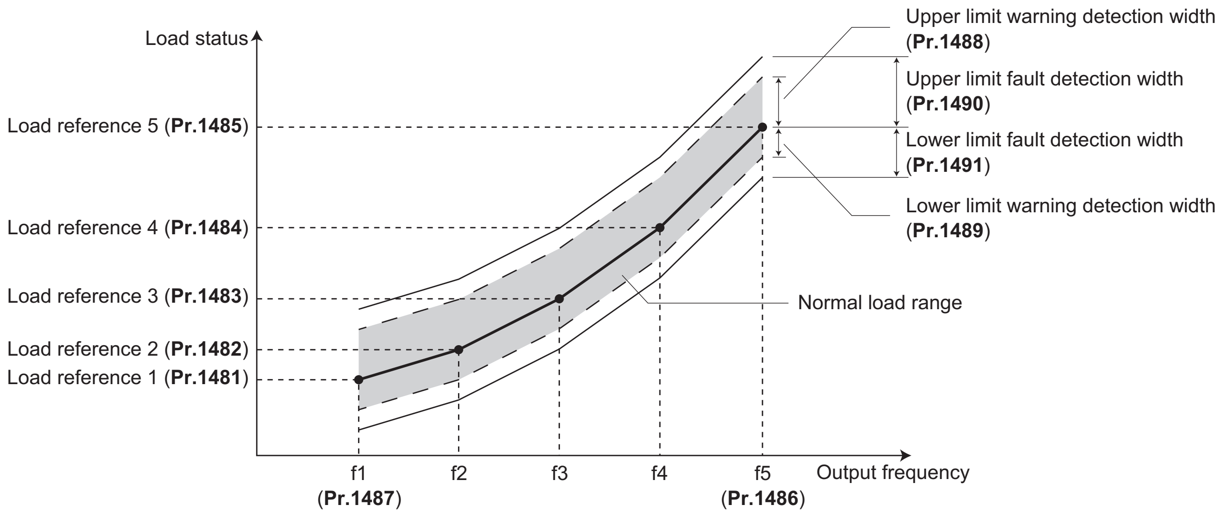
5.7.13 Load characteristics fault detection

This function is used to monitor whether the load is operating in normal condition by storing the speed/torque relationship in the inverter to detect mechanical faults or for maintenance. When the load operating condition deviates from the normal range, the protective function is activated or the warning is output to protect the inverter or the motor.

Pr.	Name	Initial value	Setting range	Description
1480 **H520**	**Load characteristics measurement mode**	0	0	Load characteristics measurement mode is not started. (Load characteristics measurement is normally completed.)
			1	Load characteristics measurement mode is started.
			2, 3, 4, 5, 81, 82, 83, 84, 85	The load characteristics measurement status is displayed. (Read-only)
1481 **H521**	**Load characteristics load reference 1**	9999	0 to 400%	Set the reference value of normal load characteristics. 8888: The present load status is written as reference status. 9999: The load reference is invalid.
1482 **H522**	**Load characteristics load reference 2**	9999		
1483 **H523**	**Load characteristics load reference 3**	9999		
1484 **H524**	**Load characteristics load reference 4**	9999		
1485 **H525**	**Load characteristics load reference 5**	9999		
1486 **H526**	**Load characteristics maximum frequency**	60 Hz	0 to 590 Hz	Set the maximum frequency of the load characteristics fault detection range.
1487 **H527**	**Load characteristics minimum frequency**	6 Hz	0 to 590 Hz	Set the minimum frequency of the load characteristics fault detection range.
1488 **H531**	**Upper limit warning detection width**	20%	0 to 400%	Set the detection width when the upper limit load fault warning is output.
			9999	Function disabled
1489 **H532**	**Lower limit warning detection width**	20%	0 to 400%	Set the detection width when the lower limit load fault warning is output.
			9999	Function disabled
1490 **H533**	**Upper limit fault detection width**	9999	0 to 400%	Set the detection width when output is shut off when the upper limit load fault occurs.
			9999	Function disabled
1491 **H534**	**Lower limit fault detection width**	9999	0 to 400%	Set the detection width when output is shut off when the lower limit load fault occurs.
			9999	Function disabled
1492 **H535**	**Load status detection signal delay time / load reference measurement waiting time**	1 s	0 to 60 s	Set the waiting time after the load fault is detected until warning output or output shutoff. In the load characteristics measurement mode, set the waiting time after the load measurement frequency is reached until the load reference is set.

◆ Load characteristics reference setting (Pr.1481 to Pr.1487)

- Use **Pr.1481 to Pr.1485** to set the reference value of load characteristics.
- Use **Pr.1486 Load characteristics maximum frequency** and **Pr.1487 Load characteristics minimum frequency** to set the output frequency range for load fault detection.



◆ Automatic measurement of the load characteristics reference (Load characteristics measurement mode) (Pr.1480)

Point

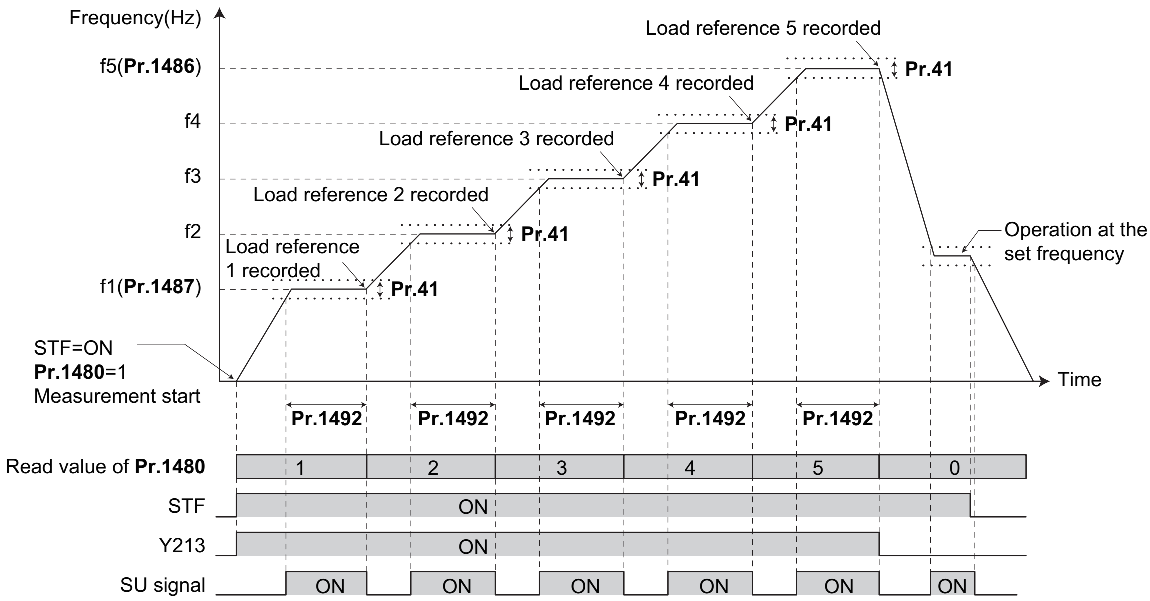
- Perform measurement under actual environment with the motor connected.
- Set the **Pr.1487 Load characteristics minimum frequency** higher than the **Pr.13 Starting frequency**.

- Setting **Pr.1480 Load characteristics measurement mode** = "1" enables automatic measurement of the load characteristics reference. (Load characteristics measurement mode)
- Use **Pr.1486 and Pr.1487** to set the frequency band for the measurement, and set **Pr.1480** = "1". After setting, when the inverter is started, the measurement starts. (When the **Pr.1486** setting is lower than the **Pr.1487** setting, the measurement does not start.)
- The automatically measured load characteristics reference is written in **Pr.1481 to Pr.1485**.
- After the measurement is started, read **Pr.1480** to display the status of the measurement. If "8" appears in the tens place, the measurement has not properly completed.

Read value of Pr.1480		Status
Tens place	Ones place	
—	1	During measurement from the starting point to Point 1
—	2	During measurement from Point 1 to Point 2
—	3	During measurement from Point 2 to Point 3
—	4	During measurement from Point 3 to Point 4
—	5	During measurement from Point 4 to Point 5
—	0	Normal completion
8	1 to 5	Termination of measurement by an activation of a protective function, inverter reset, turning ON of MRS signal, turning OFF of the start command, or timeout. (The value in the ones place represents the above-mentioned measurement point.)

- While measuring automatically, the During load characteristics measurement signal (Y213) is output. For the Y213 signal, assign the function by setting "213 (positive logic)" or "313 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- Setting "8888" in **Pr.1481 to Pr.1485** enables fine adjustment of load characteristics. When setting **Pr.1481 to Pr.1485** = "8888" during operation, the load status at that point is set in the parameter. (Only when the set frequency is within ±2 Hz of the frequency of the measurement point, and SU signal is in the ON state)

Example of starting measurement from the stop state



NOTE

- Even if the load measurement is not properly completed, the load characteristics fault is detected based on the load characteristics found by the already-completed portion of the measurement.
- During the load characteristics measurement, the load characteristics fault detection is not performed.
- During the load characteristics measurement, linear acceleration/deceleration is performed even if the S-pattern acceleration/deceleration is set.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Setting the load characteristics reference manually (Pr.1481 to Pr.1485)

- Set **Pr.1480 Load characteristics measurement mode** = "0" (initial value).
- Set **Pr.1486 and Pr.1487** to specify the frequency band for the measurement, and calculate the frequency as the load characteristics reference (f2 to f4) using the following table.
- Start the inverter operation, and set **Pr.1481** = "8888" during operation at the frequency of the load characteristics reference 1 (f1). The load status at that point is set in **Pr.1481** (only when the set frequency is within ±2 Hz of the frequency of the measurement point, and the SU signal is ON).
- Set load references in **Pr.1482 to Pr.1485** in the same way as **Pr.1481**.

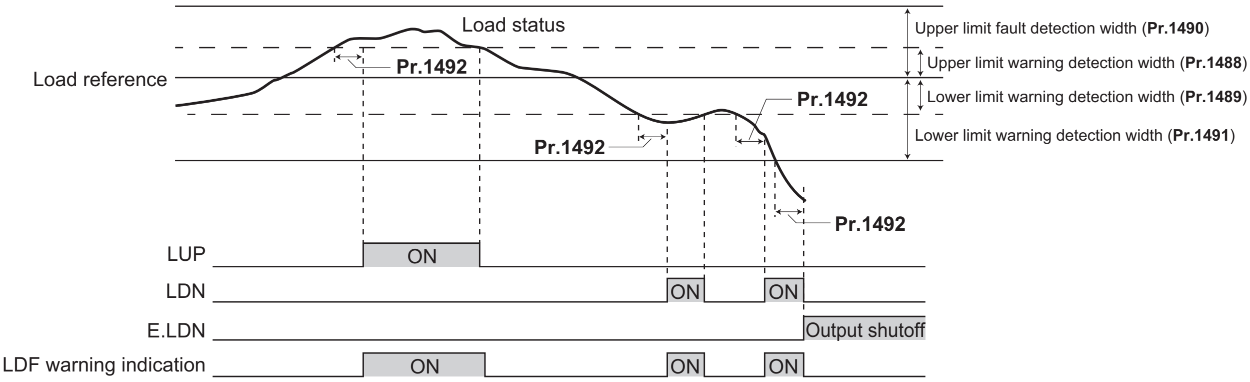
Reference	Frequency	Load reference
Load characteristics reference 1	f1: load characteristics minimum frequency (**Pr.1487**)	**Pr.1481**
Load characteristics reference 2	f2 = (f5 - f1)/4 + f1	**Pr.1482**
Load characteristics reference 3	f3 = (f5 - f1)/2 + f1	**Pr.1483**
Load characteristics reference 4	f4 = (f5 - f1) × 3/4 + f1	**Pr.1484**
Load characteristics reference 5	f5: load characteristics maximum frequency (**Pr.1486**)	**Pr.1485**

NOTE

- When inputting values directly in **Pr.1481 to Pr.1485**, input the load meter value monitored at each reference frequency.

◆ Load fault detection setting (Pr.1488 to Pr.1491)

- When the load is deviated from the detection width set in **Pr.1488 Upper limit warning detection width**, Upper limit warning detection signal (LUP) is output. When the load is deviated from the detection width set in **Pr.1489 Lower limit warning detection width**, Lower limit warning detection signal (LDN) is output. At the same time, Load fault warning (LDF) appears on the operation panel.
- For the LUP signal, assign the function by setting "211 (positive logic)" or "311 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**. For the LDN signal, assign the function by setting "212 (positive logic)" or "312 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- When the load is deviated from the detection width set in **Pr.1490 Upper limit fault detection width**, the protective function (E.LUP) is activated and the inverter output is shut off. When the load is deviated from the detection width set in **Pr.1491 Lower limit fault detection width**, the protective function (E.LDN) is activated and the inverter output is shut off.
- To prevent the repetitive on/off operation of the signal due to load fluctuation near the detection range, **Pr.1492 Load status detection signal delay time / load reference measurement waiting time** can be used to set the delay time. Even when a fault is detected out of the detection range once, the warning is not output if the characteristics value returns to the normal range from a fault state within the output delay time.



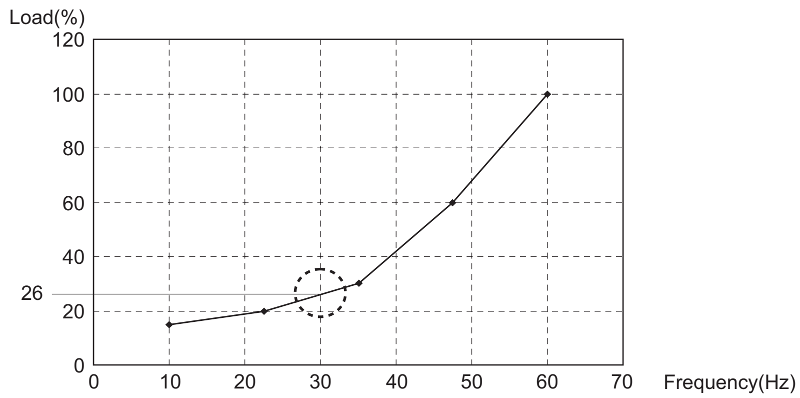
NOTE

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

◆ Setting example

- The load characteristics are calculated from the parameter setting and the output frequency.
- A setting example is shown below. The reference value is linearly interpolated from the parameter settings. For example, the reference when the output frequency is 30 Hz is 26%, which is linearly interpolated from values of the reference 2 and the reference 3.

Reference	Frequency	Load reference
Load characteristics reference 1	f1: load characteristics minimum frequency (**Pr.1487**) = 10 Hz	**Pr.1481** = 15%
Load characteristics reference 2	f2 = (f5 - f1)/4 + f1 = 22.5 Hz	**Pr.1482** = 20%
Load characteristics reference 3	f3 = (f5 - f1)/2 + f1 = 35 Hz	**Pr.1483** = 30%
Load characteristics reference 4	f4 = (f5 - f1) × 3/4 + f1 = 47.5 Hz	**Pr.1484** = 60%
Load characteristics reference 5	f5: load characteristics maximum frequency (**Pr.1486**) = 60 Hz	**Pr.1485** = 100%



NOTE

- When the load reference is not set for five points, the load characteristics value is determined by linear interpolation of the set load reference values only. If there is only one load reference setting, the set load reference is used as the load reference all through the range.

Parameters referred to

Pr.41 Up-to-frequency sensitivity ☞ page 305

Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

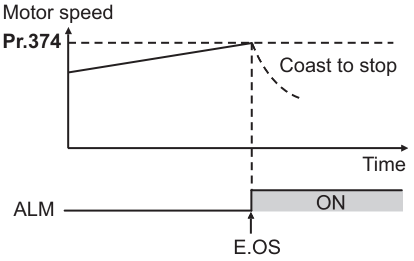
5.7.14 Motor overspeeding detection

PM

The Overspeed occurrence (E.OS) is activated when the motor speed exceeds the overspeed detection level. This function prevents the motor from accidentally speeding over the specified value, due to an error in parameter setting, etc.

Pr.	Name	Initial value	Setting range	Description
374 **H800**	**Overspeed detection level**	9999	0 to 590 Hz	If the motor rotation speed exceeds the speed set in **Pr.374** during PM motor control, Overspeed occurrence (E.OS) occurs, and the inverter output is shut off.
			9999	During PM motor control, E.OS occurs when the speed exceeds the "maximum motor frequency + 10 Hz".*1

*1 The maximum motor frequency is set in **Pr.702 Maximum motor frequency**. When **Pr.702** = "9999" (initial value), the **Pr.84 Rated motor frequency** setting is applied as the maximum motor frequency.



5.8 (M) Monitor display and monitor output signal

Purpose	Parameter to set			Refer to page
To display the motor speed. To set to rotations per minute.	Speed display and rotations per minute setting	P.M000 to P.M002	Pr.37, Pr.144, Pr.505	272
To change the monitored item on the operation panel and the parameter unit	Operation panel monitored item selection, clearing the cumulative monitor	P.M020 to P.M023, P.M030, P.M031, P.M044, P.M045, P.M050 to P.M052, P.M100 to P.M103	Pr.52, Pr.170, Pr.171, Pr.268, Pr.290, Pr.563, Pr.564, Pr.774 to Pr.776, Pr.891, Pr.1018, Pr.1106 to Pr.1108	274
To change the monitored item output from the terminals CA and AM	Terminal CA function selection	P.M040 to P.M042, P.M044, P.M300, P.M301, P.D100	Pr.54, Pr.55, Pr.56, Pr.158, Pr.290, Pr.291, Pr.866	284
To adjusting the terminal CA and AM output	Terminal CA, AM calibration	P.M310, P.M320, P.M321, P.M330 to P.M334	Pr.867, Pr.869, Pr.900, Pr.901, Pr.930, Pr.931	288
To check the effects of energy saving	Energy saving monitor	P.M023, P.M100, P.M200 to P.M207, P.M300, P.M301	Pr.52, Pr.54, Pr.158, Pr.891 to Pr.899	291
To assign functions to the output terminals	Output terminal function assignment	P.M400 to P.M406, P.M410 to P.M416, P.M420 to P.M422, P.M431	Pr.190 to Pr.196, Pr.289, Pr.313 to Pr.322	297
To detect the output frequency	Up-to-frequency sensitivity Output frequency detection Low speed detection	P.M440 to P.M444	Pr.41 to Pr.43, Pr.50, Pr.870	305
To detect the output current	Output current detection Zero current detection	P.M433, P.M460 to P.M464	Pr.150 to Pr.153, Pr.166, Pr.167	307
To detecting the output torque	Output torque detection	P.M470	Pr.864	309
To use the remote output function	Remote output	P.M500 to P.M502	Pr.495 to Pr.497	310
To use the analog remote output function	Analog remote output	P.M530 to P.M534	Pr.655 to Pr.659	312
To output the fault code from a terminal	Fault code output function	P.M510	Pr.76	314
To detect the specified output power	Pulse train output of output power	P.M520	Pr.799	315
To detect the control circuit temperature	Control circuit temperature monitor	P.M060	Pr.663	316

5.8.1 Speed display and rotations per minute setting

The monitor display unit and the frequency setting on the operation panel can be switched to motor speed and machine speed.

Pr.	Name	Initial value	Setting range	Description
37 **M000**	**Speed display**	0	0	Frequency display and setting
			1 to 9998*1	Set the machine speed for **Pr.505**.
505 **M001**	**Speed setting reference**	60 Hz	1 to 590 Hz	Set the reference speed for **Pr.37**.
144 **M002**	**Speed setting switchover**	4	0, 2, 4, 6, 8, 10, 12, 102, 104, 106, 108, 110, 112	Set the number of motor poles when displaying the motor speed.

*1 The maximum value of the setting range differs according to the **Pr.1 Maximum frequency, Pr.505 Speed setting reference**, and it can be calculated from the following formula.
The maximum value of **Pr.37** < 65535 × **Pr.505** / **Pr.1** setting value (Hz).
The maximum setting value of **Pr.37** is 9998 if the result of the above formula exceeds 9998.

◆ Display in speed (Pr.37, Pr.144)

- Set the number of motor poles (2, 4, 6, 8, 10, 12) for **Pr.144**, or the number of motor poles + 100 (102, 104, 106, 108, 110, 112) to display the motor speed.
- The **Pr.144** setting will change automatically when setting the motor poles with **Pr.81 Number of motor poles**. **Pr.81** will not automatically change when **Pr.144** is changed.

Example 1) Changing the initial value of **Pr.81** to "2" will change **Pr.144** from "4" to "2".

Example 2) When setting **Pr.81** = "2" while **Pr.144** = "104", **Pr.144** will change from "104" to "102".

◆ Display in motor speed (Pr.37, Pr.505)

- To display in the machine speed, set **Pr.37** to the machine speed at the frequency set in **Pr.505**.
- For example, when **Pr.505** is set to 60 Hz and **Pr.37** is set to "1000", the operation panel indicates "1000" as the monitor value of machine speed while the output frequency is 60 Hz. "500" is displayed while the output frequency is 30 Hz.

◆ Monitor display (setting) increments

- When both settings of **Pr.37** and **Pr.144** are changed from the initial values, a precedence order for these settings is as follows: **Pr.144** = "102 to 112" > **Pr.37** = "1 to 9998" > **Pr.144** = "2 to 12".
- The combination of the **Pr.37** and **Pr.144** settings as shown below determines the setting increment for each monitor.

Pr.37 Setting	Pr.144 Setting	Output frequency monitor	Set frequency monitor	Running speed monitor	Frequency setting parameter setting
0 (initial value)	0	0.01 Hz	0.01 Hz	1 r/min*1	0.01 Hz
	2 to 12	0.01 Hz (initial setting)	0.01 Hz (initial setting)	1 r/min*1 (initial setting)	0.01 Hz (initial setting)
	102 to 112	1 r/min*1	1 r/min *1	1 r/min*1	1 r/min*1
1 to 9998	0	0.01 Hz	0.01 Hz	1 (machine speed*1)	0.01 Hz
	2 to 12	1 (machine speed*1)	1 (machine speed*1)	1 (machine speed*1)	1 (machine speed*1)
	102 to 112	0.01 Hz	0.01 Hz	1 r/min *1	0.01 Hz

*1 Motor speed r/min conversion formula:.... frequency × 120 / number of motor poles **(Pr.144)**
Machine speed conversion formula:......... **Pr.37** × frequency / **Pr.505**
For **Pr.144** in the above formula, the value is "**Pr.144** - 100" when "102 to 112" is set in **Pr.144**; and the value is "4" when **Pr.37** = 0 and **Pr.144** = 0.
Pr.505 is always set as frequency (Hz).

NOTE

- The inverter's output frequency is displayed as synchronous speed under V/F control. The displayed value is "actual motor speed" + "motor slip." When Advanced magnetic flux vector control or PM motor control is selected, the actual motor speed (estimated value by motor slip calculation) is used.
- When **Pr.37** = "0" and **Pr.144** = "0", the running speed monitor is displayed with the number of motor poles 4. (Displays 1800 r/min at 60 Hz)
- To change the PU main monitor (PU main display), refer to **Pr.52**.
- When using the machine speed display for the parameter unit (FR-PU07), do not change the speed with the up/down key if a set speed above 65535 is being displayed. The set speed may become an undetermined value.
- When a certain type of communication option is used, the frequency display (setting) is used regardless of the **Pr.37** and **Pr.144** settings. Refer to the Instruction Manual of each communication option for details. (The frequency display (setting) is always used for HMS network options.)

⚠ CAUTION

• Make sure to set the running speed and the number of motor poles. Otherwise, the motor might run at extremely high speed, damaging the machine.

Parameters referred to

Pr.1 Maximum frequency ☞ page 253
Pr.52 Operation panel main monitor selection ☞ page 274
Pr.81 Number of motor poles ☞ page 145
Pr.800 Control method selection ☞ page 145

5.8.2 Monitor indicator selection using operation panel or via communication

The monitored item to be displayed on the operation panel or the parameter unit can be selected.

Pr.	Name	Initial value	Setting range	Description
52 **M100**	**Operation panel main monitor selection**	0 (output frequency)	0, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98, 100	Select the monitor to be displayed on the operation panel and the parameter unit. Refer to page 275 for the monitor description.
774 **M101**	**Operation panel monitor selection 1**	9999	1 to 3, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98, 100, 9999	The output frequency, output current and output voltage monitor that are displayed in monitor mode on the operation panel and the parameter unit can be switched to a specified monitor. 9999: Follows the **Pr.52** setting.
775 **M102**	**Operation panel monitor selection 2**			
776 **M103**	**Operation panel monitor selection 3**			
170 **M020**	**Watt-hour meter clear**	9999	0	Set "0" to clear the watt-hour meter monitor.
			10	Set the maximum value for monitoring via communication. Set it in the range of 0 and 9999 kWh.
			9999	Set the maximum value for monitoring via communication. Set it in the range of 0 and 65535 kWh.
563 **M021**	**Energization time carrying-over times**	0	(0 to 65535) (Read-only)	Displays the numbers of times that the cumulative energization time monitor exceeded 65535 h. Read-only.
268 **M022**	**Monitor decimal digits selection**	9999	0	Displays as integral value.
			1	Displays in 0.1 increments.
			9999	No function
891 **M023**	**Cumulative power monitor digit shifted times**	9999	0 to 4	Set the number of times to shift the cumulative power monitor digit. The monitor value is clamped at the maximum value.
			9999	No shift Monitor value is cleared when it exceeds the maximum value.
171 **M030**	**Operation hour meter clear**	9999	0	Set "0" to clear the operation hour monitor.
			9999	The read value is always 9999. Nothing happens when "9999" is set.
564 **M031**	**Operating time carrying-over times**	0	(0 to 65535) (Read-only)	Displays the numbers of times that the operating time monitor exceeded 65535 h. Read-only.
290 **M044**	**Monitor negative output selection**	0	0 to 7	Set the availability of output with a minus sign for the terminal AM, the operation panel display, or monitoring via communication. (Refer to page 282)
1018 **M045**	**Monitor with sign selection**	9999	0, 1, 9999	Select items to be displayed with minus signs.
1106 **M050**	**Torque monitor filter**	9999	0 to 5 s	The filter time constant is selectable for monitoring of the torque. A larger setting results in slower response.
			9999	0.3 s filter
1107 **M051**	**Running speed monitor filter**	9999	0 to 5 s	The filter time constant is selectable for monitoring of the running speed. A larger setting results in slower response.
			9999	0.08 s filter
1108 **M052**	**Excitation current monitor filter**	9999	0 to 5 s	The filter time constant is selectable for monitoring of the motor excitation current. A larger setting results in slower response.
			9999	0.3 s filter

◆ Monitor description list (Pr.52, Pr.774 to Pr.776)

- Set the monitor to be displayed on the operation panel and the parameter unit in **Pr.52, Pr.774 to Pr.776**.
- Refer to the following table to find the setting value for each monitoring. The value in the Pr. setting column is set in each of the parameters for monitoring (**Pr.52, Pr.774 to Pr.776**) to determine the monitor item. The value in the RS-485 column is used for the RS-485 communication special monitor selection. The value in the MODBUS RTU column is used for the MODBUS RTU real time monitor. (The items marked with " --" cannot be selected. The circle in the negative indication (-) column indicates that the indication of negative signed numbers is available.)

Monitor item	Increment and unit	Pr. setting	RS-485	MODBUS RTU	Negative indication (-)*1	Description
Output frequency/ speed*16	0.01 Hz/1 *15	1/0/100	H01	40201	○*18	Displays the inverter output frequency.
Output current *8*16	0.01 A/ 0.1 A*6	2/0/100	H02	40202		Displays the inverter output current effective value.
Output voltage*16	0.1 V	3/0/100	H03	40203		Displays the inverter output voltage.
Fault display	—	0/100	—	—		Displays 8 past faults individually.
Frequency setting value/speed setting	0.01 Hz/1 *15	5*2	H05	40205		Displays the set frequency
Running speed	1 (r/min)	6*2	H06	40206	○*18	Displays the motor speed (by the **Pr.37, Pr.144** settings). (Refer to page 272)
Motor torque	0.1%	7*2	H07	40207	○	Displays motor torque as a percentage (0% under V/F control), considering the rated torque as 100%.
Converter output voltage	0.1 V	8*2	H08	40208		Displays the DC bus voltage value.
—	—	9*7	H09	40209		For manufacturer setting. Do not set.
Electronic thermal O/L relay load factor	0.1%	10*2	H0A	40210		Displays the motor thermal cumulative value, considering the thermal operation level as 100%.
Output current peak value	0.01 A/ 0.1 A*6	11*2	H0B	40211		Saves and displays the output current monitor peak value. (Cleared with each start.)
Converter output voltage peak value	0.1 V	12*2	H0C	40212		Saves and displays the DC bus voltage peak value. (Cleared with each start.)
Input power	0.01 kW/0.1 kW*6	13*2	H0D	40213		Displays the power at the inverter input side.
Output power*8	0.01 kW/0.1 kW*6	14*2	H0E	40214		Displays the power at the inverter output side.
Load meter	0.1%	17	H11	40217		Displays torque current as a percentage, considering **Pr.56** setting value as 100%.
Motor excitation current	0.01 A/ 0.1 A*6	18	H12	40218		Displays the motor excitation current
Cumulative energization time*3	1 h	20	H14	40220		Displays the cumulative energization time since the inverter shipment. Check how many times the monitor value exceeded 65535 h with **Pr.563**.
Actual operation time*3*4	1 h	23	H17	40223		Displays the cumulative time since the inverter began running. The number of times the monitor value exceeded 65535 h can be checked with **Pr.564** This can be cleared with **Pr.171**. (Refer to page 281)

Monitor item	Increment and unit	Pr. setting	RS-485	MODBUS RTU	Negative indication (-)[*1]	Description
Motor load factor	0.1%	24	H18	40224		Displays the output current value as a percentage, considering the inverter rated current value as 100%. Monitor value = output current monitor value / inverter rated current × 100 [%]
Cumulative power	0.01 kWh/ 0.1 kWh [*5*6]	25	H19	40225		Displays the cumulative energy based on the output power monitor. This can be cleared with **Pr.170**. (Refer to page 281.)
Motor output	0.01 kW/0.1 kW[*6]	34	H22	40234		Multiplies the output torque at that time with the motor speed, and displays the machine output for the motor shaft end.
Trace status	1	38	H26	40238		Displays the trace status. (Refer to page 466.)
PLC function user monitor 1	According to the SD1215 setting	40	H28	40240		Displays the arbitrary monitoring item using the PLC function. Displays the following special register values. SD1216: Displays in No.40 SD1217: Displays in No.41 SD1218: Displays in No.42 (Refer to the PLC Function Programming Manual.)
PLC function user monitor 2		41	H29	40241		
PLC function user monitor 3		42	H2A	40242		
Station number (RS-485 terminals)	1	43	H2B	40243		Displays which station number (0 to 31) can currently be used for communication from the RS-485 terminal block.
Station number (PU)	1	44	H2C	40244		Displays which station number (0 to 31) can currently be used for communication from the PU connector.
Station number (CC-Link)	1	45	H2D	40245		Displays which station number (0 to 31) can currently be used for CC-Link communication. Displays "0" when the FR-A8NC is not connected.
Energy saving effect	Changeable by parameter setting.	50	H32	40250		Displays the energy saving effect monitor. Conversion to power saving, average power saving, price display, and percentage display can be done using parameters. (Refer to page 291.)
Cumulative energy saving		51	H33	40251		
PID set point	0.1%	52	H34	40252		Displays the set point, measured value, and deviation under PID control. (Refer to page 410)
PID measured value	0.1%	53	H35	40253		
PID deviation	0.1%	54	H36	40254	○	
Input terminal status	—	55[*17]	H0F[*10]	40215[*10]		Displays input terminal ON/OFF state of the inverter. (Refer to the instruction manual of the operation panel.)
Output terminal status	—		H10[*11]	40216[*11]		Displays output terminal ON/OFF state of the inverter. (Refer to the instruction manual of the operation panel.)
Option input terminal status[*9]	—	56[*17]	—	—		Displays input terminal ON/OFF state of the digital input option (FR-A8AX) on the DU. (Refer to the instruction manual of the operation panel.)

Monitor item	Increment and unit	Pr. setting	RS-485	MODBUS RTU	Negative indication (-)[*1]	Description
Option output terminal status[*9]	—	57[*17]	—	—		Displays output terminal ON/OFF state of the digital output option (FR-A8AY) and the relay output option (FR-A8AR) on the DU. (Refer to the instruction manual of the operation panel.)
Option input terminal status 1 (for communication)[*9]	—	—	H3A[*12]	40258[*12]		Input terminal X0 to X15 ON/OFF state of the digital input option (FR-A8AX) can be monitored via RS-485 communication and the communication option.
Option input terminal status 2 (for communication)[*9]	—	—	H3B[*13]	40259[*13]		Input terminal DY ON/OFF state of the digital input option (FR-A8AX) can be monitored via RS-485 communication and the communication option.
Option output terminal status 1 (for communication)[*9]	—	—	H3C[*14]	40260[*14]		Output terminal ON/OFF state of the digital output option (FR-A8AY) and relay output option (FR-A8AR) can be monitored via RS-485 communication and the communication option.
Motor thermal load factor	0.1%	61	H3D	40261		Displays the accumulated heat value of the motor thermal O/L relay. The motor overload trip (E.THM) occurs at 100%.
Inverter thermal load factor	0.1%	62	H3E	40262		Displays the accumulated heat value of the inverter thermal O/L relay. The inverter overload trip (E.THT) occurs at 100%.
PTC thermistor resistance	0.01 kΩ	64	H40	40264		Displays the PTC thermistor resistance when **Pr.561 PTC thermistor protection level** ≠ 9999 (voltage monitor when **Pr.561** = 9999).
PID measured value 2	0.1%	67	H43	40267		Displays PID measured value even if PID control operating conditions are not satisfied while the PID control is enabled (**Pr.128** ≠ "0"). (Refer to page 410)
Emergency drive status [*7]	1	68	H44	40268		Displays the emergency drive status (Refer to page 245)
PID input pressure value	0.1%	69	H45	40269		Displays the input pressure value of the PID input pressure control function.
32-bit cumulative power (lower 16 bits)	1 kWh	—	H4D	40277		Displays the 32-bit cumulative power value in multiples of 16 bits. Monitoring can be performed via RS-485 communication and communication options. (To find the monitor codes for each communication option, refer to the Instruction Manual of each communication option.)
32-bit cumulative power (upper 16 bits)	1 kWh	—	H4E	40278		
32-bit cumulative power (lower 16 bits)	0.01 kWh/ 0.1 kWh[*6]	—	H4F	40279		
32-bit cumulative power (upper 16 bits)	0.01 kWh/ 0.1 kWh[*6]	—	H50	40280		
BACnet reception status	1	81	H51	40281		Displays the BACnet reception status.
BACnet token pass counter	1	82	H52	40282		Displays the count of received token.
BACnet valid APDU counter	1	83	H53	40283		Displays the count of valid APDU detection.

Monitor item	Increment and unit	Pr. setting	RS-485	MODBUS RTU	Negative indication (-)*1	Description
BACnet communication error counter	1	84	H54	40284		Displays the count of communication error detection.
BACnet terminal CA output level	0.1%	85	H55	40285		Displays the value set in the Analog Output object (ID=0: Terminal CA) for BACnet communication.
BACnet terminal AM output level	0.1%	86	H56	40286	○	Displays the value set in the Analog Output object (ID=1: Terminal AM) for BACnet communication. (A display without signs displays negative values as absolute values.)
Remote output value 1	0.1%	87	H57	40287	○	Displays the setting values of **Pr.656 to Pr.659** (analog remote output). (Refer to page 312.)
Remote output value 2	0.1%	88	H58	40288		
Remote output value 3	0.1%	89	H59	40289		
Remote output value 4	0.1%	90	H5A	40290		
PID manipulated variable	0.1%	91	H5B	40291	○	Displays the PID control manipulated amount. (Refer to page 410)
Second PID set point	0.1%	92	H5C	40292		Displays the set point, measured value, and deviation under second PID control. (Refer to page 410)
Second PID measured value	0.1%	93	H5D	40293		
Second PID deviation	0.1%	94	H5E	40294	○	
Second PID measured value 2	0.1%	95	H5F	40295		Displays PID measured value even if PID control operating conditions are not satisfied while the second PID control is enabled (**Pr.753** ≠ "0"). (Refer to page 410)
Second PID manipulated variable	0.1%	96	H60	40296	○	Displays the second PID control manipulated amount. (Refer to page 410)
Control circuit temperature	1°C	98	H62	40298	○	Displays the temperature of the control circuit board. (Refer to page 316) Without minus sign: 0 to 100°C With minus sign: -20 to 100°C

*1 Indication with a minus sign is not possible via RS-485 or MODBUS RTU communication.
*2 When using the monitor item as the main monitor data on the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07), use **Pr.774 to Pr.776** or the monitor function of the FR-LU08 or the FR-PU07 for setting.
*3 The cumulative energization time and actual operation time are accumulated from 0 to 65535 hours, then cleared, and accumulated again from 0.
*4 The actual operation time does not increase if the cumulative running time before power OFF is less than an hour.
*5 When using the parameter unit (FR-PU07), "kW" is displayed.
*6 Differs according to capacities. (FR-F860-00680 or lower/FR-F860-01080 or higher)
*7 The setting is available only for standard models.
*8 When the output current is less than the specified current level (5% of the inverter rated current), the output current is monitored as 0 A. Therefore, the monitored value of an output current and output power may be displayed as "0" when using a much smaller-capacity motor compared to the inverter or in other instances that cause the output current to fall below the specified value.
*9 Available when the plug-in option is connected.
*10 Input terminal monitor details ("1" denotes terminal ON, "0" denotes terminal OFF, and "—" denotes undetermined value.)

b15															b0
-	-	-	-	CS	RES	STP (STOP)	MRS	JOG	RH	RM	RL	RT	AU	STR	STF

*11 Output terminal monitor details ("1" denotes terminal ON, "0" denotes terminal OFF, and "—" denotes undetermined value.)

b15															b0
-	-	-	-	-	-	-	-	-	ABC2	ABC1	FU	OL	IPF	SU	RUN

*12 Option input terminal monitor 1 details (FR-A8AX input terminal status, "1" denotes terminal ON and "0" denotes terminal OFF.) —— All are OFF when the option is not connected.

b15															b0
X15	X14	X13	X12	X11	X10	X9	X8	X7	X6	X5	X4	X3	X2	X1	X0

*13 Option input terminal monitor 2 details (FR-A8AX input terminal status. "1" denotes terminal ON, "0" denotes terminal OFF, "—" denotes undetermined value.) —— All are OFF when the option is not connected.

b15															b0
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	DY

*14 Option output terminal monitor details (FR-A8AY/A8AR output terminal status. "1" denotes terminal ON, "0" denotes terminal OFF, and "—" denotes undetermined value.)—— All are OFF when the option is not connected.

b15															b0
-	-	-	-	-	-	RA3	RA2	RA1	Y6	Y5	Y4	Y3	Y2	Y1	Y0

*15 The increment is 1 when **Pr.37** = "1 to 9998" or when **Pr.144** = "2 to 12, or 102 to 112". (Refer to page 272.)
*16 The monitored values are retained even if an inverter fault occurs. Resetting will clear the retained values.
*17 Parameter setting is not available for setting the monitor item as the main monitor data on the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07). Use the monitor function of the FR-LU08 or the FR-PU07 for setting.
*18 Setting of **Pr.1018 Monitor with sign selection** is required. Also, it will be displayed without a minus sign on the operation panel. Confirm the rotation direction with the [FWD] or [REV] indicator.

◆ Monitor display for operation panel (Pr.52, Pr.774 to Pr.776)

- When **Pr.52** = "0" (initial value), the monitoring of output frequency, output current, output voltage, 3-line monitor, and fault display can be selected in sequence by pressing [NEXT].
- The Load meter, Motor excitation current and Motor load factor are displayed on the second monitor (output current) position, among the monitors set in **Pr.52**. Other monitors are displayed in the third monitor (output voltage) position.
- **Pr.774** sets the output frequency monitor, **Pr.775** sets the output current monitor, and **Pr.776** sets the monitor description to be displayed at the output voltage monitor position. When **Pr.774 to Pr.776** = "9999" (initial value), the **Pr.52** setting value is used.

NOTE

- For details on the operation panel, refer to the instruction manual of the operation panel (FR-LU08).

◆ Displaying the set frequency during stop (Pr.52)

- When **Pr.52** = "100", the set frequency is displayed during stop, and output frequency is displayed during running. ("Hz" is highlighted during stop.)

Pr.52 setting	Status	Output frequency	Output current	Output voltage	Fault or alarm indication
0	During running/stop	Output frequency	Output current	Output voltage	Fault or alarm indication
100	During stop	Set frequency*1			
	Running	Output frequency			

*1 Displays the frequency that is output when the start command is ON. The value considers the maximum/minimum frequency and frequency jumps. It is different from the frequency setting displayed when **Pr.52** = "5".

NOTE

- During an error, the output frequency at error occurrence appears.
- During output shutoff by the MRS signal, the values displayed are the same as during a stop.
- During offline auto tuning, the tuning state monitor takes priority.

◆ Monitoring and resetting cumulative power (Pr.170, Pr.891)

- When the cumulative power is monitored (**Pr.52** = "25"), the output power monitor value is added up and is updated in 100 ms increments.
- The values are stored in EEPROM every 10 minutes. The values are also stored in EEPROM at power OFF or inverter reset.
- Display increments and display ranges of the operation panel, parameter unit and communication (RS-485 communication, communication option) are as indicated below (when **Pr.891** = "9999 (initial value)").

Operation panel, parameter unit*1		Communication		
Range	Unit	Range		Unit
		Pr.170 = 10	Pr.170 = 9999	
0 to 999.99 kWh	0.01 kWh*2	0 to 9999 kWh	0 to 65535 kWh (initial value)	1 kWh
1000.0 to 9999.9 kWh	0.1 kWh			
10000 to 99999 kWh	1 kWh			

*1 For the FR-F860-00680 or lower, the value is measured in 0.01 kWh increments and the upper five digits are displayed. For the FR-F860-01080 or higher, the value is measured in 0.1 kWh increments and the upper five digits are displayed.
For the FR-F860-00680 or lower, the cumulative energy up to 999.99 kWh is displayed in 0.01 increments such as "999.99", and that of 1000 kWh or more is displayed in 0.1 increments such as "1000.0".

*2 The display in 0.01 kWh increments is available only for the FR-F860-00680 or lower.

- The decimal point position on the watt-hour meter can be shifted to left. The number of digits to be shifted is equal to the setting of **Pr.891**. For example, when **Pr.891** = "2", the cumulative power value 1278.56 kWh is displayed as 12.78 (in 100 kWh increments) on the operation panel, or displayed as 12 on a display used for monitoring via communication.
- When **Pr.891** = "0 to 4", the meter stops at the maximum number. When **Pr.891** = "9999", the meter returns to 0 and the counting starts again.
- Writing "0" in **Pr.170** clears the cumulative power monitor.

NOTE

- When **Pr.170** is read just after "0" has been written in **Pr.170**, the setting "9999" or "10" is displayed.

◆ Monitoring cumulative energization time (Pr.563)

- When the cumulative energization time is selected as a monitor item (**Pr.52** = "20"), the counter of cumulative energization time since the inverter shipment accumulated every hour is displayed.
- The cumulative energization time is displayed in 0.001-hour increments until the cumulative time reaches one hour, and then the time is displayed in 1-hour increments.
- The EEPROM is updated every minute until the cumulative energization time reaches one hour, and then the EEPROM is updated every 10 minutes. The EEPROM is also updated at power OFF.
- When the cumulative energization time counter reaches 65535, it starts from 0 again. The number of times the cumulative energization time counter reaches 65535 can be checked with **Pr.563**.

NOTE

- The cumulative energization time does not increase if the power is turned OFF after less than an hour.

◆ Actual operation time monitoring (Pr.171, Pr.564)

- On the actual operation time monitoring (**Pr.52** = "23"), the inverter running time is added up every hour. (Time is not added up during a stop.)
- The time is displayed in 1-hour increments.
- The values are stored in EEPROM every 10 minutes. The EEPROM is also updated at power OFF.
- When the cumulative energization time counter reaches 65535, it starts from 0 again. The number of times the actual operation time counter reaches 65535 can be checked with **Pr.564**.
- Setting "0" in **Pr.171** clears the actual operation time meter.

NOTE

- The actual operation time does not increase if the cumulative running time before power OFF is less than an hour.
- Once "0" is set in **Pr.171**, the setting of **Pr.171** is always turned to "9999" afterwards. Setting "9999" does not clear the actual operation time meter.

◆ Hiding the decimal places for the monitors (Pr.268)

- The numerical figures after a decimal point displayed on the operation panel may continuously fluctuate during analog input, etc. The decimal places can be hidden by selecting the decimal digits with **Pr.268**.

Pr.268 setting	Description
9999 (initial value)	No function
0	For the first or second decimal places (0.1 increments or 0.01 increments) of the monitor, numbers in the first decimal place and smaller are rounded to display an integral value (1 increments). The monitor value equal to or smaller than 0.99 is displayed as 0.
1	When monitoring with the second decimal place (0.01 increments), the 0.01 decimal place is dropped and the monitor displays the first decimal place (0.1 increments). When monitoring with the first decimal place, the display will not change.

NOTE

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

◆ Negative output selection for monitoring (Pr.290)

- Negative output is available for FR Configurator2 or the trace function.

Pr.290 setting	Connection port			
	Terminal AM	Operation panel	Communication option*1	Configurator2 etc.*2
0 (initial value)	—	—	—	—
1	Enabled	—	—	—
2	—	Enabled	—	—
3	Enabled	Enabled	—	—
4	—	—	Enabled	Enabled
5	Enabled	—	Enabled	Enabled
6	—	Enabled	Enabled	Enabled
7	Enabled	Enabled	Enabled	Enabled

—: Disabled (unsigned numbers only)

*1 The following communication does not support the negative output.
RS-485 communication (Mitsubishi inverter protocol, MODBUS RTU, BACnet), LONWORKS communication (FR-A8NL), and SLMP communication

*2 Under the condition that the high-speed sampling and the negative output are selected for FR Configurator2, the display range of the output frequency (Monitor No.1) is -300.00 Hz to 300.00 Hz. A value outside the range is clamped at -300.00 Hz or 300.00 Hz. Under the same condition, the display range of the running speed (Monitor No.6) is -30000 r/min to 30000 r/min. A value outside the range is clamped at -30000 r/min or 30000 r/min. During the trace sampling, the same display ranges are applied. A value outside the ranges is clamped.

- Select items to be displayed with minus signs using **Pr.1018 Monitor with sign selection**.

Monitor item	Pr.1018 setting	
	9999	0, 1
Output frequency	—	○*1
Motor speed	—	○*1
Motor torque	○	○
PID deviation	○	○
BACnet Terminal AM output level	○	○
Remote output 1	○	○
Remote output 2	○	○
Remote output 3	○	○
Remote output 4	○	○
PID manipulated amount	○	○
Second PID deviation	○	○
Second PID manipulated amount	○	○
Control circuit temperature	○	○

○: Displayed with minus signs, —: Displayed without minus signs (unsigned numbers only)

*1 Displayed without minus signs on the operation panel. Confirm the rotation direction with the [FWD] or [REV] indicator.

NOTE

- When indication with negative numbers is enabled for the output via terminal AM (analog voltage output), the output is within the range of -10 to +10 VDC. Connect a meter suitable for the output.
- Parameter unit (FR-PU07) displays only unsigned numbers.

◆ Monitor filter (Pr.1106 to Pr.1108)

- The response level (filter time constant) of the following monitor indicators can be adjusted.

Pr.	Monitor number	Monitor indicator name
1106	7	Motor torque
	17	Load meter
1107	6	Running speed
1108	18	Motor excitation current

Parameters referred to

Pr.30 Regenerative function selection ☞ page 553

Pr.37 motor speed display, Pr.144 Speed setting switchover ☞ page 272

Pr.55 Frequency monitoring reference, Pr.56 Current monitoring reference, Pr.866 Torque monitoring reference ☞ page 284

5.8.3 Monitor display selection for terminals CA and AM

The monitored status can be output as the following items: analog voltage (terminal AM), analog current (terminal CA).
The signal (monitored item) to be output to terminal CA and terminal AM can be selected.

Pr.	Name	Initial value	Setting range	Description
54 **M300**	**CA terminal function selection**	1 (output frequency)	1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52, 53, 61, 62, 67, 69, 70, 85, 87 to 90, 92, 93, 95, 98	Select the monitored item to be output to the terminal CA.
158 **M301**	**AM terminal function selection**		1 to 3, 5 to 14, 17, 18, 21, 24, 34, 50, 52 to 54, 61, 62, 67, 69, 70, 86 to 96, 98	Select the monitored item to be output to the terminal AM.
55 **M040**	**Frequency monitoring reference**	60 Hz	0 to 590 Hz	Set the full-scale value when outputting the frequency monitor value to terminals CA and AM.
56 **M041**	**Current monitoring reference**	Inverter rated current	0 to 500 A[*1]	Set the full-scale value when outputting the output current monitor value to terminals CA and AM.
			0 to 3600 A[*2]	
866 **M042**	**Torque monitoring reference**	150%	0 to 400%	Set the full-scale value when outputting the torque monitor value to terminals CA and AM.
290 **M044**	**Monitor negative output selection**	0	0 to 7	Set the availability of output with a minus sign for the terminal AM, the operation panel display, or monitoring via communication. (Refer to page 282)
291 **D100**	**Pulse train I/O selection**	0	0	The JOG signal is assigned to terminal JOG.[*3]
			1	Pulse train input is assigned to terminal JOG.

*1 FR-F860-00680 or lower.
*2 FR-F860-01080 or higher.
*3 Function assigned to **Pr.185 JOG terminal function selection**.

◆ Monitor description list (Pr.54, Pr.158)

- Set **Pr.54 CA terminal function selection** for the monitor to be output to the terminal CA (analog current output).
- Set **Pr.158 AM terminal function selection** for the monitor to be output to the terminal AM (analog voltage output). Output with a negative sign can be made (-10 VDC to +10 VDC) from the terminal AM. ○ in the [Negative (-) output] indicates the output value is negative at the terminal AM. (For setting of the output with/without minus sign, refer to page 274.)
- Refer to the following table and set the monitor to be displayed. (Refer to page 275 for the monitor description.)

Monitor item	Increment and unit	Pr.54 (CA) Pr.158 (AM) setting	Terminal CA/AM full-scale value	Negative (-) output	Remarks
Output frequency	0.01 Hz	1	**Pr.55**	○[*3]	
Output current[*2]	0.01 A/0.1 A[*1]	2	**Pr.56**		
Output voltage	0.1 V	3	1000 V		
Frequency setting value	0.01 Hz	5	**Pr.55**		
Running speed	1 (r/min)	6	Value is **Pr.55** converted by **Pr.37, Pr.144**. (Refer to page 272.)	○[*3]	Refer to page 272 for the running speed monitor.
Motor torque	0.1%	7	**Pr.866**	○	
Converter output voltage[*2]	0.1 V	8	1000 V		
—	—	9	—		For manufacturer setting. Do not set.
Electronic thermal O/L relay load factor	0.1%	10	Electronic thermal O/L relay operation level (100%)		
Output current peak value	0.01 A/0.1 A[*1]	11	**Pr.56**		
Converter output voltage peak value	0.1 V	12	1000 V		
Input power	0.01 kW/0.1 kW[*1]	13	Inverter rated power × 2		

Monitor item	Increment and unit	Pr.54 (CA) Pr.158 (AM) setting	Terminal CA/AM full-scale value	Negative (-) output	Remarks
Output power[*2]	0.01 kW/0.1 kW[*1]	14	Inverter rated power × 2		
Load meter	0.1%	17	**Pr.866**		
Motor excitation current	0.0 1 A/0.1 A[*1]	18	**Pr.56**		
Reference voltage output	—	21	—		Terminal CA: output is 20 mA Terminal AM: output is 10 V.
Motor load factor	0.1%	24	200%		
Motor output	0.01 kW/0.1 kW[*1]	34	Rated motor capacity		
Energy saving effect	Changeable by parameter setting	50	Inverter capacity		Regarding the energy saving monitor, refer to page 291
PID set point	0.1%	52	100%		Refer to page 410 for the PID control.
PID measured value	0.1%	53	100%		
PID deviation	0.1%	54[*4]	100%	○	
Motor thermal load factor	0.1%	61	Motor thermal operation level (100%)		
Inverter thermal load factor	0.1%	62	Inverter thermal operation level (100%)		
PID measured value 2	0.1%	67	100%		Refer to page 410 for the PID control.
PID input pressure value	0.1%	69	100%		Displays the input pressure value of the PID input pressure control function.
PLC function analog output	0.1%	70	100%	○	Refer to page 463 for the PLC function.
BACnet terminal CA output level	0.1%	85[*5]	100%		The value set in the Analog Output object (ID=0: Terminal CA) for BACnet communication is output.
BACnet terminal AM output level	0.1%	86[*4]	100%	○	The value set in the Analog Output object (ID=1: Terminal AM) for BACnet communication is output. (The output is always negative regardless of the **Pr.290** setting when the monitored value is negative.)
Remote output value 1	0.1%	87	1000%		Refer to page 312 for the analog remote output.
Remote output value 2	0.1%	88	1000%		
Remote output value 3	0.1%	89	1000%		
Remote output value 4	0.1%	90	1000%		
PID manipulated variable	0.1%	91[*4]	100%	○	Refer to page 410 for the PID control.
Second PID set point	0.1%	92	100%		
Second PID measured value	0.1%	93	100%		
Second PID deviation	0.1%	94[*4]	200%	○	
Second PID measured value 2	0.1%	95	100%		
Second PID manipulated variable	0.1%	96[*4]	100%	○	
Control circuit temperature	1°C	98	100°C	○	Terminal CA: 0 to 100°C terminal AM: -20 to 100°C

*1 Differs according to capacities. (FR-F860-00680 or lower/FR-F860-01080 or higher)

*2 When the output current is less than the specified current level (5% of the inverter rated current), the output current is monitored as 0 A. Therefore, the monitored value of an output current and output power may be displayed as "0" when using a much smaller-capacity motor compared to the inverter or in other instances that cause the output current to fall below the specified value.

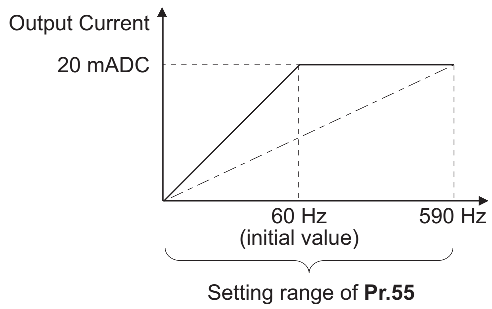
*3 Setting of **Pr.1018 Monitor with sign selection** is required.

*4 The setting is available only with terminal AM (**Pr.158**).

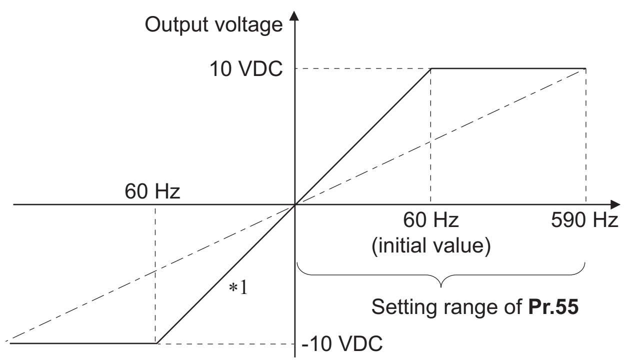
*5 The setting is available only with terminal CA (**Pr.54**).

◆ Frequency monitor reference (Pr.55)

- Set the full-scale value for outputting the monitored items of output frequency, frequency setting value to the terminals CA and AM.
- For the calibration of terminal CA, set the full-scale value of the connected meter when output current of terminal CA is 20 mA. Set the frequency to be indicated as the full scale value on the meter (20 mA DC ammeter connected between terminal CA and 5; for example, 60 Hz or 120 Hz. Output current is proportional to the frequency. (The maximum output current is 20 mA DC.)



- For the calibration of terminal AM, set the full-scale value of the connected meter when output voltage of terminal AM is 10 VDC. Set the frequency to be indicated as the full scale value on the meter (10 VDC voltmeter) connected between terminal AM and 5. (For example, 60 Hz or 120 Hz) Output voltage is proportional to the frequency. (The maximum output voltage is 10 VDC.)



*1 Output with a negative sign available when **Pr.290 Monitor negative output selection** = "1, 3"

◆ Current monitor reference (Pr.56)

- Output current, Output current peak value, Motor excitation current and monitor from the terminals CA and AM.
- For the calibration of terminal CA, set the full-scale value of the connected current meter when output current of terminals CA is 20 mA. Set the current to be indicated as the full scale value on the meter (20 mADC ammeter) connected between terminals CA and 5. Output current is proportional to the monitored value of output current. (The maximum output current is 20 mADC.)
- For the calibration of terminal AM, set the full-scale value of the connected current meter when the output voltage of terminal AM is 10 VDC. Set the current to be indicated as the full scale value on the meter (10 VDC voltmeter) connected between terminal AM and 5. Output voltage is proportional to the monitored value of output current. (The maximum output voltage is 10 VDC.)

◆ Torque monitor reference (Pr.866)

- Set the full scale value when outputting the current monitor from terminal the CA or AM.
- For the calibration of terminal CA, set the full-scale value of the connected torque meter when output current of the terminal CA is 20 mADC. Set the torque to be indicated as the full scale value on the meter (20 mADC ammeter) connected between terminals CA and 5. Output current is proportional to the monitored value of torque. (The maximum output voltage is 20 mADC.)
- For the calibration of terminal AM, set the full-scale value of the connected torque meter when the output voltage of terminal AM is at 10 VDC. Set the torque to be indicated as the full scale value on the meter (10 VDC voltmeter) connected between terminal AM and 5. Output voltage is proportional to the monitored value of torque. (The maximum output voltage is 10 VDC.)

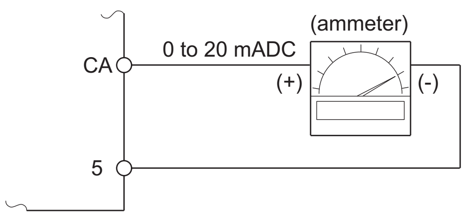
5.8.4 Adjustment of terminal CA and terminal AM

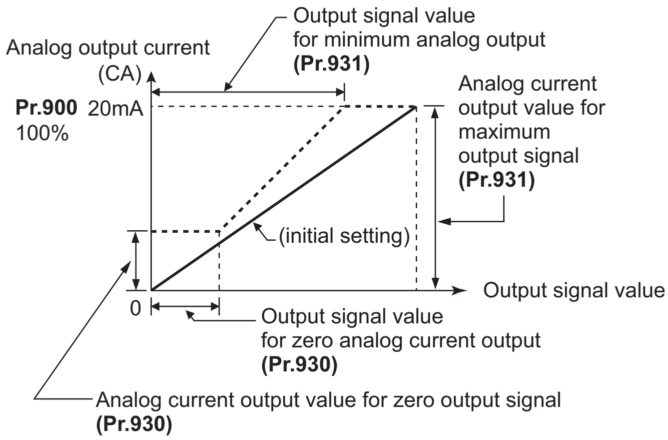
By using the operation panel or the parameter unit, terminals CA and AM can be adjusted (calibrated) to the full scale.

Pr.	Name	Initial value	Setting range	Description
900 **M310**	**CA terminal calibration**	—	—	Calibrates the scale of the meter connected to terminal CA.
901 **M320**	**AM terminal calibration**	—	—	Calibrates the scale of the analog meter connected to terminal AM.
930 **M330**	**Current output bypass signal**	0%	0 to 100%	Set the signal value at the minimum analog current output.
930 **M331**	**Current output bypass current**	0%	0 to 100%	Set the current value at the minimum analog current output.
931 **M332**	**Current output gain signal**	100%	0 to 100%	Sets the signal value when the analog current output is at maximum.
931 **M333**	**Current output gain current**	100%	0 to 100%	Set the current value at the maximum analog current output.
867 **M321**	**AM output filter**	0.01 s	0 to 5 s	Set the terminal AM output filter.
869 **M334**	**Current output filter**	0.01 s	0 to 5 s	Set the terminal CA output filter.

◆ Terminal CA calibration (Pr.900, Pr.930 to Pr.931)

- Terminal CA is initially set to provide a 20 mADC output in the full-scale state of the corresponding monitor item. **Pr.900** allows the output current ratio (gains) to be adjusted according to the meter scale. Note that the maximum output current is 20 mADC.
- Set a value at the minimum current output in the calibration parameters **Pr.930**. Calibration parameter **Pr.931** are used to set a value at the maximum current output.
- Set the output signal values (output monitor set with **Pr.54**) at zero and at the maximum current output from the terminal CA (using calibration parameters **Pr.930** and **Pr.931**. The full scale for each monitor is 100% at this time.
- Set the output current values (output monitor set with **Pr.54**) at zero and at the maximum current output from the terminal CA (using calibration parameters **Pr.930** and **Pr.931**. The output current calibrated by calibration parameter **Pr.900** is 100% at this time.





• Calibrate the terminal CA in the following procedure.

1. Connect a 0-20 mADC indicator (frequency meter) across terminals CA and 5 of the inverter. (Note the polarity. The terminal CA is positive.)

2. Set the initial value of calibration parameter **Pr.930** to **Pr.931**. If the meter needle does not indicate zero when the current input is at zero, calibrate the meter using **Pr.930**.

3. Refer to the monitor description list (page 284) and set **Pr.54**.
When the running frequency or inverter output current is selected on the monitor, set the running frequency or current value at which the output signal will be 20 mA, using **Pr.55** or **Pr.56** beforehand.

4. If the meter needle does not point to maximum even at maximum output, calibrate it with **Pr.900**.

NOTE

• When outputting such an item as the output current, which cannot reach a 100% value easily by operation, set **Pr.54** to "21" (reference voltage output) and calibrate. 20 mADC is output from the terminal CA.
• When **Pr.310 Analog meter voltage output selection** = "21", the terminal CA calibration cannot be performed. For details on **Pr.310**, refer to the Instruction Manual of FR-A8AY.
• Output is possible from terminal CA even if **Pr.930** ≥ **Pr.931**.

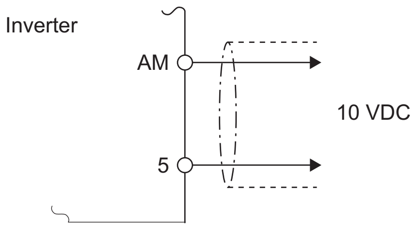
5

◆ Adjusting the response of terminal CA (Pr.869)

• Using **Pr.869**, the output voltage response of the terminal CA can be adjusted in the range of 0 to 5 s.
• Increasing the setting stabilizes the terminal CA output more but reduces the response level. (Setting "0" sets the response level to 7 ms.)

◆ Calibration of terminal AM (Pr.901)

• Terminal AM is initially set to provide a 10 VDC output in the full-scale state of the corresponding monitor item. **Pr.901** allows the output voltage ratio (gains) to be adjusted according to the meter scale. Note that the maximum output voltage is 10 VDC.



• Calibrate the AM terminal in the following procedure.

1. Connect a 0-10 VDC indicator (frequency meter) across terminals AM and 5 of the inverter.(Note the polarity. The terminal AM is positive.)

2. Refer to the monitor description list (page 275) and set **Pr.158 AM terminal function selection**.
When the running frequency or inverter output current is selected on the monitor, set the running frequency or current value at which the output signal will be 10 V, using **Pr.55** or **Pr.56** beforehand.

3. If the meter needle does not point to maximum even at maximum output, calibrate it with **Pr.901**.

NOTE

• When outputting such an item as the output current, which cannot reach a 100% value easily by operation, set **Pr.158** to "21" (reference voltage output) and calibrate. 10 VDC is output from the terminal AM.
• When **Pr.306 Analog output signal selection** = "21", the terminal AM calibration cannot be performed. For details on **Pr.306**, refer to the Instruction Manual of FR-A8AY.
• Use **Pr.290 Monitor negative output selection** to enable negative output from the terminal AM. When this is set, the output voltage range will be -10 VDC to +10 VDC. Calibrate the terminal AM with the maximum positive output value.

◆ Adjusting the response of terminal AM (Pr.867)

- Using **Pr.867**, the output voltage response of the terminal AM can be adjusted in the range of 0 to 5 s.
- Increasing the setting stabilizes the terminal AM output more but reduces the response level. (Setting "0" sets the response level to 7 ms.)

Parameters referred to

Pr.54 CA terminal function selection ☞ page 284
Pr.55 Frequency monitoring reference ☞ page 284
Pr.56 Current monitoring reference ☞ page 284
Pr.158 AM terminal function selection ☞ page 284
Pr.290 Monitor negative output selection ☞ page 284
Pr.291 Pulse train I/O selection ☞ page 222

5.8.5 Energy saving monitor

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

Pr.	Name	Initial value	Setting range	Description
52 **M100**	**Operation panel main monitor selection**	0 (output frequency)	Refer to page 274	50: Power saving monitor 51: Cumulative power saving monitor
774 **M101**	**Operation panel monitor selection 1**	9999		
775 **M102**	**Operation panel monitor selection 2**			
776 **M103**	**Operation panel monitor selection 3**			
54 **M300**	**CA terminal function selection**	1 (output frequency)	Refer to page 284	50: Power saving monitor
158 **M301**	**AM terminal function selection**			
891 **M023**	**Cumulative power monitor digit shifted times**	9999	0 to 4	Set the number of times to shift the cumulative power monitor digit. The monitored value is clamped at the maximum value.
			9999	No shift. The monitored value is cleared when it exceeds the maximum value.
892 **M200**	**Load factor**	100%	30 to 150%	Set the load factor for the commercial power supply operation. This is multiplied by the power consumption rate (page 295) during commercial power supply operation.
893 **M201**	**Energy saving monitor reference (motor capacity)**	Inverter capacity	0.1 to 55 kW*1	Set the motor capacity (pump capacity). Set when calculating the power saving power rate, average power saving rate, and power during commercial power supply operation.
			0 to 3600 kW*2	
894 **M202**	**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 **M203**	**Power saving rate reference value**	9999	0	Consider the value during commercial power supply operation as 100%.
			1	Consider **Pr.893** setting as 100%.
			9999	No function
896 **M204**	**Power unit cost**	9999	0 to 500	Set the power unit cost. The power cost savings are displayed on the energy saving monitor.
			9999	No function
897 **M205**	**Power saving monitor average time**	9999	0	Average of 30 minutes
			1 to 1000 h	Average of the set time
			9999	No function
898 **M206**	**Power saving cumulative monitor clear**	9999	0	Cumulative monitor value clear
			1	Cumulative monitor value hold
			10	Continue accumulation (communication data upper limit 9999)
			9999	Continue accumulation (communication data upper limit 65535)
899 **M207**	**Operation time rate (estimated value)**	9999	0 to 100%	This value is used for calculating the annual power saving amount. Set the annual operation ratio (consider 365 days × 24h as 100%).
			9999	No function

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.

◆ Energy saving monitor list

- The items that can be monitored on the power saving monitor (**Pr.52, Pr.54, Pr.158, Pr.774 to Pr.776** = "50") are indicated below. (Only [1 Power saving] and [3 Average power saving] can be set to **Pr.54** (terminal CA) **and Pr.158** (terminal AM).)

	Energy saving monitored item	Description and formula	Increment	Parameter setting			
				Pr.895	**Pr.896**	**Pr.897**	**Pr.899**
1	Power saving	The difference between the estimated value of the required power during commercial power supply operation and the input power calculated with the inverter. Power supply during commercial power supply operation - input power monitor	0.01 kW/0.1 kW*3	9999	—	9999	—
2	Power saving rate	The power saving ratio with the commercial power supply operation as 100%. $\frac{\textbf{[1 Power saving]}}{\textbf{Power during commercial power supply operation}} \times 100$	0.1%	0			
		The power saving ratio with **Pr.893** as 100%. $\frac{\textbf{[1 Power saving]}}{\textbf{Pr.893}} \times 100$		1			
3	Average power saving	The average power saving per hour during a predetermined time **(Pr.897)**. $\frac{\sum \textbf{([1 Power saving]} \times \Delta \textbf{t)}}{\textbf{Pr.897}}$	0.01 kWh/ 0.1 kWh*3	9999	9999	0 to 1000 h	
4	Average power saving rate	The average power saving ratio with the commercial power supply operation as 100%. $\frac{\sum \textbf{([2 Power saving rate]} \times \Delta \textbf{t)}}{\textbf{Pr.897}} \times 100$	0.1%	0			
		The average power saving ratio with **Pr.893** as 100%. $\frac{\textbf{[3 Average power saving]}}{\textbf{Pr.893}} \times 100$		1			
5	Average power cost savings	The average power saving in terms of cost. **[3 Average power saving]** × **Pr.896**	0.01/0.1*3	-	0 to 500		

- The items that can be monitored on the cumulative energy saving monitor (**Pr.52, Pr.774 to Pr.776** = "51") are indicated below. (The monitor value of the cumulative monitor can be shifted to the right with **Pr.891 Cumulative power monitor digit shifted times**.)

	Energy saving monitored item	Description and formula	Increment	Parameter setting			
				Pr.895	**Pr.896**	**Pr.897**	**Pr.899**
6	Power saving amount	The cumulative power saving is added up per hour. ∑(**[1 Power saving]** × Δt)	0.01 kWh/ 0.1 kWh *1*2*3	—	9999	—	9999
7	Power cost saving	The power saving amount in terms of cost. **[6 Power saving amount]** × **Pr.896**	0.01/0.1 *1*3	—	0 to 500		
8	Annual power saving amount	Estimated value of annual power saving amount. $\frac{\textbf{[6 Power saving amount]}}{\textbf{Operation time during power saving accumulation}} \times 24 \times 365 \times \frac{\textbf{Pr.899}}{\textbf{100}}$	0.01 kWh/ 0.1 kWh *1*2*3	—	9999		0 to 100%
9	Annual power cost savings	Annual power saving amount in terms of cost. **[8 Annual power saving amount]** × **Pr.896**	0.01/0.1 *1*3	—	0 to 500		

*1 For communication, (RS-485 communication, communication option), the display increments are 1. For example, "10.00 kWh" is displayed as "10" for communication data.

*2 When using the LCD operation panel or the parameter unit, "kW" is displayed

*3 The increment differs according to capacities. (FR-F860-00680 or lower/FR-F860-01080 or higher.)

NOTE

- The operation panel and the parameter unit has a 5-digit display. This means, for example, that when a monitor value in 0.01 units exceeds "999.99", the decimal place is moved up as in "1000.0" and the display changes to 0.1 units. The maximum display number is "99999".
- The maximum value for communication (RS-485 communication, communication option) when **Pr.898 Power saving cumulative monitor clear** = "9999" is "65535". The maximum value for the 0.01-unit monitor is "655.35", and the maximum value for the 0.1-unit monitor is "6553.5".

◆ Power saving real-time monitor ([1 Power saving] and [2 Power saving rate])

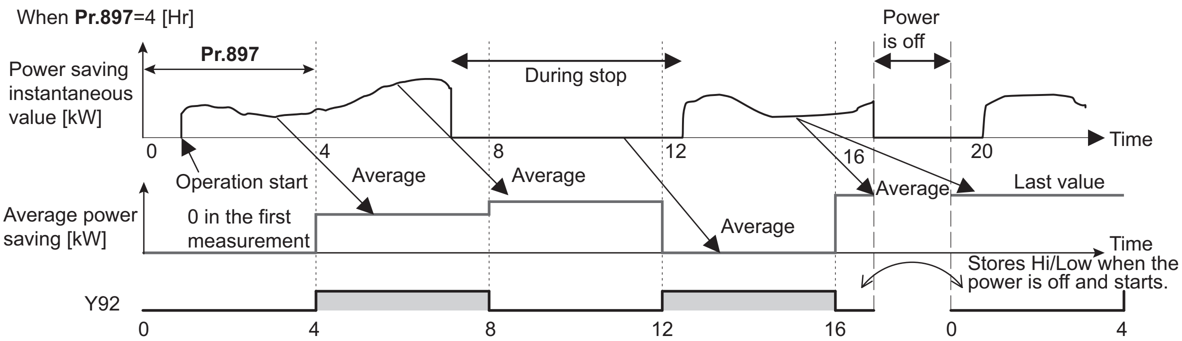
- On the [1 Power saving monitor], an energy saving effect as compared to the consumed power during commercial power supply operation (estimated value) is calculated and displays on the main monitor.
- In the following cases, the [1 Power saving monitor] indicates "0".

Calculated values of the power saving monitor are negative values.
During DC injection brake operation.
The motor is not connected (output current monitor is 0A).

- On the [2 Power saving rate monitor], the power saving rate considering the consumed power during the power supply operation (estimated value) as 100% is displayed. **Pr.895 Power saving rate reference value** needs to be set to "0". Energy saving monitor reference (motor capacity)

◆ Average power saving monitor ([3 Average power saving], [4 Average power saving rate], [5 Average power cost savings])

- The average power saving monitors are displayed by setting a value other than 9999 in **Pr.897 Power saving monitor average time**.
- On the [3 Average power saving monitor], average power saving amount for each average time period s displayed.
- When **Pr.897** is set, the average value is updated each time the average time period elapses, with the power-ON or inverter reset as the starting point. The power savings average value update timing signal (Y92) is inverted every time the average value is updated.



- When **Pr.895 Power saving rate reference value** the [2 Average power saving rate] for the averaging time period is displayed on the [4 Average power saving rate] monitor.
- When the power cost per 1 kWh power amount is set in **Pr.896 Power unit cost**, the cost of the saved power ([3 Average power saving] × **Pr.896**) is displayed on the [5 Average power cost savings].

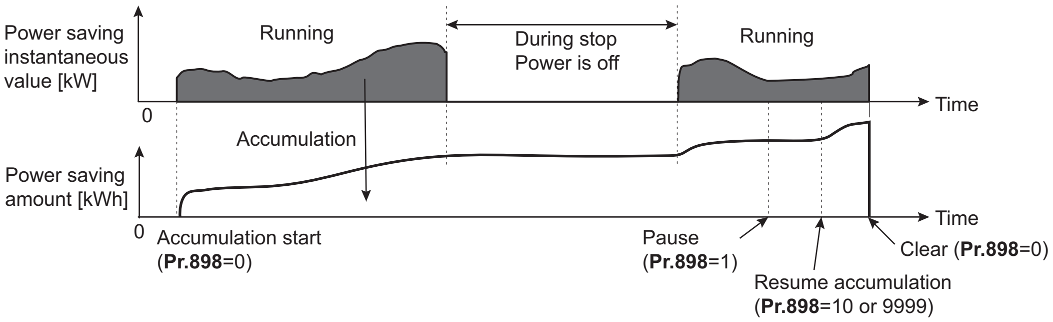
◆ Cumulative energy saving monitors ([6 Power saving amount], [7 Power cost saving], [8 Annual power saving amount], [9 Annual power saving savings]).

- On the cumulative energy saving cumulative monitors, the monitor data digit can be shifted to the right by the number of **Pr.891 Cumulative power monitor digit shifted times**. For example, if the cumulative power value is 1278.56 kWh when **Pr.891** = "2", the PU/DU display is 12.78 (display in 100 kWh increments) and the communication data is 12. If the maximum value is exceeded when **Pr.891** = "0 to 4", the value is clamped at the maximum value, indicating that a digit shift is necessary. If the maximum value is exceeded when **Pr.891** = "9999", the value returns to 0, and the counting starts again. In other monitors, the value is clamped at the displayed maximum value.
- The [6 Cumulative power saving amount] monitor (6)] can measure the power during a predetermined period. Measure with the following procedure.

1. Write "9999" or "10" in **Pr.898 Power saving cumulative monitor clear**.

2. Write "0" in **Pr.898** at the measurement start time to clear the power saving cumulative monitor value and start power saving accumulation.

3. Write "1" in **Pr.898** at the measurement end time to hold the power saving cumulative monitor value.

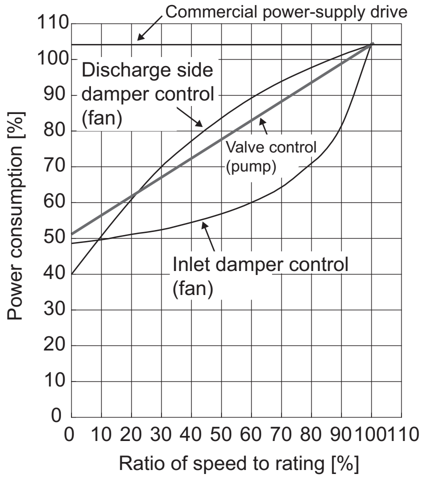


NOTE

- The power saving cumulative monitor value is saved every hour. This means that if the power is turned OFF after less than an hour, when then the power is turned ON again, the previously saved monitor value is displayed, and accumulation starts. (In some cases, the cumulative monitor value may go down.)

◆ Estimated power value in commercial power supply operation (Pr.892, Pr.893, Pr.894)

- Select the pattern for commercial power supply operation from the four patterns of discharge damper control (fan), suction damper control (fan), valve control (pump) and commercial power driving, and set it in **Pr.894 Control selection during commercial power-supply operation**.
- Set the motor capacity (pump capacity) in **Pr.893 Energy saving monitor reference (motor capacity)**.
- As shown below, the consumed power ratio (%) during commercial power supply operation is estimated from the rotations per minute ratio for each operation pattern and rating (current output frequency/**Pr.3 Base frequency**).



- The estimated value of the consumed power during commercial power supply operation (kW) is calculated from the motor capacity set in **Pr.893** and **Pr.892 Load factor** with the following formula.

$$\text{Estimated consumed power during commercial power supply operation (kW)} = \text{Pr.893 (kW)} \times \frac{\text{Consumed power (\%)}}{100} \times \frac{\text{Pr.892 (\%)}}{100}$$

NOTE

- In commercial power supply operation, because the rotations per minute cannot rise higher than the power supply frequency, if the output frequency rises to **Pr.3 Base frequency** or higher, it stays at a constant value.

◆ Annual power saving amount and power cost savings (Pr.899)

- When the operation time rate [%] (ratio of time in year that the inverter actually drives the motor) is set in **Pr.899**, the annual energy saving effect can be estimated.
- When the operation pattern is determined to a certain extent, the estimated value of the annual power saving amount can be calculated by measuring the power saving in a certain measurement period.
- Refer to the following to set the operation time rate.

1. Estimate the average time of operation per day [h/day].

2. Calculate the number of operation days per year [days/year]. (Average number of operation days per month × 12 months)

3. Calculate the annual operation time [h/year] from step 1 and step 2.

Annual operation time (h/year) = average time (h/day) × number of operation days (days/year)

4. Calculate the operation time rate and set it in **Pr.899**.

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

NOTE

- Setting example for operation time rate: When operation is performed about 21h per day for an average 16 operation days per month, Annual operation time = 21 (h/day) × 16 (days/month) × 12 months = 4032 (h/year)

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

Set 46.03% in **Pr.899**.

- Calculate the annual power saving amount from **Pr.899 Operation time rate (estimated value)** and the average power saving monitor.

$$\textbf{Annual power saving amount (kWh/year)} = \textbf{With Pr.898 = 10 or 9999, average power saving (kW) during cumulative period} \times \textbf{24h} \times \textbf{365 days} \times \frac{\textbf{Pr.899}}{\textbf{100}}$$

- When the power cost per hour is set in **Pr.896 Power unit cost**, the annual power cost savings can be monitored.

Annual power cost saving = annual power saving amount (kWh/year) × Pr.896

NOTE

- During regenerative driving, make calculation on the assumption that "power saving = power during commercial power supply operation (input power = 0)".

Parameters referred to

Pr.3 Base frequency ☞ page 539
Pr.52 Operation panel main monitor selection ☞ page 274
Pr.158 AM terminal function selection ☞ page 284
Pr.54 CA terminal function selection ☞ page 284

5.8.6 Output terminal function selection

Use the following parameters to change the functions of the open collector output terminals and relay output terminals.

Pr.	Name		Initial value	Initial set signal	Setting range
190 M400	RUN terminal function selection	Open collector output terminal	0	RUN (Inverter running)	0 to 5, 7, 8, 10 to 19, 23, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 68, 70 to 80, 82, 85, 90 to 96, 98 to 105, 107, 108, 110 to 116, 123, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 168, 170 to 180, 182, 185, 190 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 247, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 347, 9999
191 M401	SU terminal function selection		1	SU (Up to frequency)	
192 M402	IPF terminal function selection		2*1 9999*2	IPF (Instantaneous power failure/undervoltage) No function	
193 M403	OL terminal function selection		3	OL (Overload warning)	
194 M404	FU terminal function selection		4	FU (Output frequency detection)	
195 M405	ABC1 terminal function selection	Relay output terminal	99	ALM (Fault)	0 to 5, 7, 8, 10 to 19, 23, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 68, 70 to 80, 82, 85, 90, 91, 94 to 96, 98 to 105, 107, 108, 110 to 116, 123, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 168, 170 to 180, 182, 185, 190, 191, 194 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 247, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 347, 9999
196 M406	ABC2 terminal function selection		9999	No function	
313*3 M410	DO0 output selection	For terminal on the option	9999	No function	0 to 5, 7, 8, 10 to 19, 23, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 66, 68, 70 to 80, 85 to 96, 98 to 105, 107, 108, 110 to 116, 123, 125, 126, 135, 139 to 142, 145 to 154, 157, 164 to 166, 168, 170 to 180, 185 to 196, 198 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 247 to 250, 300 to 308, 311 to 313, 315, 317 to 320, 326, 328 to 330, 347 to 350, 9999
314*3 M411	DO1 output selection		9999	No function	
315*3 M412	DO2 output selection		9999	No function	
316*3 M413	DO3 output selection		9999	No function	
317*3 M414	DO4 output selection		9999	No function	
318*3 M415	DO5 output selection		9999	No function	
319*3 M416	DO6 output selection		9999	No function	
320*3 M420	RA1 output selection		0	RUN (Inverter running)	0 to 5, 7, 8, 10 to 19, 23, 25, 26, 35, 39 to 42, 45 to 54, 57, 64 to 66, 68, 70 to 80, 85 to 91, 94 to 96, 98, 99, 200 to 208, 211 to 213, 215, 217 to 220, 226, 228 to 230, 247 to 250, 9999
321*3 M421	RA2 output selection		1	SU (Up to frequency)	
322*3 M422	RA3 output selection		2*1 9999*2	IPF (Instantaneous power failure/undervoltage) No function	

Pr.	Name	Initial value	Setting range	Description
289 M431	Inverter output terminal filter	9999	5 to 50 ms	Set the time delay for the output terminal response.
			9999	No output terminal filter.

*1 The initial value is for standard models.
*2 The initial value is for separated converter types.
*3 The setting is available when the PLC function is enabled.

◆ Output signal list

- The functions of the output terminals can be set.
- Refer to the following table and set each parameter. (0 to 99, 200 to 299: Positive logic, 100 to 199, 300 to 399: Negative logic)

Setting		Signal name	Function	Operation	Related parameter	Refer to page
Positive logic	Negative logic					
0	100	RUN	Inverter running	Output during operation when the inverter output frequency reaches **Pr.13 Starting frequency** or higher.	—	303
1	101	SU	Up to frequency [*1]	Output when the output frequency reaches the set frequency.	**Pr.41**	305
2	102	IPF	Instantaneous power failure/undervoltage [*2]	Output when an instantaneous power failure or undervoltage protection operation occurs.	**Pr.57**	448, 454
3	103	OL	Overload warning	Output during operation of the stall prevention function.	**Pr.22, Pr.23, Pr.66, Pr.148, Pr.149, Pr.154**	257
4	104	FU	Output frequency detection	Output when the output frequency reaches the frequency set in **Pr.42** (**Pr.43** during reverse rotation) or higher.	**Pr.42, Pr.43**	305
5	105	FU2	Second output frequency detection	Output when the output frequency reaches the frequency set in **Pr.50** or higher.	**Pr.50**	305
7	107	For manufacturer setting. Do not set.				
8	108	THP	Electronic thermal O/L relay pre-alarm	Output when the cumulative electronic thermal O/L relay value reaches 85% of the trip level. (Electronic thermal O/L relay protection (E.THT/ E.THM) is activated when the value reaches 100%.)	**Pr.9**	230
10	110	PU	PU operation mode	Output when PU operation mode is selected.	**Pr.79**	204
11	111	RY	Inverter operation ready	Output when the reset process is completed after powering ON the inverter (when starting is possible by switching the start signal ON or during operation).	—	303
12	112	Y12	Output current detection	Output when the output current is higher than the **Pr.150** setting for the time set in **Pr.151** or longer.	**Pr.150, Pr.151**	307
13	113	Y13	Zero current detection	Output when the output current is lower than the **Pr.152** setting for the time set in **Pr.153** or longer.	**Pr.152, Pr.153**	307
14	114	FDN	PID lower limit	Output when the value is lower than the lower limit of PID control.	**Pr.127 to Pr.134, Pr.575 to Pr.577, Pr.1346, Pr.1370**	396
15	115	FUP	PID upper limit	Output when the value is higher than the upper limit of PID control.		
16	116	RL	PID forward/reverse rotation output	Output during forward rotation under PID control.		
17	—	MC1	Electronic bypass MC1	Used when using the electronic bypass function.	**Pr.135 to Pr.139, Pr.159**	376
18	—	MC2	Electronic bypass MC2			
19	—	MC3	Electronic bypass MC3			
23	123	ALM4	Output short-circuit detection	Output when E.SCF occurs or when E.GF occurs while **Pr.249** = "2".	**Pr.521, Pr.249**	238, 240
25	125	FAN	Fan fault output	Output when a fan fault occurs.	**Pr.244**	237
26	126	FIN	Heat sink overheat pre-alarm	Output when the heat sink temperature reaches about 85% of the heat sink overheat protection operation temperature.	—	578
35	135	TU	Torque detection	Output when the motor torque is higher than the **Pr.864** setting.	**Pr.864**	309
39	139	Y39	Start time tuning completion	Output when tuning is completed during start-up.	**Pr.95, Pr.574**	371
40	140	Y40	Trace status	Output during trace operation.	**Pr.1020 to Pr.1047**	396
41	141	FB	Speed detection	Output when the actual motor rotations per minute (estimated rotations per minute) reaches **Pr.42 (Pr.50)**.	**Pr.42, Pr.50**	305
42	142	FB2	Second speed detection			

Setting		Signal name	Function	Operation	Related parameter	Refer to page
Positive logic	Negative logic					
45	145	RUN3	Inverter running and start command is ON	Output while the inverter is running and the start command is ON.	—	303
46	146	Y46	During deceleration at occurrence of power failure	Output after the power-failure deceleration function operates. (Retained until canceled.)	**Pr.261 to Pr.266**	458
47	147	PID	During PID control activated	Output during PID control.	**Pr.127 to Pr.134, Pr.575 to Pr.577**	396
48	148	Y48	PID deviation limit	Output when the absolute deviation value exceeds the limit value.	**Pr.127 to Pr.134, Pr.553, Pr.554**	396
49	149	Y49	During pre-charge operation	Output during pre-charge operation.	**Pr.127 to Pr.134, Pr.241, Pr.553, Pr.554, Pr.575 to Pr.577, Pr.753 to Pr.769, C42 to C45**	424
50	150	Y50	During second pre-charge operation			
51	151	Y51	Pre-charge time over	Output when the pre-charge operation reaches the time limit set in **Pr.764** or **Pr.769**.		
52	152	Y52	Second pre-charge time over			
53	153	Y53	Pre-charge level over	Output when the measured value before reaching the ending time during pre-charge operation is higher than the detection level set in **Pr.763** or **Pr.768**.		
54	154	Y54	Second pre-charge level over			
57	157	IPM	During PM motor control	Output while the control method is PM motor control.	**Pr.71, Pr.80, Pr.998**	151
64	164	Y64	During retry	Output during retry processing.	**Pr.65 to Pr.69**	242
65	165	Y65	Emergency drive in operation *2	Output during emergency drive operation.	**Pr.514, Pr.515, Pr.523, Pr.524, Pr.1013**	245
66	166	ALM3	Fault output during emergency drive *2	Output when a fault occurs during emergency drive operation.		
67	167	Y67	Power failure *3	Output when the power failure time deceleration-to-stop function is activated during output shutoff due to power failure or undervoltage.	**Pr.261 to Pr.266**	458
68	168	EV	24 V external power supply operation	Output while operating with a 24 V power supply input from an external source.	—	63
70	170	SLEEP	PID output interruption	Output during PID output suspension function operation.	**Pr.127 to Pr.134, Pr.575 to Pr.577**	396
71	171	RO1	Commercial power supply side motor 1 connection RO1	Output depending on the motor drive conditions when the multi-pump function is used.	**Pr.575 to Pr.591**	429
72	172	RO2	Commercial power supply side motor 2 connection RO2			
73	173	RO3	Commercial power supply side motor 3 connection RO3			
74	174	RO4	Commercial power supply side motor 4 connection RO4			
75	175	RIO1	Inverter side motor 1 connection RIO1			
76	176	RIO2	Inverter side motor 2 connection RIO2			
77	177	RIO3	Inverter side motor 3 connection RIO3			
78	178	RIO4	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**	315
80	180	—	—	For manufacturer setting. Do not set.	—	—
82	182	Y82	BACnet binary output	Enables output from the Binary Output object for BACnet communication.	**Pr.549**	516
85	185	Y85	DC current feeding *2	Output when there is a power failure or undervoltage for the AC current.	**Pr.30**	553

5

Setting		Signal name	Function	Operation	Related parameter	Refer to page
Positive logic	Negative logic					
86	186	Y86	Control circuit capacitor life (for **Pr.313** to **Pr.322**) *5	Output when the control circuit capacitor approaches the end of its life.	**Pr.255 to Pr.259**	182
87	187	Y87	Main circuit capacitor life (for **Pr.313** to **Pr.322**) *2*5	Output when the main circuit capacitor approaches the end of its life.		
88	188	Y88	Cooling fan life (for **Pr.313** to **Pr.322**) *5	Output when the cooling fan approaches the end of its life.		
89	189	Y89	Inrush current limit circuit life (for **Pr.313** to **Pr.322**) *2*5	Output when the inrush current limit circuit approaches the end of its life.		
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 life.		
91	191	Y91	Fault output 3 (power-OFF signal)	Output when an error occurs due to an inverter circuit fault or connection fault.	—	304
92	192	Y92	Energy saving average value updated timing	Switches between ON and OFF each time the average power saving is updated when using the power saving monitor. This cannot be set in **Pr.195 or Pr.196**, **Pr.320 to Pr.322** (relay output terminal).	**Pr.52, Pr.54, Pr.158, Pr.891 to Pr.899**	291
93	193	Y93	Current average monitor	Outputs the average current and maintenance timer value as a pulse. This cannot be set in **Pr.195 or Pr.196**, **Pr.320 to Pr.322** (relay output terminal).	**Pr.555 to Pr.557**	187
94	194	ALM2	Fault output 2	Output when the inverter's protective function is activated to stop the output (at fault occurrence). The signal output continues even during an inverter reset, and the signal output stops after the reset release. *6	—	304
95	195	Y95	Maintenance timer	Output when **Pr.503** reaches the **Pr.504** setting or higher.	**Pr.503, Pr.504**	186
96	196	REM	Remote output	Output via terminals when certain parameters are set.	**Pr.495 to Pr.497**	310
98	198	LF	Alarm	Output when an alarm (fan fault or communication error warning) occurs.	**Pr.121, Pr.244**	237, 478
99	199	ALM	Fault	Output when the inverter's protective function is activated to stop the output (at fault occurrence). The signal output is stopped after a reset.	—	304
200	300	FDN2	Second PID lower limit	Output when the value is lower than the lower limit of second PID control.	**Pr.753 to Pr.758**	396
201	301	FUP2	Second PID upper limit	Output when the value is higher than the upper limit of second PID control.		
202	302	RL2	Second PID forward/ reverse rotation output	Output during forward rotation under second PID control.		
203	303	PID2	Second During PID control activated	Output during second PID control.		
204	304	SLEEP 2	During second PID output shutoff	Output during second PID output suspension function operation.	**Pr.753 to Pr.758, Pr.1147 to Pr.1149**	
205	305	Y205	Second PID deviation limit	Output when the absolute deviation value during second PID control exceeds the limit value.	**Pr.753 to Pr.758, Pr.1145, Pr.1146**	
206	306	Y206	Cooling fan operation command	Output when the cooling fan operation is commanded.	**Pr.244**	237
207	307	Y207	Control circuit temperature	Output when the temperature of the control circuit board reaches the detection level or higher.	**Pr.663**	316
208	308	PS	PU stopped	Output while the PU is stopped.	**Pr.75**	162

Setting		Signal name	Function	Operation	Related parameter	Refer to page
Positive logic	Negative logic					
211	311	LUP	Upper limit warning detection	Output when the load fault upper limit warning is detected.	**Pr.1480 to Pr.1492**	265
212	312	LDN	Lower limit warning detection	Output when the load fault lower limit warning is detected.		
213	313	Y213	During load characteristics measurement	Output during measurement of the load characteristics.		
215	315	Y215	During cleaning	Output during operation of the cleaning function.	**Pr.1469 to Pr.1479**	391
217	317	Y217	Priming pump operation	Outputs the signal for starting the priming pump.	**Pr.1363**	440
218	318	STIR	Stirring	Output during the stirring operation.	**Pr.1364, Pr.1365**	
219	319	Y219	PID upper/lower limit pre-warning	Output when the PID measured value meets the requirements of the limit pre-warning signal output conditions.	**Pr.1346, Pr.1370 to Pr.1373**	
220	320	Y220	Second PID upper/lower limit pre-warning			
226	326	Y226	Auxiliary pressure pump operation	Output when the PID deviation exceeds the auxiliary pressure pump operation starting level.	**Pr.1374, Pr.1375**	
228	328	DRY	Dry run	Output when a dry-run state is detected.	**Pr.42, Pr.43, Pr.132, Pr.1144, Pr.1370**	
229	329	Y229	PID input pressure warning	Output when the pump inlet pressure reaches the warning level.	**Pr.1370, Pr.1373, Pr.1377, Pr.1378, Pr.1380**	
230	330	Y230	PID input pressure fault	Output when the pump inlet pressure reaches the fault level.	**Pr.1370, Pr.1377, Pr.1379, Pr.1381**	
247	347	LSYN	Phase synchronization completion *4	Output when phase synchronization for bypass switching has completed (for FR-A8AVP).	**Pr.139**	—
248	348	Y248	Estimated residual-life of main circuit capacitor (for **Pr.313 to Pr.322**)*2*5	Output when the main circuit capacitor approaches the end of its estimated life.	**Pr.255, Pr.506**	182
249	349	Y249	ABC1 relay contact life (for **Pr.313 to Pr.322**)*5	Output when the relay contacts of terminals A1, B1, and C1 approach the end of their life.	**Pr.255, Pr.507**	
250	350	Y250	ABC2 relay contact life (for **Pr.313 to Pr.322**)*5	Output when the relay contacts of terminals A2, B2, and C2 approach the end of their life.	**Pr.255, Pr.508**	
9999		—	No function	—	—	—

*1 Take caution when changing the frequency setting with an analog signal, because this change speed and the timing of the change speed determined by the acceleration/deceleration time setting may cause the output of the SU (up to frequency) signal to switch repeatedly between ON and OFF. (This repeating does not occur when the acceleration/deceleration time setting is "0 s".)

*2 The setting is available only for standard models.

*3 This signal cannot be assigned to the output terminals for plug-in options (FR-A8AY, FR-A8AR).

*4 Available when the plug-in option is connected.

*5 This signal is available when the PLC function is enabled, or when an option (FR-A8AY, FR-A8AR, FR-A8NC, or FR-A8NCE) is installed. For the corresponding parameters of each option, refer to the Instruction Manual of the option.

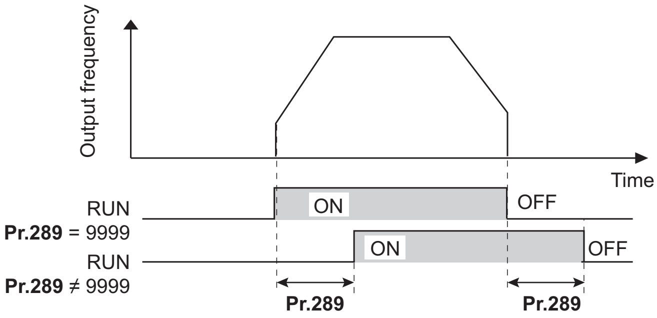
*6 When the power is reset, the fault output 2 signal (ALM2) turns OFF at the same time as the power turns OFF.

NOTE

- The same function may be set to more than one terminal
- The terminal conducts during function operation when the setting is "0 to 99, 200 to 299", and does not conduct when the setting is "100 to 199, 300 to 399".
- When **Pr.76 Fault code output selection** = "1", the output signals of terminals SU, IPF, OL and FU operate according to **Pr.76** setting. (When the inverter's protective function is activated, the signal output switches to fault code output.)
- The outputs of terminal RUN and the fault output relay are assigned according to the settings above, regardless of **Pr.76**.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.
- Do not assign signals which repeat frequently between ON and OFF to terminals A1B1C1 or A2B2C2. The life of the relay contacts will be shortened.

◆ Adjusting the output terminal response level (Pr.289)

- The response level of the output terminals can be delayed in a range of 5 to 50 ms. (Operation example for the RUN signal.)

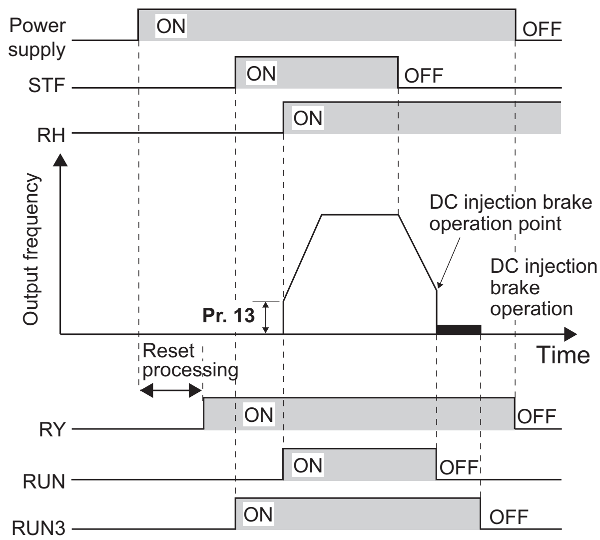


NOTE

- When **Pr.157 OL signal output timer** is set for the Overload warning (OL) signal output, the OL signal is output when the set time of (**Pr.157 + Pr.289**) elapses.
- For the output signal and the fault code output (on page 314) used in the PLC function (on page 463), the **Pr.289** setting is invalid (no filter).

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

- When the inverter is ready for operation, the Inverter operation ready (RY) signal turns ON (and stays ON during operation).
- When the inverter output frequency reaches **Pr.13 Starting frequency** or higher, the Inverter running (RUN) signals turn ON. The signal is OFF while the inverter is stopped and during DC injection brake operation. Inverter
- The Inverter running and start command is ON (RUN3) signal is ON while the inverter is running or the start signal is ON. (When the start command is ON, the RUN3 signal output turns ON even while the inverter's protective function is activated or the MRS is ON.) During DC injection brake operation as well, the output is ON, and when the inverter stops, it turns OFF.



- According to the inverter condition, the ON/OFF operation of each signal is as shown below.

Output signal	Start signal OFF (during stop)	Start signal ON (during stop)	Start signal ON (running)	DC injection brake operation	Output shutoff*2		Automatic restart after instantaneous power failure		
							Coasting		Restarting
					Start signal ON	Start signal OFF	Start signal ON	Start signal OFF	
RY*3	ON	ON	ON	ON	OFF		ON*1		ON
RUN	OFF	OFF	ON	OFF	OFF		OFF		ON
RUN3	OFF	ON	ON	ON	ON	OFF	ON	OFF	ON

*1 OFF during power failure or undervoltage.
*2 Output is shutoff in conditions like a fault and when the MRS signal is ON.
*3 OFF while power is not supplied to the main circuit power supply.

- When using the RY, RUN and RUN3 signals, refer to the following and assign the functions by **Pr.190 to Pr.196 (Output terminal function selection)**.

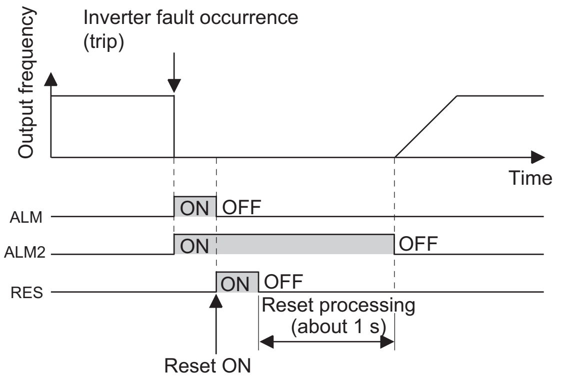
Output signal	Pr.190 to Pr.196 settings	
	Positive logic	Negative logic
RY	11	111
RUN	0	100
RUN3	45	145

NOTE

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

◆ Fault output signals (ALM, ALM2)

- The Fault (ALM, ALM2) signals are output when the inverter protective function is activated.
- The ALM2 signal stays ON during the reset period after the fault occurs.
- To use the ALM2 signal, set "94 (positive logic) or 194 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function to the output terminal.
- The ALM signal is assigned to the A1B1C1 contacts in the initial status.



NOTE

- For the inverter fault details, refer to page 570.

◆ Input MC shutoff signal (Y91)

- The Fault output 3 (Y91) signal is output when a fault originating in the inverter circuit or a connection fault occurs.
- To use the Y91 signal, set "91 (positive logic) or 191 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function to the output terminal.
- The following table shows the faults that output the Y91 signal. (For the fault details, refer to page 570.)

Fault record
Inrush current limit circuit fault (E.IOH)
CPU fault (E.CPU)
CPU fault (E.6)
CPU fault (E.7)
Parameter storage device fault (control circuit board) (E.PE)
Parameter storage device fault (main circuit board) (E.PE2)
Internal storage device fault (E.PE6)
24 VDC power fault (E.P24)
Operation panel power supply short circuit/RS-485 terminals power supply short circuit (E.CTE)
Output side earth (ground) fault overcurrent (E.GF)
Output phase loss (E.LF)
Internal circuit fault (E.BE)
Internal circuit fault (E.13/E.PBT)

◆ Changing the special relay function for the PLC function

- For the PLC function, the function of special relays (SM1225 to SM1234) can be changed by setting **Pr.313 to Pr.322**. (For details on the PLC function, refer to the PLC Function Programming Manual.)

Parameters referred to

Pr.13 Starting frequency ☞ page 201, page 202

Pr.76 Fault code output selection ☞ page 314

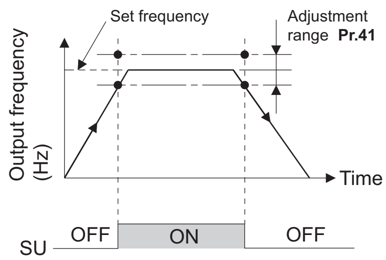
5.8.7 Output frequency detection

The inverter output frequency is detected and output as output signals.

Pr.	Name	Initial value	Setting range	Description
41 **M441**	**Up-to-frequency sensitivity**	10%	0 to 100%	Set the level where the SU signal turns ON.
42 **M442**	**Output frequency detection**	6 Hz	0 to 590 Hz	Set the frequency where the FU (FB) signal turns ON.
43 **M443**	**Output frequency detection for reverse rotation**	9999	0 to 590 Hz	Set the frequency where the FU (FB) signal turns ON in reverse rotation.
			9999	Same as the **Pr.42** setting.
50 **M444**	**Second output frequency detection**	30 Hz	0 to 590 Hz	Set the frequency where the FU2 (FB2) signal turns ON.
870 **M400**	**Speed detection hysteresis**	0 Hz	0 to 5 Hz	Set the hysteresis width for the detected frequency.

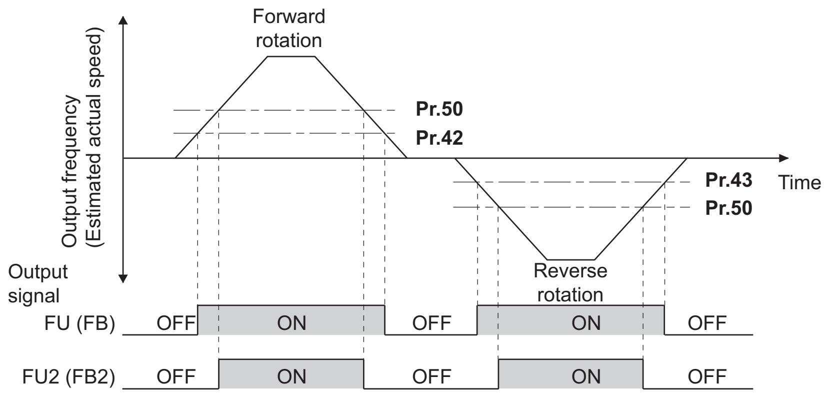
◆ Output up-to-frequency sensitivity (SU signal, Pr.41)

- Up to frequency (SU) is output when the output frequency reaches the set frequency.
- The **Pr.41** value can be adjusted within the range ±1% to ±100% considering the set frequency as 100%.
- This parameter can be used to check that the set frequency has been reached, and provide signals such as the operation start signal for related equipment.



◆ Output frequency detection (FU (FB) signal, FU2 (FB2) signal, Pr.42, Pr.43, Pr.50)

- The Output frequency detection (FU/FU2) signal or the Speed detection (FB/FB2) signal is useful for applying or releasing electromagnetic brake, etc.
- The FU signal is output when the output frequency (frequency command value) reaches or exceeds the **Pr.42** setting.
- During PM motor control, the FB signal is output when the estimated actual motor rotations per minute reaches the **Pr.42** setting. Under V/F control and Advanced magnetic flux vector control, the FU signal and the FB signal are output at the same time.
- The frequency detection dedicated to motor rotation in reverse direction is enabled by setting the frequency in **Pr.43**.
- When **Pr.43** ≠ "9999", forward rotation uses the **Pr.42** setting and reverse rotation uses the **Pr.43** setting.
- When outputting a frequency detection signal separately from the FU (FB) signal, set the detection frequency in **Pr.50**. When the output frequency reaches the **Pr.50** setting or higher, the FU2 (FB2) signal is output.

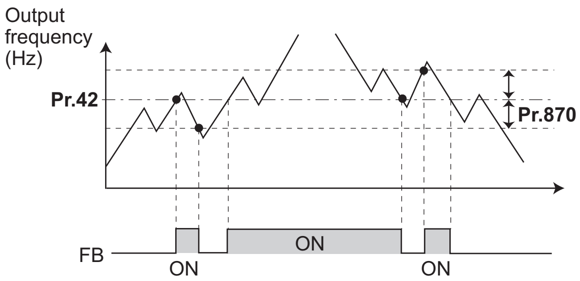


- For each signal, refer to the following table and assign the function by **Pr.190 to Pr.196 (Output terminal function selection)**.

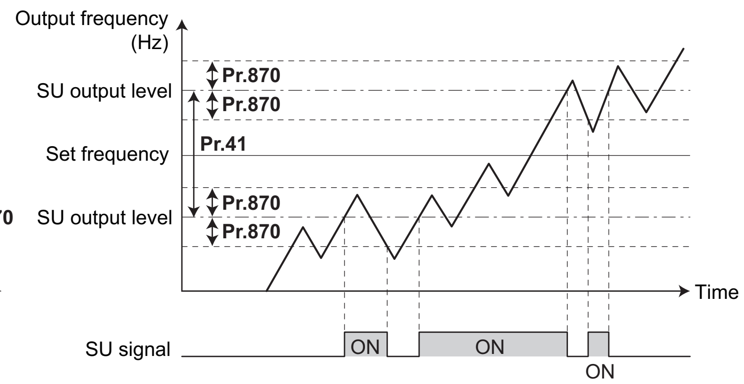
Output signal	Pr.190 to Pr.196 settings		Related parameter
	Positive logic	Negative logic	
FU	4	104	42, 43
FB	41	141	
FU2	5	105	50
FB2	42	142	

◆ Speed detection hysteresis (Pr.870)

- This function prevents chattering of the speed detection signals. When an output frequency fluctuates, the up to frequency signal (SU) and the speed detection signals (FB and FB2) may repeat ON/OFF (chatter). Setting hysteresis to the detected frequency prevents chattering of these signals.



Example of the speed detection (FB) signal



Example of the up to frequency (SU) signal

NOTE

- In the initial setting, the FU signal is assigned to the terminal FU, and the SU signal is assigned to the terminal SU.
- All signals turn OFF during DC injection brake, tuning at start-up.
- Each signal's reference frequency differs by the control method.

Control method	Compared frequency	
	FU, FU2	FB, FB2, SU
V/F control	Output frequency	Output frequency
Advanced magnetic flux vector control	Output frequency before the slip compensation	Output frequency before the slip compensation
PM motor control	Frequency command value	Estimated frequency (actual motor speed)

- Setting a higher value in **Pr.870** slows the response of frequency detection signals (SU, FB, and FB2).
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

5.8.8 Output current detection function

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

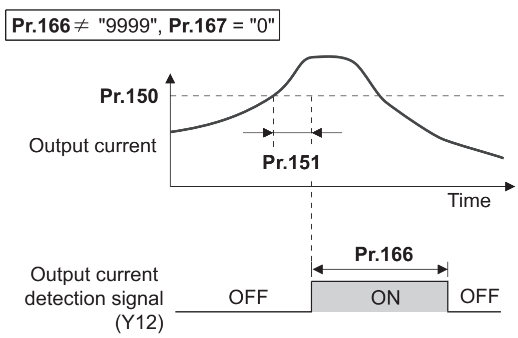
Pr.	Name	Initial value	Setting range	Description
150 M460	**Output current detection level**	110%	0 to 220%	Set the output current detection level. Consider the value of the inverter rated current as 100%.
151 M461	**Output current detection signal delay time**	0 s	0 to 300 s	Set the time from when the output current exceeds the **Pr.150** setting until the Output current detection (Y12) signal is output.
152 M462	**Zero current detection level**	5%	0 to 220%	Set the zero current detection level. The inverter rated current is regarded as 100%.
153 M463	**Zero current detection time**	0.5 s	0 to 300 s	Set the time from when the output current falls below the **Pr.152** setting until the Zero current detection (Y13) signal is output.
166 M433	**Output current detection signal retention time**	0.1 s	0 to 10 s	Set the retention time when the Y12 signal is ON.
			9999	Retain the Y12 signal ON status. The signal is turned OFF at the next start.
167 M464	**Output current detection operation selection**	0	0, 1, 10, 11	Select the operation when Y12 and Y13 signals turn ON.

5

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

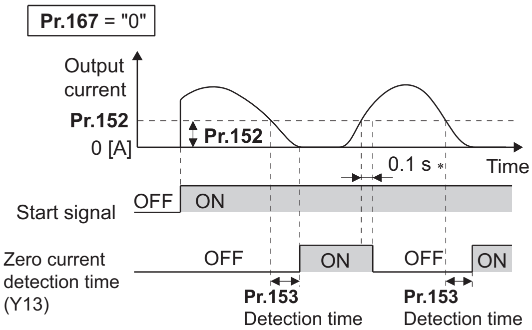
- The output current detection function can be used for purposes such as overtorque detection.
- If the inverter output during inverter running remains higher than the **Pr.150** setting for the time set in **Pr.151** or longer, the Output current detection (Y12) signal is output.
- When the Y12 signal turns ON, the ON state is retained for the time set in **Pr.166**.
- When **Pr.166** = "9999", the ON state is retained until the next start.
- Setting **Pr.167** = "1" while the Y12 signal is ON does not cause E.CDO. The **Pr.167** setting becomes valid after the Y12 signal is turned OFF.
- For the Y12 signal, set "12 (positive logic) or 112 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function to the output terminal.
- Select whether the inverter output stops or the inverter operation continues when Y12 signal turns ON, by setting **Pr.167**.

Pr.167 setting	When Y12 signal turns ON	When Y13 signal turns ON
0 (Initial value)	Continuous operation	Continuous operation
1	Inverter trip (E.CDO)	Continuous operation
10	Continuous operation	Inverter trip (E.CDO)
11	Inverter trip (E.CDO)	Inverter trip (E.CDO)



◆ Zero current detection (Y13 signal, Pr.152, Pr.153)

- If the inverter output during inverter running remains lower than the **Pr.152** setting for the time set in **Pr.153** or longer, the Zero current detection (Y13) signal is output.
- Once turned ON, the zero current detection time signal (Y13) is held ON for at least 0.1s.
- If the inverter output current decreases, slippage due to gravity may occur, especially in a lift application, because the motor torque decreases. To prevent this, the Y13 signal can be output from the inverter to apply the mechanical brake when the output current falls below the **Pr.152** setting.
- For the Y13 signal, set "13 (positive logic) or 113 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function to the output terminal.
- Select whether the inverter output stops or the inverter operation continues when Y13 signal turns ON, by setting **Pr.167**.



* When the output is restored to the **Pr.152** level, the Y13 signal is turned OFF after 0.1 s.

NOTE

- The signals are enabled even when online or offline auto tuning is being executed.
- The response time of the Y12 and Y13 signals is approximately 0.1 s. Note that the response time varies with the load.
- When **Pr.152** = "0", detection is disabled.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

CAUTION

- The zero current detection level setting should not be too low, and the zero current detection time setting not too long. When the output current is low and torque is not generated, the detection signal may not be output.
- Even when using the zero current detection signal, a safety backup such as an emergency brake must be provided to prevent hazardous machine or equipment conditions.

Parameters referred to

Online auto tuning ☞ page 371
Offline auto tuning ☞ page 353, page 363
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

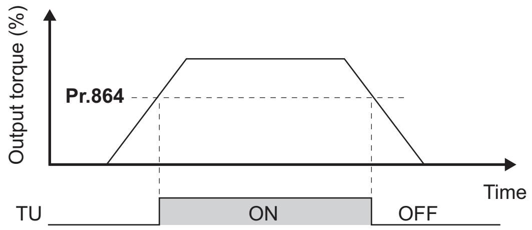
5.8.9 Output torque detection

Magnetic flux PM

A signal is output when the motor torque is higher than the setting.
This function can be used for electromagnetic brake operation, open signal, etc.

Pr.	Name	Initial value	Setting range	Description
864 **M470**	**Torque detection**	150%	0 to 400%	Set the torque value where the TU signal turns ON.

- The Torque detection (TU) signal turns ON when the output torque reaches the detection torque value set in **Pr.864** or higher. The TU signal turns OFF when the output torque drops lower than the detection torque value.
- **Pr.864** is not available under V/F control.
- For the TU signal, set "35 (positive logic) or 135 (negative logic)" in one of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function to the output terminal.



NOTE

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

Parameters referred to

Pr.190 to Pr.196 (Output terminal function selection) page 297

5.8.10 Remote output function

The inverter output signals can be turned ON/OFF like the remote output terminals of a programmable controller.

Pr.	Name	Initial value	Setting range	Description	
495 **M500**	**Remote output selection**	0	0	Remote output data is cleared when the power supply is turned OFF	Remote output data is cleared during an inverter reset
			1	Remote output data is retained when the power supply is turned OFF	
			10	Remote output data is cleared when the power supply is turned OFF	Remote output data is retained during an inverter reset
			11	Remote output data is retained when the power supply is turned OFF	
496 **M501**	**Remote output data 1**	0	0 to 4095	Set values for the bits corresponding to each output terminal of the inverter output terminal. (Refer to the diagram below.)	
497 **M502**	**Remote output data 2**	0	0 to 4095	Set values for the bits corresponding to each output terminal of options FR-A8AY and FR-A8AR. (Refer to the diagram below.)	

◆ Remote output setting (REM signal, Pr.496, Pr.497)

- The output terminal can be turned ON/OFF with the **Pr.496 and Pr.497** settings. ON/OFF control can be performed for the remote output terminal via the PU connector, RS-485 terminals and communication option.
- To assign the Remote output (REM) signal to the terminal to be used for remote output, set "96 (positive logic) or 196 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- Refer to the left figure, and set "1" in the terminal bit (terminal with the REM signal assigned) of **Pr.496 or Pr.497** to turn ON the output terminal (OFF when using negative logic). Set "0" to turn OFF the output terminal (ON when using negative logic).
- For example, when **Pr.190 RUN terminal function selection** = "96" (positive logic) and "1" (H01) is set in **Pr.496**, the terminal RUN turns ON.

Pr.496

b11											b0
*1	*1	*1	*1	*1	ABC2	ABC1	FU	OL	IPF	SU	RUN

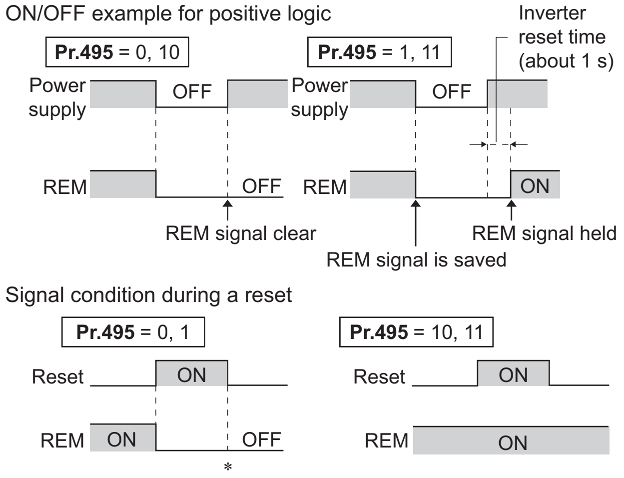
Pr.497

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

*1 Any value.
*2 Y0 to Y6 are available when the extension output option (FR-A8AY) is installed.
*3 RA1 to RA3 are available hen the relay output option (FR-A8AR) is installed.

◆ Remote output data retention (REM signal, Pr.495)

- If the power supply is reset (including a power failure) while **Pr.495** = "0 (initial value) or 10", the REM signal output is cleared. (The terminal ON/OFF status is determined by the settings in **Pr.190 to Pr.196**.) "0" is also set in **Pr.496 and Pr.497**.
- When **Pr.495** = "1 or 11", the remote output data is saved in EEPROM before the power supply is turned OFF. This means that the signal output after power restoration is the same as before the power supply was turned OFF. However, when **Pr.495** = "1", the data is not saved during an inverter reset (terminal reset, reset request via communication).
- When **Pr.495** = "10 or 11", the signal before the reset is saved even during an inverter reset.



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

NOTE

- The output terminals that have not been assigned with a REM signal by **Pr.190 to Pr.196** do not turn ON/OFF even if "0 or 1" is set in the terminal bits of **Pr.496 and Pr.497**. (ON/OFF is performed with the assigned functions.)
- When **Pr.495** = "1 or 11" (remote output data retention at power OFF), take measures such as connecting R1/L11 with P/+, and S1/L21 with N/- so that the control power is retained. If the control power is not retained, the output signal after turning ON the power is not guaranteed to work. When connecting the converter unit (FR-CC2-C), assign the instantaneous power failure detection (X11) signal to an input terminal to input the IPF signal from the FR-CC2-C to the terminal for X11 signal.

Parameters referred to

Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

5.8.11 Analog remote output function

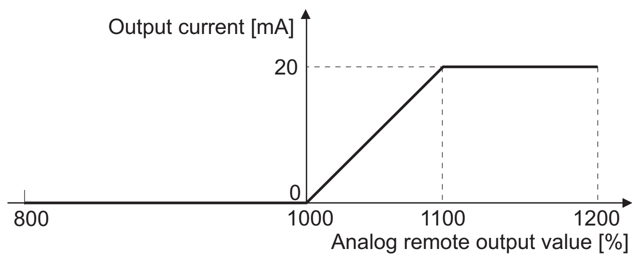
An analog value can be output from the analog output terminal.

Pr.	Name	Initial value	Setting range	Description	
655 **M530**	**Analog remote output selection**	0	0	Remote output data is cleared when the power supply is turned OFF	Remote output data is cleared during an inverter reset
			1	Remote output data is retained when the power supply is turned OFF	
			10	Remote output data is cleared when the power supply is turned OFF	Remote output data is retained during an inverter reset
			11	Remote output data is retained when the power supply is turned OFF	
656 **M531**	**Analog remote output 1**	1000%	800 to 1200%	Value output from the terminal set as "87" in terminal function selection **(Pr.54, Pr.158)**	Set the analog value for outputting from the analog output terminals CA and AM and option FR-A8AY.
657 **M532**	**Analog remote output 2**	1000%	800 to 1200%	Value output from the terminal set as "88" in terminal function selection **(Pr.54, Pr.158)**	
658 **M533**	**Analog remote output 3**	1000%	800 to 1200%	Value output from the terminal set as "89" in terminal function selection **(Pr.54, Pr.158)**	
659 **M534**	**Analog remote output 4**	1000%	800 to 1200%	Value output from the terminal set as "90" in terminal function selection **(Pr.54, Pr.158)**	

◆ Analog remote output (Pr.656 to Pr.659)

- The terminals CA/AM and the analog output terminal of the option FR-A8AY can output the values set in **Pr.656** to **Pr.659 (Analog remote output)**.
- When **Pr.54 CA terminal function selection** = "87, 88, 89, or 90" (remote output), analog current can be output from the terminal CA.
- Terminal CA output [mA] = 20 [mA] × (analog remote output value - 1000)/100

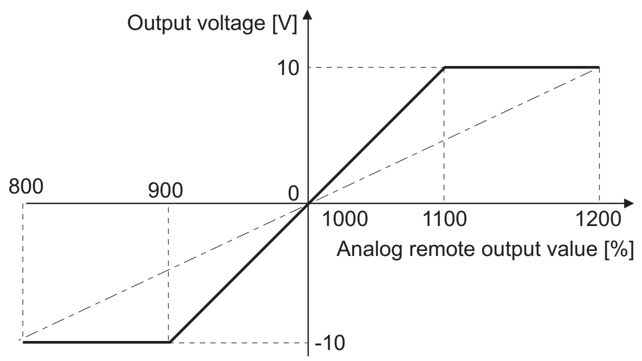
Where the output range is 0 to 20 mA.



Terminal CA

- When **Pr.158 AM terminal function selection** = "87, 88, 89, or 90", an analog voltage can be output from the terminal AM.
- Terminal AM output [V] = 10 [V] × (analog remote output value - 1000)/100

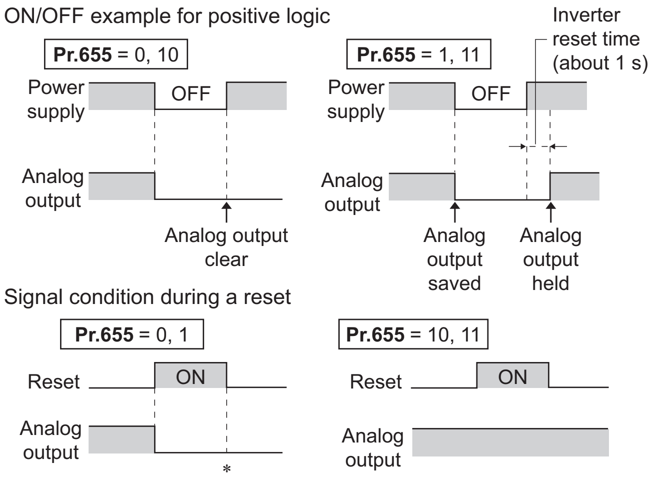
The output range is -10 V to +10 V regardless of the **Pr.290 Monitor negative output selection** setting.



Terminal AM

◆ Analog remote output data retention (Pr.655)

- When the power supply is reset (including a power failure) while **Pr.655 Analog remote output selection** = "0" (initial value) or 10" and , the remote analog output (**Pr.656 to Pr.659**) returns to its initial value (1000%).
- When **Pr.655** = "1 or 11", the analog remote output data is saved in EEPROM before the power supply is turned OFF. This means that the analog value output after power restoration is the same as before the power supply was turned OFF. However, when **Pr.655** = "1", the data is not saved during an inverter reset (terminal reset, reset request via communication).
- When **Pr.655** = "10 or 11", the analog output before the reset is saved even during an inverter reset.
- When the setting in **Pr.655** is changed, the remote analog output (**Pr.656 to Pr.659**) returns to its initial value (1000%).



* When **Pr.655** = "1", the signal condition saved in EEPROM (condition of the last power OFF) is applied.

NOTE

- When **Pr.655** = "1 or 11" (remote analog output data retention at power OFF), take measures such as connecting R1/L11 with P/+, and S1/L21 with N/- so that the control power is retained (While power is supplied to R/L1, S/L2 and T/L3). If the control power is not retained, the analog output after turning ON the power is not guaranteed to work. When connecting the converter unit (FR-CC2-C), assign the instantaneous power failure detection (X11) signal to an input terminal to input the IPF signal from the FR-CC2-C to the terminal for X11 signal.

Parameters referred to

Pr.54 CA terminal function selection ☞ page 284
Pr.158 AM terminal function selection ☞ page 284
Pr.290 Monitor negative output selection ☞ page 284
Pr.291 Pulse train I/O selection ☞ page 284

5.8.12 Fault code output selection

When a fault occurs, the corresponding data can be output as a 4-bit digital signal using via an open collector output terminal. The fault code can be read using an input module of programmable controller, etc.

Pr.	Name	Initial value	Setting range	Description
76 **M510**	**Fault code output selection**	0	0	Without fault code output
			1	With fault code output **(Refer to the table below.)**
			2	Fault code is output only when a fault occurs. **(Refer to the table below.)**

- Fault codes can be output to the output terminals by setting **Pr.76 Fault code output selection** = "1 or 2".
- When the setting is "2", a fault code is only output when a fault occurs. In normal operation the terminal outputs the signal assigned in **Pr.191 to Pr.194 (Output terminal function selection)**.
- The fault codes that can be output are shown in the table below. (0: Output transistor OFF, 1: Output transistor ON)

Fault indication	Output terminal operation				Fault 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 to E.OV3	0	1	0	0	4
E.THM	0	1	0	1	5
E.THT	0	1	1	0	6
E.IPF	0	1	1	1	7
E.UVT	1	0	0	0	8
E.FIN	1	0	0	1	9
E.BE	1	0	1	0	A
E. GF	1	0	1	1	B
E.OHT	1	1	0	0	C
E.OLT	1	1	0	1	D
E.OPT E.OP1	1	1	1	0	E
Other than the above	1	1	1	1	F

*1 When **Pr.76** = "2", the terminal outputs the signal assigned by **Pr.191 to Pr.194**.

NOTE

- If an error occurs while **Pr.76** ≠ "0", the output terminals SU, IPF, OL, and FU output the signals in the table above regardless of the settings in **Pr.191 to Pr.194 (Output terminal function selection)**. Take caution when controlling the inverter with the output signals set by **Pr.191 to Pr.194**.

Parameters referred to

Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

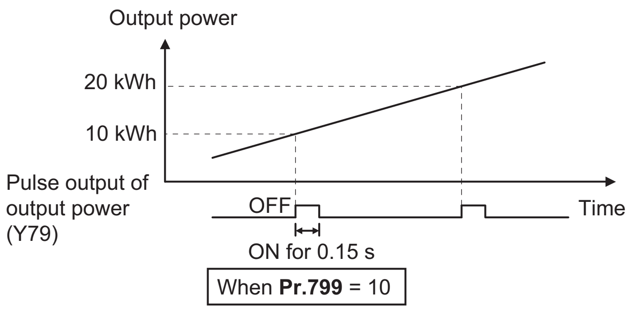
5.8.13 Pulse train output of output power

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.	Name	Initial value	Setting range	Description
799 **M520**	**Pulse increment setting for output power**	1 kWh	0.1 kWh, 1 kWh, 10 kWh, 100 kWh, 1000 kWh	Pulse train output of output power (Y79) is output in pulses at every output power (kWh) that is specified.

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

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



NOTE

- Because the accumulated data in the inverter is cleared when control power is lost by power failure or at an inverter reset, the value on the monitor cannot be used to charge electricity bill.
- Changing the terminal assignment using **Pr. 190 to Pr. 196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal. (Refer to page 297)
- In an application where the pulse outputs are frequently turned ON/OFF, do not assign the signal to the terminal ABC1 or ABC2. Otherwise, the life of the relay contact decreases.

Parameters referred to

Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

5.8.14 Detection of control circuit temperature

The temperature of the control circuit board can be monitored, and a signal can be output according to a predetermined temperature setting.

Pr.	Name	Initial value	Setting range	Description
663 **M060**	**Control circuit temperature signal output level**	0°C	0 to 100°C	Set the temperature where the Y207 signal turns ON.

◆ Control circuit temperature monitor

- The operation panel, terminal CA, or terminal AM can be used to monitor the temperature of the control circuit board within the range of 0 to 100°C. (Refer to page 274 for information on how to select the monitor item.)
- When monitoring with the operation panel or terminal AM, the range becomes -20 to 100°C by setting the display/output with a minus sign in **Pr.290 Monitor negative output selection**.
- The monitor value is a rough approximation of the change in the surrounding air temperature of the inverter. Use this parameter to grasp the operating environment of the inverter.

◆ Control circuit temperature detection (Pr.663, Y207 signal)

- The Y207 signal can be output when the control circuit temperature reaches the **Pr.663** setting or higher.
- For the Y207 signal, set "207 (positive logic) or 307 (negative logic)" in one of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function to the output terminal.

NOTE

- The Y207 signal is turned OFF when the control circuit temperature becomes 5°C or more lower than the **Pr.663** setting.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.54 CA terminal function selection ☞ page 284
Pr.158 AM terminal function selection ☞ page 284
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297
Pr.290 Monitor negative output selection ☞ page 284

5.9 (T) Multi-Function Input Terminal Parameters

Purpose	Parameter to set			Refer to page
To inverse the rotation direction with the voltage/current analog input selection (terminals 1, 2, and 4)	Analog input selection	P.T000, P.T001	Pr.73, Pr.267	318
To assign functions to analog input terminals	Terminal 1 and terminal 4 function assignment	P.T010, P.T040	Pr.858, Pr.868	322
To adjust the main speed by the analog auxiliary input	Analog auxiliary input and compensation (addition compensation and override functions)	P.T000, P.T021, P.T041, P.T050, P.T051	Pr.73, Pr.242, Pr.243, Pr.252, Pr.253	323
To eliminate noise on analog inputs	Analog input filter	P.T002, P.T003, P.T005, P.T007	Pr.74, Pr.822, Pr.832, Pr.849	326
To adjust analog input frequency/ voltage (current) (calibration)	Frequency setting voltage (current) bias and gain	P.T100 to P.T103, P.T200 to P.T203, P.T400 to P.T403, P.M043	Pr.125, Pr.126, Pr.241, Pr.902 to Pr.905, Pr.917 to Pr.918	328
To adjust voltage (current) of stall prevention operation level (calibration)	Stall prevention operation level setting voltage (current) bias and gain	P.T110 to P.T113, P.T410 to P.T413, P.M043	Pr.241, Pr.919 to Pr.920, Pr.932 to Pr.933	333
To continue operating at analog current input loss	4-mA input check	P.T052 to P.T054	Pr.573, Pr.777, Pr.778	338
To assign functions to input terminals	Input terminal function selection	P.T700 to P.T711, P.T740	Pr.178 to Pr.189, Pr.699	343
To change the input specification (NO/ NC contact) of input signals	Output stop signal (MRS) input selection	P.T720	Pr.17	346
	Inverter run enable signal (X10) input selection	P.T721	Pr.599	554
	Power failure stop external signal (X48) input selection	P.T722	Pr.606	461
To enable the second function only during the constant speed	RT signal application period selection	P.T730	Pr.155	348
To assign start and forward/reverse commands to different signals	Start signal (STF/STR) operation selection	P.G106	Pr.250	550

5

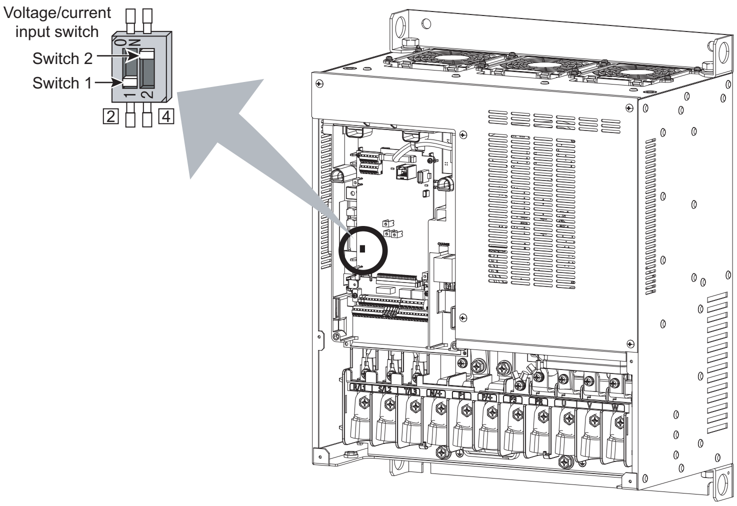
5.9.1 Analog input selection

The functions to switch the analog input terminal specifications, override function, forward/reverse rotation by the input signal polarity are selectable.

Pr.	Name	Initial value	Setting range		Description
73 **T000**	**Analog input selection**	1	0 to 5, 10 to 15	Switch 1 - OFF (initial status)	The terminal 2 input specification (0 to 5 V, 0 to 10 V, 0 to 20 mA) and terminal 1 input specification (0 to ±5 V, 0 to ±10 V) are selectable. Also the override and reversible operation settings are selectable.
			6, 7, 16, 17	Switch 1 - ON	
267 **T001**	**Terminal 4 input selection**	0	0	Switch 2 - ON (initial status)	Terminal 4 input, 4 to 20 mA
			1	Switch 2 - OFF	Terminal 4 input, 0 to 5 V
			2		Terminal 4 input, 0 to 10 V

◆ Analog input specification selection

- Concerning the terminals 2 and 4 used for analog input, the voltage input (0 to 5 V, 0 to 10 V) and current input (0 to 20 mA) are selectable. To change the input specification, change the parameters **(Pr.73, Pr.267)** and voltage/current input switch settings (switches 1, 2).



Switch state		Input specification	Input terminal	Rated specification
Switch 1	ON	Current input	Terminal 2	For voltage input, the input resistance is 10±1 kΩ and the maximum permissible voltage is 20 VDC. For current input, the input resistance is 245±5 Ω and the maximum permissible current is 30 mA.
	OFF	Voltage input (initial status)		
Switch 2	ON	Current input (initial status)	Terminal 4	
	OFF	Voltage input		

- Change the setting of the voltage/current input selection switch to change the rated specification of terminal 2 or 4.
- Correctly set **Pr.73, Pr.267** and voltage/current input switch settings so that the analog signal appropriate for the settings is input. The incorrect settings shown in the table below cause a failure. Other incorrect settings result in an incorrect operation.

Setting causing a failure		Operation
Switch setting	**Terminal input**	
ON (current input)	Voltage input	Causes an analog signal output circuit failure in an external device (due to increased loads on the signal output circuit of the external device).
OFF (voltage input)	Current input	Causes an input circuit failure in the inverter (due to an increased output power in the analog signal output circuit of an external device).

NOTE

- Check the voltage/current input switch number indication before setting, because it is different from the FR-F700 series switch number indication.

- Set the **Pr.73** and voltage/current input switch settings according to the table below.

Pr.73 setting	Terminal 2 input	Switch 1	Terminal 1 input	Compensation input terminal compensation method	Polarity reversible
0	0 to 10 V*1	OFF	0 to ±10 V	Terminal 1 Addition compensation	Not applied (state in which a negative polarity frequency command signal is not accepted)
1 (initial value)	0 to 5 V*1	OFF	0 to ±10 V		
2	0 to 10 V*1	OFF	0 to ±5 V		
3	0 to 5 V*1	OFF	0 to ±5 V		
4	0 to 10 V	OFF	0 to ±10 V*1	Terminal 2 Override	
5	0 to 5 V	OFF	0 to ±5 V*1		
6	0 to 20 mA*1	ON	0 to ±10 V	Terminal 1 Addition compensation	
7	0 to 20 mA*1	ON	0 to ±5 V		
10	0 to 10 V*1	OFF	0 to ±10 V		Applied
11	0 to 5 V*1	OFF	0 to ±10 V		
12	0 to 10 V*1	OFF	0 to ±5 V		
13	0 to 5 V*1	OFF	0 to ±5 V		
14	0 to 10 V	OFF	0 to ±10 V*1	Terminal 2 Override	
15	0 to 5 V	OFF	0 to ±5 V*1		
16	0 to 20 mA*1	ON	0 to ±10 V	Terminal 1 Addition compensation	
17	0 to 20 mA*1	ON	0 to ±5 V		

*1 The main speed setting is indicated.

- Turning the Terminal 4 input selection (AU) signal ON sets terminal 4 to the main speed. With this setting, the main speed setting terminal is invalidated.
- Set the **Pr.267** and voltage/current input switch setting according to the table below.

Pr.267 setting	Terminal 4 input	Switch 2
0 (initial value)	4 to 20 mA	ON
1	0 to 5 V	OFF
2	0 to 10 V	OFF

NOTE

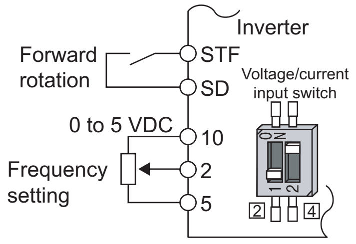
- To enable the terminal 4, turn the AU signal ON.
- Set the parameters and the switch settings so that they agree. Incorrect setting may cause a fault, failure or malfunction.
- Terminal 1 (frequency setting auxiliary input) is added to the terminal 2 or 4 main speed setting signal.
- When the override setting is selected, terminal 1 or 4 is set to the main speed setting, and terminal 2 is set to the override signal (0 to 5 V or 0 to 10 V, and 50% to 150%). (If the main speed of terminal 1 or 4 is not input, the compensation by terminal 2 is disabled.)
- Use **Pr.125 (Pr.126) (frequency setting gain)** to change the maximum output frequency at the input of the maximum output frequency command voltage (current). At this time, the command voltage (current) need not be input. The acceleration/deceleration time inclines up/down to the acceleration/deceleration reference frequency, so it is not affected by change of **Pr.73**.
- When **Pr.858 Terminal 4 function assignment and Pr.868 Terminal 1 function assignment** = "4", the terminal 1 and terminal 4 values are set to the stall prevention operation level.
- After the voltage/current input signal is switched with **Pr.73, Pr.267**, and voltage/current input switches, be sure to let calibration performed.
- When **Pr.561 PTC thermistor protection level** ≠ "9999", terminal 2 does not function as an analog frequency command.

◆ To run with an analog input voltage

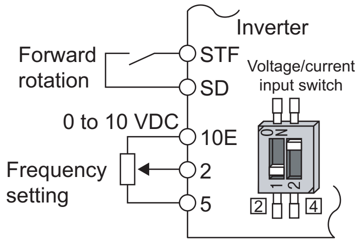
- Concerning the frequency setting signal, input 0 to 5 VDC (or 0 to 10 VDC) to terminals 2 and 5. The 5 V (10 V) input is the maximum output frequency.
- The power supply 5 V (10 V) can be input by either using the internal power supply or preparing an external power supply. The internal power source is 5 VDC output between terminals 10 and 5, and 10 VDC output between terminals 10E and 5.

Terminal	Inverter internal power source voltage	Frequency setting resolution	Pr.73 (terminal 2 input voltage)
10	5 VDC	0.030 Hz/60 Hz	0 to 5 VDC input
10E	10 VDC	0.015 Hz/60 Hz	0 to 10 VDC input

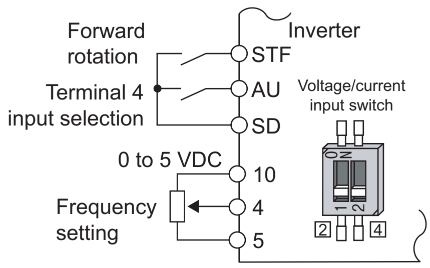
- To supply the 10 VDC input to terminal 2, set "0, 2, 4, 10, 12, or 14" in **Pr.73**. (The initial value is 0 to 5 V.)
- Setting "1 (0 to 5 VDC)" or "2 (0 to 10 VDC)" in **Pr.267** and turning the voltage/current input switches OFF sets the terminal 4 to the voltage input specification. Turning ON the AU signal activates terminal 4 input.



Connection diagram using terminal 2 (0 to 5 VDC)



Connection diagram using terminal 2 (0 to 10 VDC)



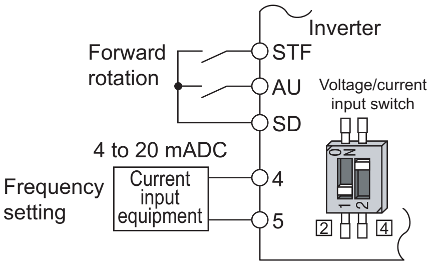
Connection diagram using terminal 4 (0 to 5 VDC)

NOTE

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

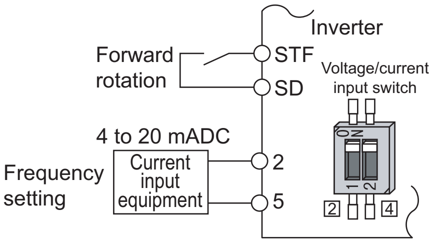
◆ Running with analog input current

- For constant pressure or temperature control with fans, pumps, or other devices, automatic operation is available by setting the regulator output signal 4 to 20 mADC to between terminals 4 and 5.
- To use the terminal 4, the AU signal needs to be turned ON.



Connection diagram using terminal 4 (4 to 20 mADC)

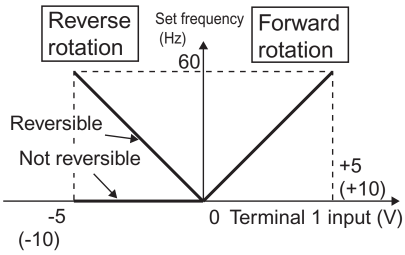
- Setting "6, 7, 16, or 17" in **Pr.73** and turning the voltage/current input switches ON sets terminal 2 to the current input specification. Concerning the settings, the AU signal does not need to be turned ON.



Connection diagram using terminal 2 (4 to 20 mADC)

◆ To perform forward/reverse rotation with the analog input (polarity reversible operation)

- Setting **Pr.73** to a value of "10 to 17" enables the polarity reversible operation.
- Setting ±input (0 to ±5 V or 0 to ±10 V) to the terminal 1 allows the operation of forward/reverse rotation by the polarity.



Compensation input characteristics when STF is ON

Parameters referred to

Pr.22 Stall prevention operation level ☞ page 257
Pr.125 Terminal 2 frequency setting gain frequency, Pr.126 Terminal 4 frequency setting gain frequency ☞ page 328
Pr.252, Pr.253 override bias/gain ☞ page 323
Pr.561 PTC thermistor protection level ☞ page 230
Pr.858 Terminal 4 function assignment, Pr.868 Terminal 1 function assignment ☞ page 322

5.9.2 Analog input terminal (terminal 1, 4) function assignment

The analog input terminal 1 and terminal 4 functions are set and changeable with parameters.

Pr.	Name	Initial value	Setting range	Description
868 **T010**	**Terminal 1 function assignment**	0	0, 4, 9999	Select the terminal 1 function (Refer to the table below.)
858 **T040**	**Terminal 4 function assignment**	0	0, 4, 9999	Select the terminal 4 function (Refer to the table below.)

- Concerning terminal 1 and terminal 4 used for analog input, the frequency (speed) command, stall prevention operation level input, and other similar commands are usable. The functions available are different depending on **Pr.868 Terminal 1 function assignment, Pr.858 Terminal 4 function assignment** as shown in the table below.

Setting value	Terminal 1 function (Pr.868)	Terminal 4 function (Pr.858)
0 (initial value)	Frequency setting auxiliary	Frequency command (AU signal-ON)
4	Stall prevention operation level input	Stall prevention operation level input *1
9999	—	—

—: No function

*1 Invalid when **Pr.868** = "4"

NOTE

- When **Pr.868** = "4" (stall prevention), the terminal 4 function is enabled whether the AU terminal is turned ON/OFF.

5.9.3 Analog input compensation

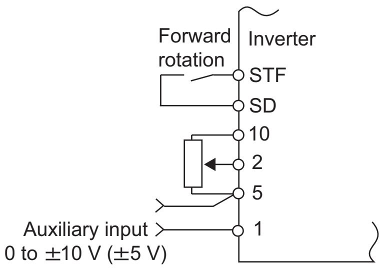
Addition compensation or fixed ratio analog compensation (override) with terminal 2 set to auxiliary input is applicable to the multi-speed operation or terminal 2/terminal 4 speed setting signal (main speed).

Pr.	Name	Initial value	Setting range	Description
73 T000	**Analog input selection**	1	0 to 3, 6, 7, 10 to 13, 16, 17	Addition compensation
			4, 5, 14, 15	Override compensation
242 T021	**Terminal 1 added compensation amount (terminal 2)**	100%	0 to 100%	Set the percentage of addition compensation when terminal 2 is set to the main speed.
243 T041	**Terminal 1 added compensation amount (terminal 4)**	75%	0 to 100%	Set the percentage of addition compensation when terminal 4 is set to the main speed.
252 T050	**Override bias**	50%	0 to 200%	Set the percentage of override function bias side compensation.
253 T051	**Override gain**	150%	0 to 200%	Set the percentage of override function gain side compensation.

5

◆ Addition compensation (Pr.242, Pr.243)

- Example of addition compensation connection

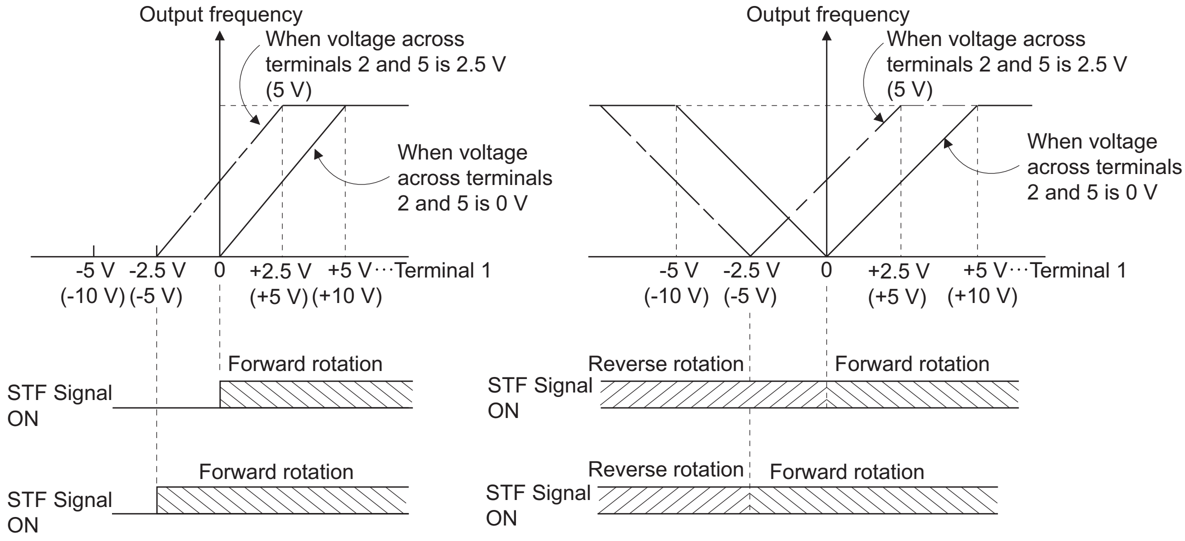


- A compensation signal is addable to the main speed setting for such as synchronous or continuous speed control operation.
- Setting a value of "0 to 3, 6, 7, 10 to 13, 16, and 17" to **Pr.73** adds the voltage between terminals 1 and 5 to the voltage signal of the terminals 2 and 5.
- When **Pr.73**= "0 to 3, 6, or 7", and if the result of addition is negative, it is regarded as 0 and the operation is stopped. When **Pr.73** = "10 to 13, 16, or 17", the operation is reversed (polarity reversible operation) with STF signal ON.
- The terminal 1 compensation input is addable to the multi-speed setting or terminal 4 (initial value: 4 to 20 mA).
- The degree of addition compensation to terminal 2 is adjustable with **Pr.242**. The degree of addition compensation to terminal 4 is adjustable with **Pr.243**.

$$\text{Analog command value with use of terminal 2} = \text{terminal 2 input} + \text{terminal 1 input} \times \frac{\textbf{Pr.242}}{100(\%)}$$

$$\text{Analog command value with use of terminal 4} = \text{terminal 4 input} + \text{terminal 1 input} \times \frac{\textbf{Pr.243}}{100(\%)}$$

- Auxiliary input characteristics



(a) When **Pr.73** setting is 0 to 3

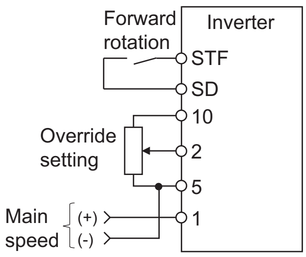
(b) When **Pr.73** setting is 10 to 13

NOTE

- After changing the **Pr.73** setting, check the voltage/current input switch setting. Incorrect setting may cause a fault, failure or malfunction. (For the settings, refer to page 318.)

◆ Override function (Pr.252, Pr.253)

- Connection example for the override function

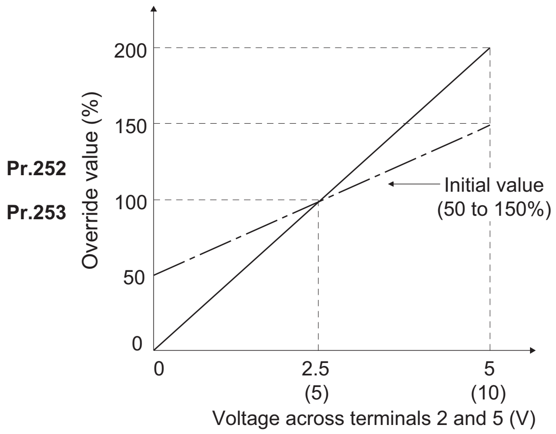


- Use the override function to make the main speed changed at a specified rate.
- Set **Pr.73** = "4, 5, 14, or 15" to select the override function.
- When the override function is selected, terminal 1 or 4 is used for the main speed setting, and terminal 2 is used for the override signal. (If the main speed is not input to the terminal 1 or 4, the compensation by terminal 2 is disabled.)
- Specify the scope of override by using **Pr.252 and Pr.253**.
- How to calculate the set frequency for override:

  Main speed setting frequency (Hz): Terminals 1 or 4 input, multi-speed setting

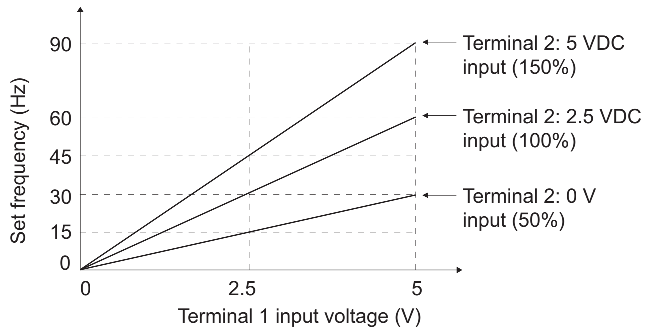
  Compensation (%): Terminal 2 input

$$\text{Set frequency (Hz)} = \text{main speed setting frequency (Hz)} \times \frac{\text{Compensation (\%)}}{100(\%)}$$



• Example) When **Pr.73** = "5"

By the terminal 1 (main speed) and terminal 2 (auxiliary) input, the setting frequency is set as shown in the figure below.



NOTE

- To use terminal 4, the AU signal needs to be turned ON.
- To make compensation input for the multi-speed operation or remote setting, set **Pr.28 Multi-speed input compensation selection** = "1" (with compensation) (initial value "0").
- After changing the **Pr.73** setting, check the voltage/current input switch setting. Incorrect setting may cause a fault, failure or malfunction. (For the settings, refer to page 318.)

Parameters referred to

Pr.28 Multi-speed input compensation selection ☞ page 226

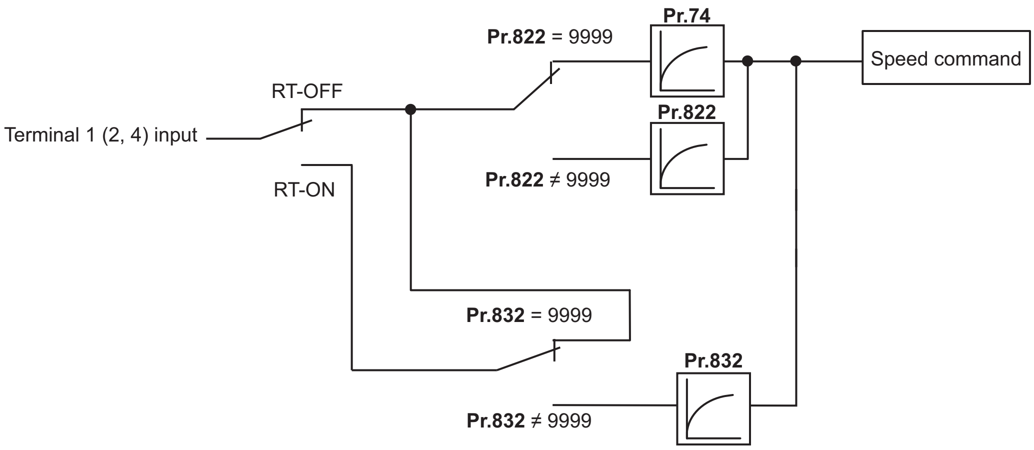
Pr.73 Analog input selection ☞ page 318

5.9.4 Analog input responsiveness and noise elimination

The frequency command responsiveness and stability are adjustable by using the analog input (terminals 1, 2, and 4) signal.

Pr.	Name	Initial value	Setting range	Description
74 **T002**	**Input filter time constant**	1	0 to 8	The primary delay filter time constant to the analog input is selectable. The higher the value, the lower the responsiveness.
822 **T003**	**Speed setting filter 1**	9999	0 to 5 s	Set the primary delay filter time constant to the external speed command (analog input command).
			9999	Use the **Pr.74** setting.
832 **T005**	**Speed setting filter 2**	9999	0 to 5 s, 9999	Second function of **Pr.822** (enabled when the RT signal is ON)
849 **T007**	**Analog input offset adjustment**	100%	0 to 200%	Make the analog speed input (terminal 2) have an offset. This prevents the motor from rotating by noise to the analog input or another cause on the speed 0 command.

◆ Block diagram



◆ Analog input time constant (Pr.74)

- It is effective to eliminate noise on the frequency setting circuit.
- Increase the filter time constant if steady operation cannot be performed due to noise, etc. A larger setting results in slower response. (The time constant can be between 0 and 8, which are about 2 ms to 1 s.)

◆ Analog speed command input time constant (Pr.822, Pr.832)

- Set the primary delay filter time constant to the external speed command (analog input command) by using **Pr.822 Speed setting filter 1**.
- To change the time constant, for example, in a case where only one inverter is used to switch between more than one motor, use **Pr.832 Speed setting filter 2**.
- **Pr.832 Speed setting filter 2** is enabled when the RT signal is ON.

◆ Analog speed command input offset adjustment (Pr.849)

- This is used to set a range in which the motor is stopped for prevention of incorrect motor operation in a very low speed rotation by the analog input speed command.
- Regarding the **Pr.849 Analog input offset adjustment** value 100% is 0, the offset voltage is set as described below:

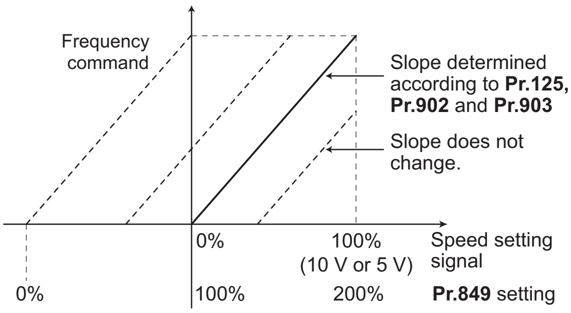
100% < **Pr.849** ...... Positive side

100% > **Pr.849** ...... Negative side

The detailed calculation of the offset voltage is as described below:

Offset voltage [V] = Voltage at the time of 100% (5 V or 10 V*1) × (**Pr.849** - 100)/100

*1 It depends on the **Pr.73** setting.



NOTE

- Under PID control, the analog input filter is invalid (no filter).

Parameters referred to

Pr.73 Analog input selection ☞ page 318

Pr.125, Pr.902, Pr.903 (bias and gain of the terminal 2 frequency setting) ☞ page 328

5

5.9.5 Frequency setting voltage (current) bias and gain

The degree (incline) of the output frequency to the frequency setting signal (0 to 5 VDC, 0 to 10 V or 4 to 20 mA) is selectable to a desired amount.

Use **Pr.73 Analog input selection, Pr.267 Terminal 4 input selection**, or the voltage/current input switch to switch among input 0 to 5 VDC, 0 to 10 V, and 4 to 20 mA. (Refer to page 318)

Pr.		Name	Initial value	Setting range	Description
902 T200		**Terminal 2 frequency setting bias frequency**	0 Hz	0 to 590 Hz	Set the terminal 2 input bias side frequency.
902 T201		**Terminal 2 frequency setting bias**	0%	0 to 300%	Set the converted % on the bias side voltage (current) of the terminal 2 input.
125 T022	**903 T202**	**Terminal 2 frequency setting gain frequency**	60 Hz	0 to 590 Hz	Set the terminal 2 input gain (maximum) frequency.
903 T203		**Terminal 2 frequency setting gain**	100%	0 to 300%	Set the converted % on the gain side voltage (current) of the terminal 2 input.
904 T400		**Terminal 4 frequency setting bias frequency**	0 Hz	0 to 590 Hz	Set the terminal 4 input bias side frequency.
904 T401		**Terminal 4 frequency setting bias**	20%	0 to 300%	Set the converted % on the bias side current (voltage) of terminal 4 input.
126 T042	**905 T402**	**Terminal 4 frequency setting gain frequency**	60 Hz	0 to 590 Hz	Set the terminal 4 input gain (maximum) frequency.
905 T403		**Terminal 4 frequency setting gain**	100%	0 to 300%	Set the converted % on gain side current (voltage) of terminal 4 input.
917 T100		**Terminal 1 bias frequency (speed)**	0 Hz	0 to 590 Hz	Set the terminal 1 input bias side frequency (speed). (speed limit)
917 T101		**Terminal 1 bias (speed)**	0%	0 to 300%	Set the converted % on bias side voltage of terminal 1 input. (speed limit)
918 T102		**Terminal 1 gain frequency (speed)**	60 Hz	0 to 590 Hz	Set the terminal 1 input gain (maximum) frequency (speed). (speed limit)
918 T103		**Terminal 1 gain (speed)**	100%	0 to 300%	Set the converted % on the gain side voltage of terminal 1 input. (speed limit)
241 M043		**Analog input display unit switchover**	0	0: % display 1: V/mA display	Select the unit for analog input display

◆ Relationship between the analog Input terminal function and the calibration parameter

- Calibration parameter according to the terminal 1 function

Pr.868 Setting	Terminal function	Calibration parameter	
		Bias setting	Gain setting
0 (initial value)	Frequency (speed) setting auxiliary	**Pr.902 Terminal 2 frequency setting bias frequency** **Pr.902 Terminal 2 frequency setting bias** **Pr.904 Terminal 4 frequency setting bias frequency** **Pr.904 Terminal 4 frequency setting bias**	**Pr.125 (Pr.903) Terminal 2 frequency setting gain frequency** **Pr.903 Terminal 2 frequency setting gain** **Pr.126 (Pr.905) Terminal 4 frequency setting gain frequency** **Pr.905 Terminal 4 frequency setting gain**
4	Stall prevention operation level*1 /torque limit	**Pr.919 Terminal 1 bias command (torque)** **Pr.919 Terminal 1 bias (torque)**	**Pr.920 Terminal 1 gain command (torque)** **Pr.920 Terminal 1 gain (torque)**
9999	No function	—	—

- Calibration parameter according to the terminal 4 function

Pr.858 setting	Terminal function	Calibration parameter	
		Bias setting	Gain setting
0 (initial value)	Frequency command	**Pr.904 Terminal 4 frequency setting bias frequency** **Pr.904 Terminal 4 frequency setting bias**	**Pr.126 (Pr.905) Terminal 4 frequency setting gain frequency** **Pr.905 Terminal 4 frequency setting gain**
4	Stall prevention operation level *1 /torque limit	**Pr.932 Terminal 4 bias command (torque)** **Pr.932 Terminal 4 bias (torque)**	**Pr.933 Terminal 4 gain command (torque)** **Pr.933 Terminal 4 gain (torque)**
9999	No function	—	—

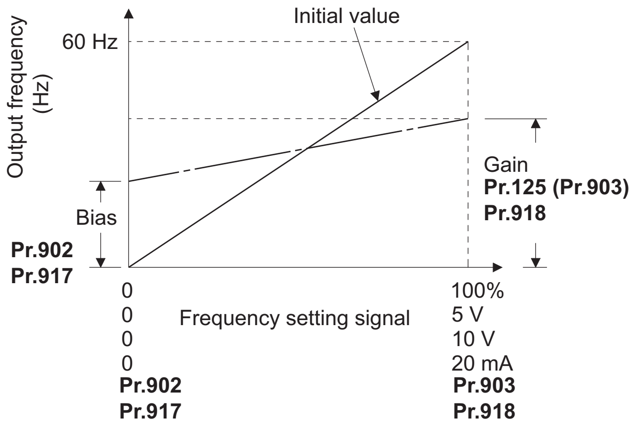
*1 Use **Pr.148 Stall prevention level at 0 V input and Pr.149 Stall prevention level at 10 V input** to adjust the bias and gain for stall prevention operation level under V/F control and Advanced magnetic flux vector control.

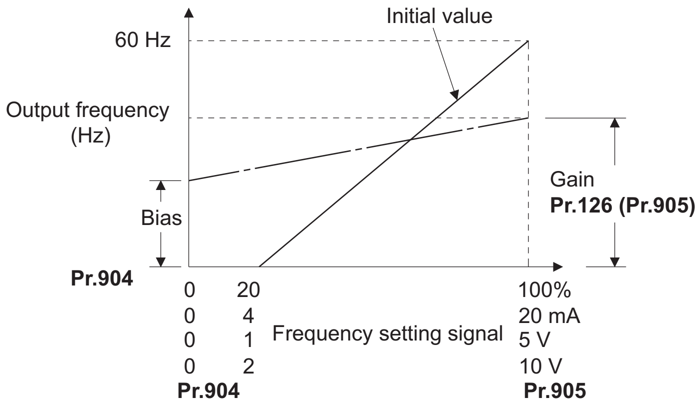
◆ To change the frequency for the maximum analog input (Pr.125, Pr.126)

- To change only the frequency setting (gain) for the maximum analog input voltage (current), set **Pr.125 (Pr.126)**. (**Pr.902 to Pr.905** settings do not need to be changed.)

◆ Analog input bias/gain calibration (Pr.902 to Pr.905, Pr.917 to Pr.918)

- The "bias" and "gain" functions serve to adjust the relationship between a setting input signal and the output frequency. A setting input signal is such as 0 to 5 VDC/0 to 10 V or 4 to 20 mADC externally input to set the output frequency.
- Set the terminal 2 input bias frequency by using **Pr.902**. (It is initially set to the frequency at 0 V.)
- Set the output frequency to the frequency command voltage (current) set by the **Pr.73 Analog input selection** by using **Pr.125 (Pr.903)**.
- Set the bias frequency of the terminal 1 input using **Pr.917**. (It is initially set to the frequency at 0 V.)
- Set the gain frequency of the terminal 1 input using **Pr.918**. (It is initially set to the frequency at 10 V.)
- Set the bias frequency of the terminal 4 input using **Pr.904**. (It is initially set to the frequency at 4 mA.)
- Set the output frequency for 20 mA of the frequency command current (4 to 20 mA) by using **Pr.126 (Pr.905)**.





- There are three methods to adjust the frequency setting voltage (current) bias/gain.

  Adjust any point with application of a voltage (current) between terminals 2 and 5 (4 and 5). ☞ page 331

  Adjust any point without application of a voltage (current) between terminals 2 and 5 (4 and 5). ☞ page 331

  Adjust frequency only without adjustment of voltage (current). ☞ page 332

NOTE

- Performing terminal 2 calibration that includes a change of the setting frequency incline changes terminal 1 setting.
- Calibration with voltage input to terminal 1 sets (terminal 2 (4) analog value + terminal 1 analog value) as the analog calibration value.
- Always calibrate the input after changing the voltage/current input signal with **Pr.73, Pr.267**, and the voltage/current input selection switch.

◆ Analog input display unit changing (Pr.241)

- The analog input display unit (%/V/mA) for analog input bias and gain calibration can be changed.
- Depending on the terminal input specification set to **Pr.73**, **Pr.267**, and voltage/current input switches, the analog value display unit of **Pr.902**, **Pr.903**, **Pr.904**, and **Pr.905** changes as described below.

Analog command (terminals 2, 4) (depending on Pr.73, Pr.267, and voltage/current input switch)	Pr.241 = 0 (initial value)	Pr.241 = 1
0 to 5 V input	0 to 5 V → 0 to 100% (0.1%)	0 to 100% → 0 to 5 V (0.01 V)
0 to 10 V input	0 to 10 V → 0 to 100% (0.1%)	0 to 100% → 0 to 5 V (0.01 V) display
0 to 20 mA input	0 to 20 mA → 0 to 100% (0.1%)	0 to 100% → 0 to 20 mA (0.01 mA)

NOTE

- When the terminal 1 input specification (0 to ±5 V, 0 to ±10 V) does not agree with the main speed (terminal 2, terminal 4 input) specification (0 to 5 V, 0 to 10 V, 0 to 20 mA), and if the voltages are applied to terminal 1, the analog input is not correctly displayed. (For example, in the initial status, when 0 V is applied to terminal 2 and 10 V is applied to terminal 1, and the analog value is displayed as 5 V (100%).) Use the inverter with the **Pr.241** = "0 (initial value)" setting. (0% display).

◆ Frequency setting voltage (current) bias/gain adjustment method

■ Adjust any point with application of a voltage (current) between terminals 2 and 5 (4 and 5). (Frequency setting gain adjustment example)

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Changing the operation mode
Select the PU operation mode.

3. Selecting the parameter number
Read **Pr.903** for terminal 2.
Read **Pr.905** for terminal 4.

4. Analog voltage (current) display
Press [A-SET]. The analog voltage (current) value (%) currently applied to the terminal 2 (4) is displayed.
Do not touch until calibration is completed.

5. Voltage (current) application
Apply a 5 V (20 mA) . (Turn the external potentiometer connected across terminals 2 and 5 (terminals 4 and 5) to a desired position.)

6. Setting completed
Press [SET] twice.
The analog voltage (current) value (%) adjustment is completed.

■ Adjust any point without application of a voltage (current) between terminals 2 and 5 (4 and 5). (Frequency setting gain adjustment example)

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Changing the operation mode
Select the PU operation mode.

3. Selecting the parameter number
Read **Pr.920** for terminal 1.
Read **Pr.933** for terminal 4.

4. Analog voltage (current) display
Press [A-SET]. The analog voltage (current) value (%) currently applied to the terminal 1 (4) is displayed.

5. Analog voltage (current) adjustment
Press [SET]. Select the gain voltage (current) value (%) currently set in the parameter.
Turn until the desired gain voltage (current) % is displayed.

6. Setting completed
Press [SET].
The analog voltage (current) value (%) adjustment is completed.

■ Adjust only frequency without adjustment of gain voltage (current) (When changing the gain frequency from 60 Hz to 50 Hz)

Operating procedure

1. Parameter selection
Read **Pr.125** for terminal 2.
Read **Pr.126** for terminal 4.
The present set value is displayed. (60.00 Hz)

2. Changing the maximum frequency.
Turn to change the set value to "50.00 Hz".
Press [SET] to enter the setting. "50.00 Hz" is set in **Pr.125 (Pr.126)**.

3. Checking the mode/monitor
Change the status to the monitor mode.

4. Start
Turn ON the start switch (STF or STR), then turn the potentiometer (frequency setting potentiometer) clockwise slowly to full. (Refer to steps 2 and 3 in page 92.)
Operate at 50 Hz.

NOTE

- If the frequency meter (display meter) connected across the terminals CA and 5 does not indicate exactly 60 Hz, set the **calibration parameter C0 CA terminal calibration**. (Refer to page 288.)
- If the gain and bias of voltage (current) setting voltage are too close, an error (Er3) may be displayed at setting.
- Changing **Pr.903 or Pr.905 (gain adjustment)** will not change **Pr.20**. Input to the terminal 1 (frequency setting auxiliary input) is added to the frequency setting signal.
- For operation outline of the parameter unit, refer to the Instruction Manual of the FR-PU07.
- To set the value to 120 Hz or higher, the **Pr.18 High speed maximum frequency** needs to be 120 Hz or higher. (Refer to page 253.)
- Make the bias frequency setting using the **Pr.902 and Pr.904**. (Refer to page 330.)

⚠ CAUTION

- Be cautious when setting any value other than "0" as the bias frequency at 0 V (0 mA). Even if a speed command is not given, simply turning ON the start signal will start the motor at the preset frequency.

Pr.1 Maximum frequency, Pr.18 High speed maximum frequency ☞ page 253
Pr.20 Acceleration/deceleration reference frequency ☞ page 190
Pr.73 Analog input selection, Pr.267 Terminal 4 input selection ☞ page 318
Pr.79 Operation mode selection ☞ page 204
Pr.858 Terminal 4 function assignment, Pr.868 Terminal 1 function assignment ☞ page 322

5.9.6 Bias and gain for voltage (current) setting of stall prevention operation level

The magnitude (slope) of the stall prevention operation level can be set as desired in relation to the analog signal (0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA).

Use **Pr.73 Analog input selection** or **Pr.267 Terminal 4 input selection** to switch among input 0 to 5 VDC, 0 to 10 V, and 4 to 20 mA. (Refer to page 318.)

Pr.	Name	Initial value	Setting range	Description
919 **T110**	**Terminal 1 bias command (torque)**	0%	0 to 400%	Set the stall prevention operation level of the bias side of terminal 1 input.
919 **T111**	**Terminal 1 bias (torque)**	0%	0 to 300%	Set the converted % on bias side voltage of terminal 1 input.
920 **T112**	**Terminal 1 gain command (torque)**	150%	0 to 400%	Set the stall prevention operation level of the gain (maximum) of terminal 1 input.
920 **T113**	**Terminal 1 gain (torque)**	100%	0 to 300%	Set the converted % on the gain side voltage of terminal 1 input.
932 **T410**	**Terminal 4 bias command (torque)**	0%	0 to 400%	Set the stall prevention operation level of the bias side of terminal 4 input.
932 **T411**	**Terminal 4 bias (torque)**	20%	0 to 300%	Set the converted % on bias side current (voltage) of terminal 4 input.
933 **T412**	**Terminal 4 gain command (torque)**	150%	0 to 400%	Set the stall prevention operation level of the gain (maximum) of terminal 4 input.
933 **T413**	**Terminal 4 gain (torque)**	100%	0 to 300%	Set the converted % on gain side current (voltage) of terminal 4 input.
241 **M043**	**Analog input display unit switchover**	0	0 1	% display V/mA display — Select the unit for analog input display.

◆ Changing the function of analog input terminal

- The initial value for terminal 1 used as analog input is set to speed setting auxiliary (speed limit auxiliary), and terminal 4 is set to speed command. To use the analog input terminal to input the stall prevention operation level, set **Pr.868 Terminal 1 function assignment** and **Pr.858 Terminal 4 function assignment** to change the function. (Refer to page 322.)

◆ Relationship between the analog input terminal function and the calibration parameter

- Calibration parameter according to the terminal 1 function

Pr.868 setting	Terminal function	Calibration parameter	
		Bias setting	Gain setting
0 (initial value)	Frequency (speed) setting auxiliary	**Pr.902 Terminal 2 frequency setting bias frequency** **Pr.902 Terminal 2 frequency setting bias** **Pr.904 Terminal 4 frequency setting bias frequency** **Pr.904 Terminal 4 frequency setting bias**	**Pr.125 (Pr.903) Terminal 2 frequency setting gain frequency** **Pr.903 Terminal 2 frequency setting gain** **Pr.126 (Pr.905) Terminal 4 frequency setting gain frequency** **Pr.905 Terminal 4 frequency setting gain**
4	Stall prevention operation level *1	**Pr.919 Terminal 1 bias command (torque)** **Pr.919 Terminal 1 bias (torque)**	**Pr.920 Terminal 1 gain command (torque)** **Pr.920 Terminal 1 gain (torque)**
9999	No function	—	—

*1 Use **Pr.148 Stall prevention level at 0 V input** and **Pr.149 Stall prevention level at 10 V input** to adjust the bias and gain for stall prevention operation level under V/F control and Advanced magnetic flux vector control.

- Calibration parameter according to the terminal 4 function

Pr.858 setting	Terminal function	Calibration parameter	
		Bias setting	Gain setting
0 (initial value)	Frequency (speed) command	**Pr.904 Terminal 4 frequency setting bias frequency** **Pr.904 Terminal 4 frequency setting bias**	**Pr.126 (Pr.905) Terminal 4 frequency setting gain frequency** **Pr.905 Terminal 4 frequency setting gain**
4	Stall prevention operation level *2	**Pr.932 Terminal 4 bias command (torque)** **Pr.932 Terminal 4 bias (torque)**	**Pr.933 Terminal 4 gain command (torque)** **Pr.933 Terminal 4 gain (torque)**
9999	No function	—	—

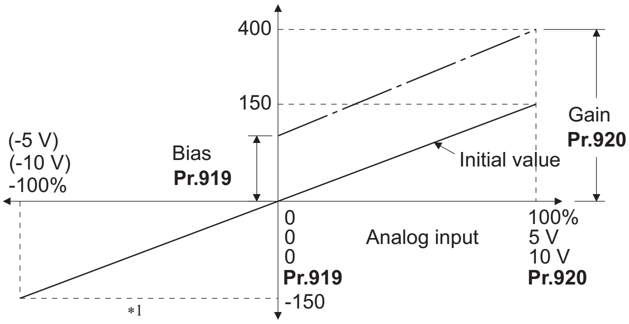
*2 Use **Pr.148 Stall prevention level at 0 V input** and **Pr.149 Stall prevention level at 10 V input** to adjust the bias and gain for stall prevention operation level under V/F control and Advanced magnetic flux vector control.

◆ Change the stall prevention operation level at maximum analog input (Pr.920, Pr.933)

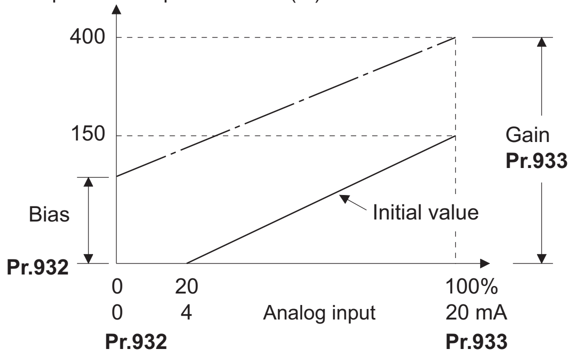
- To only change the stall prevention operation level setting (gain) of the maximum analog input voltage (current), set to **Pr.920, Pr.933**.

◆ Calibration of analog input bias and gain (Pr.919 to Pr.920, Pr.932 to Pr.933)

- "Bias"/"gain" function can adjust the relation between the stall prevention operation level and the setting input signal. Examples of setting input signals are 0 to 5 VDC, 0 to 10 VDC, or 4 to 2 mADC, and they are externally input.
- Set the bias value of the terminal 1 input using **Pr.919**. (Shipped from factory with the stall prevention operation level for 0 V)
- Set the stall prevention operation level against the input voltage set by **Pr.73 Analog input selection** with **Pr.920**. (Initial value is 10 V.)
- Set the bias value of the terminal 4 input using **Pr.932**. (The initial value is the stall prevention operation level for 4 mA.)
- Set the stall prevention operation level against the 20 mA for input current (4 to 20 mA) with **Pr.933**.



Calibration example of terminal 1



Calibration example of terminal 4

*1 If a negative command is given, the stall prevention operation level is regarded as "0".

- There are three methods to adjust the torque setting voltage (current) bias and gain.
  Method to adjust arbitrary point with application of a voltage (current) between terminals 1 and 5 (4 and 5). ☞ page 336
  Method to adjust arbitrary point without application of a voltage (current) between terminals 1 and 5 (4 and 5). ☞ page 336
  Method to adjust only stall prevention operation level without adjusting voltage (current). ☞ page 337

NOTE

- Always calibrate the input after changing the voltage/input signal with **Pr.73, Pr.267**, and the voltage/current input selection switch.

◆ Analog input display unit changing (Pr.241)

- The analog input display unit (%/V/mA) for analog input bias and gain calibration can be changed.
- Depending on the terminal input specification set to **Pr.73**, **Pr.267**, and voltage/current input switches, the analog value display unit of **Pr.919**, **Pr.920**, **Pr.932**, and **Pr.933** changes as described below.

Analog command (terminals 1 and 4) (Depends on Pr.73, Pr.267)	Pr.241 = 0 (initial value)	Pr.241 = 1
0 to 5 V input	0 to 5 V → 0 to 100% (0.1%) display	0 to 100% → 0 to 5 V (0.01 V) display
0 to 10 V input	0 to 10 V → 0 to 100% (0.1%) display	0 to 100% → 0 to 10 V (0.01 V) display
0 to 20 mA input	0 to 20 mA → 0 to 100% (0.1%) display	0 to 100% → 0 to 20 mA (0.01 mA)

◆ Adjustment method for the stall prevention operation level setting voltage (current) bias and gain

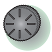
■ Adjust any point with application of a voltage (current) between terminals 1 and 5 (4 and 5).

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Changing the operation mode
Select the PU operation mode.

3. Selecting the parameter number
Read **Pr.920** for terminal 1.
Read **Pr.933** for terminal 4.

4. Analog voltage (current) display
Press [A-SET]. The analog voltage (current) value (%) currently applied to the terminal 1 (4) is displayed.
Do not touch  until calibration is completed.

5. Voltage (current) application
Apply a 5 V (20 mA). (Turn the external potentiometer connected across terminals 1 and 5 (terminals 4 and 5) to a desired position.)

6. Setting completed
Press [SET] twice.
The analog voltage (current) value (%) adjustment is completed.

■ Adjust any point without application of a voltage (current) between terminals 1 and 5 (4 and 5).

Operating procedure

1. Screen at power-ON
The monitor display appears.

2. Changing the operation mode
Select the PU operation mode.

3. Selecting the parameter number
Read **Pr.920** for terminal 1.
Read **Pr.933** for terminal 4.

4. Analog voltage (current) display
Press [A-SET]. The analog voltage (current) value (%) currently applied to the terminal 1 (4) is displayed.

5. Analog voltage (current) adjustment
Press [SET]. Select the gain voltage (current) value (%) currently set in the parameter.
Turn  until the desired gain voltage (current) % is displayed.

6. Setting completed
Press [SET].
The analog voltage (current) value (%) adjustment is completed.

■ Method to adjust only stall prevention operation level without adjusting gain voltage (current). (When changing the gain value from 150% to 130%.)

Operating procedure

1. Parameter selection
   Read **Pr.920** for terminal 1.
   Read **Pr.933** for terminal 4.
   The present set value is displayed. (150.0%)

2. Torque setting change
   Turn to change the set value to "130.0%".
   Press [SET] to enter the setting. "130%" is set in **Pr.920 (Pr.933)**.

3. Checking the mode/monitor
   Change the status to the monitor mode.

4. Start
   Turn ON the start switch (STF or STR) to apply a voltage across terminals 1 and 5 (4 and 5),
   Operation is performed with 130% torque.

NOTE

- If the gain and bias of the stall prevention operation level are too close, an error (Er3) may be displayed at setting.
- For operation outline of the parameter unit (FR-PU07), refer to the Instruction Manual of the FR-PU07.
- Set the bias setting using the **Pr.919** or **Pr.932**. (Refer to page 335.)

Parameters referred to

Pr.73 Analog input selection, Pr.267 Terminal 4 input selection page 318
Pr.79 Operation mode selection page 204
Pr.858 Terminal 4 function assignment, Pr.868 Terminal 1 function assignment page 322

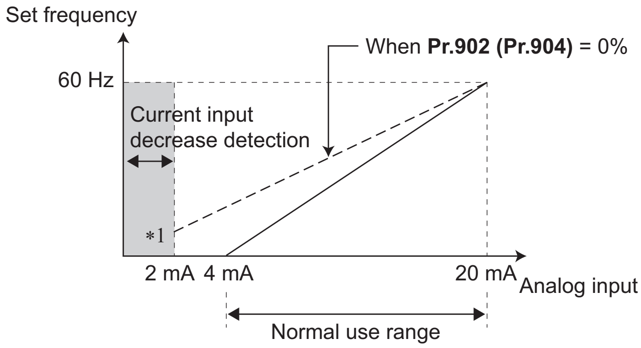
5.9.7 Checking of current input on analog input terminal

When current is input to the analog input terminal 2 and terminal 4, operation when the current input has gone below the specified level (loss of analog current input) can be selected. It is possible to continue the operation even when the analog current input is lost.

Pr.	Name	Initial value	Setting range	Description	
573 **T052**	**4 mA input check selection**	9999	1	Operation continues with output frequency before the current input loss.	Check the current input on terminals 2 and 4.
			2	4 mA input fault (E.LCI) is activated when the current input loss is detected.	
			3	The inverter output decelerates the motor to a stop when the current input loss is detected. After the motor is stopped, 4 mA input fault (E.LCI) is activated.	
			4	Operation continues at the frequency set in **Pr.777**.	
			11	Operation continues at the output frequency before the current input loss.	Check the current input on terminal 4.
			12	4 mA input fault (E.LCI) is activated when the current input loss is detected.	
			13	The inverter output decelerates the motor to a stop when the current input loss is detected. After the motor is stopped, 4 mA input fault (E.LCI) is activated.	
			14	Operation continues at the frequency set in **Pr.777**.	
			21	Operation continues at the output frequency before the current input loss.	Check the current input on terminal 2.
			22	4 mA input fault (E.LCI) is activated when the current input loss is detected.	
			23	The inverter output decelerates the motor to a stop when the current input loss is detected. After the motor is stopped, 4 mA input fault (E.LCI) is activated.	
			24	Operation continues at the frequency set in **Pr.777**.	
			9999	No current input check	
777 **T053** **A681**	**4 mA input check operation frequency**	9999	0 to 590 Hz	Set the frequency to continue operation when the current input is lost. (Valid when **Pr.573** = "4, 14, or 24")	
			9999	No current input check when **Pr.573** = "4, 14, or 24"	
778 **T054** **A682**	**4 mA input check filter**	0 s	0 to 10 s	Set the current input loss detection time.	

◆ Analog current input loss condition (Pr.778)

- When the condition of current input to the terminal 4 (terminal 2) continues to be 2 mA or less for **Pr.778** setting time, it is considered as loss of analog current input and alarm (LF) signal is turned ON. The LF signal will turn OFF when the current input becomes 3 mA or higher.
- For the LF signal, set "98 (positive logic) or 198 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assigns the function.



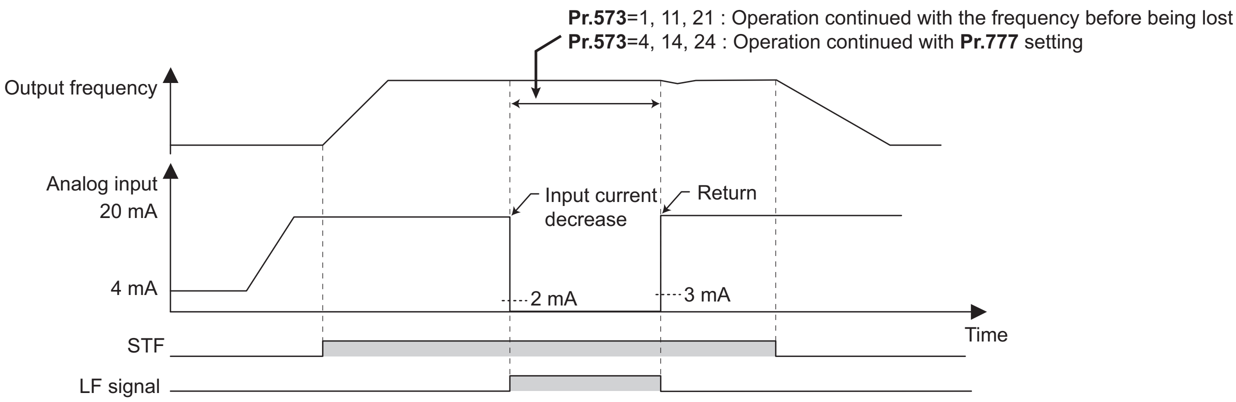
*1 When the **Pr.573** ≠ "9999" and terminal 4 (terminal 2) is calibrated to 2 mA or less with **Pr.902 (Pr.904)**, analog input frequency that is 2 mA or less will become input current loss, thus it will not be as the bias setting frequency.

NOTE

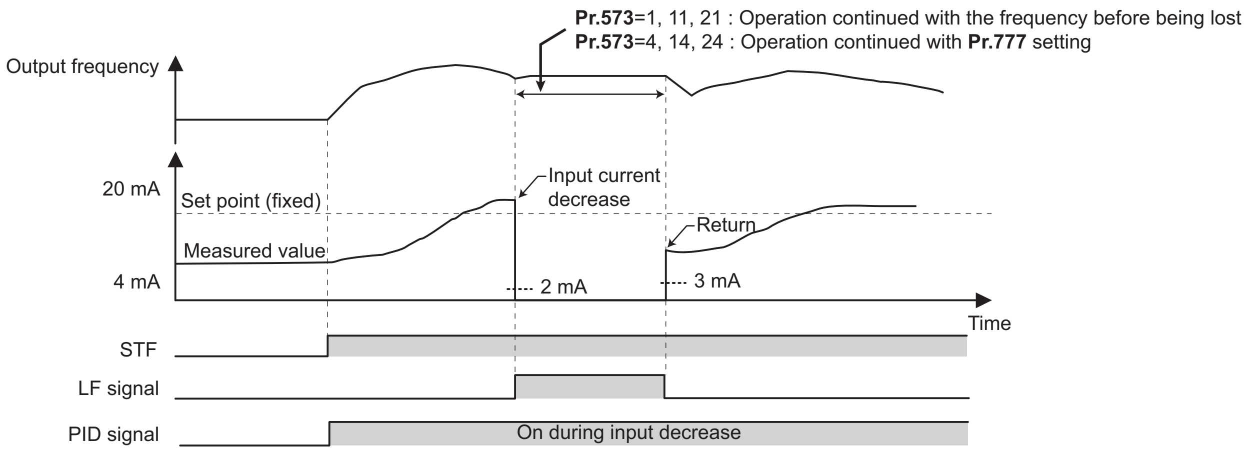
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ Continue operation at analog current input loss (Pr.573 = "1, 4, 11, 14, 21, or 24", Pr.777)

- When **Pr.573** = "1, 11, or 21", operation is continued with the output frequency before the current input loss.
- When **Pr.573** = "4, 14, or 24" and **Pr.777** ≠ "9999", operation is continued with frequency set in **Pr.777**.
- When the start command is turned OFF during the input current loss, deceleration stop is immediately performed, and the operation is not restored even if start command is input again.
- When the current input is restored, the LF signal is turned OFF, and operation is performed according to the current input.
- The following is the operation example during External operation.



• PID control (reverse action)

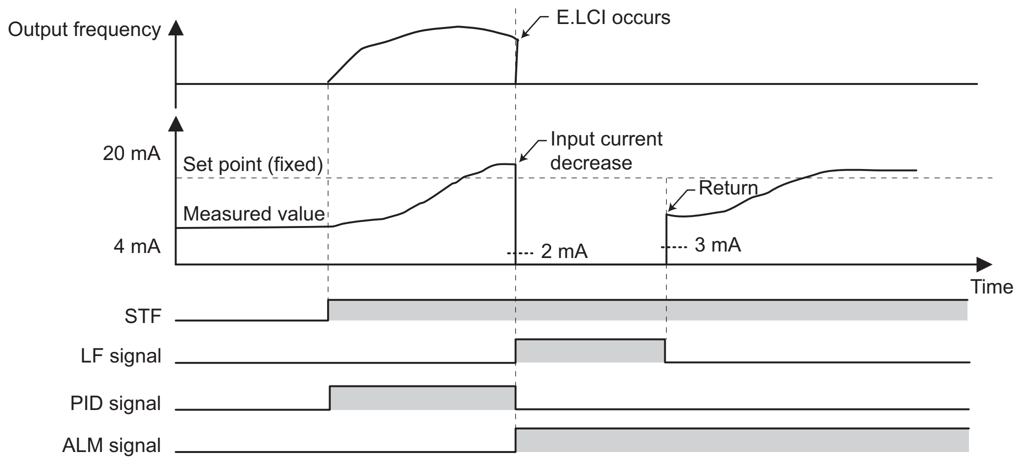


NOTE

• When the setting is changed to continuously operate after the input current loss (**Pr.573** = "1, 4, 11, 14, 21, or 24"), the motor will operate as the frequency before loss is 0 Hz.

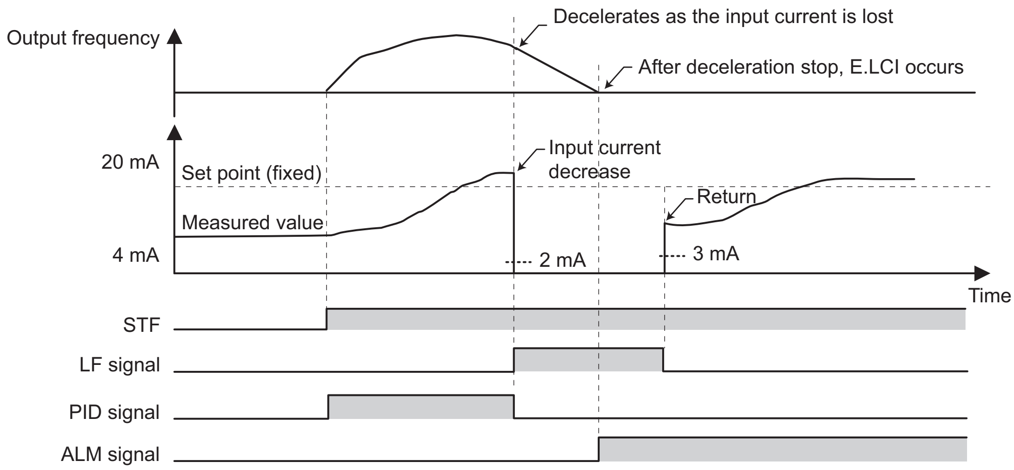
◆ Fault output (Pr.573 = "2, 12, or 22")

• When the analog current input becomes 2 mA or lower, 4 mA input fault (E.LCI) will be activated and the output is shut off.
• The following is the operation example during PID control (reverse action) operation.

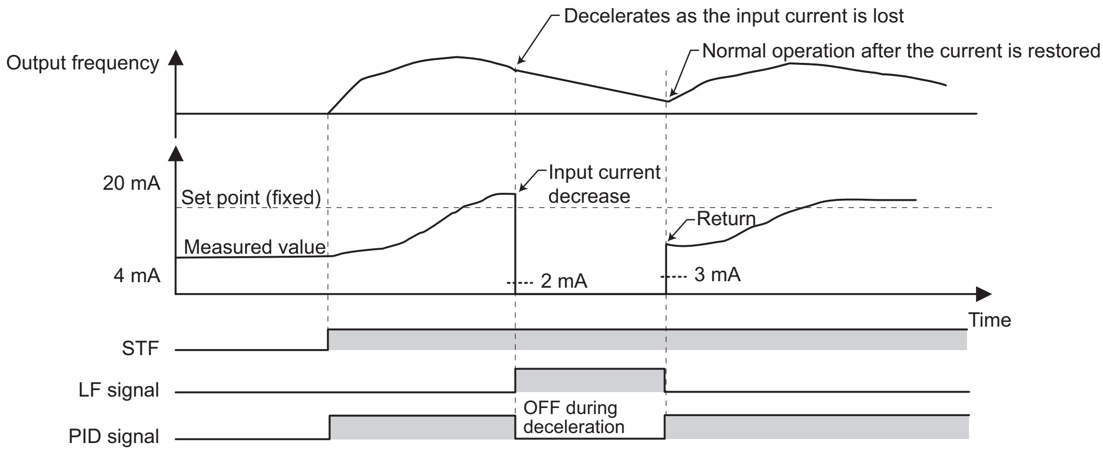


◆ Fault output after deceleration to stop (Pr.573 = "3, 13, or 23")

- When the analog current input becomes 2 mA or lower, 4 mA input fault (E.LCI) will be activated after the deceleration stop and the output is shut off.
- When the analog current input is restored during the deceleration, it will accelerate again and operate according to the current input.
- The following is the operation example during PID control (reverse action) operation.



- The following is the operation example when the analog input current is restored during deceleration under PID control (reverse action).



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◆ Function related to current input check

Function	Operation	Refer to page
Minimum frequency	When the operation continues, the minimum frequency setting is valid even during current input loss.	253
Multi-speed operation	The multi-speed setting signal is prioritized even during current input loss (operate according to multi-speed setting even during operation in continuous frequency or during deceleration stop). When the multi-speed setting signal is turned OFF due to input current loss condition during the multi-speed operation, it will perform deceleration stop even if it is set to continue operation for current input loss.	226
JOG operation	JOG operation is prioritized even during current input loss (switch to JOB operation even during operation with continuous frequency or during deceleration stop). When the JOG signal is turned OFF due to input current loss condition during the JOG operation, it will perform deceleration stop even if it is set to continue operation for current input loss.	224
MRS signal	MRS signal is enabled even during current input loss (output is shut off with MRS signal ON even during operation with continuous frequency or during deceleration stop).	346
Remote setting	During operation with remote setting and transferred to operation continuation due to input current loss, acceleration, deceleration, and clear by the remote setting is invalid. They will become valid after restoring the current input loss.	197
Retry function	When the protective function has operated during the operation continuation due to current input loss, and retry was a success, operation will continue without clearing the operation continuation frequency.	242
Added compensation, override compensation	During operation with added compensation or override compensation and transferred to operation continuation due to input current loss, added compensation and override compensation will become invalid. They will become valid after restoring the current input loss.	323
Input filter time constant	Current input loss is detected with the value before the filter. Operation continuation before the input loss will use the value after the filter.	338
PID control	PID calculation is stopped during the current input loss. However, PID control will not be disabled (normal operation). During the pre-charge, end determination or fault determination by the pre-charge function will not be performed when the current input loss occurs. Sleep function is prioritized even during current input loss. When the clearing condition of the sleep function is met during the current input loss, operation is restored with continuation frequency.	396
Power failure stop	The power failure stop function is prioritized even if power failure current input loss is detected. Set frequency after the power failure stop and re-acceleration is the operation continuation frequency at the current input loss. When the E.LCI generation at the time of current input loss is selected, E.LCI will be generated after the power failure stop.	458
Traverse function	Traverse operation is performed based on frequency even during the operation continuation during current input loss.	389

Parameters referred to

Pr.73 Analog input selection, Pr.267 Terminal 4 input selection ☞ page 318

5.9.8 Input terminal function selection

Use the following parameters to select or change the input terminal functions.

Pr.	Name	Initial value	Initial signal	Setting range
178 **T700**	**STF terminal function selection**	60	STF (Forward rotation command)	0 to 8, 10 to 14, 16, 18, 24, 25, 28, 33, 37 to 40, 46 to 48, 50, 51, 57, 58, 60, 62, 64 to 67, 70 to 73, 77 to 81, 84, 92, 94 to 98, 128, 129, 9999
179 **T701**	**STR terminal function selection**	61	STR (Reverse rotation command)	0 to 8, 10 to 14, 16, 18, 24, 25, 28, 33, 37 to 40, 46 to 48, 50, 51, 57, 58, 61, 62, 64 to 67, 70 to 73, 77 to 81, 84, 92, 94 to 98, 128, 129, 9999
180 **T702**	**RL terminal function selection**	0	RL (Low-speed operation command)	0 to 8, 10 to 14, 16, 18, 24, 25, 28, 33, 37 to 40, 46 to 48, 50, 51, 57, 58, 62, 64 to 67, 70 to 73, 77 to 81, 84, 92, 94 to 98, 128, 129, 9999
181 **T703**	**RM terminal function selection**	1	RM (Middle-speed operation command)	
182 **T704**	**RH terminal function selection**	2	RH (High-speed operation command)	
183 **T705**	**RT terminal function selection**	3	RT (Second function selection)	
184 **T706**	**AU terminal function selection**	4	AU (Terminal 4 input selection)	
185 **T707**	**JOG terminal function selection**	5	JOG (Jog operation selection)	
186 **T708**	**CS terminal function selection**	9999	No function	
187 **T709**	**MRS terminal function selection**	24*1	MRS (Output stop)	
		10*2	X10 (Inverter run enable signal)	
188 **T710**	**STOP terminal function selection**	25	STP (STOP) (Start self-holding selection)	
189 **T711**	**RES terminal function selection**	62	RES (Inverter reset)	

Pr.	Name	Initial value	Setting range	Description
699 **T740**	**Input terminal filter**	9999	5 to 50 ms	Set the time to delay the input terminal response.
			9999	No input terminal filter

*1 The initial value is for standard models.
*2 The initial value is for separated converter types.

◆ Input terminal function assignment

- Using **Pr.178 to Pr.189**, set the functions of the input terminals
- Refer to the following table and set the parameters.

Setting	Signal name	Function		Related parameter	Refer to page
0	RL	**Pr.59** = 0 (initial value)	Low-speed operation command	**Pr.4 to Pr.6, Pr.24 to Pr.27, Pr.232 to Pr.239**	226
		Pr.59 ≠ 0 *1	Remote setting (setting clear)	**Pr.59**	197
1	RM	**Pr.59** = 0 (initial value)	Middle-speed operation command	**Pr.4 to Pr.6, Pr.24 to Pr.27, Pr.232 to Pr.239**	226
		Pr.59 ≠ 0 *1	Remote setting (deceleration)	**Pr.59**	197
2	RH	**Pr.59** = 0 (initial value)	High-speed operation command	**Pr.4 to Pr.6, Pr.24 to Pr.27, Pr.232 to Pr.239**	226
		Pr.59 ≠ 0 *1	Remote setting (acceleration)	**Pr.59**	197
3	RT	Second function selection		**Pr.44 to Pr.51, Pr.450 to Pr.463, Pr.569, Pr.832, etc.**	348
4	AU	Terminal 4 input selection		**Pr.267**	318
5	JOG	Jog operation selection		**Pr.15, Pr.16**	224

Setting	Signal name	Function	Related parameter	Refer to page
6	CS	Selection of automatic restart after instantaneous power failure, flying start	**Pr.57, Pr.58, Pr.162 to Pr.165, Pr.299, Pr.611**	448
		Electronic bypass function	**Pr.57, Pr.58, Pr.135 to Pr.139, Pr.159**	376
7	OH	External thermal relay input *2	**Pr.9**	230
8	REX	15-speed selection (Combination with multi-speeds of RL, RM, and RH)	**Pr.4 to Pr.6, Pr.24 to Pr.27, Pr.232 to Pr.239**	226
10	X10	Inverter run enable signal (FR-CC2 connection)	**Pr.30, Pr.599**	553
11	X11	FR-CC2 connection, instantaneous power failure detection	**Pr.30**	553
12	X12	PU operation external interlock	**Pr.79**	204
13	X13	External DC injection brake operation start	**Pr.10 to Pr.12**	546
14	X14	PID control valid terminal	**Pr.127 to Pr.134, Pr.575 to Pr.577**	396
16	X16	PU/External operation switchover (External operation with X16-ON)	**Pr.79, Pr.340**	204
18	X18	V/F switchover (V/F control with X18-ON)	**Pr.80, Pr.81, Pr.800**	145
24	MRS	Output stop	**Pr.17**	346
		Electronic bypass function	**Pr.57, Pr.58, Pr.135 to Pr.139, Pr.159**	376
25	STP (STOP)	Start self-holding selection	**Pr.250**	550
28	X28	Start-time tuning start external input	**Pr.95**	371
33	PWS	Phase synchronization command for bypass switching	**Pr.139**	*4
37	X37	Traverse function selection	**Pr.592 to Pr.597**	389
38	PDI1	PID multistage set point setting 1	**Pr.1460 to Pr.1466**	396
39	PDI2	PID multistage set point setting 2		
40	PDI3	PID multistage set point setting 3		
46	TRG	Trace trigger input	**Pr.1020 to Pr.1047**	466
47	TRC	Trace sampling start/end	**Pr.1020 to Pr.1047**	466
48	X48	Power failure stop external	**Pr.261 to Pr.266, Pr.294, Pr.668**	458
50	SQ	Sequence start	**Pr.414**	463
51	X51	Fault clear	**Pr.414**	463 *5
57	JOGF	JOG forward rotation command	**Pr.15, Pr.16**	224
58	JOGR	JOG reverse rotation command		
60	STF	Forward rotation command (Assignable to the STF terminal (**Pr.178**) only)	**Pr.250**	550
61	STR	Reverse rotation command (Assignable to the STR terminal (**Pr.179**) only)	**Pr.250**	550
62	RES	Inverter reset	**Pr.75**	162
64	X64	During retry	**Pr.127 to Pr.134**	396
65	X65	PU/NET operation switchover (PU operation with X65-ON)	**Pr.79, Pr.340**	204
66	X66	External/NET operation switchover (NET operation with X66-ON)	**Pr.79, Pr.340**	204
67	X67	Command source switchover (Command by **Pr.338, Pr.339** enabled with X67-ON)	**Pr.338, Pr.339**	214
70	X70	DC feeding operation permission *3	**Pr.30**	553
71	X71	DC feeding cancel *3	**Pr.30**	553
72	X72	PID P control switchover	**Pr.127 to Pr.134, Pr.575 to Pr.577**	396
73	X73	Second PID P control switchover	**Pr.127 to Pr.134, Pr.575 to Pr.577**	396
77	X77	Pre-charge end command	**Pr.760 to Pr.764**	424
78	X78	Second pre-charge end command	**Pr.765 to Pr.769**	424
79	X79	Second PID forward/reverse action switchover	**Pr.753 to Pr.758**	396
80	X80	Second PID control valid terminal	**Pr.753 to Pr.758**	396
81	PGT	PID gain tuning start/forced end	**Pr.1211 to Pr.1219**	415
84	X84	Emergency drive execution command *3	**Pr.514, Pr.515, Pr.523, Pr.524, Pr.1013**	245
92	X92	Emergency stop	**Pr.1103**	190
94	X94	Control signal input for main circuit power supply MC	**Pr.30, Pr.137, Pr.248, Pr.254**	385
95	X95	Converter unit fault input	**Pr.57, Pr.58, Pr.135 to Pr.139, Pr.159**	376
96	X96	Converter unit fault (E.OHT, E.CPU) input		
97	X97	Cleaning valid	**Pr.1469 to Pr.1479**	391
98	X98	Cleaning trigger		

Setting	Signal name	Function	Related parameter	Refer to page
128	RLF	Low-speed forward rotation command	**Pr.6**	226
129	RLR	Low-speed reverse rotation command		
9999	———	No function	————	————

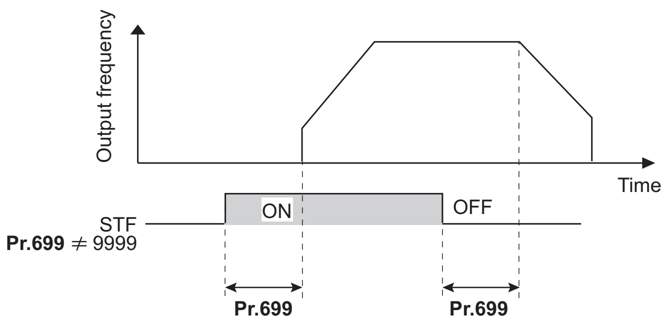
*1 When **Pr.59 Remote function selection** ≠"0", functions of the RL, RM, and RH signals will be changed as in the table.
*2 OH signal will operate with the relay contact "open".
*3 The setting is available only for standard models.
*4 Refer to the FR-A8AVP Instruction Manual (For Phase-Synchronized Bypass Switching) (575 V class).
*5 Refer to FR-A800/F800 PLC function programming manual.

NOTE

- Same function can be assigned to two or more terminals. In this case, the logic of terminal input is OR.
- Priority of the speed command is JOG > multi-speed setting (RH, RM, RL, REX) > PID (X14).
- When the (X10) signal is not set up, **Pr.79 Operation mode selection** = "7", and PU operation external interlock (X12) signal is Inverter run enable signal.
- Same signal is used to assign multi-speed (7 speed) and remote setting. Setting cannot be performed individually.
- When the terminal assignment is changed using **Pr.178 to Pr.189 (Input terminal function selection)**, the terminal name will be different, which may result in an error of wiring, or affect other functions. Set parameters after confirming the function of each terminal.

◆ Adjusting the response of input terminal (Pr.699)

- Response of the input terminal can be delayed in a range between 5 to 50 ms. (Example of STF signal operation)



NOTE

- Setting of **Pr.699** is disabled (no filter) in the following cases.
  — Input terminal is already turned ON when the power is turned ON
  — Input signal used for the PLC function
  — Inverter run enable signal (X10) signal

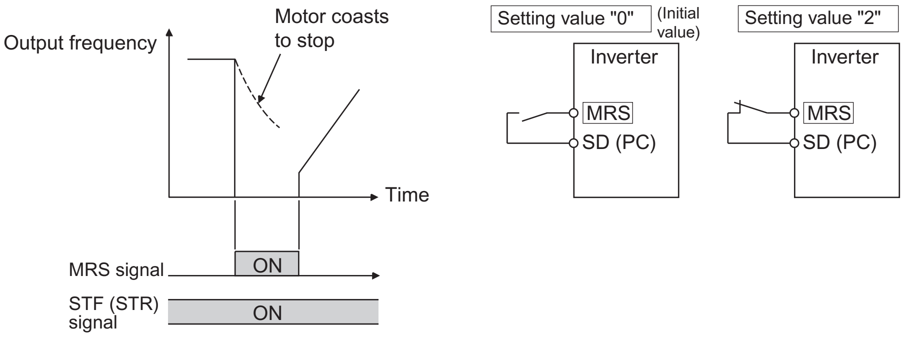
5

5.9.9 Inverter output shutoff signal

The inverter output can be shut off with the MRS signal. The logic of the MRS signal can also be selected.

Pr.	Name	Initial value	Setting range	Description
17 **T720**	**MRS input selection**	0	0	Normally open input
			2	Normally closed input (NC contact input specification)
			4	External terminal: Normally closed input (NC contact input specification) Communication: Normally open input

◆ About output shutoff signal (MRS signal)



- When the Output stop (MRS) signal is turned ON while operating the inverter, the inverter output is instantaneously shut off.
- The response time of the MRS signal is within 2 ms.
- Terminal MRS may be used as described below.

Application	Description
To stop the motor using a mechanical brake (e.g. electromagnetic brake)	The inverter output is shut off when the mechanical brake operates.
To provide interlock to disable the motor operation by the inverter	With the MRS signal ON, the motor cannot be driven by the inverter even if the start signal is input to the inverter.
To 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 = "2")

- When **Pr.17** = "2", the MRS signal can be changed to normally closed (NC contact) specification. The inverter will shut off the output with MRS signal turned OFF (opened).

◆ Assigning a different action for each MRS signal input via communication and external terminal (Pr.17 = "4")

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

External MRS	Communication MRS	Pr.17 setting		
		0	2	4
OFF	OFF	Operation enabled	Output shutoff	Output shutoff
OFF	ON	Output shutoff	Output shutoff	Output shutoff
ON	OFF	Output shutoff	Output shutoff	Operation enabled
ON	ON	Output shutoff	Operation enabled	Output shutoff

NOTE

- The MRS signal is assigned to the terminal MRS in the initial status. By setting "24" in either **Pr.178 to Pr.189 (Input terminal function selection)**, the RT signal can be assigned to the other terminal.
- When using an external terminal to input the MRS signal, the MRS signal shuts off the output in any of the operation modes.
- MRS signal is valid from either of communication or external, but when the MRS signals is to be used as Inverter run enable signal (X10), it is required to input from external.
- When the terminal assignment is changed using **Pr.178 to Pr.189 (Input terminal function selection)**, the terminal name will be different, which may result in an error of wiring, or affect other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343

5

5.9.10 Selecting operation condition of the second function selection signal (RT)

The second function can be selected using the RT signal. The condition to activate the second function can be also set.

Pr.	Name	Initial value	Setting range	Description
155 **T730**	**RT signal function validity condition selection**	0	0	The second function is immediately enabled when the RT signal is turned ON.
			10	The function cannot be changed to the second function during acceleration/deceleration. When the signal is turned ON during acceleration/deceleration, the function is changed after the acceleration/deceleration is finished.

- Turning ON the Second function selection (RT) signal enables the second functions.
- The following are the examples of the applications of the second functions.

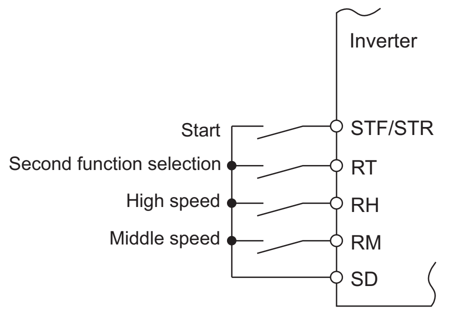
  Switching between regular use and emergency use

  Switching between heavy load and light load

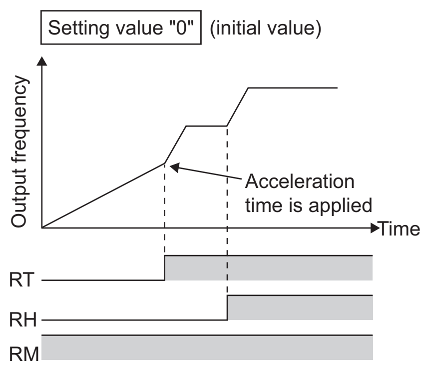
  Change the acceleration/deceleration time by break point acceleration/deceleration

  Switching characteristics of main motor and sub motor

Connection diagram for second function selection



Example of second acceleration/deceleration time



- When the RT signal is ON, second functions are selected. The following table shows the functions which can be changed to the second function.

Function	First function Parameter number	Second function Parameter number	Refer to page
Torque boost	**Pr.0**	**Pr.46**	538
Base frequency	**Pr.3**	**Pr.47**	539
Acceleration time	**Pr.7**	**Pr.44**	190
Deceleration time	**Pr.8**	**Pr.44, Pr.45**	190
Electronic thermal O/L relay	**Pr.9**	**Pr.51**	230
Free thermal	**Pr.600 to Pr.604**	**Pr.692 to Pr.696**	
Motor permissible load level *1	**Pr.607**	**Pr.608**	230
Stall prevention	**Pr.22**	**Pr.48, Pr.49**	257
Applicable motor *1	**Pr.71**	**Pr.450**	351
Motor constant *1	**Pr.80 to Pr.84, Pr.90 to Pr.94, Pr.298, Pr.702, Pr.706, Pr.707, Pr.711, Pr.712, Pr.717, Pr.721, Pr.724, Pr.725, Pr.859, Pr.1412**	**Pr.453 to Pr.457, Pr.560, Pr.458 to Pr.462, Pr.738 to Pr.747, Pr.860, Pr.1413**	353, 363
Excitation current low-speed scaling factor	**Pr.85, Pr.86**	**Pr.565, Pr.566**	542
Speed control gain (Advanced magnetic flux vector)	**Pr.89**	**Pr.569**	149
Offline auto tuning *1	**Pr.96**	**Pr.463**	353, 363
Online auto tuning *1	**Pr.95**	**Pr.574**	371
PID control	**Pr.127 to Pr.134**	**Pr.753 to Pr.758**	396
PID Pre-charge function	**Pr.760 to Pr.764**	**Pr.765 to Pr.769**	424
Speed control gain	**Pr.820, Pr.821**	**Pr.830, Pr.831**	155
Analog input filter	**Pr.822**	**Pr.832**	326
Torque control gain	**Pr.824, Pr.825**	**Pr.834, Pr.835**	155
Torque detection filter	**Pr.827**	**Pr.837**	158

*1 The function can be changed by switching the RT signal ON/OFF while the inverter is stopped. If a signal is switched during operation, the operation method changes after the inverter stops. (**Pr.450** ≠ 9999)

NOTE

- RT signal is assigned to the terminal RT in the initial status. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343

5

5.10 (C) Motor constant parameters

Purpose	Parameter to set			Refer to page
To select the motor to be used	Applicable motor	P.C100, P.C200	Pr.71, Pr.450	351
To run by maximizing the performance of the induction motor	Offline auto tuning	P.C000, P.C100 to P.C105, P.C107, P.C108, P.C110, P.C120 to P.C126, P.C200 to P.C205, P.C207, P.C208, P.C210, P.C220 to P.C226	Pr.9, Pr.51, Pr.71, Pr.80 to Pr.84, Pr.90 to Pr.94, Pr.96, Pr.450, Pr.453 to Pr.463, Pr.684, Pr.707, Pr.724, Pr.744, Pr.745, Pr.859, Pr.860	353
To run by maximizing the performance of the PM motor	PM motor offline auto tuning	P.C000, P.C100 to P.C108, P.C110, P.C120, P.C122, P.C123, P.C126, P.C130 to P.C133, P.C135, P.C150, P.C182, P.C185, P.C200 to P.C208, P.C210, P.C220, P.C222, P.C223, P.C226, P.C230 to P.C233, P.C235, P.C282, P.C285	Pr.9, Pr.51, Pr.71, Pr.80, Pr.81, Pr.83, Pr.84, Pr.90, Pr.92, Pr.93, Pr.96, Pr.450, Pr.453, Pr.454, Pr.456 to Pr.458, Pr.460, Pr.461, Pr.463, Pr.684, Pr.702, Pr.706, Pr.707, Pr.711, Pr.712, Pr.717, Pr.721, Pr.724, Pr.725, Pr.738 to Pr.747, Pr.788, Pr.859, Pr.860, Pr.1002, Pr.1412, Pr.1413	363
To perform high accuracy operation without being affected by temperature and high-torque/ultra-low speed	Online auto tuning	P.C111, P.C211	Pr.95, Pr.574	353

5.10.1 Applied motor

By setting the applied motor type, the thermal characteristic appropriate for the motor can be selected.
When using a constant-torque or PM motor, the electronic thermal O/L relay is set according to the used motor.

<table>
<tr><th>Pr.</th><th>Name</th><th>Initial value</th><th>Setting range</th><th>Description</th></tr>
<tr><td>71
C100</td><td>Applied motor</td><td>0</td><td>0 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094</td><td>By selecting a motor, the thermal characteristic and motor constant of each motor are set.</td></tr>
<tr><td rowspan="2">450
C200</td><td rowspan="2">Second applied motor</td><td rowspan="2">9999</td><td>0, 1, 3 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094</td><td>Set it when using the second motor.
(the same specifications as Pr.71)</td></tr>
<tr><td>9999</td><td>The function is disabled.</td></tr>
</table>

◆ Setting the applied motor

- Refer to the following list and set the parameters according to the applied motor.

<table>
<tr><th rowspan="2">Pr.71</th><th rowspan="2">Pr.450</th><th rowspan="2">Motor</th><th rowspan="2" colspan="2">Constant value range when performing offline auto tuning (increment)</th><th colspan="2">Operational characteristic of the electronic thermal O/L relay</th></tr>
<tr><th>Standard</th><th>Constant-torque</th></tr>
<tr><td colspan="2">0
(Pr.71 initial value)</td><td>Standard motor</td><td colspan="2" rowspan="5">Pr.82 (Pr.455) and Pr.859 (Pr.860)
• 0 to 500 A, 9999 (0.01 A)*1
• 0 to 3600 A, 9999 (0.1 A)*2
Pr.90 (Pr.458) and Pr.91 (Pr.459)
• 0 to 50 Ω, 9999 (0.001 Ω)*1
• 0 to 400 mΩ, 9999 (0.01 mΩ)*2
Pr.92 (Pr.460) and Pr.93 (Pr.461) (Induction motor)
• 0 to 6000 mH, 9999 (0.1 mH)*1
• 0 to 400 mH, 9999 (0.01 mH)*2
Pr.92 (Pr.460) and Pr.93 (Pr.461) (PM motor)
• 0 to 500 mH, 9999 (0.01 mH)*1
• 0 to 50 mH, 9999 (0.001 mH)*2
Pr.94 (Pr.462)
• 0 to 100%, 9999 (0.1%)*1
• 0 to 100%, 9999 (0.01%)*2
Pr.706 (Pr.738)
• 0 to 5000 mV/(rad/s), 9999 (0.1 mV/(rad/s))</td><td>○</td><td></td></tr>
<tr><td colspan="2">1</td><td>Constant-torque motor</td><td></td><td>○</td></tr>
<tr><td>2</td><td>—</td><td>Standard motor
Adjustable 5 points V/F (Refer to page 544.)</td><td>○</td><td></td></tr>
<tr><td colspan="2">8090</td><td>IPM motor</td><td></td><td>○</td></tr>
<tr><td colspan="2">9090</td><td>SPM motor</td><td></td><td>○</td></tr>
<tr><td colspan="2">3 (4)*3</td><td>Standard motor</td><td colspan="2" rowspan="4">Pr.82 (Pr.455), Pr.859 (Pr.860), Pr.90 (Pr.458), Pr.91 (Pr.459), Pr.92 (Pr.460), Pr.93 (Pr.461), Pr.94 (Pr.462) and Pr.706 (Pr.738)
• Internal data value 0 to 65534, 9999 (1)
The display increment can be changed in Pr.684.</td><td>○</td><td></td></tr>
<tr><td colspan="2">13 (14)*3</td><td>Constant-torque motor</td><td></td><td>○</td></tr>
<tr><td colspan="2">8093 (8094)*3</td><td>IPM motor</td><td></td><td>○</td></tr>
<tr><td colspan="2">9093 (9094)*3</td><td>SPM motor</td><td></td><td>○</td></tr>
<tr><td colspan="2">5</td><td>Standard motor</td><td rowspan="2">Star connection</td><td rowspan="4">Pr.82 (Pr.455) and Pr.859 (Pr.860)
• 0 to 500 A, 9999 (0.01 A) *1
• 0 to 3600 A, 9999 (0.1 A) *2
Pr.90 (Pr.458) and Pr.91 (Pr.459)
• 0 to 50 Ω, 9999 (0.001 Ω) *1
• 0 to 400 mΩ, 9999 (0.01 mΩ) *2
Pr.92 (Pr.460) and Pr.93 (Pr.461)
• 0 to 50 Ω, 9999 (0.001 Ω) *1
• 0 to 3600 mΩ, 9999 (0.1 mΩ) *2
Pr.94 (Pr.462)
• 0 to 500 Ω, 9999 (0.01 Ω) *1
• 0 to 100 Ω, 9999 (0.01 Ω) *2</td><td>○</td><td></td></tr>
<tr><td colspan="2">15</td><td>Constant-torque motor</td><td></td><td>○</td></tr>
<tr><td colspan="2">6</td><td>Standard motor</td><td rowspan="2">Delta connection</td><td>○</td><td></td></tr>
<tr><td colspan="2">16</td><td>Constant-torque motor</td><td></td><td>○</td></tr>
<tr><td>—</td><td>9999 (initial value)</td><td colspan="5">No second applied motor</td></tr>
</table>

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.
*3 The same operation is performed for the both settings.

NOTE

- Regardless of the **Pr.71 (Pr.450)** setting, offline auto tuning can be performed according to **Pr.96 (Pr.463) Auto tuning setting/status**. (Refer to page 353 for offline auto tuning.)

◆ Using two types of motors (RT signal, Pr.450)

- When using two types of motors with one inverter, set **Pr.450 Second applied motor**.
- The setting value "9999" (initial value) disables second applied motor.
- If **Pr.450** ≠ 9999, the following parameters will be enabled by turning ON the Second function selection (RT) signal.

Function	RT signal ON (second motor)	RT signal OFF (first motor)
Electronic thermal O/L relay	**Pr.51**	**Pr.9**
Applied motor	**Pr.450**	**Pr.71**
Motor capacity	**Pr.453**	**Pr.80**
Number of motor poles	**Pr.454**	**Pr.81**
Motor excitation current	**Pr.455**	**Pr.82**
Rated motor voltage	**Pr.456**	**Pr.83**
Rated motor frequency	**Pr.457**	**Pr.84**
Motor constant (R1)	**Pr.458**	**Pr.90**
Motor constant (R2)	**Pr.459**	**Pr.91**
Motor constant (L1)/d-axis inductance (Ld)	**Pr.460**	**Pr.92**
Motor constant (L2)/q-axis inductance (Lq)	**Pr.461**	**Pr.93**
Motor constant (X)	**Pr.462**	**Pr.94**
Auto tuning setting/status	**Pr.463**	**Pr.96**
Frequency search gain	**Pr.560**	**Pr.298**
Online auto tuning selection	**Pr.574**	**Pr.95**
Induced voltage constant (phi f)	**Pr.738, Pr.1413**	**Pr.706, Pr.1412**
Motor Ld decay ratio	**Pr.739**	**Pr.711**
Motor Lq decay ratio	**Pr.740**	**Pr.712**
Starting resistance tuning compensation	**Pr.741**	**Pr.717**
Starting magnetic pole position detection pulse width	**Pr.742**	**Pr.721**
Maximum motor frequency	**Pr.743**	**Pr.702**
Motor inertia (integer)	**Pr.744**	**Pr.707**
Motor inertia (exponent)	**Pr.745**	**Pr.724**
Motor protection current level	**Pr.746**	**Pr.725**
Torque current/Rated PM motor current	**Pr.860**	**Pr.859**

NOTE

- The RT signal is a second function selection signal. The RT signal also enables other second functions. (Refer to page 348.)
- The RT signal is assigned to the terminal RT in the initial status. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

⚠ CAUTION

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

Parameters referred to

Pr.96 Auto tuning setting/status ☞ page 353
Pr.100 to Pr.109 (Adjustable 5 points V/F) ☞ page 544
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.684 Tuning data unit switchover ☞ page 353

5.10.2 Offline auto tuning

Magnetic flux

The offline auto tuning enables the optimal operation of an motor.

- Under Advanced magnetic flux vector control, automatic measurement of motor constants (offline auto tuning) enables optimal operation of motors even when motor constants vary, when a motor of another company is used, or when the wiring distance is long.

For the offline auto tuning for a PM motor, refer to page 363.

Pr.	Name	Initial value	Setting range	Description
684 C000	**Tuning data unit switchover**	0	0	Internal data converted value
			1	The value is indicated with "A, Ω, mH or %".
71 C100	**Applied motor**	0	0 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094	By selecting a motor, the thermal characteristic and motor constant of each motor are set.
80 C101	**Motor capacity**	9999	0.4 to 55 kW[*1]	Set the applied motor capacity.
			0 to 3600 kW[*2]	
			9999	V/F control
81 C102	**Number of motor poles**	9999	2, 4, 6, 8, 10, 12	Set the number of motor poles.
			9999	V/F control
9 C103	**Electronic thermal O/L relay**	Inverter rated current	0 to 500 A[*1]	Set the rated motor current.
			0 to 3600 A[*2]	
83 C104	**Rated motor voltage**	575 V	0 to 1000 V	Set the rated motor voltage (V).
84 C105	**Rated motor frequency**	9999	10 to 400 Hz	Set the rated motor frequency (Hz).
			9999	Use the value set in **Pr.3 Base frequency**.
707 C107	**Motor inertia (integer)**	9999	10 to 999, 9999	Set the motor inertia. 9999: Uses the constant value of standard motor.
724 C108	**Motor inertia (exponent)**	9999	0 to 7, 9999	
96 C110	**Auto tuning setting/ status**	0	0	No offline auto tuning
			1	Performs offline auto tuning without rotating the motor
			11	Performs offline auto tuning without rotating the motor (V/F control) (Refer to page 363)
			101	Performs offline auto tuning by rotating the motor
90 C120	**Motor constant (R1)**	9999	0 to 50 Ω, 9999[*1 *3]	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Uses the constant value of standard motor.
			0 to 400 mΩ, 9999[*2 *3]	
91 C121	**Motor constant (R2)**	9999	0 to 50 Ω, 9999[*1 *3]	
			0 to 400 mΩ, 9999[*2 *3]	
92 C122	**Motor constant (L1)/d-axis inductance (Ld)**	9999	0 to 6000 mH, 9999[*1 *3]	
			0 to 400 mH, 9999[*2 *3]	
93 C123	**Motor constant (L2)/q-axis inductance (Lq)**	9999	0 to 6000 mH, 9999[*1 *3]	
			0 to 400 mH, 9999[*2 *3]	
94 C124	**Motor constant (X)**	9999	0 to 100%, 9999[*3]	
82 C125	**Motor excitation current**	9999	0 to 500 A, 9999[*1 *3]	
			0 to 3600 A, 9999[*2 *3]	
859 C126	**Torque current/Rated PM motor current**	9999	0 to 500 A, 9999[*1*3]	
			0 to 3600 A, 9999[*2*3]	
298 A711	**Frequency search gain**	9999	0 to 32767	The offline auto tuning automatically sets the gain required for the frequency search.
			9999	Uses the constant value of standard motor.
450 C200	**Second applied motor**	9999	0, 1, 3 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094	Set this parameter when using the second motor. (the same specifications as **Pr.71**).
			9999	The function is disabled.

Pr.	Name	Initial value	Setting range	Description
453 C201	**Second motor capacity**	9999	0.4 to 55 kW*1	Set the capacity of the second motor.
			0 to 3600 kW*2	
			9999	V/F control
454 C202	**Number of second motor poles**	9999	2, 4, 6, 8, 10, 12	Set the number of poles of the second motor.
			9999	V/F control
51 C203	**Second electronic thermal O/L relay**	9999	0 to 500 A*1	This function is enabled when the RT signal is ON. Set the rated motor current.
			0 to 3600 A*2	
			9999	Second electronic thermal O/L relay disabled
456 C204	**Rated second motor voltage**	575 V	0 to 1000 V	Set the rated voltage (V) of the second motor.
457 C205	**Rated second motor frequency**	9999	10 to 400 Hz	Set the rated frequency (Hz) of the second motor.
			9999	Use the **Pr.84 Rated motor frequency** setting.
744 C207	**Second motor inertia (integer)**	9999	10 to 999, 9999	Set the inertia of the second motor. 9999: Uses the constant value of standard motor.
745 C208	**Second motor inertia (exponent)**	9999	10 to 7, 9999	
463 C210	**Second motor auto tuning setting/status**	0	0	No auto tuning for the second motor.
			1	Performs offline auto tuning without rotating the second motor.
			11	Performs offline auto tuning without rotating the motor (V/F control) (Refer to page 363)
			101	Performs offline auto tuning by rotating the second motor.
458 C220	**Second motor constant (R1)**	9999	0 to 50 Ω, 9999*1 *3	Tuning data of the second motor (The value measured by offline auto tuning is automatically set.) 9999: Uses the constant value of standard motor.
			0 to 400 mΩ, 9999*2 *3	
459 C221	**Second motor constant (R2)**	9999	0 to 50 Ω, 9999*1 *3	
			0 to 400 mΩ, 9999*2 *3	
460 C222	**Second motor constant (L1) / d-axis inductance (Ld)**	9999	0 to 6000 mH, 9999*1 *3	
			0 to 400 mH, 9999*2 *3	
461 C223	**Second motor constant (L2) / q-axis inductance (Lq)**	9999	0 to 6000 mH, 9999*1 *3	
			0 to 400 mH, 9999*2 *3	
462 C224	**Second motor constant (X)**	9999	0 to 100%, 9999 *3	
455 C225	**Second motor excitation current**	9999	0 to 500 A, 9999*1 *3	
			0 to 3600 A, 9999*2 *3	
860 C226	**Second motor torque current/Rated PM motor current**	9999	0 to 500 A, 9999*1 *3	
			0 to 3600 A, 9999*2 *3	
560 A712	**Second frequency search gain**	9999	0 to 32767	The offline auto tuning automatically sets the gain required for the frequency search of the second motor.
			9999	Uses the constant value of standard motor.

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.
*3 The setting range and unit change according to the **Pr.71** (**Pr.450**) setting.

Point

- The function is enabled under Advanced magnetic flux vector control.
- When an induction motor by other manufacturers is used or the wiring length between the inverter and the motor is long (30 m or longer as a reference), use the offline auto tuning function to drive the motor in the optimum operation characteristic.
- Tuning is enabled even when a load is connected to the motor.
- During offline auto tuning, the motor rotation can be locked (**Pr.96** = "1") or unlocked (**Pr.96** = "101"). The tuning is more accurate when the motor can rotate (unlocked).
- Reading/writing of the motor constants tuned by offline auto tuning are enabled. The offline auto tuning data (motor constants) can be copied to another inverter with the operation panel.
- The offline auto tuning status can be monitored with the operation panel and the parameter unit.

◆ Before performing offline auto tuning

Check the following points before performing offline auto tuning:

- A value other than "9999" is set in **Pr.80 and Pr.81**, and Advanced magnetic flux vector control.
- A motor is connected. (The motor should not be rotated by the force applied from outside during the tuning.)
- For the motor capacity, the rated motor current should be equal to or less than the inverter rated current. (It must be 0.4 kW or higher.) If a motor with substantially low rated current compared with the inverter rated current is used, speed and torque accuracies may deteriorate due to torque ripples, etc. Set the rated motor current to about 40% or higher of the inverter rated current.
- The target motor is other than a high-slip motor, a high-speed motor, or a special motor.
- The highest frequency is 400 Hz.
- The motor may rotate slightly even if the offline auto tuning without motor rotation (**Pr.96 Auto tuning setting/status** = "1") is selected. (The slight motor rotation does not affect the tuning performance.) Fix the motor securely with a mechanical brake, or before tuning, make sure that it is safe even if the motor rotates. (Caution is required especially in vertical lift applications.)
- Check the following points for the offline auto tuning with motor rotation (**Pr.96 Auto tuning setting/status** = "101").
  Torque is not sufficient during tuning.
  The motor can be rotated up to the speed close to the rated speed.
  The mechanical brake is released.

◆ Settings

- To perform tuning, set the following parameters about the motor.

First motor Pr.	Second motor Pr.	Name	Initial value	Description
80	453	Motor capacity	9999 (V/F control)	Set the motor capacity (kW).
81	454	Number of motor poles	9999 (V/F control)	Set the number of motor poles (2 to 12).
9	51	Electronic thermal O/L relay	Inverter rated current	Set the rated motor current (A).
83	456	Rated motor voltage	575 V	Set the rated motor voltage (V) printed on the motor's rating plate.
84	457	Rated motor frequency	9999	Set the rated motor frequency (Hz). When the setting is "9999", the **Pr.3 Base frequency** setting is used.
71	450	Applied motor	0 (standard motor)	Set this parameter according to the motor.*1 Three types of motor constant setting ranges, units and tuning data can be stored according to settings.
96	463	Auto tuning setting/ status	0	Set "1" or "101". 1: Performs tuning without rotating the motor. (Excitation noise occurs at this point.) 101: Performs tuning without rotating the motor. The motor can rotate up to the speed near the rated motor frequency.

*1 According to the **Pr.71** setting, the range of the motor constant parameter setting values and units can be changed. Set the **Pr.71** Applied motor setting according to the motor to be used and the motor constant setting range. (For other setting values of **Pr.71**, refer to page 351.)

Motor	Pr.71 setting		
	Motor constant parameter mH, % and A unit setting	Motor constant parameter Internal data setting	Motor constant parameter Ω, mΩ and A unit setting
Standard motor	0 (initial value)	3 (4)	—
Constant-torque motor	1	13 (14)	—
Other manufacturer's standard motor	0 (initial value)	3 (4)	5 (star connection motor) 6 (delta connection motor)
Other manufacturer's constant-torque motor	1	13 (14)	15 (star connection motor) 16 (delta connection motor)

NOTE

- If **Pr.11 DC injection brake operation time** = "0" or **Pr.12 DC injection brake operation voltage** = "0", offline auto tuning is performed considering **Pr.11 or Pr.12** is set to the initial value.
- If "star connection" or "delta connection" is incorrectly selected in **Pr.71**, Advanced magnetic flux vector control is not performed normally.

- For tuning accuracy improvement, set the following parameters when the motor constants are known in advance.

First motor Pr.	Second motor Pr.	Name	Standard motor	Other motors
707	744	Motor inertia (integer)	9999 (initial value)	Motor inertia*2 Jm=**Pr.707** × 10^(- **Pr.724**) (kg/m^2)
724	745	Motor inertia (exponent)		

*2 The setting is valid only when a value other than "9999" is set in both **Pr.707** (**Pr.744**) and **Pr.724** (**Pr.745**).

◆ Performing tuning

Point

- Before performing tuning, check the monitor display of the operation panel or the parameter unit if the inverter is in the state ready for tuning. (Refer to 2) below.) Turning ON the start command while tuning is unavailable starts the motor.

- In the PU operation mode, press FWD / REV on the operation panel. For External operation, turn ON the start command (STF signal or STR signal). Tuning will start.

NOTE

- Satisfy the required inverter start conditions to start offline auto tuning. For example, stop the input of MRS signal.
- To force tuning to end, use the MRS or RES signal or press STOP RESET on the operation panel. (Turning the start signal (STF signal or STR signal) OFF also ends tuning.)
- During offline auto tuning, only the following I/O signals are valid (initial value).
  Input terminals <effective signals>: STP (STOP), OH, MRS, RT, RES, STF, and STR
  Output terminals: RUN, OL, IPF, CA, AM, and A1B1C1
- When the rotation speed and the output frequency are selected for terminals CA and AM, the progress status of offline auto tuning is output in fifteen steps from CA and AM.
- Do not perform ON/OFF switching of the Second function selection (RT) signal during offline auto tuning. Auto tuning will not be performed properly.
- When the offline auto tuning is selected (**Pr.96 Auto tuning setting/status** = "101"), the motor rotates. Take caution and ensure the safety.
- Since the Inverter running (RUN) signal turns ON when tuning is started, pay close attention especially when a sequence which releases a mechanical brake by the RUN signal has been designed.
- When executing offline auto tuning, input the run command after switching ON the main circuit power (R/L1, S/L2, T/L3) of the inverter.
- While **Pr.79 Operation mode selection** = "7", turn the PU operation external interlock (X12) signal ON to tune in the PU operation mode.

- Monitor is displayed on the operation panel and parameter unit during tuning as below.

Pr.96 setting value	1	101	1	101
	Parameter unit display		Operation panel display	
(1) Setting	READ:List TUNE 1 --- STOP PU	READ:List TUNE 101 --- STOP PU	AutoTune 12:34 TUNE 1 --- STOP PU PREV NEXT	AutoTune 12:34 TUNE 101 --- STOP PU PREV NEXT
(2) During tuning	TUNE 2 STF FWD PU	TUNE 102 STF FWD PU	AutoTune 12:34 TUNE 2 STF FWD PU PREV NEXT	AutoTune 12:34 TUNE 102 STF FWD PU PREV NEXT
(3) Normal completion	TUNE 3 COMPLETION STF STOP PU	TUNE 103 COMPLETION STF STOP PU	AutoTune 12:34 TUNE Completed 3 STF STOP PU PREV NEXT	AutoTune 12:34 TUNE Completed 103 STF STOP PU PREV NEXT

- Note: Offline auto tuning time (with the initial setting)

Offline auto tuning setting	Time
No motor rotation (**Pr.96 (Pr.463)** = "1")	Approx. 25 to 120 s (The time depends on the inverter capacity and motor type.)
With motor rotation (**Pr.96 (Pr.463)** = "101)	Approx. 40 s (The following offline auto tuning time is set according to the acceleration/deceleration time setting. Offline auto tuning time = acceleration time + deceleration time + approx. 30 s)

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

NOTE

- The motor constants measured once in the offline auto tuning are stored as parameters and their data are held until the offline auto tuning is performed again. However, the tuning data is cleared by performing all parameter clear.
- Changing **Pr.71** (**Pr.450**) after tuning completion will change the motor constant. For example, if **Pr.71** = "3" is set after tuning is performed with **Pr.71** = "0", the tuning data becomes invalid. Set **Pr.71** = "0" again for using the tuning data.

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

Error display	Error cause	Countermeasures
8	Forced end	Set **Pr.96 (Pr.463)** = "1" or "101" and try again.
9	Inverter protective function operation	Make the setting again.
91	The current limit (stall prevention) function is activated.	Set the acceleration/deceleration time longer. Set **Pr.156** = "1".
92	The converter output voltage has dropped to 75% of the rated voltage.	Check for the power supply voltage fluctuation. Check the **Pr.83 Rated motor voltage (Pr.456 Rated second motor voltage)** setting.
93	Calculation error The motor is not connected.	Check the **Pr.83** and **Pr.84** settings. Check the motor wiring and make the setting again.
94	Rotation tuning frequency setting error (The frequency command for the tuning was given to exceed the maximum frequency setting, or to be in the frequency jump range.)	Check the **Pr.1 Maximum frequency** and **Pr.31** to **Pr.36** Frequency jump settings.

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

NOTE

- An instantaneous power failure occurring during tuning will result in a tuning error. After power is restored, the inverter starts normal operation. Therefore, when STF (STR) signal is ON, the motor runs in the forward (reverse) rotation.
- Any alarm occurring during tuning is handled as in the normal operation. Note that even if a retry operation has been set, retry is not performed.
- The set frequency monitor displayed during the offline auto tuning is 0 Hz

⚠ CAUTION

- Note that the motor may start running suddenly.
- For the offline auto tuning in vertical lift applications, etc., caution is required to avoid falling due to insufficient torque.

◆ Changing the motor constants

- If the motor constants are known, the motor constants can be set directly or set using data measured through offline auto tuning.
- According to the **Pr.71 (Pr.450)** setting, the range of the motor constant parameter setting values and units can be changed. The setting values are stored in the EEPROM as motor constant parameters, and three types of motor constants can be stored.

◆ Changing the motor constants (If setting the Pr.92 and Pr.93 motor constants in units of mH)

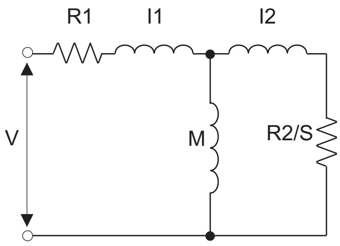
- Set **Pr.71** as shown below.

Motor	Pr.71 setting
Standard motor	0 (initial value)
Constant-torque motor	1

- Use the following formula to find the **Pr.94** setting value and set a given value as the motor constant parameter.

The setting value of **Pr.94** = $\left(1 - \frac{M^2}{L1 \times L2}\right) \times 100(\%)$

- Equivalent circuit diagram of the motor



R1: Primary resistance
R2: Secondary resistance
l1: Primary leakage inductance
l2: Secondary leakage inductance
M: Excitation inductance
S: Slip

L1= l1+ M: Primary inductance
L2= l2+ M: Secondary inductance

First motor Pr.	Second motor Pr.	Name	Setting range	Setting increments	Initial value
82	455	Motor excitation current (No-load current)	0 to 500 A, 9999[*1]	0.01 A[*1]	9999
			0 to 3600 A, 9999[*2]	0.1 A[*2]	
90	458	Motor constant (R1)	0 to 50 Ω, 9999[*1]	0.001 Ω[*1]	
			0 to 400 mΩ, 9999[*2]	0.01 mΩ[*2]	
91	459	Motor constant (R2)	0 to 50 Ω, 9999[*1]	0.001 Ω[*1]	
			0 to 400 mΩ, 9999[*2]	0.01 mΩ[*2]	
92	460	Motor constant (L1)/d-axis inductance (Ld)	0 to 6000 mH, 9999[*1]	0.1 mH[*1]	
			0 to 400 mH, 9999[*2]	0.01 mH[*2]	
93	461	Motor constant (L2)/q-axis inductance (Lq)	0 to 6000 mH, 9999[*1]	0.1 mH[*1]	
			0 to 400 mH, 9999[*2]	0.01 mH[*2]	
94	462	Motor constant (X)	0 to 100%, 9999	0.1%[*1]	
				0.01%[*2]	
859	860	Torque current/Rated PM motor current	0 to 500 A, 9999[*1]	0.01 A[*1]	
			0 to 3600 A, 9999[*2]	0.1 A[*2]	
298	560	Frequency search gain	0 to 32767, 9999	1	

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.

NOTE

- If "9999" is set, tuning data will be invalid and the motor constant values for standard motors are used.

◆ Changing the motor constants (If setting motor constants in the internal data of the inverter)

- Set **Pr.71** as follows.

Motor	Pr.71 setting
Standard motor	3 (4)
Constant-torque motor	13 (14)
Other manufacturer's standard motor	3 (4)
Other manufacturer's constant-torque motor	13 (14)

- Set given values as the motor constant parameters. The displayed increments of the read motor constants can be changed with **Pr.684 Tuning data unit switchover**.

First motor Pr.	Second motor Pr.	Name	Pr.684 = 0 (initial value)		Pr.684 = 1		Initial value
			Setting range	Setting increments	Range indication	Unit indication	
82	455	Motor excitation current	0 to ***, 9999	1	0 to 500 A, 9999[*1]	0.01 A[*1]	9999
					0 to 3600 A, 9999[*2]	0.1 A[*2]	
90	458	Motor constant (R1)			0 to 50 Ω, 9999[*1]	0.001 Ω[*1]	
					0 to 400 mΩ, 9999[*2]	0.01 mΩ[*2]	
91	459	Motor constant (R2)			0 to 50 Ω, 9999[*1]	0.001 Ω[*1]	
					0 to 400 mΩ, 9999[*2]	0.01 mΩ[*2]	
92	460	Motor constant (L1)/d-axis inductance (Ld)			0 to 6000 mH, 9999[*1]	0.1 mH[*1]	
					0 to 400 mH, 9999[*2]	0.01 mH[*2]	
93	461	Motor constant (L2)/q-axis inductance (Lq)			0 to 6000 mH, 9999[*1]	0.1 mH[*1]	
					0 to 400 mH, 9999[*2]	0.01 mH[*2]	
94	462	Motor constant (X)			0 to 100%, 9999	0.1%[*1]	
						0.01%[*2]	
859	860	Torque current/Rated PM motor current			0 to 500 A, 9999[*1]	0.01 A[*1]	
					0 to 3600 A, 9999[*2]	0.1 A[*2]	
298	560	Frequency search gain	0 to 32767, 9999	1	0 to 32767, 9999	1	

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.

NOTE

- As the motor constants measured in the offline auto tuning have been converted into internal data (****), refer to the following setting example when making setting:
- Setting example: To slightly increase the **Pr.90** value (5%)
  If **Pr.90** = "2516" is displayed, the value is calculated with 2516 × 1.05 = 2641.8. Therefore set **Pr.90** = "2642". (The value displayed has been converted into a value for internal use. Hence, simple addition of a given value to the displayed value has no significance.)
- If "9999" is set, tuning data will be invalid and the motor constant values for standard motors are used.

◆ Changing the motor constants (If setting the Pr.92 and Pr.93 motor constants in units of [Ω])

- Set **Pr.71** as shown below.

Applicable motor	Pr.71 setting	
	Star connection motor	Delta connection motor
Standard motor	5	6
Constant-torque motor	15	16

- Set given values as the motor constant parameters.

I_q = torque current, I_{100} = rated current, I_0 = no load current

$$I_q = \sqrt{I_{100}^2 - I_0^2}$$

First motor Pr.	Second motor Pr.	Name	Setting range	Setting increments	Initial value
82	455	Motor excitation current (No-load current)	0 to 500 A, 9999*1	0.01 A*1	9999
			0 to 3600 A, 9999*2	0.1 A*2	
90	458	Motor constant (r1)	0 to 50 Ω, 9999*1	0.001 Ω*1	
			0 to 400 mΩ, 9999*2	0.01 mΩ*2	
91	459	Motor constant (r2)	0 to 50 Ω, 9999*1	0.001 Ω*1	
			0 to 400 mΩ, 9999*2	0.01 mΩ*2	
92	460	Motor constant (x1)	0 to 50 Ω, 9999*1	0.001 Ω*1	
			0 to 3600 mΩ, 9999*2	0.01 mΩ*2	
93	461	Motor constant (x2)	0 to 50 Ω, 9999*1	0.001 Ω*1	
			0 to 3600 mΩ, 9999*2	0.01 mΩ*2	
94	462	Motor constant (xm)	0 to 500 Ω, 9999*1	0.01 Ω	
			0 to 100 Ω, 9999*2		
859	860	Torque current/Rated PM motor current	0 to 500 A, 9999*1	0.01 A*1	
			0 to 3600 A, 9999*2	0.1 A*2	
298	560	Frequency search gain	0 to 32767, 9999	1	

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.

NOTE

- If "star connection" or "delta connection" is incorrectly selected in **Pr.71**, Advanced magnetic flux vector control is not performed normally.
- If "9999" is set, tuning data will be invalid and the motor constant values for standard motors are used.

◆ Tuning the second applied motor

- When one inverter switches the operation between two different motors, set the second motor in **Pr.450 Second applied motor**. (Refer to page 351.) In the initial setting, no second motor is applied.
- Turning ON the RT signal will enable the parameter settings for the second motor as shown below.

Function	RT signal ON (second motor)	RT signal OFF (first motor)
Motor capacity	**Pr.453**	**Pr.80**
Number of motor poles	**Pr.454**	**Pr.81**
Motor excitation current	**Pr.455**	**Pr.82**
Rated motor voltage	**Pr.456**	**Pr.83**
Rated motor frequency	**Pr.457**	**Pr.84**
Motor constant (R1)	**Pr.458**	**Pr.90**
Motor constant (R2)	**Pr.459**	**Pr.91**
Motor constant (L1)/d-axis inductance (Ld)	**Pr.460**	**Pr.92**
Motor constant (L2)/q-axis inductance (Lq)	**Pr.461**	**Pr.93**
Motor constant (X)	**Pr.462**	**Pr.94**
Auto tuning setting/status	**Pr.463**	**Pr.96**
Frequency search gain	**Pr.560**	**Pr.298**

NOTE

- The RT signal is assigned to the terminal RT in the initial status. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.1 Maximum frequency ☞ page 253
Pr.9 Electronic thermal O/L relay ☞ page 230
Pr.31 to Pr.36 Frequency jump ☞ page 255
Pr.71 Applied motor ☞ page 351
Pr.156 Stall prevention operation selection ☞ page 257
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

5.10.3 Offline auto tuning for a PM motor (motor constants tuning)

PM

The offline auto tuning for a PM motor enables the optimal operation of a PM motor.

- Automatic measurement of motor constants (offline auto tuning) enables optimal operation of motors for PM motor control even when motor constants vary or when the wiring distance is long.

For the offline auto tuning under Advanced magnetic flux vector control, refer to page 353.

Pr.	Name	Initial value	Setting range	Description
684 C000	**Tuning data unit switchover**	0	0	Internal data converted value
			1	The value is indicated with "A, Ω, mH or mV".
1002 C150	**Lq tuning target current adjustment coefficient**	9999	50 to 150%	Perform adjustment if the overcurrent protective function is activated during tuning.
			9999	No adjustment
71 C100	**Applied motor**	0	0 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094	By selecting a motor, the thermal characteristic and motor constant of each motor are set.
80 C101	**Motor capacity**	9999	0.4 to 55 kW[*1]	Applied motor capacity setting.
			0 to 3600 kW[*2]	
			9999	V/F control
81 C102	**Number of motor poles**	9999	2, 4, 6, 8, 10, 12	Set the number of motor poles.
			9999	V/F control
9 C103	**Electronic thermal O/L relay**	Inverter rated current	0 to 500 A[*1]	Set the rated motor current.
			0 to 3600 A[*2]	
83 C104	**Rated motor voltage**	575 V	0 to 1000 V	Set the rated motor voltage (V).
84 C105	**Rated motor frequency**	9999	10 to 400 Hz	Set the rated motor frequency (Hz).
			9999	The inverter internal data is used. Use the correct setting according to the motor specification.
702 C106	**Maximum motor frequency**	9999	0 to 400 Hz	Set the maximum frequency of the motor.
			9999	**Pr.84** setting is used.
707 C107	**Motor inertia (integer)**	9999	10 to 999, 9999	Set the motor inertia. 9999: The inverter internal data is used.
724 C108	**Motor inertia (exponent)**	9999	0 to 7, 9999	
96 C110	**Auto tuning setting/status**	0	0, 11, 101	No offline auto tuning.
			1	Performs offline auto tuning without rotating the motor.
90 C120	**Motor constant (R1)**	9999	0 to 50 Ω, 9999[*1*3]	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: The inverter internal data is used.
			0 to 400 mΩ, 9999[*2*3]	
92 C122	**Motor constant (L1)/d-axis inductance (Ld)**	9999	0 to 500 mH, 9999[*1*3]	
			0 to 50 mH, 9999[*2*3]	
93 C123	**Motor constant (L2)/q-axis inductance (Lq)**	9999	0 to 500 mH, 9999[*1*3]	
			0 to 50 mH, 9999[*2*3]	
859 C126	**Torque current/Rated PM motor current**	9999	0 to 500 A, 9999[*1*3]	
			0 to 3600 A, 9999[*2*3]	
706 C130	**Induced voltage constant (phi f)**	9999	0 to 5000 mV/(rad/s)[*3]	Set this parameter according to the PM motor specifications.
			9999	The value calculated by the motor constant parameter setting is used.

Pr.	Name	Initial value	Setting range	Description
1412 C135	**Motor induced voltage constant (phi f) exponent**	9999	0 to 2	Set the exponent n when the induced voltage constant phi f (**Pr.706**) is multiplied by 10^n.
			9999	No exponent setting
711 C131	**Motor Ld decay ratio**	9999	0 to 100%, 9999	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: The inverter internal data is used.
712 C132	**Motor Lq decay ratio**	9999	0 to 100%, 9999	
717 C182	**Starting resistance tuning compensation**	9999	0 to 200%, 9999	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: The inverter internal data is used.
721 C185	**Starting magnetic pole position detection pulse width**	9999	0 to 6000 μs, 10000 to 16000 μs, 9999	
725 C133	**Motor protection current level**	9999	100 to 500%	Set the maximum current (OCT) level of the motor.
			9999	Maximum current level of the motor: 200%
450 C200	**Second applied motor**	9999	0, 1, 3 to 6, 13 to 16, 8090, 8093, 8094, 9090, 9093, 9094	Set this parameter when using the second motor. (the same specifications as **Pr.71**).
			9999	The function is disabled.
453 C201	**Second motor capacity**	9999	0.4 to 55 kW*1	Set the capacity of the second motor.
			0 to 3600 kW*2	
			9999	V/F control
454 C202	**Number of second motor poles**	9999	2, 4, 6, 8, 10, 12	Set the number of poles of the second motor.
			9999	V/F control
51 C203	**Second electronic thermal O/L relay**	9999	0 to 500 A*1	Set the rated current of the second motor.
			0 to 3600 A*2	
			9999	Second electronic thermal O/L relay disabled.
456 C204	**Rated second motor voltage**	575 V	0 to 1000 V	Set the rated voltage (V) of the second motor.
457 C205	**Rated second motor frequency**	9999	10 to 400 Hz	Set the rated frequency (Hz) of the second motor.
			9999	The inverter internal data is used. Use the correct setting according to the motor specification.
743 C206	**Second motor maximum frequency**	9999	0 to 400 Hz	Set the maximum frequency of the second motor.
			9999	The setting value of **Pr.457** is used.
744 C207	**Second motor inertia (integer)**	9999	10 to 999, 9999	Set the inertia of the second motor. 9999: The inverter internal data is used.
745 C208	**Second motor inertia (exponent)**	9999	0 to 7, 9999	
463 C210	**Second motor auto tuning setting/status**	0	0, 11, 101	No auto tuning for the second motor.
			1	Performs offline auto tuning without rotating the second motor.
458 C220	**Second motor constant (R1)**	9999	0 to 50 Ω, 9999*1*3	Tuning data of the second motor (The value measured by offline auto tuning is automatically set.) 9999: The inverter internal data is used.
			0 to 400 mΩ, 9999*2*3	
460 C222	**Second motor constant (L1) / d-axis inductance (Ld)**	9999	0 to 500 mH, 9999*1*3	
			0 to 50 mH, 9999*2*3	
461 C223	**Second motor constant (L2) / q-axis inductance (Lq)**	9999	0 to 500 mH, 9999*1*3	
			0 to 50 mH, 9999*2*3	
860 C226	**Second motor torque current/ Rated PM motor current**	9999	0 to 500 A, 9999*1*3	
			0 to 3600 A, 9999*2*3	
738 C230	**Second motor induced voltage constant (phi f)**	9999	0 to 5000 mV/(rad/s)*3	Set this parameter according to the PM motor specifications.
			9999	The value calculated by the motor constant parameter setting is used.

Pr.	Name	Initial value	Setting range	Description
1413 C235	**Second motor induced voltage constant (phi f) exponent**	9999	0 to 2	Set the exponent n when the induced voltage constant phi f (**Pr.738**) is multiplied by 10^n.
			9999	No exponent setting
739 C231	**Second motor Ld decay ratio**	9999	0 to 100%, 9999	Tuning data of the second motor. (The value measured by offline auto tuning is automatically set.) 9999: The inverter internal data is used.
740 C232	**Second motor Lq decay ratio**	9999	0 to 100%, 9999	
741 C282	**Second starting resistance tuning compensation**	9999	0 to 200%, 9999	Tuning data of the second motor. (The value measured by offline auto tuning is automatically set.) 9999: The inverter internal data is used.
742 C285	**Second motor magnetic pole detection pulse width**	9999	0 to 6000 μs, 10000 to 16000 μs, 9999	
746 C233	**Second motor protection current level**	9999	100 to 500%	Set the maximum current (OCT) level of the second motor.
			9999	Maximum current level of the motor: 200%

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.
*3 The setting range and unit change according to the **Pr.71** (**Pr.450**) setting.

Point

- The settings are valid under the PM motor control.
- The offline auto tuning enables the operation with SPM motors and IPM motors. (When a PM motor is used, always perform the offline auto tuning.)
- Tuning is enabled even when a load is connected to the motor.
- Reading/writing of the motor constants tuned by offline auto tuning are enabled. The offline auto tuning data (motor constants) can be copied to another inverter with the operation panel.
- The offline auto tuning status can be monitored with the operation panel and the parameter unit.

◆ Before performing offline auto tuning

Check the following points before performing offline auto tuning.

- The PM motor control is selected.
- A motor is connected. Note that the motor should be at a stop at a tuning start. (The motor should not be rotated by the force applied from outside during the tuning.)
- For the motor capacity, the rated motor current should be equal to or less than the inverter rated current. (It must be 0.4 kW or higher.) If a motor with substantially low rated current compared with the inverter rated current is used, speed and torque accuracies may deteriorate due to torque ripples, etc. Set the rated motor current to about 40% or higher of the inverter rated current.
- The maximum frequency under PM motor control is 400 Hz.
- The motor may rotate slightly even if the offline auto tuning without motor rotation (**Pr.96 Auto tuning setting/status** = "1") is selected. (It does not affect the tuning performance.) Fix the motor securely with a mechanical brake, or before tuning, make sure that it is safe even if the motor rotates. (Caution is required especially in vertical lift applications.)
- Tuning may be disabled depending on the motor characteristics.

◆ Setting

- To perform tuning, set the following parameters about the motor.

First motor Pr.	Second motor Pr.	Name	Setting
80	453	Motor capacity	Motor capacity (kW)
81	454	Number of motor poles	The number of motor poles (2 to 12)
9	51	Electronic thermal O/L relay	Rated motor current (A)
84	457	Rated motor frequency	Rated motor frequency (Hz)
83	456	Rated motor voltage	Rated motor voltage (V)
71	450	Applied motor	8090, 8093 (IPM motor) 9090, 9093 (SPM motor)*1
96	463	Auto tuning setting/status	1

*1 Set **Pr.71 Applied motor** according to the motor to be used. According to the **Pr.71** setting, the range of the motor constant parameter setting values and units can be changed. (For other setting values of **Pr.71**, refer to page 351.)

Motor	Pr.71 setting	
	Motor constant parameter Ω, mH and A unit setting	Motor constant parameter internal data setting
IPM motor	8090	8093 (8094)
SPM motor	9090	9093 (9094)

NOTE

- If PM motor control is performed, tuning cannot be performed even when **Pr.96** = "11, 101" is set.

- For the tuning accuracy improvement, set the following parameter when the motor constant is known in advance.

First motor Pr.	Second motor Pr.	Name	Setting
702	743	Maximum motor frequency	The maximum motor frequency (Hz)
707	744	Motor inertia (integer)	Motor inertia*2 Jm=**Pr.707** × 10^(- **Pr.724**) (kg/m^2)
724	745	Motor inertia (exponent)	
725	746	Motor protection current level	Maximum current level of the motor (%)

*2 The setting is valid only when both of the **Pr.707** (**Pr.744**) and **Pr.724** (**Pr.745**) settings are other than "9999".

◆ Performing tuning

Point

- Before performing tuning, check the monitor display of the operation panel or the parameter unit if the inverter is in the state ready for tuning. Turning ON the start command while tuning is unavailable starts the motor.

- In the PU operation mode, press FWD / REV on the operation panel. For External operation, turn ON the start command (STF signal or STR signal). Tuning will start.

NOTE

- Satisfy the required inverter start conditions to start offline auto tuning. For example, stop the input of MRS signal.
- To force tuning to end, use the MRS or RES signal or press STOP RESET on the operation panel. (Turning the start signal (STF signal or STR signal) OFF also ends tuning.)
- During offline auto tuning, only the following I/O signals are valid (initial value)
  Input terminals <effective signals>: STP (STOP), OH, MRS, RT, RES, STF, and STR
  Output terminals: RUN, OL, IPF, CA, AM, and A1B1C1
- When the rotation speed and the output frequency are selected for terminals CA and AM, the progress status of offline auto tuning is output in fifteen steps from CA and AM.
- Do not perform ON/OFF switching of the Second function selection(RT) signal during offline auto tuning. Auto tuning will not be performed properly.
- A motor with 14 or more poles cannot be tuned.
- Since the Inverter running (RUN) signal turns ON when tuning is started, pay close attention especially when a sequence which releases a mechanical brake by the RUN signal has been designed.
- When executing offline auto tuning, input the run command after switching ON the main circuit power (R/L1, S/L2, T/L3) of the inverter.
- While **Pr.79 Operation mode selection** = "7", turn the PU operation external interlock (X12) signal ON to tune in the PU operation mode.

- Monitor is displayed on the operation panel and parameter unit during tuning as below.

Pr.96 (Pr.463) Setting	1	1
	Parameter unit display	Operation panel display
(1) Setting	READ:List TUNE 1 --- STOP PU	AutoTune 12:34 TUNE 1 --- STOP PU PREV NEXT
(2) During tuning	TUNE 2 STF FWD PU	AutoTune 12:34 TUNE 2 STF FWD PU PREV NEXT
(3) Normal completion	TUNE 3 COMPLETION STF STOP PU	AutoTune 12:34 TUNE Completed 3 STF STOP PU PREV NEXT

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

NOTE

- The motor constants measured once in the offline auto tuning are stored as parameters and their data are held until the offline auto tuning is performed again. However, the tuning data is cleared by performing all parameter clear.
- Changing **Pr.71** after tuning completion will change the motor constant. For example, if **Pr.71** = "8093" is set after tuning is performed with **Pr.71** ="8090", the tuning data becomes invalid. Set **Pr.71** = "8090" again for using the tuning data.

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

Error display	Error cause	Countermeasures
8	Forced end	Set **Pr.96 (Pr.463)** = "1" and try again.
9	Inverter protective function operation	Make the setting again.
92	The converter output voltage has dropped to 75% of the rated voltage.	Check for the power supply voltage fluctuation. Check the **Pr.83 Rated motor voltage (Pr.456 Rated second motor voltage)** setting.
93	Calculation error. The motor is not connected.	Check the motor wiring and make the setting again.
94	Rotation tuning frequency setting error (The frequency command for the tuning was given to exceed the maximum frequency setting, or to be in the frequency jump range.)	Check the **Pr.1 Maximum frequency** and **Pr.31 to Pr.36 Frequency jump** settings.

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

NOTE

- An instantaneous power failure occurring during tuning will result in a tuning error. After power is restored, the inverter starts normal operation. Therefore, when STF (STR) signal is ON, the motor runs in the forward (reverse) rotation.
- Any alarm occurring during tuning is handled as in the normal operation. However, if the retry function is set, no retry is performed even when a protective function that performs a retry is activated.
- The set frequency monitor displayed during the offline auto tuning is 0 Hz.

CAUTION

- Note that the motor may start running suddenly.

◆ Parameters in which the tuning results are set to after tuning

First motor Pr.	Second motor Pr.	Name	Description
90	458	Motor constant (R1)	Resistance per phase
92	460	Motor constant (L1)/d-axis inductance (Ld)	d-axis inductance
93	461	Motor constant (L2)/q-axis inductance (Lq)	q-axis inductance
711	739	Motor Ld decay ratio	d-axis inductance decay ratio
712	740	Motor Lq decay ratio	q-axis inductance decay ratio
717	741	Starting resistance tuning compensation	
721	742	Starting magnetic pole position detection pulse width	When the setting value is 10000 or more: With polarity inversion for compensation, voltage pulse (Pr. setting minus 10000) μs
859	860	Torque current/Rated PM motor current	
96	463	Auto tuning setting/status	

◆ Tuning adjustment (Pr.1002)

- The overcurrent protective function may be activated during Lq tuning for an easily magnetically saturated motor (motor with a large Lg decay ratio). In such case, adjust the target flowing current used for tuning with **Pr.1002 Lq tuning target current adjustment coefficient**.

◆ Changing the motor constants

- If the motor constants are known, the motor constants can be set directly or set using data measured through offline auto tuning.
- According to the **Pr.71 (Pr.450)** setting, the range of the motor constant parameter setting values and units can be changed. The setting values are stored in the EEPROM as motor constant parameters, and two types of motor constants can be stored.

◆ Changing the motor constants (If setting motor constants in units of [Ω], [mH] or [A])

5

- Set **Pr.71** as shown below.

Motor	Pr.71 setting
IPM motor	8090
SPM motor	9090

- Set given values as the motor constant parameters.

First Pr.	Second Pr.	Name	Setting range	Setting increments	Initial value
90	458	Motor constant (R1)	0 to 50 Ω, 9999*1	0.001 Ω*1	9999
			0 to 400 mΩ, 9999*2	0.01 mΩ*2	
92	460	Motor constant (L1)/d-axis inductance (Ld)	0 to 500 mH, 9999*1	0.01 mH*1	
			0 to 50 mH, 9999*2	0.001 mH*2	
93	461	Motor constant (L2)/q-axis inductance (Lq)	0 to 500 mH, 9999*1	0.01 mH*1	
			0 to 50 mH, 9999*2	0.001 mH*2	
706	738	Induced voltage constant (phi f)	0 to 5000 mV/(rad/s), 9999	0.1 mV/(rad/s)	
859	860	Torque current/Rated PM motor current	0 to 500 A, 9999*1	0.01 A*1	
			0 to 3600 A, 9999*2	0.1 A*2	
1412	1413	Motor induced voltage constant (phi f) exponent	0 to 2, 9999	1	

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.

NOTE

- Setting "9999" disables the tuning data. The inverter internal constant is used.
- To change a motor induced voltage constant of PM motors, the setting in **Pr.706 Induced voltage constant (phi f)** or **Pr.738 Second motor induced voltage constant (phi f)** must be changed. If the constant after the change exceeds the setting range of **Pr.706** or **Pr.738** (0 to 5000 mV (rad/s)), set **Pr.1412** or **Pr.1413** to set a value in the exponent n in the following formula: **Pr.706 (Pr.738)** × 10^n [mV (rad/s)] to set the induced voltage constant (phi f).
- When **Pr.71 (Pr.450)** = "8093, 8094, 9093, or 9094", or **Pr.1412 (Pr.1413)** = "9999", the motor induced voltage constant is as set in **Pr.706 (Pr.738)**. (No exponent setting)

◆ Changing the motor constants (If setting a motor constants in the internal data of the inverter)

- Set **Pr.71** as follows.

Motor	Pr.71 setting
IPM motor	8093 (8094)
SPM motor	9093 (9094)

- Set given values as the motor constant parameters. The displayed increments of the read motor constants can be changed with **Pr.684 Tuning data unit switchover**.

First motor Pr.	Second motor Pr.	Name	Pr.684 = 0 (initial value)		Pr.684 = 1		Initial value
			Setting range	Setting increments	Setting range	Setting increments	
90	458	Motor constant (R1)	0 to ***, 9999	1	0 to 50 Ω, 9999[*1]	0.001 Ω[*1]	9999
					0 to 400 mΩ, 9999[*2]	0.01 mΩ[*2]	
92	460	Motor constant (L1)/d-axis inductance (Ld)			0 to 500 mH, 9999[*1]	0.01 mH[*1]	
					0 to 50 mH, 9999[*2]	0.001 mH[*2]	
93	461	Motor constant (L2)/q-axis inductance (Lq)			0 to 500 mH, 9999[*1]	0.01 mH[*1]	
					0 to 50 mH, 9999[*2]	0.001 mH[*2]	
706	738	Induced voltage constant (phi f)			0 to 5000 mV/s/rad, 9999	0.1 mV/(rad/s)	
859	860	Torque current/Rated PM motor current			0 to 500 A, 9999[*1]	0.01 A[*1]	
					0 to 3600 A, 9999[*2]	0.1 A[*2]	
1412	1413	Motor induced voltage constant (phi f) exponent			0 to 2, 9999	1	

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.

NOTE

- As the motor constants measured in the offline auto tuning have been converted into internal data (****), refer to the following setting example when making setting:
- Setting example: To slightly increase **Pr.90** value (5%)
  If **Pr.90** = "2516" is displayed, the value is calculated with 2516 × 1.05 = 2641.8. Therefore set **Pr.90** = "2642". (The value displayed has been converted into a value for internal use. Hence, simple addition of a given value to the displayed value has no significance.)
- Setting "9999" disables the tuning data. The inverter internal constant is used.
- To change a motor induced voltage constant of PM motors, the setting in **Pr.706 Induced voltage constant (phi f)** or **Pr.738 Second motor induced voltage constant (phi f)** must be changed. If the constant after the change exceeds the setting range of **Pr.706** or **Pr.738** (0 to 5000 mV (rad/s)), set **Pr.1412** or **Pr.1413** to set a value in the exponent n in the following formula: **Pr.706 (Pr.738)** × 10^n [mV (rad/s)] to set the induced voltage constant (phi f).
- When **Pr.71 (Pr.450)** = "8093, 8094, 9093, or 9094", or **Pr.1412 (Pr.1413)** = "9999", the motor induced voltage constant is as set in **Pr.706 (Pr.738)**. (No exponent setting)

Parameters referred to

Pr.9 Electronic thermal O/L relay ☞ page 230
Pr.71 Applied motor ☞ page 351
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343

5.10.4 Online auto tuning

Magnetic flux

If online auto tuning is selected under Advanced magnetic flux vector control, favorable torque accuracy is retained by adjusting temperature even when the resistance value varies due to increase in the motor temperature.

Pr.	Name	Initial value	Setting range	Description
95 **C111**	**Online auto tuning selection**	0	0	Do not perform online auto tuning
			1	Perform online auto tuning at startup
574 **C211**	**Second motor online auto tuning**	0	0 and 1	Select online auto tuning for the second motor. (same as **Pr.95**)

◆ Performing online auto tuning at startup (setting value "1")

- By promptly tuning the motor status at startup, accurate operation without being affected by motor temperature is achieved. Also high torque can be provided at very low speed and stable operation is possible.
- When using Advanced magnetic flux vector control (**Pr.80 Motor capacity, Pr.81 Number of motor poles**), select the online auto tuning at start.
- Make sure to perform offline auto tuning before performing online auto tuning.

Operating procedure

1. Perform offline auto tuning. (Refer to page 353.)

2. Check that **Pr.96 Auto tuning setting/status** = "3 or 103 (offline auto tuning completion)".

3. Set **Pr.95 Online auto tuning selection** = "1 (online auto tuning at start)".

4. Check that the following parameters are set before starting operation.

Pr.	Description
9	Uses both rated motor current and electronic thermal O/L relay.
71	Applicable motor
80	Motor capacity (with the rated motor current equal to or lower than the inverter rated current)*1
81	Number of motor poles

*1 If a motor with substantially low rated current compared with the inverter rated current is used, speed and torque accuracies may deteriorate due to torque ripples, etc. Set the rated motor current to about 40% or higher of the inverter rated current.

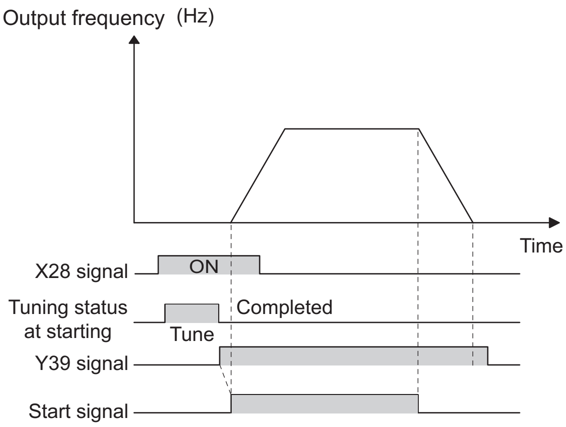
5. In the PU operation mode, press FWD / REV on the operation panel.
For External operation, turn ON the start command (STF signal or STR signal).

NOTE

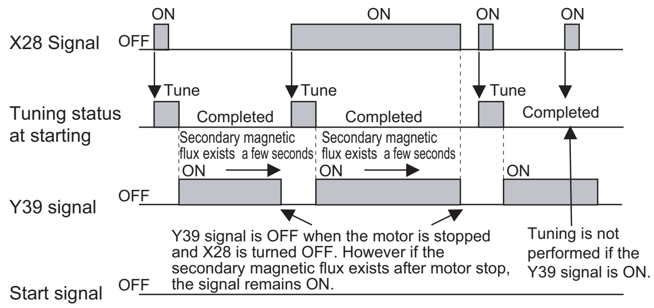
- When performing online auto tuning at startup for a lift, consider using an external terminal. The tuning is completed in at most approximately 500 ms after starting. However, during this time, it is possible that not enough torque is provided and caution is required to prevent the object from dropping. Use of the start-time tuning start (X28) signal is recommended to perform tuning. (Refer to page 372.)
- Perform online auto tuning at startup when the motor is stopped.
- The online auto tuning is disabled when the MRS signal is being input, the setting speed is **Pr.13 Starting frequency** or lower (V/F control, Advanced magnetic flux vector control), an inverter fault is occurring, or the inverter's startup condition is not satisfied.
- Online auto tuning does not operate during deceleration and restart from DC injection brake operation.
- It is disabled during JOG operation.
- If automatic restart after instantaneous power failure is selected, automatic restart is prioritized. (Online auto tuning at startup does not run during frequency search.) If automatic restart after instantaneous power failure is used together, perform online auto tuning while stopping operation with the X28 signal. (Refer to page 372.)
- Zero current detection and output current detection are enabled during online auto tuning.
- No RUN signal is output during online auto tuning. The RUN signal is turned ON at operation startup.
- If the time between the inverter stop and restart is within 4 s, tuning is performed at startup but its result will not be applied.

◆ Online auto tuning at startup using the external terminal (setting value "1", X28 signal and Y39 signal)

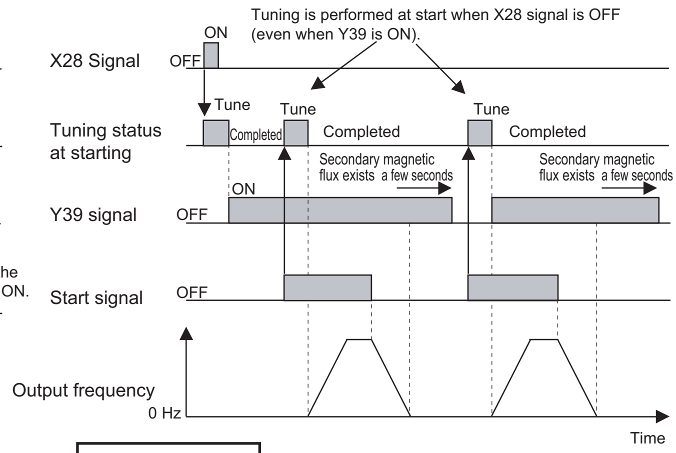
- Before turning ON the start signal (STF or STR), online auto tuning can be performed by turning ON the Start-time tuning start external input (X28) signal in a stopped status. Such operation will minimize the startup delay by turning at start.
- Perform offline auto tuning and set **Pr.95** = "1" (tuning at start).
- When Start time tuning completion (Y39) is OFF, tuning at start can be performed with X28 signal.
- Up to 500 ms can be taken to complete tuning at startup.
- To use the X28 signal, set "28" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to an input terminal.
- To use the Y39 signal, set "39 (positive logic) or 139 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign function to an output terminal.



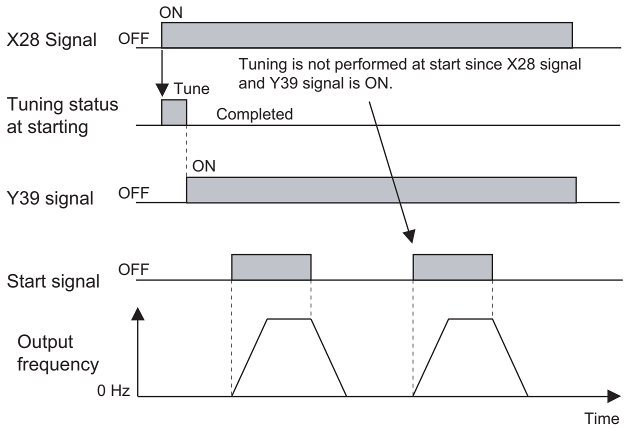
While the motor is stopped



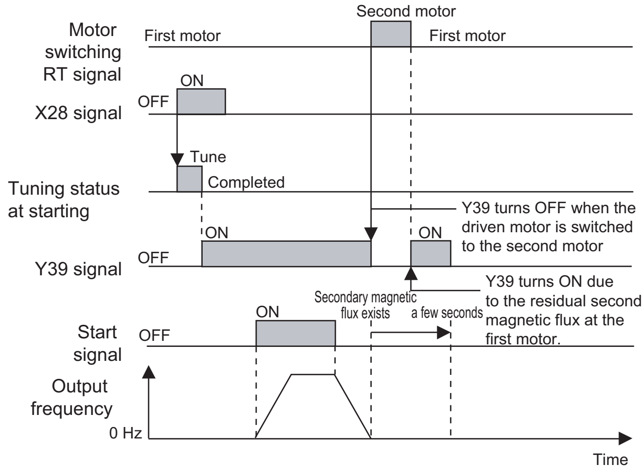
While the X28 signal is OFF



While the X28 signal is ON



Switching motor



NOTE

- The Y39 signal remains ON as long as there is second flux even after the motor is stopped.
- The X28 signal is disabled while the Y39 signal is ON.
- The STF and STR signals are enabled after completing tuning at start.
- The Inverter running (RUN) signal is not turned ON during online auto tuning. The RUN signal is turned ON after starting up.
- It is disabled during V/F control or PM motor control.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection) and Pr.190 to Pr.196 (Output terminal function selection)** may affect other functions. Set parameters after confirming the function of each terminal.

◆ Tuning the second applied motor (Pr.574)

- When switching two different motors by one inverter, set the second motor in **Pr.450 Second applied motor**. (In the initial setting, no second motor is applied. (Refer to page 351.))
- **Pr.574** is enabled when the Second function selection (RT) signal is turned ON.

Pr.	Description
450	Applicable motor
453	Motor capacity (with the rated motor current equal to or lower than the inverter rated current)*1
454	Number of motor poles

*1 If a motor with substantially low rated current compared with the inverter rated current is used, speed and torque accuracies may deteriorate due to torque ripples, etc. Set the rated motor current to about 40% or higher of the inverter rated current.

NOTE

- The RT signal is a second function selection signal. The RT signal also enables other second functions. (Refer to page 343.) The RT signal is assigned to the terminal RT in the initial status. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.9 Electronic thermal O/L relay ☞ page 230
Pr.71 Applied motor ☞ page 351
Pr.80 Motor capacity ☞ page 145, page 353, page 363
Pr.81 Number of motor poles ☞ page 145, page 353, page 363
Pr.96 Auto tuning setting/status ☞ page 353, page 363
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

5.11 (A) Application parameters

Purpose	Parameter to set			Refer to page
To operate by switching between the inverter and the commercial power supply operation	Electronic bypass function	P.A000 to P.A005	Pr.135 to Pr.139, Pr.159	376
To reduce the standby power	Self power management	P.A002, P.A006, P.A007, P.E300	Pr.30, Pr.137, Pr.248, Pr.254	385
To count the number of inverter startups	Start count monitor	P.A170, P.A171	Pr.1410, Pr.1411	388
To strengthen or weaken the frequency at a constant cycle	Traverse operation	P.A300 to P.A305	Pr.592 to Pr.597	389
To remove stains on the impellers or fans of pumps by repeating a forward/reverse rotation	Cleaning function	P.A420 to P.A430	Pr.1469 to Pr.1479	391
To perform process control, such as for the pump flow volume and air volume	Multi-pump function (Advanced PID function)	P.A400 to P.A414, P.A442	Pr.578 to Pr.591, Pr.1370, Pr.1376	429
	PID pre-charge function	P.A616 to P.A620, P.A626, P.A656 to P.A660, P.A666	Pr.760 to Pr.769, Pr.1132, Pr.1133	424
	PID display adjustment	P.A600, P.A630 to P.A633, P.A670 to P.A673	Pr.759, Pr.934, Pr.935, Pr.1136 to Pr.1139	421
	PID control	P.A442, P.A457, P.A601 to P.A607, P.A610 to P.A615, P.A621 to P.A625, P.A640 to P.A644, P.A650 to P.A655, P.A661 to P.A665, P.A683 to P.A689	Pr.127 to Pr.134, Pr.553, Pr.554, Pr.575 to Pr.577, Pr.609, Pr.610, Pr.753 to Pr.758, Pr.1015, Pr.1134, Pr.1135, Pr.1140, Pr.1141, Pr.1143 to Pr.1149, Pr.1346, Pr.1370, Pr.1460 to Pr.1466	396
	PID control enhanced functions	P.A440 to P.A457, P.A627 to P.A629, P.F031	Pr.111, Pr.1346, Pr.1361 to Pr.1375, Pr.1377 to Pr.1381	440
To set the constant optimal for PID control	PID gain tuning	P.A690 to P.A698	Pr.1211 to Pr.1219	415
To continue operating at analog current input loss	4 mA input check	P.A680 to P.A682	Pr.573, Pr.777, Pr.778	338
To restart without stopping the motor at instantaneous power failure	Automatic restart after instantaneous power failure / flying start function for induction motors	P.A700 to P.A705, P.A710, P.F003	Pr.57, Pr.58, Pr.162 to Pr.165, Pr.299, Pr.611	448
	Frequency search accuracy improvement (V/F control, offline auto tuning)	P.A700, P.A711, P.A712, P.C110, P.C210	Pr.96, Pr.162, Pr.298, Pr.463, Pr.560	454
To decelerate the motor to a stop at instantaneous power failure	Power failure time deceleration-to-stop function	P.A730 to P.A735, P.A785	Pr.261 to Pr.266, Pr.294	458
To operate with sequence program	PLC function	P.A800 to P.A805, P.A811 to P.A859	Pr.414 to Pr.417, Pr.498, Pr.675, Pr.1150 to Pr.1199	463
To store the inverter running status to a USB memory device	Trace function	P.A900 to P.A906, P.A910 to P.A920, P.A930 to P.A939	Pr.1020 to Pr.1047	466

5

5.11.1 Electronic bypass function

V/F Magnetic flux

The inverter contains complicated sequence circuits for switching between the commercial power supply operation and inverter operation. Therefore, interlock operation of the magnetic contactor for switching can be easily performed by simply inputting start, stop, and automatic switching selection signals.

Pr.	Name	Initial value	Setting range	Description
57 **A702**	**Restart coasting time**	9999	0	Coasting time differs according to the inverter capacity.[*1]
			0.1 to 30 s	Set the waiting time for the inverter to perform a restart at power restoration after an instantaneous power failure.
			9999	No restart
58 **A703**	**Restart cushion time**	1 s	0 to 60 s	Set the voltage cushion time for restart.
135 **A000**	**Electronic bypass sequence selection**	0	0	Without electronic bypass sequence
			1	With electronic bypass sequence
136 **A001**	**MC switchover interlock time**	1 s	0 to 100 s	Set the operation interlock time for MC2 and MC3.
137 **A002**	**Start waiting time**	0.5 s	0 to 100 s	Set a time period that is a little longer than the time period from the ON signal input to the actual pick-up operation of MC3 (0.3 to 0.5 s).
138 **A003**	**Bypass selection at a fault**	0	0	Inverter output stop (motor coasting) at inverter failure
			1	Automatic switchover to commercial power supply operation at inverter failure. (Switchover is not possible when an external thermal relay operation (E.OHT), CPU fault (E.CPU), or output short-circuit fault (E.SCF) is occurring, or when output side earth (ground) fault overcurrent (E.GF) is occurring while **Pr.249** = "2".)
139 **A004**	**Automatic switchover frequency from inverter to bypass operation**	9999	0 to 60 Hz	Set the frequency where the inverter operation is switched to commercial power supply operation. The inverter operation is performed from a start to **Pr.139** setting, then it switches automatically to the commercial power supply operation when the output frequency is equal to or above **Pr.139**.
			9999	Without automatic switchover
159 **A005**	**Automatic switchover frequency range from bypass to inverter operation**	9999	0 to 10 Hz	Set the frequency where the commercial power supply operation, which has been switched from the inverter operation with **Pr.139**, switches back to inverter operation. When the frequency command becomes less than (**Pr.139** - **Pr.159**), the motor switches automatically to inverter operation and operates at the frequency of the frequency command. Turning OFF the inverter start command (STF/STR) also switches the operation to the inverter operation.
			9999	To switch the commercial power supply operation, which has been switched from the inverter operation with **Pr.139**, to the inverter operation again, the inverter start command (STF/STR) is turned OFF. The operation switches to the inverter operation, and the motor decelerates to a stop.

*1 The coasting time when **Pr.57** = "0" is as shown below. (When **Pr.162 Automatic restart after instantaneous power failure selection** is set to the initial value.)
FR-F860-00027: 0.5 s
FR-F860-00061 and FR-F860-00090: 1.0 s
FR-F860-00170 to 00680: 3.0 s
FR-F860-01080 or higher: 5.0 s

◆ Electronic bypass sequence function

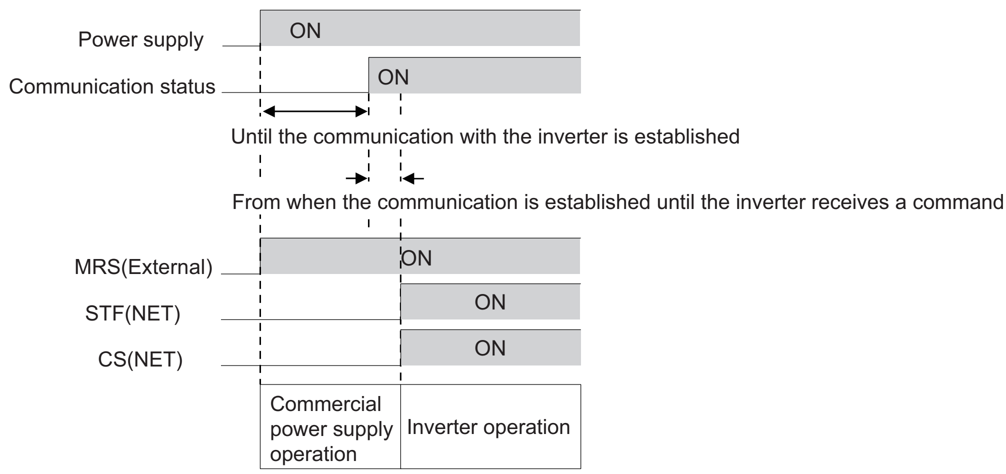
- When operating the motor at 60 Hz (or 50 Hz), the motor can be more efficiently operated with a commercial power supply. In addition, if the motor cannot be stopped for a long period of time even for an inverter maintenance and inspection, it is recommended that a commercial power supply circuit be installed.
- When switching between inverter operation and commercial power supply operation, commercial power supply may be accidentally applied to the output side of the inverter. To avoid such situation, provide an interlock where the magnetic contactor at the commercial power supply side turns ON at turn OFF of the magnetic contactor at the inverter output side. The inverter's electronic bypass sequence that outputs timing signals for the magnetic contactors can act as a complicated interlock between the commercial power supply operation and the inverter operation.

NOTE

- Note that a PM motor cannot be driven by the commercial power supply.

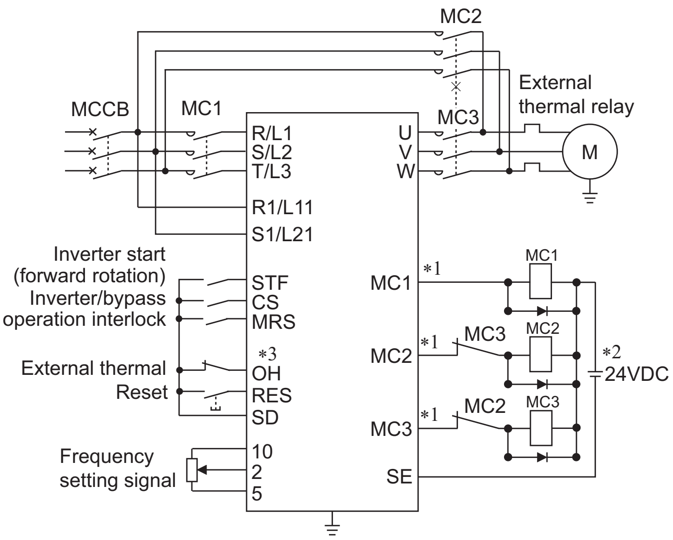
◆ Precautions for electronic bypass sequence function

- The response time of the inverter to the signals depends on the command source, NET or External. After the communication with the inverter is established, the motor operation is performed according to the command via NET. The commercial power supply operation with the motor is performed when the MRS signal turns ON before the communication is established. It is recommended to turn the MRS signal ON after the communication is established. Example: the response time of the inverter to the signals in the Network operation mode (power-ON). The command source is External for the MRS signal and NET for the STF (STR) and CS signals.

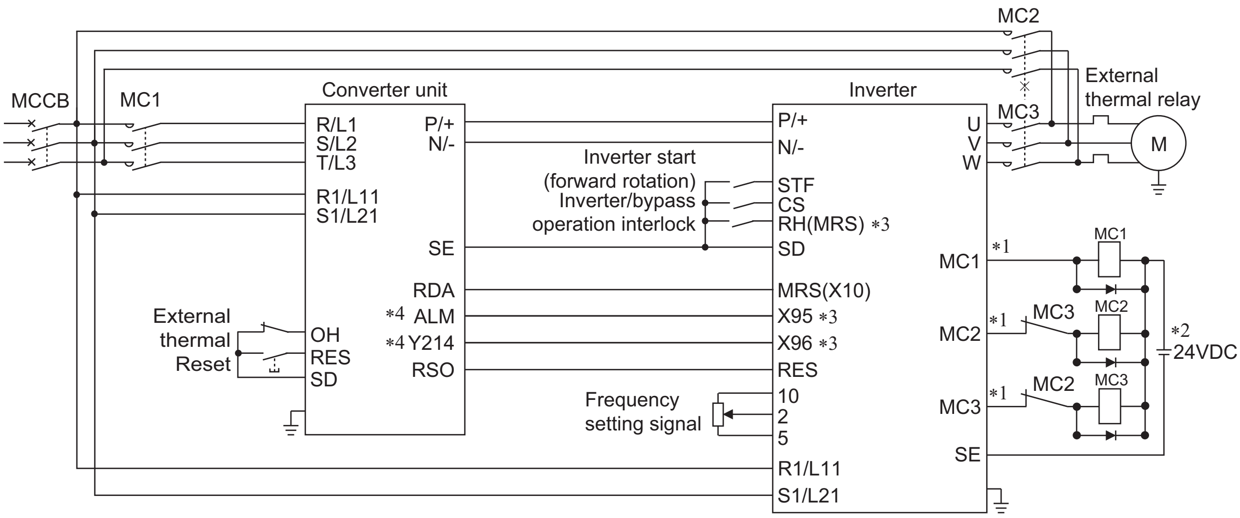


◆ Connection diagram

- A typical connection diagram of the electronic bypass sequence is shown below.
- Standard models



- Separated converter type



*1 Be careful of the capacity of the sequence output terminals. The applied terminals differ by the settings of **Pr.190 to Pr.196 (Output terminal function selection)**.

Output terminal capacity	Output terminal permissible load
Open collector output of inverter (RUN, SU, IPF, OL, FU)	24 VDC 0.1 A
Inverter relay output (A1-C1, B1-C1, A2-B2, B2-C2) Relay output option (FR-A8AR)	230 VAC 0.3 A 30 VDC 0.3 A

*2 When connecting a DC power supply, insert a protective diode.
When connecting an AC power supply, use relay output terminals of the inverter or contact output terminals of the relay output option (FR-A8AR).

*3 The applied terminals differ by the settings of **Pr.180 to Pr.189 (Input terminal function selection)**.

*4 To use the signal, assign the function to the output terminal **Pr.190 to Pr.195 (Output terminal function selection)** of the converter unit. Always set the negative logic for the ALM signal.

NOTE

- Use the electronic bypass function in External operation mode. In addition, the wiring terminals R1/L11 and S1/L21 must be connected to a separate power source that does go through MC1. Be sure to connect using a separate power supply.
- Be sure to provide a mechanical interlock for MC2 and MC3.

• Operation of magnetic contactor (MC1, MC2, MC3)

Magnetic contactor	Installation location	Operation		
		During commercial power supply operation	During inverter operation	During inverter fault
MC1	Between power supply and inverter input side	Shorted	Shorted	Open (short by reset)
MC2	Between power supply and motor	Shorted	Open	Open (Selected by **Pr.138**. Always open when the external thermal relay is operating.)
MC3	Between inverter output side and motor	Open	Shorted	Open

• The input signals are as shown below.

Signal	Applied terminal	Function	Operation	MC operation*8		
				MC1*6	MC2	MC3
MRS	MRS*1	Selects whether or not operation is available.*2	ON Electronic bypass operation available	○	-	-
			OFF Electronic bypass operation not available	○	×	Unchanged
CS	CS	Inverter/commercial power supply operation switchover*3	ON Inverter operation	○	×	○
			OFF Commercial power supply operation	○	○	×
STF (STR)	STF (STR)	Inverter operation command (Disabled during commercial power supply operation)*4	ON Forward rotation (reverse rotation)	○	×	○
			OFF Stop	○	×	○
OH	Set one of **Pr.180 to Pr.189** to "7".	External thermal relay input	ON Motor normal	○	-	-
			OFF Motor fault	×	×	×
RES	RES	Operation status reset*5	ON Reset	Unchanged	×	Unchanged
			OFF Normal operation	○	-	-
X95/X96	Set "95" and "96" in any of **Pr.180 to Pr.189**.	Converter unit fault / Converter unit fault (E.OHT, E.CPU)	X95 signal OFF, X96 signal OFF Converter fault (E.OHT, E.CPU)	×	×	×
			X95 signal ON, X96 signal ON Converter normal	○	-	-
			X95 signal OFF, X96 signal ON Converter fault (other than E.OHT or E.CPU)	×	-*7	×

*1 When the X10 signal is not assigned to any input terminal using **Pr.178** to **Pr.189** while **Pr.30 Regenerative function selection** = "10 or 110", the MRS signal is used as the X10 signal. Assign the X10 signal to an input terminal not used for inputting the MRS signal. For the MRS signal, set "24" to any of **Pr.180 to Pr.189 (Input terminal function selection)** to assign the function to another terminal.
*2 When the MRS signal is OFF, neither the commercial power supply operation nor the inverter operation can be performed.
*3 Terminal CS is initially set to "no function". To enable CS signal, set "6" in **Pr.186 CS terminal function selection** to assign the function to a terminal. The CS signal operates only when the MRS signal is ON.
*4 STF(STR) operates only when the MRS and CS signals are both ON.
*5 The RES signal can be used for reset input acceptance with **Pr.75 Reset selection/disconnected PU detection/PU stop selection**. When RES signal and another input signal are simultaneously input, the MC operation by the RES signal has a higher priority.
*6 MC1 turns OFF at an inverter fault.
*7 When **Pr.138**="0 (electronic bypass invalid at a fault)", MC2 is OFF. When **Pr.138**="1 (electronic bypass valid at a fault)", MC2 is ON.
*8 MC operation is as shown below.

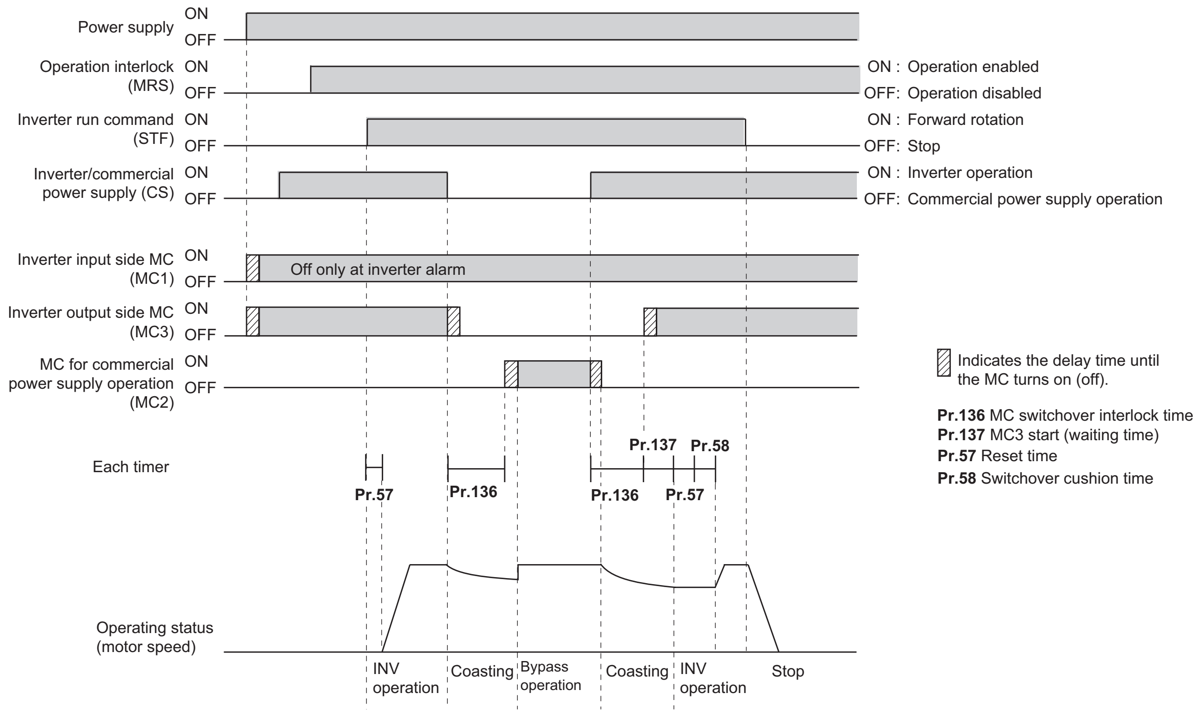
Notation	MC operation
○	ON
×	OFF
—	During inverter operation: MC2-OFF, MC3-ON During commercial power supply operation: MC2-ON, MC3-OFF
No change	The operation status before changing the signal state to ON or OFF is held.

• The output signals are as shown below.

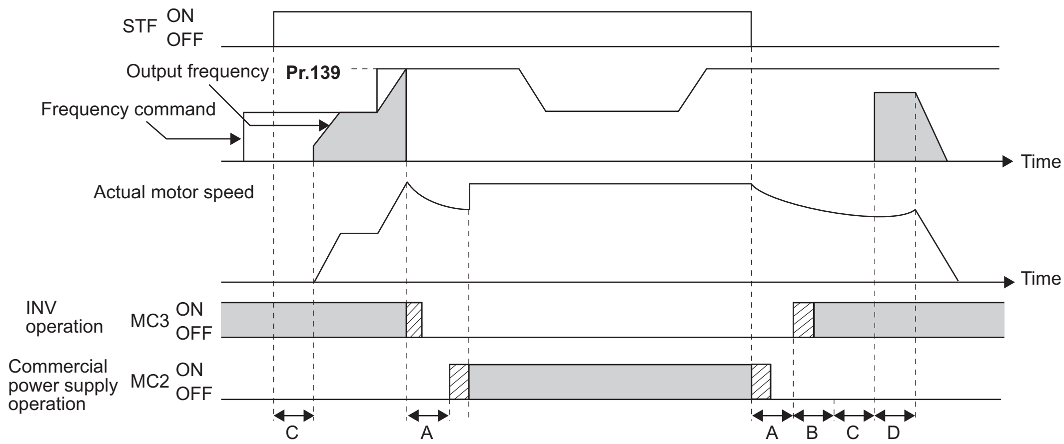
Signal	Applied terminal (Pr.190 to Pr.196 setting)	Description
MC1	17	Operation output signal of the magnetic contactor MC1 on the inverter's input side.
MC2	18	Operation output signal of the magnetic contactor MC2 for the commercial power supply operation.
MC3	19	Operation output signal of the magnetic contactor MC3 on the inverter's output side.

◆ Electronic bypass operation sequence

- Example of operation sequence without automatic bypass sequence (**Pr.139** = "9999")



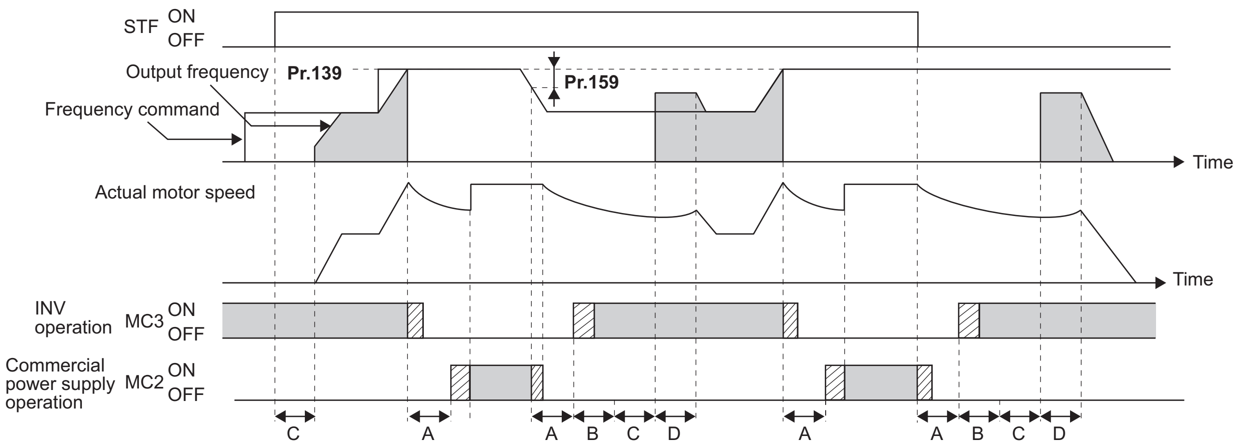
- Example of operation sequence with automatic bypass sequence (**Pr.139** ≠ "9999", **Pr.159** = "9999")



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

5

• Example of operation sequence with automatic bypass sequence (**Pr.139** ≠ "9999", **Pr.159** ≠ "9999")



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

Operating procedure

• Operation flowchart

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

• **Pr.135** = "1"
• **Pr.136** = "2.0 s"
• **Pr.137** = "1.0 s" (Set the time until MC3 is actually turned ON and the inverter and motor are electrically connected. If the time is short, the restart may not function properly.)
• **Pr.57** = "0.5 s"
• **Pr.58** = "0.5 s" (Always set this to switchover from the commercial power supply operation to the inverter operation.)

• Signal operation after setting parameters

Status	MRS	CS	STF	MC1	MC2	MC3	Remarks
Power ON	OFF (OFF)	OFF (OFF)	OFF (OFF)	OFF→ON (OFF→ON)	OFF (OFF)	OFF→ON (OFF→ON)	External operation mode (PU operation mode)
At start (Inverter)	OFF→ON	OFF→ON	OFF→ON	ON	OFF	ON	
During constant-speed operation (commercial power supply)	ON	ON→OFF	ON	ON	OFF→ON	ON→OFF	MC2 turns ON after MC3 turns OFF. Waiting time is 2 s (while coasting).
For deceleration, switched to the inverter operation (inverter)	ON	OFF→ON	ON	ON	ON→OFF	OFF→ON	MC3 turns ON after MC2 turns OFF. Waiting time is 4 s (while coasting).
Stop	ON	ON	ON→OFF	ON	OFF	ON	

NOTE

- Connect the control power (R1/L11, S1/L21) in front of the input-side MC1. If the control power is connected behind the input-side MC1, the electronic bypass sequence function will not operate.
- The electronic bypass sequence function is enabled only when **Pr.135** = "1" and the inverter is in either External operation mode, PU/External combined operation mode 1 (**Pr.79** = "3"), or Network operation mode. MC1 and MC3 turn ON when **Pr.135** = "1" and in an operation mode other than mentioned above.
- MC3 turns ON when the MRS and CS signals are ON and the STF(STR) signal is OFF. If the motor was coasted to a stop from commercial power supply operation at the previous stop, the motor starts running only after waiting the time set in **Pr.137**.
- Inverter operation is only available when the MRS, STF(STR), and CS signals are ON. In all other cases (when the MRS signal is ON), commercial power supply operation is available.
- When the CS signal is OFF, the motor switches to the commercial power supply operation. However, when the STF(STR) signal is OFF, the motor decelerates to a stop during inverter operation.
- From the point where MC2 and MC3 are both turned OFF, there is a waiting time set in **Pr.136**, till MC2 or MC3 is turned ON.
- Even when the electronic bypass sequence is enabled (**Pr.135** = "1"), the **Pr.136 and Pr.137** settings are ignored in PU operation mode. In addition, the input terminals (STF, CS, MRS, OH) return to perform their normal functions.
- When the electronic bypass sequence function (**Pr.135** = "1") and PU operation interlock function (**Pr.79** = "7") are used at the same time, the MRS signal is shared with the PU operation external interlock if the X12 signal is not assigned. (The inverter operation is available when the MRS and CS signals are ON.)
- Set the acceleration time to the level that does not activate the stall prevention operation.
- When switching to the commercial power supply operation while a failure such as an output short circuit is occurring between the magnetic contactor MC3 and the motor, the damage may further spread. When a failure occurs between the MC3 and motor, make sure to provide a protection circuit, such as using the OH signal input.
- Changing the terminal functions with **Pr.178 to Pr.189 and Pr.190 to Pr.196** may affect other functions. Set parameters after confirming the function of each terminal.
- Switching with the electronic bypass sequence is not available during retry. Switching occurs after the retry. When the electronic bypass is valid at a fault (**Pr.138** = "1"), switching occurs also during retry.
- When the electronic bypass sequence function and the retry function of the converter unit are used at the same time for the separated converter type, set 101 or more in the number of retries at fault occurrence (**Pr.67**) on the converter unit side. When a value less than 100 is set, ALM signal does not turn ON until the retry count is exceeded. In this case, the electronic bypass at a fault is not performed until the retry count is exceeded.

◆ Operation in combination with the self power management function for the separated converter type

- When the self power management function is used with the separated converter type, the input signal operations are as follows.

X95 (Converter unit fault)	X96 (Converter unit fault (E.OHT, E.CPU))	X94 (Control signal for main circuit power supply MC)	MC operation*3			Converter status
			MC1	MC2	MC3	
OFF	OFF	ON	○*2	×	×	Converter fault (E.OHT (**Pr.248**="2"))
		OFF	×	×	×	Converter fault (E.OHT (**Pr.248**="1"), E.CPU)
ON	ON	ON	○*2	-	-	Converter normal
OFF	ON	ON	○*2	-*1	×	Converter fault (other than the circuit failure fault or E.OHT) (**Pr.248**="2")
		OFF	×	-*1	×	Converter fault (other than E.OHT or E.CPU)

*1 When **Pr.138**="0 (electronic bypass invalid at a fault)", MC2 is OFF. When **Pr.138**="1 (electronic bypass valid at a fault)", MC2 is ON.
*2 The self power management operation is followed.
*3 MC operation is as shown below.

Notation	MC operation
○	ON
×	OFF
—	During inverter operation: MC2-OFF, MC3-ON During commercial power supply operation: MC2-ON, MC3-OFF

Parameters referred to

Pr.11 DC injection brake operation time ☞ page 546
Pr.57 Restart coasting time ☞ page 448
Pr.58 Restart cushion time ☞ page 448
Pr.79 Operation mode selection ☞ page 204
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

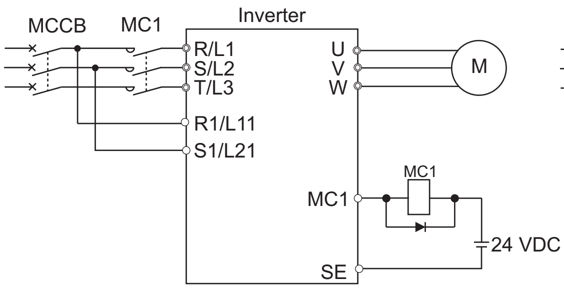
5.11.2 Self power management

By turning ON the magnetic contactor (MC) on the input side before the motor is started and turning OFF the MC after the motor is stopped, power is not supplied to the main circuit, reducing the standby power.

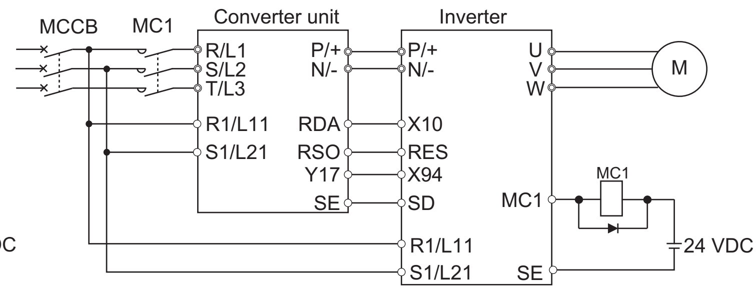
Pr.	Name	Initial value	Setting range	Description
248 A006	**Self power management selection**	0	0	Self power management function disabled
			1	Self power management function enabled (main circuit OFF at protective function activation)
			2	Self power management function enabled (main circuit OFF at protective function activation due to a circuit failure)
137 A002	**Start waiting time**	0.5 s	0 to 100 s	Set a time period that is a little longer than the time period from the ON signal input to the actual pick-up operation of MC1 (0.3 to 0.5 s).
254 A007	**Main circuit power OFF waiting time**	600 s	1 to 3600 s	Set the waiting time until the main circuit power supply is turned OFF after the motor is stopped.
			9999	The main circuit power supply is turned OFF only when the protective function selected by **Pr.248** is activated.
30 E300	**Regenerative function selection**	0	100, 101	Power supply to the inverter: AC (terminals R, S, and T) When power is supplied only to the control circuit, and then switched to be supplied to both the control and main circuits, inverter reset is not performed.
			0 to 2, 10, 11, 20, 21, 102, 110, 111, 120, 121	For other settings, refer to page 553.

◆ Connection diagram

- Terminal R1, S1 inputs

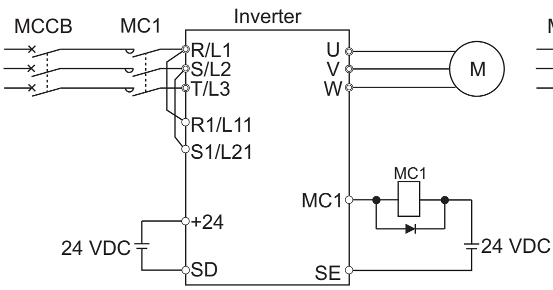


Standard models

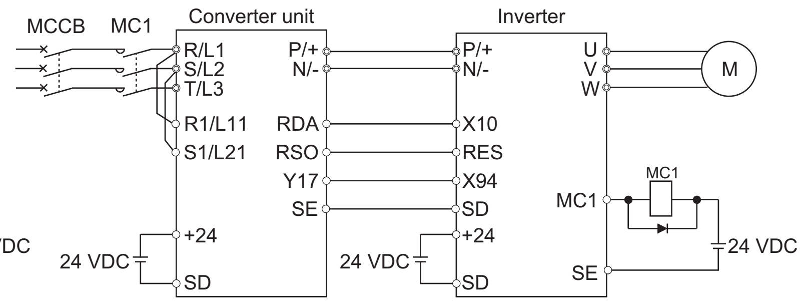


Separated converter type

- 24 V external power supply input



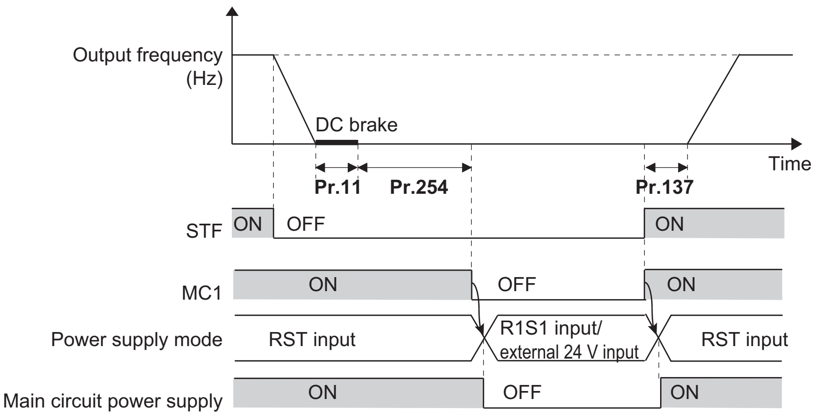
Standard models



Separated converter type

◆ Operation of the self power management function

- This function controls the magnetic contactor (MC) on the input side using the output relay to reduce the standby power during inverter stop. With the terminals R1/L11 and S1/L21 (refer to page 60) and 24 V external power supply input (refer to page 63), the main circuit power supply and control circuit power supply are separated, and the MC for main circuit power supply is controlled by the electronic bypass MC1 signal.
- Set **Pr.248 Self power management selection** = "1 or 2", **Pr.30 Regenerative function selection** ≠ "20, 21, 120, or 121" (other than DC feeding mode 2), and **Pr.190 to Pr.196 (Output terminal function selection)** = "17 (positive logic)" to assign the Electronic bypass MC1 (MC1) signal to an output terminal.
- After the inverter is stopped and the time set in **Pr.11 DC injection brake operation time** and **Pr.254 Main circuit power OFF waiting time** have passed, turning OFF the MC1 signal releases the MC on the input side (main circuit power supply OFF). Set **Pr.254** to prevent frequent MC operation.
- Turning ON the start signal turns ON the MC1 signal and closes the MC on the input side (main circuit power supply ON). After the time set in **Pr.137 Start waiting time** has passed, the inverter starts. Set time slightly longer (about 0.3 to 0.5 s) than the time period from the MC1-ON to the actual pick-up operation of the MC is turned ON in **Pr.137**.



- When the protective function of the inverter is activated, the MC1 signal is immediately turned OFF according to the **Pr.248** setting. (The MC1 signal is turned OFF before the time set in **Pr.254** has passed.) When **Pr.248**="1", the MC1 signal is turned OFF when the protective function is activated due to any cause. When **Pr.248**="2", the MC1 signal is turned OFF only when the protective function is activated due to an error resulted from a failure in the inverter circuit or a wiring error (refer to the following table). (For the alarm details, refer to page 570.)

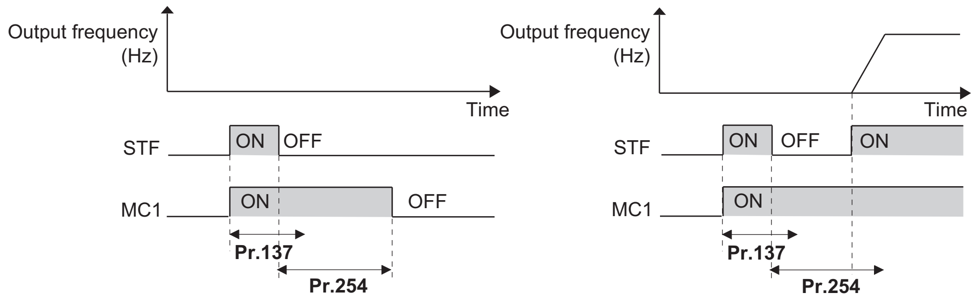
Fault record
Inrush current limit circuit fault (E.IOH)
CPU fault (E.CPU)
CPU fault (E.6)
CPU fault (E.7)
Parameter storage device fault (control circuit board) (E.PE)
Parameter storage device fault (main circuit board) (E.PE2)
24 VDC power fault (E.P24)
Operation panel power supply short circuit/RS-485 terminals power supply short circuit (E.CTE)
Output side earth (ground) fault overcurrent (E.GF)
Output phase loss (E.LF)
Internal circuit fault (E.BE)
Internal circuit fault (E.13/E.PBT)

- To enable the self power management function for the separated converter type, enable the self power management function also on the converter unit side. To activate the self power management function when a converter unit fault occurs, connect the terminal to which Y17 signal of the converter unit is assigned and the terminal to which X94 signal of the inverter is assigned.

Y17 output signal (on the converter unit side)	MC1 output signal (inverter side)	MC1 output signal actual operation	Main circuit power supply
OFF	OFF	OFF	Stop
OFF	ON	OFF	Stop
ON	OFF	OFF	Stop
ON	ON	ON	Supplied

NOTE

- When the start signal is turned OFF before the time set in **Pr.137** has passed after the start signal is turned ON, the inverter does not start and the MC1 signal is turned OFF after the time set in **Pr.254** has passed. If the start signal is turned ON again before the time set in **Pr.254** has passed, the inverter immediately starts outputting.



- At inverter reset, the status of the MC1 signal is held and operation of the magnetic contactor is not performed.
- When the inverter stops the output due to, for example, the Output stop (MRS) signal, the MC1 signal is turned OFF after the time set in **Pr.254** has passed.
- During the stop, turning ON the External DC injection brake operation start signal (X13) turns ON the MC1 signal.
- To avoid inverter reset when starting to supply power to the main circuit when power is already supplied only to the control circuit, set 100 or more in **Pr.30**. (For the separated converter type, setting **Pr.30** of the converter unit is also required.)
- When supplying power to the main circuit is started when power is supplied only to the control circuit, there is a little waiting time before starting.
- Repeated operation of the magnetic contactor due to frequent start and stop or activation of the protective function may shorten the inverter life.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection) and Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.11 DC injection brake operation time ☞ page 546
Pr.30 Regenerative function selection ☞ page 553
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

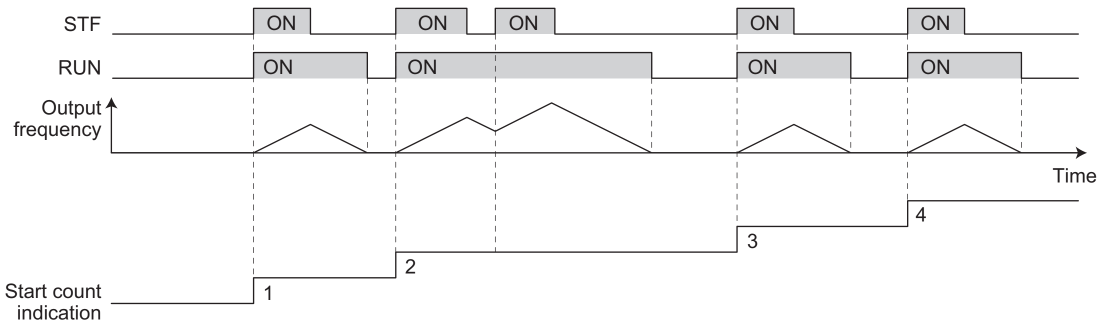
5.11.3 Start count monitor

The inverter starting times can be counted.

Confirming the starting times can be used to determinate the timing of the maintenance, using as a reference for system inspection or parts replacement.

Pr.	Name	Initial value	Setting range	Description
1410 **A170**	**Starting times lower 4 digits**	0	0 to 9999	Displays the lower four digits of the number of the inverter starting times.
1411 **A171**	**Starting times upper 4 digits**	0	0 to 9999	Displays the upper four digits of the number of the inverter starting times.

- Every start signal input (the RUN signal ON) while the inverter output is stopped is counted as the inverter starting time.



- The lower four digits of the number of starting times is displayed in **Pr.1410 Starting times lower 4 digits**, and the upper four digits of the number of starting times is displayed in **Pr.1411 Starting times upper 4 digits**.
- The maximum count is "99999999". When "99999999" is exceeded on the monitor, the monitor value is reset to "0".

Display data		PU display
10000	**Pr.1410** (Lower digits monitor)	0
	Pr.1411 (Upper digits monitor)	1
100	**Pr.1410** (Lower digits monitor)	100
	Pr.1411 (Upper digits monitor)	0

NOTE

- Any value can be set in **Pr.1410** or **Pr.1411**. Set "0" to clear the number on the monitor.
- Starting during offline auto tuning is not counted.
- The counting is enabled even if the RUN signal is not assigned to an output terminal.
- For the RUN signal, refer to page 297.
- Starting during test operation (**Pr.800** ="9") is not counted.

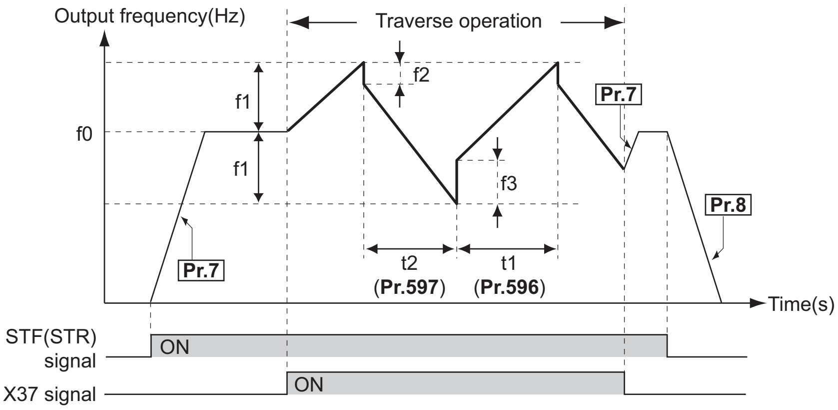
5.11.4 Traverse function

The traverse operation, which oscillates the frequency at a constant cycle, is available.

Pr.	Name	Initial value	Setting range	Description
592 A300	**Traverse function selection**	0	0	Traverse function invalid
			1	Traverse function valid only in External operation mode
			2	Traverse function valid regardless of the operation mode
593 A301	**Maximum amplitude amount**	10%	0 to 25%	Level of amplitude during traverse operation
594 A302	**Amplitude compensation amount during deceleration**	10%	0 to 50%	Compensation amount during amplitude inversion (from acceleration to deceleration)
595 A303	**Amplitude compensation amount during acceleration**	10%	0 to 50%	Compensation amount during amplitude inversion (from deceleration to acceleration)
596 A304	**Amplitude acceleration time**	5 s	0.1 to 3600 s	Time period of acceleration during traverse operation
597 A305	**Amplitude deceleration time**	5 s	0.1 to 3600 s	Time period of deceleration during traverse operation

5

- Setting **Pr.592 Traverse function selection** = "1 or 2" will enable the traverse function.
- Assigning the Traverse function selection (X37) signal to the input terminal will enable the traverse function only when the X37 signal is ON. (When the X37 signal is not assigned, the traverse function is always available.) To input the X37 signal, set "37" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to a terminal.



f0: set frequency
f1: amplitude amount from the set frequency (f0 × **Pr.593**/100)
f2: compensation amount at transition from acceleration to deceleration (f1 × **Pr.594**/100)
f3: compensation amount at transition from deceleration to acceleration (f1 × **Pr.595**/100)
t1: time from acceleration during traverse operation (Time from (f0 – f1) to (f0 + f1)) (**Pr.596**)
t2: time from deceleration during traverse operation (Time from (f0 + f1) to (f0 – f1)) (**Pr.597**)

- The motor accelerates to the set frequency f0 according to the normal **Pr.7 Acceleration time** at turn ON of the start command (STF or STR).
- When the output frequency reaches f0 and the X37 signal turns ON, the inverter begins traverse operation and accelerates to f0 + f1. The acceleration time at this time is according to the **Pr.596** setting. (If the X37 signal turns ON before the output frequency reaches f0, traverse operation begins after the output frequency reaches f0.)
- After the inverter accelerates to f0 + f1, this is compensated with f2 (f1 × **Pr.594**), and the inverter decelerates to f0 - f1. The deceleration time at this time is according to the **Pr.597** setting.
- After the inverter decelerates to f0 - f1, this is compensated with f3 (f1 × **Pr.595**), and the inverter accelerates again to f0 + f1.
- When the X37 signal turns OFF during traverse operation, the inverter 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 inverter decelerates to a stop according to the normal deceleration time (**Pr.8**).

NOTE

- If the set frequency (f0) and traverse operation parameters (**Pr.593 to Pr.597**) are changed during traverse operation, this is applied in operations after the output frequency reaches f0 before the change was made.
- If the output frequency exceeds **Pr.1 Maximum frequency** or **Pr.2 Minimum frequency** during traverse operation, the output frequency is clamped at the maximum/minimum frequency when the set pattern exceeds the maximum/minimum frequency.
- When the traverse function and S-pattern acceleration/deceleration (**Pr.29** ≠ "0") are selected, S-pattern acceleration/deceleration operation occurs only in the range operated at the normal acceleration/deceleration time (**Pr.7, Pr.8**). Acceleration/deceleration during traverse operation is performed linearly.
- If stall prevention activates during traverse operation, traverse operation stops and normal operation begins. When stall prevention operation is completed, the inverter accelerates/decelerates to f0 at the normal acceleration/deceleration time (**Pr.7, Pr.8**). After the output frequency reaches f0, the traverse operation begins again.
- If the value of the amplitude inversion compensation amount (**Pr.594, Pr.595**) is too large, an overvoltage trip or stall prevention occurs, and pattern operation cannot be performed as set.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.3 Base frequency ☞ page 539
Pr.180 to Pr.186 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.195 (Output terminal function selection) ☞ page 297

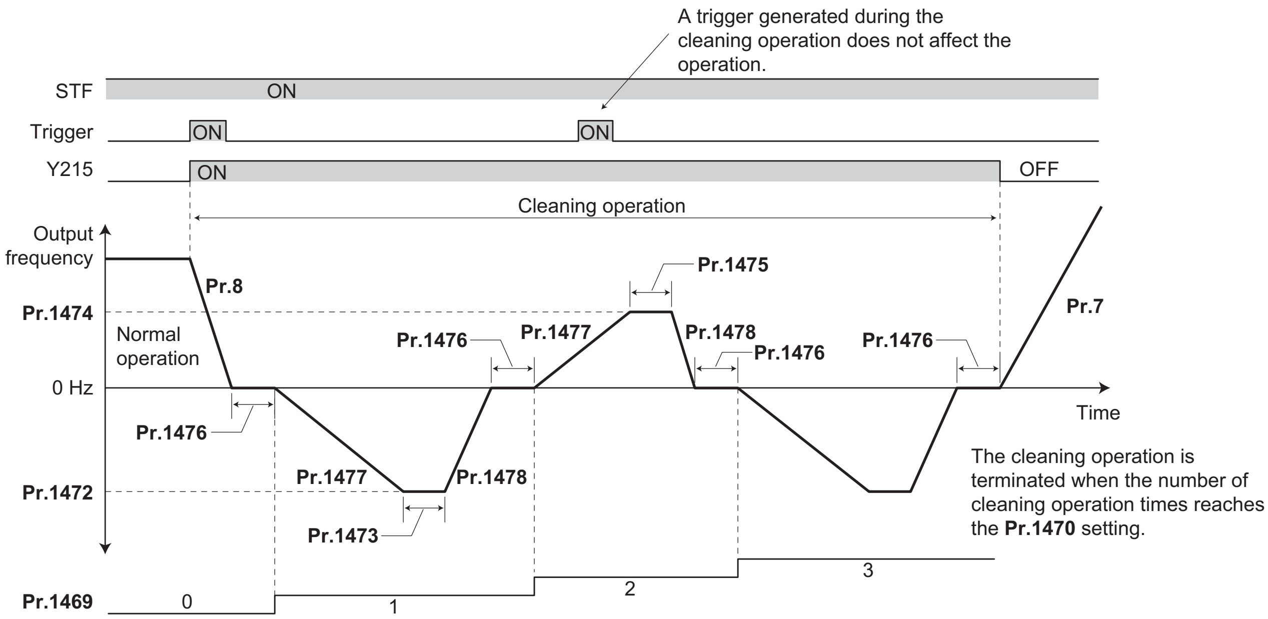
5.11.5 Cleaning function

This is a function to remove stains or foreign matter on the impellers or fans of pumps by setting a forward/reverse rotation sequence.

Pr.	Name	Initial value	Setting range	Description
1469 A420	**Number of cleaning times monitor**	0	0 to 255	Displays the number of cleaning times. (Read-only)
1470 A421	**Number of cleaning times setting**	0	0 to 255	Set the number of cleaning times.
1471 A422	**Cleaning trigger selection**	0	0 to 15	Select the condition to start cleaning.
1472 A423	**Cleaning reverse rotation frequency**	30 Hz	0 to 590 Hz	Set the reverse rotation frequency for cleaning operation.
1473 A424	**Cleaning reverse rotation operation time**	5 s	0 to 3600 s	Set the operating time after the cleaning reverse rotation frequency is reached.
1474 A425	**Cleaning forward rotation frequency**	9999	0 to 590 Hz	Set the forward rotation frequency for cleaning operation.
			9999	As set in **Pr.1472**.
1475 A426	**Cleaning forward rotation operation time**	9999	0 to 3600 s	Set the operating time after the cleaning forward rotation frequency is reached.
			9999	As set in **Pr.1473**.
1476 A427	**Cleaning stop time**	5 s	0 to 3600 s	Set the stop time when the rotation is switched from forward to reverse or from reverse to forward.
1477 A428	**Cleaning acceleration time**	9999	0 to 3600 s	Set the acceleration time during cleaning.
			9999	Acceleration time for normal operation
1478 A429	**Cleaning deceleration time**	9999	0 to 3600 s	Set the deceleration time during cleaning.
			9999	Deceleration time for normal operation
1479 A430	**Cleaning time trigger**	0	0	Time trigger disabled
			0.1 to 6000 h	Cleaning is performed at a set time interval.

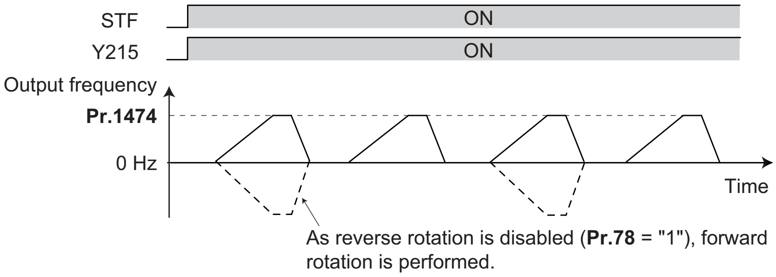
◆ Outline of the cleaning operation

- Setting a number in **Pr.1470 Number of cleaning times setting** enables the cleaning function.
- The cleaning operation is started when the trigger set in **Pr.1471** or **Pr.1479** occurs, or when X98 signal turns ON. When the cleaning is started initially, the operation in the opposite direction to the start command is performed.



- When the number of times of cleaning operation is an odd number, the operation in the opposite direction to the start command is performed. When the number of cleaning times is an even number, the operation in the start command direction is performed.

• When the motor rotation direction is restricted in **Pr.78 Reverse rotation prevention selection**, rotation is performed not in the prohibited direction but in the permitted direction.



• Use **Pr.1472 Cleaning reverse rotation frequency** and **Pr.1474 Cleaning forward rotation frequency** to set the running frequency for cleaning operation, and use **Pr.1473 Cleaning reverse rotation operation time** and **Pr.1475 Cleaning forward rotation operation time** to set the operating time after the cleaning running frequency is reached.
• Use **Pr.1477 Cleaning acceleration time** and **Pr.1478 Cleaning deceleration time** to set the acceleration/deceleration time during cleaning operation.
• Y215 signal turns ON during cleaning operation. For the Y215 signal, assign the function by setting "215 (positive logic)" or "315 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.

◆ Cleaning trigger selection (Pr.1471, Pr.1479, X98 signal)

• Use **Pr.1471 Cleaning trigger selection** the trigger to start cleaning operation. As set in **Pr.1471**, cleaning operation is started when any of the applicable trigger conditions is satisfied.

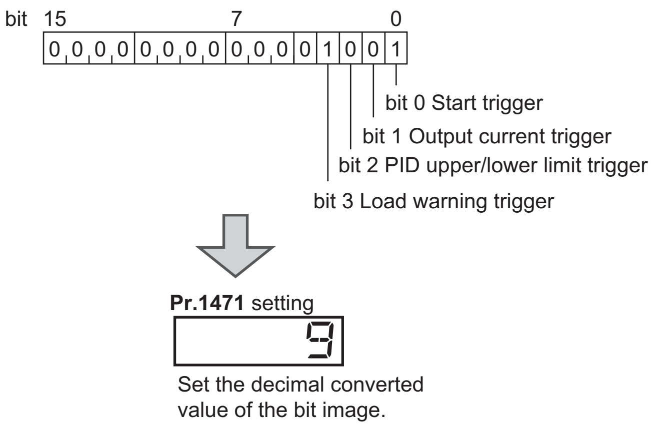
Pr.1471 setting	Trigger factor	Value in each bit		Remarks
		0	1	
Bit 0	Start trigger	Trigger disabled	Trigger enabled	Turning ON of the start command is defined as a trigger. *1*6*7
Bit 1	Output current	Trigger disabled	Trigger enabled	Turning ON of Y12 signal is defined as a trigger. *2*5
Bit 2	PID upper/lower limit	Trigger disabled	Trigger enabled	Turning ON of FUP, FDN, FUP2, or FDN2 signal is defined as a trigger. *3*5
Bit 3	Load warning	Trigger disabled	Trigger enabled	Turning ON of LUP or LDN signal is defined as a trigger. *4*5
-	X98 signal input	-		Turning ON of X98 signal is defined as a trigger. (This trigger is always enabled by assigning X98 signal to an input terminal.)
-	Time trigger	-		When **Pr.1479** ≠ "0", the trigger is enabled.

*1 The ON state at power-ON or inverter reset is not regarded as a trigger.
*2 Use **Pr.150 and Pr.151** to set the detection level. (Refer to page 307.)
*3 Use **Pr.131, Pr.132, Pr.1143, and Pr.1144** to set the detection level. When the frequency reflection is not provided for the PID setting, or when the function is disabled, a trigger does not occur. (Refer to page 396.)
*4 Set the load characteristics fault detection function. When the function is disabled, a trigger does not occur. (Refer to page 265.)
*5 The output signal can be used as a trigger if the signal is not assigned to a terminal.
*6 When the automatic restart after instantaneous power failure is set for every start, or when the online auto tuning is enabled, cleaning is started upon completion of the set operations.
*7 While the self power management is enabled, the start trigger is disabled.

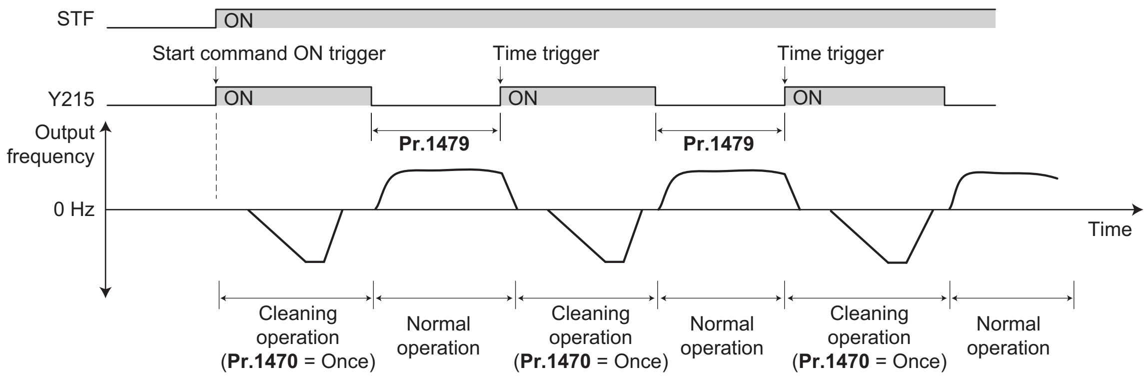
• Convert a bit image (binary) of the trigger factor into a decimal value, and set the value in **Pr.1471**.

Pr.1471		bit 3	bit 2	bit 1	bit 0
Decimal	Binary				
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	×	×	×	×

○: Trigger enabled, ×: Trigger disabled



- Turning ON of X98 signal can be used as a trigger to start the cleaning operation. For the X98 signal input, set "98" in any of **Pr.178 to Pr.189** to assign the function.
- When using the cleaning function for the purpose of periodic maintenance in such applications that require continuous pump operation for a long time, use a time trigger. The time trigger is enabled by setting a time period before starting the cleaning operation in **Pr.1479 Cleaning time trigger**. The timer starts when the timer starting condition is satisfied, and the cleaning operation is performed at a time interval set in **Pr.1479**.
- Starting conditions of the timer for a time trigger
  When the start command turns ON
  When the cleaning ends



◆ Cleaning operation by the cleaning signal (X97 signal)

- When the X97 signal is assigned to an input terminal, the cleaning operation can be finished when the cleaning signal (X97) is turned from ON to OFF.
- For the X97 signal input, set "97" in any of **Pr.178 to Pr.189** to assign the function.

Pr.1470 setting	X97 signal		Cleaning operation	Cleaning end condition
	Assignment	ON/OFF		
0	Optional	Optional	Invalid	-
Other than 0	Not assigned	-	Enabled	After cleaning is performed for the number of times set in **Pr.1470**
	Assigned	OFF	Invalid	-
		ON	Enabled	• After cleaning is performed for the number of times set in **Pr.1470** • When X97 signal turns OFF

NOTE

- When a trigger occurs during the following operations, the cleaning operation is started upon completion of the following operations. Automatic restart after instantaneous power failure, online auto tuning at startup
- The following functions are disabled during cleaning operation. PID control automatic switchover frequency, PID control sleep function, pre-charge fault, determination of pre-charge ending with parameters, PID gain tuning, electronic bypass with the automatic switchover frequency of the inverter (**Pr.139**), automatic switchover of auxiliary motors of the multi-pump function, output stop function (**Pr.522**), restart at every start during cleaning
- When the stall prevention is activated during acceleration of the cleaning function, the operation is shifted to the cleaning deceleration operation.
- If the number of cleaning times set in **Pr.1470** is an even number, the operation is shifted to the normal operation after the cleaning forward/reverse operation time (**Pr.1473**/**Pr.1475**) of the final cleaning operation has elapsed.
- Changing the terminal assignment with **Pr.178 to Pr.189 and Pr.190 to Pr.196** may affect other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297
Pr.7 Acceleration time, Pr.8 Deceleration time ☞ page 190

5.11.6 PID control

Process control such as flow rate, air volume or pressure are possible on the inverter.

A feedback system can be configured and PID control can be performed using the terminal 2 input signal or parameter setting value as the set point, and the terminal 4 input signal as the feedback value.

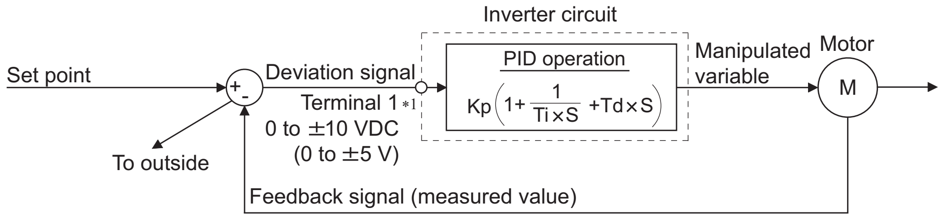
Pr.	Name	Initial value	Setting range	Description
127 A612	**PID control automatic switchover frequency**	9999	0 to 590 Hz	Set the value at which control is automatically switched to PID control.
			9999	Without PID control automatic switchover function
128 A610	**PID action selection**	0	0, 10, 11, 20, 21, 50, 51, 60, 61, 70, 71, 80, 81, 90, 91, 100, 101, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	Select how to input the deviation value, measured value and set point, and forward and reverse action.
129 A613	**PID proportional band**	100%	0.1 to 1000%	If a narrow proportional band is set (small parameter setting value), the manipulated amount changes considerably by slight changes in the measured value. As a result, response improves as the proportional band becomes narrower, though stability worsens as shown by the occurrence of hunting. Gain Kp=1/proportional band
			9999	Without proportional band
130 A614	**PID integral time**	1 s	0.1 to 3600 s	With deviation step input, this is the time (Ti) used for obtaining the same manipulated amount as proportional band (P) by only integral (I) action. Arrival to the set point becomes quicker the shorter an integral time is set, though hunting is more likely to occur.
			9999	Without integral control
131 A601	**PID upper limit**	9999	0 to 100%	Sets the upper limit. The FUP signal is output when the feedback value exceeds this setting. The maximum input (20 mA/5 V/10 V) of the measured value (terminal 4) is equivalent to 100%.
			9999	No function
132 A602	**PID lower limit**	9999	0 to 100%	Set the lower limit. The FDN signal is output when the measured value falls below the setting range. The maximum input (20 mA/5 V/10 V) of the measured value (terminal 4) is equivalent to 100%.
			9999	No function
133 A611	**PID action set point**	9999	0 to 100%	Set the set point during PID control.
			9999	Set point set by **Pr.128**.
134 A615	**PID differential time**	9999	0.01 to 10 s	With deviation ramp input, this is the time (Td) used for obtaining the manipulated amount only by proportional action (P). Response to changes in deviation increase greatly as the differential time increases.
			9999	Without differential control
553 A603	**PID deviation limit**	9999	0 to 100%	The Y48 signal is output when the absolute value of the deviation exceeds the deviation limit value.
			9999	No function
554 A604	**PID signal operation selection**	0	0 to 7, 10 to 17	The action when the upper or lower limit for a measured value input is detected or when a limit for the deviation is detected can be selected. The operation for PID output suspension function can be selected.
575 A621	**Output interruption detection time**	1 s	0 to 3600 s	If the status where the output frequency after PID calculation is less than the **Pr.576** setting is continuously the **Pr.575** set time or more, inverter running is suspended.
			9999	Without output interruption function
576 A622	**Output interruption detection level**	0 Hz	0 to 590 Hz	Set the frequency at which output interruption is performed.
577 A623	**Output interruption cancel level**	1000%	900 to 1100%	Level at which the PID output suspension function is released. Set "**Pr.577** -1000%".

Pr.	Name	Initial value	Setting range	Description	
609 A624	PID set point/deviation input selection	2	1	Input of set point, deviation value from terminal 1	
			2	Input of set point, deviation value from terminal 2	
			3	Input of set point, deviation value from terminal 4	
			4	Input of set point, deviation value via communication	
			5	Input of set point, deviation value by PLC function	
610 A625	PID measured value input selection	3	1	Terminal 1 input	Direct input of the measured value
			2	Terminal 2 input	
			3	Terminal 4 input	
			4	Communication input	
			5	PLC function input	
			101	Terminal 1 input	Input of the square root of the measured value
			102	Terminal 2 input	
			103	Terminal 4 input	
			104	Communication input	
			105	PLC function input	
1015 A607	Integral stop selection at limited frequency	0	0	Integral stopped at the limit, manipulation range of ±100%, integral cleared during output interruption	
			1	Integral continued at the limit, manipulation range of ±100%, integral cleared during output interruption	
			2	Integral stopped at the limit, manipulation range of 0 to 100%, integral cleared during output interruption	
			10	Integral stopped at the limit, manipulation range of ±100%, integral stopped during output interruption	
			11	Integral continued at the limit, manipulation range of ±100%, integral stopped during output interruption	
			12	Integral stopped at the limit, manipulation range of 0 to 100%, integral stopped during output interruption	
1346 A457	PID lower limit operation detection time	9999	0 to 900 s	Set the time from when the measured value input falls below the **Pr.132** setting until the FDN signal is output.	
			9999	As set in **Pr.1370**.	
1370 A442	Detection time for PID limiting operation	0 s	0 to 900 s	Set the time from when the measured value input exceeds the **Pr.131** or **Pr.132** setting until the FUP or FDN signal is output.	
1460 A683	PID multistage set point 1	9999	0 to 100%	Seven set points can be set according to the combination of the PDI1, PDI2, and PDI3 signals. 9999: Not selected	
1461 A684	PID multistage set point 2				
1462 A685	PID multistage set point 3				
1463 A686	PID multistage set point 4				
1464 A687	PID multistage set point 5				
1465 A688	PID multistage set point 6				
1466 A689	PID multistage set point 7				

Pr.	Name	Initial value	Setting range	Description	
753 A650	**Second PID action selection**	0	0, 10, 11, 20, 21, 50, 51, 60, 61, 70, 71, 80, 81, 90, 91, 100, 101, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	Refer to **Pr.128**.	Set the second PID control. For how to enable the second PID control, refer to page 412.
754 A652	**Second PID control automatic switchover frequency**	9999	0 to 590 Hz, 9999	Refer to **Pr.127**.	
755 A651	**Second PID action set point**	9999	0 to 100%, 9999	Refer to **Pr.133**.	
756 A653	**Second PID proportional band**	100	0.1 to 1000%, 9999	Refer to **Pr.129**.	
757 A654	**Second PID integral time**	1 s	0.1 to 3600 s, 9999	Refer to **Pr.130**.	
758 A655	**Second PID differential time**	9999	0.01 to 10 s, 9999	Refer to **Pr.134**.	
1140 A664	**Second PID set point/ deviation input selection**	2	1 to 5	Refer to **Pr.609**.	
1141 A665	**Second PID measured value input selection**	3	1 to 5, 101 to 105	Refer to **Pr.610**.	
1143 A641	**Second PID upper limit**	9999	0 to 100%, 9999	Refer to **Pr.131**.	
1144 A642	**Second PID lower limit**	9999	0 to 100%, 9999	Refer to **Pr.132**.	
1145 A643	**Second PID deviation limit**	9999	0 to 100%, 9999	Refer to **Pr.553**. (Y205 signal is output.)	
1146 A644	**Second PID signal operation selection**	0	0 to 7, 10 to 17	Refer to **Pr.554**.	
1147 A661	**Second output interruption detection time**	1 s	0 to 3600 s, 9999	Refer to **Pr.575**.	
1148 A662	**Second output interruption detection level**	0 Hz	0 to 590 Hz	Refer to **Pr.576**.	
1149 A663	**Second output interruption cancel level**	1000%	900 to 1100%	Refer to **Pr.577**.	

◆ Basic configuration of PID control

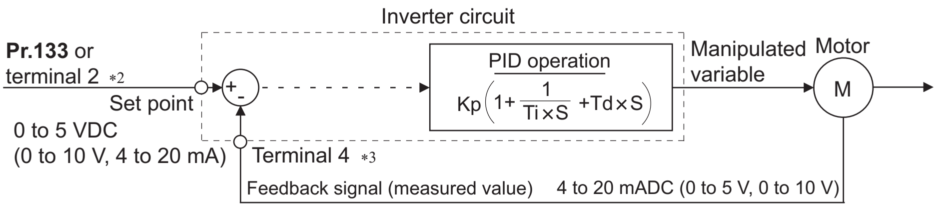
- **Pr.128** ="10, 11" (deviation value signal input)



Kp: Proportionality constant Ti: Integral time S: Operator Td: Differential time

*1 Set "0" to **Pr.868 Terminal 1 function assignment**. When **Pr.868** ≠ "0", PID control is invalid.

- **Pr.128** = "20, 21" (measured value input)



Kp: Proportionality constant Ti: Integral time S: Operator Td: Differential time

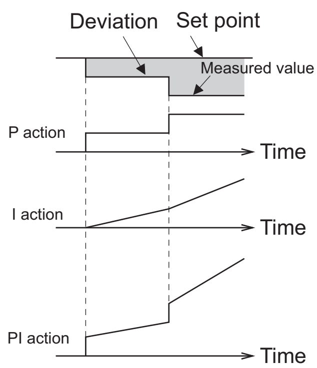
*2 Note that the input of terminal 1 is added to the set point of terminal 2 as a set point.
*3 Set "0" to **Pr.858 Terminal 4 function assignment**. When **Pr.858** ≠ "0", PID control is invalid.

◆ PID action outline

- PI action

PI action is a combination of proportional action (P) and integral action (I), and applies a manipulated amount according to the size of the deviation and transition or changes over time.

[Example of action when the measured value changes in a stepped manner]

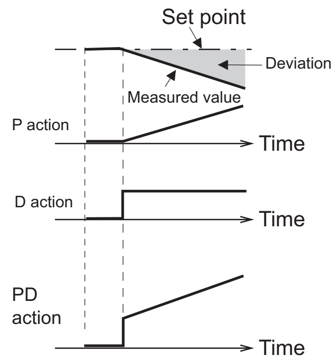


(Note) PI action is the result of P and I actions being added together.

• PD action

PD action is a combination of proportional action (P) and differential action (D), and applies a manipulated amount according to the speed of the deviation to improve excessive characteristics.

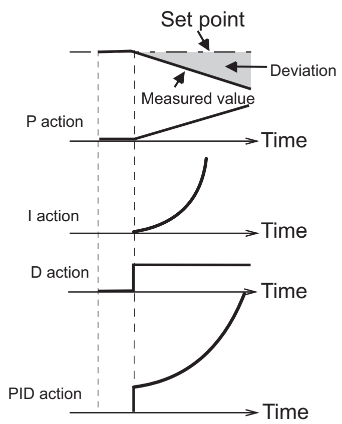
[Example of action when the measured value changes proportionately]



(Note) PD action is the result of P and D actions being added together.

• PID action

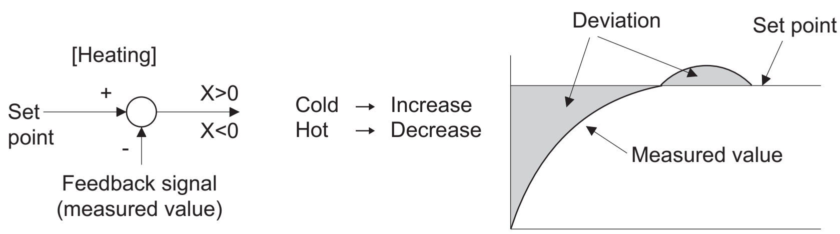
PID action is a combination of PI and PD action, which enables control that incorporates the respective strengths of these actions.



(Note) PID action is the result of all P, I and D actions being added together.

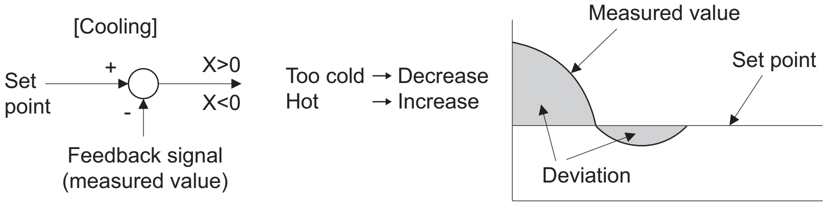
• Reverse action

When deviation X = (set point - measured value) is a plus value, the manipulated amount (output frequency) is increased, and when the deviation is a minus value, the manipulated amount is decreased.



- Forward action

When deviation X = (set point - measured value) is a minus value, the manipulated amount (output frequency) is increased, and when the deviation is a plus value, the manipulated amount is decreased.



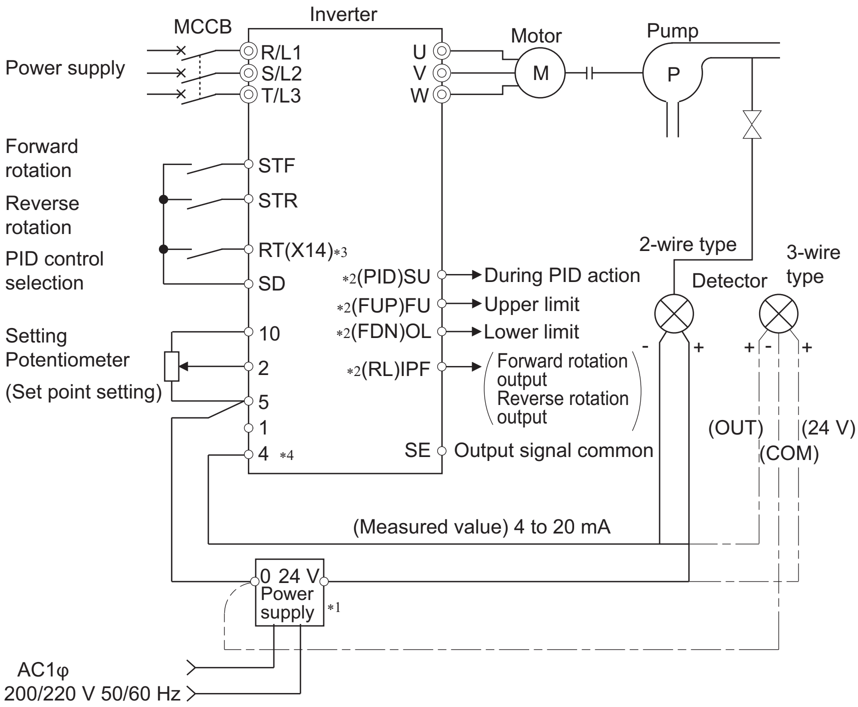
Relationship between deviation and manipulated amount (output frequency)

PID action setting	Deviation	
	Plus	Minus
Reverse action	↗	↘
Forward action	↘	↗

5

◆ Connection diagram

Sink logic
Pr.128=20
Pr.183=14
Pr.191=47
Pr.192=16
Pr.193=14
Pr.194=15



*1 Prepare a power supply matched to the power supply specification of the detector.
*2 The output signal terminal to be used differs according to the **Pr.190 to Pr.196 (Output terminal function selection)** setting.
*3 The input signal terminal to be used differs according to the **Pr.178 to Pr.189 (Input terminal function selection)** setting.
*4 The AU signal need not be input.

◆ Selection of deviation value, measured value and set point input method, and PID action method (Pr.128, Pr.609, Pr.610)

- Using **Pr.128**, select the input method for the PID set point, measured value detected by the meter, and externally calculated deviation. Also, select forward or reverse action.
- Switch the power voltage/current specifications of terminals 2 and 4 by **Pr.73 Analog input selection** or **Pr.267 Terminal 4 input selection** to match the specification of the input device. After changing the **Pr.73 and Pr.267** settings, check the voltage/current input selection switch. Incorrect setting may cause a fault, failure or malfunction. (Refer to page 318 for the setting.)

Pr.128 setting	Pr.609 Pr.610	PID action	Set point input	Measured value input	Deviation input
0	Invalid	PID invalid	—	—	—
10		Reverse action	—	—	Terminal 1
11		Forward action			
20		Reverse action	Terminal 2 or **Pr.133** *1	Terminal 4	—
21		Forward action			
50	Invalid	Reverse action	—	—	Communication*2
51		Forward action			
60		Reverse action	Communication*2	Communication*2	—
61		Forward action			
70		Reverse action	—	—	PLC function (with frequency reflected)*3
71		Forward action			
80		Reverse action	PLC function (with frequency reflected)*3	PLC function (with frequency reflected)*3	—
81		Forward action			
90		Reverse action	—	—	PLC function (without frequency reflected)*3
91		Forward action			
100		Reverse action	PLC function (without frequency reflected)*3	PLC function (without frequency reflected)*3	—
101		Forward action			

Pr.128 setting	Pr.609 Pr.610	PID action	Set point input	Measured value input	Deviation input
1000	Valid	Reverse action	According to **Pr.609** *1	According to **Pr.610**	—
1001		Forward action			
1010		Reverse action	—	—	According to **Pr.609**
1011		Forward action			
2000		Reverse action (without frequency reflected)	According to **Pr.609** *1	According to **Pr.610**	—
2001		Forward action (without frequency reflected)			
2010		Reverse action (without frequency reflected)	—	—	According to **Pr.609**
2011		Forward action (without frequency reflected)			

*1 When **Pr.133** ≠ "9999", the **Pr.133** setting is valid.

*2 BACnet MS/TP, CC-Link, CC-Link IE Field Network, or LONWORKS communication is available. For details on BACnet MS/TP protocol, refer to page 516. For details of other types of communication, refer to the Instruction Manual of each option.

*3 For details on the PLC function, refer to the PLC Function Programming Manual.

5

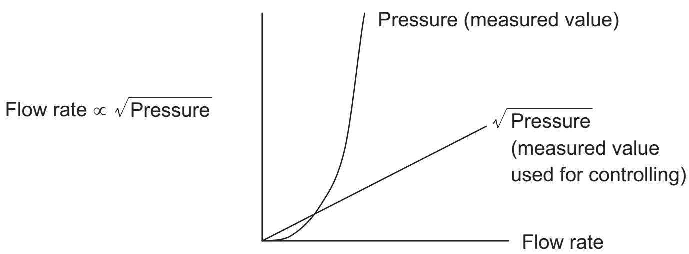
- The set point/deviation input method can also be flexibly selected by **Pr.609 PID set point/deviation input selection** and the measured value input method can be selected by **Pr.610 PID measured value input selection**. Selection by **Pr.609 and Pr.610** is valid when **Pr.128** = "1000 to 2011".

Setting value		Command source	Input method
Pr.609	Pr.610		
1	1	Terminal 1*4	Direct input
2	2	Terminal 2*4	
3	3	Terminal 4*4	
4	4	Communication*5	
5	5	PLC function	
—	101	Terminal 1*4	Square root input
—	102	Terminal 2*4	
—	103	Terminal 4*4	
—	104	Communication*5	
—	105	PLC function	

*4 When the same command source has been selected for the set point and measured value using **Pr.609** and **Pr.610**, set point input is invalid. (The inverter runs at set point 0%)

*5 BACnet MS/TP, CC-Link, CC-Link IE Field Network, or LONWORKS communication is available. For details on BACnet MS/TP protocol, refer to page 516. For details of other types of communication, refer to the Instruction Manual of each option.

- When **Pr.610 PID measured value input selection** = "101 to 105", the square root of the input value is used as the measured value.



NOTE

- When terminals 2 and 4 are selected for deviation input, perform bias calibration using **Pr.902** and **Pr.904** to prevent a minus voltage from being entered as the deviation input signal. Input of a minus voltage might damage devices and the inverter.

• The following shows the relationship between the input values of the analog input terminals and set point, measured value and deviation. (Calibration parameter initial values)

Input terminal	Inspect specification*6	Relationship with analog input			Calibration parameter
		Set point	Result	Deviation	
Terminal 2	0 to 5 V	0 V=0% 5 V=100%	0 V=0% 5 V=100%	0 V=0% 5 V=100%	**Pr.125, C2 to C4**
	0 to 10 V	0 V=0% 10 V=100%	0 V=0% 10 V=100%	0 V=0% 10 V=100%	
	0 to 20 mA	0 mA=0% 20 mA=100%	0 mA=0% 20 mA=100%	0 V=0% 20 mA=100%	
Terminal 1	0 to ±5 V	-5 V to 0 V=0% 5 V=+100%	-5 V to 0 V=0% 5 V=+100%	-5 V=-100% 0 V=0% 5 V=+100%	When **Pr.128** = "10", **Pr.125, C2 to C4**. When **Pr.128** ≥ "1000", **C12 to C15**.
	0 to ±10 V	-10 V to 0 V=0% 10 V=+100%	-10 V to 0 V=0% 10 V=+100%	-10 V=-100% 0 V=0% 10 V=+100%	
Terminal 4	0 to 5 V	0 V to 1 V=0% 5 V=100%	0 Vto 1 V=0% 5 V=100%	0 V=-20% 1 V=0% 5 V=100%	**Pr.126, C5 to C7**
	0 to 10 V	0 V to 2 V=0% 10 V=100%	0 V to 2 V=0% 10 V=100%	0 V=-20% 1 V=0% 10 V=100%	
	0 to 20 mA	0 to 4 mA=0% 20 mA=100%	0 to 4 mA=0% 20 mA=100%	0 V=-20% 4 mA=0% 20 mA=100%	

*6 Can be changed by **Pr.73 and Pr.267** and the voltage/current input switch. (Refer to page 318.)

NOTE

• Always perform calibration after changing the voltage/input specification with **Pr.73**, **Pr.267**, and the voltage/current input selection switch.

◆ Multistage set point input (Pr.1460 to Pr.1466)

• The set point can be selected by combining the ON/OFF status of the PDI1 to PDI3 signals. Up to eight set points can be selected. Use **Pr.1460 PID multistage set point 1 to Pr.1466 PID multistage set point 7** to set the target values for selection.
• When "9999" is set in the selected multistage set point parameter, PID control is performed according to the **Pr.128, Pr.609, and Pr.133** settings.

Selected set point	PDI1*1	PDI2*1	PDI3*1	Parameter for setting
—	OFF	OFF	OFF	As set in the **Pr.128** and **Pr.609** PID settings. As set **Pr.133** when **Pr.133**≠"9999".
Multistage set point 1	ON	OFF	OFF	**Pr.1460**
Multistage set point 2	OFF	ON	OFF	**Pr.1461**
Multistage set point 3	ON	ON	OFF	**Pr.1462**
Multistage set point 4	OFF	OFF	ON	**Pr.1463**
Multistage set point 5	ON	OFF	ON	**Pr.1464**
Multistage set point 6	OFF	ON	ON	**Pr.1465**
Multistage set point 7	ON	ON	ON	**Pr.1466**

*1 When functions are not assigned to the input terminals, the signals are treated as OFF.

NOTE

• The multistage set point input is not available for the second PID.
• The priority of the set point input is as follows: **Pr.1460 to Pr.1466** > **Pr.133** > **Pr.128**.

◆ Input/output signals

- Assigning the PID control valid terminal signal (X14) to the input terminal by **Pr.178 to Pr.189 (Input terminal function selection)** enables PID control to be performed only when the X14 signal is turned ON. When the X14 signal is OFF, regular inverter running is performed without PID action. (When the X14 signal is not assigned, PID control is enabled only by setting **Pr.128** ≠ "0".)
- Input signal

Signal	Function	Pr.178 to Pr.189 setting	Description
X14	PID control valid terminal	14	When the signal is assigned to the input terminal, PID control is enabled when the signal is ON.
X80	Second PID control valid terminal	80	
PDI1	PID multistage set point setting 1	38	The set point set in **Pr.1460 to Pr.1466** can be selected by combining the ON/OFF status of the signals.
PDI2	PID multistage set point setting 2	39	
PDI3	PID multistage set point setting 3	40	
X64	During retry	64	PID control is switched between forward and reverse action without changing parameters by turning ON the signal.
X79	Second PID forward/ reverse action switchover	79	
X72	PID P control switchover	72	Integral and differential values can be reset by turning the signal ON.
X73	Second PID P control switchover	73	

- Output signal

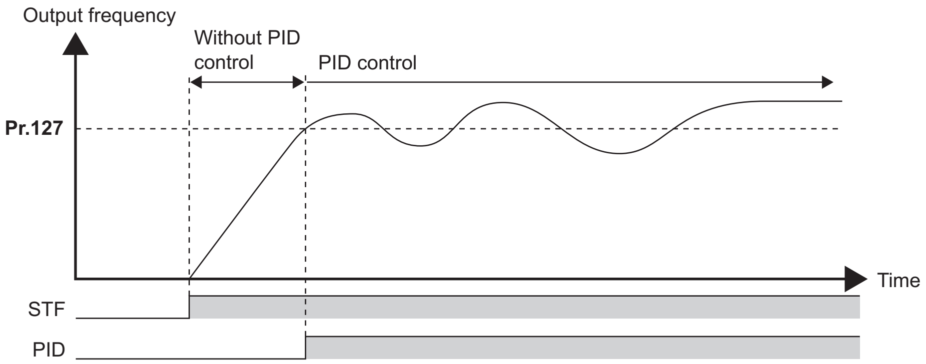
Signal	Function	Pr.190 to Pr.196 setting value		Description
		positive logic	negative logic	
FUP	PID upper limit	15	115	Output when the measured value signal exceeds **Pr.131 PID upper limit (Pr.1143 Second PID upper limit)**.
FUP2	Second PID upper limit	201	301	
FDN	PID lower limit	14	114	Output when the measured value signal falls below **Pr.132 PID lower limit (Pr.1144 Second PID lower limit)**.
FDN2	Second PID lower limit	200	300	
RL	PID forward/reverse rotation output	16	116	"Hi" is output when the output display of the parameter unit is forward rotation (FWD), and "Low" is output when the display is reverse rotation (REV) and stop (STOP).
RL2	Second PID forward/ reverse rotation output	202	302	
PID	During PID control activated	47	147	Turns ON during PID control. When the PID calculation result is reflected to the output frequency (**Pr.128** < "2000"), the PID signal turns OFF at turn OFF of the start signal. When the PID calculation result is not reflected to the output frequency (**Pr.128** ≥ "2000"), the PID signal turns ON during PID calculation regardless of the start signal status.
PID2	Second During PID control activated	203	303	
Y48	PID deviation limit	48	148	Output when the absolute deviation value exceeds the limit value set in **Pr.553 PID deviation limit (Pr.1145 Second PID deviation limit)**.
Y205	Second PID deviation limit	205	305	
SLEEP	PID output interruption	70	170	Set **Pr.575 Output interruption detection time (Pr.1147 Second output interruption detection time)** ≠ "9999". This signal turns ON when the PID output suspension function is activated.
SLEEP2	During second PID output shutoff	204	304	

NOTE

- Changing the terminal functions with **Pr.178 to Pr.189 and Pr.190 to Pr.196** may affect other functions. Set parameters after confirming the function of each terminal.

◆ PID automatic switchover control (Pr.127)

- The system can be started up more quickly by starting up without PID control activated.
- When **Pr.127 PID control automatic switchover frequency** is set, the startup is made without PID control until the output frequency reaches the **Pr.127** setting. Once the PID control starts, the PID control is continued even if the output frequency drops to **Pr.127** setting or lower.



◆ Selection of action at a communication error and sleep function stop selection (FUP signal, FDN signal, Y48 signal, Pr.554)

- Using **Pr.554 PID signal operation selection**, set the action when the measured value input exceeds the upper limit **(Pr.131 PID upper limit)** or lower limit **(Pr.132 PID lower limit)**, or when the deviation input exceeds the permissible value **(Pr.553 PID deviation limit)**.
- Set the time from when the measured value input exceeds the **Pr.131** or **Pr.132** setting until the FUP or FDN signal is output in **Pr.1370 Detection time for PID limiting operation**. To set the detection time for upper and lower limits separately, set **Pr.1346 PID lower limit operation detection time**.
- Set **Pr.554** to select the operation when the FUP/FDN or Y48 signal is output, and the operation when the sleep function is activated.

Pr.554 setting	Inverter operation		
	At FUP signal, FDN signal output[*1]	At Y48 signal output[*1]	At SLEEP operation start
0 (Initial value)	Signal output only	Signal output only	Coasts to stop
1	Signal output + output shutoff (E.PID)[*2]		
2	Signal output only	Signal output + output shutoff (E.PID)[*2]	
3	Signal output + output shutoff (E.PID)[*2]		
4	Signal output + deceleration stop (E.PID)[*3]	Signal output only	
5	Signal output + deceleration stop (restart)[*4]		
6	Signal output + deceleration stop (E.PID)[*3]	Signal output + output shutoff (E.PID)[*2]	
7	Signal output + deceleration stop (restart)[*4]		
10	Signal output only	Signal output only	Deceleration stop
11	Signal output + output shutoff (E.PID)[*2]		
12	Signal output only	Signal output + output shutoff (E.PID)[*2]	
13	Signal output + output shutoff (E.PID)[*2]		
14	Signal output + deceleration stop (E.PID)[*3]	Signal output only	
15	Signal output + deceleration stop (restart)[*4]		
16	Signal output + deceleration stop (E.PID)[*3]	Signal output + output shutoff (E.PID)[*2]	
17	Signal output + deceleration stop (restart)[*4]		

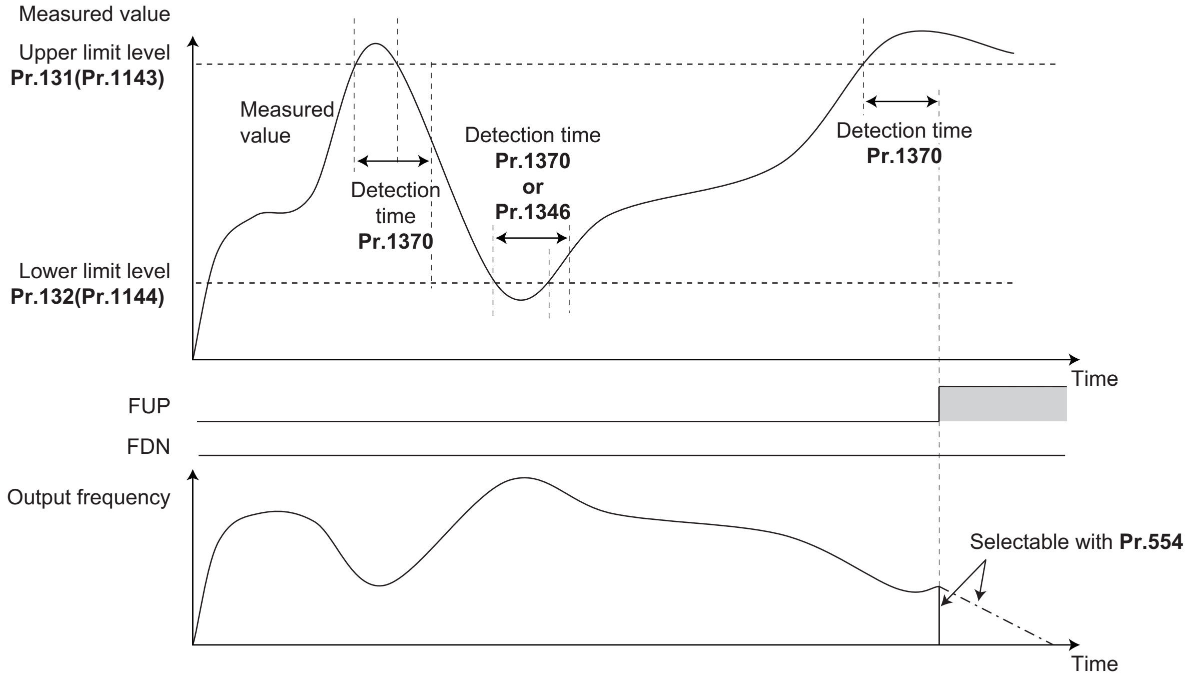
*1 When each of **Pr.131, Pr.132 and Pr.553** corresponding to each of the FUP, FDN and Y48 signals is set to "9999" (function not activated), signal output and protective function are disabled.

*2 At the same time with the signal output, the protective function (E.PID) is activated.

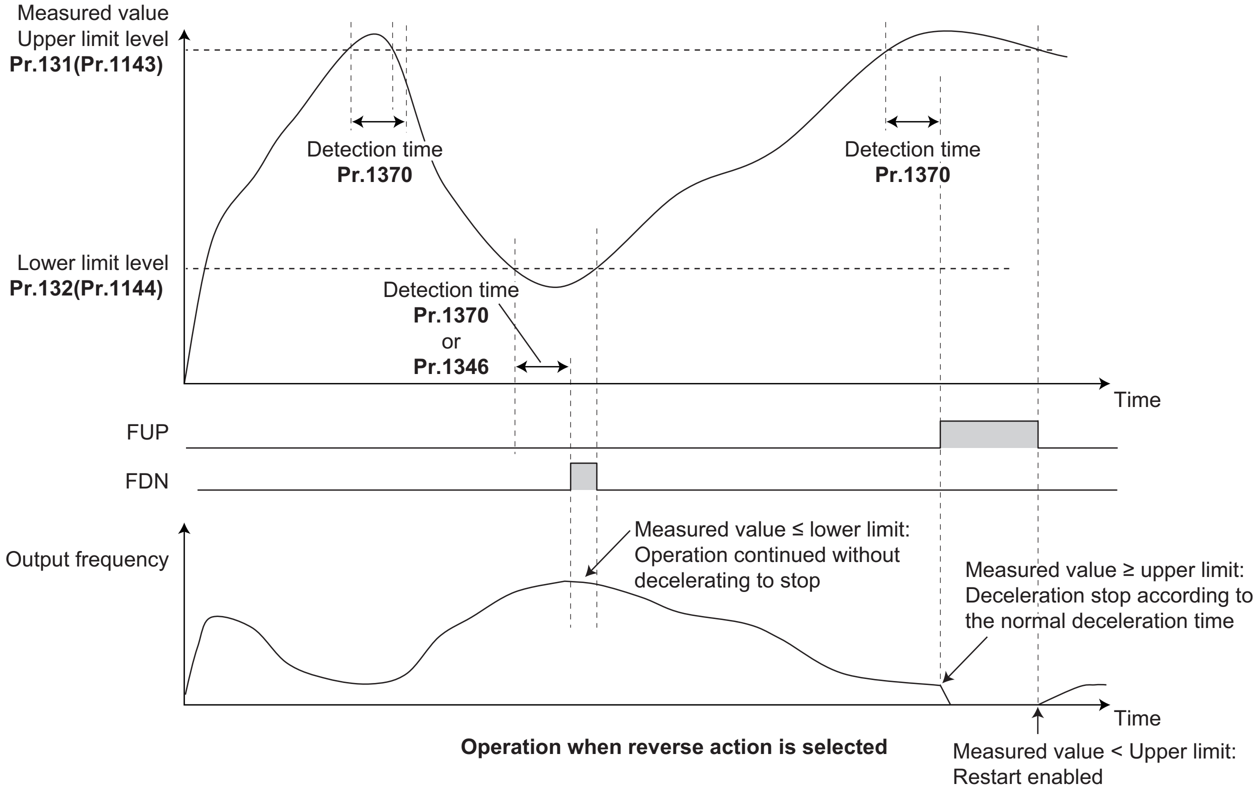
*3 At the same time with the signal output, deceleration is performed using the normal deceleration time. After the deceleration stop, the protective function (E.PID) is activated.

*4 At the same time with the signal output, deceleration is performed using the normal deceleration time. When the measured value returns to normal, operation can be restarted.

- The following is the operation example of the FUP and FDN signals.



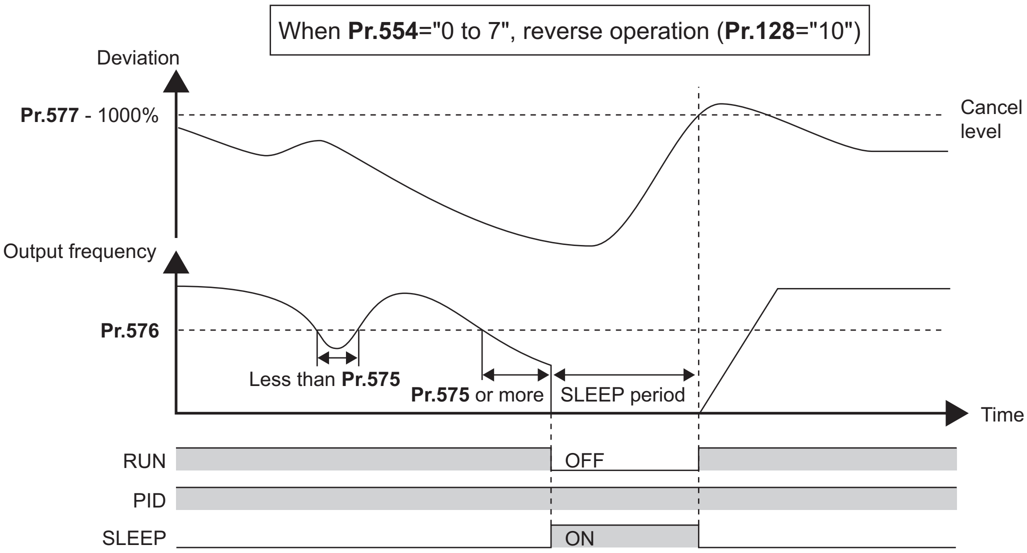
- When deceleration stop (restart) is selected (**Pr.554** = "5, 7, 15, or 17"), deceleration starts at the same time the signal is output and operation is decelerated to stop using the normal deceleration time. If the measured value falls within the range between the upper and lower limits, restarting is enabled and operation will be restarted in the PID control mode. When reverse action is selected for PID action, deceleration stop is not performed although the FDN signal is output when the measured value falls below the lower limit. (When forward action is selected, deceleration stop is not performed although the FUP signal is output when the measured value exceeds the upper limit.) When the sleep function is used at the same time, the sleep function is prioritized during sleep operation.

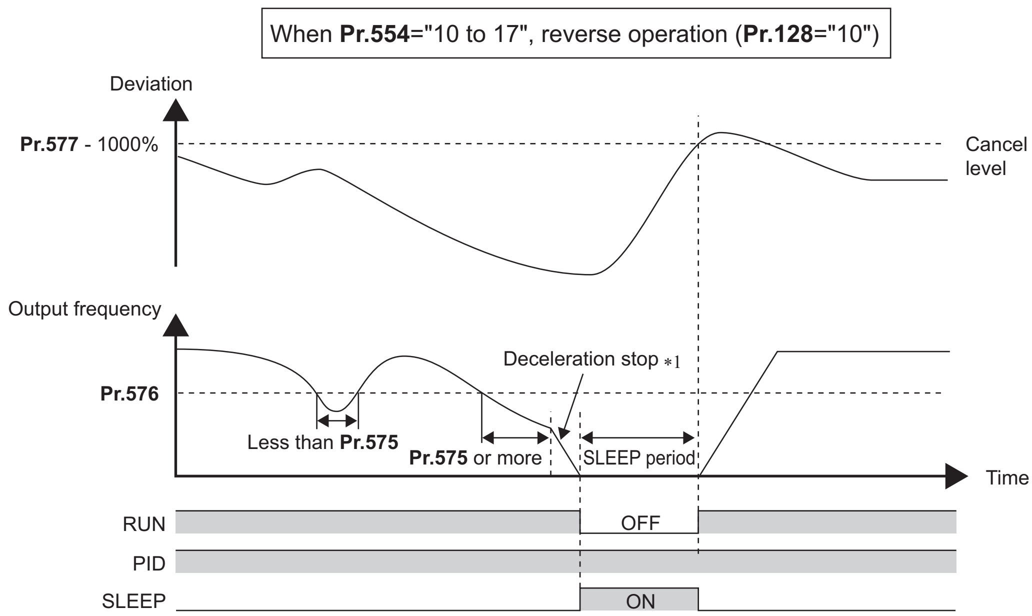


Operation when reverse action is selected

◆ PID output suspension function (SLEEP function) (SLEEP signal, Pr.575 to Pr.577)

- When a status where the output frequency after PID calculation is less than **Pr.576 Output interruption detection level** has continued for the time set in **Pr.575 Output interruption detection time** or longer, inverter running is suspended. This allows the amount of energy consumed in the inefficient low-speed range to be reduced.
- When the deviation (for instance, the set point - measured value) reaches the PID output shutoff release level (**Pr.577** setting value -1000%) while the PID output suspension function is activated, the PID output suspension function is released, and PID control operation is automatically restarted.
- Whether to allow motor to coast to a stop or perform a deceleration stop when SLEEP operation is started can be selected using **Pr.554**.
- While the PID output suspension function is activated, the PID output interruption signal (SLEEP) is output. During this time, the inverter running signal (RUN) turns OFF and the During PID control activated signal (PID) turns ON.
- For the terminal used for the SLEEP signal, set "70 (positive logic)" or "170 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.





*1 When the PID output shutoff release level is reached during a deceleration stop, output shutoff is released, operation is re-accelerated and PID control is continued. During deceleration **Pr.576 Output interruption detection level** is invalid.

NOTE

- The stirring function during the PID sleep prevents clogging of the pump while the sleep function is activated. (Refer to page 440.)
- The PID sleep boost function maintains the sleep state for a long period of time. (Refer to page 440.)

◆ Integral stop selection when the frequency is limited (Pr.1015)

- The operation for the integral term can be selected when the frequency or the manipulated amount is limited during PID control. The operation during output suspension can be selected for the integral term using the PID output suspension (sleep) function.
- The manipulation range can be selected.

Pr.1015 setting	Operation at limited frequency	Range of manipulation	Operation during output interruption
0 (initial value)	Integral stop	-100% to +100%	Integral clear
1	Integral continuation		
2	Integral stop	0 to 100%	
10	Integral stop	-100% to +100%	Integral stop
11	Integral continuation		
12	Integral stop	0 to 100%	

NOTE

- While the integral stop is selected, the integral stop is enabled when any of the following conditions is met.

Integral stop conditions
The frequency reaches the upper or lower limit. The manipulated amount falls outside the range of ±100% (**Pr.1015** = "0 or 10"). The manipulated amount falls outside the range from 0 to 100% (**Pr.1015** = "2 or 12"). When a frequency set in **Pr.576 Output interruption detection level** is lower than the minimum frequency, the frequency command value falls down to the level set in **Pr.576** after PID calculation (when the PID output suspension function is enabled).

◆ PID monitor function

- This function displays the PID control set point, measured value and deviation on the operation panel, and can output these from the terminals AM and CA.
- An integral value indicating a negative % can be displayed on the deviation monitor. 0% is displayed as 1000. (These values cannot be output on the deviation monitor from terminal CA.)
- Set the following values to **Pr.52 Operation panel main monitor selection, Pr.774 to Pr.776 (Operation panel monitor selection), Pr.54 CA terminal function selection** and **Pr.158 AM terminal function selection** for each monitor.

Parameter settings	Monitor description	Minimum increment	Monitor range			Remarks
			Terminal CA	Terminal AM	Operation panel	
52	PID set point	0.1%	0 to 100%[*1]			"0" is displayed at all times when PID control is based in deviation input.
92	Second PID set point					
53	PID measured value	0.1%	0 to 100%[*1]			
93	Second PID measured value					
67	PID measured value 2	0.1%	0 to 100%[*1]			Displays PID measured value even if the PID control operating conditions are not satisfied while the PID control is enabled. "0" is displayed at all times when PID control is based in deviation input.
95	Second PID measured value 2					
54	PID deviation	0.1%	Setting not available	-100% to 100%[*1*2]	900% to 1100% or -100% to 100%[*1]	Using **Pr.290 Monitor negative output selection**, minus values can be output to the terminal AM and displayed on the operation panel. Even if minus display is enabled, the display range is 900% to 1100% in monitors on the operation panel. (0% is offset and displayed as 1000%.)
94	Second PID deviation					
91	PID manipulated variable	0.1%	Setting not available	-100% to 100%[*2]	900% to 1100% or -100% to 100%	
96	Second PID manipulated variable					

*1 When **Pr.934** and **Pr.935** are set, the minimum increment changes from unit % to no unit, and the monitor range can be changed. (Refer to page 421.)

*2 When the minus value display is set disabled using **Pr.290**, the terminal AM output becomes "0".

◆ Adjustment procedure

1. Enable PID control
When **Pr.128** ≠ "0", PID control is enabled.
Set the set point, measured value and deviation input methods at **Pr.128, Pr.609 and Pr.610**.

2. Setting the parameter
Adjust the PID control parameters of **Pr.127, Pr.129 to Pr.134, Pr.553, Pr.554, Pr.575 to Pr.577**.

3. PID gain tuning
Pr.129, **Pr.130** and **Pr.134** are adjusted automatically by PID gain tuning. (Refer to page 415.)

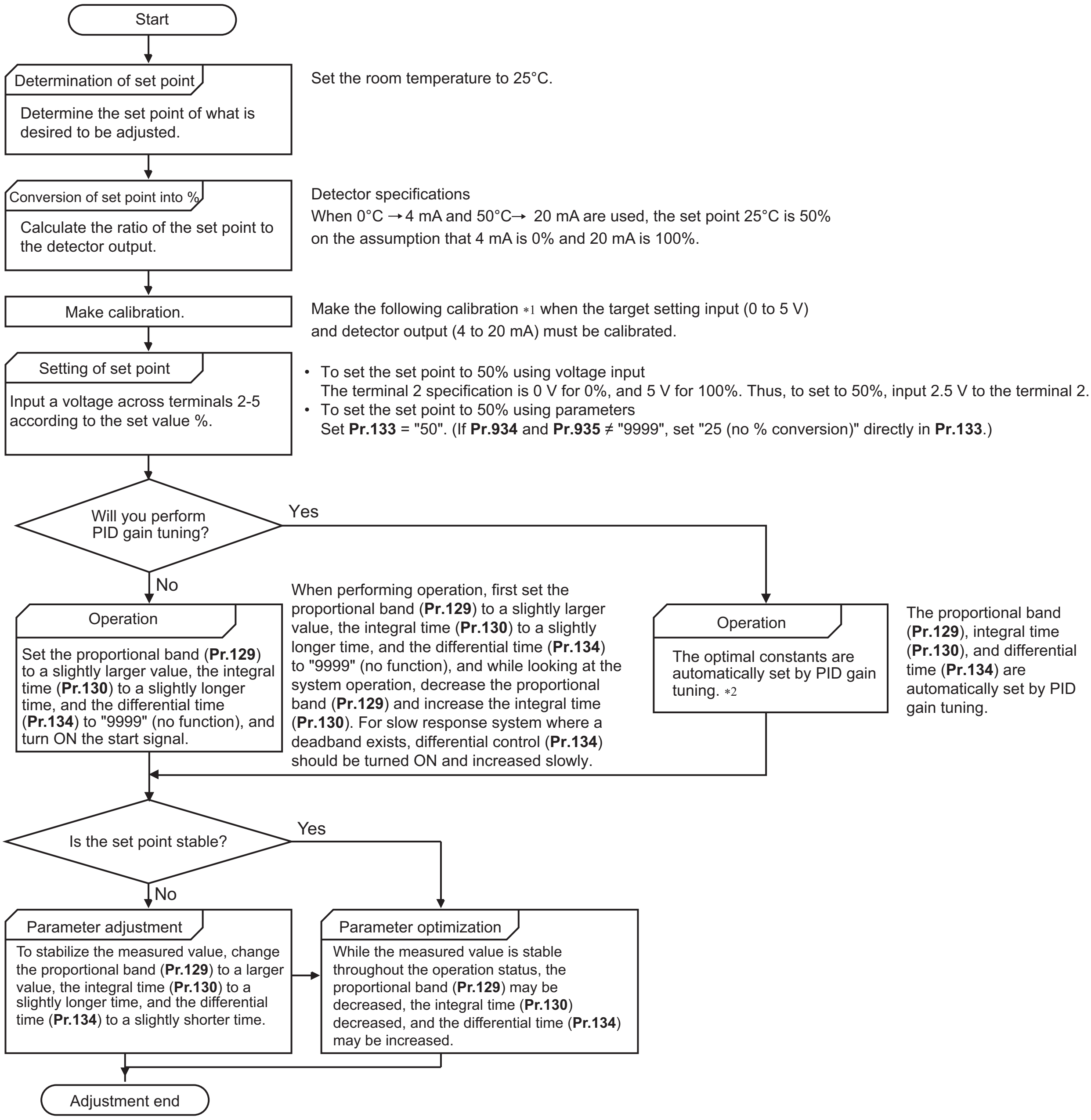
4. Terminal setting
Set the I/O terminals for PID control. (**Pr.178 to Pr.189 (Input terminal function selection), Pr.190 to Pr.196 (Output terminal function selection)**)

5. Turn the X14 signal ON
When the X14 signal is assigned to the input terminal, PID control is enabled by the X14 signal turning ON.

6. Start

◆ Calibration example

Adjust room temperature to 25°C by PID control using a detector that outputs 4 mA at 0°C and 20 mA at 50°C.)



*1 When calibration is required
Calibrate detector output and set point input by **Pr.125, Pr.902, and Pr.903** (terminal 2) or **Pr.126, Pr.904, and Pr.905** (terminal 4). (Refer to page 328.) When both **Pr.934 and Pr.935** are other than "9999", calibrate the detector output and set point input by **Pr.934 and Pr.935** (terminal 4). (Refer to page 421.) Make calibration in the PU operation mode during an inverter stop.

*2 For the PID gain tuning, refer to page 415.

- Calibrating set point input

(Example: To enter the set point on terminal 2)

1. Apply the input (for example, 0 V) of set point setting 0% across terminals 2 and 5.
2. Using **Pr.902**, enter the frequency (for example, 0 Hz) to be output by the inverter when the deviation is 0%.
3. Using **Pr.902**, set the voltage value at 0%.
4. Apply the input (for example, 5 V) of set point setting 100% across terminals 2 and 5.
5. Using **Pr.125 (Pr.903)**, enter the frequency (for example, 60 Hz) to be output by the inverter when the deviation is 100%.
6. Using **Pr.903**, set the voltage value at 100%.

NOTE

- When the set point is set at **Pr.133**, the setting frequency of **Pr.902** is equivalent to 0% and the setting frequency of **Pr.903** is equivalent to 100%.

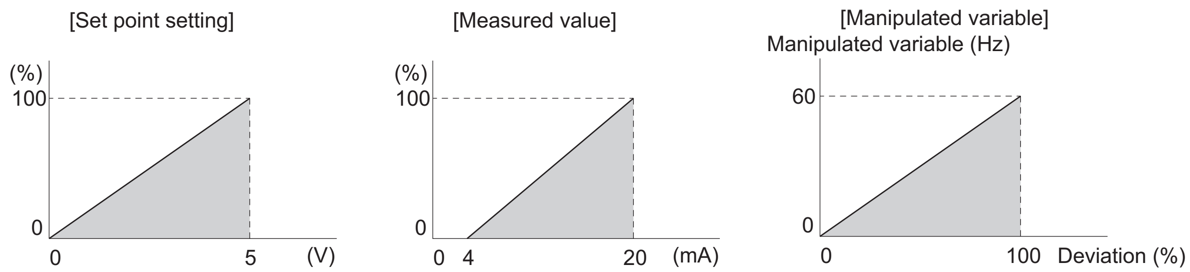
- Calibrating measured value input

1. Apply the input (for example, 4 mA) of measured value 0% across terminals 4 and 5.
2. Perform calibration by **Pr.904**.
3. Apply the input (for example, 20 mA) of measured value 100% across terminals 4 and 5.
4. Perform calibration by **Pr.905**.

NOTE

- Set the frequencies set at **Pr.904 and Pr.126 (Pr.905)** to each of the same values set at **Pr.902 and Pr.125 (Pr.903)**.
- The display unit for analog input can be changed from "%" to "V" or "mA". (Refer to page 330.)

- The figure below shows the results of having performed the calibration above.



◆ Setting multiple PID functions

- When the second PID function is set, two sets of PID functions can be switched for use. The PID setting is selected as shown in the table below.

Pr.128 setting (First PID setting)	Pr.753 setting (Second PID setting)	Pr.155 setting *1	RT signal	PID setting applied to the output frequency
"0" or not applied to the frequency	"0" or not applied to the frequency	—	—	Control other than PID control
"0" or not applied to the frequency	Applied to the frequency	—	—	Second PID setting
Applied to the frequency	"0" or not applied to the frequency	—	—	First PID setting
Applied to the frequency	Applied to the frequency	0	OFF	First PID setting
			ON	Second PID setting
		10	—	First PID setting

*1 While **Pr.155** = "0", the second function is enabled immediately after RT signal turns ON. While **Pr.155** = "10", the second function is enabled only during constant speed operation when RT signal turns ON. (Refer to page 348 for the details.)

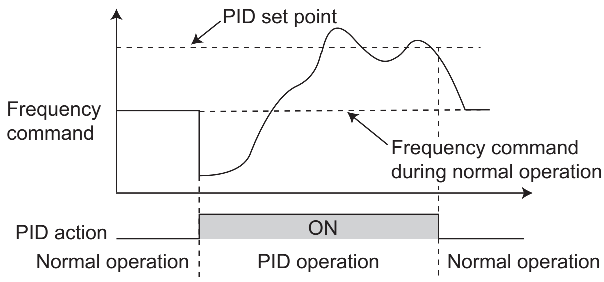
• The second PID function parameters and signals function in the same way as the following parameters and signals of the first PID function. Refer to the first PID function when setting the second PID functions.

Classification	First PID function parameters		Second PID function parameters	
	Pr.	Name	Pr.	Name
Parameter	127	PID control automatic switchover frequency	754	Second PID control automatic switchover frequency
	128	PID action selection	753	Second PID action selection
	129	PID proportional band	756	Second PID proportional band
	130	PID integral time	757	Second PID integral time
	131	PID upper limit	1143	Second PID upper limit
	132	PID lower limit	1144	Second PID lower limit
	133	PID action set point	755	Second PID action set point
	134	PID differential time	758	Second PID differential time
	553	PID deviation limit	1145	Second PID deviation limit
	554	PID signal operation selection	1146	Second PID signal operation selection
	575	Output interruption detection time	1147	Second output interruption detection time
	576	Output interruption detection level	1148	Second output interruption detection level
	577	Output interruption cancel level	1149	Second output interruption cancel level
	609	PID set point/deviation input selection	1140	Second PID set point/deviation input selection
	610	PID measured value input selection	1141	Second PID measured value input selection

Classification	First PID function parameters		Second PID function parameters	
	signal	Name	signal	Name
Input signal	X14	PID control valid terminal	X80	Second PID control valid terminal
	X64	During retry	X79	Second PID forward/reverse action switchover
	X72	PID P control switchover	X73	Second PID P control switchover
Output signal	FUP	PID upper limit	FUP2	Second PID upper limit
	FDN	PID lower limit	FDN2	Second PID lower limit
	RL	PID forward/reverse rotation output	RL2	Second PID forward/reverse rotation output
	PID	During PID control activated	PID2	Second During PID control activated
	SLEEP	PID output interruption	SLEEP2	During second PID output shutoff
	Y48	PID deviation limit	Y205	Second PID deviation limit

NOTE

- Even if the X14 signal is ON, PID control is stopped and multi-speed or JOG operation is performed when the RH, RM, RL, or REX signal (multi-speed operation) or JOG signal (JOG operation) is input.
- PID control is invalid under the following settings. **Pr.79 Operation mode selection** = "6" (Switchover mode)
- Note that input to the terminal 1 is added to the terminals 2 and 4 inputs. For example when **Pr.128** = "20 or 21", the terminal 1 input is considered as a set point and added to the set point of the terminal 2.
- To use terminal 4 and 1 inputs in PID control, set "0" (initial value) to **Pr.858 Terminal 4 function assignment** and **Pr.868 Terminal 1 function assignment**. When a value other than "0", PID control is invalid.
- Changing the terminal assignment using **Pr.178 to Pr.189 or Pr.190 to Pr.196** may affect other functions. Set parameters after confirming the function of each terminal.
- When PID control is selected, the minimum frequency becomes the frequency of **Pr.902** and the maximum frequency becomes the frequency of **Pr.903**. (The **Pr.1 Maximum frequency** and **Pr.2 Minimum frequency** settings also are valid.)
- During PID operation, the remote operation function is invalid.
- When control is switched to PID control during normal operation, the frequency during that operation is not carried over, and the value resulting from PID calculation referenced to 0 Hz becomes the command frequency.



Operation when control is switched to PID control during normal operation

Parameters referred to

Pr.59 Remote function selection ☞ page 197
Pr.73 Analog input selection ☞ page 318
Pr.79 Operation mode selection ☞ page 204
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297
Pr.290 Monitor negative output selection ☞ page 284
Pr.902 to Pr.905 Frequency setting voltage (current) bias/gain ☞ page 328

5.11.7 PID gain tuning

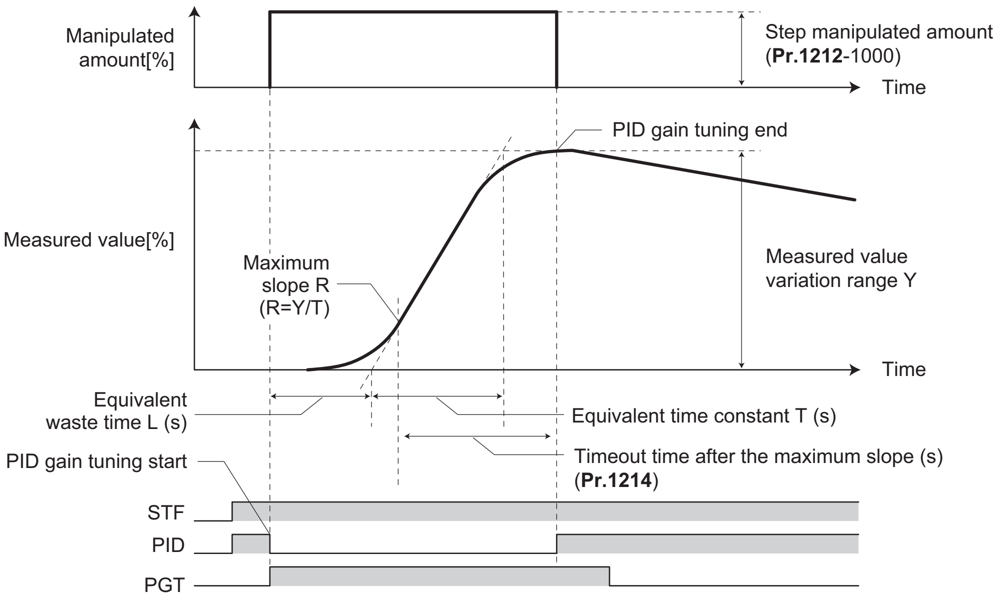
Changing the PID control manipulated amount and measuring the PID control response enable automatic setting of the constant optimal for PID control.

For tuning, use the step response method or the limit cycle method.

Pr.	Name	Initial value	Setting range	Description
1211 A690	**PID gain tuning timeout time**	100 s	1 to 9999 s	Set the time after the PID gain tuning starts until a timeout error occurs.
1212 A691	**Step manipulated amount**	1000%	900 to 1100%	Set the step manipulated amount when using the step response method to perform the PID gain tuning.
1213 A692	**Step response sampling cycle**	1 s	0.01 to 600 s	Set the cycle for sampling of measurement values when using the step response method to perform the PID gain tuning.
1214 A693	**Timeout time after the maximum slope**	10 s	1 to 9999 s	Set the time after the measurement of the maximum slope until the completion of the tuning when using the step response method to perform the PID gain tuning.
1215 A694	**Limit cycle output upper limit**	1100%	900 to 1100%	Set the upper limit value of the two-position output when using the limit cycle method to perform the PID gain tuning.
1216 A695	**Limit cycle output lower limit**	1000%	900 to 1100%	Set the lower limit value of the two-position output when using the limit cycle method to perform the PID gain tuning.
1217 A696	**Limit cycle hysteresis**	1%	0.1 to 10%	Set the hysteresis of the set point when using the limit cycle method to perform the PID gain tuning.
1218 A697	**PID gain tuning setting**	0	0, 100 to 102, 111, 112, 121, 122, 200 to 202, 211, 212, 221, 222	Select the target loop, method, and control adjustment method for the PID gain tuning.
1219 A698	**PID gain tuning start/status**	0	0	PID gain tuning function disabled
			1	PID gain tuning start
			2	During PID gain tuning (read only)
			8	PID gain tuning forced end
			9, 90 to 96	Tuning error (read only)

◆ Step response method

- In the step response method, the manipulated amount is changed step by step for the real system. From the change in the measured values, the maximum slope (R) and the equivalent waste time (L) are calculated to determine each constant.



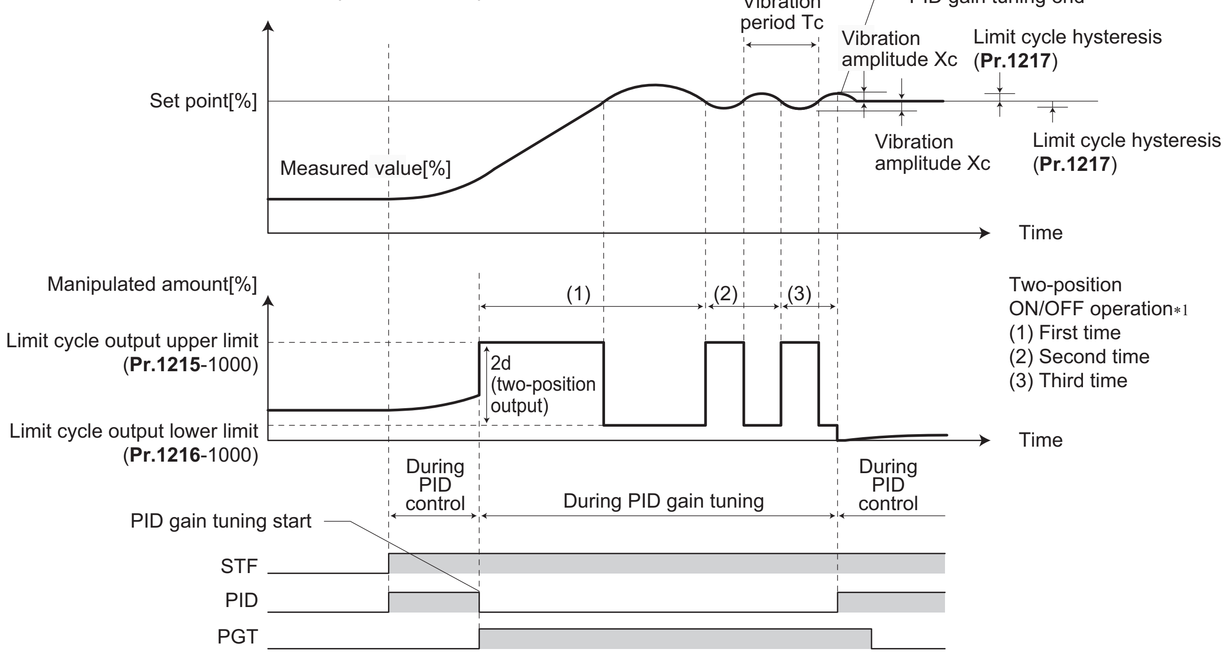
- The step manipulated amount (**Pr.1212** - 1000) is added to the present manipulated amount.
- The measured value is taken for every sampling cycle of step response (**Pr.1213**). From the variation between the measured values (Y) and the time (t), the maximum slope (R) is calculated.

- The measurement ends when the timeout time after the maximum slope (**Pr.1214**) elapsed after the maximum slope is obtained.
- After the integral term is cleared, PID control is performed with the constant to which the change has been applied (the constant used before PID gain tuning when a fault occurs).

◆ Limit cycle method

- In the limit cycle method, the two-position ON/OFF operation is performed three times for output of the manipulated amount for the real system. From the vibration waveform data of the measured values, the vibration amplitude (Xc) and the vibration cycle (Tc) are measured. Based on the measured values, each constant is determined.
- In the limit cycle method, less influence of the noise of the measured values is given as compared in the step response method, and a stable tuning result can be obtained.

Example: Measured value ≤ set point (reverse action)



*1 Details of the two-position ON/OFF operation

PID control operation	Initial output of the manipulated amount	Two-position ON/OFF operation
Reverse action	When measured value ≤ set point Manipulated amount = Upper limit of the output (**Pr.1215**-1000) When measured value > set point Manipulated amount = Lower limit of the output (**Pr.1216**-1000)	Using measured value ≥ set point + hysteresis (**Pr.1217**) Manipulated amount = Lower limit of the output (**Pr.1216**-1000) Using measured value ≤ set point - hysteresis (**Pr.1217**) Manipulated amount = Upper limit of the output (**Pr.1215**-1000)
Forward action	When measured value ≤ set point Manipulated amount = Lower limit of the output (**Pr.1216**-1000) When measured value > set point Manipulated amount = Upper limit of the output (**Pr.1215**-1000)	Using measured value ≥ set point + hysteresis (**Pr.1217**) Manipulated amount = Upper limit of the output (**Pr.1215**-1000) Using measured value ≤ set point - hysteresis (**Pr.1217**) Manipulated amount = Lower limit of the output (**Pr.1216**-1000)

- The manipulated amount is output at the limit cycle output upper limit (**Pr.1215** - 1000). (When measured value > set point, the manipulated amount is once output at the limit cycle lower limit (**Pr.1216** - 1000), and then after set point > measured value is achieved, the manipulated amount is output at the limit cycle output upper limit (**Pr.1215** - 1000).)
- The two-position ON/OFF operation is repeated three times. From the waveform data of the values measured for output of the second and third two-position operation, the vibration amplitude (Xc) and the vibration cycle (Tc) are measured.
- From the vibration amplitude (Xc) and the vibration cycle (Tc), the threshold sensitivity (Ku) and the threshold cycle (Tu) are calculated.
- Each constant is calculated using a formula depending on the **Pr.1218** setting, and PID gain tuning is finished.
- After the integral term is cleared, PID control is performed with the constant to which the change has been applied (the constant used before PID gain tuning when a fault occurs).

NOTE

- Confirm that the measured values are stable when performing PID gain tuning with the step response method. When the measured values are unstable, the tuning result may not be accurate.
- Accurate measurement of the maximum slope may not be achieved if the **Pr.1213** setting is small in the step response method.

◆ PID gain tuning operation setting (Pr.1218)

- Set the PID gain tuning operation in this parameter. The digit in the hundreds place represents the target PID loop. The digit in the tens place represents the tuning method. The digit in the ones place represents the control adjustment method.

Pr.1218 setting value	Target PID	Tuning method	Control adjustment method
0 (initial value)	PID gain tuning function disabled		
100	First PID	Step response method	P control adjustment
101			PI control adjustment
102			PID control adjustment
111		Limit cycle method (set-point control)	PI control adjustment
112			PID control adjustment
121		Limit cycle method (follow-up control)	PI control adjustment
122			PID control adjustment
200	Second PID	Step response method	P control adjustment
201			PI control adjustment
202			PID control adjustment
211		Limit cycle method (set-point control)	PI control adjustment
212			PID control adjustment
221		Limit cycle method (follow-up control)	PI control adjustment
222			PID control adjustment

◆ Parameter setting for each PID gain tuning method

- Set the following parameters according to the selected tuning method (step response method / limit cycle method).

Pr.	Tuning method		Item	Description
	Step response method	Limit cycle method		
128 (753)	○	○	PID action selection	Select the PID action.
1218	○	○	PID gain tuning setting	Select the PID gain tuning operation.
1211	○	○	PID gain tuning timeout time	Set the timeout time for PID gain tuning. A timeout error occurs when the elapsed time exceeds the setting.
1212	○	-	Step manipulated amount	Set the step manipulated amount for PID gain tuning.
1213	○	-	Step response sampling cycle	Set the cycle for sampling of measurement values for PID gain tuning.
1214	○	-	Timeout time after the maximum slope	Set the timeout time after the maximum slope measurement for PID gain tuning. The measurement for tuning is completed when the elapsed time exceeds the setting.
1215	-	○	Limit cycle output upper limit	Set the upper limit value of the two-position output for PID gain tuning.
1216	-	○	Limit cycle output lower limit	Set the lower limit value of the two-position output for PID gain tuning. (When the setting exceeds the **Pr.1215** setting, a tuning error occurs.)
1217	-	○	Limit cycle hysteresis	Set the hysteresis of the set point for PID gain tuning.

○: Parameter to set

◆ Execution of PID gain tuning (Pr.1219, PGT signal)

- While the PID gain tuning function is enabled (**Pr.1218** ≠ "0"), PID gain tuning is started when any of the following operations is performed during PID control.
  - Turning ON the PID gain tuning start/forced end signal (PGT).
  - Setting **Pr.1219 PID gain tuning start/status** = "1".
- To use the PGT signal, set "81" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to an input terminal.
- The PID gain tuning status can be checked with the read value of **Pr.1219** or the PID gain tuning status monitor. The PID gain tuning status monitor is displayed instead of the output voltage monitor.

Status monitor	PID gain tuning status
2	During tuning
3	Tuning completed
8	Tuning forced end

- When PID gain tuning is completed, the following parameters are automatically set.

Pr.	Name	Step response method			Limit cycle method	
		P control	PI control	PID control	PI control	PID control
129 (756)	PID proportional band	○	○	○	○	○
130 (757)	PID integral time	-	○	○	○	○
134 (758)	PID differential time	-	-	○	-	○

○: The calculation result is applied.

-: "9999" is set.

- To forcibly terminate the tuning during PID gain tuning, perform any of the following operations.
  - Turning OFF the PID gain tuning start/forced end signal (PGT).
  - Setting **Pr.1219 PID gain tuning start/status** = "8".
  - Turn the power supply OFF, reset the inverter, or turn OFF the start command.

NOTE

- By PID gain tuning, the settings of the PID constant parameters (**Pr.129, Pr.130, Pr.134, Pr.756 to Pr.758**) are automatically changed. Before performing PID gain tuning, record the PID constant parameter settings before tuning as required.
- PID gain tuning also requires setting of the PID upper limit (**Pr.131** or **Pr.1143**), PID lower limit (**Pr.132** or **Pr.1144**), PID deviation limit (**Pr.553** or **Pr.1145**).
- Changing the terminal assignment with **Pr.178 to Pr.189** may affect other functions. Set parameters after confirming the function of each terminal.
- By PID gain tuning, the amount of operation is changed considerably. In some applications such as a winding machine, materials may be affected.

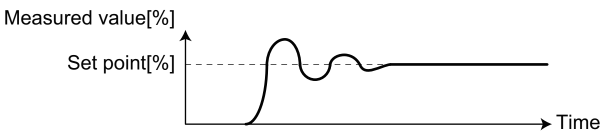
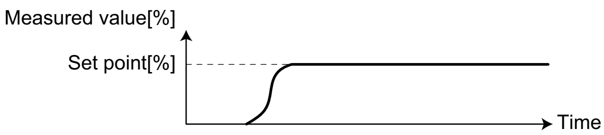
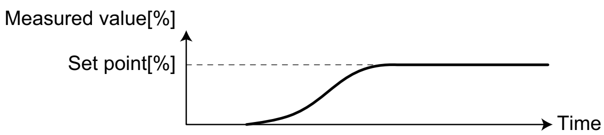
◆ PID gain tuning error

- When the read value of **Pr.1219** or the PID gain tuning status monitor display is "9, 90 to 96", tuning has not been properly completed due to a tuning error. Remove the cause of the tuning error, and perform tuning again.

Monitor value	Error definition	Cause of tuning error	Corrective action for error
9	Termination of tuning due to activation of an inverter protective function	An inverter protective function is activated.	Remedy the cause. (Refer to page 570.)
90	Input upper limit error	The measured value is higher than the PID upper limit (**Pr.131** or **Pr.1143**).	Change the **Pr.131** or **Pr.1143** setting as appropriate.
91	Input lower limit error	The measured value is lower than the PID lower limit (**Pr.132** or **Pr.1144**).	Change the **Pr.132** or **Pr.1144** setting as appropriate.
92	Deviation limit error	The deviation exceeded the PID deviation limit (**Pr.553** or **Pr.1145**).	Change the **Pr.553** or **Pr.1145** setting as appropriate.
93	Timeout error	Tuning is not terminated within the time set in **Pr.1211** after the start of PID gain tuning.	Change the **Pr.1211** setting as appropriate.
94	Calculation error	The tuning calculation is inconsistent.	In the step response method, change the **Pr.1212** and **Pr.1213** settings as appropriate. In the limit cycle method, change the **Pr.1217** setting as appropriate.
95	Setting error	• PID control is disabled during tuning. • The PID control setting has been changed during tuning. • In the limit cycle method, the **Pr.1215** setting is equal to or lower than the **Pr.1216** setting.	• Enable PID control. • Change the **Pr.1215 and Pr.1216** settings as appropriate.
96	PID mode error	• PID gain tuning has been started during automatic switchover or pre-charge operation. • A stall prevention or regeneration avoidance operation occurred during PID gain tuning. • A condition for output shutoff by the sleep function was satisfied during PID gain tuning. • Frequency fluctuation occurred because of the frequency jump, maximum frequency, or minimum frequency during PID gain tuning.	Change the setting of each function as appropriate.

◆ Fine adjustment after PID gain tuning

- If fine adjustment is required after completion of PID gain tuning, adjust the proportional band (**Pr.129** or **Pr.756**), integral time (**Pr.130** or **Pr.757**), and differential time (**Pr.134** or **Pr.758**).

Status of measurement values	Adjustment method
The response is fast, but vibrations are observed. 	• Increase the proportional band (**Pr.129** or **Pr.756**). (Smaller proportional effect) • Increase the integral time (**Pr.130** or **Pr.757**). (Smaller integral effect)
Optimal 	—
Response is slow. 	• Decrease the proportional band (**Pr.129** or **Pr.756**). (Larger proportional effect) • Decrease the integral time (**Pr.130** or **Pr.757**). (Larger integral effect)

NOTE

- When the differential operation is used, adjust the differential time (**Pr.134** or **Pr.758**) while checking the stability and the response. (Increasing the differential time makes the differential effect larger, and decreasing the differential time makes the differential effect smaller.)

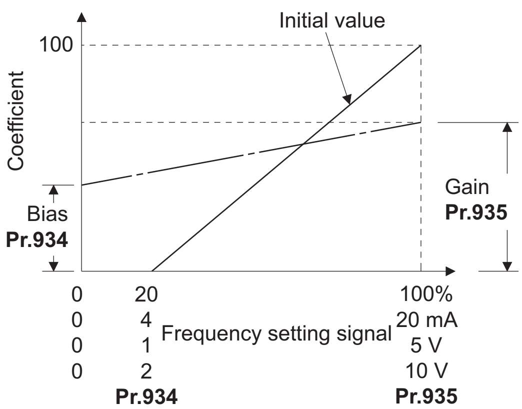
5.11.8 Changing the display increment of the numerical values used in PID control

When the operation panel or the parameter unit is used, the display unit of parameters and monitored items related to PID control can be changed to various units.

Pr.	Name	Initial value	Setting range	Description	
759 A600	**Operation mode selection**	0	0 to 43	Change the PID control-related display unit that is displayed on the operation panel or the parameter unit.	
			9999	Without display unit switching	
934 A630	**PID display bias coefficient**	9999	0 to 500	Set the coefficient of the bias side (minimum) of measured value input.	
			9999	Displayed in %.	
934 A631	**PID display bias analog value**	20%	0 to 300%	Set the converted % of the bias side (minimum) current/ voltage of measured value input.	
935 A632	**PID display gain coefficient**	9999	0 to 500	Set the coefficient of the gain side (maximum) of measured value input.	
			9999	Displayed in %.	
935 A633	**PID display gain analog value**	100%	0 to 300%	Set the converted % of the gain side (maximum) current/ voltage of measured value input.	
1136 A670	**Second PID display bias coefficient**	9999	0 to 500 9999	Refer to **Pr.934**	Second PID control
1137 A671	**Second PID display bias analog value**	20%	0 to 300%	Refer to **Pr.934**	
1138 A672	**Second PID display gain coefficient**	9999	0 to 500 9999	Refer to **Pr.935**	
1139 A673	**Second PID display gain analog value**	100%	0 to 300%	Refer to **Pr.935**	
1142 A640	**Second PID unit selection**	9999	0 to 43, 9999	Refer to **Pr.759**	

◆ Calibration of PID display bias and gain (Pr.934 to Pr.935)

- When both **Pr.934 and Pr.935** ≠ "9999", the bias and gain values for the set point, measured value and deviation in PID control can be calibrated.
- "Bias"/"gain" function can adjust the relation between PID displayed coefficient and measured value input signal that is externally input. Examples of these measured value input signals are 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mADC.
- Set the value that is displayed when the PID measured value (control amount) is 0% to **Pr.934** and the value that is displayed when the PID measured value (control amount) is 100% to **Pr.935**.
- When both of **Pr.934 and Pr.935** ≠"9999" and **Pr.133** is set as the set point, the setting of **Pr.934** is treated as 0%, and **Pr.935** as 100%.



- There are three methods to adjust the PID display bias/gain.
  Method to adjust any point by application of a current (voltage) to the measured value input terminal
  Method to adjust any point without application of a current (voltage) to the measured value input terminal
  Method to adjust only the display coefficient without adjustment of current (voltage)

(Refer to page 328 for details, and make the necessary adjustments by considering **Pr.905** as **Pr.935** and **Pr.126 (Pr.905)** as **Pr.935**.

NOTE

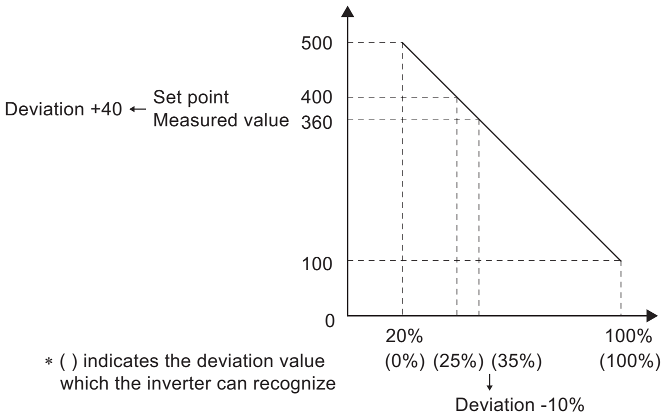
- Always calibrate the input after changing the voltage/current input specification with **Pr.73 and Pr.267**, and the voltage/current input selection switch.

- Take caution when the following condition is satisfied because the inverter recognizes the deviation value as negative (positive) value even though a positive (negative) deviation is given: **Pr.934** (PID bias coefficient) > **Pr.935** (PID gain coefficient)

To perform a reverse action, set **Pr.128 PID action selection** to forward action. Alternatively, to perform a forward action, set **Pr.128** to reverse action.

Pr.934 < Pr.935 (normal setting)		Pr.934 ≥ Pr.935	
Reverse action	Reverse action setting to **Pr.128**	Reverse action	Forward action setting to **Pr.128**
Forward action	Forward action setting to **Pr.128**	Forward action	Reverse action setting to **Pr.128**
PID output shutoff release level	**Pr.577** -1000	PID output shutoff release level	1000 -**Pr.577**

(Example) Set the following: **Pr.934** = "500", 20% (4 mA is applied), **Pr.935** = "100", 100% (20 mA is applied). When the set point = 400 and the measured value = 360, the deviation is +40 (>0), but the inverter recognizes the deviation as -10% (<0). Because of this, operation amount does not increase in the reverse operation setting. The operation amount increases when the forward operation is set. To perform PID output shutoff release at deviation of +40 or higher, set **Pr.577** = "960".



- The display of the following parameters is changed according to the **Pr.934, Pr.935, Pr.1136, and Pr.1138** settings.

Pr.	Name
131	PID upper limit
132	PID lower limit
133	PID action set point
553	PID deviation limit
577	Output interruption cancel level
761	Pre-charge ending level
763	Pre-charge upper detection level

Pr.	Name
1143	Second PID upper limit
1144	Second PID lower limit
755	Second PID action set point
1145	Second PID deviation limit
1149	Second output interruption cancel level
766	Second pre-charge ending level
768	Second pre-charge upper detection level

◆ Changing the PID display coefficient of the operation panel, parameter unit (Pr.759)

- Use **Pr.759 PID unit selection** to change the unit displayed on operation panel or parameter unit. For the coefficient set in **Pr.934 and Pr.935**, the displayed units can be changed to the following units.

Pr.759 setting	Displayed unit	Unit name	Pr.759 setting	Displayed unit	Unit name
9999	%	%	22	ftM	Feet per Minute
0	—	Not displayed	23	ftS	Feet per Second
1	K	Kelvin	24	m/M	Meter per Minute
2	C	Degree Celsius	25	m/S	Meter per Second
3	F	Degree Fahrenheit	26	lbH	Pound per Hour
4	PSI	Pound-force per Square Inch	27	lbM	Pound per Minute
5	MPa	Mega Pascal	28	lbS	Pound per Second
6	kPa	Kilo Pascal	29	iWC	Inch Water Column
7	Pa	Pascal	30	iWG	Inch Water Gauge
8	bar	Bar	31	fWG	Feet of Water Gauge
9	mbr	Millibar	32	mWG	Meter of Water Gauge
10	GPH	Gallon per Hour	33	iHg	Inches of Mercury
11	GPM	Gallon per Minute	34	mHg	Millimeters of Mercury
12	GPS	Gallon per Second	35	kgH	Kilograms per Hour
13	L/H	Liter per Hour	36	kgM	Kilograms per Minute
14	L/M	Liter per Minute	37	kgS	Kilograms per Second
15	L/S	Liter per Second	38	ppm	Pulse per Minute
16	CFH	Cubic Feet per Hour	39	pps	Pulse per Second
17	CFM	Cubic Feet per Minute	40	kW	Kilo Watt
18	CFS	Cubic Feet per Second	41	hp	Horse Power
19	CMH	Cubic Meter per Hour	42	Hz	Hertz
20	CMM	Cubic Meter per Minute	43	rpm	Revolutions per Minute
21	CMS	Cubic Meter per Second			

5.11.9 PID pre-charge function

This function drives the motor at a certain speed before starting PID control. This function is useful for a pump with a long hose. Without this function, PID control would start before the pump is filled with water, and proper control would not be performed.

<table>
<tr><th>Pr.</th><th>Name</th><th>Initial value</th><th>Setting range</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">760
A616</td><td rowspan="2">Pre-charge fault selection</td><td rowspan="2">0</td><td>0</td><td colspan="2">Fault indication with output shutoff immediately after pre-charge fault occurs.</td></tr>
<tr><td>1</td><td colspan="2">Fault indication with deceleration stop after pre-charge fault occurs.</td></tr>
<tr><td rowspan="2">761
A617</td><td rowspan="2">Pre-charge ending level</td><td rowspan="2">9999</td><td>0 to 100%</td><td colspan="2">Set the measured amount to end the pre-charge operation.</td></tr>
<tr><td>9999</td><td colspan="2">Without pre-charge ending level</td></tr>
<tr><td rowspan="2">762
A618</td><td rowspan="2">Pre-charge ending time</td><td rowspan="2">9999</td><td>0 to 3600 s</td><td colspan="2">Set the time to end the pre-charge operation.</td></tr>
<tr><td>9999</td><td colspan="2">Without pre-charge ending time</td></tr>
<tr><td rowspan="2">763
A619</td><td rowspan="2">Pre-charge upper detection level</td><td rowspan="2">9999</td><td>0 to 100%</td><td colspan="2">Set the upper limit for the pre-charged amount. A pre-charge fault occurs when the measured value exceeds the setting during pre-charging.</td></tr>
<tr><td>9999</td><td colspan="2">Without pre-charge upper limit level</td></tr>
<tr><td rowspan="2">764
A620</td><td rowspan="2">Pre-charge time limit</td><td rowspan="2">9999</td><td>0 to 3600 s</td><td colspan="2">Set the time limit for the pre-charged amount. A pre-charge fault occurs when the pre-charge time exceeds the setting.</td></tr>
<tr><td>9999</td><td colspan="2">Without pre-charge time limit</td></tr>
<tr><td rowspan="2">1132
A626</td><td rowspan="2">Pre-charge change increment amount</td><td rowspan="2">9999</td><td>0 to 100%</td><td colspan="2">Set the change increment amount per second after the automatic switchover frequency is reached (for vertical pumps).</td></tr>
<tr><td>9999</td><td colspan="2">Constant-speed operation after the automatic switchover frequency is reached (for horizontal pumps).</td></tr>
<tr><td>765
A656</td><td>Second pre-charge fault selection</td><td>0</td><td>0, 1</td><td>Refer to Pr.760.</td><td rowspan="6">Set the second pre-charge function. The second pre-charge function is valid when the RT signal is ON.</td></tr>
<tr><td>766
A657</td><td>Second pre-charge ending level</td><td>9999</td><td>0 to 100%, 9999</td><td>Refer to Pr.761.</td></tr>
<tr><td>767
A658</td><td>Second pre-charge ending time</td><td>9999</td><td>0 to 3600 s, 9999</td><td>Refer to Pr.762.</td></tr>
<tr><td>768
A659</td><td>Second pre-charge upper detection level</td><td>9999</td><td>0 to 100%, 9999</td><td>Refer to Pr.763.</td></tr>
<tr><td>769
A660</td><td>Second pre-charge time limit</td><td>9999</td><td>0 to 3600 s, 9999</td><td>Refer to Pr.764.</td></tr>
<tr><td>1133
A666</td><td>Second pre-charge change increment amount</td><td>9999</td><td>0 to 100%, 9999</td><td>Refer to Pr.1132.</td></tr>
</table>

◆ Operation selection for the pre-charge function

- To enable the pre-charge function when PID control is enabled, set the pre-charge end conditions at **Pr.761 Pre-charge ending level** and at **Pr.762 Pre-charge ending time**, or set "77" to **Pr.178 to Pr.189 (Input terminal function selection)**. When operation is started, the inverter runs at the frequency set to **Pr.127 PID control automatic switchover frequency** to enter the pre-charge state.
- Pre-charge ends and PID control starts after a pre-charge ending condition is satisfied.
- The pre-charge function is also activated at a start after release of a PID output suspension (SLEEP) state or MRS (output shutoff). The PID output suspension (SLEEP) function is not activated until the started pre-charge operation ends.
- During pre-charge operation, the During pre-charge operation (Y49) signal is output. For the terminal used for Y49 signal output, set "49 (positive logic)" or "149 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.

- The pre-charge function valid/invalid settings and pre-charge ending conditions are as follows:

Pr.127 setting	Pre-charge ending condition setting			Pre-charge function	Valid pre-charge ending condition[*1]		
	Pr.761 setting	Pr.762 setting	X77 signal				
9999	-	-	-	Disabled	-		
Other than 9999	9999	9999	Not assigned				
			Assigned	Enabled	-	-	X77
		Other than 9999	Not assigned		-	Time	-
			Assigned		-	Time	X77
	Other than 9999	9999	Not assigned		Result	-	-
			Assigned		Result	-	X77
		Other than 9999	Not assigned		Result	Time	-
			Assigned		Result	Time	X77

*1 When two or more ends conditions are satisfied, the pre-charge operation ends by the first-satisfied condition.

NOTE

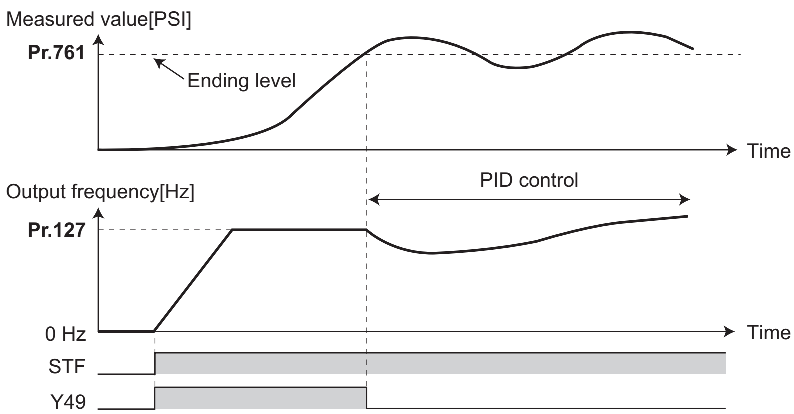
- During the pre-charge operation, it is regarded as integrated value=estimated value. The motor speed may drop shortly from the automatic switchover frequency depending on the parameter settings.
- Parameter changes and switchover to the second PID control are applied immediately. If PID control has not started when the settings were changed, PID control starts with changed settings. (If PID control has already started, these settings do not apply. If the changed settings already satisfies a condition to start PID control, the PID control starts as soon as these are changed.)
- The pre-charge also ends when PID control is set to invalid, the start command has been turned OFF, and output has been shut off.

◆ Example of pre-charge operation

- When the measured amount reaches the pre-charge ending level (**Pr.761 Pre-charge ending level** ≠ "9999")

The pre-charge operation ends when the measured value reaches the **Pr.761** setting or higher, then the PID control is performed.

- When **Pr.1132 Pre-charge change increment amount** = "9999" (horizontal pumps)



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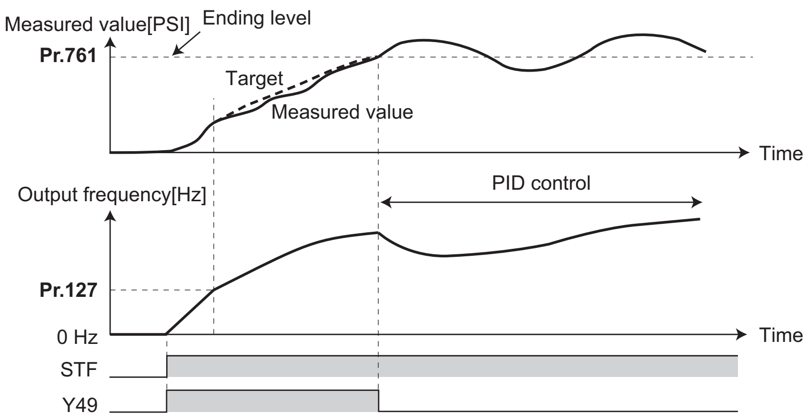
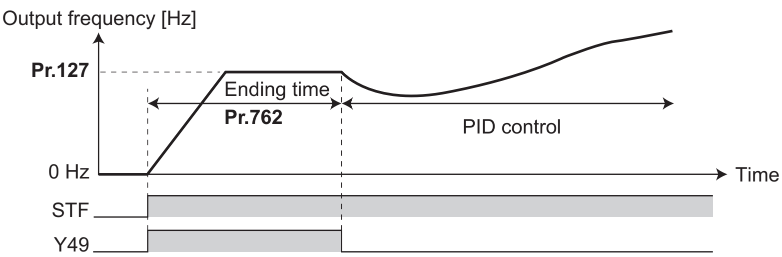
- When **Pr.1132 Pre-charge change increment amount** ≠ "9999" (vertical pumps), PID control is performed so that the change increment amount of the set point equals the **Pr.1132** setting after the automatic switchover frequency is reached until the pre-charge ending condition is satisfied. (Although PID control is performed after the automatic switchover frequency is reached until the pre-charge ends, the status is regarded as the one during pre-charge.)



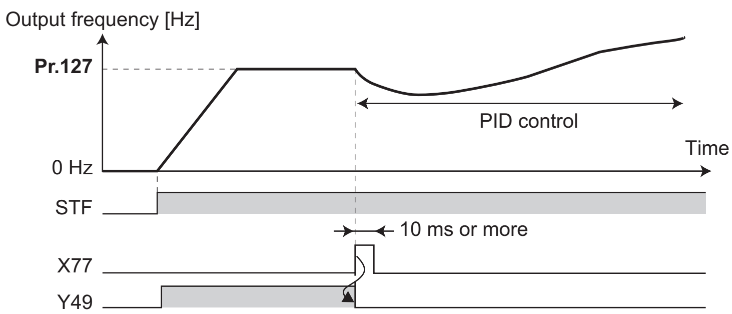
- When the elapsed time reaches the pre-charge ending time (**Pr.762 Pre-charge ending time** ≠ "9999")

The pre-charge operation ends when the pre-charge time reaches the **Pr.762** setting or higher, then the PID control is performed.



- When the signal is input to end the pre-charge operation

When the X77 signal turns ON, the pre-charge operation ends, and the PID control starts. (If a start command is given while the X77 signal is ON, the pre-charge operation is not performed, and PID control starts.)



NOTE

- When the PID output suspension (SLEEP) function is in use, and the X77 signal is set to valid after this function is released, set the X77 signal to OFF after checking that the during pre-charge operation signal (Y49) is OFF.
- When the PID output suspension (SLEEP) function is in use, and PID control is to be performed immediately after this function is released, leave the X77 signal ON until PID control ends.
- When the pre-charge operation is valid, the pre-charge operation is performed at the output shutoff cancellation (MRS signal, etc.). (The pre-charge operation is also performed in the case of instantaneous power failure when the automatic restart after instantaneous power failure is valid.)
- When the control method is changed to PID control from a control with higher priority in frequency command (multi-speed setting, Jog operation, etc.), the motor is accelerated/decelerated until its speed reaches the automatic switchover frequency (**Pr.127**), and the pre-charge is performed.

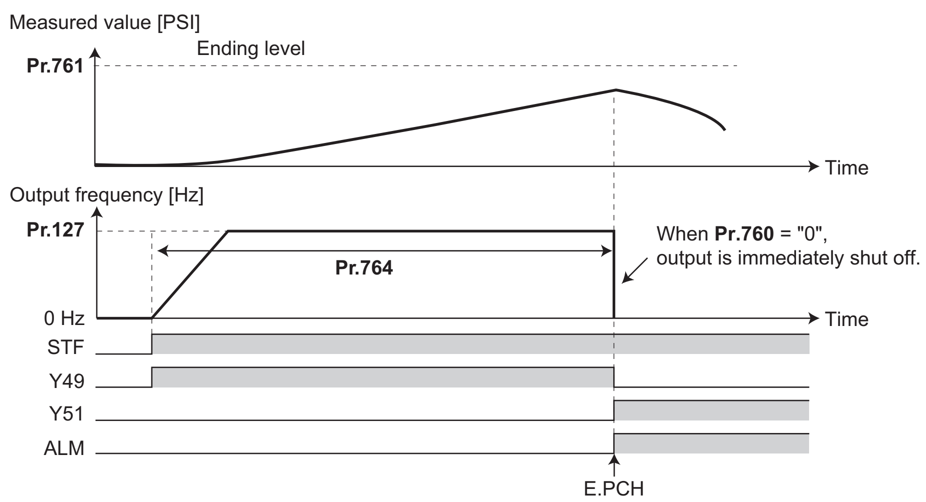
◆ Operation setting at pre-charge fault

- The protective function can be activated when limit values are exceeded if the time limit is set at **Pr.764 Pre-charge time limit** and the measured value limit level is set at **Pr.763 Pre-charge upper detection level**.
- Whether to shut off output immediately after the protective function is activated or after a deceleration stop can be selected by **Pr.760 Pre-charge fault selection**.
- When the time limit is exceeded, the Pre-charge time over (Y51) signal is output. When the measured value limit level is exceeded, the Pre-charge level over (Y53) signal is output. For the Y51 signal, set "51 (positive logic)" or "151 (negative logic)" to **Pr.190 to Pr.196 (Output terminal function selection)**, and for the Y53 signal, set "53 (positive logic)" or "153 (negative logic)" in **Pr.190 to Pr.196 (Output terminal function selection)** to assign the functions to terminals.

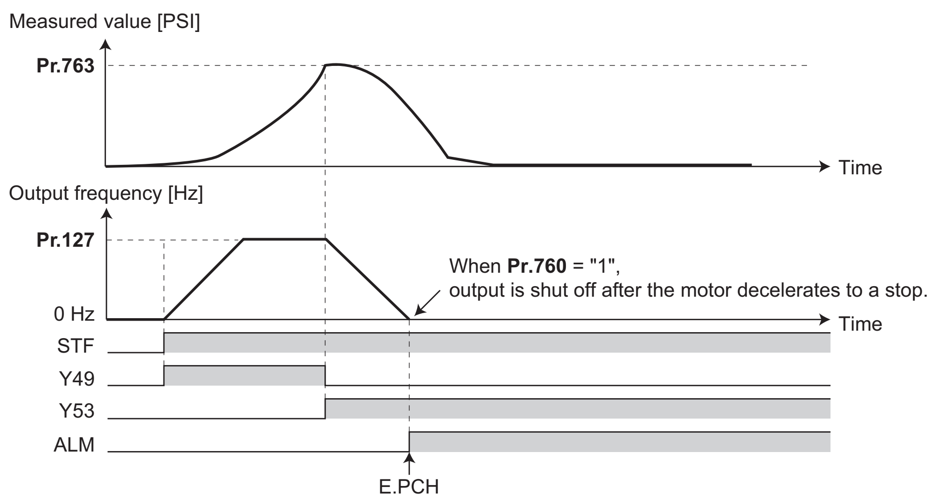
NOTE

- For **Pr.764 Pre-charge time limit**, set a value greater than **Pr.762 Pre-charge ending time**.
- For **Pr.763 Pre-charge upper detection level**, set a value greater than **Pr.761 Pre-charge ending level**.

- Example of protective function by time limit (**Pr.760** = "0")



- Example of protective function measured value limit (**Pr.760** = "1")



◆ Setting multiple PID pre-charge functions

- When the second pre-charge function is set, two sets of pre-charge functions can be switched for use. The second pre-charge function is enabled by turning ON the RT signal.
- The second pre-charge function parameters and signals function in the same way as the following parameters and signals of the first pre-charge function. Refer to the first pre-charge function when setting the second pre-charge functions.

Classification	First pre-charge function parameters		Second pre-charge function parameters	
	Pr.	Name	Pr.	Name
Parameter	760	Pre-charge fault selection	765	Second pre-charge fault selection
	761	Pre-charge ending level	766	Second pre-charge ending level
	762	Pre-charge ending time	767	Second pre-charge ending time
	763	Pre-charge upper detection level	768	Second pre-charge upper detection level
	764	Pre-charge time limit	769	Second pre-charge time limit
	1132	Pre-charge change increment amount	1133	Second pre-charge change increment amount

Classification	First pre-charge function parameters		Second pre-charge function parameters	
	Signal	Name	Signal	Name
Input signal	X77	Pre-charge end command	X78	Second pre-charge end command
Output signal	Y49	During pre-charge operation	Y50	During second pre-charge operation
	Y51	Pre-charge time over	Y52	Second pre-charge time over
	Y53	Pre-charge level over	Y54	Second pre-charge level over

NOTE

- The second PID pre-charge function is valid also when the first pre-charge function is set to invalid and the second pre-charge function is set.
- When "10" (second function enabled only during constant-speed operation) is set to **Pr.155**, the second PID function is not selected even if the RT signal turns ON.

5.11.10 Multi-pump function (Advanced PID function)

PID control function can adjust the volume of water, etc. by controlling pumps. When the motor output is insufficient, auxiliary motors can be driven by the commercial power supply. Up to three auxiliary motors can be connected.

Pr.	Name	Initial value	Setting range	Description
578 A400	**Auxiliary motor operation selection**	0	0	No auxiliary motor operation
			1 to 3	Set the number of auxiliary motors to be run.
579 A401	**Motor connection function selection**	0	0	Basic system
			1	Alternative system
			2	Direct system
			3	Alternative direct system
580 A402	**MC switchcover interlock time (multi-pump)**	1 s	0 to 100 s	Set the MC switchover interlock time.
581 A403	**Start waiting time (multi-pump)**	1 s	0 to 100 s	Set the time from when the MC is switched until it starts. Set this time a little longer than the MC switching time.
582 A404	**Auxiliary motor connection-time deceleration time**	1 s	0 to 3600 s	Used to decrease the output frequency of the inverter when a motor connection occurs. Set the deceleration time for decreasing the output frequency.
			9999	The output frequency is not decreased when a motor connection occurs.
583 A405	**Auxiliary motor disconnection-time acceleration time**	1 s	0 to 3600 s	Used to increase the output frequency of the inverter when a motor connection occurs. Set the acceleration time for increasing the output frequency.
			9999	The output frequency is not increased when a motor connection occurs.
584 A406	**Auxiliary motor 1 starting frequency**	60 Hz	0 to 590 Hz	Set the frequency to start the auxiliary motor.
585 A407	**Auxiliary motor 2 starting frequency**	60 Hz	0 to 590 Hz	
586 A408	**Auxiliary motor 3 starting frequency**	60 Hz	0 to 590 Hz	
587 A409	**Auxiliary motor 1 stopping frequency**	0 Hz	0 to 590 Hz	Set the frequency to stop the auxiliary motor.
588 A410	**Auxiliary motor 2 stopping frequency**	0 Hz	0 to 590 Hz	
589 A411	**Auxiliary motor 3 stopping frequency**	0 Hz	0 to 590 Hz	
590 A412	**Auxiliary motor start detection time**	5 s	0 to 3600 s	Set the delay time until the auxiliary motor is started.
591 A413	**Auxiliary motor stop detection time**	5 s	0 to 3600 s	Set the delay time until the auxiliary motor is stopped.
1370 A442	**Detection time for PID limiting operation**	0 s	0 to 900 s	Set the time until the auxiliary motor is stopped when the PID overpressure control function is used.
1376 A414	**Auxiliary motor stopping level**	9999	0 to 100%	Set the level for stopping the auxiliary motor by the PID overpressure control function.
			9999	The PID overpressure control function is disabled.

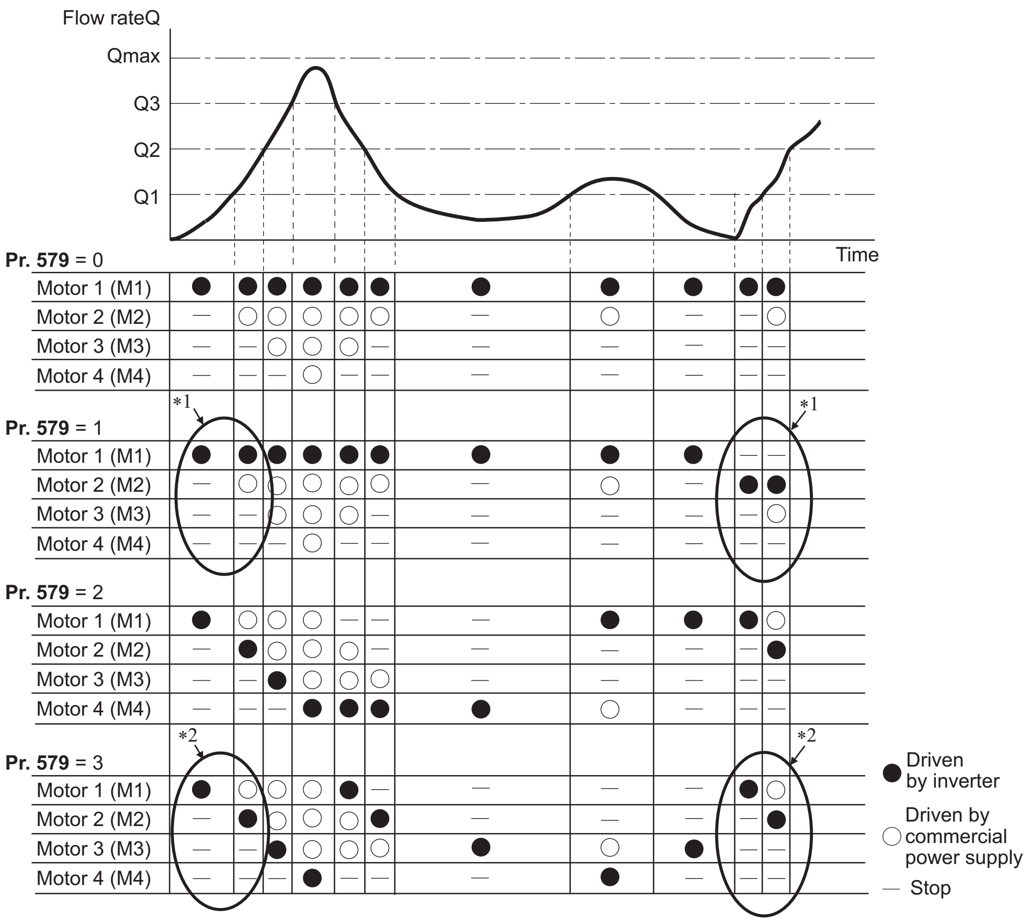
Point

- Refer to page 396 to set PID control.
- When using the sleep function, refer to page 408 to set the function.

◆ Multi-pump function control method

- Use **Pr.579 Motor connection function selection** to select the control method for the multi-pump function. Use **Pr.578 Auxiliary motor operation selection** to set the number of auxiliary motors.

Pr.579 setting	Control method	Description
0	Basic system	The motor driven by the inverter is always fixed. Commercial power supply operation of auxiliary motors is available by turning on and off the MC between the power supply and the motor depending on the output frequency of the inverter.
1	Alternative system	The motor driven by the inverter is fixed during operation. Commercial power supply operation of auxiliary motors is available by turning on and off the MC between the power supply and the motor depending on the output frequency of the inverter. When output is shut off by the SLEEP function, the MC between the inverter and the motor is switched to switch the motor to be driven by the inverter.
2	Direct system	When the start signal is turned ON, the motor is started by the inverter. When the conditions to start the next motor are established, MCs between the inverter and the motor and the power supply and the motor are switched to change the operation of the motor driven by the inverter to commercial power supply operation, and the next motor is started by the inverter. When conditions to stop motors are established while auxiliary motors are running, the motor started first (currently driven by the commercial power supply) is stopped first, and then the other motors are stopped.
3	Alternative direct system	When the start signal is turned ON, the motor is started by the inverter. When the conditions to start the next motor are established, MCs between the inverter and the motor and the power supply and the motor are switched to change the operation of the motor driven by the inverter to commercial power supply operation, and the next motor is started by the inverter. When conditions to stop motors are established while auxiliary motors are running, the motor driven by the inverter is decelerated to stop, and operation of a motor currently driven by the commercial power supply is switched to the inverter-driven operation after frequency search. To perform frequency search when the motor operation is switched from commercial power supply operation to inverter-driven operation, set **Pr.57 Restart coasting time** ≠ "9999".



*1 The starting order of motors is M2 → M3 → M1 if the previous order was M1 → M2 → M3.

*2 The motor starts in the order of elapsed time after completion of the previous inverter-driven operation, from the longest to the shortest. (The motor that has not been driven by the inverter for the longest time starts first.)

NOTE

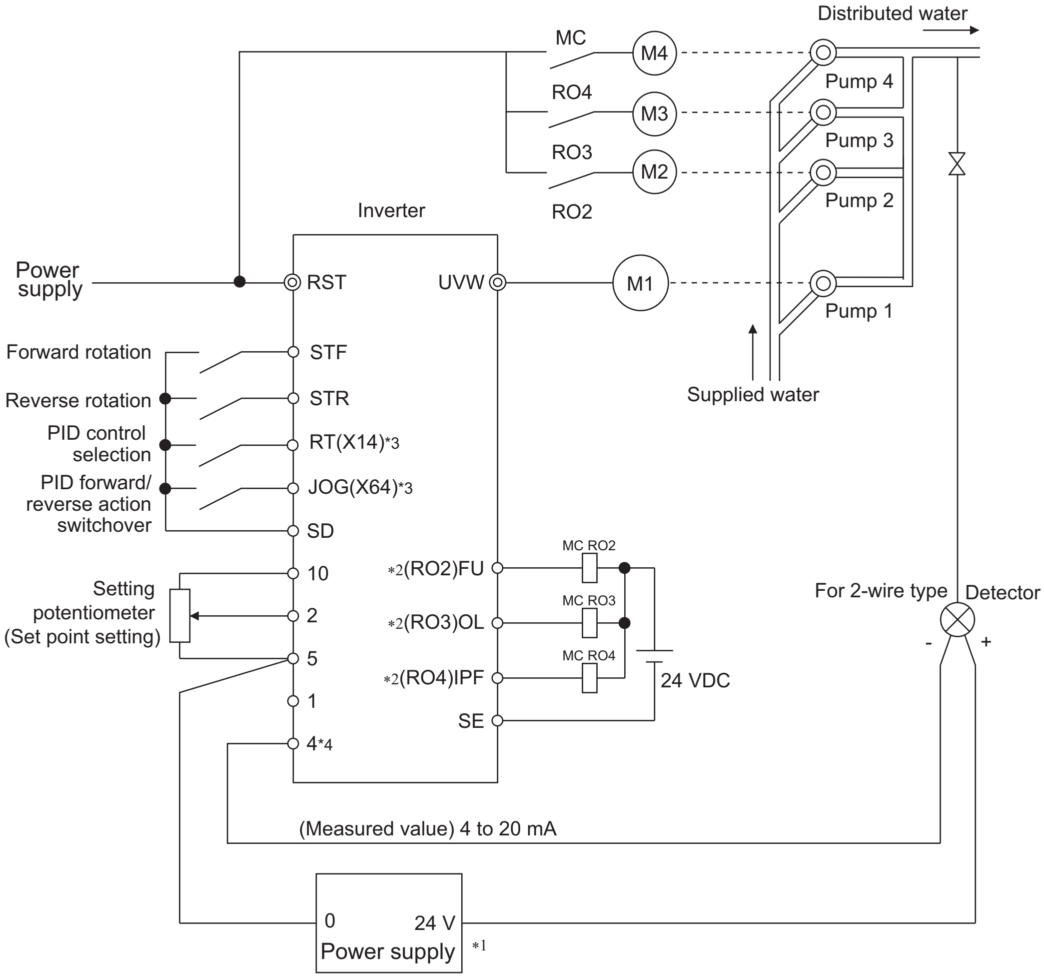
- The motor 1 (M1) starts first when power is turned ON for the first time or after inverter reset.
- When the **Pr.578 or Pr.579** setting has been changed, The motor 1 (M1) starts first.

◆ Connection diagram

- Basic system

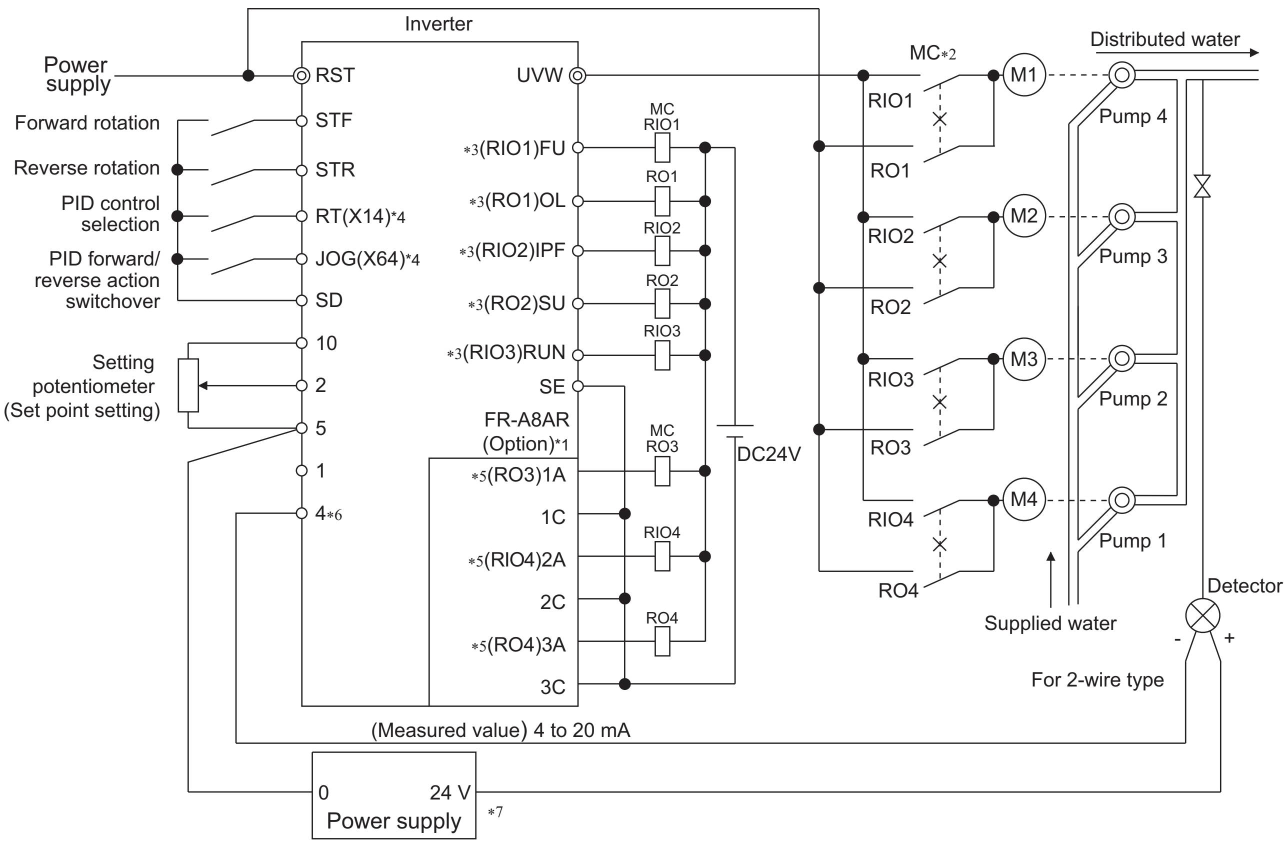
(**Pr.579** = "0")

- Sink logic
- **Pr.183**=14
- **Pr.185**=64
- **Pr.194**=72
- **Pr.193**=73
- **Pr.194**=74



*1 Prepare the power supply in accordance with the power supply specifications of the detector.
*2 The applied output signal terminals differ by the settings of **Pr.190 to Pr.196 (Output terminal function selection)**.
*3 The applied input signal terminals differ by the settings of **Pr.178 to Pr.189 (Input terminal function selection)**.
*4 There is no need to input AU signal.

- Alternative system (**Pr.579** = "1"), direct system (**Pr.579** = "2"), alternative direct system (**Pr.579** = "3")
  - Sink logic
  - **Pr.183** = 14, **Pr.185** = 64, **Pr.194** = 75, **Pr.193**=71, **Pr.192** = 76, **Pr.191** = 72, **Pr.190** = 77
  - **Pr.320** = 73, **Pr.321** = 78, **Pr.322** = 74



*1 When driving three or more motors, use the plug-in option (FR-A8AR).
*2 Always provide mechanical interlocks for the MC.
*3 The applied output signal terminals differ by the settings of **Pr.190 to Pr.196 (Output terminal function selection)**.
*4 The applied input signal terminals differ by the settings of **Pr.178 to Pr.189 (Input terminal function selection)**.
*5 The applied output signal terminals differ by the settings of **Pr.320 to Pr.322 (RA output selection)**.
*6 There is no need to input AU signal.
*7 Prepare the commercial power supply in accordance with the power supply specifications of the detector.

◆ I/O signals

- When the PID control valid (X14) signal is assigned to the input terminal by setting **Pr.178 to Pr.189 (Input terminal function selection)**, the multi-pump function is enabled only at turn-ON of the X14 signal.
- Use **Pr.190 to Pr.196 (Output terminal function selection)** or plug-in option (FR-A8AR) to assign functions of motor control signal to **Pr.320 to Pr.322 (RA output selection)**. (Only positive logic is available.)

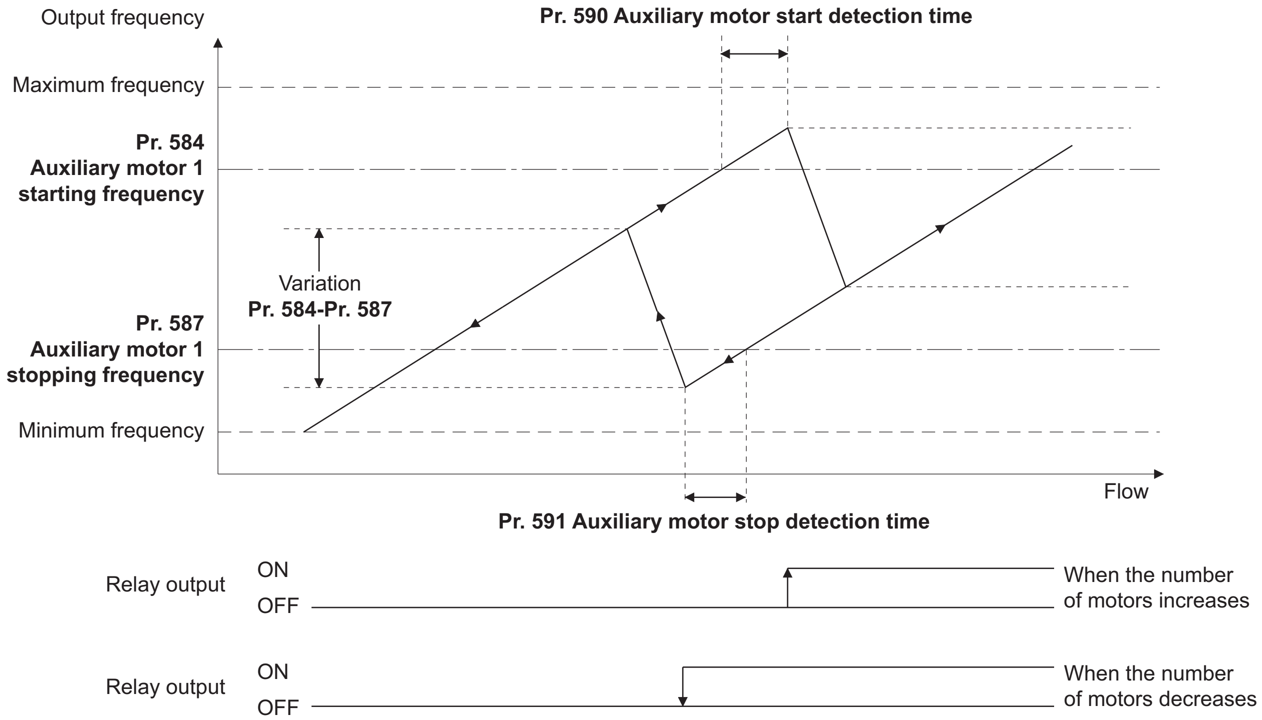
Output signal	Pr.190 to Pr.196 and Pr.320 to Pr.322 settings		Function
	Positive logic	Negative logic	
SLEEP	70	170*1	PID output interruption
RO1	71	—*2	Commercial power supply side motor 1 connection RO1
RO2	72	—*2	Commercial power supply side motor 2 connection RO2
RO3	73	—*2	Commercial power supply side motor 3 connection RO3
RO4	74	—*2	Commercial power supply side motor 4 connection RO4
RIO1	75	—*2	Inverter side motor 1 connection RIO1
RIO2	76	—*2	Inverter side motor 2 connection RIO2
RIO3	77	—*2	Inverter side motor 3 connection RIO3
RIO4	78	—*2	Inverter side motor 4 connection RIO4

*1 The value cannot be set in **Pr.320 to Pr.322**.

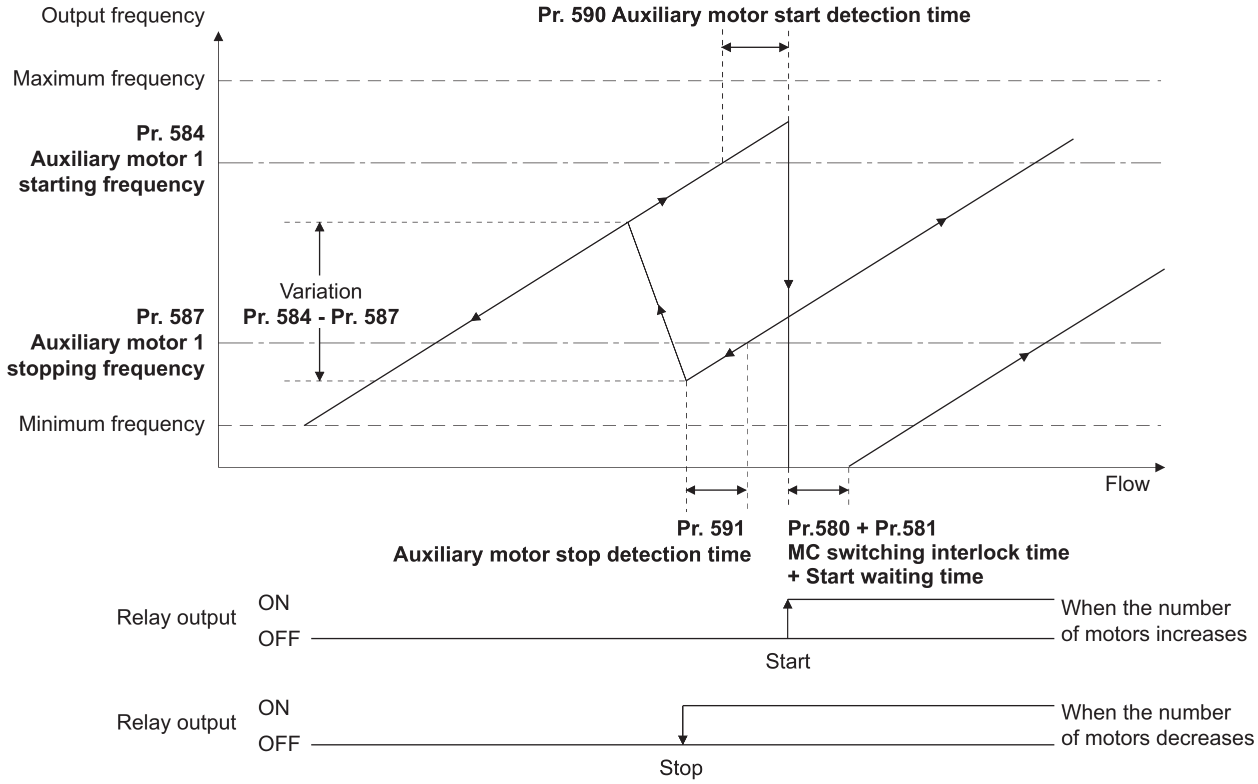
*2 Negative logic cannot be set.

◆ 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")



- 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")

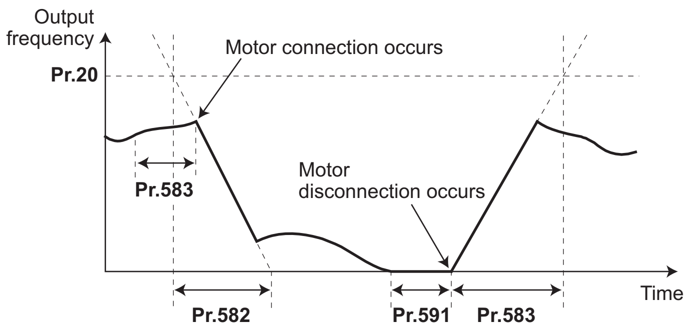


◆ Waiting time setting at MC switchover (Pr.580, Pr.581)

- Set a waiting time for switchover of MC for the direct system (**Pr.579**="2") or alternative direct system (**Pr.579**="3").
- Set the MC switching time (for example, the time after RIO1 turns OFF until RO1 turns ON) in **Pr.580 MC switchcover interlock time (multi-pump)**.
- Set the time after the MC switchover until the motor starts (for example, the time after RIO1 turns OFF and RIO2 turns ON until the inverter output starts) in **Pr.581 Start waiting time (multi-pump)**. 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)

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



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◆ Starting auxiliary motors (Pr.584 to Pr.586, Pr.590)

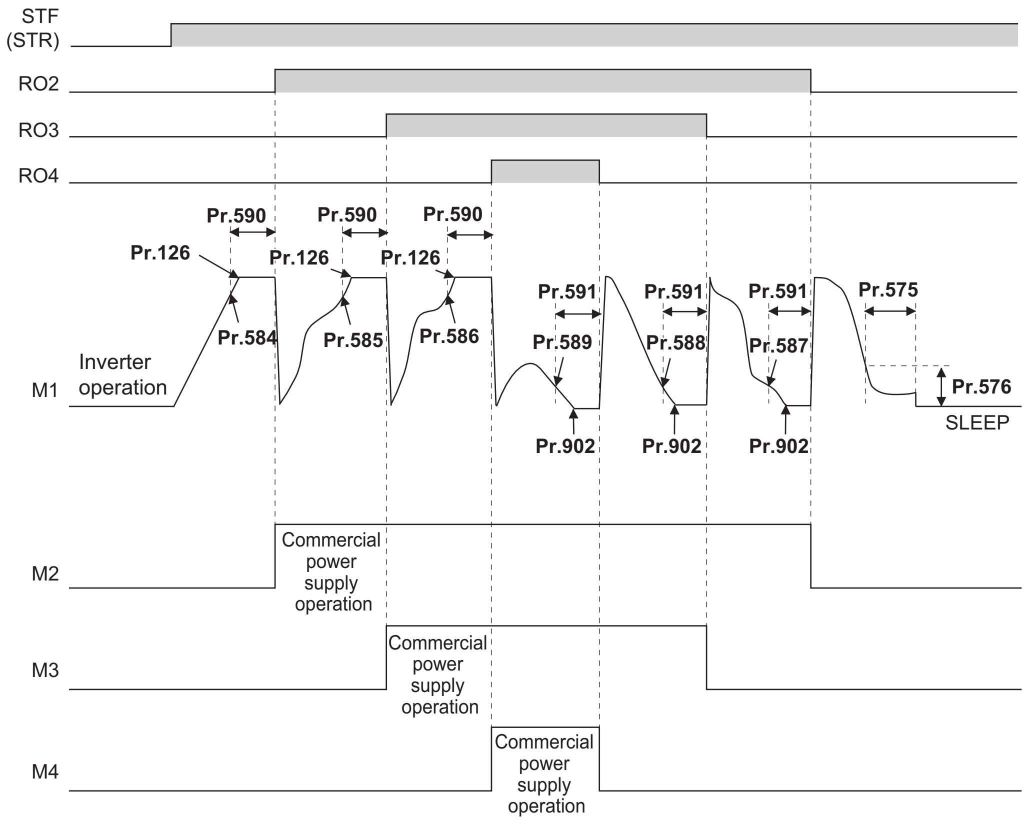
- Use **Pr.584 to Pr.586** to set the output frequency of the inverter at which the commercial power supply operation motors are started. When output frequency equals to or higher than the setting continues for longer than the time set in **Pr.590 Auxiliary motor start detection time**, auxiliary motors driven by the commercial power supply are started.
- To set the starting frequency, use **Pr.584 Auxiliary motor 1 starting frequency** for the first auxiliary motor, and use **Pr.585 Auxiliary motor 2 starting frequency** for the second motor, and use **Pr.586 Auxiliary motor 3 starting frequency** for the third motor.
- The starting sequence depends on the **Pr.579 Motor connection function selection** setting.

◆ Stopping auxiliary motors (Pr.587 to Pr.589, Pr.591)

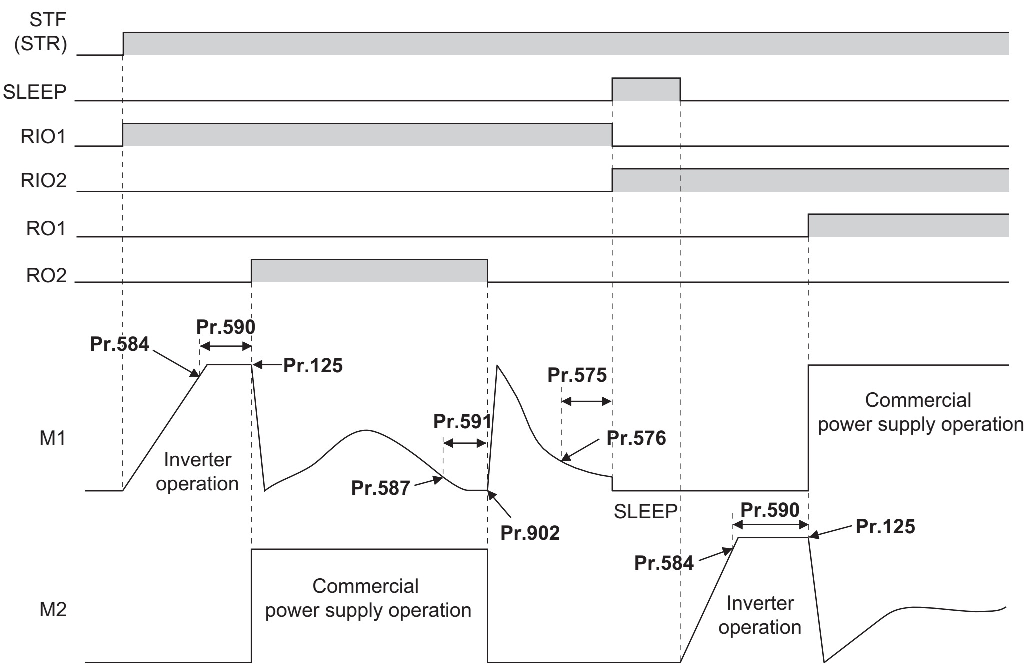
- Use **Pr.587 to Pr.589** to set the output frequency of the inverter at which the commercial power supply operation motors are stopped. When output frequency equals to or lower than the setting continues for longer than the time set in **Pr.591 Auxiliary motor stop detection time**, auxiliary motors driven by the commercial power supply are stopped.
- To set the stopping frequency, use **Pr.587 Auxiliary motor 1 stopping frequency** for the first auxiliary motor, and use **Pr.588 Auxiliary motor 2 stopping frequency** for the second motor, and use **Pr.589 Auxiliary motor 3 stopping frequency** for the third motor.
- The stopping sequence depends on the **Pr.579 Motor connection function selection** setting.

◆ Timing diagram

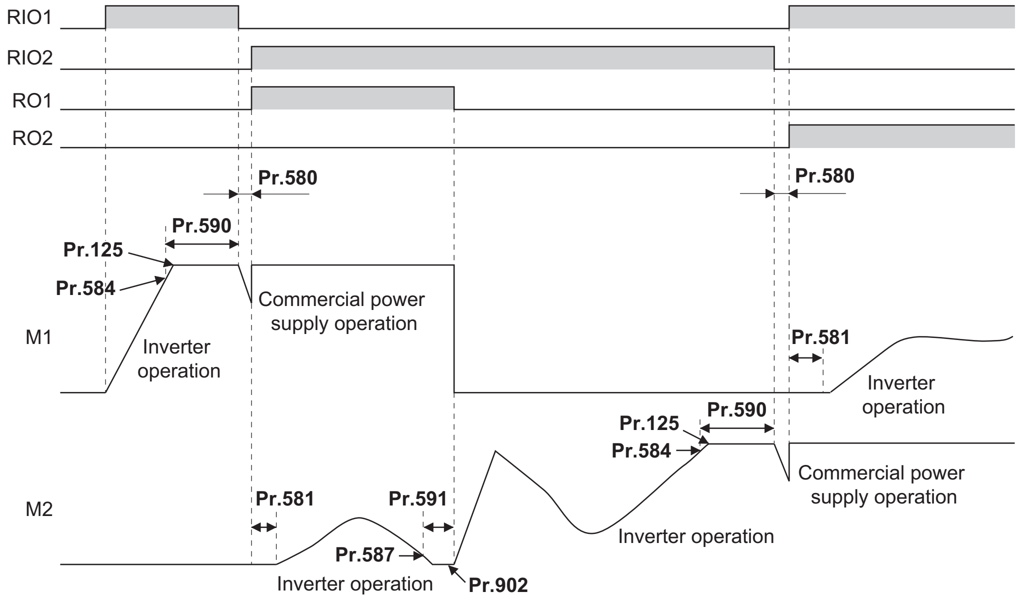
- When using four motors in the basic system (**Pr.579**="0")



- When using two motors in the alternative system (**Pr.579**="1")



• When using two motors in the direct system (**Pr.579**="2")

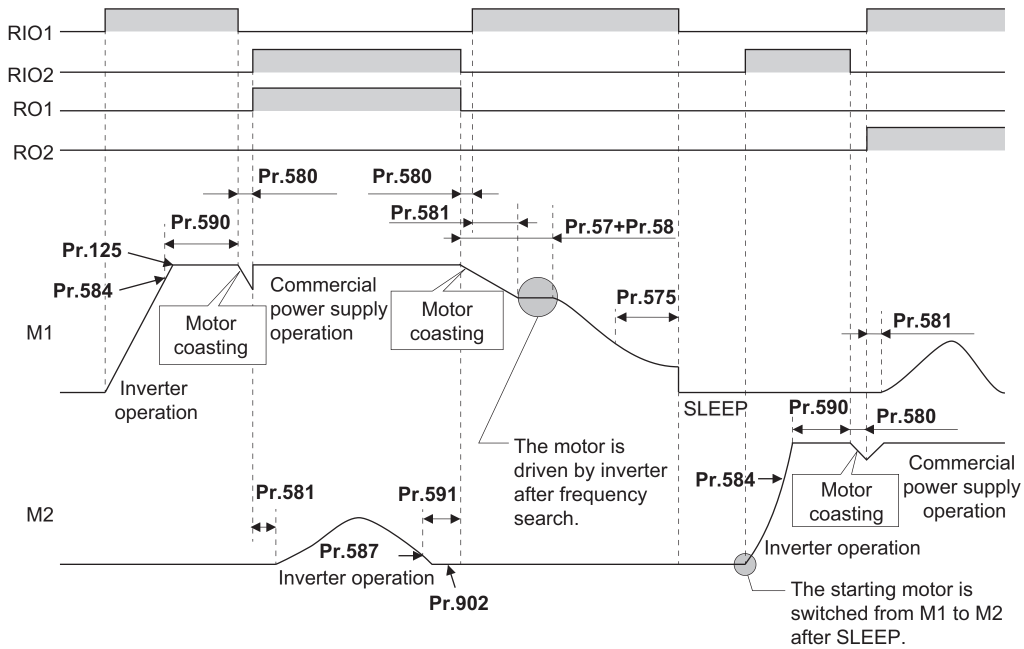


NOTE

- When a start signal is turned OFF while running, MC (RO1 to RO4) turns OFF and the motor decelerates.
- When a protective function is activated while running, MC (RO1 to RO4) turns OFF and the inverter output is shut off.

5

• When using two motors in the alternative direct system (**Pr.579**="3")



NOTE

• When the start signal is turned OFF during operation, the inverter-driven motor is decelerated to stop. The motors under commercial power supply operation are switched over to inverter-driven operation one at a time and decelerated to stop after frequency search in order from the longest operation time.
• When a protective function is activated while running, MC (RO1 to RO4) turns OFF and the inverter output is shut off.
• When the MRS signal is turned ON during operation, the inverter output is shut off and the running motors coast to a stop. 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 output shutoff status remains. When the MRS signal is turned OFF, the inverter-driven operation starts after frequency search.
• If the starting signal is turned ON during deceleration regardless of the **Pr.579** setting, the multi-pump operation is performed again.

◆ PID overpressure control (Pr.1370 and Pr.1376)

- When the main valve is suddenly closed in the multi-pump function system, a sudden increase of the pipe pressure may occur, and the pipes may be broken. To prevent fracture of the pipes, all auxiliary motors are stopped when the feedback value exceeds the predetermined level.
- When the PID measured value reaches or exceeds the **Pr.1376 Auxiliary motor stopping level** and the elapsed time exceeds the **Pr.1370 Detection time for PID limiting operation** while the multi-pump function is activated, all operating auxiliary motors are disconnected and allowed to coast to a stop regardless of the **Pr.579 Motor connection function selection** setting. The motor driven by the inverter continues its operation.
- After the auxiliary motor is stopped, the motor operation does not start while the PID measured value is equal to **Pr.1376** setting or more even when the auxiliary motor starting condition is satisfied.

NOTE

- The PID overpressure control function can be used when PID control is performed (reverse action only) by the set point or measured value input using the multi-pump function.
- Either the first or the second PID measured value is used according to the PID control selection. When the control switches between the first PID control and second PID control, the measured value to be used is also switched to continue the control operation.

5

Parameters referred to

Pr.20 Acceleration/deceleration reference frequency, Pr.21 Acceleration/deceleration time increments ☞ page 190
Pr.57 Restart coasting time, Pr.58 Restart cushion time ☞ page 448
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297

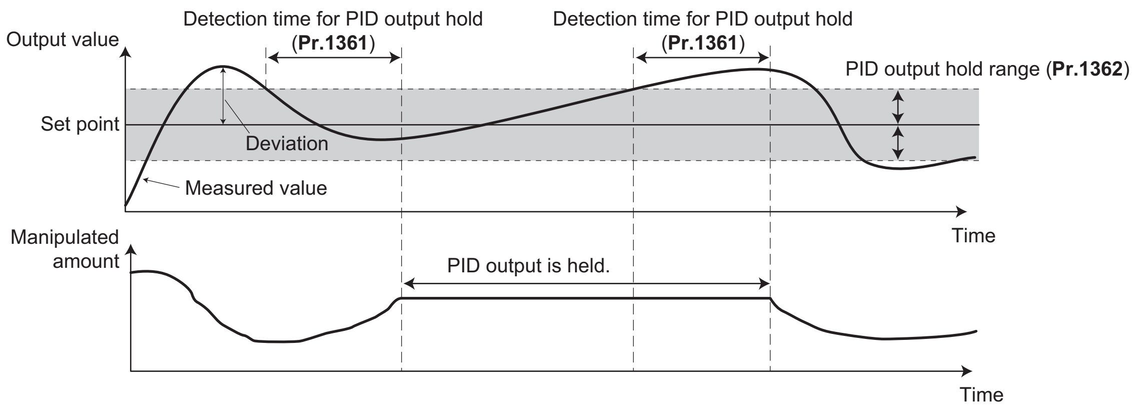
5.11.11 PID control enhanced functions

PID control enhanced functions can be used to perform PID control according to applications.

Pr.	Name	Initial value	Setting range	Description
1361 A440	**Detection time for PID output hold**	5 s	0 to 900 s	Set the time from when the deviation falls within the PID output hold range until the PID output is held.
1362 A441	**PID output hold range**	9999	0 to 50%	Set the range in which the PID output is held.
			9999	The PID output holding is disabled.
1363 A447	**PID priming time**	9999	0 to 360 s	Set the time from when the priming operation starts until the main pump starts.
			9999	The PID priming pump function is disabled.
1364 A448	**Stirring time during sleep**	15 s	0 to 3600 s	Set the stirring time.
1365 A449	**Stirring interval time**	0 h	0 to 1000 h	Set the interval time for the stirring operation.
1366 A627	**Sleep boost level**	9999	0 to 100%	Increase the set point before the PID output suspension function is activated.
			9999	The PID sleep boost function is disabled.
1367 A628	**Sleep boost waiting time**	0 s	0 to 360 s	Set the waiting time for the sleep boost operation.
1368 A629	**Output interruption cancel time**	0 s	0 to 360 s	Set the time from when the deviation reaches the output interruption cancel level until the output is started.
111 F031	**Check valve deceleration time**	9999	0 to 3600 s	Set the deceleration time for the check valve deceleration function.
			9999	The check valve deceleration function is disabled.
1369 A446	**Check valve closing completion frequency**	9999	0 to 120 Hz	Set the frequency at which the check valve deceleration stops.
			9999	The check valve deceleration function is disabled.
1346 A457	**PID lower limit operation detection time**	9999	0 to 900 s	Set the time from when the measured value reaches the lower limit pre-warning level (**Pr.1371**) until the set point change is started.
			9999	As set in **Pr.1370**.
1370 A442	**Detection time for PID limiting operation**	0 s	0 to 900 s	Set the time from when the measured value reaches the pre-warning level (**Pr.1371**) until the set point change is started.
1371 A443	**PID upper/lower limit pre-warning level range**	9999	0 to 50%	Set the operation range for the PID upper/lower limit pre-warning function.
			9999	The PID upper/lower limit pre-warning function is disabled.
1372 A444	**PID measured value control set point change amount**	5%	0 to 50%	Set the set point change amount for the PID upper/lower limit pre-warning operation.
1373 A445	**PID measured value control set point change rate**	0%	0 to 100%	Set the set point change rate for the PID upper/lower limit pre-warning operation.
1374 A450	**Auxiliary pressure pump operation starting level**	1000%	900 to 1100%	Set the deviation level for operating the auxiliary pressure pump.
1375 A451	**Auxiliary pressure pump operation stopping level**	1000%	900 to 1100%	Set the deviation level for stopping the auxiliary pressure pump.
1377 A452	**PID input pressure selection**	9999	1	Terminal 1 pressure input
			2	Terminal 2 pressure input
			3	Terminal 4 pressure input
			9999	The PID input pressure control function is disabled.
1378 A453	**PID input pressure warning level**	20%	0 to 100%	Set the input pressure warning level.
1379 A454	**PID input pressure fault level**	9999	0 to 100%	Set the input pressure fault level.
			9999	The input pressure fault detection is disabled.
1380 A455	**PID input pressure warning set point change amount**	5%	0 to 100%	Set the set point change amount when the pressure reaches the input pressure warning level.
1381 A456	**PID input pressure fault operation selection**	0	0	The protective function (E.PID) for the input pressure fault is activated.
			1	A deceleration stop is performed when the input pressure fault occurs.

◆ PID output hold (Pr.1361 and Pr.1362)

- The manipulated amount (PID output) can be fixed when the fluctuation of the deviation is small. This function eliminates unnecessary acceleration/deceleration, which is effective to reduce the power consumption.
- When the deviation falls within the **Pr.1362 PID output hold range** and the elapsed time exceeds the **Pr.1361 Detection time for PID output hold**, the manipulated amount (PID output) is fixed at the output frequency at that time.
- Even if the deviation falls out of the PID output hold range, the manipulated amount (PID output) is maintained for the detection time for PID output hold.

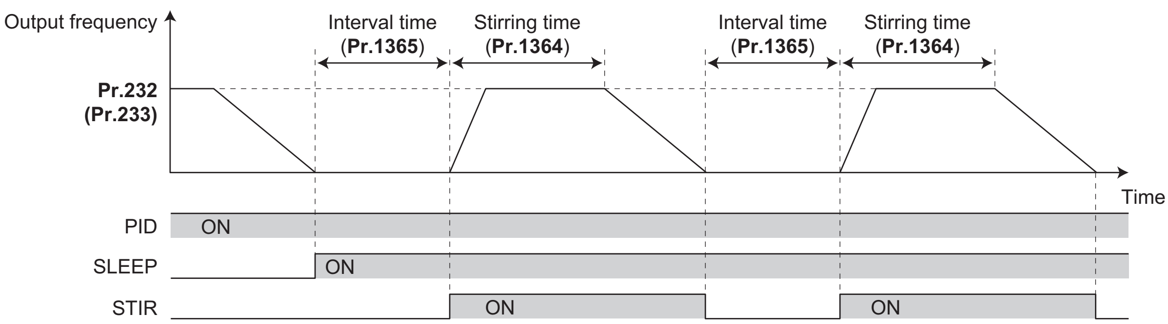


NOTE

- While the PID output is held, calculation is not performed for the P term, I term, and D term. For the P and I terms, the values at the start of the holding period are kept. The D term is set to "0".
- When the control switches between the first PID control and second PID control, the PID output holding state is canceled.
- The PID output holding function is disabled in the following cases:
  When **Pr.1362**="9999", while the PID setting is not applied to the frequency, during the sleep function, at switching to the auxiliary motor in the multi-pump function, during PID gain tuning, and during the sleep boost.

◆ Stirring function during the PID sleep (Pr.1364 and Pr.1365)

- This function starts the pump periodically to prevent clogging of the pump while the PID output suspension function (sleep function) is activated.
- When the sleep function is activated and the elapsed time exceeds the **Pr.1365 Stirring interval time**, the pump is operated at the stirring frequency (**Pr.232** or **Pr.233**). The pump decelerates to stop when the elapsed time exceeds the **Pr.1364 Stirring time during sleep**. The interval time count for the second time onward starts after the previous deceleration stop is completed.



- The rotation direction depends on the **Pr.232** and **Pr.233** settings.

Stirring frequency		Rotation direction	Remarks
Pr.232 setting	Pr.233 setting		
9999	9999	—	The stirring function during the PID sleep is disabled.
0 to 590 Hz	Arbitrary	Command direction	**Pr.232** frequency is used for stirring.
9999	0 to 590 Hz	Opposite to the command direction	**Pr.233** frequency is used for stirring.

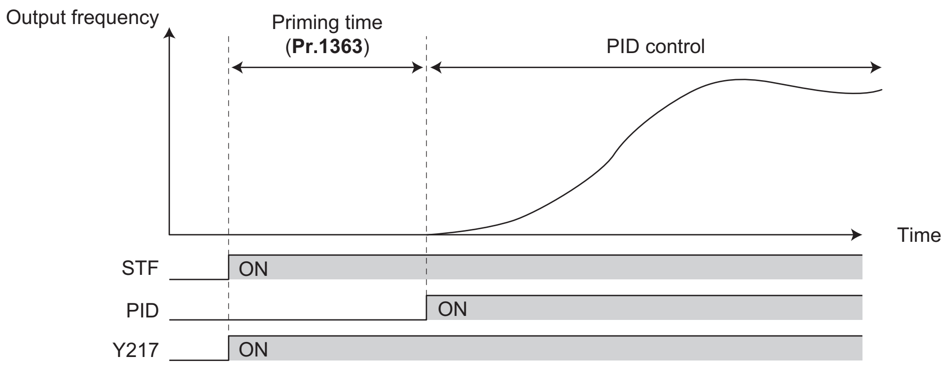
- The stirring signal (STIR) turns ON during the stirring operation. For the STIR signal, set "218 (positive logic)" or "318 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.
- When **Pr.579 Motor connection function selection** (multi-pump function) is set to 1 or 3, the starting order of the motors is changed when the sleep function is activated. The stirring operation during the sleep is applied to the motor to be started first next time. For example, when the previous starting order was M1 → M2 → M3 → M4, and the next starting order of motors is M2 → M3 → M4 → M1, stirring operation during the sleep will be applied to the M2 motor.
- When the auxiliary motor starting condition is satisfied by the stirring operation during the sleep while the multi-pump function is used, the stirring operation continues. The auxiliary motor does not start.

NOTE

- When the control switches between the first PID control and second PID control during the sleep function, the interval time and the stirring time timer are carried over.
- When the sleep function cancellation condition is satisfied, the sleep function is cancelled, and the stirring function during the sleep is also cancelled.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ PID priming pump function (Pr.1363)

- This function starts the priming pump first before starting the main pump so that the main pump does not intake air at start.
- When the start command is turned ON after setting **Pr.1363 PID priming time**≠"9999", the priming pump operation signal (Y217) turns ON to start the priming pump. When the elapsed time exceeds the **Pr.1363** setting, the main pump starts.
- The priming pump continues operation during operation of the main pump. When the STF signal is turned OFF to stop the main pump, the priming pump also stops.
- For the Y217 signal, set "217 (positive logic)" or "317 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.

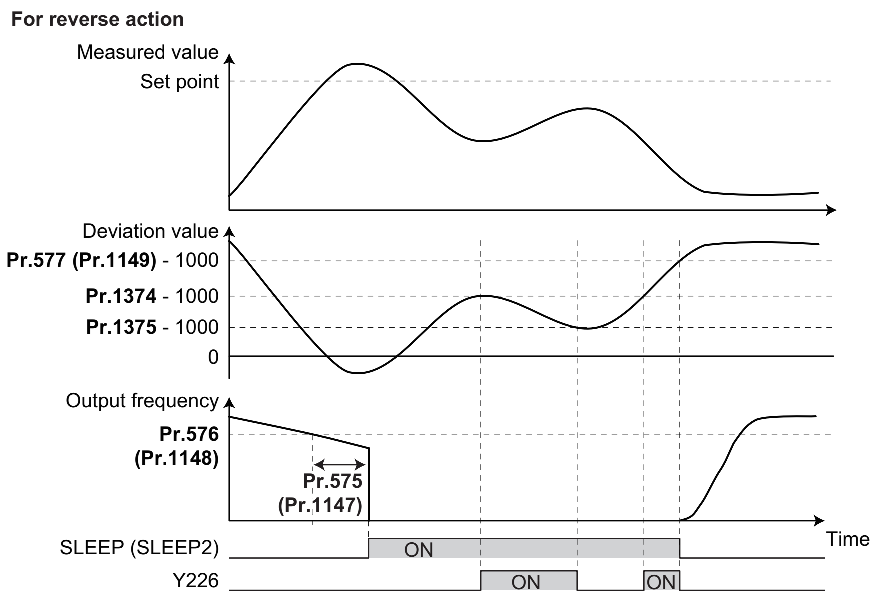


NOTE

- The priming operation is performed at every startup.
- When the operation is restarted after inverter reset by a protective function activation, the priming operation is performed.
- When the inverter is restarted by the retry operation at a fault occurrence, the priming pump operation is continued and after the restart, the PID control operation is performed without waiting for the priming time.
- When the control switches between the first PID control and second PID control during the priming time, the priming time is carried over.
- The PID priming pump function is enabled when the PID setting is applied to the frequency.
- Even when the inverter emergency stop operation (output shutoff by the MRS signal, etc.) is performed, the PID priming pump function operation continues while the power is supplied to the control circuit. For the emergency stop operation, configure another circuit to stop the priming pump.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆ PID auxiliary pressure pump function (Pr.1374 and Pr.1375)

- This function enables signal output to activate an auxiliary pressure pump when the pump flow rate is low in the system which constantly requires a high pressure.
- When the deviation exceeds the auxiliary pressure pump operation starting level (**Pr.1374 Auxiliary pressure pump operation starting level** - 1000%) after the PID output suspension function (sleep function) is activated, the auxiliary pressure pump starts and the auxiliary pressure pump operation signal (Y226) turns ON.
- When the deviation falls below the auxiliary pressure pump operation stopping level (**Pr.1375 Auxiliary pressure pump operation stopping level** - 1000%) during the auxiliary pressure pump operation, the auxiliary pressure pump stops.
- For the Y226 signal, set "226 (positive logic)" or "326 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.

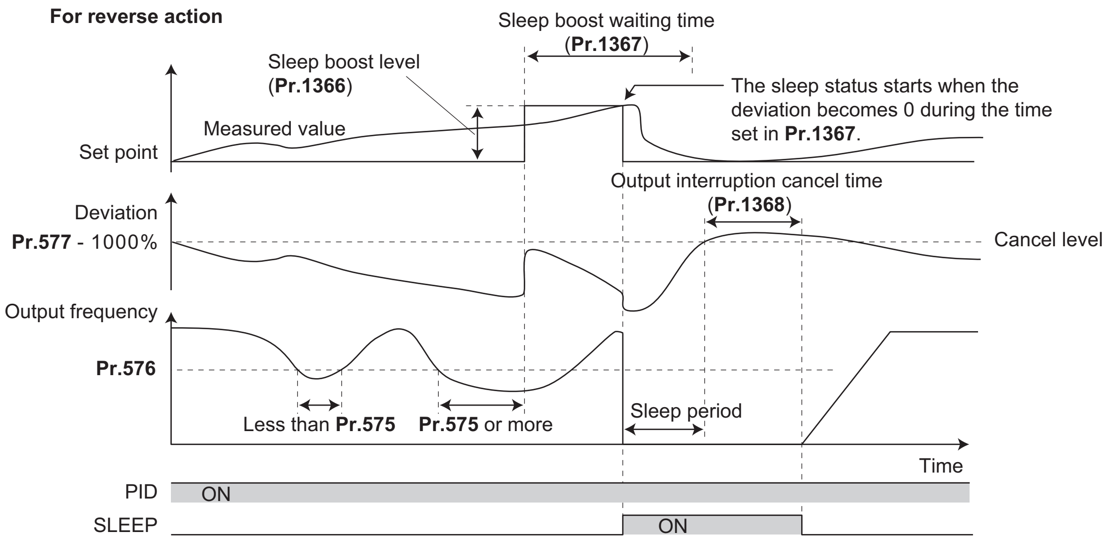


NOTE

- The recommended settings of **Pr.577 (Pr.1149), Pr.1374, and Pr.1375** are as follows. **Pr.577 (Pr.1149)** > **Pr.1374** > **Pr.1375**
- Even when the inverter emergency stop operation (output shutoff by the MRS signal, etc.) is performed, the PID auxiliary pressure pump function operation continues while the power is supplied to the control circuit. For the emergency stop operation, configure another circuit to stop the auxiliary pressure pump.
- Changing the terminal assignment using **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

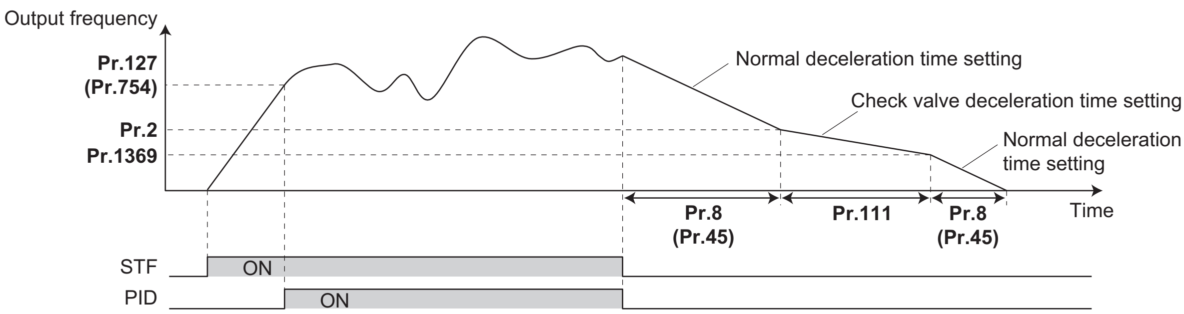
◆ PID sleep boost (Pr.1366 to Pr.1368)

- The pump pressure can be increased before the PID output suspension function (sleep function) is activated. This function is useful to prevent frequent repetition of starting and stopping of the pump, and to maintain the sleep state for a long period of time.
- When the normal condition to activate the sleep function is satisfied (the output frequency is less than **Pr.576** setting for the time set in **Pr.575** or longer), the PID set point automatically increases by the amount set in **Pr.1366 Sleep boost level**.
- When the measured value reaches to the set point during **Pr.1367 Sleep boost waiting time**, the sleep function is activated. Then, the set point returns to its original value from the sleep boost set point.
- When the measured value does not reach to the sleep boost set point after the time set in **Pr.1367** passes, PID control continues without activating the sleep function.
- When the deviation remains at the **Pr.577** setting or higher for the time set in **Pr.1368 Output interruption cancel time**, the inverter output restarts.



◆ Check valve deceleration function (Pr.111 and Pr.1369)

- When the pump is stopped, slow deceleration can be applied to the predetermined section to prevent the water hammer sound caused by closing the valve.
- The **Pr.111 Check valve deceleration time** setting is applied to the section between **Pr.2 Minimum frequency** and **Pr.1369 Check valve closing completion frequency**.



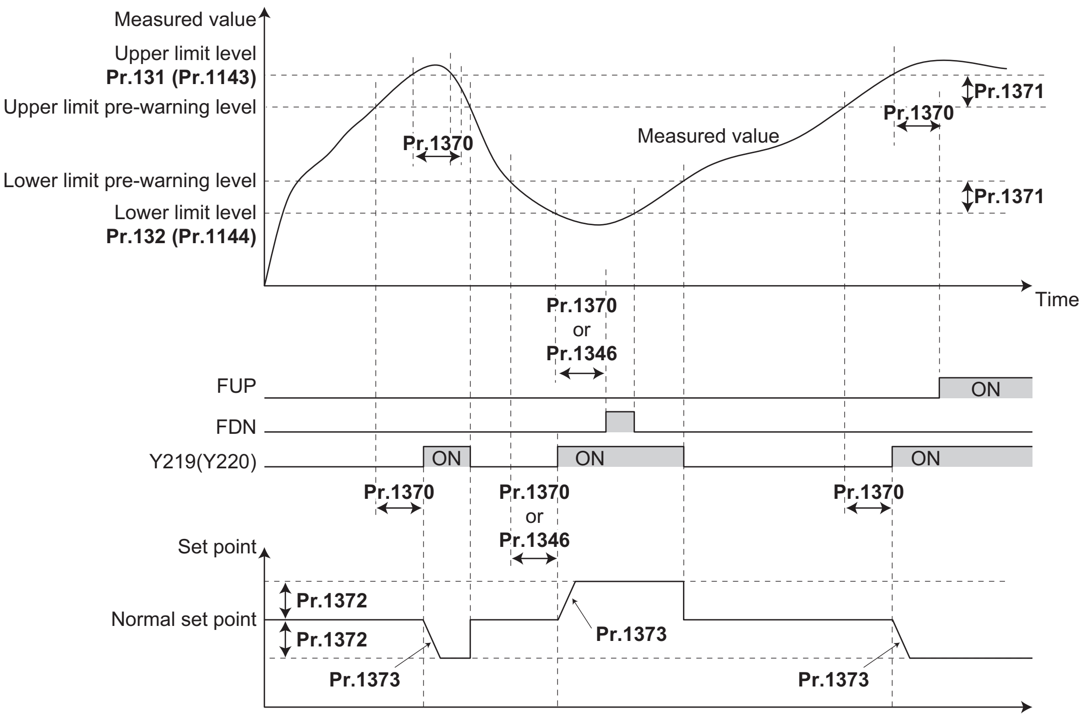
NOTE

- The check valve deceleration function is enabled when the PID setting is applied to the frequency.
- When the **Pr.1369** setting is higher than the **Pr.2** setting, the normal deceleration time (**Pr.8** or **Pr.45**) setting is applied.

◆ PID upper/lower limit pre-warning (Pr.1346, Pr.1370 to Pr.1373)

- The set point can be changed to suppress increase of the measured value before PID upper limit (FUP) or PID lower limit (FDN) is detected.
- When the measured value reaches and remains at the pre-warning level set in **Pr.1371 PID upper/lower limit pre-warning level range** for the time set in **Pr.1370 Detection time for PID limiting operation**, the PID upper/lower limit pre-warning signal (Y219) or the second PID upper/lower limit pre-warning signal (Y220) is output. Also, the set point is changed by the amount set in **Pr.1372 PID measured value control set point change amount**.
- To set the detection time for upper and lower limits separately, set **Pr.1346 PID lower limit operation detection time**.
- Set the rate (%/s) for changing the set point by the **Pr.1372** setting value in **Pr.1373 PID measured value control set point change rate**. When the measured value falls within the normal range, the set point returns to its original value.
- For the Y219 and Y220 signals, assign the functions to output terminals using the **Pr.190 to Pr.196 (Output terminal function selection)**.

Output signal	Pr.190 to Pr.196 setting	
	Positive logic	Negative logic
Y219	219	319
Y220	220	320



NOTE

- When **Pr.554**="5, 7, 15, or 17" and a deceleration stop is performed by the FUP/FDN signal detection, the set point changed by the **Pr.1372** setting value remains effective.
- The set point change by the PID upper/lower limit pre-warning function is enabled when the PID setting is applied to the frequency.
- When the control switches between the first PID control and second PID control while the set point is changed by the **Pr.1372** setting value or while the Y219 (Y220) signal is output, the set point returns to its original value.
- When the upper limit or lower limit is disabled (**Pr.131** or **Pr.132** = "9999"), the upper/lower limit pre-warning function is not activated.
- The settings in **Pr.1346 and Pr.1370** is used for the detection time for output of the FUP and FDN signals. (Refer to page 396.)

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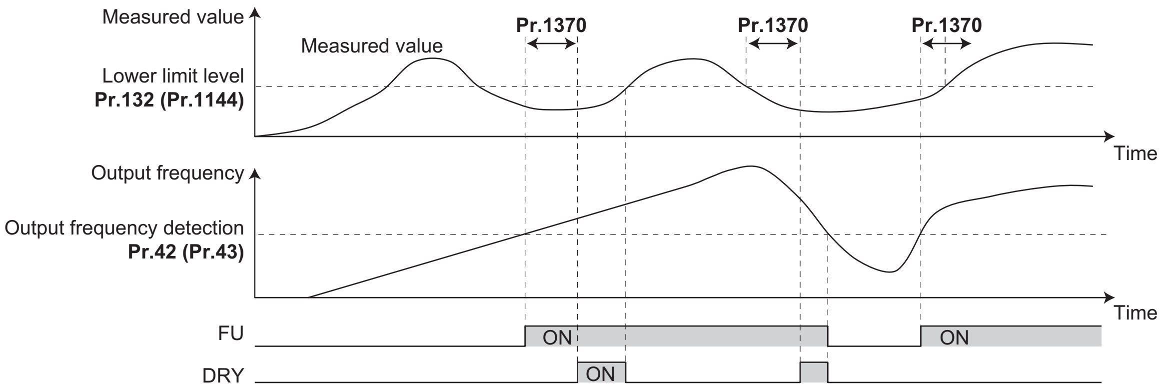
◆ PID dry run monitoring function (Pr.1370)

- This function can prevent operation without water in the pipes by monitoring the flow rate (measured value) inside the pipes. When the flow rate decreases while the FU signal is ON, an output signal is sent for notification.
- The dry run signal (DRY) is output during PID control when the measured value is lower than the lower limit (**Pr.132** or **Pr.1144**) and the output frequency is higher than the setting in **Pr.42 Output frequency detection** or **Pr.43 Output frequency detection for reverse rotation** (FU signal ON) for the time set in **Pr.1370 Detection time for PID limiting operation**.
- For the DRY signal, set "228 (positive logic)" or "328 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.
- The PID dry run monitoring function is enabled for the reverse action.



NOTE

- The PID dry run monitoring function is enabled when the PID setting is applied to the frequency.

◆ PID input pressure control (Pr.1370, Pr.1373, and Pr.1377 to Pr.1381)

- In order to prevent air intake and cavitation inside the pump, this function controls the pump inlet pressure so that there is no water shortage.
- To enable the PID input pressure control function, set the terminal for the pressure input in **Pr.1377 PID input pressure selection**. (Select a terminal different from the one used for inputting the set point, measured value, or deviation.)

Pr.1377 setting	Pressure input terminal	Remarks
1	Terminal 1	Set **Pr.868**="0 (initial value)".
2	Terminal 2	—
3	Terminal 4	Set **Pr.858**="0 (initial value)".
9999 (Initial value)	The PID input pressure control function is disabled.	—

- When the input pressure measured at the inlet remains lower than the **Pr.1378 PID input pressure warning level** for the time set in **Pr.1370 Detection time for PID limiting operation**, the PID input pressure warning signal (Y229) is output. Also, the set point is changed by the amount set in **Pr.1380 PID input pressure warning set point change amount**.
- Set the rate (%/s) for changing the set point by the **Pr.1380** setting value in **Pr.1373 PID measured value control set point change rate**. When the input pressure falls within the normal range, the set point returns to its original value.
- When the input pressure measured at the inlet remains lower than the **Pr.1379 PID input pressure fault level** for the time set in **Pr.1370 Detection time for PID limiting operation**, the operation for the abnormal input pressure starts and the PID input pressure fault signal (Y230) is output.
- Select the operation for the abnormal input pressure in **Pr.1381**.

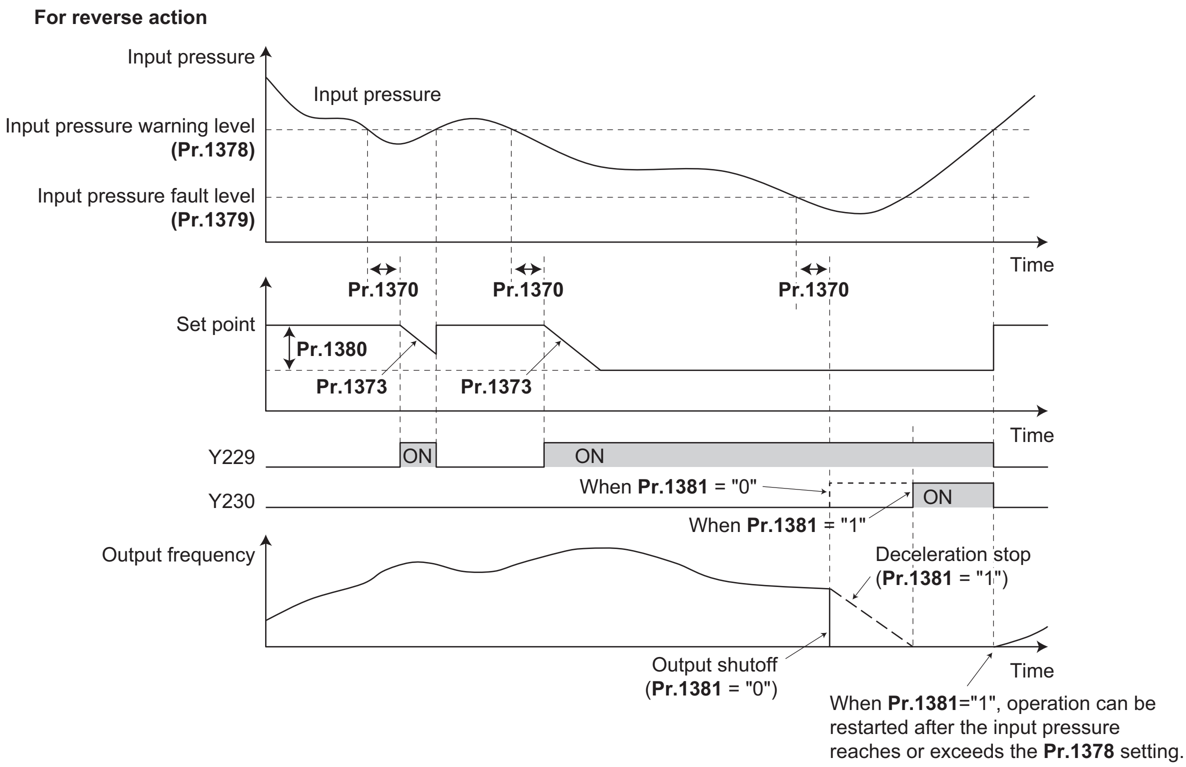
Pr.1381 setting	Operation for the abnormal input pressure	Y230 signal
0 (Initial value)	Output shutoff by the protective function (E.PID) activation	The signal is output at the same time with the protective function.
1	Deceleration stop (Operation can be restarted when the input pressure returns to normal.)	The signal is output after a deceleration stop.

- For the Y229 and Y230 signals, assign the functions to output terminals using the **Pr.190 to Pr.196 (Output terminal function selection)**.

Output signal	Pr.190 to Pr.196 setting	
	Positive logic	Negative logic
Y229	229	329
Y230	230	330

- To monitor the input pressure, set "69" in the monitor selection parameters. (0.1% increments)

Monitor type	Parameter setting			Communication monitor code	
	Pr.52, Pr.774 to Pr.776, and Pr.992 (Operation panel indication)	Pr.54 (Terminal CA output)	Pr.158 (Terminal AM output)	RS-485 communication dedicated monitor (hexadecimal)	MODBUS RTU real time monitor
PID input pressure value	69	69	69	H45	40269



NOTE

- When the control switches between the first PID control and second PID control while the set point is changed by the **Pr.1380** setting value or while the Y229/Y230 signal is output, the set point returns to its original value or the signal turns OFF, and the detection restarts.
- When the PID input pressure control function and the PID upper/lower limit pre-warning function are used simultaneously, each function may change the set point. When the set point change is attempted by both functions, the change by the PID input pressure control function has priority.
- When the PID input pressure control function and the PID sleep boost function are used simultaneously, each function may change the set point. When the set point change is attempted by both functions, the change by the PID input pressure control function has priority. (The sleep state is established without applying the set point change by the PID sleep boost function.)

5.11.12 Automatic restart after instantaneous power failure/flying start with an induction motor

V/F Magnetic flux

The inverter can be restarted without stopping the motor in the following conditions:

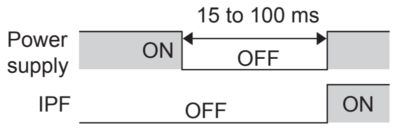
- When switching from commercial power supply operation over to inverter running
- When an instantaneous power failure occurs during inverter running
- When the motor is coasting at start

Pr.	Name	Initial value	Setting range	Description
162 A700	**Automatic restart after instantaneous power failure selection**	0	0 (2)*2, 1000 (1002)*2	Frequency search only performed at the first start
			1, 1001	Reduced voltage start only at the first start (no frequency search)
			3, 1003	Frequency search only performed at the first start (reduced impact restart)
			10 (12)*2, 1010 (1012)*2	Frequency search at every start
			11, 1011	Reduced voltage start at every start (no frequency search)
			13, 1013	Frequency search at every start (reduced impact restart)
299 A701	**Rotation direction detection selection at restarting**	9999	0	Without rotation direction
			1	With rotation direction
			9999	When **Pr.78** = "0", with rotation direction When **Pr.78** = "1, 2" without rotation direction
57 A702	**Restart coasting time**	9999	0	Coasting time differs according to the inverter capacity.*1
			0.1 to 30 s	Set the time delay for the inverter to perform a restart after restoring power due to an instantaneous power failure.
			9999	No restart
58 A703	**Restart cushion time**	1 s	0 to 60 s	Set the voltage cushion time for restart.
163 A704	**First cushion time for restart**	0 s	0 to 20 s	Set the voltage cushion time for restart. Consider this matched to the size of the load (moment of inertia/torque)
164 A705	**First cushion voltage for restart**	0%	0 to 100%	
165 A710	**Stall prevention operation level for restart**	110%	0 to 400%	Set the stall prevention operation level at a restart operation on the assumption that the inverter rated current is 100%.
611 F003	**Acceleration time at a restart**	9999	0 to 3600 s	Set the acceleration time that takes to reach **Pr.20 Acceleration/deceleration reference frequency setting** at a restart.
			9999	Standard acceleration time (for example, **Pr.7**) is applied as the acceleration time at restart.

*1 The coasting time when **Pr.57** = "0" is as shown below. (When **Pr.162, Pr.570** are set to the initial value.)
FR-F860-00027: 0.5 s
FR-F860-00061 and FR-F860-00090: 1.0 s
FR-F860-00170 to 00680: 3.0 s
FR-F860-01080 or higher: 5.0 s

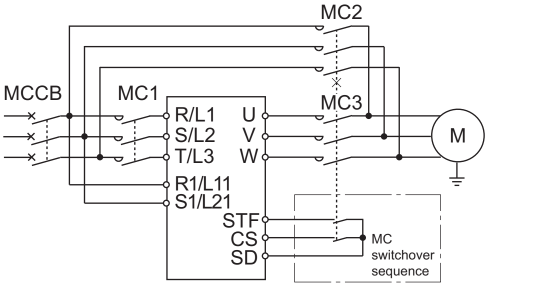
*2 The same operation is performed for the both settings.

◆ Automatic restart after instantaneous power failure function

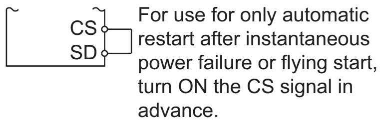


- The inverter output is shut off at the activation of the instantaneous power failure protection (E.IPF) or undervoltage protection (E.UVT). (Refer to page 570 for E.IPF or E.UVT.)
- When E.IPF or E.UVT is activated, the instantaneous power failure (IPF)/undervoltage signal is output.
- The IPF signal is assigned to terminal IPF in the initial setting. To assign the IPF signal to a different terminal, set "2 (positive logic) or 102 (negative logic)" to any of **Pr.190 to Pr.196 (Output terminal function selection)**.
- When the automatic restart after instantaneous power failure function is selected, motor restarts at the power restoration after an instantaneous power failure or undervoltage. (E.IPF and E.UVT are not activated.)

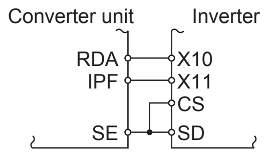
◆ Connection (CS signal)



With electronic bypass sequence



Only with restart after instantaneous power failure



Separated converter type

- When the automatic restart after instantaneous power failure / flying start signal (CS) is assigned to the input terminal by setting **Pr.178 to Pr.189 (Input terminal function selection)**, restart operation is enabled at turn-ON of the CS signal.
- When the CS signal is assigned to an input terminal and **Pr.57 Restart coasting time** ≠ "9999" (with restart), the inverter cannot be operated while the CS signal remains OFF.
- Separated converter types detect the instantaneous power failure on the converter unit side. Perform wiring so that the IPF signal transmitted from the converter unit is input to the terminal to which the X11 signal is assigned. On the converter unit side, enable the restart operation. (For setting the converter unit, refer to the Instruction Manual of the converter unit.)
- For the terminal to be used for the X10 and X11 signal, set "10" (X10), "11" (X11) in **Pr.178 to Pr.189** and assign the function. (For separated converter types, the X10 signal is assigned to the terminal MRS in the initial setting.)
- For the X10 signal of separated converter types, NC contact input specification is selected in the initial setting. Set **Pr.599** = "0" to change the input specification to NO contact.

NOTE

- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect other functions. Set parameters after confirming the function of each terminal.
- If the CS signal is not assigned to any input terminal, solely setting **Pr.57** will enable the restart operation at all times.

◆ Setting for the automatic restart after instantaneous power failure operation (Pr.162)

- The **Pr.162** settings and the instantaneous power failure automatic restart operation under each operation mode are as shown below.

Pr.162 setting	Restart timing	Automatic restart operation selection after instantaneous power failure	CS signal command source selection under Network operation mode
0, 2	Restart only at the first start	Frequency search	Always External
1		Reduced voltage start	
3		Frequency search (reduced impact restart)	
10, 12	Restart at every start	Frequency search	
11		Reduced voltage start	
13		Frequency search (reduced impact restart)	
1000, 1002	Restart only at the first start	Frequency search	Network (**Pr.338** = "0") or External (**Pr.338** = "1")
1001		Reduced voltage start	
1003		Frequency search (reduced impact restart)	
1010, 1012	Restart at every start	Frequency search	
1011		Reduced voltage start	
1013		Frequency search (reduced impact restart)	

◆ Restart operation with frequency search (Pr.162 = "0, 2, 3, 10, 12, 13, 1000, 1002, 1003, 1010, 1012, or 1013", Pr.299)

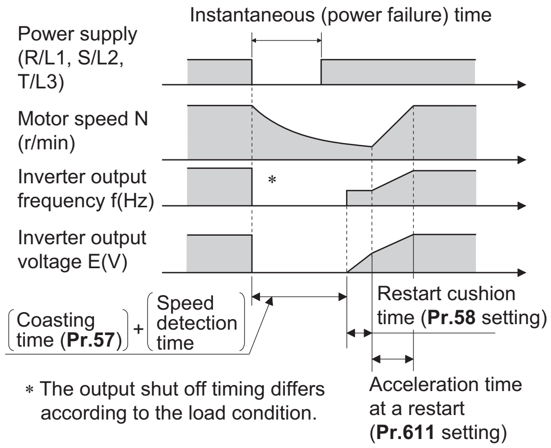
- When **Pr.162** = "0 (initial value), 2, 3, 10, 12, 13, 1000, 1002, 1003, 1010, 1012, or 1013", the motor speed is detected at a power restoration so that the motor can re-start smoothly.
- The encoder also detects the rotation direction so that the motor can re-start smoothly even during the reverse rotation.
- Whether or not to detect the rotation direction can be selected by **Pr.299 Rotation direction detection selection at restarting**. If the motor capacity is different from the inverter capacity, set **Pr.299** = "0 (no rotation direction detection)".
- When the rotation direction is detected, the following operation is performed according to the **Pr.78 Reverse rotation prevention selection** setting.

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

○: With rotation direction detection ×: Without rotation direction detection

- By setting "3, 13, 1003, or 1013" in **Pr.162**, the restart can be made smoother with even less impact than when "0, 2, 10, 12, 1000, 1002, 1010, or 1012" is set in **Pr.162**. When the inverter is restarted with "3, 13, 1003, or 1013" set to **Pr.162**, offline auto tuning is required. (For details on offline auto tuning of Advanced magnetic flux vector control, refer to page 353, and for details on offline auto tuning of V/F control, refer to page 455.)

V/F control, Advanced magnetic flux vector control



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

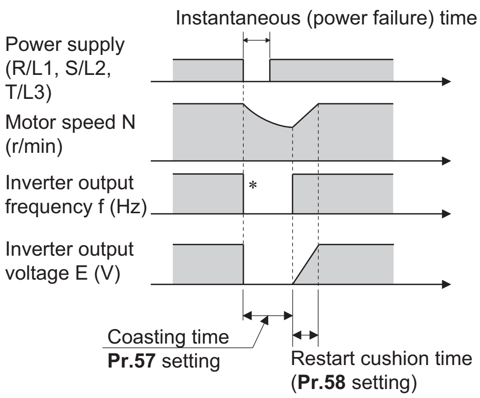
NOTE

- The rotation speed detection time (frequency search) changes according to the rotation speed of the motor. (maximum 1 s)
- When the inverter capacity is two ranks or greater than the motor capacity, the overcurrent protective function (E.OC[]) is sometimes activated and prevents the inverter from restarting.
- If two or more motors are connected to one inverter, this function operates abnormally. (The inverter does not restart successfully.)
- Because a DC injection brake is applied instantaneously at speed detection during a restart, the speed might drop if the moment of inertia (J) of the load is small.
- If reverse operation is detected when "1" (reverse rotation disabled) is set to **Pr.78**, operation decelerates by reverse rotation and then changes to forward rotation when the start command is forward rotation. The inverter does not restart when the start command is reverse rotation.
- When "3, 13, 1003, or 1013" is set to **Pr.162**, limit the wiring length to within 100 m.

◆ Restart operation without frequency search (Pr.162 = "1, 11, 1001, or 1011")

- When **Pr.162** = "1, 11, 1001, or 1011", reduced voltage start is used for the restart operation. In this method, the voltage is raised gradually while keeping the output frequency level at the level before the instantaneous failure, regardless of the motor's coasting speed.

V/F control, Advanced magnetic flux vector control



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

NOTE

- This restart method uses the output frequency that was active before the instantaneous power failure stored in memory. If the instantaneous power failure time is 0.2 s or more, the output frequency can no longer be stored and held in memory, so the restart is performed from **Pr.13 Starting frequency** (initial value is 1.5 Hz).

◆ Restart at every start (Pr.162 ="10 to 13, or 1010 to 1013")

- When "10 to 13, or 1010 to 1013" is set in **Pr.162**, a restart operation is performed at each start and automatic restart after instantaneous power failure (**Pr.57** start after the reset time has elapsed). When "0 (initial value) to 3, or 1000 to 1003" is set in **Pr.162**, a restart operation is performed at the first start after a power-ON, and from the second power-ON onwards, a start from the starting frequency is performed.

◆ Automatic restart operation of MRS (X10) signal

- The restart operation after restoration from output shutoff by the MRS (X10) signal is as shown in the table below according to the **Pr.30** setting.

Pr. 30 setting	Operation after restoration from output shutoff by the MRS (X10) signal
10, 110	Restart operation (starting from the coasting speed)
Other than the above	Starting from **Pr.13 Starting frequency**.

◆ Adjustment of restart coasting time (Pr.57)

- Restart coasting time is the time period from the occurrence of instantaneous power failure until the operation is restarted after power is restored. With frequency search, the motor speed is detected and operation is restarted after the coasting time.
- To enable restart operation, set "0" to **Pr.57 Restart coasting time**. If "0" is set to **Pr.57**, the coasting time is automatically set to the following value (Unit: s). Generally, this setting does not interfere with inverter operation.

Pr.162 setting	FR-F860-[]							
	00027	00061	00090	00170	00320	00450	00680	01080 or higher
3, 13, 1003, 1013	1	2		3				5
Other than the above	0.5	1		3				5

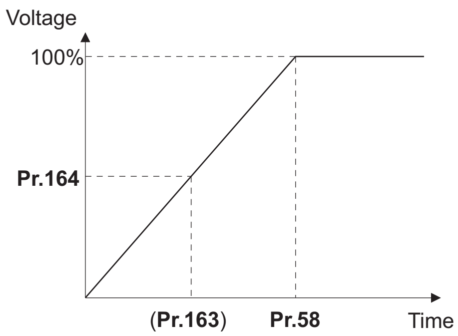
- Inverter operation is sometimes hindered by the size of the moment of inertia (J) of the load or running frequency. Adjust this coasting time within the range 0.1 s to 30 s to match the load specification.

◆ Restart cushion time (Pr.58)

- The cushion time is the time taken to raise the voltage to the level required for the specified speed after the motor speed detection (output frequency before instantaneous power failure when **Pr.162** = "1, 11, 1001, or 1011").
- Normally, the motor runs at the initial value as it is. However, adjust to suit the moment of inertia (J) of the load or the size of the torque.

◆ Adjustment of restart operation (Pr.163 to Pr.165, Pr.611)

- The voltage cushion time at a restart can be adjusted by **Pr.163 and Pr.164** as shown in the following figure.



- The stall prevention operation level at a restart operation can be set at **Pr.165**.
- Using **Pr.611**, the acceleration time to reach **Pr.20 Acceleration/deceleration reference frequency** after a restart operation can be set. This can be set individually from the normal acceleration time.

NOTE

- Changing the **Pr.21** setting does not affect the **Pr.611** setting increment.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.
- When the restart operation is selected, undervoltage (E.UVT) and instantaneous power failure (E.IPF) of the fault output signals become invalid.
- The SU and FU signals are not output during the restart. These signals are output after the restart cushion time passes.
- Restart operation is also performed after the inverter reset is released or after the retry by the retry function occurs.

◆ Operation command source selection for the CS signal during communication operation (Pr.162 = "1000 to 1003, 1010 to 1013")

- When "1000 to 1003, or 1010 to 1013" is set in **Pr.162**, the CS signal input via communication is enabled depending on the setting in **Pr.338 Communication operation command source**. (When **Pr.162** = "0 to 3, or 10 to 13", the CS signal can be input via an external terminal only.)

⚠CAUTION

- Provide a mechanical interlock for MC1 and MC2. The inverter will be damaged if power supply is input to the inverter output section.
- When the automatic restart after instantaneous power failure function is selected, the motor suddenly starts (after reset time passes) when an instantaneous power failure occurs. Stay away from the motor and machinery. Apply the supplied CAUTION stickers to easily visible places when automatic restart after instantaneous power failure has been selected.

Parameters referred to

Pr.7 Acceleration time, Pr.21 Acceleration/deceleration time increments ☞ page 190
Pr.13 Starting frequency ☞ page 201, page 202
Pr.65, Pr.67 to Pr.69 retry function ☞ page 242
Pr.78 Reverse rotation prevention selection ☞ page 221
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343

5

5.11.13 Offline auto tuning for a frequency search

V/F

During V/F control, the accuracy of the "frequency search", which is used to detect the motor speed for the automatic restart after instantaneous power failure and flying start, can be improved.

Pr.	Name	Initial value	Setting range	Description
162 **A700**	**Automatic restart after instantaneous power failure selection**	0	0 (2)[*3], 1000 (1002)[*3]	Frequency search only performed at the first start
			1, 1001	Reduced voltage start only at the first start (no frequency search)
			3, 1003	Frequency search only performed at the first start (reduced impact restart)
			10 (12)[*3], 1010 (1012)[*3]	Frequency search at every start
			11, 1011	Reduced voltage start at every start (no frequency search)
			13, 1013	Frequency search at every start (reduced impact restart)
298 **A711**	**Frequency search gain**	9999	0 to 32767	The offline auto tuning automatically sets the gain required for the frequency search.
			9999	Uses the constant value of standard motor.
560 **A712**	**Second frequency search gain**	9999	0 to 32767	The offline auto tuning automatically sets the gain required for the frequency search of the second motor.
			9999	Uses the constant value of standard motor.
96 **C110**	**Auto tuning setting/status**	0	0	No offline auto tuning.
			1, 101	Perform offline auto tuning for the Advanced magnetic flux vector control. (Refer to page 353.)
			11	Performs offline auto tuning without rotating the motor (V/F control).
90 **C120**	**Motor constant (R1)**	9999	0 to 50 Ω, 9999[*1]	Tuning data (The value measured by offline auto tuning is automatically set.) 9999: Uses the constant value of standard motor.
			0 to 400 mΩ, 9999[*2]	
463 **C210**	**Second motor auto tuning setting/status**	0	0	No auto tuning for the second motor.
			1, 101	Performs offline auto tuning for the second motor. (Refer to page 353.)
			11	Performs offline auto tuning without rotating the second motor (V/F control).
458 **C220**	**Second motor constant (R1)**	9999	0 to 50 Ω, 9999[*1]	Tuning data of the second motor (same as **Pr.90**)
			0 to 400 mΩ, 9999[*2]	

*1 For the FR-F860-00680 or lower.
*2 For the FR-F860-01080 or higher.
*3 The same operation is performed for the both settings.

◆ Offline auto tuning when performing a frequency search by V/F control (reduced impact restart)

- When the frequency search (reduced impact restart) is selected by setting **Pr.162 Automatic restart after instantaneous power failure selection** = "3, 13, 1003, or 1013", perform offline auto tuning.

◆ Before executing offline auto tuning

Check the following points before performing offline auto tuning:

- V/F control is selected.
- A motor is connected. (The motor should not be rotated by the external force applied from outside during the tuning.)
- The motor with the rated motor current equal to or less than the inverter rated current is used. (It must be 0.4 kW or higher.) If a motor with substantially low rated current compared with the inverter rated current is used, speed and torque accuracies may deteriorate due to torque ripples, etc. Set the rated motor current to about 40% or higher of the inverter rated current.
- The target motor is other than a high-slip motor, a high-speed motor, or a special motor.
- The motor may run slightly without actually turning during offline auto-tuning (**Pr.96 Auto tuning setting/status** = "11"), so either firmly secure the motor by the mechanical brake or check to see if turning the motor will cause any safety problems. (Attention is required for lifts, in particular.) The motor turning slightly will not affect tuning performance.

5

◆ Setting

1. Set **Pr.96 Auto tuning setting/status** = "11".

2. Set the rated motor current (initial value is inverted rated current) to **Pr.9 Electronic thermal O/L relay**. (Refer to page 230.)

3. Set **Pr.71 Applied motor** according to the motor to be used.

Motor	Pr.71 setting
Standard motor	0 (3, 4)
Constant-torque motor	1 (13, 14)
Other manufacturer's standard motor	0 (3, 4)
Other manufacturer's constant-torque motor	1 (13, 14)

◆ Performing tuning

Point

- Before performing tuning, check the monitor display of the operation panel or the parameter unit if the inverter is in the state ready for tuning. Turning ON the start command while tuning is unavailable starts the motor.

- In the PU operation mode, press FWD / REV on the operation panel. For External operation, turn ON the start command (STF signal or STR signal). Tuning will start. (At this time, excitation noise occurs.)

NOTE

- It takes about 10 seconds for tuning to complete. (The time depends on the inverter capacity and motor type.)
- Satisfy the required inverter start conditions to start offline auto tuning. For example, stop the input of MRS signal.
- To force tuning to end, use the MRS or RES signal or press STOP RESET on the operation panel. (Turning the start signal (STF signal or STR signal) OFF also ends tuning.)
- During offline auto tuning, only the following I/O signals are valid. (Initial value)

Input terminals <valid signals> STP (STOP), OH, MRS, RT, RES, STF, and STR.

Output terminals: RUN, OL, IPF, CA, AM, and A1B1C1

- When the rotation speed and the output frequency are selected for terminals CA and AM, the progress status of offline auto tuning is output in fifteen steps from CA and AM.
- During execution of offline auto tuning, do not switch the second function selection signal (RT) ON or OFF. Auto tuning is not executed properly.
- Since the RUN signal turns ON when tuning is started, caution is required especially when a sequence which releases a mechanical brake by the RUN signal has been designed
- When executing offline auto tuning, input the run command after switching ON the main circuit power (R/L1, S/L2, T/L3) of the inverter.
- While **Pr.79 Operation mode selection** = "7", turn the PU operation external interlock (X12) signal ON to tune in the PU operation mode.

- Monitor is displayed on the operation panel and parameter unit during tuning as below.

status	Parameter unit display	Operation panel display
Setting	READ:List TUNE 11 --- STOP PU	AutoTune 12:34 TUNE 11 --- STOP PU PREV NEXT
Tuning in progress	TUNE 12 STF FWD PU	AutoTune 12:34 TUNE 12 STF FWD PU PREV NEXT
Normal end	TUNE 13 COMPLETION STF STOP PU	AutoTune 12:34 TUNE Completed 13 STF STOP PU PREV NEXT

- When offline auto tuning ends, press STOP RESET on the operation panel during PU operation. For External operation, turn OFF the start signal (STF signal or STR signal). This operation resets the offline auto tuning, and the PU's monitor display returns to the normal indication. (Without this operation, next operation cannot be started.)
- At tuning completion, the tuning results are set in the following parameters:

Parameter	Name
90	Motor constant (R1)
298	Frequency search gain
96	Auto tuning setting/status

NOTE

- The motor constants measured once in the offline auto tuning are stored as parameters and their data are held until the offline auto tuning is performed again. However, the tuning data is cleared when performing all parameter clear.

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

Error display	Error cause	Countermeasures
8	Forced end	Set "11" to **Pr.96** and retry.
9	Inverter protective function operation	Make the setting again.
91	The current limit (stall prevention) function is activated.	Set the acceleration/deceleration time longer. Set **Pr.156 Stall prevention operation selection** = "1".
92	The converter output voltage fell to 75% of the rated value.	Check for the power supply voltage fluctuation.
93	Calculation error The motor is not connected.	Check the motor wiring and make the setting again.
94	Rotation tuning frequency setting error (The frequency command for the tuning was given to exceed the maximum frequency setting, or to be in the frequency jump range.)	Check the **Pr.1 Maximum frequency** and **Pr.31** to **Pr.36** Frequency jump settings.

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

5

NOTE

- An instantaneous power failure occurring during tuning will result in a tuning error. After power is restored, the inverter goes into the normal operation. Therefore, when STF (STR) signal is ON, the motor runs in the forward (reverse) rotation.
- Any alarm occurring during tuning is handled as in the normal operation. Note that even if a retry operation has been set, retry is not performed.
- The set frequency monitor displayed during the offline auto tuning is 0 Hz.

◆ Tuning the second applied motor (Pr.463)

- When performing operation where two motors are switched between one inverter, set the second motor in **Pr.450 Second applied motor**, set **Pr.463 Second motor auto tuning setting/status** = "11", and perform tuning of the second motor.
- Turning ON the RT signal will enable the parameter settings for the second motor as shown below.

Function	RT signal ON (second motor)	RT signal OFF (first motor)
Motor constant (R1)	**Pr.458**	**Pr.90**
Auto tuning setting/status	**Pr.463**	**Pr.96**
Frequency search gain	**Pr.560**	**Pr.298**

NOTE

- The RT signal is assigned to the terminal RT in the initial status. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

⚠CAUTION

- Note that the motor may start running suddenly.
- For the offline auto tuning in vertical lift applications, etc., caution is required to avoid falling due to insufficient torque.

Parameters referred to

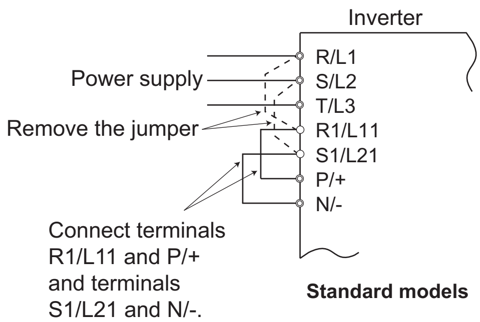
Pr.9 Electronic thermal O/L relay ☞ page 230
Pr.65, Pr.67 to Pr.69 retry function ☞ page 242
Pr.71 Applied motor ☞ page 351
Pr.79 Operation mode selection ☞ page 204
Pr.156 Stall prevention operation selection ☞ page 257
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343

5.11.14 Power failure time deceleration-to-stop function

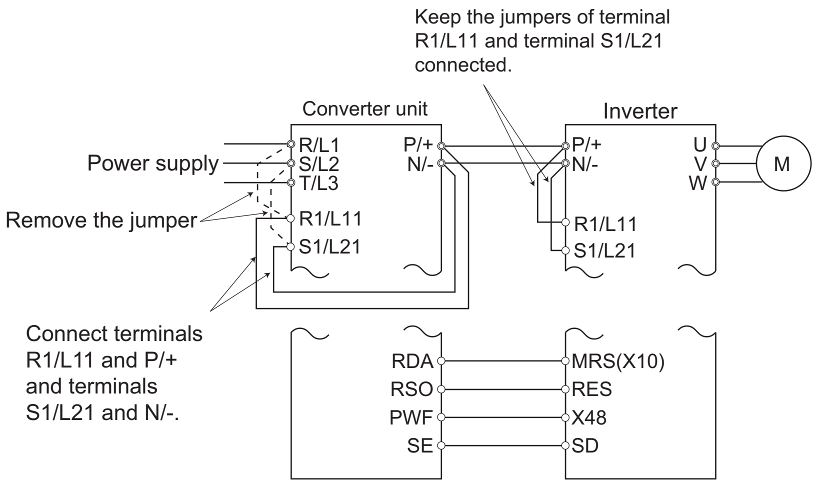
This is a function to decelerate the motor to a stop when an instantaneous power failure or undervoltage occurs.

Pr.	Name	Initial value	Setting range	Description
261 **A730**	**Power failure stop selection**	0	0	Power failure time deceleration-to-stop function disabled
			1, 2, 11, 12, 21, 22	Power failure time deceleration-to-stop function enabled Select action at an undervoltage or when an power failure occurs.
262 **A731**	**Subtracted frequency at deceleration start**	3 Hz	0 to 20 Hz	Normally, the motor runs at the initial value as it is. However, adjust to suit the size of the load specification (moment of inertia, torque).
263 **A732**	**Subtraction starting frequency**	60 Hz	0 to 590 Hz	When output frequency ≥ **Pr.263**: The motor decelerates if the output frequency decreases by the frequency set in **Pr.262**. When output frequency < **Pr.263**: The motor decelerates at frequencies of the output frequency.
			9999	The motor decelerates from the "output frequency - **Pr.262**".
264 **A733**	**Power-failure deceleration time 1**	5 s	0 to 3600 s	Set the slope applicable from the deceleration start to the **Pr.266** set frequency.
265 **A734**	**Power-failure deceleration time 2**	9999	0 to 3600 s	Set the slope applicable for the frequency range starting at **Pr.266** and downward.
			9999	Same as **Pr.264**.
266 **A735**	**Power failure deceleration time switchover frequency**	60 Hz	0 to 590 Hz	Set the frequency at which the slope during deceleration switches from the **Pr.264** setting to the **Pr.265** setting.
294 **A785**	**UV avoidance voltage gain**	100%	0 to 200%	Adjust the response at undervoltage avoidance operation. Setting a large value improves the response to changes in the bus voltage.
668 **A786**	**Power failure stop frequency gain**	100%	0 to 200%	Adjust the response level for the operation where the deceleration time is automatically adjusted.
606 **T722**	**Power failure stop external signal input selection**	1	0	Normally open input (NO contact input specification)
			1	Normally closed input (NC contact input specification)

◆ Connection and parameter setting



Standard models



Separated converter type

- For the standard model, remove the jumpers between terminals R/L1 and R1/L11 and terminals S/L2 and S1/L21, and connect terminals R1/L11 and P/+ and terminals S1/L21 and N/-.
- If an undervoltage, power failure or input phase loss occurs when **Pr.261 Power failure stop selection** ≠ "0", the motor decelerates to a stop.

- The power failure time deceleration stop function operates as follows at an input phase loss.

Pr.261	Pr.872	Operation when an input phase loss occurs
0	0	Continuous operation
	1	Input phase loss (E.ILF)
1, 2	0	Continuous operation
	1	Deceleration stop
21, 22	—	Deceleration stop

- For the separated converter type, remove the jumpers between terminals R/L1 and R1/L11 and terminals S/L2 and S1/L21 of the converter unit, and connect terminals R1/L11 and P/+ and terminals S1/L21 and N/-. Do not remove the jumpers of terminal R1/L11 and terminal S1/L21 of the inverter. (In the initial status of the separated converter type, terminals P/+ and R1/L11 and terminals N/- and S1/L21 are connected.)
- For the separated converter type, connect the terminal to which PWF signal of the converter unit is assigned and the terminal to which X48 signal of the inverter is assigned. Also, set **Pr.261** of the converter unit in accordance with the inverter setting. (Refer to the Instruction Manual of the converter unit.)

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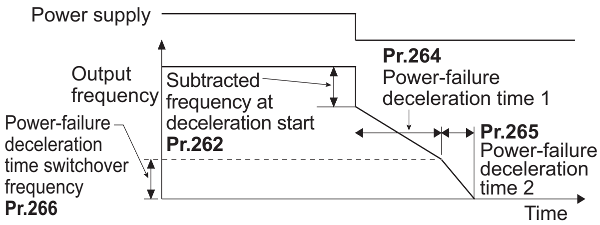
◆ Outline of operation of deceleration stop at a power failure

- If an undervoltage or power failure occurs, the output frequency is turned OFF only for the frequency set to **Pr.262 Subtracted frequency at deceleration start**.
- The motor decelerates for the time set to **Pr.264 Power-failure deceleration time 1**. (The deceleration time setting is the time it takes for the motor to stop from **Pr.20 Acceleration/deceleration reference frequency**.)
- Change the deceleration time (slope) to stop using **Pr.265 Power-failure deceleration time 2** when the frequency is too low to obtain the regenerative energy or in other instances.



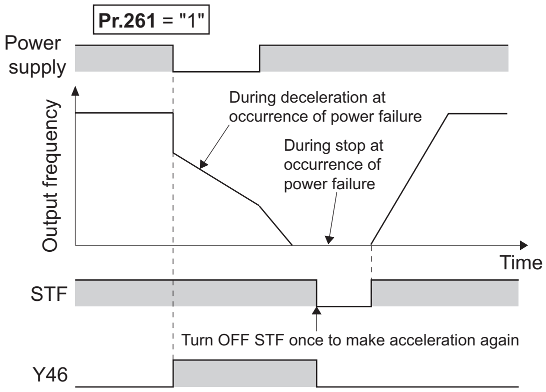
◆ Action setting at undervoltage and power failure

- Set **Pr.261** to select the action at an undervoltage and power failure.

Pr.261 Setting	Action at undervoltage and power failure	Power restoration during deceleration at occurrence of power failure	Deceleration stop time	Undervoltage avoidance function
0	Coasts to stop	Coasts to stop	—	—
1	Deceleration stop	Deceleration stop	According to **Pr.262 to Pr.266** setting	Not used
2		Re-acceleration		Not used
11		Deceleration stop		With
12		Re-acceleration		With
21		Deceleration stop	Automatic adjustment of deceleration time	Not used
22		Re-acceleration		Not used

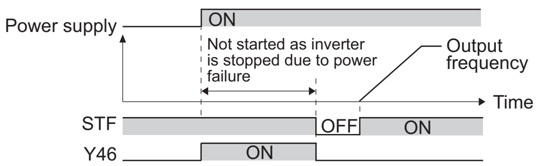
◆ Power failure stop function (Pr.261 ="1, 11, 21")

- Even if power is restored during deceleration triggered by a power failure, deceleration stop is continued after which the inverter stays stopped. To restart operation, turn the start signal OFF then ON again.



NOTE

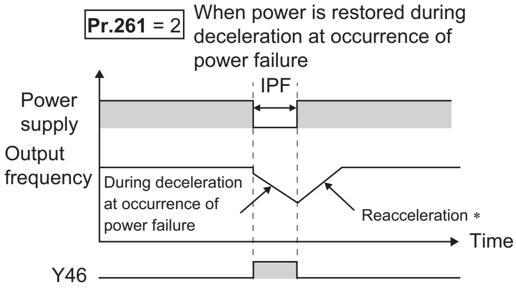
- If the automatic restart after instantaneous power failure is selected (**Pr.57 Restart coasting time** ≠ "9999") while the power failure time deceleration-to-stop function is set enabled (**Pr.261** = "1, 11, or 21"), the power failure time deceleration-to-stop function is disabled.
- When the power failure time deceleration-to-stop function is enabled (**Pr.261** = "1, 11 or 21"), the inverter will not start even if the power is turned ON or inverter reset is performed with the start signal (STF/STR) ON. Turn OFF the start signal once and then ON again to make a start.



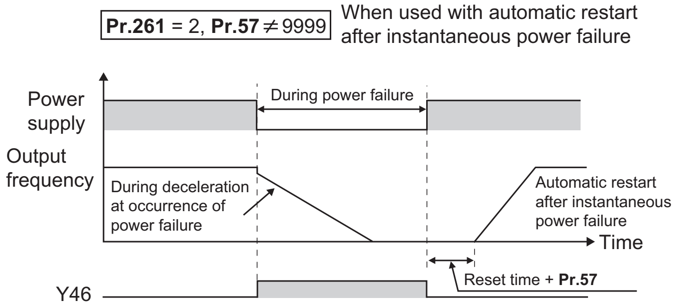
- During cyclic transmission or the like (in which start commands are periodically transmitted), operation is restarted if the power is restored during the deceleration even when the power failure time deceleration-to-stop function is enabled.

◆ Continuous operation function at instantaneous power failure (Pr.261 ="2, 12, 22")

- The motor re-accelerates to the set frequency if the power restores during the deceleration to stop.
- Combining with the automatic restart after instantaneous power failure function enables a power failure time deceleration stop and re-acceleration at a power restoration. If the power is restored after stoppage by a power failure, a restart operation is performed when automatic restart after instantaneous power failure (**Pr.57** ≠ "9999") is selected.



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



◆ Undervoltage avoidance function (Pr.261 = "11, 12" Pr.294)

- If "11, 12" is set to **Pr.261**, the deceleration time is adjusted (shortened) to prevent an undervoltage from occurring during deceleration at occurrence of power failure.
- Adjust the downward frequency slope and the response level using **Pr.294 UV avoidance voltage gain**. Setting a large value improves the response to the bus voltage.

◆ Automatic adjustment of deceleration time (Pr.261 ="21, 22", Pr.294, Pr.668)

- When "21, 22" is set to **Pr.261**, the deceleration time is automatically adjusted to keep (DC bus) voltage constant in the converter when the motor decelerates to a stop at a power failure. Setting of **Pr.262 to Pr.266** is not required.
- If a phenomenon such as motor vibration occurs during operation of the deceleration time automatic adjustment function, adjust the response level by setting the **Pr.668 Power failure stop frequency gain**. Increasing the setting improves the response to change in the bus voltage. However, the output frequency may become unstable.
- If setting **Pr.294 UV avoidance voltage gain** lower also does not suppress the vibration, set **Pr.668** lower.

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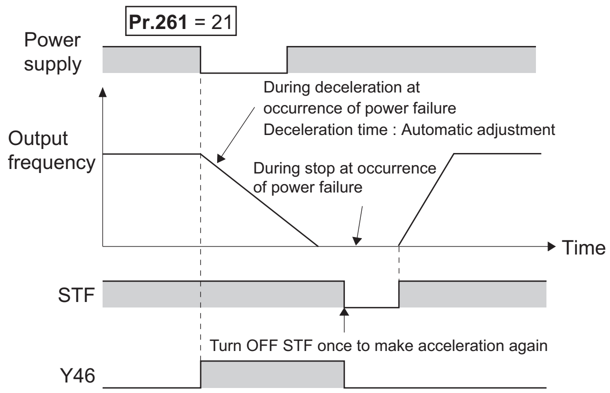

◆ Deceleration stop by the power failure stop external signal (X48)

- By turning OFF X48 signal, the power failure time deceleration-to-stop function is activated. This function is used, for example, when an external power failure detection circuit is installed.
- To use the power failure time deceleration-to-stop function for the separated converter type, use X48 signal. Connect the terminal to which PWF signal of the converter unit is assigned and the terminal to which X48 signal of the inverter is assigned.
- In the initial setting, X48 signal is used with the normally closed (NC contact) input specification. Use **Pr.606 Power failure stop external signal input selection** to change the specification to the normally open (NO contact) input.
- To use the X48 signal, set "48" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to an input terminal.

◆ During deceleration at occurrence of power failure signal (Y46)

- After deceleration by a power failure, the inverter is not restarted even though the start command is input. Check the during deceleration at occurrence of power failure signal (Y46) at a power failure. (For example, when input phase loss protection (E.ILF) occurs.)
- The Y46 signal is turned ON during deceleration at occurrence of power failure and in a stop status after deceleration at occurrence of power failure.
- For the Y46 signal, assign the function by setting "46 (positive logic)" or "146 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.

◆ Power failure signal (Y67 signal)

- Y67 signal turns ON when the output is shut off due to detection of power failure (power supply fault) or undervoltage, or the power failure time deceleration-to-stop function is activated.
- To use the Y67 signal, assign the function by setting "67 (positive logic)" or "167 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)**.

NOTE

- If the "output frequency - **Pr.262**" at undervoltage or at power failure is a negative value, it is regarded as 0 Hz. (DC injection brake operation is performed without deceleration.)
- The power failure time deceleration stop function is disabled during a stop or when the breaker is tripped.
- The Y46 signal turns ON if an undervoltage occurs even if a deceleration at a power failure has not occurred. For this reason, the Y46 signal is sometimes output instantaneously when the power supply is turned OFF. This is not a fault.
- When the power failure time deceleration-to-stop function is selected, undervoltage protection (E.UVT), instantaneous power failure protection (E.IPF) and input phase loss protection (E.ILF) are not invalid.
- When the load is high during PM motor control, an undervoltage sometimes causes the coasting stop.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** or **Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

⚠ CAUTION

- Even if the power failure time deceleration-to-stop function is set, some loads might cause the inverter to trip and the motor to coast. The motor will coast if sufficient regenerative power is not obtained from the motor.

Parameters referred to

Pr.12 DC injection brake operation voltage ☞ page 546
Pr.20 Acceleration/deceleration reference frequency, Pr.21 Acceleration/deceleration time increments ☞ page 190
Pr.30 Regenerative function selection ☞ page 553
Pr.57 Restart coasting time ☞ page 448
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297
Pr.872 Input phase loss protection selection ☞ page 241

5.11.15 PLC function

The inverter can be run in accordance with a sequence program.
In accordance with the machine specifications, a user can set various operation patterns: inverter movements at signal inputs, signal outputs at particular inverter status, and monitor outputs, etc.

Pr.	Name	Initial value	Setting range	Description	
414 **A800**	**PLC function operation selection**	0	0	PLC function disabled	
			1, 11	PLC function enabled	The SQ signal is enabled by input from a command source (external input terminal/ communication).
			2, 12		The SQ signal is enabled by input from an external input terminal.
415 **A801**	**Inverter operation lock mode setting**	0	0	The inverter start command is enabled regardless of the operating status of the sequence program.	
			1	The inverter start command is enabled only while the sequence program is running.	
416 **A802**	**Pre-scale function selection**	0	0 to 5	Unit scale factor 0: No function 1: ×1 2: ×0.1 3: ×0.01 4: ×0.001 5: ×0.0001	When the pulse train is input from terminal JOG, the number of sampled pulses can be converted. The result of conversion is stored to SD1236. "Number of sampled pulses" = "input pulse value per count cycle" × "pre-scale setting value **(Pr.417)**" × "unit scale factor **(Pr.416)**"
417 **A803**	**Pre-scale setting value**	1	0 to 32767	Pre-scale setting value	
498 **A804**	**PLC function flash memory clear**	0	0, 9696 (0 to 9999)	0: Clears the flash memory fault display (no operation after writing while the flash memory is in normal operation).	Write
				9696: Clears the flash memory (no operation Write after writing during flash memory fault).	
				Other than 0 and 9696: Outside of the setting range	
				0: Normal display	Read
				1: The flash memory has not been cleared because the PLC function is enabled.	
				9696: During flash memory clearing operation or flash memory fault	
675 **A805**	**User parameter auto storage function selection**	9999	1	Auto storage function enabled	
			9999	Auto storage function disabled	
1150 to 1199 **A810 to A859**	**User parameters 1 to PLC function user parameters 50**	0	0 to 65535	Desired values can be set. Because devices D206 to D255 used by the PLC function can be mutually accessed, the values set to **Pr.1150 to Pr.1199** can be used by the sequence program. The result of performing calculation by a sequence program can also be monitored by **Pr.1150 to Pr.1199**.	

◆ Outline of PLC function

- To enable the PLC function, set a value other than "0" in **Pr.414 PLC function operation selection**. When "2 or 12" is set in **Pr.414**, the Sequence startup (SQ) signal from the external input terminal is valid regardless of the setting of the **Pr.338 Communication operation command source**. (The **Pr.414** setting change becomes valid after inverter reset.)
- Switch the execution key (RUN/STOP) of the sequence program by turning the SQ signal ON/OFF. The sequence program can be executed by turning the SQ signal ON. To input the SQ signal, set "50" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function to a terminal.
- When "1" is set in **Pr.415 Inverter operation lock mode setting**, the inverter can be operated only when the sequence program is running. By changing the PLC program status from RUN to STOP during inverter operation, the motor decelerates to stop. To stop the inverter operation at the STOP status of the PLC program while performing auto operation using SD1148 (or SM1200 to 1211) of the PLC program, set **Pr.415** = "1".
- For reading or writing sequence programs, use FR Configurator2 on the personal computer connected to the inverter via RS-485 communication or USB. (When **Pr.414** ≠ "0", sequence programs can be read from or written to FR Configurator2.)

- The following shows the required conditions to enable the SQ signal.

Pr.414 setting	Pr.338 setting	SQ signal	
		Input via an external (physical) terminal	Input via a communication virtual terminal
1, 11	0	ON	ON
	1	ON	—
2, 12	—	ON	—

—: Not required to enable the SQ signal

◆ User parameter (data register (D)) auto storage function selection

- Setting **Pr.675** = "1" enables the auto storage function for user parameters.
- The user parameter auto storage function is used to store the setting of **Pr.1195 PLC function user parameters 46** (D251) to **Pr.1199 PLC function user parameters 50** (D255) automatically in EEPROM at power OFF or inverter reset.
- The auto storage function is disabled while the inverter performs any of the following. Measurement of the main circuit capacitor's life, offline auto tuning, emergency drive function, measurement of load characteristics, or PID gain tuning

NOTE

- The auto storage function may fail if the EEPROM is accessed by other functions at the same time at power OFF. To ensure the auto storage, provide a power source for the control circuit separately from that of the main circuit.

◆ User parameter reading from EEPROM

- User parameters (**Pr.1150 to Pr.1199**) are read from RAM or EEPROM according to the settings in **Pr.342 Communication EEPROM write selection** and **Pr.414 PLC function operation selection**. When **Pr.414** = "11 or 12", RAM data is read regardless of the **Pr.342** setting.

Device	Pr.342	Pr.414	Read from	Written to
Inverter (via communication), FR Configurator2	0	0, 1, 2	EEPROM	EEPROM
		11, 12	RAM	
	1	0, 1, 2	RAM	RAM
		11, 12	RAM	
Communication option	0	0, 1, 2	(Differs according to the option type.)	EEPROM
		11, 12	RAM	
	1	0, 1, 2	RAM	RAM
		11, 12	RAM	
Parameter unit Operation panel	0	0, 1, 2	EEPROM	EEPROM
		11, 12	RAM	
	1	0, 1, 2	EEPROM	RAM
		11, 12	RAM	

NOTE

- For details on the PLC function, refer to the PLC Function Programming Manual and the Instruction Manual of FR Configurator2.

◆ Copying the PLC function project data to USB memory

- This function copies the PLC function project data to a USB memory device. The PLC function project data copied in the USB memory device can be copied to other inverters. This function is useful in backing up the parameter setting and for allowing multiple inverters to operate by the same sequence programs.
- Refer to page 67 for an outline of the USB communication function.
- The following data can be copied by copying the project data via USB memory device.

Extension	File type	Copy from inverter to USB memory device	Copy from USB memory device to inverter
.QPA	Parameter file	Supported	Supported
.QPG	Program file	Supported	Supported
.C32	Function block source information	Supported	Supported
.QCD	Global text comment information	Supported	Supported
.DAT	Project management information	Supported	Not available
.TXT	Copy information	Supported	Not available

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NOTE

- If the project data of the PLC function is locked with a password using FR Configurator2, copying to the USB memory device and verification are disabled. Also if set to write-disabled, writing to the inverter is disabled. (For details on the PLC function, refer to the PLC Function Programming Manual and the Instruction Manual of FR Configurator2.)

Parameters referred to

Pr.338 Communication operation command source ☞ page 214

5.11.16 Trace function

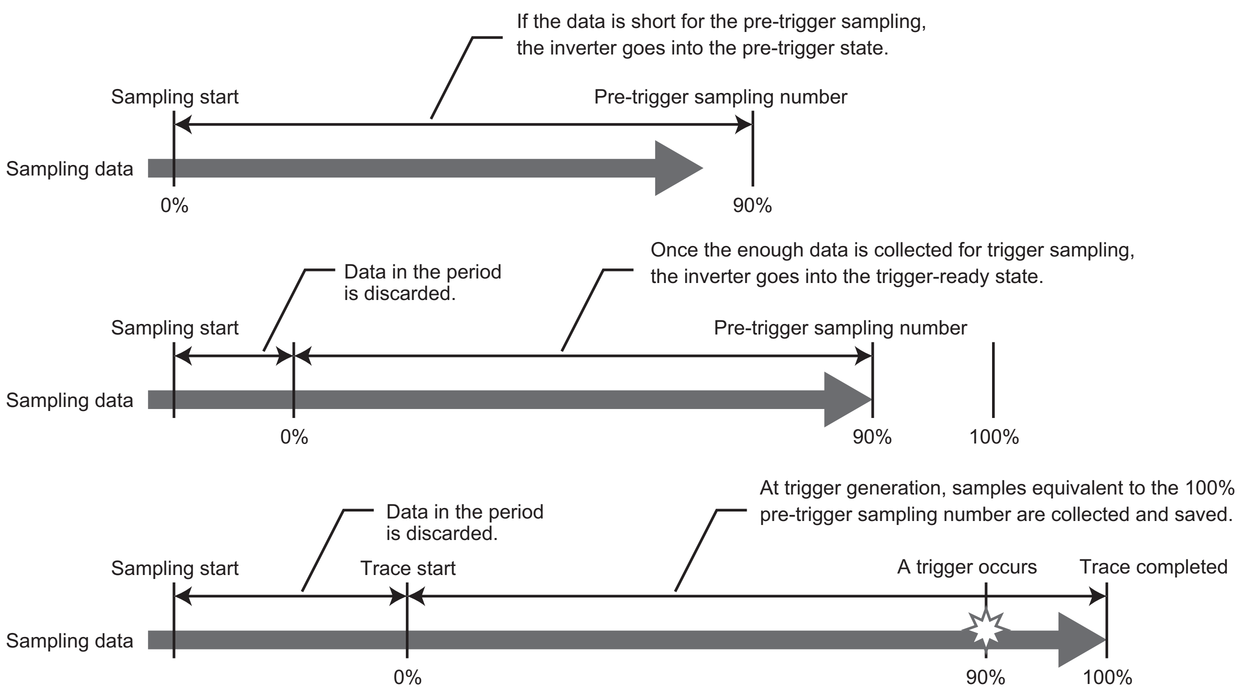
- The operating status of the inverter can be traced and saved on a USB memory device.
- Stored data can be monitored by FR Configurator2, and the status of the inverter can be analyzed.

Pr.	Name	Initial value	Setting range	Description
1020 A900	**Trace operation selection**	0	0	Without trace operation (The read value is always "0".)
			1	Sampling start
			2	Forced trigger
			3	Sampling stop
			4	Transfer of data to USB memory device
1021 A901	**Trace mode selection**	0	0	Memory mode
			1	Memory mode (automatic transfer)
			2	Recorder mode
1022 A902	**Sampling cycle**	2	0 to 9	Set the sampling cycle. 0: 0.125 ms, 1: 0.252 ms, 2: 1 ms, 3: 2 ms, 4: 5 ms, 5: 10 ms, 6: 50 ms, 7: 100 ms, 8: 500 ms, 9: 1 s (Regarding the setting value "0 and 1", the cycle varies by the control mode.)
1023 A903	**Number of analog channels**	4	1 to 8	Select the number of analog channels to be sampled.
1024 A904	**Sampling auto start**	0	0	Manual sampling start
			1	Sampling starts automatically when the power supply is turned ON or at a reset
1025 A905	**Trigger mode selection**	0	0	Fault trigger
			1	Analog trigger
			2	Digital trigger
			3	Analog or digital trigger (OR logic)
			4	Both analog and digital trigger (AND logic)
1026 A906	**Number of sampling before trigger**	90%	0 to 100%	Set the percentage of the pre-trigger sampling time with respect to the overall sampling time.
1027 A910	**Analog source selection (1ch)**	201	1 to 3, 5 to 14, 17, 18, 20, 23, 24, 34, 40 to 42, 52 to 54, 61, 62, 64, 67 to 69, 81 to 96, 98, 201 to 213, 230 to 232, 237, 238	Select the analog data (monitor) to be sampled on each channel.
1028 A911	**Analog source selection (2ch)**	202		
1029 A912	**Analog source selection (3ch)**	203		
1030 A913	**Analog source selection (4ch)**	204		
1031 A914	**Analog source selection (5ch)**	205		
1032 A915	**Analog source selection (6ch)**	206		
1033 A916	**Analog source selection (7ch)**	207		
1034 A917	**Analog source selection (8ch)**	208		
1035 A918	**Analog trigger channel**	1	1 to 8	Select the analog channel to be the trigger.
1036 A919	**Analog trigger operation selection**	0	0	Sampling starts when the value of the analog monitor exceeds the value set at the trigger level (**Pr.1037**)
			1	Sampling starts when the value of the analog monitor falls below the value set at the trigger level (**Pr.1037**)
1037 A920	**Analog trigger level**	1000	600 to 1400	Set the level at which the analog trigger turns ON. The trigger level is the value obtained by subtracting 1000 from the set value.

Pr.	Name	Initial value	Setting range	Description
1038 A930	**Digital source selection (1ch)**	1	1 to 255	Select the digital data (I/O signal) to be sampled on each channel.
1039 A931	**Digital source selection (2ch)**	2		
1040 A932	**Digital source selection (3ch)**	3		
1041 A933	**Digital source selection (4ch)**	4		
1042 A934	**Digital source selection (5ch)**	5		
1043 A935	**Digital source selection (6ch)**	6		
1044 A936	**Digital source selection (7ch)**	7		
1045 A937	**Digital source selection (8ch)**	8		
1046 A938	**Digital trigger channel**	1	1 to 8	Select the digital channel to be the trigger.
1047 A939	**Digital trigger operation selection**	0	0	Trace starts when the signal turns ON
			1	Trace starts when the signal turns OFF

◆ Operation outline

- This function samples the status (analog monitor and digital monitor) of the inverter, traces the sampling data when a trigger (trace start condition) is generated, and saves the resulting trace data.
- When the trace function is set enabled, samplings are collected and the inverter goes into the pre-trigger status.
- In the pre-trigger status, samples are collected, and the trigger standby status is entered when sufficient samples for the number of pre-trigger samples have been collected.
- When the trigger is generated in the trigger standby status, the trace is started and the trace data is saved.



◆ Selection of trace mode (Pr.1021)

- Select how to save the trace data which results from sampling the inverter status.
- There are two trace data save methods, memory mode and recorder mode.

Pr.1021 setting	Mode	Description	Storing trace data
0	Memory mode	Trace data is stored sequentially to the internal RAM in the inverter.	To store trace data on a USB memory device, set **Pr.1020 Trace operation selection** = "4" after the sampling and tracing is completed.
1	Memory mode (automatic transfer)	Trace data is stored sequentially to the internal RAM in the inverter, and automatically transferred to the USB memory device.	Trace data is automatically stored on the USB memory device after tracing is completed.
2	Recorder mode	Trace data is stored directly on the USB memory device. Sampling data is fixed at 8 analog channels and 8 digital channels. The sampling cycle in this mode is longer than in the memory mode. (1 ms or longer)	To stop sampling and complete storing trace data after the sampling is started, set "2" (forced trigger) or "3" (sampling stop) in **Pr.1020 Trace operation selection**.*1

*1 For details on **Pr.1020**, refer to page 471.

NOTE

- When the trace function is used in the recorder mode, use a USB memory device having at least 1 GB of free space.
- Data transferred to USB is saved in the "TRC" folder under the "FR_INV" folder.
- Up to 99 sets of trace data can be stored in the USB memory device in the memory mode. When a data set is transferred to the USB memory that contains 99 sets of data, its "MEM001.tr1" file will be overwritten. REC001.tr1 is the only data file stored in the recorder mode.
- The data sampled in the recorder mode will be corrupted by resetting or turning OFF the inverter during sampling.
- By using FR Configurator2, the trace data of the internal RAM can be directly transmitted to the personal computer via the USB cable. For details, refer to the Instruction Manual of FR Configurator2.

◆ Selection of sampling time (Pr.1022, Pr.1023)

- The sampling time is determined by the sampling cycle and the number of data acquisition points. The number of data acquisition points differs between the memory mode and the recorder mode.

Memory mode

The sampling time varies depending on the setting in **Pr.1022 Sampling cycle** and **Pr.1023 Number of analog channels**.

Pr.1023 Number of analog channels	Memory mode sampling time		Number of data acquisition points
	Minimum (Pr.1022 = "0")	Maximum (Pr.1022 = "9")	
1	213 ms	1704 s	1704
2	160 ms	1280 s	1280
3	128 ms	1024 s	1024
4	106.5 ms	852 s	852
5	91 ms	728 s	728
6	80 ms	640 s	640
7	71 ms	568 s	568
8	64 ms	512 s	512

Recorder mode

The sampling time varies depending on the setting in **Pr.1023 Number of analog channels**.

Analog channel number	Recorder mode sampling time		Number of data acquisition points
	Minimum (Pr.1022 = "2")*1	Maximum (Pr.1022 = "9")	
Fixed to 8ch (analog source selection)	Approx. 14 hours	Approx. 621 days	53687091

*1 Sampling is performed at a sampling cycle of 1 ms even if "0 or 1" is set to **Pr.1022 Sampling cycle**.

◆ Analog source (monitored item) selection

- Select the analog sources (monitored items) to be set to **Pr.1027** to **Pr.1034** from the table below.

Setting value	Monitored item*1	Minus sign display*2	Trigger level criterion*3
1	Output frequency/speed		*4
2	Output current		*4
3	Output voltage		*4
5	Frequency setting value/ speed setting		*4
6	Running speed		*4
7	Motor torque		*4
8	Converter output voltage		*4
9*5	For manufacturer setting		—
10	Electronic thermal O/L relay load factor		*4
11	Output current peak value		*4
12	Converter output voltage peak value		*4
13	Input power		*4
14	Output power		*4
17	Load meter		*4
18	Motor excitation current		*4
20	Cumulative energization time		65535
23	Actual operation time		65535
24	Motor load factor		*4
34	Motor output		*4
40	PLC function user monitor 1	○	*4
41	PLC function user monitor 2	○	*4
42	PLC function user monitor 3	○	*4
52	PID set point		*4
53	PID measured value		*4
54	PID deviation	○	*4
61	Motor thermal load factor		*4
62	Inverter thermal load factor		*4
64	PTC thermistor resistance		**Pr.561**
67	PID measured value 2		*4
68*5	Emergency drive status		65535
69	PID input pressure value		*4
81	BACnet reception status		65535
82	BACnet token pass counter		65535

Setting value	Monitored item*1	Minus sign display*2	Trigger level criterion*3
83	BACnet valid APDU counter		65535
84	BACnet communication error counter		65535
85	BACnet terminal CA output level		100%
86	BACnet terminal AM output level		100%
87	Remote output value 1	○	*4
88	Remote output value 2	○	*4
89	Remote output value 3	○	*4
90	Remote output value 4	○	*4
91	PID manipulated variable	○	*4
92	Second PID set point		*4
93	Second PID measured value		*4
94	Second PID deviation	○	*4
95	Second PID measured value 2		*4
96	Second PID manipulated variable	○	*4
98	Control circuit temperature	○	*4
201	*Output frequency		**Pr.84**
202	*U Phase Output Current	○	*7
203	*V Phase Output Current	○	*7
204	*W Phase Output Current	○	*7
205	*Converter Output Voltage		1000 V
206	*Output Current (all three phases)		*7
207	*Excitation Current(A)		*7
208	*Torque Current(A)		*7
209	Terminal 2		100%
210	Terminal 4		100%
211	Terminal 1	○	100%
212	*Excitation Current (%)	○	100%
213	*Torque Current (%)	○	100%
230	*Output Frequency (signed)	○	**Pr.84**
231	*Motor Speed	○	*6
232	*Speed Command	○	*6
237	*Excitation Current Command	○	100%
238	*Torque Current Command	○	100%

1 "" shows a monitored item with a high-speed sampling cycle.
*2 "○" shows that the display with a minus sign is available.
*3 Indicates a criterion at 100% when the analog trigger is set.
*4 Refer to Terminal CA/AM Full-scale value (page 284).
*5 The setting is available only for standard models.
*6 Rated motor frequency × 120 / number of motor poles
*7 The reference current for the trigger level is as follows.

Model FR-F860-[]	00027	00061	00090	00170	00320	00450	00680	01080	01440	01670	02430	02890	03360	04420
Trigger level reference current (A)	1.7	4	6.1	12	22	33	55	84	104	131	152	221	255	304

◆ Digital source (monitored item) selection

- Select the digital sources (input/output signals) to be set to **Pr.1038 to Pr.1045** from the table below. When a value other than the below, 0 (OFF) is applied for display.

Setting value	Signal name	Remarks
1	STF	For details on the signals, refer to page 343.
2	STR	
3	AU	
4	RT	
5	RL	
6	RM	
7	RH	
8	JOG	
9	MRS	
10	STP (STOP)	
11	RES	
12	CS	
21	X0	For details on the signals, refer to the Instruction Manual of FR-A8AX (option).
22	X1	
23	X2	
24	X3	
25	X4	
26	X5	
27	X6	
28	X7	
29	X8	
30	X9	
31	X10	
32	X11	
33	X12	
34	X13	
35	X14	
36	X15	
37	DY	
101	RUN	For details on the signals, refer to page 297.
102	SU	
103	IPF	
104	OL	
105	FU	
106	ABC1	
107	ABC2	
121	DO0	For details on the signals, refer to the Instruction Manual of FR-A8AY (option).
122	DO1	
123	DO2	
124	DO3	
125	DO4	
126	DO5	
127	DO6	
128	RA1	For details on the signals, refer to the Instruction Manual of FR-A8AR (option).
129	RA2	
130	RA3	

◆ Trigger setting (Pr.1025, Pr.1035 to Pr.1037, Pr.1046, Pr.1047)

- Set the trigger generating conditions and trigger target channels.

Pr.1025 setting	Trigger generating conditions	Selection of trigger target channel
0	Trace starts when inverter enters an fault status (protective function activated)	—
1	Trace starts when analog monitor satisfies trigger conditions	**Pr.1035**
2	Trace starts when digital monitor satisfies trigger conditions	**Pr.1046**
3	Trace starts when either of analog or digital monitor satisfies trigger conditions (OR)	**Pr.1035, Pr.1046**
4	Trace starts when both of analog or digital monitor satisfies trigger conditions (AND)	**Pr.1035, Pr.1046**

- Set the trigger generation conditions for the analog monitor.

Pr.1036 setting	Trigger generation conditions	Trigger level setting
0	Sampling starts when the analog data targeted for the trigger exceeds the value specified at the trigger level	Set the trigger level by **Pr.1037** (-400% to 400%)*1
1	Sampling starts when the analog data targeted for the trigger has fallen below the value specified at the trigger level	

*1 For **Pr.1037**, set the number obtained by adding 1,000 to the trigger level.

- Set the trigger generation conditions for the digital monitor.

Pr.1047 setting	Trigger generation conditions
0	Trace starts when the digital data targeted for the trigger turns ON
1	Trace starts when the digital data targeted for the trigger turns OFF

◆ Start of sampling and copying of data (Pr.1020, Pr.1024)

- Set the trace operation. The trace operation is set by setting **Pr.1020 Trace operation selection**.
- When "1" is set in **Pr.1020**, sampling is started.
- When "2" is set in **Pr.1020**, a trigger is regarded as having been generated (for instance, a forced trigger), sampling is stopped and the trace is started.
- When "3" is set in **Pr.1020**, sampling is stopped.
- When "4" is set in **Pr.1020**, the trace data in internal RAM is transferred to a USB memory device. (Trace data cannot be transferred during sampling.)
- To automatically start sampling when the power supply is turned ON or at a recovery after an inverter reset, set "1" to **Pr.1024 Sampling auto start**.

Pr.1020 setting	Operation
0	Sampling standby
1	Sampling start
2	Forced trigger (sampling stop)
3	Sampling stop
4	Data transmission

- The read value of **Pr.1020** is always "0".

◆ Selection of trace operation by input terminal (TRG signal, TRC signal)

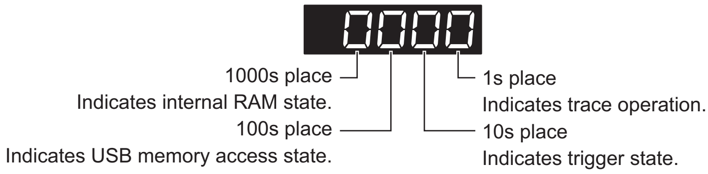
- Trace operation can be selected by signal inputs.
- A forced trigger can be applied when the Trace trigger input (TRG) signal is ON.
- Sampling is started and stopped by the Trace sampling start/end (TRC) signal turning ON and OFF, respectively.
- To input the TRG signal, set "46" in any of **Pr.178 to Pr.189 (Input terminal function selection)**, and to input the TRC signal, set "47" to assign the function to a terminal.

NOTE

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

◆ Monitoring the trace status

- The trace status can be monitored on the operation panel by setting "38" in **Pr.52 Operation panel main monitor selection, Pr.774 to Pr.776 (Operation panel monitor selection)**.



Monitor value	Trace status			
	1000s place	**100s place**	**10s place**	**1s place**
0 or no display*1	No trace data in internal RAM	USB memory not accessed	Trigger not detected	Trace stopped
1	Trace data in internal RAM	USB memory being accessed	Trigger detected	Trace operation
2	—	USB memory transfer error	—	—
3	—	USB buffer overrun	—	—

*1 The "0(s)" to the left of the leftmost non-zero digit is(are) not shown in the monitor display.
For example, if no trace data is in internal RAM, the USB memory is not accessed, no trigger is detected, and the trace operation is performed, "1" appears (not "0001").

- When copying the traced data to a USB memory device, the operating status of the USB host can be checked with the inverter LED. For the overview of the USB communication function, refer to page 67.

LED status	Operating status
OFF	No USB connection.
ON	The communication is established between the inverter and the USB device.
Flickering rapidly	Traced data is being transmitted. (In the memory mode, transmission command is being issued. In the recorder mode, sampling is being performed.)
Flickering slowly	Error in the USB connection.

- During trace operation, the trace status signal (Y40) can be output. To use the Y40 signal, set "40 (positive logic) or 140 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function to the output terminal.

NOTE

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

Parameters referred to

Pr.52 Operation panel main monitor selection ☞ page 274
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343

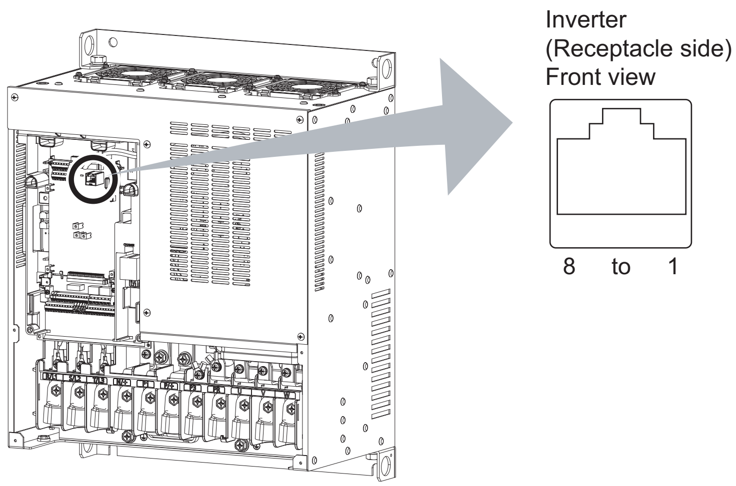
5.12 (N) Operation via communication and its settings

Purpose	Parameter to set			Refer to page
To start operation via communication	Initial setting of operation via communication	P.N000, P.N001, P.N013, P.N014	Pr.549, Pr.342, Pr.502, Pr.779	478
To operate via communication from PU connector	Initial setting of computer link communication (PU connector)	P.N020 to P.N028	Pr.117 to Pr.124	483
To operate via communication from RS-485 terminals	Initial setting of computer link communication (RS-485 terminals)	P.N030 to P.N038	Pr.331 to Pr.337, Pr.341	
	MODBUS RTU communication specification	P.N002, P.N030, P.N031, P.N033, P.N034, P.N080	Pr.539, Pr.331 to Pr.334, Pr.343	500
	BACnet MS/TP protocol	P.N030, P.N031, P.N050 to P.N054	Pr.331, Pr.332, Pr.390, Pr.726 to Pr.729	516
To Communicate using USB (FR Configurator2)	USB communication	P.N040, P.N041	Pr.547, Pr.548	532
To connect a GOT	GOT automatic recognition	P.N020, P.N030	Pr.117, Pr.331	533
To back up the data of parameter settings and PLC function to the GOT	Backup/restore	P.N110, P.N111	Pr.434, Pr.435	535

5.12.1 Wiring and configuration of PU connector

Using the PU connector enables 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.

◆ PU connector pin-outs



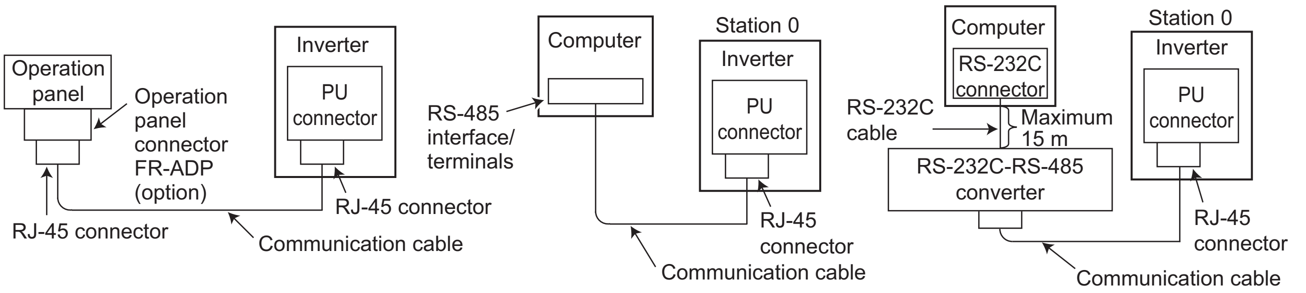
Pin number	Name	Description
1	SG	Earth (ground) (connected to terminal 5)
2	—	Operation panel power supply
3	RDA	Inverter receive+
4	SDB	Inverter send-
5	SDA	Inverter send+
6	RDB	Inverter receive-
7	SG	Earth (ground) (connected to terminal 5)
8	—	Operation panel power supply

NOTE

- Pins No. 2 and 8 provide power to the operation panel or the 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.

◆ Wiring and configuration of PU connector communication system

- System configuration



- Wiring of computer by RS-485

Computer Side Terminals: Signal name	Computer Side Terminals: Description	Cable connection and signal direction (Communication cable)	Inverter: PU connector
RDA	Receive data	←	SDA
RDB	Receive data	←	SDB
SDA	Send data	→	RDA
SDB	Send data	→	RDB
RSA	Request to send	*1	
RSB	Request to send	*1	
CSA	Clear to send	*1	
CSB	Clear to send	*1	
SG	Signal ground	← 0.2 mm^2 or more	SG
FG	Frame ground		

*1 Make connection in accordance with the Instruction Manual of the computer to be used with. Fully check the terminal numbers of the computer since they vary with the model.

NOTE

- When performing RS-485 communication with multiple inverters, use the RS-485 terminals. (Refer to page 476.)
- Computer-inverter connection cable

Refer to the following for the connection cable (RS-232C ⇔ RS-485 converter) between the computer with an RS-232C interface and an inverter. Commercially available products (as of October 2020)

Model	Manufacturer
Interface embedded cable DAFXIH-CAB (D-SUB25P for personal computer side) DAFXIH-CABV (D-SUB9P for personal computer side) + Connector conversion cable DINV-485CAB (for inverter side) *2	Diatrend Corp.
Interface embedded cable dedicated for inverter DINV-CABV *2	

*2 The conversion cable cannot connect multiple inverters. (The computer and inverted are connected in a 1:1 pair.) This is an RS232C-to-RS485 converter-embedded conversion cable. No additional cable or connector is required. For the product details, contact the manufacturer.

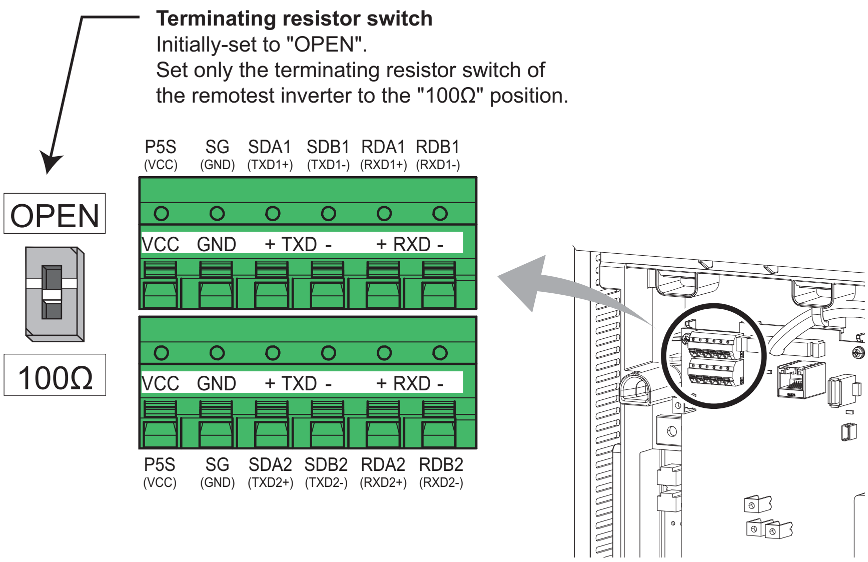
- Use Ethernet cables compliant with the following standards when fabricating the cable.

Ethernet cable	Connector	Type
Category 5e or higher straight cable (double shielded / STP)*3	RJ-45 connector	The following conditioning cables: • IEEE 802.3 (1000BASE-T) • ANSI/TIA/EIA-568-B (Category 5e)

*3 Do not use pins No. 2 and 8 of the communication cable.

5.12.2 Wiring and configuration of RS-485 terminals

◆ RS-485 terminal layout



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

◆ Connection of RS-485 terminals and wires

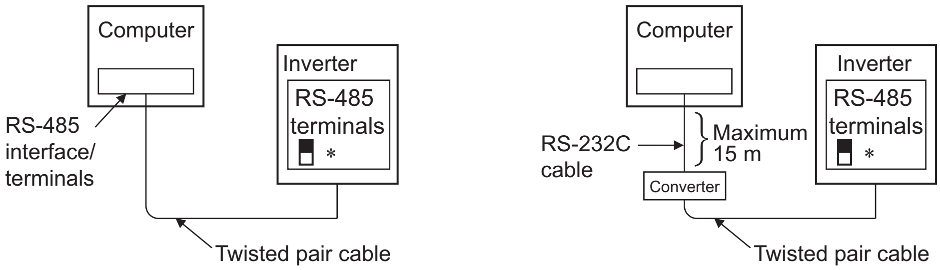
- The size of RS-485 terminal block is the same as the control circuit terminal block. Refer to page 56 for the wiring method.

NOTE

- To avoid malfunction, keep the RS-485 terminal wires away from the control circuit board.
- When the FR-F860-00680 or higher is used with a plug-in option, lead the wires on the left side of the plug-in option for wiring of the RS-485 terminals.

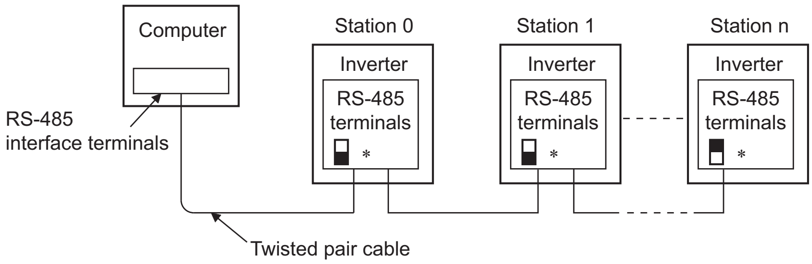
◆ System configuration of RS-485 terminals

- Computer and inverter connection (1:1)

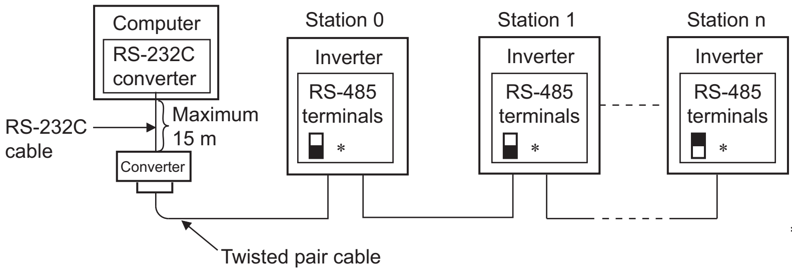


*Set the terminating resistor switch to the "100 Ω" position.

- Combination of computer and multiple inverters (1:n)



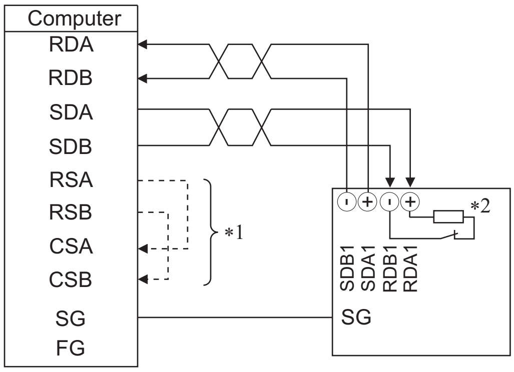
*Set only the terminating resistor switch of the remotest inverter to the "100 Ω" position.



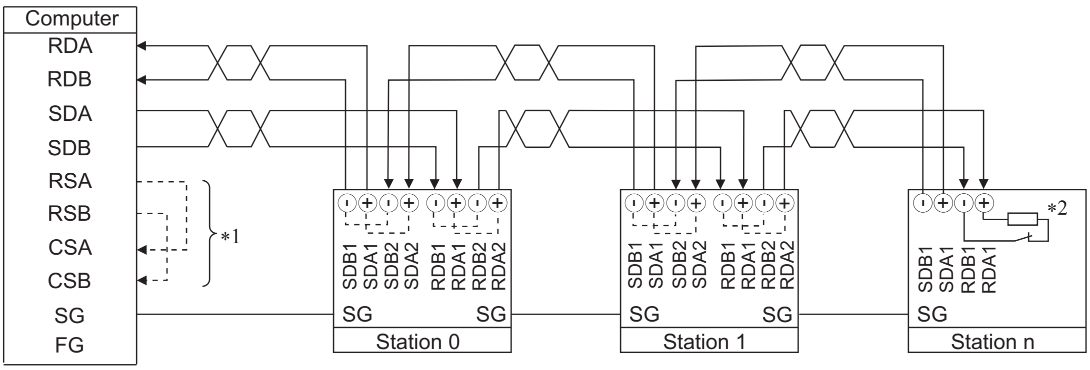
*Set only the terminating resistor switch of the remotest inverter to the "100 Ω" position.

◆ How to wire RS-485 terminals

- 1 inverter and 1 computer with RS-485 terminals



- Multiple inverters and 1 computer with RS-485 terminals

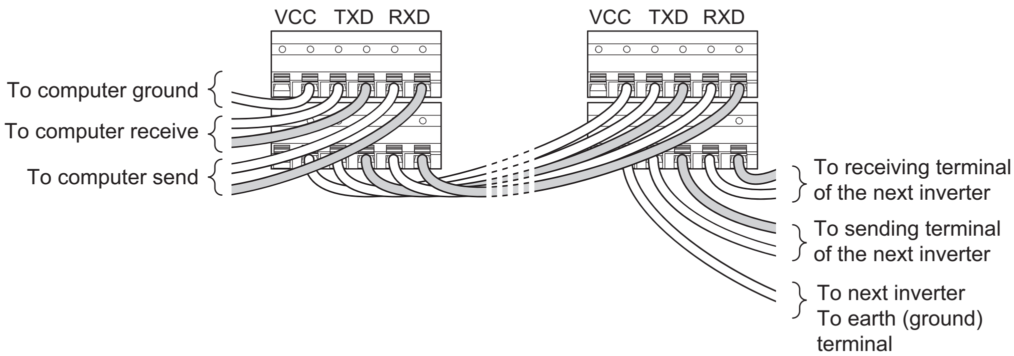


*1 Make connection in accordance with the Instruction Manual of the computer to be used with. Fully check the terminal numbers of the computer since they vary with the model.

*2 For the inverter farthest from the computer, set the terminating resistor switch to ON (100 W side).

NOTE

- For branching, connect the wires as shown below.

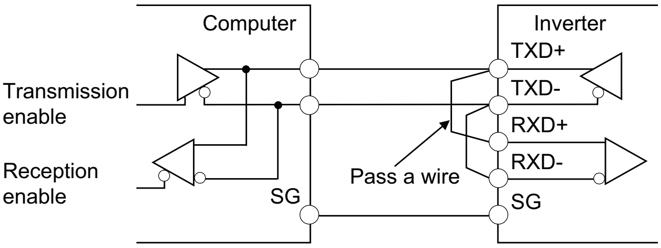


- To connect multiple inverters using RS-485 distributors, refer to the following. Commercially available products (as of October 2020)

Product name	Model	Manufacturer
RS-485 distributor	BMJ-8-28N (Pins No. 2 and No. 8 are not connected internally.) (A plug with a terminating resistor is not used.)	HACHIKO ELECTRIC CO., LTD.
	DMDH-3PN (Pins No. 2 and No. 8 are not connected internally.) DMDH-10PN (Pins No. 2 and No. 8 are not connected internally.)	Diatrend Corp.

◆ Two-wire type connection

- If the computer is 2-wire type, a connection from the inverter can be changed to 2-wire type by passing wires across reception terminals and transmission terminals of the RS-485 terminals.



NOTE

- A program should be created so that transmission is disabled (receiving state) when the computer is not sending and reception is disabled (sending state) during sending to prevent the computer from receiving its own data.

5.12.3 Initial setting of operation via communication

Set the action when the inverter is performing operation via communication.

- Set the communication protocol. (Mitsubishi inverter protocol/MODBUS RTU protocol)
- Set the action at fault occurrence or at writing of parameters

Pr.	Name	Initial value	Setting range	Description
549 **N000**	**Protocol selection**	0	0	Mitsubishi inverter protocol (computer link)
			1	MODBUS RTU protocol
			2	BACnet MS/TP protocol
342 **N001**	**Communication EEPROM write selection**	0	0	Parameter values written by communication are written to the EEPROM and RAM.
			1	Parameter values written by communication are written to the RAM.
349[*1]	**Communication reset selection/Ready bit status selection/Reset selection after inverter faults are cleared/DriveControl writing restriction selection**	0	0	Enables the error reset function in any operation mode.
			1	Enables the error reset function only in the Network operation mode.
			100, 101	For details, refer to page 641 and page 643.
			1000, 1001, 1100, 1101, 10000, 10001, 10100, 10101, 11000, 11001, 11100, 11101	For details, refer to page 641.
N010[*1]	**Communication reset selection**	0	0	Enables the error reset function in any operation mode.
			1	Enables the error reset function only in the Network operation mode.
N240[*1]	**Ready bit status selection**	0	0	The status of Ready bit in communication data can be changed.
			1	
502 **N013**	**Stop mode selection at communication error**	0	0 to 4	Select the operation at a communication error occurrence.
779 **N014**	**Operation frequency during communication error**	9999	0 to 590 Hz	Set the frequency to be run at a communication error occurrence.
			9999	The motor runs at the frequency used before the communication error.

*1 The setting is available only when a communication option is installed.

◆ Setting the communication protocol (Pr.549)

- Select the communication protocol.
- The MODBUS RTU protocol can be used by communication from the RS-485 terminals.

Pr.549 setting	Communication protocol
0 (initial value)	Mitsubishi inverter protocol (computer link)
1	MODBUS RTU protocol
2	BACnet MS/TP protocol

◆ Communication EEPROM write selection (Pr.342)

- When parameter write is performed via the inverter PU connector, RS-485 terminal, USB communication, or a communication option, the parameters storage device can be changed from EEPROM + RAM to RAM only. Use this function if parameter settings are changed frequently.
- When changing the parameter values frequently, set "1" in **Pr.342 Communication EEPROM write selection** to write them to the RAM only. The life of the EEPROM will be shorter if parameter write is performed frequently with the setting unchanged from "0 (initial value)" (EEPROM write).

5

NOTE

- Turning OFF the inverter's power supply clears the modified parameter settings when **Pr.342** = "1 (write only to RAM)". Therefore, the parameter values at next power-ON are the values last stored in EEPROM.
- The parameter setting written in RAM cannot be checked on the operation panel. (The values displayed on the operation panel are the ones stored in EEPROM.)

◆ Operation selection at a communication error (Pr.502, Pr.779)

- For communication using RS-485 terminals or a communication option, operation at a communication error can be selected. The operation is active under the Network operation mode.
- Select the stop operation at the retry count excess (**Pr.335**, only with Mitsubishi inverter protocol) or at a signal loss detection **(Pr.336, Pr.539)**.

Fault record	Pr.502 setting	At fault occurrence			At fault removal		
		Operation	Indication	Fault (ALM) signal	Operation	Indication	Fault (ALM) signal
Communication line	0 (initial value)	Output shutoff	"E.SER"[*1]	ON	Output stop status continues.	"E.SER"[*1]	ON
	1	Output to decelerate and stop the motor	"E.SER" after stop[*1]	ON after stop			
	2			OFF	Restart[*2]	Normal	OFF
	3	Operation continues at the set frequency of **Pr.779**.	Normal	OFF	Normal	Normal	OFF
	4		"CF" warning	OFF			
Communication option (when a communication option is used)	0, 3	Output shutoff	"E.1"	ON	Output stop status continues.	"E.1"	ON
	1, 2	Output to decelerate and stop the motor	"E.1" after stop	ON after stop			
	4	Operation continues at the set frequency of **Pr.779**.	"CF" warning	OFF	Operation continues at the set frequency of **Pr.779**.	"CF" warning	OFF

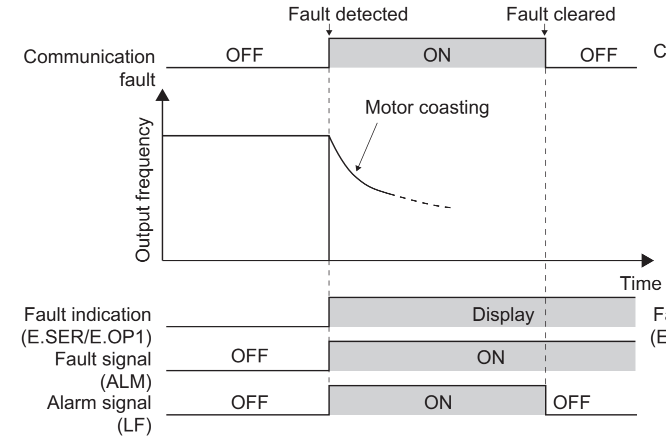
*1 If in communication by the communication option, E.OP1 is displayed.

*2 When the communication error is removed during deceleration, the motor re-accelerates.

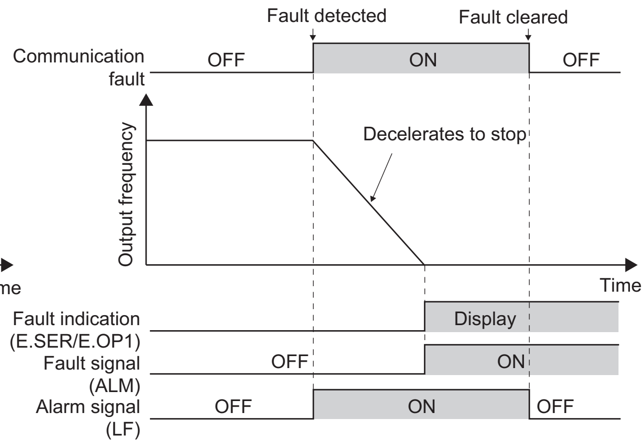
- When a communication error is detected during communication through the RS-485 terminals or communication option, the alarm (LF) signal is output to an output terminal of the inverter. To use the LF signal, set "98 (positive logic) or 198 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function to the output terminal. (To output the LF signal even if communication through RS-485 terminals is not performed for the time set in **Pr.336** or longer, or during communication using a communication option, set "3 or 4" in **Pr.502**.)

• The following charts show operations when a communication line error occurs.

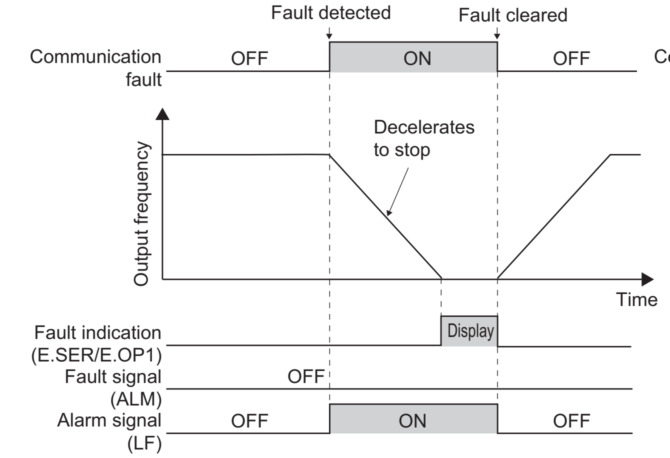
Pr. 502 = "0" (initial value)



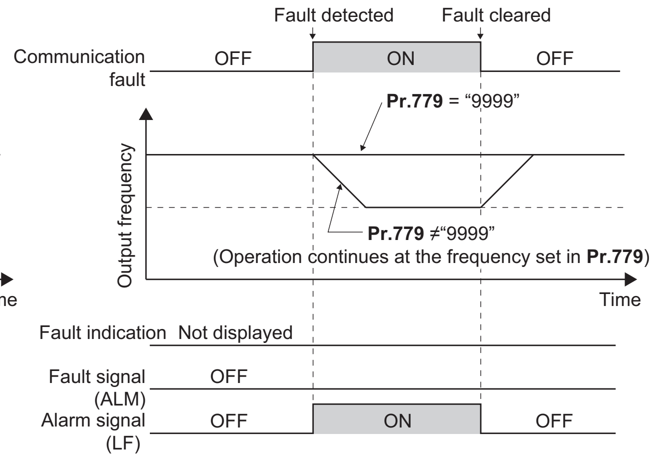
Pr. 502 = "1"



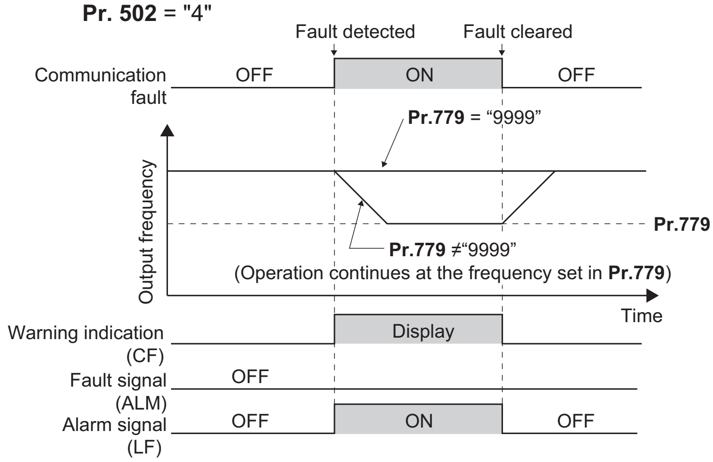
Pr. 502 = "2"



Pr. 502 = "3"

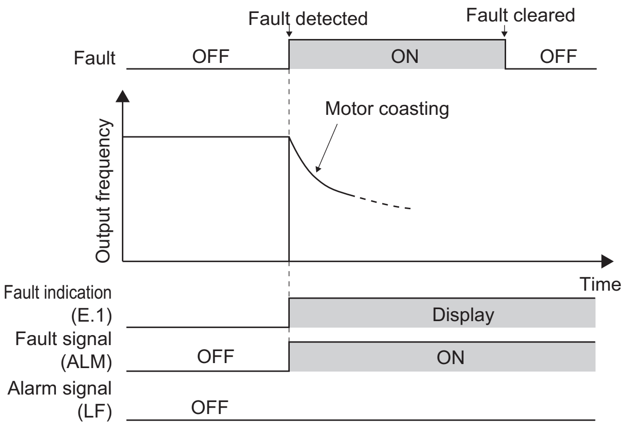


Pr. 502 = "4"

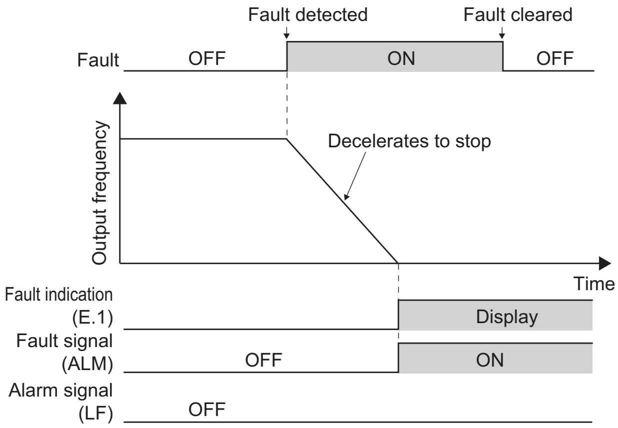


• The following charts show operations when a communication option fault occurs.

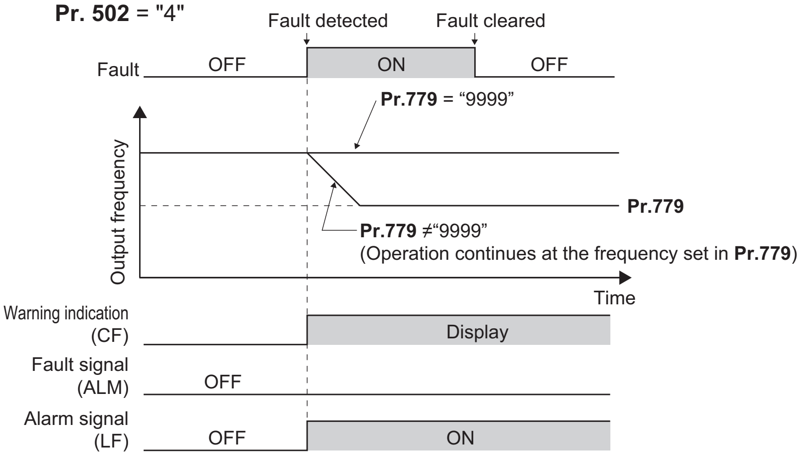
Pr. 502 = "0 (initial value) or 3"



Pr. 502 = "1 or 2"



Pr. 502 = "4"



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NOTE

- Fault output indicates the Fault signal (ALM) and an alarm bit output.
- When the fault output is set enabled, fault records are stored in the fault history. (A fault record is written to the fault history at a fault output.)
- When the fault output is not set enabled, fault record is overwritten to the fault history of the fault history temporarily but not stored.
- After the fault is removed, the fault indication goes back to normal indication on the monitor, and the fault history goes back to the previous status.
- When **Pr.502** ≠ "0", the normal deceleration time setting (settings like **Pr.8, Pr.44, and Pr.45**) is applied as the deceleration time. Normal acceleration time setting (settings like **Pr.7 and Pr.44**) is applied as the acceleration time for restart.
- When **Pr.502** = "2, 3, or 4", the inverter operates with the start command and the speed command, which were used before the fault.
- If a communication line error occurs, then the error is removed during deceleration while **Pr.502** = "2", the motor re-accelerates from that point. (When a communication option is used, acceleration does not restart at a communication option error.)
- The **Pr.502 and Pr.779** settings are valid when communication is performed via the RS-485 terminals or a communication option.
- These parameters are valid under the Network operation mode. When performing communication with RS-485 terminals, set **Pr.551 PU mode operation command source selection** ≠ "1".
- **Pr.502** is valid for the device that has the command source under the Network operation mode. If a communication option is installed while **Pr.550** = "9999 (initial value)", a communication error in RS-485 terminals occurs and **Pr.502** becomes invalid.
- If the communication error setting is disabled with **Pr.502** = "3 or 4", **Pr.335** = "9999", and **Pr.539** = "9999", the inverter does not continue its operation with the frequency set by **Pr.779** at a communication error.
- If a communication error occurs while continuous operation at **Pr.779** is selected with **Pr.502** = "3 or 4", the inverter operates at the frequency set in **Pr.779** even though the speed command source is at the external terminals.
- Example) If a communication error occurs while **Pr.339** = "2" and the external terminal RL is ON, the operation is continued at the frequency set in **Pr.779**.

CAUTION

- When **Pr.502** = "3" and a communication line error occurs, or a **Pr.502** = "4" and a communication line error or a communication option fault occurs, the operation continues. When setting "3 or 4" in **Pr.502**, provide a safety stop countermeasure other than via communication. For example, input a signal (RES or MRS) through an external terminal or press the PU stop on the operation panel.

Parameters referred to

Pr.7 Acceleration time, Pr.8 Deceleration time page 190
Pr.335 RS-485 communication retry count page 483
Pr.336 RS-485 communication check time interval page 483
Pr.539 MODBUS RTU communication check time interval page 500
Pr.550 NET mode operation command source selection page 214
Pr.551 PU mode operation command source selection page 214

5.12.4 Initial settings and specifications of RS-485 communication

Use the following parameters to perform required settings for the RS-485 communication between the inverter and a personal computer.

- Use the PU connector on the inverter or RS-485 terminals as communication interface.
- The Mitsubishi inverter protocol, MODBUS-RTU protocol, or BACnet protocol is used. Parameter setting, monitoring, etc. can be performed through communication.
- To make communication between the personal computer and inverter, setting of the communication specifications must be made to the inverter in advance. Data communication cannot be made if the initial settings are not made or if there is any setting error.

[Parameters related to PU connector communication]

Pr.	Name	Initial value	Setting range	Description	
117 **N020**	**PU communication station number**	0	0 to 31	Use this parameter to specify the inverter station number. Set the inverter station numbers when two or more inverters are connected to one personal computer.	
118 **N021**	**PU communication speed**	192	48, 96, 192, 384, 576, 768, 1152	Set the communication speed. The setting value × 100 equals the communication speed. For example, if 192 is set, the communication speed is 19200 bps.	
N022	**PU communication data length**	0	0	Data length 8 bits	
			1	Data length 7 bits	
N023	**PU communication stop bit length**	1	0	Stop bit length 1 bit	
			1	Stop bit length 2 bits	
119	**PU communication stop bit length / data length**	1	0	Stop bit length 1 bit	Data length 8 bits
			1	Stop bit length 2 bits	
			10	Stop bit length 1 bit	Data length 7 bits
			11	Stop bit length 2 bits	
120 **N024**	**PU communication parity check**	2	0	Parity check disabled.	
			1	Parity check (odd parity) enabled.	
			2	Parity check (even parity) enabled.	
121 **N025**	**Number of PU communication retries**	1	0 to 10	Set the permissible number of retries for unsuccessful data reception. If the number of consecutive errors exceeds the permissible value, the inverter will trip.	
			9999	If a communication error occurs, the inverter will not trip.	
122 **N026**	**PU communication check time interval**	9999	0	No PU connector communication	
			0.1 to 999.8 s	Set the interval of the communication check (signal loss detection) time. If a no-communication state persists for longer than the permissible time, the inverter will trip.	
			9999	No communication check (signal loss detection)	
123 **N027**	**PU communication waiting time setting**	9999	0 to 150 ms	Set the time delay between data transmission to the inverter and the response.	
			9999	The time delay is not set in this parameter but in communication data. Delay time: Number set in the data × 10 ms	
124 **N028**	**PU communication CR/LF selection**	1	0	Without CR/LF	
			1	With CR	
			2	With CR/LF	

[Parameters related to communication with the RS-485 terminals]

Parameter number	Name	Initial value	Setting range	Description
331 **N030**	**RS-485 communication station number**	0	0 to 31 (0 to 247) *1*2	Set the inverter station number. (Same specifications as **Pr.117**)
332 **N031**	**RS-485 communication speed**	96	3, 6, 12, 24, 48, 96, 192, 384, 576, 768, 1152*3	Select the communication speed. (Same specifications as **Pr.118**)
N032	**RS-485 communication data length**	0	0, 1	Select the data length. (Same specifications as **P.N022**)*4
N033	**RS-485 communication stop bit length**	1	0, 1	Select the stop bit length. (Same specifications as **P.N023**)*5
333	**RS-485 communication stop bit length / data length**	1	0, 1, 10, 11	Select the stop bit length and data bit length. (Same specifications as **Pr.119**)*4*5
334 **N034**	**RS-485 communication parity check selection**	2	0, 1, 2	Select the parity check specifications. (Same specifications as **Pr.120**)
335 **N035***6	**RS-485 communication retry count**	1	0 to 10, 9999	Set the permissible number of retries for unsuccessful data reception. (Same specifications as **Pr.121**)
336 **N036***6	**RS-485 communication check time interval**	0 s	0	RS-485 communication is available, but the inverter trips in the NET operation mode.
			0.1 to 999.8 s	Set the interval of the communication check (signal loss detection) time. (Same specifications as **Pr.122**)
			9999	No communication check (signal loss detection)
337 **N037***6	**RS-485 communication waiting time setting**	9999	0 to 150 ms, 9999	Set the waiting time between data transmission to the inverter and the response. (Same specifications as **Pr.123**)
341 **N038***6	**RS-485 communication CR/LF selection**	1	0, 1, 2	Select the presence/absence of CR/LF. (Same specifications as **Pr.124**)

*1 When "1" (MODBUS RTU protocol) is set in **Pr.549**, the setting range within parentheses is applied.
*2 When a value outside the setting range is set, the inverter operates at the initial value.
*3 When **Pr.549** = "2" (BACnet MS/TP protocol), the setting range is "96 to 1152".
*4 In the MODBUS RTU protocol, the data length is fixed at 8 bits.
*5 In the MODBUS RTU protocol, **Pr.334** setting is applied as the stop bit length. (Refer to page 500.)
*6 In the MODBUS RTU protocol, this is invalid.

NOTE

- The monitored items and parameter settings can be read during communication with the **Pr.336 RS-485 communication check time interval** = "0 (initial value)" setting, but such operation will become faulty once the operation mode is changed to the NET operation mode. When the NET operation mode is selected as the start-up operation mode, communication is performed once, then a Communication fault (inverter) (E.SER) occurs. To perform operation or parameter writing via communication, set "9999" or a large setting value in **Pr.336**. (The setting value is determined by the computer program.)(Refer to page 492.)
- Always reset the inverter after making the initial settings of the parameters. After changing the communication-related parameters, communication cannot be made until the inverter is reset.

5.12.5 Mitsubishi inverter protocol (computer link communication)

Parameter settings and monitoring are possible by using the Mitsubishi inverter protocol (computer link communication) via inverter PU connector and the RS-485 terminals.

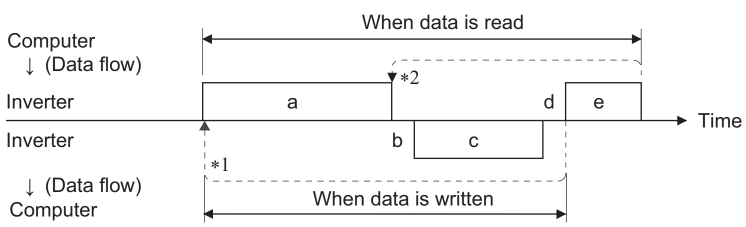
◆ Communication specifications

- The communication specifications are given below.

Item		Description	Related Parameter
Communication protocol		Mitsubishi inverter protocol (computer link)	**Pr.551**
Conforming standard		EIA-485 (RS-485)	—
Connectable units		1:N (maximum 32 units), the setting range of station number is 0 to 31.	**Pr.117** **Pr.331**
Communication Speed	PU connector	Selected among 4800/9600/19200/38400/57600/76800/115200 bps	**Pr.118**
	RS-485 terminals	Selected among 300/600/1200/2400/4800/9600/19200/38400/38400/ 57600/76800/115200 bps	**Pr.332**
Control procedure		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 (at even or odd numbers) or no check can be selected.	**Pr.120** **Pr.334**
	Error check	Sum code check	—
	Terminator	CR/LF (presence/absence selectable)	**Pr.124** **Pr.341**
Waiting time setting		Selectable between presence and absence	**Pr.123** **Pr.337**

◆ Communication procedure

- Data communication between the computer and inverter is made in the following procedure.
  (a) Request data is sent from the computer to the inverter. (The inverter will not send data unless requested.)
  (b) After waiting for the waiting time,
  (c) The inverter sends reply data to the computer in response to the computer request.
  (d) After waiting for the inverter data processing time,
  (e) An answer from the computer in response to reply data (c) of the inverter is transmitted. (Even if (e) is not sent, subsequent communication is made properly.)



*1 If a data error is detected and a retry must be made, perform retry operation with the user program. The inverter trips if the number of consecutive retries exceeds the parameter setting.

*2 On receipt of a data error occurrence, the inverter returns reply data (c) to the computer again. The inverter trips 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).
- Communication operation presence/absence and data format types are as follows.

Symbol	Operation		Operation command	Operation frequency	Multi command	Parameter write	Inverter reset	Monitor	Parameter read
a	Communication request is sent to the inverter in accordance with the user program in the computer.		A, A1	A	A2	A	A	B	B
b	Inverter data processing time		With	With	With	With	Without	With	With
c	Reply data from the inverter (Data (a) is checked for an error)	No error *1 (Request accepted)	C	C	C1*3	C	C*2	E, E1, E2, E3	E
		With error (Request rejected)	D	D	D	D	D*2	D	D
d	Computer processing delay time		10 ms or more						
e	Answer from computer in response to reply data c (Data c is checked for error)	No error *1 (No inverter processing)	Without	Without	Without (C)	Without	Without	Without (C)	Without (C)
		With error (Inverter outputs c again.)	Without	Without	F	Without	Without	F	F

*1 In the communication request data from the computer to the inverter, the time of 10 ms or more is also required after an acknowledgment (ACK) signal showing "No data error detected" is sent. (Refer to page 490.)

*2 Reply from the inverter to the inverter reset request can be selected. (Refer to page 495.)

*3 At mode error, and data range error, C1 data contains an error code. (Refer to page 499.) Except for those errors, the error is returned with data format D.

- Data writing format

a. Communication request data from the computer to the inverter

<table>
<tr><th rowspan="2">Format</th><th colspan="19">Number of characters</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th></tr>
<tr><td>A</td><td>ENQ *1</td><td colspan="2">Inverter station No. *2</td><td colspan="2">Instruction code</td><td>*3</td><td colspan="4">Data</td><td colspan="2">Sum check</td><td>*4</td><td colspan="6"></td></tr>
<tr><td>A1</td><td>ENQ *1</td><td colspan="2">Inverter station No. *2</td><td colspan="2">Instruction code</td><td>*3</td><td colspan="2">Data</td><td colspan="2">Sum check</td><td>*4</td><td colspan="8"></td></tr>
<tr><td>A2</td><td>ENQ *1</td><td colspan="2">Inverter station No. *2</td><td colspan="2">Instruction code</td><td>*3</td><td>Send data type</td><td>Receive data type</td><td colspan="4">Data1</td><td colspan="4">Data2</td><td colspan="2">Sum check</td><td>*4</td></tr>
</table>

c. Reply data from the inverter to the computer (No data error detected)

<table>
<tr><th rowspan="2">Format</th><th colspan="19">Number of characters</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th></tr>
<tr><td>C</td><td>ACK *1</td><td colspan="2">Inverter station No. *2</td><td>*4</td><td colspan="15"></td></tr>
<tr><td>C1</td><td>STX *1</td><td colspan="2">Inverter station No. *2</td><td>Send data type</td><td>Receive data type</td><td>Error code 1</td><td>Error code 2</td><td colspan="4">Data1</td><td colspan="4">Data2</td><td>ETX *1</td><td colspan="2">Sum check</td><td>*4</td></tr>
</table>

c. Reply data from the inverter to the computer (Data error detected)

Format	Number of characters				
	1	2	3	4	5
D	NAK[*1]	Inverter station No. [*2]		Error code	[*4]

*1 A control code.
*2 The inverter station number is specified in hexadecimal in the range of H00 to H1F (stations No. 0 to 31).
*3 Set the delay time. When **Pr.123 PU communication waiting time setting** or **Pr.337 RS-485 communication waiting time setting** is set to other than "9999", create the communication request data without "delay time" in the data format. (The number of characters decreases by 1.)
*4 CR+LF code: When a computer transmits data to the inverter, some computers automatically provide either one or both of the codes CR (carriage return) and LF (line feed) at the end of a data group. In this case, the same setting is required for data sent from the inverter to the computer. Use **Pr.124** or **Pr.341** for the CR+LF code setting.

- Data reading format

a. Communication request data from the computer to the inverter

Format	Number of characters								
	1	2	3	4	5	6	7	8	9
B	ENQ [*1]	Inverter station No. [*2]		Instruction code		[*3]	Sum check		[*4]

c. Reply data from the inverter to the computer (No data error detected)

Format	Number of characters												
	1	2	3	4	5	6	7	8	9	10	11	12	13
E	STX[*1]	Inverter station No. [*2]		Read data				ETX[*1]	Sum check		[*4]		
E1	STX[*1]	Inverter station No. [*2]		Read data		ETX[*1]	Sum check		[*4]				
E2	STX[*1]	Inverter station No. [*2]		Read data						ETX[*1]	Sum check		[*4]

Format	Number of characters							
	1	2	3	4 to 23	24	25	26	27
E3	STX[*1]	Inverter station No. [*2]		Read data (Inverter model information)	ETX[*1]	Sum check		[*4]

c. Reply data from the inverter to the computer (Data error detected)

Format	Number of characters				
	1	2	3	4	5
D	NAK[*1]	Inverter station No. [*2]		Error code	[*4]

e. Transmission data from the computer to the inverter when reading data

Format	Number of characters			
	1	2	3	4
C (No data error detected)	ACK[*1]	Inverter station No. [*2]		[*4]
F (Data error detected)	NAK[*1]	Inverter station No. [*2]		[*4]

*1 A control code.
*2 The inverter station number is specified in hexadecimal in the range of H00 to H1F (stations No. 0 to 31).
*3 Set the delay time. When **Pr.123 PU communication waiting time setting** or **Pr.337 RS-485 communication waiting time setting** is set to other than "9999", create the communication request data without "delay time" in the data format. (The number of characters decreases by 1.)
*4 CR+LF code: When a computer transmits data to the inverter, some computers automatically provide either one or both of the codes CR (carriage return) and LF (line feed) at the end of a data group. In this case, the same setting is required for data sent from the inverter to the computer. Use **Pr.124** or **Pr.341** for the CR+LF code setting.

◆ Data definitions

- Control code

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)

- Inverter station number

Specify the station number of the inverter which communicates with the computer.

- Instruction code

Specify the processing request, for example, operation or monitoring, given by the computer to the inverter. Therefore, the operation or monitoring an item is enabled by specifying the corresponding instruction code. (Refer to page 495.)

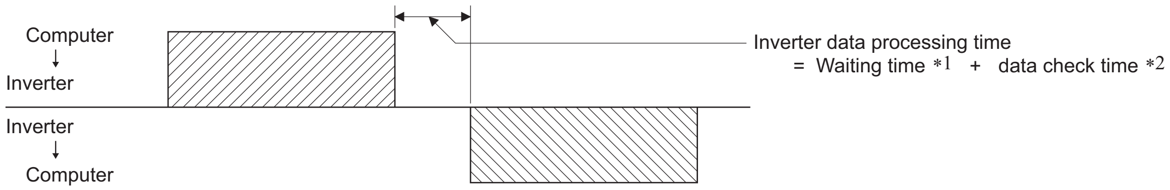
- Data

Read/write data such as parameters transmitted from/to the inverter. The definitions and ranges of set data are determined in accordance with the instruction codes. (Refer to page 495.)

- Time delay

Specify the delay time (time period between the time when the inverter receives data from the computer and the time when the inverter starts transmission of reply data). Set the delay time in accordance with the response time of the computer in the range of 0 to 150 ms in 10 ms increments. (For example, "1" for 10 ms or "2" for 20 ms.)

When **Pr.123 PU communication waiting time setting** or **Pr.337 RS-485 communication waiting time setting** is set to other than "9999", create the communication request data without "delay time" in the data format. (The number of characters decreases by 1.)



*1 Number set in data × 10 (ms) when **Pr.123** = "9999". **Pr.123** setting (ms) when **Pr.123** ≠ "9999".

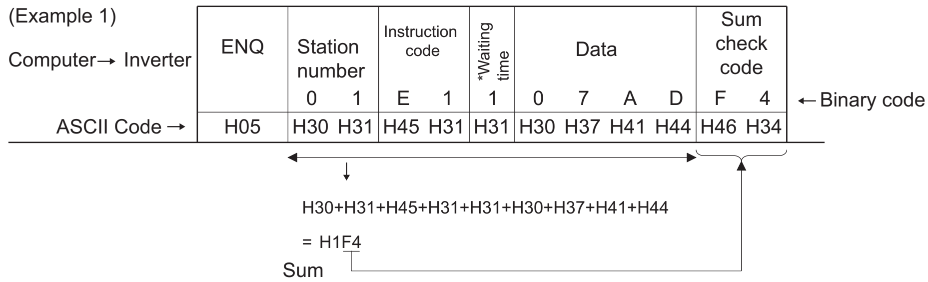
*2 About 5 to 50 ms. It varies depending on the instruction code.

NOTE

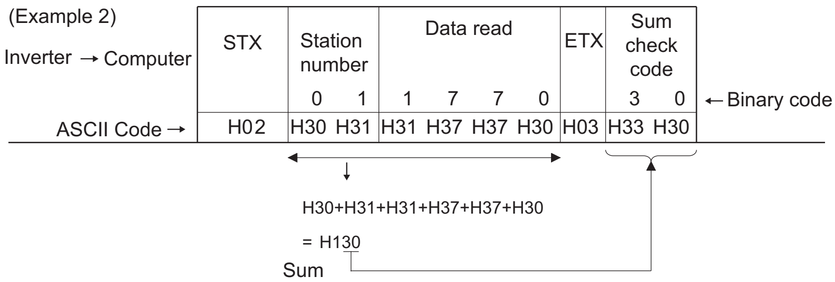
- The data check time varies depending on the instruction code. (Refer to page 490.)

- Sum check code

The sum check code is a 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum derived from the checked ASCII data.



*When the **Pr.123 or 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.)

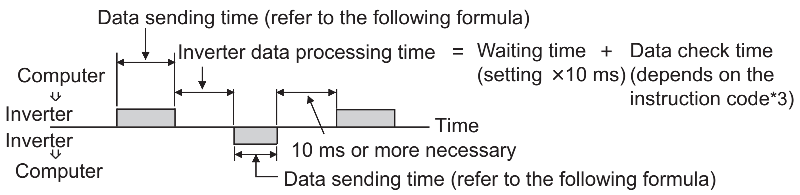


- Error code

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

Error Code	Error Item	Error Description	Inverter Operation
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than the permissible number of retries.	Trips (E.PUE/E.SER) if error occurs continuously more than the permissible number of retries. The LF signal is output.
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. Or, data receive is not completed within the predetermined time. The CR or LF code specification is not the same as the setting of 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 the received data, but the inverter does not trip.
H8	—	—	—
H9	—	—	—
HA	Mode error	Parameter write was attempted when the inverter does not perform computer link communication, when the operation commands are not given through communication, or during inverter operation.	Does not accept the received data, but the inverter does not trip.
HB	Instruction code error	The specified instruction code does not exist.	
HC	Data range error	Invalid data has been specified for parameter writing, set frequency setting, etc.	
HD	—	—	—
HE	—	—	—
HF	Normal (no error)	—	—

◆ Response time



[Formula for data transmission time]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters *1} \times \begin{array}{l}\text{Communication specifications}\\ \text{(Total number of bits) *2}\end{array} = \text{data transmission time (s)}$$

*1 Refer to page 486.

*2 Communication specifications

Name		Number of bits
Stop bit length		1 bit 2 bits
Data Length		7 bits 8 bits
Parity check	With	1 bit
	Without	0

In addition to the above, 1 start bit is necessary.

Minimum number of total bits: 9 bits

Maximum number of total bits: 12 bits

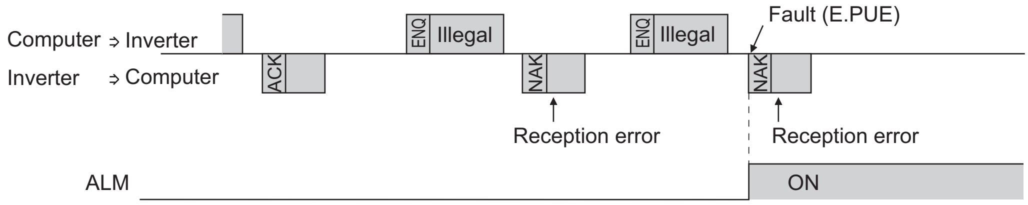
*3 Data check time

Item	Check time
Operation command, inverter status monitor, reading the monitor item, reading/writing the set frequency (RAM)	< 20 ms
Reading/writing the set frequency (EEPROM)	< 40 ms
Reading/writing parameters (RAM)	< Approximately 20 ms
Reading/writing parameters (EEPROM)	< Approximately 50 ms

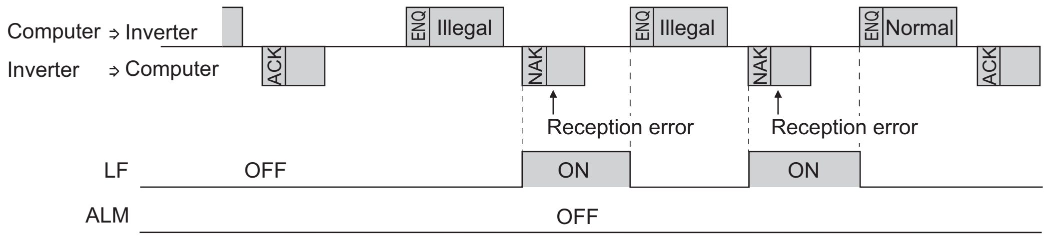
◆ Retry count setting (Pr.121, Pr.335)

- Set the permissible number of retries at data receive error occurrence. (Refer to page 489 for data receive error for retry.)
- When the data receive errors occur consecutively and the number of retries exceeds the permissible number setting, a communication fault (PU connector communication: E.PUE, RS-485 terminal communication: E.SER) occurs and the inverter trips.
- When a data transmission error occurs while "9999" is set, the inverter does not trip but outputs the alarm (LF) signal. To use the LF signal, set "98 (positive logic) or 198 (negative logic)" in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function to an output terminal.

Example: PU connector communication, **Pr. 121** = "1" (initial value)



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



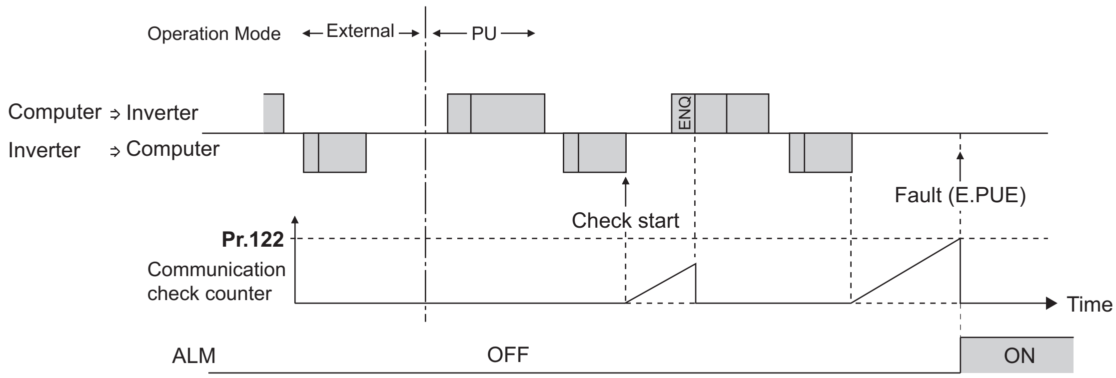
NOTE

- For the RS-485 terminal communication, the operation at a communication error occurrence depends on the **Pr.502 Stop mode selection at communication error** setting. (Refer to page 478)

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

- If a signal loss (communication stop) is detected between the inverter and computer as a result of a signal loss detection, a communication fault (PU connector communication: E.PUE, RS-485 terminal communication: E.SER) occurs and the inverter trips.
- The LF signal is not output when a signal loss is detected. However, when a signal loss is detected via communication through the RS-485 terminals while **Pr.502** = "3 or 4", the LF signal is output.
- When the setting is "9999", communication check (signal loss detection) is not made.
- When the setting is "0", communication from the PU connector is not possible. In the case of communication by RS-485 terminals, reading, etc. of monitors and parameters is possible, though a communication error (E.SER) occurs instantly when the Network operation mode is switched to.
- A signal loss detection is made when the setting is any of "0.1 s to 999.8 s". To make a signal loss detection, it is necessary to send data (for details on control codes, refer to page 488) from the computer within the communication check time interval. (The inverter makes a communication check (clearing of communication check counter) regardless of the station number setting of the data sent from the master).
- Communication check is started at the first communication in the operation mode having the operation source (PU operation mode for PU connector communication in the initial setting or Network operation mode for RS-485 terminal communication).

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



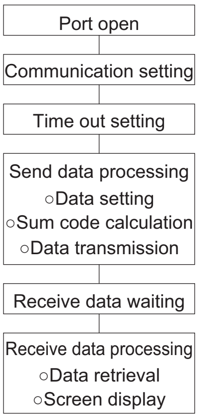
◆ Instructions for the program

- When data from the computer has any error, the inverter does not accept that data. Hence, in the user program, always insert a retry program for data error.
- All data communication, for example, run command or monitoring, are started when the computer gives a communication request. The inverter does not return any data without the computer's request. Hence, design the program so that the computer gives a data read request for monitoring, etc. as required.
- Program example: To switch to the Network operation mode

Microsoft® Visual C++® (Ver.6.0) programming example

```
#include <stdio.h>
#include <windows.h>

void main(void){
	HANDLE		hCom;		// Communication handle
	DCB		hDcb;		// Structure for setting communication settings
	COMMTIMEOUTS		hTim;	// Structure for setting timeouts

	char		szTx[0x10];		// Send buffer
	char		szRx[0x10];		// Receive buffer
	char		szCommand[0x10];// Command
	int		nTx,nRx;		// For storing buffer size
	int		nSum;		// For calculating sum code
	BOOL		bRet;
	int		nRet;
	int		i;

	// **** Open COM1 port ****
	hCom = CreateFile("COM1", (GENERIC_READ | GENERIC_WRITE), 0, NULL, OPEN_EXISTING, FILE_ATTRIBUTE_NORMAL, NULL);
	if(hCom != NULL) {
		// **** Set COM1 port communication ****
		GetCommState(hCom,&hDcb);				// Get current communication information
		hDcb.DCBlength = sizeof(DCB);				// Structure size setting
		hDcb.BaudRate  = 19200;				// Communication speed = 19200 bps
		hDcb.ByteSize  = 8;				// Data length = 8 bits
		hDcb.Parity    = 2;				// Parity check at even numbers
		hDcb.StopBits  = 2;				// Stop bit = 2 bits
		bRet = SetCommState(hCom,&hDcb);				// Setting of changed communication information
		if(bRet == TRUE) {
			// **** Set COM1 port timeout  ****
			GetCommTimeouts(hCom,&hTim);			// Get current timeout values
			hTim.WriteTotalTimeoutConstant = 1000;			// Write timeout 1 second
			hTim.ReadTotalTimeoutConstant = 1000;			// Read timeout 1 second
			hTim.ReadTotalTimeoutConstantSetCommTimeouts(hCom,&hTim);// Setting of changed timeout values
			// **** Setting of command for switching the station number 1 inverter to the Network operation mode ****
			sprintf(szCommand,"01FB10000");			// Send data (NET operation write)
			nTx = strlen(szCommand);			// Send data size
			// **** Generate sum code ****
			nSum = 0;			// Initialize sum data
			for(i = 0;i < nTx;i++) {
				nSum += szCommand[i];		// Calculate sum code
				nSum &= (0xff);		// Mask data
			}

			// **** Generate send data ****
			memset(szTx,0,sizeof(szTx));			// Initialize send buffer
			memset(szRx,0,sizeof(szRx));			// Initialize receive buffer
			sprintf(szTx,"\5%s%02X",szCommand,nSum);// ENQ code + send data + sum code
			nTx = 1 + nTx + 2;			// ENQ code + number of send data + number of sum codes

			nRet = WriteFile(hCom,szTx,nTx,&nTx,NULL);
			// **** Send ****
			if(nRet != 0) {
				nRet = ReadFile(hCom,szRx,sizeof(szRx),&nRx,NULL);
			// **** Receive ****
				if(nRet != 0) {
					// **** Display receive data ****
					for(i = 0;i < nRx;i++) {
						printf("%02X ",(BYTE)szRx[i]);// Output received data to console
						// Display ASCII code in Hexadecimal' In case of 0', "30" is displayed.
					}
					printf("\n\r");
				}
			}
		}
		CloseHandle(hCom);				// Close communication port
	}
}
```

General flowchart



CAUTION

- Always set the communication check time interval before starting operation to prevent hazardous conditions.
- Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc., the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter will trip (E.PUE, E.SER). The inverter can be coasted to a stop by switching ON the RES signals or by switching the 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 settings, set the instruction codes and data, then start communication from the computer to allow various types of operation control and monitoring.

Item		Read/ Write	Instruction code	Data description	Number of data digits (Format)*1
Operation mode		Read	H7B	H0000: Network operation H0001: External operation H0002: PU operation, External/PU combined operation, PUJOG operation	4 digits (B and E/D)
		Write	HFB	H0000: Network operation H0001: External operation H0002: PU operation (RS-485 communication operation via PU connector)	4 digits (A and C/D)
Monitor	Output frequency/ speed	Read	H6F	H0000 to HFFFF: Output frequency in 0.01Hz increments (The display can be changed to the rotations per minute using **Pr.37** and **Pr.144**. (Refer to page 272.))	4 digits (B and E/D)
	Output current	Read	H70	H0000 to HFFFF: Output current (hexadecimal) Increment 0.01 A (FR-F860-00680 or lower) Increment 0.1 A (FR-F860-01080 or higher)	4 digits (B and E/D)
	Output voltage	Read	H71	H0000 to HFFFF: Output voltage (hexadecimal) in 0.1 V increments	4 digits (B and E/D)
	Special monitor	Read	H72	H0000 to HFFFF: Monitor data selected in the instruction code HF3	4 digits (B and E/D)
	Special monitor selection No.	Read	H73	Monitor selection data (Refer to page 274 for details on selection No.)	2 digits (B and E1/D)
		Write	HF3		2 digits (A1 and C/D)
	Fault record	Read	H74 to H77	H0000 to HFFFF: Two fault records per code. b15 b8 b7 b0 H74: Second latest fault / Latest fault H75: Fourth latest fault / Third latest fault H76: Sixth latest fault / Fifth latest fault H77: Eighth latest fault / Seventh latest fault Fault record display example (instruction code H74) With the read data H30A0 (Second fault : THT) (Latest fault : OPT) b15 b8 b7 b0 0 0 1 1 0 0 0 0 1 0 1 0 0 0 0 0 Second fault (H30) / Latest fault (HA0) (Refer to page 568 for details on fault record read data.)	4 digits (B and E/D)
Operation command (extended)		Write	HF9	Control input commands such as forward rotation signal (STF) and reverse rotation signal (STR) can be set. (For the details, refer to page 498.)	4 digits (A and C/D)
Operation command		Write	HFA		2 digits (A1 and C/D)
Inverter status monitor (extended)		Read	H79	The states of the output signals such as forward rotation, reverse rotation and inverter running (RUN) can be monitored. (For the details, refer to page 498.)	4 digits (B and E/D)
Inverter status monitor		Read	H7A		2 digits (B and E1/D)
Set frequency (RAM)		Read	H6D	Read the set frequency/speed from the RAM or EEPROM. H0000 to HFFFF: Set frequency in 0.01Hz increments (The display can be changed to the rotations per minute using **Pr.37** and **Pr.144**. (Refer to page 272))	4 digits (B and E/D)
Set frequency (EEPROM)			H6E		

Item	Read/ Write	Instruction code	Data description	Number of data digits (Format)[*1]
Set frequency (RAM)	Write	HED	Write the set frequency/speed into the RAM or EEPROM. H0000 to HE678 (0 to 590.00Hz): frequency in 0.01Hz increments (The display can be changed to the rotations per minute using **Pr.37** and **Pr.144**. (Refer to page 272)) • To change the set frequency consecutively, write data to the inverter RAM. (Instruction code: HED)	4 digits (A and C/D)
Set frequency (RAM, EEPROM)	Write	HEE		
Inverter reset	Write	HFD	H9696: Inverter reset • As the inverter is reset at the start of communication by the computer, the inverter cannot send reply data back to the computer.	4 digits (A and C/D)
			H9966: Inverter reset • After the computer correctly starts communication and send data to the inverter, the inverter returns the ACK signal to the computer before being reset.	4 digits (A and D)
Fault history clear	Write	HF4	H9696: Fault history is cleared.	4 digits (A and C/D)
Parameter clear All clear	Write	HFC	All parameters return to initial values. Whether to clear communication parameters or not can be selected according to the data. • Parameter clear H9696: Parameters including communication parameters are cleared. H5A5A: Parameters other than communication parameters are cleared.[*2] • All parameter clear H9966: Parameters including communication parameters are cleared. H55AA: Parameters other than communication parameters are cleared.[*2] For details on whether or not to clear parameters, refer to page 623. When a clear is performed with H9696 or H9966, communication related parameter settings also return to the initial values. When resuming the operation, set the parameters again. Performing a clear will clear the instruction code HEC, HF3, and HFF settings. Only H9966 and H55AA (all parameter clear) are valid during the password lock (refer to page 170).	4 digits (A and C/D)
Parameter	Read	H00 to H6B	Refer to the instruction code (page 623) and write and/or read parameter values as required. When setting **Pr.100** and later, the link parameter extended setting must be set.	4 digits (B and E/D)
	Write	H80 to HEB		4 digits (A and C/D)
Link parameter Extended setting	Read	H7F	Parameter settings are changed (extended) according to the settings. For details of the settings, refer to the instruction code (page 623).	2 digits (B and E1/D)
	Write	HFF		2 digits (A1 and C/D)
Second parameter changing (instruction code HFF = 1, 9)	Read	H6C	When setting the calibration parameters [*3] H00: Frequency [*4] H01: Parameter-set analog value H02: Analog value input from terminal	2 digits (B and E1/D)
	Write	HEC		2 digits (A1 and C/D)
Multi command	Write/ Read	HF0	Available for writing 2 commands, and monitoring 2 items for reading data (refer to page 499 for detail)	10 digits (A2 and C1/D)
Inverter model monitor — Inverter model	Read	H7C	Reading inverter model in ASCII code. "H20" (blank code) is set for blank area Example of "FR-F860-3" H46, H52, H2D, H46, H38, H36, H30, H2D, H33, H20, H20.........H20	20 digits (B and E3/D)
Inverter model monitor — Capacity	Read	H7D	The capacity in the inverter model can be read in ASCII code. Data is read in increments of 0.1 kW, and rounds down to 0.01 kW increments "H20" (blank code) is set for blank area Example 0.75K..."7" (H20, H20, H20, H20, H20, H37)	6 digits (B and E2/D)

*1 Refer to page 486 for data formats (A, A1, A2, B, C, C1, D, E, E1, E2, E3, F)

*2 Turning OFF the power supply while clearing parameters with H5A5A or H55AA returns the communication parameter settings to the initial settings.

*3 Refer to the calibration parameter list below for details on calibration parameters.

*4 The gain frequency can be also written using **Pr.125** (instruction code: H99) or **Pr.126** (instruction code: H9A).

NOTE

- 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.
- When a 32-bit parameter setting or monitored value is read and the read value exceeds HFFFF, the reply data will be HFFFF.

Example) When reading the **Pr.902 and Pr.904** settings from the inverter of station No. 0.

	Computer send data	Inverter send data	Description
a	ENQ 00 FF 0 01 7D	ACK 00	Set "H01" in the extended link parameter
b	ENQ 00 EC 0 01 79	ACK 00	Set "H01" in second parameter changing
c	ENQ 00 5E 0 0A	STX 00 0000 ETX 20	**Pr.902** is read. 0% is read.
d	ENQ 00 60 0 F6	STX 00 0000 ETX 20	**Pr.904** is read. 0% is read.

To read/write **Pr.902** or **Pr.904** after inverter reset or parameter clear, execute from (a) again.

5

◆ List of calibration parameters

Pr.	Name	Instruction code		
		Read	Write	Extended
902	Terminal 2 frequency setting bias frequency	5E	DE	1
902	Terminal 2 frequency setting bias	5E	DE	1
125 (903)	Terminal 2 frequency setting gain frequency	5F	DF	1
903	Terminal 2 frequency setting gain	5F	DF	1
904	Terminal 4 frequency setting bias frequency	60	E0	1
904	Terminal 4 frequency setting bias	60	E0	1
126 (905)	Terminal 4 frequency setting gain frequency	61	E1	1
905	Terminal 4 frequency setting gain	61	E1	1
917	Terminal 1 bias frequency (speed)	11	91	9
917	Terminal 1 bias (speed)	11	91	9
918	Terminal 1 gain frequency (speed)	12	92	9
918	Terminal 1 gain (speed)	12	92	9
919	Terminal 1 bias command (torque)	13	93	9
919	Terminal 1 bias (torque)	13	93	9
920	Terminal 1 gain command (torque)	14	94	9
920	Terminal 1 gain (torque)	14	94	9
930	Current output bias signal	1E	9E	9
930	Current output bias current	1E	9E	9
931	Current output gain signal	1F	9F	9
931	Current output gain current	1F	9F	9
932	Terminal 4 bias command (torque)	20	A0	9
932	Terminal 4 bias (torque)	20	A0	9
933	Terminal 4 gain command (torque)	21	A1	9
933	Terminal 4 gain (torque)	21	A1	9
934	PID display bias coefficient	22	A2	9
934	PID display bias analog value	22	A2	9
935	PID display gain coefficient	23	A3	9
935	PID display gain analog value	23	A3	9

◆ Operation command

Item	Instruction code	Bit length	Description *1*4	Example
Operation command	HFA	8 bits	b0: AU (Terminal 4 input selection) b1: Forward rotation command b2: Reverse rotation command b3: RL (Low-speed operation command) b4: RM (Middle-speed operation command) b5: RH (High-speed operation command) b6: RT (Second function selection) b7: MRS (Output stop) *2	[Example 1] H02 Forward rotation b7 … b0 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 [Example 2] H00 Stop b7 … b0 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Operation command (extended)	HF9	16 bits	b0: AU (Terminal 4 input selection) b1: Forward rotation command b2: Reverse rotation command b3: RL (Low-speed operation command) b4: RM (Middle-speed operation command) b5: RH (High-speed operation command) b6: RT (Second function selection) b7: MRS (Output stop) *2 b8: JOG (Jog operation selection) *3 b9: CS (No function) *3 b10: STP (STOP) (Start self-holding selection) *3 b11: RES (Inverter reset) *3 b12 to b15: -	[Example 1] H0002 Forward rotation b15 … b0 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 [Example 2] H0804 Low-speed reverse 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 | 1 | 0 | 0

*1 The signal within parentheses ( ) is the initial status. The description changes depending on the setting of **Pr.180 to Pr.184, Pr.187 (Input terminal function selection)** (page 343).

*2 The inverter run enable signal is in the initial status for the separated converter type.

*3 JOG operation/automatic restart after instantaneous power failure/start self-holding selection/reset cannot be controlled over a network, so in the initial status bit8 to bit11 are invalid. To use bit8 to bit11, change the signal by **Pr.185, Pr.186, Pr.188, or Pr.189 (Input terminal function selection)** (page 343) (A reset can be executed by the instruction code HFD.)

*4 In RS-485 communication from the PU connector, only the forward rotation command and reverse rotation command can be used.

◆ Inverter status monitor

Item	Instruction code	Bit length	Description *1	Example
Inverter status monitor	H7A	8 bits	b0: RUN (Inverter running) b1: During forward rotation b2: During reverse rotation b3: SU (Up to frequency) b4: OL (Overload warning) b5: IPF (Instantaneous power failure/ undervoltage) *2 b6: FU (Output frequency detection) b7: ABC1 (Fault)	[Example 1] H03··· During forward rotation b7 … b0 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 [Example 2] H80··· Stop at fault occurrence b7 … b0 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0
Inverter status monitor (extended)	H79	16 bits	b0: RUN (Inverter running) b1: During forward rotation b2: During reverse rotation b3: SU (Up to frequency) b4: OL (Overload warning) b5: IPF (Instantaneous power failure/ undervoltage) *2 b6: FU (Output frequency detection) b7: ABC1 (Fault) b8: ABC2 (—) b9 to b14: - b15: Fault occurrence	[Example 1] H0003···During forward rotation b15 … b0 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 [Example 2] H8080···Stop at fault occurrence b15 … b0 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0

*1 The signal within parentheses ( ) is the initial status. The description changes depending on the setting of **Pr.190 to Pr.196 (Output terminal function selection)**.

*2 No function is assigned in the initial status for the separated converter type.

◆ Multi command (HF0)

- Sending data format from computer to inverter

Format	Number of characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A2	ENQ	Inverter station No.		Instruction Code (HF0)		Waiting time	Send data type *1	Receive data type *2	Data1 *3				Data2 *3				Sum check		CR/ LF

- Reply data format from inverter to computer (No data error detected)

Format	Number of characters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
C1	STX	Inverter station No.		Send data type *1	Receive data type *2	Error code 1 *5	Error code 2 *5	Data1 *4				Data2 *4				ETX	Sum check		CR/ LF

*1 Specify the data type of sending data (from computer to inverter).
*2 Specify the data type of reply data (from inverter to computer).
*3 Combination of data 1 and data 2 for sending

Data type	Data 1	Data 2	Remarks
0	Operation command (extended)	Set frequency (RAM)	Run command (extended) is same as instruction code HF9 (Refer to page 498.)
1	Operation command (extended)	Set frequency (RAM, EEPROM)	

*4 Combination of data 1 and data 2 for reply

Data type	Data 1	Data 2	Remarks
0	Inverter status monitor (extended)	Output frequency (speed)	Inverter status monitor (extended) is same as instruction code H79 (Refer to page 498.)
1	Inverter status monitor (extended)	Special monitor	Replies the monitor item specified in instruction code HF3 for special monitor. (Refer to page 274.)

*5 Error code for sending data 1 is set in error code 1, and error code for sending data 2 is set in error code 2. Mode error (HA), instruction code error (HB), data range error (HC) or no error (HF) is replied. (Refer to page 568 for details on the error codes.)

5.12.6 MODBUS RTU communication specification

Operation by MODBUS RTU communication or parameter setting is possible by using the MODBUS RTU communication protocol from the RS-485 terminals of the inverter.

<table>
<tr><th>Pr.</th><th>Name</th><th>Initial value</th><th>Setting range</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">331
N030</td><td rowspan="2">RS-485 communication station number</td><td rowspan="2">0</td><td>0</td><td colspan="2">Broadcast communication</td></tr>
<tr><td>1 to 247</td><td colspan="2">Inverter station number specification
Set the inverter station numbers when two or more inverters are connected to one personal computer.</td></tr>
<tr><td>332
N031</td><td>RS-485 communication speed</td><td>96</td><td>3, 6, 12, 24, 48, 96, 192, 384, 576, 768, 1152</td><td colspan="2">Set the communication speed.
The setting value × 100 equals the communication speed.
For example, if 96 is set, the communication speed is 9600 bps.</td></tr>
<tr><td rowspan="2">N033</td><td rowspan="2">RS-485 communication stop bit length</td><td rowspan="2">1</td><td>0</td><td>Stop bit length 1 bit</td><td rowspan="2">Valid when Pr. N034 (334) = "0"</td></tr>
<tr><td>1</td><td>Stop bit length 2 bits</td></tr>
<tr><td rowspan="4">333</td><td rowspan="4">RS-485 communication stop bit length / data length</td><td rowspan="4">1</td><td>0</td><td>Stop bit length 1 bit</td><td rowspan="4">Valid when Pr. 334 = "0"</td></tr>
<tr><td>1</td><td>Stop bit length 2 bits</td></tr>
<tr><td>10</td><td>Stop bit length 1 bit</td></tr>
<tr><td>11</td><td>Stop bit length 2 bits</td></tr>
<tr><td rowspan="3">334
N034</td><td rowspan="3">RS-485 communication parity check selection</td><td rowspan="3">2</td><td>0</td><td colspan="2">Without parity check
Stop bit length 1 bit / 2 bits (depends on the setting of Pr.333)</td></tr>
<tr><td>1</td><td colspan="2">With parity check at odd numbers
Stop bit length 1 bit</td></tr>
<tr><td>2</td><td colspan="2">With parity check at even numbers
Stop bit length 1 bit</td></tr>
<tr><td>343
N080</td><td>Communication error count</td><td>0</td><td>—</td><td colspan="2">Displays the communication error count during MODBUS RTU communication. Read-only.</td></tr>
<tr><td rowspan="3">539
N002</td><td rowspan="3">MODBUS RTU communication check time interval</td><td rowspan="3">9999</td><td>0</td><td colspan="2">MODBUS RTU communication, but the inverter trips in the NET operation mode.</td></tr>
<tr><td>0.1 to 999.8 s</td><td colspan="2">Set the interval of the communication check (signal loss detection) time (same specifications as Pr.122).</td></tr>
<tr><td>9999</td><td colspan="2">No communication check (signal loss detection)</td></tr>
<tr><td rowspan="3">549
N000</td><td rowspan="3">Protocol selection</td><td rowspan="3">0</td><td>0</td><td colspan="2">Mitsubishi inverter protocol (computer link)</td></tr>
<tr><td>1</td><td colspan="2">MODBUS RTU protocol</td></tr>
<tr><td>2</td><td colspan="2">BACnet MS/TP protocol</td></tr>
</table>

NOTE

- To use the MODBUS RTU protocol, set "1" to **Pr.549 Protocol selection**.
- If MODBUS RTU communication is performed from the master to the address 0 (station number 0), the data is broadcasted, and the inverter does not send any reply to the master. To obtain replies from the inverter, set **Pr.331 RS-485 communication station number** ≠ "0 (initial value)". Some functions are disabled in broadcast communication. (Refer to page 503.)
- If a communication option is mounted with **Pr.550 NET mode operation command source selection** = "9999 (initial value)", commands (operation commands) transmitted via RS-485 terminals become invalid. (Refer to page 214.)

◆ Communication specifications

- The communication specifications are given below.

Item		Description	Related parameter
Communication protocol		MODBUS RTU protocol	**Pr.549**
Conforming standard		EIA-485 (RS-485)	—
Connectable units		1:N (maximum 32 units), setting is 0 to 247 stations	**Pr.331**
Communication Speed		Selected among 300/600/1200/2400/4800/9600/19200/38400/57600/76800/ 115200 bps	**Pr.332**
Control procedure		Asynchronous system	—
Communication method		Half-duplex system	—
Communication specifications	Character system	Binary (fixed at 8 bits)	—
	Start bit	1 bit	—
	Stop bit length Parity check	Select from the following three types: No parity check, stop bit length 1 bit/2 bits (depends on the setting of **Pr.333**) Odd parity check, stop bit length 1 bit Even parity check, stop bit length 1 bit	**Pr.333** **Pr.334**
	Error check	CRC code check	—
	Terminator	Not used	—
Waiting time setting		Not used	—

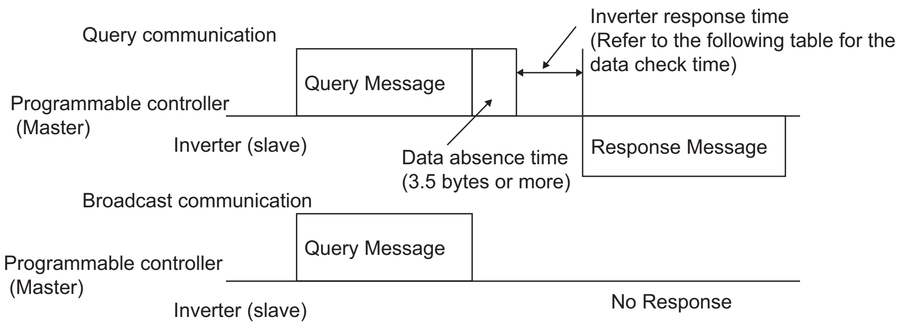
◆ Outline

- The MODBUS communication protocol was developed by Modicon for programmable controllers.
- The MODBUS protocol uses exclusive message frames to perform serial communication between a master and slaves. These exclusive message frames are provided with a feature called "functions" that allows data to be read or written. These functions can be used to read or write parameters from the inverter, write input commands to the inverter or check the inverter's operating status, for example. This product classifies the data of each inverter into holding register area (register address 40001 to 49999). The master can communicate with inverters (for instance, slaves) by accessing pre-assigned holding register addresses.

NOTE

- There are two serial transmission modes, the ASCII (American Standard Code for Information Interchange) mode and the RTU (Remote Terminal Unit) mode. However, this product supports only the RTU mode, which transfers 1 byte data (8 bits) as it is. Also, only communication protocol is defined by the MODBUS protocol. Physical layers are not stipulated.

◆ Message format



- Data check time

Item	Check time
Monitoring, operation command, frequency setting (RAM)	< 20 ms
Frequency setting (EEPROM)	< 50 ms
Reading/writing parameters	< Approximately 50 ms
Parameter clear / All parameter clear	< 5 s
Reset command	No reply

- Query

A message is sent to the slave (for instance, the inverter) having the address specified by the master.

- Normal Response

After the query from the master is received, the slave executes the request function, and returns the corresponding normal response to the master.

- Error Response

When an invalid function code, address or data is received by the slave, the error response is returned to the master. This response is appended with an error code that indicates the reason why the request from the master could not be executed. This response cannot be returned for errors, detected by the hardware, frame error and CRC check error.

- Broadcast

The master can broadcast messages to all slaves by specifying address 0. All slaves that receive a message from the master execute the requested function. With this type of communication, slaves do not return a response to the master.

NOTE

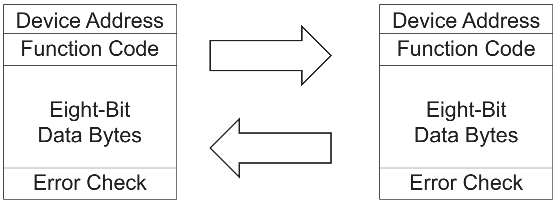
- During broadcast communication, functions are executed regarded of the set inverter station number **(Pr.331)**.

◆ Message frame (protocol)

- Communication method

Basically, the master sends a Query message (question), and slaves return the Response message (response). At normal communication, the Device Address and Function Code are copied as they are, and at erroneous communication (illegal function code or data code), bit7 (= 80 h) of the Function Code is turned ON, and the error code is set at Data Bytes.

Query message from Master



Response message from slave

Message frames comprise of the four message fields shown in the figures above.

A slave recognizes message data as a message by the message data being prefixed and appended with a no data time of 3.5 characters (T1: start/end).

- Details of protocol

The following table explains the four message fields.

Start	Address	Function	Data	CRC Check		End
T1	8 bits	8 bits	n × 8 bits	L 8 bits	H 8 bits	T1

Message field	Description
Address field	0 to 247 can be set in single byte lengths (8 bits). Set "0" when sending broadcast messages (instructions to all addresses), and "1 to 247" to send messages to individual slaves. The address set by the master is also returned when the response from the slave is. The value set to **Pr.331 RS-485 communication station number** is the slave address.
Function field	1 to 255 can be set in single byte lengths (8 bits) for the function code. The master sets the function to be sent to the slave as the request, and the slave performs the requested operation. "Function code list" summarizes the supported function codes. An error response is generated when a function code other than "Function code list" is set. At a response from the slave, the function code set by the master is returned in the case of a normal response. At an error response, H80 + the function code is returned.
Data field	The format changes according to the function code. (Refer to page 504.) The data, for example, includes the byte count, number of bytes and accessing content of holding registers.
CRC Check field	Errors in the received message frame are detected. Errors are detected in the CRC check, and the message is appended with data 2 bytes long. When the message is appended with the CRC, the lower bytes are appended first, followed by the upper bytes. The CRC value is calculated by the sender that appends the message with the CRC. The receiver recalculates the CRC while the message is being received, and compares the calculation result against the actual value that was received in the error check field. If the two values do not match, the result is treated as an error.

◆ Function code list

Function name	Read/ Write	Code	Outline	Broadcast communication	Message format reference page
Read Holding Register	Read	H03	The data of the holding registers is read. The various data of the inverter can be read from MODBUS registers. System environmental variable (Refer to page 511.) Real time monitor (Refer to page 275.) Fault history (Refer to page 513.) Model information monitor (Refer to page 513.) Inverter parameters (Refer to page 512.)	Not available	page 505.
Preset Single Register	Write	H06	Data is written to holding registers. Data can be written to MODBUS registers to output instructions to the inverter or set parameters. System environmental variable (Refer to page 511.) Inverter parameters (Refer to page 512.)	Available	page 506.
Diagnostics	Read	H08	Functions are diagnosed. (communication check only) A communication check can be made since the query message is sent and the query message is returned as it is as the return message (subfunction code H00 function). Subfunction code H00 (Return Query Data)	Not available	page 507.
Preset Multiple Registers	Write	H10	Data is written to consecutive multiple holding registers. Data can be written to consecutive multiple MODBUS registers to output instructions to the inverter or set parameters. System environmental variable (Refer to page 511.) Inverter parameters (Refer to page 512.)	Available	page 508.
Read holding register access log	Read	H46	The number of registers that were successfully accessed by the previous communication is read. Queries by function codes H03 and H10 are supported. The number and start address of holding registers successfully accessed by the previous communication are returned. "0" is returned for both the number and start address for queries other than function code H03 and H10.	Not available	page 509.

◆ Read Holding Register (reading of data of holding registers) (H03 or 03)

• Query message

a. Slave Address	b. Function	c. Starting Address		d. No. of Points		CRC Check	
(8 bits)	H03 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

• Normal response (Response message)

a. Slave Address	b. Function	e. Byte Count	f. Data			CRC Check	
(8 bits)	H03 (8 bits)	(8 bits)	H (8 bits)	L (8 bits)	... (n × 16 bits)	L (8 bits)	H (8 bits)

• Query message setting

Message		Description
a	Slave Address	Set the address to send messages to. Broadcast communication is not possible. (Invalid when "0" is set.)
b	Function	Set H03.
c	Starting Address	Set the address from which to start reading of data from the holding register. Start address = start register address (decimal) - 40001 For example, when start register address 0001 is set, the data of holding register address 40002 is read.
d	No. of Points	Set the number of holding registers to read. Data can be read from up to 125 registers.

• Content of normal response

Message		Description
e	Byte Count	The setting range is H02 to HFA (2 to 250). Twice the number of reads specified by (d) is set.
f	Data	The amount of data specified by (d) is set. Read data is output Hi bytes first followed by Lo bytes, and is arranged as follows: data of start address, data of start address+1, data of start address+2, and so forth.

■ Example) Read the register values of 41004 (Pr.4) to 41006 (Pr.6) from 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)

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 (60.00 Hz)

Register 41005 **(Pr.5)**: H0BB8 (30.00 Hz)

Register 41006 **(Pr.6)**: H03E8 (10.00 Hz)

◆ Preset Single Register (writing of data to holding registers) (H06 or 06)

- The content of the "system environmental variables" and "inverter parameters" assigned to the holding register area (refer to the register list (page 511)) can be written.
- Query message

a. Slave Address	b. Function	c. Register Address		d. 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)

a. Slave Address	b. Function	c. Register Address		d. Preset Data		CRC Check	
(8 bits)	H06 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Query message setting

Message		Description
a	Slave Address	Set the address to send messages to. Setting "0" enables broadcast communication.
b	Function	Set H06.
c	Register Address	Set the address from data is written to the holding register. Register address = holding register address (decimal) - 40001 For example, when register address 0001 is set, data is written to holding register address 40002.
d	Preset Data	Set the data to write to the holding register. Write data is fixed at 2 bytes.

- Content of normal response

With a normal response, the content is the same as **a to d** (including the CRC check) query messages. In the case of broadcast communication, no response is returned.

■ Example) Write 60Hz (H1770) to 40014 (set frequency) of 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 query message

NOTE

- With broadcast communication, no response is generated even if a query is executed, so when the next query is made, it must be made after waiting for the inverter data processing time after the previous query is executed.

◆ Diagnostics (diagnosis of functions) (H08 or 08)

- A communication check can be made since the query message is sent and the query message is returned as it is as the return message (subfunction code H00 function). Subfunction code H00 (Return Query Data)
- Query message

a. Slave Address	b. Function	c. Subfunction		d. 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)

a. Slave Address	b. Function	c. Subfunction		d. 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)

- Query message setting

Message		Description
a	Slave Address	Set the address to send messages to. Broadcast communication is not possible. (Invalid when "0" is set.)
b	Function	Set H08.
c	Subfunction	Set H0000.
d	Data	Any data 2 bytes long can be set. Setting range is H0000 to HFFFF.

- Content of normal response

With a normal response, the content is the same as **a to d** (including the CRC check) query messages.

NOTE

- With broadcast communication, no response is generated even if a query is executed, so when the next query is made, it must be made after waiting for the inverter data processing time after the previous query is executed.

◆ Preset Multiple Registers (writing of data to multiple holding registers) (H10 or 16)

- Data can be written to multiple holding registers.
- Query message

a. Slave Address	b. Function	c. Starting Address		d. No. of Registers		e. Byte Count	f. Data			CRC Check	
(8 bits)	H10 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	(8 bits)	H (8 bits)	L (8 bits)	... (n × 2 × 8 bits)	L (8 bits)	H (8 bits)

- Normal response (Response message)

a. Slave Address	b. Function	c. Starting Address		d. No. of Registers		CRC Check	
(8 bits)	H10 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Query message setting

Message		Description
a	Slave Address	Set the address to send messages to. Setting "0" enables broadcast communication.
b	Function	Set H10.
c	Starting Address	Set the address from which to start writing of data to the holding register. Start address = start register address (decimal) - 40001 For example, when starting address 0001 is set, data is written to holding register 40002.
d	No. of registers	Set the number of holding registers to write to. Data can be written to up to 125 registers.
e	Byte Count	The setting range is H02 to HFA (2 to 250). Set twice the value specified by **d**.
f	Data	Set the amount of data specified by **d**. Set write data Hi bytes first followed by Lo bytes, and arrange it as follows: data of start address, data of start address+1, data of start address+2, and so forth.

- Content of normal response

With a normal response, the content is the same as **a to d** (including the CRC check) query messages.

■ Example) Write 0.5 s (H05) to 41007 (Pr.7) and 1 s (H0A) to 41008 (Pr.8) of slave address 25 (H19).

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		CRC Check	
H19 (8 bits)	H10 (8 bits)	H03 (8 bits)	HEE (8 bits)	H00 (8 bits)	H02 (8 bits)	H22 (8 bits)	H61 (8 bits)

◆ Read Holding Register access Log (H46 or 70)

- Queries by function codes H03 and H10 are supported. The number and start address of holding registers successfully accessed by the previous communication are returned. "0" is returned for both the number and start address for queries other than the function codes.
- Query message

a. Slave Address	b. Function	CRC Check	
(8 bits)	H46 (8 bits)	L (8 bits)	H (8 bits)

- Normal response (Response message)

a. Slave Address	b. Function	c. Starting Address		d. No. of Points		CRC Check	
(8 bits)	H46 (8 bits)	H (8 bits)	L (8 bits)	H (8 bits)	L (8 bits)	L (8 bits)	H (8 bits)

- Query message setting

Message		Description
a	Slave Address	Set the address to send messages to. Broadcast communication is not possible. (Invalid when "0" is set.)
b	Function	Set H46.

- Content of normal response

Message		Description
c	Starting Address	The start address of the holding register that was successfully accessed is returned. Start address = start register address (decimal) - 40001 For example, when start address 0001 is returned, the holding register address that was successfully accessed is 40002.
d	No. of Points	The number of holding registers that were successfully accessed is returned.

■ Example) Read the successful register start address and number of successful accesses from 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)

Two successful reads of start address 41007 **(Pr.7)** are returned.

5

◆ Error response

- An error response is returned if the query message received from the master contains an illegal function, address or data. No response is returned for parity, CRC, overrun, framing, and Busy errors.

NOTE

- No response is also returned in the case of broadcast communication.

- Error response (Response message)

a. Slave Address	b. Function	c. Exception Code	CRC Check	
(8 bits)	H80 + Function (8 bits)	(8 bits)	L (8 bits)	H (8 bits)

	Message	Description
a	Slave Address	Set the address received from the master.
b	Function	The function code requested by the master + H80 is set.
c	Exception Code	The codes in the following table are set.

- Error code list

Code	Error Item	Error description
01	ILLEGAL FUNCTION	The query message from the master is set with a function code that cannot be handled by the slave.
02	ILLEGAL DATA ADDRESS [*1]	The query message from the master is set with a register address that cannot be handled by the inverter. (No parameter, parameter cannot be read, parameter cannot be written)
03	ILLEGAL DATA VALUE	The query message from the master is set with data that cannot be handled by the inverter. (Out of parameter write range, a mode is specified, other error)

*1 An error does not occur in the following cases:
Function code H03 (read data of holding register)
When there are 1 or more number of reads (No. of Points) and there is 1 or more holding register from where data can be read
Function code H10 (write data to multiple holding registers)
When there are 1 or more number of writes (No. of registers) and there is 1 or more holding registers to which data can be written.
In other words, when function code H03 or H10 is used and multiple holding registers are accessed, an error will not occur even if a non-existent holding register or holding register that cannot be read or written is accessed.

NOTE

- An error will occur if all accesses holding registers do not exist. The data read value of non-existent holding registers is 0, and data is invalid when written to non-existent holding registers.

- Error detection of message data

The following errors are detected in message data from the master. The inverter is not tripped even if an error is detected.

Error check items

Error item	Error description	Inverter operation
Parity error	The data received by the inverter is different from the specified parity (**Pr.334** setting).	When this error occurs, **Pr.343** is incremented by one. When this error occurs, the LF signal is output.
Framing error	The data received by the inverter is different from the stop bit length (**Pr.333/Pr.334**) setting.	
Overrun error	The next data has been sent by the master before the inverter completes receiving the preceding data.	
Message frame error	The data length of the message frame is checked, and an error is generated if the received data length is less than 4 bytes.	
CRC check error	An error is generated if the data in the message frame does not match the calculation result.	

NOTE

- The LF signal can be assigned to an output terminal by setting **Pr.190 to Pr.196 (Output terminal function selection)**. Changing the terminal assignment may affect other functions. Set parameters after confirming the function of each terminal.

◆ MODBUS register

- The following shows the MODBUS registers for system environment variables (read/write), real time monitor items (read), parameters (read/write), fault history data (read/write), and model information monitor items (read).
- System environmental variables

Register	Definition	Read/Write	Remarks
40002	Inverter reset	Write	Any value can be written
40003	Parameter clear	Write	Set H965A for the write value.
40004	All parameter clear	Write	Set H99AA for the write value.
40006	Parameter clear *1	Write	Set H5A96 for the write value.
40007	All parameter clear *1	Write	Set HAA99 for the write value.
40009	Inverter status/control input command *2	Read/Write	Refer to the following.
40010	Operation mode/inverter setting *3	Read/Write	Refer to the following.
40014	Set frequency (RAM value)	Read/Write	The display can be changed to the rotations per minute using **Pr.37** and **Pr.144**. (Refer to page 272)
40015	Set frequency (EEPROM value)	Write	

*1 Communication parameter settings are not cleared.
*2 At a write, the data is set as the control input command.
At a read, the data is read as the inverter running status.
*3 At a write, the data is set as the operation mode setting.
At a read, the data is read as the operation mode setting.

- Inverter status/control input command

Bit	Definition	
	Control input command	Inverter status
0	Stop command	RUN (Inverter running) *6
1	Forward rotation command	During forward rotation
2	Reverse rotation command	During reverse rotation
3	RH (High-speed operation command) *4	SU (Up to frequency) *6
4	RM (Middle-speed operation command) *4	OL (Overload warning) *6
5	RL (Low-speed operation command) *4	IPF (Instantaneous power failure/undervoltage) *6*7
6	JOG (Jog operation selection) *4	FU (Output frequency detection) *6
7	RT (Second function selection) *4	ABC1 (Fault) *6
8	AU (Terminal 4 input selection) *4	ABC2 (-) *6
9	CS (No function) *4	0
10	MRS (Output stop) *4*5	0
11	STP (STOP) (Start self-holding selection) *4	0
12	RES (Inverter reset) *4	0
13	—	0
14	—	0
15	—	Fault occurrence

*4 The signal within parentheses ( ) is the initial status. The description changes depending on the setting of **Pr.180 to Pr.189 (Input terminal function selection)** (page 343).
For each of the assigned signals, some signals are enabled by NET and some are disabled. (Refer to page 219.)
*5 The inverter run enable signal is in the initial status for the separated converter type.
*6 The signal within parentheses ( ) is the initial status. The description changes depending on the setting of **Pr.190 to Pr.196 (Output terminal function selection)** (page 297).
*7 No function is assigned in the initial status for the separated converter type.

- Operation mode/inverter setting

Mode	Read value	Write value
EXT	H0000	H0010*8
PU	H0001	H0011*8
EXT JOG	H0002	—
PU JOG	H0003	—
NET	H0004	H0014
PU+EXT	H0005	—

*8 Enable/disable parameter writing by **Pr.79 and Pr.340** settings. For the details, refer to page 213.
Restrictions in each operation mode conform with the computer link specification.

- Real-time monitor

Refer to page 274 for the register numbers and monitored items of the real time monitor.

- Parameters

Pr.	Register	Name	Read/Write	Remarks
0 to 999	41000 to 41999	For details on parameter names, refer to the parameter list (page 108).	Read/Write	The parameter number + 41000 is the register number.
902	41902	Terminal 2 frequency setting bias (frequency)	Read/Write	
902	42092	Terminal 2 frequency setting bias (analog value)	Read/Write	Analog value (%) set to **Pr.902**
	43902	Terminal 2 frequency setting bias (terminal analog value)	Read	Analog value (%) of voltage (current) applied to terminal 2
125 (903)	41903	Terminal 2 frequency setting gain (frequency)	Read/Write	
903	42093	Terminal 2 frequency setting gain (analog value)	Read/Write	Analog value (%) set to **Pr.903**
	43903	Terminal 2 frequency setting gain (terminal analog value)	Read	Analog value (%) of voltage (current) applied to terminal 2
904	41904	Terminal 4 frequency setting bias (frequency)	Read/Write	
904	42094	Terminal 4 frequency setting bias (analog value)	Read/Write	Analog value (%) set to **Pr.904**
	43904	Terminal 4 frequency setting bias (terminal analog value)	Read	Analog value (%) of current (voltage) applied to terminal 4
905	41905	Terminal 4 frequency setting gain (frequency)	Read/Write	
905	42095	Terminal 4 frequency setting gain (analog value)	Read/Write	Analog value (%) set to **Pr.905**
	43905	Terminal 4 frequency setting gain (terminal analog value)	Read	Analog value (%) of current (voltage) applied to terminal 4
917	41917	Terminal 1 bias frequency (speed)	Read/Write	
917	42107	Terminal 1 bias (speed)	Read/Write	Analog value (%) set to **Pr.917**
	43917	Terminal 1 bias (speed) (terminal analog value)	Read	Analog value (%) of voltage applied to terminal 1
918	41918	Terminal 1 gain frequency (speed)	Read/Write	
918	42108	Terminal 1 gain (speed)	Read/Write	Analog value (%) set to **Pr.918**
	43918	Terminal 1 gain (speed) (terminal analog value)	Read	Analog value (%) of voltage applied to terminal 1
919	41919	Terminal 1 bias command (torque)	Read/Write	
919	42109	Terminal 1 bias (torque)	Read/Write	Analog value (%) set to **Pr.919**
	43919	Terminal 1 bias (torque) (terminal analog value)	Read	Analog value (%) of voltage applied to terminal 1
920	41920	Terminal 1 gain command (torque)	Read/Write	
920	42110	Terminal 1 gain (torque)	Read/Write	Analog value (%) set to **Pr.920**
	43920	Terminal 1 gain (torque) (terminal analog value)	Read	Analog value (%) of voltage applied to terminal 1
930	41930	Current output bias signal	Read/Write	
930	42120	Current output bias current	Read/Write	Analog value (%) set to **Pr.930**
931	41931	Current output gain signal	Read/Write	
931	42121	Current output gain current	Read/Write	Analog value (%) set to **Pr.931**

Pr.	Register	Name	Read/Write	Remarks
932	41932	Terminal 4 bias command (torque)	Read/Write	
932	42122	Terminal 4 bias (torque)	Read/Write	Analog value (%) set to **Pr.932**
	43932	Terminal 4 bias (torque) (terminal analog value)	Read	Analog value (%) of current (voltage) applied to terminal 4
933	41933	Terminal 4 gain command (torque)	Read/Write	
933	42123	Terminal 4 gain (torque)	Read/Write	Analog value (%) set to **Pr.933**
	43933	Terminal 4 gain (torque) (terminal analog value)	Read	Analog value (%) of current (voltage) applied to terminal 4
934	41934	PID display bias coefficient	Read/Write	
934	42124	PID display bias analog value	Read/Write	Analog value (%) set to **Pr.934**
	43934	PID display bias analog value (terminal analog value)	Read	Analog value (%) of current (voltage) applied to terminal 4
935	41935	PID display gain coefficient	Read/Write	
935	42125	PID display gain analog value	Read/Write	Analog value (%) set to **Pr.935**
	43935	PID display gain analog value (terminal analog value)	Read	Analog value (%) of current (voltage) applied to terminal 4
1000 to 1999	45000 to 45999	For details on parameter names, refer to the parameter list (page 108).	Read/Write	The parameter number + 44000 is the register number.

- Fault history

Register	Definition	Read/Write	Remarks
40501	Fault record 1	Read/Write	Data is 2 bytes and so is stored in "H00○○". The lowest 1 byte can be referred to for the error code. (For details on error codes, refer to page 568.) The fault history is batch-cleared by writing to register 40501. Set any value for the data.
40502	Fault record 2	Read	
40503	Fault record 3	Read	
40504	Fault record 4	Read	
40505	Fault record 5	Read	
40506	Fault record 6	Read	
40507	Fault record 7	Read	
40508	Fault record 8	Read	

- Model information monitor

Register	Definition	Read/Write	Remarks
44001	Model (First and second characters)	Read	Reading inverter type in ASCII code. "H20" (blank code) is set for blank area. Example of FR-F860-3 H46, H52, H2D, H46, H38, H36, H30, H2D, H33, H20......H20
44002	Model (Third and fourth characters)	Read	
44003	Model (Fifth and sixth characters)	Read	
44004	Model (Seventh and eighth characters)	Read	
44005	Model (Ninth and tenth characters)	Read	
44006	Model (Eleventh and twelfth characters)	Read	
44007	Model (Thirteenth and fourteenth characters)	Read	
44008	Model (Fifteenth and sixteenth characters)	Read	
44009	Model (Seventeenth and eighteenth characters)	Read	
44010	Model (Nineteenth and twentieth characters)	Read	
44011	Capacity (First and second characters)	Read	The capacity in the inverter model can be read in ASCII code. Data is read in increments of 0.1 kW, and rounds down to 0.01 kW increments. "H20" (blank code) is set for blank area. Example 0.75K........."7" (H20, H20, H20, H20, H20, H37)
44012	Capacity (Third and fourth characters)	Read	
44013	Capacity (Fifth and sixth characters)	Read	

NOTE

- When a 32-bit parameter setting or monitored value is read and the read value exceeds HFFFF, the reply data will be HFFFF.

◆ Pr.343 Communication error count

- The communication error occurrence count can be checked.

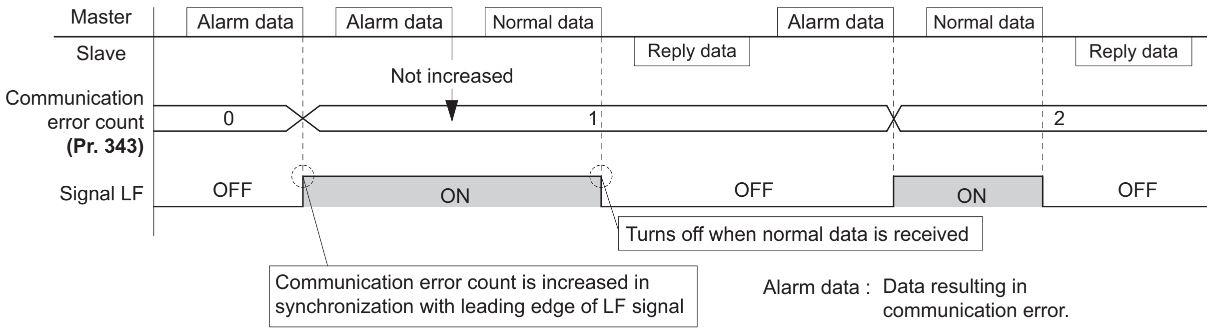
Parameter	Setting range	Minimum setting range	Initial value
343	(Read only)	1	0

NOTE

- The communication error count is temporarily stored in the RAM memory. The value is not stored in EEPROM, and so is cleared to 0 when power is reset and the inverter is reset.

◆ Output signal LF "alarm output (communication error warning)"

- During a communication error, the alarm signal (LF signal) is output by open collector output. Assign the terminal to be used using any of **Pr.190 to Pr.196 (Output terminal function selection)**.



NOTE

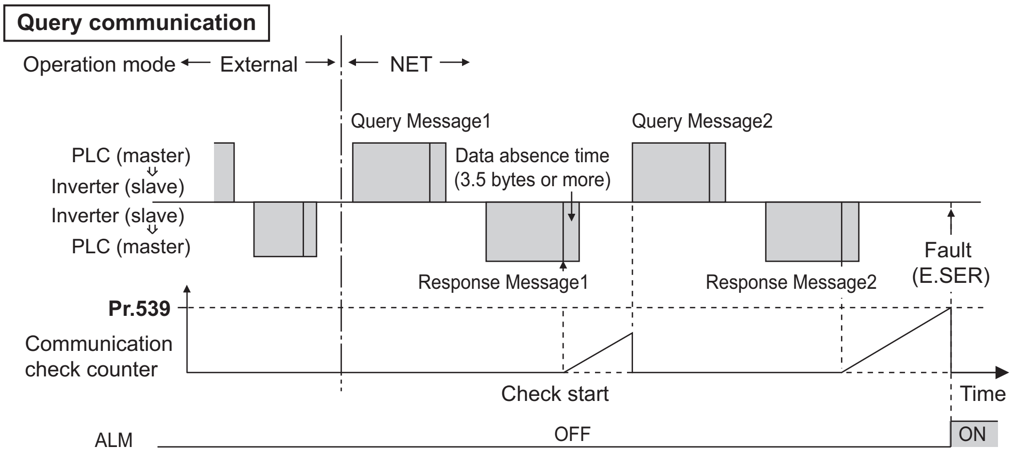
- The LF signal can be assigned to an output terminal by setting **Pr.190 to Pr.196**. Changing the terminal assignment may affect other functions. Set parameters after confirming the function of each terminal.

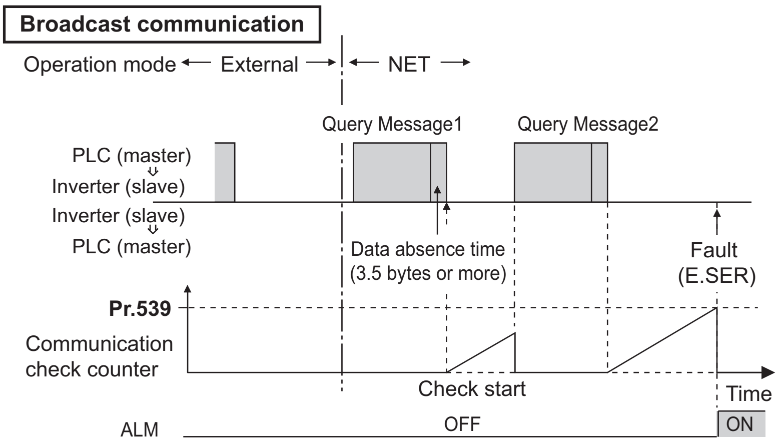
◆ Signal loss detection (Pr.539 MODBUS RTU communication check time interval)

- If a signal loss (communication) is detected between the inverter and the master as a result of a signal loss detection, an inverter communication fault (E.SER) occurs and the inverter trips.
- When the setting is "9999", communication check (signal loss detection) is not made.
- When the setting is "0", reading, etc. of monitors and parameters is possible, though a Communication fault (inverter) (E.SER) occurs instantly when the Network operation mode is switched to.
- A signal loss detection is made when the setting is any of "0.1 s to 999.8 s". To make a signal loss detection, it is necessary to send data from the master within the communication check time interval. (The inverter makes a communication check (clearing of communication check counter) regardless of the station number setting of the data sent from the master).
- The communication check is made from the first communication in the Network operation mode (can be changed by **Pr.551 PU mode operation command source selection**).
- The communication check time by query communication includes a no data time (3.5 bytes). This no data time differs according to the communication speed, so take this time no data time into consideration when setting the communication check time.

5

Example: RS-485 terminal communication, **Pr. 539** = "0.1 to 999.8 s"





NOTE

- For the RS-485 terminal communication, the operation at a communication error occurrence depends on the **Pr.502** Stop mode selection at communication error setting. (Refer to page 478)

5.12.7 BACnet MS/TP protocol

Using BACnet MS/TP protocol, communication operation and parameter setting are available from the RS-485 terminals of the inverter.

Pr.	Name	Initial value	Setting range	Description
52 **M100**	**Operation panel main monitor selection**	0	0, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98, 100	81: BACnet reception status 82: BACnet token pass counter (Displays the count of received token) 83: BACnet valid APDU counter (Displays the count of valid APDU detection) 84: BACnet communication error counter (Displays the count of communication error) 85: Terminal CA output level (Same display as Analog Output 0) 86: Terminal AM output level (Same display as Analog Output 1) The count of the setting values "82" and "83" returns to "0" if the count exceeds "9999". The upper limit of the count of the setting value "84" is "9999".
774 **M101**	**Second motor inertia (integer)**	9999	1 to 3, 5 to 14, 17, 18, 20, 23 to 25, 34, 38, 40 to 45, 50 to 57, 61, 62, 64, 67 to 69, 81 to 96, 98, 100	
775 **M102**	**Second motor inertia (exponent)**			
776 **M103**	**Second motor protection current level**			
331 **N030**	**RS-485 communication station number**	0	0 to 127 *1	Set the inverter station number (node).
332 **N031**	**RS-485 communication speed**	96	96, 192, 384, 576, 768, 1152 *1*2	Set the communication speed. The setting value × 100 equals the communication speed. For example, the communication speed is 9600 bps when the setting value is "96".
390 **N054**	**% setting reference frequency**	60 Hz	1 to 590 Hz	Set a reference frequency of the set frequency.
549 **N000**	**Protocol selection**	0	0	Mitsubishi inverter (computer link) protocol
			1	MODBUS RTU protocol
			2	BACnet MS/TP protocol
726 **N050**	**Auto Baudrate/Max Master**	255	0 to 255	Auto baud rate (bit 7) 0: inactive, 1: active
				Max Master (bit 0 to bit 6) setting range: 0 to 127 Maximum address for master node
727 **N051**	**Max Info Frames**	1	1 to 255	Set the maximum number of frames that the inverter can transmit while it owns the token.
728 **N052**	**Device instance number (Upper 3 digits)**	0	0 to 419 (0 to 418)	Device identifier When the combination of **Pr.728 and Pr.729** is not within "0 to 4194302", the setting is out of range. When **Pr.728**="419", the setting range of **Pr.729** is "0 to 4302". When **Pr.729**="4303" or more, the setting range of **Pr.728** is "0 to 418".
729 **N053**	**Device instance number (Lower 4 digits)**	0	0 to 9999 (0 to 4302)	

*1 When the set value is outside of the setting range, the initial value is applied.

*2 When the Auto baudrate is used, the communication speed is changed to the detected communication speed.

◆ Communication specifications

- The specifications conform to the BACnet standard of physical medium EIA-485.

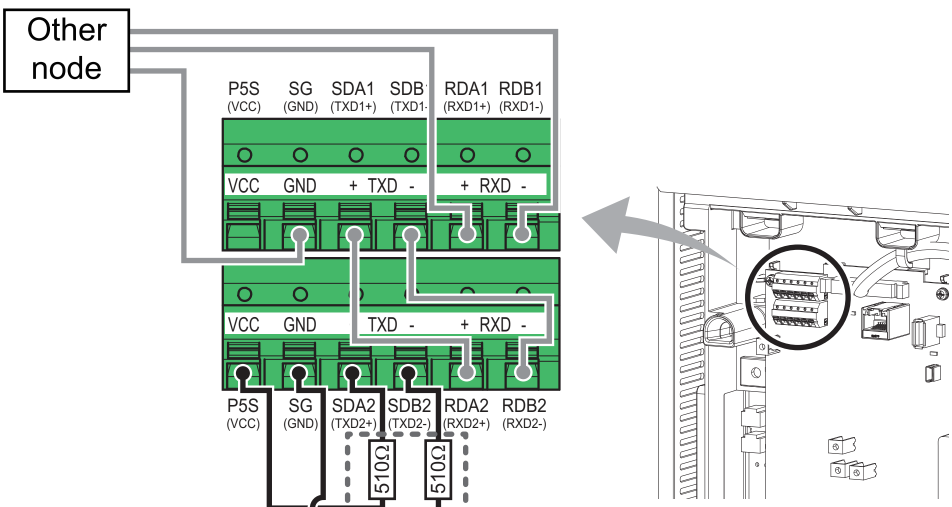
Item		Description
Physical medium		EIA-485 (RS-485)
	Connection port	RS-485 terminals (PU connector is not available.)
	Data transfer method	NRZ encoding
	Baud rate	9600 bps, 19200 bps, 38400 bps, 57600 bps, 76800 bps, 115200 bps
	Start bit	Fixed to 1 bit
	Data length	Fixed to 8 bits
	Parity bit	Fixed to none
	Stop bit	Fixed to 1 bit
Network topology		Bus topology
Communication method		Token passing (token bus)
		Master-slave (Only the master is available for this product.)
Communication protocol		MS/TP (master-slave/token passing LAN)
Maximum connection		255 (up to 32 for one segment, addition with a repeater available)
Node number		0 to 127
	Master	0 to 127 (This product is the master.)
Supported property of BACnet standard object type		Refer to page 520.
Supported BIBBs (Annex K)		Refer to page 529.
BACnet standard device profile (Annex L)		Refer to page 529.
Segmentation		Not supported
Device address binding		Not supported

NOTE

- This product conforms to BACnet Application Specific Controller (B-ASC).
- This product is designed for multiple master network, therefore 2-wire type connection is supported.

◆ Node with network bias resistors

- This product is a node with local bias resistors. Therefore at least one node must be a node with network bias resistors in the network configuration.
- When configuring the network with only this products, refer to the following, and make the node with network bias resistors. (When using two sets in one segment, insert them into both ends of the network.)



Connect two 510 Ω (1/4W) resistors.

◆ BACnet reception status monitor (Pr.52)

- Set **Pr.52**="81" to monitor the BACnet communication status on the operation panel.

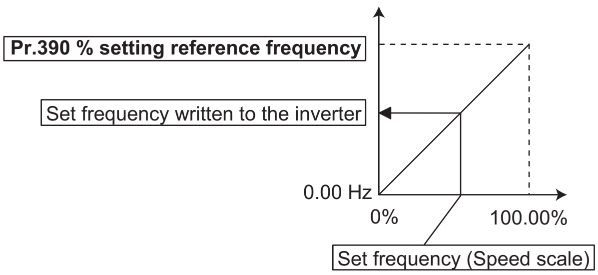
Monitor value	Status	Description	LF signal output
0	Idle	Never had BACnet communication	OFF
1	Automatic baud rate recognition	Automatic baud rate recognition (Communication error during automatic baud rate recognition is not counted.)	OFF
2	Not joined the network	Waiting for a token to own node	OFF
10	Data to own node	Received a token to own node	OFF
11		Received a supported request to own node (including broadcasting)	OFF
12		Received an unsupported request to own node (including broadcasting)	OFF
20	Data to other node	Received a token to other nodes	OFF
30	Node separated	Separated from token passing after joined in it	OFF
90	Error data	Detected a communication error	ON
91		Protocol error (LPDU, NPDU, APDU are not following the format regulations.)	ON

◆ % setting reference frequency (Pr.390)

- Set a reference frequency of the set frequency. The setting value of **Pr.390 % setting reference frequency** is 100% reference. The ratio of the frequency command is converted to the set frequency in the following formula.

Set frequency = **% setting reference frequency** × Speed scale*1

*1 Refer to page 523



NOTE

- The % setting reference frequency cannot be set at less than the minimum frequency resolution of the inverter.
- The set frequency is written to RAM.
- The set frequency is applied at the writing of Speed scale. (The set frequency is not applied at the setting of **Pr.390**.)

◆ Automatic baud rate recognition (Pr.726 Auto Baudrate/Max Master)

- Automatic changing of baud rate is available with **Pr.726** setting. When **Pr.726**="128 to 255", turn the power ON from OFF or reset the inverter to start automatic baud rate recognition.

Pr.726 setting	Operation
0 to 127	Automatic baud rate recognition is invalid. (The **Pr.332** setting is used as the baud rate.)
128 to 255	The inverter monitors the data on the communication bus, and automatically switches the baud rate. The recognized baud rate is written to **Pr.332**.

NOTE

- After the baud rate recognition, the recognized baud rate is written in EEPROM as the **Pr.332** setting regardless of the **Pr.342 Communication EEPROM write selection** setting.
- The BACnet status monitor displays "1" during automatic baud rate recognition.
- The communication error monitor count is not performed during automatic baud rate recognition.
- During automatic baud rate recognition, the inverter does not transmit data, but only accepts data.
- The baud rate switching operation cannot be finished if the inverter is not connected to the communication bus. (BACnet protocol will not be established.)
- The baud rate switching operation cannot be finished if the inverter is continuously receiving abnormal data during automatic baud rate switching. (BACnet protocol will not be established.)

◆ Supported property of BACnet standard object type

R: Read only, W: Read/Write (Commandable values not supported), C: Read/Write (Commandable values supported)

Property	Object support condition							
	Analog Input	Analog Output	Analog Value	Binary Input	Binary Output	Binary Value	Device	Network Port
APDU Timeout							R	
Application Software Version							R	
Database Revision							R	
Device Address Binding							R	
Event State	R	R	R	R	R	R		
Firmware Revision							R	
Max APDU Length Accepted							R	
Max Info Frames							W	W
Max Master							W	W
Model Name							R	
Number of APDU Retries							R	
Object Identifier	R	R	R	R	R	R	R	R
Object List							R	
Object Name	R	R	R	R	R	R	R	R
Object Type	R	R	R	R	R	R	R	R
Out Of Service	R	R	R	R	R	R		R
Polarity				R	R			
Present Value	R	C	C*1	R	C	C*1		
Priority Array		R	R*2		R	R*2		
Protocol Object Types Supported							R	
Protocol Revision							R	
Protocol Services Supported							R	
Protocol Version							R	
Relinquish Default		R	R*2		R	R*2		
Segmentation Supported							R	
Status Flags	R	R	R	R	R	R		R
System Status							R	
Unit	R	R	R					
Vendor Identifier							R	
Vendor Name							R	
Property List	R	R	R	R	R	R	R	R
Current Command Priority		R			R			
Reliability								R
Network Type								R
Protocol Level								R
Network Number								R*3
Network Number Quality								R
Changes Pending								R
APDU Length								R
Link Speed								R
MAC Address								R
IP Address								R
IP Subnet_Mask								R
IP Default Gateway								R
IP DNS Server								R

*1 This property is commandable for some instances of this object. Otherwise it is read/write.
*2 This property is supported only for instances of this object where the Present Value property is commandable.
*3 Writing is possible when the network type is not PTP.

◆ Details of the supported properties

- The details of the properties supported by the network port are as follows.

Property	Details
Max Info Frames	Shows the maximum number of frames that the inverter can transmit while it owns the token. When a value is written, it is reflected to the **Pr.727** setting.
Max Master	Shows the maximum address for master node When a value is written, it is reflected to the **Pr.726** setting.
Object Identifier	Shows the unique numeric code to identify the object.
Object Name	Shows the object name.
Object Type	Network Port: NETWORK_PORT (56)
Out Of Service	FALSE (0)
Status Flags	Always 0.
Property List	Shows the property identifier list.
Reliability	Shows the reliability of the network port. Fixed to no-fault-detected (0) for the FR-F800.
Network Type	Shows the communication method of the network. Fixed to MSTP (2) for the FR-F800.
Protocol Level	Shows the protocol level. Fixed to BACNET_APPLICATION (2) for the FR-F800.
Network Number	Shows the network number. Fixed to 0 for the FR-F800. If a value other than "0" is written, an error code VALUE_OUT_OF_RANGE (37) will be returned.
Network Number Quality	Shows the quality of the network port number. Fixed to UNKNOWN (0) for the FR-F800.
Changes Pending	If the property value whose change is to be reflected at a reset is changed, TRUE is returned. FALSE is returned after the status is initialized by a reset.
APDU Length	Shows the maximum number of octets. Fixed to 50 octets for the FR-F800.
Link Speed	Shows the communication speed in the unit of bit/s. The **Pr.332** setting value × 100 equals the communication speed.
MAC Address	Shows the MAC address of the network port. The **Pr.331** setting value is used for the MAC address. For example, the MAC address is 7F when **Pr.331** = "127".
IP Address	A rejection code (0) is displayed when the property is read.
IP Subnet Mask	A rejection code (0) is displayed when the property is read.
IP Default Gateway	A rejection code (0) is displayed when the property is read.
IP DNS Server	A rejection code (0) is displayed when the property is read.

◆ Supported BACnet object

■ ANALOG INPUT

Object identifier	Object name	Present value access type*1	Description	Unit
0	Terminal 1	R	Represents actual input voltage of terminal 1. (The range varies depending on the **Pr.73 and Pr.267** settings. -10 to +10 V (-100% to +100%), -5 to +5 V (-100% to +100%))	percent (98)
1	Terminal 2	R	Represents actual input voltage (or input current) of terminal 2. (The range varies depending on the **Pr.73 and Pr.267** settings. 0 to 10 V (0% to 100%), 0 to 5 V (0% to 100%), 0 to 20 mA (0% to 100%))	percent (98)
2	Terminal 4	R	Represents actual input voltage (or input current) of terminal 4. (The range varies depending on the **Pr.73 and Pr.267** settings. 2 to 10 V (0% to 100%), 1 to 5 V (0% to 100%), 4 to 20 mA (0% to 100%))	percent (98)

*1 R: Read only, W: Read/Write (Commandable values not supported), C: Read/Write (Commandable values supported)

■ ANALOG OUTPUT

Object identifier	Object name	Present value access type*1	Description	Unit
0	Terminal CA	C	Controls actual output current level of terminal CA. Control is available when **Pr.54 CA terminal function selection**="85"*2. (Setting range: 0 to 200%)	percent (98)
1	Terminal AM	C	Controls actual output voltage level of terminal AM. Control is available when **Pr.158 AM terminal function selection**="86"*2. (Setting range: -200 to 200%)	percent (98)

*1 R: Read only, W: Read/Write (Commandable values not supported), C: Read/Write (Commandable values supported)
Values written to the objects that support the commandable values are stored in the Priority Array, even when "Write Access Denied" is returned due to inconsistency of the writing requirements such as the operating mode, on condition that the values are written within the setting range.

*2 Available regardless of the operation mode, operation command source, and speed command source.

■ ANALOG VALUE

Object identifier	Object name	Present value access type*1	Description	Unit
1	Output frequency	R	Represents the output frequency monitor.	hertz (27)
2	Output current	R	Represents the output current monitor.	amperes (3)
3	Output voltage	R	Represents the output voltage monitor.	volts (5)
6	Running speed	R	Represents the running speed monitor.	revolution-per-minute (104)
8	Converter output voltage	R	Represents the converter output voltage monitor.	volts (5)
14	Output power	R	Represents the output power monitor.	kilowatts (48)
17	Load meter	R	Represents the load meter monitor.	percent (98)
20	Cumulative energization time	R	Represents the cumulative energization time monitor.	hours (71)
23	Actual operation time	R	Represents the actual operation time monitor.	hours (71)

Object identifier	Object name	Present value access type*1	Description	Unit
25	Cumulative power	R	Represents the cumulative power monitor.	kilowatt-hours (19)
52	PID set point	R	Represents the PID set point monitor.	no-units (95)
54	PID deviation	R	Represents the PID deviation monitor. (Minus display is available with reference to 0%, in 0.1% increment.)	no-units (95)
67	PID measured value 2	R	Represents the PID measured value 2 monitor.	no-units (95)
92	Second PID set point	R	Represents the second PID set point monitor.	no-units (95)
94	Second PID deviation	R	Represents the second PID deviation monitor. (Minus display is available with reference to 0%, in 0.1% increment.)	no-units (95)
95	Second PID measured value 2	R	Represents the second PID measured value 2 monitor.	no-units (95)
200	Alarm history 1	R	Represents the fault history 1 (the latest fault) monitor.	no-units (95)
201	Alarm history 2	R	Represents the fault history 2 (second fault in past) monitor.	no-units (95)
202	Alarm history 3	R	Represents the fault history 3 (third fault in past) monitor.	no-units (95)
203	Alarm history 4	R	Represents the fault history 4 (fourth fault in past) monitor.	no-units (95)
300	Speed scale *2	C	Controls the ratio of the frequency command. (Setting range: 0.00 to 100.00) (Refer to page 518.)	percent (98)
310	PID set point CMD *2	C	Set the PID action set point. This object is the set point during PID operation if **Pr.128** = "60 or 61". (Setting range: 0.00 to 100.00)*3	no-units (95)
311	PID measured value CMD *2	C	Set the PID measured value. This object is the measured value during PID operation if **Pr.128** = "60 or 61". (Setting range: 0.00 to 100.00)*3	no-units (95)
312	PID deviation CMD *2	C	Set the PID deviation. (0.01 increment) This object is the deviation during PID operation if **Pr.128** = "50 or 51". (Setting range: -100.00 to 100.00)	percent (98)
320	Second PID set point CMD	C	Set the second PID action set point. This object is the set point during PID operation if **Pr.753** = "60 or 61". (Setting range: 0.00 to 100.00)*3	no-units (95)
321	Second PID measured value CMD	C	Set the second PID measured value. This object is the measured value during PID operation if **Pr.753** = "60 or 61". (Setting range: 0.00 to 100.00)*3	no-units (95)
322	Second PID deviation CMD	C	Set the second PID deviation. (0.01 increment) This object is the deviation during PID operation if **Pr.753** = "50 or 51". (Setting range: -100.00 to 100.00)	percent (98)
398	Mailbox parameter	W	Access to the properties which are not defined as objects are available. (Refer to page 526.)	no-units (95)
399	Mailbox value	W		no-units (95)
10007	Acceleration time	W	Set **Pr.7 Acceleration time**.	seconds (73)
10008	Deceleration time	W	Set **Pr.8 Deceleration time**.	seconds (73)

*1 R: Read only, W: Read/Write (Commandable values not supported), C: Read/Write (Commandable values supported)
Values written to the objects that support the commandable values are stored in the Priority Array, even when "Write Access Denied" is returned due to inconsistency of the writing requirements such as the operating mode, on condition that the values are written within the setting range.

*2 If communication speed command source is other than NET, the setting value can be written, but not to be applied.

*3 When both **Pr.1136 and Pr.1138** ≠ "9999", the setting range is from the smaller coefficient to the larger coefficient of **Pr.1136 and Pr.1138**. Depending on the setting, the writing value and the reading value may not be the same at the minimum digit.

■ BINARY INPUT

Object identifier	Object name	Present value access type*1	Description (0: Inactive, 1: Active)
0	Terminal STF	R	Represents actual input of terminal STF.
1	Terminal STR	R	Represents actual input of terminal STR.
2	Terminal AU	R	Represents actual input of terminal AU.
3	Terminal RT	R	Represents actual input of terminal RT.
4	Terminal RL	R	Represents actual input of terminal RL.
5	Terminal RM	R	Represents actual input of terminal RM.
6	Terminal RH	R	Represents actual input of terminal RH.
7	Terminal JOG	R	Represents actual input of terminal JOG.
8	Terminal MRS	R	Represents actual input of terminal MRS.
9	Terminal STOP	R	Represents actual input of terminal STOP.
10	Terminal RES	R	Represents actual input of terminal RES.
11	Terminal CS	R	Represents actual input of terminal CS.
100	Terminal RUN	R	Represents actual output of terminal RUN.
101	Terminal SU	R	Represents actual output of terminal SU.
102	Terminal IPF	R	Represents actual output of terminal IPF.
103	Terminal OL	R	Represents actual output of terminal OL.
104	Terminal FU	R	Represents actual output of terminal FU.
105	Terminal ABC1	R	Represents actual output of terminal ABC1.
106	Terminal ABC2	R	Represents actual output of terminal ABC2.
107	Terminal So (SO)	R	Represents actual output of terminal So (SO).

*1 R: Read only, W: Read/Write (Commandable values not supported), C: Read/Write (Commandable values supported)

■ BINARY OUTPUT

Object identifier	Object name	Present value access type*1	Description (0: Inactive, 1: Active)
0	Terminal RUN CMD	C	Represents actual output of terminal RUN. Available when **Pr.190 RUN terminal function selection**="82 or 182".*2
1	Terminal SU CMD	C	Controls actual output of terminal SU. Available when **Pr.191 SU terminal function selection**="82 or 182".*2
2	Terminal IPF CMD	C	Controls actual output of terminal IPF. Available when **Pr.192 IPF terminal function selection**="82 or 182".*2
3	Terminal OL CMD	C	Controls actual output of terminal OL. Available when **Pr.193 OL terminal function selection**="82 or 182".*2
4	Terminal FU CMD	C	Controls actual output of terminal FU. Available when **Pr.194 FU terminal function selection**="82 or 182".*2
5	Terminal ABC1 CMD	C	Controls actual output of terminal ABC1. Available when **Pr.195 ABC1 terminal function selection**="82 or 182".*2
6	Terminal ABC2 CMD	C	Controls actual output of terminal ABC2. Available when **Pr.196 ABC2 terminal function selection**="82 or 182".*2

*1 R: Read only, W: Read/Write (Commandable values not supported), C: Read/Write (Commandable values supported)
Values written to the objects that support the commandable values are stored in the Priority Array, even when "Write Access Denied" is returned due to inconsistency of the writing requirements such as the operating mode, on condition that the values are written within the setting range.

*2 Available regardless of the operation mode, operation command source, and speed command source.

■ BINARY VALUE

Object identifier	Object name	Present value access type*1	Description
0	Inverter running	R	Represents inverter running (RUN signal) status.
11	Inverter operation ready	R	Represents inverter operation ready (RY signal) status.
98	Alarm output	R	Represents alarm output (LF signal) status.
99	Fault output	R	Represents fault output (ALM signal) status.
200	Inverter running reverse	R	Represents inverter reverse running status.
300	Control input instruction AU	C	Controls the function assigned to terminal AU. Setting 1 in this object turns ON the signal assigned to **Pr.184 AU terminal function selection**.
301	Control input instruction RT	C	Controls the function assigned to terminal RT. Setting 1 in this object turns ON the signal assigned to **Pr.183 RT terminal function selection**.
302	Control input instruction RL	C	Controls the function assigned to terminal RL. Setting 1 in this object turns ON the signal assigned to **Pr.180 RL terminal function selection**.
303	Control input instruction RM	C	Controls the function assigned to terminal RM. Setting 1 in this object turns ON the signal assigned to **Pr.181 RM terminal function selection**.
304	Control input instruction RH	C	Controls the function assigned to terminal RH. Setting 1 in this object turns ON the signal assigned to **Pr.182 RH terminal function selection**.
305	Control input instruction JOG *2	C	Controls the function assigned to terminal JOG. Setting 1 in this object turns ON the signal assigned to **Pr.185 JOG terminal function selection**.
306	Control input instruction MRS	C	Controls the function assigned to terminal MRS. Setting 1 in this object turns ON the signal assigned to **Pr.187 MRS terminal function selection**.
307	Control input instruction STOP *2	C	Controls the function assigned to terminal STOP. Setting 1 in this object turns ON the signal assigned to **Pr.188 STOP terminal function selection**.
308	Control input instruction RES *2	C	Controls the function assigned to terminal RES. Setting 1 in this object turns ON the signal assigned to **Pr.189 RES terminal function selection**.
309	Control input instruction CS *2	C	Controls the function assigned to terminal CS. Setting 1 in this object turns ON the signal assigned to **Pr.186 CS terminal function selection**.
400	Run/Stop	C	Controls the start/stop command. The start command is written after the Speed scale is applied. *3 1: Start 0: Stop
401	Forward/Reverse	C	Controls the forward/reverse rotation. *3 1: Reverse rotation 0: Forward rotation
402	Fault reset	C	Clears fault output status. (Release of an inverter fault without inverter reset is available.)

*1 R: Read only, W: Read/Write (Commandable values not supported), C: Read/Write (Commandable values supported)
Values written to the objects that support the commandable values are stored in the Priority Array, even when "Write Access Denied" is returned due to inconsistency of the writing requirements such as the operating mode, on condition that the values are written within the setting range.

*2 The following signals cannot be controlled by the network: Jog operation, selection of automatic restart after instantaneous power failure, start self-holding, and reset. Therefore control input instruction JOG, STOP, RES, and CS are invalid in the initial status. To use the control input instruction JOG, STOP, RES, and CS, change the signals with **Pr.185, Pr.186, Pr.188, Pr.189 (Input terminal function selection)**. (Refer to page 343.) (Reset is available with ReinitializeDevice.)

*3 If communication operation command source is other than NET, the setting value can be written, but not to be applied.

5

◆ Mailbox parameter / Mailbox value (BACnet registers)

- Access to the properties which are not defined as objects are available by using "Mailbox parameter" and "Mailbox value".
- To read a property, write the register of the intended property to "Mailbox parameter", and then read "Mailbox value". To write a property, write the register of the intended property to "Mailbox parameter", and then write a value to "Mailbox value".
- System environment variable

Register	Definition	Read/write	Remarks
40010	Operation mode / inverter setting	Read/write	For write, set data as the operation mode setting. For read, data is read as the operation mode status.

- Operation mode / inverter setting

Mode	Read value	Write value
EXT	H0000	H0010 *1
PU	H0001	H0011 *1
EXT JOG	H0002	-
PU JOG	H0003	-
NET	H0004	H0014
PU + EXT	H0005	-

*1 Writing is available depending on the **Pr.79 and Pr.340** settings. For the details, refer to page 213.
The restrictions depending on the operation mode changes according to the computer link specifications.

- Real time monitor

The register numbers and the monitor items are the same as those of the MODBUS RTU real time monitor. Refer to the MODBUS RTU real time monitor on page 274.

- Parameter

Pr.	Register	Parameter name	Read/write	Remarks
0 to 999	41000 to 41999	Refer to the parameter list (page 108) for parameter names.	Read/write	The parameter number + 41000 is the register number.
902	41902	Terminal 2 frequency setting bias (frequency)	Read/write	
902	42092	Terminal 2 frequency setting bias (analog value)	Read/write	Analog value (%) set to **Pr.902**
	43902	Terminal 2 frequency setting bias (terminal analog value)	Read	Analog value (%) of the voltage (current) applied to the terminal 2
125 (903)	41903	Terminal 2 frequency setting gain (frequency)	Read/write	
903	42093	Terminal 2 frequency setting gain (analog value)	Read/write	Analog value (%) set to **Pr.903**
	43903	Terminal 2 frequency setting gain (terminal analog value)	Read	Analog value (%) of the voltage (current) applied to the terminal 2
904	41904	Terminal 4 frequency setting bias (frequency)	Read/write	
904	42094	Terminal 4 frequency setting bias (analog value)	Read/write	Analog value (%) set to **Pr.904**
	43904	Terminal 4 frequency setting bias (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to the terminal 4
126 (905)	41905	Terminal 4 frequency setting gain (frequency)	Read/write	
905	42095	Terminal 4 frequency setting gain (analog value)	Read/write	Analog value (%) set to **Pr.905**
	43905	Terminal 4 frequency setting gain (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to the terminal 4
917	41917	Terminal 1 bias frequency (speed)	Read/write	
917	42107	Terminal 1 bias (speed)	Read/write	Analog value (%) set to **Pr.917**
	43917	Terminal 1 bias (speed) (terminal analog value)	Read	Analog value (%) of the voltage applied to the terminal 1
918	41918	Terminal 1 gain frequency (speed)	Read/write	

Pr.	Register	Parameter name	Read/write	Remarks
918	42108	Terminal 1 gain (speed)	Read/write	Analog value (%) set to **Pr.918**
	43918	Terminal 1 gain (speed) (terminal analog value)	Read	Analog value (%) of the voltage applied to the terminal 1
919	41919	Terminal 1 bias command (torque)	Read/write	
919	42109	Terminal 1 bias (torque)	Read/write	Analog value (%) set to **Pr.919**
	43919	Terminal 1 bias (torque) (terminal analog value)	Read	Analog value (%) of the voltage applied to the terminal 1
920	41920	Terminal 1 gain command (torque)	Read/write	
920	42110	Terminal 1 gain (torque)	Read/write	Analog value (%) set to **Pr.920**
	43920	Terminal 1 gain (torque) (terminal analog value)	Read	Analog value (%) of the voltage applied to the terminal 1
930	41930	Current output bias signal	Read/write	
930	42120	Current output bias current	Read/write	Analog value (%) set to **Pr.930**
931	41931	Current output gain signal	Read/write	
931	42121	Current output gain current	Read/write	Analog value (%) set to **Pr.931**
932	41932	Terminal 4 bias command (torque)	Read/write	
932	42122	Terminal 4 bias (torque)	Read/write	Analog value (%) set to **Pr.932**
	43932	Terminal 4 bias (torque) (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to the terminal 4
933	41933	Terminal 4 gain command (torque)	Read/write	
933	42123	Terminal 4 gain (torque)	Read/write	Analog value (%) set to **Pr.933**
	43933	Terminal 4 gain (torque) (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to the terminal 4
934	41934	PID display bias coefficient	Read/write	
934	42124	PID display bias analog value	Read/write	Analog value (%) set to **Pr.934**
	43934	PID display bias analog value (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to the terminal 4
935	41935	PID display gain coefficient	Read/write	
935	42125	PID display gain analog value	Read/write	Analog value (%) set to **Pr.935**
	43935	PID display gain analog value (terminal analog value)	Read	Analog value (%) of the current (voltage) applied to the terminal 4
1000 to 1999	45000 to 45999	Refer to the parameter list (page 108) for parameter names.	Read/write	The parameter number + 44000 is the register number.

- Fault history

Register	Definition	Read/write	Remarks
40501	Fault record 1	Read/write	Being 2 bytes in length, the data is stored as "H00○○". Refer to the lowest 1 byte for the error code. (Refer to page 568 for the error codes.) Performing write using the register 40501 batch-clears the fault history. Set any value as data.
40502	Fault record 2	Read	
40503	Fault record 3	Read	
40504	Fault record 4	Read	
40505	Fault record 5	Read	
40506	Fault record 6	Read	
40507	Fault record 7	Read	
40508	Fault record 8	Read	

• Model information monitor

Register	Definition	Read/write	Remarks
44001	Inverter type (1st and 2nd characters)	Read	Reading inverter type in ASCII code. "H20" (blank code) is set for blank area. Example) For the "FR-F860-3", H46, H52, H2D, H46, H38, H36, H30, H2D, H33, H20...H20
44002	Inverter type (3rd and 4th characters)	Read	
44003	Inverter type (5th and 6th characters)	Read	
44004	Inverter type (7th and 8th characters)	Read	
44005	Inverter type (9th and 10th characters)	Read	
44006	Inverter type (11th and 12th characters)	Read	
44007	Inverter type (13th and 14th characters)	Read	
44008	Inverter type (15th and 16th characters)	Read	
44009	Inverter type (17th and 18th characters)	Read	
44010	Inverter type (19th and 20th characters)	Read	
44011	Capacity (1st and 2nd characters)	Read	Reading inverter capacity in ASCII code. Data is read in increments of 0.1 kW, and rounds down to 0.01 kW increments. "H20" (blank code) is set for blank area. Example) 0.75K......"7" (H20, H20, H20, H20, H20, H37)
44012	Capacity (3rd and 4th characters)	Read	
44013	Capacity (5th and 6th characters)	Read	

NOTE

• When a 32-bit parameter setting or monitor item is read and the value to be read exceeds HFFFF, HFFFF is returned.

◆ ANNEX A - PROTOCOL IMPLEMENTATION CONFORMANCE STATEMENT (NORMATIVE)

(This annex is part of this Standard and is required for its use.)

BACnet Protocol Implementation Conformance Statement

Date: 1st Jul 2014

Vendor Name: Mitsubishi Electric Corporation

Product Name: Inverter

Product Model Number: FR-F860-3, FR-F862-3, FR-F860-E3, FR-F862-E3

Application Software Version: XXXX* (Four-digit number followed by a letter)

Firmware Revision: 2.00

BACnet Protocol Revision: 19

Product Description:

BACnet Standardized Device Profile (Annex L):

☐ BACnet Cross-Domain Advanced Operator Workstation (B-XAWS)

☐ BACnet Advanced Operator Workstation (B-AWS)

☐ BACnet Operator Workstation (B-OWS)

☐ BACnet Operator Display (B-OD)

☐ BACnet Advanced Life Safety Workstation (B-ALSWS)

☐ BACnet Life Safety Workstation (B-LSWS)

☐ BACnet Life Safety Annunciator Panel (B-LSAP)

☐ BACnet Advanced Access Control Workstation (B-AACWS)

☐ BACnet Access Control Workstation (B-ACWS)

☐ BACnet Access Control Security Display (B-ACSD)

☐ BACnet Building Controller (B-BC)

☐ BACnet Advanced Application Controller (B-AAC)

☒ BACnet Application Specific Controller (B-ASC)

☐ BACnet Smart Sensor (B-SS)

☐ BACnet Smart Actuator (B-SA)

☐ BACnet Advanced Life Safety Controller (B-ALSC)

☐ BACnet Life Safety Controller (B-LSC)

☐ BACnet Advanced Access Control Controller (B-AACC)

☐ BACnet Access Control Controller (B-ACC)

☐ BACnet Router (B-RTR)

☐ BACnet Gateway (B-GW)

☐ BACnet Broadcast Management Device (B-BBMD)

☐ BACnet Access Control Door Controller (B-ACDC)

☐ BACnet Access Control Credential Reader (B-ACCR)

☐ BACnet General (B-GENERAL)

List all BACnet Interoperability Building Blocks Supported (Annex K):

DS-RP-B, DS-WP-B, DM-DDB-B, DM-DOB-B, DM-DCC-B, DM-RD-B

Segmentation Capability:

☐ Able to transmit segmented messages   Window Size ______________
☐ Able to receive segmented messages   Window Size ______________

Standard Object Types Supported:

An object type is supported if it may be present in the device. For each standard Object Type supported provide the following data:

1. Whether objects of this type are dynamically creatable using the CreateObject service
2. Whether objects of this type are dynamically deletable using the DeleteObject service
3. List of the optional properties supported
4. List of all properties that are writable where not otherwise required by this standard
5. List of all properties that are conditionally writable where not otherwise required by this standard
6. List of proprietary properties and for each its property identifier, datatype, and meaning
7. List of any property range restrictions

Dynamic object creation and deletion is not supported.

To check the object types supported by the FR-F800 series, refer to page 522.

Data Link Layer Options:

☐ ARCNET (ATA 878.1), 2.5 Mb. (Clause 8)
☐ ARCNET (ATA 878.1), EIA-485 (Clause 8), baud rate(s) ______________
☐ BACnet IP, (Annex J)
☐ BACnet IP, (Annex J), BACnet Broadcast Management Device (BBMD)
☐ BACnet IP, (Annex J), Network Address Translation (NAT Traversal)
☐ BACnet IPv6, (Annex U)
☐ BACnet IPv6, (Annex U), BACnet Broadcast Management Device (BBMD)
☐ BACnet/ZigBee (Annex O) ______________
☐ ISO 8802-3, Ethernet (Clause 7)
☒ MS/TP master (Clause 9), baud rate(s): 9600, 19200, 38400, 57600, 76800, 115200
☐ MS/TP slave (Clause 9), baud rate(s): ______________
☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s): ______________
☐ Point-To-Point, modem, (Clause 10), baud rate(s):
☐ Other: ______________

Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐ Yes ☒ No

Networking Options:

☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.
☐ Annex H, BACnet Tunneling Router over IP

Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

☐ ISO 10646 (UTF-8)	☐ IBM™/Microsoft™ DBCS	☐ ISO 8859-1
☐ ISO 10646 (UCS-2)	☐ ISO 10646 (UCS-4)	☐ JIS X 0208

Gateway Options:

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports:

____

____

____

If this product is a communication gateway which presents a network of virtual BACnet devices, a separate PICS shall be provided that describes the functionality of the virtual BACnet devices. That PICS shall describe a superset of the functionality of all types of virtual BACnet devices that can be presented by the gateway.

5

Network Security Options:

☐ Non-secure Device - is capable of operating without BACnet Network Security

☐ Secure Device - is capable of using BACnet Network Security (NS-SD BIBB)

☐ Multiple Application-Specific Keys

☐ Supports encryption (NS-ED BIBB)

☐ Key Server (NS-KS BIBB)

5.12.8 USB device communication

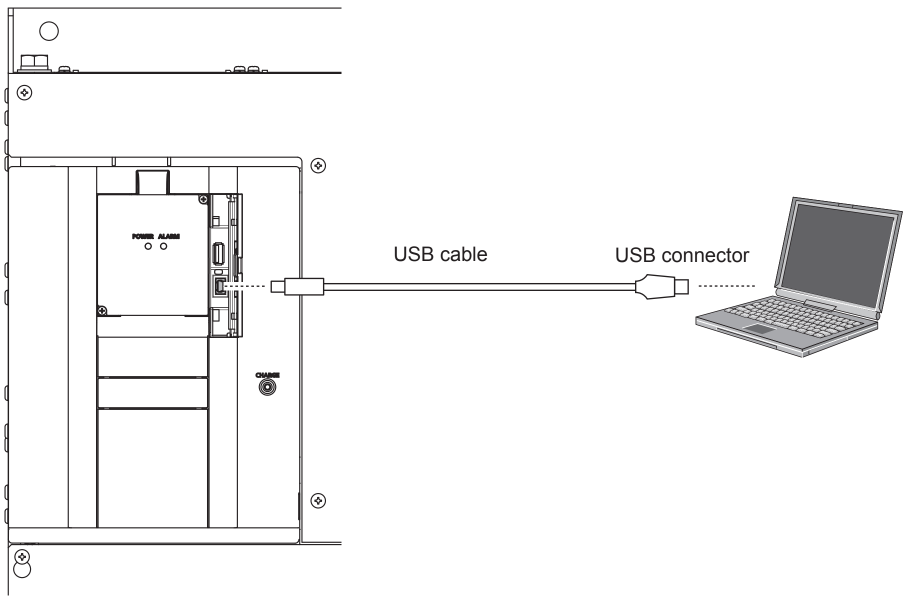
- A personal computer and an inverter can be connected with a USB cable. Setup of the inverter can be easily performed with FR Configurator2.
- The inverter can be connected simply to a personal computer by a USB cable.

Pr.	Name	Initial value	Setting range	Description
547[*1] **N040**	**USB communication station number**	0	0 to 31	Inverter station number specification
548[*1] **N041**	**USB communication check time interval**	9999	0	USB communication is possible, however the inverter will trip (E.USB) when the mode changes to the PU operation mode.
			0.1 to 999.8 s	Set the communication check time interval. If a no-communication state persists for longer than the permissible time, the inverter will trip (E.USB).
			9999	No communication check

*1 Changed setting value becomes valid at power ON or the inverter reset.

◆ USB communication specifications

Interface	Conforms to USB 1.1 (USB 2.0 full speed)
Transmission speed	12 Mbps
Wiring length	Maximum 5 m
Connector	USB mini B connector (receptacle)
Power supply	Self-powered
Recommended USB cable	MR-J3USBCBL3M (cable length 3 m)



- At the initial setting (**Pr.551 PU mode operation command source selection** = "9999"), communication with FR Configurator2 can be made in the PU operation mode simply by connecting a USB cable. To fix the command source to the USB connector in the PU operation mode, set "3" in **Pr.551**.
- Parameter setting and monitoring can be performed by using FR Configurator2. For details, refer to the Instruction Manual of FR Configurator2.

Parameters referred to

Pr.551 PU mode operation command source selection page 214

5.12.9 Automatic connection with GOT

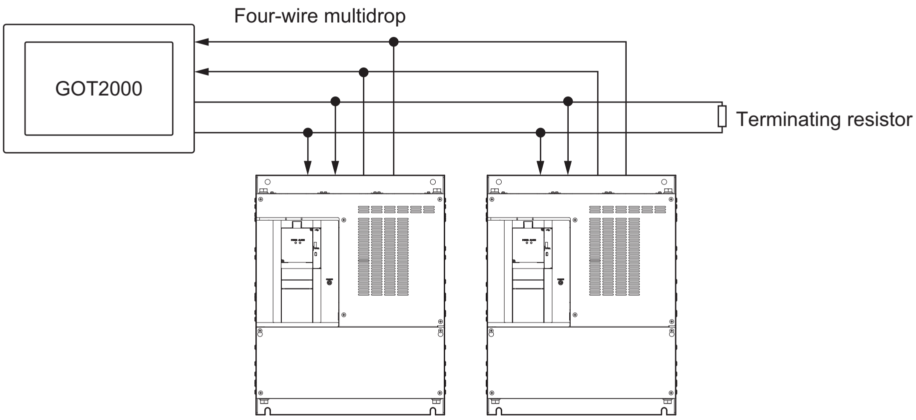
When the automatic connection is enabled in the GOT2000 series, the inverter can communicate with the GOT2000 series with only setting the station number and connecting the GOT. This eliminates the need for the communication parameter setting.

Pr.	Name	Initial value	Setting range	Description
117 **N020**	**PU communication station number**	0	0 to 31	Set the inverter station numbers. The inverter station number setting is required when multiple inverters are connected to one GOT (PU connector communication).
331 **N030**	**RS-485 communication station number**	0	0 to 31 (0 to 247)*1*2	Set the inverter station numbers. The inverter station number setting is required when multiple inverters are connected to one GOT (RS-485 terminal communication).

*1 When **Pr.549 Protocol selection** = "1" (MODBUS RTU protocol), the setting range is as shown in the parentheses.

*2 When the set value is outside of the setting range, the initial value is applied.

◆ Automatic connection system configuration



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◆ GOT2000 series automatic recognition

- When the GOT2000 series is connected, the parameters required for the GOT connection are automatically changed by setting the automatic recognition on the GOT2000 series side.
- Set the station number (**Pr.117** or **Pr.331**) of the inverter before the automatic recognition is performed.
- Connect all the stations of inverters with GOT before the automatic recognition is performed. The inverter newly added after automatic recognition will not be recognized automatically. (When an inverter is added, perform the initial setting in **Pr.999 Automatic parameter setting** or set the automatic recognition on the GOT side again.)

Automatic change item	Automatic change parameter		Setting value after change
	PU connector connection	RS-485 terminal connection	
Communication speed	**Pr.118**	**Pr.332**	Depending on the setting of the connected device on the GOT side.
Data length/stop bit	**Pr.119**	**Pr.333**	
Parity	**Pr.120**	**Pr.334**	
Waiting time setting	**Pr.123**	**Pr.337**	
CR/LF selection	**Pr.124**	**Pr.341**	
Number of communication retries	**Pr.121**	**Pr.335**	9999 (fixed)
Communication check time interval	**Pr.122**	**Pr.336**	9999 (fixed)
Protocol selection	**—** (**Pr.549** holds the value before the automatic recognition.)	**Pr.549**	0 (fixed to Mitsubishi inverter protocol)

NOTE

- If the automatic recognition cannot be performed, initial setting in **Pr.999** is required.
- For connecting the inverter to the GOT2000 series using the RS-485 terminal block, set **Pr.549 Protocol selection** = "0 (initial value) or 1".
- For connection to a device other than the GOT2000 series, initial setting in **Pr.999** is required.
- For details, refer to the GOT2000 Series Connection Manual (Mitsubishi Electric Product).

Parameters referred to

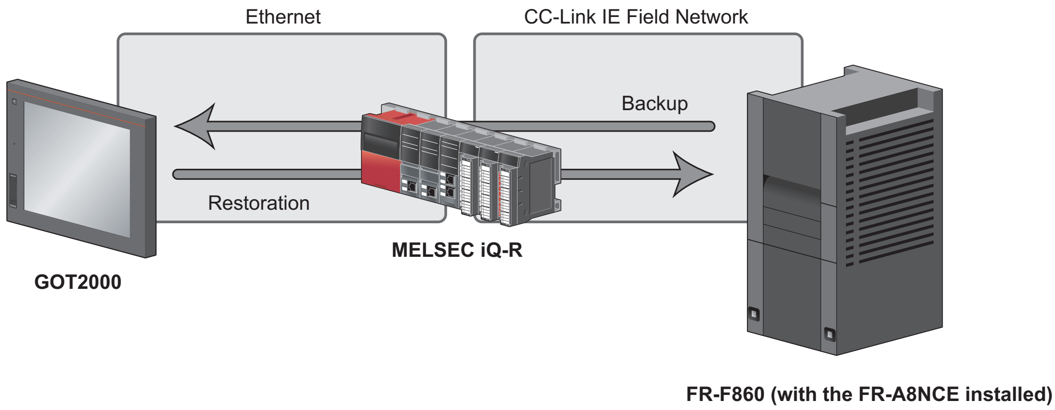
Pr.999 Automatic parameter setting ☞ page 173

5.12.10 Backup/restore

- The GOT can be used for backing up inverter parameters and the data used in the PLC function of inverter.
- The backup data stored in the GOT can be used to restore the data in the inverter.

Pr.	Name	Initial value	Setting range	Description
434 **N110** *1	**Network number (CC-Link IE)**	0	0 to 255	Enter the network number of the inverter.
435 **N111** *1	**Station number (CC-Link IE)**	0	0 to 255	Enter the station number of the inverter.

*1 The setting is available in the inverter on which the FR-A8NCE is installed.



◆ Connected devices

- To enable backup/restore, connect either the general-purpose inverter with the FR-A8NCE to a programmable controller (master station) via the CC-Link IE Field Network.

NOTE

- The backup/restore function is enabled only when the inverter is connected to a master station programmable controller.
- For details on the connected devices, refer to the GOT2000 Series User's Manual (Monitor).

◆ Data to be backed up and restored

- The following data can be backed up and restored. The data other than listed below cannot be backed up or restored.

Item
Inverter parameters
Parameters used for activating the PLC function
Programs (including SFCs) used in the PLC function
Global device comment information used in the PLC function
Function block source information

◆ Backup/restore operation

- The GOT backs up all applicable data in all the inverters that can be identified with the network numbers and station numbers in the controller list file.
- The GOT restores all relevant data of the inverters selected based on the network numbers and station numbers using the backup data.
- The backup/restore cannot be performed in the following cases.

Operation	Inverter status
Backup	During an inverter reset While password protection is enabled or the password is locked (**Pr.297** ≠ "9999") During parameter copy using an operation panel or USB memory device (during writing to the inverter) During restore While password protection is enabled for files used in the PLC function (read protection) While PLC function project data is written to, read from, or verified against a USB memory device
Restore	During an inverter reset During running During auto tuning While password protection is enabled or the password is locked (**Pr.297** ≠ "9999") While parameter write is disabled (**Pr.77** = "1") During parameter copy using an operation panel or USB memory device (during writing to / reading from / verification against the inverter) During backup operation During the RUN status of the PLC function While password protection is enabled for files used in the PLC function (write protection) While PLC function project data is written to, read from, or verified against a USB memory device

NOTE

- To enable the restore operation, **Pr.434 Network number (CC-Link IE) and Pr.435 Station number (CC-Link IE)** must be set.
- Backup is performed for parameters for which parameter copy can be performed.
- For details on backup/restore function, refer to the GOT2000 Series User's Manual (Monitor).

5.13 (G) Control parameters

Purpose	Parameter to set			Refer to page
To set the starting torque manually	Manual torque boost	P.G000, P.G010	Pr.0, Pr.46	538
To set the motor constant	Base frequency, base frequency voltage	P.G001, P.G002, P.G011	Pr.3, Pr.19, Pr.47	539
To select the V/F pattern matching the application	Load pattern selection	P.G003	Pr.14	541
To improve the torque in the low-speed range	Excitation current low-speed scaling factor	P.G003, P.G080, P.G201, P.G202, P.G301, P.G302	Pr.14, Pr.85, Pr.86, Pr.565, Pr.566, Pr.617	542
To perform energy saving operation	Energy saving operation	P.G030	Pr.60	543
To use a special motor	Adjustable 5 points V/F	P.C100, P.G040 to P.G049	Pr.71, Pr.100 to Pr.109	544
To adjust the motor braking torque	DC injection brake	P.G100, P.G101, P.G110	Pr.10 to Pr.12	546
To coast the motor to a stop	Output stop function	P.G105	Pr.522	548
	Selection of motor stop method	P.G106	Pr.250	550
To use the regeneration unit to increase the motor braking torque	Regenerative brake selection	P.E300, P.T721	Pr.30, Pr.599	553
To operate the inverter with DC power supply	DC feeding mode	P.E300	Pr.30	553
To avoid overvoltage alarm due to regenerative driving by automatic adjustment of the output frequency	Regeneration avoidance function	P.G120 to P.G125	Pr.882 to Pr.886, Pr.665	559
To decrease the deceleration time of the motor	Increased magnetic excitation deceleration	P.G130 to P.G132	Pr.660 to Pr.662	562
To select the control method	Control method selection	P.G200	Pr.800	145
To secure the low-speed torque by compensating the slip of the motor	Slip compensation	P.G203 to P.G205	Pr.245 to Pr.247	563
To adjust the speed control gain	Speed control gain	P.G211, P.G212 P.G311, P.G312	Pr.820, Pr.821, Pr.830, Pr.831	155
To adjust the torque control gain	Torque control gain	P.G213, P.G214, P.G313, P.G314	Pr.824, Pr.825, Pr.834, Pr.835	155
To stabilizes torque feedback signal	Torque detection filter	P.G216, P.G316	Pr.827, Pr.837	158
To suppress the machine resonance	Speed smoothing control	P.G410, P.G411	Pr.653, Pr.654	564
To adjust the speed gain for Advanced magnetic flux vector control	Speed control gain	P.G932, P.G942	Pr.89, Pr.569	149

5

5.13.1 Manual torque boost

V/F

Voltage drop in the low-frequency range can be compensated, improving reduction of the motor torque in the low-speed range.

- Motor torque in the low-frequency range can be adjusted according to the load, increasing the motor torque at the start up.
- By using the RT signal, it is possible to switch between 2 types of torque boost.

Pr.	Name	Initial value	Setting range	Description
0 **G000**	**Torque boost**	3%*1 2%*2 1%*3	0 to 30%	Set the output voltage at 0 Hz in %.
46 **G010**	**Second torque boost**	9999	0 to 30%	Set the torque boost value at when RT signal is ON.
			9999	Without second torque boost

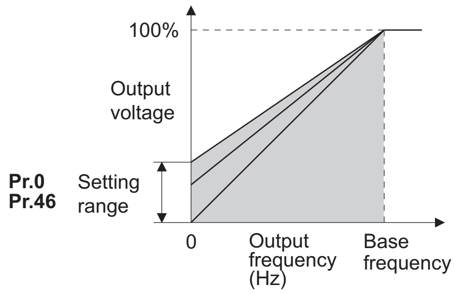
*1 Initial value for the FR-F860-00027.

*2 Initial value for the FR-F860-00061 and FR-F860-00090.

*3 Initial value for the FR-F860-00170 or higher.

◆ Starting torque adjustment

- Assuming **Pr.19 Base frequency voltage** is 100%, set the output voltage at 0 Hz to **Pr.0 (Pr.46, Pr.112)** in percentage.
- Perform the adjustment of the parameter little by little (approximately 0.5%), and confirm the status of the motor each time. The motor may overheat when the value is set too high. Do not use more than 10% as a guideline.



◆ Setting multiple torque boosts (RT signal, Pr.46)

- When changing the torque boost depending on the usage or when using single inverter switching between multiple motors, use the second torque boost.
- **Pr.46 Second torque boost** will become enabled when the RT signal turns ON.

NOTE

- The RT signal acts as the second function selection signal and makes the other second functions valid. (Refer to page 348.)
- The RT signal is assigned to the terminal RT in the initial status. Set "3" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the RT signal to another terminal.
- Set a larger value when the distance between the inverter and the motor is long or when there is not enough motor torque in the low-speed range. It may cause overcurrent trip when it is set too large.
- Setting for **Pr.0** and **Pr.46** becomes enabled only when the V/F control is selected.
- When the initial value is set in **Pr.0**, the **Pr.0** setting is automatically changed by changing the **Pr.71 Applied motor, Pr.81 Number of motor poles** setting. (Refer to page 351)
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.3 Base frequency, Pr.19 Base frequency voltage ☞ page 539

Pr.71 Applied motor ☞ page 351

Pr.178 to Pr.182 (Input terminal function selection) ☞ page 343

5.13.2 Base frequency, voltage

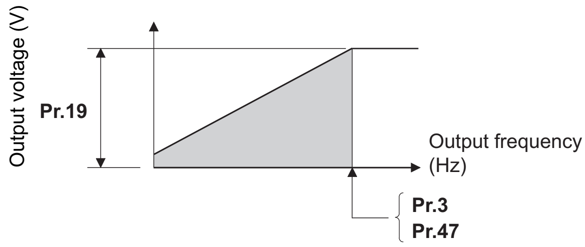
V/F

Use this function to adjust the inverter outputs (voltage, frequency) to match with the motor rating.

Pr.	Name	Initial value	Setting range	Description
3 **G001**	**Base frequency**	60 Hz	0 to 590 Hz	Set the frequency at the rated motor torque. (50 Hz/60 Hz)
19 **G002**	**Base frequency voltage**	9999	0 to 1000 V	Set the base voltage.
			8888	95% of the power supply voltage
			9999	Same as the power supply voltage
47 **G011**	**Second V/F (base frequency)**	9999	0 to 590 Hz	Set the base frequency at the RT signal ON.
			9999	Second V/F disabled

◆ Setting of base frequency (Pr.3)

- When operating a standard motor, generally set the rated frequency of the motor in **Pr.3 Base frequency**. When the motor operation require switching to the commercial power supply, set the power supply frequency in **Pr.3**.
- When the frequency described on the motor rating plate is 50 Hz only, make sure to set to 50 Hz. When it is set to 60 Hz, the voltage will drop too much, causing insufficient torque. As a result, the inverter may trip due to overload. A caution is required especially in case of **Pr.14 Load pattern selection** = "1" (variable torque load).



◆ Setting multiple base frequencies (Pr.47)

- To change the base frequency when using single inverter switching between multiple motors, use **Pr.47 Second V/F (base frequency)**.
- **Pr.47** will become enabled when the RT signal turns ON.

NOTE

- The RT signal acts as the second function selection signal and makes the other second functions valid. (Refer to page 348.)
- The RT signal is assigned to the terminal RT in the initial status. It is also possible to assign the RT signal to other terminal by setting "3" on **Pr.178 to Pr.189 (Input terminal function selection)**.

◆ Setting of base frequency voltage (Pr.19)

- For **Pr.19 Base frequency voltage**, set the base voltage (rated motor voltage, etc.).
- When it is set lower than the power supply voltage, maximum output voltage of the inverter will be the voltage set in **Pr.19**.
- **Pr.19** can be used in following cases.
  - (a) Regenerative driving (continuous regeneration, etc.) is performed often
    Output voltage will get higher than the specification during the regenerative driving, which may cause overcurrent trip (E.OC[]) by the increase in motor current.
  - (b) When the fluctuation of power supply voltage is high
    When the power supply voltage exceeds the rated voltage of the motor, fluctuation of rotation speed or overheating of motor may occur due to excessive torque or increase in motor current.

NOTE

- When the Advanced magnetic flux vector control or PM motor control is selected, **Pr.3, Pr.47 and Pr.19** will become disabled, and **Pr.83 and Pr.84** will become enabled. However, S-pattern curve with **Pr.29 Acceleration/deceleration pattern selection** = "1" (S-pattern acceleration/deceleration A) will make **Pr.3** or **Pr.47** enabled. (S-pattern curve at the time of the PM motor control is the rated frequency of the motor.)
- When **Pr.71 Applied motor** = "2" (adjustable 5 points V/F), setting for **Pr.47** will become disabled. Also, **Pr.19** cannot be set to "8888" or "9999".
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.14 Load pattern selection ☞ page 541
Pr.29 Acceleration/deceleration pattern selection ☞ page 194
Pr.71 Applied motor ☞ page 351
Pr.83 Rated motor voltage, Pr.84 Rated motor frequency ☞ page 353
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343

5.13.3 Load pattern selection

V/F

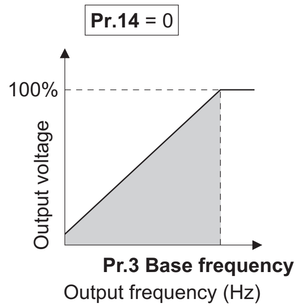
Optimal output characteristics (V/F characteristics) for application or load characteristics can be selected.

Pr.	Name	Initial value	Setting range	Description
14 G003	**Load pattern selection**	1	0	For constant-torque load
			1	For variable-torque load
			12 to 15*1	Excitation current low-speed scaling factor (Refer to page 542.)

*1 When the setting value is selected under V/F control, the operation is the same as the one for constant-torque load (**Pr.14** = "0").

◆ Application for constant-torque load (Pr.14 = "0")

- The output voltage will change linearly against the output frequency at the base frequency or lower.
- Set this parameter when driving a load that has constant load torque even when the rotation speed is changed, such as conveyor, dolly, or roll drive.

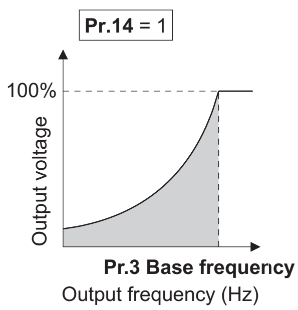


Point

Select for constant-torque load (setting value "0") even for fan and pump in following cases.
- When accelerating a blower with large moment of inertia (J) in a short period of time.
- When it is a constant-torque load such as rotary pump or gear pump.
- When the load torque increases in low speed such as screw pump.

◆ Application for variable-torque load (Pr.14 = "1", initial value)

- The output voltage will change in square curve against the output frequency at the base frequency or lower. (1.75th-power curve for FR-F860-00680 or higher)
- Set this parameter when driving a load with load torque change proportionally against the square of the rotation speed, such as fan and pump.



NOTE

- **Pr.14** will become enabled at the time of V/F control.

Parameters referred to

Pr.0 Torque boost ☞ page 538
Pr.3 Base frequency ☞ page 539
Pr.178 to Pr.182 (Input terminal function selection) ☞ page 343

5.13.4 Excitation current low-speed scaling factor

Magnetic flux

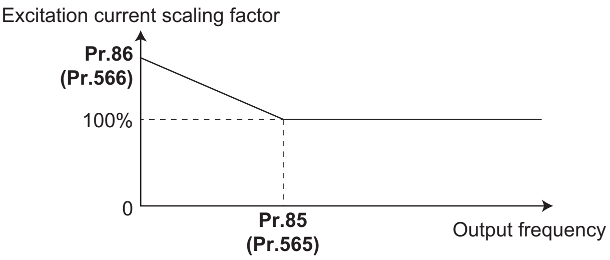
Under Advanced magnetic flux vector control, the excitation current scaling factor in the low-speed range can be adjusted.

Pr.	Name	Initial value	Setting range	Description	
14 G003	**Load pattern selection**	1	0	Excitation current low-speed scaling factor: **Pr.86**	For constant-torque load[*1]
			1		For variable-torque load[*1]
			12[*2]	Forward rotation excitation current low-speed scaling factor: **Pr.86** Reverse rotation excitation current low-speed scaling factor: **Pr.617**	
			13[*2]	Forward rotation excitation current low-speed scaling factor: **Pr.617** Reverse rotation excitation current low-speed scaling factor: **Pr.86**	
			14[*2]	Forward rotation excitation current low-speed scaling factor: **Pr.86** Reverse rotation excitation current low-speed scaling factor: **Pr.617**	
			15[*2]	Forward rotation excitation current low-speed scaling factor: **Pr.617** Reverse rotation excitation current low-speed scaling factor: **Pr.86**	
85 G201	**Excitation current break point**	9999	0 to 400 Hz	Set the frequency at which increased excitation is started.	
			9999	10 Hz is applied.	
86 G202	**Excitation current low-speed scaling factor**	9999	0 to 300%	Set an excitation current scaling factor at 0 Hz.	
			9999	130% is applied.	
617 G080	**Reverse rotation excitation current low-speed scaling factor**	9999	0 to 300%	Set an excitation current scaling factor when different excitation current scaling factors are used for forward and reverse rotation.	
			9999	130% is applied.	
565 G301	**Second motor excitation current break point**	9999	0 to 400 Hz	Set an excitation current break point when the RT signal is ON.	
			9999	10 Hz is applied.	
566 G302	**Second motor excitation current low-speed scaling factor**	9999	0 to 300%	Set an excitation current low-speed scaling factor when the RT signal is ON.	
			9999	130% is applied.	

*1 The setting is applied to the operation under V/F control.

*2 The setting is valid only under Advanced magnetic flux vector control. When **Pr.14** = "12 to 15" and V/F control is selected, the operation is the same as the one for constant-torque load (**Pr.14** = "0").

- Under Advanced magnetic flux vector control, excitation current in the low-speed range can be increased to improve torque. When **Pr.14** = "12 to 15", the excitation current scaling factor can be switched for the forward/reverse rotation.
- Increased excitation is applied when the output frequency is equal to or lower than the setting in **Pr.85 Excitation current break point**. The excitation current scaling factor at 0 Hz is set in **Pr.86 Excitation current low-speed scaling factor**. Use **Pr.565 Second motor excitation current break point** and **Pr.566 Second motor excitation current low-speed scaling factor** for the setting for using the second motor (RT signal-ON).



- An excitation current low-speed scaling factor set in the parameter shown in the table is used according to the **Pr.14** setting and other conditions.

Pr.14 setting	During forward rotation		During reverse rotation	
	RT signal OFF	RT signal ON	RT signal OFF	RT signal ON
0, 1	**Pr.86**	**Pr.566**	**Pr.86**	**Pr.566**
12	**Pr.86**	**Pr.566**	**Pr.617**	**Pr.617**
13	**Pr.617**	**Pr.617**	**Pr.86**	**Pr.566**
14	**Pr.86**	**Pr.566**	**Pr.617**	**Pr.566**
15	**Pr.617**	**Pr.566**	**Pr.86**	**Pr.566**

5.13.5 Energy saving control

V/F Magnetic flux

Inverter will perform energy saving control automatically even when the detailed parameter settings are made.
It is appropriate for applications such as fan and pump.

Pr.	Name	Initial value	Setting range	Description
60 **G030**	**Energy saving control selection**	0	0	Normal operation
			4	Energy saving operation
			9	Optimum excitation control

5

◆ Energy saving operation (setting "4")

- Setting **Pr.60** = "4" will select the energy saving operation.
- With the energy saving operation, the inverter will automatically control the output voltage so the inverter output power during the constant-speed operation will become minimal.
- Energy saving operation will be enabled under V/F control.

◆ Optimum excitation control (setting "9")

- Setting **Pr.60** = "9" will select the Optimum excitation control.
- The Optimum excitation control is a control method to decide the output voltage by controlling the excitation current so the efficiency of the motor is maximized.
- Optimum excitation control will be enabled under V/F control and Advanced magnetic flux vector control.

NOTE

- An energy saving effect is not expected with the energy saving operation mode for applications with high load torque or with the equipment with frequent acceleration and deceleration.
- An energy saving effect is not expected with the Optimum excitation control mode when the motor capacity is extremely small compared with the inverter capacity or when multiple motors are connected to a single inverter.
- When the energy saving operation mode or Optimum excitation control mode is selected, the deceleration time may become longer than setting value. Also, it may cause overvoltage more often compared to constant-torque load characteristics, so set the deceleration time longer.
- When the motor becomes unstable during the acceleration, set the acceleration time longer.
- Output current may increase slightly with the energy saving operation mode or the Optimum excitation control mode since the output voltage is controlled.

5.13.6 Adjustable 5 points V/F

By setting a desired V/F characteristic from the start up to the base frequency or base voltage with the V/F control (frequency voltage/frequency), a dedicated V/F pattern can be generated.

Optimal V/F pattern matching the torque characteristics of the facility can be set.

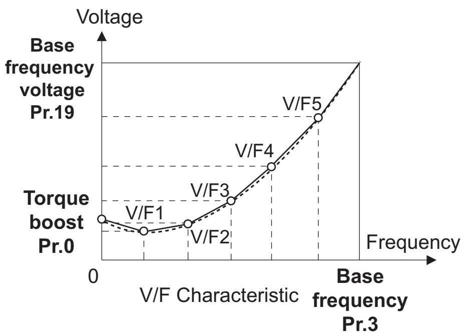
Pr.	Name	Initial value	Setting range	Description
71 C100	Applied motor	0	2	Standard motor Adjustable 5 points V/F
			Others	Refer to page 351.
100 G040	V/F1 (first frequency)	9999	0 to 590 Hz, 9999	Set each point of the V/F pattern (frequency, voltage). 9999: Do not set V/F
101 G041	V/F1 (first frequency voltage)	0 V	0 to 1000 V	
102 G042	V/F2 (second frequency)	9999	0 to 590 Hz, 9999	
103 G043	V/F2 (second frequency voltage)	0 V	0 to 1000 V	
104 G044	V/F3 (third frequency)	9999	0 to 590 Hz, 9999	
105 G045	V/F3 (third frequency voltage)	0 V	0 to 1000 V	
106 G046	V/F4 (fourth frequency)	9999	0 to 590 Hz, 9999	
107 G047	V/F4 (fourth frequency voltage)	0 V	0 to 1000 V	
108 G048	V/F5 (fifth frequency)	9999	0 to 590 Hz, 9999	
109 G049	V/F5 (fifth frequency voltage)	0 V	0 to 1000 V	

- By setting the **V/F1 (first frequency voltage/first frequency) to V/F5** parameters in advance, a desired V/F characteristic can be obtained.
- For an example, with the equipment with large static friction factor and small dynamic friction factor, large torque is required only at the start up, so a V/F pattern that will raise the voltage only at the low-speed range is set.
- Setting procedure

1. Set the rated motor voltage in **Pr.19 Base frequency voltage**. (No function at the setting of "9999" or "8888".)

2. Set **Pr.71 Applied motor** = "2" (adjustable 5 points V/F).

3. Set frequency and voltage to be set in **Pr.100 to Pr.109**.



V/F Characteristic

⚠ CAUTION

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

NOTE

- Adjustable 5 points V/F will become enabled at the time of V/F control.
- At the time of **Pr.19 Base frequency voltage** = "8888, 9999", setting of **Pr.71** = "2" cannot be made. When setting **Pr.71** = "2", set the rated motor voltage in **Pr.19**.
- Read only error (Er1) is generated when the frequency value for each point is same.
- Set each point for **Pr.100 to Pr.109** (frequency, voltage) within the range of **Pr.3 Base frequency and Pr.19 Base frequency voltage**.
- When **Pr.71** = "2", **Pr.47 Second V/F (base frequency)** will not function.
- When **Pr.71** = "2", electronic thermal O/L relay will make calculations assuming a standard motor.
- By simultaneously using **Pr.60 Energy saving control selection** and the adjustable 5 points V/F, further energy saving effect is expected.

Parameters referred to

Pr.0 Torque boost ☞ page 538
Pr.3 Base frequency, Pr.19 Base frequency voltage ☞ page 539
Pr.12 DC injection brake operation voltage ☞ page 546
Pr.47 Second V/F (base frequency) ☞ page 544
Pr.60 Energy saving control selection ☞ page 543
Pr.71 Applied motor, Pr.450 Second applied motor ☞ page 351

5.13.7 DC injection brake

- Timing to stop or braking torque can be adjusted by applying DC injection brake at the time of stopping motor. By the DC injection brake operation, DC voltage is applied to the motor to prevent rotation of the motor shaft. The motor shaft will not return to its original position when it is rotated due to external force.

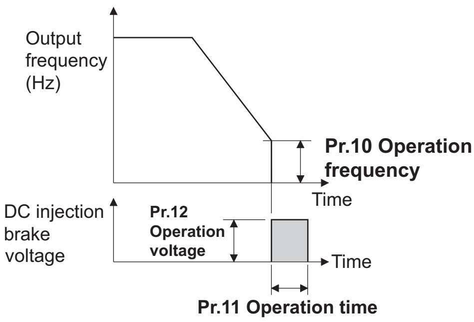
Pr.	Name	Initial value	Setting range	Description
10 **G100**	**DC injection brake operation frequency**	3 Hz	0 to 120 Hz	Set the operation frequency for the DC injection brake.
			9999	Operate at **Pr.13** or lower
11 **G101**	**DC injection brake operation time**	0.5 s	0	Without DC injection brake
			0.1 to 10 s	Set the operation time for the DC injection brake.
			8888	Operate with X13 signal ON
12 **G110**	**DC injection brake operation voltage**	1%	0 to 30%	Set the DC injection brake voltage (torque). When set to "0", there will be without DC injection brake.

◆ Setting of operating frequency (Pr.10)

- By setting the frequency to operate the DC injection brake to **Pr.10 DC injection brake operation frequency**, the DC injection brake will operate when it reaches this frequency at the time of deceleration.
- When **Pr.10** = "9999", DC injection brake will start when the frequency reaches **Pr.13 Starting frequency**.
- The DC injection brake operation frequency depends on the stopping method.

Stopping method	Parameter setting	DC injection brake operation frequency
Press the STOP key on the operation panel Turning OFF of the STF/STR signal	0.5 Hz or higher in **Pr.10**	**Pr.10** setting
	Lower than 0.5 Hz in **Pr.10**, and 0.5 Hz or higher in **Pr.13**	0.5 Hz
	Lower than 0.5 Hz in both **Pr.10** and **Pr.13**	**Pr.10** or **Pr.13** setting, whichever larger
Set the frequency to 0 Hz	—	**Pr.13** setting or 0.5 Hz, whichever smaller

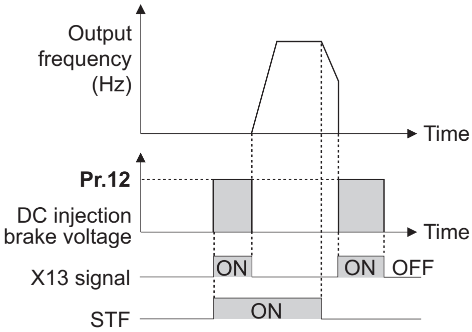
- DC injection brake operation frequency will be fixed to 0 Hz at the time of PM motor control.



◆ Setting of operation time (X13 signal, Pr.11)

- Set the time applying the DC injection brake to **Pr.11 DC injection brake operation time**.
- When the motor does not stop due to large load moment (J), increasing the setting produces an effect.
- When **Pr.11** = "0 s", DC injection brake will not operate. (The motor will coast to stop.)
- When **Pr.11** = "8888", DC injection brake will operate when the X13 signal is turned ON. DC injection brake will operate when the X13 signal is turned ON even while operating.
- For the X13 signal input, set "13" in any of **Pr.178 to Pr.189** to assign the function.

When **Pr.11** = "8888"



NOTE

- The X13 signal is disabled during PM motor control.

◆ Setting of operation voltage (torque) (Pr.12)

- **Pr.12 DC injection brake operation voltage** will set the percent against the power supply voltage.
- DC injection brake will not operate with setting of **Pr.12** = "0%". (The motor will coast to stop.)

NOTE

- Even if the setting value of **Pr.12** is made larger, braking torque will be limited so the output current will be within the rated current of the inverter.

⚠ CAUTION

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

Parameters referred to

Pr.13 Starting frequency ☞ page 201, page 202
Pr.71 Applied motor ☞ page 351
Pr.80 Motor capacity ☞ page 353
Pr.178 to Pr.182 (Input terminal function selection) ☞ page 343

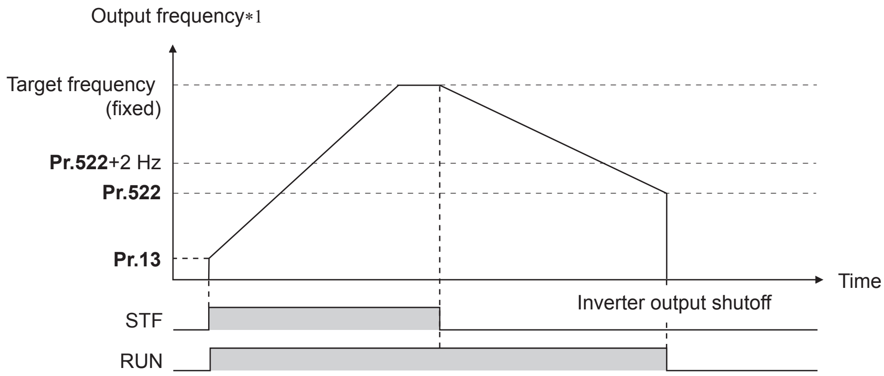
5.13.8 Output stop function

The motor coasts to a stop (inverter output shutoff) when inverter output frequency falls to **Pr. 522** setting or lower.

Pr.	Name	Initial value	Setting range	Description
522 **G105**	**Output stop frequency**	9999	0 to 590 Hz	Set the frequency to start coasting to a stop (output shutoff).
			9999	No function

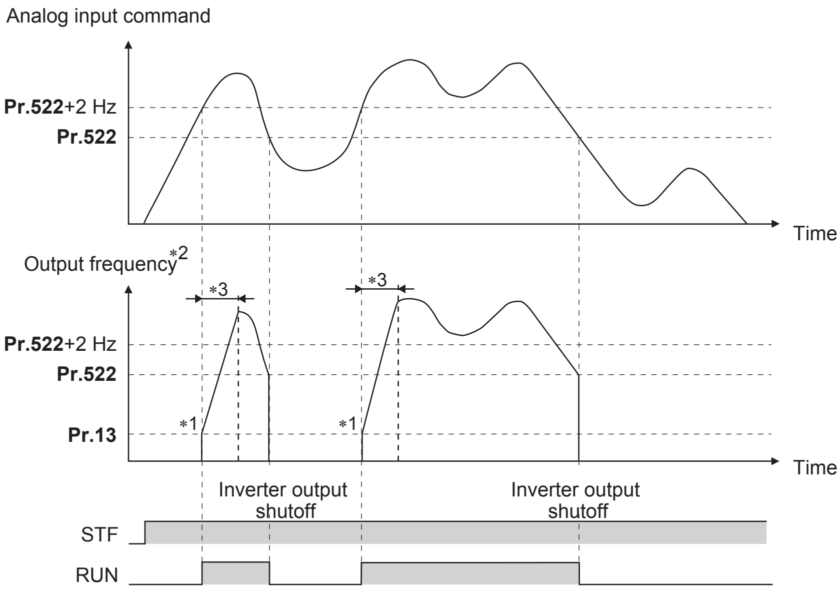
- When both of the frequency setting signal and output frequency falls to the frequency set in **Pr. 522** or lower, the inverter stops the output and the motor coasts to a stop.
- At a stop condition, the motor starts running when the frequency setting signal exceeds **Pr.522** + 2 Hz. The motor is accelerated at the **Pr.13 Starting frequency** (0.01 Hz under PM motor control) at the start.

Example of when target frequency>**Pr.522**+2 Hz, and start signal is ON/OFF



*1 The output frequency before the slip compensation is compared with the **Pr.522** setting.

Example of: target frequency = analog input command, start signal always ON



*1 At a stop condition, the motor is accelerated at the **Pr.13 Starting frequency** (0.01 Hz under PM motor control).

*2 The output frequency to be compared with the **Pr.522** setting is the output frequency before slip compensation (V/F control and Advanced magnetic flux vector control), or the speed command value converted into the frequency (PM motor control).

*3 Steepness of the slope depends on the acceleration/deceleration time settings such as **Pr.7**.

NOTE

- When the output stop function is valid (**Pr.522** ≠ "9999"), the DC injunction brake becomes invalid and the motor coasts to stop when the output frequency drops to the **Pr.522** setting or lower.
- Motor coasts when the command value drops to **Pr.522** or lower while the start signal is ON. If the command value exceeds **Pr.522**+2 Hz again while coasting, the motor starts running at **Pr.13 Starting frequency** (0.01 Hz under PM motor control). When the motor re-accelerates after coasting, the inverter may trip in some parameter settings. (Activation of the restart function is recommended especially for a PM motor.)
- The output stop frequency function is disabled during PID control, JOG operation, power failure stop, traverse function operation, or offline auto tuning.
- 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.

5

⚠ CAUTION

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

Parameters referred to

Pr.10 DC injection brake operation frequency, Pr.11 DC injection brake operation time, Pr.12 DC injection brake operation voltage ☞ page 546
Pr.13 Starting frequency ☞ page 201, page 202

5.13.9 Start signal operation selection / Stop selection

Select the stopping method (deceleration to stop or coasting) at turn-OFF of the start signal.
Use this function to stop a motor with a mechanical brake at turn-OFF of the start signal.
Selection of start signal (STF/STR) operation can also be selected.

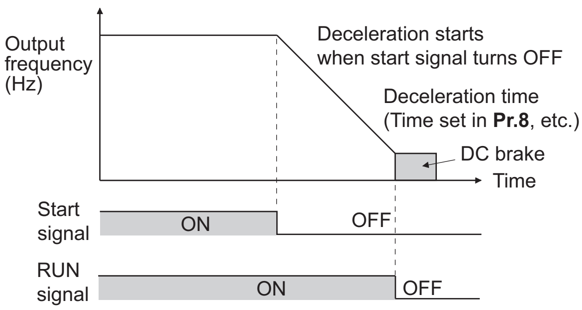
Pr.	Name	Initial value	Setting range	Description	
				Start signal (STF/STR)	**Stop operation**
250 **G106**	**Stop selection**	9999	0 to 100 s	STF signal: Forward rotation start STR signal: Reverse rotation start	It will coast to stop after set time when the start signal is turned OFF.
			1000 s to 1100 s*1	STF signal: Start signal STR signal: Forward/reverse rotation signal	It will coast to stop after (**Pr.250** - 1000) s when the start signal is turned OFF.
			9999	STF signal: Forward rotation start STR signal: Reverse rotation start	It will perform deceleration stop when the start signal is turned OFF.
			8888*1	STF signal: Start signal STR signal: Forward/reverse rotation signal	

*1 This setting value is valid only in External operation mode.

◆ Stop selection

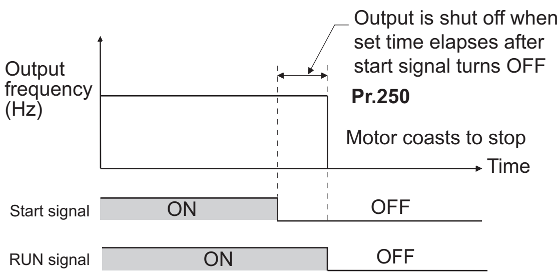
■ Make the motor perform deceleration stop

- Set **Pr.250** = "9999 (initial value) or 8888".
- It will perform deceleration stop when the start signal (STF/STR) is turned OFF.



■ Make the motor perform coast to stop

- Set the time from the time the start signal is turned OFF to when the output is shutoff in **Pr.250**. When set to "1000 to 1100", output is shutoff after (**Pr.250** - 1000) s.
- The output is shutoff after the set time of **Pr.250** has elapsed after the start signal is turned OFF. The motor will coast to stop.
- The RUN signal will be turned OFF at the time of output stop.



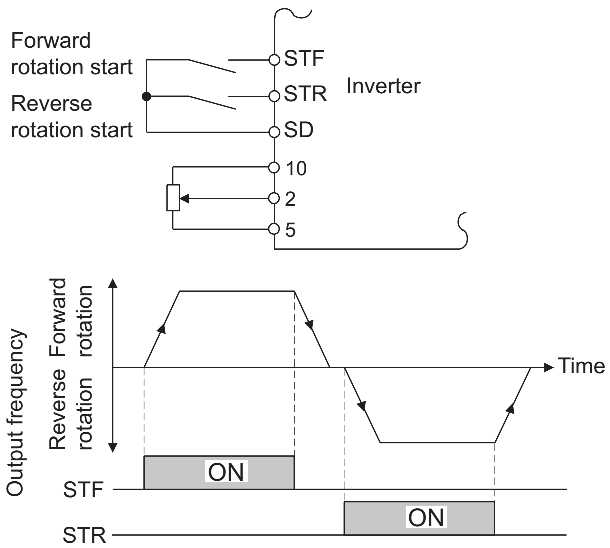
NOTE

- Stop selection is disabled when following functions are operating.
  Power failure stop function (**Pr.261**)
  PU stop (**Pr.75**)
  Deceleration stop due to communication error (**Pr.502**)
  Offline auto tuning (with motor rotation)
- When **Pr.250** ≠ "9999 or 8888", acceleration/deceleration is performed in accordance to the frequency command until the output is shutoff by turning OFF the start signal.
- When the restart signal is turned ON during the motor coasting, the operation is resumed from **Pr.13 Starting frequency**.

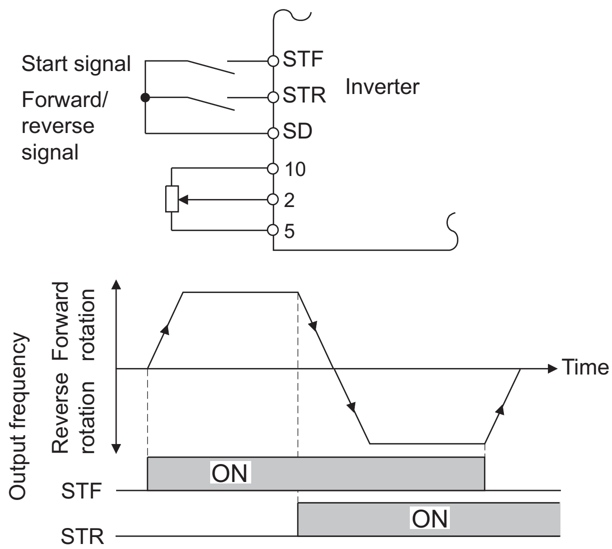
◆ Start signal operation selection

■ 2-wire type (STF, STR signal)

- The following figure shows the connection in 2-wire type.
- As an initial setting, forward/reverse rotation signals (STF/STR) acts as both start and stop signals. Either one turned ON will be enabled, and the operation will follow that signal. The motor will perform a deceleration stop when both are turned OFF (or both are turned ON) during the operation.
- There are methods such as inputting 0 to 10 VDC between the speed setting input terminals 2 and 5, or **Pr.4 to Pr.6 multi-speed setting (fast, medium, slow)** for the frequency setting signal. (For multi-speed operation, refer to page 226.)
- By setting **Pr.250** = "1000 to 1100, 8888", STF signal becomes start command and STF signal becomes forward/reverse command.



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



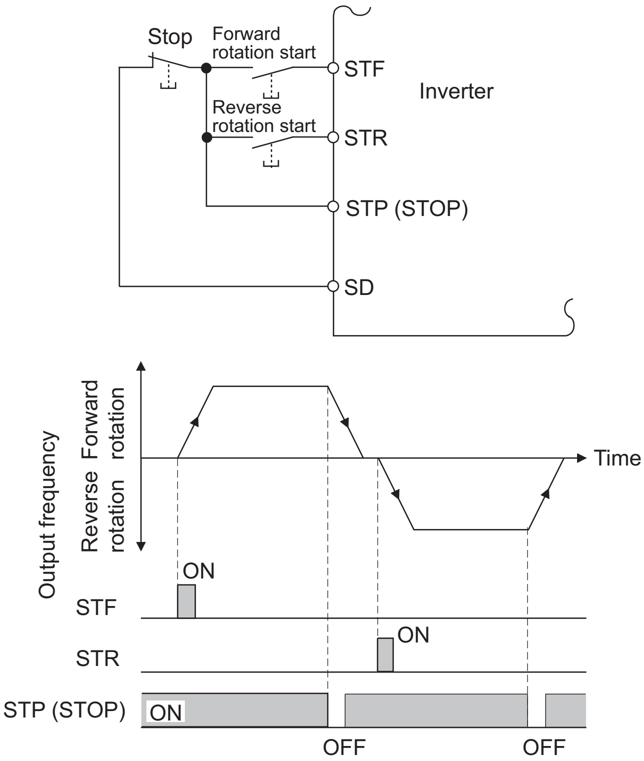
2-wire type connection example (Pr.250 = "8888")

NOTE

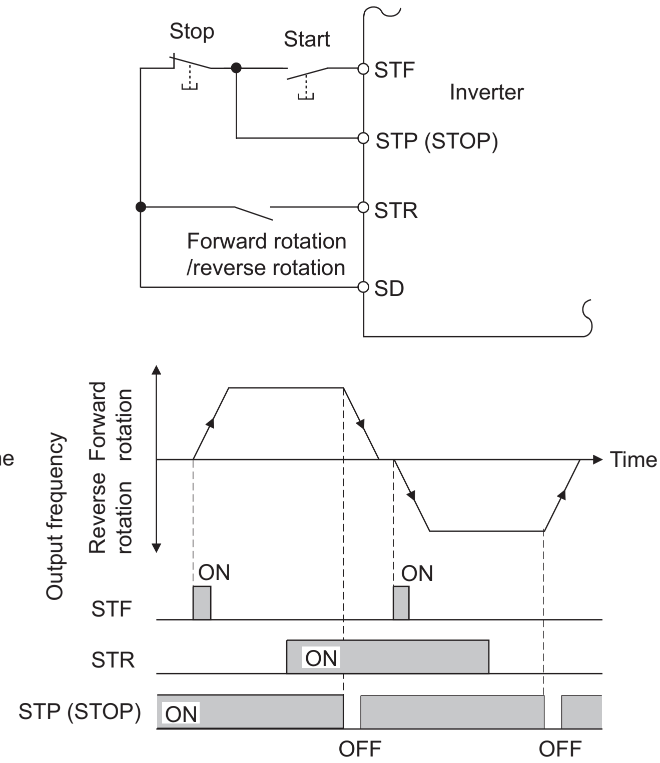
- By setting **Pr.250** = "0 to 100, 1000 to 1100", it will perform coast to stop when the start command is turned OFF.
- The STF and STR signals are assigned to the terminals STF and STR in the initial status. STF signal can be assigned to a terminal by **Pr.178 STF terminal function selection**, and STR signal can be assigned to a terminal by **Pr.179 STR terminal function selection**.

■ 3-wire type (STF, STR, STP (STOP) signal)

- The following figure shows the connection in 3-wire type.
- Start self-holding function is enabled when the STP (STOP) signal is turned ON. In such case, forward/reverse signal will only operate as start signal.
- Even if start signal (STF or STR) is turned ON and then OFF, the start signal will be maintained and it will start. To change the rotation direction, turn STR (STF) ON once and then OFF.
- The inverter will perform deceleration stop by turning the STP (STOP) signal OFF once.



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



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

NOTE

- The STP (STOP) signal is assigned to the terminal STP (STOP) by the initial setting. Set "25" in any of **Pr.178 to Pr.189** to assign the STP (STOP) signal to another terminal.
- When the JOG operation is enabled by turning ON the JOG signal, STOP signal will be disabled.
- Even when the output is stopped by turning ON the MRS signal, self-holding function is not canceled.

■ Start signal selection

STF	STR	Pr.250 setting and inverter condition	
		0 to 100 s, 9999	1000 s to 1100 s, 8888
OFF	OFF	Stop	Stop
OFF	ON	Reverse rotation	
ON	OFF	Forward rotation	Forward rotation
ON	ON	Stop	Reverse rotation

Parameters referred to

Pr.4 to Pr.6 (multi-speed setting) ☞ page 226
Pr.7 Acceleration time, Pr.8 Deceleration time ☞ page 190
Pr.13 Starting frequency ☞ page 201, page 202
Pr.75 Reset selection/disconnected PU detection/PU stop selection ☞ page 162
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.261 Power failure stop selection ☞ page 458
Pr.502 Stop mode selection at communication error ☞ page 478

5.13.10 DC feeding mode

- It is possible to choose between the DC feeding mode 1, which will operate with DC power supply (terminals P and N), and DC feeding mode 2, which will normally operate in AC power supply (terminals R, S, and T) and operate in DC power supply (terminal P and N), such as batteries, at the time of power failure.
- While the power is supplied only to the control circuit, the reset operation when the power is supplied to the main circuit can be selected.

Pr.	Name	Initial value	Setting range	Description
30 **E300**	**Regenerative function selection**	0[*1] 10[*2]	0, 10, 20, 100, 110, 120[*1]	Select the value according to the terminals used for power supply and whether to reset the inverter when the power is supplied to the main circuit.
			10, 110[*2]	
			1, 2, 11, 21, 101, 102, 111, 121	For manufacturer setting. Do not set.
599 **T721**	**X10 terminal input selection**	0[*1] 1[*2]	0	Normally open input
			1	Normally closed input (NC contact input specification)

*1 The initial value or setting range for the standard model

*2 The initial value or setting range for the separated converter type.

◆ Details of the setting value

Power supply terminals of inverter	Pr.30 Setting[*1]
R, S, T	0 (initial value), 100
P, N	10, 110
R, S, T/P, N	20, 120
For manufacturer setting. Do not set.	1, 2, 11, 21, 101, 102, 111, 121

- FR-F862-05450 or higher

Regeneration unit	Pr.30 Setting[*1]
Without regenerative function (FR-CC2-C)	10 (initial value), 110
For manufacturer setting. Do not set.	2, 11, 102, 111

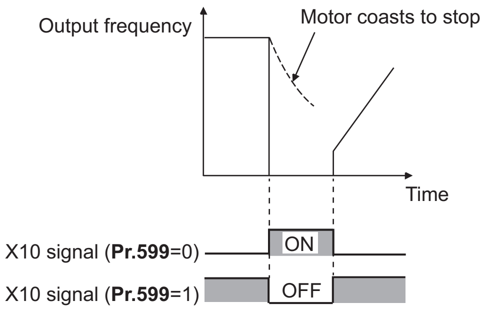
*1 While the power is supplied only to the control circuit with **Pr.30** = "100 or higher", the inverter reset is not performed when the power is supplied to the main circuit.

◆ When using the converter unit (FR-CC2-C) (Separated converter type)

- When using FR-CC2, set **Pr.30**="10" (initial value of separated converter type).
- Assign the following signal to a contact input terminal using any of **Pr.178 to Pr.189 (Input terminal function selection)**.
  - (a) Inverter run enable signal (X10): FR-CC2-C connection
    To have coordinated protection with FR-CC2-C, shutoff the inverter output by the X10 signal.
    Input the RDA signal of FR-CC2-C.
  - (b) FR-CC2 connection, instantaneous power failure detection signal (X11): FR-CC2-C connection
    During the operation using RS-485 communication, with the remote output and analog remote output functions enabled, the X11 signal is used to store the status when the inverter is set to store the status before an instantaneous power failure.
    Input the IPF signal (instantaneous power failure detection signal) of the FR-CC2-C.
- For the terminal to be used for the X10 and X11 signal, set "10" (X10), "11" (X11) in **Pr.178 to Pr.189** and assign the function. (For separated converter types, the X10 signal is assigned to the terminal MRS in the initial setting.)

◆ Logic reversing of inverter run enable signal (X10 signal, Pr.599) (Separated converter type)

- Use **Pr.599 X10 terminal input selection** to select the X10 signal input specification between normally open (NO contact) and normally closed (NC contact). With the normally closed (NC contact) input specification, the inverter output is shut off by turning OFF (opening) the X10 signal.
- Changing the inverter logic (NO/NC contact) with the **Pr.599** setting is required according to the logic of the inverter operation enable signal sent from the option unit.
- The response time of the X10 signal is within 2 ms.



- Relationship between **Pr.599** and the inverter operation enable signal of each option unit

Pr.599 setting	Corresponding signals of the FR-CC2-C	Operation according to the X10 signal status
0 (Initial value)	RDB	X10-ON: Inverter output shutoff (NO contact)
1 (Initial value)	RDA	X10-OFF: Inverter output shutoff (NC contact)

NOTE

- If the X10 signal is unassigned while **Pr.30** = "10 or 110" (DC feeding mode 1), the MRS signal can be used as the X10 signal. At this time, logic setting for the signal will follow **Pr.17 MRS input selection**.
- The X10 signal is valid when **Pr.30** = "10 or 110".
- MRS signal is enabled from any of the communication or external input, but when using the MRS signal as Inverter run enable signal (X10), it can be used as input from external.
- When the terminal assignment is changed with **Pr.178 to Pr.189 (Input terminal function selection)**, wiring may be mistaken due to different terminal name and signal contents, or may affect other functions. Set parameters after confirming the function of each terminal.

◆ Reset when the power is supplied to the main circuit (Pr.30 = "100, 110, or 120")

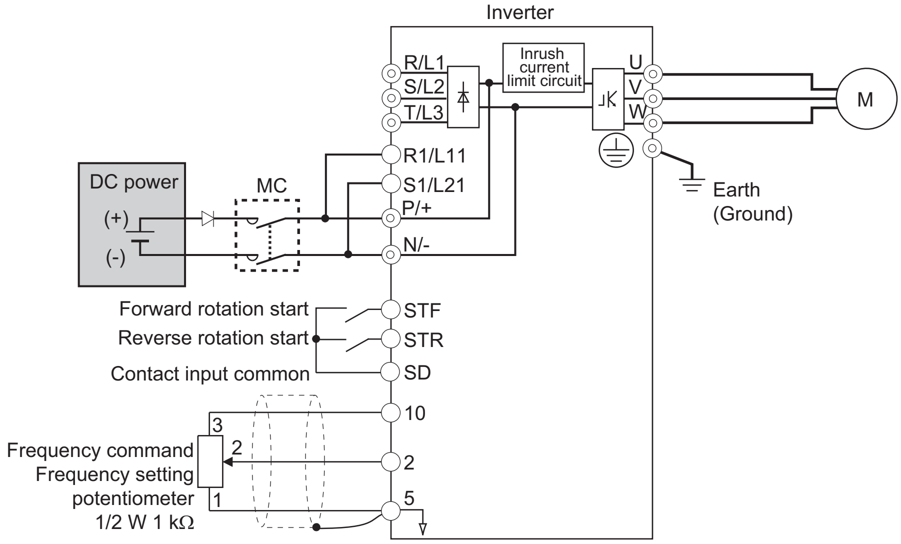
- While the power is supplied only to the control circuit (R1/L11, S1/L12 input or 24 V external power supply) with **Pr.30** = "100 or higher", the inverter reset is not performed when the power is supplied (R/L1, S/L2, T/L3 input) to the main circuit.
- When a communication option, etc. is used, communication interruption due to the inverter reset can be avoided.

NOTE

- When the power is supplied to the main circuit while the inverter protective function is activated, the inverter reset is performed even if it the setting is "No reset" at power ON.

◆ DC feeding mode 1 (Pr.30 = "10") (Standard models)

- For standard models, setting **Pr.30** = "10" allows operation with a DC power supply.
- Do not connect anything to the AC power supply connecting terminals R/L1, S/L2, and T/L3, and connect the DC power supply to the terminals P/+ and N/-. Also, remove the jumpers between terminal R/L1 and R/L11as well as between S/L2 and S1/L21, and connect the terminals R1/L11 and S1/L21 to the terminals P/+ and N/-.
- Following is a connection example.



CAUTION

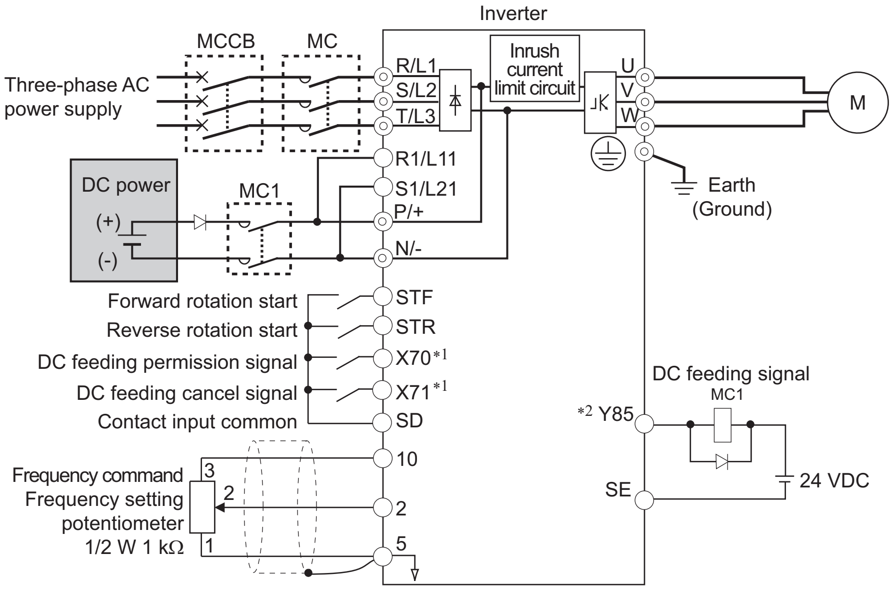
• Do not connect a separated converter type inverter to a DC power supply. Doing so may damage the inverter.

◆ DC feeding mode 2 (Pr.30 = "20") (Standard models)

- When **Pr.30** = "20", it will normally operate with AC power supply and operate with DC power supply such as batteries at the time of power failure.
- Connect the AC power supply to the AC power supply connecting terminals R/L1, S/L2, and T/L3, and connect the DC power supply to the terminals P/+ and N/-. Also, remove the jumpers between terminal R/L1 and R/L11as well as between S/L2 and S1/L21, and connect the terminals R1/L11 and S1/L21 to the terminals P/+ and N/-.
- Operation with DC current is possible by turning ON the DC feeding operation permission signal (X70). For details on I/O signal, refer to following table.

Signal name		Name	Description	Parameter setting
Input	X70	DC feeding operation permission signal	To operate with DC feeding, turn ON the X70 signal. When the inverter output is shutoff due to power failure, it will be possible to start up 200 ms after turning ON the X70 signal. (Automatic restart after instantaneous power failure can start after the time set in **Pr.57** has elapsed.) When the X70 signal is turned OFF while operating the inverter, output shutoff (**Pr.261** = 0) or deceleration stop (**Pr.261** ≠ 0) will occur.	Set "70" to either of **Pr.178 to Pr.189**.
Input	X71	DC feeding cancel signal	Turn ON when stopping the DC feeding. When the X71 signal is turned ON during the operation of the inverter and X70 signal is ON, output shutoff (**Pr.261** = 0) or deceleration stop (**Pr.261** ≠ 0) will occur, and Y85 signal will turn OFF after stopping. After turning ON the X71 signal, operation is not possible even if the X70 signal is turned ON.	Set "71" to either of **Pr.178 to Pr.189**.
Output	Y85	DC feeding signal	This will turn ON during power failure or undervoltage of the AC power supply. It will turn OFF when the X71 signal turns ON or power restoration. The Y85 signal will not turn OFF even with the power restoration while the inverter is running, but turns OFF after stopping the inverter. When the Y85 signal is turned ON due to undervoltage, the Y85 signal will not turn OFF even when the undervoltage is resolved. The ON/OFF status is maintained when the inverter is reset.	Set "85 (positive logic) or 185 (negative logic)" to one of **Pr.190 to Pr.196**.

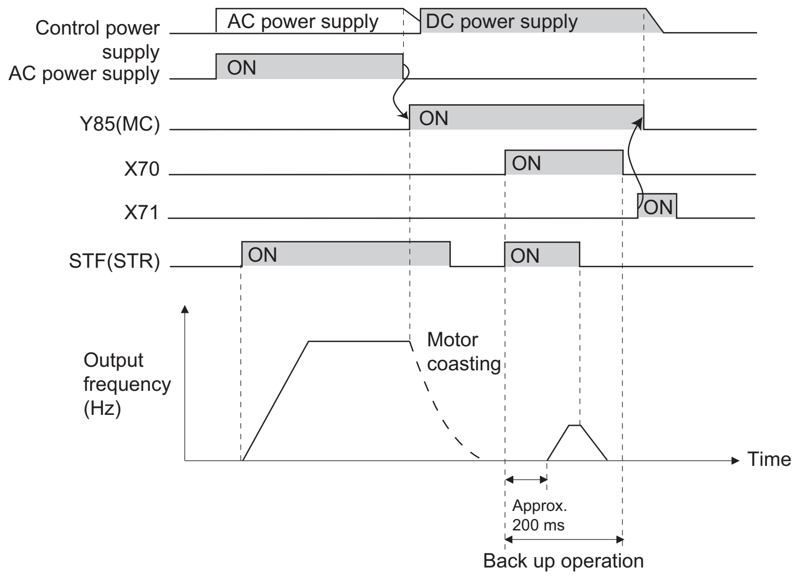
• Following is the connection diagram of switching to DC power supply using the power failure detection of the inverter.



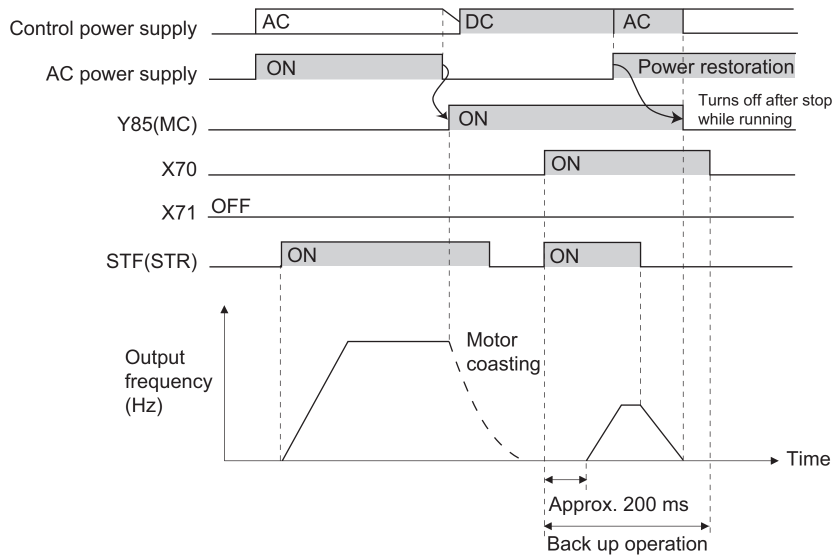
*1 Assign the function by setting **Pr.178 to Pr.189 (Input terminal function selection)**.

*2 Assign the function by setting **Pr.190 to Pr.196 (Output terminal function selection)**.

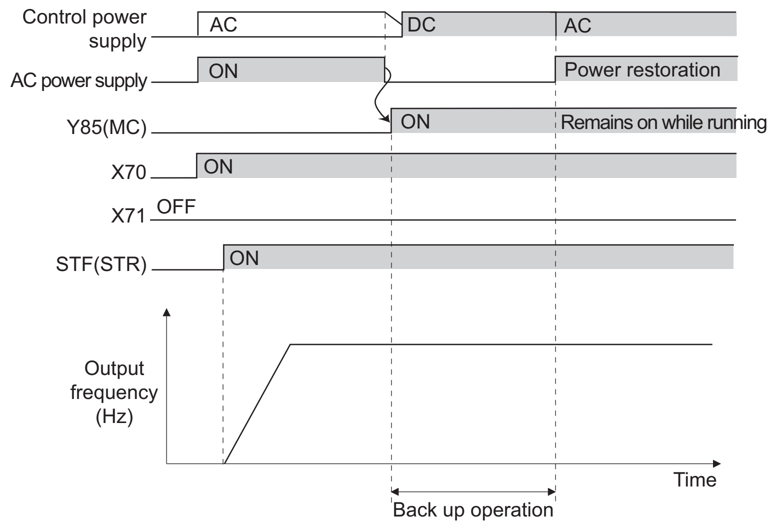
• Operation example at the time of power failure occurrence 1



• Operation example at the time of power failure occurrence 2 (when the AC power supply is restored)



• Operation example at the time of power failure occurrence 3 (when continuing the operation)



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◆ Power supply specification for DC feeding (Standard models)

Rated input DC voltage	742 V DC to 848 V DC
Permissible fluctuation	667 V DC to 933 V DC

NOTE

- The voltage between P and N will temporarily increase to 1057 V or higher during the regenerative driving, so take caution on the selection of the DC power supply.
- When an AC power supply is connected to the R/L1, S/L2, and T/L3 terminals during the DC feeding with **Pr.30** = "10" (DC feeding), an option fault (E.OPT) will occur.
- When the input voltage is insufficient during inverter operation with **Pr.30** = "10, 20" (DC deeding), the inverter output will be shut off. (The undervoltage protection function (E.UVT) is not activated.)
- When set to **Pr.30** = "10, 20" (DC feeding) and operated by DC feeding, detection of Instantaneous power failure (E.IPF) is not performed.
- When DC power is switched on, a larger inrush current flows than in AC power. The number of power-on times should be minimized.
- Changing the terminal assignment using **Pr.178 to Pr.189 (Input terminal function selection) or Pr.190 to Pr.196 (Output terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

Parameters referred to

Pr.17 MRS input selection ☞ page 346
Pr.57 Restart coasting time ☞ page 448
Pr.178 to Pr.189 (Input terminal function selection) ☞ page 343
Pr.190 to Pr.196 (Output terminal function selection) ☞ page 297
Pr.261 Power failure stop selection ☞ page 458

5.13.11 Regeneration avoidance function

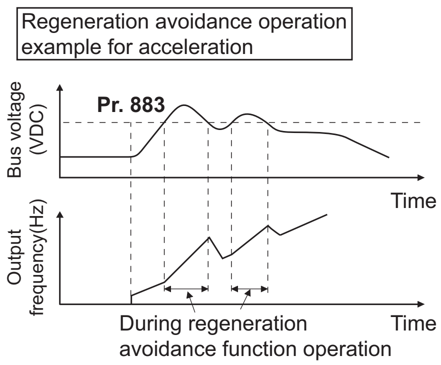
The regenerative status can be avoided by detecting the regenerative status and raising the frequency.

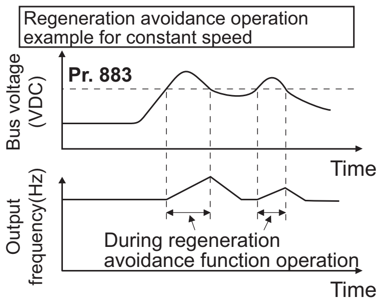
- Continuous operation is possible by increasing the frequency automatically so it will not go into regenerative operation even when the fan is turned forcefully by other fans in the same duct.

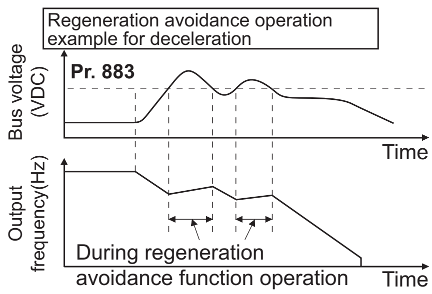
Pr.	Name	Initial value	Setting range	Description
882 G120	**Regeneration avoidance operation selection**	0	0	Disables regeneration avoidance function
			1	Constantly enables regeneration avoidance function
			2	Enables regeneration avoidance function only during constant-speed operation
883 G121	**Regeneration avoidance operation level**	940 VDC	300 to 1200 V	Set the bus voltage level to operate the regeneration avoidance operation. When the bus voltage level is set low, it will be harder to generate overvoltage error, but actual deceleration time will be longer. Set the setting value higher than power supply voltage $\times \sqrt{2}$.
884 G122	**Regeneration avoidance at deceleration detection sensitivity**	0	0	Disables regeneration avoidance due to bus voltage change rate
			1 to 5	Set the sensitivity to detect the bus voltage change rate Setting value 1 (detection sensitivity: low) to 5 (detection sensitivity: high)
885 G123	**Regeneration avoidance compensation frequency limit value**	6 Hz	0 to 590 Hz	Set the limit value for frequency to rise when the regeneration avoidance function operates.
			9999	Disables frequency limit
886 G124	**Regeneration avoidance voltage gain**	100%	0 to 200%	Adjust the response at the time of regeneration avoidance operation. When the setting value is set larger, response against the bus voltage change will improve, but the output frequency may become unstable. When the vibration cannot be stabilized even if the setting value of **Pr.886** is made smaller, set the setting value of **Pr.665** smaller.
665 G125	**Regeneration avoidance frequency gain**	100%	0 to 200%	

◆ What is regeneration avoidance operation? (Pr.882, Pr.883)

- When the regenerative status is large, DC bus voltage will rise, which may cause overvoltage alarm (E.OV[]). Regenerative status can be avoided by detecting this rise of bus voltage, and raising the frequency when the bus voltage level exceeds **Pr.883 Regeneration avoidance operation level**.
- The regeneration avoidance operation can be selected to operate constantly or operate only during constant speed.
- The regeneration avoidance function is enabled by setting to **Pr.882 Regeneration avoidance operation selection** = "1, 2".







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NOTE

- The slope of frequency rising or lowering by the regeneration avoidance operation will change depending on the regenerative status.
- The DC bus voltage of the inverter will be approximately $\sqrt{2}$ times of the normal input voltage. The bus voltage will be approximately 813 VDC in case of input voltage of 575 VAC. However, it may vary depending on the input power supply waveform.
- Make sure that the setting value of **Pr.883** will not get under DC bus voltage level. The frequency will rise with operation of the regeneration avoidance function even at the time of no regenerative status.
- The stall prevention (overvoltage) (oL) will only operate during deceleration, stopping the lowering of output frequency, but on the other hand, the regeneration avoidance function will constantly operate (**Pr.882** = "1") or operate only at constant speed (**Pr.882** = "2"), and raise the frequency depending on the amount of regeneration.
- When the motor becomes unstable due to operation of the stall prevention (overcurrent) (OL) during the regeneration avoidance operation, increase the deceleration time or lower the setting of **Pr.883**.

◆ To detect the regenerative status during deceleration faster (Pr.884)

- Since a rapid change in bus voltage cannot be handled by bus voltage level detection during the regeneration avoidance operation, deceleration is stopped by detecting the change in bus voltage and if it is equal or lower than **Pr.883 Regeneration avoidance operation level**. Set the detectable bus voltage change rate as the detection sensitivity in **Pr.884 Regeneration avoidance at deceleration detection sensitivity** . A larger set value increases the detection sensitivity.

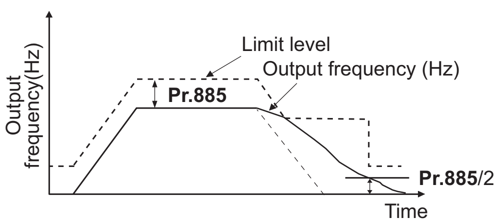
NOTE

- When the setting value is too small (detection sensitivity is not good), detection will not be possible, and regeneration avoidance will operate even with the bus voltage change caused by a change in the input power.

◆ Limit regeneration avoidance operation frequency (Pr.885)

- It is possible to assign a limit to the output frequency corrected (rise) by the regeneration avoidance operation.
- Limit of the frequency is output frequency (frequency before regeneration avoidance operation) + **Pr.885 Regeneration avoidance compensation frequency limit value** for during acceleration and constant speed. During deceleration, when the frequency increases due to the regeneration avoidance operation and exceeds the limit value, the limit value will be retained until the output frequency is reduced to be the half the **Pr.885** setting.
- When the frequency that have increased by the regeneration avoidance operation exceeds **Pr.1 Maximum frequency**, it will be limited to the maximum frequency.
- By setting to **Pr.885** = "9999", regeneration avoidance operation frequency limitation is disabled.
- Set using the motor rated slip frequency as a guideline. Raise the setting value if the overvoltage protection function (E.OV[]) operation at the start of deceleration.

$$\text{Rated motor slip frequency} = \frac{\text{Synchronized speed at the time of base frequency} - \text{rated rotation speed}}{\text{Synchronized speed at the time of base frequency}} \times \text{Rated motor frequency}$$



◆ Adjustment of regeneration avoidance operation (Pr.665, Pr.886)

- When the frequency becomes unstable at the time of regeneration avoidance operation, set the setting value for **Pr.886 Regeneration avoidance voltage gain** smaller. On the other hand, if an overvoltage fault occurs due to a sudden regeneration, increase the setting.
- When the vibration cannot be stabilized even if the setting value of **Pr.886** is made smaller, set the setting value of **Pr.665 Regeneration avoidance frequency gain** smaller.

NOTE

- During the regeneration avoidance operation, the stall prevention (overvoltage) (oL) is displayed and the overload alarm (OL) signal is output. The operation when the OL signal is output can be set with **Pr.156 Stall prevention operation selection**. The OL signal output timing can be set with **Pr.157 OL signal output timer**.
- The stall prevention is enabled even at the time of regeneration avoidance operation.
- The regeneration avoidance function cannot decrease the actual deceleration time for the motor to stop.

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Parameters referred to

Pr.1 Maximum frequency ☞ page 253
Pr.8 Deceleration time ☞ page 190
Pr.22 Stall prevention operation level ☞ page 257

5.13.12 Increased magnetic excitation deceleration

V/F Magnetic flux

Increase the loss in the motor by increasing the magnetic flux at the time of deceleration. Deceleration time can be reduced by suppressing the stall prevention (overvoltage) (oL).

It will make possible to reduce the deceleration time without a brake resistor.

Pr.	Name	Initial value	Setting range	Description
660 G130	**Increased magnetic excitation deceleration operation selection**	0	0	Without increased magnetic excitation deceleration
			1	With increased magnetic excitation deceleration
661 G131	**Magnetic excitation increase rate**	9999	0 to 40%	Set the increase of excitation.
			9999	Magnetic excitation increase rate 10%
662 G132	**Increased magnetic excitation current level**	100%	0 to 300%	The increased magnetic excitation rate is automatically lowered when the output current exceeds the setting value at the time of increased magnetic excitation deceleration.

◆ Setting of increased magnetic excitation rate (Pr.660, Pr.661)

- To enable the increased magnetic excitation deceleration, set **Pr.660 Increased magnetic excitation deceleration operation selection** = "1".
- Set the amount of excitation increase in **Pr.661 Magnetic excitation increase rate**.
- Increased magnetic excitation deceleration will be disabled when **Pr.661** = "0". When "8888 or 9999" is not set in **Pr.19** under V/F control, increased magnetic excitation deceleration will be enabled even when **Pr.661** = "0".
- When the DC bus voltage exceeds the increased magnetic excitation deceleration operation level during the deceleration, excitation is increased in accordance with the setting value in **Pr.661**.
- The increased magnetic excitation deceleration will continue even if the DC bus voltage goes under the increased magnetic excitation deceleration operation level (850 V) during increased magnetic excitation deceleration.
- When the stall prevention (overvoltage) occurs during the increased magnetic excitation deceleration operation, increase the deceleration time or raise the setting value of **Pr.661**. When the stall prevention (overcurrent) occurs, increase the deceleration time or lower the setting value of **Pr.661**.
- Increased magnetic excitation deceleration is enabled with V/F control, Advanced magnetic flux vector control.

NOTE

- The increased magnetic excitation deceleration will be disabled in the following conditions:

During PM motor control, power failure stop, energy saving operation, Optimum excitation control.

◆ Overcurrent prevention function (Pr.662)

- The overcurrent prevention function is valid under V/F control and Advanced magnetic flux vector control.
- Increased magnetic excitation rate is lowered automatically when the output current exceeds **Pr.662** at the time of increased magnetic excitation deceleration.
- When the inverter protective function (E.OC[], E.THT) operates due to increased magnetic excitation deceleration, adjust with **Pr.662**.
- Overcurrent preventive function will be disabled when **Pr.662**= "0".

NOTE

- When set to **Pr.662** > **Pr.22 Stall prevention operation level**, overcurrent preventive function will operate at the setting value of **Pr.22**. (Operates at **Pr.622** when **Pr.22** = "0")

Parameters referred to

Pr.19 Stall prevention operation level ☞ page 539
Pr.22 Stall prevention operation level ☞ page 257
Pr.30 Regenerative function selection ☞ page 553
Pr.60 Energy saving control selection ☞ page 543
Pr.162 Automatic restart after instantaneous power failure selection ☞ page 448
Pr.261 Power failure stop selection ☞ page 458

5.13.13 Slip compensation

V/F

Slip of the motor is estimated from the inverter output current at the time of V/F control, and maintain the rotation of the motor constant.

Pr.	Name	Initial value	Setting range	Description
245 **G203**	**Rated slip**	9999	0.01 to 50%	Set the rated motor slip.
			0, 9999	Without slip compensation
246 **G204**	**Slip compensation time constant**	0.5 s	0.01 to 10 s	Set the response time of the slip compensation. Response will become faster when the value is lowered, but the regenerative overvoltage (E.OV[]) error will occur more frequently when the load inertia is larger.
247 **G205**	**Constant-power range slip compensation selection**	9999	0	Do not perform slip compensation at constant output range (frequency range higher than the frequency set in **Pr.3**).
			9999	Perform the slip compensation of the constant output range.

- Slip compensation will become enabled by calculating the rated motor slip, and setting to **Pr.245**. Slip compensation is not performed when **Pr.245** = "0, 9999".

$$\text{Rated slip} = \frac{\text{Synchronized speed at the time of base frequency - rated rotation speed}}{\text{Synchronized speed at the time of base frequency}} \times 100\ [\%]$$

NOTE

- When the slip compensation is performed, the output frequency may become larger than the set frequency. Set **Pr.1 Maximum frequency** higher than the set frequency.
- Slip compensation will be disabled in following cases. At the times of stall preventive (oL, OL) operation, regeneration avoidance operation, auto tuning

Parameters referred to

Pr.1 Maximum frequency ☞ page 253
Pr.3 Base frequency ☞ page 539

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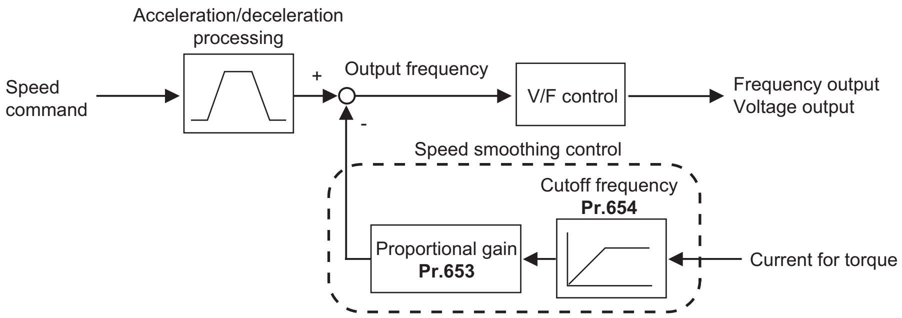
5.13.14 Speed smoothing control

V/F

There are times where the vibration due to mechanical resonance affect the inverter, making the output current (torque) unstable. In such case, vibration can be decreased by reducing the deviation in the output current (torque) by changing the output frequency.

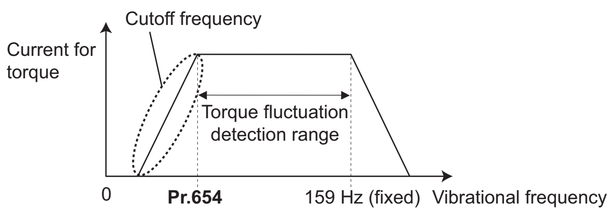
Pr.	Name	Initial value	Setting range	Description
653 **G410**	**Speed smoothing control**	0%	0 to 200%	Confirm the effect by raising and lowering the value with 100% as a reference.
654 **G411**	**Speed smoothing cutoff frequency**	20 Hz	0 to 120 Hz	Set the lower limit of the torque deviation cycle (frequency).

◆ Control block diagram



◆ Setting method

- When vibration caused by mechanical resonance occurs, set 100% in **Pr.653 Speed smoothing control**, perform operation at the frequency with the largest vibration, and check if the vibration is suppressed after few seconds.
- If there is no effect, gradually raise the setting value of **Pr.653**, perform the operation and confirmation of the effect repeatedly, and use the value (**Pr.653**) with most effect as the final setting value.
- If the vibration gets larger by raising **Pr.653**, lower the value of **Pr.653** under 100%, and perform the confirmation of result in a same manner.
- When the vibration frequency (frequency of torque deviation, speed deviation, or converter output voltage deviation) by the mechanical resonance with a measurement device, etc., set the frequency of 1/2 to 1 times the vibration frequency in **Pr.654 Speed smoothing cutoff frequency**. (Setting vibrational frequency range can suppress the vibration better.)



NOTE

- Depending on the equipment, the vibration may not be suppressed sufficiently or the effect is not obtained.

CHAPTER 6 PROTECTIVE FUNCTIONS

6 PROTECTIVE FUNCTIONS

This chapter explains the PROTECTIVE FUNCTION that operates in this product.
Always read the instructions before using the equipment.

6.1 Inverter fault and alarm indications

- When the inverter detects a fault, depending on the nature of the fault, the operation panel displays an error message or warning, or a protective function is activated to trip the inverter.
- When any fault occurs, take an appropriate corrective action, then reset the inverter, and resume the operation. Restarting the operation without a reset may break or damage the inverter.
- When a protective function is activated, note the following points.

Item	Description
Fault output signal	Opening the magnetic contactor (MC) provided on the input side of the inverter at a fault occurrence shuts off the control power to the inverter, therefore, the fault output will not be retained.
Fault or alarm indication	When a protective function activates, the operation panel displays a fault indication.
Operation restart method	While a protective function is activated, the inverter output is kept shutoff. Reset the inverter to restart the operation.

- Inverter fault or alarm indications are categorized as below.

Displayed item	Description
Error message	A message regarding an operational fault and setting fault by the operation panel and the parameter unit. The inverter does not trip.
Warning	The inverter does not trip even when a warning. However, failure to take appropriate measures will lead to a fault.
Alarm	The inverter does not trip. An Alarm (LF) signal can also be output with a parameter setting.
Fault	A protective function is activated to trip the inverter and output a Fault (ALM) signal.

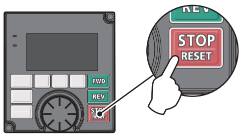
NOTE

- The past eight faults can be displayed on the operation panel. (Fault history) (For the operation, refer to the operation panel or the parameter unit Instruction Manual.)

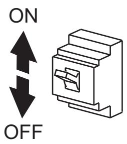
6.2 Reset method for the protective functions

Reset the inverter by performing any of the following operations. Note that the accumulated heat value of the electronic thermal relay function and the number of retries are cleared (erased) by resetting the inverter.
The inverter recovers about 1 s after the reset is released.

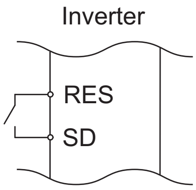
- On the operation panel, press the STOP/RESET key to reset the inverter. (This may only be performed when a fault occurs. (Refer to page 575 of the Instruction Manual for faults.))



- Switch the power OFF once, then switch it ON again.



- Turn ON the reset signal (RES) for 0.1 s or more. (If the RES signal is kept ON, "Err" appears (flickers) to indicate that the inverter is in a reset status.)



NOTE

- OFF status of the start signal must be confirmed before resetting the inverter fault. Resetting an inverter fault with the start signal ON restarts the motor suddenly.

6.3 The list of fault displays

If the displayed message does not correspond to any of the following or if you have any other problem, please contact your sales representative.

◆ Error message

- A message regarding operational fault and setting fault by the operation panel and the parameter unit is displayed. The inverter does not trip.

Abbreviation	Name	Refer to
LOCD	Password locked	570
Er1 to Er 4 Er8	Parameter write error	570
rE1 to rE8	Copy operation error	571
Err.	Error	572

◆ Warning

- The inverter does not trip even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.

Abbreviation	Name	Refer to page
OL	Stall prevention (overcurrent)	573
oL	Stall prevention (overvoltage)	573
TH	Electronic thermal relay function pre-alarm	573
PS	PU stop	574
CP	Parameter copy	574
SA	Safety stop	574
MT1 to MT3	Maintenance signal output	574
UF	USB host error	574
CF	Continuous operation during communication fault	574
ED	Emergency drive in operation	574
LDF	Load fault warning	575

◆ Alarm

- The inverter does not trip. An Alarm (LF) signal can also be output with a parameter setting.

Abbreviation	Name	Refer to page
FN	Fan alarm	575

◆ Fault

- A protective function trips the inverter and outputs a Fault (ALM) signal.
- The data code is used for checking the fault detail via communication or with **Pr.997 Fault initiation**.

Abbreviation	Name	Data code	Refer to page
E.OC1	Overcurrent trip during acceleration	16 (H10)	575
E.OC2	Overcurrent trip during constant speed	17 (H11)	576
E.OC3	Overcurrent trip during deceleration or stop	18 (H12)	576
E.SCF	Output short-circuit fault	20 (H14)	576
E.OV1	Regenerative overvoltage trip during acceleration	32 (H20)	576
E.OV2	Regenerative overvoltage trip during constant speed	33 (H21)	577
E.OV3	Regenerative overvoltage trip during deceleration or stop	34 (H22)	577
E.THT	Inverter overload trip (electronic thermal relay function)	48 (H30)	577
E.THM	Motor overload trip (electronic thermal relay function)	49 (H31)	577
E.FIN	Heat sink overheat	64 (H40)	578
E.IPF	Instantaneous power failure	80 (H50)	578
E.UVT	Undervoltage	81 (H51)	578
E.ILF	Input phase loss	82 (H52)	578
E.OLT	Stall prevention stop	96 (H60)	579
E.SOT	Loss of synchronism detection	97 (H61)	579
E.LUP	Upper limit fault detection	98 (H62)	579
E.LDN	Lower limit fault detection	99 (H63)	579
E.BE	Internal circuit fault	112 (H70)	583
E.GF	Output side earth (ground) fault overcurrent	128 (H80)	579
E.LF	Output phase loss	129 (H81)	580
E.OHT	External thermal relay operation	144 (H90)	580
E.PTC	PTC thermistor operation	145 (H91)	580
E.OPT	Option fault	160 (HA0)	580
E.OP1	Communication option fault	161 (HA1)	580

Abbreviation	Name	Data code	Refer to page
E.16	User definition error by the PLC function	164 (HA4)	581
E.17		165 (HA5)	
E.18		166 (HA6)	
E.19		167 (HA7)	
E.20		168 (HA8)	
E.PE6	Internal storage device fault	172 (HAC)	581
E.PE	Parameter storage device fault (control circuit board)	176 (HB0)	581
E.PUE	PU disconnection	177 (HB1)	581
E.RET	Retry count excess	178 (HB2)	581
E.PE2	Parameter storage device fault (main circuit board)	179 (HB3)	581
E.CPU	CPU fault	192 (HC0)	582
E.5		245 (HF5)	
E.6		246 (HF6)	
E.7		247 (HF7)	
E.CTE	Operation panel power supply short circuit/RS-485 terminals power supply short circuit	193 (HC1)	582
E.P24	24 VDC power fault	194 (HC2)	582
E.CDO	Abnormal output current detection	196 (HC4)	582
E.IOH	Inrush current limit circuit fault	197 (HC5)	582
E.SER	Communication fault (inverter)	198 (HC6)	583
E.AIE	Analog input fault	199 (HC7)	583
E.USB	USB communication fault	200 (HC8)	583
E.SAF	Safety circuit fault	201 (HC9)	583
E.PBT	Internal circuit fault	202 (HCA)	583
E.13		253 (HFD)	583
E.OS	Overspeed occurrence	208 (HD0)	583
E.LCI	4 mA input fault	228 (HE4)	584
E.PCH	Pre-charge fault	229 (HE5)	584
E.PID	PID signal fault	230 (HE6)	584
E.1	Option fault	241 (HF1)	584
E.2		242 (HF2)	
E.3		243 (HF3)	

◆ Others

- The fault history or the operation status of the inverter is notified. It is not a fault indication.

Abbreviation	Name	Refer to page
E.0	No fault history	585
EV	24 V external power supply operation	585
RD	Backup in progress	585
WR	Restoration in progress	585

If faults other than the above appear, contact your sales representative.

6

6.4 Causes and corrective actions

◆ Error message

A message regarding operational troubles is displayed. Output is not shut off.

Abbreviation	LOCD
Name	Password locked
Description	Password function is active. Display and setting of parameters are restricted.
Check point	————
Corrective action	Enter the password in **Pr.297 Password lock/unlock** to unlock the password function before operating. (Refer to page 172.)

Abbreviation	Er1
Name	Parameter write error
Description	• Parameter setting was attempted while **Pr.77 Parameter write selection** is set to disable parameter write. • Overlapping range has been set for the frequency jump. • Overlapping range has been set for the adjustable 5 points V/F. • The PU and inverter cannot make normal communication.
Check point	• Check the **Pr.77 Parameter write selection** setting. (Refer to page 168.) • Check the settings of **Pr.31 to Pr.36 (frequency jump)**. (Refer to page 255.) • Check the settings of **Pr.100 to Pr.109 (adjustable 5 points V/F)**. (Refer to page 544.) • Check the connection of PU and the inverter.

Abbreviation	Er2
Name	Write error during operation
Description	Parameter write was attempted while **Pr.77** = "0".
Check point	• Check that the inverter is stopped.
Corrective action	• After stopping the operation, make parameter setting. • When setting **Pr.77** = "2", parameter write is enabled during operation. (Refer to page 168.)

Abbreviation	**Er3**
Name	Calibration error
Description	Analog input bias and gain calibration values have been set too close.
Check point	Check the settings of **Pr.902, Pr.903, Pr.904, and Pr.905** (calibration functions). (Refer to page 328.)

Abbreviation	Er4
Name	Mode designation error
Description	• Parameter setting was attempted in the External or NET operation mode while **Pr.77** = "1". • Parameter write was attempted when the command source is not at the operation panel.
Check point	• Check that operation mode is PU operation mode. • Check that the **Pr.551** setting is correct.
Corrective action	• After setting the operation mode to the "PU operation mode", make parameter setting. (Refer to page 204.) • When **Pr.77** = "2", parameter write is enabled regardless of the operation mode. (Refer to page 168.) • Set **Pr.551** = "2". (Refer to page 214.)

Abbreviation	Er8
Name	USB memory device operation error
Description	• An operation command was given during the USB memory device operation. • A copy operation (writing) was performed while the PLC function was in the RUN state. • A copy operation was attempted for a password locked project.
Check point	• Check if the USB memory device is operating. • Check if the PLC function is in the RUN state. • Check if the project data is locked with a password.
Corrective action	• Perform the operation after the USB memory device operation is completed. • Stop the PLC function. (Refer to page 466 and the PLC function programming manual.) • Unlock the password of the project data using FR Configurator2. (Refer to the Instruction Manuals of FR Configurator2 and GX Works2.)

Abbreviation	rE1
Name	Parameter read error
Description	• A failure has occurred at the operation panel side EEPROM while reading the copied parameters. • A failure has occurred in the USB memory device while copying the parameters or reading the PLC function project data.
Check point	————
Corrective action	• Perform parameter copy again. • Perform PLC function project data copy again. (Refer to page 466.) • The USB memory device may be faulty. Replace the USB memory device. • The operation panel may be faulty. Please contact your sales representative.

Abbreviation	rE2
Name	Parameter write error
Description	• Parameter copy from the operation panel to the inverter was attempted during operation. • A failure has occurred at the operation panel side EEPROM while writing the copied parameters. • A failure has occurred in the USB memory device while writing the copied parameters or PLC function project data.
Check point	• Check that the inverter is stopped.
Corrective action	• After stopping the operation, perform parameter copy again. • The operation panel may be faulty. Please contact your sales representative. • Perform parameter copy or PLC project data copy again. (Refer to page 466.) • The USB memory device may be faulty. Replace the USB memory device.

Abbreviation	rE3
Name	Parameter verification error
Description	• The data in the inverter are different from the data in the operation panel. • A failure has occurred at the operation panel side EEPROM during parameter verification. • A failure has occurred in the USB memory device during parameter verification. • The data in the inverter are different from the data in the USB memory device or the personal computer (FR Configurator2)
Check point	• Check the parameter setting of the source inverter against the setting of the destination inverter.
Corrective action	• Continue the verification by pressing [SET]. Perform parameter verification again. • The operation panel may be faulty. Please contact your sales representative. • The USB memory device may be faulty. Replace the USB memory device. • Verify the PLC function project data again. (Refer to page 466.)

Abbreviation	rE4
Name	Model error
Description	• A different model was used when parameter copy from the operation panel or parameter verification was performed. • The data in the operation panel were not correct when parameter copy from the operation panel or parameter verification was performed.
Check point	• Check that the parameter copy or verification source inverter is of the same model. • Check that parameter copy to the operation panel was not interrupted by switching OFF the power or by disconnecting the operation panel.
Corrective action	• Perform parameter copy and parameter verification between inverters of the same model (FR-F800 series). • Perform parameter copy to the operation panel from the inverter again.

Abbreviation	rE5
Name	File error
Description	• The data in the USB memory device may be damaged.
Check point	————
Corrective action	• Delete the copy file in the USB memory device and perform parameter copy again.

Abbreviation	rE6
Name	File error
Description	• The parameter copy file in the USB memory device cannot be recognized. • An error has occurred in the file system during transfer of the PLC function data or writing to RAM.
Check point	————
Corrective action	• Perform parameter copy again. • Copy the PLC function project data again. (Refer to page 466.)

Abbreviation	rE7
Name	File quantity error
Description	• A parameter copy was attempted to the USB memory device in which the copy files from 001 to 099 had already been saved.
Check point	• Check if the number of copy files in the USB memory device has reached 99.
Corrective action	• Delete the copy file in the USB memory device and perform parameter copy again.

Abbreviation	rE8
Name	No PLC function project file
Description	The specified PLC function project file does not exist in the USB memory device.
Check point	• Check that the file exists in the USB memory device. • Check that the folder name and the file name in the USB memory device is correct.
Corrective action	The data in the USB memory device may be damaged.

Abbreviation	Err.
Name	RES signal ON or communication circuit fault
Description	• The RES signal is turned ON. • The operation panel and inverter cannot make normal communication (contact faults of the connector). • This error may occur when the voltage at the input side of the inverter drops. • When using a separate power source for the control circuit power (R1/L11, S1/L21) from the main circuit power (R/L1, S/L2, T/L3), this error may appear at turning ON of the main circuit. It is not a fault.
Corrective action	• Turn OFF the RES signal. • Check the connection between the operation panel and the inverter. • Check the voltage on the input side of the inverter.

◆ Warning

Output is not shut off when a protective function activates.

Abbreviation	OL	FR-LU08 FR-PU07	OL
Name	Stall prevention (overcurrent)		
Description	• When the output current of the inverter increases, the stall prevention (overcurrent) function activates. • The following section explains about the stall prevention (overcurrent) function.		
	During acceleration	When the output current of the inverter exceeds the stall prevention level (**Pr.22 Stall prevention operation level**, etc.), this function stops the increase in frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has reduced below stall prevention operation level, this function increases the frequency again.	
	During constant-speed operation	When the output current of the inverter exceeds the stall prevention level (**Pr.22 Stall prevention operation level**, etc.), this function reduces frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has reduced below stall prevention operation level, this function increases the frequency up to the set value.	
	During deceleration	When the output current of the inverter exceeds the stall prevention level (**Pr.22 Stall prevention operation level**, etc.), this function stops the decrease in frequency until the overload current decreases to prevent the inverter from resulting in overcurrent trip. When the overload current has decreased below stall prevention operation level, this function decreases the frequency again.	
Check point	• Check that the **Pr.0 Torque boost** setting is not too large. • The **Pr.7 Acceleration time and Pr.8 Deceleration time** settings may be too short. • Check that the load is not too heavy. • Check for any failures in peripheral devices. • Check that the **Pr.13 Starting frequency** is not too large. • Check that **Pr.22 Stall prevention operation level** is appropriate.		
Corrective action	• Gradually increase or decrease the **Pr.0** setting by 1% at a time and check the motor status. (Refer to page 538.) • Set a larger value in **Pr.7 Acceleration time and Pr.8 Deceleration time**. (Refer to page 190.) • Reduce the load. • Try Advanced magnetic flux vector control. • Change the **Pr.14 Load pattern selection** setting. • The stall prevention operation current can be set in **Pr.22 Stall prevention operation level**. 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.)		

Abbreviation	oL	FR-LU08 FR-PU07	oL
Name	Stall prevention (overvoltage)		
Description	• When the output voltage of the inverter increases, the stall prevention (overvoltage) function activates. • The regeneration avoidance function activates due to excessive regenerative power of the motor. (Refer to page 559.) • The following section explains the stall prevention (overvoltage) function.		
	During deceleration	If the regenerative power of the motor becomes excessive to exceed the regenerative power consumption capability, this function stops decreasing the frequency to prevent overvoltage trip. As soon as the regenerative power has reduced, deceleration resumes.	
Check point	• Check for sudden speed reduction. • Check if the regeneration avoidance function **(Pr.882 to Pr.886)** is being used. (Refer to page 559.)		
Corrective action	The deceleration time may change. Increase the deceleration time using **Pr.8 Deceleration time**.		

Abbreviation	TH	FR-LU08 FR-PU07	TH
Name	Electronic thermal relay function pre-alarm		
Description	Appears if the cumulative value of the electronic thermal O/L relay reaches or exceeds 85% of the preset level of **Pr.9 Electronic thermal O/L relay**. If the specified value is reached, the protection circuit is activated to shut off the inverter output.		
Check point	• Check for large load or sudden acceleration. • Check that the **Pr.9** setting is appropriate. (Refer to page 230.)		
Corrective action	• Reduce the load and frequency of operation. • Set an appropriate value in **Pr.9**. (Refer to page 230.)		

Abbreviation	PS	FR-LU08 FR-PU07	PS
Name	PU stop		
Description	• The motor is stopped using STOP RESET under the mode other than the PU operation mode. (To enable STOP RESET under the mode other than the PU operation mode, set **Pr.75 Reset selection/disconnected PU detection/PU stop selection**. Refer to page 162 for details.)		
Check point	• Check for a stop made by pressing STOP RESET of the operation panel.		
Corrective action	• Turn the start signal OFF and release with PU EXT.		

Abbreviation	CP	FR-LU08 FR-PU07	CP
Name	Parameter copy		
Description	Appears when parameter copy is performed between inverters FR-F860-00680 or lower, FR-F860-01080 or higher		
Check point	Resetting of **Pr.9, Pr.30, Pr.51, Pr.56, Pr.57, Pr.72, Pr.80, Pr.82, Pr.90 to Pr.94, Pr.453, Pr.455, Pr.458 to Pr.462, Pr.557, Pr.859, Pr.860 and Pr.893** is necessary.		
Corrective action	Set the initial value in **Pr.989 Parameter copy alarm release**.		

Abbreviation	SA	FR-LU08 FR-PU07	SA
Name	SA		
Description	Appears when the shorting wire across the terminals S1 and PC or the terminals S2 and PC is disconnected.		
Check point	Check if the shorting wire across the terminals S1 and PC or the terminals S2 and PC is disconnected.		
Corrective action	Short across the terminals S1 and PC and the terminals S2 and PC with shortening wires.		

Abbreviation	MT1 to MT3	FR-LU08 FR-PU07	MT1 to MT3
Name	Maintenance signal output 1 to 3		
Description	Appears when the inverter's cumulative energization time reaches or exceeds the parameter set value. Set the time until the MT is displayed using **Pr.504 Maintenance timer 1 warning output set time** (MT1), **Pr.687 Maintenance timer 2 warning output set time** (MT2), and **Pr.689 Maintenance timer 3 warning output set time** (MT3). MT does not appear when the settings of **Pr.504, Pr.687, and Pr.689** are initial values (9999).		
Check point	The set time of maintenance timer has been exceeded. (Refer to page 186.)		
Corrective action	Take appropriate countermeasures according to the purpose of the maintenance timer setting. Setting "0" in **Pr.503 Maintenance timer 1, Pr.686 Maintenance timer 2**, and **Pr.688 Maintenance timer 3** clears the indication.		

Abbreviation	UF	FR-LU08 FR-PU07	UF
Name	USB host error		
Description	Appears when an excessive current flows into the USB A connector.		
Check point	Check if a USB device other than a USB memory device is connected to the USB A connector.		
Corrective action	• If a device other than a USB memory device is connected to the USB A connector, remove the device. • Setting **Pr.1049 USB host reset** = "1" or inverter reset clears the UF indication.		

Abbreviation	CF	FR-LU08 FR-PU07	CF
Name	Continuous operation during communication fault		
Description	Appears when the operation continues while an error is occurring in the communication line or communication option (when **Pr.502** = "4").		
Check point	• Check for a break in the communication cable. • Check for communication option faults.		
Corrective action	• Check the connection of communication cable. • Replace the communication option.		

Abbreviation	ED	FR-LU08 FR-PU07	ED
Name	Emergency drive in operation		
Description	Appears during emergency drive operation.		
Check point	• Emergency drive operation is performed by turning ON X84 signal.		
Corrective action	• The display is cleared when the emergency drive operation ends. (Refer to page 245.)		

Abbreviation	LDF	FR-LU08 FR-PU07	LDF
Name	Load fault warning		
Description	Appears when the load is deviated from the detection width set in **Pr.1488 Upper limit warning detection width** or **Pr.1489 Lower limit warning detection width**.		
Check point	• Check if too much load is applied to the equipment, or if the load is too light. • Check that the load characteristics settings are correct.		
Corrective action	• Inspect the equipment. • Set the load characteristics (**Pr.1481 to Pr.1487**) correctly.		

◆ Alarm

Output is not shut off when a protective function activates. An alarm can also be output with a parameter setting.
(Set "98" in **Pr.190 to Pr.196 (Output terminal function selection)**. (Refer to page 297.)

Abbreviation	FN	FR-LU08 FR-PU07	FN
Name	Fan alarm		
Description	For the inverter that contains a cooling fan, FN appears on the operation panel when the cooling fan stops due to a fault, low rotation speed or different operation from the setting of **Pr.244 Cooling fan operation selection**.		
Check point	When the cooling fan is replaced, check that the fan is not installed upside down. Check the cooling fan for a failure.		
Corrective action	Install the fan correctly. (Refer to page 600.) If the fan alarm still occurs after the fan is installed correctly, the fan may be faulty. Contact your sales representative.		

◆ Fault

When a protective function activates, the inverter trips and a fault signal is output.

Abbreviation	E.OC1	FR-LU08 FR-PU07	OC During Acc
Name	Overcurrent trip during acceleration		
Description	When the inverter output current reaches or exceeds approximately 170% (LD rating) / 148% (SLD rating) of the rated current during acceleration, the protection circuit is activated and the inverter trips.		
Check point	• Check for sudden speed acceleration. • Check if the downward acceleration time is too long in a lift application. • Check for output short-circuit. • Check that the **Pr.3 Base frequency** setting is not 60 Hz when the motor rated frequency is 50 Hz. • Check if the stall prevention operation level is set too high. Check if the fast-response current limit operation is disabled. • Check that the regenerative driving is not performed frequently. (Check if the output voltage becomes larger than the V/F reference voltage at regenerative driving and overcurrent occurs due to increase in the motor current.) • Check that the inverter capacity matches with the motor capacity. (PM motor control) • Check if a start command is given to the inverter while the motor is coasting. (PM motor control)		
Corrective action	• Set the acceleration time longer. (Shorten the downward acceleration time of the lift.) • If "E.OC1" always appears at start, disconnect the motor once and restart the inverter. If "E.OC1" still appears, contact your sales representative. • Check the wiring to make sure that output short circuit does not occur. • Set 50 Hz in **Pr.3 Base frequency**. (Refer to page 539.) • Lower the stall prevention operation level. Activate the fast-response current limit operation. (Refer to page 257.) • Set the base voltage (rated voltage of the motor, etc.) in **Pr.19 Base frequency voltage**. (Refer to page 539.) • Choose inverter and motor capacities that match. (PM motor control) • Input a start command after the motor stops. (IPM motor control)		

Abbreviation	E.OC2	FR-LU08	OC During Cnst Spd
		FR-PU07	Steady Spd OC
Name	Overcurrent trip during constant speed		
Description	When the inverter output current reaches or exceeds approximately 170% (LD rating) / 148% (SLD rating) of the rated current during constant-speed operation, the protection circuit is activated and the inverter trips.		
Check point	• Check for sudden load change. • Check for output short-circuit. • Check if the stall prevention operation level is set too high. Check if the fast-response current limit operation is disabled. • Check that the inverter capacity matches with the motor capacity. (PM motor control) • Check if a start command is given to the inverter while the motor is coasting. (PM motor control)		
Corrective action	• Keep the load stable. • Check the wiring to make sure that output short circuit does not occur. • Lower the stall prevention operation level. Activate the fast-response current limit operation. (Refer to page 257.) • Choose inverter and motor capacities that match. (PM motor control) • Input a start command after the motor stops. (PM motor control)		

Abbreviation	E.OC3	FR-LU08 FR-PU07	OC During Dec
Name	Overcurrent trip during deceleration or stop		
Description	When the inverter output current reaches or exceeds approximately 170% (LD rating) / 148% (SLD rating) of the rated current during deceleration (other than acceleration or constant speed), the protection circuit is activated and the inverter trips.		
Check point	• Check for sudden speed reduction. • Check for output short-circuit. • Check for too fast operation of the motor's mechanical brake. • Check if the stall prevention operation level is set too high. Check if the fast-response current limit operation is disabled. • Check that the inverter capacity matches with the motor capacity. (PM motor control) • Check if a start command is given to the inverter while the motor is coasting. (PM motor control)		
Corrective action	• Set the deceleration time longer. • Check the wiring to make sure that output short circuit does not occur. • Check the mechanical brake operation. • Lower the stall prevention operation level. Activate the fast-response current limit operation. (Refer to page 257.) • Choose inverter and motor capacities that match. (PM motor control) • Input a start command after the motor stops. (PM motor control)		

Abbreviation	E.SCF	FR-LU08 indication	Fault
Name	Output short-circuit fault		
Description	The inverter output is shut off when an output short-circuit is detected while **Pr.521** = "1". When **Pr.521** = "0" (initial value), E.OC1, E.OC2, or E.OC3 appears when an output short-circuit is detected.		
Check point	Check for output short-circuit.		
Corrective action	Check the wiring to make sure that any output short circuit does not occur, then turn OFF the control circuit power to reset the inverter.		

Abbreviation	E.OV1	FR-LU08 FR-PU07	OV During Acc
Name	Regenerative overvoltage trip during acceleration		
Description	If regenerative power causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protection circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.		
Check point	• Check for too slow acceleration. (e.g. during downward acceleration in vertical lift load) • Check that the **Pr.22 Stall prevention operation level** is not set to the no load current or lower. • Check if the stall prevention operation is frequently activated in an application with a large load inertia.		
Corrective action	• Set the acceleration time shorter. Use the regeneration avoidance function **(Pr.882 to Pr.886)**. (Refer to page 559.) • Set a value larger than the no load current in **Pr.22**. • Set **Pr.154 Voltage reduction selection during stall prevention operation** = "10, 11". (Refer to page 257.)		

Abbreviation	E.OV2	FR-LU08	OV During Cnst Spd
		FR-PU07	Stedy Spd OV
Name	Regenerative overvoltage trip during constant speed		
Description	If regenerative power causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protection circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.		
Check point	• Check for sudden load change. • Check that the **Pr.22 Stall prevention operation level** is not set to the no load current or lower. • Check if the stall prevention operation is frequently activated in an application with a large load inertia. • Check that acceleration/deceleration time is not too short.		
Corrective action	• Keep the load stable. • Use the regeneration avoidance function **(Pr.882 to Pr.886)**. (Refer to page 559.) • Set a value larger than the no load current in **Pr.22**. • Set **Pr.154 Voltage reduction selection during stall prevention operation** = "10, 11". (Refer to page 257.) • Set the acceleration/deceleration time longer. (Under Advanced magnetic flux vector control, the output torque can be increased. However, sudden acceleration may cause an overshoot in speed, resulting in an occurrence of overvoltage.)		

Abbreviation	E.OV3	FR-LU08 FR-PU07	OV During Dec
Name	Regenerative overvoltage trip during deceleration or stop		
Description	If regenerative power causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protection circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.		
Check point	• Check for sudden speed reduction. • Check if the stall prevention operation is frequently activated in an application with a large load inertia.		
Corrective action	• Set the deceleration time longer. (Set the deceleration time which matches the moment of inertia of the load.) • Make the brake cycle longer. • Use the regeneration avoidance function **(Pr.882 to Pr.886)**. (Refer to page 559.) • Set **Pr.154 Voltage reduction selection during stall prevention operation** = "10, 11". (Refer to page 257.)		

Abbreviation	E.THT	FR-LU08	Inv. overload trip
		FR-PU07	Inv. Overload
Name	Inverter overload trip*1		
Description	When the temperature of the output transistor element exceeds the protection level while a current flows at the rated output current level or higher without causing an overcurrent trip (E.OC[]), the inverter output is stopped.(Permissible overload capacity 110% 60 s)		
Check point	• Check that acceleration/deceleration time is not too short. • Check that torque boost setting is not too large (small). • Check that load pattern selection setting is appropriate for the load pattern of the using machine. • Check the motor for the use under overload.		
Corrective action	• Set the acceleration/deceleration time longer. • Adjust the torque boost setting. • Set the load pattern selection setting according to the load pattern of the using machine. • Reduce the load.		

*1 Resetting the inverter initializes the internal cumulative heat value of the electronic thermal O/L relay function.

Abbreviation	E.THM	FR-LU08	Motor overload trip
		FR-PU07	Motor Ovrload
Name	Motor overload trip*2		
Description	The electronic thermal O/L relay function in the inverter detects motor overheat, which is caused by overload or reduced cooling capability during low-speed operation. When the cumulative heat value reaches 85% of the **Pr.9 Electronic thermal O/L relay** setting, pre-alarm (TH) is output. When the accumulated value reaches the specified value, the protection circuit is activated to stop the inverter output.		
Check point	• Check the motor for the use under overload. • Check that the setting of **Pr.71 Applied motor** for motor selection is correct. (Refer to page 351.) • Check that the stall prevention operation setting is correct.		
Corrective action	• Reduce the load. • For a constant-torque motor, set the constant-torque motor in **Pr.71**. • Set the stall prevention operation level accordingly. (Refer to page 257.)		

*2 Resetting the inverter initializes the internal cumulative heat value of the electronic thermal O/L relay function.

Abbreviation	E.FIN	FR-LU08	Heat sink overheat
		FR-PU07	H/Sink O/Temp
Name	Heat sink overheat		
Description	When the heat sink overheats, the temperature sensor activates, and the inverter output is stopped. The FIN signal can be output when the temperature becomes approximately 85% of the heat sink overheat protection operation temperature. For the terminal used for the FIN signal output, assign the function by setting "26 (positive logic) or 126 (negative logic)" from **Pr.190 to Pr.196 (Output terminal function selection)**. (Refer to page 297.)		
Check point	• Check for too high surrounding air temperature. • Check for heat sink clogging. • Check that the cooling fan is not stopped. (Check that FN is not displayed on the operation panel.)		
Corrective action	• Set the surrounding air temperature to within the specifications. • Clean the heat sink. • Replace the cooling fan.		

Abbreviation	E.IPF	FR-LU08	Instant Pwr failure
		FR-PU07	Inst. Pwr. Loss
Name	Instantaneous power failure (Standard models only)		
Description	If a power failure occurs for longer than 15 ms (this also applies to inverter input shut-off), the instantaneous power failure protective function is activated to trip the inverter in order to prevent the control circuit from malfunctioning. If a power failure persists for 100 ms or longer, the fault 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 15 ms.) In some operating status (load magnitude, acceleration/ deceleration time setting, etc.), overcurrent or other protection may be activated upon power restoration. When instantaneous power failure protection is activated, the IPF signal is output. (Refer to page 448.)		
Check point	Find the cause of instantaneous power failure occurrence.		
Corrective action	• Remedy the instantaneous power failure. • Prepare a backup power supply for instantaneous power failure. • Set the function of automatic restart after instantaneous power failure **(Pr. 57)**. (Refer to page 448.)		

Abbreviation	E.UVT	FR-LU08 FR-PU07	Under Voltage
Name	Undervoltage (Standard models only)		
Description	If the power supply voltage of the inverter decreases, the control circuit will not perform normal functions. In addition, the motor torque will be insufficient and/or heat generation will increase. To prevent this, if the power supply voltage decreases to about 440 VAC or below, this function shuts off the inverter output. When a jumper is not connected across P/+ and P1, the undervoltage protective function is activated. When undervoltage protection is activated, the IPF signal is output. (Refer to page 448.)		
Check point	• Check if a high-capacity motor is driven. • Check if the jumper is connected across terminals P/+ and P1.		
Corrective action	• Check the power supply system equipment such as the power supply. • Do not remove the jumper across terminals P/+ and P1 except when connecting a DC reactor. • If the problem still persists after taking the above measure, contact your sales representative.		

Abbreviation	E.ILF	FR-LU08 FR-PU07	Input phase loss
Name	Input phase loss (Standard models only)		
Description	When **Pr.872 Input phase loss protection selection** is enabled ("1") and one of the three-phase power input is lost, the inverter output is shut off. This protective function is not available when **Pr.872** is set to the initial value (**Pr.872** = "0"). (Refer to page 241)		
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.		

Abbreviation	E.OLT	FR-LU08	Stall prevention STP
		FR-PU07	Stll Prev STP
Name	Stall prevention stop		
Description	V/F Magnetic flux If the output frequency has fallen to 0.5 Hz by stall prevention operation and remains for 3 s, a fault (E.OLT) appears and the inverter trips. OL appears while stall prevention is being activated. PM During speed control, a fault (E.OLT) appears and the inverter trips if the frequency value converted from the motor rotation speed drops to 1.5 Hz or lower by stall prevention operation and the output torque exceeds the **Pr.874 OLT level setting** (refer to page 257) and remains there for 3 s.		
Check point	• Check the motor for the use under overload. • Check that the **Pr.874** values are correct. (Check the **Pr.22 Stall prevention operation level** setting under V/F control and Advanced magnetic flux vector control.) • Check if a motor is connected under PM motor control.		
Corrective action	• Reduce the load. • Change the **Pr.22** and **Pr.874** values. (Check the **Pr.22** setting under V/F control and Advanced magnetic flux vector control.) • For a test run without connecting a motor, select the PM motor control test operation. (Refer to page 145.) • Also check that the stall prevention (overcurrent) warning (OL) or the stall prevention (overvoltage) warning (oL) countermeasure is taken.		

Abbreviation	E.SOT PM	FR-LU08 FR-PU07	Motor Step Out
Name	Loss of synchronism detection		
Description	The inverter trips when the motor operation is not synchronized. (This function is only available under PM motor control.)		
Check point	• Check that the PM motor is not driven overloaded. • Check if a start command is given to the inverter while the PM motor is coasting. • Check if a motor is connected under PM motor control.		
Corrective action	• Set the acceleration time longer. • Reduce the load. • Check the connection of the PM motor. • For a test run without connecting a motor, select the PM motor control test operation. (Refer to page 145.) • Offline auto tuning must be performed. (Refer to page 363.)		

Abbreviation	E.LUP	FR-LU08	Upper limit fault
		FR-PU07	E.LUP
Name	Upper limit fault detection		
Description	When the load exceeds the upper limit fault detection range, the inverter trips. This protective function is not available in the initial setting of **Pr.1490** (**Pr.1490** = "9999").		
Check point	• Check if too much load is applied to the equipment. • Check that the load characteristics settings are correct.		
Corrective action	• Inspect the equipment. • Set the load characteristics (**Pr.1481 to Pr.1487**) correctly.		

Abbreviation	E.LDN	FR-LU08	Lower limit fault
		FR-PU07	E.LDN
Name	Lower limit fault detection		
Description	When the load falls below the lower limit fault detection range, the inverter trips. This protective function is not available in the initial setting of **Pr.1491** (**Pr.1491** = "9999").		
Check point	• Check if the equipment load is too light. • Check that the load characteristics settings are correct.		
Corrective action	• Inspect the equipment. • Set the load characteristics (**Pr.1481 to Pr.1487**) correctly.		

Abbreviation	E.GF	FR-LU08 FR-PU07	Ground Fault
Name	Output side earth (ground) fault overcurrent		
Description	The inverter trips if an earth (ground) fault overcurrent flows due to an earth (ground) fault that occurred on the inverter's output side (load side).		
Check point	Check for an earth (ground) fault in the motor and connection cable.		
Corrective action	Remedy the earth (ground) fault portion.		

Abbreviation	E.LF	FR-LU08	Output phase loss
		FR-PU07	E.LF
Name	Output phase loss		
Description	The inverter trips if one of the three phases (U, V, W) on the inverter's output side (load side) is lost.		
Check point	• Check the wiring. (Check that the motor is normally operating.) • Check that the capacity of the motor used is not smaller than that of the inverter. • Check if a start command is given to the inverter while the motor is coasting. (PM motor control)		
Corrective action	• Wire the cables properly. • Input a start command after the motor stops. (PM motor control)		

Abbreviation	E.OHT	FR-LU08	Ext TH relay oper
		FR-PU07	OH Fault
Name	External thermal relay operation		
Description	The inverter trips if the external thermal relay provided for motor overheat protection or the internally mounted thermal relay in the motor, etc. switches ON (contacts open). This function is available when "7" (OH signal) is set in any of **Pr.178 to Pr.189 (Input terminal function selection)**. This protective function is not available in the initial status. (OH signal is not assigned.)		
Check point	• Check for motor overheating. • Check that the value "7" (OH signal) is set correctly to any of **Pr.178 to Pr.189 (Input terminal function selection)**.		
Corrective action	• Reduce the load and operation duty. • Even if the relay contacts are reset automatically, the inverter will not restart unless it is reset.		

Abbreviation	E.PTC	FR-LU08	PTC thermistor oper
		FR-PU07	PTC activated
Name	PTC thermistor operation		
Description	The inverter trips if resistance of the PTC thermistor connected between the terminal 2 and terminal 10 is equal to or higher than the **Pr.561 PTC thermistor protection level** setting for a continuous time equal to or longer than the setting value in **Pr.1016 PTC thermistor protection detection time**. When the initial value (**Pr.561** = "9999") is set, this protective function is not available.		
Check point	• Check the connection with the PTC thermistor. • Check the **Pr.561, Pr.1016** setting. • Check the motor for operation under overload.		
Corrective action	Reduce the load.		

Abbreviation	E.OPT	FR-LU08 FR-PU07	Option Fault
Name	Option fault		
Description	• Appears when the AC power supply is connected to the terminal R/L1, S/L2, or T/L3 accidentally when **Pr.30 Regenerative function selection** = "2 or 102". • Appears when the switch for manufacturer setting of the plug-in option is changed. • Appears when a communication option is connected while **Pr.296 Password lock level** = "0 or 100".		
Check point	• Check if "2 or 102" is set in **Pr.30**. • Check for the password lock with a setting of **Pr.296** = "0, 100".		
Corrective action	• Check the **Pr.30** setting and wiring. • The setting values "2 and 102" of **Pr.30** are for manufacturer setting. Do not set. • Set the switch on the plug-in option, which is for manufacturer setting, back to the initial setting. (Refer to the Instruction Manual of each option.) • To apply the password lock when installing a communication option, set **Pr.296** ≠ "0, 100". (Refer to page 170.)		

Abbreviation	E.OP1	FR-LU08 FR-PU07	Option1 Fault
Name	Communication option fault		
Description	The inverter trips if a communication line error occurs in the communication option.		
Check point	• Check for an incorrect option function setting and operation. • Check that the plug-in option is plugged into the connector properly. • 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.		

Abbreviation	E.16 to E.20	FR-LU08 FR-PU07	Fault 16 to Fault 20
Name	User definition error by the PLC function		
Description	The protective function is activated by setting "16 to 20" in the special register SD1214 for the PLC function. The inverter trips when the protective function is activated. The protective function is activated when the PLC function is enabled. This protective function is not available in the initial setting (**Pr.414** = "0"). Any character string can be displayed on FR-LU08 or FR-PU07 by sequence programs.		
Check point	• Check if "16 to 20" is set in the special register SD1214.		
Corrective action	• Set a value other than "16 to 20" in the special register SD1214.		

Abbreviation	E.PE6	FR-LU08 FR-PU07	Fault
Name	Internal storage device fault		
Description	This protective function is activated by an inverter reset if writing data fails due to power-OFF or a data fault occurs in the storage device during parameter operations*3.		
Check point	Check if the power was turned OFF during parameter operations.		
Corrective action	Check the power supply or the devices on the power system to check that the devices have no fault. • When E.PE6 occurs due to power-OFF during parameter operations: Check the read value of **Pr.890**. When the value is "7" or smaller, perform All parameter clear and then an inverter reset. The parameters that had been changed before All parameter clear must be set again. • When E.PE6 occurs due to other reason (such as turning OFF/ON the power or an inverter reset) or when the read value of **Pr.890** is "8" or more: Contact your sales representative.		

*3 For example, when parameter clear, All parameter clear, Parameter copy, or offline auto tuning is performed in the inverter, or when parameter batch write is performed in FR Configurator2.

Abbreviation	E.PE	FR-LU08	Corrupt Memory
		FR-PU07	Corrupt Memry
Name	Parameter storage device fault (control circuit board) (control circuit board)		
Description	The inverter trips if a fault occurs in the parameter stored. (EEPROM failure)		
Check point	Check for too many number of parameter write times.		
Corrective action	Please contact your sales representative. Set "1" in **Pr.342 Communication EEPROM write selection** (write to RAM) for the operation which requires frequent parameter writing via communication, etc. Note that writing to RAM goes back to the initial status at power OFF.		

Abbreviation	E.PUE	FR-LU08	PU disconnection
		FR-PU07	PU Leave Out
Name	PU disconnection		
Description	• The inverter trips if communication between the inverter and PU is suspended, e.g. the operation panel or the parameter unit is disconnected, when the disconnected PU disconnection function is valid in **Pr.75 Reset selection/disconnected PU detection/PU stop selection**. • The inverter trips if communication errors occurred consecutively for more than permissible number of retries when **Pr.121 Number of PU communication retries** ≠ "9999" during the RS-485 communication. • The inverter trips if communication is broken within the period of time set in **Pr.122 PU communication check time interval** during the RS-485 communication via the PU connector.		
Check point	• Check that the operation panel or the parameter unit is connected properly. • Check the **Pr.75** setting.		
Corrective action	Fit the operation panel or the parameter unit securely.		

Abbreviation	E.RET	FR-LU08	Retry count excess
		FR-PU07	Retry No Over
Name	Retry count excess		
Description	The inverter trips if the operation cannot be resumed properly within the number of retries set in **Pr.67 Number of retries at fault occurrence**.		
Check point	Find the cause of the fault occurrence.		
Corrective action	Eliminate the cause of the error preceding this error indication.		

Abbreviation	E.PE2	FR-LU08 FR-PU07	PR storage alarm
Name	Parameter storage device fault (main circuit board) (main circuit board)		
Description	The inverter trips if a fault occurs in the parameter stored. (EEPROM failure)		
Check point	—————		
Corrective action	Please contact your sales representative.		

6

Abbreviation	E.CPU	FR-LU08 FR-PU07	CPU Fault
	E. 5		Fault 5
	E. 6		Fault 6
	E. 7		Fault 7
Name	CPU fault		
Description	The inverter trips if the communication fault of the built-in CPU occurs.		
Check point	Check for devices producing excess electrical noises around the inverter.		
Corrective action	• Take measures against noises if there are devices producing excess electrical noises around the inverter. • Please contact your sales representative.		

Abbreviation	E.CTE	FR-LU08	Circuit fault
		FR-PU07	E.CTE
Name	Operation panel power supply short circuit/RS-485 terminals power supply short circuit		
Description	• When the power supply for the operation panel (PU connector) is shorted, the power output is shutoff and the inverter trips. The use of the operation panel (parameter unit) and the RS-485 communication via the PU connector are disabled. To reset, enter the RES signal from the terminal, reset via communication through the RS-485 terminals, or switch power OFF then ON again. • When the power supply for the RS-485 terminals are short circuited, this function shuts off the power output. At this time, communication from the RS-485 terminals cannot be made. To reset, use STOP RESET on the operation panel, enter the RES signal, or switch power OFF then ON again.		
Check point	• Check that the PU connector cable is not shorted. • Check that the RS-485 terminals are connected correctly.		
Corrective action	• Check PU and the cable. • Check the connection of the RS-485 terminals.		

Abbreviation	E.P24	FR-LU08	24 VDC power fault
		FR-PU07	E.P24
Name	24 VDC power fault		
Description	When the 24 VDC 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. • Check that the 24 V external power supply voltage is correct.		
Corrective action	• Repair the short-circuited portion. • Supply the power at 24 V. (If the power at insufficient voltage is supplied to the 24V input circuit for a long time, the inverter internal circuit may heat up. Input power at correct voltage although it will not damage the inverter.)		

Abbreviation	E.CDO	FR-LU08 FR-PU07	OC detect level
Name	Abnormal output current detection		
Description	The inverter trips if the output current exceeds the **Pr.150 Output current detection level** setting. This functions is available when **Pr.167 Output current detection operation selection** is set to "1". When the initial value (**Pr.167** = "0") is set, this protective function is not available.		
Check point	Check the settings of **Pr.150, Pr.151 Output current detection signal delay time, Pr.166 Output current detection signal retention time, and Pr.167**. (Refer to page 307.)		

Abbreviation	E.IOH	FR-LU08 FR-PU07	Inrush overheat
Name	Inrush current limit circuit fault (Standard models only)		
Description	The inverter trips when the resistor of the inrush current limit circuit is overheated. The inrush current limit circuit failure		
Check point	• Check that frequent power ON/OFF is not repeated. • Check if the input side fuse (5A) in the power supply circuit of the inrush current limit circuit contactor (FR-F860-02890 or higher) is blown. • Check that the power supply circuit of inrush current limit circuit contactor is not damaged.		
Corrective action	Configure a circuit where frequent power ON/OFF is not repeated. If the situation does not improve after taking the above measure, please contact your sales representative.		

Abbreviation	E.SER	FR-LU08 FR-PU07	VFD Comm error
Name	Communication fault (inverter)		
Description	The inverter trips when communication error occurs consecutively for the permissible number of retries or more when **Pr.335 RS-485 communication retry count** ≠ "9999" during RS-485 communication from the RS-485 terminals. The inverter also trips if communication is broken for the period of time set in **Pr.336 RS-485 communication check time interval**.		
Check point	Check the RS-485 terminal wiring.		
Corrective action	Perform wiring of the RS-485 terminals properly.		

Abbreviation	E.AIE	FR-LU08	Analog input fault
		FR-PU07	Analog in error
Name	Analog input fault		
Description	The inverter trips when a 30 mA or higher current or a 7.5 V or higher voltage is input to terminal 2 while the current input is selected by **Pr.73 Analog input selection**, or to terminal 4 while the current input is selected by **Pr.267 Terminal 4 input selection**.		
Check point	Check the **Pr.73**, **Pr.267**, and the voltage/current input switch settings. (Refer to page 318)		
Corrective action	Either give a current less than 30 mA, or set **Pr.73**, **Pr.267**, and the voltage/current input switch to the voltage input and input a voltage.		

Abbreviation	E.USB	FR-LU08 FR-PU07	USB comm error
Name	USB communication fault		
Description	The inverter trips when the communication is cut off for the time set in **Pr.548 USB communication check time interval**.		
Check point	• Check that the USB communication cable is connected securely.		
Corrective action	• Check the **Pr.548** setting. • Connect the USB communication cable securely. • Increase the **Pr.548** setting or set "9999." (Refer to page 532.)		

Abbreviation	E.SAF	FR-LU08	Safety circuit fault
		FR-PU07	E.SAF
Name	Safety circuit fault		
Description	• Appears when internal circuits are malfunctioning. • Appears when one of the lines between S1 and PC, or between S2 and PC is opened. • Settings of the switches (SW3 and SW4) for manufacturer setting may have been changed from the initial settings.		
Check point	• Check if the shorting wire across the terminals S1 and PC or the terminals S2 and PC is disconnected. • Check that the initial position of each switch was not changed.		
Corrective action	• Short across the terminals S1 and PC and the terminals S2 and PC with shortening wires. • Set each manufacturer setting switch to the initial position (OFF). (Refer to page 18 for the positions of the switches.)		

Abbreviation	E.PBT	FR-LU08	PBT fault
		FR-PU07	E.PBT
	E.13	FR-LU08	Intrnl circuit fault
		FR-PU07	Fault 13
	E.BE	FR-LU08	Brake transistor err
		FR-PU07	Br.Cct.Fault
Name	Internal circuit fault		
Description	The inverter trips when an internal circuit fault occurs.		
Corrective action	Please contact your sales representative.		

Abbreviation	E.OS	FR-LU08	Overspeed occurrence
		FR-PU07	E.OS
Name	Overspeed occurrence		
Description	The inverter trips when the motor speed exceeds the **Pr.374 Overspeed detection level** under PM motor control. When **Pr.374** = "9999 (initial value)", the inverter output is shut off when the motor speed exceeds the "maximum motor frequency + 10 Hz".		
Check point	• Check that the **Pr.374** setting is correct.		
Corrective action	• Set the **Pr.374** correctly.		

Abbreviation	E.LCI	FR-LU08	4 mA input fault
		FR-PU07	Lost mA Input
Name	4 mA input fault		
Description	The inverter trips when the analog input current is 2 mA or less for the time set in **Pr.778 4 mA input check filter**. This function is available when **Pr.573 4 mA input check selection** = "2 or 3". (Refer to page 338.) This function is not available in the initial status.		
Check point	• Check for a break in the wiring for the analog current input. • Check that the **Pr.778** setting is not too short.		
Corrective action	• Check the wiring for the analog current input. • Set the **Pr.778** setting larger.		

Abbreviation	E.PCH	FR-LU08	Pre-charge fault
		FR-PU07	Precharge Error
Name	Pre-charge fault		
Description	• The inverter trips when the pre-charge time exceeds **Pr.764 Pre-charge time limit**. • The inverter trips when the measured value exceeds **Pr.763 Pre-charge upper detection level** during pre-charging. • This function is available when **Pr.764 and Pr.763** are set. This protective function is not available in the initial status.		
Check point	• Check that the **Pr.764** setting is not too short. • Check that the **Pr.763** setting is not too small. • Check that the **Pr.127 PID control automatic switchover frequency** setting is not too low. • Check for a break in the connection to the pump.		
Corrective action	• Set the **Pr.764** setting longer. • Set the **Pr.763** setting larger. • Set the **Pr.127** setting higher. • Check the connection to the pump.		

Abbreviation	E.PID	FR-LU08	PID signal fault
		FR-PU07	PID Signal Error
Name	PID signal fault		
Description	The inverter trips if the measured value exceeds the PID upper limit or PID lower limit parameter setting, or the absolute deviation value exceeds the PID deviation parameter setting during PID control. Set this function in **Pr.131 PID upper limit, Pr.132 PID lower limit, Pr.553 PID deviation limit, and Pr.554 PID signal operation selection**. (Refer to page 396.) The inverter trips when the input pressure reaches the fault level under PID input pressure control. Use **Pr.1370 Detection time for PID limiting operation** and **Pr.1379 PID input pressure fault level** to set the function. (Refer to page 440.) This protective function is not available in the initial status.		
Check point	• Check the meter for a failure or break. • Check that the parameter settings are correct.		
Corrective action	• Check that the meter has no failure or break. • Set the parameters correctly.		

Abbreviation	E. 1 to E. 3	FR-LU08 FR-PU07	Fault 1 to Fault 3
Name	Option fault		
Description	The inverter trips when a contact fault is found between the inverter and the plug-in option, or when the communication option is not connected to the connector 1. Appears when the switch for manufacturer setting of the plug-in option is changed.		
Check point	• Check that the plug-in option is plugged into the connector properly. (1 to 3 indicate connector numbers for connection of options.) • Check for excessive noise around the inverter. • Check if the communication option is connected to the connector 2 or 3.		
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 situation does not improve after taking the above measure, please contact your sales representative. • Connect the communication option to the connector 1. • Set the switch on the plug-in option, which is for manufacturer setting, back to the initial setting. (Refer to the Instruction Manual of each option.)		

◆ Others

Indicate the status of the inverter. It is not a fault.

Abbreviation	E.0	FR-LU08	No faults
Name	No fault history		
Description	Appears when no fault records are stored. (Appears when the fault history is cleared after the protective function has been activated.)		

Abbreviation	EV	FR-LU08	—
		FR-PU07	EV
Name	24 V external power supply operation		
Description	Blinks when the main circuit power supply is off and the 24 V external power supply is being input.		
Check point	Power is supplied from a 24 V external power supply.		
Corrective action	• Turning ON the power supply (main circuit) of the inverter clears the indication. • If the indication is still displayed after turning ON of the power supply (main circuit) of the inverter, the power supply voltage may be low, or the jumper between terminals P/+ and P1 may be disconnected.		

Abbreviation	RD	FR-LU08 FR-PU07	Rd
Name	Backup in progress		
Description	The GOT is used for backing up inverter parameters and the data used in the PLC function of inverter. (Refer to page 535.)		

Abbreviation	WR	FR-LU08 FR-PU07	WR
Name	Restoration in progress		
Description	The backup data stored in the GOT is used to restore the data in the inverter. (Refer to page 535.)		

NOTE

- If protective functions with indication of "Fault" on the FR-LU08 or FR-PU07 are activated, "ERR" appears in the fault history of the FR-LU08 or FR-PU07.
- If faults other than the above appear, contact your sales representative.

6.5 Check first when you have a trouble

NOTE

- If the cause is still unknown after every check, it is recommended to initialize the parameters, set the required parameter values and check again.

6.5.1 Motor does not start

Check points	Possible cause	Countermeasure	Refer to page
Main circuit	Appropriate power supply voltage is not applied. (Operation panel display is not provided.)	Power on a molded 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.	60
	Motor is not connected properly.	Check the wiring between the inverter and the motor. If the electronic bypass function is active, check the wiring of the magnetic contactor (MC) between the inverter and the motor.	42
	The jumper across P/+ to P1 is disconnected. A DC reactor is not connected.	Securely fit a jumper across P/+ and P1. When using a DC reactor, remove the jumper across P/+ to P1, and then connect the DC reactor. Connect the DC reactor securely when required according to the capacity.	42, 69
Input signal	Start signal is not input.	Check the start command source, and input a start signal. PU operation mode: FWD / REV External operation mode: STF/STR signal	207
	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 in the initial setting, a stop command is given.	50
	Frequency command is zero.	Check the frequency command source and enter a frequency command.	207
	AU signal is not ON when terminal 4 is used for frequency setting.	Turn ON the AU signal. Turning ON the AU signal activates terminal 4 input.	318
	Output stop signal (MRS) or reset signal (RES) is ON.	Turn MRS or RES signal OFF. Inverter starts the operation with a given start command and a frequency command after turning OFF MRS or RES signal. Before turning OFF, ensure the safety.	50
	CS signal is OFF while the automatic restart after instantaneous power failure function is selected (**Pr.57 Restart coasting time** ≠ 9999).	Turn ON the automatic restart after instantaneous power failure/flying start (CS) signal. When the CS signal is assigned to an input terminal, automatic restart operation is enabled when the CS signal is turned ON.	448
	Jumper connector of sink - source is incorrectly selected.	Check that the control logic switchover jumper connector is correctly installed. If it is not installed correctly, input signal is not recognized.	54
	Voltage/current input switch is not correctly set for analog input signal (0 to 5 V/0 to 10 V, 4 to 20 mA).	Set **Pr.73 Analog input selection, Pr.267 Terminal 4 input selection**, and a voltage/current input switch correctly, then input an analog signal in accordance with the setting.	318
	STOP RESET was pressed. (Operation panel indication is [PS].)	During the External operation mode, check the method of restarting from a STOP RESET input stop from PU.	164, 574
	For the separated converter type, terminals RDA and SE of the converter unit are not connected to terminals MRS (X10 signal) and SD (PC for source logic) of the inverter respectively.	Check for the wiring.	Refer to the Instruction Manual (Hardware) of the FR-F862.
	Two-wire or three-wire type connection is incorrect.	Check the wiring. Use the Start self-holding selection (STP (STOP)) signal when the three-wire type is used.	550

Check points	Possible cause	Countermeasure	Refer to page
Parameter setting	Under V/F control, **Pr.0 Torque boost** setting is improper.	Increase the **Pr.0** setting by 0.5% increments while observing the rotation of a motor. If that makes no difference, decrease the setting.	538
	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.	221
	Pr.79 Operation mode selection setting is incorrect.	Select the operation mode which corresponds with input methods of start command and frequency command.	204
	Bias and gain **(Pr.902 to Pr.905)** settings are improper.	Check the bias and gain **(Pr.902 to Pr.905)** settings.	328
	Pr.13 Starting frequency setting is greater than the set frequency.	Set frequency higher than **Pr.13**. The inverter does not start if the frequency setting signal is less than the value set in **Pr.13**.	201, 202
	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.	226, 253
	Pr.15 Jog frequency is lower than **Pr.13 Starting frequency** for JOG operation.	Set **Pr.15** higher than **Pr.13**.	201, 202, 224
	Operation mode and a writing device do not correspond.	Check **Pr.79 Operation mode selection, Pr.338 Communication operation command source, Pr.339 Communication speed command source, Pr.550 NET mode operation command source selection** and **Pr.551 PU mode operation command source selection**, and select an operation mode suitable for the purpose.	204, 214
	Start signal operation selection is set by **Pr.250 Stop selection**.	Check the **Pr.250** setting and the connection of STF and STR signals.	550
	The motor has 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. When **Pr.261 Power failure stop selection** = "2 or 12", the motor automatically restarts after the power is restored.	458
	Performing auto tuning.	When offline auto tuning ends, press STOP RESET of the operation panel for the PU operation. For the External operation, turn OFF the start signal (STF or STR). This operation resets the offline auto tuning, and the PU's monitor display returns to the normal indication. (Without this operation, next operation cannot be started.)	353, 455
	The automatic restart after instantaneous power failure function or power failure stop function has been 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 function was activated during acceleration.	241, 448, 458
	The motor test operation is selected under PM motor control.	Check the **Pr.800 Control method selection** setting.	145
	When the FR-CC2-C is used, the input logic setting of the X10 signal is incorrect.	Set **Pr.599**="0" to use the X10 signal with the NO contact input specification, and **Pr.599**="1" (initial value for separated converter types) to use the X10 signal with the NC contact input specification.	553
Load	Load is too heavy.	Reduce the load.	—
	Shaft is locked.	Inspect the machine (motor).	—

6.5.2 Motor or machine is making abnormal acoustic noise

Check points	Possible cause	Countermeasure	Refer to page
Input signal	Disturbance due to EMI when frequency or torque command is given from analog input (terminal 1, 2, 4).	Take countermeasures against EMI.	72
Parameter setting		Increase the **Pr.74 Input filter time constant** if steady operation cannot be performed due to EMI.	326
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.	179
	The motor noise increases due to activation of the carrier frequency automatic reduction function when the motor is driven overloaded.	Reduce the load. Disable the automatic reduction function by setting **Pr.260 PWM frequency automatic switchover** = "0".	179
	Resonance occurs. (output frequency)	Set **Pr.31 to Pr.36, Pr.552 (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.	255
	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.	179
	Auto tuning is not performed under Advanced magnetic flux vector control.	Perform offline auto tuning.	353
	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.	396
	The gain is too high under PM motor control.	Check the setting values of **Pr.820 Speed control P gain 1** and **Pr.824 Torque control P gain 1 (current loop proportional gain)**.	155
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.	—

6.5.3 Inverter generates abnormal noise

Check points	Possible cause	Countermeasure	Refer to page
Fan	Fan cover was not correctly installed when a cooling fan was replaced.	Install a fan cover correctly.	601

6.5.4 Motor generates heat abnormally

Check points	Possible cause	Countermeasure	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.	607
Parameter setting	**Pr.71 Applied motor** setting is incorrect.	Check the **Pr.71 Applied motor** setting.	351
—	Motor current is large.	Refer to "6.5.11 Motor current is too large".	591

6.5.5 Motor rotates in the opposite direction

Check points	Possible cause	Countermeasure	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.	42
Input signal	The start signals (forward rotation, reverse rotation) are connected improperly.	Check the wiring. (STF: forward rotation, STR: reverse rotation)	50, 550
	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.	318

6.5.6 Speed greatly differs from the setting

Check points	Possible cause	Countermeasure	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.	73
Parameter setting	**Pr.1 Maximum frequency, Pr.2 Minimum frequency, Pr.18 High speed maximum frequency, and Pr.902 to Pr.905** settings are improper.	Check the settings of **Pr.1, Pr.2, and Pr.18**.	253
		Check the **Pr.902 to Pr.905** settings.	328
	Pr.31 to Pr.36, Pr.552 (frequency jump) settings are improper.	Narrow down the range of frequency jump.	255
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. (If **Pr.22** is set too high, an overcurrent trip (E.OC[]) is likely to occur.)	257
Motor		Check the capacities of the inverter and the motor.	—

6.5.7 Acceleration/deceleration is not smooth

Check points	Possible cause	Countermeasure	Refer to page
Parameter setting	Acceleration/deceleration time is too short.	Increase the acceleration/deceleration time.	190
	Torque boost **(Pr.0, Pr.46)** setting is improper under V/F control, so the stall prevention function is activated.	Increase/decrease the **Pr.0 Torque boost** setting value by 0.5% increments so that stall prevention does not occur.	538
	The base frequency does not match the motor characteristics.	Under V/F control, set **Pr.3 Base frequency, Pr.47 Second V/F (base frequency)**.	539
		Under Advanced magnetic flux vector control or PM motor control, set **Pr.84 Rated motor frequency**.	145
	Regeneration avoidance operation is performed	If the frequency becomes unstable during regeneration avoidance operation, decrease the setting of **Pr.886 Regeneration avoidance voltage gain**.	559
Load	Stall prevention (torque limit) 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. (If **Pr.22** is set too high, an overcurrent trip (E.OC[]) is likely to occur.)	257
Motor		Check the capacities of the inverter and the motor.	—

6.5.8 Speed varies during operation

Under Advanced magnetic flux vector control, the output frequency varies between 0 and 2 Hz as the load fluctuates. This is a normal operation and not a fault.

Check points	Possible cause	Countermeasure	Refer to page
Load	Load varies during an operation.	Select Advanced magnetic flux vector control.	145
Input signal	Frequency setting signal is varying.	Check the frequency setting signal.	—
	The frequency setting signal is affected by EMI.	Set filter to the analog input terminal using **Pr.74 Input filter time constant, Pr.822 Speed setting filter 1**.	326
		Take countermeasures against EMI, such as using shielded wires for input signal lines.	73
	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.	55
	Multi-speed command signal is chattering.	Take countermeasures to suppress chattering.	—
Parameter setting	Fluctuation of power supply voltage is too large.	Under V/F control, change the **Pr.19 Base frequency voltage** setting (approximately by 3%).	539
	Pr.80 Motor capacity and **Pr.81 Number of motor poles** are not appropriate for the motor capacity under Advanced magnetic flux vector control, or PM motor control.	Check the settings of **Pr.80** and **Pr.81**.	145
	Wiring length exceeds 30 m when Advanced magnetic flux vector control, or PM motor control is selected.	Perform offline auto tuning.	353
	Under V/F control, wiring is too long and a voltage drop occurs.	In the low-speed range, set 0.5% in **Pr.0 Torque boost**.	538
		Change the control method to Advanced magnetic flux vector control.	145
	Hunting occurs by the generated vibration, for example, when structural rigidity at load side is insufficient.	Disable automatic control functions, such as the energy saving operation, fast-response current limit operation, regeneration avoidance function, Advanced magnetic flux vector control, stall prevention, and online auto tuning. Under PID control, set smaller values to **Pr.129 PID proportional band** and **Pr.130 PID integral time**. Adjust so that the control gain decreases and the level of safety increases.	—
		Change **Pr.72 PWM frequency selection** setting.	179

6.5.9 Operation mode is not changed properly

Check points	Possible cause	Countermeasure	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.	50, 550
Parameter setting	**Pr.79 Operation mode selection** setting is improper.	When the **Pr.79** is set to "0 (initial value)", the operation mode is the External operation mode at power ON. To switch to the PU operation mode, press PU EXT on the operation panel (press PU on the parameter unit (FR-PU07)). At other settings (1 to 4, 6, 7), the operation mode is limited accordingly.	204
	Operation mode and a writing device do not correspond.	Check **Pr.79 Operation mode selection, Pr.338 Communication operation command source, Pr.339 Communication speed command source, Pr.550 NET mode operation command source selection** and **Pr.551 PU mode operation command source selection**, and select an operation mode suitable for the purpose.	204, 214

6.5.10 Operation panel display is not operating

Check points	Possible cause	Countermeasure	Refer to page
Main circuit Control circuit	Power is not input.	Input the power.	39
Front cover	Operation panel is not properly connected to the inverter.	Check if the inverter front cover is installed securely.	28

6.5.11 Motor current is too large

Check points	Possible cause	Countermeasure	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 the **Pr.0 Torque boost** setting value by 0.5% increments so that stall prevention does not occur.	538
	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 (for example, rated motor voltage).	539
		Change **Pr.14 Load pattern selection** according to the load characteristic.	541
	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. (If **Pr.22** is set too high, an overcurrent trip (E.OC[]) is likely to occur.)	257
		Check the capacities of the inverter and the motor.	—
	Offline auto tuning is not performed under Advanced magnetic flux vector control.	Perform offline auto tuning.	353
	When PM motor control is selected for a PM motor, and offline auto tuning is not performed.	Perform offline auto tuning for a PM motor.	363

6.5.12 Speed does not accelerate

Check points	Possible cause	Countermeasure	Refer to page
Input signal	Start command and frequency command are chattering.	Check if the start command and the frequency command are correct.	—
	The wiring length used for analog frequency command is too long, and it is causing a voltage (current) drop.	Perform Analog input bias/gain calibration.	328
	The input signal lines are affected by external EMI.	Take countermeasures against EMI, such as using shielded wires for input signal lines.	73
Parameter setting	**Pr.1 Maximum frequency, Pr.2 Minimum frequency, Pr.18 High speed maximum frequency, and Pr.902 to Pr.905** settings are improper.	Check the settings of **Pr.1 and Pr.2** and set **Pr.18**.	253
		Check the **Pr.902 to Pr.905** settings.	328
	The maximum voltage (current) input value is not set during the External operation. **(Pr.125, Pr.126, Pr.18)**	Check the settings of **Pr.125 Terminal 2 frequency setting gain frequency** and **Pr.126 Terminal 4 frequency setting gain frequency**. To operate at 120 Hz or higher, set **Pr.18 High speed maximum frequency**.	253, 328
	Torque boost **(Pr.0, Pr.46)** setting is improper under V/F control, so the stall prevention function is activated.	Increase/decrease the **Pr.0 Torque boost** setting value by 0.5% increments so that stall prevention does not occur.	538
	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 (for example, rated motor voltage).	539
		Change **Pr.14 Load pattern selection** according to the load characteristic.	541
	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. (If **Pr.22** is set too high, an overcurrent trip (E.OC[]) is likely to occur.)	257
		Check the capacities of the inverter and the motor.	—
	Auto tuning is not performed under Advanced magnetic flux vector control.	Perform offline auto tuning.	353
	The setting of pulse train input is improper.	Check the specification of the pulse generator (open collector output or complementary output) and check the adjustment of the pulse train and frequency (**Pr.385 Frequency for zero input pulse and Pr.386 Frequency for maximum input pulse**).	222
	During PID control, output frequency is automatically controlled to make measured value = set point.		396

6.5.13 Unable to write parameter setting

Check points	Possible cause	Countermeasure	Refer to page
Input signal	Operation is being performed (signal STF or STR is ON).	Stop the operation. When **Pr.77 Parameter write selection** = "0" (initial value), write is enabled only during a stop.	168
Parameter setting	You are attempting to set the parameter in the External operation mode.	Choose the PU operation mode. Or, set **Pr.77 Parameter write selection** = "2" to enable parameter write regardless of the operation mode.	168, 204
	Parameter write is disabled by the **Pr.77 Parameter write selection** setting.	Check the **Pr.77** setting.	168
	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.	204, 214

6.5.14 Power lamp is not lit

Check points	Possible cause	Countermeasure	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 is supplied to the control circuit (R1/L11, S1/L21).	41

6

MEMO

CHAPTER 7 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

7 PRECAUTIONS FOR MAINTENANCE AND INSPECTION

This chapter explains the PRECAUTIONS FOR MAINTENANCE AND INSPECTION for this product.

Always read the instructions before using the equipment.

For the PRECAUTIONS FOR MAINTENANCE AND INSPECTION of the separated converter type, refer to the FR-F862 (Separated Converter Type) Instruction Manual (Hardware).

7.1 Inspection item

The inverter is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to the adverse effects of the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

◆ Precautions for maintenance and inspection

When accessing the inverter for inspection, wait for at least 10 minutes after the power supply has been switched OFF, and then make sure that the voltage across the main circuit terminals P/+ and N/- of the inverter is not more than 30 VDC using a tester, etc.

7.1.1 Daily inspection

Basically, check for the following faults during operation.

- Motor operation fault
- Improper installation environment
- Cooling system fault
- Abnormal vibration, abnormal noise
- Abnormal overheat, discoloration

7.1.2 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection.

Consult us for periodic inspection.

- Check and clean the cooling system. Clean the air filter, etc.
- Check the tightening and retighten. The screws and bolts may become loose due to vibration, temperature changes, etc. Check and tighten them. Tighten them according to the specified tightening torque. (Refer to page 44.)
- Check the conductors and insulating materials for corrosion and damage.
- Measure the insulation resistance.
- Check and change the cooling fan and relay.

7.1.3 Daily and periodic inspection

Area of inspection	Inspection item		Description	Inspection interval		Corrective action at fault occurrence	Check by the user
				Daily	Periodic *3		
General	Surrounding environment		Check the surrounding air temperature, humidity, dirt, corrosive gas, oil mist, etc.	○		Improve the environment.	
	Overall unit		Check for unusual vibration and noise.	○		Check fault location and retighten.	
			Check for dirt, oil, and other foreign material. *1	○		Clean.	
	Power supply voltage		Check that the main circuit voltages and control voltages are normal. *2	○		Inspect the power supply.	
Main circuit	General		Check with megger (across main circuit terminals and earth (ground) terminal).		○	Contact the manufacturer.	
			Check for loose screws and bolts.		○	Retighten.	
			Check for overheat traces on the parts.		○	Contact the manufacturer.	
			Check for stain.		○	Clean.	
	Conductors, cables		Check conductors for distortion.		○	Contact the manufacturer.	
			Check cable sheaths for breakage and deterioration (crack, discoloration, etc.).		○	Contact the manufacturer.	
	Transformer/ reactor		Check for unusual odor and abnormal increase of whining sound.	○		Stop the equipment and contact the manufacturer.	
	Terminal block		Check for a damage.		○	Stop the equipment and contact the manufacturer.	
	Smoothing aluminum electrolytic capacitor		Check for liquid leakage.		○	Contact the manufacturer.	
			Check for safety valve projection and bulge.		○	Contact the manufacturer.	
			Visual check and judge by the life check of the main circuit capacitor. (Refer to page 600.)		○		
	Relay/contactor		Check that the operation is normal and no chattering sound is heard.		○	Contact the manufacturer.	
Control circuit, protective circuit	Operation check		Check that the output voltages across phases are balanced while operating the inverter alone.		○	Contact the manufacturer.	
			Check that no fault is found in protective and display circuits in a sequence protective operation test.		○	Contact the manufacturer.	
	Components check	Overall	Check for unusual odor and discoloration.		○	Stop the equipment and contact the manufacturer.	
			Check for serious rust development.		○	Contact the manufacturer.	
		Aluminum electrolytic capacitor	Check for liquid leakage in a capacitor and deformation trace.		○	Contact the manufacturer.	
			Visual check and judge by the life check of the control circuit capacitor. (Refer to page 600.)		○		
Cooling system	Cooling fan		Check for unusual vibration and noise.	○		Replace the fan.	
			Check for loose screws and bolts.		○	Fix with the fan cover fixing screws	
			Check for stain.		○	Clean.	
	Heat sink		Check for clogging.		○	Clean.	
			Check for stain.		○	Clean.	

7

Area of inspection	Inspection item	Description	Inspection interval		Corrective action at fault occurrence	Check by the user
			Daily	Periodic *3		
Display	Indication	Check that indications are correct.	○		Contact the manufacturer.	
		Check for stain.		○	Clean.	
	Meter/counter	Check that readouts are correct.	○		Stop the equipment and contact the manufacturer.	
Load motor	Operation check	Check for vibration and abnormal increase in operation noise.	○		Stop the equipment and contact the manufacturer.	

*1 Oil component of the heat dissipation grease used inside the inverter may leak out. The oil component, however, is not flammable, corrosive, nor conductive and is not harmful to humans. Wipe off such oil component.

*2 It is recommended to install a voltage monitoring device for checking the voltage of the power supplied to the inverter.

*3 One to two years of periodic inspection cycle is recommended. However, it differs according to the installation environment. Consult us for periodic inspection.

NOTE

- Continuous use of a leaked, deformed, or degraded smoothing aluminum electrolytic capacitor (as shown in the table above) may lead to a burst, breakage or fire. Replace such a capacitor without delay.

7.1.4 Checking the inverter module and the converter module

◆ Preparation

- Disconnect the external power supply cables (R/L1, S/L2, T/L3) and motor cables (U, V, W).
- Prepare a continuity tester. (For the resistance measurement, use the 100 Ω range.)

◆ Checking method

Change the polarity of the tester alternately at the inverter terminals R/L1, S/L2, T/L3, U, V, W, P/+, and N/- and check the electric continuity.

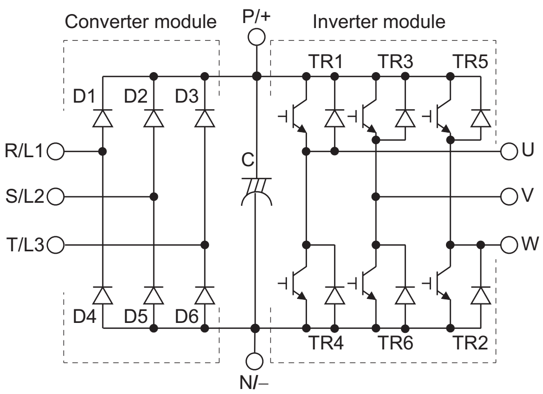
NOTE

- Before measurement, check that the smoothing capacitor is discharged.
- At the time of electric discontinuity, the measured value is almost ∞. When there is an instantaneous electric continuity, due to the smoothing capacitor, the tester may not indicate ∞. At the time of electric continuity, the measured value is several Ω to several tens of Ω. When all measured values are almost the same (although values may not be constant depending on the tester type), it shows that there are no electrical paths with problems.

◆ Module device numbers and terminals to be checked

		Tester polarity		Result		Tester polarity		Result
		⊕	⊖			⊕	⊖	
Converter module	D1	R/L1	P/+	Discontinuity	D4	R/L1	N/-	Continuity
		P/+	R/L1	Continuity		N/-	R/L1	Discontinuity
	D2	S/L2	P/+	Discontinuity	D5	S/L2	N/-	Continuity
		P/+	S/L2	Continuity		N/-	S/L2	Discontinuity
	D3	T/L3	P/+	Discontinuity	D6	T/L3	N/-	Continuity
		P/+	T/L3	Continuity		N/-	T/L3	Discontinuity
Inverter module	TR1	U	P/+	Discontinuity	TR4	U	N/-	Continuity
		P/+	U	Continuity		N/-	U	Discontinuity
	TR3	V	P/+	Discontinuity	TR6	V	N/-	Continuity
		P/+	V	Continuity		N/-	V	Discontinuity
	TR5	W	P/+	Discontinuity	TR2	W	N/-	Continuity
		P/+	W	Continuity		N/-	W	Discontinuity

(Assuming that an analog meter is used.)



7.1.5 Cleaning

Always run the inverter in a clean status.

When cleaning the inverter, gently wipe dirty areas with a soft cloth immersed in neutral detergent or ethanol.

NOTE

- Do not use solvent, such as acetone, benzene, toluene and alcohol, as these will cause the inverter surface paint to peel off.
- The display, etc. of the operation panel (FR-LU08) and the parameter unit (FR-PU07) are vulnerable to detergent and alcohol. Therefore, avoid using them for cleaning.

7.1.6 Replacement of parts

The inverter consists of many electronic parts such as semiconductor devices.

The following parts may deteriorate with age because of their structures or physical characteristics, leading to reduced performance or fault of the inverter. For preventive maintenance, the parts must be replaced periodically.

Use the life check function as a guidance of parts replacement.

Part name	Estimated lifespan*1	Description
Cooling fan	10 years	Replace (as required)
Main circuit smoothing capacitor	10 years*2	Replace (as required)
On-board smoothing capacitor	10 years*2	Replace the board (as required)
Relays	—	As required
Main circuit fuse (FR-F860-02890 or higher)	10 years	Replace the fuse (as required)

*1 Estimated lifespan for when the yearly average surrounding air temperature is 40°C. (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)

*2 Output current: 80% of the inverter rating

NOTE

- For parts replacement, contact the nearest Mitsubishi Electric FA center.

◆ Displaying the life of the inverter parts

The inverter diagnoses the main circuit capacitor, control circuit capacitor, cooling fan, and inrush current limit circuit by itself and estimates their lives.

The self-diagnostic warning is output when the life span of each part is near its end. It gives an indication of replacement time. The life warning output can be used as a guideline for life judgment.

Parts	Judgment level
Main circuit capacitor	85% of the initial capacity
Control circuit capacitor	Estimated remaining life 10%
Inrush current limit circuit	Estimated remaining life 10% (Power ON: 100,000 times left)
Cooling fan	Less than the specified speed.

NOTE

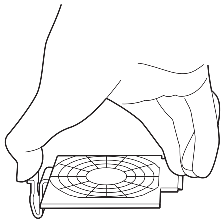
- Refer to page 182 to perform the life check of the inverter parts.

◆ Replacement procedure of the cooling fan

The replacement interval of the cooling fan used for cooling the parts generating heat such as the main circuit semiconductor is greatly affected by the surrounding air temperature. When unusual noise and/or vibration are noticed during inspection, the cooling fan must be replaced immediately.

■ Removal (FR-F860-00061 to 02430)

1. Push the hooks from above and remove the fan cover.



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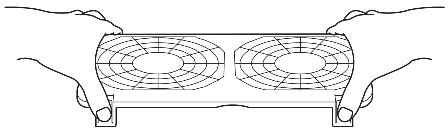

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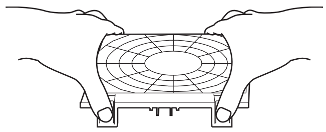
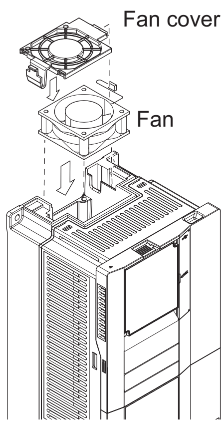


FR-F860-00680 to 02430

2. Disconnect the fan connectors.

3. Remove the fan.



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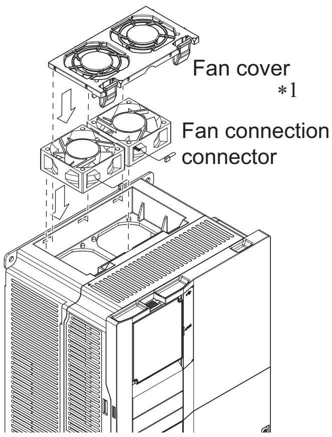

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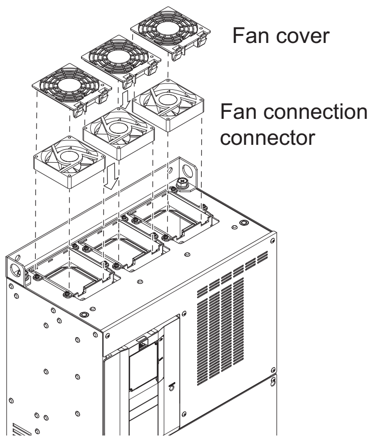
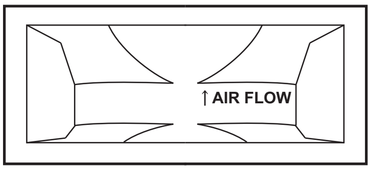


FR-F860-00680 to 02430

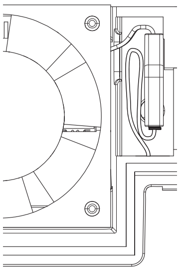
*1 The number of cooling fans differs according to the inverter capacity.

■ Reinstallation (FR-F860-00061 to 02430)

1. After confirming the orientation of the fan, reinstall the fan so that the "AIR FLOW" faces up.



2. Reconnect the fan connectors.



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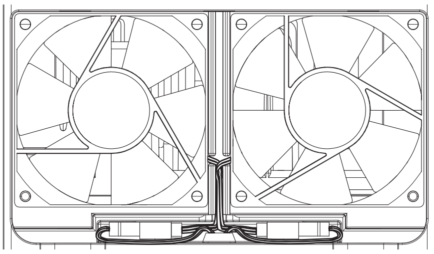

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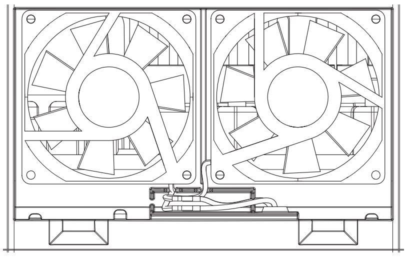

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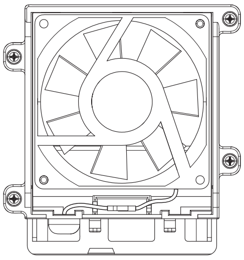

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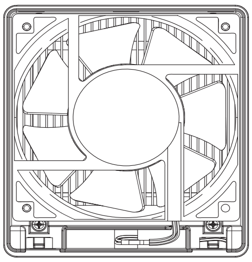
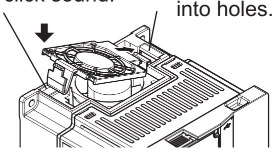
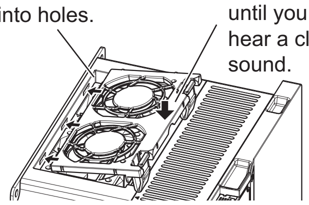


FR-F860-01440 to 02430

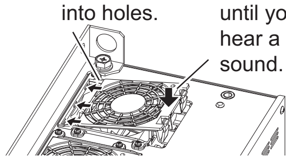
3. Reinstall the fan cover.



FR-F860-00061, 00090



FR-F860-00170 to 00450



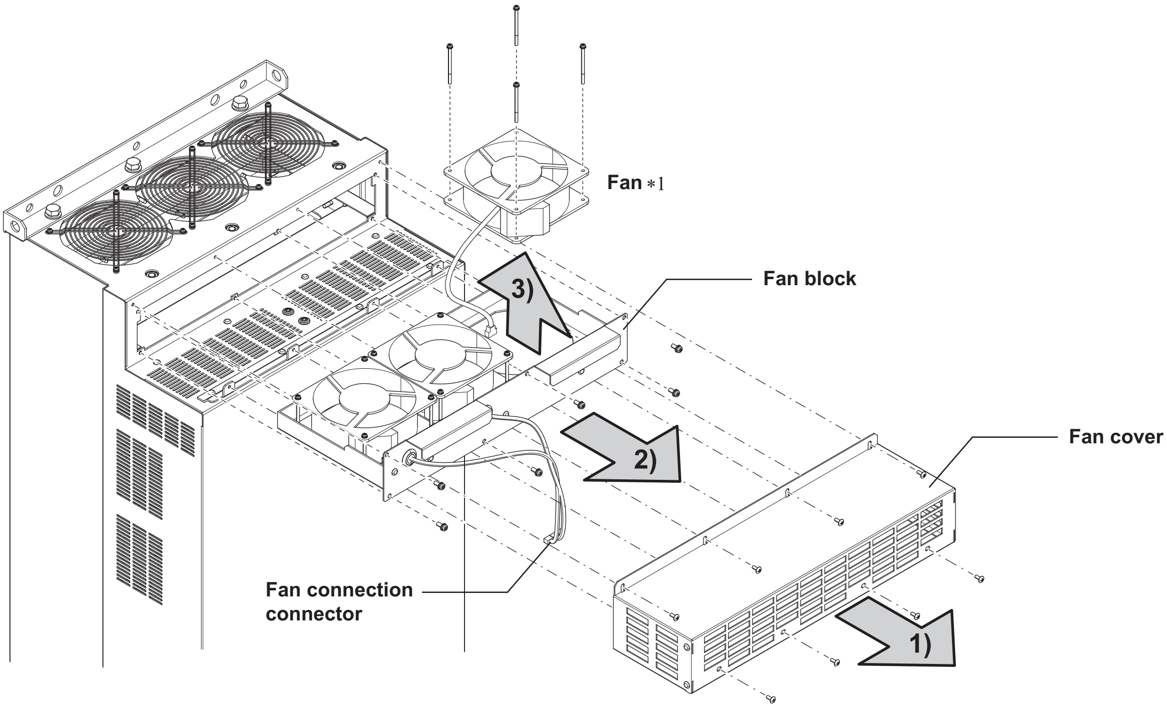
FR-F860-00680 to 02430

NOTE

- Installing the fan in the opposite direction of air flow can cause the inverter life to be shorter.
- Prevent the cable from being caught when installing a fan.
- Switch the power OFF before replacing fans. Since the inverter circuits are charged with voltage even after power OFF, replace fans only when the inverter cover is on the inverter to prevent an electric shock accident.

■ Removal (FR-F860-02890 or higher)

1. Remove the fan cover fixing screws, and remove the fan cover.
2. Disconnect the fan connector and remove the fan block.
3. Remove the fan fixing screws, and remove the fan.

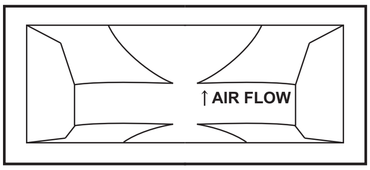


*1 The number of cooling fans differs according to the inverter capacity.

■ Reinstallation (FR-F860-02890 or higher)

1. After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.

- <Fan side face>



2. Install fans referring to the above figure. The tightening torque of the fan fixing screws is 0.73 N·m.

NOTE

- Installing the fan in the opposite air flow direction can cause the inverter life to be shorter.
- Prevent the cable from being caught when installing a fan.
- Switch the power OFF before replacing fans. Since the inverter circuits are charged with voltage even after power OFF, replace fans only when the inverter cover is on the inverter to prevent an electric shock accident.

◆ Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing in the DC section of the main circuit, and an aluminum electrolytic capacitor is used for stabilizing the control power in the control circuit. Adverse effects from ripple currents deteriorate capacitors. Replacement intervals of capacitors vary greatly with surrounding temperatures and operating conditions. Replace them roughly every 10 years when used in normal air-conditioned environments.

Inspecting the product visually:

- Case: Check that the sides and bottom of the capacitor have not ruptured.
- Rubber seal: Check for any noticeable bulging or severe cracks.
- Check for external cracks, discoloration, leakage, etc. It is assumed that the capacitor has reached the end of its life when its capacity has dropped below 80% of its rated capacity.

NOTE

- The inverter diagnoses the main circuit capacitor and control circuit capacitor by itself and estimates its remaining life. (Refer to page 182.)

◆ For relay output terminal

- The contacts of relays deteriorate over time. To prevent faults from occurring, relays must be replaced when they have reached the maximum of switching operations (switching life).
- The control terminal block must be replaced (refer to page 605) in case of failure of either relay between the relay output terminals C1 and B1 or A1, or terminals C2 and B2 or A2. (After replacing the control terminal block, connect the jumper connector to the correct position in accordance with the control logic of input signals. (Refer to page 54.))

◆ Main circuit fuse inside the inverter (FR-F860-02890 or higher)

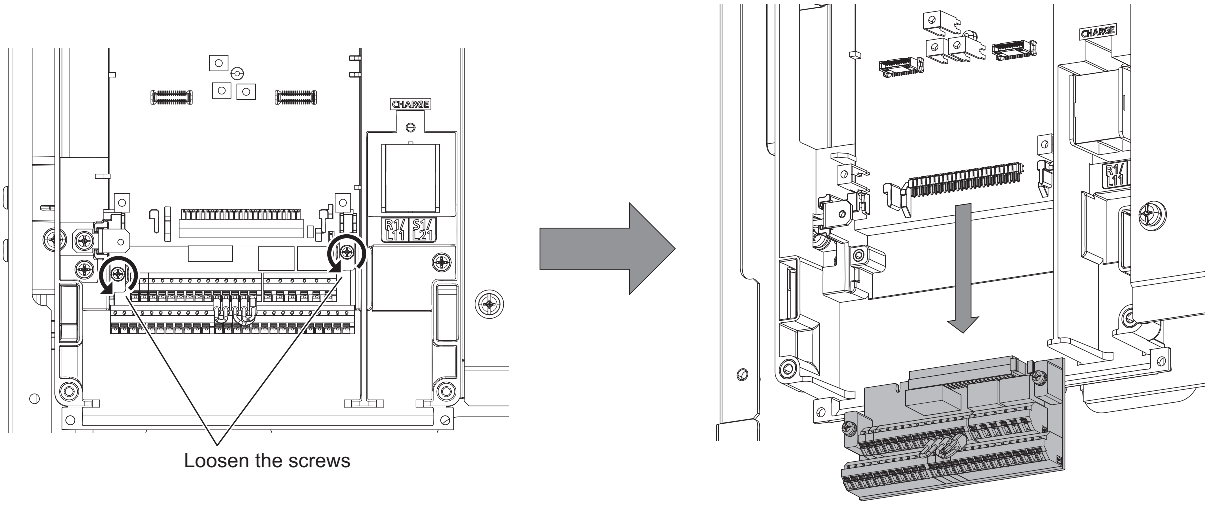
A fuse is used inside the inverter. Replacement intervals of fuses vary with surrounding temperatures and operating conditions. Replace them roughly every 10 years when used in normal air-conditioned environments.

7.1.7 Removal and reinstallation of the control circuit terminal block

The FR-F800 series inverter has a removable control circuit terminal block, which can be replaced with a new one or a control terminal option.

◆ Removal and reinstallation

1. Loosen the two mounting screws at the both side of the control circuit terminal block. (These screws cannot be removed.) Slide down the control circuit terminal block to remove it.



2. Be careful 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.

NOTE

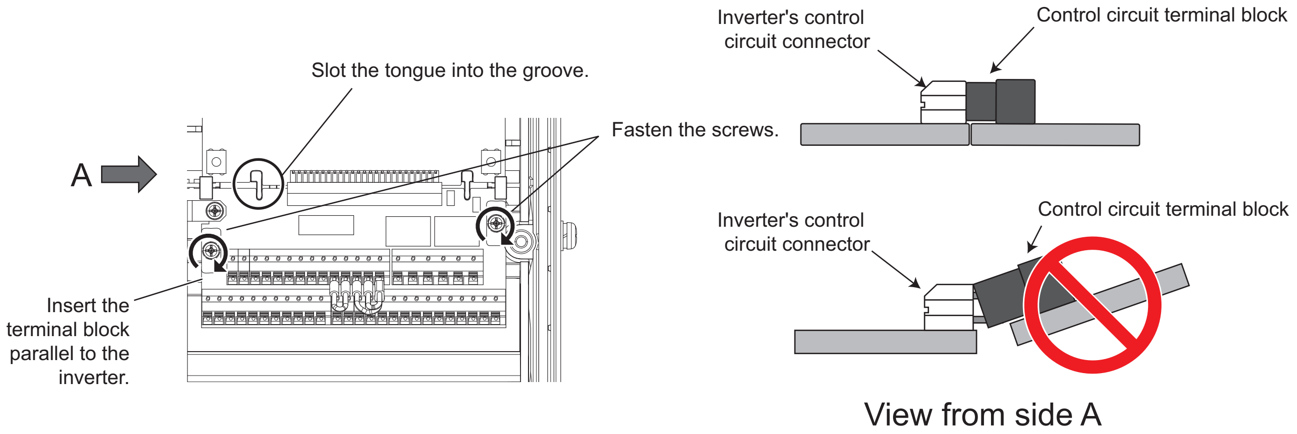
- Before starting the replacement, power OFF the inverter, wait for at least 10 minutes, and then check that the charge lamp is OFF to ensure safety.

◆ Removal and reinstallation precautions

Precautions to be taken when removing or reinstalling the control circuit terminal block are shown below.

Observe the following precautions and handle the inverter properly to avoid malfunctions or failures.

- To remove or reinstall the control circuit terminal block, keep it upright so that it is parallel with the inverter.
- To install the control circuit terminal block, slide it upward so that the tongues on the inverter slot into the grooves on the terminal block.
- Check that the terminal block is parallel to the inverter and the pins on the inverter control circuit connector are not bent. After checking proper connection, fix the terminal block in place with two screws.



NOTE

- Do not tilt the terminal block while tightening the screws or removing it from the inverter. (Otherwise, stress applied to the control circuit terminal block or the control circuit connector may damage the pins.)
- After replacing the control terminal block, connect the jumper connector to the correct position in accordance with the control logic of input signals. (Refer to page 54.)

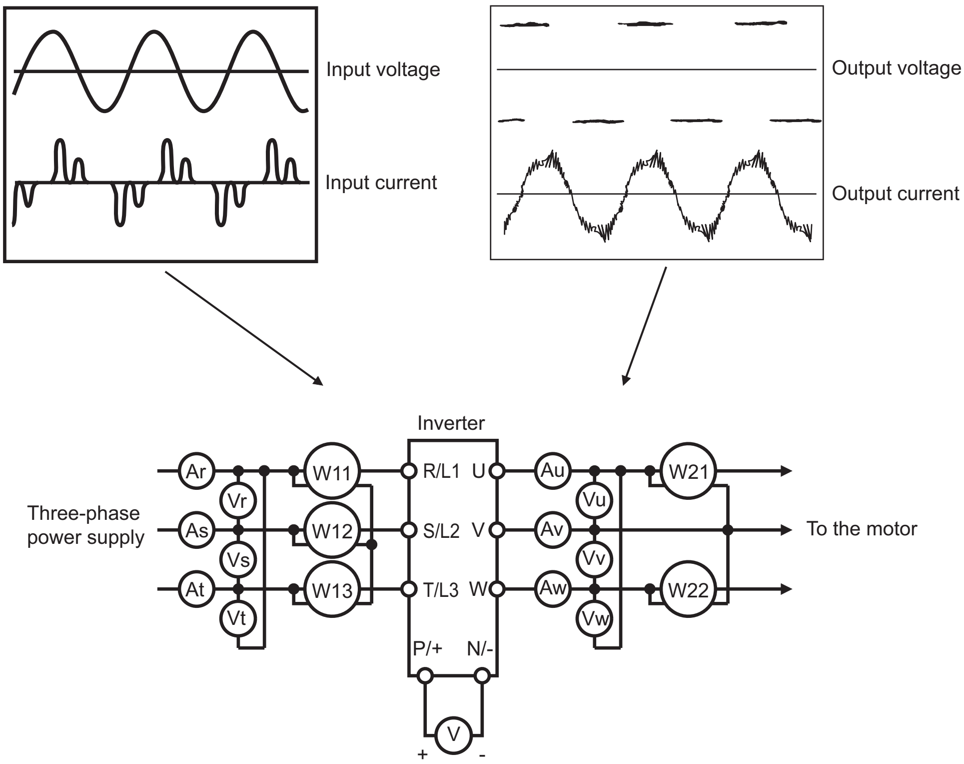
7.2 Measurement of main circuit voltages, currents and powers

Since the voltages and currents on the inverter power supply and output sides include harmonics, measurement data depends on the instruments used and circuits measured. When instruments for commercial frequency are used for measurement, measure the following circuits with the instruments given on the next page.

NOTE

- When installing meters etc. on the inverter output side

When the inverter-to-motor wiring length is large, small-capacity models, the meters and CTs may generate heat due to line-to-line leakage current. Therefore, choose the equipment which has enough allowance for the current rating. To measure and display the output voltage and output current of the inverter, it is recommended to use the terminal AM and CA output functions of the inverter.



◆ Measuring points and instruments

Item	Measuring point	Measuring instrument	Remarks (reference measured value)	
Power supply voltage V1	Across R/L1 and S/L2, S/L2 and T/L3, T/L3 and R/L1	Digital power meter (for inverter)	Commercial power supply Within permissible AC voltage fluctuation (Refer to page 612.)	
Power supply side current I1	R/L1, S/L2, T/L3 line current			
Power supply side power P1	R/L1, S/L2, T/L3 and Across R/L1 and S/L2, S/L2 and T/L3, T/L3 and R/L1		P1 = W11 + W12 + W13 (3-wattmeter method)	
Power supply side power factor Pf1	Calculate after measuring power supply voltage, power supply side current and power supply side power. $Pf_1 = \frac{P_1}{\sqrt{3}V_1 \times I_1} \times 100\%$			
Output side voltage V2	Across U and V, V and W, and W and U	Digital power meter (for inverter)[*1]	Difference between the phases is within 1% of the maximum output voltage.	
Output side current I2	U, V and W line currents	Digital power meter (for inverter)	Difference between the phases is 10% or lower of the inverter rated current.	
Output side power P2	U, V, W and across U and V, V and W		P2 = W21 + W22 2-wattmeter method (or 3-wattmeter method)	
Output side power factor Pf2	Calculate in similar manner to power supply side power factor. $Pf_2 = \frac{P_2}{\sqrt{3}V_2 \times I_2} \times 100\%$			
Converter output	Across P/+ and N/-	Tester such as a digital multimeter	Inverter LED is lit. 1.35 × V1	
Frequency setting signal	Across 2, 4(+) and 5	Tester such as a digital multimeter, or moving-coil type instrument (internal resistance 50 kΩ or more)	0 to 10 VDC, 4 to 20 mA	"5" is common
	Across 1(+) and 5		0 to ±5 VDC and 0 to ±10 VDC	
Frequency setting power supply	Across 10(+) and 5		5.2 VDC	
	Across 10E(+) and 5		10 VDC	
Frequency meter signal	Across AM(+) and 5		Approximately 10 VDC at maximum frequency (without frequency meter)	
	Across CA(+) and 5		Approximately 20 mADC at maximum frequency	
Start signal Select signal Reset signal Output stop signal	Across STF, STR, RH, RM, RL, JOG, RT, AU, STP (STOP), CS, RES, MRS(+) and SD (for sink logic)		When open 20 to 30 VDC ON voltage: 1 V or less	"SD" is common
Fault signal	Across A1 and C1 Across B1 and C1	Tester such as a digital multimeter	Continuity check[*2] Normal: discontinuity across A1 and C1 (continuity across B1 and C1) Fault: continuity across A1 and C1 (discontinuity across B1 and C1)	

*1 Use an FFT to measure the output voltage accurately. A tester or general measuring instrument cannot measure accurately.
*2 When the setting of **Pr.195 ABC1 terminal function selection** is the positive logic

7.2.1 Measurement of powers

Use digital power meters (for inverter) for the both of inverter input and output side.

7.2.2 Measurement of voltages

◆ Inverter input side

Use a digital power meter (for inverter) on the inverter's input side.

◆ Inverter output side

When using a measuring instrument, use a digital power meter for inverters since the inverter outputs PWM-controlled square wave voltage. The value monitored on the operation panel is the inverter-controlled voltage itself. Monitoring values via the operation panel or by outputting the analog signal is recommended as these values are accurate.

7.2.3 Measurement of currents

Use a digital power meter (for inverter) both on the inverter's input and output sides. Since current on the inverter input side tends to be unbalanced, measurement of three phases is recommended. Correct value cannot be obtained by measuring only one or two phases. On the other hand, the unbalanced ratio of each phase of the output side current should be within 10%.
The inverter output current can be monitored on the operation panel. 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.

7

7.2.4 Measurement of inverter input power factor

Calculate using effective power and apparent power. A power-factor meter cannot indicate an exact value.

$$\text{Total power factor of the inverter} = \frac{\text{Effective power}}{\text{Apparent power}}$$

$$= \frac{\text{Three-phase input power found by the 3-wattmeter method}}{\sqrt{3}\times\text{V (power supply voltage)} \times \text{I (input current effective value)}}$$

7.2.5 Measurement of converter output voltage (across terminals P and N)

The output voltage of the converter is output across terminals P and N, and can be measured with a voltmeter such as a digital multimeter. Although the voltage varies according to the power supply voltage, approximately 800 VDC to 900 VDC is output when no load is connected and voltage decreases during driving load operation.
When energy is regenerated from the motor during deceleration, for example, the converter output voltage rises to nearly 1100 VDC to 1300 VDC maximum.

7.2.6 Measurement of inverter output frequency

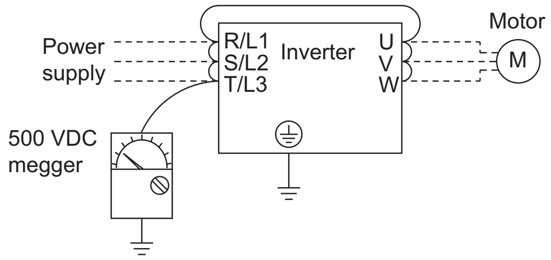
In the initial setting, a pulse train proportional to the output frequency is output across the analog current output terminals CA and 5 of the inverter. Measure the current using a tester.
For detailed specifications of the analog current output terminal CA, refer to page 288.

7.2.7 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 500 VDC megger.)

NOTE

- Before performing the insulation resistance test on the external circuit, disconnect the cables from all terminals of the inverter so that the test voltage is not applied to the inverter.
- For the continuity test of the control circuit, use a tester (high resistance range) and do not use the megger or buzzer.



7.2.8 Pressure test

Do not conduct a pressure test. Deterioration may occur.

CHAPTER 8 SPECIFICATIONS

8 SPECIFICATIONS

This chapter explains the SPECIFICATIONS of this product.

Always read the instructions before using the equipment.

For the "SPECIFICATIONS" of the separated converter type, refer to the FR-F862 (Separated Converter Type) Instruction Manual (Hardware).

8.1 Inverter rating

Model FR-F860-[ ]				00680	01080	01440	01670	02430	02890	03360	04420
Inverter capacity (kW)				45	75	90	110	132	160	220	250
Applicable motor capacity (kW) *1		SLD		45	75	110	110	185	220	260	335
		LD		45	75	90	110	150	185	220	300
Output	Rated capacity (kVA) *2	SLD		68	108	144	167	242	288	335	441
Output		LD		62	99	131	152	221	254	303	401
Output	Rated current (A) *3	SLD		68 (57.8)	108 (91.8)	144 (122)	167 (141)	243 (206)	289 (245)	336 (285)	442 (375)
Output		LD		62 (52.7)	99 (84.1)	131 (122)	152 (129)	221 (187)	255 (216)	304 (258)	402 (341)
Output	Overload current rating *4	SLD		110% 60 s, 120% 3 s (inverse-time characteristics) at surrounding air temperature 40°C							
Output		LD		120% 60 s, 150% 3 s (inverse-time characteristics) at surrounding air temperature 40°C	120% 60 s, 150% 3 s (inverse-time characteristics) at surrounding air temperature 50°C						
Output	Rated voltage *5			Three-phase 525 to 600 V							
Power supply	Rated input AC voltage/frequency			Three-phase 525 to 600 V 60 Hz							
Power supply	Permissible AC voltage fluctuation			472 to 660 V 60 Hz							
Power supply	Permissible frequency fluctuation			±5%							
Power supply	Rated input current (A) *6	Without DC reactor	SLD	87.0	—	—	—	—	—	—	—
Power supply			LD	79.0	—	—	—	—	—	—	—
Power supply		With DC reactor *3	SLD	68.0 (57.8)	108.0 (91.8)	144.0 (122.0)	167.0 (141.0)	243.0 (206.0)	289.0 (245.0)	336.0 (285.0)	442.0 (375.0)
Power supply			LD	62.0 (52.7)	99.0 (84.1)	131.0 (122.0)	152.0 (129.0)	221.0 (187.0)	255.0 (216.0)	304.0 (258.0)	402.0 (341.0)
Power supply	Power supply capacity (kVA) *7	Without DC reactor	SLD	86.8	—	—	—	—	—	—	—
Power supply			LD	79.1	—	—	—	—	—	—	—
Power supply		With DC reactor	SLD	68.0	108.0	144.0	167.0	242.0	288.0	335.0	441.0
Power supply			LD	62.0	99.0	131.0	152.0	221.0	254.0	303.0	401.0
Protective structure (IEC 60529)				Open type (IP00)							
Cooling system				Forced air							
Approx. mass (kg)				36	41	52	52	55	112	115	153

*1 The applicable motor capacity indicated is the maximum capacity applicable for use of the 4-pole standard motor.

*2 The rated output capacity indicated assumes that the output voltage is 575 V.

*3 When an operation is performed with the carrier frequency set to 3 kHz or more, and the inverter output current reaches the value indicated in the parenthesis, the carries frequency is automatically lowered. The motor noise becomes louder accordingly.

*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 maximum point of the voltage waveform at the inverter output side is the power supply voltage multiplied by about $\sqrt{2}$.

*6 The rated input current indicates a value at a rated output voltage. The impedance at the power supply side (including those of the input reactor and cables) affects the rated input current.

*7 The power supply capacity is the value when at the rated output current. It varies by the impedance at the power supply side (including those of the input reactor and cables).

8.2 Common specifications

Control specifications	Control method		Soft-PWM control, high carrier frequency PWM control (selectable among V/F control (Optimum excitation control), Advanced magnetic flux vector control (Advanced optimum excitation control) and PM motor control)
	Output frequency range		0.2 to 590 Hz (The upper-limit frequency is 400 Hz under Advanced magnetic flux vector control, and PM motor control.)
	Frequency setting resolution	Analog input	0.015 Hz/60 Hz (terminal 2, 4: 0 to 10 V/12 bits) 0.03 Hz/60 Hz (0 to 5 V/11 bits or 0 to 20 mA/approx. 11 bits for terminals 2 and 4, 0 to ±10 V/12 bits for terminal 1) 0.06 Hz/60 Hz (0 to ±5 V/11 bits for terminal 1)
		Digital input	0.01 Hz
	Frequency accuracy	Analog input	Within ±0.2% of the max. output frequency (25°C ±10°C)
		Digital input	Within 0.01% of the set output frequency
	Voltage/frequency characteristics		Base frequency can be set from 0 to 590 Hz. Constant-torque/variable-torque pattern or adjustable 5 points V/F can be selected.
	Starting torque	Induction motor	120% 0.5 Hz (Advanced magnetic flux vector control)
		IPM motor	50%
	Torque boost		Manual torque boost
	Acceleration/deceleration time setting		0 to 3600 s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/ deceleration mode, backlash countermeasures acceleration/deceleration can be selected.
	DC injection brake (induction motor)		Operation frequency (0 to 120 Hz), operation time (0 to 10 s), operation voltage (0 to 30%) variable
	Stall prevention operation level		Activation range of stall prevention operation (SLD rating: 0 to 120%, LD rating: 0 to 150%). Whether to use the stall prevention or not can be selected. (V/F control, Advanced magnetic flux vector control)
Operation specifications	Frequency setting signal	Analog input	Terminals 2 and 4: 0 to 10 V, 0 to 5 V, 4 to 20 mA (0 to 20 mA) are available. Terminal 1: -10 to +10 V, -5 to 5 V are available.
		Digital input	Input using the setting dial of the operation panel or the parameter unit Four-digit BCD or 16-bit binary (when used with option FR-A8AX)
	Start signal		Forward and reverse rotation or start signal automatic self-holding input (3-wire input) can be selected.
	Input signals (twelve terminals)		Low-speed operation command, Middle-speed operation command, High-speed operation command, Second function selection, Terminal 4 input selection, Jog operation selection, Output stop, Start self-holding selection, Forward rotation command, Reverse rotation command, Inverter reset The input signal can be changed using **Pr.178 to Pr.189 (Input terminal function selection)**.
		Pulse train input	100 k pulses/s
	Operational functions		Maximum and minimum frequency settings, multi-speed operation, acceleration/deceleration pattern, thermal protection, DC injection brake, starting frequency, JOG operation, output stop (MRS), stall prevention, regeneration avoidance, increased magnetic excitation deceleration, DC feeding*1, frequency jump, rotation display, automatic restart after instantaneous power failure, electronic bypass sequence, remote setting, retry function, carrier frequency selection, fast-response current limit, forward/reverse rotation prevention, operation mode selection, slip compensation, speed smoothing control, traverse, auto tuning, applied motor selection, RS-485 communication, PID control, PID pre-charge function, cooling fan operation selection, stop selection (deceleration stop/coasting), power-failure deceleration stop function, PLC function, life diagnosis, maintenance timer, current average monitor, multiple rating, test run, 24 V power supply input for control circuit, self power management, BACnet communication, PID gain tuning, cleaning, load characteristics storage, emergency drive
	Output signal Open collector output (five terminals) Relay output (two terminals)		Inverter running, Up to frequency, Instantaneous power failure/undervoltage*1, Overload warning, Output frequency detection, Fault The output signal can be changed using **Pr.190 to Pr.196 (Output terminal function selection)**. Fault codes of the inverter can be output (4 bits) from the open collector.
		Pulse train output	50 k pulses/s
Indication	For meter	Current output	Max. 20 mADC: one terminal (output frequency) The monitored item can be changed using **Pr.54 CA terminal function selection**.
		Voltage output	Max. 10 VDC: one terminal (output frequency) The monitored item can be changed using **Pr.158 AM terminal function selection**.

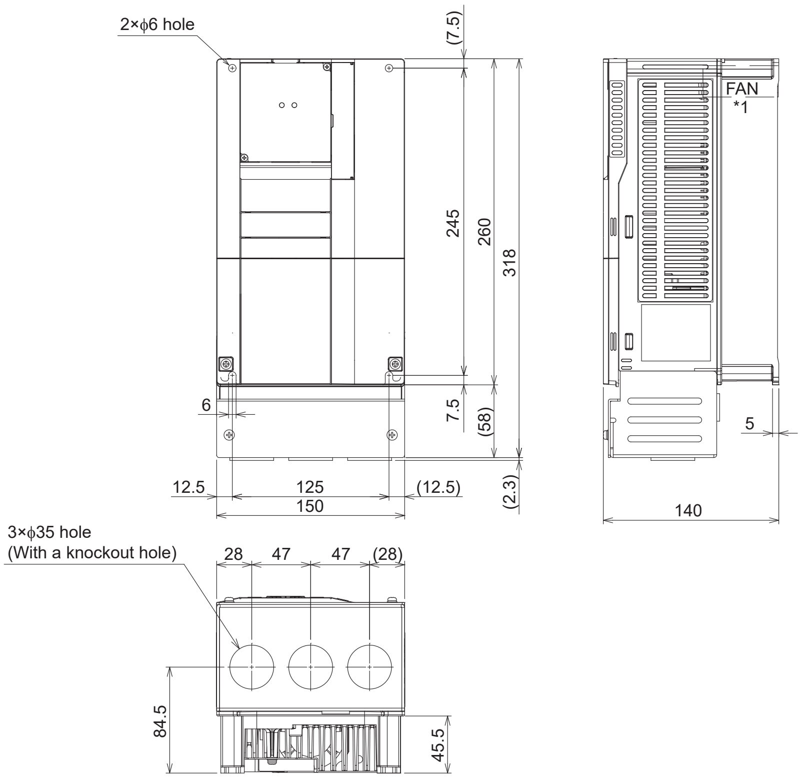
Protective/ warning function	Protective function	Overcurrent trip during acceleration, Overcurrent trip during constant speed, Overcurrent trip during deceleration or stop, Regenerative overvoltage trip during acceleration, Regenerative overvoltage trip during constant speed, Regenerative overvoltage trip during deceleration or stop, Inverter overload trip (electronic thermal relay function), Motor overload trip (electronic thermal relay function), Heat sink overheat, Instantaneous power failure[*1], Undervoltage[*1], Input phase loss[*1*2], Stall prevention stop, Loss of synchronism detection[*2], Upper limit fault detection, Lower limit fault detection, Output side earth (ground) fault overcurrent, Output short circuit, Output phase loss, External thermal relay operation[*2], PTC thermistor operation[*2], Option fault, Communication option fault, Parameter storage device fault (control circuit board), PU disconnection, Retry count excess[*2], CPU fault, Operation panel power supply short circuit/RS-485 terminals power supply short circuit, 24 VDC power fault, Abnormal output current detection[*2], Inrush current limit circuit fault[*1], Communication fault (inverter), Analog input fault, USB communication fault, Safety circuit fault, Overspeed occurrence[*2], 4 mA input fault[*2], Pre-charge fault[*2], PID signal fault[*2], Internal circuit fault, User definition error in the PLC function, Internal storage device fault
	Warning function	Fan alarm, Stall prevention (overcurrent), Stall prevention (overvoltage), Electronic thermal relay function pre-alarm, PU stop, Parameter copy, Maintenance timer 1 to 3[*2], USB host error, Operation panel lock[*2], Password locked[*2], Parameter write error, Copy operation error, 24 V external power supply operation, Load fault warning, Emergency drive in operation, Continuous operation during communication fault[*2]
Environment	Surrounding air temperature	FR-F860-00090 or lower : -10°C to +40°C (non-freezing) (LD rating), -10°C to +30°C (non-freezing) (SLD rating) FR-F860-00170 to 01080 : -10°C to +40°C (non-freezing) FR-F860-01440 or higher : -10°C to +50°C (non-freezing) (LD rating), -10°C to +40°C (non-freezing) (SLD rating)
	Surrounding air humidity	95% RH or less (non-condensing)
	Storage temperature[*3]	-20°C to +65°C
	Atmosphere	Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt, etc.)
	Altitude/vibration	Maximum 2500 m (For the installation at an altitude above 1000 m, consider a 3% reduction in the rated current per 500 m increase in altitude.), 5.9 m/s^2 or less[*4] at 10 to 55 Hz (directions of X, Y, Z axes)

*1 Available only for the standard model.
*2 This protective function is not available in the initial status.
*3 Temperature applicable for a short time, e.g. in transit.
*4 2.9 m/s^2 or less for the FR-F860-02890 or higher.

8.3 Outline dimension drawings

8.3.1 Inverter outline dimension drawings

FR-F860-00027, 00061, 00090

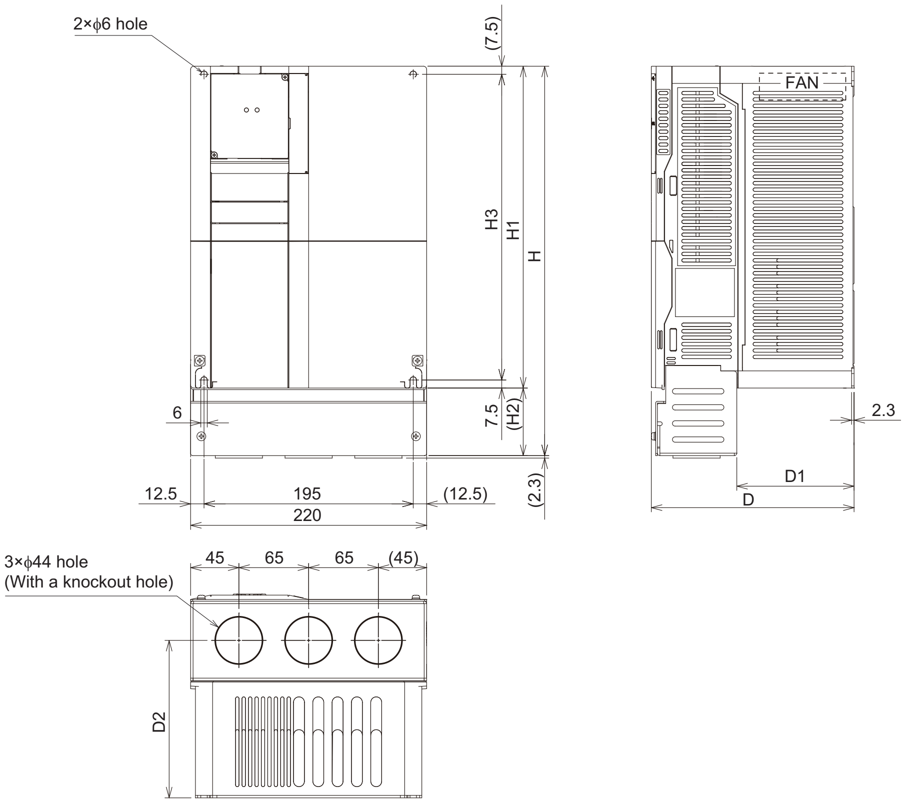


*1 FR-F860-00027 is not provided with a cooling fan.

(Unit: mm)

8

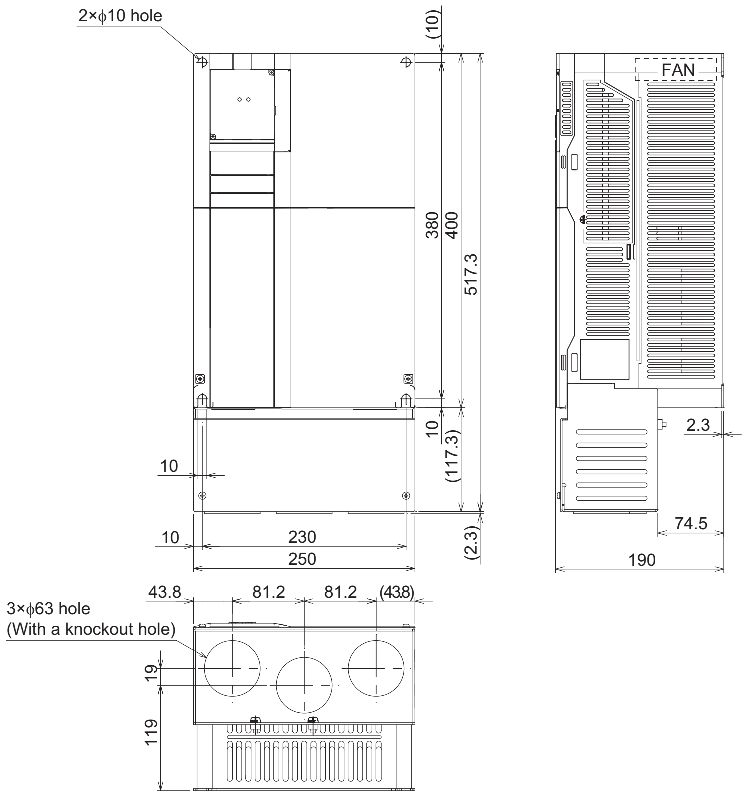
FR-F860-00170, 00320



Inverter Model	H	H1	H2	H3	D	D1	D2
FR-F860-00170	324	260	64	245	170	89.3	126.8
FR-F860-00320	363	300	63	285	190	109.3	146.8

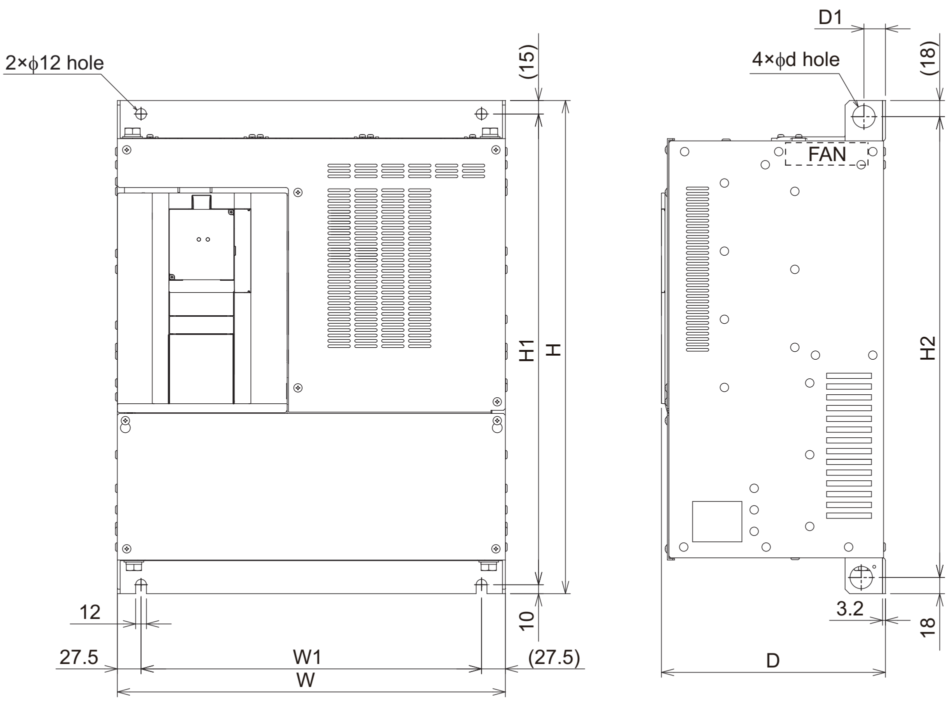
(Unit: mm)

FR-F860-00450



(Unit: mm)

FR-F860-00680, 01080, 01440, 01670, 02430

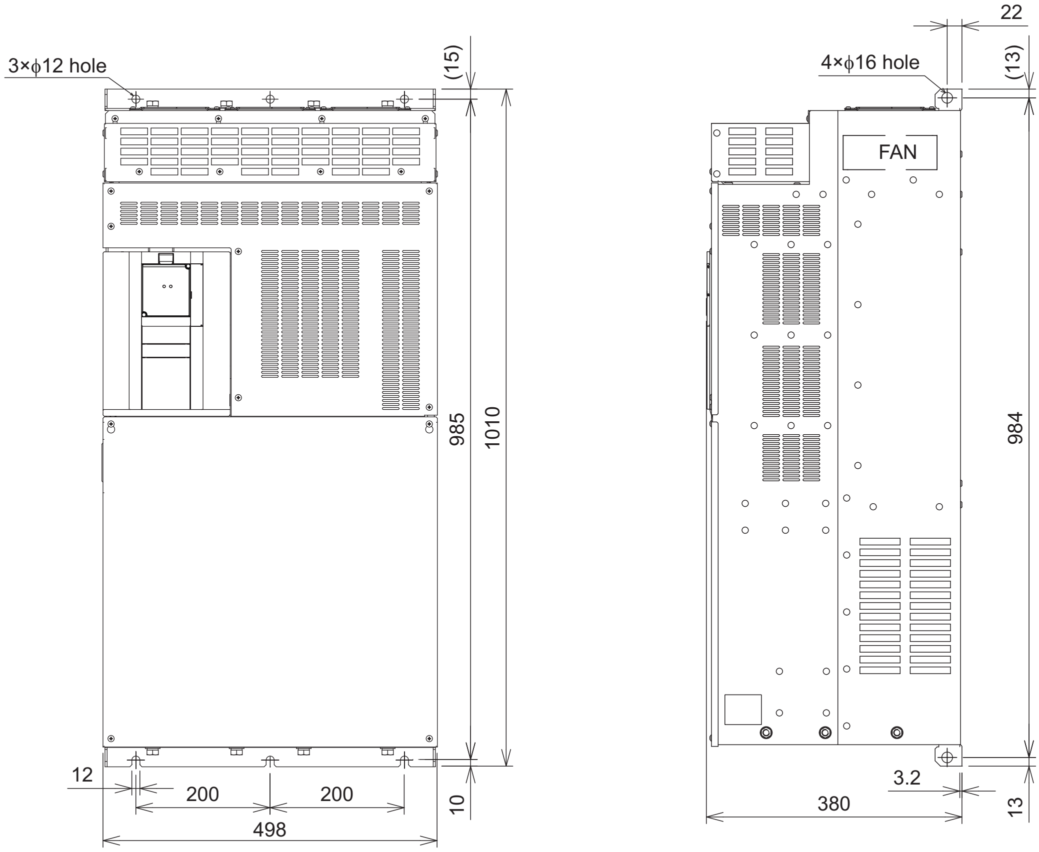


Inverter Model	W	W1	H	H1	H2	d	D	D1
FR-F860-00680, 01080*1	435	380	550	525	514	25	250	24
FR-F860-01440*1, 01670*1, 02430*1	465	400	620	595	584	24	300	22

*1 For the FR-F860-01080 or higher, or whenever a 75 kW or higher motor is used, always connect a DC reactor.

(Unit: mm)

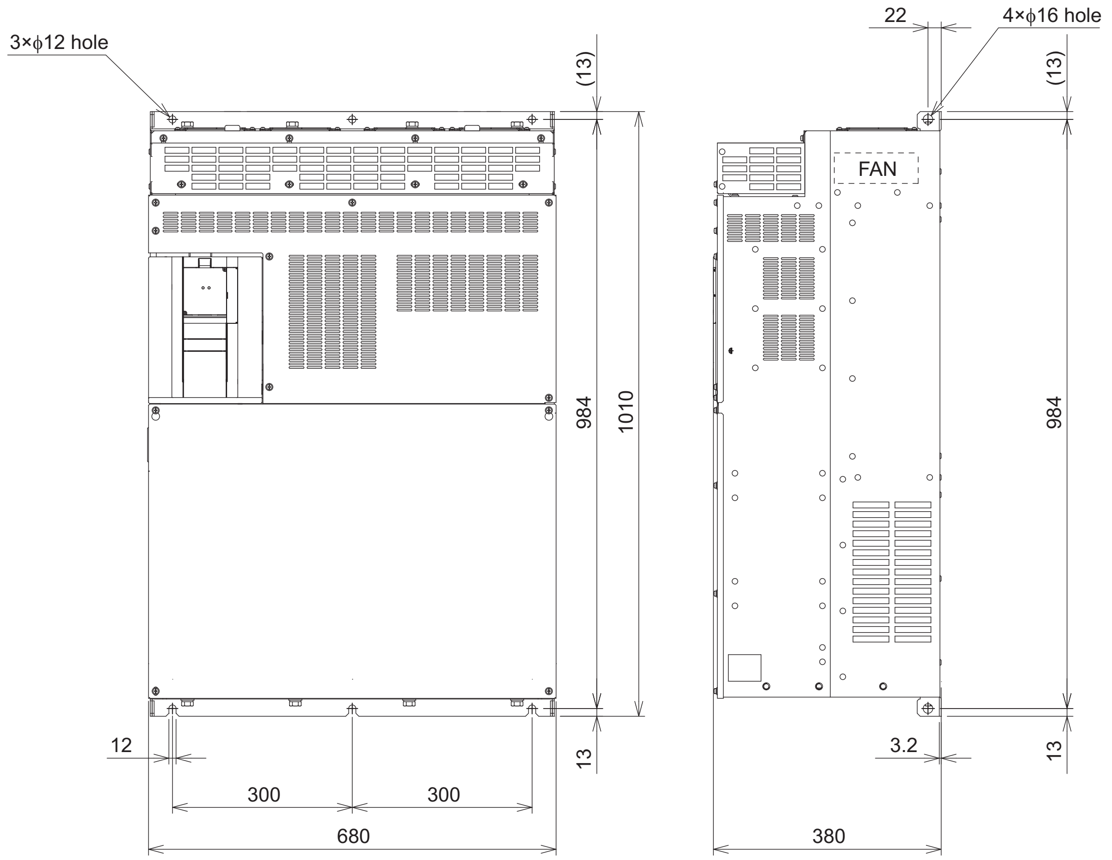
FR-F860-02890, 03360



Always connect a DC reactor.

(Unit: mm)

FR-F860-04420

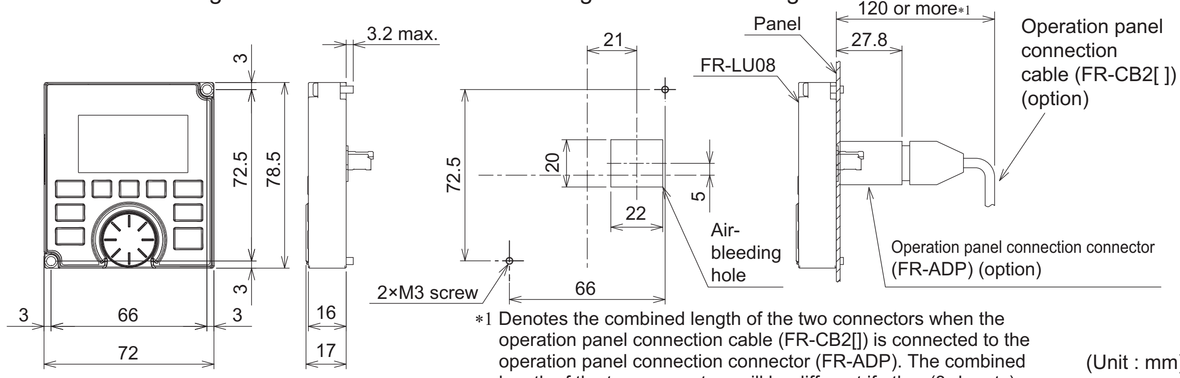


Always connect a DC reactor.

(Unit: mm)

Operation panel (FR-LU08)

<Outline drawing> <Panel cutting dimension drawing>



*1 Denotes the combined length of the two connectors when the operation panel connection cable (FR-CB2[]) is connected to the operation panel connection connector (FR-ADP). The combined length of the two connectors will be different if other (3rd party) operation panel connection cables are used.

(Unit : mm)

8

MEMO

CHAPTER 9 APPENDIX

9 APPENDIX

APPENDIX provides the reference information for use of this product.
Refer to APPENDIX as required.

9.1 Specification comparison between PM motor control and induction motor control

Item	PM motor control	Induction motor control
Applicable motor	PM motor (tuning required) (The same capacity as the inverter capacity)	Induction motor*1
Number of connectable motors	1: 1	Several motors can be driven under V/F control.
Maximum starting torque	50%	120% (Advanced magnetic flux vector control)
Carrier frequency	Four patterns of 2 kHz, 6 kHz, 10 kHz, and 14 kHz*2	Selectable between 0.75 kHz to 14.5 kHz*2
	Two patterns of 2 kHz and 6 kHz*3	0.75 kHz to 6 kHz*3
Automatic restart after instantaneous power failure	No startup waiting time. Using the regeneration avoidance function together is recommended.	Startup waiting time exists.
Startup delay	Startup delay of about 0.1 s for initial tuning.	No startup delay.
Driving by the commercial power supply	Not available Never connect a PM motor to the commercial power supply.	Can be driven by the commercial power supply.
Operation during motor coasting	While the motor is coasting, an electrical potential is generated across motor terminals. Before wiring, make sure that the motor is stopped.	While the motor is coasting, no potential is generated across motor terminals.
Maximum motor wiring length	100 m or shorter	Overall length: 500 m or shorter

*1 For the motor capacity, the rated motor current should be equal to or less than the inverter rated current.
If a motor with substantially low rated current compared with the inverter rated current is used, speed and torque accuracies may deteriorate due to torque ripples, etc. Set the rated motor current to 40% or higher of the inverter rated current.
*2 For the FR-F860-00680 or lower
*3 For the FR-F860-01080 or higher

NOTE

- Before wiring, make sure that the motor is stopped. Otherwise you may get an electric shock.
- Never connect a PM motor to the commercial power supply.
- No slippage occurs with a PM motor because of its characteristic. If a PM motor, which took over an induction motor, is driven at the same frequency as for the general-purpose motor, the rotation speed of the PM motor becomes faster by the amount of the general-purpose motor's slippage. Adjust the speed command to run the PM motor at the same speed as the induction motor, as required.

9.2 Parameters (functions) and instruction codes under different control methods

*1 Instruction codes are used to read and write parameters in accordance with the Mitsubishi inverter protocol of RS-485 communication. (For RS-485 communication, refer to page 483.)

*2 Function availability under each control method is shown as below:
○: Available
×: Not available

*3 For "parameter copy", "parameter clear", and "all parameter clear", "○" indicates the function is available, and "×" indicates the function is not available.

*4 Communication parameters that are not cleared by parameter clear or all clear (H5A5A or H55AA) via communication.

*5 When a communication option is installed, parameter clear (lock release) during password lock (**Pr.297** ≠ "9999") can be performed only from the communication option.

*6 Reading and writing via the PU connector are available.

Symbols in the table indicate parameters that operate when the options are connected.

AR FR-A8AR, AX FR-A8AX, AY FR-A8AY, AVP FR-A8AVP, NC FR-A8NC, NCE FR-A8NCE, NCG FR-A8NCG, ND FR-A8ND, NF FR-A8NF, NP FR-A8NP

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
0	Torque boost	00	80	0	○	×	×	○	○	○
1	Maximum frequency	01	81	0	○	○	○	○	○	○
2	Minimum frequency	02	82	0	○	○	○	○	○	○
3	Base frequency	03	83	0	○	×	×	○	○	○
4	Multi-speed setting (high speed)	04	84	0	○	○	○	○	○	○
5	Multi-speed setting (middle speed)	05	85	0	○	○	○	○	○	○
6	Multi-speed setting (low speed)	06	86	0	○	○	○	○	○	○
7	Acceleration time	07	87	0	○	○	○	○	○	○
8	Deceleration time	08	88	0	○	○	○	○	○	○
9	Electronic thermal O/L relay	09	89	0	○	○	○	○	○	○
10	DC injection brake operation frequency	0A	8A	0	○	○	○	○	○	○
11	DC injection brake operation time	0B	8B	0	○	○	○	○	○	○
12	DC injection brake operation voltage	0C	8C	0	○	○	×	○	○	○
13	Starting frequency	0D	8D	0	○	○	○	○	○	○
14	Load pattern selection	0E	8E	0	○	×	×	○	○	○
15	Jog frequency	0F	8F	0	○	○	○	○	○	○
16	Jog acceleration/deceleration time	10	90	0	○	○	○	○	○	○
17	MRS input selection	11	91	0	○	○	○	○	○	○
18	High speed maximum frequency	12	92	0	○	○	○	○	○	○
19	Base frequency voltage	13	93	0	○	×	×	○	○	○
20	Acceleration/deceleration reference frequency	14	94	0	○	○	○	○	○	○
21	Acceleration/deceleration time increments	15	95	0	○	○	○	○	○	○
22	Stall prevention operation level	16	96	0	○	○	○	○	○	○
23	Stall prevention operation level compensation factor at double speed	17	97	0	○	○	×	○	○	○
24	Multi-speed setting (speed 4)	18	98	0	○	○	○	○	○	○
25	Multi-speed setting (speed 5)	19	99	0	○	○	○	○	○	○
26	Multi-speed setting (speed 6)	1A	9A	0	○	○	○	○	○	○
27	Multi-speed setting (speed 7)	1B	9B	0	○	○	○	○	○	○
28	Multi-speed input compensation selection	1C	9C	0	○	○	○	○	○	○
29	Acceleration/deceleration pattern selection	1D	9D	0	○	○	○	○	○	○
30	Regenerative function selection	1E	9E	0	○	○	○	○	○	○
31	Frequency jump 1A	1F	9F	0	○	○	○	○	○	○
32	Frequency jump 1B	20	A0	0	○	○	○	○	○	○
33	Frequency jump 2A	21	A1	0	○	○	○	○	○	○
34	Frequency jump 2B	22	A2	0	○	○	○	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
35	Frequency jump 3A	23	A3	0	○	○	○	○	○	○
36	Frequency jump 3B	24	A4	0	○	○	○	○	○	○
37	Speed display	25	A5	0	○	○	○	○	○	○
41	Up-to-frequency sensitivity	29	A9	0	○	○	○	○	○	○
42	Output frequency detection	2A	AA	0	○	○	○	○	○	○
43	Output frequency detection for reverse rotation	2B	AB	0	○	○	○	○	○	○
44	Second acceleration/deceleration time	2C	AC	0	○	○	○	○	○	○
45	Second deceleration time	2D	AD	0	○	○	○	○	○	○
46	Second torque boost	2E	AE	0	○	×	×	○	○	○
47	Second V/F (base frequency)	2F	AF	0	○	×	×	○	○	○
48	Second stall prevention operation level	30	B0	0	○	○	×	○	○	○
49	Second stall prevention operation frequency	31	B1	0	○	○	×	○	○	○
50	Second output frequency detection	32	B2	0	○	○	○	○	○	○
51	Second electronic thermal O/L relay	33	B3	0	○	○	○	○	○	○
52	Operation panel main monitor selection	34	B4	0	○	○	○	○	○	○
54	CA terminal function selection	36	B6	0	○	○	○	○	○	○
55	Frequency monitoring reference	37	B7	0	○	○	○	○	○	○
56	Current monitoring reference	38	B8	0	○	○	○	○	○	○
57	Restart coasting time	39	B9	0	○	○	○	○	○	○
58	Restart cushion time	3A	BA	0	○	○	×	○	○	○
59	Remote function selection	3B	BB	0	○	○	○	○	○	○
60	Energy saving control selection	3C	BC	0	○	○	×	○	○	○
65	Retry selection	41	C1	0	○	○	○	○	○	○
66	Stall prevention operation reduction starting frequency	42	C2	0	○	○	×	○	○	○
67	Number of retries at fault occurrence	43	C3	0	○	○	○	○	○	○
68	Retry waiting time	44	C4	0	○	○	○	○	○	○
69	Retry count display erase	45	C5	0	○	○	○	○	○	○
70	Parameter for manufacturer setting. Do not set.									
71	Applied motor	47	C7	0	○	○	○	○	○	○
72	PWM frequency selection	48	C8	0	○	○	○	○	○	○
73	Analog input selection	49	C9	0	○	○	○	○	○	○
74	Input filter time constant	4A	CA	0	○	○	○	○	○	○
75	Reset selection/disconnected PU detection/PU stop selection	4B	CB	0	○	○	○	○	×	×
76	Fault code output selection	4C	CC	0	○	○	○	○	○	○
77*6	Parameter write selection	4D	CD	0	○	○	○	○	○	○
78	Reverse rotation prevention selection	4E	CE	0	○	○	○	○	○	○
79*6	Operation mode selection	4F	CF	0	○	○	○	○	○	○
80	Motor capacity	50	D0	0	×	○	○	○	○	○
81	Number of motor poles	51	D1	0	×	○	○	○	○	○
82	Motor excitation current	52	D2	0	×	○	×	○	×	○
83	Rated motor voltage	53	D3	0	×	○	○	○	○	○
84	Rated motor frequency	54	D4	0	×	○	○	○	○	○
85	Excitation current break point	55	D5	0	×	○	×	○	○	○
86	Excitation current low-speed scaling factor	56	D6	0	×	○	×	○	○	○
89	Speed control gain (Advanced magnetic flux vector)	59	D9	0	×	○	×	○	×	○
90	Motor constant (R1)	5A	DA	0	×	○	○	○	×	○
91	Motor constant (R2)	5B	DB	0	×	○	×	○	×	○
92	Motor constant (L1)/d-axis inductance (Ld)	5C	DC	0	×	○	○	○	×	○
93	Motor constant (L2)/q-axis inductance (Lq)	5D	DD	0	×	○	○	○	×	○
94	Motor constant (X)	5E	DE	0	×	○	×	○	×	○
95	Online auto tuning selection	5F	DF	0	×	○	×	○	○	○
96	Auto tuning setting/status	60	E0	0	×	○	○	○	×	○
100	V/F1 (first frequency)	00	80	1	○	×	×	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
101	V/F1 (first frequency voltage)	01	81	1	○	×	×	○	○	○
102	V/F2 (second frequency)	02	82	1	○	×	×	○	○	○
103	V/F2 (second frequency voltage)	03	83	1	○	×	×	○	○	○
104	V/F3 (third frequency)	04	84	1	○	×	×	○	○	○
105	V/F3 (third frequency voltage)	05	85	1	○	×	×	○	○	○
106	V/F4 (fourth frequency)	06	86	1	○	×	×	○	○	○
107	V/F4 (fourth frequency voltage)	07	87	1	○	×	×	○	○	○
108	V/F5 (fifth frequency)	08	88	1	○	×	×	○	○	○
109	V/F5 (fifth frequency voltage)	09	89	1	○	×	×	○	○	○
111	Check valve deceleration time	0B	8B	1	○	○	○	○	○	○
117	PU communication station number	11	91	1	○	○	○	○	○*4	○*4
118	PU communication speed	12	92	1	○	○	○	○	○*4	○*4
119	PU communication stop bit length / data length	13	93	1	○	○	○	○	○*4	○*4
120	PU communication parity check	14	94	1	○	○	○	○	○*4	○*4
121	Number of PU communication retries	15	95	1	○	○	○	○	○*4	○*4
122	PU communication check time interval	16	96	1	○	○	○	○	○*4	○*4
123	PU communication waiting time setting	17	97	1	○	○	○	○	○*4	○*4
124	PU communication CR/LF selection	18	98	1	○	○	○	○	○*4	○*4
125	Terminal 2 frequency setting gain frequency	19	99	1	○	○	○	○	×	○
126	Terminal 4 frequency setting gain frequency	1A	9A	1	○	○	○	○	×	○
127	PID control automatic switchover frequency	1B	9B	1	○	○	○	○	○	○
128	PID action selection	1C	9C	1	○	○	○	○	○	○
129	PID proportional band	1D	9D	1	○	○	○	○	○	○
130	PID integral time	1E	9E	1	○	○	○	○	○	○
131	PID upper limit	1F	9F	1	○	○	○	○	○	○
132	PID lower limit	20	A0	1	○	○	○	○	○	○
133	PID action set point	21	A1	1	○	○	○	○	○	○
134	PID differential time	22	A2	1	○	○	○	○	○	○
135	Electronic bypass sequence selection	23	A3	1	○	○	×	○	○	○
136	MC switchover interlock time	24	A4	1	○	○	×	○	○	○
137	Start waiting time	25	A5	1	○	○	×	○	○	○
138	Bypass selection at a fault	26	A6	1	○	○	×	○	○	○
139	Automatic switchover frequency from inverter to bypass operation	27	A7	1	○	○	×	○	○	○
140	Backlash acceleration stopping frequency	28	A8	1	○	○	○	○	○	○
141	Backlash acceleration stopping time	29	A9	1	○	○	○	○	○	○
142	Backlash deceleration stopping frequency	2A	AA	1	○	○	○	○	○	○
143	Backlash deceleration stopping time	2B	AB	1	○	○	○	○	○	○
144	Speed setting switchover	2C	AC	1	○	○	○	○	○	○
145	PU display language selection	2D	AD	1	○	○	○	○	×	×
147	Acceleration/deceleration time switching frequency	2F	AF	1	○	○	○	○	○	○
148	Stall prevention level at 0 V input	30	B0	1	○	○	×	○	○	○
149	Stall prevention level at 10 V input	31	B1	1	○	○	×	○	○	○
150	Output current detection level	32	B2	1	○	○	○	○	○	○
151	Output current detection signal delay time	33	B3	1	○	○	○	○	○	○
152	Zero current detection level	34	B4	1	○	○	○	○	○	○
153	Zero current detection time	35	B5	1	○	○	○	○	○	○
154	Voltage reduction selection during stall prevention operation	36	B6	1	○	○	×	○	○	○
155	RT signal function validity condition selection	37	B7	1	○	○	○	○	○	○
156	Stall prevention operation selection	38	B8	1	○	○	○	○	○	○
157	OL signal output timer	39	B9	1	○	○	○	○	○	○
158	AM terminal function selection	3A	BA	1	○	○	○	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
159	Automatic switchover frequency range from bypass to inverter operation	3B	BB	1	○	○	×	○	○	○
160	User group read selection	00	80	2	○	○	○	○	○	○
161	Parameter for manufacturer setting. Do not set.									
162	Automatic restart after instantaneous power failure selection	02	82	2	○	○	○	○	○	○
163	First cushion time for restart	03	83	2	○	○	×	○	○	○
164	First cushion voltage for restart	04	84	2	○	○	×	○	○	○
165	Stall prevention operation level for restart	05	85	2	○	○	×	○	○	○
166	Output current detection signal retention time	06	86	2	○	○	○	○	○	○
167	Output current detection operation selection	07	87	2	○	○	○	○	○	○
168	Parameter for manufacturer setting. Do not set.									
169										
170	Watt-hour meter clear	0A	8A	2	○	○	○	○	×	○
171	Operation hour meter clear	0B	8B	2	○	○	○	×	×	×
172	User group registered display/batch clear	0C	8C	2	○	○	○	×	×	×
173	User group registration	0D	8D	2	○	○	○	×	×	×
174	User group clear	0E	8E	2	○	○	○	×	×	×
178	STF terminal function selection	12	92	2	○	○	○	○	×	○
179	STR terminal function selection	13	93	2	○	○	○	○	×	○
180	RL terminal function selection	14	94	2	○	○	○	○	×	○
181	RM terminal function selection	15	95	2	○	○	○	○	×	○
182	RH terminal function selection	16	96	2	○	○	○	○	×	○
183	RT terminal function selection	17	97	2	○	○	○	○	×	○
184	AU terminal function selection	18	98	2	○	○	○	○	×	○
185	JOG terminal function selection	19	99	2	○	○	○	○	×	○
186	CS terminal function selection	1A	9A	2	○	○	○	○	×	○
187	MRS terminal function selection	1B	9B	2	○	○	○	○	×	○
188	STOP terminal function selection	1C	9C	2	○	○	○	○	×	○
189	RES terminal function selection	1D	9D	2	○	○	○	○	×	○
190	RUN terminal function selection	1E	9E	2	○	○	○	○	×	○
191	SU terminal function selection	1F	9F	2	○	○	○	○	×	○
192	IPF terminal function selection	20	A0	2	○	○	○	○	×	○
193	OL terminal function selection	21	A1	2	○	○	○	○	×	○
194	FU terminal function selection	22	A2	2	○	○	○	○	×	○
195	ABC1 terminal function selection	23	A3	2	○	○	○	○	×	○
196	ABC2 terminal function selection	24	A4	2	○	○	○	○	×	○
232	Multi-speed setting (speed 8)	28	A8	2	○	○	○	○	○	○
233	Multi-speed setting (speed 9)	29	A9	2	○	○	○	○	○	○
234	Multi-speed setting (speed 10)	2A	AA	2	○	○	○	○	○	○
235	Multi-speed setting (speed 11)	2B	AB	2	○	○	○	○	○	○
236	Multi-speed setting (speed 12)	2C	AC	2	○	○	○	○	○	○
237	Multi-speed setting (speed 13)	2D	AD	2	○	○	○	○	○	○
238	Multi-speed setting (speed 14)	2E	AE	2	○	○	○	○	○	○
239	Multi-speed setting (speed 15)	2F	AF	2	○	○	○	○	○	○
240	Soft-PWM operation selection	30	B0	2	○	○	○	○	○	○
241	Analog input display unit switchover	31	B1	2	○	○	○	○	○	○
242	Terminal 1 added compensation amount (terminal 2)	32	B2	2	○	○	○	○	○	○
243	Terminal 1 added compensation amount (terminal 4)	33	B3	2	○	○	○	○	○	○
244	Cooling fan operation selection	34	B4	2	○	○	○	○	○	○
245	Rated slip	35	B5	2	○	×	×	○	○	○
246	Slip compensation time constant	36	B6	2	○	×	×	○	○	○
247	Constant-power range slip compensation selection	37	B7	2	○	×	×	○	○	○
248	Self power management selection	38	B8	2	○	○	○	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
249	Earth (ground) fault detection at start	39	B9	2	○	○	×	○	○	○
250	Stop selection	3A	BA	2	○	○	○	○	○	○
251	Output phase loss protection selection	3B	BB	2	○	○	○	○	○	○
252	Override bias	3C	BC	2	○	○	○	○	○	○
253	Override gain	3D	BD	2	○	○	○	○	○	○
254	Main circuit power OFF waiting time	3E	BE	2	○	○	○	○	○	○
255	Life alarm status display	3F	BF	2	○	○	○	×	×	×
256	Inrush current limit circuit life display	40	C0	2	○	○	○	×	×	×
257	Control circuit capacitor life display	41	C1	2	○	○	○	×	×	×
258	Main circuit capacitor life display	42	C2	2	○	○	○	×	×	×
259	Main circuit capacitor life measuring	43	C3	2	○	○	○	○	○	○
260	PWM frequency automatic switchover	44	C4	2	○	○	○	○	○	○
261	Power failure stop selection	45	C5	2	○	○	○	○	○	○
262	Subtracted frequency at deceleration start	46	C6	2	○	○	○	○	○	○
263	Subtraction starting frequency	47	C7	2	○	○	○	○	○	○
264	Power-failure deceleration time 1	48	C8	2	○	○	○	○	○	○
265	Power-failure deceleration time 2	49	C9	2	○	○	○	○	○	○
266	Power failure deceleration time switchover frequency	4A	CA	2	○	○	○	○	○	○
267	Terminal 4 input selection	4B	CB	2	○	○	○	○	×	○
268	Monitor decimal digits selection	4C	CC	2	○	○	○	○	○	○
269	Parameter for manufacturer setting. Do not set.									
289	Inverter output terminal filter	61	E1	2	○	○	○	○	×	○
290	Monitor negative output selection	62	E2	2	○	○	○	○	○	○
291	Pulse train I/O selection	63	E3	2	○	○	○	○	×	○
294	UV avoidance voltage gain	66	E6	2	○	○	○	○	○	○
295	Parameter for manufacturer setting. Do not set.									
296	Password lock level	68	E8	2	○	○	○	○	×	○
297	Password lock/unlock	69	E9	2	○	○	○	○	○*5	○
298	Frequency search gain	6A	EA	2	○	○	×	○	×	○
299	Rotation direction detection selection at restarting	6B	EB	2	○	○	×	○	○	○
300	BCD input bias AX	00	80	3	○	○	○	○	○	○
301	BCD input gain AX	01	81	3	○	○	○	○	○	○
302	BIN input bias AX	02	82	3	○	○	○	○	○	○
303	BIN input gain AX	03	83	3	○	○	○	○	○	○
304	Digital input and analog input compensation enable/disable selection AX	04	84	3	○	○	○	○	○	○
305	Read timing operation selection AX	05	85	3	○	○	○	○	○	○
306	Analog output signal selection AY	06	86	3	○	○	○	○	○	○
307	Setting for zero analog output AY	07	87	3	○	○	○	○	○	○
308	Setting for maximum analog output AY	08	88	3	○	○	○	○	○	○
309	Analog output signal voltage/current switchover AY	09	89	3	○	○	○	○	○	○
310	Analog meter voltage output selection AY	0A	8A	3	○	○	○	○	○	○
311	Setting for zero analog meter voltage output AY	0B	8B	3	○	○	○	○	○	○
312	Setting for maximum analog meter voltage output AY	0C	8C	3	○	○	○	○	○	○
313	DO0 output selection AY NC NCE NCG	0D	8D	3	○	○	○	○	×	○
314	DO1 output selection AY NC NCE NCG	0E	8E	3	○	○	○	○	×	○
315	DO2 output selection AY NC NCE NCG	0F	8F	3	○	○	○	○	×	○
316	DO3 output selection AY	10	90	3	○	○	○	○	×	○
317	DO4 output selection AY	11	91	3	○	○	○	○	×	○
318	DO5 output selection AY	12	92	3	○	○	○	○	×	○
319	DO6 output selection AY	13	93	3	○	○	○	○	×	○

9

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
320	RA1 output selection AR	14	94	3	○	○	○	○	×	○
321	RA2 output selection AR	15	95	3	○	○	○	○	×	○
322	RA3 output selection AR	16	96	3	○	○	○	○	×	○
323	AM0 0V adjustment AY	17	97	3	○	○	○	○	×	○
324	AM1 0mA adjustment AY	18	98	3	○	○	○	○	×	○
329	Digital input unit selection AX	1D	9D	3	○	○	○	○	×	○
331	RS-485 communication station number	1F	9F	3	○	○	○	○	○*4	○*4
332	RS-485 communication speed	20	A0	3	○	○	○	○	○*4	○*4
333	RS-485 communication stop bit length / data length	21	A1	3	○	○	○	○	○*4	○*4
334	RS-485 communication parity check selection	22	A2	3	○	○	○	○	○*4	○*4
335	RS-485 communication retry count	23	A3	3	○	○	○	○	○*4	○*4
336	RS-485 communication check time interval	24	A4	3	○	○	○	○	○*4	○*4
337	RS-485 communication waiting time setting	25	A5	3	○	○	○	○	○*4	○*4
338	Communication operation command source	26	A6	3	○	○	○	○	○*4	○*4
339	Communication speed command source	27	A7	3	○	○	○	○	○*4	○*4
340	Communication startup mode selection	28	A8	3	○	○	○	○	○*4	○*4
341	RS-485 communication CR/LF selection	29	A9	3	○	○	○	○	○*4	○*4
342	Communication EEPROM write selection	2A	AA	3	○	○	○	○	○	○
343	Communication error count	2B	AB	3	○	○	○	×	×	×
345	DeviceNet address ND	2D	AD	3	○	○	○	○	○*4	○*4
346	DeviceNet/ControlNet baud rate ND	2E	AE	3	○	○	○	○	○*4	○*4
349	Communication reset selection/Ready bit status selection/ Reset selection after inverter faults are cleared/ DriveControl writing restriction selection NC NCE NCG ND NP NF	31	B1	3	○	○	○	○	○*4	○*4
374	Overspeed detection level	4A	CA	3	×	×	○	○	○	○
384	Input pulse division scaling factor	54	D4	3	○	○	○	○	○	○
385	Frequency for zero input pulse	55	D5	3	○	○	○	○	○	○
386	Frequency for maximum input pulse	56	D6	3	○	○	○	○	○	○
390	% setting reference frequency	5A	DA	3	○	○	○	○	○	○
414	PLC function operation selection	0E	8E	4	○	○	○	○	×	×
415	Inverter operation lock mode setting	0F	8F	4	○	○	○	○	○	○
416	Pre-scale function selection	10	90	4	○	○	○	○	○	○
417	Pre-scale setting value	11	91	4	○	○	○	○	○	○
418	Extension output terminal filter AY AR	12	92	4	○	○	○	○	×	○
434	Network number (CC-Link IE) NCE IP address 1 NCG	22	A2	4	○	○	○	○	○*4	○*4
435	Station number (CC-Link IE) NCE IP address 2 NCG	23	A3	4	○	○	○	○	○*4	○*4
436	IP address 3 NCG	24	A4	4	○	○	○	○	○*4	○*4
437	IP address 4 NCG	25	A5	4	○	○	○	○	○*4	○*4
438	Subnet mask 1 NCG	26	A6	4	○	○	○	○	○*4	○*4
439	Subnet mask 2 NCG	27	A7	4	○	○	○	○	○*4	○*4
440	Subnet mask 3 NCG	28	A8	4	○	○	○	○	○*4	○*4
441	Subnet mask 4 NCG	29	A9	4	○	○	○	○	○*4	○*4
450	Second applied motor	32	B2	4	○	○	○	○	○	○
453	Second motor capacity	35	B5	4	×	○	○	○	○	○
454	Number of second motor poles	36	B6	4	×	○	○	○	○	○
455	Second motor excitation current	37	B7	4	×	○	×	○	×	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
456	Rated second motor voltage	38	B8	4	×	○	○	○	○	○
457	Rated second motor frequency	39	B9	4	×	○	○	○	○	○
458	Second motor constant (R1)	3A	BA	4	×	○	○	○	×	○
459	Second motor constant (R2)	3B	BB	4	×	○	○	○	×	○
460	Second motor constant (L1) / d-axis inductance (Ld)	3C	BC	4	×	○	○	○	×	○
461	Second motor constant (L2) / q-axis inductance (Lq)	3D	BD	4	×	○	○	○	×	○
462	Second motor constant (X)	3E	BE	4	×	○	×	○	×	○
463	Second motor auto tuning setting/status	3F	BF	4	×	○	○	○	×	○
495	Remote output selection	5F	DF	4	○	○	○	○	○	○
496	Remote output data 1	60	E0	4	○	○	○	×	×	×
497	Remote output data 2	61	E1	4	○	○	○	×	×	×
498	PLC function flash memory clear	62	E2	4	○	○	○	×	×	×
500	Communication error execution waiting time NC NCE NCG ND NF NP	00	80	5	○	○	○	○	○	○
501	Communication error occurrence count display NC NCE NCG ND NF NP	01	81	5	○	○	○	×	○	○
502	Stop mode selection at communication error	02	82	5	○	○	○	○	○	○
503	Maintenance timer 1	03	83	5	○	○	○	×	×	×
504	Maintenance timer 1 warning output set time	04	84	5	○	○	○	○	×	○
505	Speed setting reference	05	85	5	○	○	○	○	○	○
506	Display estimated main circuit capacitor residual life	06	86	5	○	○	○	×	×	×
507	Display/reset ABC1 relay contact life	07	87	5	○	○	○	×	×	×
508	Display/reset ABC2 relay contact life	08	88	5	○	○	○	×	×	×
514	Emergency drive dedicated retry waiting time	0E	8E	5	○	○	○	○	×	○
515	Emergency drive dedicated retry count	0F	8F	5	○	○	○	○	×	○
521	Output short-circuit detection	15	95	5	○	○	○	○	○	○
522	Output stop frequency	16	96	5	○	○	○	○	○	○
523	Emergency drive mode selection	17	97	5	○	○	○	○	×	○
524	Emergency drive running speed	18	98	5	○	○	○	○	×	○
539	MODBUS RTU communication check time interval	27	A7	5	○	○	○	○	○*4	○*4
541	Frequency command sign selection NC NCE NCG NP	29	A9	5	○	○	○	○	○*4	○*4
542	Communication station number (CC-Link) NC	2A	AA	5	○	○	○	○	○*4	○*4
543	Baud rate selection (CC-Link) NC	2B	AB	5	○	○	○	○	○*4	○*4
544	CC-Link extended setting NC	2C	AC	5	○	○	○	○	○*4	○*4
547	USB communication station number	2F	AF	5	○	○	○	○	○*4	○*4
548	USB communication check time interval	30	B0	5	○	○	○	○	○*4	○*4
549	Protocol selection	31	B1	5	○	○	○	○	○*4	○*4
550	NET mode operation command source selection	32	B2	5	○	○	○	○	○*4	○*4
551	PU mode operation command source selection	33	B3	5	○	○	○	○	○*4	○*4
552	Frequency jump range	34	B4	5	○	○	○	○	○	○
553	PID deviation limit	35	B5	5	○	○	○	○	○	○
554	PID signal operation selection	36	B6	5	○	○	○	○	○	○
555	Current average time	37	B7	5	○	○	○	○	○	○
556	Data output mask time	38	B8	5	○	○	○	○	○	○
557	Current average value monitor signal output reference current	39	B9	5	○	○	○	○	○	○
560	Second frequency search gain	3C	BC	5	○	○	×	○	×	○
561	PTC thermistor protection level	3D	BD	5	○	○	○	○	×	○
563	Energization time carrying-over times	3F	BF	5	○	○	○	×	×	×
564	Operating time carrying-over times	40	C0	5	○	○	○	×	×	×
565	Second motor excitation current break point	41	C1	5	×	○	×	○	○	○
566	Second motor excitation current low-speed scaling factor	42	C2	5	×	○	×	○	○	○
569	Second motor speed control gain	45	C5	5	×	○	×	○	×	○

9

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
570	Multiple rating setting	46	C6	5	○	○	○	○	×	×
571	Holding time at a start	47	C7	5	○	○	×	○	○	○
573	4 mA input check selection	49	C9	5	○	○	○	○	○	○
574	Second motor online auto tuning	4A	CA	5	×	○	×	○	○	○
575	Output interruption detection time	4B	CB	5	○	○	○	○	○	○
576	Output interruption detection level	4C	CC	5	○	○	○	○	○	○
577	Output interruption cancel level	4D	CD	5	○	○	○	○	○	○
578	Auxiliary motor operation selection	4E	CE	5	○	○	○	○	○	○
579	Motor connection function selection	4F	CF	5	○	○	○	○	○	○
580	MC switchcover interlock time (multi-pump)	50	D0	5	○	○	○	○	○	○
581	Start waiting time (multi-pump)	51	D1	5	○	○	○	○	○	○
582	Auxiliary motor connection-time deceleration time	52	D2	5	○	○	○	○	○	○
583	Auxiliary motor disconnection-time acceleration time	53	D3	5	○	○	○	○	○	○
584	Auxiliary motor 1 starting frequency	54	D4	5	○	○	○	○	○	○
585	Auxiliary motor 2 starting frequency	55	D5	5	○	○	○	○	○	○
586	Auxiliary motor 3 starting frequency	56	D6	5	○	○	○	○	○	○
587	Auxiliary motor 1 stopping frequency	57	D7	5	○	○	○	○	○	○
588	Auxiliary motor 2 stopping frequency	58	D8	5	○	○	○	○	○	○
589	Auxiliary motor 3 stopping frequency	59	D9	5	○	○	○	○	○	○
590	Auxiliary motor start detection time	5A	DA	5	○	○	○	○	○	○
591	Auxiliary motor stop detection time	5B	DB	5	○	○	○	○	○	○
592	Traverse function selection	5C	DC	5	○	○	○	○	○	○
593	Maximum amplitude amount	5D	DD	5	○	○	○	○	○	○
594	Amplitude compensation amount during deceleration	5E	DE	5	○	○	○	○	○	○
595	Amplitude compensation amount during acceleration	5F	DF	5	○	○	○	○	○	○
596	Amplitude acceleration time	60	E0	5	○	○	○	○	○	○
597	Amplitude deceleration time	61	E1	5	○	○	○	○	○	○
599	X10 terminal input selection	63	E3	5	○	○	○	○	○	○
600	First free thermal reduction frequency 1	00	80	6	○	○	○	○	○	○
601	First free thermal reduction ratio 1	01	81	6	○	○	○	○	○	○
602	First free thermal reduction frequency 2	02	82	6	○	○	○	○	○	○
603	First free thermal reduction ratio 2	03	83	6	○	○	○	○	○	○
604	First free thermal reduction frequency 3	04	84	6	○	○	○	○	○	○
606	Power failure stop external signal input selection	06	86	6	○	○	○	○	○	○
607	Motor permissible load level	07	87	6	○	○	○	○	○	○
608	Second motor permissible load level	08	88	6	○	○	○	○	○	○
609	PID set point/deviation input selection	09	89	6	○	○	○	○	○	○
610	PID measured value input selection	0A	8A	6	○	○	○	○	○	○
611	Acceleration time at a restart	0B	8B	6	○	○	○	○	○	○
617	Reverse rotation excitation current low-speed scaling factor	11	91	6	×	○	×	○	○	○
653	Speed smoothing control	35	B5	6	○	×	×	○	○	○
654	Speed smoothing cutoff frequency	36	B6	6	○	×	×	○	○	○
655	Analog remote output selection	37	B7	6	○	○	○	○	○	○
656	Analog remote output 1	38	B8	6	○	○	○	×	×	×
657	Analog remote output 2	39	B9	6	○	○	○	×	×	×
658	Analog remote output 3	3A	BA	6	○	○	○	×	×	×
659	Analog remote output 4	3B	BB	6	○	○	○	×	×	×
660	Increased magnetic excitation deceleration operation selection	3C	BC	6	○	○	×	○	○	○
661	Magnetic excitation increase rate	3D	BD	6	○	○	×	○	○	○
662	Increased magnetic excitation current level	3E	BE	6	○	○	×	○	○	○
663	Control circuit temperature signal output level	3F	BF	6	○	○	○	○	○	○
665	Regeneration avoidance frequency gain	41	C1	6	○	○	○	○	○	○
675	User parameter auto storage function selection	4B	CB	6	○	○	○	○	○	○
668	Power failure stop frequency gain	44	C4	6	○	○	○	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
684	Tuning data unit switchover	54	D4	6	×	○	○	○	○	○
686	Maintenance timer 2	56	D6	6	○	○	○	×	×	×
687	Maintenance timer 2 warning output set time	57	D7	6	○	○	○	○	×	○
688	Maintenance timer 3	58	D8	6	○	○	○	×	×	×
689	Maintenance timer 3 warning output set time	59	D9	6	○	○	○	○	×	○
692	Second free thermal reduction frequency 1	5C	DC	6	○	○	○	○	○	○
693	Second free thermal reduction ratio 1	5D	DD	6	○	○	○	○	○	○
694	Second free thermal reduction frequency 2	5E	DE	6	○	○	○	○	○	○
695	Second free thermal reduction ratio 2	5F	DF	6	○	○	○	○	○	○
696	Second free thermal reduction frequency 3	60	E0	6	○	○	○	○	○	○
699	Input terminal filter	63	E3	6	○	○	○	○	×	○
702	Maximum motor frequency	02	82	7	×	×	○	○	○	○
706	Induced voltage constant (phi f)	06	86	7	×	×	○	○	×	○
707	Motor inertia (integer)	07	87	7	×	×	○	○	○	○
711	Motor Ld decay ratio	0B	8B	7	×	×	○	○	×	○
712	Motor Lq decay ratio	0C	8C	7	×	×	○	○	×	○
717	Starting resistance tuning compensation	11	91	7	×	×	○	○	×	○
721	Starting magnetic pole position detection pulse width	15	95	7	×	×	○	○	×	○
724	Motor inertia (exponent)	18	98	7	×	×	○	○	○	○
725	Motor protection current level	19	99	7	×	×	○	○	○	○
726	Auto Baudrate/Max Master	1A	9A	7	○	○	○	○	○*4	○*4
727	Max Info Frames	1B	9B	7	○	○	○	○	○*4	○*4
728	Device instance number (Upper 3 digits)	1C	9C	7	○	○	○	○	○*4	○*4
729	Device instance number (Lower 4 digits)	1D	9D	7	○	○	○	○	○*4	○*4
738	Second motor induced voltage constant (phi f)	26	A6	7	×	×	○	○	×	○
739	Second motor Ld decay ratio	27	A7	7	×	×	○	○	×	○
740	Second motor Lq decay ratio	28	A8	7	×	×	○	○	×	○
741	Second starting resistance tuning compensation	29	A9	7	×	×	○	○	×	○
742	Second motor magnetic pole detection pulse width	2A	AA	7	×	×	○	○	×	○
743	Second motor maximum frequency	2B	AB	7	×	×	○	○	○	○
744	Second motor inertia (integer)	2C	AC	7	×	×	○	○	○	○
745	Second motor inertia (exponent)	2D	AD	7	×	×	○	○	○	○
746	Second motor protection current level	2E	AE	7	×	×	○	○	○	○
753	Second PID action selection	35	B5	7	○	○	○	○	○	○
754	Second PID control automatic switchover frequency	36	B6	7	○	○	○	○	○	○
755	Second PID action set point	37	B7	7	○	○	○	○	○	○
756	Second PID proportional band	38	B8	7	○	○	○	○	○	○
757	Second PID integral time	39	B9	7	○	○	○	○	○	○
758	Second PID differential time	3A	BA	7	○	○	○	○	○	○
759	PID unit selection	3B	BB	7	○	○	○	○	○	○
760	Pre-charge fault selection	3C	BC	7	○	○	○	○	○	○
761	Pre-charge ending level	3D	BD	7	○	○	○	○	○	○
762	Pre-charge ending time	3E	BE	7	○	○	○	○	○	○
763	Pre-charge upper detection level	3F	BF	7	○	○	○	○	○	○
764	Pre-charge time limit	40	C0	7	○	○	○	○	○	○
765	Second pre-charge fault selection	41	C1	7	○	○	○	○	○	○
766	Second pre-charge ending level	42	C2	7	○	○	○	○	○	○
767	Second pre-charge ending time	43	C3	7	○	○	○	○	○	○
768	Second pre-charge upper detection level	44	C4	7	○	○	○	○	○	○
769	Second pre-charge time limit	45	C5	7	○	○	○	○	○	○
774	Operation panel monitor selection 1	4A	CA	7	○	○	○	○	○	○
775	Operation panel monitor selection 2	4B	CB	7	○	○	○	○	○	○
776	Operation panel monitor selection 3	4C	CC	7	○	○	○	○	○	○
777	4 mA input check operation frequency	4D	CD	7	○	○	○	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
778	4 mA input check filter	4E	CE	7	○	○	○	○	○	○
779	Operation frequency during communication error	4F	CF	7	○	○	○	○	○	○
791	Acceleration time in low-speed range	5B	DB	7	×	×	○	○	○	○
792	Deceleration time in low-speed range	5C	DC	7	×	×	○	○	○	○
799	Pulse increment setting for output power	63	E3	7	○	○	○	○	○	○
800	Control method selection	00	80	8	○	○	○	○	○	○
815	Torque limit level 2	0F	8F	8	×	×	○	○	○	○
820	Speed control P gain 1	14	94	8	×	×	○	○	○	○
821	Speed control integral time 1	15	95	8	×	×	○	○	○	○
822	Speed setting filter 1	16	96	8	×	×	○	○	○	○
824	Torque control P gain 1 (current loop proportional gain)	18	98	8	×	×	○	○	○	○
825	Torque control integral time 1 (current loop integral time)	19	99	8	×	×	○	○	○	○
827	Torque detection filter 1	1B	9B	8	×	×	○	○	○	○
828	Parameter for manufacturer setting. Do not set.									
830	Speed control P gain 2	1E	9E	8	×	×	○	○	○	○
831	Speed control integral time 2	1F	9F	8	×	×	○	○	○	○
832	Speed setting filter 2	20	A0	8	×	×	○	○	○	○
834	Torque control P gain 2 (current loop proportional gain)	22	A2	8	×	×	○	○	○	○
835	Torque control integral time 2 (current loop integral time)	23	A3	8	×	×	○	○	○	○
837	Torque detection filter 2	25	A5	8	×	×	○	○	○	○
849	Analog input offset adjustment	31	B1	8	○	○	○	○	○	○
858	Terminal 4 function assignment	3A	BA	8	○	○	○	○	×	○
859	Torque current/Rated PM motor current	3B	BB	8	×	○	○	○	×	○
860	Second motor torque current/Rated PM motor current	3C	BC	8	×	○	○	○	×	○
864	Torque detection	40	C0	8	×	×	○	○	○	○
866	Torque monitoring reference	42	C2	8	×	○	○	○	○	○
867	AM output filter	43	C3	8	○	○	○	○	○	○
868	Terminal 1 function assignment	44	C4	8	○	○	○	○	×	○
869	Current output filter	45	C5	8	○	○	○	○	○	○
870	Speed detection hysteresis	46	C6	8	○	○	○	○	○	○
872	Input phase loss protection selection	48	C8	8	○	○	○	○	○	○
874	OLT level setting	4A	CA	8	×	×	○	○	○	○
882	Regeneration avoidance operation selection	52	D2	8	○	○	○	○	○	○
883	Regeneration avoidance operation level	53	D3	8	○	○	○	○	○	○
884	Regeneration avoidance at deceleration detection sensitivity	54	D4	8	○	○	○	○	○	○
885	Regeneration avoidance compensation frequency limit value	55	D5	8	○	○	○	○	○	○
886	Regeneration avoidance voltage gain	56	D6	8	○	○	○	○	○	○
888	Free parameter 1	58	D8	8	○	○	○	○	×	×
889	Free parameter 2	59	D9	8	○	○	○	○	×	×
890	Internal storage device status indication	5A	DA	8	○	○	○	×	×	×
891	Cumulative power monitor digit shifted times	5B	DB	8	○	○	○	○	○	○
892	Load factor	5C	DC	8	○	○	○	○	○	○
893	Energy saving monitor reference (motor capacity)	5D	DD	8	○	○	○	○	○	○
894	Control selection during commercial power-supply operation	5E	DE	8	○	○	○	○	○	○
895	Power saving rate reference value	5F	DF	8	○	○	○	○	○	○
896	Power unit cost	60	E0	8	○	○	○	○	○	○
897	Power saving monitor average time	61	E1	8	○	○	○	○	○	○
898	Power saving cumulative monitor clear	62	E2	8	○	○	○	○	×	○
899	Operation time rate (estimated value)	63	E3	8	○	○	○	○	○	○
900	CA terminal calibration	5C	DC	1	○	○	○	○	×	○
901	AM terminal calibration	5D	DD	1	○	○	○	○	×	○
902	Terminal 2 frequency setting bias frequency	5E	DE	1	○	○	○	○	×	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
902	Terminal 2 frequency setting bias	5E	DE	1	○	○	○	○	×	○
903 (125)	Terminal 2 frequency setting gain frequency	5F	DF	1	○	○	○	○	×	○
903	Terminal 2 frequency setting gain	5F	DF	1	○	○	○	○	×	○
904	Terminal 4 frequency setting bias frequency	60	E0	1	○	○	○	○	×	○
904	Terminal 4 frequency setting bias	60	E0	1	○	○	○	○	×	○
905 (126)	Terminal 4 frequency setting gain frequency	61	E1	1	○	○	○	○	×	○
905	Terminal 4 frequency setting gain	61	E1	1	○	○	○	○	×	○
917	Terminal 1 bias frequency (speed)	11	91	9	×	×	○	○	×	○
917	Terminal 1 bias (speed)	11	91	9	×	×	○	○	×	○
918	Terminal 1 gain frequency (speed)	12	92	9	×	×	○	○	×	○
918	Terminal 1 gain (speed)	12	92	9	×	×	○	○	×	○
919	Terminal 1 bias command (torque)	13	93	9	×	×	○	○	×	○
919	Terminal 1 bias (torque)	13	93	9	×	×	○	○	×	○
920	Terminal 1 gain command (torque)	14	94	9	×	×	○	○	×	○
920	Terminal 1 gain (torque)	14	94	9	×	×	○	○	×	○
930	Current output bias signal	1E	9E	9	○	○	○	○	○	○
930	Current output bias current	1E	9E	9	○	○	○	○	○	○
931	Current output gain signal	1F	9F	9	○	○	○	○	○	○
931	Current output gain current	1F	9F	9	○	○	○	○	○	○
932	Terminal 4 bias command (torque)	20	A0	9	×	×	○	○	×	○
932	Terminal 4 bias (torque)	20	A0	9	×	×	○	○	×	○
933	Terminal 4 gain command (torque)	21	A1	9	×	×	○	○	×	○
933	Terminal 4 gain (torque)	21	A1	9	×	×	○	○	×	○
934	PID display bias coefficient	22	A2	9	○	○	○	○	×	○
934	PID display bias analog value	22	A2	9	○	○	○	○	×	○
935	PID display gain coefficient	23	A3	9	○	○	○	○	×	○
935	PID display gain analog value	23	A3	9	○	○	○	○	×	○
989	Parameter copy alarm release	59	D9	9	○	○	○	○	×	○
990	PU buzzer control	5A	DA	9	○	○	○	○	○	○
991	PU contrast adjustment	5B	DB	9	○	○	○	○	×	○
992	Parameter for manufacturer setting. Do not set.									
997	Fault initiation	61	E1	9	○	○	○	×	○	○
998	PM parameter initialization	62	E2	9	○	○	○	○	○	○
999	Automatic parameter setting	63	E3	9	○	○	○	×	×	○
1000	Direct setting selection	00	80	A	○	○	○	○	○	○
1002	Lq tuning target current adjustment coefficient	02	82	A	×	×	○	○	○	○
1006	Clock (year)	06	86	A	○	○	○	×	×	×
1007	Clock (month, day)	07	87	A	○	○	○	×	×	×
1008	Clock (hour, minute)	08	88	A	○	○	○	×	×	×
1013	Running speed after emergency drive retry reset	0D	8D	A	○	○	○	○	×	○
1015	Integral stop selection at limited frequency	0F	8F	A	○	○	○	○	○	○
1016	PTC thermistor protection detection time	10	90	A	○	○	○	○	×	○
1018	Monitor with sign selection	12	92	A	○	○	○	○	○	○
1019	Analog meter voltage negative output selection AY	13	93	A	○	○	○	○	○	○
1020	Trace operation selection	14	94	A	○	○	○	○	○	○
1021	Trace mode selection	15	95	A	○	○	○	○	○	○
1022	Sampling cycle	16	96	A	○	○	○	○	○	○
1023	Number of analog channels	17	97	A	○	○	○	○	○	○
1024	Sampling auto start	18	98	A	○	○	○	○	○	○
1025	Trigger mode selection	19	99	A	○	○	○	○	○	○
1026	Number of sampling before trigger	1A	9A	A	○	○	○	○	○	○
1027	Analog source selection (1ch)	1B	9B	A	○	○	○	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
1028	Analog source selection (2ch)	1C	9C	A	○	○	○	○	○	○
1029	Analog source selection (3ch)	1D	9D	A	○	○	○	○	○	○
1030	Analog source selection (4ch)	1E	9E	A	○	○	○	○	○	○
1031	Analog source selection (5ch)	1F	9F	A	○	○	○	○	○	○
1032	Analog source selection (6ch)	20	A0	A	○	○	○	○	○	○
1033	Analog source selection (7ch)	21	A1	A	○	○	○	○	○	○
1034	Analog source selection (8ch)	22	A2	A	○	○	○	○	○	○
1035	Analog trigger channel	23	A3	A	○	○	○	○	○	○
1036	Analog trigger operation selection	24	A4	A	○	○	○	○	○	○
1037	Analog trigger level	25	A5	A	○	○	○	○	○	○
1038	Digital source selection (1ch)	26	A6	A	○	○	○	○	○	○
1039	Digital source selection (2ch)	27	A7	A	○	○	○	○	○	○
1040	Digital source selection (3ch)	28	A8	A	○	○	○	○	○	○
1041	Digital source selection (4ch)	29	A9	A	○	○	○	○	○	○
1042	Digital source selection (5ch)	2A	AA	A	○	○	○	○	○	○
1043	Digital source selection (6ch)	2B	AB	A	○	○	○	○	○	○
1044	Digital source selection (7ch)	2C	AC	A	○	○	○	○	○	○
1045	Digital source selection (8ch)	2D	AD	A	○	○	○	○	○	○
1046	Digital trigger channel	2E	AE	A	○	○	○	○	○	○
1047	Digital trigger operation selection	2F	AF	A	○	○	○	○	○	○
1048	Parameter for manufacturer setting. Do not set.									
1049	USB host reset	31	B1	A	○	○	○	×	○	○
1103	Deceleration time at emergency stop	03	83	B	○	○	○	○	○	○
1106	Torque monitor filter	06	86	B	○	○	○	○	○	○
1107	Running speed monitor filter	07	87	B	○	○	○	○	○	○
1108	Excitation current monitor filter	08	88	B	○	○	×	○	○	○
1132	Pre-charge change increment amount	20	A0	B	○	○	○	○	○	○
1133	Second pre-charge change increment amount	21	A1	B	○	○	○	○	○	○
1136	Second PID display bias coefficient	24	A4	B	○	○	○	○	×	○
1137	Second PID display bias analog value	25	A5	B	○	○	○	○	×	○
1138	Second PID display gain coefficient	26	A6	B	○	○	○	○	×	○
1139	Second PID display gain analog value	27	A7	B	○	○	○	○	×	○
1140	Second PID set point/deviation input selection	28	A8	B	○	○	○	○	○	○
1141	Second PID measured value input selection	29	A9	B	○	○	○	○	○	○
1142	Second PID unit selection	2A	AA	B	○	○	○	○	○	○
1143	Second PID upper limit	2B	AB	B	○	○	○	○	○	○
1144	Second PID lower limit	2C	AC	B	○	○	○	○	○	○
1145	Second PID deviation limit	2D	AD	B	○	○	○	○	○	○
1146	Second PID signal operation selection	2E	AE	B	○	○	○	○	○	○
1147	Second output interruption detection time	2F	AF	B	○	○	○	○	○	○
1148	Second output interruption detection level	30	B0	B	○	○	○	○	○	○
1149	Second output interruption cancel level	31	B1	B	○	○	○	○	○	○
1150	User parameters 1	32	B2	B	○	○	○	○	○	○
1151	User parameters 2	33	B3	B	○	○	○	○	○	○
1152	User parameters 3	34	B4	B	○	○	○	○	○	○
1153	User parameters 4	35	B5	B	○	○	○	○	○	○
1154	User parameters 5	36	B6	B	○	○	○	○	○	○
1155	User parameters 6	37	B7	B	○	○	○	○	○	○
1156	User parameters 7	38	B8	B	○	○	○	○	○	○
1157	User parameters 8	39	B9	B	○	○	○	○	○	○
1158	User parameters 9	3A	BA	B	○	○	○	○	○	○
1159	User parameters 10	3B	BB	B	○	○	○	○	○	○
1160	User parameters 11	3C	BC	B	○	○	○	○	○	○
1161	User parameters 12	3D	BD	B	○	○	○	○	○	○
1162	User parameters 13	3E	BE	B	○	○	○	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
1163	User parameters 14	3F	BF	B	○	○	○	○	○	○
1164	User parameters 15	40	C0	B	○	○	○	○	○	○
1165	User parameters 16	41	C1	B	○	○	○	○	○	○
1166	User parameters 17	42	C2	B	○	○	○	○	○	○
1167	User parameters 18	43	C3	B	○	○	○	○	○	○
1168	User parameters 19	44	C4	B	○	○	○	○	○	○
1169	User parameters 20	45	C5	B	○	○	○	○	○	○
1170	User parameters 21	46	C6	B	○	○	○	○	○	○
1171	User parameters 22	47	C7	B	○	○	○	○	○	○
1172	User parameters 23	48	C8	B	○	○	○	○	○	○
1173	User parameters 24	49	C9	B	○	○	○	○	○	○
1174	User parameters 25	4A	CA	B	○	○	○	○	○	○
1175	User parameters 26	4B	CB	B	○	○	○	○	○	○
1176	User parameters 27	4C	CC	B	○	○	○	○	○	○
1177	User parameters 28	4D	CD	B	○	○	○	○	○	○
1178	User parameters 29	4E	CE	B	○	○	○	○	○	○
1179	User parameters 30	4F	CF	B	○	○	○	○	○	○
1180	User parameters 31	50	D0	B	○	○	○	○	○	○
1181	User parameters 32	51	D1	B	○	○	○	○	○	○
1182	User parameters 33	52	D2	B	○	○	○	○	○	○
1183	User parameters 34	53	D3	B	○	○	○	○	○	○
1184	User parameters 35	54	D4	B	○	○	○	○	○	○
1185	User parameters 36	55	D5	B	○	○	○	○	○	○
1186	User parameters 37	56	D6	B	○	○	○	○	○	○
1187	User parameters 38	57	D7	B	○	○	○	○	○	○
1188	User parameters 39	58	D8	B	○	○	○	○	○	○
1189	User parameters 40	59	D9	B	○	○	○	○	○	○
1190	User parameters 41	5A	DA	B	○	○	○	○	○	○
1191	User parameters 42	5B	DB	B	○	○	○	○	○	○
1192	User parameters 43	5C	DC	B	○	○	○	○	○	○
1193	User parameters 44	5D	DD	B	○	○	○	○	○	○
1194	User parameters 45	5E	DE	B	○	○	○	○	○	○
1195	PLC function user parameters 46	5F	DF	B	○	○	○	○	○	○
1196	User parameters 47	60	E0	B	○	○	○	○	○	○
1197	User parameters 48	61	E1	B	○	○	○	○	○	○
1198	User parameters 49	62	E2	B	○	○	○	○	○	○
1199	PLC function user parameters 50	63	E3	B	○	○	○	○	○	○
1211	PID gain tuning timeout time	0B	8B	C	○	○	○	○	○	○
1212	Step manipulated amount	0C	8C	C	○	○	○	○	○	○
1213	Step response sampling cycle	0D	8D	C	○	○	○	○	○	○
1214	Timeout time after the maximum slope	0E	8E	C	○	○	○	○	○	○
1215	Limit cycle output upper limit	0F	8F	C	○	○	○	○	○	○
1216	Limit cycle output lower limit	10	90	C	○	○	○	○	○	○
1217	Limit cycle hysteresis	11	91	C	○	○	○	○	○	○
1218	PID gain tuning setting	12	92	C	○	○	○	○	○	○
1219	PID gain tuning start/status	13	93	C	○	○	○	×	×	×
1344	R-S turns ratio compensation AVP	2C	AC	D	○	○	○	○	×	×
1345	T-S turns ratio compensation AVP	2D	AD	D	○	○	○	○	×	×
1346	PID lower limit operation detection time	2E	AE	D	○	○	○	○	○	○
1361	Detection time for PID output hold	3D	BD	D	○	○	○	○	○	○
1362	PID output hold range	3E	BE	D	○	○	○	○	○	○
1363	PID priming time	3F	BF	D	○	○	○	○	○	○
1364	Stirring time during sleep	40	C0	D	○	○	○	○	○	○
1365	Stirring interval time	41	C1	D	○	○	○	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
1366	Sleep boost level	42	C2	D	○	○	○	○	○	○
1367	Sleep boost waiting time	43	C3	D	○	○	○	○	○	○
1368	Output interruption cancel time	44	C4	D	○	○	○	○	○	○
1369	Check valve closing completion frequency	45	C5	D	○	○	○	○	○	○
1370	Detection time for PID limiting operation	46	C6	D	○	○	○	○	○	○
1371	PID upper/lower limit pre-warning level range	47	C7	D	○	○	○	○	○	○
1372	PID measured value control set point change amount	48	C8	D	○	○	○	○	○	○
1373	PID measured value control set point change rate	49	C9	D	○	○	○	○	○	○
1374	Auxiliary pressure pump operation starting level	4A	CA	D	○	○	○	○	○	○
1375	Auxiliary pressure pump operation stopping level	4B	CB	D	○	○	○	○	○	○
1376	Auxiliary motor stopping level	4C	CC	D	○	○	○	○	○	○
1377	PID input pressure selection	4D	CD	D	○	○	○	○	○	○
1378	PID input pressure warning level	4E	CE	D	○	○	○	○	○	○
1379	PID input pressure fault level	4F	CF	D	○	○	○	○	○	○
1380	PID input pressure warning set point change amount	50	D0	D	○	○	○	○	○	○
1381	PID input pressure fault operation selection	51	D1	D	○	○	○	○	○	○
1382	MC switchover interlock time (for phase-synchronized bypass switching function) AVP	52	D2	D	○	○	×	○	○	○
1383	Phase compensation amount for synchronous bypass switching AVP	53	D3	D	○	○	×	○	○	○
1384	PLL tuning gain AVP	54	D4	D	○	○	×	○	○	○
1410	Starting times lower 4 digits	0A	8A	E	○	○	○	○	○	○
1411	Starting times upper 4 digits	0B	8B	E	○	○	○	○	○	○
1412	Motor induced voltage constant (phi f) exponent	0C	8C	E	×	×	○	○	○	○
1413	Second motor induced voltage constant (phi f) exponent	0D	8D	E	×	×	○	○	○	○
1442	IP filter address 1 (Ethernet) NCG	2A	AA	E	○	○	○	○	○*4	○*4
1443	IP filter address 2 (Ethernet) NCG	2B	AB	E	○	○	○	○	○*4	○*4
1444	IP filter address 3 (Ethernet) NCG	2C	AC	E	○	○	○	○	○*4	○*4
1445	IP filter address 4 (Ethernet) NCG	2D	AD	E	○	○	○	○	○*4	○*4
1446	IP filter address 2 range specification (Ethernet) NCG	2E	AE	E	○	○	○	○	○*4	○*4
1447	IP filter address 3 range specification (Ethernet) NCG	2F	AF	E	○	○	○	○	○*4	○*4
1448	IP filter address 4 range specification (Ethernet) NCG	30	B0	E	○	○	○	○	○*4	○*4
1459	Clock source selection NCG	3B	BB	E	○	○	○	○	○	○
1460	PID multistage set point 1	3C	BC	E	○	○	○	○	○	○
1461	PID multistage set point 2	3D	BD	E	○	○	○	○	○	○
1462	PID multistage set point 3	3E	BE	E	○	○	○	○	○	○
1463	PID multistage set point 4	3F	BF	E	○	○	○	○	○	○
1464	PID multistage set point 5	40	C0	E	○	○	○	○	○	○
1465	PID multistage set point 6	41	C1	E	○	○	○	○	○	○
1466	PID multistage set point 7	42	C2	E	○	○	○	○	○	○
1469	Number of cleaning times monitor	45	C5	E	○	○	○	×	×	×
1470	Number of cleaning times setting	46	C6	E	○	○	○	○	○	○
1471	Cleaning trigger selection	47	C7	E	○	○	○	○	○	○
1472	Cleaning reverse rotation frequency	48	C8	E	○	○	○	○	○	○
1473	Cleaning reverse rotation operation time	49	C9	E	○	○	○	○	○	○
1474	Cleaning forward rotation frequency	4A	CA	E	○	○	○	○	○	○
1475	Cleaning forward rotation operation time	4B	CB	E	○	○	○	○	○	○
1476	Cleaning stop time	4C	CC	E	○	○	○	○	○	○
1477	Cleaning acceleration time	4D	CD	E	○	○	○	○	○	○
1478	Cleaning deceleration time	4E	CE	E	○	○	○	○	○	○
1479	Cleaning time trigger	4F	CF	E	○	○	○	○	○	○
1480	Load characteristics measurement mode	50	D0	E	○	○	○	○	○	○
1481	Load characteristics load reference 1	51	D1	E	○	○	○	○	○	○

Pr.	Name	Instruction code*1			Control method*2			Parameter		
		Read	Write	Extended	V/F	Magnetic flux	PM	Copy*3	Clear*3	All clear*3
1482	Load characteristics load reference 2	52	D2	E	○	○	○	○	○	○
1483	Load characteristics load reference 3	53	D3	E	○	○	○	○	○	○
1484	Load characteristics load reference 4	54	D4	E	○	○	○	○	○	○
1485	Load characteristics load reference 5	55	D5	E	○	○	○	○	○	○
1486	Load characteristics maximum frequency	56	D6	E	○	○	○	○	○	○
1487	Load characteristics minimum frequency	57	D7	E	○	○	○	○	○	○
1488	Upper limit warning detection width	58	D8	E	○	○	○	○	○	○
1489	Lower limit warning detection width	59	D9	E	○	○	○	○	○	○
1490	Upper limit fault detection width	5A	DA	E	○	○	○	○	○	○
1491	Lower limit fault detection width	5B	DB	E	○	○	○	○	○	○
1492	Load status detection signal delay time / load reference measurement waiting time	5C	DC	E	○	○	○	○	○	○
1499	Parameter for manufacturer setting. Do not set.									

9

9.3 For customers using HMS network options

◆ List of inverter monitored items / command items

The following items can be set using a communication option.

◆ 16-bit data

No.	Description	Unit	Type	Read/write
H0000	No data	-	-	-
H0001	Output frequency	0.01 Hz	unsigned	R
H0002	Output current	0.01 A/0.1 A	unsigned	R
H0003	Output voltage	0.1 V	unsigned	R
H0004	reserved	-	-	-
H0005	Frequency setting value	0.01 Hz	unsigned	R
H0006	Motor speed	1 r/min	unsigned	R
H0007	Motor torque	0.1%	unsigned	R
H0008	Converter output voltage	0.1 V	unsigned	R
H0009	reserved	-	-	-
H000A	Electric thermal relay function load factor	0.1%	unsigned	R
H000B	Output current peak value	0.01 A/0.1 A	unsigned	R
H000C	Converter output voltage peak value	0.1 V	unsigned	R
H000D	Input power	0.01 kW/0.1 kW	unsigned	R
H000E	Output power	0.01 kW/0.1 kW	unsigned	R
H000F	Input terminal status*1	-	-	R
H0010	Output terminal status*1	-	-	R
H0011	Load meter	0.1%	unsigned	R
H0012	Motor excitation current	0.01 A/0.1 A	unsigned	R
H0013	reserved	-	-	-
H0014	Cumulative energization time	1 h	unsigned	R
H0015	reserved	-	-	-
H0016	Orientation status	1	unsigned	R
H0017	Actual operation time	1 h	unsigned	R
H0018	Motor load factor	0.1%	unsigned	R
H0019	Cumulative power	1 kWh	unsigned	R
H001A to H0021	reserved	-	-	-
H0022	Motor output	0.1 kW	unsigned	R
H0023 to H0025	reserved	-	-	-
H0026	Trace status	-	unsigned	R
H0027	reserved	-	-	-
H0028	PLC function user monitor 1	-	unsigned	R
H0029	PLC function user monitor 2	-	unsigned	R
H002A	PLC function user monitor 3	-	unsigned	R
H002B to H0031	reserved	-	-	-
H0032	Power saving effect	-	unsigned	R
H0033	Cumulative saving power	-	unsigned	R
H0034	PID set point	0.1%	unsigned	R/W
H0035	PID measured value	0.1%	unsigned	R/W
H0036	PID deviation	0.1%	unsigned	R/W
H0037 to H0039	reserved	-	-	-
H003A	Option input terminal status1*1	-	-	R
H003B	Option input terminal status2*1	-	-	R
H003C	Option output terminal status*1	-	-	R
H003D	Motor thermal load factor	0.1%	unsigned	R
H003E	Transistor thermal load factor	0.1%	unsigned	R

No.	Description	Unit	Type	Read/write
H003F	reserved	-	-	-
H0040	PTC thermistor resistance	0.01 kΩ	unsigned	R
H0041	Output power (with regenerative display)	0.1 kW	unsigned	R
H0042	Cumulative regenerative power	1 kWh	unsigned	R
H0043	PID measured value 2	0.1%	unsigned	R
H0044	Second PID set point	0.1%	unsigned	R/W
H0045	Second PID measured value	0.1%	unsigned	R/W
H0046	Second PID deviation	0.1%	unsigned	R/W
H0047 to H004F	reserved	-	-	-
H0050	Integrated power on time	1 h	unsigned	R
H0051	Running time	1 h	unsigned	R
H0052	Saving energy monitor	-	unsigned	R
H0053	reserved	-	-	-
H0054	Fault code (1)	-	-	R
H0055	Fault code (2)	-	-	R
H0056	Fault code (3)	-	-	R
H0057	Fault code (4)	-	-	R
H0058	Fault code (5)	-	-	R
H0059	Fault code (6)	-	-	R
H005A	Fault code (7)	-	-	R
H005B	Fault code (8)	-	-	R
H005C to H005E	reserved	-	-	-
H005F	Second PID measured value 2	0.1%	unsigned	R
H0060	Second PID manipulated variable	0.1%	signed	R
H0061 to H0065	reserved	-	-	-
H0066	PID manipulated variable	0.1%	signed	R
H0067 to H00F8	reserved	-	-	-
H00F9	Run command*2	-	-	R/W
H00FA to H01FF	reserved	-	-	-

*1 For details, refer to page 274.

*2 Run command

Users can specify the terminal function using this data. These bits function is depending on inverter parameter setting. (Refer to page 343)

b15 b0

-	-	-	-	RES	STP (STOP)	CS	JOG	MRS	RT	RH	RM	RL	-	-	AU

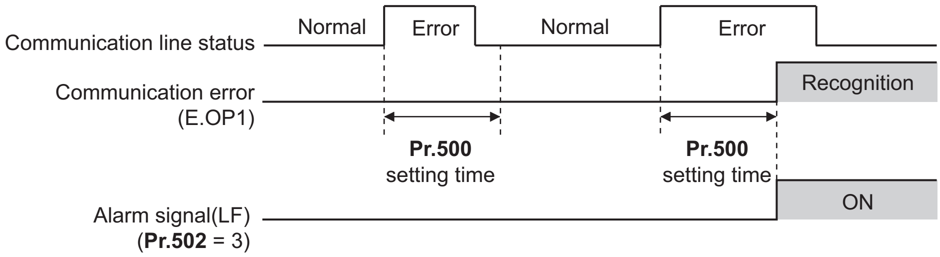
◆ 32-bit data

No.	Description	Unit	Type	Read/write
H0200	reserved	-	-	-
H0201	Output frequency (0-15bit)	0.01 Hz	signed	R
H0202	Output frequency (16-31bit)			
H0203	Setting frequency (0-15bit)	0.01 Hz	unsigned	R
H0204	Setting frequency (16-31bit)			
H0205	Motor rotation (0-15bit)	1 r/min	signed	R
H0206	Motor rotation (16-31bit)			
H0207	Load meter (0-15bit)	0.1%	unsigned	R
H0208	Load meter (16-31bit)			
H0209, H020A	reserved	-	-	-
H020B	Watt-hour meter (1kWh step) (0-15bit)	1 kWh	unsigned	R
H020C	Watt-hour meter (1kWh step) (16-31bit)			
H020D	Watt-hour meter (0.1/0.01kWh step) (0-15bit)	0.1/0.01 kWh	unsigned	R
H020E	Watt-hour meter(0.1/0.01kWh step) (16-31bit)			
H020F to H03FF	reserved	-	-	-

◆ Waiting time for the communication line error output after a communication error

Waiting time for the communication error output after a communication line error occurrence can be set.

Pr.	Name	Setting range	Minimum setting increments	Initial value
500	**Communication error execution waiting time**	0 to 999.8 s	0.1 s	0 s



When a communication line error occurs and lasts longer than the time set in **Pr.500**, it is recognized as a communication error. If the communication returns to normal within the time, it is not recognized as a communication error, and the operation continues.

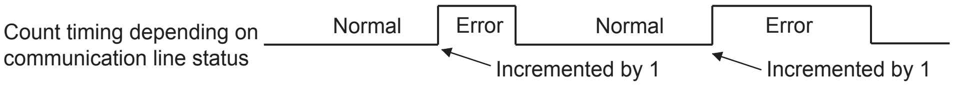
NOTE

- The communication option error (E. 1) is not included in the targets of **Pr.500**.
- Operations at communication error occurrences can be selected with **Pr.502 Stop mode selection at communication error**. (Refer to page 479)

◆ Displaying and clearing the communication error count

The cumulative count of communication error occurrences can be displayed. Write "0" to clear this cumulative count.

Pr.	Name	Setting range	Minimum setting increments	Initial value
501	**Communication error occurrence count display**	0	1	0



At the point of communication line error occurrence, **Pr.501 Communication error occurrence count display** is incremented by 1.

The cumulative count of communication error occurrences is counted from 0 to 65535. When the count exceeds 65535, the displayed value is cleared and the counting starts over from 0 again.

NOTE

- Communication error count is temporarily stored in the RAM memory. The error count is stored in EEPROM only once per hour. If power reset or inverter reset is performed, **Pr.501** setting will be the one that is last stored to EEPROM depending on the reset timing.

◆ Error reset and Ready bit status selection

- An error reset command from a communication option can be invalidated in the External operation mode or the PU operation mode.
- The status of Ready bit is selectable.

Pr.	Name	Initial value	Setting range	Description
349	**Communication reset selection/ Ready bit status selection/Reset selection after inverter faults are cleared/DriveControl writing restriction selection**	0	0, 1, 100, 101, 1000, 1001, 1100, 1101, 10000, 10001, 10100, 10101, 11000, 11001, 11100, 11101	Use this parameter to select the error reset operation, Ready bit status, inverter reset operation when a fault is cleared, and DriveControl settings.
N010	**Communication reset selection**	0	0	Enables the error reset function in any operation mode.
			1	Enables the error reset function only in the Network operation mode.
N240	**Ready bit status selection**	0	0	The status of Ready bit in communication data can be selected.
			1	
N241	**Reset selection after inverter faults are cleared**	0	0	The inverter is reset when a fault is cleared.
			1	The inverter is not reset when a fault is cleared.
N242	**DriveControl writing restriction selection**	0	0	DriveControl writing is not restricted.
			1	DriveControl writing is restricted.

- The status of Ready bit in communication data can be changed when an HMS network option is installed. (**P.N240**)
- When an HMS network option is installed and the communication option is specified for the command source in Network operation mode, it is possible to select whether the inverter is reset after the "Fault reset" command is executed. (**P.N241**)

• When an HMS network option is installed, the command source to change the DriveControl settings can be restricted to only the command source selected by **Pr.550 NET mode operation command source selection**. (**P.N242**)

Setting value					Description					
Pr.349	N010	N240	N241	N242	Communication reset selection*1		Ready bit status selection*2		Reset selection after inverter faults are cleared	DriveControl writing restriction
					NET operation mode	Other than NET operation mode	Main circuit: power-ON	Main circuit: power-OFF*3		
0	0	0	0	0	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: ON	Reset	Not restricted
1	1	0	0	0	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: ON	Reset	Not restricted
100	0	1	0	0	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: OFF	Reset	Not restricted
101	1	1	0	0	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: OFF	Reset	Not restricted
1000	0	0	1	0	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: ON	Not reset*4	Not restricted
1001	1	0	1	0	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: ON	Not reset*4	Not restricted
1100	0	1	1	0	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: OFF	Not reset*4	Not restricted
1101	1	1	1	0	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: OFF	Not reset*4	Not restricted
10000	0	0	0	1	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: ON	Reset	Restricted*4
10001	1	0	0	1	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: ON	Reset	Restricted*4
10100	0	1	0	1	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: OFF	Reset	Restricted*4
10101	1	1	0	1	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: OFF	Reset	Restricted*4
11000	0	0	1	1	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: ON	Not reset*4	Restricted*4
11001	1	0	1	1	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: ON	Not reset*4	Restricted*4
11100	0	1	1	1	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: OFF	Not reset*4	Restricted*4
11101	1	1	1	1	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: OFF	Not reset*4	Restricted*4

*1 The operation mode affects the availability of communication reset.
*2 The ON/OFF state of the power supply affects the ON/OFF state of Ready bit.
*3 When either the external 24 V power supply or the control circuit power supply is ON.
*4 Available when the HMS network option is installed.

9.4 Ready bit status selection (Pr.349, N240)

◆ To select the error reset operation at inverter failure

- The status of Ready bit in communication data can be selected when a communication option (FR-A8ND, FR-A8NF, or FR-A8NL) is installed.
- An error reset command from a communication option can be invalidated in the External operation mode or the PU operation mode.
- The status of Ready bit is selectable.

Pr.	Name	Initial value	Setting range	Function
349[*1]	**Communication reset selection/Ready bit status selection/Reset selection after inverter faults are cleared/DriveControl writing restriction selection**	0	0, 100	Error reset is enabled independently of operation mode.
			1, 101	Error reset is enabled in the Network operation mode.
			1000, 1001, 1100, 1101, 10000, 10001, 10100, 10101, 11000, 11001, 11100, 11101	For details, refer to page 638.
N010[*1]	**Communication reset selection**	0	0	Enables the error reset function in any operation mode.
			1	Enables the error reset function only in the Network operation mode.
N240[*1]	**Ready bit status selection**	0	0	The status of Ready bit in communication data can be selected when a communication option is installed.
			1	

*1 The setting is available only when a communication option is installed.

■ Ready bit status selection (P.N240)

The status of Ready bit in communication data can be selected.

Setting value			Description			
			Communication reset selection		Ready bit status selection	
Pr.349	N010	N240	NET operation mode	Other than NET operation mode	Main circuit: power-ON	Main circuit: power-OFF[*1]
0	0	0	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: ON
1	1	0	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: ON
100	0	1	Reset enabled	Reset enabled	Ready bit: ON	Ready bit: OFF
101	1	1	Reset enabled	Reset disabled	Ready bit: ON	Ready bit: OFF

*1 When either the external 24 V power supply or the control circuit power supply is ON.

- FR-A8ND

Class 0x29 Instance 1

Attribute ID	Access	Name	Data type	Number of data bytes	Initial value	Range	Description	
9	Get	Ready	BOOL	1	1	0	Other than the below	
						1	**Pr.349** = "0, 1" **N240** = "0"	During stop / during acceleration / during constant speed operation / during deceleration / during reverse rotation deceleration
							Pr.349 = "100, 101" **N240** = "1"	During stop while the RY signal is ON / during acceleration / during constant speed operation / during deceleration / during reverse rotation deceleration

9

• FR-A8NF

Inverter status monitor

Bit	Signal name	Description		
14	READY signal	Reset cancel	**Pr.349** = "0, 1" **N240** = "0"	0: During an inverter reset / during startup after power-ON. 1: During normal operation
			Pr.349 = "100, 101" **N240** = "1"	0: RY signal is OFF 1: RY signal is ON

• FR-A8NL

Inverter output signal (network output SNVT_state nvoInvOutputSig)

Bit	Signal name	Description	
15	Ready signal	**Pr.349** = "0, 1" **N240** = "0"	The value in the bit turns to 1 when the inverter is ready for operation after power-ON.[*1]
		Pr.349 = "100, 101" **N240** = "1"	The value in the bit turns to 1 when the RY signal turns ON.

*1 The value in the bit turns to 1 when power is supplied to the control circuit only.

MEMO

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision Date	*Manual Number	Revision
Oct. 2016	IB(NA)-0600688ENG-A	First edition
Mar. 2019	IB(NA)-0600688ENG-B	Added • Continuous operation during communication fault • Reset selection/disconnected PU detection/PU stop selection (**Pr.75** = "1000 to 1003, 1014 to 1017, 1100 to 1103, 1114 to 1117") • Automatic restart after instantaneous power failure selection (**Pr.162** = "1000 to 1003, 1010 to 1013") • Error reset operation selection at inverter fault (**Pr.349** = "100, 101") • PLC function (**Pr.414** ="11, 12", **Pr.675**) • Control method selection (**Pr.800** = "109, 110") • Monitor with sign selection (**Pr.1018** = "1")
Feb. 2022	IB(NA)-0600688ENG-C	Added • Main circuit capacitor life measurement at power OFF (every time) (**Pr.259** = "11") • **Pr.506 Display estimated main circuit capacitor residual life** • Current input check terminal selection (**Pr.573** = "11 to 14, 21 to 24") • Low-speed forward rotation command (RLF) signal, Low-speed reverse rotation command (RLR) signal • Reset selection after inverter faults are cleared (with the HMS network option installed) • Cooling fan operation selection during the test operation (**Pr.244** = "1000, 1001, 1101 to 1105") • Display/reset ABC relay contact life (**Pr.507, Pr.508**) • Reset selection after inverter faults are cleared, DriveControl writing restriction selection (**Pr.349** = "1000, 1001, 1100, 1101, 10000, 10001, 10100, 10101, 11000, 11001, 11100, 11101") • **Pr.890 Internal storage device status indication** • Internal storage device fault (E.PE6)
Mar. 2023	IB(NA)-0600688ENG-D	Added • Restricting reset method for an earth (ground) fault (**Pr.249** ="2") • Output short-circuit detection (**Pr.521**) • Torque limit level 2 (**Pr.815**) • Deceleration time at emergency stop (**Pr.1103**, X92 signal) • Output short-circuit fault (E.SCF) Edited • **Pr.151**, **153** setting range: 0 to 300 s

FR-F800 Series
Instruction Manual Supplement

1 Emergency drive status monitor

"10" has been added for the emergency drive status monitor display on the operation panel.

- Set "68" in **Pr.52, Pr.774 to Pr.776, Pr.992** to monitor the status of the emergency drive on the operation panel.
- Description of the status monitor

Operation panel indication	Description		
	Emergency drive setting	Emergency drive operating status	
0	Emergency drive function setting is not available.	—	
1	Electronic bypass during emergency drive operation is disabled.	During normal operation	
2		Emergency drive in operation	Operating properly
3			A certain alarm is occurring.[*2]
4			A fault is occurring. The operation is being continued by the retry.
5			A fault is occurring. The continuous operation is not allowed due to output shutoff.
10	Parameter settings for electronic bypass during emergency drive operation are enabled.	During normal operation	
11	Electronic bypass during emergency drive operation is enabled.		
12		Emergency drive in operation	Operating properly
13			A certain alarm is occurring.[*2]
14			A fault is occurring. The operation is being continued by the retry.
15			A fault is occurring. The continuous operation is not allowed due to output shutoff.
2[][*1]		Electronic bypass is started during emergency drive (during acceleration/deceleration to the switchover frequency).	
3[][*1]		During electronic bypass during emergency drive (waiting during the interlock time).	
4[][*1]		During commercial power supply operation during emergency drive	

*1 The value in the ones place indicates the previous displayed value (the setting at a fault occurrence).
*2 "A certain alarm" means a protective function disabled during emergency drive.

NOTE

- For other information on the emergency drive function, refer to the Instruction Manual (Detailed).

FR-F800 Series
FR-F862 Instruction Manual Supplement

1 Emergency drive (Fire mode)

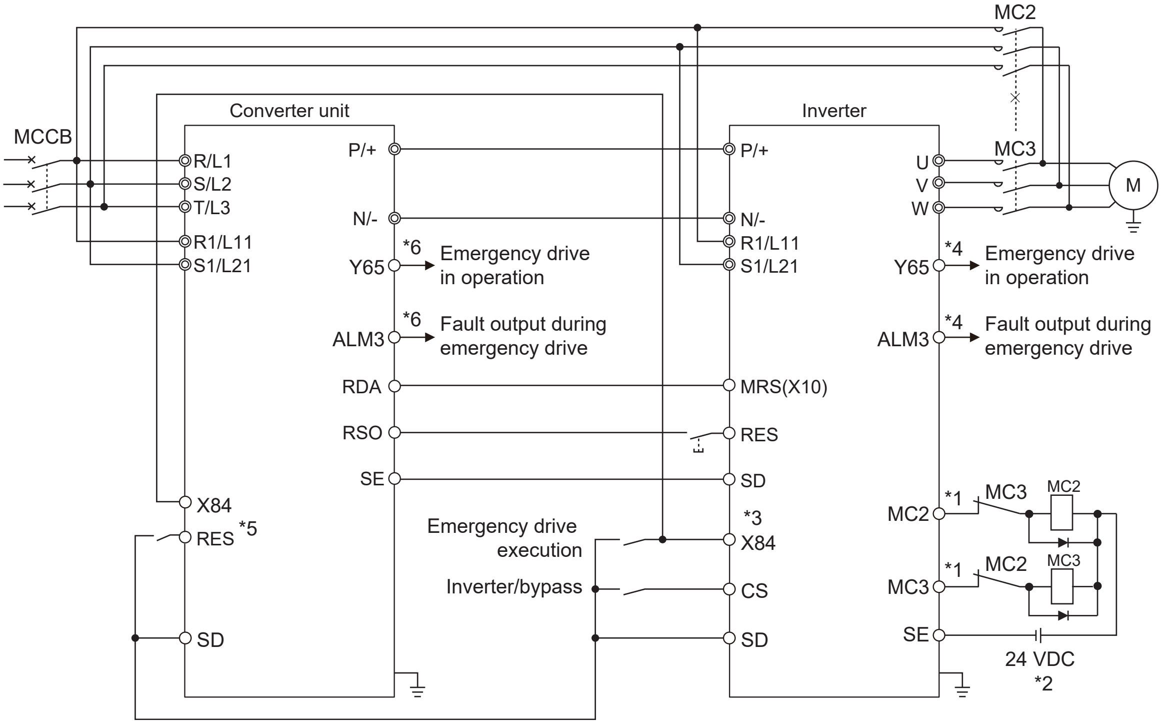
The emergency drive function is available for the separated converter type.
The inverter can continue driving the motor in case of emergency such as a fire, since protective functions are not activated even if the inverter detects a fault. Using this function may damage the motor or inverter because driving the motor is given the highest priority. Use this function for emergency operation only. The operation can be switched to the commercial power supply operation at the occurrence of a fault which may cause damage of the inverter. To set the emergency drive function, enable the function also in the converter unit.

Pr.	Name	Initial value	Setting range	Description
523 H320	**Emergency drive mode selection**	9999	100, 111, 112, 121, 122, 123, 124, 200, 211, 212, 221, 222, 223, 224, 300, 311, 312, 321, 322, 323, 324, 400, 411, 412, 421, 422, 423, 424	Select the operation mode of the emergency drive.
			9999	Emergency drive disabled.
524 H321[*1]	**Emergency drive running speed**	9999	0 to 590 Hz[*2]	Set the running frequency in the fixed frequency mode of the emergency drive (when the fixed frequency mode is selected in **Pr.523**).
			0 to 100%[*2]	Set the PID set point in the PID control mode of the emergency drive (when the PID control mode is selected in **Pr.523**).
			9999[*2]	Emergency drive disabled.
515 H322	**Emergency drive dedicated retry count**	1	1 to 200	Set the retry count during emergency drive operation.
			9999[*2]	Without retry count excess (no restriction on the number of retries)
1013 H323	**Running speed after emergency drive retry reset**	60 Hz	0 to 590 Hz	Set the frequency for operation after a retry when any of E.CPU, E.1 to E.3, and E.5 to E.7 occurs during emergency drive operation.
514 H324	**Emergency drive dedicated retry waiting time**	9999	0.1 to 600 s	Set the retry waiting time during emergency drive operation.
			9999	The **Pr.68** setting is applied to the operation.
136 A001	**MC switchover interlock time**	1 s	0 to 100 s	Set the operation interlock time for MC2 and MC3.
139 A004	**Automatic switchover frequency from inverter to bypass operation**	9999	0 to 60 Hz	Set the frequency at which the inverter-driven operation is switched over to the commercial power supply operation when the condition for the electronic bypass is established during emergency drive operation.
			8888, 9999	Electronic bypass during emergency drive is disabled.
57 A702	**Restart coasting time**	9999	0	Coasting time differs depending on the inverter capacity. (For details on the coasting time, refer to the Instruction Manual (Detailed).)
			0.1 to 30 s	Set the delay time for the inverter to perform a restart after restoring power due to an instantaneous power failure.
			9999	No restart

*1 Set **Pr.523** before setting **Pr.524**.
*2 When **Pr.523** = "100, 200, 300, or 400", the emergency drive is activated regardless of the **Pr.524** setting.

◆ Connection example

- The following diagram shows a connection example for emergency drive operation (in the commercial mode).



*1 Be careful of the capacity of the sequence output terminals.
The applied terminals differ by the settings of **Pr.190 to Pr.196 (Output terminal function selection)**.

Output terminal capacity	Output terminal permissible load
Open collector output of inverter (RUN, SU, IPF, OL, FU)	24 VDC 0.1 A
Inverter relay output (A1-C1, B1-C1, A2-B2, B2-C2) Relay output option (FR-A8AR)	230 VAC 0.3 A 30 VDC 0.3 A

*2 When connecting a DC power supply, insert a protective diode.
When connecting an AC power supply, use relay output terminals of the inverter or contact output terminals of the relay output option (FR-A8AR).

*3 The applied terminals differ by the settings of **Pr.180 to Pr.189 (Input terminal function selection)**

*4 The applied terminals differ by the settings of **Pr.190 to Pr.196 (Output terminal function selection)**.

*5 The applied terminals differ by the settings of **Pr.178, Pr.187, and Pr.189 (Input terminal function selection)**. For setting the converter unit, refer to the Instruction Manual of the converter unit.

*6 The applied terminals differ by the settings of **Pr.190 to Pr.195 (Output terminal function selection)**. For setting the converter unit, refer to the Instruction Manual of the converter unit.

NOTE

- Be sure to provide a mechanical interlock for MC2 and MC3.

◆ Emergency drive execution sequence

Point

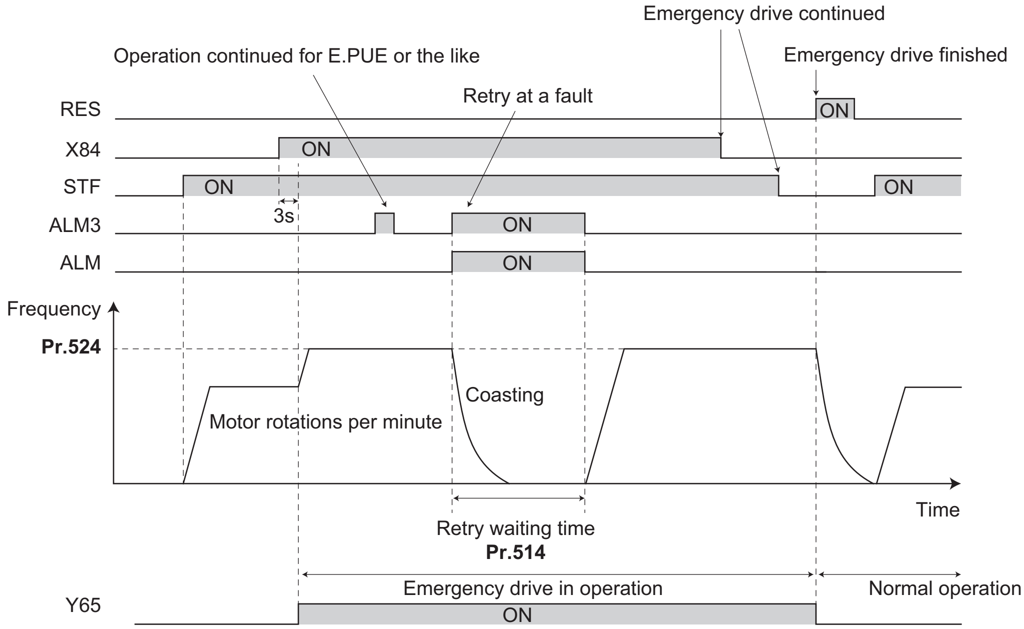
- When the X84 signal is ON for three seconds, the emergency drive is activated.
- The Y65 signal is ON during emergency drive operation.
- "ED" is displayed on the operation panel during emergency drive operation.
- The ALM3 signal is ON when a fault occurs during emergency drive operation.
- For protective functions (faults) valid during emergency drive operation, refer to page 8.

- To activate the emergency drive, the X84 signal needs to be ON for three seconds while all the following conditions are satisfied.

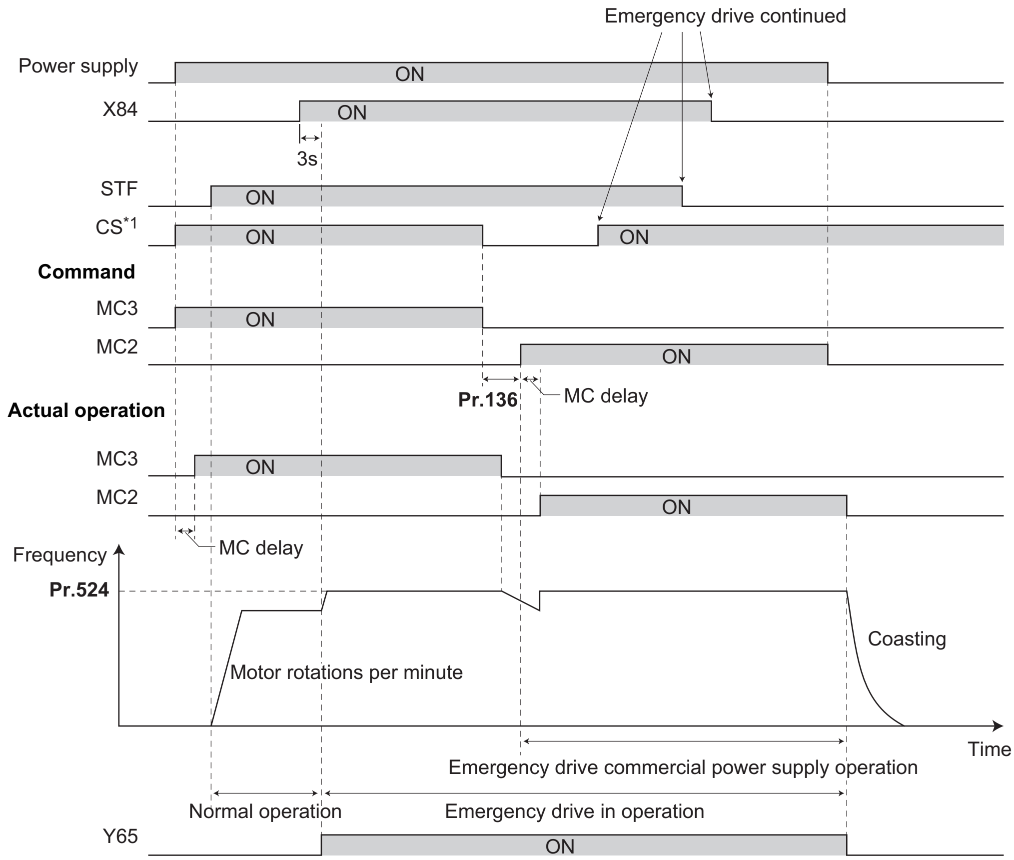
Item	Condition
Emergency drive parameter settings	**Pr.523** ≠ "9999" **Pr.524** ≠ "9999" (Setting is not required when **Pr.523** = "100, 200, 300, or 400".)
Contradictory condition	None of the following conditions are satisfied. • Enabling the electronic bypass sequence function • During offline auto tuning • Supplying power through terminals R1 and S1

- When the "retry" (**Pr.523** = "2[][], 3[][]") is selected, it is recommended to use the automatic restart after instantaneous power failure function at the same time.
- Parameter setting is not available during emergency drive operation.
- To return to the normal operation during emergency drive operation, do the following. (The operation will not be returned to normal only by turning OFF the X84 signal.)
  Reset the inverter, or turn OFF the power supply.
  Clear a fault by turning ON the X51 signal while the sequence function is enabled (when the protective function is activated).
- The operation is switched over to the commercial power supply operation in case of the following during emergency drive operation while the commercial mode or the retry / commercial mode is selected.
  24 V external power supply operation, power failure status or operation with the power supplied through R1/S1, undervoltage
- To input the X84 signal, set "84" in any of **Pr.178 to Pr.189 (Input terminal function selection)** to assign the function.
- To output the Y65 signal, set "65" (positive logic) or "165" (negative logic) in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function. To output the ALM3 signal, set "66" (positive logic) or "166" (negative logic) in any of **Pr.190 to Pr.196 (Output terminal function selection)** to assign the function.
- The X84 signal input is valid either through the external terminal or via network regardless of the **Pr.338** and **Pr.339** settings (Selection of control source in Network operation mode).
- During emergency drive operation, the operation is performed as **Pr.502 Stop mode selection at communication error** = "0 (initial value)" and communication errors (such as E.SER) do not occur. (A protective function is performed according to its operation during emergency drive operation.)

- The following diagram shows the operation of the emergency drive function (in the retry / output shutoff mode or in the fixed frequency mode (**Pr.523** = "211")).



- The following diagram shows the operation of switching over to the commercial power supply operation during emergency drive operation by using the CS signal (in the commercial mode or in the fixed frequency mode (**Pr.523** = "411")).



*1 Input the CS signal via an external terminal.

◆ Emergency drive operation selection (Pr.523, Pr.524)

- Use **Pr.523 Emergency drive mode selection** to select the emergency drive operation. Set a value in the hundreds place to select the operation when a valid protective function is activated (fault) during emergency drive operation. Set values in the ones and tens places to select the operation method.
- For protective functions (faults) valid during emergency drive operation, refer to **page 8**.

Pr.523 setting	Emergency drive operation mode			Description
1□□	Output shutoff mode		Selecting operation when a fault occurs during emergency drive operation	Output shutoff when a fault occurs.
2□□	Retry / output shutoff mode			Retry operation when a fault occurs. Output shutoff when a fault for which retry is not permitted occurs or when the retry count is exceeded.
3□□*1	Retry / commercial mode			Retry operation when a fault occurs. The operation is switched over to the commercial power supply operation when a fault for which retry is not permitted occurs or when the retry count is exceeded. While **Pr.515** = "9999", the operation is switched over to the commercial power supply operation when the retry count reaches 200.
4□□*1	Commercial mode			The operation is switched over to the commercial power supply operation when a fault occurs.
□00	Normal operation		Selecting the operation method during emergency drive operation	The operation is performed with the same set frequency and by the same starting command as those in the normal operation. Use this mode to avoid output shutoff due to a fault.
□11	Fixed frequency mode	Forward rotation		The operation is forcibly performed with the frequency set in **Pr.524**. Even when the motor is stopped, the operation is started by the emergency drive operation.
□12		Reverse rotation		
□21	PID control mode	Forward rotation		The operation is performed under PID control using the **Pr.524** setting as a set point. The measured values are input in the method set in **Pr.128**.
□22		Reverse rotation		
□23		Forward rotation (Second PID measured value input)		The operation is performed under PID control using the **Pr.524** setting as a set point. The measured values are input in the method set in **Pr.753**.
□24		Reverse rotation (Second PID measured value input)		
9999	Emergency drive disabled.			

*1 Under PM motor control, the operation is not switched over to the commercial power supply operation and the output is shut off.

NOTE

- The operation is automatically switched from the PU operation mode or External/PU combined operation mode to the External operation mode when the emergency drive is activated in the fixed frequency mode or in the PID control mode.

◆ Retry operation during emergency drive operation (Pr.515, Pr.514)

- Set the retry operation during emergency drive operation. Use **Pr.515 Emergency drive dedicated retry count** to set the retry count, and use **Pr.514 Emergency drive dedicated retry waiting time** to set the retry waiting time.
- The ALM signal output conditions depend on the **Pr.67 Number of retries at fault occurrence** setting. (For details on the retry function, refer to the Instruction Manual (Detailed).)
- For the protective functions (faults) for which retry is permitted during emergency drive operation, refer to **page 8**.

NOTE

- The **Pr.65 Retry selection** is disabled during emergency drive operation.

◆ Electronic bypass during emergency drive (Pr.136, Pr.139, Pr.57)

- For selecting the commercial mode (**Pr.523** = "3[][], 4[][]"), setting is required as follows.
  Set **Pr.136 MC switchover interlock time** and **Pr.139 Automatic switchover frequency from inverter to bypass operation** and assign the MC2 and MC3 signals to output terminals.
  When the CS signal is assigned to an input terminal, set **Pr.57 Restart coasting time** ≠ "9999" and input the CS signal through the terminal. (In the initial setting, the CS signal is assigned to the terminal CS.)
  Select V/F control or Advanced magnetic flux vector control. (Under PM motor control, the operation is not switched over to the commercial power supply operation and the output is shut off.)
- During emergency drive operation, the operation is switched over to the commercial power supply operation when any of the following conditions is satisfied.
  The CS signal turns OFF.
  A fault for which retry is not permitted occurs while **Pr.523** = "3[][]".
  A fault occurs while **Pr.523** = "4[][]".
- While the motor is driven by the inverter during emergency drive operation, if a condition for electronic bypass is satisfied, the output frequency is accelerated/decelerated to the **Pr.139** setting. When the frequency reaches the set frequency, the operation is switched over to the commercial power supply operation. (The operation is immediately switched over to the commercial power supply operation during output shutoff due to a fault occurrence.)
- If the parameter for electronic bypass is not set while the commercial mode is set (**Pr.523** = "3[][], 4[][]"), the operation is not switched over to the commercial power supply operation even when a condition for switchover is satisfied, and the output is shut off.
- To assign the MC2 and MC3 signals to output terminals, use any two of **Pr.190 to Pr.196 (Output terminal function selection)** and set "18" (positive logic) for the MC2 signal and set "19" (positive logic) for the MC3 signal.
- Operation of magnetic contactor (MC2, MC3)

Magnetic contactor	Installation location	Operation	
		During commercial power supply operation	During inverter operation
MC2	Between power supply and motor	Shorted	Open
MC3	Between inverter output side and motor	Open	Shorted

- The input signals are as follows.

Signal	Function	Operation	MC operation*4	
			MC2	MC3
CS*1	Inverter/bypass	ON: Inverter operation	×	○
		OFF: Emergency drive commercial power supply operation*2	○	×
X84	Emergency drive operation	ON: Emergency drive operation	—	—
		OFF: Normal operation*3	×	○
RES	Operation status reset	ON: Reset	×	Unchanged
		OFF: Normal operation	—	—

*1 Input the CS signal via an external terminal. (Set **Pr.162** = "0 to 3, 10 to 13" or **Pr.338** = "1".)
*2 If the signal is turned ON after switchover to the emergency drive commercial power supply operation, the operation will not be returned to the inverter-driven operation.
*3 The operation is not switched over to the normal operation even when the signal is turned OFF during emergency drive operation.

*4 MC operation is as follows.

Notation	MC operation
○	ON
×	OFF
—	During inverter operation: MC2-OFF, MC3-ON During commercial power supply operation: MC2-ON, MC3-OFF
Unchanged	The status of the MC remains the same after turning ON or OFF the signal.

NOTE

- During electronic bypass operation while the electronic bypass sequence is enabled (**Pr.135** = "1"), the emergency drive function is not available.

◆ PID control during emergency drive operation

- The **Pr.524** setting is used as a set point for operation during emergency drive operation in the PID control mode. Input the measured values in the method set in **Pr.128** or **Pr.753**.
- When the PID control mode is selected for emergency drive, the PID action during emergency drive operation is as follows depending on the PID control setting.

Item	PID control action		
	Set point / measured value input setting	Deviation input setting	Without PID control setting
Measured value input selection (**Pr.128 and Pr.753**)	Held	Terminal 4 input	Terminal 4 input
Forward action / reverse action selection (**Pr.128 and Pr.753**)	Held	Held	Reverse action
Proportional band (**Pr.129 and Pr.756**)	Held	Held	100% (initial setting)
Integral time (**Pr.130 and Pr.757**)	Held	Held	1 s (initial setting)
Differential time (**Pr.134 and Pr.758**)	Held	Held	Not used (initial setting)
Applied to the frequency / calculation only (**Pr.128 and Pr.753**)	Applied to the frequency	Applied to the frequency	Applied to the frequency
Other PID-related settings	Held	Held	Held

- While the "retry" (**Pr.523** = "22[], 32[]") is selected in the PID control mode, if a retry occurs at an occurrence of E.CPU, E.1 to E.3, or E.5 to E.7 during emergency drive operation, the operation is performed not under PID control but with the fixed frequency.
  Use **Pr.1013 Running speed after emergency drive retry reset** to set the fixed frequency.

NOTE

- For details on the PID control, refer to the Instruction Manual (Detailed).

◆ Protective functions during emergency drive operation

- Protective functions during emergency drive operation are as follows.

Protective function	Operation during emergency drive	Protective function	Operation during emergency drive	Protective function	Operation during emergency drive
E.OC1	Retry	E.PTC	Retry	E.CDO	Retry
E.OC2	Retry	E.OPT	The function is disabled.	E.SER	The function is disabled.
E.OC3	Retry	E.OP1	The function is disabled.	E.AIE	The function is disabled.
E.SCF	Output shutoff	E.OP2	The function is disabled.	E.USB	The function is disabled.
E.OV1	Retry	E.OP3	The function is disabled.	E.SAF	Retry*1
E.OV2	Retry	E.16	The function is disabled.	E.PBT	Retry*1
E.OV3	Retry	E.17	The function is disabled.	E.OS	The function is disabled.
E.THT	Retry	E.18	The function is disabled.	E.LCI	The function is disabled.
E.THM	Retry	E.19	The function is disabled.	E.PCH	The function is disabled.
E.FIN	Retry	E.20	The function is disabled.	E.PID	The function is disabled.
E.OLT	Retry	E.PE6	The function is disabled.	E.1	Retry*3
E.SOT	Retry	E.PE	Output shutoff	E.2	Retry*3
E.LUP	The function is disabled.	E.PUE	The function is disabled.	E.3	Retry*3
E.LDN	The function is disabled.	E.RET	Output shutoff	E.5	Retry*3
E.BE	Retry*1	E.PE2	Output shutoff	E.6	Retry*1*3
E.GF*2	Retry	E.CPU	Retry	E.7	Retry*1*3
E.LF	The function is disabled.	E.CTE	The function is disabled.	E.11	The function is disabled.
E.OHT	Retry	E.P24	The function is disabled.	E.13	Output shutoff

*1 If the same protective function is activated continuously while the electronic bypass during emergency drive operation is enabled, retry is performed up to twice and then operation is switched over to the commercial power supply operation.

*2 If E.GF occurs when **Pr.249** = "2", the output is shut off.

*3 In normal operation (**Pr.523** = "200 or 300"), the start signal is turned OFF at the same time the retry function resets the protective function. Input the start signal again to resume the operation.

- Fault output during emergency drive operation are as follows.

Signal	Pr.190 to Pr.196 setting		Description
	Positive logic	Negative logic	
ALM	99	199	The signal is ON at the occurrence of a fault that causes the above-mentioned "retry" or "output shutoff" during emergency drive operation.
ALM3	66	166	The signal is output when a fault occurs during emergency drive operation. When a fault which does not activate protective functions occurs during emergency drive operation, the signal is ON for three seconds and then turned OFF.

◆ Input signal operation

- During emergency drive operation in the fixed frequency mode or in the PID control mode, input signals unrelated to the emergency drive become invalid with some exceptions.
- The following table shows functions of the signals that do not become invalid during emergency drive operation in the fixed frequency mode or in the PID control mode.

Input signal status	Fixed frequency mode	PID control mode
Valid	OH, X10, MRS*1, TRG, TRC, X51, RES, X70, X71	OH, X10, MRS*1, TRG, TRC, X51, RES, X70, X71
Held	RT, X18, SQ, X84	RT, X18, SQ, X64, X65, X66, X67, X79, X84
Always-ON	—	X14, X77, X78, X80

*1 When the X10 signal is not assigned to any input terminal, the MRS signal is used as the X10 signal. Therefore, the MRS signal becomes valid when the X10 signal is not assigned to any input terminal.

◆ Emergency drive status monitor

- Set "68" in **Pr.52, Pr.774 to Pr.776, Pr.992** to monitor the status of the emergency drive on the operation panel.
- Description of the status monitor

<table>
<tr><th rowspan="2">Operation panel indication</th><th colspan="3">Description</th></tr>
<tr><th>Emergency drive setting</th><th colspan="2">Emergency drive operating status</th></tr>
<tr><td>0</td><td>Emergency drive function setting is not available.</td><td colspan="2">—</td></tr>
<tr><td>1</td><td rowspan="5">Electronic bypass during emergency drive operation is disabled.</td><td colspan="2">During normal operation</td></tr>
<tr><td>2</td><td rowspan="4">Emergency drive in operation</td><td>Operating properly</td></tr>
<tr><td>3</td><td>A certain alarm is occurring.[*2]</td></tr>
<tr><td>4</td><td>A fault is occurring. The operation is being continued by the retry.</td></tr>
<tr><td>5</td><td>A fault is occurring. The continuous operation is not allowed due to output shutoff.</td></tr>
<tr><td>10</td><td>Parameter settings for electronic bypass during emergency drive operation are enabled.</td><td colspan="2" rowspan="2">During normal operation</td></tr>
<tr><td>11</td><td rowspan="8">Electronic bypass during emergency drive operation is enabled.</td></tr>
<tr><td>12</td><td rowspan="4">Emergency drive in operation</td><td>Operating properly</td></tr>
<tr><td>13</td><td>A certain alarm is occurring.[*2]</td></tr>
<tr><td>14</td><td>A fault is occurring. The operation is being continued by the retry.</td></tr>
<tr><td>15</td><td>A fault is occurring. The continuous operation is not allowed due to output shutoff.</td></tr>
<tr><td>2[][*1]</td><td colspan="2">Electronic bypass is started during emergency drive (during acceleration/deceleration to the switchover frequency).</td></tr>
<tr><td>3[][*1]</td><td colspan="2">During electronic bypass during emergency drive (waiting during the interlock time).</td></tr>
<tr><td>4[][*1]</td><td colspan="2">During commercial power supply operation during emergency drive</td></tr>
</table>

*1 The value in the ones place indicates the previous displayed value (the setting at a fault occurrence).

*2 "A certain alarm" means a protective function disabled during emergency drive shown in the tables on **page 8**.

⚠CAUTION

- When the emergency drive function is enabled, the operation is continued or the retry operation (automatic reset and restart) is repeated even if a fault occurs, which may damage or burn this product and the motor. Before restarting the normal operation after using this function, make sure that the inverter and motor have no fault. Any damage of the inverter or the motor caused by using the emergency drive function is not covered by the warranty even within the guarantee period.

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IB(NA)-0600688ENG-D(2303)MEE Printed in Japan