MITSUBISHI ELECTRIC

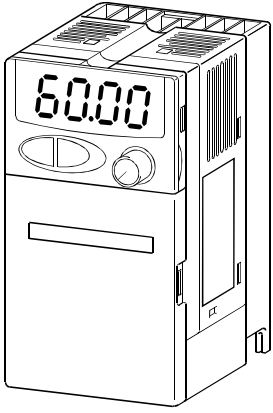
TRANSISTORIZED INVERTER

FR-E500

INSTRUCTION MANUAL

HIGH PERFORMANCE
&
HIGH FUNCTION

FR-E520-0.1K to 7.5K(C)
FR-E540-0.4K to 7.5K(C)
FR-E520S-0.1K to 0.75K
FR-E510W-0.1K to 0.75K



Thank you for choosing the Mitsubishi Transistorized inverter.
This instruction manual gives handling information and precautions for use of this equipment.
Incorrect handling might cause an unexpected fault. Before using the inverter, please read this manual carefully to use the equipment to its optimum.
Please forward this manual to the end user.

This section is specifically about safety matters

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

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

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

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

SAFETY INSTRUCTIONS

1. Electric Shock Prevention

⚠ WARNING

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

2. Fire Prevention

⚠ CAUTION

- Install the inverter on an incombustible wall without holes, etc. Installing the inverter directly on or near a combustible surface could lead to a fire.
- If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
- When a brake resistor is used, use an alarm signal to switch power off.
  Otherwise, the brake resistor may excessively overheat due to damage of the brake transistor and such, causing a fire.
- Do not connect the resistor directly to the DC terminals P(+) and N(-). This could cause a fire.

3. Injury Prevention

⚠ CAUTION

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

4. Additional Instructions

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

(1) Transportation and installation

⚠ CAUTION

- When carrying products, use correct lifting gear to prevent injury.
- Do not stack the inverter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the inverter. Install according to the information in the Instruction Manual.
- Do not operate if the inverter is damaged or has parts missing.
- Do not hold the inverter by the front cover or operation panel; it may fall off.
- Do not stand or rest heavy objects on the inverter.
- Check the inverter mounting orientation is correct.
- Prevent screws, wire fragments or other conductive bodies or oil or other flammable substance from entering the inverter.
- Do not drop the inverter, or subject it to impact.
- Use the inverter under the following environmental conditions:

Environment	Ambient temperature	-10°C to +50°C (non-freezing) (-10°C to +40°C for totally enclosed structure feature)
	Ambient humidity	90%RH or less (non-condensing)
	Storage temperature	-20°C to +65°C *
	Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude, vibration	Maximum 1000m above sea level for standard operation. After that derate by 3% for every extra 500m up to 2500m (91%). 5.9m/s^2 or less

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

(2) Wiring

⚠CAUTION

- Do not fit capacitive equipment such as power factor correction capacitor, capacitor type filter or surge suppressor to the output of the inverter.
- The connection orientation of the output cables U, V, W to the motor will affect the direction of rotation of the motor.

(3) Trial run

⚠CAUTION

- Check all parameters, and ensure that the machine will not be damaged by a sudden start-up.

(4) Operation

⚠WARNING

- When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.
- Since the [STOP] key is valid only when functions are set (refer to page 130), provide a circuit and switch separately to make an emergency stop (power off, mechanical brake operation for emergency stop, etc).
- Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart the motor suddenly.
- The load used should be a three-phase induction motor only. 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 inverter.

⚠ CAUTION

- The electronic thermal reray function does not guarantee protection of the motor from overheating.
- Do not use a magnetic contactor on the inverter input for frequent starting/ stopping of the inverter.
- Use a noise filter to reduce the effect of electromagnetic interference. Otherwise nearby electronic equipment may be affected.
- Take measures to suppress harmonics. Otherwise power supply harmonics from the inverter may heat/damage the power capacitor and generator.
- When a 400V class motor is inverter-driven, please use an insulation-enhanced motor or measures taken to suppress surge voltages. Surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation.
- The inverter can be easily set for high-speed operation. Before changing its setting, fully examine the performances of the motor and machine.
- In addition to the inverter's holding function, install a holding device to ensure safety.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation.

(5) Emergency stop

⚠ CAUTION

- Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.
- When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.
- When any protective function is activated, take the corrective appropriate action, then reset the inverter, and resume operation.

(6) Maintenance, inspection and parts replacement

⚠ CAUTION

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

(7) Disposing of the inverter

⚠ CAUTION

- Treat as industrial waste.

(8) General instructions

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

CONTENTS

CHAPTER 1 OUTLINE

This chapter gives information on the basic "outline" of this product.
Always read the instructions before using the equipment.

<Abbreviations>
- PU
  Operation panel and parameter unit (FR-PU04)
- Inverter
  Mitsubishi transistorized inverter FR-E500 series
- Pr.
  Parameter number

1.1 Pre-Operation Information

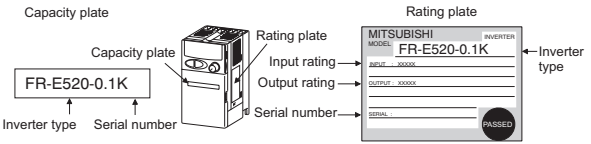
1.1.1 Precautions for operation

This manual is written for the FR-E500 series transistorized inverters.
Incorrect handling may cause the inverter to operate incorrectly, causing its life to be reduced considerably, or at the worst, the inverter to be damaged. Handle the inverter properly in accordance with the information in each section as well as the precautions and instructions of this manual to use it correctly.
For handling information on the parameter unit (FR-PU04), stand-alone options, etc., refer to the corresponding manuals.

(1) Unpacking and product check

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

1) Inverter type



- **Inverter type**

FR - E520 - 0.1 K - ☐

Symbol	Voltage Class
E520	Three-phase 200V class
E540	Three-phase 400V class
E520S	Single-phase 200V class
E510W	Single-phase 100V class

Represents the inverter capacity "kW".

Symbol	Protective Structure
None	Enclosed-type
C	Totally enclosed structure IP40

2) Accessory
Instruction manual

If you have found any discrepancy, damage, etc., please contact your sales representative.

(2) Preparation of instruments and parts required for operation

Instruments and parts to be prepared depend on how the inverter is operated. Prepare equipment and parts as necessary. (Refer to page 64.)

(3) Installation

To operate the inverter with high performance for a long time, install the inverter in a proper place, in the correct direction, with proper clearances. (Refer to page 14.)

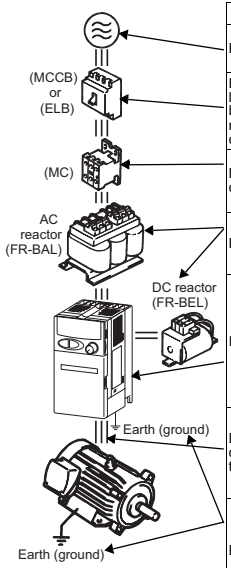
(4) Wiring

Connect the power supply, motor and operation signals (control signals) to the terminal block. Note that incorrect connection may damage the inverter and peripheral devices. (See page 16.)

1.2 Basic Configuration

1.2.1 Basic configuration

The following devices are required to operate the inverter. Proper peripheral devices must be selected and correct connections made to ensure proper operation. Incorrect system configuration and connections can cause the inverter to operate improperly, its life to be reduced considerably, and in the worst case, the inverter to be damaged. Please handle the inverter properly in accordance with the information in each section as well as the precautions and instructions of this manual. (For connections of the peripheral devices, refer to the corresponding manuals.)



Name	Description
Power supply	Use the power supply within the permissible power supply specifications of the inverter. (Refer to page 228.)
Earth (ground) leakage circuit breaker or moulded case circuit breaker	The breaker should be selected with care since a large inrush current flows in the inverter at power on. (Refer to page 49.)
Magnetic contactor	Install for your safety. (Refer to page 54.) Do not use this magnetic contactor to start or stop the inverter. It might reduce the inverter life. (Refer to page 49.)
Reactors	The reactors must be used when the power factor is to be improved or the inverter is installed near a large power supply system (500KVA or more and wiring distance within 10m). Make selection carefully.
Inverter	• The life of the inverter is influenced by ambient temperature. The ambient temperature should be as low as possible within the permissible range. This must be noted especially when the inverter is installed in an enclosure. (Refer to page 14.) • Wrong wiring might lead to damage of the inverter. The control signal lines should be kept away from the main circuit to protect them from noise. (Refer to page 16.)
Devices connected to the output	Do not connect a power capacitor, surge suppressor or capacitor type filter on the output side. When installing a moulded case circuit breaker on the output side of the inverter, contact each manufacturer for selection of the moulded case circuit breaker.
Earth (Ground)	To prevent an electric shock, always earth (ground) the motor and inverter. For reduction of induction noise from the power line of the inverter, it is recommended to wire the earth (ground) cable by returning it to the earth (ground) terminal of the inverter. (Refer to page 46.)

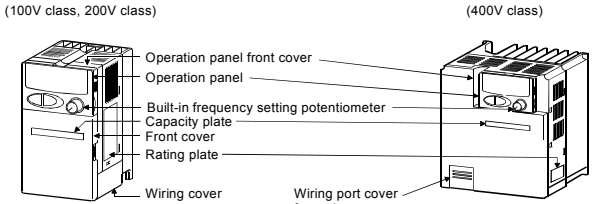
Harmonic suppression guideline (when inverters are used in Japan)

All models of general-purpose inverters used by specific consumers are covered by "Harmonic suppression guideline for consumers who receive high voltage or special high voltage". (For further details, refer to page 40.)

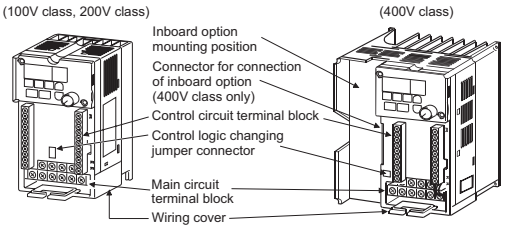
1.3 Structure

1.3.1 Appearance and structure

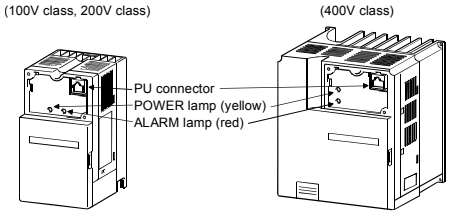
(1) Front view



(2) Without front cover and operation panel front cover



(3) Without operation panel



Lamp indication

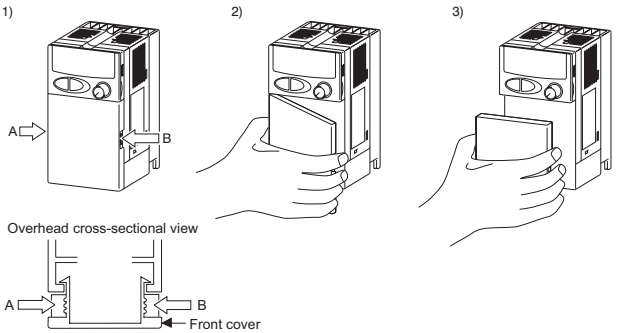
Power lamp.....Lit when power is spplied to the main circuit (R (L1),S (L2),T (L3)).
Alarm lamp.....Lit when the inverter is in the alarm status (major faults).

1.3.2 Removal and reinstallation of the front cover

●**Removal**

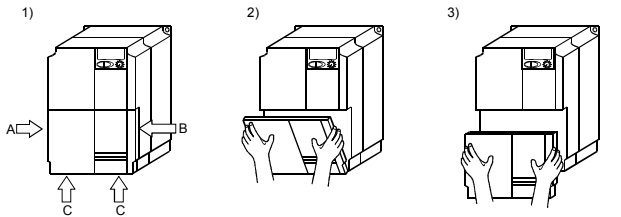
(For the FR-E520-0.1K to 3.7K, FR-E520S-0.1K to 0.75K, FR-E510W-0.1K to 0.75K)

The front cover is secured by hooks in positions A and B as shown below.
Push either A or B in the direction of arrows, and using the other end as a support, pull the front cover toward you to remove.



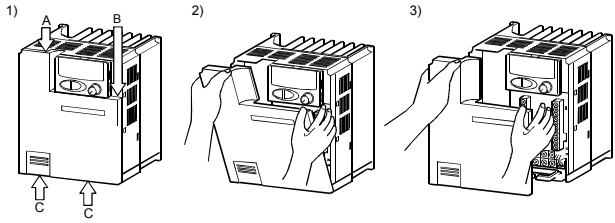
(For the FR-E520-5.5K, 7.5K)

The front cover is fixed with hooks in positions A, B and C.
Push A and B in the directions of arrows at the same time and remove the cover using C as supporting points.



(For the FR-E540-0.4K to 7.5K)

The front cover is fixed with hooks in positions A, B and C.
Push A and B in the directions of arrows at the same time and remove the cover using C as supporting points.



●Reinstallation

When reinstalling the front cover after wiring, fix the hooks securely.
With the front cover removed, do not switch power on.

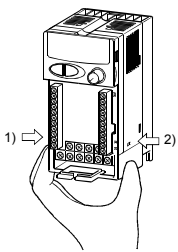
Note: 1. Make sure that the front cover has been reinstalled securely.
2. The same serial number is printed on the capacity plate of the front cover and the rating plate of the inverter. Before reinstalling the front cover, check the serial numbers to ensure that the cover removed is reinstalled to the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

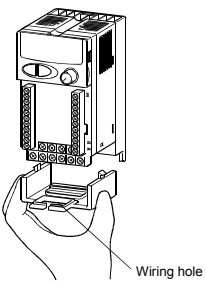
1.3.3 Removal and reinstallation of the wiring cover

●**Removal**

(For the FR-E520-0.1K to 7.5K, FR-E520S-0.1K to 0.75K, FR-E510W-0.1K to 0.75K)

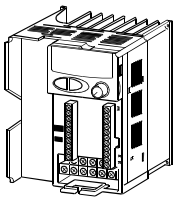
The wiring cover is fixed by hooks in positions 1) and 2).
Push either 1) or 2) in the direction of arrows and pull the wiring cover downward to remove.

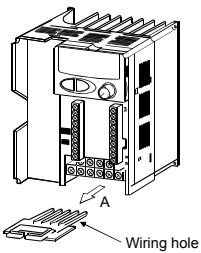




(For the FR-E540-0.4K to 7.5K)

Remove the wiring cover by pulling it in the direction of arrow A.





●Reinstallation

Pass the cables through the wiring hole and reinstall the cover in the original position.

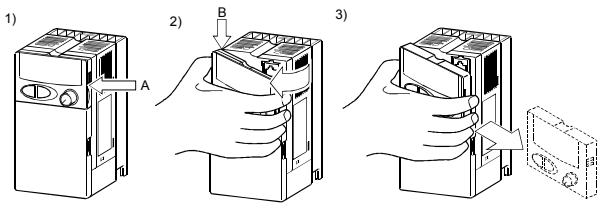
1.3.4 Removal and reinstallation of the operation panel

To ensure safety, remove and reinstall the operation panel after switching power off.

The charging area and control printed board are exposed on the rear surface of the operation panel. When removing the operation panel, always fit the rear cover option FR-E5P. Never touch the control printed board because touching it can cause the inverter to fail

●Removal

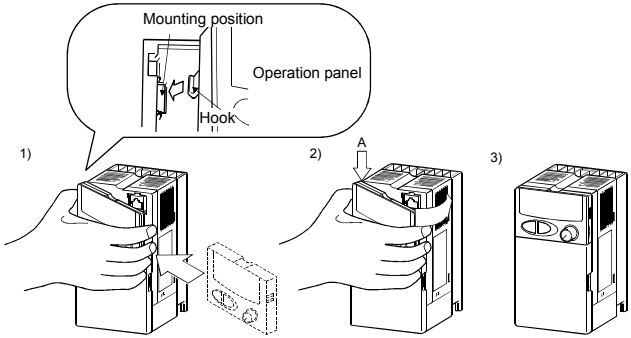
Hold down the portion A indicated by the arrow and lift the right hand side using the portion B indicated by the arrow as a support, and pull out the operation panel to the right.



(If the above procedure is not used for removal, the internal connector may be damaged by the force applied.)

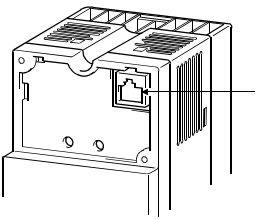
● Reinstallation

Insert the mounting hook (left hand side) of the operation panel into the mounting position of the inverter and push in the right hand side mounting hook to install the operation panel.



●Using the connection cable for operation

1) Remove the operation panel.
2) Fit the rear cover option FR-E5P to the back surface of the operation panel.
3) Securely plug one end of the connection cable into the PU connector of the inverter and the other end into the adaptor of the FR-E5P option to connect it to the operation panel. (For the connection cable of the FR-E5P, refer to page 30.)

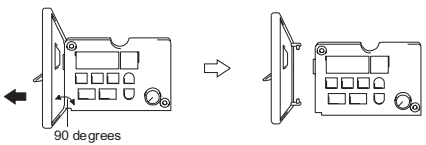


●Mounting the operation panel on an enclosure

When you open the operation panel front cover, the screw mounting guides for fixing the operation panel to an enclosure appear on the top left and bottom right. Remove the operation panel, fit the rear cover of the FR-E5P option, drill holes in the operation panel mounting guides, and securely mount the operation panel on the enclosure with screws.

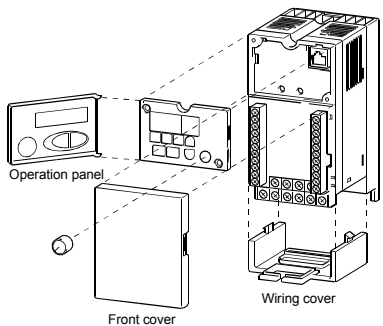
1.3.5 Removal of the operation panel front cover

1)Open the operation panel front cover to 90 degrees.
2)Pull out the operation panel front cover to the left to remove it.

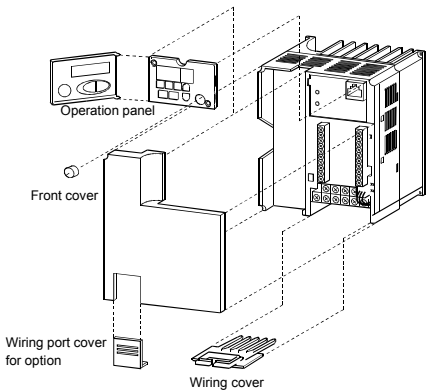


1.3.6 Exploded view

- **FR-E520-0.1K to 7.5K**
- **FR-E520S-0.1K to 0.75K**
- **FR-E510W-0.1K to 0.75K**



- **FR-E540-0.4K to 7.5K**



CAUTION

Do not remove any parts other than the operation panel, front cover, and wiring cover from the inverter. Doing so will damage the inverter.

MEMO

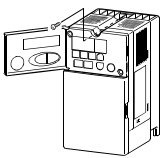
CHAPTER2
INSTALLATION AND WIRING

This chapter gives information on the basic "installation and wiring" for use of this product.
Always read the instructions in this chapter before using the equipment.

2.1 Installation

2.1.1 Instructions for installation

The FR-E520(S)-0.1K to 0.75K and FR-E510W-0.1K to 0.4K have top mounting holes in the back of the operation panel front cover. Tighten the screws after opening the cover.



1) Handle the unit carefully.
   The inverter uses plastic parts. Handle it gently to protect it from damage.
   Also, hold the unit with even strength and do not apply too much strength to the front cover alone.

2) Install the inverter in a place where it is not affected by vibration easily (5.9m/s^2 maximum).
   Note the vibration of a cart, press, etc.

3) Note on the ambient temperature.
   The inverter life is under great influence of the ambient temperature. In the place of installation, the ambient temperature must be within the permissible range -10°C to +50°C (-10°C to +40°C when using the totally enclosed structure). Check that the ambient temperature is within that range in the positions shown in figure 3).

4) Install the inverter on a non-combustible surface.
   The inverter will be very hot (maximum about 150°C). Install it on a non-combustible surface (e.g. metal). Also leave sufficient clearances around the inverter.

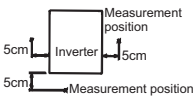
5) Avoid high temperature and high humidity.
   Avoid direct sunlight and places of high temperature and high humidity.

6) Avoid places where the inverter is exposed to oil mist, flammable gases, fluff, dust, dirt etc.
   Install the inverter in a clean place or inside a "totally enclosed" panel which does not accept any suspended matter.

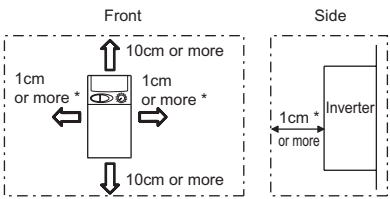
7) Note the cooling method when the inverter is installed in an enclosure.
When two or more inverters are installed or a ventilation fan is mounted in an enclosure, the inverters and ventilation fan must be installed in proper positions with extreme care taken to keep the ambient temperatures of the inverters with the permissible values. If they are installed in improper positions, the ambient temperatures of the inverters will rise and ventilation effect will be reduced.

8) Install the inverter securely in the vertical direction with screws or bolts.

3) Note on ambient temperatures

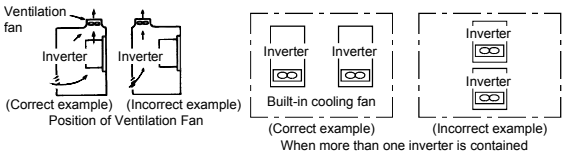


4) Clearances around the inverter

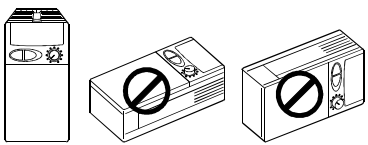


*5cm or more for 5.5K and 7.5K

7) For installation in an enclosure



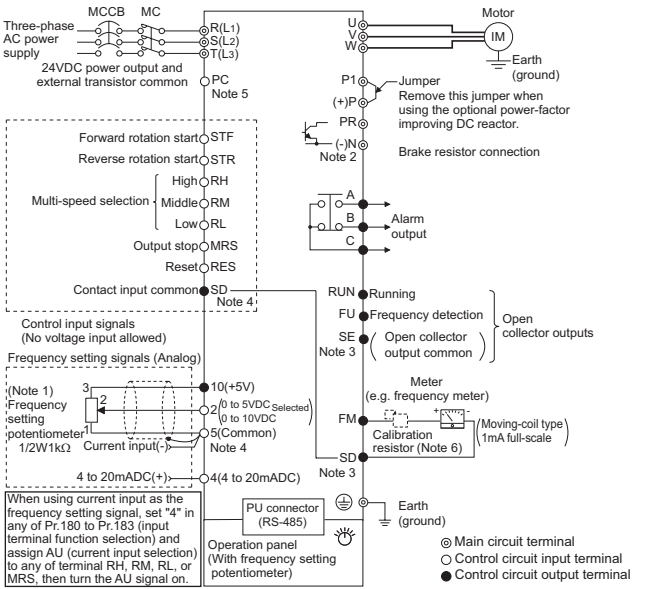
8) Vertical mounting



2.2 Wiring

2.2.1 Terminal connection diagram

- **Three-phase 200V power input**
- **Three-phase 400V power input**



Note: 1. If the potentiometer is to be operated often, use a 2W1kΩ potentiometer.
2. 0.1K and 0.2K do not contain a transistor.
3. Terminals SD and SE are isolated.
4. Terminals SD and 5 are common terminals. Do not earth (ground) them to the ground. Terminals SD and 5 are not isolated. (Those of the 400V class are isolated.)
5. When terminals PC-SD are used as a 24VDC power supply, be careful not to short these terminals. If they are shorted, the inverter will be damaged.
6. Not needed when the operation panel or parameter unit (FR-PU04) is used for calibration. Used when calibration must be made near the frequency meter for such a reason as a remote frequency meter. However, the frequency meter needle may not deflect to full-scale if the calibration resistor is connected. In this case, use this resistor and the operation panel or parameter unit together.

- **Single-phase 200V power input**
- **Single-phase 100V power input**

Note: 1. To ensure safety, connect the power input to the inverter via a magnetic contactor and earth (ground) leakage circuit breaker or moulded case circuit breaker, and use the magnetic contactor to switch power on-off.
2. The output is three-phase 200V.

(1) Description of the main circuit terminals

Symbol	Terminal Name	Description
R, S, T (L_1, L_2, L_3) (Note)	AC power input	Connect to the commercial power supply. Keep these terminals open when using the high power factor converter (FR-HC) or power regeneration common converter (FR-CV).
U, V, W	Inverter output	Connect a three-phase squirrel-cage motor.
P (+), PR	Brake resistor connection	Connect the optional brake resistor across terminals P-PR (+ - PR) (not for 0.1K and 0.2K).
P (+), N (-)	Brake unit connection	Connect the optional brake unit, high power factor converter (FR-HC), and power regeneration common converter (FR-CV).
P (+), P1	Power factor improving DC reactor connection	Disconnect the jumper from terminals P-P1 (+ - P1) and connect the optional power factor improving DC reactor. (can not be connected to the single phase 100V power input specification inverter)
⏚	Earth (Ground)	For earthing (grounding) the inverter chassis. Must be earthed (grounded).

Note: R, S (L_1, L_2) terminals for single-phase power input.

(2) Description of the control circuit terminals

Type		Symbol	Terminal Name	Description	
Input signals	Contact input	STF	Forward rotation start	Turn on the STF signal to start forward rotation and turn it off to stop.	When the STF and STR signals are turned on simultaneously, the stop command is given.
		STR	Reverse rotation start	Turn on the STR signal to start reverse rotation and turn it off to stop.	
		RH, RM, RL	Multi-speed selection	Combine the RH, RM and RL signals as appropriate to select multiple speeds.	Input terminal function selection (Pr. 180 to Pr. 183) changes terminal functions.
		MRS	Output stop	Turn on the MRS signal (20ms or longer) to stop the inverter output. Used to shut off the inverter output to bring the motor to a stop by the electromagnetic brake.	
		RES	Reset	Used to reset the protective circuit activated. Turn on the RES signal for more than 0.1s then turn it off. Factory setting is for reset always. By setting Pr.75, reset can be set to enabled only at an inverter alarm occurrence. (Refer to page 130.) Recover about 1s after reset is cancelled.	
	SD		Contact input common (sink) (initial setting)	Common terminal for contact input terminal (sink logic) and terminal FM.	
			External transistor common (source)	When connecting the transistor output (open collector output), such as a programmable controller, when source logic is selected, connect the external power supply common for transistor output to this terminal to prevent a malfunction caused by undesirable currents.	
			24VDC power supply common	Common output terminal for 24VDC 0.1A power supply (PC terminal). Isolated from terminals 5 and SE.	
	PC		External transistor common (sink) (initial setting)	When connecting the transistor output (open collector output), such as a programmable controller, when sink logic is selected, connect the external power supply common for transistor output to this terminal to prevent a malfunction caused by undesirable currents.	
			Contact input common (source)	Common terminal for contact input terminal (source logic).	
			24VDC power supply	Can be used as 24VDC 0.1A power supply.	

Type		Symbol	Terminal Name	Description
Analog	Frequency setting	10	Frequency setting power supply	5VDC, permissible load current 10mA
		2	Frequency setting (voltage)	By entering 0 to 5VDC (0 to 10VDC), the maximum output frequency is reached at 5V (or 10V) and I/O are proportional. Use Pr. 73 to switch between input 0 to 5VDC (factory setting) and 0 to 10VDC. Input resistance 10kΩ. Maximum permissible voltage 20V.
		4	Frequency setting (current)	By entering 4 to 20mADC, the maximum output frequency is reached at 20mA and I/O are proportional. This input signal is valid only when the AU signal (Note) is on (voltage input is invalid). Input resistance approximately 250Ω. Maximum permissible current 30mA.
		5	Frequency setting common	Common to the frequency setting signals (terminal 2, 1 or 4). Do not connect to the earth (ground).

Note: Assign the AU signal to any of the terminals using the input terminal function selection (Pr. 180 to Pr. 183).

* Used as a contact input signal common terminal by switching between sink logic and source logic. (Refer to page 27.)

Type		Symbol	Terminal Name	Description	
Output signals	Contact	A, B, C	Alarm output	1 changeover contact output indicating that the output has been stopped by the inverter protective function activated. 230VAC 0.3A, 30VDC 0.3A. Alarm: discontinuity across B-C (continuity across A-C), normal: continuity across B-C (discontinuity across A-C).	Output terminal function selection (Pr. 190 to Pr. 192) changes terminal functions.
	Open collector	RUN	Inverter running	Switched low when the inverter output frequency is equal to or higher than the starting frequency (factory set to 0.5Hz, variable). Switched high during stop or DC injection brake operation (*1). Permissible load 24VDC 0.1A. (a voltage drop is 3.4V maximum when the signal is on)	
		FU	Frequency detection	Switched low when the inverter output frequency is equal to or higher than the preset detected frequency and high when less than the preset detected frequency. (*1). Permissible load 24VDC 0.1A	
		SE	Open collector output common	Common to the RUN and FU terminals	
	Pulse	FM	For meter	One selected from output frequency, motor current and output voltage is output (*2). The output signal is proportional to the magnitude of each monitoring item.	Factory setting of output item: Frequency permissible load current 1mA 1440 pulses/s at 60Hz
Communication	RS-485	——	PU connector	With the operation panel connector, communication can be made using the RS-485 protocol. • Conforming Standard: EIA-485 (RS-485) • Transmission format: Multi-drop link system • Communication speed: Maximum 19200bps • Overall length: 500m	

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

*2: Not output during inverter resetting.

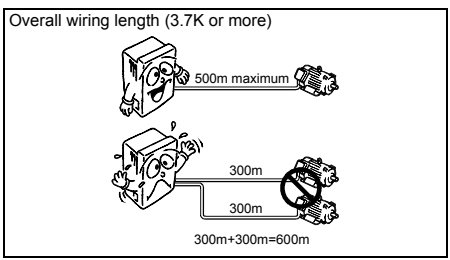
2.2.2 Wiring of the Main Circuit

(1) Wiring instructions

1) It is recommended to use insulation-sleeved crimping terminals for power supply and motor cables.
2) Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.
3) After wiring, wire off-cuts must not be left in the inverter.
   Wire off-cuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in an enclosure etc., take care not to allow chips and other foreign matter to enter the inverter.
4) Use thick cables to make the voltage drop 2% or less.
   If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease, especially at the output of a low frequency. (A selection example for the wiring length of 20m is shown on page 24.)
5) For long distance wiring, the overcurrent protection may be activated improperly or the devices connected to the output side may misoperate or become faulty under the influence of a charging current due to the stray capacitance of the wiring.
   Therefore, the maximum overall wiring length should be as indicated in the following table. If the wiring length exceeds the value, it is recommended to set "1" in Pr. 156 to make the fast-response current limit function invalid. (When two or more motors are connected to the inverter, the total wiring length should be within the indicated value.)

Inverter Capacity		0.1K	0.2K	0.4K	0.75K	1.5K	2.2K	3.7K or more
Non-low acoustic noise mode	100V, 200V class	200	200	300	500	500	500	500
	400V class	——	——	200	200	300	500	500
Low acoustic noise mode	100V, 200V class	30	100	200	300	500	500	500
	400V class	——	——	30	100	200	300	500

(Unit: m)



6) Connect only the recommended optional brake resistor between the terminals P-PR (+ - PR). Keep terminals P-PR (+ - PR) of 0.1K or 0.2K open.
These terminals must not be shorted.
0.1K and 0.2K do not accept the brake resistor. Keep terminals P-PR (+ - PR) open.
Also, never short these terminals.

7) Electromagnetic wave interference
The input/output (main circuit) of the inverter includes high frequency components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, install the FR-BIF optional capacitor type filter (for use in the input side only) or FR-BSF01 or FR-BLF common mode filter to minimize interference.

8) Do not install a power capacitor, surge suppressor or capacitor type filter (FR-BIF option) on the output side of the inverter.
This will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices are installed, immediately remove them. (When using the FR-BIF capacitor type filter with a single-phase power supply, connect it to the input side of the inverter after isolating the T phase securely.)

9) When rewiring after operation, make sure that the POWER lamp has gone off, and when more than 10 minutes has elapsed after power-off, check with a meter etc. that the voltage is zero. After that, start rewiring work. For some time after power-off, there is a dangerous voltage in the capacitor.

Notes on Earthing (Grounding)

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

- Use the dedicated earth (ground) terminal to earth (ground) the inverter. (Do not use the screw in the case, chassis, etc.) For the earth (ground) connection, avoid direct contact between aluminium and copper. Tin-plated cable lugs can be used if the plating does not contain zinc. When tightening the screws, take care not to damage the thread in the aluminium frame.

- Use the thickest possible earth (ground) cable. Use the cable whose size is equal to or greater than that indicated below, and minimize the cable length. The earthing (grounding) point should be as near as possible to the inverter.

(Unit: mm^2)

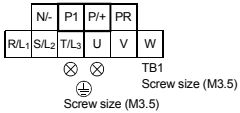
Motor Capacity	Earth (ground) Cable Gauge		
	100V class	200V class	400V class
2.2kW or less	2 (2.5)	2 (2.5)	2 (2.5)
3.7kW	—	3.5 (4)	2 (4)
5.5kW, 7.5kW	—	5.5 (6)	3.5 (4)

For use as a product compliant with the Low Voltage Directive, use PVC cable whose size is indicated within parentheses.

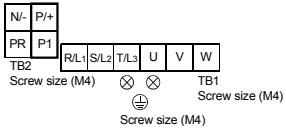
- Earth (ground) the motor on the inverter side using one wire of the 4-core cable.

(2) Terminal block layout of the power circuit

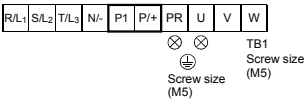
FR-E520-0.1K, 0.2K, 0.4K, 0.75K



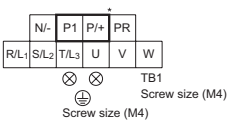
FR-E520-1.5K, 2.2K, 3.7K



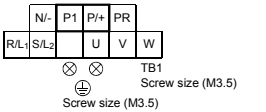
FR-E520-5.5K, 7.5K



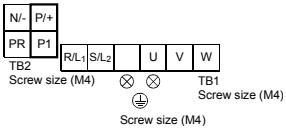
FR-E540-0.4K to 7.5K



FR-E520S-0.1K, 0.2K, 0.4K
FR-E510W-0.1K, 0.2K, 0.4K



FR-E520S-0.75K
FR-E510W-0.75K



2

(3) Cables, crimping terminals, etc.

The following table lists the cables and crimping terminals used with the inputs (R (L_1), S (L_2), T (L_3)) and outputs (U, V, W) of the inverter and the torques for tightening the screws:

1) FR-E520-0.1K to 7.5K

Applicable Inverter Type	Terminal Screw Size	Tightening Torque N·m	Crimping Terminals		Cables				PVC insulated Cables	
					mm²		AWG		mm²	
			R, S, T (L_1, L_2, L_3)	U, V, W	R, S, T (L_1, L_2, L_3)	U, V, W	R, S, T (L_1, L_2, L_3)	U, V, W	R, S, T (L_1, L_2, L_3)	U, V, W
FR-E520-0.1K to 0.75K	M3.5	1.2	2-3.5	2-3.5	2	2	14	14	2.5	2.5
FR-E520-1.5K, 2.2K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-E520-3.7K	M4	1.5	5.5-4	5.5-4	3.5	3.5	12	12	4	2.5
FR-E520-5.5K	M5	2.5	5.5-5	5.5-5	5.5	5.5	10	10	6	4
FR-E520-7.5K	M5	2.5	14-5	8-5	14	8	6	8	16	6

2) FR-E540-0.4K to 7.5K

Applicable Inverter Type	Terminal Screw Size	Tightening Torque N·m	Crimping Terminals		Cables				PVC insulated Cables	
					mm²		AWG		mm²	
			R, S, T (L_1, L_2, L_3)	U, V, W	R, S, T (L_1, L_2, L_3)	U, V, W	R, S, T (L_1, L_2, L_3)	U, V, W	R, S, T (L_1, L_2, L_3)	U, V, W
FR-E540-0.4K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-E540-0.75K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-E540-1.5K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-E540-2.2K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-E540-3.7K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-E540-5.5K	M4	1.5	5.5-4	2-4	3.5	2	12	14	4	2.5
FR-E540-7.5K	M4	1.5	5.5-4	5.5-4	3.5	3.5	12	12	4	4

3) FR-E520S-0.1K to 0.75K

Applicable Inverter Type	Terminal Screw Size	Tightening Torque N·m	Crimping Terminals		Cables				PVC insulated Cables	
					mm²		AWG		mm²	
			R, S (L_1, L_2)	U, V, W	R, S (L_1, L_2)	U, V, W	R, S (L_1, L_2)	U, V, W	R, S (L_1, L_2)	U, V, W
FR-E520S-0.1K to 0.4K	M3.5	1.2	2-3.5	2-3.5	2	2	14	14	2.5	2.5
FR-E520S-0.75K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5

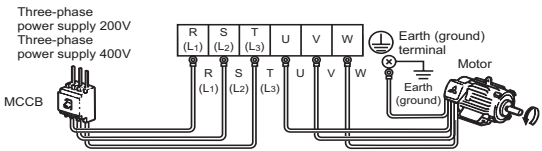
4) FR-E510W-0.1K to 0.75K

Applicable Inverter Type	Terminal Screw Size	Tightening Torque N·m	Crimping Terminals		HIV Cables mm²		HIV Cables AWG		PVC insulated Cables mm²	
			R, S (L1, L2)	U, V, W	R, S (L1, L2)	U, V, W	R, S (L1, L2)	U, V, W	R, S (L1, L2)	U, V, W
FR-E510W-0.1K to 0.4K	M3.5	1.2	2-3.5	2-3.5	2	2	14	14	2.5	2.5
FR-E510W-0.75K	M4	1.5	5.5-4	2-4	3.5	2	12	14	4	2.5

Note: 1. The cables used should be 75°C copper cables.
2. Tighten the terminal screws to the specified torques.
Undertightening can cause a short or misoperation.
Overtightening can cause the screws and unit to be damaged, resulting in a short or misoperation.
3. The power supply cable size of the motor indicated assumes that its length is 20m.

(4) Connection of the power supply and motor

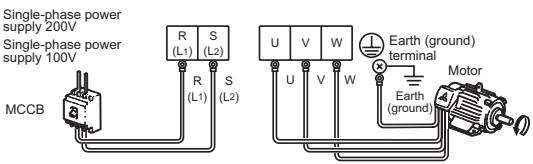
● **Three-phase power input**



The power supply cables must be connected to R, S, T (L1, L2 ,L3). Never connect the power cable to the U, V, W of the inverter. Doing so will damage the inverter.
(Phase sequence need not be matched.)

Connect the motor to U, V, W. In the above connection, turning on the forward rotation switch (signal) rotates the motor in the counterclockwise (arrow) direction when viewed from the load shaft.

● **Single-phase power input**



Note: 1. To ensure safety, connect the power input to the inverter via a magnetic contactor and earth (ground) leakage circuit breaker or moulded case circuit breaker, and use the magnetic contactor to switch power on-off.
2. The output is three-phase 200V.

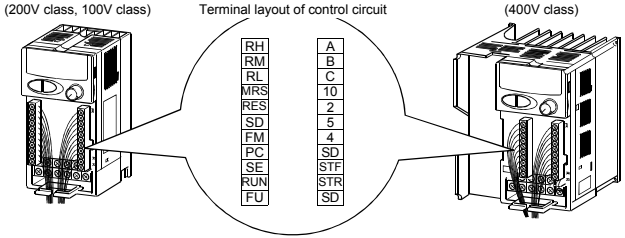
2.2.3 Wiring of the control circuit

(1) Wiring instructions

1) Terminals SD, SE and 5 are common to the I/O signals. These common terminals must not be earthed (grounded) to the ground.
   Terminals SD and 5 are not isolated. Do not connect terminals SE-5. (Those of the 400V class are isolated. Avoid connecting the terminal SD and 5 and the terminal SE and 5.)
2) Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit).
3) The frequency input signals to the control circuit are micro currents. When contacts are required, use two or more parallel micro signal contacts or a twin contact to prevent a contact fault.
4) It is recommended to use the cables of 0.3mm^2 to 0.75mm^2 gauge for connection to the control circuit terminals.

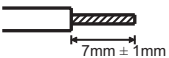
(2) Terminal block layout

In the control circuit of the inverter, the terminals are arranged as shown below:
Terminal screw size: M2.5



(3) Wiring method

1) For wiring the control circuit, use cables after stripping their sheaths.
   Refer to the gauge printed on the inverter and strip the sheaths to the following dimensions. If the sheath is stripped too much, its cable may be shorted with the adjoining cable. If the sheath is stripped too little, the cable may come off.



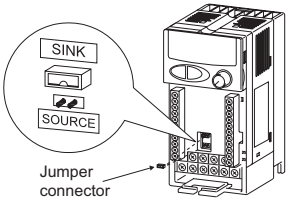
2) When using bar terminals and solid wires for wiring, their diameters should be 0.9mm maximum. If they are larger, the threads may be damaged during tightening.
3) Loosen the terminal screw and insert the cable into the terminal.
4) Tighten the screw to the specified torque.
   Undertightening can cause cable disconnection or misoperation. Overtightening can cause damage to the screw or unit, leading to short circuit or misoperation.
   Tightening torque: 0.25N·m to 0.49N·m
   *Use a size 0 screwdriver to tighten.

Note: When routing the stripped cables, twist them so that they do not become loose.
In addition, do not solder it.

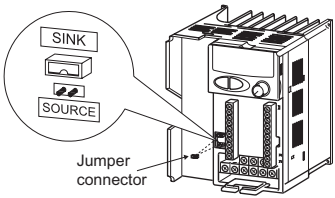
(4) Control logic changing

The input signal logic is factory-set to the sink logic.
To change the control logic, the position of the jumper connector must be changed.

1) Use tweezers etc. to remove the jumper connector in the sink logic position and fit it in the source logic position.
   Do this position changing before switching power on.



(100V/200V class)

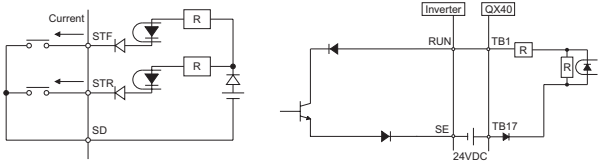


(400V class)

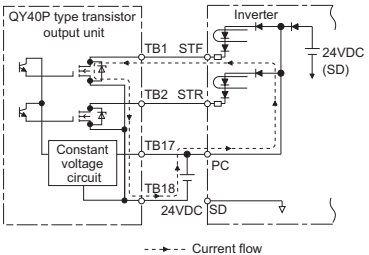
Note: 1. Make sure that the front cover has been installed securely.
2. The front cover has a capacity plate and the inverter a rating plate on it. Since these plates have the same serial numbers, always reinstall the removed cover to the inverter from where it was removed.
3. Always install the sink-source logic changing jumper connector in either of the positions. If two connectors are installed in these positions at the same time, the inverter may be damaged.

2) Sink logic type

- In this logic, a signal switches on when a current flows out of the corresponding signal input terminal.
  Terminal SD is common to the contact input signals. Terminal SE is common to the open collector output signals.

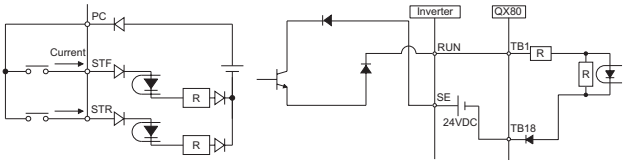


- Use terminal PC as a common terminal, and perform wiring as shown below. (Do not connect terminal SD of the inverter with terminal 0V of the external power supply. When using terminals PC-SD as a 24VDC power supply, do not install a power supply in parallel in the outside of the inverter. Doing so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

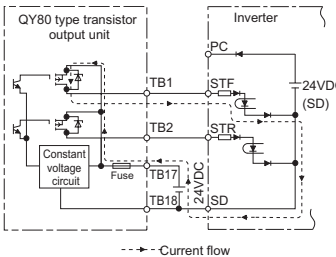


3) Source logic type

- In this 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.

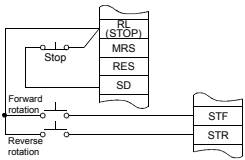


- Use terminal SD as a common terminal, and perform wiring as shown below. (Do not connect terminal PC of the inverter with terminal +24V of the external power supply. When using terminals PC-SD as a 24VDC power supply, do not install an external power supply in parallel with the inverter. Doing so may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



(5) How to use the STOP signal

The following connection example shows how to self-hold the start signals (forward rotation, reverse rotation).
Use Pr. 180 to Pr. 183 (input terminal function selection) to assign the STOP signal.



(Wiring example for sink logic)

2.2.4 Connection to the PU connector

(1) When connecting the operation panel or parameter unit using a cable

Use the option FR-CB2□□ or the following connector and commercially available cable:

<Connection cable>

- Connector: RJ45 connector
  Example: 5-554720-3, Tyco Electronics Corporation
- Cable: :Cable conforming to EIA568 (e.g. 10BASE-T cable)
  Example: SGLPEV-T 0.5mm×4P (Twisted pair cable, 4 pairs),
  MITSUBISHI CABLE INDUSTRIES, LTD.

Note: The rear cover and junction adaptor are required since the circuit board is exposed in the back of the operation panel. Use the FR-E5P option (cover and adaptor available as a set).

<Maximum wiring length>

- Operation panel: 20m
- Parameter unit (FR-PU04): 20m

(2) For RS-485 communication

With the operation panel disconnected, the PU connector can be used for 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 the parameters.

<PU connector pin-outs>

Viewed from the inverter (receptacle side) front

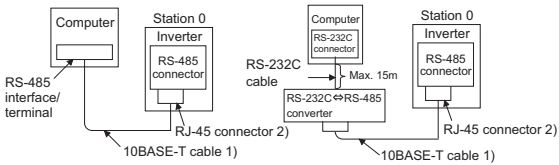
8) to 1)

1) SG 5) SDA
2) P5S 6) RDB
3) RDA 7) SG
4) SDB 8) P5S

Note: 1. Do not connect the PU connector to a computer's LAN board, FAX modem socket or telephone modular connector. The product could be damaged due to differences in electrical specifications.
2. Pins 2) and 8) (P5S) provide power to the operation panel or parameter unit.
   Do not use these pins for RS-485 communication.
3. Refer to page 144 for the communication parameters.

<System configuration example>

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



- Computer-inverter connection cable
  For a connection cable between the computer having RS-232C and the inverter (RS-232C⇔RS-485 converter), refer to the table below.
  Example of product available on the market (as of Sep., 2006)

Model	Maker
FA-T-RS40□*	Mitsubishi Electric Engineering Co., Ltd.

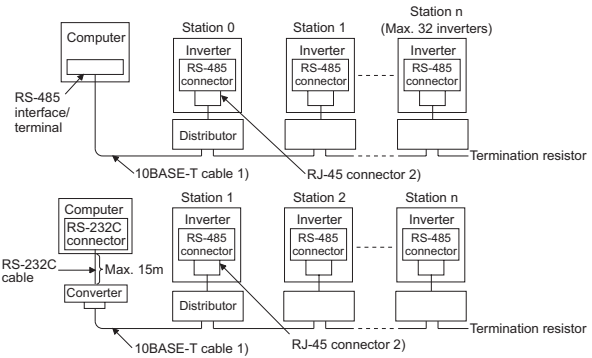
* The converter cable cannot connect two or more inverters (the computer and inverter are connected on a 1:1 basis). Since the product is packed with the RS-232C cable and RS-485 cable (10BASE-T + RJ-45 connector), the cable and connector need not be prepared separately. Contact a maker for details of the product.

REMARKS

Refer to the following when fabricating the cable on the user side.
Example of product available on the market (as of Sep., 2006)

	Product	Model	Maker
1)	10BASE-T cable	SGLPEV-T 0.5mm × 4P * Do not use No. 2 and No. 8 pin (P5S).	Mitsubishi Cable Industries, Ltd.
2)	RJ-45 connector	5-554720-3	Tyco Electronics Corporation

(2) Connection of a computer to multiple inverters (1:n connection)



REMARKS

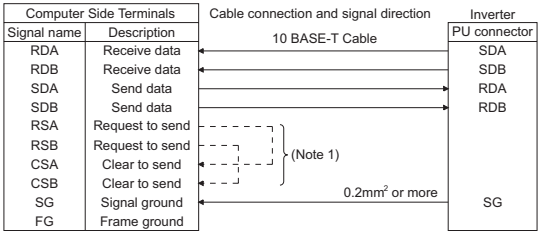
Refer to the following when fabricating the cable on the user side.
Example of product available on the market (as of Sep., 2006)

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

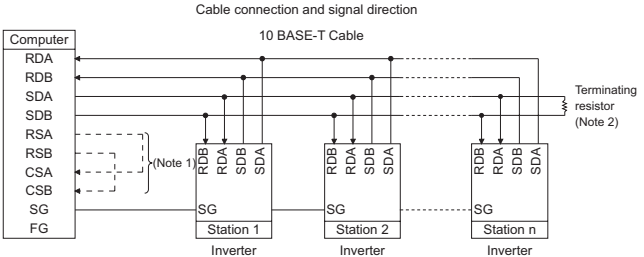
* Do not use No. 2 and No. 8 pin (P5S) of the 10 BASE-T cable.

<Wiring methods>

1) Wiring of one RS-485 computer and one inverter



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



Note: 1. Make connections in accordance with the instruction manual of the computer used.
Fully check the terminal numbers of the computer as they differ between models.

2. There may be the influence of reflection depending on the transmission speed and/or transmission distance. If this reflection hinders communication, provide a terminating resistor. If the PU connector is used to make a connection, use the distributor as a terminating resistor cannot be fitted.
Connect the terminating resistor to only the inverter remotest from the computer. (Terminating resistor: 100Ω)

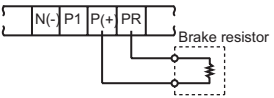
2.2.5 Connection of stand-alone option units

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

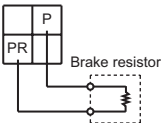
(1) Connection of the dedicated external brake resistor (option) (Cannot be connected to 0.1K and 0.2K)

Connect a brake resistor across terminals P (+) and PR. Connect a dedicated brake resistor only.
(For the locations of terminals P (+) and PR, refer to the terminal block layout (page 23).)

- FR-E520-0.4K, 0.75K, 5.5K, 7.5K
- FR-E540-0.4K to 7.5K
- FR-E520S-0.4K
- FR-E510W-0.4K



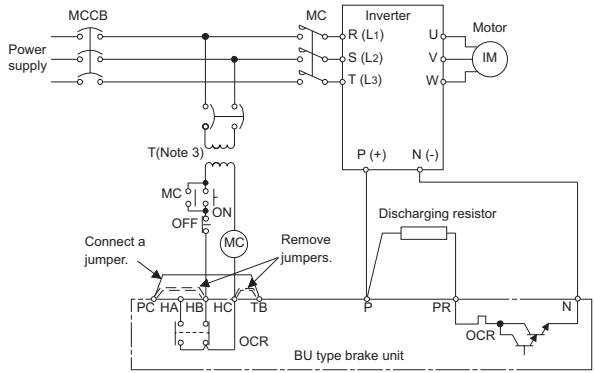
- FR-E520-1.5K to 3.7K
- FR-E520S-0.75K
- FR-E510W-0.75K



Do not remove a jumper across terminal P and P1 except when connecting a DC reactor.

(2) Connection of the brake unit (BU)

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

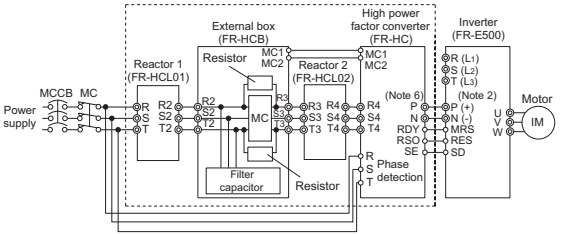


Note: 1. The wiring distance between the inverter, brake unit and discharging resistor should be within 2m. If twisted wires are used, the distance should be within 5m.
2. If the transistors in the brake unit should fail, the resistor will be extremely hot, causing a fire. Therefore, install a magnetic contactor on the inverter's power supply side to shut off current in case of failure.
3. When the power supply is 400V class, install a step-down transformer.
4. Do not remove a jumper across terminal P and P1 except when connecting a DC reactor.

(3) Connection of the high power factor converter (FR-HC)

(In the case of single-phase power input, the FR-HC cannot be connected.)

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



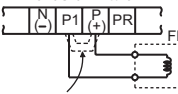
Note: 1. Use sink logic (factory setting) when the FR-HC is connected. The FR-HC cannot be connected when source logic is selected.
2. The power input terminals R, S, T (L_1, L_2, L_3) must be open. Incorrect connection will damage the inverter.
3. The voltage phases of terminals R, S, T (L_1, L_2, L_3) and terminals R4, S4, T4 must be matched before connection.
4. The MRS terminal functions can be changed using Pr.183 "MRS terminal function selection". When connecting the high power factor converter (FR-HC), use the inverter with "6" (factory-set) in Pr.183. (Refer to page 171.)
5. If the load capacity is less than half of the high power factor converter capacity, satisfactory harmonic suppression effects cannot be produced.
6. Do not install the MCCB between terminals P-N (P (+) -P, N (-) -N). Opposite polarity of terminals P (+), N (-) will damage the inverter.
7. Do not remove a jumper across terminal P and P1 except when connecting a DC reactor.

(4) Connection of the power factor improving DC reactor (FR-BEL)

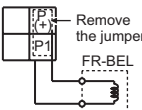
Connect the FR-BEL power factor improving DC reactor between terminals P1-P (+). In this case, the jumper connected across terminals P1-P (+) must be removed. Otherwise, the reactor will not function.

<Connection method>

- FR-E520-0.1K to 0.75K,5.5K,7.5K
- FR-E540-0.4K to 7.5K
- FR-E520S-0.1K to 0.4K



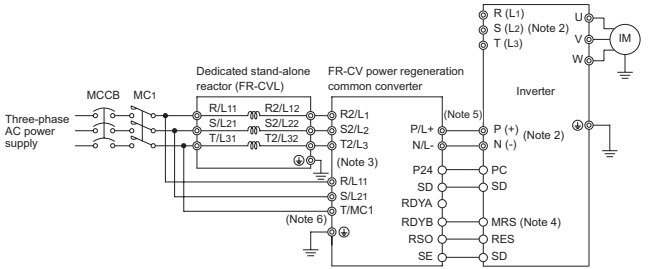
- FR-E520-1.5K to 3.7K
- FR-E520S-0.75K



Note: 1. The wiring distance should be within 5m.
2. The size of the cables used should be equal to or larger than that of the power supply cables (R (L_1), S (L_2), T (L_3)).

(5) Connection of the power regeneration common converter (FR-CV)

When connecting the type power regeneration common converter (FR-CV), connect the inverter terminals (P(+), N(-)) and power regeneration common converter (FR-CV) terminals as shown below so that their signals match with each other. For details, refer to the instruction manual of the power regeneration common converter (FR-CV).



Note: 1. When the FR-CV is connected, use sink logic (factory setting). For source logic, the FR-CV cannot be connected.
2. The DC power supply input from the terminals P (+) and N (-) is used as the control power supply. The power input terminals R (L1), S (L2), T (L3) must be open. Accidental connection will damage the inverter.
3. The voltage phases of terminals R/L11, S/L21, T/MC1 and terminals R2/L1, S2/L2, T2/L3 must be matched before connection.
4. The MRS terminal functions can be changed using Pr.183 "MRS terminal function selection". When connecting the power regeneration common converter (FR-CV), use the inverter with "6" (factory-set) in Pr.183. (Refer to page 171.)
5. Do not insert MCCB between terminals P-N (P (+) - P/L+, N (-) - N/L-). Opposite polarity of terminals P (+), N (-) will damage the inverter.
6. Make sure terminals R/L11, S/L21, T/MC1 are connected to the power supply. Running the inverter without connecting the terminals will damage the power regeneration common converter.
7. Do not remove a jumper across terminal P and P1 except when connecting a DC reactor.

2.2.6 Design information

1) When performing commercial power supply-inverter switch-over operation, securely provide electrical and mechanical interlocks for the MC1 and MC2 used for electronic bypass operation.
   When there is a commercial power supply-inverter switch-over circuit as shown below, the inverter will be damaged by leakage current from the power supply due to arcs generated at the time of switch-over or chattering caused by a sequence error.

2) If the machine must not be restarted when power is restored after a power failure, provide a magnetic contactor in the inverter's primary circuit 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.

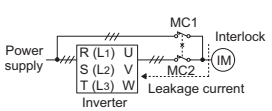
3) Since the input signals to the control circuit are on a low level, use two or more parallel micro signal contacts or a twin contact for contact inputs to prevent a contact fault.

4) Do not apply a large voltage to the contact input terminals (e.g. STF) of the control circuit.

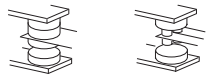
5) Always apply a voltage to the alarm output terminals (A, B, C) via a relay coil, lamp, etc.

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

1) Electronic bypass



3) Low-level signal contacts



2.3 Other Wiring

2.3.1 Power supply harmonics

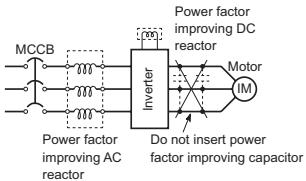
Power supply harmonics may be generated from the converter section of the inverter, affecting the power supply equipment, power capacitor, etc. Power supply harmonics are different in generation source, frequency band and transmission path from radio frequency (RF) noise and leakage currents. Take the following counter measures.

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

Item	Harmonics	RF Noise
Frequency	Normally 40th to 50th degrees or less (up to 3kHz or less)	High frequency (several 10kHz to 1GHz order)
Environment	To wire paths, power impedance	Across spaces, distance, laying paths
Quantitative understanding	Logical computation is possible	Occurs randomly, quantitative understanding is difficult.
Generated amount	Approximately proportional to load capacity	According to current fluctuation rate (larger with faster switching)
Immunity of affected device	Specified in standards for each device.	Differs according to maker's device specifications.
Examples of safeguard	Install a reactor.	Increase the distance.

● **Countermeasures**

The harmonic current generated from the inverter to the power supply differs according to various conditions such as the wiring impedance, whether a power factor improving reactor is used or not, and output frequency and output current on load side.
For the output frequency and output current, the adequate method is to obtain them under rated load at the maximum operating frequency.



Note: A power factor improving capacitor and surge suppressor on the inverter's output side may overheat or be damaged due to the harmonics 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. To improve the power factor, insert a power factor improving reactor in the inverter's input or DC circuit. For details, refer to the FR-A500/E500 series technical information.

2.3.2 Harmonic suppression guideline in Japan

Harmonic currents flow from the inverter to a power receiving point via a power transformer. The harmonic suppression guideline was established to protect other consumers from these outgoing harmonic currents.
The three-phase 200V input specifications 3.7kW or less (single phase 200V class is 2.2kW or less and single phase 100V class is 0.75kW or less) are previously covered by "Harmonic suppression guideline for household appliances and general-purpose products" and other models are covered by "Harmonic suppression guideline for consumers who receive high voltage or special high voltage". However, the general-purpose inverter has been excluded from the target products covered by "Harmonic suppression guideline for household appliances and general-purpose products" in January 2004. Later, this guideline was repealed on September 6, 2004. All capacities of all models are now target products of "Harmonic suppression guideline for consumers who receive high voltage or special high voltage" (hereinafter referred to as "Guideline for specific consumers").

"Guideline for specific consumers"

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

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

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

(1) Application of the harmonic suppression guideline for specific consumers

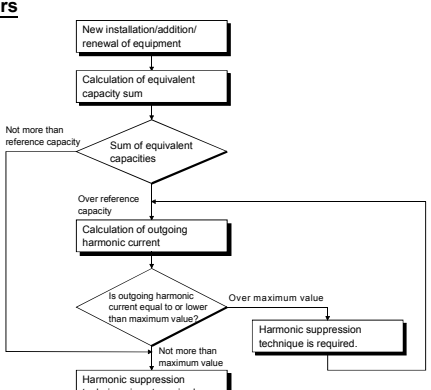


Table 2 Conversion Factors for FR-E500 Series

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

Table 3 Equivalent Capacity Limits

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

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

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

1) Calculation of equivalent capacity (P0) of harmonic generating equipment
The "equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of consumer's harmonic generating equipment and is calculated with the following equation. If the sum of equivalent capacities is higher than the limit in Table 3, harmonics must be calculated with the following procedure:

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

Ki : Conversion factor (refer to Table 2)
Pi : Rated capacity of harmonic generating equipment* [kVA]
i : Number indicating the conversion circuit type

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

2) Calculation of outgoing harmonic current
Outgoing harmonic current = fundamental wave current (value converterd from received power voltage) × operation ratio × harmonic content

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

Table 5 Rated Capacities and Outgoing Harmonic Currents for Inverter Drive

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

3) Application of the guideline for specific consumers

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

4) Harmonic suppression techniques

No.	Item	Description
1	Reactor installation (ACL, DCL)	Install a reactor (ACL) on the AC side of the inverter or a reactor (DCL) on its DC side or both to suppress outgoing harmonic currents.
2	High power factor converter (FR-HC)	The converter circuit is switched on-off to convert an input current waveform into a sine wave, suppressing harmonic currents substantially. The high power factor converter (FR-HC) is used with the standard accessory.
3	Installation of power factor improving capacitor	When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents.
4	Transformer multi-phase operation	Use two transformers with a phase angle difference of 30° as in ⅄-Δ, Δ-Δ combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
5	AC filter	A capacitor and a reactor are used together to reduce impedances at specific frequencies, producing a great effect of absorbing harmonic currents.
6	Passive filter (Active filter)	This filter detects the current of a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress a harmonic current at a detection point, providing a great effect of absorbing harmonic currents.

2.3.3 EMC measures

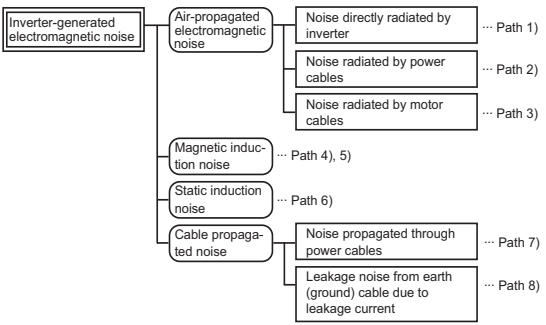
Some electromagnetic noises enter the inverter causing it to incorrectly operate, and others are radiated by the inverter causing misoperation of peripheral devices. Though the inverter is designed have high immunity performance, it handles low-level signals, so it requires the following basic measures to be taken. Also, since the inverter chops the output at high carrier frequencies, it could generate electromagnetic noise. If these electromagnetic noises cause peripheral devices to malfunction, EMI measures should be taken to suppress noise. The measures differ slightly depending on noise propagation paths.

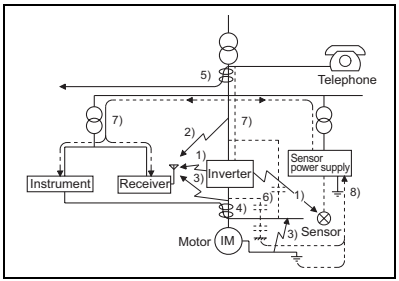
1) Basic techniques
   - Do not run the power cables (I/O cables) and signal cables of the inverter in parallel with each other and do not bundle them.
   - Use twisted shield cables for the detector connecting and control signal cables and connect the sheathes of the shield cables to terminal SD.
   - Earth (ground) the inverter, motor, etc. at one point.

2) Techniques to reduce electromagnetic noises that enter and malfunction the inverter
   When devices which generate electromagnetic noise (devices which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the inverter, the inverter may be malfunctioned by electromagnetic noises. The following measures must be taken:
   - Provide surge suppressors for devices that generate electromagnetic noise to suppress electromagnetic noise.
   - Fit data line filters (refer to page 46) to signal cables.
   - Earth (ground) the shields of the detector connection and control signal cables with cable clamp metal.

3) Techniques to reduce electromagnetic noises that are radiated by the inverter to malfunction peripheral devices (EMI measures) periperal devices

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



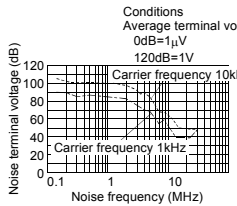
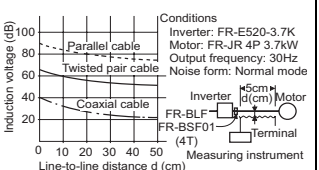


Noise Path	Measures
1), 2), 3)	When devices that handle low-level signals and are liable to malfunction due to electromagnetic noises, e.g. instruments, receivers and sensors, are contained in the enclosure that contains the inverter or when their signal cables are run near the inverter, the devices may be malfunctioned by air-propagated electromagnetic noises. The following measures must be taken: (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible from the inverter. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) Insert common mode filters onto I/O and capacitors between the inputs lines to suppress cable-radiated noises. (5) Use shielded cables for signal cables and power cables and run them in individual metal conduits to further reduce effects.
4), 5), 6)	When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables causing misoperation of the devices and the following measures must be taken: (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible from the inverter. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) Use shielded cables for signal cables and power cables and run them in individual metal conduits to further reduce effects.
7)	When the power supplies of the peripheral devices are connected to the power supply of the inverter within the same line, inverter-generated noise may flow back through the power supply cables causing misoperation of the devices and the following measures must be taken: (1) Install the capacitor type filter (FR-BIF) to the power cables (input cables) of the inverter. (2) Install the common mode filter (FR-BLF, FR-BSF01) to the power cables (I/O cables) of the inverter.
8)	When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage current may flow through the earth (ground) cable of the inverter causing misoperation of the device. In such a case, disconnection of the earth (ground) cable of the device may cause the device to operate properly.

● **Data line filter**

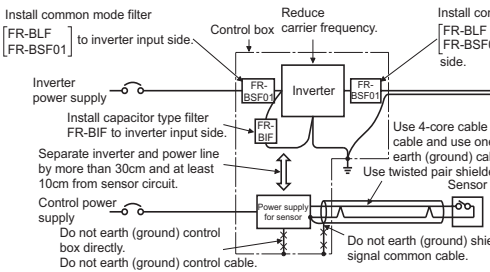
As immunity measures it may effective, provide a data line filter for the detector or other cable.

● **Data examples**

By decreasing the carrier frequency, the noise terminal voltage* can be reduced. Use Pr. 72 to set the carrier frequency to a low value (1kHz). Though motor noise increases at a low carrier frequency, selection of Soft-PWM will make it unoffending.	By using shielded cables as signal cables, induction noise can be reduced greatly (1/10 to 1/100). Induction noise can also be reduced by moving the signal cables away from the inverter output cables. (Separation of 30cm reduces noise to 1/2 to 1/3.) By fitting the FR-BSF01 or BLF on the inverter output side, induction noise to the signal cables can be reduced.
Differences between noise terminal voltages at different carrier frequencies	Noise induced to signal cables by inverter output cables
	

* Noise terminal voltage:Represents the magnitude of noise propagated from the inverter to the power supply.

● **EMC measures**



2.3.4 Leakage currents and countermeasures

Due to the static capacitance existing in the inverter I/O wiring and motor, leakage currents flow through them. Since their values depend on the static capacitance, carrier frequency, etc., take the following measures.

(1) To-earth (ground) leakage currents

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

● **Countermeasures**

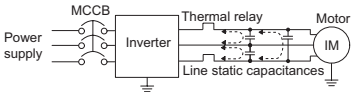
- If the carrier frequency setting is high, decrease the carrier frequency (Pr. 72) of the inverter.
  Note that motor noise increases. Selection of Soft-PWM (Pr. 240) will make it unoffending.
- By using earth (ground) leakage circuit breakers designed for harmonic and surge suppression in the inverter's own line and other line, operation can be performed with the carrier frequency kept high (with low noise).

● **To-earth (ground) leakage current**

- Take caution as long wiring length will increase leakage currents. Decreasing the carrier frequency of the inverter reduces leakage currents.
- Increasing the motor capacity increases leakage currents. The leakage currents of the 400V class are higher than those of the 200V class.

(2) Line-to-line leakage currents

Harmonics of leakage currents flowing in static capacities between the inverter output cables may operate the external thermal relay unnecessarily.



Line-to-line leakage current path

● **Countermeasures**

- Use the electronic thermal relay function of the inverter.
- Decrease the carrier frequency. Note that motor noise increases. Selection of Soft-PWM will make it unoffending.
  To ensure that the motor is protected not to be influenced by line-to-line leakage currents, we recommend the protection method which uses a temperature sensor to directly detect motor temperature.

2.3.5 Inverter-driven 400V class motor

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

● **Measures**

It is recommended to take either of the following measures:

(1) Rectifying the motor insulation

For the 400V class motor, use an insulation-enhanced motor. Specifically,

1) Specify the "400V class inverter-driven, insulation-enhanced motor".
2) For the dedicated motor such as the constant-torque motor and low-vibration motor, use the "inverter-driven, dedicated motor".

Note: If the wiring length between the motor and inverter is 40m or longer, set Pr. 240 to long wiring mode in addition to the above countermeasures to operate the inverter. (Refer to page 127 for Pr. 240 "Soft-PWM selection".)

(2) Suppressing the surge voltage on the inverter side

On the secondary side of the inverter, connect the optional surge voltage suppression filter (FR-ASF-H).

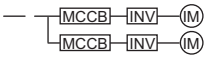
2.3.6 Peripheral devices

(1) Selection of peripheral devices

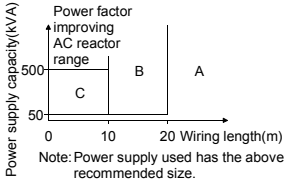
Check the inverter type of the inverter to be used with the inverter you purchased. Appropriate peripheral devices must be selected according to the capacity. Refer to the following list and prepare appropriate peripheral devices:

	Inverter Type	Motor Output (kW)	Power Supply Capacity (kVA)	Moulded Case Circuit Breaker (MCCB) or Earth (Ground) Leakage Circuit Breaker (NV) (Note 6)		Magnetic Contactor (MC)		
				Standard	With power factor improving reactor	A	B	C
Three-phase 200V	FR-E520-0.1K	0.1	0.4	30AF 5A	30AF 5A	S-N11	S-N18	S-N20
	FR-E520-0.2K	0.2	0.8	30AF 5A	30AF 5A	S-N18	S-N20	S-N20
	FR-E520-0.4K	0.4	1.5	30AF 5A	30AF 5A	S-N18	S-N21	S-N21
	FR-E520-0.75K	0.75	2.5	30AF 10A	30AF 10A	S-N18	S-N21	S-N21
	FR-E520-1.5K	1.5	4.5	30AF 15A	30AF 15A	S-N21	S-N25	S-N50
	FR-E520-2.2K	2.2	5.5	30AF 20A	30AF 15A	S-N10		
	FR-E520-3.7K	3.7	9	30AF 30A	30AF 30A	S-N20, S-N21		
	FR-E520-5.5K	5.5	12	50AF 50A	50AF 40A	S-N25		
	FR-E520-7.5K	7.5	17	100AF 60A	50AF 50A	S-N35		
Three-phase 400V	FR-E540-0.4K	0.4	1.5	30AF 5A	30AF 5A	S-N10		
	FR-E540-0.75K	0.75	2.5	30AF 5A	30AF 5A	S-N10		
	FR-E540-1.5K	1.5	4.5	30AF 10A	30AF 10A	S-N10		
	FR-E540-2.2K	2.2	5.5	30AF 15A	30AF 10A	S-N10		
	FR-E540-3.7K	3.7	9	30AF 20A	30AF 15A	S-N20, S-N21		
	FR-E540-5.5K	5.5	12	30AF 30A	30AF 20A	S-N20, S-N21		
	FR-E540-7.5K	7.5	17	30AF 30A	30AF 30A	S-N20, S-N21		
Single-phase 200V	FR-E520S-0.1K	0.1	0.4	30AF 5A	30AF 5A	S-N18	S-N20	S-N20
	FR-E520S-0.2K	0.2	0.8	30AF 10A	30AF 10A	S-N18	S-N21	S-N21
	FR-E520S-0.4K	0.4	1.5	30AF 10A	30AF 10A	S-N21	S-N25	S-N50
	FR-E520S-0.75K	0.75	2.5	30AF 15A	30AF 15A	S-N21	S-N25	S-N50
Single-phase 100V	FR-E510W-0.1K	0.1	0.5	30AF 10A	30AF 10A	S-N18	S-N21	S-N21
	FR-E510W-0.2K	0.2	0.9	30AF 15A	30AF 15A	S-N21	S-N25	S-N25
	FR-E510W-0.4K	0.4	1.5	30AF 20A	30AF 20A	S-N21	S-N25	S-N50
	FR-E510W-0.75K	0.75	2.5	30AF 30A	30AF 30A	S-N21	S-N25	S-N50

Note: 1. • Select the MCCB according to the power supply capacity.
• Install one MCCB per inverter.



2. The inverter input side magnetic contactor to be chosen differs between the applicable ranges A, B and C shown on the right, depending on the power supply capacity and wiring length. For the FR-E520-0.4K to 1.5K, FR-E520S-0.4K to 0.75K and FR-E510W-0.4K to 0.75K, choose the S-N10 when the power factor improving reactor (FR-BEL or FR-BAL) is used.



3. When the inverter capacity is greater than the motor capacity, choose the MCCB and magnetic contactor in accordance with the inverter type and choose the cables and power factor improving reactor in accordance with the motor output.
4. When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.
5. For installations in the United States or Canada, the circuit breaker must be inverse time or instantaneous trip type.

● Installation and selection of moulded case circuit breaker

Install a moulded case circuit breaker (MCCB) in the power supply side for protection of the inverter's primary wiring. Refer to the previous table and choose the MCCB according to the inverter's power supply side power factor (which changes with the power supply voltage, output frequency and load). Especially for a completely electromagnetic type MCCB, the one with a larger capacity must be selected since its operational characteristics change with harmonic currents. (Check the data of the corresponding breaker for confirmation.) Also the earth (ground) leakage circuit breaker used should be our product durable against harmonics/surges.

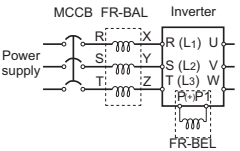
● **Power factor improving reactor**

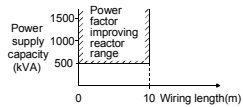
	Inverter Model	Power Factor Improving AC Reactor	Power Factor Improving DC Reactor
Three-phase 200V	FR-E520-0.1K	FR-BAL-0.4K (Note 1)	FR-BEL-0.4K (Note 1)
	FR-E520-0.2K	FR-BAL-0.4K (Note 1)	FR-BEL-0.4K (Note 1)
	FR-E520-0.4K	FR-BAL-0.4K	FR-BEL-0.4K
	FR-E520-0.75K	FR-BAL-0.75K	FR-BEL-0.75K
	FR-E520-1.5K	FR-BAL-1.5K	FR-BEL-1.5K
	FR-E520-2.2K	FR-BAL-2.2K	FR-BEL-2.2K
	FR-E520-3.7K	FR-BAL-3.7K	FR-BEL-3.7K
	FR-E520-5.5K	FR-BAL-5.5K	FR-BEL-5.5K
	FR-E520-7.5K	FR-BAL-7.5K	FR-BEL-7.5K
Three-phase 400V	FR-E540-0.4K	FR-BAL-H0.4K	FR-BEL-H0.4K
	FR-E540-0.75K	FR-BAL-H0.75K	FR-BEL-H0.75K
	FR-E540-1.5K	FR-BAL-H1.5K	FR-BEL-H1.5K
	FR-E540-2.2K	FR-BAL-H2.2K	FR-BEL-H2.2K
	FR-E540-3.7K	FR-BAL-H3.7K	FR-BEL-H3.7K
	FR-E540-5.5K	FR-BAL-H5.5K	FR-BEL-H5.5K
	FR-E540-7.5K	FR-BAL-H7.5K	FR-BEL-H7.5K
Single-phase 200V	FR-E520S-0.1K	FR-BAL-0.4K (Note 1)	FR-BEL-0.4K (Note 1)
	FR-E520S-0.2K	FR-BAL-0.4K (Note 1)	FR-BEL-0.4K (Note 1)
	FR-E520S-0.4K	FR-BAL-0.75K (Note 1)	FR-BEL-0.75K (Note 1)
	FR-E520S-0.75K	FR-BAL-1.5K (Note 1)	FR-BEL-1.5K (Note 1)
Single-phase 100V	FR-E510W-0.1K	FR-BAL-0.75K (Note 1)	— (Note 2)
	FR-E510W-0.2K	FR-BAL-1.5K (Note 1)	— (Note 2)
	FR-E510W-0.4K	FR-BAL-2.2K (Note 1)	— (Note 2)
	FR-E510W-0.75K	FR-BAL-3.7K (Note 1)	— (Note 2)

Note: 1. The power factor may be slightly lower.
2. The single-phase 100V power input models does not allow the power factor improving DC reactor to be fitted.

When the inverter is connected near a large-capacity power supply transformer (500kVA or more, wiring length 10m maximum) or there is power capacitor switch-over, excessive peak currents may flow into the power input circuit and damage the converter circuit. In such a case, the power supply improving reactor (FR-BEL or FR-BAL) must be installed.

When the FR-E510W-0.4K is connected to a single-phase 100V class output power transformer (in excess of 50kVA capacity), install the power factor improving reactor (FR-BAL-2.2K) to improve reliability

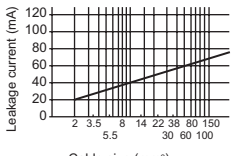




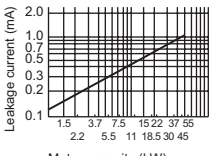
(2) Selecting the rated sensitivity current for the earth (ground) leakage circuit breaker

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

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



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

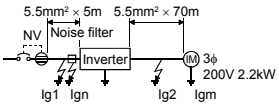


- Breaker for harmonic and surge
  Rated sensitivity current: IΔn ≥ 10×(Ig1+Ign+Ig2+Igm)
- Standard breaker
  Rated sensitivity current: IΔn ≥ 10×{Ig1+Ign+3×(Ig2+Igm)}

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

* Note the leakage current value of the noise filter installed on the inverter input side.

<Example>



Note: 1. Install the earth (ground) leakage breaker (ELB) on the input side of the inverter.
2. Earth (Ground) fault on the secondary side of the inverter can be detected at the running frequency of 120Hz or lower.
3. In the 人 connection neutral point earthed (grounded) system, the sensitivity current becomes worse for earth (ground) faults on the inverter secondary side. Earthing (Ground) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards)
4. When the breaker is installed on the secondary side of the inverter, it may be unnecessarily operated by harmonics if the effective value is less than the rating. In this case, do not install the breaker since the eddy current, hysteresis loss, and the temperature all increase.
5. General products indicate the following models.
   BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, NV-2F, earth (ground) leakage relay (except NV-ZHA), NV with AA neutral wire open-phase protection
   The other models are designed for harmonic and surge suppression
   NV-C/NV-S/MN series, NV30-FA, NV50-FA, BV-C2, earth (ground) leakage alarm breaker (NF-Z), NV-ZHA, NV-H

	Breaker for Harmonic and Surge	**Standard Breaker**
Leakage current (Ig1) (mA)	$33 \times \frac{5m}{1000m} = 0.17$	
Leakage current (Ign) (mA)	0 (without noise filter)	
Leakage current (Ig2) (mA)	$33 \times \frac{70m}{1000m} = 2.31$	
Motor leakage current (Igm) (mA)	0.18	
Total leakage current (mA)	2.66	7.64
Rated sensitivity current (mA) (≥ Ig × 10)	30	100

2.3.7 Power off and magnetic contactor (MC)

(1) Inverter primary side magnetic contactor (MC)

On the inverter primary side, it is recommended to provide an MC for the following purposes. (Refer to page 49 for selection.)

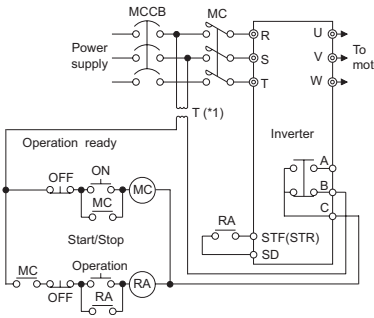
1) To release the inverter from the power supply when the inverter protective function is activated or the drive becomes faulty (e.g. emergency stop operation)
   When cycle operation or heavy-duty operation is performed with an optional brake resistor connected, overheat and burnout of the discharging resistor can be prevented if a regenerative brake transistor is damaged due to insufficient heat capacity of the discharging resistor and excess regenerative brake duty.
2) To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure
3) To rest the inverter for an extended period of time
   The control power supply for inverter is always running and consumes a little power. When stopping the inverter for a long time, switching inverter power off saves power slightly.
4) To separate the inverter from the power supply to ensure safe maintenance and inspection work
   As the inverter's primary MC is used for the above purposes, select class JEM1038-AC3 for the inverter input side current when making an emergency stop during normal operation.

REMARKS

The MC may be switched on/off to start/stop the inverter. However, since repeated inrush currents at power-on will shorten the life of the converter circuit (switching life is about 100,000 times), frequent starts and stops 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 right, always use the start signal (ON or OFF across terminals STF or STR-SD) to make a start or stop. (Refer to page 18.)



REMARKS

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

(2) Handling of secondary side magnetic contactor

Note that if it is switched off then on again during operation when the magnetic contactor is installed between the inverter and motor, a large inrush current may flow, affecting the motor.

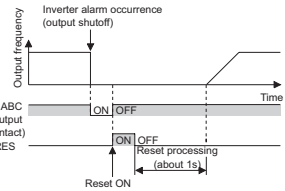
2.3.8 Failsafe of the system which uses the inverter

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

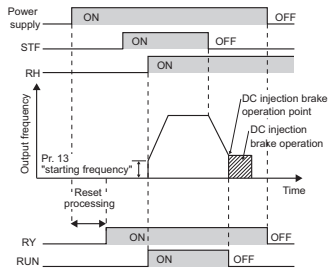
(1) Interlock method which uses the inverter status output signals
By combining the inverter status output signals to provide an interlock as shown below, an inverter alarm can be detected.

No	Interlock Method	Check Method	Used Signals	Refer to Page
1)	Inverter protective function operation	Operation check of an alarm contact Circuit error detection by negative logic	Alarm output signal (ABC signal)	173
2)	Inverter running status	Operation ready signal check	Operation ready signal (RY signal)	173
3)	Inverter running status	Logic check of the start signal and running signal	Start signal (STF signal, STR signal) Running signal (RUN signal)	16
4)	Inverter running status	Logic check of the start signal and output current	Start signal (STF signal, STR signal) Output current detection signal (Y12 signal)	16, 173

1) Check by the inverter alarm output signal
When the inverter protective function is activated to stop the inverter output, the alarm output signal (ABC signal) is output (ABC signal is assigned to terminal ABC in the initial setting).
Check that the inverter functions properly.



2) Checking the inverter operating status by the inverter operation ready completion signal
Operation ready signal (RY signal) is output when the inverter power is on and the inverter becomes operative.
Check if the RY signal is output after powering on the inverter.



3) Checking the inverter operating status by the start signal input to the inverter and inverter running signal.
The inverter running signal (RUN signal) is output when the inverter is running (RUN signal is assigned to terminal RUN in the initial setting).
Check if RUN signal is output when inputting the start signal to the inverter (forward signal is STF signal and reverse signal is STR signal). For logic check, note that RUN signal is output for the period from the inverter decelerates until output to the motor is stopped, configure a sequence considering the inverter deceleration time.

4) Checking the motor operating status by the start signal input to the inverter and inverter output current detection signal.
The output current detection signal (Y12 signal) is output when the inverter operates and currents flows in the motor. Check if Y12 signal is output when inputting the start signal to the inverter (forward signal is STF signal and reverse signal is STR signal). Note that the current level at which Y12 signal is output is set to 150% of the inverter rated current in the initial setting, it is necessary to adjust the level to around 20% using no load current of the motor as reference with Pr. 150 "output current detection level".
For logic check, as same as the inverter running signal (RUN signal), the inverter outputs for the period from the inverter decelerates until output to the motor is stopped, configure a sequence considering the inverter deceleration time.

Output Signal	Pr. 190 to Pr. 192 Setting
ABC	99
RY	11
RUN	0
Y12	12

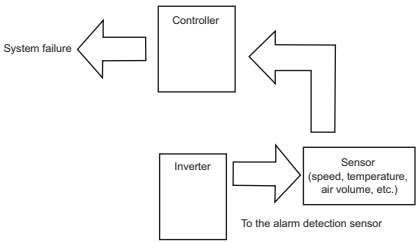
- When using various signals, assign functions to Pr. 190 to Pr. 192 (output terminal function selection) referring to the table on the left.

Note: Changing the terminal assignment using Pr. 190 to Pr. 192 (output terminal function selection) may affect the other functions. Make setting after confirming the function of each terminal.

(2) Backup method outside the inverter
Even if the interlock is provided by the inverter status signal, enough failsafe is not ensured depending on the failure status of the inverter itself. For example, even if the interlock is provided using the inverter alarm output signal, start signal and RUN signal output, there is a case where an alarm output signal is not output and RUN signal is kept output even if an inverter alarm occurs.
Provide a speed detector to detect the motor speed and current detector to detect the motor current and consider the backup system such as checking up as below according to the level of importance of the system.

1) Start signal and actual operation check
Check the motor running and motor current while the start signal is input to the inverter by comparing the start signal to the inverter and detected speed of the speed detector or detected current of the current detector. Note that the motor current runs as the motor is running for the period until the motor stops since the inverter starts decelerating even if the start signal turns off. For the logic check, configure a sequence considering the inverter deceleration time. In addition, it is recommended to check the three-phase current when using the current detector.

2) Command speed and actual operation check
Check if there is no gap between the actual speed and commanded speed by comparing the inverter speed command and detected speed of the speed detector.



2.3.9 Instructions for UL, cUL

(Standard to comply with: UL 508C, CSA C22.2 No. 14)

(1) Installation

The above types of inverter have been approved as products for use in enclosure and approval tests were conducted under the following conditions. For enclosure design, refer to these conditions so that the ambient temperature of the inverter is 50°C or less.

● **200V class, 100V class**

Inverter Type	Cabinet (enclosure) Size (Unit: mm)	Vent Hole Area	Cooling Fan
FR-E520 -3.7K	W H D 255×192×218	• 55% of both the side of the Cabinet • Width of each slit: 3.2mm • To be provided on each of the upper side areas.	Installed at the enclosure top to suck air from inside the enclosure to the outside. (Fan air flow: 2 × 0.59m^3/min or more)

● **400V class**

Design the enclosure so that the ambient temperature, humidity and ambience of the inverter will satisfy the above specifications. (Refer to page 233.)

Branch circuit protection

For installation in the United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes.

For installation in Canada, branch circuit protection must be provided in accordance with the Canada Electrical Code and any applicable provincial codes.

(2) Wiring of the power supply and motor

Screw the cables wired to the input (R, S, T) <L_1, L_2, L_3> and output (U, V, W) terminals and control circuit of the inverter to the specified tightening torque using UL-recognized, 75°C or higher rated copper wires and round crimping terminals. Crimp the crimping terminals with the crimping tool recommended by the terminal maker.

(3) Short circuit ratings

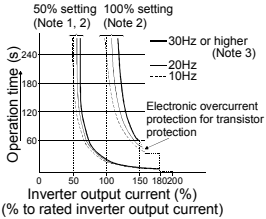
- **100V class**
  Suitable For Use in A Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 132 V Maximum.
- **200V class**
  Suitable For Use in A Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 264 V Maximum.
- **400V class**
  Suitable For Use in A Circuit Capable of Delivering Not More Than 100 kA rms Symmetrical Amperes, 528 V Maximum.

(4) Motor overload protection

When using the electronic thermal relay function as motor overload protection, set the rated motor current in Pr. 9 "electronic thermal O/L relay".

When connecting two or more motors to the inverter, install external thermal relays for individual motors

Reference: Motor overload protection characteristics



- Protection activating range
  Range on the right of characteristic curve
- Normal operating range
  Range on the left of characteristic curve

(Note 1) When you set the 50% value (current value) of the rated inverter output current.

(Note 2) The % value denotes the percentage of the current value to the rated inverter output current, not to the rated motor current.

(Note 3) This characteristic curve will be described even under operation of 6Hz or higher when you set the electronic overcurrent protection dedicated to the Mitsubishi constant-torque motor.

2.3.10 Instructions for compliance with the European Directive

(The products conforming to the Low Voltage Directive carry the CE mark.)

(1) EMC Directive

1) Our view of transistorized inverters for the EMC Directive

A transistorized inverter is a component designed for installation in a control box and for use with the other equipment to control the equipment/device.

Therefore, we understand that the EMC Directive does not apply directly to transistorized inverters. For this reason, we do not place the CE mark on the transistorized inverters. (The CE mark is placed on inverters in accordance with the Low Voltage Directive.) The European power drive manufacturers' organization (CEMEP) also holds this point of view.

2) Compliance

We understand that the transistorized inverters are not covered directly by the EMC Directive. However, the EMC Directive applies to machines/equipment into which transistorized inverters have been incorporated, and these machines and equipment must carry the CE marks. Hence, we prepared the technical information "EMC Installation Guidelines" (information number BCN-A21041-202) so that machines and equipment incorporating transistorized inverters may conform to the EMC Directive more easily.

3) Outline of installation method

Install an inverter using the following methods:

* Use the inverter with an European Standard-compliant noise filter.
* For wiring between the inverter and motor, use shielded cables or run them in a metal piping and earth (ground) the cables on the inverter and motor sides with the shortest possible distance.
* Insert a common mode filter and ferrite core into the power and control lines as required.

  Full information including the European Standard-compliant noise filter specifications are written in the technical information "EMC Installation Guidelines" (BCN-A21041-202). Please contact your sales representative.

(2) Low Voltage Directive

1) Our view of transistorized inverters for the Low Voltage Directive

Transistorized inverters are covered by the Low Voltage Directive (Standard to comply with: DIN VDE0160 (200V class), EN50178 (400V class, 100V class)).

2) Compliance

We have self-confirmed our inverters as products compliant to the Low Voltage Directive and place the CE mark on the inverters.

3) Outline of instructions

* In the 400V class inverters, the rated input voltage range is three-phase, 380V to 415V, 50Hz/60Hz.
* Connect the equipment to the earth (ground) securely. Do not use an earth (ground) leakage circuit breaker as an electric shock protector without connecting the equipment to the earth (ground).
* Wire the earth (ground) terminal independently. (Do not connect two or more cables to one terminal.)
* The wire size on pages 22 and 24 are shown for following conditions
  - Ambient Temp: 40°C maximum
  - Wire installation: On wall without ducts or conduits

  If conditions are different from above, select appropriate wire according to EN60204 ANNEX C TABLE 5.
* Use the moulded case circuit breaker and magnetic contactor which conform to the EN or IEC Standard.

  Design notice: Where residual-current-operated protective device (RCD) is used for protection in case of direct or indirect contact, only RCD of Type B is allowed on the supply side of this Electronic Equipment (EE). Otherwise another protective measure shall be applied such as separation of the EE from the environment by double or reinforced insulation or isolation of EE and supply system by a transformer. (Extract from EN51078)
* Use the inverter under the conditions of overvoltage category II and contamination level 2 or higher specified in IEC664.
  (a) To use the inverter under the conditions of overvoltage category II, put an insulated transformer or surge absorber which conform to the EN or IEC standard on the inverter input side.
  (b) To meet the contamination level 2, install the inverter in a control box protected against ingress of water, oil, carbon, dust, etc. (IP54 or higher).
* On the input and output of the inverter, use cables of the type and size set forth in EN60204 Appendix C.
* The operating capacity of the relay outputs (terminal symbols A, B, C) should be 30VDC, 0.3A.
* The terminals indicated as the input and output terminals for control circuit on page 16 are isolated safely from the main circuit.

Environment

	During operation	In storage	During transportation
Ambient Temperature	-10°C to +50°C	-20°C to +65°C	-20°C to +65°C
Ambient Humidity	90% RH or less	90% RH or less	90% RH or less
Maximum Altitude	1,000 m	1,000 m	10,000 m

Details are given in the technical information "Low Voltage Directive Conformance Guide" (BCN-A21041-203). Please contact your sales representative.

MEMO

CHAPTER 3
OPERATION/CONTROL

This chapter provides the basic "operation/control" for use of this product.
Always read this chapter before using the equipment.

3.1 Pre-Operation Information

3.1.1 Types of operation modes

The inverter can be operated in any of "PU operation mode", "external operation mode", "combined operation mode" and "communication operation mode". Prepare required instruments and parts according to the operation mode. For the way of changing the operation mode, refer to page 70.

(1) PU operation mode (factory setting, Pr. 79 "operation mode selection" = 1)

The inverter is operated from the operation panel or parameter unit.
Use Pr. 146 "frequency setting command selection" to choose the way to make frequency setting from the operation panel. For the Pr. 146 setting method, refer to page 71.

Pr. 146 = 0: Frequency setting using the built-in frequency setting potentiometer (factory setting)

Pr. 146 = 1: Digital frequency setting using (▲)/(▼) key

Preparation

- Operation unit.....Operation panel (equipped as standard) or parameter unit (FR-PU04)
- Connection cable.....To be prepared for use of the operation panel away from the inverter or for use of the parameter unit (FR-PU04). FR-CB2□□ (option)
- FR-E5P (option) .....To be prepared for use of the operation panel away from the inverter. It is available as a set of operation panel cover and connection cable junction adaptor.

(2) External operation mode (Pr. 79 "operation mode selection" = 2)

The inverter is operated using an external start signal and an external frequency setting signal.

Preparation

- Start signal .....Switch, relay, etc.
- Frequency setting signal..0 to 5V, 0 to 10V or 4 to 20mA DC signals or multiple speeds from a potentiometer or outside the inverter

Note: Operation cannot be started by the start signal alone. Both the start signal and frequency setting signal are required to run the inverter.

(3) Combined operation mode 1 (Pr. 79 "operation mode selection" = 3)

The start signal is an external signal.
The frequency setting signal is set using the operation panel or parameter unit.
Use Pr. 146 "frequency setting command selection" to choose the way to make frequency setting from the operation panel. For the Pr. 146 setting method, refer to page 71.

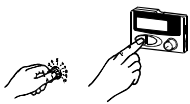
Pr. 146 = 0: Frequency setting using the built-in frequency setting potentiometer (factory setting)

Pr. 146 = 1: Digital frequency setting using (▲)/(▼) key

Preparation

- Start signal ..... Switch, relay, etc.
- Operation unit ..... Operation panel (equipped as standard) or parameter unit (FR-PU04)
- Connection cable ..... Refer to (1) PU operation mode.
- FR-E5P (option) ..... Refer to (1) PU operation mode.

(4) Combined operation mode 2 (Pr. 79 "operation mode selection" = 4)



The start signal is entered from the operation command key of the operation panel.
The frequency setting signal is set using the external frequency setting signal.

Preparation

- Frequency setting signal .. 0 to 5V, 0 to 10V or 4 to 20mA DC signals from an external potentiometer or from outside the inverter
- Operation unit ..... Operation panel (equipped as standard) or parameter unit (FR-PU04)
- Connection cable ..... Refer to (1) PU operation mode.
- FR-E5P (option) ..... Refer to (1) PU operation mode.

(5) Communication operation mode
(Pr. 79 "operation mode selection" = 0 or 1)

Communication operation can be performed by connecting a personal computer and the PU connector with the RS-485 communication cable. The inverter setup software (FR-SW□-SETUP-WE (or -WJ for Japanese Version)) is available as an FR-E500 inverter start-up support software package.

Preparation

- Connection cable..... Connector: RJ45 connector
  Cable: Cable conforming to EIA568
  (e.g. 10BASE-T cable)
- Personal computer ..... Refer to the instruction manual of the inverter setup software for hardware requirements of the inverter setup software.
- RS-485, RS-232C converter .... To be prepared when the communication port of the personal computer has RS-232C specifications.

3.1.2 Power on

Before switching power on, check the following.

● **Installation check**

Make sure that the inverter is installed correctly in a proper location. (Refer to page 14.)

● **Wiring check**

Make sure that the main and control circuits are wired correctly.
Make sure that the options and peripheral devices are selected and connected correctly. (Refer to page 16.)

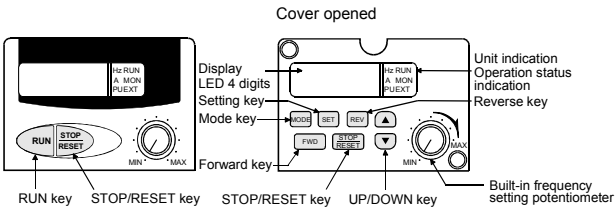
● **Switch power on.**

Power-on is complete if the operation panel LED shows correct data or the POWER lamp (lit only when the operation panel is removed) is lit and the ALARM lamp is off.

3.2 About the Operation Panel

With the operation panel, you can run the inverter, set the frequency, monitor the operation command display, set parameters, and display an error.

3.2.1 Names and functions of the operation panel



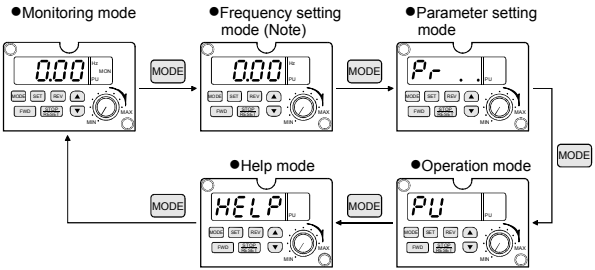
● **Key indication**

Key	Description
RUN key	Used to give a start rotation command.
Built-in frequency setting potentiometer	You can set a frequency on an analog basis.
MODE key	You can select the operation mode or setting mode.
SET key	You can determine the frequency and parameter setting.
▲/▼ key	• Used to increase or decrease the running frequency consecutively. Hold down this key to change the frequency. • Press this key in the setting mode to change the parameter setting consecutively.
FWD key	Used to give a forward rotation command.
REV key	Used to give a reverse rotation command.
STOP RESET key	• Used to stop operation. • Used to reset the inverter when its output is stopped by the activated protective function.

● **Unit indications, operating status indications**

Indication	Description
Hz	Lit to indicate frequency. (Flickers or lit when Pr.52 "operation panel/PU main display data selection" = "100". Refer to page 113.)
A	Lit to indicate the current.
RUN	Lit while the inverter is operating. Lit to indicate forward rotation, and flickers to indicate reverse rotation.
MON	Lit in the monitor display mode.
PU	Lit in the PU operation mode.
EXT	Lit in the external operation mode.

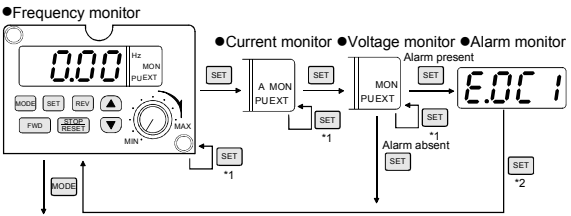
3.2.2 Monitor display is changed by pressing the MODE key



(Note)The frequency setting mode is displayed only in the PU operation mode.

3.2.3 Monitoring

- Operation command indications given while a monitor display is being provided EXT is lit to indicate external operation.
  PU is lit to indicate PU operation.
  Both EXT and PU are lit to indicate combined operation.
- The monitor display can also be changed during operation.

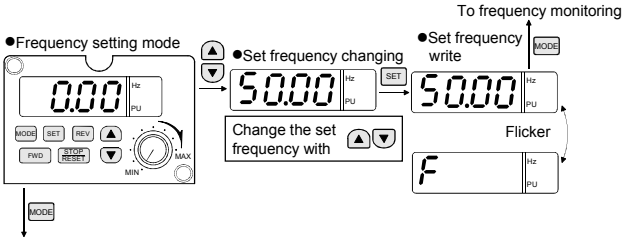


Note: 1. Hold down the SET key marked *1 for more than 1.5 s to change the current monitor to the power-on monitor.
2. Hold down the SET key marked *2 for more than 1.5 s to display the last four errors including the most recent one.
3. In the external operation mode, it shifts to the parameter setting mode.

3.2.4 Frequency setting

When the built-in frequency setting potentiometer is invalid (Pr. 146 = 1) in the PU operation mode, set the frequency value used for operation performed under the operation command given by the RUN key (FWD or REV key).
This mode is displayed only in PU operation.

- When the ▲/▼ key is used to make the frequency setting
  Set "1" (built-in frequency setting potentiometer invalid) in Pr. 146 "frequency setting command selection". (For the setting method, refer to page 71.)
  Change the set frequency with the ▲/▼ key.



3.2.5 Parameter setting method

With the exception of some parameters, parameter setting can be made when the PU operation mode is selected by the Pr. 79 setting.
(Also, as other to set method independently of the operation mode, you can set "2" in Pr. 77. Refer to page 132.)

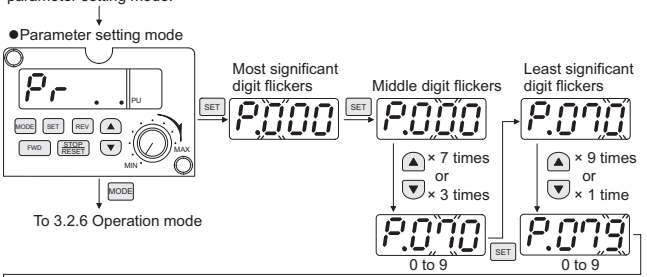
- A parameter value may either be set by updating its parameter number or setting the value digit-by-digit using the ▲/▼ key.
- To write the setting, change it and press the SET key for about 1.5 s.

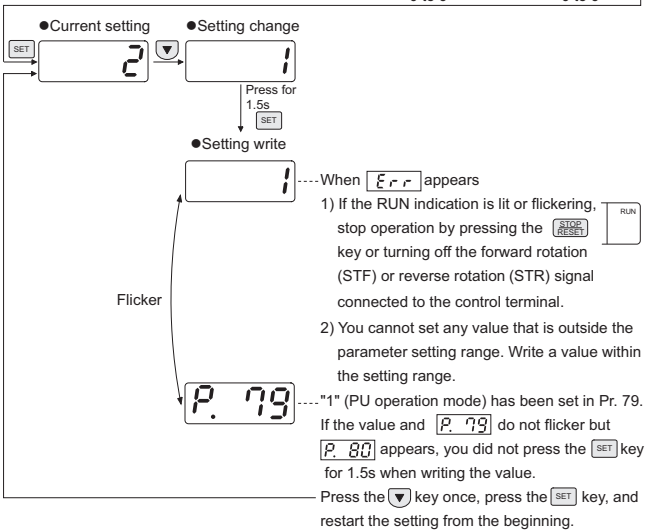
Note: If parameter write cannot be performed, refer to page 212.

(1) Example:To change the Pr. 79 "operation mode selection" setting from "2" (external operation mode) to "1" (PU operation mode)

(For details of Pr. 79, refer to page 133.)

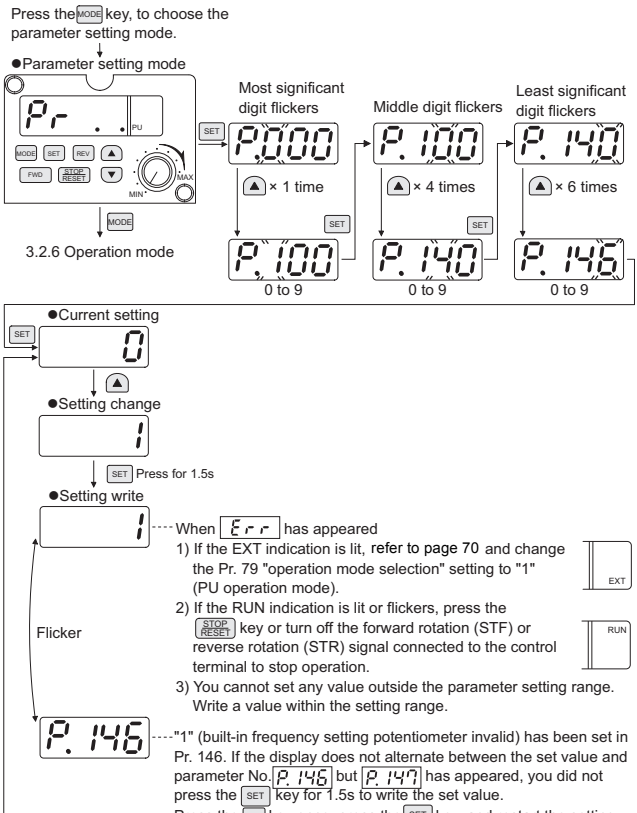
Press the MODE key, to choose the parameter setting mode.





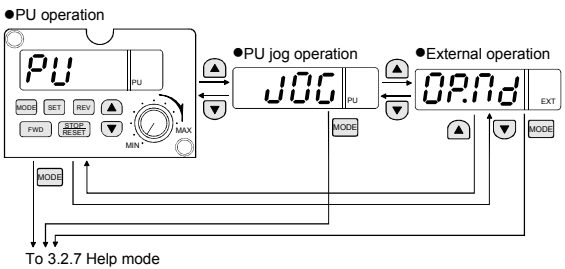
(2) When changing the Pr. 146 "frequency setting command selection" setting from "0" (built-in frequency setting potentiometer valid) to "1" (built-in frequency setting potentiometer invalid)

(For details of Pr. 146, refer to page 166.)



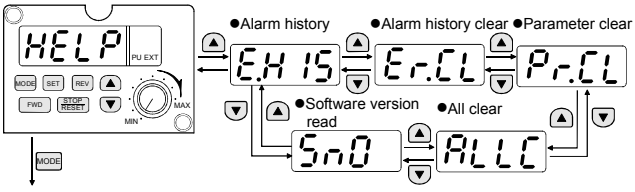
3.2.6 Operation mode

The operation mode change method which is shown below is only allowed when Pr. 79 "operation mode selection" is "0".



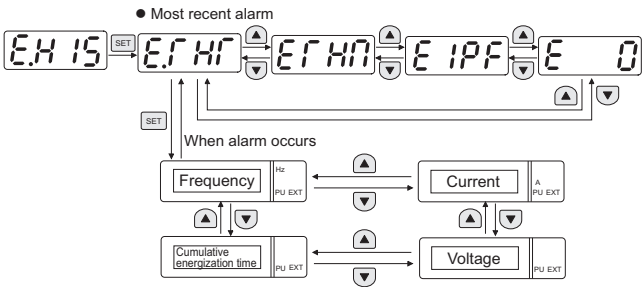
Note: If the operation mode cannot be changed, refer to page 212.

3.2.7 Help mode



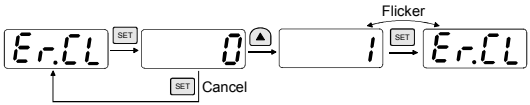
(1) Alarm history

Four past alarms can be displayed with the ▲/▼ key.
("." is appended to the most recent alarm.)
When no alarm exists, E._ _0 is displayed.



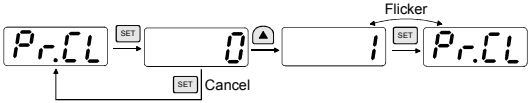
(2) Alarm history clear

Clears all alarm history.



(3) Parameter clear

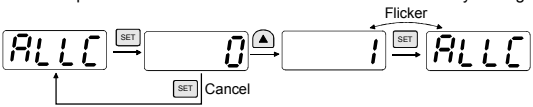
Initializes the parameter values to the factory settings. The calibration values are not initialized.
(Parameter values are not cleared by setting "1" in Pr. 77 "parameter write disable selection")



Note: The Pr. 75, Pr. 146, Pr. 180 to Pr. 183, Pr. 190 to Pr. 192, Pr. 900 to Pr. 905, Pr. 922 and Pr. 923 values are not initialized.

(4) All clear

Initializes the parameter values and calibration values to the factory settings.



Note: The Pr. 75 and Pr. 146 values are not initialized.

3.3 Operation

3.3.1 Pre-operation checks

Before starting operation, check the following:

- Safety
  Perform test operation after making sure that safety is ensured if the machine should become out of control.

- Machine
  Make sure that the machine is free of damage.

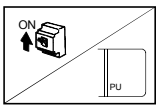
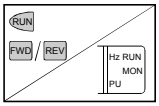
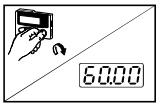
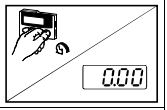
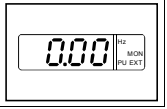
- Parameters
  Set the parameter values to match the operating machine (system) environment.

- Test operation
  Perform test operation and make sure that the machine operates safely under light load at a low frequency. After that, start operation.
  Since the Pr. 240 "Soft-PWM setting" value is factory-set to select Soft-PWM control, the tone is different from that in the conventional non-low acoustic noise mode, this is not a fault.

3.3.2 PU operation mode (Operation using the operation panel)

(1) Using the built-in frequency setting potentiometer for operation at 60Hz (Factory setting)

Operation command: RUN key or FWD / REV key
Frequency setting: built-in frequency setting potentiometer
Related parameters: Pr. 79 "operation mode selection", Pr. 146 "frequency setting command selection"

Step	Description	Image
1	Power on → Operation mode check In the factory setting, switching power on chooses the PU operation mode and lights up the [PU] indication. If the [PU] indication is not lit, refer to page 70 and set "1" in Pr. 79.	
2	Frequency setting potentiometer selection Refer to page 71 and set "0" (built-in frequency setting potentiometer) in Pr. 146 "frequency setting command selection". (Refer to page 166)	
3	Start Press the RUN key (or FWD or REV key) of the operation panel. The [RUN] indication is lit to indicate forward rotation, or flickers to indicate reverse rotation.	
4	Acceleration → Constant speed Slowly turn the potentiometer fully clockwise. The frequency shown on the display increases gradually to 60.00Hz.	
5	Deceleration Slowly turn the potentiometer fully counterclockwise. The frequency shown on the display decreases gradually to 0.00Hz. The motor stops running.	
6	Stop Press the STOP/RESET key. The [RUN] indication goes off.	

<Reference> The running frequency available by turning the potentiometer fully counterclockwise or fully clockwise can be changed using Pr. 922 "built-in frequency setting potentiometer bias" or Pr. 923 "built-in frequency setting potentiometer gain". (Refer to page 186.)

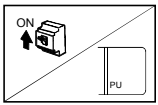
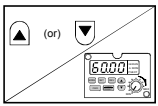
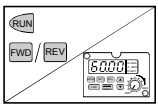
(2) Using the digital frequency setting for operation at 60Hz

By repeating step 2 below during motor run, speed can be varied.

Operation command: RUN key or FWD / REV key

Frequency setting: ▲ / ▼ key

Related parameters: Pr. 79 "operation mode selection", Pr. 146 "frequency setting command selection"

Step	Description	Image
1	Power on → Operation mode check In the factory setting, switching power on chooses the PU operation mode and shows [PU]. If the [PU] indication is not lit, refer to page 70 and set "1" in Pr. 79.	
2	Running frequency setting Set the running frequency to 60Hz. 1) Refer to page 71 and set "1" (built-in frequency setting potentiometer invalid) in Pr. 146 "frequency setting command selection". 2) Refer to page 68 and choose the frequency setting mode using the MODE key. 3) Refer to page 69, change the setting using the ▲ / ▼ key, and press the SET key to write the setting.	
3	Start Press the RUN key (or FWD / REV key). The monitoring mode is automatically selected and the output frequency is displayed. The [RUN] indication is lit to indicate forward rotation, or flickers to indicate reverse rotation.	
4	Stop Press the STOP RESET key. The motor is decelerated to a stop. The [RUN] indication goes off.	

(3) PU jog operation

Hold down the RUN (or FWD or REV) key to perform operation, and release it to stop.

1) Set Pr. 15 "jog frequency" and Pr. 16 "jog acceleration/deceleration time".
2) Select the PU jog operation mode. (Refer to page 72.)
3) Hold down the RUN (or FWD or REV) key to perform operation.
   (If the motor remains stopped, check Pr. 13 "starting frequency". The motor will not start if its setting is lower than the starting frequency.

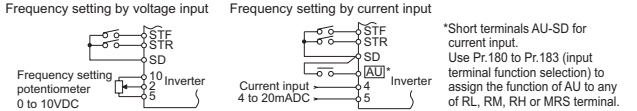
3.3.3 External operation mode (Operation using the external frequency setting potentiometer and external start signal)

(1) Operation at 60Hz

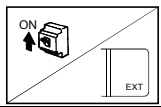
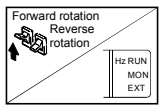
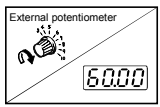
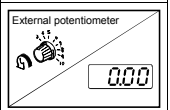
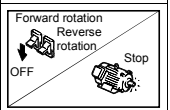
Operation command: Externally connected start signal

Frequency setting : Externally connected frequency setting potentiometer

<Connection diagram>



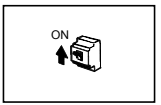
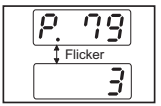
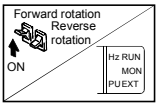
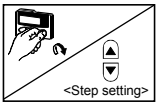
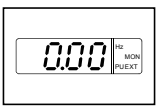
Refer to page 18 for details of each terminal.

Step	Description	Image
1	Power on → Operation mode check Switch power on, refer to page 70, and set "2" in Pr. 79 "operation mode selection". The [EXT] indication is lit.	
2	Start Set the start switch (STF or STR) to ON. The [RUN] indication is lit to indicate forward rotation, or flickers to indicate reverse rotation. Note: The motor does not start if both the forward and reverse rotation switches are turned on. If both switches are turned on during operation, the motor decelerates to a stop.	
3	Acceleration → Constant speed Slowly turn the potentiometer connected across terminals 2-5 (4-5) (frequency setting potentiometer) fully clockwise. The frequency shown on the display increases gradually to 60.00Hz.	
4	Deceleration Slowly turn the potentiometer connected across terminals 2-5 (4-5) (frequency setting potentiometer) fully counterclockwise. The frequency shown on the display decreases gradually to 0.00Hz. The motor stops running.	
5	Stop Turn off the start switch (STF or STR).	

<Reference> If other frequency is required at fully clockwise position, change Pr. 38 "frequency at 5V (10V)", Pr.39 "frequency at 20mA input" setting. (Refer to page 110.)

3.3.4 Combined operation mode 1 (Operation using both external start signal and operation panel)

When the start signal is provided externally (switch, relay, etc.) and the running frequency is set from the operation panel (Pr. 79 = 3).
The external frequency setting signal and PU's forward rotation, reverse rotation and stop keys are not accepted. (Note)
Operation command: externally connected start signal
Frequency setting: Built-in frequency setting potentiometer or (▲)/(▼) key, or multi-speed command (multi-speed command has priority) (Refer to page 95)
Related parameter: Pr. 146 "frequency setting command selection"

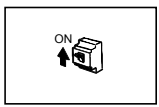
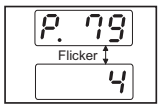
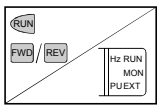
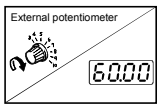
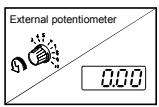
Step	Description	Image
1	Power on Switch power on.	
2	Operation mode selection Refer to page 70 and set "3" in Pr. 79 "operation mode selection". The [PU] and [EXT] indications are lit.	
3	Start Turn on the start switch (STF or STR). Note: The motor does not start if both the forward and reverse rotation switches are turned on. If both switches are turned on during operation, the motor decelerates to a stop. The [RUN] indication is lit to indicate forward rotation, or flickers to indicate reverse rotation.	
4	Running frequency setting Slowly turn the built-in frequency setting potentiometer fully clockwise or set the running frequency to 60.00Hz with the (▲)/(▼) key. Note: Use the built-in frequency setting potentiometer or (▲)/(▼) key to make frequency setting. Select the operation using Pr. 146 "frequency setting command selection". Pr. 146 = "0" (Built-in frequency setting potentiometer valid) Pr. 146 = "1" (Built-in frequency setting potentiometer invalid) (Refer to page 71)	
5	Stop Turn off the start switch (STF or STR). The motor stops. The [RUN] indication goes off.	

Note: The STOP/RESET key is made valid if any of "14" to "17" is set in Pr. 75 "PU stop selection".

3.3.5 Combined operation mode 2

When the running frequency is set from a potentiometer connected across terminals 2-5 (frequency setting potentiometer) and the start signal is provided by the RUN key or FWD/REV key of the operation panel. (Pr.79 = 4)

Operation command: RUN key (or FWD/REV key) of the operation panel
Frequency setting: Externally connected frequency setting potentiometer or multi-speed command (multi-speed command has priority) (Refer to page 95).

Step	Description	Image
1	Power on Switch power on.	
2	Operation mode Refer to page 70 and set "4" in Pr. 79 "operation mode selection". The [PU] and [EXT] indications are lit.	
3	Start Press the RUN key (or FWD / REV key) of the operation panel. The [RUN] indication is lit to indicate forward rotation, or flickers to indicate reverse rotation.	
4	Acceleration → Constant speed Slowly turn the potentiometer connected across terminals 2-5 (frequency setting potentiometer) fully clockwise. The frequency shown on the display increases gradually to 60.00Hz.	
5	Deceleration Slowly turn the potentiometer connected across terminals 2-5 (frequency setting potentiometer) fully counterclockwise. The frequency shown on the display decreases gradually to 0.00Hz. The motor stops running.	
6	Stop Press the STOP/RESET key. The operation command indication RUN goes off.	

<Reference> If other frequency is required at fully clockwise position, change Pr. 38 "frequency at 5V (10V) " setting. (Refer to page 110.)

MEMO

CHAPTER4 PARAMETERS

This chapter explains the "parameters" of this product.
With the factory settings, the inverter is designed to perform simple variable-speed operation. Set necessary parameter values according to the load and operating specifications.
Always read the instructions before using the equipment.

Note: By making parameter setting, you can change the functions of contact input terminals RL, RM, RH, MRS, open collector output terminals RUN, FU, and contact output terminals A, B, C. Therefore, signal names corresponding to the functions are used in the description of this chapter (except in the wiring examples). Note that they are not terminal names.

REMARKS

Do not use the copy/verify function between this inverter and another type (CC-Link type FR-E520-KN, DeviceNet type FR-E520-KND) inverter.

4.1 Parameter List

4.1.1 Parameter list

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Basic functions	0	Torque boost (Note 1)	0 to 30%	0.1%	6%/4% (Note 10)	92	
	1	Maximum frequency	0 to 120Hz	0.01Hz (Note 3)	120Hz	93	
	2	Minimum frequency	0 to 120Hz	0.01Hz (Note 3)	0Hz	93	
	3	Base frequency (Note 1)	0 to 400Hz	0.01Hz (Note 3)	60Hz	94	
	4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz (Note 3)	60Hz	95	
	5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz (Note 3)	30Hz	95	
	6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz (Note 3)	10Hz	95	
	7	Acceleration time	0 to 3600s/ 0 to 360s	0.1s/0.01s	5s/10s (Note 4)	96	
	8	Deceleration time	0 to 3600s/ 0 to 360s	0.1s/0.01s	5s/10s (Note 4)	96	
	9	Electronic thermal O/L relay	0 to 500A	0.01A	Rated current (Note 5)	98	
Standard operation functions	10	DC injection brake operation frequency	0 to 120Hz	0.01Hz (Note 3)	3Hz	99	
	11	DC injection brake operation time	0 to 10s	0.1s	0.5s	99	
	12	DC injection brake voltage	0 to 30%	0.1%	6%	99	
	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	100	
	14	Load pattern selection (Note 1)	0 to 3	1	0	101	
	15	Jog frequency	0 to 400Hz	0.01Hz (Note 3)	5Hz	102	
	16	Jog acceleration/ deceleration time	0 to 3600s/ 0 to 360s	0.1s/ 0.01s	0.5s	102	
	18	High-speed maximum frequency	120 to 400Hz	0.01Hz (Note 3)	120Hz	93	
	19	Base frequency voltage (Note 1)	0 to 1000V, 8888, 9999	0.1V	9999	94	
	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz (Note 3)	60Hz	96	
	21	Acceleration/deceleration time increments	0, 1	1	0	96	
	22	Stall prevention operation level	0 to 200%	0.1%	150%	103	
	23	Stall prevention operation level compensation factor at double speed (Note 6)	0 to 200%, 9999	0.1%	9999	103	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Standard operation functions	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	29	Acceleration/deceleration pattern	0, 1, 2	1	0	106	
	30	Regenerative function selection	0, 1	1	0	107	
	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	108	
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	108	
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	108	
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	108	
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	108	
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	108	
	37	Speed display	0, 0.01 to 9998	0.001	0	109	
	38	Frequency at 5V (10V) input	1 to 400Hz	0.01Hz (Note 3)	60Hz (Note 2)	110	
	39	Frequency at 20mA input	1 to 400Hz	0.01Hz (Note 3)	60Hz (Note 2)	110	
Output terminal functions	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	111	
	42	Output frequency detection	0 to 400Hz	0.01Hz (Note 3)	6Hz	112	
	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	112	
Second functions	44	Second acceleration/ deceleration time	0 to 3600s /0 to 360s	0.1s/0.01s	5s/10s (Note 11)	96	
	45	Second deceleration time	0 to 3600s /0 to 360s, 9999	0.1s/0.01s	9999	96	
	46	Second torque boost (Note 1)	0 to 30%, 9999	0.1%	9999	92	
	47	Second V/F (base frequency) (Note 1)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	94	
	48	Second electronic thermal O/L relay	0 to 500A, 9999	0.01A	9999	98	
Display functions	52	Operation panel/PU main display data selection	0, 23, 100	1	0	113	
	54	FM terminal function selection	0, 1, 2	1	0	113	
	55	Frequency monitoring reference	0 to 400Hz	0.01Hz (Note 3)	60Hz	115	
	56	Current monitoring reference	0 to 500A	0.01A	Rated current	115	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Automatic restart functions	57	Restart coasting time	0 to 5s, 9999	0.1s	9999	116	
	58	Restart cushion time	0 to 60s	0.1s	1.0s	116	
Additional function	59	Remote setting function selection	0, 1, 2	1	0	118	
Operation selection functions	60	Shortest acceleration/ deceleration mode	0, 1, 2, 11, 12	1	0	121	
	61	Reference current	0 to 500A, 9999	0.01A	9999	121	
	62	Reference current for acceleration	0 to 200%, 9999	1%	9999	121	
	63	Reference current for deceleration	0 to 200%, 9999	1%	9999	121	
	65	Retry selection	0, 1, 2, 3	1	0	123	
	66	Stall prevention operation level reduction starting frequency (Note 6)	0 to 400Hz	0.01Hz (Note 3)	60Hz	103	
	67	Number of retries at alarm occurrence	0 to 10, 101 to 110	1	0	123	
	68	Retry waiting time	0.1 to 360s	0.1s	1s	123	
	69	Retry count display erasure	0	1	0	123	
	70	Special regenerative brake duty	0 to 30%	0.1%	0%	107	
	71	Applied motor (Note 6)	0, 1, 3, 5, 6, 13, 15, 16, 23, 100, 101, 103, 105, 106, 113, 115, 116, 123,	1	0	125	
	72	PWM frequency selection	0 to 15	1	1	105	
	73	0-5V/0-10V selection	0, 1	1	0	129	
	74	Filter time constant	0 to 8	1	1	129	
	75	Reset selection/ disconnected PU detection/ PU stop selection	0 to 3, 14 to 17	1	14	130	
	77	Parameter write disable selection	0, 1, 2	1	0	132	
	78	Reverse rotation prevention selection	0, 1, 2	1	0	133	
	79	Operation mode selection (Note 6)	0 to 4, 6 to 8	1	1	133	
General-purpose magnetic flux vector control	80	Motor capacity (Note 6)	0.1 to 7.5kW, 9999 (Note 8)	0.01kW	9999	137	
	82	Motor excitation current	0 to 500A, 9999	0.01A	9999	138	
	83	Rated motor voltage (Note 6)	0 to 1000V	0.1V	200V/ 400V	138	
	84	Rated motor frequency (Note 6)	50 to 120Hz	0.01Hz (Note 3)	60Hz	138	
	90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999	138	
	96	Auto-tuning setting/status (Note 6)	0, 1	1	0	138	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Communication functions	117	Communication station number	0 to 31	1	0	144	
	118	Communication speed	48, 96, 192	1	192	144	
	119	Stop bit length	0, 1 (data length 8) 10, 11 (data length 7)	1	1	144	
	120	Parity check presence/absence	0, 1, 2	1	2	144	
	121	Number of communication retries	0 to 10, 9999	1	1	144	
	122	Communication check time interval	0, 0.1 to 999.8s, 9999	0.1s	0	144	
	123	Waiting time setting	0 to 150ms, 9999	1	9999	144	
	124	CR/LF selection	0, 1, 2	1	1	144	
PID control	128	PID action selection	0, 20, 21, 50,51,60,61	1	0	157	
	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	157	
	130	PID integral time	0.1 to 3600s, 9999	0.1s	1s	157	
	131	Upper limit	0 to 100%, 9999	0.1%	9999	157	
	132	Lower limit	0 to 100%, 9999	0.1%	9999	157	
	133	PID action set point for PU operation	0 to 100%	0.01%	0%	157	
	134	PID differential time	0.01 to 10.00s, 9999	0.01s	9999	157	
Additional function	145	Parameter for option (FR-PU04).					
	146	Frequency setting command selection	0, 1, 9999	1	0	166	
Current detection	150	Output current detection level	0 to 200%	0.1%	150%	167	
	151	Output current detection period	0 to 10s	0.1s	0	167	
	152	Zero current detection level	0 to 200.0%	0.1%	5.0%	168	
	153	Zero current detection period	0.05 to 1s	0.01s	0.5s	168	
Sub function	156	Stall prevention operation selection	0 to 31,100	1	0	103	
Additional function	160	User group read selection	0, 1, 10, 11	1	0	169	
	168	Parameters set by manufacturer. Do not set.					
	169						
Initial monitor	171	Actual operation hour meter clear	0	———	0	171	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
User functions	173	User group 1 registration	0 to 999	1	0	169	
	174	User group 1 deletion	0 to 999, 9999	1	0	169	
	175	User group 2 registration	0 to 999	1	0	169	
	176	User group 2 deletion	0 to 999, 9999	1	0	169	
Terminal assignment functions	180	RL terminal function selection (Note 6)	0 to 8, 16, 18	1	0	171	
	181	RM terminal function selection (Note 6)	0 to 8, 16, 18	1	1	171	
	182	RH terminal function selection (Note 6)	0 to 8, 16, 18	1	2	171	
	183	MRS terminal function selection (Note 6)	0 to 8, 16, 18	1	6	171	
	190	RUN terminal function selection (Note 6)	0 to 99	1	0	173	
	191	FU terminal function selection (Note 6)	0 to 99	1	4	173	
	192	A, B, C terminal function selection (Note 6)	0 to 99	1	99	173	
Multi-speed operation	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	236	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	237	Multi-speed setting (speed 13)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	238	Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
	239	Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	95	
Sub functions	240	Soft-PWM setting	0, 1, 10, 11 (Note 12)	1	1	105	
	244	Cooling fan operation selection	0, 1	1	0	174	
	245	Rated motor slip	0 to 50%, 9999	0.01%	9999	175	
	246	Slip compensation response time	0.01 to 10s	0.01s	0.5s	175	
	247	Constant power range slip compensation selection	0, 9999	1	9999	175	
	249	Earth (ground) fault detection at start (Note 9)	0, 1	1	0	176	
Stop selection function	250	Stop selection	0 to 100s, 1000 to 1100s, 8888, 9999	1s	9999	177	

Function	Parameter Number	Name	Setting Range		Minimum Setting Increments	Factory Setting		Refer To:	Customer Setting
Additional function	251	Output phase loss protection selection	0, 1		1	1		178	
	342	E^2PROM write selection	0, 1		1	0		144	
Capacitor life	503	Capacitor life timer (Note 9)	—		1 (100h)	0		179	
	504	Capacitor life alarm output set time (Note 9)	0 to 9998, (9999)		1 (100h)	500 (50000h)		179	
Current average value monitor	555	Current average time	0.1 to 1.0s		0.1s	1s		180	
	556	Data output mask time	0.0 to 20.0s		0.1s	0s		180	
	557	Current average value monitor signal output reference current	0.1 to 999A		0.01A	Rated inverter current		180	
Calibration functions	900	FM terminal calibration	——		——	——		184	
	902	Frequency setting voltage bias	0 to 10V	0 to 60Hz	0.01Hz	0V	0Hz	186	
	903	Frequency setting voltage gain	0 to 10V	1 to 400Hz	0.01Hz	5V	60 Hz	186	
	904	Frequency setting current bias	0 to 20mA	0 to 60Hz	0.01Hz	4 mA	0Hz	186	
	905	Frequency setting current gain	0 to 20mA	1 to 400Hz	0.01Hz	20 mA	60 Hz	186	
	922	Built-in frequency setting potentiometer bias	0 to 5V	0 to 60Hz	0.01Hz	0V	0Hz	186	
	923	Built-in frequency setting potentiometer gain	0 to 5V	1 to 400Hz	0.01Hz	5V	60 Hz	186	
	990	Parameter for options (FR-PU04).							
	991								

Note:
1. Indicates the parameter of which setting is ignored when the general-purpose magnetic flux vector control mode is selected.
2. Since calibration is made before shipment from the factory, the settings differ slightly between inverters. The inverter is preset to provide a frequency slightly higher than 60Hz.
3. When the operation panel is used and the setting is 100Hz or more, the setting increments are 0.1Hz.
   The setting increments are 0.01Hz when operating in the communication mode.
4. The setting varies according to the inverter capacity: (0.1K to 3.7K)/(5.5K to 7.5K).
5. The 0.1K to 0.75K are set to 85% of the rated inverter current.
6. If "2" is set in Pr. 77 (parameter write disable selection), the setting cannot be changed during operation.
7. The shaded parameters allow their settings to be changed during operation if "0" (factory setting) has been set in Pr. 77 (parameter write disable selection). (However, the Pr. 72 and Pr. 240 values may be changed during PU operation only.)
8. The Pr. 80 setting range changes with the inverter class: 0.2kW to 7.5kW, 9999 for the 400V class.
9. Pr. 249, Pr. 503, Pr. 504 can be set for the 200V/100V class only.
10. The factory setting of Pr. 0 changes with the inverter capacity: 4% for the FR-E540-5.5K, 7.5K.
11. For the FR-E540-5.5K and 7.5K, the factory setting is 10s.
12. The setting values "10, 11" can be set for the 400V class only.

4.1.2 List of parameters classified by purpose of use

Set parameters according to the operating conditions. The following list indicates purpose of use and corresponding parameters.

Purpose of Use		Parameter Numbers
		Parameter numbers which must be set
Related to operation	Operation mode selection	Pr. 79, Pr. 146
	Acceleration/deceleration time/pattern adjustment	Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 29
	Selection of output characteristics optimum for load characteristics	Pr. 3, Pr. 14, Pr. 19
	Output frequency restriction (limit)	Pr. 1, Pr. 2, Pr. 18
	Operation over 60Hz	Pr. 1, Pr. 18, Pr. 38, Pr. 39, Pr. 903, Pr. 905, Pr. 923
	Adjustment of frequency setting signals and outputs	Pr. 38, Pr. 39, Pr. 73, Pr. 902 to Pr. 905, Pr. 922, Pr. 923
	Motor output torque adjustment	Pr. 0, Pr. 80
	Brake operation adjustment	Pr. 10, Pr. 11, Pr. 12
	Multi-speed operation	Pr. 1, Pr. 2, Pr. 4, Pr. 5, Pr. 6, Pr. 15, Pr. 24, Pr. 25, Pr. 26, Pr. 27, Pr. 232, Pr. 233, Pr. 234, Pr. 235, Pr. 236, Pr. 237, Pr. 238, Pr. 239
	Jog operation	Pr. 15, Pr. 16
	Frequency jump operation	Pr. 31, Pr. 32, Pr. 33, Pr. 34, Pr. 35, Pr. 36
	Automatic restart operation after instantaneous power failure	Pr. 57, Pr. 58
	Optimum acceleration/deceleration within continuous rated range	Pr. 60
	Slip compensation setting	Pr. 245 to Pr. 247
	Output stop method selection	Pr. 250
	Setting of output characteristics matching the motor	Pr. 3, Pr. 19, Pr. 71
	Stall prevention of motor, lift operation	Pr. 156
Related to application operation	General-purpose magnetic flux vector control operation	Pr. 80
	Electromagnetic brake operation timing	Pr. 42, Pr. 190 to Pr. 192
	Offline auto tuning setting	Pr. 82 to Pr. 84, Pr. 90, Pr. 96
	Sub-motor operation	Pr. 0, Pr. 3, Pr. 7, Pr. 8, Pr. 9, Pr. 44, Pr. 45, Pr. 46, Pr. 47, Pr. 48
	Regenerative function selection	Pr. 30, Pr. 70
	Operation in communication with personal computer	Pr. 117 to Pr. 124, Pr. 342
	Operation under PID control	Pr. 73, Pr. 79, Pr. 128 to Pr. 134, Pr. 180 to Pr. 183, Pr. 190 to Pr. 192
	Noise reduction	Pr. 72, Pr. 240

Purpose of Use		Parameter Numbers
		Parameter numbers which must be set
Related to monitoring	Frequency meter calibration	Pr. 54, Pr. 55, Pr. 56, Pr. 900
	Display of monitor on operation panel or parameter unit (FR-PU04)	Pr. 54, Pr. 55, Pr. 56, Pr. 900
	Display of speed, etc.	Pr. 37, Pr. 52
	Clearing of inverter's actual operation time	Pr. 171
Related to incorrect operation prevention	Function write prevention	Pr. 77
	Reverse rotation prevention	Pr. 78
	Parameter grouping	Pr. 160, Pr. 173 to Pr. 176
	Current detection	Pr. 150 to Pr. 153, Pr. 190 to Pr. 192
	Motor stall prevention	Pr. 22, Pr. 23, Pr. 66, Pr. 156
Others	Input terminal function assignment	Pr. 180 to Pr. 183
	Output terminal function assignment	Pr. 190 to Pr. 192
	Increased cooling fan life	Pr. 244
	Motor protection from overheat	Pr. 9, Pr. 71
	Automatic restart operation at alarm stop	Pr. 65, Pr. 67, Pr. 68, Pr. 69
	Earth (ground) fault overcurrent protection setting	Pr. 249
	Inverter reset selection	Pr. 75
	Output phase loss protection selection	Pr. 251
	To determine the replacement time of capacitor	Pr. 503, Pr. 504

4.1.3 Parameters recommended to be set by the user

We recommend the following parameters to be set by the user.
Set them according to the operation specifications, load, etc.

Parameter Number	Name	Application
1	Maximum frequency	Used to set the maximum and minimum output frequencies.
2	Minimum frequency	
7	Acceleration time	Used to set the acceleration and deceleration times.
8	Deceleration time	
9	Electronic thermal O/L relay	Used to set the current of the electronic overcurrent protection to protect the motor from overheat.
14	Load pattern selection	Used to select the optimum output characteristics which match the application and load characteristics.
71	Applied motor	Used to set the thermal characteristics of the electronic overcurrent protection according to the motor used.
73	0-5V/0-10V selection	Used to select the specifications of the frequency setting signal entered across terminal 2-5 to perform operation with the voltage input signal.
146	Frequency setting command selection	Select whether the output frequency setting is the setting using the built-in frequency setting potentiometer or the digital setting using the ▲/▼ key.
156	Stall prevention operation selection	In vertical lift applications, make setting so that the fast-response current limit is not activated. When fast-response current limit is activated, torque may not be produced, causing a gravity drop.
900	FM terminal calibration	Used to calibrate the meter connected across terminals FM-SD.
902	Frequency setting voltage bias	Used to set the magnitude (slope) of the output frequency relative to the frequency setting signal (0 to 5V, 0 to 10V or 4 to 20mA DC) as desired.
903	Frequency setting voltage gain	
904	Frequency setting current bias	
905	Frequency setting current gain	
922	Built-in frequency setting potentiometer bias	You can set the magnitude (slope) of the output frequency relative to the built-in frequency setting potentiometer of the operation panel as desired.
923	Built-in frequency setting potentiometer gain	

4.2 Parameter Function Details

4.2.1 Torque boost (Pr. 0, Pr. 46)

Pr. 0 "torque boost"

Pr. 46 "second torque boost"

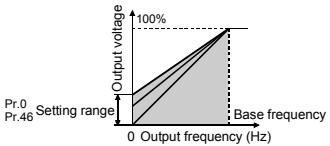
Related parameters

Pr. 3 "base frequency"
Pr. 19 "base frequency voltage"
Pr. 71 "applied motor"
Pr. 80 "motor capacity"
Pr. 180 to Pr. 183 (input terminal function selection)

Increase the setting value when the distance between the inverter and motor is long or when the motor torque in the low speed range is insufficient, etc.

- Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque.
- You can select either of the two starting torque boosts by RT terminal switching.

Parameter Number	Factory Setting	Setting Range	Remarks
0	6%/4% (Note)	0 to 30%	(Note) FR-E510W-0.1K to 0.75K: 6% FR-E520 (S)-0.1K to 7.5K: 6% FR-E540-0.4K to 3.7K: 6% FR-E540-5.5K, 7.5K : 4%
46	9999	0 to 30%, 9999	9999: Function invalid



<Setting>

- Assuming that the base frequency voltage is 100%, set the 0Hz voltage in %.
- Pr. 46 "second torque boost" is valid when the RT signal is on. (Note 3)
- When using the inverter-dedicated motor (constant-torque motor), change the setting as indicated below:
  FR-E520 (S)-0.1K to 0.75K, FR-E540-0.4K, 0.75K, FR-E510W-0.1K to 0.75K.....6%
  FR-E520-1.5K to 7.5K, FR-E540-1.5K to 3.7K..... 4%
  FR-E540-5.5K, 7.5K.....3%
  If you leave the factory setting as it is and change the Pr. 71 value to the setting for use of the constant-torque motor, the Pr. 0 setting changes to the above value.

Note: 1. This parameter setting is ignored when the general-purpose magnetic flux vector control mode has been selected.
2. A large setting may result in an overheated motor or overcurrent trip. The guideline for the largest value for this parameter is about 10%.
3. The RT signal serves as the second function selection signal and makes the other second functions valid. Refer to page 171 for Pr. 180 to Pr. 183 (input terminal function selection).

4.2.2 Output frequency range (Pr. 1, Pr. 2, Pr. 18)

Pr. 1 "maximum frequency"

Pr. 2 "minimum frequency"

Pr. 18 "high-speed maximum frequency"

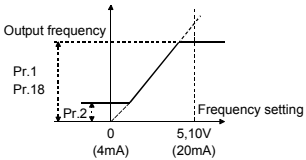
Used to clamp the upper and lower limits of the output frequency. Used for high-speed operation at or over 120Hz.

Related parameters

Pr. 13 "starting frequency"
Pr. 38 "frequency at 5V (10V) input"
Pr. 39 "frequency at 20mA input"
Pr. 79 "operation mode selection"
Pr. 146 "frequency setting command selection"

- Can be used to set the upper and lower limits of motor speed.

Parameter Number	Factory Setting	Setting Range
1	120Hz	0 to 120Hz
2	0Hz	0 to 120Hz
18	120Hz	120 to 400Hz



<Setting>

- Use Pr. 1 to set the upper limit of the output frequency. If the frequency of the frequency command entered is higher than the setting, the output frequency is clamped at the maximum frequency.
- To perform operation over 120Hz, set the upper limit of the output frequency in Pr. 18. (When the Pr. 18 value is set, Pr. 1 automatically changes to the frequency in Pr. 18. Also, when the Pr. 1 value is set, Pr. 18 automatically changes to the frequency in Pr. 1.)
- Use Pr. 2 to set the lower limit of the output frequency.

Note: When the potentiometer (frequency setting potentiometer) connected across terminals 2-5 is used for operation beyond 60Hz, change the value of Pr. 38 (or Pr. 39 for use of the potentiometer connected across terminals 4-5). Alternatively, when the built-in frequency setting potentiometer (Pr.146 = 0) is used for operation beyond 60Hz, change the Pr. 923 value.
Operation over 60Hz cannot be performed by merely changing the settings of Pr. 1 and Pr. 18.

⚠ CAUTION

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

4.2.3 Base frequency, base frequency voltage (Pr. 3, Pr. 19, Pr. 47)

Pr. 3 "base frequency"

Pr. 19 "base frequency voltage"

Pr. 47 "second V/F(base frequency)

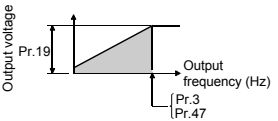
Related parameters
Pr. 14 "load pattern selection"
Pr. 71 "applied motor"
Pr. 80 "motor capacity"
Pr. 83 "rated motor voltage"
Pr. 180 to Pr. 183 (input terminal function selection)

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

- When running a standard motor, generally set the rated motor frequency. When running the motor using the electronic bypass, set the base frequency to the same value as the power supply frequency.
- If the frequency given on the motor rating plate is "50Hz" only, always set to "50Hz". Leaving it as "60Hz" may make the voltage too low and the torque less, resulting in overload tripping. Care must be taken especially when Pr. 14 "load pattern selection = 1.

Parameter Number	Factory Setting	Setting Range	Remarks
3	60Hz	0 to 400Hz	
19	9999	0 to 1000V, 8888, 9999	8888: 95% of power supply voltage *1 9999: Same as power supply voltage *2
47	9999	0 to 400Hz, 9999	9999: Function invalid

*1: The base frequency voltage of the FR-E510W-0.1K to 0.75K is 1.9 times larger than the power supply voltage.
*2: The base frequency voltage of the FR-E510W-0.1K to 0.75K is 2 times larger than the power supply voltage.



<Setting>

- Use Pr. 3 and Pr. 47 to set the base frequency (rated motor frequency). Two base frequencies can be set and the required frequency can be selected from them.
- Pr. 47 "second V/F (base frequency)" is valid when the RT signal is on. (Note 3)
- Use Pr. 19 to set the base voltage (e.g. rated motor voltage).

Note: 1. Set 60Hz in Pr. 3 "base frequency" when using a Mitsubishi constant-torque motor.
2. When the general-purpose magnetic flux vector control mode has been selected, Pr. 3, Pr. 19 and Pr. 47 are made invalid and Pr. 83 and Pr. 84 are made valid.
However, Pr. 3 or Pr. 47 is made valid for the S-shaped inflection pattern point of Pr. 29.
3. The RT signal serves as the second function selection signal and makes the other second functions valid. Refer to page 171 for Pr. 180 to Pr. 183 (input terminal function selection).

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

Pr. 4 "multi-speed setting (high speed)"

Pr. 5 "multi-speed setting (middle speed)"

Pr. 6 "multi-speed setting (low speed)"

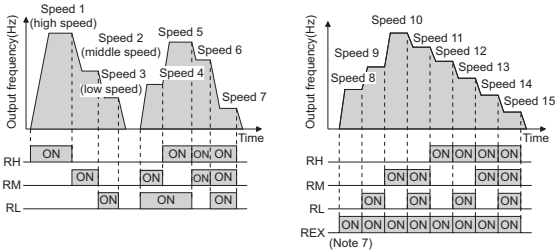
Pr. 24 to Pr. 27 "multi-speed setting (speeds 4 to 7)"

Pr. 232 to Pr. 239 "multi-speed setting (speeds 8 to 15)"

Related parameters
- Pr. 1 "maximum frequency"
- Pr. 2 "minimum frequency"
- Pr. 29 "acceleration/ deceleration pattern"
- Pr. 79 "operation mode selection"
- Pr. 146 "frequency setting command selection"
- Pr. 180 to Pr. 183 (input terminal function selection)

Used to switch between the predetermined running speeds.
- Any speed can be selected by merely switching on/off the corresponding contact signals (RH, RM, RL, REX signals).
- By using these functions with Pr. 1 "maximum frequency" and Pr. 2 "minimum frequency", up to 17 speeds can be set.
- Valid in the external operation mode or combined mode (Pr. 79 = 3 or 4)

Parameter Number	Factory Setting	Setting Range	Remarks
4	60Hz	0 to 400Hz	
5	30Hz	0 to 400Hz	
6	10Hz	0 to 400Hz	
24 to 27	9999	0 to 400Hz, 9999	9999: Not selected
232 to 239	9999	0 to 400Hz, 9999	9999: Not selected



<Setting>
- Set the running frequencies in the corresponding parameters.
- Each speed (frequency) can be set as desired between 0 and 400Hz during inverter operation.
  After the required multi-speed setting parameter has been read, the setting can be changed by pressing the ▲/▼ key. In this case, when you release the ▲/▼ key, press the SET key (WRITE key when using the parameter unit (FR-PU04)) to store the set frequency.
- Use any of Pr. 180 to Pr. 183 to assign the terminal used to input the REX signal.

Note: 1. The priorities of external terminal of the frequency command are in order of jog, multi-speed, terminal 4 and terminal 2.
2. The multi-speeds can also be set in the PU or external operation mode.
3. For multi-speed setting, if two or three speeds are simultaneously selected, priority is given to the frequency setting of the lower signal.
4. Pr. 24 to Pr. 27 and Pr. 232 to Pr. 239 settings have no priority between them.
5. The parameter values can be changed during operation.
6. Changing the terminal assignment using Pr. 180 to Pr. 183 (input terminal function selection) may affect the other functions. Check the functions of the corresponding terminals before making setting.
7. When only the REX signal is on with "9999" set in Pr.232, the set frequency is changed to 0Hz.

4.2.5 Acceleration/deceleration time (Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 44, Pr. 45)

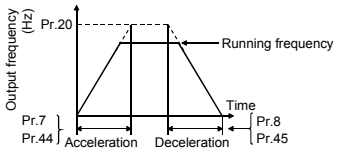
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"
Pr. 20 "acceleration/deceleration reference frequency"
Pr. 21 "acceleration/deceleration time increments"
Pr. 44 "second acceleration/deceleration time"
Pr. 45 "second deceleration time"

Related parameters
Pr. 3 "base frequency"
Pr. 29 "acceleration/deceleration pattern"

Used to set motor acceleration/deceleration time.
Set a larger value for a slower speed increase/decrease or a smaller value for a faster speed increase/decrease.

Parameter Number	Factory Setting		Setting Range	Remarks
7	0.1K to 3.7K	5s	0 to 3600s/0 to 360s	
	5.5K, 7.5K	10s		
8	0.1K to 3.7K	5s	0 to 3600s/0 to 360s	
	5.5K, 7.5K	10s		
20	60Hz		1 to 400Hz	
21	0		0, 1	0: 0 to 3600s 1: 0 to 360s
44	5s (Note)		0 to 3600s/0 to 360s	
45	9999		0 to 3600s/ 0 to 360s, 9999	9999: acceleration time = deceleration time

Note: The FR-E540-5.5K and 7.5K are factory-set to 10s.



<Setting>

- Use Pr. 21 to set the acceleration/deceleration time and minimum setting increments:
  Set value "0" (factory setting).....0 to 3600s (minimum setting increments: 0.1s)
  Set value "1".....0 to 360s (minimum setting increments: 0.01s)
- When you have changed the Pr. 21 setting, set the deceleration time again. (Note 5)
- Use Pr. 7 and Pr. 44 to set the acceleration time required to reach the frequency set in Pr. 20 from 0Hz.
- Use Pr. 8 and Pr. 45 to set the deceleration time required to reach 0Hz from the frequency set in Pr. 20.
- Pr. 44 and Pr. 45 are valid when the RT signal is on. When the RT signal is on, the other second functions such as second torque boost are also selected.
- Set "9999" in Pr. 45 to make the deceleration time equal to the acceleration time (Pr. 44).

Note: 1. In S-shaped acceleration/deceleration pattern A (refer to page 106), the set time is the period required to reach the base frequency set in Pr. 3.

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

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

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

•Guideline for acceleration/deceleration time at the base frequency of 60Hz (0Hz to set frequency)

Frequency setting (Hz) / Acceleration/ deceleration time (s)	60	120	200	400
5	5	12	27	102
15	15	35	82	305

2. If the Pr. 20 setting is changed, the settings of calibration functions Pr. 903 and Pr. 905 (frequency setting signal gains) remain unchanged.
   To adjust the gains, adjust calibration functions Pr. 903 and Pr. 905.
3. When the setting of Pr. 7, Pr. 8, Pr. 44 or Pr. 45 is 0.03s or less, the acceleration/deceleration time is 0.04s. At this time, set 120Hz or less in Pr. 20.
4. If the shortest 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's J (moment of inertia) and motor torque.
5. Changing the Pr. 21 setting changes the acceleration/deceleration setting (Pr. 7, Pr. 8, Pr. 16, Pr. 44, Pr. 45).
   <Example>
   When Pr. 21 = "0" and the setting of Pr. 7 = "5.0"s, and if the setting of Pr. 21 is changed to "1", the setting value of Pr. 7 will change to "0.5"s.

4.2.6 Electronic thermal relay function (Pr. 9, Pr. 48)

Pr. 9 "electronic thermal O/L relay

Pr. 48 "second electronic thermal O/L relay "

Related parameter
Pr. 71 "applied motor"
Pr. 180 to Pr. 183 (input terminal function selection)

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

Parameter Number	Factory Setting	Setting Range	Remarks
9	Rated current*	0 to 500A	
48	9999	0 to 500A, 9999	9999: Function invalid

*0.1K to 0.75K are set to 85% of the rated inverter current.

<Setting>

- Set the rated current [A] of the motor.
  (Normally set the rated current at 50Hz if the motor has both 50Hz and 60Hz rated current.)
- Setting "0" makes the electronic thermal relay function (motor protective function) invalid. (The inverter's protective function is valid.)
- Set "1" in Pr.71 when using the Mitsubishi constant torque motor. (This provides a 100% continuous torque characteristic in the low-speed range.) Then, set the rated motor current in Pr. 9.
- Pr. 48 "second electronic thermal O/L relay" is made valid when the RT signal is on. (Note 4)

Note: 1. When two or more motors are connected to the inverter, they cannot be protected by the electronic overcurrent protection. Install an external thermal relay to each motor.
2. When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
3. A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.
4. The RT signal serves as the second function selection signal and makes the other second functions valid. Refer to page 171 for Pr. 180 to Pr. 183 (input terminal function selection).

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

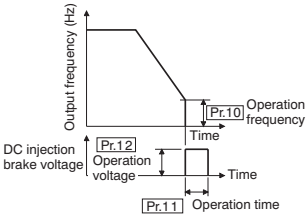
Pr. 10 "DC injection brake operation frequency"

Pr. 11 "DC injection brake operation time"

Pr. 12 "DC injection brake voltage"

By setting the DC injection brake voltage (torque), operation time and operation starting frequency, the stopping accuracy of positioning operation, etc. or the timing of operating the DC injection brake to stop the motor can be adjusted according to the load.

Parameter Number	Factory Setting	Setting Range
10	3Hz	0 to 120Hz
11	0.5s	0 to 10s
12	6%	0 to 30%



<Setting>

- Use Pr. 10 to set the frequency at which the DC injection brake operation is started.
- Use Pr. 11 to set the period during when the brake is operated.
- Use Pr. 12 to set the percentage of the power supply voltage.
- Change the Pr. 12 setting when using the inverter-dedicated motor (constant-torque motor).
  FR-E520 (S)-0.1K to 7.5K, FR-E510W-0.1K to 0.75K ..... 4% (Note)
  FR-E540-0.4K to 7.5K 6%

Note: When the Pr. 12 value is as factory-set, changing the Pr. 71 value to the setting for use of a constant-torque motor changes the Pr. 12 value to 4% automatically.

⚠ CAUTION

⚠ Install a mechanical brake. No holding torque is provided.

4.2.8 Starting frequency (Pr. 13)

Pr. 13 "starting frequency"

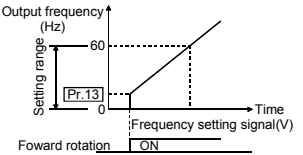
Related parameters

Pr. 2 "minimum frequency"

You can set the starting frequency between 0 and 60Hz.

- Set the starting frequency at which the start signal is switched on.

Parameter Number	Factory Setting	Setting Range
13	0.5Hz	0 to 60Hz



Note: The inverter will not start if the frequency setting signal is less than the value set in Pr. 13 "starting frequency".
For example, when 5Hz is set in Pr. 13, the motor will not start running until the frequency setting signal reaches 5Hz.

⚠ CAUTION

⚠ **Note that when Pr. 13 is set to any value lower than Pr. 2 "minimum frequency", simply turning on the start signal will run the motor at the preset frequency if the command frequency is not input.**

4.2.9 Load pattern selection (Pr. 14)

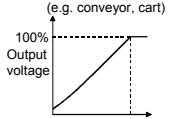
Pr. 14 "load pattern selection"

Related parameters
Pr. 0 "torque boost"
Pr. 46 "second torque boost"
Pr. 80 "motor capacity"
Pr. 180 to Pr. 183 (input terminal function selection)

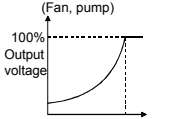
You can select the optimum output characteristic (V/F characteristic) for the application and load characteristics.

Parameter Number	Factory Setting	Setting Range
14	0	0 to 3

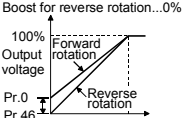
Pr.14=0
For constant-torque loads
(e.g. conveyor, cart)



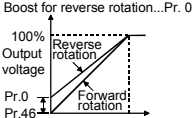
Pr.14=1
For variable-torque loads
(Fan, pump)



Pr.14=2
For lift
Boost for forward rotation...Pr. 0 (Pr.46) setting
Boost for reverse rotation...0%



Pr.14=3
For lift
Boost for forward rotation...0%
Boost for reverse rotation...Pr. 0 (Pr.46) setting



Note: 1. This parameter setting is ignored when the general-purpose magnetic flux vector control mode has been selected.
2. Pr. 46 "second torque boost" is made valid when the RT signal turns on.
The RT signal acts as the second function selection signal and makes the other second functions valid.
Refer to page 171 for Pr. 180 to Pr. 183 (input terminal function selection).

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

Pr. 15 "jog frequency"

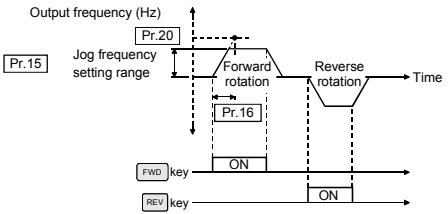
Pr. 16 "jog acceleration/ deceleration time"

Related parameters
Pr. 20 "acceleration/deceleration reference frequency"
Pr. 21 "acceleration/deceleration time increments"

Jog operation can be started and stopped by selecting the jog mode from the operation panel and pressing and releasing the RUN key (FWD, REV key).

- Set the frequency and acceleration/deceleration time for jog operation.

Parameter Number	Factory Setting	Setting Range	Remarks
15	5Hz	0 to 400Hz	
16	0.5s	0 to 3600s	When Pr. 21 = 0
		0 to 360s	When Pr. 21 = 1



Note: 1. In S-shaped acceleration/deceleration pattern A, the acceleration/deceleration time is the period of time required to reach Pr. 3 "base frequency", not Pr. 20.
2. The acceleration time and deceleration time cannot be set separately for jog operation.
3. The value set in Pr. 15 "jog frequency" should be equal to or greater than the Pr. 13 "starting frequency" setting.
4. When Pr. 79 Operation mode selection="4", pressing FWD/REV of the PU (operation panel FR-PU04) starts the inverter and pressing STOP RESET stops the inverter.

Pr. 18 ➔ Refer to Pr. 1, Pr. 2.

Pr. 19 ➔ Refer to Pr. 3.

Pr. 20, Pr. 21 ➔ Refer to Pr. 7, Pr. 8.

4.2.11 Stall prevention and current limit (Pr. 22, Pr. 23, Pr. 66, Pr. 156)

Pr. 22 "stall prevention operation level"

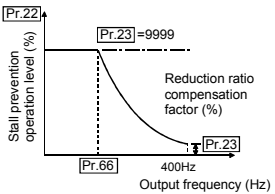
Pr. 23 "stall prevention operation level compensation factor at double speed"

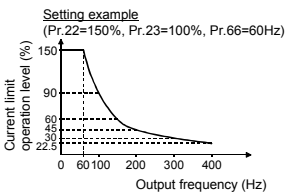
Pr. 66 "stall prevention operation level reduction starting frequency"

Pr. 156 "stall prevention operation selection"

- Stall prevention.....If the current exceeds the stall prevention operation level, the output frequency of the inverter is automatically varied to reduce the current.
- Fast-response current limit.....If the current exceeds the limit value, the output of the inverter is shut off to prevent an overcurrent.
- Set the output current level (% to the rated inverter output current) at which the output frequency will be adjusted to prevent the inverter from stopping due to overcurrent etc.
- For high-speed operation at or over the motor base frequency, acceleration may not be made because the motor current does not increase.
  To improve the operation characteristics of the motor in such a case, the stall prevention level in the high-frequency range can be reduced. This is effective for operation of a centrifugal separator up to the high-speed range. Normally, set 60Hz in Pr. 66 and 100% in Pr. 23.
- For operation in the high-frequency range, the current in the locked motor state is smaller than the rated output current of the inverter and the inverter does not result in an alarm (protective function is not activated) if the motor is at a stop. To improve this and activate the alarm, the stall prevention level can be reduced.
- You can make setting to prevent stall caused by overcurrent and/or to prevent the inverter from resulting in an overcurrent trip (to disable fast-response current limit that limits the current) when an excessive current flows due to sudden load fluctuation or ON-OFF on the output side of a running inverter.

Parameter Number	Factory Setting	Setting Range	Remarks
22	150%	0 to 200%	
23	9999	0 to 200%, 9999	9999: Constant according to Pr. 22
66	60Hz	0 to 400Hz	
156	0	0 to 31, 100	





<Setting of stall prevention operation level>

- In Pr. 22, set the stall prevention operation level. Normally set it to 150% (factory setting). Set "0" in Pr. 22 to disable the stall prevention operation.
- To reduce the stall prevention operation level in the high-frequency range, set the reduction starting frequency in Pr. 66 and the reduction ratio compensation factor in Pr. 23.

Formula for stall prevention operation level

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

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

- By setting "9999" (factory setting) in Pr. 23, the stall prevention operation level is constant at the Pr. 22 setting up to 400Hz.

<Setting of stall prevention operation selection>

Refer to the following table and set the parameter.

Pr. 156 Setting	Fast-Response Current Limit ○: Activated ●: Not activated	Stall Prevention Operation Selection ○: Activated ●: Not activated			OL Signal Output ○: Operation continued ●: Operation not continued (Note 1)
		Acceleration	Constant speed	Deceleration	
0	○	○	○	○	○
1	●	○	○	○	○
2	○	●	○	○	○
3	●	●	○	○	○
4	○	○	●	○	○
5	●	○	●	○	○
6	○	●	●	○	○
7	●	●	●	○	○
8	○	○	○	●	○
9	●	○	○	●	○
10	○	●	○	●	○
11	●	●	○	●	○
12	○	○	●	●	○
13	●	○	●	●	○
14	○	●	●	●	○
15	●	●	●	●	— (Note2)

Pr. 156 Setting		Fast-Response Current Limit ○: Activated ●: Not activated	Stall Prevention Operation Selection ○: Activated ●: Not activated			OL Signal Output ○: Operation continued ●: Operation not continued (Note 1)
			Acceleration	Constant speed	Deceleration	
16		○	○	○	○	●
17		●	○	○	○	●
18		○	●	○	○	●
19		●	●	○	○	●
20		○	○	●	○	●
21		●	○	●	○	●
22		○	●	●	○	●
23		●	●	●	○	●
24		○	○	○	●	●
25		●	○	○	●	●
26		○	●	○	●	●
27		●	●	○	●	●
28		○	○	●	●	●
29		●	○	●	●	●
30		○	●	●	●	●
31		●	●	●	●	— (Note2)
100	Driving	○	○	○	○	○
	Regenerative	●	●	●	●	— (Note2)

Note: 1. When "Operation not continued for OL signal output" is selected using Pr.156, the "E.OLT" alarm code (stopped by stall prevention) is displayed and operation stopped.
(Alarm stop display "E.OLT")
2. Since both fast-response current limit and stall prevention are not activated, OL signal and E.OLT are not output.
3. If the load is heavy, the lift is predetermined, or the acceleration/deceleration time is short, the stall prevention may be activated and the motor not stopped in the preset acceleration/deceleration time. Therefore, set optimum values to the Pr. 156 and Pr. 22 (Pr. 23).
4. When the fast-response current limit has been set in Pr. 156 (factory setting has the current limit activated), do not set the Pr. 22 value to 170% or more. Torque will not be developed by doing so.
5. In vertical lift applications, make setting so that the fast-response current limit is not activated. Torque may not be produced, causing a gravity drop.

⚠ CAUTION

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

⚠ **Test operation must be performed.**
Stall prevention operation during acceleration may increase the acceleration time.
Stall prevention operation during constant speed may change the speed suddenly.
Stall prevention operation during deceleration may increase the deceleration time, increasing the deceleration distance.

Pr. 24 to Pr. 27 ➔Refer to Pr. 4 to Pr. 6.

4

4.2.12 Acceleration/deceleration pattern (Pr. 29)

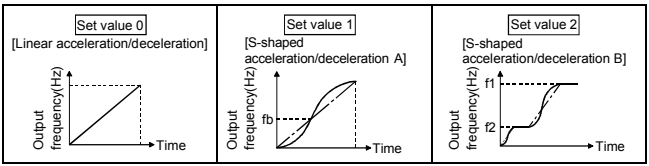
Pr. 29 "acceleration/deceleration pattern"

Set the acceleration/deceleration pattern.

Parameter Number	Factory Setting	Setting Range
29	0	0, 1, 2

Related parameters

Pr. 3 "base frequency"
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"
Pr. 20 "acceleration/deceleration reference frequency"
Pr. 44 "second acceleration/deceleration time"
Pr. 45 "second deceleration time"



<Setting>

Pr. 29 Setting	Function	Description
0	Linear acceleration/ deceleration	Linear acceleration/deceleration is made up/down to the preset frequency (factory setting).
1	S-shaped acceleration/ deceleration A (Note)	For machine tool spindles This setting is used when it is necessary to make acceleration/deceleration in a short time up to the base frequency or higher speed range. In this acceleration/deceleration pattern, fb (base frequency) is always the inflection point of an S shape, and you can set the acceleration/deceleration time according to the reduction in motor torque in the base frequency or higher constant-output operation range.
2	S-shaped acceleration/ deceleration B	For prevention of cargo collapse on conveyor, etc. This setting provides S-shaped acceleration/deceleration from f2 (current frequency) to f1 (target frequency), easing an acceleration/deceleration shock. This pattern has an effect on the prevention of cargo collapse, etc.

Note: For the acceleration/deceleration time, set the time required to reach the "base frequency" in Pr. 3, not the "acceleration/deceleration reference frequency" in Pr. 20.

4.2.13 Regenerative brake duty (Pr. 30, Pr. 70)

Pr. 30 "regenerative function selection"

Pr. 70 "special regenerative brake duty"

- When making frequent starts/stops, use the optional "brake resistor" to increase the regenerative brake duty. (0.4K or more)

Parameter Number	Factory Setting	Setting Range
30	0	0,1
70	0%	0 to 30%

<Setting>

(1) When using the brake resistor (MRS), BU type brake unit, high power factor converter (FR-HC), power regeneration common converter (FR-CV)

- Set "0" in Pr. 30.
- The Pr. 70 setting is made invalid.

(2) When using the brake resistors (2 MYSs in parallel) (3.7K is only allowed)

- Set "1" in Pr. 30.
- Set "6%" in Pr. 70.

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

- Set "1" in Pr. 30.
- Set "10%" in Pr. 70.

Note: 1. Pr. 70 "special regenerative brake duty" indicates the %ED of the built-in brake transistor operation. The setting should not be higher than the permissible value of the brake resistor used. Otherwise, the resistor can overheat.
2. When Pr. 30 = "0", Pr. 70 is not displayed but the brake duty is fixed at 3%. (Fixed at 2% for 5.5K, 7.5K)
3. The brake resistor cannot be connected to 0.1K and 0.2K inverters.

⚠WARNING

⚠ The value set in Pr. 70 should not exceed the value set to the brake resistor used.
Otherwise, the resistor can overheat.

4.2.14 Frequency jump (Pr. 31 to Pr. 36)

Pr. 31 "frequency jump 1A"

Pr. 32 "frequency jump 1B"

Pr. 33 "frequency jump 2A"

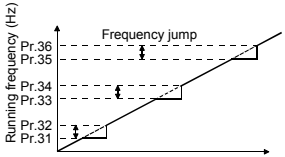
Pr. 34 "frequency jump 2B"

Pr. 35 "frequency jump 3A"

Pr. 36 "frequency jump 3B"

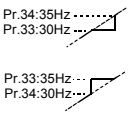
- When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped. Up to three areas may be set, with the jump frequencies set to either the top or bottom point of each area.
- The value set to 1A, 2A or 3A is a jump point and operation is performed at this frequency.

Parameter Number	Factory Setting	Setting Range	Remarks
31	9999	0 to 400Hz, 9999	9999: Function invalid
32	9999	0 to 400Hz, 9999	9999: Function invalid
33	9999	0 to 400Hz, 9999	9999: Function invalid
34	9999	0 to 400Hz, 9999	9999: Function invalid
35	9999	0 to 400Hz, 9999	9999: Function invalid
36	9999	0 to 400Hz, 9999	9999: Function invalid



<Setting>

- To fix the frequency at 30Hz between Pr. 33 and Pr. 34 (30Hz and 35Hz), set 35Hz in Pr. 34 and 30Hz in Pr. 33.
- To jump to 35Hz between 30 and 35Hz, set 35Hz in Pr. 33 and 30Hz in Pr. 34.



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

4.2.15 Speed display (Pr. 37)

Pr. 37 "speed display"

Related parameter
Pr. 52 "operation panel/PU main display data selection"

The unit of the output frequency display of the operation panel and PU (FR-PU04) can be changed from the frequency to the motor speed or machine speed.

Parameter Number	Factory Setting	Setting Range	Remarks
37	0	0, 0.01 to 9998	0: Output frequency

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

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

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

<Setting>

- To display the machine speed, set in Pr. 37 the machine speed for 60Hz operation.

Note: 1. The motor speed is converted into the output frequency and does not match the actual speed.
2. To change the operation panel monitor (PU main display), refer to Pr. 52.
3. As the operation panel display is 4 digits, "----" is displayed when the monitored value exceeds "9999".
4. Only the PU monitor display uses the unit set in this parameter. Set the other speed-related parameters (e.g. Pr. 1) in the frequency unit.
5. Due to the restrictions of the resolution of the set frequency, the displayed value may be different from the setting for the second decimal place.

⚠ CAUTION

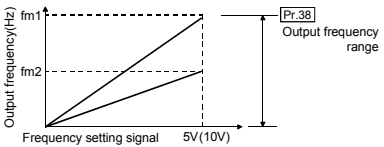
⚠ **Make sure that the running speed setting is correct.**
Otherwise, the motor might run at extremely high speed, damaging the machine.

4.2.16 Frequency at 5V (10V) input (Pr. 38)

Pr. 38 "frequency at 5V (10V) input"

Related parameters
Pr. 73 "0-5V/0-10V selection"
Pr. 79 "operation mode selection"
Pr. 902 "frequency setting voltage bias"
Pr. 903 "frequency setting voltage gain"

- You can set the frequency provided when the frequency setting signal from the potentiometer connected across terminals 2-5 (frequency setting potentiometer) is 5VDC (or 10VDC).



Parameter Number	Factory Setting	Setting Range
38	60Hz	1 to 400Hz

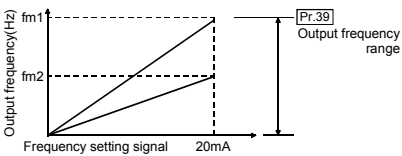
Note: For the frequency setting of the built-in frequency setting potentiometer, refer to Pr. 922 and Pr. 923. (Page 186)

4.2.17 Frequency at 20mA input (Pr. 39)

Pr. 39 "frequency at 20mA input"

Related parameters
Pr. 79 "operation mode selection"
Pr. 904 "frequency setting current bias"
Pr. 905 "frequency setting current gain"

- You can set the frequency provided when the frequency setting signal input across terminals 4-5 is 20mA.



Parameter Number	Factory Setting	Setting Range
39	60Hz	1 to 400Hz

4.2.18 Up-to-frequency sensitivity (Pr. 41)

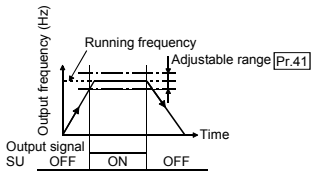
Pr. 41 "up-to-frequency sensitivity"

Related parameters

Pr. 190 to Pr. 192 (output terminal function selection)

The ON range of the up-to-frequency signal (SU) output when the output frequency reaches the running frequency can be adjusted between 0 and ±100% of the running frequency.
This parameter can be used to ensure that the running frequency has been reached or used as the operation start signal etc. for related equipment.

Parameter Number	Factory Setting	Setting Range
41	10%	0 to 100%



- Use any of Pr. 190 to Pr. 192 to allocate the terminal used for SU signal output. Refer to page 173 for Pr. 190 to Pr. 192 (output terminal function selection).

Note: Changing the terminal assignment using Pr. 190 to Pr. 192 (output terminal function selection) may affect the other functions. Check the functions of the corresponding terminals before making settings.

4.2.19 Output frequency detection (Pr. 42, Pr. 43)

Pr. 42 "output frequency detection"

Pr. 43 "output frequency detection for reverse rotation"

Related parameters

Pr. 190 to Pr. 192 (output terminal function selection)

The output frequency detection signal (FU) is output when the output frequency reaches or exceeds the setting. This function can be used for electromagnetic brake operation, open signal etc.

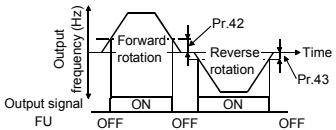
- You can also set the frequency detection used exclusively for reverse rotation. This function is effective for switching the timing of electromagnetic brake operation between forward rotation (rise) and reverse rotation (fall) during vertical lift operation etc.

Parameter Number	Factory Setting	Setting Range	Remarks
42	6Hz	0 to 400Hz	
43	9999	0 to 400Hz, 9999	9999: Same as Pr. 42 setting

<Setting>

Refer to the figure below and set the corresponding parameters:

- When Pr. 43 ≠ 9999, the Pr. 42 setting applies to forward rotation and the Pr. 43 setting applies to reverse rotation.
- Assign the terminal used for FU signal output with any of Pr. 190 to Pr. 192 (output terminal function selection).
  Refer to page 173 for Pr. 190 to Pr. 192 (output terminal function selection).



Note: Changing the terminal assignment using Pr. 190 to Pr. 192 may affect the other functions. Make setting after confirming the function of each terminal.

Pr. 44, Pr. 45 ➔Refer to Pr. 7.

Pr. 46 ➔Refer to Pr. 0.

Pr. 47 ➔Refer to Pr. 3.

Pr. 48 ➔Refer to Pr. 9.

4.2.20 Monitor display (Pr. 52, Pr. 54)

Pr. 52 "operation panel/PU main display data selection"

Pr. 54 "FM terminal function selection"

Related parameters
Pr. 37 "speed display"
Pr. 55 "frequency monitoring reference"
Pr. 56 "current monitoring reference"
Pr. 171 "actual operation hour meter clear"
Pr. 900 "FM terminal calibration"

You can select the signals shown on the operation panel/parameter unit (FR-PU04) main display screen and the signal output to the FM terminal .
•There is a pulse train output terminal FM. Select the signal using Pr. 54.

Parameter Number	Factory Setting	Setting Range
52	0	0, 23, 100
54	0	0, 1, 2

<Setting>

Set Pr. 52 and Pr. 54 in accordance with the following table:

Signal Type	Unit	Parameter Setting			Full-Scale Value of FM Level Meter
		Pr. 52		Pr. 54	
		Operation panel LED	PU main monitor	FM terminal	
Output frequency	Hz	0/100	0/100	0	Pr. 55
Output current	A	0/100	0/100	1	Pr. 56
Output voltage	——	0/100	0/100	2	400V or 800V
Alarm display	——	0/100	0/100	×	——
Actual operation time	10h	23	23	×	——

4

When 100 is set in Pr. 52, the monitor value is different depending on whether the inverter is at a stop or running: (LED of Hz flickers during stop and is lit during operation.)

	Pr. 52		
	0	100	
	During operation/ during stop	During stop	During operation
Output frequency	Output frequency	Set frequency	Output frequency
Output current	Output current		
Output voltage	Output voltage		
Alarm display	Alarm display		

Note: 1. During an error, the output frequency at error occurrence is displayed.
2. During MRS, the values are the same as during a stop.
During offline auto tuning, the tuning status monitor has priority.

Note: 1. The monitoring of items marked × cannot be selected.
2. By setting "0" in Pr. 52, the monitoring of "output frequency to alarm display" can be selected in sequence by the SET key.
3. Running speed on the PU main monitor is selected by "other monitor selection" of the parameter unit (FR-PU04).
4. The actual operation time displayed by setting "23" in Pr. 52 is calculated using the inverter operation time. (Inverter stop time is not included.) Set "0" in Pr. 171 to clear it.
5. The actual operation time is calculated from 0 to 99990 hours, then cleared, and recalculated from 0. If the operation time is less than 10 hours there is no display.
6. The actual operation time is not calculated if the inverter has not operated for more than 1 hour continuously.
7. When the operation panel is used, the display unit is Hz or A only.

4.2.21 Monitoring reference (Pr. 55, Pr. 56)

Pr. 55 "frequency monitoring reference"

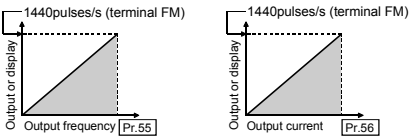
Pr. 56 "current monitoring reference"

Related parameters

Pr. 54 "FM terminal function selection"
Pr. 900 "FM terminal calibration"

Set the frequency or current which is referenced when the output frequency or output current is selected for the FM terminal.

Parameter Number	Factory Setting	Setting Range
55	60Hz	0 to 400Hz
56	Rated current	0 to 500A



<Setting>

Refer to the above diagrams and set the frequency monitoring reference value in Pr. 55 and the current monitoring reference value in Pr. 56.

Pr. 55 is set when Pr. 54 = 0 and Pr. 56 is set when Pr. 54 = 1.

Set the Pr. 55 and Pr. 56 values so that the output pulse train output of terminal FM is 1440pulses/s.

Note: The maximum pulse train output of terminal FM is 2400pulses/s. If Pr. 55 is not adjusted, the output of terminal FM will be filled to capacity. Therefore, adjust Pr. 55.

4.2.22 Automatic restart after instantaneous power failure (Pr. 57, Pr. 58)

Pr. 57 "restart coasting time"

Pr. 58 "restart cushion time"

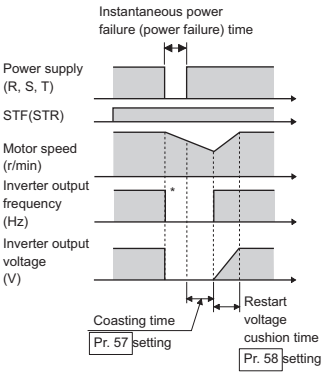
- You can restart the inverter without stopping the motor (with the motor coasting) when power is restored after an instantaneous power failure.

Parameter Number	Factory Setting	Setting Range	Remarks
57	9999	0 to 5 s, 9999	9999: No restart
58	1.0 s	0 to 60 s	

<Setting>

Refer to the following table and set the parameters:

Parameter Number	Setting	Description		
57	0	0.1K to 1.5K	0.5s coasting time	Generally use this setting.
		2.2K to 7.5K	1.0s coasting time	
	0.1 to 5 s	Waiting time for inverter-triggered restart after power is restored from an instantaneous power failure. (Set this time between 0.1s and 5s according to the magnitude of the moment (J) of inertia of the load and torque.)		
	9999	No restart		
58	0 to 60 s	Normally the inverter may be run with the factory settings. These values are adjustable to the load (moment of inertia, torque).		



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

Note: 1. Automatic restart after instantaneous power failure uses a reduced-voltage starting system in which the output voltage is raised gradually with the preset frequency unchanged, independently of the coasting speed of the motor.
As in the FR-A024/044, a motor coasting speed detection system (speed search system) is not used but the output frequency before an instantaneous power failure is output. Therefore, if the instantaneous power failure time is longer than 0.2s, the frequency before the instantaneous power failure cannot be stored and the inverter will start at 0Hz.
2. The SU and FU signals are not output during restart but are output after the restart cushion time has elapsed.

⚠ CAUTION

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

⚠ **When the start signal is turned off or the STOP RESET key is pressed during the cushion time for automatic restart after instantaneous power failure, deceleration starts after the automatic restart cushion time set in Pr. 58 "cushion time for automatic restart after instantaneous power failure" has elapsed.**

4.2.23 Remote setting function selection (Pr. 59)

Pr. 59 "remote setting function selection"

Related parameters

Pr. 1 "maximum frequency"
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"
Pr. 18 "high-speed maximum frequency"
Pr. 44 "second acceleration/ deceleration time"
Pr. 45 "second deceleration time"

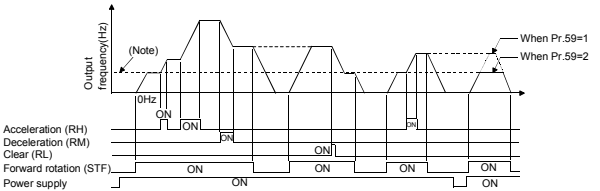
If the operator panel is located away from the control box, you can use contact signals to perform continuous variable-speed operation, without using analog signals.

- By merely setting this parameter, you can use the acceleration, deceleration and setting clear functions of the motorized speed setter (FR-FK).
- When the remote function is used, the output frequency of the inverter can be compensated for as follows:

  External operation mode — Frequency set by RH/RM operation plus external analog frequency command

  PU operation mode — Frequency set by RH/RM operation plus PU's digitally-set frequency or built-in frequency setting potentiometer

Parameter Number	Factory Setting	Setting Range
59	0	0, 1, 2



Note: External operation frequency or PU operation frequency other than multi-speed

Pr. 59 Setting	Operation	
	Remote setting function	Frequency setting storage function (E^2PROM)
0	No	—
1	Yes	Yes
2	Yes	No

- Use Pr. 59 to select whether the remote setting function is used or not and whether the frequency setting storage function* in the remote setting mode is used or not. When "remote setting function - yes" is selected, the functions of signals RH, RM and RL are changed to acceleration (RH), deceleration (RM) and clear (RL). Use Pr. 180 to Pr. 183 (input terminal function selection) to set signals RH, RM and RL.

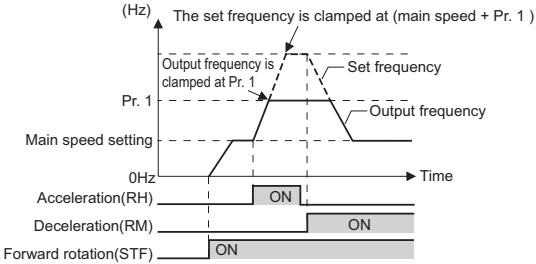
* Frequency setting storage function

The remote setting frequency (frequency set by RH, RM operation) is stored into memory. When power is switched off once, then on, operation is resumed with that output frequency value. (Pr. 59 = 1)

<Frequency setting storage condition>

- Frequency at the time when the start signal (STF or STR) has switched off
- The remotely-set frequency is stored every one minute after one minute has elapsed since turn off (on) of both the RH (acceleration) and RM (deceleration) signals. (The frequency is written if the present frequency setting compared with the past frequency setting every one minute is different.) (The state of the RL signal dose not affect writing.)

Note: 1. The range of frequency changeable by RH (acceleration) and RM (deceleration) is 0 to maximum frequency (Pr. 1 or Pr. 18 setting). Note that the maximum value of set frequency is (main speed + maximum frequency).



2. When the acceleration or deceleration signal switches on, the set frequency varies according to the slope set in Pr. 44 or Pr. 45. The output frequency acceleration/deceleration times are as set in Pr. 7 and Pr. 8, respectively. Therefore, the longer preset times are used to vary the actual output frequency.
3. If the start signal (STF or STR) is off, turning on the acceleration (RH) or deceleration (RM) signal varies the set frequency.
4. 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 (E^2PROM) invalid (Pr. 59 = "2").

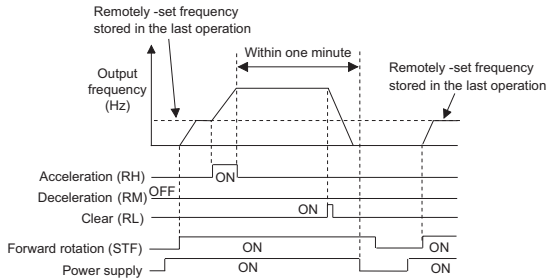
   If set invalid (Pr. 59 = "1"), frequency is written to E^2PROM frequently, this will shorten the life of the E^2PROM.

REMARKS

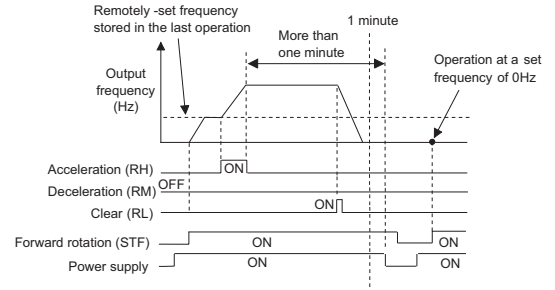
This function is invalid during jog operation and PID control operation.

Setting frequency is "0"

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



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



⚠ CAUTION

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

4.2.24 Shortest acceleration/deceleration mode (Pr. 60 to Pr. 63)

Pr. 60 "shortest acceleration/deceleration mode"

Pr. 61 "reference current"

Pr. 62 "reference current for acceleration"

Pr. 63 "reference current for deceleration"

Related parameters
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"

The inverter automatically sets the shortest time for acceleration/deceleration for operation.

- If you do not set the acceleration and deceleration times and V/F pattern, you can run the inverter as if appropriate values had been set in the corresponding parameters. This operation mode is useful when you want to operate without fine parameter setting.
  Pr. 61 to Pr. 63 are valid only when Pr. 60 = "1, 2, 11,12".
  When the shortest acceleration/deceleration mode is selected, the setting values of Pr. 7 "acceleration time", Pr. 8 "deceleration time", Pr. 22 "stall prevention operation level" are made invalid.

Parameter Number	Factory Setting	Setting Range	Remarks
60	0	0, 1, 2, 11, 12	
61	9999	0 to 500A, 9999	9999: Referenced from rated inverter current.
62	9999	0 to 200%, 9999	
63	9999	0 to 200%, 9999	

<Setting>

Pr. 60 Setting	Operation Mode	Description		Invalid parameter
0	Ordinary operation mode	————		————
1	Shortest acceleration/ deceleration mode I	Set to accelerate/decelerate the motor in the shortest time. The inverter makes acceleration/ deceleration in the shortest time using its full capabilities. Set "11" or "12" when using brake resistance and the brake unit.	Stall prevention operation level 150%	Pr. 7, Pr. 8, Pr. 22
11				
2	Shortest acceleration/ deceleration mode II		Stall prevention operation level 180%	
12				

Note: When the shortest acceleration/deceleration mode is selected, regenerative over voltage (E.OV3) may occur if the regenerative brake does not have enough capability at deceleration.

- Set the parameters when it is desired to improve the performance in the shortest acceleration/deceleration mode.

(1) Pr. 61 "reference current"

Set the current value (A) that is referenced for stall prevention operation level.
Set this value when you want to use the motor rated current as reference such as when capacities of the motor and inverter differ.

Setting	Reference Current
9999 (factory setting)	Referenced from rated inverter current
0 to 500A	Referenced from setting (rated motor current)

(2) Pr. 62 "reference current for acceleration"

Set the stall prevention operation level (%) at acceleration.
Set when you want to restrict torque at acceleration, etc.
The value set in Pr.61 "reference current" becomes the reference value (100%).

Setting	Reference Current
9999 (factory setting)	150% (180%) is the limit value.
0 to 200%	The setting of 0 to 200% is the limit value.

(3) Pr. 63 "reference current for deceleration"

Set the stall prevention operation level (%) at deceleration.
Set when you want to restrict torque at deceleration, etc.
The value set in Pr.61 "reference current" becomes the reference value (100%).

Setting	Reference Current
9999 (factory setting)	150% (180%) is the limit value.
0 to 200%	The setting of 0 to 200% is the limit value.

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

Pr. 65 "retry selection"

Pr. 67 "number of retries at alarm occurrence"

Pr. 68 "retry waiting time"

Pr. 69 "retry count display erasure"

When any protective function (major fault) is activated and the inverter stops its output, the inverter itself resets automatically and performs retries. You can select whether retry is made or not, alarms reset for retry, number of retries made, and waiting time.

Parameter Number	Factory Setting	Setting Range
65	0	0 to 3
67	0	0 to 10, 101 to 110
68	1 s	0.1 to 360s
69	0	0

<Setting>

Use Pr. 65 to select the protective functions (major faults) which execute retry.

Errors Reset for Retry	Setting			
Display	0	1	2	3
E.OC1	●	●		●
E.OC2	●	●		●
E.OC3	●	●		●
E.OV1	●		●	●
E.OV2	●		●	●
E.OV3	●		●	●
E.THM	●			
E.THT	●			
E.FIN				
E. BE	●			
E. GF	●			
E. LF				
E.OHT	●			
E.OLT	●			
E.OPT	●			
E. PE	●			
E.PUE				
E.RET				
E.CPU				
E.P24				
E. 3				
E. 6				
E. 7				

Note: ● indicates the retry items selected.

Use Pr. 67 to set the number of retries at alarm occurrence.

Pr. 67 Setting	Number of Retries	Alarm Signal Output
0	Retry is not made.	————
1 to 10	1 to 10 times	Not output.
101 to 110	1 to 10 times	Output.

- Use Pr. 68 to set the waiting time from when an inverter alarm occurs until a restart in the range 0.1 to 360s.
- Reading the Pr. 69 value provides the cumulative number of successful restart times made by retry. The cumulative number of time is cleared when setting value "0" is written.

Note: 1. The cumulative number in Pr. 69 is incremented by "1" when retry operation is regarded as successful, i.e. when normal operation is continued without the protective function (major fault) activated during a period five times longer than the time set in Pr. 68.
2. If the protective function (major fault) is activated consecutively within a period five times longer than the above waiting time, the operation panel may show data different from the most recent data or the parameter unit (FR-PU04) may show data different from the first retry data. The data stored as the error reset for retry is only that of the protective function (major fault) which was activated the first time.
3. When an inverter alarm is reset by the retry function at the retry time, the stored data of the electronic thermal relay function, etc. are not cleared. (Different from the power-on reset.)

⚠ CAUTION

⚠ **When you have selected the retry function, stay away from the motor and machine unless required. They will start suddenly (after the reset time has elapsed) after occurrence of an alarm.**
When you have selected the retry function, apply the supplied CAUTION stickers easily visible places.

Pr. 66 ➔Refer to Pr. 22.

Pr. 70 ➔Refer to Pr. 30.

4.2.26 Applied motor (Pr. 71)

Pr. 71 "applied motor"

Related parameters
Pr. 0 "torque boost"
Pr. 12 "DC injection brake voltage"
Pr. 19 "base frequency voltage"
Pr. 80 "motor capacity"
Pr. 96 "auto-tuning setting/status"

Set the motor used.

- When using the Mitsubishi constant-torque motor, set "1" in Pr. 71 for either V/F control or general-purpose magnetic flux vector control.
  The electronic thermal relay function is set to the thermal characteristic of the constant-torque motor.
- When you selected the Mitsubishi constant-torque motor, the values of the following parameters are automatically changed. (only for the factory setting value)
  Pr. 0 "torque boost", Pr. 12 "DC injection brake voltage"

Parameter Number	Factory Setting	Setting Range
71	0	0, 1, 3, 5, 6, 13, 15, 16, 23, 100, 101, 103, 105, 106, 113, 115, 116, 123

<Setting>

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

Pr. 71 Setting	Thermal Characteristics of Electronic Thermal Relay Function			Applied Motor: Standard	Applied Motor: Constant-Torque
0, 100	Thermal characteristics of a standard motor			○	
1, 101	Thermal characteristics of a Mitsubishi constant-torque motor				○
3, 103	Standard motor	Select "offline auto tuning setting".		○	
13, 113	Constant-torque motor				○
23, 123	Mitsubishi general-purpose motor SF-JR4P (1.5kW (2HP) or less)			○	
5, 105	Standard motor	Star connection	Motor constants can be entered directly.	○	
15, 115	Constant-torque motor				○
6, 106	Standard motor	Delta connection		○	
16, 116	Constant-torque motor				○

4

By setting any of "100 to 123", thermal characteristic of electronic thermal relay function (applied motor) can be changed as indicated below according to the ON/OFF status of the RT signal:

RT Signal	Thermal Characteristic of Electronic Thermal Relay Function (Applied Motor)
OFF	As indicated in the above table
ON	Constant-torque motor

⚠ CAUTION

⚠ **Set this parameter correctly according to the motor used.**
Incorrect setting may cause the motor to overheat and burn.
Set the electronic thermal relay function to the thermal characteristic for the constant-torque motor when using a geared motor (GM-G, GM-D, GM-SY, GM-HY2 series) to perform general-purpose magnetic-flux vector control.

4.2.27 PWM carrier frequency and long wiring mode (Pr. 72, Pr. 240)

Pr. 72 "PWM frequency selection"

Pr. 240 "Soft-PWM setting"

You can change the motor tone.

The long wiring mode can be set for the 400V class.

- By parameter setting, you can select Soft-PWM control which changes the motor tone.
- Soft-PWM control is a control method that changes the motor noise from a metallic tone into an unoffending complex tone.
- Surge voltage is suppressed regardless of wiring length in the long wiring mode. (When operating a 400V motor with wiring length of 40m or longer, select long wiring mode.)

Parameter Number	Factory Setting	Setting Range	Remarks
72	1	0 to 15	0: 0.7kHz, 15: 14.5kHz
240	1	0, 1, 10, 11 (*)	—

*The setting values "10, 11" can be set for the 400V class only.

<Setting>

- Refer to the following list and set the parameters:

Pr. 72 Setting	Setting	Description
72	0 to 15	PWM carrier frequency can be changed. The setting displayed is in [kHz]. Note that 0 indicates 0.7kHz and 15 indicates 14.5kHz.

Note: 1. Note that when the inverter is run at the ambient temperature above 40°C with a 2kHz or higher value set in Pr. 72, the rated output current of the inverter must be reduced. (Refer to page 228.)
2. An increased PWM frequency will decrease the motor sound but increase noise and leakage currents. Therefore, perform the reduction techniques (Refer to pages 43 to 47).

<Setting>

Pr. 240 Setting	Description		
	Soft-PWM	Long wiring mode	Remarks
0	invalid	invalid	—
1	valid (when Pr. 72="0 to 5")	invalid	—
10 (Note)	invalid	valid	Setting can be made only for the 400V class
11 (Note)	valid	valid	

Note: Note the following when Pr. 240="10 or 11"

1. When Pr. 72 "PWM frequency selection" = "2 or more", PWM carrier frequency is 1kHz.
2. When "10 or 11" (long wiring mode) is set in Pr. 240, the output voltage at the rated frequency drops by a maximum of 4V.
3. If you copied parameters to the previous version inverter (Pr. 240="10 or 11" is not available), set Pr. 240 again.
4. For the 400V class, use an insulation-enhanced motor. (Using other motors may result in insulation deterioration of motors due to surge voltage independently of the Pr. 240 setting.)
5. Values exceeding 120Hz can not be written to Pr. 1 (Pr. 18) when Pr. 240="10 or 11". Similarly, "10 or 11" can not be written to Pr. 240 when the value set in Pr. 1 (Pr. 18) exceeds 120Hz.

4.2.28 Voltage input (Pr. 73)

Pr. 73 "0-5V/0-10V selection"

Related parameters

Pr. 38 "frequency at 5V (10V) input"

• You can change the input (terminal 2) specifications in response to the frequency setting voltage signal. When entering 0 to 10VDC, always make this setting.

Parameter Number	Factory Setting	Setting Range
73	0	0, 1

Setting	Terminal 2 Input Voltage
0	For 0 to 5VDC input (factory setting)
1	For 0 to 10VDC input

Note: 1. To change the maximum output frequency at the input of the maximum frequency command voltage, use Pr. 38. Also, the acceleration/deceleration time, which is a slope up/down to the acceleration/deceleration reference frequency, is not affected by the change in Pr. 73 setting.
2. When connecting a frequency setting potentiometer across terminals 10-2-5 for operation, always set "0" in this parameter.

4.2.29 Input filter time constant (Pr. 74)

Pr. 74 "filter time constant"

You can set the input section's internal filter constant for an external voltage or current frequency setting signal.

• Effective for eliminating noise in the frequency setting circuit.
• Increase the filter time constant if steady operation cannot be performed due to noise. A larger setting results in slower response. (The time constant can be set between approximately 1ms to 1s with the setting of 0 to 8. A larger setting results in a larger filter time constant.)

Parameter Number	Factory Setting	Setting Range
74	1	0 to 8

4.2.30 Reset selection/disconnected PU detection/PU stop selection (Pr. 75)

Pr. 75 "reset selection/disconnected PU detection/PU stop selection"

You can select the reset input acceptance, PU (operation panel/FR-PU04) connector disconnection detection function and PU stop function.

- Reset selection : You can select the reset function input timing.
- PU disconnection detection: When it is detected that the PU (operation panel/FR-PU04) is disconnected from the inverter for more than 1s, the inverter outputs an alarm code (E.PUE) and comes to an alarm stop.
- PU stop selection : When an alarm occurs in any operation mode, you can stop the inverter from the PU by pressing the STOP RESET key.

Parameter Number	Factory Setting	Setting Range
75	14	0 to 3, 14 to 17

<Setting>

Pr. 75 Setting	Reset Selection	PU Disconnection Detection	PU Stop Selection
0	Reset input normally enabled.	If the PU is disconnected, operation will be continued.	Pressing the STOP RESET key decelerates the inverter to a stop only in the PU operation mode.
1	Reset input enabled only when the inverter is tripped.		
2	Reset input normally enabled.	When the PU is disconnected, an error is displayed on the PU and the inverter output is shut off.	
3	Reset input enabled only when the inverter is tripped.		
14	Reset input normally enabled.	If the PU is disconnected, operation will be continued.	Pressing the STOP RESET key decelerates the inverter to a stop in any of the PU, external and communication operation modes.
15	Reset input enabled only when the inverter is tripped.		
16	Reset input normally enabled.	When the PU is disconnected, an error is displayed on the PU and the inverter output is shut off.	
17	Reset input enabled only when the inverter is tripped.		

How to make a restart after a stop by the STOP/RESET key on the PU

(1) Operation panel

1) After completion of deceleration to a stop, switch off the STF or STR signal.
2) Press the MODE key two times* to display "0P.Md".

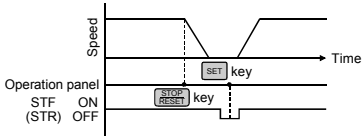
> Note: When Pr. 79 = 3, press the MODE key three times, to display "PU". Then, press the ▼ key and proceed to step 3).

(For the monitor screen) .....Refer to page 68 for the monitor display provided by pressing the MODE key.

3) Press the SET key.
4) Switch on the STF or STR signal.

(2) Parameter unit (FR-PU04)

1) After completion of deceleration to a stop, switch off the STF or STR signal.
2) Press the SET key.
3) Switch on the STF or STR signal.



Stop and restart example for external operation

The other way of making a restart other than the above method is to perform a power-reset or to make a reset with the inverter reset terminal.

Note: 1. If the reset signal (RES) is provided during operation, the inverter shuts off its output while it is reset, the data of the electronic thermal relay function and regenerative brake duty are reset, and the motor coasts.
2. The PU disconnection detection function judges that the PU is disconnected when it is removed from the inverter for more than 1s. If the PU had been disconnected before power-on, it is not judged as an alarm.
3. To resume operation, reset the inverter after confirming that the PU is connected securely.
4. The Pr. 75 value can be set any time. Also, if parameter (all) clear is executed, this setting will not return to the initial value.
5. When the inverter is stopped by the PU stop function, PS is displayed but an alarm is not output.
When the PU connector is used for RS-485 communication operation, the reset selection and PU stop selection functions are valid but the PU disconnection detection function is invalid.

⚠ CAUTION

⚠ **Do not reset the inverter with the start signal on.**
Otherwise, the motor will start instantly after resetting, leading to potentially hazardous conditions.

4.2.31 Parameter write disable selection (Pr. 77)

Pr. 77 "parameter write disable selection"

Related parameters
Pr. 79 "operation mode selection"

You can select between write-enable and disable for parameters. This function is used to prevent parameter values from being rewritten by incorrect operation.

Parameter Number	Factory Setting	Setting Range
77	0	0, 1, 2

<Setting>

Pr. 77 Setting	Function
0	Parameter values may only be written during a stop in the PU operation mode. (Note 1)
1	Write disabled. (Note 2) Values of Pr. 22, Pr. 75, Pr. 77 and Pr. 79 "operation mode selection" can be written.
2	Write enabled even during operation. (Note 3) Setting is enabled independently of the operation mode.

Note: 1. The shaded parameters in the parameter list (page 82) can be set at any time.
2. By setting "1" in Pr. 77, the following clear operations can be inhibited:
   • Parameter clear
   • All parameter clear
3. If Pr. 77 = 2, the values of Pr. 23, Pr. 66, Pr. 71, Pr. 79, Pr. 80, Pr. 83, Pr. 84, Pr. 96, Pr. 180 to Pr.183 and Pr. 190 to Pr. 192 cannot be written during operation. Stop operation when changing their parameter settings.

4.2.32 Reverse rotation prevention selection (Pr. 78)

Pr. 78 "reverse rotation prevention selection"

Related parameters
Pr. 79 "operation mode selection"

This function can prevent any reverse rotation fault resulting from the incorrect input of the start signal.

- Used for a machine which runs only in one direction, e.g. fan, pump.
  (The setting of this function is valid for the combined, PU, external and communication operations.)

Parameter Number	Factory Setting	Setting Range
78	0	0, 1, 2

<Setting>

Pr. 78 Setting	Function
0	Both forward and reverse rotations allowed
1	Reverse rotation disallowed
2	Forward rotation disallowed

4.2.33 Operation mode selection (Pr. 79)

Pr. 79 "operation mode selection"

Related parameters
Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 (multi-speed operation)
Pr. 75 "reset selection/disconnected PU detection/PU stop selection"
Pr. 146 "frequency setting command selection"
Pr. 180 to Pr. 183 (input terminal function selection)

Used to select the operation mode of the inverter. The inverter can be run from the operation panel or parameter unit (PU operation), with external signals (external operation), or by combination of PU operation and external operation (external/PU combined operation).
When power is switched on (factory setting), the PU operation mode is selected.

Parameter Number	Factory Setting	Setting Range
79	1	0 to 4, 6 to 8

<Setting>

In the following table, operation using the operation panel or parameter unit is abbreviated to PU operation.

Pr. 79 Setting	Function		
0	When power is switched on, the external operation mode is selected. PU or external operation can be selected by pressing the keys of the operation panel or parameter unit. (Refer to page 60) For these modes, refer to the setting 1 and 2 below.		
1	**Operation mode** PU operation mode (*)	**Running frequency** Digital setting using the built-in frequency setting potentiometer or by the key operation of the operation panel or parameter unit	**Start signal** RUN (FWD , REV) key of operation panel or FWD or REV key of parameter unit
2	External operation mode	External signal input (across terminals 2 (4)-5, multi-speed selection)	External signal input (terminal STF, STR)
3	External/PU combined operation mode 1 (*)	Digital setting using the built-in frequency setting potentiometer or by the key operation of the operation panel or parameter unit, or external signal input (multi-speed setting only)	External signal input (terminal STF, STR)
4	External/PU combined operation mode 2	External signal input (across terminals 2 (4)-5, multi-speed selection)	RUN (FWD , REV) key of operation panel or FWD or REV key of parameter unit
6	Switch-over mode Switch-over between PU and external operation modes can be done while running.		
7	External operation mode (PU operation interlock) MRS signal ON ..... Able to be switched to PU operation mode (output stop during external operation) MRS signal OFF ..... Switching to PU operation mode inhibited		
8	Switching to other than external operation mode (disallowed during operation) X16 signal ON ..... Switched to external operation mode X16 signal OFF ..... Switched to PU operation mode		

* Use Pr. 146 "frequency setting command selection" to select whether operation is to be performed with the built-in frequency setting potentiometer or ▲/▼ key.

Note: 1. Either "3" or "4" may be set to select the PU/external combined operation. These settings differ in starting method.

2. The stop function (PU stop selection) activated by pressing STOP RESET of the PU (operation panel/FR-PU04) is valid even in other than the PU operation mode when shipped from the factory. (Refer to page 130.)

(1) Switch-over mode

During operation, you can change the current operation mode to another operation mode.

Operation Mode Switching	Switching Control/Operating Status
External operation to PU operation	1) Operate the operation panel keys to select the PU operation mode. • Rotation direction is the same as that of external operation. • Set frequency is the same as the external frequency setting signal value. (Note that the setting will disappear when power is switched off or the inverter is reset.)
PU operation to external operation	1) Operate the operation panel keys to select the external operation mode. • Rotation direction is determined by the external operation input signal. • Set frequency is determined by the external frequency setting signal.

Note: When the switch-over mode is selected, the operation panel's potentiometer setting is made invalid even if the Pr. 146 "built-in potentiometer switching" setting is 0 or 9999.

(2) PU operation interlock

The PU operation interlock function is designed to forcibly change the operation mode to external operation mode when the MRS signal switches off. This function prevents the inverter from being inoperative by the external command if the mode is accidentally left unswitched from PU operation mode.

1)Preparation

- Set "7" in Pr. 79 (PU operation interlock).
- Set the terminal used for MRS signal input with any of Pr. 180 to Pr. 183 (input terminal function selection).
  Refer to page 171 for Pr. 180 to Pr. 183 (input terminal function selection).

Note: Changing the terminal assignment using Pr. 180 to Pr. 183 (input terminal function selection) may affect the other functions.
Check the functions of the corresponding terminals before making settings.

2)Function

MRS Signal	Function/Operation
ON	Output stopped during external operation. Operation mode can be switched to PU operation mode. Parameter values can be rewritten in PU operation mode. PU operation allowed.
OFF	Forcibly switched to external operation mode. External operation allowed. Switching to PU operation mode inhibited.

<Function/operation changed by switching on-off the MRS signal>

Operating Condition		MRS Signal	Operation Mode (Note 4)	Operating Status	Parameter Write	Switching to PU Operation Mode
Operation mode	Status					
PU	During stop	ON → OFF (Note 3)	External	During stop	Enabled → disabled	Disabled
	During operation	ON → OFF (Note 3)		If external operation frequency setting and start signal are entered, operation is performed in that status.	Enabled → disabled	Disabled
External	During stop	OFF → ON	External	During stop	Disabled → disabled	Enabled
		ON → OFF			Disabled → disabled	Disabled
	During operation	OFF → ON		During operation → output stop	Disabled → disabled	Disabled
		ON → OFF		Output stop → operation	Disabled → disabled	Disabled

Note: 1. If the MRS signal is on, the operation mode cannot be switched to the PU operation mode when the start signal (STF, STR) is on.
2. The operation mode switches to the external operation mode independently of whether the start signal (STF, STR) is on or off.
Therefore, the motor is run in the external operation mode when the MRS signal is switched off with either of STF and STR on.
3. When the protective function (major fault) is activated, the inverter can be reset by pressing the STOP/RESET key of the operation panel.
4. Switching the MRS signal on and rewriting the Pr. 79 value to other than "7" in the PU operation mode causes the MRS signal to provide the ordinary MRS function (output stop). Also as soon as "7" is set in Pr. 79, the operation mode is switched to PU operation mode.

(3) Operation mode switching by external signal

1) Preparation
Set "8" (switching to other than external operation mode) in Pr. 79.
Use any of Pr. 180 to Pr. 183 (input terminal function selection) to set the terminal used for X16 signal input.
Refer to page 171 for Pr. 180 to Pr. 183 (input terminal function selection).

Note: Changing the terminal assignment using Pr. 180 to Pr. 183 (input terminal function selection) may affect the other functions.
Check the functions of the corresponding terminals before making settings.

2) Function
This switching is enabled during an inverter stop only and cannot be achieved during operation.

X16 Signal	Operation Mode
ON	External operation mode (cannot be changed to PU operation mode)
OFF	PU operation mode (cannot be changed to external operation mode)

4.2.34 General-purpose magnetic flux vector control selection (Pr. 80)

Pr. 80 "motor capacity"

Related parameters
Pr. 71 "applied motor"
Pr. 83 "rated motor voltage"
Pr. 84 "rated motor frequency"
Pr. 96 "auto-tuning setting/status"

You can set the general-purpose magnetic flux vector control.

- General-purpose magnetic flux vector control
  Provides large starting torque and sufficient low-speed torque.
  If the motor constants vary slightly, stable, large low-speed torque is provided without specific motor constant setting or tuning.

Parameter Number	Factory Setting	Setting Range	Remarks
80	9999	0.1kW to 7.5kW, 9999 (Note)	9999: V/F control

Note: The setting range changes with the inverter: 0.2kW to 7.5kW, 9999 for the 400V class.

If any of the following conditions are not satisfied, faults such as torque shortage and speed fluctuation may occur. In this case, select V/F control.

<Operating conditions>

- The motor capacity is equal to or one rank lower than the inverter capacity.
- The number of motor poles is any of 2, 4, and 6. (4 poles only for the constant-torque motor)
- Single-motor operation (one motor for one inverter) is performed.
- The wiring length between the inverter and motor is within 30m. (If the length is over 30m, perform offline auto tuning with the cables wired.)

<Setting>

(1) General-purpose magnetic flux vector control

- The general-purpose magnetic flux vector control can be selected by setting the capacity of the motor used in Pr. 80.

Parameter Number	Setting	Description	
80	9999	V/F control	
	0.1 to 7.5/ 0.2 to 7.5 (Note)	Set the motor capacity applied.	General-purpose magnetic flux vector control

Note: The setting range changes with the inverter: 0.2kW to 7.5kW, 9999 for the 400V class.

- When using Mitsubishi constant-torque motor (SF-JRCA), set "1" in Pr. 71. (When using the SF-HRCA, perform the offline auto tuning.)

4.2.35 Offline auto tuning function (Pr. 82 to Pr. 84, Pr. 90, Pr. 96)

Pr. 82 "motor excitation current"

Pr. 83 "rated motor voltage"

Pr. 84 "rated motor frequency"

Pr. 90 "motor constant (R1)"

Pr. 96 "auto-tuning setting/status"

Related parameters

Pr. 7 "acceleration time"
Pr. 9 "electronic thermal O/L relay "
Pr. 71 "applied motor"
Pr. 79 "operation mode selection"
Pr. 80 "motor capacity"

What is auto tuning?

(1) The general-purpose magnetic flux vector control system gets the best performance from the motor for operation.

(2) Using the offline auto tuning function to improve the operational performance of the motor.

When you use the general-purpose magnetic flux vector control, you can perform the offline auto tuning operation to calculate the motor constants automatically.

- Offline auto tuning is made valid only when Pr. 80 is set to other than "9999" to select the general-purpose magnetic flux vector control.
- The Mitsubishi standard motor (SF-JR0.4kW or more) or Mitsubishi constant-torque motor (SF-JRCA 200V class and 4-pole motor of 0.4kW to 7.5kW) allows general-purpose magnetic flux vector control operation to be performed without using the offline auto tuning function. However, if any other motor (Motor made of the other manufacturers or SF-JRC, etc.) is used or the wiring distance is long, using the offline auto tuning function allows the motor to be operated with the optimum operational characteristics.
- Offline auto tuning
  Automatically measures the motor constants used for general-purpose magnetic flux vector control.
  - Offline auto tuning can be performed with the load connected.
  - The offline auto tuning status can be monitored with the operation panel or parameter unit (FR-PU04).
  - Offline auto tuning is available only when the motor is at a stop.
- Tuning data (motor constants) can be copied to another inverter with the parameter unit (FR-PU04).
  - You can read, write and copy the motor constants tuned by the offline auto tuning.

Parameter Number	Factory Setting	Setting Range	Remarks
82	9999	0 to 500A, 9999	9999: Mitsubishi standard motor
83	200V/400V	0 to 1000V	Rated inverter voltage
84	60Hz	50 to 120Hz	
90	9999	0 to 50Ω, 9999	9999: Mitsubishi standard motor
96	0	0, 1	0: No tuning

<Operating conditions>

- The motor is connected.
- The motor capacity is equal to or one rank lower than the inverter capacity.
- Special motors such as high-slip motors and high-speed motors cannot be tuned.
- The motor may move slightly. Therefore, fix the motor securely with a mechanical brake, or before tuning, make sure that there will be no problem in safety if the motor runs.
  *This instruction must be followed especially for vertical lift applications.
  If the motor runs slightly, tuning performance is unaffected.
- Offline auto tuning will not be performed properly if it is started when a reactor or surge voltage suppression filter (FR-ASF-H) is connected between the inverter and motor. Remove it before starting tuning.

<Setting>

(1) Parameter setting

- Set the motor capacity (kW) in Pr. 80 and select the general-purpose magnetic flux vector control.
- Refer to the parameter details list and set the following parameters:

1) Set "1" in Pr. 96.
2) Set the rated motor current (A) in Pr. 9.
3) Set the rated motor voltage (V) in Pr. 83.
4) Set the rated motor frequency (Hz) in Pr. 84.
5) Select the motor using Pr. 71.
   - Standard motor ..... Pr. 71 = "3" or "103"
   - Constant-torque motor ..... Pr. 71 = "13" or "113"
   - Mitsubishi standard motor SF-JR 4 poles (1.5kW or less)..... Pr. 71 = "23" or "123"

Note: Pr. 83 and Pr. 84 are only displayed when the general-purpose magnetic flux vector control is selected.
In these parameters, set the values given on the motor plate. Set 200V/60Hz or 400V/60Hz if the standard or other motor has more than one rated value.
After tuning is over, set the Pr. 9 "electronic thermal O/L relay" value to the rated current at the operating voltage/frequency.

■ **Parameter details**

Parameter Number	Setting	Description		
9	0 to 500A	Set the rated motor current (A).		
71 (Note)	0, 100	Thermal characteristics suitable for standard motor		
	1, 101	Thermal characteristics suitable for Mitsubishi's constant-torque motor		
	3, 103	Standard motor		Select "offline auto tuning setting"
	13, 113	Constant-torque motor		
	23, 123	Mitsubishi's SF-JR4P standard motor (1.5kW or less)		
	5, 105	Standard motor	Star connection	Direct input of motor constants enabled
	15, 115	Constant-torque motor		
	6, 106	Standard motor	Delta connection	
	16, 116	Constant-torque motor		
83	0 to 1000V	Set the rated motor voltage (V).		
84	50 to 120Hz	Set the rated motor frequency (Hz).		
90	0 to 50Ω, 9999	Tuning data (Values measured by offline auto tuning are set automatically.)		
96	0	Offline auto tuning is not performed.		
	1	Offline auto tuning is performed.		

Note: The electronic thermal relay function characteristics are also selected simultaneously. By setting any of "100 to 123", the electronic thermal relay function changes to the thermal characteristic of the constant-torque motor when the RT signal switches on.

(2) Tuning execution

- For PU operation or combined operation 2, press the FWD or REV key.
- For external operation or combined operation 1, switch on the run command.

Note: 1. To force tuning to end
- Switch on the MRS or RES signal or press the STOP/RESET key to end.
- Switch off the tuning start command to make a forced end.

2. During offline auto tuning, only the following I/O signals are valid:
- Input signals
  <Valid signals>
  MRS, RES, STF, STR
- Output signals
  RUN, FM, A, B, C

3. Special caution should be exercised when a sequence has been designed to open the mechanical brake with the RUN signal.

(3) Monitoring the offline tuning status

When the parameter unit (FR-PU04) is used, the Pr. 96 value is displayed during tuning on the main monitor as shown below. When the operation panel is used, the same value as on the FR-PU04 is only displayed:

• Operation panel display

(For inverter trip)

	1. Setting	2. Tuning in progress	3. Completion	4. Error-activated end
Displayed value	1	→ 2	→ 3	9

• Parameter unit (FR-PU04) main monitor

(For inverter trip)

	1. Setting	2. Tuning in progress	3. Completion	4. Error-activated end
Display	1 ---STOP PU	→ TUNE 2 STF FWD PU	→ TUNE 3 COMPLETION STF STOP PU	→ TUNE 9 ERROR STF STOP PU

• Reference: Offline auto tuning time (factory setting) is about 10s.

(4) Ending the offline auto tuning

1) Confirm the Pr. 96 value.
   - Normal end: "3" is displayed.
   - Abnormal end: "9", "91", "92" or "93" is displayed.
   - Forced end: "8" is displayed.

2) When tuning ended normally

   For PU operation or combined operation 2, press the STOP RESET key. For external operation or combined operation 1, switch off the start signal (STF or STR) once. This operation resets the offline auto tuning and the PU's monitor display returns to the ordinary indication. (Without this operation, next operation cannot be done.)
   Do not change the Pr.96 setting after completion of tuning (3). If the Pr.96 setting is changed, tuning data is made invalid. If the Pr.96 setting is changed, tuning must be performed again.

3) When tuning was ended due to an error

   Offline auto tuning did not end normally. (The motor constants have not been set.)
   Reset the inverter and start tuning all over again.

4) Error display definitions

Error Display	Error Cause	Remedy
9	Inverter trip	Make setting again.
91	Current limit (stall prevention) function was activated.	Increase acceleration/deceleration time. Set "1" in Pr. 156.
92	Converter output voltage reached 75% of rated value.	Check for fluctuation of power supply voltage.
93	Calculation error	Check the motor wiring and make setting again.

No connection with motor will result in a calculation (93) error.

5) When tuning was forced to end

An forced end occurs when you forced the tuning to end by pressing the STOP RESET key or switching off the start signal (STF or STR) during tuning.
In this case, the offline auto tuning has not ended normally.
(The motor constants are not set.)
Reset the inverter and restart the tuning.

Note: 1. The R1 motor constant measured during the offline auto tuning is stored as a parameter and its data is held until the offline auto tuning is performed again.
2. An instantaneous power failure occurring during tuning will result in a tuning error.
After power is restored, the inverter goes into the ordinary operation mode. Therefore, when STF (STR) is on, the motor runs in forward (reverse) rotation.
3. Any alarm occurring during tuning is handled as in the ordinary mode. Note that if an error retry has been set, retry is ignored.
4. The set frequency monitor displayed during the offline auto tuning is 0Hz.

⚠ CAUTION

⚠ **When the offline auto tuning is used for an elevating machine, e.g. a lifter, it may drop due to insufficient torque.**

<Setting the motor constant as desired>

- To set the motor constant without using the offline auto tuning data

<Operating procedure>

1. Set any of the following values in Pr. 71:

		Star Connection Motor	Delta Connection Motor
Setting	Standard motor	5 or 105	6 or 106
	Constant-torque motor	15 or 115	16 or 116

By setting any of "105 to 116", the electronic thermal relay function changes to the thermal characteristics of the constant-torque motor when the RT signal switches on.

2. Set "801" in Pr. 77.
   (Only when the Pr. 80 setting is other than "9999", the parameter values of the motor excitation current (Pr. 82) and motor constant (Pr. 90) can be displayed. Though the parameters other than Pr. 82 and Pr. 90 can also be displayed, they are parameters for manufacturer setting and their values should not be changed.)
3. In the parameter setting mode, read the following parameters and set desired values:

Parameter Number	Name	Setting Range	Setting Increments	Factory Setting
82	Motor excitation current	0 to 500A, 9999	0.01A	9999
90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999

4. Return the Pr. 77 setting to the original value.
5. Refer to the following table and set Pr. 84:

Parameter Number	Name	Setting Range	Setting Increments	Factory Setting
84	Rated motor frequency	50 to 120Hz	0.01Hz	60Hz

Note: 1. The Pr. 90 value may only be read when general-purpose magnetic flux vector control has been selected.
2. Set "9999" in Pr. 90 to use the standard motor constant (including that for the constant-torque motor).
3. If "star connection" is mistaken for "delta connection" or vice versa during setting of Pr. 71, general-purpose magnetic flux vector control cannot be exercised normally.

4.2.36 Computer link operation (Pr. 117 to Pr. 124, Pr. 342)

Pr. 117 "communication station number"
Pr. 118 "communication speed"
Pr. 119 "stop bit length"
Pr. 120 "parity check presence/absence"
Pr. 121 "number of communication retries"
Pr. 122 "communication check time interval"
Pr. 123 "waiting time setting"
Pr. 124 "CR/LF selection"

Related parameter
Pr. 146 "frequency setting command selection"

Pr. 342 "E^{2}PROM write selection"

Used to perform required settings for RS-485 communication between the inverter and personal computer.
Using the inverter setup software (FR-SW□-SETUP-WE (or -WJ for Japanese version)), parameter setting, monitoring, etc. can be done efficiently.

- **The motor can be run from the PU connector of the inverter using RS-485 communication.**

Communication specifications

Conforming standard			EIA-485 (RS-485)
Number of inverters connected			1:N (maximum 32 inverters)
Communication speed			Selectable between 19200, 9600 and 4800bps
Control protocol			Asynchronous
Communication method			Half-duplex
Communication specifications	Character system		ASCII (7 bits/8 bits) selectable
	Stop bit length		Selectable between 1 bit and 2 bits.
	Terminator		CR/LF (presence/absence selectable)
	Check system	Parity check	Selectable between presence (even/odd) and absence
		Sum check	Present
	Waiting time setting		Selectable between presence and absence

- **For the instruction codes of the parameters, refer to Appendix 1 "Instruction Code List" (page 242).**

REMARKS

For computer link operation, set 65520 (HFFF0) as the value "8888" and 65535 (HFFFF) as the value "9999".

Parameter Number	Factory Setting	Setting Range	
117	0	0 to 31	
118	192	48, 96, 192	
119	1	Data length 8	0, 1
		Data length 7	10, 11
120	2	0, 1, 2	
121	1	0 to 10ms, 9999	
122*	0	0, 0.1 to 999.8 s, 9999	
123	9999	0 to 150ms, 9999	
124	1	0, 1, 2	
342	0	0, 1	

* When making communication, set any value other than 0 in Pr. 122 "communication check time interval".

<Setting>

To make communication between the personal computer and inverter, initialization of the communication specifications must be made to the inverter. If initial setting is not made or there is a setting fault, data transfer cannot be made.

Note: After making the initial setting of the parameters, always reset the inverter. After you have changed the communication-related parameters, communication cannot be made until the inverter is reset.

Parameter Number	Name	Setting		Description
117	Communication station number	0 to 31		Station number specified for communication from the PU connector. Set the inverter station numbers when two or more inverters are connected to one personal computer.
118	Communication speed	48		4800bps
		96		9600bps
		192		19200bps
119	Stop bit length	8 bits	0	Stop bit length 1 bit
			1	Stop bit length 2 bits
		7 bits	10	Stop bit length 1 bit
			11	Stop bit length 2 bits
120	Parity check presence/ absence	0		Absent
		1		Odd parity present
		2		Even parity present
121	Number of communication retries	0 to 10		Set the permissible number of retries at occurrence of a data receive error. If the number of consecutive errors exceeds the permissible value, the inverter will come to an alarm stop.
		9999 (65535)		If a communication error occurs, the inverter will not come to an alarm stop. At this time, the inverter can be coasted to a stop by MRS or RES input. During a communication error (H0 to H5), the minor fault signal (LF) is switched on. Allocate the used terminal with any of Pr. 190 to Pr. 192 (multi-function outputs).

4

Parameter Number	Name	Setting	Description
122	Communication check time interval	0	No communication
		0.1 to 999.8	Set the communication check time [seconds] interval. If a no-communication state persists for longer than the permissible time, the inverter will come to an alarm stop.
		9999	Communication check suspension
123	Waiting time setting	0 to 150	Set the waiting time [ms] between data transmission to the inverter and response.
		9999	Set with communication data.
124	CR/LF selection	0	Without CR/LF
		1	With CR, without LF
		2	With CR/LF
342*	E^2PROM write selection	0	When parameter write is performed from the computer, parameters are written to E^2PROM.
		1	When parameter write is performed from the computer, parameters are written to RAM.

* When you have set write to RAM, powering off the inverter clears the parameter values that have been changed. Therefore the parameter values available when power is switched on again are those stored previously in E^2PROM.
When the parameter values will be changed frequently, set "1" in Pr. 342 to choose write to RAM. Performing frequent parameter write with "E^2PROM write" set will shorten the life of the E^2PROM.
The Pr. 342 " E^2PROM write selection" setting is also valid when the communication option is fitted.

- Set "1" or "9999" in Pr. 146 "frequency setting command selection" .

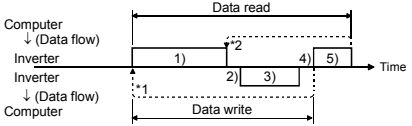
REMARKS

When parameter is set to without E^2PROM write (Pr.342="1"), performing power reset or terminal reset returns the setting value to the original value (value stored in E^2PROM).

<Computer programming>

(1) Communication protocol

Data communication between the computer and inverter is performed using the following procedure:



*1. If a data error is detected and a retry must be made, execute retry operation with the user program. The inverter comes to an alarm stop if the number of consecutive retries exceeds the parameter setting.
*2. On receipt of a data error occurrence, the inverter returns "reply data 3)" to the computer again. The inverter comes to an alarm stop if the number of consecutive data errors reaches or exceeds the parameter setting.

(2) Communication operation presence/absence and data format types

Communication operation presence/absence and data format types are as follows:

No.	Operation		Run Command	Running Frequency	Parameter Write	Inverter Reset	Monitoring	Parameter Read
1)	Communication request is sent to the inverter in accordance with the user program in the computer.		A'	A (A") Note 1	A (A") Note 2	A	B	B
2)	Inverter data processing time		Present	Present	Present	Absent	Present	Present
3)	Reply data from the inverter (Data 1) is checked for error.	No error* (Request accepted)	C	C	C	Absent	E,E' (E") Note 1	E (E") Note 2
		With error (request rejected)	D	D	D	Absent	F	F
4)	Computer processing delay time		Absent	Absent	Absent	Absent	Absent	Absent
5)	Answer from computer in response to reply data 3). (Data 3) is checked for error)	No error* (No inverter processing)	Absent	Absent	Absent	Absent	G	G
		With error. (Inverter outputs 3) again)	Absent	Absent	Absent	Absent	H	H

* In the communication request data from the computer to the inverter, 10ms or more is also required after "no data error (ACK)". (Refer to page 150.)

Note: 1. Setting any of "0.01 to 9998" in Pr. 37 "speed display" and "1" in instruction code "HFF" changes the data format to A" or E" (400V class). Regardless of the instruction code "HFF" setting, the data format for 200V or 100V class is always A" or E". The output frequency is the value of the speed display and its unit is 0.001r/min. If the instruction code FF is not 1, the unit is 1r/min and the 4-digit data format can be used.
2. The read/write data format of Pr. 37 "speed display" is always E"/A".

(3) Data format

Data communication between the computer and inverter is made in ASCII code (hexadecimal code).

• Data format types

1) Communication request data from computer to inverter

[Data write]

Format A

1	2	3	4	5	6	7	8	9	10	11	12	13
*1 ENQ	*2 Inverter station number		Instruction code		*3 Waiting time	Data				Sum check		*4

← Number of characters

Format A'

1	2	3	4	5	6	7	8	9	10	11
*1 ENQ	*2 Inverter station number		Instruction code		*3 Waiting time	Data		Sum check		*4

← Number of characters

Format A"

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
*1 ENQ	*2 Inverter station number		Instruction code		*3 Waiting time	Data						Sum check		*4

← Number of characters

[Data read]

Format B

1	2	3	4	5	6	7	8	9
*1 ENQ	*2 Inverter station number		Instruction code		*3 Waiting time	Sum check		*4

← Number of characters

2) Reply data from inverter to computer during data write

[No data error detected]

Format C

1	2	3	4
*1 ACK	*2 Inverter station number		*4

← Number of characters

[Data error detected]

Format D

1	2	3	4	5
*1 NAK	*2 Inverter station number		Error code	*4

← Number of characters

3) Reply data from inverter to computer during data read

[No data error detected]

Format E

1	2	3	4	5	6	7	8	9	10	11
*1 STX	*2 Inverter station number		Read data				*1 ETX	Sum check		*4

Format E'

1	2	3	4	5	6	7	8	9
*1 STX	*2 Inverter station number		Read data		*1 ETX	Sum check		*4

← Number of characters

Format E"

1	2	3	4	5	6	7	8	9	10	11	12	13
*1 STX	*2 Inverter station number		Read data						*1 ETX	Sum check		*4

[Data error detected]

Format F

1	2	3	4	5
*1 NAK	*2 Inverter station number		Error code	*4

4) Send data from computer to inverter during data read

[No data error detected] (can be skipped)

Format G

1	2	3	4
*1 ACK	*2 Inverter station number		*4

← Number of characters

[Data error detected]

Format H

1	2	3	4
*1 NAK	*2 Inverter station number		*4

← Number of characters

*1. Indicate a control code. (Refer to (4) Data definitions.)
*2. The inverter station numbers may be set between H00 and H1F (stations 0 and 31) in hexadecimal.
*3. When the Pr. 123 "waiting time setting" setting is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters is decremented by 1.)
*4. CR, LF code
When data is transmitted from the computer to the inverter, CR (carriage return) and LF (line feed) (codes) are automatically set at the end of a data group on some computers. In this case, setting must also be made on the inverter according to the computer. Also, the presence or absence of the CR and LF codes can be selected using Pr. 124.

(4) Data definitions

1)Control codes

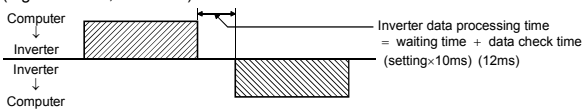
Signal	ASCII Code	Description
STX	H02	Start of Text (Start of data)
ETX	H03	End of Text (End of data)
ENQ	H05	Enquiry (Communication request)
ACK	H06	Acknowledge (No data error detected)
LF	H0A	Line Feed
CR	H0D	Carriage Return
NAK	H15	Negative Acknowledge (Data error detected)

2)Inverter station number
Specify the station number of the inverter which communicates with the computer.

3)Instruction code
Specify the processing request, e.g. operation or monitoring, given by the computer to the inverter. Hence, the inverter can be run and monitored in various ways by specifying the instruction code as appropriate. (Refer to page 242.)

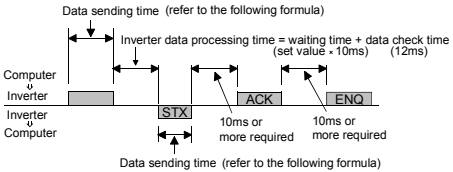
4)Data
Indicates the data such as frequency and parameters transferred to and from the inverter. The definitions and ranges of set data are determined in accordance with the instruction codes. (Refer to page 242.)

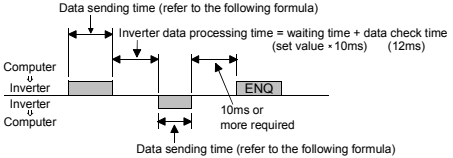
5)Waiting time
Specify the waiting time between the receipt of data at the inverter from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments (e.g. 1 = 10ms, 2 = 20ms).



Note: When the Pr. 123 "waiting time setting" setting is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters is decremented by 1.)

6)Response time





[Formula for data sending time]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters (Refer to page 148)} \times \text{Communication specification (Total number of bits) (See below)} = \text{Data sending time (s)}$$

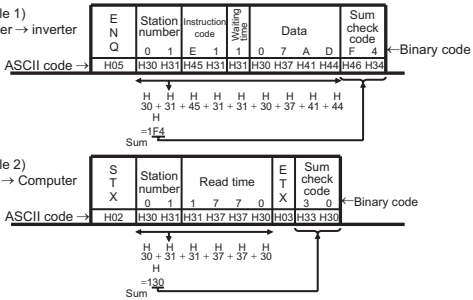
●Communication specification

Name		Number of Bits
Stop bit length		1 bit 2 bits
Data length		7 bits 8 bits
Parity check	Yes	1 bit
	No	0 bit

In addition to the bits in the above table, 1 bit is required for the start bit.
Minimum total number of bits..... 9 bits
Maximum total number of bits..... 12 bits

7)Sum check code

The sum check code is 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum (binary) derived from the checked ASCII data.



8)Error code

If any error is found in the data received by the inverter, its definition is sent back to the computer together with the NAK code. (Refer to page 155.)

Note: 1. When the data from the computer has an error, the inverter will not accept that data.
2. Any data communication, e.g. run command, monitoring, is started when the computer gives a communication request. Without the computer's command, the inverter does not return any data. For monitoring, therefore, design the program to cause the computer to provide a data read request as required.
3. When the parameter setting is read or written, the data of the link parameter expansion setting changes depending on the parameter. For the data, refer to the parameter instruction code list on page 242.

4

⚠ CAUTION

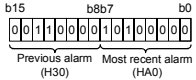
⚠ **When the inverter's permissible communication check time interval is not set, interlocks are provided to disable operation to prevent hazardous conditions. Always set the communication check time interval before starting operation.**

⚠ **Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc, the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter will come to an alarm stop (E.PUE).**
The inverter can be coasted to a stop by switching on its RES signal or by switching power off.

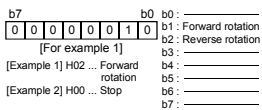
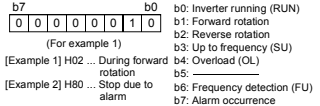
⚠ **If communication is broken due to signal cable breakage, computer fault etc, the inverter does not detect such a fault. This should be fully noted.**

<Setting items and set data>

After completion of parameter settings, set the instruction codes and data then start communication from the computer to allow various types of operation control and monitoring.

<table>
<tr><th>No.</th><th colspan="3">Item</th><th>Instruction Code</th><th>Description</th><th>Number of Data Digits (Instruction code FF=1)</th></tr>
<tr><td rowspan="2">1</td><td colspan="2" rowspan="2">Operation mode</td><td>Read</td><td>H7B</td><td>H0001: External operation
H0002: Communication operation</td><td rowspan="2">4 digits</td></tr>
<tr><td>Write</td><td>HFB</td><td>H0001: External operation
H0002: Communication operation</td></tr>
<tr><td rowspan="5">2</td><td rowspan="5">Monitoring</td><td colspan="2">Output frequency [speed]</td><td>H6F</td><td>H0000 to HFFFF: Output frequency (hexadecimal) in 0.01Hz increments
[Speed (hexadecimal) in r/min increments if Pr. 37 = 1 to 9998]</td><td>4 digits
(6 digits)</td></tr>
<tr><td colspan="2">Output current</td><td>H70</td><td>H0000 to HFFFF: Output current (hexadecimal) in 0.01A increments</td><td>4 digits</td></tr>
<tr><td colspan="2">Output voltage</td><td>H71</td><td>H0000 to HFFFF: Output voltage (hexadecimal) in 0.1V increments</td><td>4 digits</td></tr>
<tr><td colspan="2">Alarm definition</td><td>H74 to H77</td><td>H0000 to HFFFF: Two most recent alarm definitions
Alarm definition display example (instruction code H74)
 

Alarm data
<table>
<tr><th>Data</th><th>Description</th></tr>
<tr><td>H00</td><td>No alarm</td></tr>
<tr><td>H10</td><td>OC1</td></tr>
<tr><td>H11</td><td>OC2</td></tr>
<tr><td>H12</td><td>OC3</td></tr>
<tr><td>H20</td><td>OV1</td></tr>
<tr><td>H21</td><td>OV2</td></tr>
<tr><td>H22</td><td>OV3</td></tr>
<tr><td>H30</td><td>THT</td></tr>
<tr><td>H31</td><td>THM</td></tr>
<tr><td>H40</td><td>FIN</td></tr>
<tr><td>H60</td><td>OLT</td></tr>
<tr><td>H70</td><td>BE</td></tr>
</table>
<table>
<tr><th>Data</th><th>Description</th></tr>
<tr><td>H80</td><td>GF</td></tr>
<tr><td>H81</td><td>LF</td></tr>
<tr><td>H90</td><td>OHT</td></tr>
<tr><td>HA0</td><td>OPT</td></tr>
<tr><td>HB0</td><td>PE</td></tr>
<tr><td>HB1</td><td>PUE</td></tr>
<tr><td>HB2</td><td>RET</td></tr>
<tr><td>HC2</td><td>P24</td></tr>
<tr><td>HF3</td><td>E. 3</td></tr>
<tr><td>HF6</td><td>E. 6</td></tr>
<tr><td>HF7</td><td>E. 7</td></tr>
</table></td><td>4 digits</td></tr>
</table>

<table>
<tr><th>No.</th><th>Item</th><th>Instruction Code</th><th>Description</th><th>Number of Data Digits (Instruction code FF=1)</th></tr>
<tr><td>3</td><td>Run command</td><td>HFA</td><td> 
</td><td>2 digits</td></tr>
<tr><td>4</td><td>Inverter status monitor</td><td>H7A</td><td> 
</td><td>2 digits</td></tr>
<tr><td rowspan="4">5</td><td>Set frequency read (RAM)</td><td>H6D</td><td rowspan="2">Reads the set frequency (RAM or E^{2}PROM).
H0000 to H9C40: 0.01Hz increments (hexadecimal)</td><td rowspan="2">4 digits
(6 digits)</td></tr>
<tr><td>Set frequency read (E^{2}PROM)</td><td>H6E</td></tr>
<tr><td>Set frequency write (RAM)</td><td>HED</td><td rowspan="2">H0000 to H9C40: 0.01Hz increments (hexadecimal)
(0 to 400.00Hz)
To change the set frequency consecutively, write data to the inverter RAM.
(Instruction code: HED)</td><td rowspan="2">4 digits
(6 digits)</td></tr>
<tr><td>Set frequency write (E^{2}PROM)</td><td>HEE</td></tr>
<tr><td>6</td><td>Inverter reset</td><td>HFD</td><td>H9696: Resets the inverter.
As the inverter is reset on start of communication by the computer, the inverter cannot send reply data back to the computer.</td><td>4 digits</td></tr>
<tr><td>7</td><td>Alarm definition batch clear</td><td>HF4</td><td>H9696: Batch clear of alarm history</td><td>4 digits</td></tr>
<tr><td>8</td><td>All parameter clear</td><td>HFC</td><td>All parameters return to the factory settings.
Any of four different all clear operations is performed according to the data.
<table><tr><th>Pr. / Data</th><th>Communication Pr.</th><th>Calibration</th><th>Other Pr.*</th><th>HEC HFF</th></tr><tr><td>H9696</td><td>○</td><td>×</td><td>○</td><td>○</td></tr><tr><td>H9966</td><td>○</td><td>○</td><td>○</td><td>○</td></tr><tr><td>H5A5A</td><td>×</td><td>×</td><td>○</td><td>○</td></tr><tr><td>H55AA</td><td>×</td><td>○</td><td>○</td><td>○</td></tr></table>When all parameter clear is executed for H9696 or H9966, communication-related parameter settings also return to the factory settings.
When resuming operation, set the parameters again.
* Pr. 75 and Pr. 146 are not cleared.</td><td>4 digits</td></tr>
</table>

No.	Item		Instruction Code	Description	Number of Data Digits (Instruction code FF=1)
9	Parameter write		H80 to HFD	Refer to the "Instruction Code List" (page 242) and write and/or read the values as required. When setting Pr. 100 and later, link parameter extended setting must be set.	4 digits
10	Parameter read		H00 to H7B		
11	Link parameter expansion setting	Read	H7F	Parameter description is changed according to the H00 to H09 setting. For details of the settings, refer to the parameter instruction code list (page 242).	2 digits
		Write	HFF		
12	Second parameter changing (Instruction code HFF = 1)	Read	H6C	When setting the bias/gain (instruction codes H5E to H61, HDE to HE1) parameters H00: Offset/gain H01: Analog H02: Analog value of terminal	2 digits
		Write	HEC		

REMARKS

For the instruction codes HFF, HEC, their set values are held once they are written, but changed to 0 when the inverter is reset or all clear is performed.

<Error Code List>

The corresponding error code in the following list is displayed if an error is detected in any communication request data from the computer:

Error Code	Item	Definition	Inverter Operation
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than allowed number of retries.	Brought to an alarm stop (E.PUE) if error occurs continuously more than the allowable number of retries.
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	Data received by the inverter is in wrong protocol, data receive is not completed within given time, or CR and LF are not as set in the parameter.	
H4	Framing error	The stop bit length is not as specified by initialization.	
H5	Overrun error	New data has been sent by the computer before the inverter completes receiving the preceding data.	
H6	—	—	—
H7	Character error	The character received is invalid (other than 0 to 9, A to F, control code).	Does not accept received data but is not brought to an alarm stop.
H8	—	—	—
H9	—	—	—
HA	Mode error	Parameter write was attempted in other than the computer link operation mode or during inverter operation.	Does not accept received data but is not brought to an alarm stop.
HB	Instruction code error	The specified command does not exist.	
HC	Data range error	Invalid data has been specified for parameter write, frequency setting, etc.	
HD	—	—	—
HE	—	—	—
HF	—	—	—

(5) Communication specifications for RS-485 communication

Operation Location	Item	Operation Mode	
		Communication Operation from PU Connector	External Operation
Computer user program via PU connector	Run command (start)	Enabled	Disabled
	Running frequency setting	Enabled	Enabled (Combined operation mode)
	Monitoring	Enabled	Enabled
	Parameter write	Enabled (*2)	Disabled (*2)
	Parameter read	Enabled	Enabled
	Inverter reset	Enabled	Enabled
	Stop command (*1)	Enabled	Enabled
Control circuit terminal	Inverter reset	Enabled	Enabled
	Run command	Disabled	Enabled
	Running frequency setting	Disabled	Enabled

*1. As set in Pr. 75 "reset selection/disconnected PU detection/PU stop selection".
*2. As set in Pr. 77 "parameter write disable selection".

Note: At occurrence of RS-485 communication fault, the inverter cannot be reset from the computer.

(6) Operation at alarm occurrence

Fault Location	Status		Operation Mode	
			Communication Operation (PU connector)	External Operation
Inverter fault	Inverter operation		Stop	Stop
	Communication	PU connector	Continued	Continued
Communication error (Communication from PU connector)	Inverter operation		Stop/continued (*3)	Continued
	Communication	PU connector	Stop	Stop

*3. Can be selected using the corresponding parameter (factory-set to stop).

(7) Communication error

Fault Location	Error Message	Remarks
Communication error (Error in communication from PU connector)	Not displayed	Error code is E.PUE

4.2.37 PID control (Pr. 128 to Pr. 134)

Pr. 128 "PID action selection"

Pr. 129 "PID proportional band"

Pr. 130 "PID integral time"

Pr. 131 "upper limit"

Pr. 132 "lower limit"

Pr. 133 "PID action set point for PU operation"

Pr. 134 "PID differential time"

Related parameters
Pr. 73 "0-5V/0-10V selection"
Pr. 79 "operation mode selection"
Pr. 180 to Pr. 183 (input terminal function selection)
Pr. 190 to Pr. 192 (output terminal function selection)
Pr. 902 to Pr. 905 (frequency setting voltage (current) biases and gains)

The inverter can be used to exercise process control, e.g. flow rate, air volume or pressure.

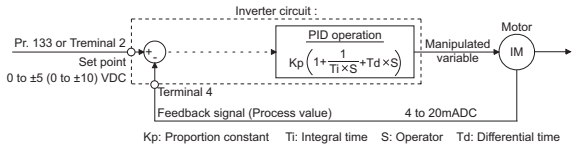
- The voltage input signal (0 to ±5V or 0 to ±10V) or Pr. 133 setting is used as a set point and the 4 to 20mA DC current input signal used as a feedback value to constitute a feedback system for PID control.

Parameter Number	Factory Setting	Setting Range	Remarks
128	0	0, 20, 21, 50, 51, 60, 61 *	
129	100%	0.1 to 1000%, 9999	9999: No proportional control
130	1s	0.1 to 3600s, 9999	9999: No integral control
131	9999	0 to 100%, 9999	9999: Function invalid
132	9999	0 to 100%, 9999	9999: Function invalid
133	0%	0 to 100%	
134	9999	0.01 to 10.00s, 9999	9999: No differential control

* "50, 51, 60, 61" can be set when used with the FR-E5NL.

<Setting>

(1) Basic PID control configuration



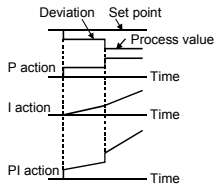
(2) PID action overview

1) PI action

A combination of proportional control action (P) and integral control action (I) for providing a manipulated variable in response to deviation and changes with time.

[Operation example for stepped changes of process value]

Note: PI action is the sum of P and I actions.

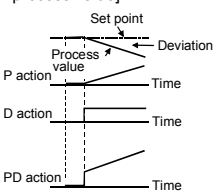


2) PD action

A combination of proportional control action (P) and differential control action (D) for providing a manipulated variable in response to deviation speed to improve the transient characteristic.

[Operation example for proportional changes of process value]

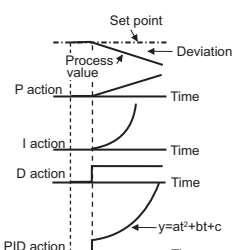
Note: PD action is the sum of P and D actions.



3) PID action

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

Note: The PID action is the sum of the P, I and D actions.



4) Reverse action

Increases the manipulated variable (output frequency) if deviation X = (set point - process value) is positive, and decreases the manipulated variable if deviation is negative.

5) Forward action

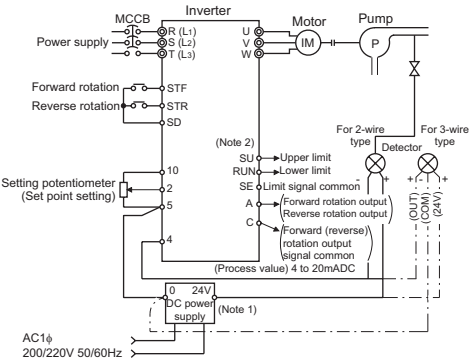
Increases the manipulated variable (output frequency) if deviation X = (set point - process value) is negative, and decreases the manipulated variable if deviation is positive.

Relationships between deviation and manipulated variable (output frequency)

	Deviation	
	Positive	**Negative**
Reverse action	↗	↘
Forward action	↘	↗

(3) Wiring example

- Pr. 128 = 20
- Pr. 190 = 14
- Pr. 191 = 15
- Pr. 192 = 16



Note: 1. The power supply must be selected in accordance with the power specifications of the detector used.
2. The output signal terminals used depends on the Pr. 190 to Pr. 192 settings.

(4) I/O signals

Signal		Terminal Used	Function	Description
Input	2	2	Set point input	Enter the set point for PID control.
	4	4	Process value input	Enter the 4 to 20mA process value signal from the detector.
Output	FUP	Depending on Pr. 190 to Pr. 192	Upper limit output	Output to indicate that the process value signal exceeded the upper limit value.
	FDN		Lower limit output	Output to indicate that the process value signal exceeded the lower limit value.
	RL		Forward (reverse) rotation direction output	"Hi" is output to indicate that the output indication of the parameter unit is forward rotation (FWD) or "Low" to indicate that it is reverse rotation (REV) or stop (STOP).

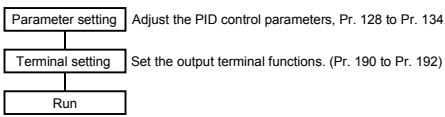
- Enter the set point across inverter terminals 2-5 or in Pr. 133 and enter the process value signal across inverter terminals 4-5. At this time, set "20" or "21" in Pr. 128.

Item	Entry	Description	
Set point	Across terminals 2-5	Set 0V as 0% and 5V as 100%.	When "0" is set in Pr. 73 (5V selected for terminal 2).
		Set 0V as 0% and 10V as 100%.	When "1" is set in Pr. 73 (10V selected for terminal 2).
	Pr. 133	Set the set point (%) in Pr. 133.	
Process value	Across terminals 4-5	4mA is equivalent to 0% and 20mA to 100%.	

(5) Parameter setting

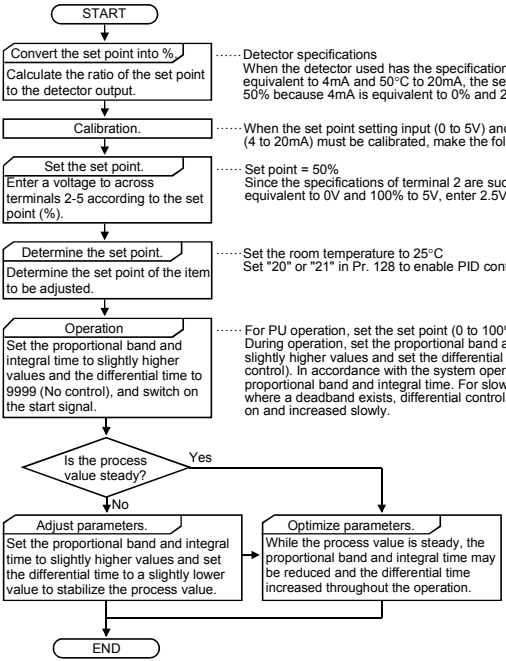
Parameter Number	Setting	Name	Description	
128	0	PID action selection	No PID action	
	20		For heating, pressure control, etc.	PID reverse action
	21		For cooling, etc.	PID forward action
	50		Refer to the E5NL instruction manual for details.	
	51			
	60			
	61			
129	0.1 to 1000%	PID proportional band	If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the process value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, e.g. hunting occurs. Gain K = 1/proportional band	
	9999		No proportional control	
130	0.1 to 3600s	PID integral time	Time required for the integral (I) action to provide the same manipulated variable as that for the proportional (P) action. As the integral time decreases, the set point is reached earlier but hunting occurs more easily.	
	9999		No integral control.	
131	0 to 100%	Upper limit	Set the upper limit. If the feedback value exceeds the setting, the FUP signal is output. (Process value of 4mA is equivalent to 0% and 20mA to 100%.)	
	9999		No function	
132	0 to 100%	Lower limit	Set the lower limit. (If the feedback value falls below the setting, the FDN signal is output. Process value of 4mA is equivalent to 0% and 20mA to 100%.)	
	9999		No function	
133	0 to 100%	PID action set point for PU operation	Only valid for the PU command in the PU operation or PU/external combined operation mode. For external operation, the voltage across 2-5 is the set point. (Pr. 902 value is equivalent to 0% and Pr. 903 value to 100%.)	
134	0.01 to 10.00 s	PID differential time	Time required for the differential (D) action to provide the same process value as that for the proportional (P) action. As the differential time increases, greater response is made to the deviation change.	
	9999		No differential control.	

(6) Adjustment procedure



(7) Calibration example

(A detector of 4mA at 0°C and 20mA at 50°C is used to adjust the room temperature to 25°C under PID control. The set point is given to across inverter terminals 2-5 (0-5V).)



* When calibration is required, use Pr. 902 and Pr. 903 (terminal 2) or Pr. 904 and Pr. 905 (terminal 4) to calibrate the detector output and set point setting input in the PU mode during an inverter stop.

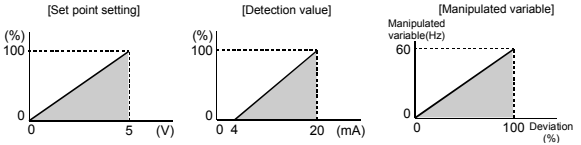
<Set point input calibration>

1. Apply the input voltage of 0% set point setting (e.g. 0V) to across terminals 2-5.
2. Make calibration using Pr. 902. At this time, enter the frequency which should be output by the inverter at the deviation of 0% (e.g. 0Hz).
3. Apply the voltage of 100% set point setting (e.g. 5V) to across terminals 2-5.
4. Make calibration using Pr. 903. At this time, enter the frequency which should be output by the inverter at the deviation of 100% (e.g. 60Hz).

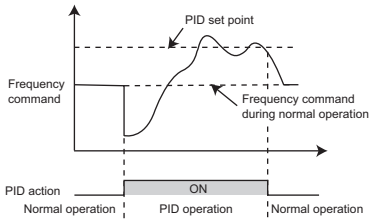
<Detector output calibration>

1. Apply the output current of 0% detector setting (e.g. 4mA) across terminals 4-5.
2. Make calibration using Pr. 904.
3. Apply the output current of 100% detector setting (e.g. 20mA) across terminals 4-5.
4. Make calibration using Pr. 905.

Note: The frequencies set in Pr. 904 and Pr. 905 should be the same as set in Pr. 902 and Pr. 903.
The results of the above calibration are as shown below:



Note: 1. Entering multi-speed (RH, RM, RL signal) or JOG operation will stop PID control and start multi-speed or JOG operation.
2. Changing the terminal assignment using Pr. 190 to Pr. 192 (output terminal function selection) may affect the other functions. Confirm the functions of the corresponding terminals before making settings.
3. When you have chosen the PID control, the minimum frequency is as set in Pr. 902 and the maximum frequency is as set in Pr. 903.
(The settings of Pr. 1 "maximum frequency" and Pr. 2 "minimum frequency" are also valid.)
4. When the control is switched to PID control during normal operation, the frequency command value calculated by PID operation using 0Hz as standard is used without the frequency during the operation.



Operation when control is switched to PID control during normal operation

4

4.2.38 Frequency setting command selection (Pr. 146)

Pr. 146 "frequency setting command selection"

Related parameters
Pr. 79 "operation mode selection"

- Used to switch the frequency setting between the frequency setting using the built-in frequency setting potentiometer and the digital frequency setting using the ▲/▼ key.

Parameter Number	Factory Setting	Setting Range
146	0	0, 1, 9999

<Setting>

Pr. 146 Setting	Frequency Setting Command
0	Built-in frequency setting potentiometer valid Frequency setting using the built-in frequency setting potentiometer
1	Built-in frequency setting potentiometer invalid Digital frequency setting using the ▲/▼ key Using this method, the frequency is varied continuously by pressing the ▲/▼ key. The frequency is varied only while the ▲/▼ key is pressed.
9999	• Frequency setting using the built-in frequency setting potentiometer is made valid when the frequency setting using the ▲/▼ key is "0Hz". (When you press the ▲/▼ key during operation performed by the frequency setting potentiometer, the digital frequency setting is selected and the frequency setting using the potentiometer is made invalid.) • When power is switched on with "0" set in Pr. 79 "operation mode selection", the PU operation mode is selected.

4.2.39 Output current detection function (Pr. 150, Pr. 151)

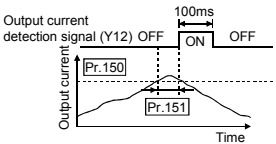
Pr. 150 "output current detection level"

Pr. 151 "output current detection period"

Related parameters
Pr. 190 to Pr. 192 (output terminal function selection)

- If the output current remains higher than the Pr. 150 setting during inverter operation for longer than the time set in Pr. 151, the output current detection signal (Y12) is output from the inverter's open collector output terminal.
  (Use any of Pr. 190 to Pr. 192 to assign the terminal used for Y12 signal output.)

Parameter Number	Factory Setting	Setting Range
150	150%	0 to 200.0%
151	0s	0 to 10 s



<Setting>

Refer to the following list and set the parameters:

Parameter Number	Description
150	Set the output current detection level. 100% is the rated inverter current.
151	Set the output current detection period. Set a period of time from when the output current rises to or above the Pr. 150 setting to when the output current detection signal (Y12) is output.

Note: 1. Once turned ON, when the output current has risen above the preset detection level, the output current detection signal is held for at least 100ms (approximately).
2. This function is also valid during execution of offline auto tuning.
3. When the terminal functions are changed using Pr. 190 to Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

4.2.40 Zero current detection (Pr. 152, Pr. 153)

Pr. 152 "zero current detection level"

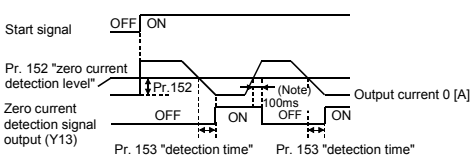
Pr. 153 "zero current detection period"

Related parameters
Pr. 190 to Pr. 192 (output terminal function selection)

When the inverter's output current falls to "0", torque will not be generated. This may cause a gravity drop when the inverter is used in vertical lift application.
To prevent this, the output current "zero" signal can be output from the inverter to close the mechanical brake when the output current has fallen to "zero".

- If the output current remains lower than the Pr. 152 setting during inverter operation for longer than the time set in Pr. 153, the zero current detection (Y13) signal is output from the inverter's open collector output terminal.
  (Use any of Pr. 190 to Pr. 192 to assign the terminal used for Y13 signal output.)

Parameter Number	Factory Setting	Setting Range
152	5.0%	0 to 200.0%
153	0.5 s	0.05 to 1 s



<Setting>

Refer to the following list and set the parameters:

Parameter Number	Description
152	Set the zero current detection level. Set this parameter to define the percentage of the rated current at which the zero current will be detected.
153	Set the zero current detection time. Set a period of time from when the output current falls to or below the Pr. 152 setting to when the zero current detection signal (Y13) is output.

Note: 1. If the current rises above the preset detection level but the timing condition is not satisfied, the zero current detection signal is held on for about 100ms.
2. This function is also valid during execution of offline auto tuning.
3. When the terminal functions are changed using Pr. 190 to Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

⚠ CAUTION

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

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

Pr. 156 ➔Refer to Pr. 22.

4.2.41 User group selection (Pr. 160, Pr. 173 to Pr. 176)

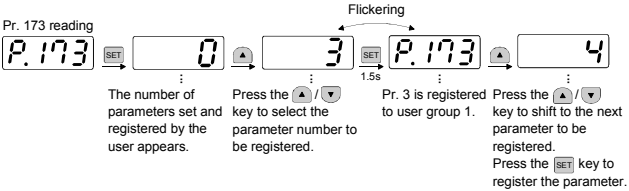
Pr. 160 "user group read selection"
Pr. 173 "user group 1 registration"
Pr. 174 "user group 1 deletion"
Pr. 175 "user group 2 registration"
Pr. 176 "user group 2 deletion"

Among all parameters, a total of 32 parameters can be registered to two different user groups. The registered parameters may only be accessed.
The other parameters cannot be read.

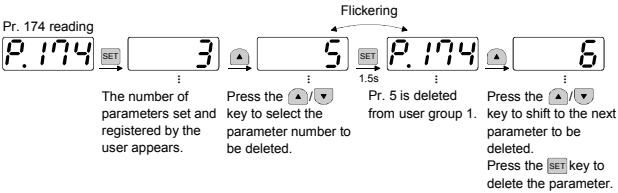
Parameter Number	Factory Setting	Setting Range	Remarks
160	0	0, 1, 10, 11	
173	0	0 to 999	
174	0	0 to 999, 9999	9999: Batch deletion
175	0	0 to 999	
176	0	0 to 999, 9999	9999: Batch deletion

<Examples of use>

(1) Registration of parameter to user group (when registering Pr. 3 to user group 1)



(2) Deletion of parameter from the user group (when Pr. 5 is deleted from user group 1)



(3) Set the required value in Pr. 160 to make the user group or groups valid or invalid.

Pr. 160 Setting	Description
0	Accessible to all parameters.
1	Accessible to only the parameters registered to user group 1.
10	Accessible to only the parameters registered to user group 2.
11	Accessible to only the parameters registered to user groups 1 and 2.

Note: 1. The Pr. 77, Pr. 160 and Pr. 991 values may always be read independently of the user group setting.
2. The Pr. 173 or Pr. 174 value read indicates the number of parameters registered to group 1, and the Pr. 175 or Pr. 176 value read indicates the number of parameters registered to group 2.
3. If "0" is set in the second digit of two-digit Pr. 160, it is not displayed. However, "0" is displayed when it is set in the first digit only.
4. When "9999" is set in Pr. 174 or Pr. 176, the parameters registered to the corresponding user group are batch-deleted.

4.2.42 Actual operation hour meter clear (Pr. 171)

Pr. 171 "actual operation hour meter clear"

Related parameter
Pr. 52 "operation panel/PU main display data selection"

You can clear the monitor (actual operation hour) value which is selected when Pr. 52 is "23".

Parameter Number	Factory Setting	Setting Range
171	0	0

<Setting>

Write "0" in the parameter to clear the actual operation hour.

Pr. 173 to Pr. 176 ➔Refer to Pr. 160.

4.2.43 Input terminal function selection (Pr. 180 to Pr. 183)

Pr. 180 "RL terminal function selection"

Pr. 181 "RM terminal function selection"

Pr. 182 "RH terminal function selection"

Pr. 183 "MRS terminal function selection"

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

Parameter Number	Terminal Symbol	Factory Setting	Factory-Set Terminal Function	Setting Range
180	RL	0	Low-speed operation command (RL)	0 to 8, 16, 18
181	RM	1	Middle-speed operation command (RM)	0 to 8, 16, 18
182	RH	2	High-speed operation command (RH)	0 to 8, 16, 18
183	MRS	6	Output shut-off (MRS)	0 to 8, 16, 18

<Setting>

Refer to the following list and set the parameters.

Setting	Signal Name	Function		Related Parameters
0	RL	Pr. 59 = 0	Low-speed operation command	Pr. 4 to Pr. 6 Pr. 24 to Pr. 27 Pr. 232 to Pr. 239
		Pr. 59 = 1, 2 *	Remote setting (setting clear)	Pr. 59
1	RM	Pr. 59 = 0	Middle-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
		Pr. 59 = 1, 2 *	Remote setting (deceleration)	Pr. 59
2	RH	Pr. 59 = 0	High-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
		Pr. 59 = 1, 2 *	Remote setting (acceleration)	Pr. 59
3	RT	Second function selection		Pr. 44 to Pr. 48
4	AU	Current input selection (Note 6)		
5	STOP	Start self-holding terminal		
6	MRS	Output shut-off terminal		
7	OH	External thermal relay input ** The external thermal relay provided for overheat protection or the embedded temperature relay within the motor is activated to stop the inverter.		Refer to page 203
8	REX	15-speed selection (combination with three speeds of RL, RM, RH)		Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
16	X16	PU operation-external operation switch-over		Pr. 79
18	X18	General-purpose magnetic flux vector-V/F switch-over (OFF: general-purpose magnetic flux vector control, ON: V/F control) (Note 3)		Pr. 80

* : When Pr. 59 = "1" or "2", the functions of the RL, RM and RH signals change as listed above.

**: Activated when the relay contact "opens".

Note: 1. One function can be assigned to two or more terminals. In this case, the terminal inputs are OR' ed.
2. The speed command priorities are higher in order of multi-speed setting (RH, RM, RL, REX) and AU.
3. When V/F control is selected using the V/F-general-purpose magnetic flux switch-over function, the secondary functions are also selected.
During operation, you cannot switch between V/F and general-purpose magnetic flux. Should you switch between V/F and general-purpose magnetic flux, only the second functions are selected.
4. Use common terminals to assign multi-speeds (7 speeds) and remote setting. They cannot be set individually.
(Common terminals are used since these functions are designed for multiple speed setting and need not be set at the same time.)
5. Functions are invalid if values other than the above are set to Pr. 180 to Pr. 183 (input terminal function selection).
6. Turning the AU signal on makes voltage input invalid.

4.2.44 Output terminal function selection (Pr. 190 to Pr. 192)

Pr. 190 "RUN terminal function selection"

Pr. 191 "FU terminal function selection"

Pr. 192 "A, B, C terminal function selection"

You can change the functions of the open collector and contact output terminals.

Parameter Number	Terminal Symbol	Factory Setting	Factory-Set Terminal Function	Setting Range
190	RUN	0	Inverter running	0 to 99
191	FU	4	Output frequency detection	0 to 99
192	ABC	99	Alarm output	0 to 99

<Setting>

Refer to the following table and set the parameters:

Setting	Signal Name	Function	Operation	Related Parameters
0	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above the starting frequency.	——
1	SU	Up to frequency	Refer to Pr. 41 "up-to-frequency sensitivity". (Note 1)	Pr. 41
3	OL	Overload alarm	Output while stall prevention function is activated.	Pr. 22, Pr. 23, Pr. 66
4	FU	Output frequency detection	Refer to Pr. 42, Pr. 43 (output frequency detection).	Pr. 42, Pr. 43
11	RY	Inverter operation ready	Output when the inverter is ready to be started by switching the start signal on.	——
12	Y12	Output current detection	Refer to Pr. 150 and Pr. 151 (output current detection).	Pr. 150, Pr. 151
13	Y13	Zero current detection	Refer to Pr. 152 and Pr. 153 (zero current detection).	Pr. 152, Pr. 153
14	FDN	PID lower limit	Refer to Pr. 128 to Pr. 134 (PID control).	Pr. 128 to Pr. 134
15	FUP	PID upper limit		
16	RL	PID forward-reverse rotation output		
93	Y93	Current average value monitor signal	The output current average value and capacitor life timer value are output during the constant speed operation. (Note 3)	Pr. 555 to Pr. 557
95	Y95	Capacitor life alarm output	Refer to Pr.503 and Pr.504 (capacitor life alarm).	Pr. 503, Pr. 504
98	LF	Minor fault output	Output when a minor fault (fan failure or communication error warning) occurs.	Pr. 121, Pr. 244
99	ABC	Alarm output	Output when the inverter's protective function is activated to stop the output (major fault).	——

Note: 1. The same function may be set to more than one terminal.
2. Pr. 190 to Pr. 192 do not function if the values set are other than the above.
3. The FR-E520-0.1K to 7.5K (C), FR-E520S-0.1K to 0.75K, and FR-E510W-0.1K to 0.75K only can be set.
Only Pr. 190 and Pr. 191 can be set.

Pr. 232 to Pr. 239 ➔ Refer to Pr. 4.

Pr. 240 ➔ Refer to Pr. 72.

4.2.45 Cooling fan operation selection (Pr. 244)

Pr. 244 "cooling fan operation selection"

You can control the operation of the cooling fan built in the inverter (whether there is a cooling fan or not depends on the models. Refer to the outline dimensional drawings (page 193)).

Parameter Number	Factory Setting	Setting Range
244	0	0, 1

<Setting>

Setting	Description
0	Operated at power on (independent of whether the inverter is running or at a stop).
1	Cooling fan on-off control valid (The cooling 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 temperature.)

<Reference>

In either of the following cases, fan operation is regarded as faulty, [FN] is shown on the operation panel, and the minor fault (LF) signal is output. Use any of Pr. 190 to Pr. 192 (output terminal function selection) to allocate the terminal used to output the LF signal.

1) Pr. 244 = "0"
When the fan comes to a stop with power on.
2) Pr. 244 = "1"
When the inverter is running and the fan stops during fan ON command.

Note: Changing the terminal assignment using Pr. 190 to Pr. 192 (output terminal function selection) may affect the other functions. Confirm the functions of the corresponding terminals before making settings.

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

Pr. 245 "rated motor slip"

Pr. 246 "slip compensation response time"

Pr. 247 "constant power range slip compensation selection"

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

Parameter Number	Factory Setting	Setting Range	Remarks
245	9999	0 to 50%, 9999	9999: No slip compensation
246	0.5	0.01 to 10 s	
247	9999	0, 9999	9999: Slip compensation is made in the constant power range when Pr.245 ≠ "9999"and slip compensation is selected.

<Setting>

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

Parameter Number	Setting	Function
245	0 to 50%	Used to set the rated motor slip.
	9999	Slip compensation is not made.
246	0.01 to 10s	Used to set the slip compensation response time. (Note)
247	0	Slip compensation is not made in the constant power range (frequency range above the frequency set in Pr. 3).
	9999	Slip compensation is made in the constant power range when Pr.245 ≠ "9999"and slip compensation is selected. Slip compensation is not made when Pr.245 = "9999"

Note: When this value is made smaller, response will be faster.
However, as load inertia is greater, a regenerative overvoltage (OVT) error is more liable to occur.

4

4.2.47 Earth (ground) fault detection at start (Pr. 249) (400V class does not have this function)

Pr. 249 "earth (ground) fault detection at start"

You can select whether earth (ground) fault detection at start is made or not. Earth (ground) fault detection is made only immediately after the start signal is input to the inverter.

If an earth (ground) fault occurs during operation, the protective function is not activated.

Parameter Number	Factory Setting	Setting Range
249	0	0, 1

<Setting>

Setting	Description
0	Earth (ground) fault detection not made
1	Earth (ground) fault detection made

Note: 1. Since detection is made at a start, an about 20ms output delay occurs at every start.
2. When an earth (ground) fault is detected with "1" set in Pr. 249, alarm output "E.GF" is detected and the output is shut off.
3. If the motor capacity is less than 0.1kW, earth (ground) fault protection may not be provided.

4.2.48 Stop selection (Pr. 250)

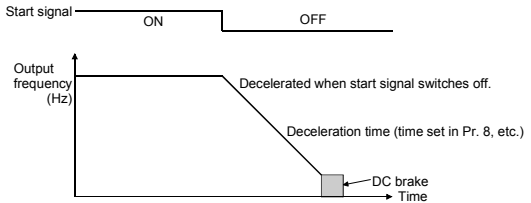
Pr. 250 "stop selection"

Related parameters
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"
Pr. 44 "second acceleration/ deceleration time"
Pr. 45 "second deceleration time"

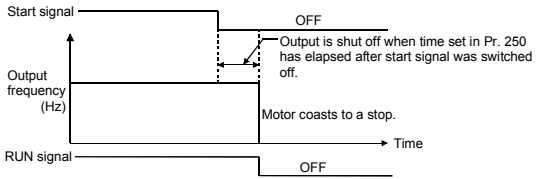
Used to select the stopping method (deceleration to a stop or coasting) when the start signal (STF/STR) switches off.

Parameter Number	Factory Setting	Setting Range
250	9999	0 to 100s, 1000 to 1100s, 8888, 9999

(1) Pr. 250 = "9999"
When the start signal switches off, the motor is decelerated to a stop.



(2) Pr. 250 = 0 to 100s (output is shut off after preset time)
The output is shut off when the time set in Pr. 250 has elapsed after the start signal was switched off. The motor coasts to a stop.



When the Pr. 250 value is 8888, the functions of terminals STF and STR change as shown below:
STF = start signal, STR = rotation direction signal

STF	STR	Inverter Operating Status
OFF	OFF	Stop
OFF	ON	
ON	OFF	Forward rotation
ON	ON	Reverse rotation

When the Pr. 250 value is any of 1000 to 1100s, the functions of terminals STF and STR are the same as when the Pr. 250 value is 8888.
Also, for the stopping method used when the start signal switches off, the output is shut off (the motor coasts to a stop) after the period set in Pr. 250 (i.e. 1000s) have elapsed.

Note: 1. The RUN signal switches off when the output stops.
2. When the start signal is switched on again during motor coasting, the motor starts at 0Hz.
3. When the Pr. 250 value is 0, the output is shut off within the shortest time.

4.2.49 Output phase loss protection selection (Pr. 251)

Pr. 251 "Output phase loss protection selection"

You can make invalid the output phase loss protection (E.LF) function which stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) becomes open.
Choose "without output phase loss protection" when the motor capacity is smaller than the inverter capacity (when the output current is less than approximately 25% of the rated inverter current value as a guideline), since performing operation in such a case may activate output phase loss protection.

Parameter Number	Setting Range	Minimum Setting Increments	Factory Setting	Description
251	0, 1	1	1	0: Without output phase loss protection 1: With output phase loss protection

Pr. 342 ➔ Refer to Pr. 117

4.2.50 Capacitor life alarm (Pr. 503, Pr. 504) (No function for the 400V class)

Pr. 503 "capacitor life timer"

Pr. 504 "capacitor life alarm output set time"

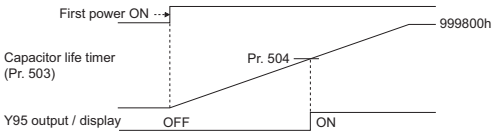
Related parameter
Pr. 190 to Pr. 192 (output terminal function selection)

Indicates the replacement time (note 1) of the inverter main circuit smoothing capacitor by outputting the capacitor life alarm output signal "Y95" when the cumulative energization time of the inverter reaches the time set in Pr.504 "capacitor life alarm output set time".

Parameter Number	Factory Setting	Setting Range
503	—	—
504	500 (50000h)	0 to 9998, (9999)

<Setting>

Parameter Number	Setting	Description	Remarks
503	—	Displays the cumulative energization time of the inverter in 100h increments. (Cannot be written.) Clamped at 9998(999800h).	The capacitor life is counted every 1h and the figures above hundreds are displayed.
504	0 to 9998	Set the time until the maintenance timer alarm signal (Y95) is output.	By setting "95" in Pr.190 to Pr.192 "output terminal function selection", the capacitor life alarm signal "Y95" can be output. (Refer to page 173.)
	9999	For maker setting. The set time is 50000h.	



The life of electrolytic capacitor is about eight years (50000h) if used for 20 hours a day and 300 days a year in the average yearly ambient temperature of 35ºC. (Note 2)
The life of electrolytic capacitor decreases to half if the ambient temperature increases by 10ºC and doubles if decreases by 10ºC. Please note this as reference when setting the time
For example, when the average yearly ambient temperature is 45ºC, set "250" (25000h) in Pr. 504.

Note: 1. For replacement of the capacitor, contact the nearest Mitsubishi FA center.
2. The estimated life time (50000h) of the capacitor differs according to the environmental conditions (ambient temperature, conditions, etc.) of the inverter.

4.2.51 Current average value monitor signal (Pr. 555 to Pr. 557) (no function for the 400V class)

Pr. 555 "current average time"

Pr. 556 "data output mask time"

Pr. 557 "current average value monitor signal output reference current"

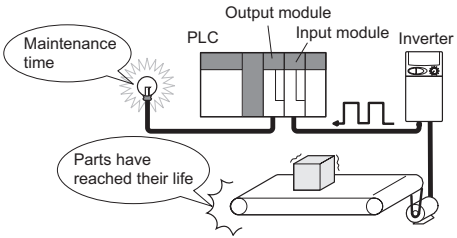
Related parameter

Pr. 57 "restart coasting time"
Pr. 503 "capacitor life timer"
Pr. 190, Pr. 191 (output terminal function selection)

The average value of the output current during constant speed operation and the capacitor life timer value (Pr. 503) are output as pulses to the current average value monitor signal (Y93).

The pulse width measured by inputting the signal to the I/O module of the PLC or the like can be used as a guideline for increase in output current due to abrasion of peripheral machines and elongation of belt and for aged deterioration of peripheral devices to know the maintenance time.

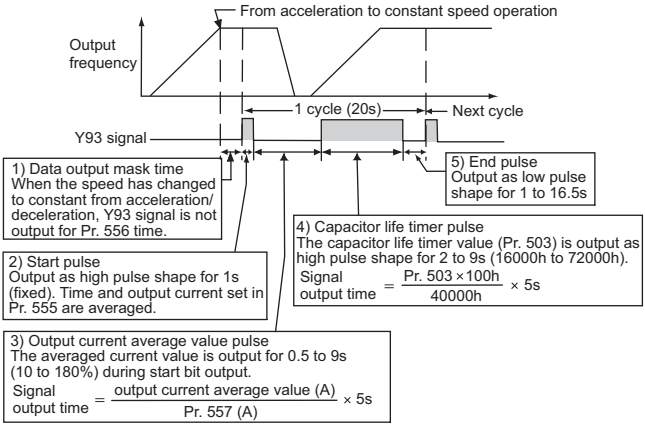
The current average value monitor signal (Y93) is output as pulse for 20s as 1 cycle and repeatedly output during constant speed operation.



Parameter Number	Factory Setting	Setting Range
555	1.0s	0.1 to 1.0s
556	0.0s	0.0 to 20s
557	1.0A	0.1 to 999A

<Pulse operation>

The output pulse of the current average value monitor signal (Y93) is shown below.



<Setting>

Perform setting according to the following steps.

1) Setting of Pr. 556 "data output mask time"
The output current is unstable (transient state) right after the operation is changed from the acceleration/deceleration state to the constant speed operation. Set the time for not obtaining (mask) transient state data in Pr. 556.

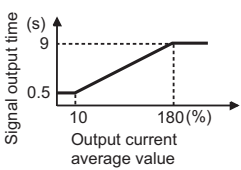
2) Setting of Pr. 555 "output current average time"
The average output current is calculated during output of start pulse (1s) as high pulse shape. Set the time taken to average the current during start pulse output in Pr. 555.

3) Setting of Pr. 557 "current average value monitor signal output reference current"
Set the reference (100%) for outputting the signal of the current average value. Obtain the time to output the signal from the following formula.

$$\frac{\text{output current average value}}{\text{setting value of output reference current (Pr. 557)}} \times 5\text{s (output current average value 100\%/5s)}$$

Note that the output time range is 0.5s to 9s, and it is 0.5s when the output current average value is less than 10% of the setting value of output reference current (Pr. 557) and 9s when exceeds 180%.

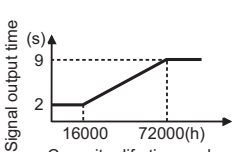
Example) when Pr. 557 = 10A and the average value of output current is 15A
As 15A/10A × 5s = 7.5, the current average value monitor signal is output as low pulse shape for 7.5s.



4) Output of capacitor life timer value (Pr. 503)
After the output current average value is output as low pulse shape, the capacitor life timer value is output as high pulse shape. The output time of the capacitor life timer value is obtained from the following formula.

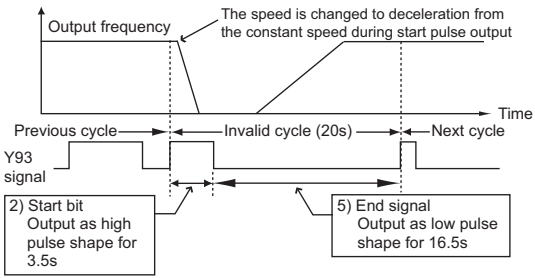
$$\frac{\text{Capacitor life timer value (Pr. 503)} \times 100\text{h}}{40000\text{h}} \times 5\text{s (capacitor life timer value 100\%/5s)}$$

Note that the output time range is 2 to 9s, and it is 2s when the capacitor life timer value (Pr. 503) is less than 16000h and 9s when exceeds 72000h.



REMARKS

- Mask of data output and sampling of output current are not performed during acceleration/deceleration.
- Set "93" in Pr. 190 (RUN terminal) and Pr. 191 (FU terminal) and assign the current average value monitor signal (Y93) to the RUN terminal. It can not be assigned to the ABC contact (Pr. 192)
- When the speed is changed to acceleration/deceleration from constant speed during start pulse output, the data is judged as invalid, the start pulse is output as high pulse shape for 3.5s, and the end signal is output as low pulse shape for 16.5s. The signal is output for at least 1 cycle even when acceleration/deceleration state continues after the start pulse output is completed.



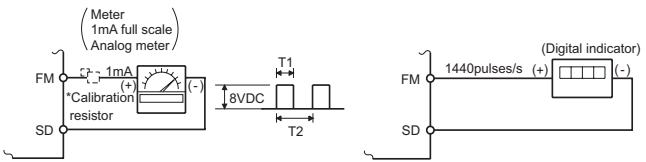
- When the output current value (inverter output current monitor) is 0A on completion of the 1 cycle signal output, the signal is not output until the speed becomes constant next time.
- The current average value monitor signal (Y93) is output as low shape pulse for 20s (without data output) under the following condition.
  1) when the motor is in the acceleration/deceleration state on completion of the 1 cycle signal output
  2) when the 1 cycle output is completed during restart operation with automatic restart after instantaneous power failure (Pr. 571 ≠ "9999")
  3) when automatic restart operation was being performed with automatic restart after instantaneous power failure selected (Pr. 571 ≠ "9999") on completion of the data output mask

4.2.52 Meter (frequency meter) calibration (Pr. 900)

Pr. 900 "FM terminal calibration"

Related parameters
Pr. 54 "FM terminal function selection"
Pr. 55 "frequency monitoring reference"
Pr. 56 "current monitoring reference"

- By using the operation panel or parameter unit, you can calibrate a meter connected to terminal FM to full scale deflection.
- Terminal FM provides the pulse output. By setting Pr. 900, you can calibrate the meter connected to the inverter from the parameter unit without providing a calibration resistor.
- You can display a digital value on a digital counter using the pulse train signal from terminal FM. A 1440 pulses/s output is provided at the full scale value as explained in the section of Pr. 54. When the running frequency has been selected for monitoring, the ratio of this FM terminal output frequency can be set in Pr. 55.



Pulse width T1 : Adjusted with Pr. 900
Pulse period T2 : Set in Pr. 55 (frequency monitoring)
Set in Pr. 56 (current monitoring)

Note : The parameter is factory-set to 1mA full-scale or 1440pulses/s.
FM output frequency at 60Hz.

* Not needed when the operation panel or parameter unit (FR-PU04) is used for calibration. Used when calibration must be made near the frequency meter for such a reason as a remote frequency meter. However, the frequency meter needle may not deflect to full-scale if the calibration resisitor is connected. In this case, use this resistor and the operation panel or parameter unit together.

(1) Calibration of terminal FM
1) Connect an indicator (frequency meter) across inverter terminals FM-SD. (Note the polarity. FM is the positive terminal.)
2) When a calibration resistor has already been connected, adjust the resistance to "0" or remove the resistor.
3) Set any of "0 to 2" in Pr. 54.
When the running frequency or inverter output current has been selected as the output signal, preset in Pr. 55 or Pr. 56 the running frequency or current at which the output signal is 1440pulses/s.
At this 1440 pulses/s, the meter normally deflects to full scale.

<Operation procedure>

- When using the operation panel

1) Select the PU operation mode.

2) Set the running frequency.

3) Press the SET key.

4) Read Pr. 900 "FM terminal calibration".

5) Press the FWD key to run the inverter. (Motor need not be connected.)

6) Hold down the ▲/▼ key to adjust the meter needle to a required position.
(Depending on the setting, it may take some time until the needle moves.)

7) Press the SET key for about 1.5s.

8) Press the STOP/RESET key to stop the inverter.

REMARKS

Calibration can also be made for external operation. Set the frequency in the external operation mode and make calibration in the steps 4) to 8).

Note: 1. Pr. 900 is factory-set to 1mA full-scale and FM output frequency of 1440 pulses/s at 60Hz. The maximum pulse train output of terminal FM is 2400 pulses/s.
2. When a frequency meter is connected across terminals FM-SD to monitor the running frequency, the FM terminal output is filled to capacity at the factory setting if the maximum output frequency reaches or exceeds 100Hz. In this case, the Pr. 55 setting must be changed to the maximum frequency.
3. It is possible to calibrate even during operation.

4.2.53 Biases and gains of the frequency setting voltage (current) and built-in frequency setting potentiometer (Pr. 902 to Pr. 905, Pr. 922, Pr. 923)

Pr. 902 "frequency setting voltage bias"

Pr. 903 "frequency setting voltage gain"

Pr. 904 "frequency setting current bias"

Pr. 905 "frequency setting current gain"

Related parameters
Pr. 38 "frequency at 5V (10V) input"
Pr. 39 "frequency at 20mA input"
Pr. 73 "0-5/0-10V selection"
Pr. 79 "operation mode selection"
Pr.146"frequency setting command selection"

Pr. 922 "built-in frequency setting potentiometer bias"

Pr. 923 "built-in frequency setting potentiometer gain"

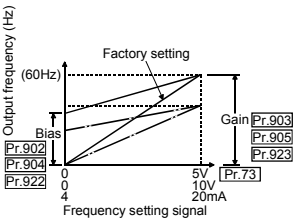
You can set the output frequency as desired in relation to the frequency setting potentiometer of the operation panel or the external frequency setting signal (0 to 5V,0 to 10V or 4 to 20mA DC).

The "bias" and "gain" functions are used to adjust the relationship between the input signal entered from outside the inverter (to set the output frequency), i.e. 0 to 5VDC,0 to 10VDC or 4 to 20mADC, and the output frequency.

- Use Pr. 902 to set the bias of the voltage signal and use Pr. 903 to set its gain
- Use Pr. 904 to set the bias of the current signal and use Pr. 905 to set its gain.
- Use Pr. 922 to set the bias of the operation panel's potentiometer and use Pr. 923 to set its gain.

Parameter Number	Factory Setting (*)		Setting Range	
902	0V	0Hz	0 to 10V	0 to 60Hz
903	5V	60Hz	0 to 10V	1 to 400Hz
904	4mA	0Hz	0 to 20mA	0 to 60Hz
905	20mA	60Hz	0 to 20mA	1 to 400Hz
922	0V	0Hz	0 to 5V	1 to 60Hz
923	5V	60Hz	0 to 5V	1 to 400Hz

* Factory settings may differ because of calibration parameters.



<Setting>

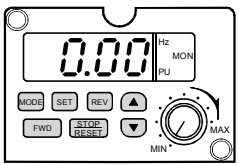
(1) The frequency setting voltage (current) biases and gains may be adjusted by any of the three following ways:
   1) Any point can be adjusted with a voltage applied across terminals 2-5 (with a current flowing across terminals 4-5).
   2) Any point can be adjusted with no voltage applied across terminals 2-5 (with no current flowing across terminals 4-5).
   3) Only the bias and gain frequencies are adjusted and the voltage (current) is not adjusted.

(2) The bias and gain of the frequency setting potentiometer may also be adjusted by any of the three following ways:
1) Any point can be adjusted with the potentiometer being turned.
2) Any point can be adjusted without the potentiometer being turned.
3) Only the bias and gain frequencies are adjusted.

Pr. 903 "frequency setting voltage gain"
(Pr. 902, Pr. 904 and Pr. 905 can also be adjusted similarly.)

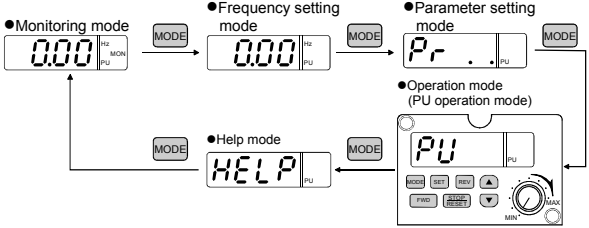
<Adjustment procedure>
When using an external frequency setting signal to set the frequency.

(1) Power-on (monitoring mode)



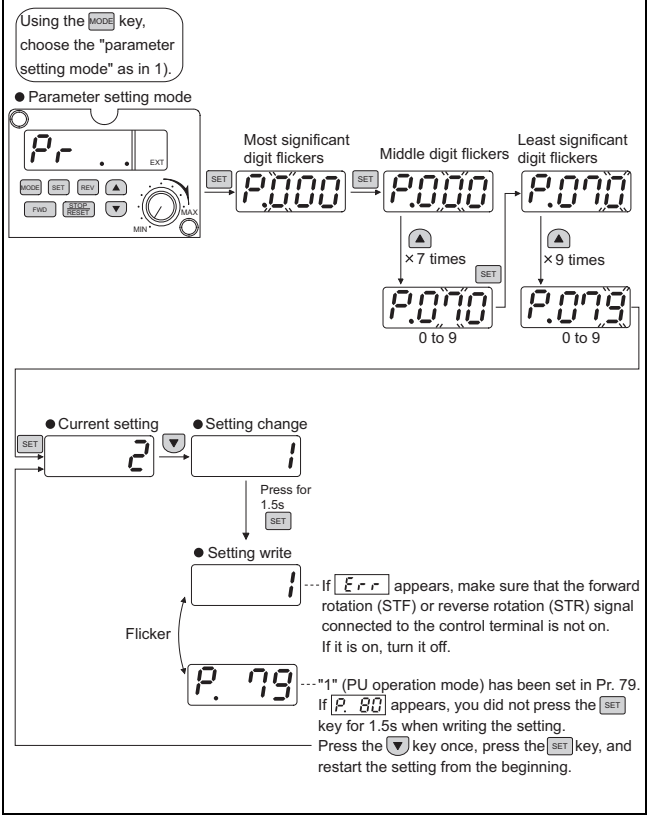
(2) Choose the PU operation mode.

1) Using the MODE key, make sure that the PU operation mode has been selected.

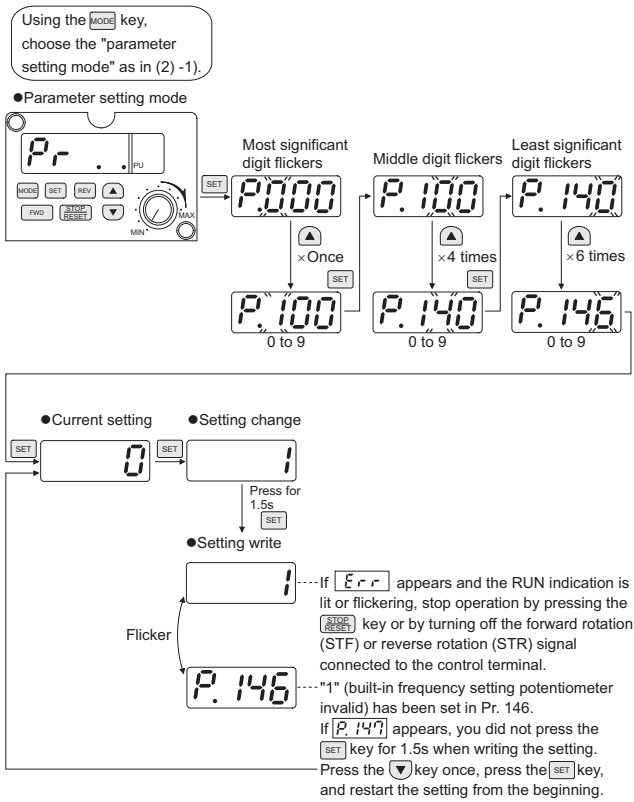


Confirm that the PU operation mode (PU) has been chosen.
In the JOG operation mode (JOG) or external operation mode (OPRd), press the ▲/▼ key to display PU .
If PU cannot be displayed by pressing the ▲/▼ key in the external operation mode (OPRd) (if Pr. 79 "operation mode selection" ≠ "0"), refer to 2) and set "1" (PU operation mode) in Pr. 79 "operation mode selection".

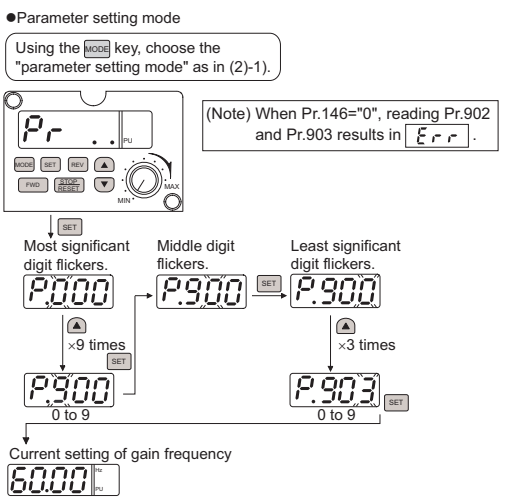
2)Set "1" (PU operation mode) in Pr. 79 "operation mode selection".
Example: To change the external operation mode (Pr. 79 = 2) to the PU operation mode (Pr. 79 = 1)



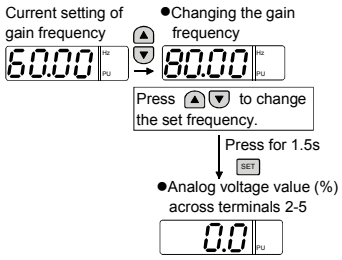
3)Set "1" (built-in frequency setting potentiometer invalid) in Pr. 146 "frequency setting command selection".
Change the setting of built-in frequency setting potentiometer valid (Pr. 146 = 0) to that of built-in frequency setting potentiometer invalid (Pr. 146 = 1).



(3) Read Pr. 903 and show the current setting of the gain frequency. (Pr. 902, Pr. 904 and Pr. 905 can also be adjusted similarly.)



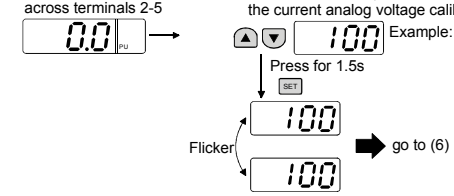
(4) Set a gain frequency in Pr. 903 and show the analog voltage value across terminals 2-5 in % (when the frequency is set to 80Hz)



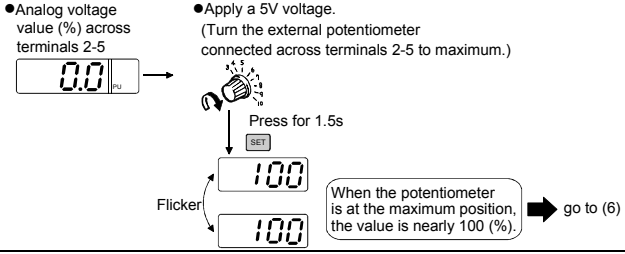
In any of the methods in (5)-1) to (5)-3) on the following page, continue the setting until the analog voltage value flickers. If you end the setting here, the gain frequency change will not be reflected.

- When not adjusting the gain voltage → go to (5)-1)
- When adjusting any point by applying a voltage → go to (5)-2)
- When adjusting any point without applying a voltage → go to (5)-3)

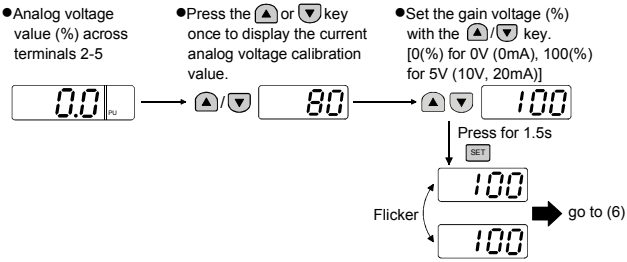
(5)-1)How to adjust only the gain frequency and not to adjust the voltage



(5)-2) How to adjust any point by applying a voltage across terminals 2-5 (e.g. from the external potentiometer) (current: across terminals 4-5) (when applying 5V))



(5)-3)How to adjust any point without applying a voltage across terminals 2-5 (without a current flowing across terminals 4-5) (when changing from 4V (80%) to 5V (100%)



4

(6) Press the SET key to shift to the next parameter.

(7) Re-set Pr. 79 "operation mode selection" according to the operation mode to be used.

Note: 1. If the Pr. 903 or Pr. 905 (gain adjustment) value is changed, the Pr. 20 value does not change.
2. When the Pr. 903 or Pr. 905 value is set, the value of Pr. 38 "frequency at 5V (10V) input" or Pr. 39 "frequency at 20mA input" changes automatically.

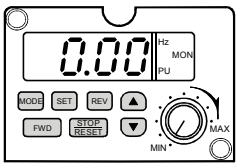
⚠ CAUTION

⚠ **Be careful when setting the bias frequency at 0V to any value other than "0". Even without the speed command, the motor will start running at the set frequency by merely switching on the start signal.**

Pr. 923 "built-in frequency setting potentiometer gain"
(Pr. 922 can be adjusted in the same manner)

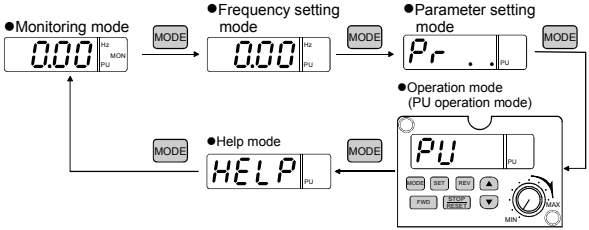
When the built-in frequency setting potentiometer is used to set the bias and gain of the built-in frequency setting potentiometer to set the magnitude (slope) of the output frequency as desired.

(1) Power-on (monitoring mode)



(2) Choose the PU operation mode.

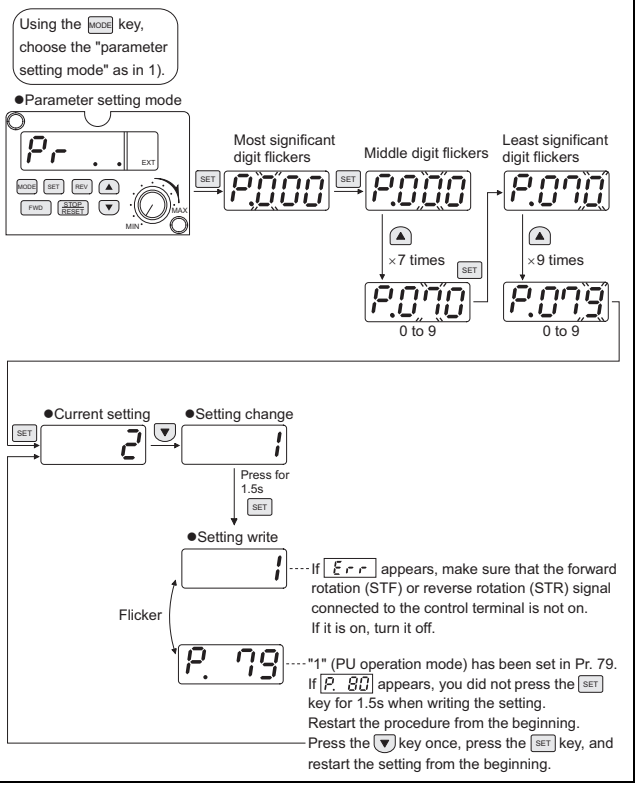
1)Using the MODE key, make sure that the PU operation mode has been selected.



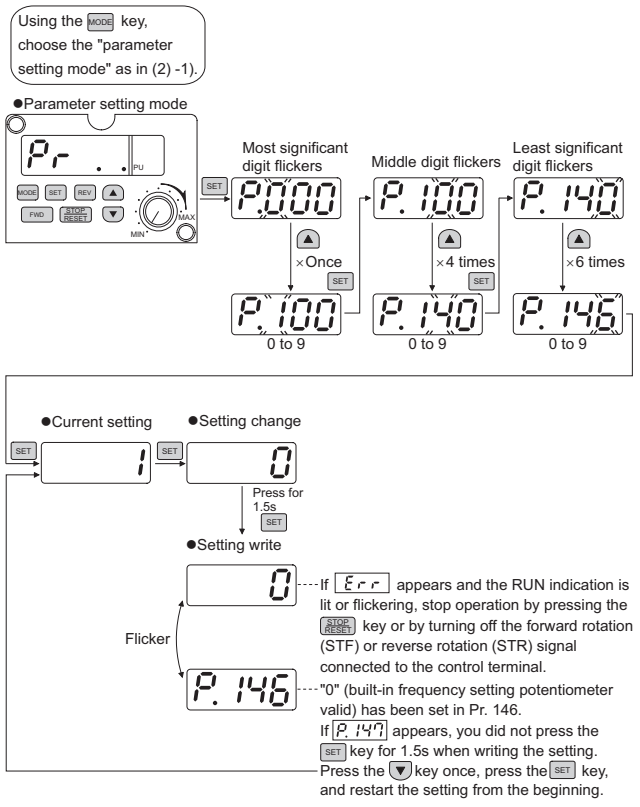
Confirm that the PU operation mode (PU) has been chosen.
In the JOG operation mode (JOG) or external operation mode (OPNd), press the ▲/▼ key to display PU.
If PU cannot be displayed by pressing the ▲/▼ key in the external operation mode (OPNd) (if Pr. 79 "operation mode selection" ≠ "0"), refer to 2) and set "1" (PU operation mode) in Pr. 79 "operation mode selection".

4

2)Set "1" (PU operation mode) in Pr. 79 "operation mode selection".
Example: To change the external operation mode (Pr. 79 = 2) to the PU operation mode (Pr. 79 = 1)



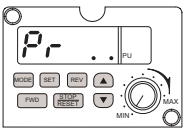
3)Set "0" (built-in frequency setting potentiometer valid) in Pr. 146 "frequency setting command selection".
Change the setting of built-in frequency setting potentiometer invalid (Pr. 146 = 1) to that of built-in frequency setting potentiometer valid (Pr. 146 = 0).



(3) Read Pr. 923 and show the current setting of the gain frequency. (Pr. 922 can also be adjusted similarly.)

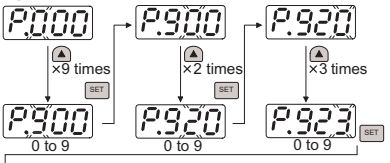
● Parameter setting mode

Using the MODE key, choose the "parameter setting mode" as in (2)-1).



SET

Most significant digit flickers. Middle digit flickers. Least significant digit flickers.



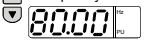
Current setting of gain frequency

(4) Set a new gain frequency in Pr. 923 and show the analog voltage value of the built-in frequency setting potentiometer. (when the frequency is set to 80Hz at MAX)

●Current setting of gain frequency

A near-0 value is shown at the MIN position of the potentiometer, and near-100 at MAX.
Set to the potentiometer position where operation is to be performed at the set frequency (80Hz in the example).

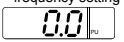
●Changing the gain frequency



Press ▲ ▼ to change the set frequency.

Press for 1.5s SET

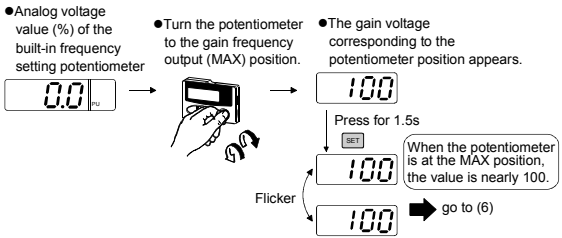
●Analog voltage value (%) of the built-in frequency setting potentiometer



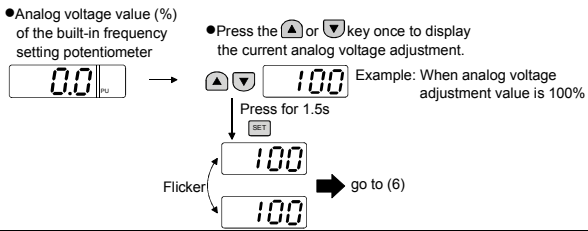
In any of the methods in (5)-1) to (5)-3) on the following pages, continue the setting until the analog voltage value flickers. If you end the setting here, the gain frequency change will not be reflected.

- When adjusting any point by turning the potentiometer → go to (5)-1)
- When not adjusting the gain voltage → go to (5)-2)
- When adjusting any point without turning the potentiometer → go to (5)-3)

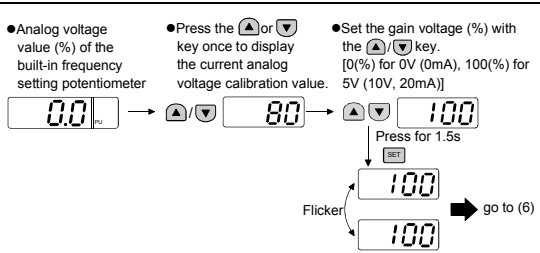
(5)-1)How to adjust any point by turning the built-in frequency setting potentiometer (when applying 5V)



(5)-2)How to adjust the gain frequency only without the voltage being adjusted



(5)-3) How to adjust any point without turning the potentiometer (When changing from 4V (80%) to 5V (100%))



4

(6) Press the SET key to shift to the next parameter.

(7) Re-set Pr. 79 "operation mode selection" according to the operation mode to be used.

⚠ CAUTION

⚠ **You should be careful when setting any value other than "0" to the bias frequency at 0V, since the motor will start at the preset frequency by merely turning on the start signal if no speed command is given.**

CHAPTER5 PROTECTIVE FUNCTIONS

This chapter explains the "protective functions" of this product.
Always read the instructions before using the equipment.

5.1 Errors (Alarms)

When an alarm occurs in the inverter, the protective function is activated bringing the inverter to an alarm stop and the PU display automatically changes to any of the following error (alarm) indications.

If your fault does not correspond to any of the following errors or if you have any other problem, please contact your sales representative.

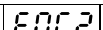
- Retention of alarm output signal ..... When the magnetic contactor (MC) provided on the power supply side of the inverter is opened at the activation of the protective function, the inverter's control power will be lost and the alarm output will not be held.
- Alarm indication ..... When the protective function is activated, the operation panel display automatically switches to the above indication.
- Resetting method..... When the protective function is activated, the inverter output is kept stopped. Unless reset, therefore, the inverter cannot restart. Switch power off once, then on again; or apply RES signal for more than 0.1s. If the RES signal is kept on, "Err." appears (flickers) to indicate that the inverter is in a reset status.
- When the protective function is activated, take the appropriate corrective action, then reset the inverter, and resume operation.

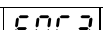
5.1.1 Error (alarm) definitions

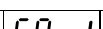
(1) Major faults

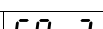
When the protective function is activated, the inverter output is shut off and the alarm is output.

Operation Panel Indication	E. OC1		**FR-PU04**	OC During Acc
Name	Overcurrent shut-off during acceleration			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated current during acceleration, the protective circuit is activated to stop the inverter output			
Check point	Check for sudden acceleration. Check that the downward acceleration time is not long in vertical lift application. Check for output short-circuit/earth (ground) fault.			
Corrective action	Increase the acceleration time. (Shorten the downward acceleration time in vertical lift application.)			

Operation Panel Indication	E. OC2		FR-PU04	Stedy Spd OC
Name	Overcurrent shut-off during constant speed			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated current during constant speed, the protective circuit is activated to stop the inverter output.			
Check point	Check for sudden load change. Check for output short-circuit/earth (ground) fault.			
Corrective action	Keep load stable.			

Operation Panel Indication	E. OC3		FR-PU04	OC During Dec
Name	Overcurrent shut-off during deceleration			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated current during deceleration (other than acceleration or constant speed), the protective circuit is activated to stop the inverter output.			
Check point	Check for sudden speed reduction. Check for output short-circuit/earth (ground) fault. Check for too fast operation of the motor's mechanical brake.			
Corrective action	Increase the deceleration time. Adjust brake operation.			

Operation Panel Indication	E. OV1		FR-PU04	OV During Acc
Name	Regenerative overvoltage shut-off during acceleration			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.			
Check point	Check for too slow acceleration. (e.g. during descending acceleration with lifting load)			
Corrective action	Decrease the acceleration time.			

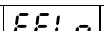
Operation Panel Indication	E. OV2		FR-PU04	Stedy Spd OV
Name	Regenerative overvoltage shut-off during constant speed			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.			
Check point	Check for sudden load change.			
Corrective action	• Keep load stable. • Use the brake unit, high power factor converter (FR-HC) or power regeneration common converter (FR-CV) as required.			

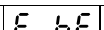
Operation Panel Indication	E. OV3		FR-PU04	OV During Dec
Name	Regenerative overvoltage shut-off during deceleration or stop			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.			
Check point	Check for sudden speed reduction.			
Corrective action	• Increase the deceleration time. (Set the deceleration time which matches the moment of inertia of the load) • Longer the brake cycle • Use the brake unit, high power factor converter (FR-HC) or power regeneration common converter (FR-CV) as required.			

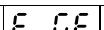
Operation Panel Indication	E. THM		FR-PU04	Motor Ovrload
Name	Motor overload shut-off (electronic thermal relay function) (Note 1)			
Description	The electronic overcurrent protection in the inverter detects motor overheat due to overload or reduced cooling capability during constant-speed operation to stop the inverter output. When a multi-pole motor or two or more motors are run, provide a thermal relay on the output side of the inverter.			
Check point	Check the motor for use under overload.			
Corrective action	• Reduce the load weight. • For the constant-torque motor, change the Pr. 71 setting to the constant-torque motor setting.			

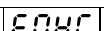
Operation Panel Indication	E. THT		FR-PU04	Inv. Ovrload
Name	Inverter overload shut-off (electronic thermal relay function) (Note 1)			
Description	If a current of more than 150% of the rated output current flows and overcurrent shut-off does not occur (200% or less), the electronic thermal relay activate to stop the inverter output in order to protect the output transistors.			
Check point	Check the motor for use under overload.			
Corrective action	Reduce the load weight.			

Note: 1. Resetting the inverter initializes the internal heat integrating data of the electronic thermal relay function.

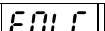
Operation Panel Indication	E. FIN		FR-PU04	H/Sink O/Temp
Name	Fin overheat			
Description	If the heatsink overheats, the temperature sensor is actuated to stop the inverter output.			
Check point	• Check for too high ambient temperature. • Check for heatsink clogging.			
Corrective action	Set the ambient temperature to within the specifications.			

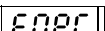
Operation Panel Indication	E. BE		FR-PU04	Br. Cct. Fault (Note)
Name	Brake transistor alarm detection			
Description	If a brake transistor fault occurs due to excessively large regenerative energy from the motor, for example, that fault is detected to stop the inverter output. In this case, the inverter power must be switched off immediately.			
Check point	Check for improper braking duty.			
Corrective action	Change the inverter. Please contact your sales representative.			

Operation Panel Indication	E. GF		FR-PU04	Ground Fault
Name	Output side earth (ground) fault overcurrent			
Description	This function stops the inverter output if an earth (ground) fault overcurrent flows due to an earth (ground) fault which occurred in the inverter's output (load) side. Use Pr. 249 "ground fault detection at start" to set whether the protective function is to be activated or not. (The 400V class always has the protective function.)			
Check point	Check for an earth (ground) fault in the motor and connection cable.			
Corrective action	Remedy the earth (ground) fault portion.			

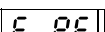
Operation Panel Indication	E. OHT		FR-PU04	OH Fault
Name	External thermal relay operation (Note 2)			
Description	If the external thermal relay provided for motor overheat protection or the internally mounted temperature relay in the motor switches on (contacts open), the inverter output is stopped. If the relay contacts are reset automatically, the inverter will not restart unless it is reset.			
Check point	•Check for motor overheating. •Check that the value of "7" (OH signal) is set correctly in any of Pr. 180 to Pr. 183 (input terminal function selection).			
Corrective action	Reduce the load and operating duty.			

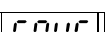
Note: 2. This function is activated only when OH has been set to any of Pr. 180 to Pr. 183 (input terminal function selection).

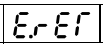
Operation Panel Indication	E. OLT		FR-PU04	Stll Prev STP
Name	Stall prevention			
Description	The running frequency has fallen to 0 by stall prevention activated. (OL while stall prevention is being activated.)			
Check point	Check the motor for use under overload.			
Corrective action	Reduce the load weight.			

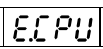
Operation Panel Indication	E.OPT		FR-PU04	Option Fault
Name	Option alarm			
Description	Stops the inverter output if a functional fault (e.g. communication error of the communication option) occurs in the communication option. Stops the inverter output if the inverter station is disconnected from the system in the NET mode. (Note 3) Stops the inverter output if a setting error or connection (connector) fault occurs during use of in-board option.			
Check point	Check that the communication cable is not open.			
Corrective action	Please contact your sales representative.			

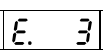
Note:3. Only when the communication option is fitted to the three-phase 400V power input model.

Operation Panel Indication	E. PE		FR-PU04	Corrupt Memry
Name	Parameter storage device alarm			
Description	A fault occurred in parameters stored (example: E^2PROM fault).			
Check point	Check for too many number of parameter write times.			
Corrective action	Please contact your sales representative.			

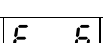
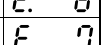
Operation Panel Indication	E. PUE		FR-PU04	PU Leave Out
Name	Parameter unit disconnection			
Description	This function stops the inverter output if communication between the inverter and PU is suspended, e.g. the PU is disconnected, when "2", "3", "16" or "17" was set in Pr. 75. This function stops the inverter output if the number of successive communication errors is greater than the number of permissible retries when the Pr. 121 value is other than "9999" for RS-485 communication from the PU connector.			
Check point	• Check for loose fitting of the operation panel or FR-PU04. • Check the Pr. 75 setting.			
Corrective action	Fit the operation panel and FR-PU04 securely.			

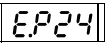
Operation Panel Indication	E. RET		FR-PU04	Retry No Over
Name	Retry count exceeded			
Description	If operation cannot be resumed properly within the number of retries set, this function stops the inverter output.			
Check point	Find the cause of alarm occurrence.			
Corrective action	Eliminate the cause of the error preceding this error indication.			

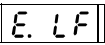
Operation Panel Indication	E. CPU		FR-PU04	CPU Fault
Name	CPU error			
Description	If the arithmetic operation of the built-in CPU does not end within a predetermined period, the inverter self-determines it as an alarm and stops the output.			
Check point	———			
Corrective action	Please contact your sales representative.			

Operation Panel Indication	E. 3		FR-PU04	Fault 3
Name	Option fault			
Description	Also stops the inverter output if the dedicated option used in the inverter results in setting error or connection (connector) fault. (Note 4)			
Check point	• Check that the function setting and operation of the option are correct. • Check that the communication option is plugged in the connector securely. • Check for devices producing excess electrical noises around the inverter.			
Corrective action	• Connect the communication option securely. • Take measures against noises if there are devices producing excess electrical noises around the inverter. • Contact your sales representative.			

Note:4. Only when the communication option is fitted to the three-phase 400V power input model.

Operation Panel Indication	E. 6		FR-PU04	Fault 6
	E. 7			Fault 7
Name	CPU error			
Description	This function stops the inverter output if a communication error occurs in the built-in CPU. (400V class only)			
Check point	Check for devices producing excess electrical noises around the inverter.			
Corrective action	• Take measures against noises if there are devices producing excess electrical noises around the inverter. • Please contact your sales representative.			

Operation Panel Indication	E. P24		FR-PU04	Pr.24 alarm
Name	24VDC power output short circuit			
Description	When the 24VDC power output from the PC terminal is shorted, this function shuts off the power output. At this time, all external contact inputs switch off. The inverter cannot be reset by entering the RES signal. To reset it, use the operation panel or switch power off, then on again. (for 400V class only)			
Check point	Check for a short circuit in the PC terminal output.			
Corrective action	Remedy the earth (ground) fault portion.			

Operation Panel Indication	E. LF		FR-PU04	E. LF
Name	Output phase loss			
Description	This function stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) is lost.			
Check point	• Check the wiring (Check the motor for a fault.) • Check that the capacity of the used motor is not smaller than the inverter capacity.			
Corrective action	• Wire the cables properly. • Check the setting of Pr. 251 "output phase loss protection selection".			

(2) Minor fault

The output is not shut off when the protective function is activated. You can make parameter setting to output the minor fault signal. (Set "98" in any of Pr. 190 to Pr. 192 (output terminal function selection). Refer to page 173.)

Operation Panel Indication	FN		FR-PU04	Fan Failure
Name	Fan fault			
Description	For the inverter which contains a cooling fan, FN appears on the operation panel when the cooling fan stops due to a fault or operates differently from the setting of Pr. 244 "cooling fan operation selection"			
Check point	Check the cooling fan for a fault.			
Corrective action	Replace the fan. (Refer to page 219.)			

(3) Warnings

Operation Panel Indication	OL		FR-PU04	OL
Name	Stall prevention (overcurrent)			
Description	During acceleration	If a current of more than 150% (Note 5) of the rated inverter current flows in the motor, this function stops the increase in frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 150%, this function increases the frequency again.		
	During constant-speed operation	If a current of more than 150% (Note 5) of the rated inverter current flows in the motor, this function lowers the frequency until the overload current reduces to prevent overcurrent shut-off. When the overload current has reduced below 150%, this function increases the frequency up to the set value.		
	During deceleration	If a current of more than 150% (Note 5) of the rated inverter current flows in the motor, this function stops the decrease in frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 150%, this function decreases the frequency again.		
Check point	Check the motor for use under overload.			
Corrective action	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".			

Note:5. The stall prevention operation current can be set as desired. It is factory-set to 150%.

Operation Panel Indication	oL		FR-PU04	oL
Name	Stall prevention (overvoltage)			
Description	During deceleration	If the regenerative energy of the motor increases too much to exceed the brake capability, this function stops the decrease in frequency to prevent overvoltage shut-off. As soon as the regenerative energy has reduced, deceleration resumes.		
Check point	Check for sudden speed reduction.			
Corrective action	The deceleration time may change. Increase the deceleration time using Pr. 8 "deceleration time".			

Operation Panel Indication	PS		FR-PU04	PS
Name	PU stop			
Description	A stop made by pressing the STOP RESET key of the PU has been set in Pr. 75 "PU stop selection".			
Check point	Check for a stop made by pressing the STOP RESET key of the operation panel during external operation.			
Corrective action	Refer to page 130.			

Operation Panel Indication	Err.	
Description	This alarm appears if: • The RES signal is on; • You attempted to set any parameter value in the external operation mode; • You attempted to change the operation mode during operation; • You attempted to set any parameter value outside its setting range. • You attempted to set any parameter value during operation (while signal STF or STR is ON). • You attempted to set any parameter value while parameter write is being inhibited in Pr. 77 "parameter write disable selection".	
Corrective action	Perform operation correctly.	

5.1.2 To know the operating status at the occurrence of alarm

When any alarm has occurred, the display automatically switches to the indication of the corresponding protective function (error). By pressing the MODE key at this point without resetting the inverter, the display shows the output frequency. In this way, it is possible to know the running frequency at the occurrence of the alarm. This also applies to the current. After resetting, you can confirm the data in the alarm history (refer to page 73).

5.1.3 Correspondence between digital and actual characters

There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the operation panel:

Actual	Display
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Actual	Display
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
L	

Actual	Display
M	
N	
O	
o	
P	
S	
T	
U	
V	
r	
-	

5.1.4 Resetting the inverter

The inverter can be reset by performing any of the following operations. Note that the electronic overcurrent protection's internal heat calculation value and the number of retries are cleared (erased) by resetting the inverter.
Recover about 1s after reset is cancelled.

Operation 1: .....Using the operation panel, press the STOP RESET key to reset the inverter. (This may only be performed when the inverter protective function (major fault) is activated.)

Operation 2: .....Switch power off once, then switch it on again after the POWER lamp on the operation panel turns off.

Operation 3: .....Switch on the reset signal (RES).

5.2 Troubleshooting

POINT: Check the corresponding areas. If the cause is still unknown, it is recommended to initialize the parameters (return to factory settings), reset the required parameter values, and check again.

5.2.1 Motor remains stopped

1) Check the main circuit
- Check that a proper power supply voltage is applied (operation panel display is provided).
- Check that the motor is connected properly.
- Check that the conductor across P1-P is connected.

2) Check the input signals
- Check that the start signal is input.
- Check that both the forward and reverse rotation start signals are not input.
- Check that the frequency setting signal is not zero.
- Check that the AU signal is on when the frequency setting signal is 4 to 20mA.
- Check that the output stop signal (MRS) or reset signal (RES) is not on.
- Check that the sink/source jumper connector is fitted securely.

3) Check the parameter settings
- Check that the reverse rotation prevention (Pr. 78) is not selected.
- Check that the operation mode (Pr. 79) setting is correct.
- Check that the frequency setting command selection (Pr. 146) setting is correct.
- Check that the bias and gain (Pr. 902 to Pr. 905, Pr. 922, Pr. 923) settings are correct.
- Check that the starting frequency (Pr. 13) setting is not greater than the running frequency.
- Check that various operational functions (such as three-speed operation), especially the maximum frequency (Pr. 1), are not zero.

4) Check the load
- Check that the load is not too heavy.
- Check that the shaft is not locked.

5) Others
- Check that the ALARM lamp is off.
- Check that the operation panel display does not show an error (e.g. E.OC1).
- Check that the Pr. 15 "jog frequency" setting is not lower than the Pr. 13 "starting frequency" value.

5.2.2 Motor rotates in opposite direction

- Check that the phase sequence of output terminals U, V and W is correct.
- Check that the start signals (forward rotation, reverse rotation) are connected properly.

5.2.3 Speed greatly differs from the setting

- Check that the frequency setting signal is correct. (Measure the input signal level.)
- Check that the following parameter settings are correct (Pr. 1, Pr. 2, Pr. 19, Pr. 38, Pr. 39, Pr. 245, Pr. 902 to Pr. 905).
- Check that the input signal lines are not affected by external noise. (Use shielded cables)
- Check that the load is not too heavy.

5.2.4 Acceleration/deceleration is not smooth

- Check that the acceleration and deceleration time settings are not too short.
- Check that the load is not too heavy.
- Check that the torque boost setting is not too large to activate the stall prevention function.

5.2.5 Motor current is large

- Check that the load is not too heavy.
- Check that the torque boost setting is not too large.

5.2.6 Speed does not increase

- Check that the maximum frequency setting is correct.
- Check that the load is not too heavy. (In agitators, etc., load may become heavier in winter.)
- Check that the torque boost setting is not too large to activate the stall prevention function.
- Check that the brake resistor is not connected to terminals P-P1 or terminals P1-PR accidentally.

5.2.7 Speed varies during operation

When slip compensation is selected, the output frequency varies with load fluctuation between 0 and 2Hz. This is a normal operation and is not a fault.

1) Inspection of load
   - Check that the load is not varying.

2) Inspection of input signal
   - Check that the frequency setting signal is not varying.
   - Check that the frequency setting signal is not affected by noise.
   - Check that a malfunction does not occur due to an undesirable current when the transistor output unit is connected, for example. (Refer to page 27.)

3) Others
   - Check that the setting of the applied motor capacity (Pr. 80) is correct for the inverter capacities in general-purpose magnetic flux vector control.
   - Check that the wiring length is within 30m in general-purpose magnetic flux vector control.
   - Check that the wiring length is correct in V/F control.

5.2.8 Operation mode is not changed properly

If the operation mode does not change correctly, check the following:

- 1) External input signal ..... Check that the STF or STR signal is off. When it is on, the operation mode cannot be changed.
- 2) Parameter setting ..... Check the Pr. 79 setting. When the setting of Pr. 79 "operation mode selection" is "0", switching input power on places the inverter in the external operation mode. By pressing the MODE key twice and pressing the ▲ key, the external operation mode changes to the PU operation mode. For any other setting (1 to 8), the operation mode is limited according to the setting. (For details of Pr. 79, refer to page 133.)

5.2.9 Operation panel display is not operating

- Make sure that the operation panel is connected securely with the inverter.
- Check for a short circuit across terminals PC-SD.
- Check that the jumper across terminals P-P1 is fitted securely.

5.2.10 POWER lamp is not lit

(Check the power lamp after removing the operation panel.)

- Make sure that the wiring and installation are correct.

5.2.11 Parameter write cannot be performed

- Make sure that operation is not being performed (signal STF or STR is not ON).
- Make sure that you pressed the SET key (WRITE key) for longer than 1.5s.
- Make sure that you are not attempting to set the parameter outside the setting range.
- Make sure that you are not attempting to set the parameter in the external operation mode.
  (Set "2" in Pr. 77 when performing parameter setting in the external operation mode. (Refer to page 132))
- Check Pr. 77 "parameter write disable selection".

CHAPTER6
MAINTENANCE/ INSPECTION

This chapter explains the "maintenance/inspection" of this product.
Always read the instructions before using the equipment.

6.1 Precautions for Maintenance and Inspection

The transistorized inverter is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to adverse influence by the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

6.1.1 Precautions for maintenance and inspection

For some short time after the power is switched off, a high voltage remains in the smoothing capacitor. Therefore, when more than 10 minutes have elapsed after power-off, make sure that the voltage across the main circuit terminals P (+) - N (–) of the inverter is 30VDC or less using a meter, etc. Then, access the inverter for inspection.

6.1.2 Check items

(1) Daily inspection

- Check the following:
  1) Motor operation fault
  2) Improper installation environment
  3) Cooling system fault
  4) Unusual vibration and noise
  5) Unusual overheating and discoloration
- During operation, check the inverter input voltages using a meter.

(2) Cleaning

Always run the inverter in a clean state.
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 they will cause the inverter surface paint to peel off.
Do not use detergent or alcohol to clean the display and other sections of the operation panel as these sections may deform.

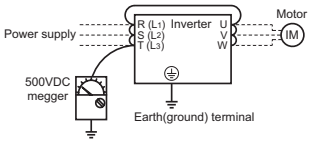
6.1.3 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection.

1) Cooling system: ..... Clean the air filter, etc.
2) Screws and bolts: ..... These parts may become loose due to vibration, temperature changes, etc. Check that they are tightened securely and retighten as necessary.
3) Conductors and insulating materials: Check for corrosion and damage.
4) Insulation resistance: Measure.
5) Cooling fan, smoothing capacitor: Check and change if necessary.

6.1.4 Insulation resistance test using megger

1) Before performing the insulation resistance test using a megger on the external circuit, disconnect the cables from all terminals of the inverter so that the test voltage is not applied to the inverter.
2) For the continuity test of the control circuit, use a meter (high resistance range) and do not use the megger or buzzer.
3) For the inverter, conduct the insulation resistance test on the main circuit only as shown below and do not perform the test on the control circuit. (Use a 500VDC megger.)



6.1.5 Pressure test

Do not conduct a pressure test. The inverter's main circuit uses semiconductors, which may deteriorate if a pressure test is made.

6.1.6 Daily and periodic inspection

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument	Customer's check
			Daily	Periodic* 1 year	Periodic* 2 years				
General	Surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	○			Refer to page 14.	Ambient temperature: -10°C to +50°C°, non-freezing. Ambient humidity: 90% or less, non-condensing.	Thermo-meter, hygrometer, recorder	
	Overall unit	Check for unusual vibration and noise.	○			Visual and auditory checks.	No fault.		
	Power supply voltage	Check that main circuit voltage is normal.	○			Measure voltage across inverter terminals R-S-T (L1-L2-L3).	Within permissible AC (DC) voltage fluctuation (Refer to page 228)	Meter, digital multimeter	
Main circuit	General	(1) Check with megger (across main circuit terminals and earth (ground) terminal). (2) Check for loose screws and bolts. (3) Check for overheat on each part. (4) Clean.		○ ○ ○	○	(1) Disconnect all cables from inverter and measure across terminals R (L1), S (L2), T (L3), U, V, W and earth (ground) terminal with megger. (2) Retighten. (3) Visual check.	(1) 5MΩ or more. (2), (3) No fault.	500VDC class megger	
	Conductors, cables	(1) Check conductors for distortion. (2) Check cable sheaths for breakage.		○ ○		(1), (2) Visual check.	(1), (2) No fault.		
	Terminal block	Check for damage.		○		Visual check	No fault		
	Inverter module Converter module	Check resistance across terminals.			○	Disconnect cables from inverter and measure across terminals R, S, T-P, N (L1, L2, L3 - +, –), and across U, V, W - P (+), N (–) with a meter with a 100Ω range.	Refer to page 218.	Analog meter	
	Smoothing capacitor	(1) Check for liquid leakage. (2) Check for safety valve projection and bulge. (3) Measure electrostatic capacity.	○ ○	 ○		(1), (2) Visual check. (3) Measure with capacity meter.	(1), (2) No fault. (3) 85% or more of rated capacity.	Capacity meter	

Area of Inspection	Inspection Item	Description	Interval				Method	Criterion	Instrument	Customer's check
			Daily	Periodic* 1 year	Periodic* 2 years					
Main circuit	Relay	(1) Check for chatter during operation. (2) Check for rough surface on contacts.		○ ○			(1) Auditory check. (2) Visual check.	(1) No fault. (2) No fault.		
Control circuit Protective circuit	Operation check	(1) Check balance of output voltages across phases with inverter operated independently. (2) Perform sequence protective operation test to make sure there is no fault in protective or display circuits.		○ ○			(1) Measure voltage across inverter output terminals U-V-W. (2) Simulate connection of inverter protective circuit output terminals.	(1) Phase-to-phase voltage balance within 4V (8V) for 200V (400V). (2) Fault must occur because of sequence.	Digital multimeter, rectifier type voltmeter	
Cooling system	Cooling fan	(1) Check for unusual vibration and noise. (2) Check for loose connection.	○	 ○			(1) Turn by hand with power off. (2) Visual check.	No unusual vibration and unusual noise.		
Display	Display	(1) Check for LED lamp blown. (2) Clean.	○	 ○			(1) Lamps indicate indicator lamps on panel. (2) Clean with rag.	(1) Check that lamps are lit.		
	Meter	Check that reading is normal.	○				Check reading of meters on panel.	Must satisfy specified and management values.	Voltmeter, ammeter, etc.	
Motor	General	(1) Check for unusual vibration and noise. (2) Check for unusual odor.	○ ○				(1) Auditory, sensory, visual checks. (2) Check for unusual odor due to overheat, damage, etc.	(1), (2) No fault.		
	Insulation resistance	Check with megger (across terminals and earth (ground) terminal).			○		Disconnect cables from U, V, W, including motor cables.	5MΩ or more.	500V megger	

Note: The values within the parentheses are for the 400V class.

* For periodic inspection, contact you nearest Mitsubishi sales representative.

6

- **Checking the inverter and converter modules**

<Preparation>

(1) Disconnect the external power supply cables (R, S, T (L_1, L_2, L_3)) and motor cables (U, V, W).

(2) Prepare a meter. (Use 100Ω range.)

<Checking method>

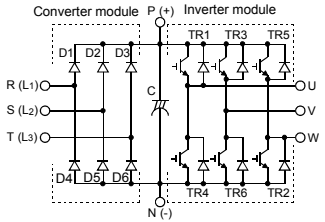
Change the polarity of the meter alternately at the inverter terminals R (L_1), S (L_2), T (L_3), U, V, W, P (+) and N (–), and check for continuity.

Note: 1. Before measurement, check that the smoothing capacitor is discharged.
2. At the time of discontinuity, the measured value is almost ∞. When there is an instantaneous continuity, due to the smoothing capacitor the tester may not indicate ∞. At the time of continuity, the measured value is several to several ten's-of ohms depending on the number of modules, number of parallel modules, circuit tester type, etc. If all measured values are almost the same, the modules are without fault.

<Module device numbers and terminals to be checked>

		Tester Polarity		Measured Value		Tester Polarity		Measured Value
		⊕	⊖			⊕	⊖	
Converter module	D1	R (L_1)	P (+)	Discontinuity	D4	R (L_1)	N (–)	Continuity
		P (+)	R (L_1)	Continuity		N (–)	R (L_1)	Discontinuity
	D2	S (L_2)	P (+)	Discontinuity	D5	S (L_2)	N (–)	Continuity
		P (+)	S (L_2)	Continuity		N (–)	S (L_2)	Discontinuity
	D3	T (L_3)	P (+)	Discontinuity	D6	T (L_3)	N (–)	Continuity
		P (+)	T (L_3)	Continuity		N (–)	T (L_3)	Discontinuity
Inverter module	TR1	U	P (+)	Discontinuity	TR4	U	N (–)	Continuity
		P (+)	U	Continuity		N (–)	U	Discontinuity
	TR3	V	P (+)	Discontinuity	TR6	V	N (–)	Continuity
		P (+)	V	Continuity		N (–)	V	Discontinuity
	TR5	W	P (+)	Discontinuity	TR2	W	N (–)	Continuity
		P (+)	W	Continuity		N (–)	W	Discontinuity

(Assumes the use of an analog meter.)



Note: The FR-E520S-0.1K to 0.75K and FR-E510W-0.1K to 0.75K do not have T (L_3), D3 and D6.

6.1.7 Replacement of parts

The inverter consists of many electronic parts such as semiconductor devices.
The following parts may deteriorate with age because of their structural or physical characteristics, leading to reduced performance or failure of the inverter. For preventive maintenance, the parts must be changed periodically.

Part Name	Standard Replacement Interval	Description
Cooling fan	2 to 3 years	Replace (as required)
Smoothing capacitor in main circuit	8 years *	Replace (as required)
Smoothing capacitor on control board	8 years *	Replace the board (as required).

* The design life of electrolytic capacitor is about eight years (50000h) if used for 20 hours a day and 300 days a year in the average yearly ambient temperature of 35°C.

Note: For part replacement, contact the nearest Mitsubishi FA center.

(1) Cooling fan

The cooling fan cools heat-generating parts such as the main circuit semiconductor devices. The life of the cooling fan bearing is usually 10,000 to 35,000 hours. Hence, the cooling fan must be changed every 2 to 3 years if the inverter is run continuously. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be replaced immediately. When you need to change the cooling fan, contact the nearest Mitsubishi FA Center.

Inverter Model No.	Fan Type
FR-E520-0.75K	MMF-04C24DS BKO-CA1382H01
FR-E520-1.5K, 2.2K, 3.7K FR-E520S-0.75K	MMF-06D24DS BKO-C2461H07
FR-E520-5.5K, 7.5K	MMF-06D24ES BKO-CA1027H08
FR-E540-1.5K, 2.2K, 3.7K	MMF-06D24ES-FC4 BKO-CA1027H09
FR-E540-5.5K, 7.5K	MMF-06D24ES-FC5 BKO-CA1027H10

● **Removal**

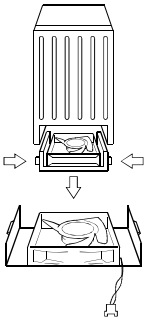
(For the FR-E520-0.75K to 3.7K, FR-E520S- 0.75K)

1) Remove the wiring cover. (Refer to page 8.)

2) Unplug the fan connector.
The cooling fan is plugged into the cooling fan connector beside the inverter terminal block.
Unplug the connector and separate the inverter from the cooling fan.

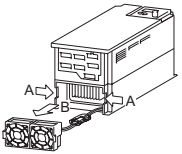
3) Remove the cooling fan cover.
Push the cover in the direction of arrow and pull it down.

4) Remove the cooling fan and cooling fan cover.
The cooling fan is secured by the fixing hooks.
Disengage the fixing catches to remove the cooling fan and cooling fan cover.

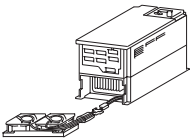


(For the FR-E520-5.5K and 7.5K)

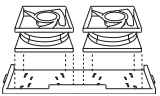
1) Remove the cooling fan cover from the inverter. (Push the cover in the direction of arrow A and pull it down in the direction of B.)
Take care of connection cables of the cooling fan and inverter.



2) Remove the cooling fan connectors.
The cooling fan is connected to the inverter with a connector.
Slide the connector cover out of the way to remove the connector.

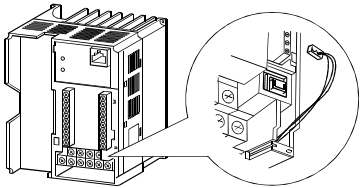


3) Remove the cooling fan.
The cooling fan is secured by the fixing hooks.
Disengage the fixing hooks to remove the cooling fan and cooling fan cover.

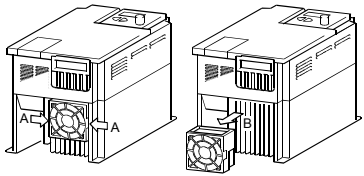


(For the FR-E540-1.5K to 7.5K)

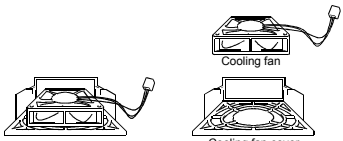
1) Remove the front cover (Refer to page 6).
2) Unplug the fan connector.
   The cooling fan is connected to the cooling fan connector beside the main circuit terminal block of the inverter.
   Unplug the connector.



3) Remove the inverter and cooling fan.
   Push in the direction of arrow A and pull out in the direction of arrow B.



4) Remove the cooling fan and cooing fan cover.
   The cooling fan is secured by the fixing hooks.
   You can remove the cooling fan and cooling fan cover by disengaging the fixing hooks.



● **Reinstallation**

(For the FR-E520-0.75K to 7.5K, FR-E520S-0.75K)

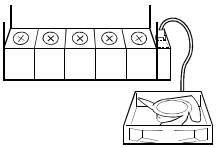
1) After confirming the orientation of the fan, reinstall the fan to the cover so that the arrow on the left of "AIR FLOW" faces in the opposite direction of the fan cover.

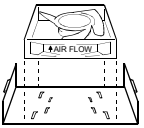
   Note: If the air flow is set in the wrong direction, the inverter life can be shorter.

2) Reinstall the fan cover to the inverter. Run the cable through the wiring groove to prevent it from being caught between the chassis and cover.

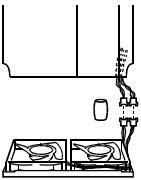
3) Reconnect the cable to the connector.

4) Reinstall the wiring cover.





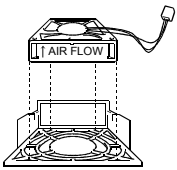
(For 5.5K, 7.5K)



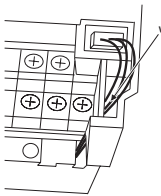
*Wire the cables using care so that they are not caught by the cooling fan.

(For the FR-E540-1.5K to 7.5K)

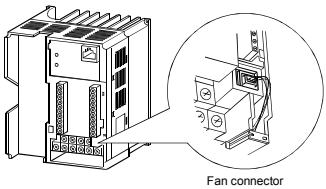
1) After confirming the orientation of the fan, reinstall the fan to the cover so that the arrow on the left of "AIR FLOW" faces in the opposite direction of the fan cover.
   Note: If the air flow is set in the wrong direction, the inverter life can be shorter.



2) Reinstall the fan cover to the inverter.
   Run the cable through the wiring groove to prevent it from being caught between the chassis and cover.



3) Reconnect the cable to the connector.



4) Reinstall the front cover.

(2) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing the DC in the main circuit, and an aluminum electrolytic capacitor is also used for stabilizing the control power in the control circuit.

Their characteristics are adversely affected by ripple current, etc. When the inverter is operated in an ordinary, air-conditioned environment, change the capacitors about every 5 years. When 5 years have elapsed, the capacitors will deteriorate more rapidly. Check the capacitors at least every year (less than six months if the life will be expired soon). Check the following:

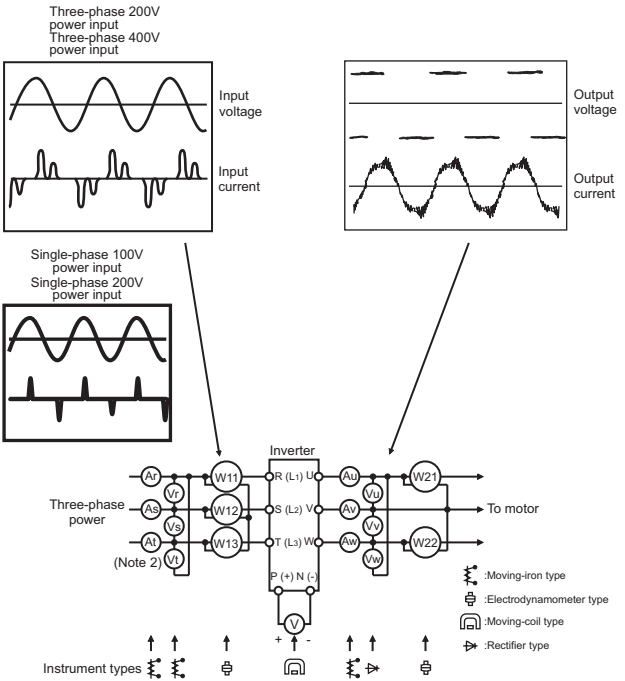
1) Case (side faces and bottom face for expansion)
2) Sealing plate (for remarkable warp and extreme crack)
3) Appearance, external cracks, discoloration, leakage.
   When the measured capacitance of the capacitor has reduced below 80% of the rating, replace the capacitor.
   The capacitor life alarm is output to give an indication of replacement time. (Refer to page 179.)

6.1.8 Measurement of main circuit voltages, currents and powers

● **Measurement of voltages and currents**

Since the voltages and currents on the inverter power supply and output sides include harmonics, accurate measurement depends on the instruments used and circuits measured.

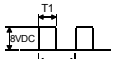
When instruments for commercial frequency are used for measurement, measure the following circuits using the instruments given on the next page.



Typical Measuring Points and Instruments

Note: 1. Use FFT (Fast Fourier Transforms) to measure the output voltage accurately. It cannot be measured accurately with a meter or general instrument.
2. For FR-E520S-0.1K to 0.75K and FR-E510W-0.1K to 0.75K do not use At, As, Vt, Vs, W12 and W13.

Measuring Points and Instruments

Item	Measuring Point	Measuring Instrument	Remarks (Reference Measured Value)	
Power supply voltage (V1)	Across R-S (L1-L2), S-T (L2-L3) and T-R (L3-L1)	Moving-iron type AC voltmeter	Is the commercial power supply within permissible variation of AC voltage (Refer to page 228)	
Power supply side current (I1)	R, S and T line currents (L1, L2 and L3 line currents)	Moving-iron type AC ammeter		
Power supply side power (P1)	At R (L1), S (L2) and T (L3), and across R-S (L1-L2), S-T (L2-L3) and T-R (L3-L1)	Electrodynamic type single-phase wattmeter	P1 = W11 + W12 + W13 (3-wattmeter method)	
Power supply side power factor (Pf1)	Calculate after measuring power supply voltage, power supply side current and power supply side power. [For three-phase power supply] $Pf1=\frac{P1}{\sqrt{3}V1\times I1}\times 100\%$ [For single-phase power supply] $Pf1=\frac{P1}{V1\times I1}\times 100\%$			
Output side voltage (V2)	Across U-V, V-W and W-U	(Note 1) (Cannot be measured by moving-iron type)	Difference between phases is within ±1% of maximum output voltage.	
Output side current (I2)	U, V and W line currents	Moving-iron type AC ammeter (Note 2)	Current should be equal to or less than rated inverter current.Difference between phases is 10% or lower.	
Output side power (P2)	At U, V and W, and across U-V and V-W	Electrodynamic type single-phase wattmeter	P2 = W21 + W22 2-wattmeter method (or 3-wattmeter method)	
Output side power factor (Pf2)	Calculate in similar manner to power supply side power factor. $Pf2=\frac{P2}{\sqrt{3}V2\times I2}\times 100\%$			
Converter output	Across P-N (+ - –)	Moving-coil type (such as tester)	Inverter LED display is lit. 1.35 × V1 Maximum 380V (760V) during regenerative operation	
Frequency setting signal	Across 2 (positive)-5	Moving-coil type (Meter, etc. may be used) (Internal resistance: 50Ω or larger)	0 to 5V/0 to 10VDC	"5" is common.
	Across 4 (positive)-5		4 to 20mADC	
Frequency setting power supply	Across 10 (positive)-5		5VDC	
Frequency meter signal	Across FM (positive)-SD		Approximately 5VDC at maximum frequency (without frequency meter)  Pulse width T1: Adjusted with Pr. 900 Pulse cycle T2: Set with Pr. 55 (Valid for frequency monitoring only)	SD is common.
Start signal Select signal	Across STF, STR, RH, RM, RL, MRS, RES-SD	Moving-coil type (Meter, etc. may be used) (Internal resistance: 50kΩ or larger)	20 to 30VDC when open.ON voltage: 1V or less	SD is common.
Reset	Across RES (positive)-SD			
Output stop	Across MRS (positive)-SD			
Alarm signal	Across A-C Across B-C	Moving-coil type (such as a meter)	Continuity check <Normal> <Fault> Across A-C: Discontinuity Continuity Across B-C: Continuity Discontinuity	

Note: 1. Use FFT to measure the output voltage accurately. It can not be measured accurately with a meter or general instrumentation.
2. If the carrier frequency exceeds 5kHz, do not use this instrument since using it may increase eddy-current loss produced in metal parts inside the instrument, leading to burnout. In this case, use an approximate effective value type instrument.

*The value within the parentheses is for the 400V class.

MEMO

CHAPTER 7 SPECIFICATIONS

This chapter explains the "protective functions" of this product.
Always read the instructions before using the equipment.

7.1 Standard Specifications

7.1.1 Model specifications

(1) Three-phase 200V power supply

Type FR-E520- ☐ K(C) (Note 8)		0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5
Applicable motor capacity (kW) (Note 1)		0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5
Output	Rated capacity (kVA) (Note 2)	0.3	0.6	1.2	2.0	3.2	4.4	7.0	9.5	13.1
	Rated current (A) (Note 6)	0.8 (0.8)	1.5 (1.4)	3 (2.5)	5 (4.1)	8 (7)	11 (10)	17.5 (16.5)	24 (23)	33 (31)
	Overload capacity (Note 3)	150% 60s 200% 0.5s (inverse-time characteristics)								
	Voltage (Note 4)	Three phase, 200V to 240V								
Power supply	Rated input AC (DC) voltage, frequency	Three phase, 200V to 240V 50Hz/60Hz (280VDC, Note 7)								
	Permissible AC (DC) voltage fluctuation	170 to 264V 50Hz/60Hz (252 to 310VDC, Note 7)								
	Permissible frequency fluctuation	±5%								
	Power supply system capacity (kVA)(Note 5)	0.4	0.8	1.5	2.5	4.5	5.5	9	12	17
Protective structure (JEM1030)		Enclosed type (IP20), IP40 for totally enclosed structure series								
Cooling system		Self-cooling			Forced air cooling					
Approximate weight (kg)		0.6	0.6	0.8	1.0	1.7	1.7	2.2	4.4	4.9

Note: 1. The applicable motor capacity indicated is the maximum capacity applicable when a Mitsubishi 4-pole standard motor is used.
2. The rated output capacity indicated assumes that the output voltage is 230V.
3. The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
4. The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.
5. The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables).
6. The rated output current in the parentheses applies when low acoustic noise operation is to be performed at the ambient temperature higher than 40°C(30°C for the totally enclosed structure) with the Pr. 72 (PWM frequency selection) value set to 2kHz or higher.
7. When using a DC power supply
   (1) The guideline for the power supply voltage fluctuation range is 280VDC ±10%, and usually use the power supply at or below 300VDC.
   (2) When DC power is switched on, a larger inrush current flows than in AC power. The number of power-on times should be minimized.
   (3) 300VDC must be reserved to make the torque characteristic equal to when AC power supply is used.
8. The type code of the dirt-protection structure series ends with C.

(2) Three-phase 400V power supply

Type FR-E540- ☐ K (C) (Note 7)		0.4	0.75	1.5	2.2	3.7	5.5	7.5
Applicable motor capacity (kW) (Note 1)		0.4	0.75	1.5	2.2	3.7	5.5	7.5
Output	Rated capacity (kVA) (Note 2)	1.2	2.0	3.0	4.6	7.2	9.1	13.0
	Rated current (A) (Note 6)	1.6 (1.4)	2.6 (2.2)	4.0 (3.8)	6.0 (5.4)	9.5 (8.7)	12	17
	Overload capacity (Note 3)	150% 60s 200% 0.5s (inverse-time characteristics)						
	Voltage (Note 4)	Three phase, 380V to 480V						
Power supply	Rated input AC voltage, frequency	Three phase, 380V to 480V 50Hz/60Hz						
	Permissible AC voltage fluctuation	325V to 528V 50Hz/60Hz						
	Permissible frequency fluctuation	±5%						
	Power supply system capacity (kVA) (Note 5)	1.5	2.5	4.5	5.5	9.5	12	17
Protective structure (JEM1030)		Enclosed type (IP20), IP40 for totally enclosed structure series						
Cooling system		Self-cooling		Forced air cooling				
Approximate weight (kg)		1.9	1.9	2.0	2.1	2.1	3.8	3.8

Note: 1. The applicable motor capacity indicated is the maximum capacity applicable when a Mitsubishi 4-pole standard motor is used.
2. The rated output capacity indicated assumes that the output voltage is 440V.
3. The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
4. The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.
5. The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables).
6. The rated output current in the parentheses applies when low acoustic noise operation is to be performed at the ambient temperature higher than 40°C (104°F) (30°C for the totally enclosed structure) with the Pr. 72 (PWM frequency selection) value set to 2kHz or higher.
7. The type code of the dirt-protection structure series ends with C.

(3) Single-phase 200V power supply

Type FR-E520S- ☐ K		0.1	0.2	0.4	0.75
Applicable motor capacity (kW) (Note 1)		0.1	0.2	0.4	0.75
Output	Rated capacity (kVA) (Note 2)	0.3	0.6	1.2	2.0
	Rated output current (A) (Note 6)	0.8 (0.8)	1.5 (1.4)	3.0 (2.5)	5.0 (4.1)
	Overload capacity (Note 3)	150% 60s 200% 0.5s (inverse-time characteristics)			
	Voltage (Note 4)	Three phase, 200V to 240V			
Power supply	Rated input AC voltage, frequency	Single phase, 200V to 240V 50Hz/60Hz			
	Permissible AC voltage fluctuation	Single phase, 170 to 264V 50Hz/60Hz			
	Permissible frequency fluctuation	Within ±5%			
	Power supply capacity (kVA) (Note 5)	0.5	0.9	1.5	2.5
Protective structure (JEM1030)		Enclosed type (IP20)			
Cooling system		Self-cooling			Forced air cooling
Approximate weight (kg)		0.6	0.6	1.0	1.7

Note: 1. The applicable motor capacity indicated is the maximum capacity applicable when a Mitsubishi 4-pole standard motor is used.
Normally, the rated current (at 50Hz) of the motor applied should not exceed the rated current.

2. The rated output capacity indicated assumes that the output voltage is 230V.
3. The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
4. The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.
5. The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables). Prepare the power supply capacity which is not less than the indicated.
6. The rated output current in the parentheses applies when low acoustic noise operation is to be performed at the ambient temperature higher than 40°C with the Pr. 72 (PWM frequency selection) value set to 2kHz or higher.

(4) Single-phase 100V power supply

Type FR-E510W- ☐ K		0.1	0.2	0.4	0.75
Applicable motor capacity (kW) (Note 1)		0.1	0.2	0.4	0.75
Output	Rated capacity (kVA) (Note 2)	0.3	0.6	1.2	2
	Rated output current (A) (Note 7)	0.8 (0.8)	1.5 (1.4)	3.0 (2.5)	5.0 (4.1)
	Overload capacity (Note 3)	150% 60s 200% 0.5s (inverse-time characteristics)			
	Voltage (Note 4)	Three phase, 200V to 230V (Note 4, 8)			
Power supply	Rated input AC voltage, frequency	Single phase, 100V to 115V 50Hz/60Hz			
	Permissible AC voltage fluctuation	Single phase, 90 to 132V 50Hz/60Hz			
	Permissible frequency fluctuation	Within ±5%			
	Power supply capacity (kVA) (Note 5)	0.5	0.9	1.5	2.5
Protective structure (JEM1030)		Enclosed type (IP20)			
Cooling system		Self-cooling			
Approximate weight (kg)		0.6	0.6	1.0	1.7

Note: 1. The applicable motor capacity indicated is the maximum capacity applicable when the Mitsubishi 4-pole standard motor is used.
Normally, the rated current (at 50Hz) of the motor applied should not exceed the rated current.

2. The rated output capacity indicated assumes that the output voltage is 230V.
3. The % value of the overload current rating indicated is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
4. For single-phase 100V power input, the output voltage provided cannot be twice or more than the power supply voltage. The pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.
5. The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables). Prepare the power supply capacity which is not less than the indicated.
6. Load applied to the motor will reduce the output voltage about 10 to 15%. When using a general-purpose motor, it must be used under reduced load.
7. The rated output current in the parentheses applies when low acoustic noise operation is to be performed at the ambient temperature higher than 40°C with the Pr. 72 "PWM frequency selection" value set to not less than 2kHz.
8. For single-phase 100V power input, the application of motor load reduces the output voltage about 10 to 15%. Therefore, the load must be reduced when a general-purpose motor is used.

7.1.2 Common specifications

Control specifications	Control system			Selectable between Soft-PWM control and high carrier frequency PWM control, V/F control or general-purpose magnetic flux vector control are selectable.	
	Output frequency range			0.2 to 400Hz (starting frequency variable between 0 and 60Hz)	
	Frequency setting resolution		Analog input	Across terminals 2-5: 1/500 of maximum set frequency (5VDC input), 1/1000 (10VDC, 4-20mADC input), 1/256 (when operation panel potentiometer is used)	
				Frequency setting potentiometer: 1/256 of maximum set frequency	
			Digital input	0.01Hz (less than 100Hz), 0.1Hz (100Hz or more) when digital setting is made using the operation panel	
	Frequency accuracy		Analog input	Within ±0.5% of maximum output frequency (25°C ±10°C)	
			Digital input	Within 0.01% of set output frequency when setting is made from operation panel.	
	Voltage/frequency characteristic			Base frequency set as required between 0 and 400Hz. Constant torque or variable torque pattern can be selected.	
	Starting torque			150% or more (at 1Hz), 200% or more (at 3Hz) when general-purpose magnetic flux vector control or slip compensation is selected	
	Torque boost			Manual torque boost, 0 to 30% may be set.	
	Acceleration/deceleration time setting			0.01, 0.1 to 3600s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode can be selected.	
	Braking torque		Regenerative (Note 3)	0.1K, 0.2K ... 150%, 0.4K, 0.75K ... 100%, 1.5K ... 50%, 2.2K, 3.7K, 5.5K, 7.5K ... 20%	
			DC injection brake	Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 30%) variable	
	Current stall prevention operation level			Operation current level can be set (0 to 200% variable), presence or absence can be selected.	
	Voltage stall prevention operation level			Operation level is fixed, presence or absence can be selected.	
	Fast-response current limit level			Operation level is fixed, presence or absence can be selected.	
	Input signals	Frequency setting signal	Analog input	0 to 5VDC, 0 to 10VDC, 4 to 20mADC, built-in frequency setting potentiometer.	
			Digital input	Entered from operation panel.	
		Start signal		Forward rotation and reverse rotation, start signal self-holding input (3-wire input) selectable.	
		Alarm reset		Used to reset alarm output provided when protective function is activated.	
		Multi-speed selection		Up to 15 speeds can be selected. (Each speed can be set between 0 and 400Hz, running speed can be changed during operation from the operation panel.)	Use Pr. 180 to Pr. 183 for selection.
		Second function selection		Used to select second functions (acceleration time, deceleration time, torque boost, base frequency, electronic overcurrent protection).	
		Output stop		Instantaneous shut-off of inverter output (frequency, voltage).	
		Current input selection		Used to select input of frequency setting signal 4 to 20mADC (terminal 4).	
		External thermal relay input		Thermal relay contact input for use when the inverter is stopped by the external thermal relay.	
		PU operation-external operation switchover		Used to switch between PU operation and external operation from outside the inverter.	
		V/F-general-purpose magnetic flux switching		Used to switch between V/F control and general-purpose magnetic flux vector control from outside the inverter.	

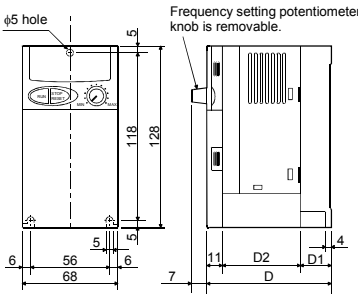
Control specifications	Operation functions			Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, automatic restart operation after instantaneous power failure, forward/reverse rotation prevention, slip compensation, operation mode selection, offline auto tuning function, PID control, computer link operation (RS-485)
	Output signals	Operating status		2 open collector output signals can be selected from inverter running, up to frequency, frequency detection, overload alarm, zero current detection, output current detection, PID upper limit, PID lower limit, PID forward/reverse rotation, operation ready, capacitor life alarm, current average value monitor, minor fault and alarm, and 1 contact output (230VAC 0.3A, 30VDC 0.3A) can be selected.
		For meter		1 signal can be selected from output frequency, output current and output voltage. Pulse train output (1440 pulses/s/full scale).
Display	Operation panel display		Operating status	Output voltage, output current, set frequency, running.
			Alarm definition	Alarm definition is displayed when protective function is activated. 4 alarm definitions are stored.
	LED display			Power application (POWER), Alarm (ALARM)
Protective/alarm functions				Overcurrent shut-off (during acceleration, deceleration, constant speed), regenerative overvoltage shut-off, undervoltage (Note 1), instantaneous power failure (Note 1), overload shut-off (electronic overcurrent protection), brake transistor alarm, output short circuit, stall prevention, brake resistor overheat protection, heatsink overheat, fan failure (Note 4), parameter error, PU disconnection, output phase loss protection, earth (ground) fault overcurrent protection (400V class), starting-time earth (ground) fault overcurrent protection (other than 400V class), option alarm (400V class), 24VDC power supply short circuit (400V class).
Environment	Ambient temperature			-10°C to +50°C (non-freezing) (-10°C to +40°C for totally-enclosed structure feature)
	Ambient humidity			90%RH or less (non-condensing)
	Storage temperature (Note 2)			-20°C to +65°C
	Ambience			Indoors (no corrosive and flammable gases, oil mist, dust and dirt.)
	Altitude, vibration			Maximum 1000m above sea level for standard operation.

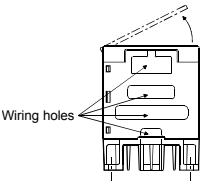
Note: 1. When undervoltage or instantaneous power failure has occurred, alarm display or alarm output is not provided but the inverter itself is protected. Overcurrent, regenerative overvoltage or other protection may be activated at power restoration according to the operating status (load size, etc.)
2. Temperature applicable for a short period in transit, etc.
3. The braking torque indicated is a short-duration average torque (which varies with motor loss) when the motor alone is decelerated from 60Hz in the shortest time and is not a continuous regenerative torque. When the motor is decelerated from the frequency higher than the base frequency, the average deceleration torque will reduce. Since the inverter does not contain a brake resistor, use the optional brake resistor when regenerative energy is large. (The optional brake resistor cannot be used with 0.1K and 0.2K.) A brake unit (BU) may also be used.
4. Not provided for the FR-E540-0.4K, 0.75K, FR-E520(S)-0.1K to 0.4K and FR-E510W-0.1K to 0.75K which are not equipped with a cooling fan.

7.1.3 Outline dimension drawings

(1) 200V class, 100V class

- **FR-E520-0.1K, 0.2K, 0.4K, 0.75K**
- **FR-E520S-0.1K, 0.2K, 0.4K**
- **FR-E510W-0.1K, 0.2K, 0.4K**



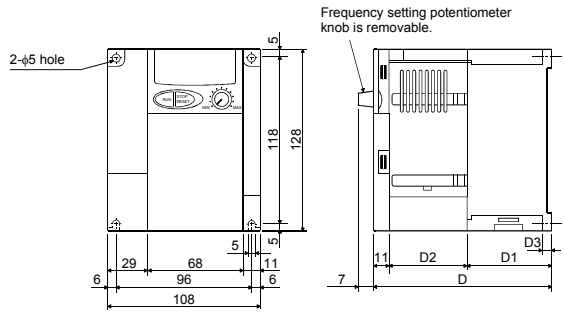


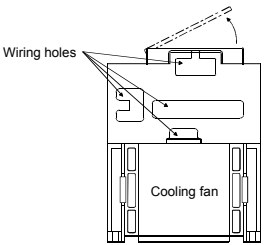
Inverter Type	D	D1	D2
FR-E520-0.1K	76	10	55
FR-E520-0.2K	76	10	55
FR-E520-0.4K	108	42	55
FR-E520-0.75K	128	62	55
FR-E520S-0.1K	76	10	55
FR-E520S-0.2K	76	10	55
FR-E520S-0.4K	138	42	85
FR-E510W-0.1K	76	10	55
FR-E510W-0.2K	106	10	85
FR-E510W-0.4K	138	42	85

Note: FR-E520-0.75K is provided with cooling fan.

(Unit: mm)

- **FR-E520-1.5K, 2.2K**
- **FR-E520S-0.75K**
- **FR-E510W-0.75K**



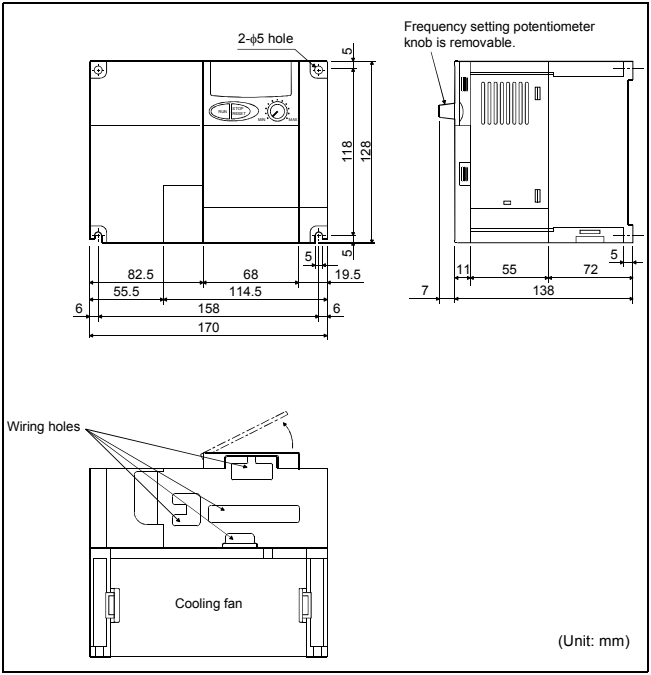


Inverter Type	D	D1	D2	D3
FR-E520-1.5K, 2.2K	131	65	55	8
FR-E520S-0.75K	131	65	55	8
FR-E510W-0.75K	155	59	85	5

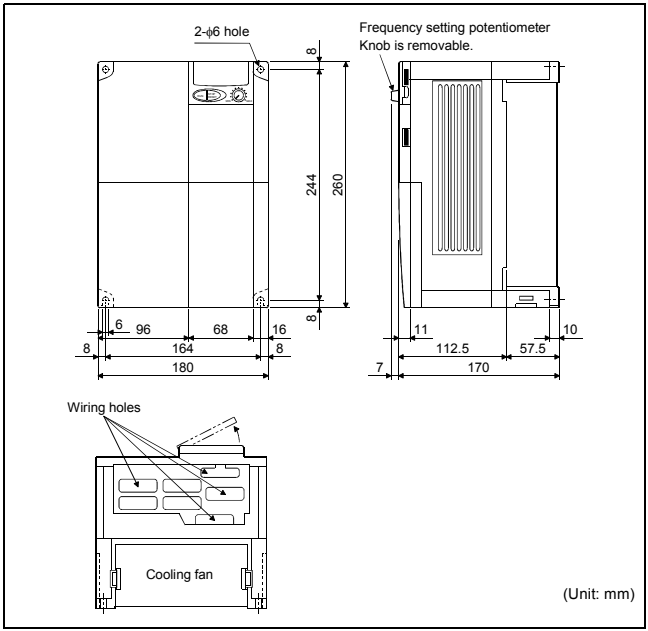
Note: FR-E510W-0.75K is not equipped with a cooling fan.

(Unit: mm)

● **FR-E520-3.7K**

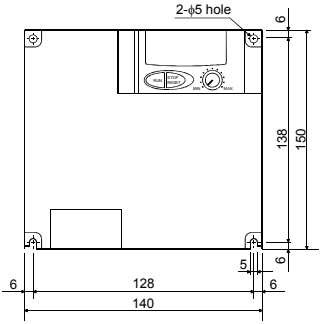

2-φ5 hole
Frequency setting potentiometer knob is removable.
5
118
128
5
5
82.5
68
19.5
55.5
114.5
6
158
6
170
11
55
72
5
7
138
Wiring holes
Cooling fan
(Unit: mm)

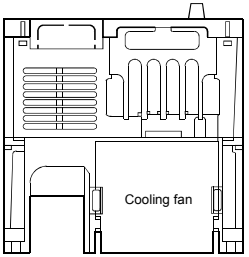
● **FR-E520-5.5K, 7.5K**



(2) 400V class

●FR-E540-0.4K, 0.75K, 1.5K, 2.2K, 3.7K



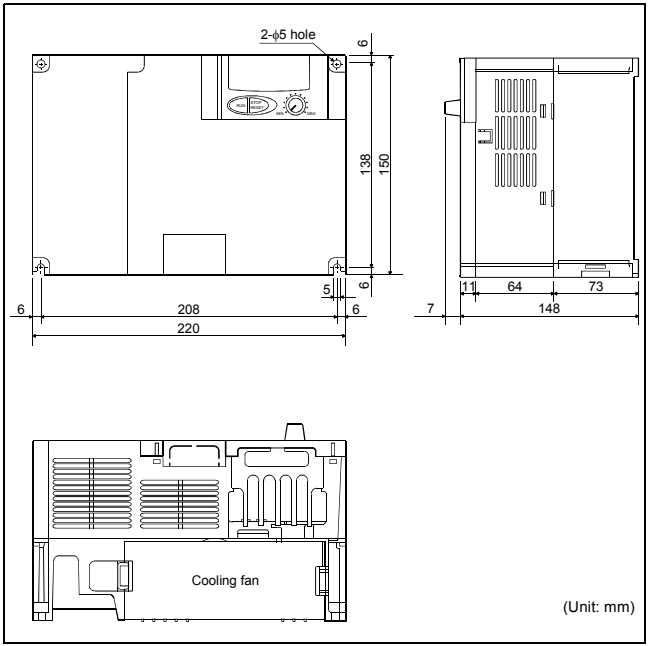


Inverter Type	D	D1
FR-E540-0.4K, 0.75K	116	44
FR-E540-1.5K to 3.7K	136	64

Note: There is no cooling fan in the FR-E540-0.4K and 0.75K

(Unit: mm)

● **FR-E540-5.5K, 7.5K**



MEMO

APPENDIX

This chapter provides "supplementary information" for use of this product.
Always read the instructions before using the equipment.

APPENDIX 1 Instruction Code List

Function	Parameter Number	Name	Instruction Code		Link Parameter Extension Setting (Instruction Code 7F/FF)
			Read	Write	
Basic functions	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
Standard operation functions	10	DC injection brake operation frequency	0A	8A	0
	11	DC injection brake operation time	0B	8B	0
	12	DC injection brake 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
	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
	29	Acceleration/deceleration pattern	1D	9D	0
	30	Regenerative function selection	1E	9E	0
	31	Frequency jump 1A	1F	9F	0
	32	Frequency jump 1B	20	A0	0
	33	Frequency jump 2A	21	A1	0
	34	Frequency jump 2B	22	A2	0
	35	Frequency jump 3A	23	A3	0
	36	Frequency jump 3B	24	A4	0
	37	Speed display	25	A5	0
	38	Frequency at 5V (10V) input	26	A6	0
	39	Frequency at 20mA input	27	A7	0
Output terminal functions	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
Second functions	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 electronic thermal O/L relay	30	BO	0

Func-tion	Parameter Number	Name	Instruction Code		Link Parameter Extension Setting (Instruction Code 7F/FF)
			Read	Write	
Display functions	52	Operation panel/PU main display data selection	34	B4	0
	54	FM terminal function selection	36	B6	0
	55	Frequency monitoring reference	37	B7	0
	56	Current monitoring reference	38	B8	0
Automatic restart functions	57	Restart coasting time	39	B9	0
	58	Restart cushion time	3A	BA	0
Additional function	59	Remote setting function selection	3B	BB	0
Operation selection functions	60	Shortest acceleration/deceleration mode	3C	BC	0
	61	Reference current	3D	BD	0
	62	Reference current for acceleration	3E	BE	0
	63	Reference current for deceleration	3F	BF	0
	65	Retry selection	41	C1	0
	66	Stall prevention operation level reduction starting frequency	42	C2	0
	67	Number of retries at alarm occurrence	43	C3	0
	68	Retry waiting time	44	C4	0
	69	Retry count display erasure	45	C5	0
	70	Special regenerative brake duty	46	C6	0
	71	Applied motor	47	C7	0
	72	PWM frequency selection	48	C8	0
	73	0-5V/0-10V selection	49	C9	0
	74	Filter time constant	4A	CA	0
	75	Reset selection/disconnected PU detection/PU stop selection	4B	CB	0
	77	Parameter write disable selection	4D	CD	0
	78	Reverse rotation prevention selection	4E	CE	0
	79	Operation mode selection	4F	CF	0
General-purpose magnetic flux vector control	80	Motor capacity	50	D0	0
	82	Motor excitation current	52	D2	0
	83	Rated motor voltage	53	D3	0
	84	Rated motor frequency	54	D4	0
	90	Motor constant (R1)	5A	DA	0
	96	Auto-tuning setting/status	60	E0	0
Communication functions	117	Communication station number	11	91	1
	118	Communication speed	12	92	1
	119	Stop bit length	13	93	1
	120	Parity check presence/absence	14	94	1
	121	Number of communication retries	15	95	1
	122	Communication check time interval	16	96	1
	123	Waiting time setting	17	97	1
	124	CR/LF selection	18	98	1

Function	Parameter Number	Name	Instruction Code		Link Parameter Extension Setting (Instruction Code 7F/FF)
			Read	Write	
PID control	128	PID action selection	1C	9C	1
	129	PID proportional band	1D	9D	1
	130	PID integral time	1E	9E	1
	131	Upper limit	1F	9F	1
	132	Lower limit	20	A0	1
	133	PID action set point for PU operation	21	A1	1
	134	PID differential time	22	A2	1
Additional function	145	PU display language selection	2D	AD	1
	146	Frequency setting command selection	2E	AE	1
Current detection	150	Output current detection level	32	B2	1
	151	Output current detection period	33	B3	1
	152	Zero current detection level	34	B4	1
	153	Zero current detection period	35	B5	1
Sub function	156	Stall prevention operation selection	38	B8	1
Additional function	160	User group read selection	00	80	2
Initial monitor	170	Watt-hour meter clear	0A	8A	2
	171	Actual operation hour meter clear	0B	8B	2
User functions	173	User group 1 registration	0D	8D	2
	174	User group 1 deletion	0E	8E	2
	175	User group 2 registration	0F	8F	2
	176	User group 2 deletion	10	90	2
Terminal assignment functions	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	MRS terminal function selection	17	97	2
	190	RUN terminal function selection	1E	9E	2
	191	FU terminal function selection	1F	9F	2
	192	A, B, C terminal function selection	20	A0	2
Multi-speed operation	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
Sub functions	240	Soft-PWM setting	30	B0	2
	244	Cooling fan operation selection	34	B4	2
	245	Rated motor slip	35	B5	2
	246	Slip compensation response time	36	B6	2
	247	Constant-output region slip compensation selection	37	B7	2
	249	Earth (ground) fault detection at start	39	B9	2

Function	Parameter Number	Name	Instruction Code		Link Parameter Extension Setting (Instruction Code 7F/FF)
			Read	Write	
Stop selection function	250	Stop selection	3A	BA	2
Aditional function	251	Output phase loss protection selection	3B	BB	2
Computer link function	338*	Operation command source	26	A6	3
	339*	Speed command source	27	A7	3
	340*	Link startup mode selection	28	A8	3
	342	E^2PROM write selection	2A	AA	3
DeviceNet™ functions	345*	DeviceNet address startup data (lower byte)	2D	AD	3
	346*	DeviceNet baudrate startup data (lower byte)	2E	AE	3
	347*	DeviceNet address startup data (higher byte)	2F	AF	3
	348*	DeviceNet baudrate startup data (higher byte)	30	B0	3
LONWORKS® functions	387*	Initial communication delay time	57	D7	3
	388*	Send time interval at hart beat	58	D8	3
	389*	Minimum sending time at hart beat	59	D9	3
	390*	% setting reference frequency	5A	DA	3
	391*	Receive time interval at hart beat	5B	DB	3
	392*	Event driven detection width	5C	DC	3
Addtional Function	500*	Communication error recognition waiting time	00	80	5
	501*	Communication error occurrence count display	01	81	5
	502*	Stop mode selection at communication error	02	82	5
Current average value monitor	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
Calibration functions	900	FM terminal calibration	5C	DC	1
	901	AM terminal calibration	5D	DD	1
	902	Frequency setting voltage bias	5E	DE	1
	903	Frequency setting voltage gain	5F	DF	1
	904	Frequency setting current bias	60	E0	1
	905	Frequency setting current gain	61	E1	1
	922	Built-in frequency setting potentiometer bias	16	96	9
	923	Built-in frequency setting potentiometer gain	17	97	9
	990	PU buzzer control	5A	DA	9
	991	PU contrast adjustment	5B	DB	9

*For only the 400V class fitted with the communication option.

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APPENDIX 2 When using the communication option. (400V class only)

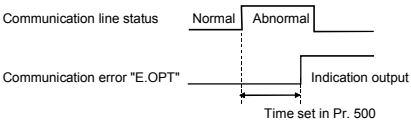
Operation at Communication Error Occurrence

The extended functions for E.OPT error and E. 3 error have been added to this instruction manual. (Pr. 500 to Pr. 502)

(1) Pr. 500 "communication error execution waiting time"

You can set the waiting time from occurrence of a communication line fault to communication error indication "E.OPT".

Parameter Number	Setting Range	Minimum Setting Increment	Factory Setting
500	0 to 999.8 s	0.1 s	0

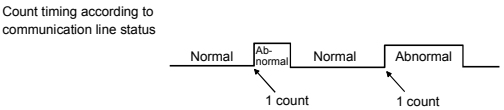


If a communication line fault still persists after the time set in Pr. 500 has elapsed, it is recognized as a communication error and the communication error indication "E.OPT" is output. If communication is restored to normal during the set time, operation is continued without a communication error indication.

(2) Pr. 501 "communication error occurrence count indication"

You can display the cumulative number of communication line faults that occurred.
Write "0" to Pr. 501 to clear the communication error occurrence count.

Parameter Number	Setting Range	Minimum Setting Increment	Factory Setting
501	0	1	0



At the time when a communication line fault occurs, one count is made in Pr. 501 "communication error occurrence count indication".

Note: The communication error occurrence count indication is temporarily stored in RAM. As it is reflected to E^2PROM per hour only, performing power-on reset or inverter reset causes the last value stored in E^2PROM to display as the value of Pr. 501.

(3) Pr. 502 "stop mode selection at communication error"

You can select inverter operation to be performed in the occurrence of a communication line fault or an option error.

Parameter Number	Setting Range	Minimum Setting Increment	Factory Setting
502	0, 1, 2	1	0

(About the settings)

Fault	Pr. 502 Setting	At Occurrence of Fault			Error Recognition after Elapse of Pr. 500 Time			At Resolution of Fault		
		Operating status	Indi-cation	Alarm output	Operating status	Indi-cation	Alarm output	Operating status	Indi-cation	Alarm output
Communication line	0	Continued	No	Not provided	Coasting to stop	E.OPT lit	Provided	Stop held	E.OPT kept lit	Provided
	1	Continued	No	Not provided	Decele-ration to stop	E.OPT lit after stop	Provided after stop	Stop held	E.OPT kept lit	Provided
	2	Continued	No	Not provided	Decele-ration to stop	E.OPT lit after stop	Not provided	Restart	E.OPT kept lit	Not provided
Option error	0	Coasting to stop	E.3 lit	Provided	Coasting to stop	E.3 lit	Provided	Stop held	E.3 kept lit	Provided
	1	Decele-ration to stop	E.3 lit after stop	Provided after stop	Decele-ration to stop	E.3 lit after stop	Provided after stop	Stop held	E.3 kept lit	Provided
	2	Decele-ration to stop	E.3 lit after stop	Provided after stop	Decele-ration to stop	E.3 lit after stop	Provided after stop	Stop held	E.3 kept lit	Provided

Note: 1. A communication error [E.OPT (fault data: A0H)] is a fault on the communication line, and a communication error [E. 3 (fault data: F3H)] is a communication error inside the inverter.
2. The alarm output is the ABC contact output or alarm bit output.
3. If the Pr. 502 setting is 1 or 2, the deceleration time is the ordinary deceleration time setting (Pr. 8, Pr. 44, Pr. 45).
4. The acceleration time at restart is the ordinary acceleration time setting (Pr. 7, Pr. 44).
5. If the Pr. 502 setting is 2, the operation command/speed command at restart follows the command before occurrence of a fault.
6. For the setting of alarm output, the fault definition is stored in the alarm history.(Write to the alarm history is performed when the alarm output is provided.)If the alarm output is not provided, the fault definition overwrites the alarm indication of the alarm history temporarily but is not stored.After the fault is cleared, the alarm indication is reset and returns to the ordinary monitor and the alarm history returns to the original alarm history.
7. When a communication line fault, which occurred at the Pr. 502 setting of 2, is cleared during deceleration, acceleration restarts at that point. (Acceleration does not restart at occurrence of a Option fault.)

Switching mode between the PU operation mode and network operation mode (when used with a communication option)

You can switch operation between the PU operation and network operation from the operation panel or parameter unit (FR-PU04) during starting up in the network operation mode.

Pr. 340 Setting	Operation Mode		Mode at Power On or at Restoration from Instantaneous Power Failure
	Pr. 79		
10	0	PU or network operation	Inverter operates in the network operation mode. Operation mode can be switched between the PU operation and the network operation.
	1	PU operation	Inverter operates in the PU operation mode.
	2	Network operation	Inverter operates in the network operation mode.
	3	External/PU combined operation	Input running frequency from the PU and the start signal from outside.
	4	External/PU combined operation	Input running frequency from outside and the start signal from the PU.
	6	Switch-over	Inverter operates in the network operation mode. Operation mode can be switched between the PU operation and the network operation.
	7*	PU operation interlock	MRS signal ON..... Inverter operates in the external operation mode. (Operation mode can be switched to the PU operation mode by the parameter unit.) MRS signal OFF ... Inverter operates in the external operation mode.
	8*	Operation mode switch-over by the external signal	X16 signal ON ..... Inverter operates in the external operation mode. X16 signal OFF .... Inverter operates in the PU operation mode.

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

* When Pr. 79 = "7 or 8", the inverter operates in the same manner as when Pr. 340 = "0". (The inverter will not operate in the network operation mode at powering on.)

When Pr. 340="10" and Pr. 79="0 or 6", operation can be switched between the PU operation and network operation from the operation panel or parameter unit (FR-PU04).

- Operation panel

  Shifts to the PU operation mode when  is displayed on the operation mode switching menu and shifts to the network operation when  is displayed.

- FR-PU04

  Shifts to the PU operation mode when  is displayed and to the network operation mode when is displayed.

REMARKS

1. Change of the Pr. 340 setting is made valid when powering on or resetting the inverter.
2. When copying parameters to the inverter which is not available with Pr. 340="10", the inverter operates in the same manner as when Pr. 340 ="0". For Pr. 340="0, 1", refer to the instruction manual of each communication option.

MEMO

⚠ For Maximum Safety

- Mitsubishi general-purpose inverters are not designed or manufactured to be used in equipment or systems in situations that can affect or endanger human life.

- When considering this product for operation in special applications such as machinery or systems used in passenger transportation, medical, aerospace, atomic power, electric power, or submarine repeating applications, please contact your nearest Mitsubishi sales representative.

- Although this product was manufactured under conditions of strict quality control, you are strongly advised to install safety devices to prevent serious accidents when it is used in facilities where breakdowns of the product are likely to cause a serious accident.

- Please do not use this product for loads other than three-phase induction motors.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Nov., 1997	IB(NA)-66813-A	First edition
Jun., 1998	IB(NA)-66813-B	Additions • Single-phase 200V power input specifications • Response to Standard-compliant models • FR-E520-5.5K, 7.5K • Pr. 146 "frequency setting command selection" • Pr. 249 "earth (ground) fault detection at start" Modifications • Corrections to clerical errors • Factory setting of Pr. 79 "operation mode selection"
Jul., 1999	IB(NA)-66813-C	Additions • Three-phase 400V power input specifications • Single-phase 100V power input specifications Modifications • Control circuit terminal screw tightening torque
Nov., 2000	IB(NA)-66813-D	Additions • Pr. 251 "output phase failure protection selection" • Pr. 342 "E^2PROM write selection" (400V class only) Modifications • Alarm indications (E. 6, E. 7) • Instructions for compliance with U.S. and Canadian Electrical Codes
Jul., 2001	IB(NA)-66813-E	Modifications • Pr. 342 "E^2PROM write selection" • Alarm indications (E. 3)
Jul., 2003	IB(NA)-66813-F	Additions • Pr. 503 "capacitor life timer" • Pr. 504 "capacitor life alarm output set time Modifications • The setting range of Pr.240 "Soft-PWM setting" • The setting range of Pr.340 "link start up mode selection"
Apr., 2004	IB(NA)-66813-G	Additions • Control logic change function for the 100V/200V class
Jun., 2007	IB(NA)-66813-H	Additions • Current average value monitor signal (Pr. 555 to Pr. 557) • Setting value "93" of Pr. 190 and Pr. 191