



# MITSUBISHI

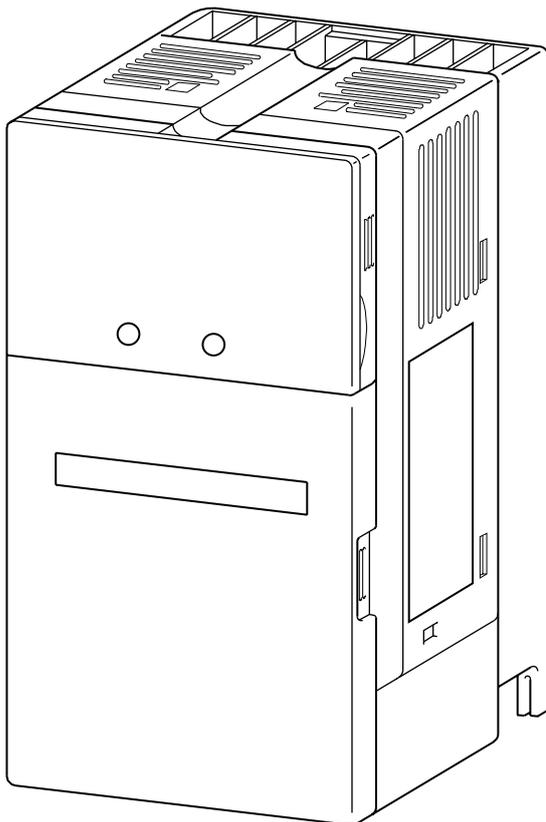
## TRANSISTORIZED INVERTER

### FR-E500

## INSTRUCTION MANUAL

*CC-Link*

# FR-E520-0.1KN to 7.5K-KN



**OUTLINE** Chapter 1

**INSTALLATION  
AND WIRING** Chapter 2

**OPERATION/  
CONTROL** Chapter 3

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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".



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



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.

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# SAFETY INSTRUCTIONS

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## 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 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, switch power off, wait for more than 10 minutes, and check for residual voltage with a meter (refer to chapter 2 for further details) etc.
- Earth the inverter.
- 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.
- While power is on, do not move the station number and baudrate setting switches. Doing so can cause an electric shock.

## 2. Fire Prevention

 **CAUTION**

- Mount the inverter and brake resistor on an incombustible surface. 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 will overheat abnormally due a brake transistor or other fault, resulting in a fire.
- Do not connect a resistor directly to the DC terminals P (+), N (-). This could cause a fire.

### 3. Injury Prevention

 **CAUTION**

- Apply only the voltage specified in the instruction manual to each terminal 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	Constant torque : -10°C to +50°C (non-freezing)
	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 <sup>2</sup> or less (conforming to JIS C 0400)

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

## (2) Wiring

### **CAUTION**

- Do not fit capacitive equipment such as a power factor correction capacitor, radio noise 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.
- 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.

 **CAUTION**

- The electronic overcurrent protection 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 harmonics from the inverter may heat/damage the power capacitor and generator.
- 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.

(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.

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# CHAPTER 1

# OUTLINE

This chapter gives information on the basic "outline" of this product.

Always read the instructions before using the equipment.

1.1 Pre-Operation Information .....	1
1.2 Basic Configuration.....	3
1.3 Structure .....	4

#### <Abbreviations and generic names>

- PU  
Parameter unit (FR-PU04)
- Inverter  
Mitsubishi transistorized inverter  
FR-E500 series
- Pr.  
Parameter number
- CC-Link  
Control & Communication Link

Chapter 1

Chapter 2

Chapter 3

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Chapter 6

# 1.1 Pre-Operation Information

## 1.1.1 Precautions for operation

This manual is written for the FR-E500 series Control & Communication Link (hereafter referred to as "CC-Link") type transistorized inverters.

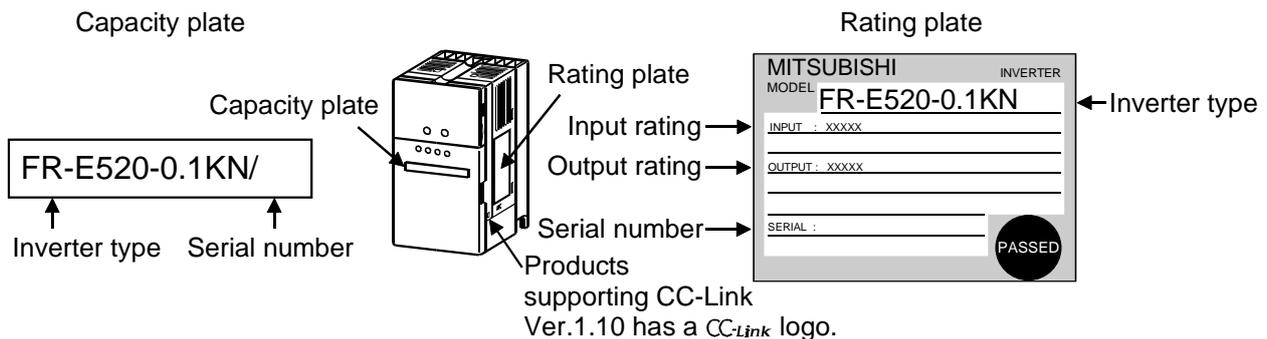
Incorrect handling may cause the inverter to operate incorrectly, causing its life to be reduced considerably, or at the worst, the inverter to be damaged. Handle the inverter properly in accordance with the information in each section as well as the precautions and instructions of this manual to use it correctly.

For handling information on the parameter unit (FR-PU04), stand-alone options, etc., refer to the corresponding manuals.

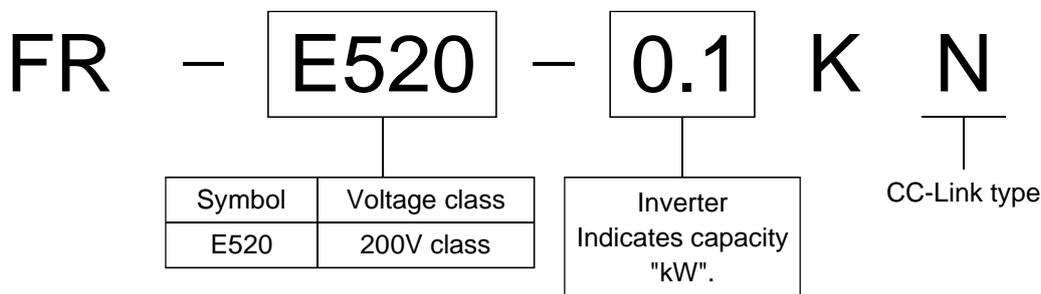
### (1) Unpacking and product check

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



#### 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 48.)

**(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 11.)

**(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 13.)

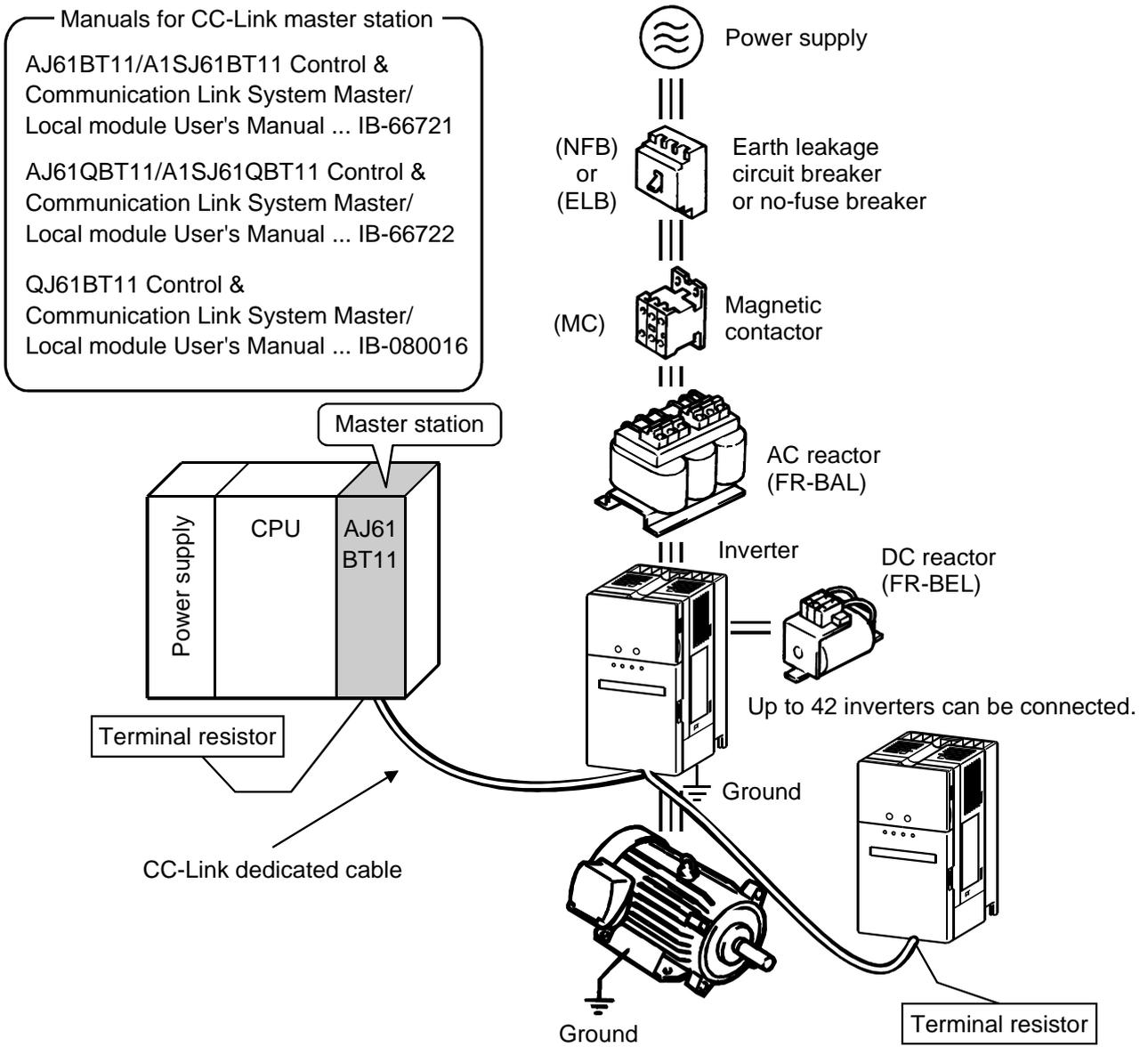
**(5) Grounding**

To prevent an electric shock, always use the motor and inverter after grounding them. The ground cable provided for reduction of induction noise from the power line of the inverter is recommended to be run by returning it up to the ground terminal of the inverter. (Refer to page 39)

# 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.)

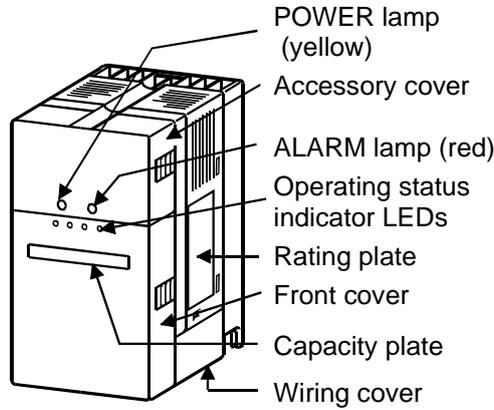


### Japanese Harmonic Suppression Guideline

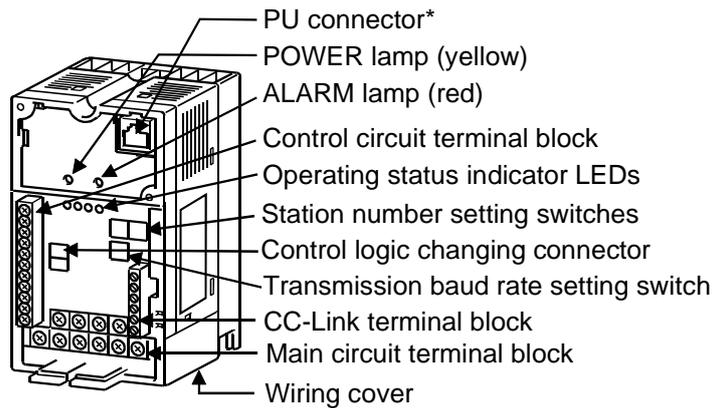
The "harmonic suppression guideline for household appliance and general-purpose products" issued by Ministry of Economy, Trade and Industry (formerly Ministry of International Trade and Industry) in September, 1994 applies to 3-phase 200V class inverters of 3.7kW or less. By installing the power factor improving reactor (FR-BEL or FR-BAL), inverters comply with the "harmonic suppression techniques for transistorized inverters (input current 20A or less)" established by the Japan Electrical Manufacturers' Association.

## 1.3.1 Appearance and structure

### (1) Front view

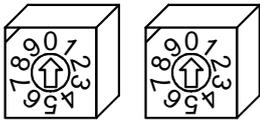


### (2) Without accessory cover and front cover



\* Use the PU connector for the FR-PU04 (option) and RS-485 communication.

### 1.3.2 Functions

Name	Function
Station number setting switches	 <p>Used to set the inverter station number between 1 and 64. For details, refer to page 49.</p>
Transmission baud rate setting switch	Switch used to set the transmission speed. For details, refer to page 50.
POWER lamp (yellow)	Lit to indicate that power is input (present).
ALARM lamp (red)	Lit to indicate that a protective function is activated.
Operating status indicator LEDs	<p>L.RUN : Lit to indicate normal receipt of refresh data. Extinguished when data is interrupted for some time.</p> <p>SD : Extinguished to indicate that send data is "0".</p> <p>RD : Lit to indicate detection of carrier in receive data.</p> <p>L.ERR : Lit to indicate the communication error of the station itself. Flickers to indicate that the switch or other setting was changed while power is on.</p>

### 1.3.3 Inverter communication specifications

Form	Terminal block connection system (disconnectable from inverter front)
Number of units connected	Maximum 42 units (1 station/unit occupied), other models may also be used.
Terminal block connected	6-terminal block (M2×6 screws)
Cable size	0.75 to 2mm <sup>2</sup>
Station type	Remote device station
Number of stations occupied	One inverter occupies one station
Connection cable	CC-Link dedicated cable, CC-Link Version 1.10 compatible CC-Link dedicated cable

### 1.3.4 CC-Link Ver. 1.10

The conventional CC-Link products, whose inter-station cable lengths have equally been changed to 20cm (7.87 inch) or more to improve the inter-station cable length restriction, are defined as CC-Link Ver. 1.10. In comparison, the conventional products are defined as CC-Link Ver. 1.00.

Refer to the CC-Link Master Module Manual for the maximum overall cable lengths and inter-station cable lengths of CC-Link Ver. 1.00 and Ver. 1.10.

#### **(1) CC-Link Ver. 1.10 compatibility conditions**

- 1) All modules that comprise a CC-Link system should be compatible with CC-Link Ver. 1.10.
- 2) All data link cables should be CC-Link Ver. 1.10 compatible, CC-Link dedicated cables. (CC-Link Ver. 1.10 compatible cables have a *CC-Link* logo or Ver. 1.10 indication.)

Note: In a system that uses the CC-Link Ver. 1.00 and Ver. 1.10 modules and cables together, the maximum overall cable length and inter-station cable length are as specified for CC-Link Ver. 1.00.

#### **(2) How to confirm the CC-Link Ver. 1.10 compatible products**

Only the FR-E520-KN units manufactured in and after September 2001 are CC-Link Ver. 1.10 compatible.

- 1) Product having SERIAL of numbers shown below or later on its body and shipping carton  
(The shipping carton has only three upper digits of the six-digit control number.)

Type	SERIAL
FR-E520-0.1KN	X19○○○○○○
FR-E520-0.2KN, 0.4KN	Y19○○○○○○
FR-E520-0.75KN	Z19○○○○○○
FR-E520-1.5KN, 2.2KN	X19○○○○○○
FR-E520-3.7KN	V19○○○○○○
FR-E520-5.5KN, 7.5KN	W19○○○○○○

X
1
9
○○○○○○  
 Symbol Year Month Control number  
 SERIAL number

- 2) Product having a *CC-Link* logo on its body  
Refer to page 1 for the SERIAL and logo positions on the body.

### 1.3.5 Communication with remote devices

#### **(1) When the CPU has automatic refresh function (example: QnA series CPU)**

Through communication with the corresponding devices using sequence ladder logic, data is automatically transferred to/from the refresh buffer of the master station at the execution of the END instruction to perform communication with the remote devices.

#### **(2) When the CPU does not have automatic refresh function (example: AnA series CPU)**

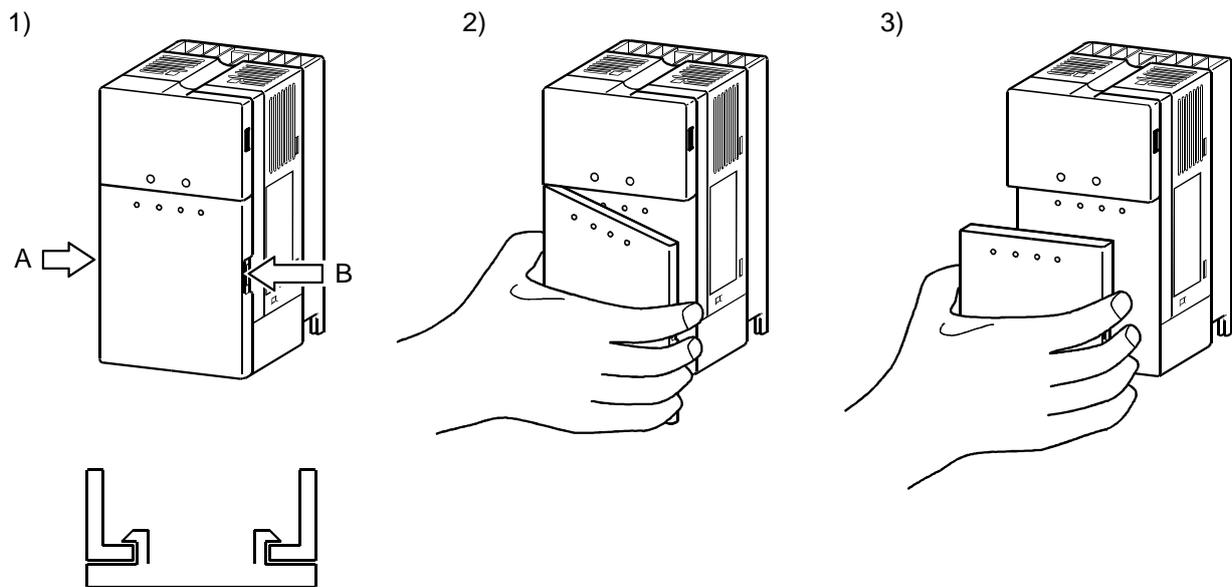
Data is transferred to/from the refresh buffer of the master station directly by sequence ladder logic to perform communication with the remote devices.

### 1.3.6 Removal and reinstallation of the front cover

● **Removal**

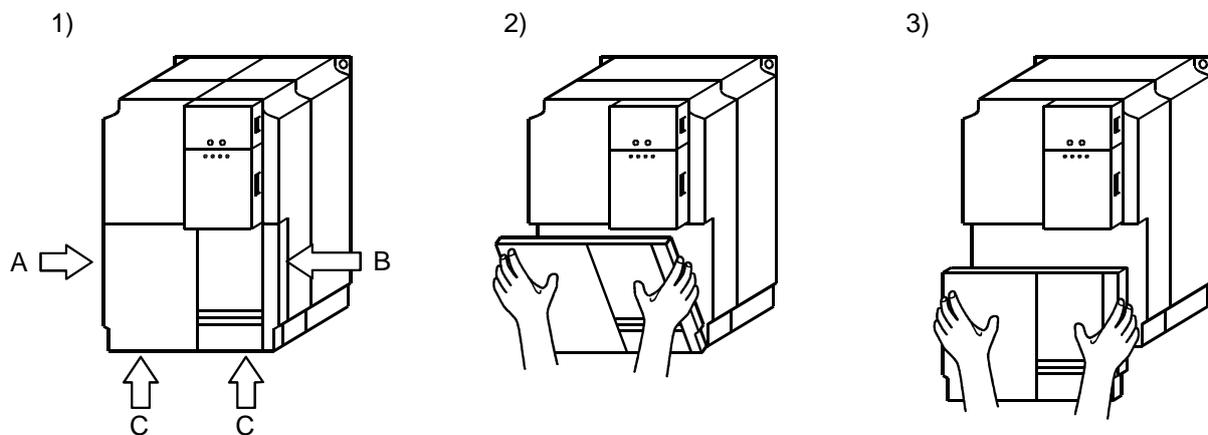
**(For the FR-E520-0.1KN to 3.7KN)**

The front cover is secured by catches 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-E520-5.5KN, 7.5KN)**

The front cover is fixed with catches 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**

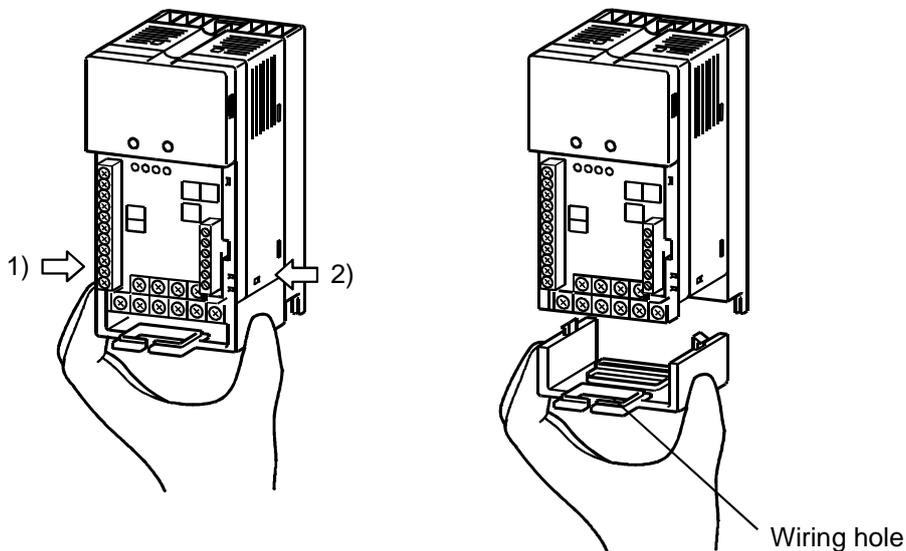
When reinstalling the front cover after wiring, fix the catches securely. With the front cover removed, do not switch power on.

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.

### 1.3.7 Removal and reinstallation of the wiring cover

● **Removal**

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



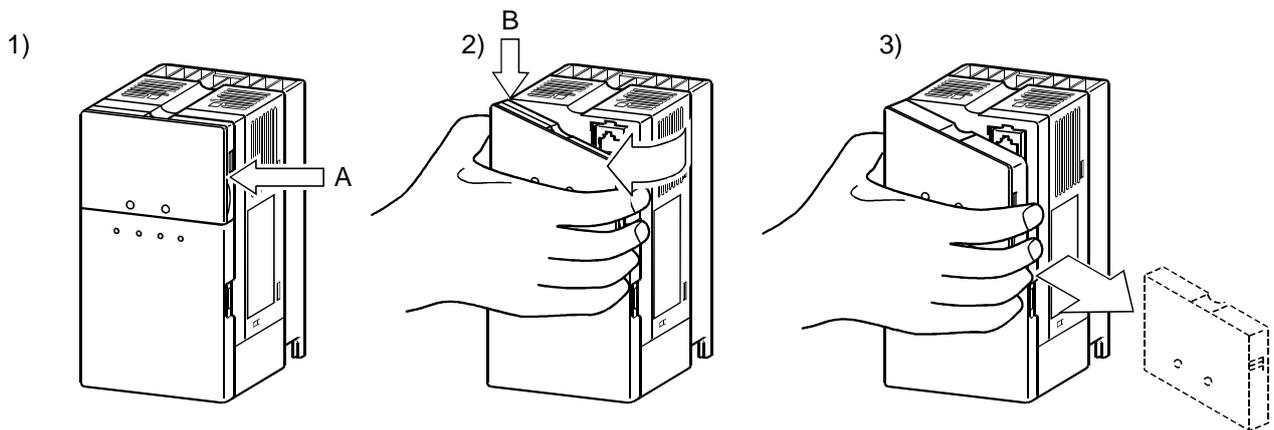
● **Reinstallation**

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

### 1.3.8 Removal and reinstallation of the accessory cover

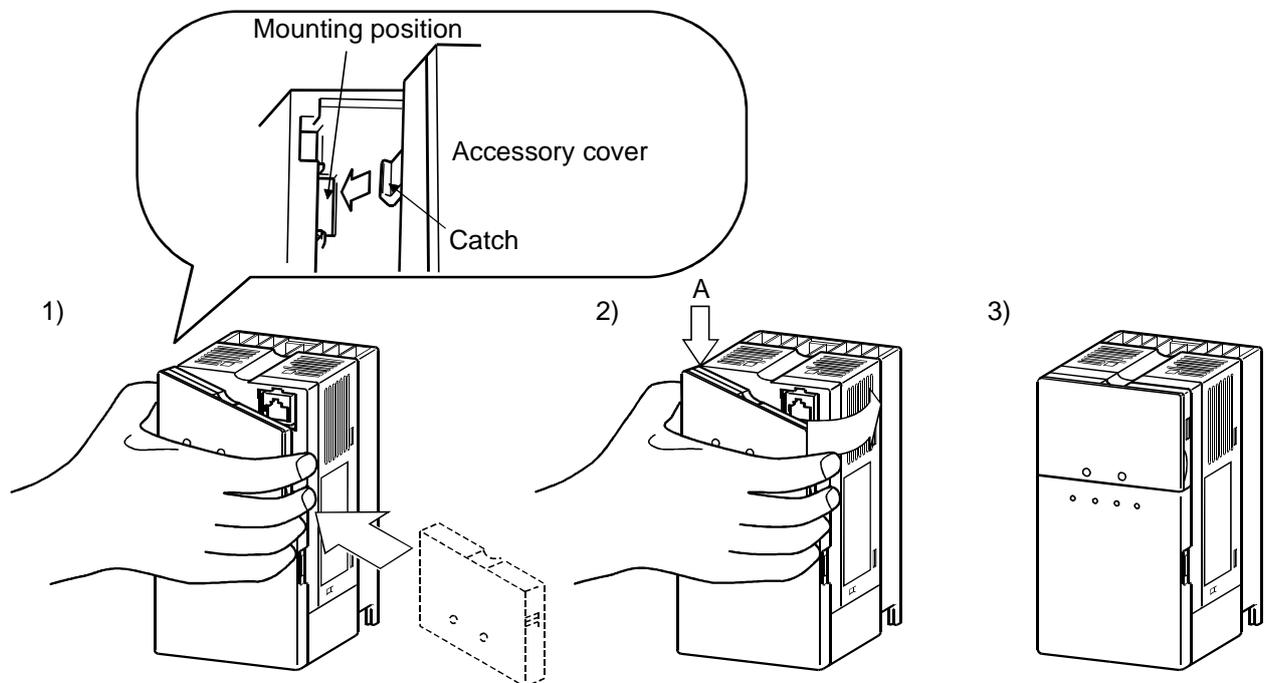
● **Removal**

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 accessory cover to the right.

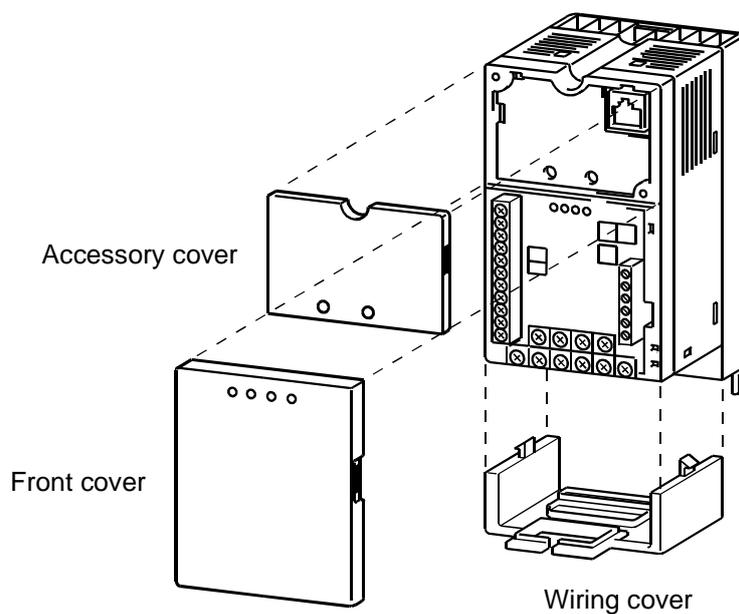


● **Reinstallation**

Insert the mounting catch (left hand side) of the accessory cover into the mounting position of the inverter and push in the right hand side mounting catch to install the accessory cover.



### 1.3.9 Exploded view



Note: Do not remove any parts other than the accessory cover, front cover and wiring cover.

# CHAPTER 2

## 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 .....	11
2.2 Wiring .....	13
2.3 Other Wiring .....	32

Chapter 1

**Chapter 2**

Chapter 3

Chapter 4

Chapter 5

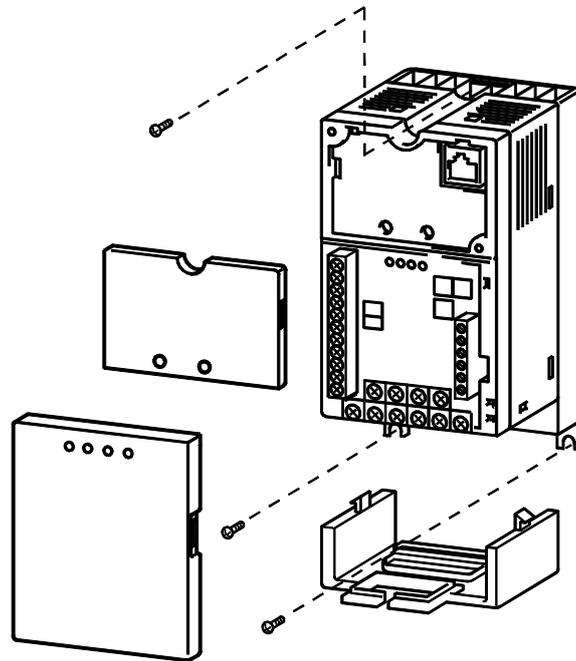
Chapter 6

## 2.1 Installation

### INSTALLATION AND WIRING

#### 2.1.1 Instructions for installation

When mounting any of the FR-E520-0.1KN to 0.75KN, remove the accessory cover, front cover and wiring cover.

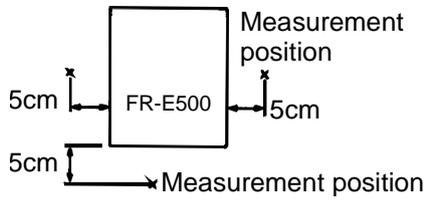
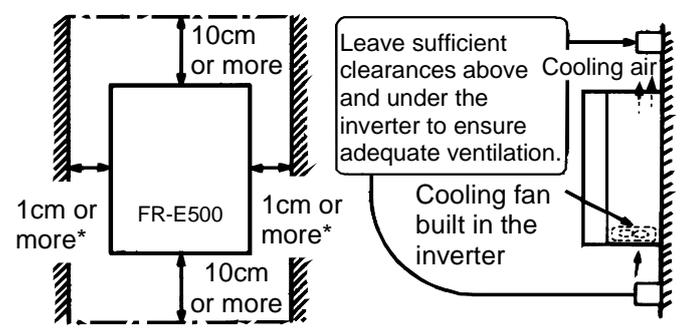
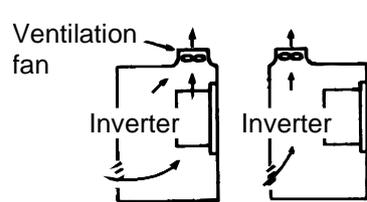
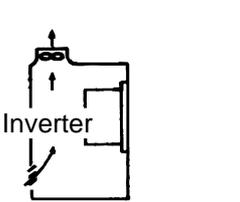
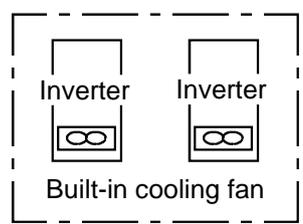
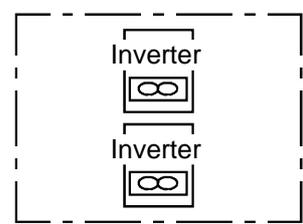
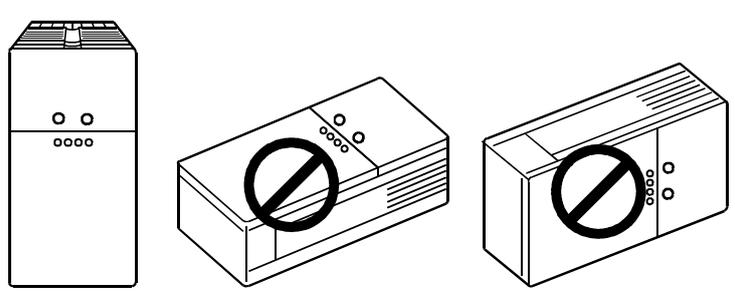


- 1) Handle the unit carefully.  
The inverter uses plastic parts. Handle it gently to protect it from damage. Also, hold the unit with even strength and do not apply too much strength to the front cover alone.
- 2) Install the inverter in a place where it is not affected by vibration easily ( $5.9\text{m/s}^2$  maximum.).  
Note the vibration of a cart, press, etc.
- 3) Note on ambient temperature.  
The inverter life is under great influence of ambient temperature. In the place of installation, the ambient temperature must be within the permissible range  $-10^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ . Check that the ambient temperature is within the permissible range in the positions shown in Fig. 3).
- 4) Install the inverter on a non-combustible surface.  
The inverter will be very hot (maximum about  $150^{\circ}\text{C}$ ). Install it on a non-combustible surface (e.g. metal). Also leave sufficient clearances around the inverter.
- 5) Avoid high temperatures 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.

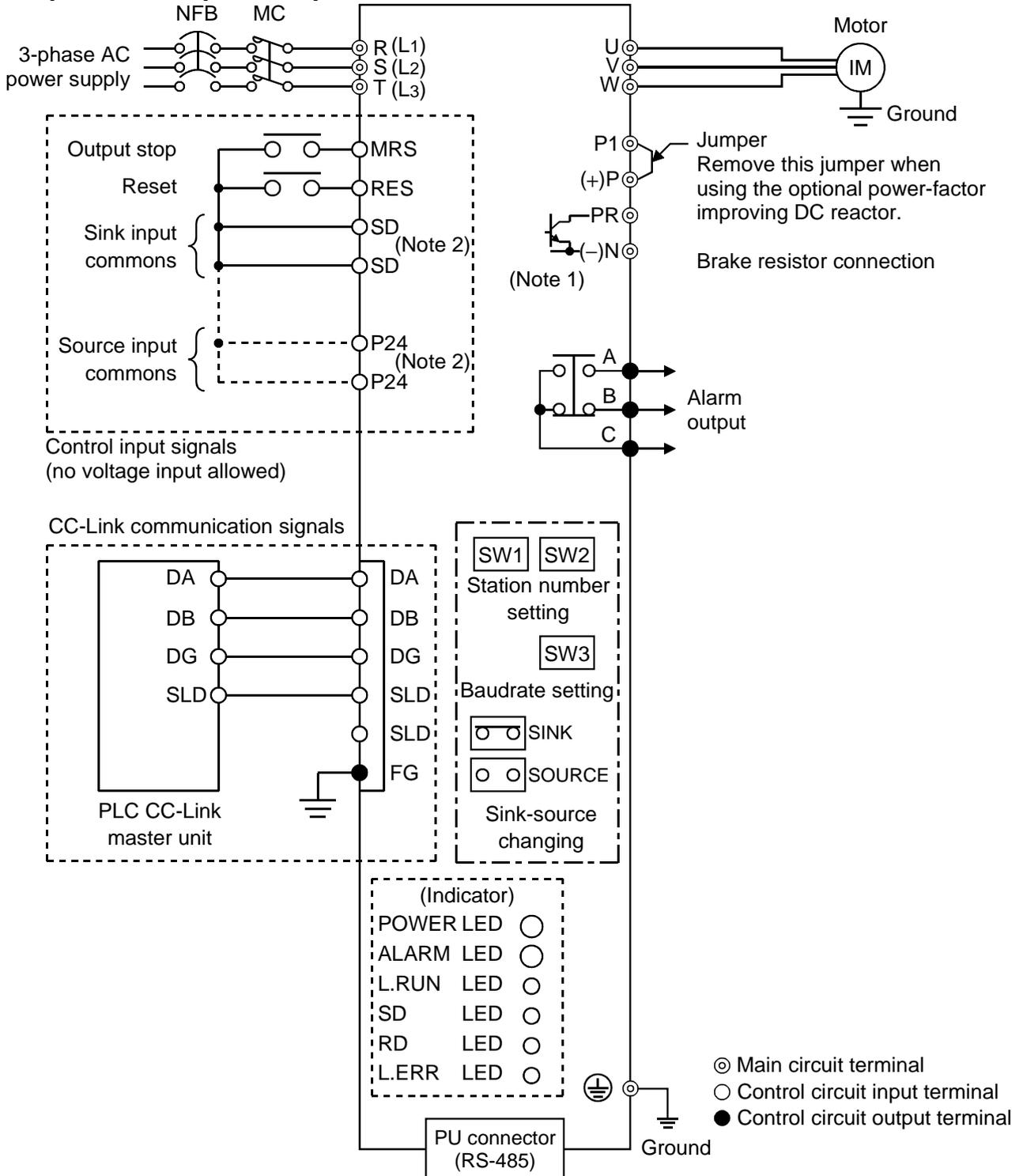
8) Install the inverter securely in the vertical direction with screws or bolts.

<p>3) Note on ambient temperatures</p> 	<p>4) Clearances around the inverter</p>  <p style="text-align: center;">*5cm or more for 5.5K and 7.5K These clearances are also necessary for changing the cooling fan.</p>
<p>7) For installation in an enclosure</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>(Correct example)</p> </div> <div style="text-align: center;">  <p>(Incorrect example)</p> </div> </div> <p style="text-align: center;">Position of Ventilation Fan</p> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="text-align: center;">  <p>Built-in cooling fan</p> <p>(Correct example)</p> </div> <div style="text-align: center;">  <p>(Incorrect example)</p> </div> </div> <p style="text-align: center;">When more than one inverter is contained</p>	
<p>8) Vertical mounting</p> 	

# 2.2 Wiring

## 2.2.1 Terminal connection diagram

### ● 3-phase 200V power input



Note: 1. 0.1K and 0.2K do not contain a transistor.

2. Terminals SD and P24 are common terminals. Do not earth them to the ground.

## **(1) Description of the main circuit terminals**

Symbol	Terminal Name	Description
R, S, T (L1, L2, L3)	AC power input	Connect to the commercial power supply. Keep these terminals unconnected when using the high power factor converter.
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 or high power factor converter.
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.
	Ground	For grounding the inverter chassis. Must be earthed.

## **(2) Description of the control circuit terminals**

Type	Symbol	Terminal Name	Description
Input signals	Contacts, e.g. start and synchronous selection	MRS	Output halt 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. Setting of Pr. 183 "MRS terminal (RY9) function selection" changes the terminal function.
		RES	Reset Used to reset the protective circuit activated. Turn on the RES signal for more than 0.1 second, then turn it off. The signal can always be reset with the factory setting. Setting Pr. 75 enables reset only at an inverter alarm occurrence. (Refer to page 103.)
		P24	Contact input common (source) Common terminal for contact inputs for use in the source input mode. In the source input mode, connection with this terminal switches the signal on and disconnection switches it off.
		SD	Contact input common (sink) Common terminal for contact inputs for use in the sink input mode. In the sink input mode, connection with this terminal switches the signal on and disconnection switches it off.
Output signals	Contact	A, B, C (note)	Alarm output 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 (remote input) function choices (Pr. 190 to Pr. 192) change the terminal functions.

Note : Wire the cables for application of voltages to the contact outputs so that they may be separated from the PLC power at the no-fuse breaker etc. If they are connected to the same power supply as is used by the PLC, the inverter cannot be changed during CC-Link communication.

**(3) CC-Link communication signals**

<b>Terminal Symbol</b>	<b>Terminal Name</b>	<b>Description</b>
DA DB DG SLD SLD FG	CC-Link communication signals	Connected with the master station and other local stations to make CC-Link communication.

**(4) RS-485 communication**

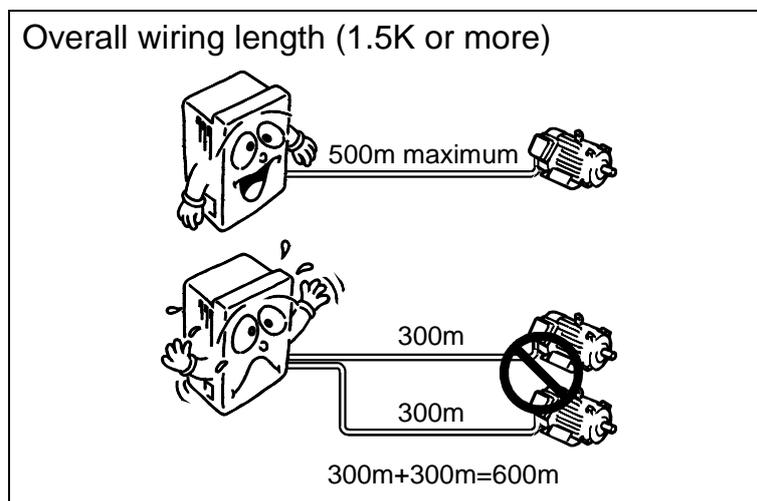
<b>Name</b>	<b>Description</b>
PU connector	Communication can be made by the PU connector in accordance with RS-485. <ul style="list-style-type: none"><li>• Compliant standard: EIA Standard RS-485</li><li>• Transmission form: Multidrop link system</li><li>• Communication speed: Maximum 19200bps</li><li>• Overall distance: 500m</li></ul>

**2.2.2 Wiring of the Main Circuit**

**(1) Wiring instructions**

- 1) It is recommended to use insulation-sleeved solderless terminals for power supply and motor wiring.
- 2) Power must not be applied to the output terminals (U, V, W) of the inverter. Otherwise the inverter will be damaged.
- 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 a control box or the like, be careful so that chips and others do not 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 18.)
- 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 or more
Non-low acoustic noise mode	200m	200m	300m	500m	500m
Low acoustic noise mode	30m	100m	200m	300m	500m



- 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 harmonic components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, install the FR-BIF optional radio noise filter (for use in the input side only) or FR-BSF01 or FR-BLF line noise filter to minimize interference.
- 8) Do not install a power capacitor, surge suppressor or radio noise filter (FR-BIF option) in 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 radio noise 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 Grounding**

- Leakage currents flow in the inverter. To prevent an electric shock, the inverter and motor must be grounded.
- Use the dedicated ground terminal to ground the inverter. (Do not use the screw in the case, chassis, etc.)
- The ground cable should be as thick as possible. Its gauge should be equal to or larger than those indicated in the following table. The grounding point should be as near as possible to the inverter to minimize the ground cable length.

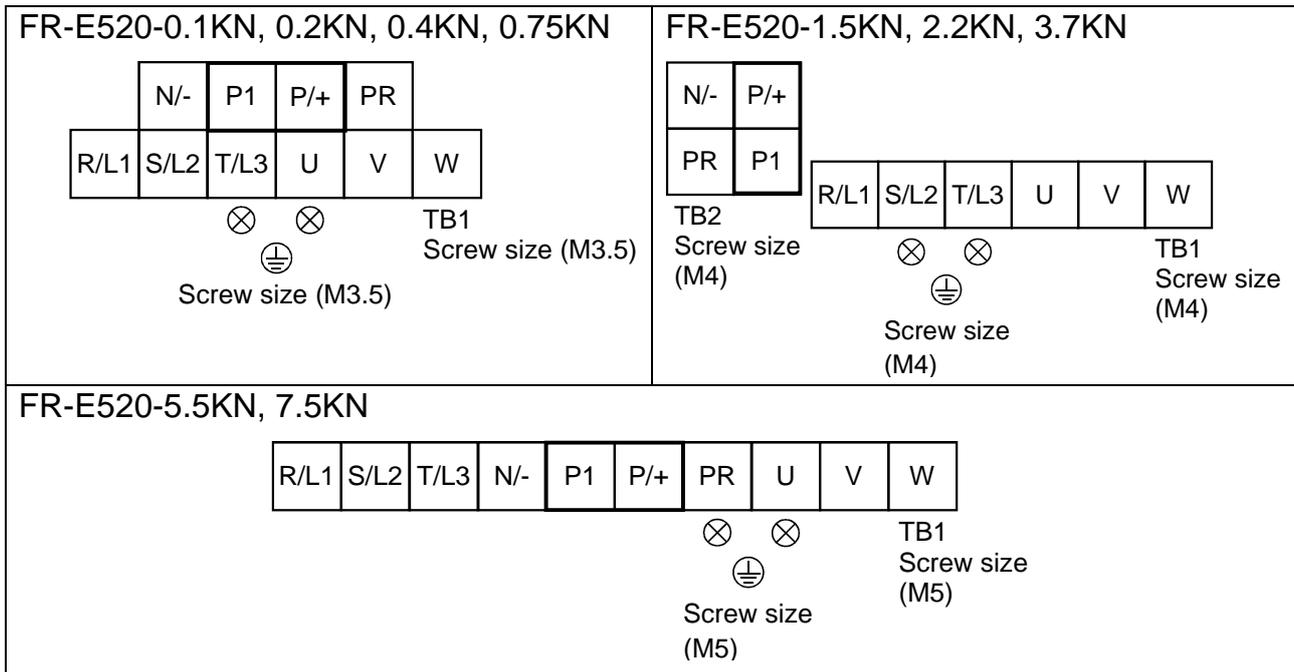
(Unit: mm<sup>2</sup>)

Motor Capacity	Ground Cable Gauge
	200V class
2.2kW or less	2 (2.5)
3.7kW	3.5 (4)
5.5kW, 7.5kW	5.5 (6)

To meet the Low Voltage Directive, use PVC insulated cables larger than specified size in brackets ( ).

- Ground the motor on the inverter side using one wire of the 4-core cable.

**(2) Terminal block layout**



**(3) Cables, crimping terminals, etc.**

The following table lists the cables and crimping terminals used with the inputs (R (L<sub>1</sub>), S (L<sub>2</sub>), T (L<sub>3</sub>)) and outputs (U, V, W) of the inverter and the torques for tightening the screws:

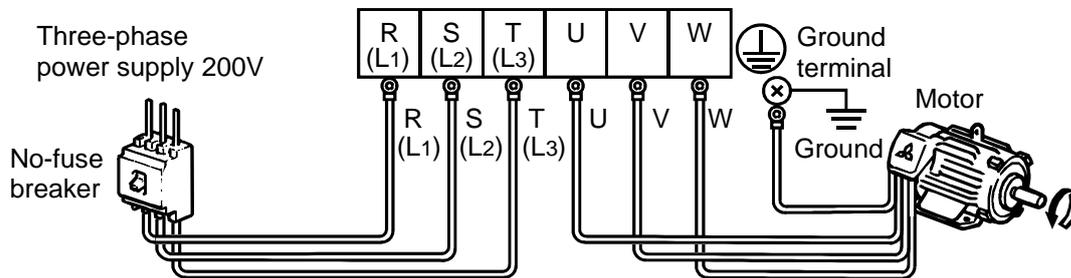
● **FR-E520-0.1KN to 7.5KN**

Applicable Inverter Type	Terminal Screw Size	Tightening Torque N·m	Crimping Terminals		Cables				PVC insulated Cables	
					mm <sup>2</sup>		AWG		mm <sup>2</sup>	
			R, S, T (L <sub>1</sub> , L <sub>2</sub> , L <sub>3</sub> )	U, V, W	R, S, T (L <sub>1</sub> , L <sub>2</sub> , L <sub>3</sub> )	U, V, W	R, S, T (L <sub>1</sub> , L <sub>2</sub> , L <sub>3</sub> )	U, V, W	R, S, T (L <sub>1</sub> , L <sub>2</sub> , L <sub>3</sub> )	U, V, W
FR-E520-0.1KN-0.75KN	M3.5	1.2	2-3.5	2-3.5	2	2	14	14	2.5	2.5
FR-E520-1.5KN, 2.2KN	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-E520-3.7KN	M4	1.5	5.5-4	5.5-4	3.5	3.5	12	12	4	2.5
FR-E520-5.5KN	M5	2.5	5.5-5	5.5-5	5.5	5.5	10	10	6	4
FR-E520-7.5KN	M5	2.5	14-5	8-5	14	8	6	8	16	6

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.

**(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) If they are connected to U, V, W, the inverter will be damaged.  
(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.

**Note:** To ensure safety, connect the power input to the inverter via a magnetic contactor and earth leakage circuit breaker or no-fuse breaker, and use the magnetic contactor to switch power on-off.

## **2.2.3 Wiring of the control circuit**

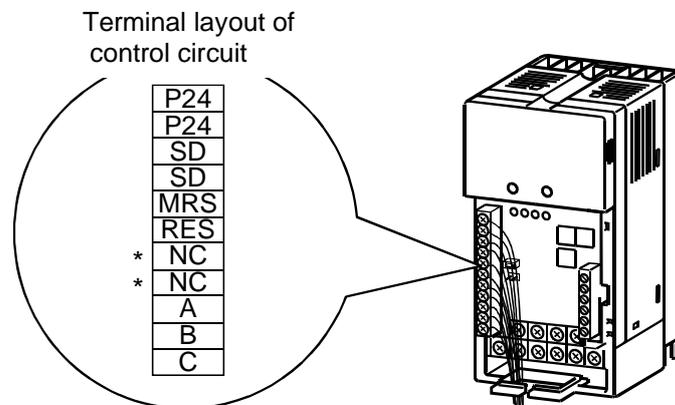
### **(1) Wiring instructions**

- 1) Terminals SD are common terminals for I/O signals. These common terminals must not be earthed to the ground.
- 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<sup>2</sup> to 0.75mm<sup>2</sup> gauge for connection to the control circuit terminals.
- 5) When bar terminals and solid wires are used for wiring, their diameters should be 0.9mm maximum. If they are larger, the screw threads may be damaged during tightening.

### **(2) Terminal block layout**

In the control circuit of the inverter, the terminals are arranged as shown below:

**Terminal screw size: M2.5**

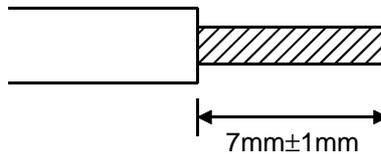


\*: Keep NC unconnected.

**(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: 0.25 N·m to 0.49 N·m

\* Use a size 0 screwdriver.

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

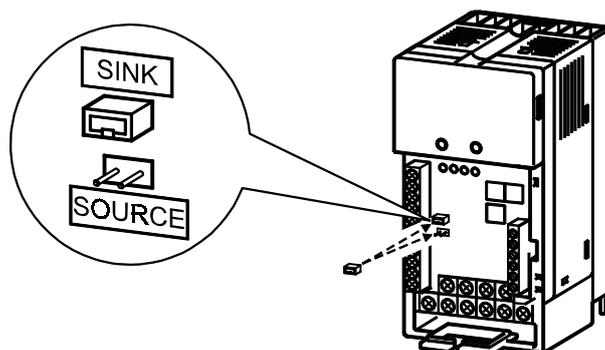
**(4) Control logic changing**

The input signal logic is factory-set to the sink mode.

To change the control logic, the position of the connector beside the control circuit terminal block must be changed.

1) Using tweezers etc. to remove the connector in the sink logic position and fit it in the source logic position.

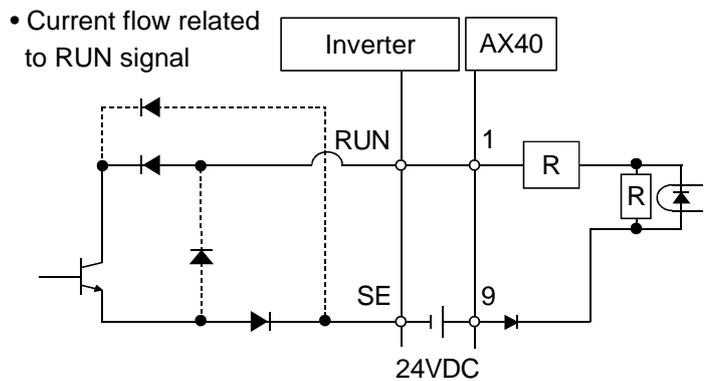
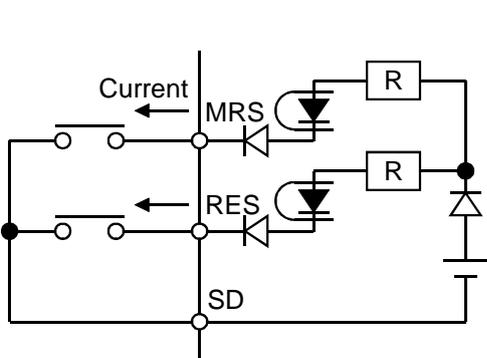
Do this position changing before switching power on.



- 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 connector in either of the positions. If two connectors are installed in these positions at the same time, the inverter may be damaged.

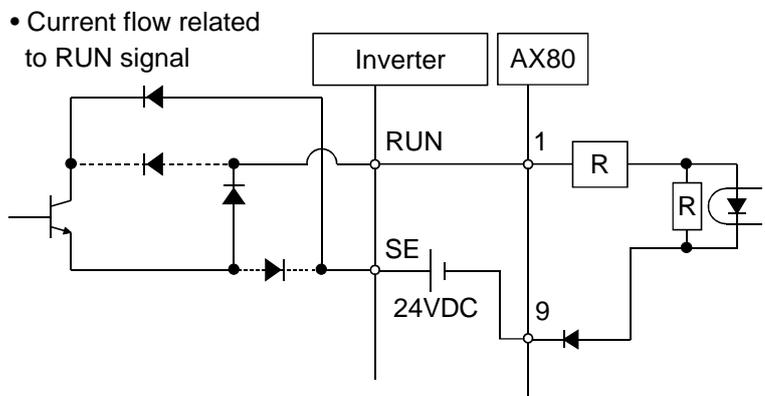
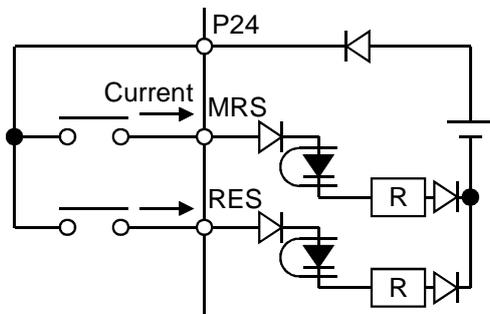
2) Sink logic type

- 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.



3) Source logic type

- In this logic, a signal switches on when a current flows into the corresponding signal input terminal.
- Terminal P24 is common to the contact input signals.  
Terminal SE is common to the open collector output signals.

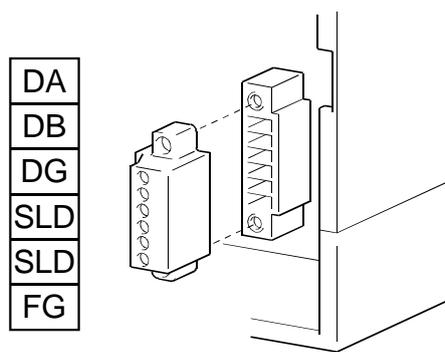


## **2.2.4 Wiring of CC-Link communication signals**

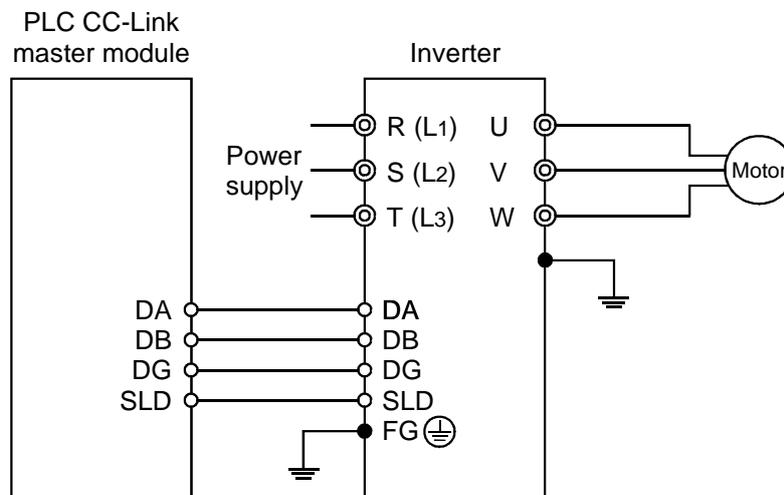
### **(1) Terminal block wiring**

The terminals for CC-Link communication signals are arranged in the inverter as shown below.

Terminal screw size: M2.5

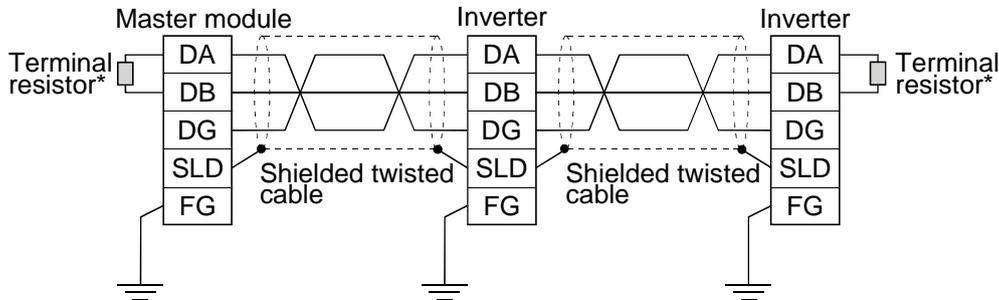


### **(2) Wiring of inverter and PLC**



**(3) Connection of two or more inverters**

Factory Automation can be applied to several inverters which share a link system as CC-Link remote device stations and are controlled and monitored by PLC user programs.



\*Use the terminal resistors supplied with the PLC.

- 1) Maximum number of units connected to one master station  
42 units (when only inverters are connected)

If there are other units, the following conditions must be satisfied since the number of stations occupied changes with the unit:

$$\{(1 \times a) + (2 \times b) + (3 \times c) + (4 \times d)\} \leq 64$$

- a: Number of units occupying 1 station
- b: Number of units occupying 2 stations
- c: Number of units occupying 3 stations
- d: Number of units occupying 4 stations

$$\{(16 \times A) + (54 \times B) + (88 \times C)\} \leq 2304$$

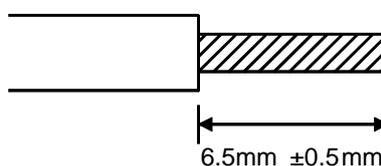
- A: Number of remote I/O station  $\leq 64$
- B: Number of remote device stations  $\leq 42$
- C: Number of local, standby master and intelligent device stations  $\leq 26$

**(4) Wiring method**

- 1) 1) Use twisted cables (three wire type) after stripping the cable sheaths and twisting the wires. If the sheath is stripped too long, the cable may contact with the adjacent cable, causing a short circuit. If the sheath is stripped too short, the cable may be disconnected. Use the recommended cables. For the specifications and availability of the CC-Link dedicated cable, refer to the CC-Link catalog.

Recommended tightening torque: 0.22 N·m to 0.25 N·m

Use a small flat-blade screwdriver (tip thickness: 0.6mm/full length: 3.5mm).



**(5) Recommendation of bar terminals**

For wiring of the CC-Link communication signals, two CC-Link dedicated cables must be twisted together and connected to one terminal block.

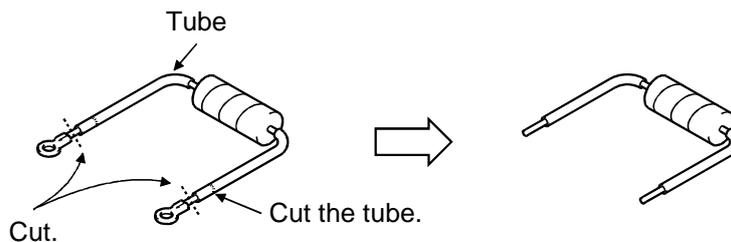
When using bar terminals, the following terminals and tool are recommended.

- 1) Recommended bar terminal, crimping tool
  - Company: Phoenix Contact Co., Ltd.
  - Bar terminal type: AI-TWIN2×0.5-8WH
  - Crimping tool type: CRIMPFOX UD6, ZA3

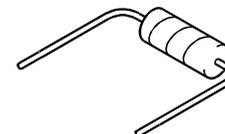
2) Connection of terminal resistor

Connect a terminal resistor between terminals DA-DB of the inverter located at the end.

Work the resistor attached to the master unit of the PLC for use as the terminal resistor.

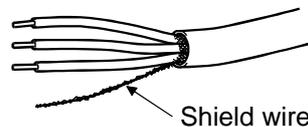


Note: When there is no resistor attached to the master unit, use a commercially available 110Ω, 1/2W resistor.



3) Connection of shield wire of the CC-Link dedicated cable

Twist the shield wire of the CC-Link dedicated cable and connect it to terminal SLD.



Note: The two SLD terminals are connected in the inverter.

## 2.2.5 Connection to the PU connector

### (1) When connecting the 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 0.5mm×4P (Twisted pair cable, 4 pairs),  
MITSUBISHI CABLE INDUSTRIES, LTD.

#### <Maximum wiring length>

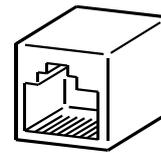
- Parameter unit (FR-PU04): 20m

### (2) For RS-485 communication

By removing the accessory cover and using the PU connector, communication operation can be performed from a personal computer etc.

#### <PU connector pin-outs>

Viewed from the inverter (receptacle side) front



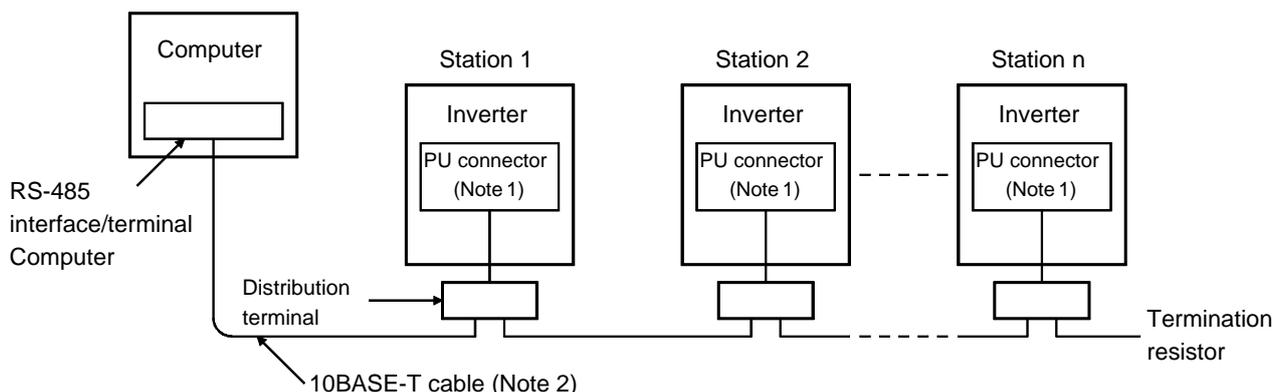
- |        |        |
|--------|--------|
| 1) SG  | 5) SDA |
| 2) P5S | 6) RDB |
| 3) RDA | 7) SG  |
| 4) SDB | 8) P5S |

8) to 1)

- Note: 1. Do not connect the PU connector to a computer's LAN board, FAX modem socket or telephone modular connector. Otherwise, the product may be damaged due to electrical specification differences.
2. Pins 2 and 8 (P5S) provide power to the control panel or parameter unit. Do not use these pins for RS-485 communication.
3. Refer to page 115 for the communication parameters.

#### <System configuration examples>

1) When a computer having a RS-485 interface is used with several inverters



Use the connectors and cables which are available on the market.

Note: 1. Connector: RJ45 connector

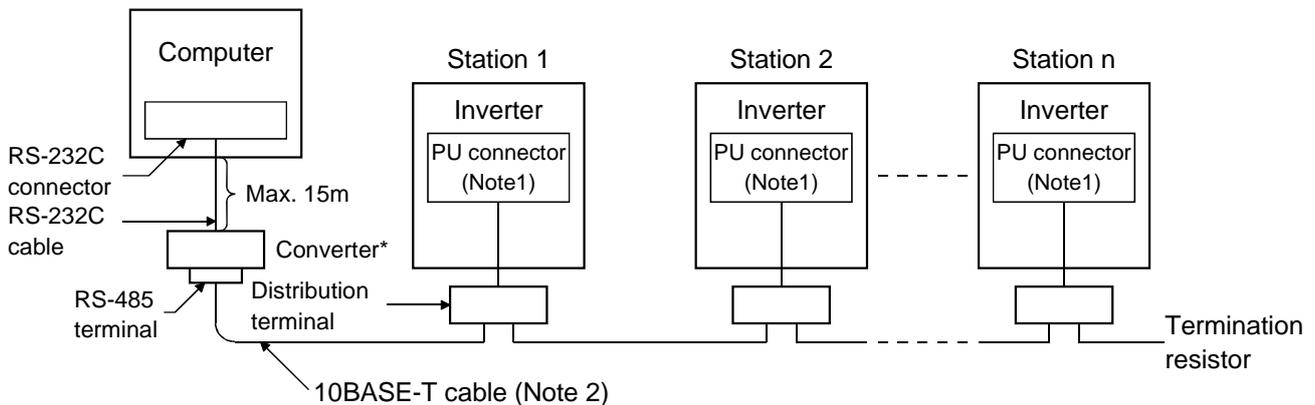
Example: 5-554720-3, Tyco Electronics Corporation

2. Cable : Cable conforming to EIA568 (such as 10BASE-T cable)

Example: SGLPEV 0.5mm × 4P (Twisted pair cable, 4 pairs),  
Mitsubishi Cable Industries, Ltd.

(Do not use pins 2) and 8) (P5S).)

### 2) When a computer having a RS-232C interface is used with inverters



\*Commercially available converter is required. (Note 3)

Use the connectors, cables and converter which are available on the market.

Note: 1. Connector: RJ45 connector

Example: 5-554720-3, Tyco Electronics Corporation

2. Cable : Cable conforming to EIA568 (such as 10BASE-T cable)

Example: SGLPEV 0.5mm × 4P (Twisted pair cable, 4 pairs),  
Mitsubishi Cable Industries, Ltd.

(Do not use pins 2) and 8) (P5S).)

3. \*Commercially available converter examples

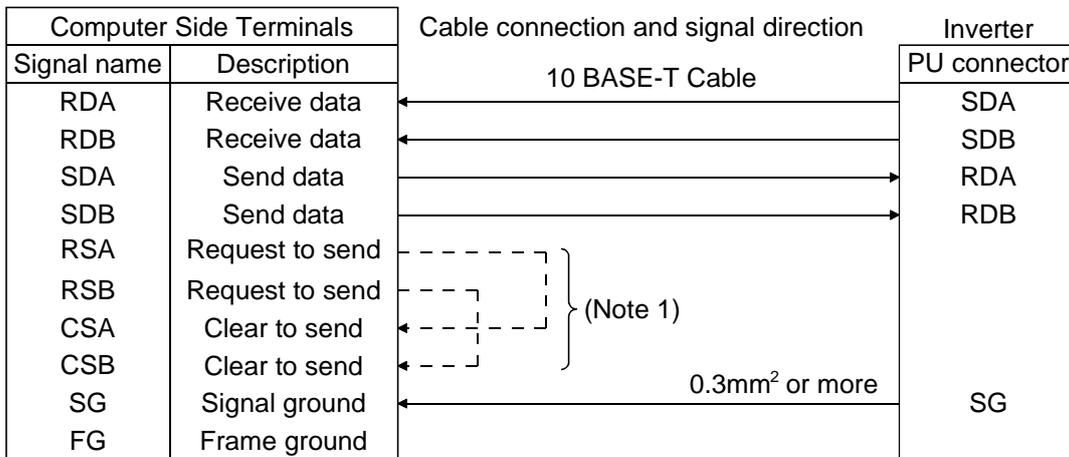
Model: FA-T-RS40

Converter

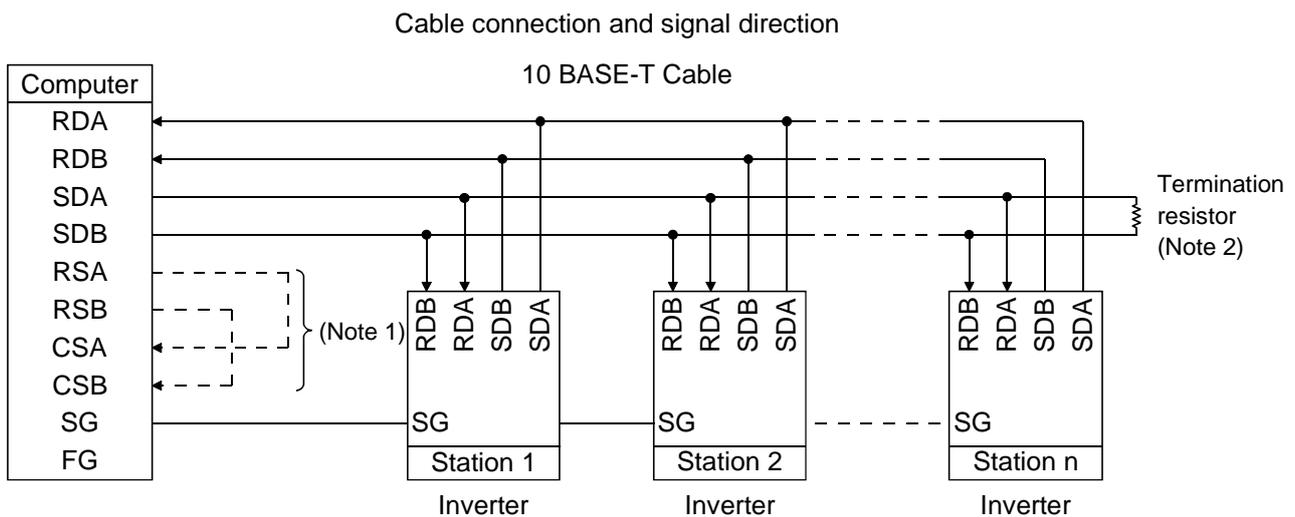
Nagoya Sales Office, Mitsubishi Electric Engineering Co., Ltd.

**<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 termination resistor. If the PU connector is used to make a connection, use the distributor as a termination resistor cannot be fitted. Connect the termination resistor to only the inverter remotest from the computer. (Termination resistor: 100Ω)

## 2.2.6 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.

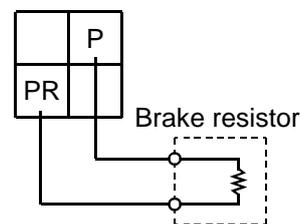
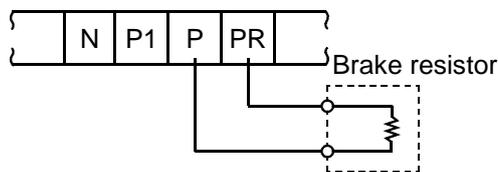
### **(1) Connection of the dedicated external brake resistor (option)** **(Cannot be connected to 0.1K and 0.2K)**

Connect a brake resistor across terminals P (+) and PR. Connect a dedicated brake resistor only.

(For the positions of terminals P (+) and PR, refer to the terminal block layout (page 18.)

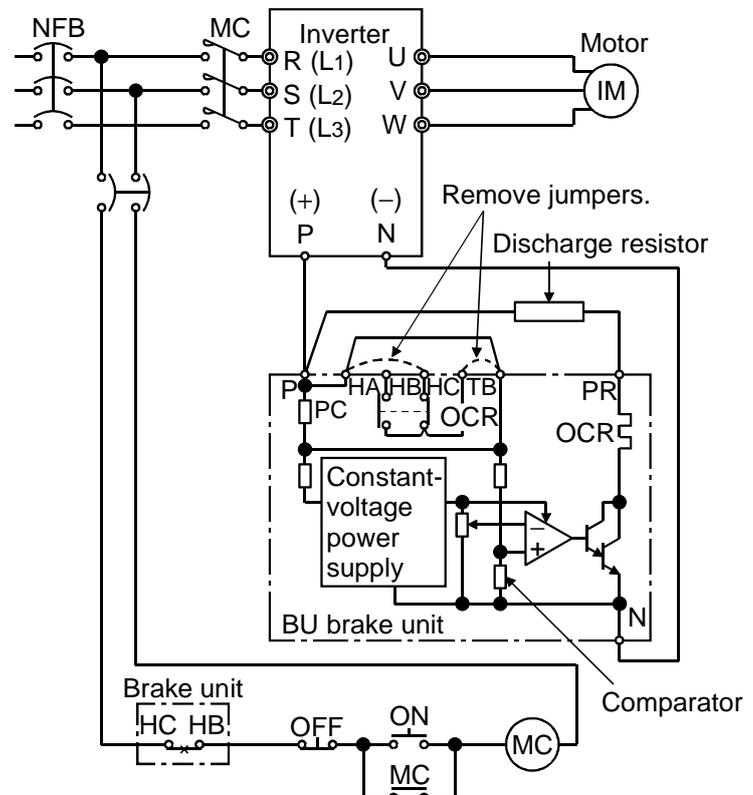
• FR-E520-0.4KN, 0.75KN, 5.5KN, 7.5KN

• FR-E520-1.5KN to 3.7KN



### **(2) Connection of the BU brake unit (option)**

Connect the BU brake unit correctly as shown on the right. Incorrect connection will damage the inverter.

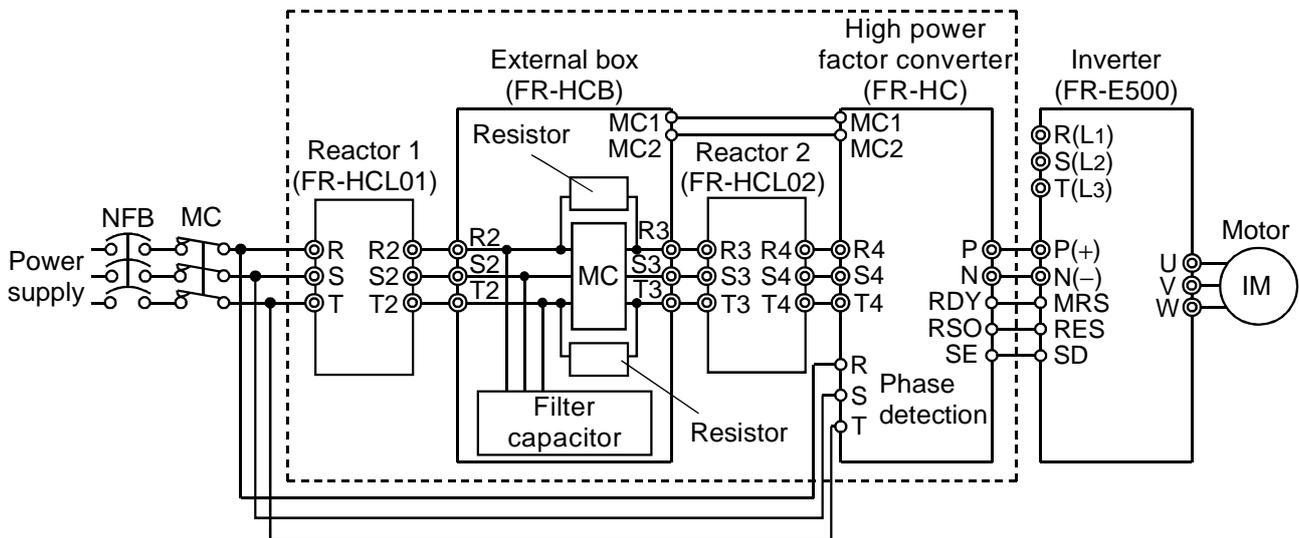


- Note: 1. The wiring distance between the inverter, brake unit and discharge resistor should be within 2m. If twisted wires are used, the distance should be within 5m.  
2. If the transistors in the brake unit should fail, the resistor will be extremely hot, causing a fire. Therefore, install a magnetic contactor on the inverter's power supply side to shut off current in case of failure.

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

(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 harmonics, wire as shown below. Wrong connection will damage the high power factor converter and inverter.



- Note: 1. The power input terminals R, S, T (L1, L2, L3) must be open. Incorrect connection will damage the inverter. Reverse polarity of terminals N (-), P (+) will damage the inverter.
2. The voltage phases of terminals R, S, T (L1, L2, L3) and terminals R4, S4, T4 must be matched before connection.
3. If the load capacity is less than half of the high power factor converter capacity, satisfactory harmonic suppression effects cannot be produced.

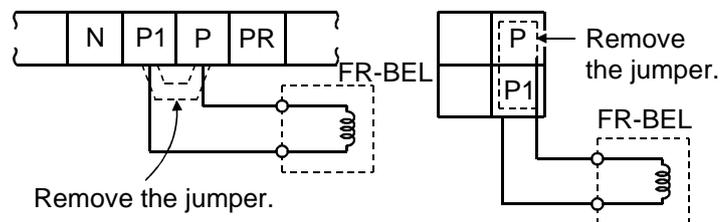
### (4) Connection of the power factor improving DC reactor (option)

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-E520-0.1KN to 0.75KN, 5.5KN, 7.5KN

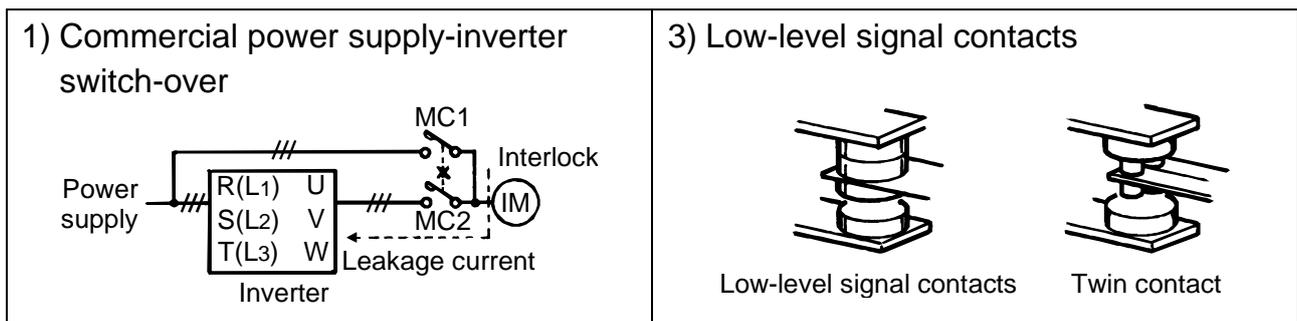
- FR-E520-1.5KN to 3.7KN



- 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 (L1), S (L2), T (L3)).

## 2.2.7 Design information

- 1) Provide electrical and mechanical interlocks for MC1 and MC2 which are used for commercial power supply-inverter switch-over.  
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 voltage to the contact input terminals of the control circuit.
- 5) Always apply a voltage to the alarm output signal terminals (A, B, C) via a relay coil, lamp, etc.
- 6) Make sure that the specifications and rating match the system requirements.



## 2.3 Other Wiring

### 2.3.1 Power supply harmonics

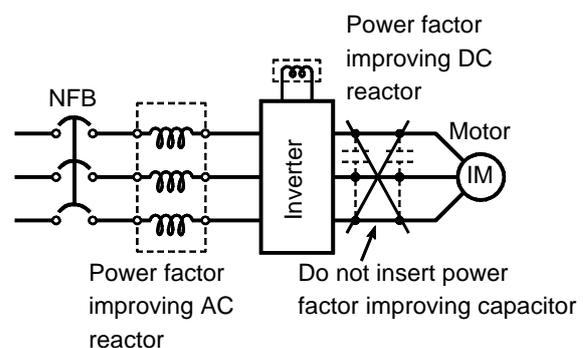
Power supply harmonics may be generated from the converter section of the inverter, affecting the power supply equipment, power capacitor etc. Power supply harmonics are different in generation source, frequency band and transmission path from radio frequency (RF) noise and leakage currents. Take the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

- The differences between harmonics and RF noises are indicated below:

Item	Harmonics	RF Noise
Frequency	Normally 40 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, when an overcurrent flows in the inverter, the overcurrent protection is activated. Hence, when the motor is driven by the inverter, do not install a capacitor or surge suppressor on the inverter's output side. 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 Japanese harmonic suppression guideline

Harmonic currents flow from the inverter to a power receiving point via a power transformer. The harmonic suppression guideline was established to protect other consumers from these outgoing harmonic currents.

1) "Harmonic suppression guideline for household appliances and general-purpose products"

This guideline was issued by Ministry of Economy, Trade and Industry (formerly Ministry of International Trade and Industry) in September, 1994 and applies to 3-phase 200V class inverters of 3.7kW or less. By installing the FR-BEL or FR-BAL power factor improving reactor, inverters comply with the "harmonic suppression techniques for transistorized inverters (input current 20A or less)" established by the Japan Electrical Manufacturers' Association. Therefore install the optional reactor for the 3-phase 200V class, 3.7kW or less inverter.

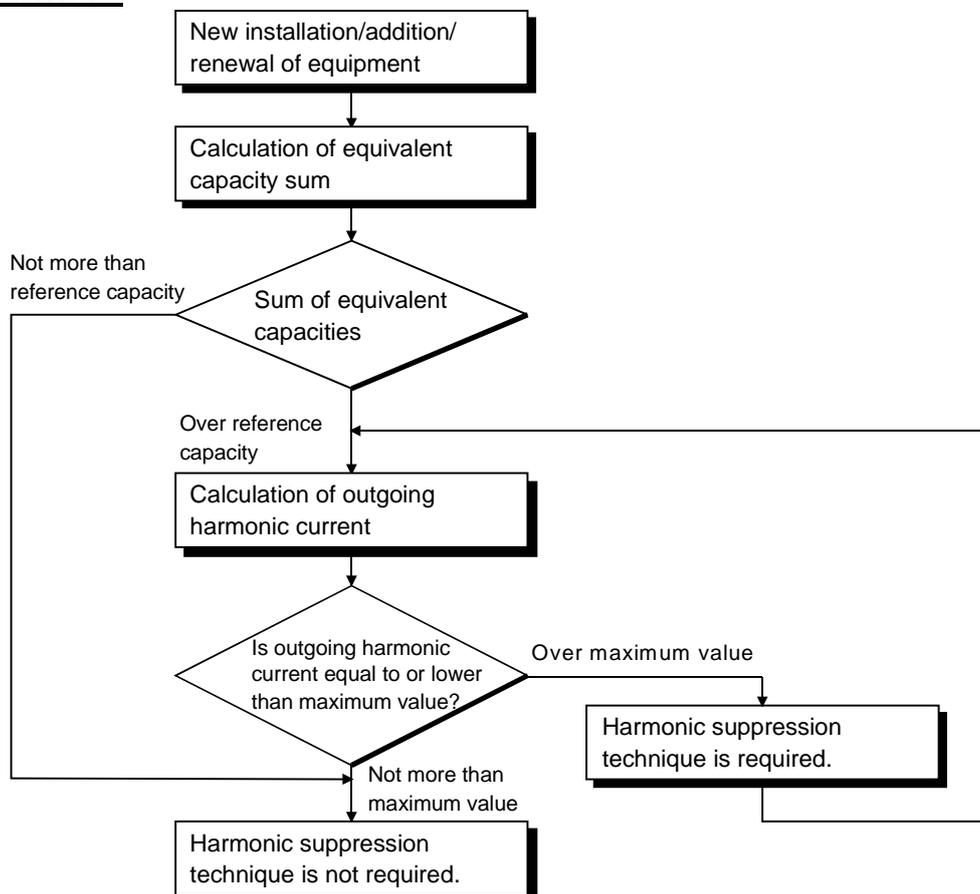
2) "Harmonic suppression guideline for specific consumers"

This guideline sets forth the maximum values of harmonic currents outgoing from a high-voltage or specially 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
22 kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33 kV	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	3-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-exciting 3-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:

$$P0 = \sum (Ki \times Pi) \text{ [kVA]}$$

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 converted from received power voltage) × operation ratio × harmonic content

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

**Table 5 Rated Capacities and Outgoing Harmonic Currents for Inverter Drive**

Applied Motor (kW)	200V class 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)							
				5th	7th	11th	13th	17th	19th	23rd	25th
0.4	1.61 (Note)	49	0.57	31.85	20.09	4.165	3.773	2.107	1.519	1.274	0.882
0.75	2.74 (Note)	83	0.97	53.95	34.03	7.055	6.391	3.569	2.573	2.158	1.494
1.5	5.50 (Note)	167	1.95	108.6	68.47	14.20	12.86	7.181	5.177	4.342	3.006
2.2	7.93 (Note)	240	2.81	156.0	98.40	20.40	18.48	10.32	7.440	6.240	4.320
3.7	13.0 (Note)	394	4.61	257.1	161.5	33.49	30.34	16.94	12.21	10.24	7.092
5.5	19.1	579	6.77	376.1	237.4	49.22	44.58	24.90	17.95	15.05	10.42
7.5	25.6	776	9.07	504.4	318.2	65.96	59.75	33.37	24.06	20.18	13.97

Note: When a motor of 3.7kW or less capacity is driven by a transistorized inverter of more than 3.7kW. For example, when a 3.7kW or less motor is driven by a 5.5kW transistorized inverter, the transistorized inverter is not the target of the household appliances/general-purpose products guideline, but because they must be included in the calculation of the harmonic current of the guideline, the fundamental wave input currents are indicated.

3) Harmonic suppression technique requirement

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) in the AC side of the inverter or a reactor (DCL) in 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 $\lambda$ - $\Delta$ , $\Delta$ - $\Delta$ 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 Inverter-generated noise and reduction techniques

Some 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 to be insusceptible to noise, 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 noise. If these noises cause peripheral devices to misoperate, measures should be taken to suppress noise. The measures differ slightly depending on noise propagation paths.

#### 1) Basic measures

- 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.
- Ground the inverter, motor, etc. at one point.

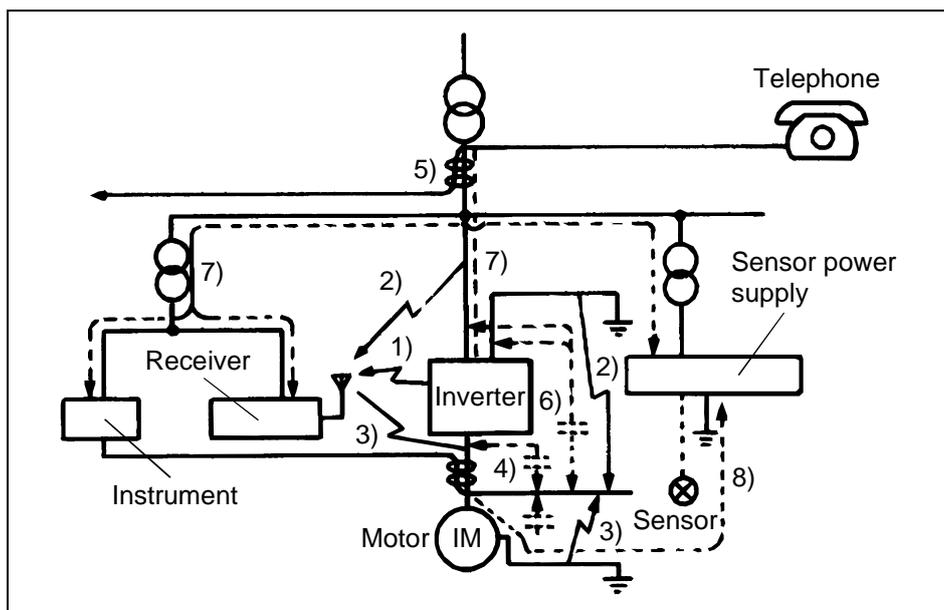
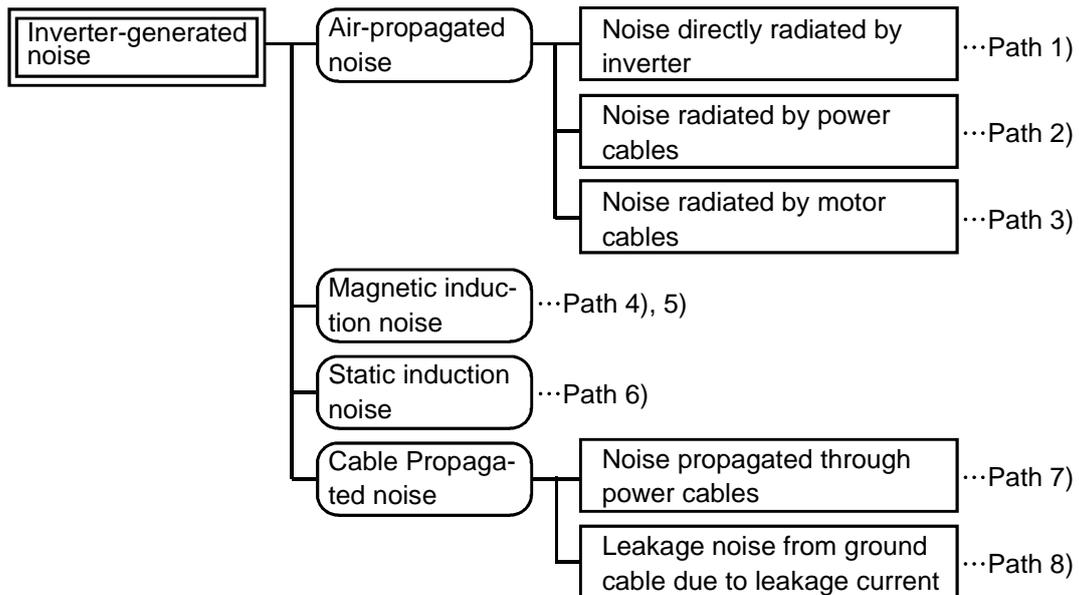
#### 2) Measures against noise which enters and causes misoperation of the inverter

When devices which generate noise (devices which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the inverter, the inverter may misoperate due to noise. The following measures must be taken:

- Provide surge suppressors for devices that generate noise to suppress noise.
- Fit data line filters to signal cables. (Refer to page 39)
- Ground the shields of the detector connection and control signal cables with cable clamp metal.

3) Measures against noises which are radiated by the inverter causing misoperation of peripheral 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.

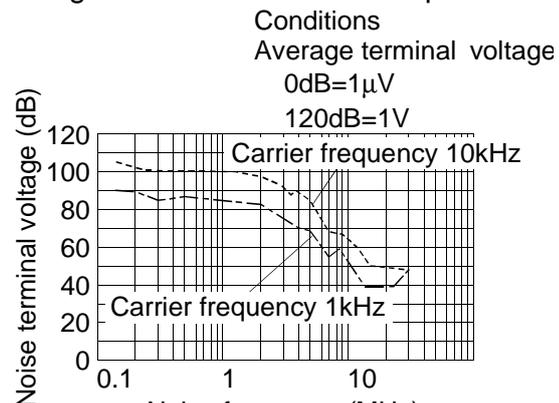
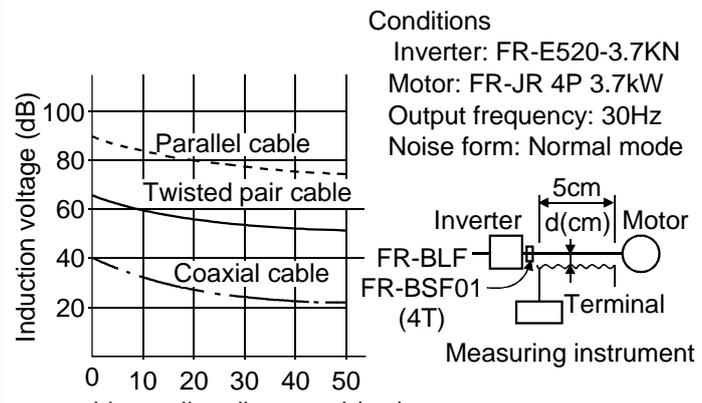


Noise Path	Measures
1), 2), 3)	<p>When devices which handle low-level signals and are susceptible to misoperation due to noise (such as instruments, receivers and sensors) are installed near the inverter and their signal cables are contained in the same panel as the inverter or are run near the inverter, the devices may be misoperated by air-propagated noise and the following measures must be taken:</p> <ol style="list-style-type: none"> <li>(1) Install easily affected devices as far away as possible from the inverter.</li> <li>(2) Run easily affected signal cables as far away as possible from the inverter.</li> <li>(3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them.</li> <li>(4) Insert line noise filters onto I/O and radio noise filters into inputs to suppress cable-radiated noises.</li> <li>(5) Use shielded cables for signal cables and power cables and run them in individual metal conduits to further reduce effects.</li> </ol>
4), 5), 6)	<p>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:</p> <ol style="list-style-type: none"> <li>(1) Install easily affected devices as far away as possible from the inverter.</li> <li>(2) Run easily affected signal cables as far away as possible from the inverter.</li> <li>(3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them.</li> <li>(4) Use shielded cables for signal cables and power cables and run them in individual metal conduits to further reduce effects.</li> </ol>
7)	<p>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:</p> <ol style="list-style-type: none"> <li>(1) Install the radio noise filter (FR-BIF) to the power cables (input cables) of the inverter.</li> <li>(2) Install the line noise filter (FR-BLF, FR-BSF01) to the power cables (I/O cables) of the inverter.</li> </ol>
8)	<p>When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage current may flow through the ground cable of the inverter causing misoperation of the device. In such a case, disconnection of the ground cable of the device may cause the device to operate properly.</p>

● **Data line filter**

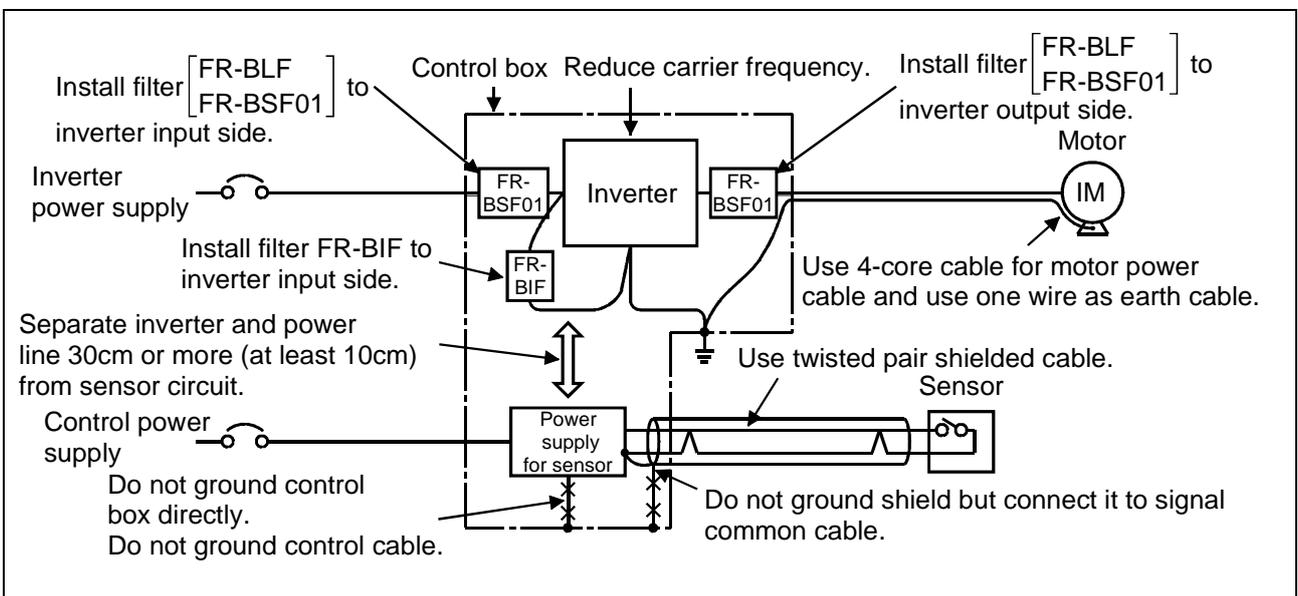
Noise entry can be prevented by providing a data line filter for the detector or other cable.

● **Data examples**

<p>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.</p>	<p>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.</p>
<p>Differences between noise terminal voltages at different carrier frequencies</p> <p>Conditions Average terminal voltage 0dB=1μV 120dB=1V</p> 	<p>Noise induced to signal cables by inverter output cables</p> <p>Conditions Inverter: FR-E520-3.7KN Motor: FR-JR 4P 3.7kW Output frequency: 30Hz Noise form: Normal mode</p> 

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

● **Example of measures against noise**



### 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-ground leakage currents

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

##### ● Countermeasures

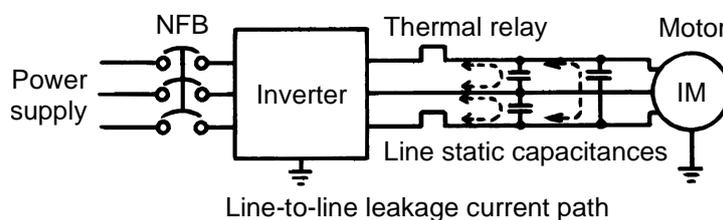
- If the carrier frequency setting is high, decrease the carrier frequency (Pr. 72) of the inverter.  
Note that motor noise increases. Selection of Soft-PWM (Pr. 240) will make it unoffending.
- By using earth leakage circuit breakers designed for harmonic and surge suppression (e.g. Mitsubishi's Progressive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

##### ● To-ground leakage current

- Note that a long wiring length will increase leakage currents. Decrease the carrier frequency of the inverter to reduce leakage currents.
- Higher motor capacity leads to larger leakage currents.

#### (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.



##### ● Countermeasures

- Use the electronic overcurrent protection 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.

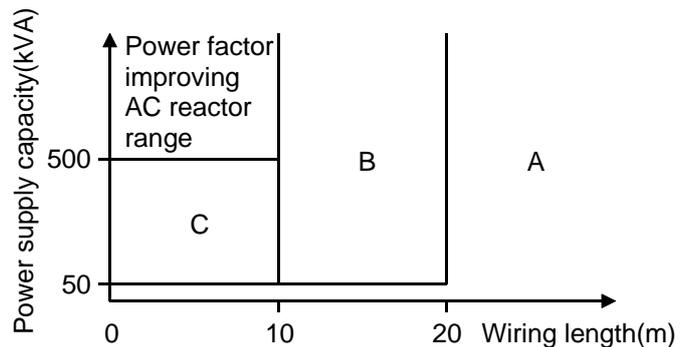
## 2.3.5 Peripheral devices

### (1) Selection of peripheral devices

Check the capacity of the motor 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)	No-Fuse Breaker (NFB) or Earth Leakage Circuit Breaker (NV) (Note 5)		Magnetic Contactor (MC)		
				Standard	With power factor improving reactor	A	B	C
Three-phase 200V	FR-E520-0.1KN	0.1	0.4	30AF 5A	30AF 5A	S-N11	S-N18	S-N20
	FR-E520-0.2KN	0.2	0.8	30AF 5A	30AF 5A	S-N18	S-N20	S-N20
	FR-E520-0.4KN	0.4	1.5	30AF 5A	30AF 5A	S-N18	S-N21	S-N21
	FR-E520-0.75KN	0.75	2.5	30AF 10A	30AF 10A	S-N18	S-N21	S-N21
	FR-E520-1.5KN	1.5	4.5	30AF 15A	30AF 15A	S-N21	S-N25	S-N50
	FR-E520-2.2KN	2.2	5.5	30AF 20A	30AF 15A	S-N11,S-N12		
	FR-E520-3.7KN	3.7	9	30AF 30A	30AF 30A	S-N20		
	FR-E520-5.5KN	5.5	12	50AF 50A	50AF 40A	S-N25		
	FR-E520-7.5KN	7.5	17	100AF 60A	50AF 50A	S-N35		

- Note: 1. Select the type of the no-fuse breaker in (NFB) response to the power supply capacity.
2. The power supply cable size of the motor indicated assumes that its length is 20m.
3. 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



Note: Power supply used has the above recommended size.

- length. For the FR-E520-0.4KN to 1.5KN, choose the S-N10 when the power factor improving reactor (FR-BEL or FR-BAL) is used.
4. When the inverter capacity is greater than the motor capacity, choose the breaker and magnetic contactor in accordance with the inverter type and choose the cables and power factor improving reactor in accordance with the motor output.
5. For installations in the United States or Canada, the circuit breaker must be inverse time or instantaneous trip type.

● **Installation and selection of no-fuse breaker**

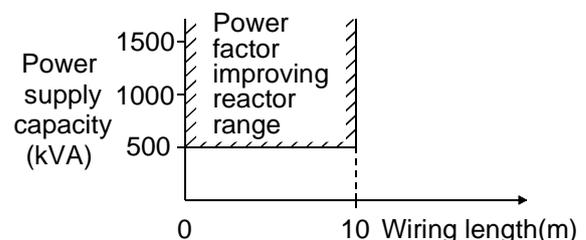
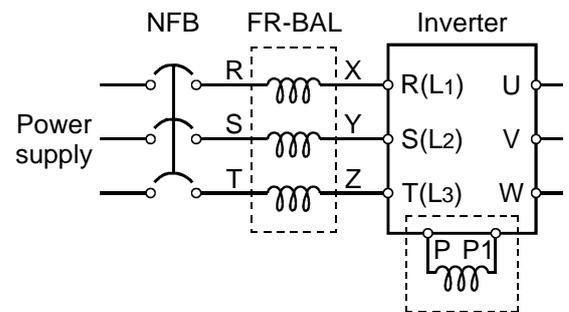
Install a no-fuse breaker (NFB) in the power supply side for protection of the inverter's primary wiring. Refer to the previous table and choose the NFB according to the inverter's power supply side power factor (which changes with the power supply voltage, output frequency and load). Especially for a completely electromagnetic type NFB, 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 leakage circuit breaker used should be durable against harmonic/surge (such as Progressive Super Series).

● **Power factor improving reactor**

	<b>Inverter Model</b>	<b>Power Factor Improving AC Reactor</b>	<b>Power Factor Improving DC Reactor</b>
Three-phase 200V	FR-E520-0.1KN	FR-BAL-0.4K (Note 1)	FR-BEL-0.4K (Note 1)
	FR-E520-0.2KN	FR-BAL-0.4K (Note 1)	FR-BEL-0.4K (Note 1)
	FR-E520-0.4KN	FR-BAL-0.4K	FR-BEL-0.4K
	FR-E520-0.75KN	FR-BAL-0.75K	FR-BEL-0.75K
	FR-E520-1.5KN	FR-BAL-1.5K	FR-BEL-1.5K
	FR-E520-2.2KN	FR-BAL-2.2K	FR-BEL-2.2K
	FR-E520-3.7KN	FR-BAL-3.7K	FR-BEL-3.7K
	FR-E520-5.5KN	FR-BAL-5.5K	FR-BEL-5.5K
	FR-E520-7.5KN	FR-BAL-7.5K	FR-BEL-7.5K

Note: 1. The power factor may be slightly lower.

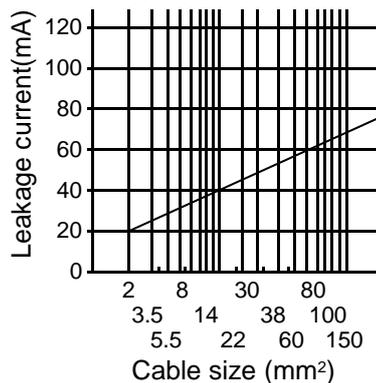
When the inverter is connected near a large-capacity power supply transformer (500kVA or more, wiring length 10m maximum) or there is power capacitor switch-over, excessive peak currents may flow into the power input circuit and damage the converter circuit. In such a case, the power supply improving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



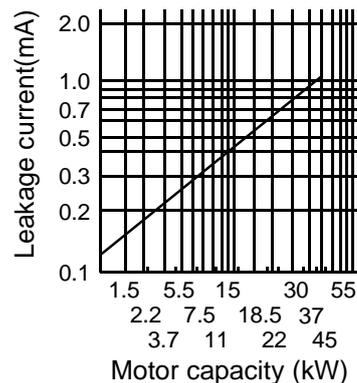
## (2) Selecting the rated sensitivity current for the earth leakage circuit breaker

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

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 3-phase induction motor during commercial power supply operation (200V 60Hz)



- Breaker for harmonic surge  
Rated sensitivity current:  $I\Delta n \geq 10 \times (I_{g1} + I_{gn} + I_{g2} + I_{gm})$

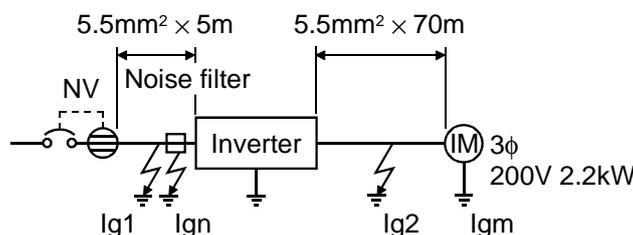
- Standard breaker  
Rated sensitivity current:  $I\Delta n \geq 10 \times \{I_{g1} + I_{gn} + 3 \times (I_{g2} + I_{gm})\}$

$I_{g1}, I_{g2}$  : Leakage currents of cable path during commercial power supply operation

$I_{gn}^*$  : Leakage current of noise filter on inverter input side

$I_{gm}$  : Leakage current of motor during commercial power supply operation

### <Example>



- Note: 1. The earth leakage circuit breaker should be installed to the primary (power supply) side of the inverter.
2. Ground fault in the secondary side of the inverter can be detected at the running frequency of 120Hz or lower.
3. In the  $\Delta$  connection neutral point grounded system, the sensitivity current is purified against ground fault in the inverter secondary side. Hence, the protective grounding of the load equipment should be 10Ω or less.

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 rises all increase.
  5. The following models are standard breakers  
 Type BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, NV-2F type leakage current relay (except for NV-ZH), AA neutral wire, NV with open phase protection  
 The following models are for harmonic surge  
 NV-C/NV-S/MN series, NV30-FA, NV50-FA, BV-C2, leakage current alarm breaker, NV-ZH
- \* Note the leakage current value of the noise filter installed on the inverter input side.

	<b>Breaker for Harmonic Surge</b>	<b>Standard Breaker</b>
Leakage current (lg1) (mA)	$33 \times \frac{5m}{1000m} = 0.17$	
Leakage current (lgn) (mA)	0 (without noise filter)	
Leakage current (lg2) (mA)	$33 \times \frac{70m}{1000m} = 2.31$	
Motor leakage current (lgm) (mA)	0.18	
Total leakage current (mA)	2.66	7.64
Rated sensitivity current (mA) ( $\geq lg \times 10$ )	30	100

**2.3.6 Instructions for compliance with U.S. and Canadian Electrical Codes**



(Standard to comply with: UL 508C)

**(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.

Inverter Type	Cabinet (enclosure) Size (Unit: mm)	Vent Hole Area	Cooling Fan
FR-E520 -3.7KN	W H D 255×192×218	<ul style="list-style-type: none"> <li>• 55% of both the side of the Cabinet</li> <li>• Width of each slit: 3.2mm</li> <li>• To be provided on each of the upper side areas.</li> </ul>	Installed at the enclosure top to suck air from inside the enclosure to the outside. (Fan air flow: 2 × 0.59m <sup>3</sup> /min or more)

**(2) Branch circuit protection**

For installation in 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.

**(3) Short circuit ratings**

Suitable For Use In A Circuit Capable Of Delivering Not More Than 5 kA rms Symmetrical Amperes.

**(4) Wiring of the power supply and motor**

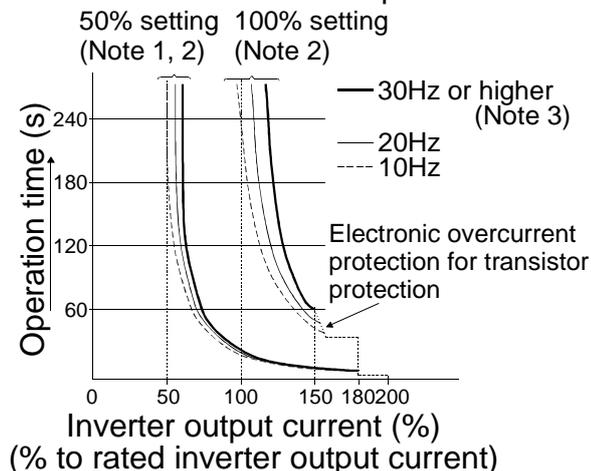
Use the UL-listed cables (rated at 75°C) and round crimping terminals to wire the input (R, S, T) <L<sub>1</sub>, L<sub>2</sub>, L<sub>3</sub>> and output (U, V, W) terminals of the inverter. Crimp the terminals with the crimping tool recommended by the terminal manufacturer.

**(5) Motor overload protection**

When using the electronic overcurrent protection 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.

## **2.3.7 Instructions for compliance with the European standards**

(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, but the machines/equipment into which they have been incorporated are covered by the EMC Directive and 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 ground the cables on the inverter and motor sides with the shortest possible distance.
- \* Insert a line noise 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).

#### 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

- \* Connect the equipment to the earth securely. Do not use an earth leakage circuit breaker as an electric shock protector without connecting the equipment to the earth.
- \* Wire the earth terminal independently. (Do not connect two or more cables to one terminal.)
- \* The wire size on pages 17 and 18 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 no-fuse 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 meet the overvoltage category II, insert an EN or IEC standard-compliant earthed star connection isolation transformer in the input of the inverter.
  - (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 13 are isolated safely from the main circuit.

Environment

\	<b>During operation</b>	<b>In storage</b>	<b>During transportation</b>
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.

# CHAPTER 3

## OPERATION/CONTROL

This chapter provides the basic "operation" for use of this product.

Always read this chapter before using the equipment.

3.1 Inverter Setting .....	48
3.2 Function Overview .....	52
3.3 Communication Specifications .....	55
3.4 Programming Examples.....	59

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

# 3.1 Inverter Setting

## 3.1.1 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.

### 3.1.2 Inverter station number setting

Set the inverter station number before switching on the inverter and do not change the setting while power is on.

When setting the station number, the following points should be taken into consideration:

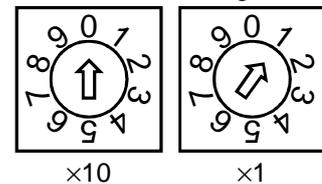
1) The station number may be set between 1 and 64.

Fully note that if the station number is changed during operation, data communication cannot be made with the new station number.

2) Setting method

- Set the arrow (↑) of the corresponding switch to the required numeral.

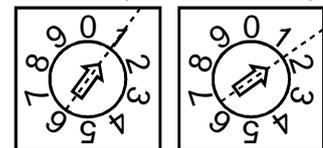
Station number setting switches



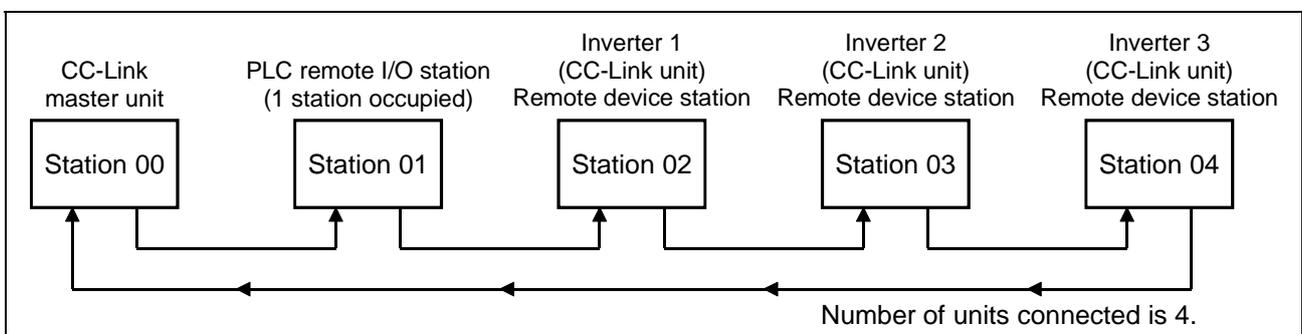
Example:

- For station 1: Set (↑) of ×10 to "0" and (↑) of ×1 to "1".
- For station 26: Set (↑) of ×10 to "2" and (↑) of ×1 to "6".
- Set station numbers consecutively in a connection sequence. (The station numbers may also be set independently of the connection sequence.)
- Note that the same station number cannot be repeated. (If the same station number is repeated, proper communication cannot be made.)
- Set each station number switch to the position of its numeral without error. If it is set to any position between numerals, normal data communication cannot be made.

Good example Bad example



3) Connection example



Note: One inverter occupies one station. (One station of remote device station)

### 3.1.3 Setting of the transmission baudrate setting switch

This switch is used to set the transmission speed.  
(For details, refer to the CC-Link Master Unit Manual.)

Setting Switch	Transmission Speed
0	156kbps
1	625kbps
2	2.5Mbps
3	5Mbps
4	10Mbps
Positions 5 and later are not used. (If the switch is set to any such positions, the "L.ERR" LED is lit to indicate a communication error.)	

Set the transmission speed before switching on the inverter and do not change the setting while power is on.

### 3.1.4 Power on

Before switching power on, check the following:

#### ● Installation check

Make sure that the inverter is installed correctly in a correct place. (Refer to page 11.)

#### • 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 13.)

#### ● Switch power on.

Power-on is complete if the POWER lamp is lit and the ALARM lamp is off.

### 3.1.5 Confirmation of the operation mode

There are the "PU operation mode" and "CC-Link operation mode".

Use Pr. 79 "operation mode selection" to select between these operation modes.

Before changing from one operation mode to the other, confirm the following:

- 1) The inverter is at a stop;
- 2) Both the forward and reverse rotation signals are off; and
- 3) The Pr. 79 "operation mode" setting is correct.

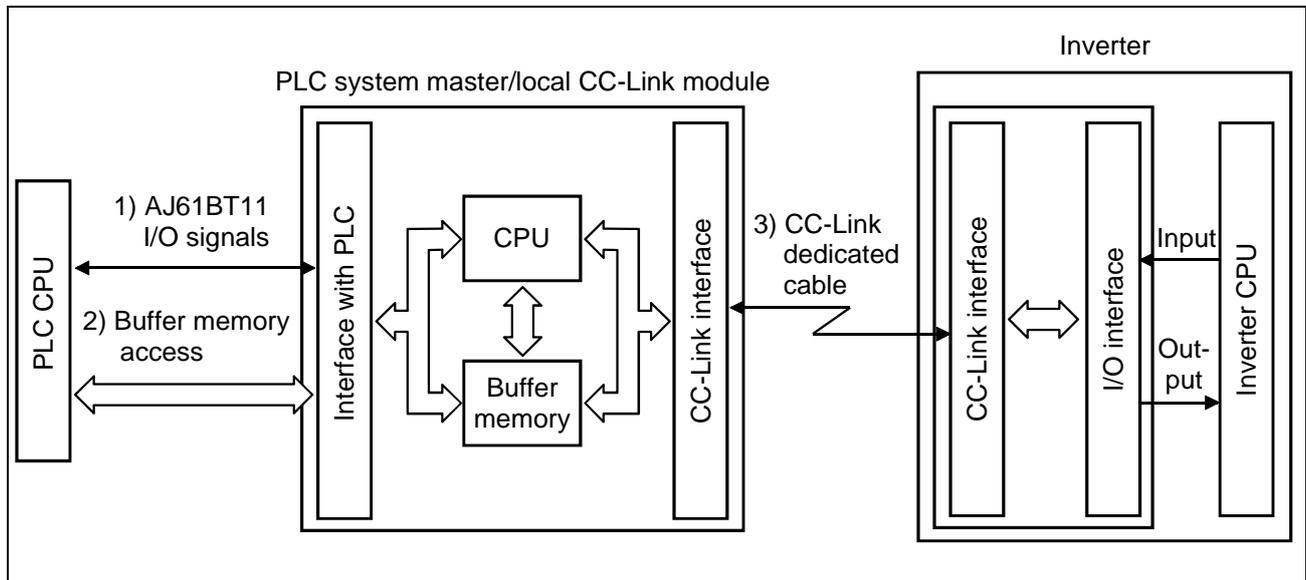
Pr. 79 Setting	Description
0	The parameter unit (FR-PU04) can be used to change between the PU operation mode and CC-Link operation mode. The CC-Link operation mode is selected at power-on reset.
1	PU operation mode (operation using the parameter unit (FR-PU04)).
2 (Factory setting)	CC-Link operation mode.

## 3.2 Function Overview

### 3.2.1 Function Block Diagram

Using function blocks, this section explains I/O data transfer to/from an inverter using CC-Link.

Link refresh is continuously executed between the master station and inverter in the CC-Link system at intervals of 1.1ms to 141ms (per station).



- 1) I/O signals assigned to the CC-Link system master/local unit.  
These signals are used for communication between the PLC CPU and CC-Link system master/local unit.  
For further details of the signals, refer to page 55.
- 2) You can read input data from the inverter, write output data to the inverter, and read CC-Link faulty station, for example. Use the FROM/TO instruction in the sequence program to access the buffer memory. (When the automatic refresh function is used, the FROM/TO instruction is not needed.) For details of the buffer memory, refer to the CC-Link system master/local module manual.
- 3) Direct a PLC link start from the sequence program. After CC-Link has started, link refresh is always made asynchronously (synchronously) with the execution of the sequence program.  
For details, refer to the CC-Link system master/local module manual.

### 3.2.2 Function overview

The following table lists the functions that can be performed from the PC in the CC-Link system:

Item	Operation Mode	
	CC-Link operation	PU operation
Monitoring function	Allowed	Allowed
Operation command	Allowed	Disallowed
Parameter write	Allowed (Note 1)	Disallowed
Parameter read	Allowed	Allowed
Inverter reset	Allowed (Note 2)	Disallowed

Note 1. Parameters cannot be written during inverter operation.  
 2. When a CC-Link fault occurs, the inverter cannot be reset from the PLC.  
 (For inverter reset, refer to page 150.)

#### (1) Monitoring function

(Refer to page 62.)

The following items can be monitored by the PLC:

- 1) Output frequency..... Binary in 0.01Hz increments
- 2) Output current ..... Binary in 0.01A increments
- 3) Output voltage..... Binary in 0.1V increments
- 4) Alarm definition
- 5) Special monitoring..... Monitored data selected by instruction code F3H
- 6) Inverter status
  - Forward running
  - Reverse running
  - Running (RUN)\*
  - Up to frequency (SU)
  - Overload (OL)
  - Frequency detection (FU)\*
  - Alarm\*

The output signals marked \* can be changed using Pr. 190 to Pr. 192 (output terminal (remote input) function selection).

Note: Items 1) to 4) are read from the buffer memory by setting the corresponding code numbers when needed.  
 Item 6) can be read from the buffer memory any time.

## **(2) Operation commands**

(Refer to page 62.)

Any of the following commands can be output from the PLC to the inverter as an operation command any time:

- Forward rotation (STF)
- Reverse rotation (STR)
- Low speed (RL), middle speed (RM), high speed (RH), inverter output halt (MRS):

The input signals can be changed using Pr. 180 to Pr. 183 (input terminal (remote output) function selection).

## **(3) Running frequency**

(Refer to page 65.)

The running frequency is written from the PLC to the inverter when it is changed  
(Binary in 0.01Hz increments)

The frequency may either be written to E<sup>2</sup>PROM or RAM.

When changing the frequency continuously, always write the data to the inverter RAM.

## **(4) Parameter write**

(Refer to page 64.)

Functions can be written from the PLC. Note that write during inverter operation will result in a write error.

Refer to page 173 for the parameter data codes.

## **(5) Parameter read**

(Refer to page 63.)

Functions can be read to the PLC.

Refer to page 173 for the parameter data codes.

## 3.3 Communication Specifications

### 3.3.1 I/O signal list

The following device No.s are those for station 1.

For stations 2 and later, the device No.s are different. (For the device No. correspondence list, refer to the master unit manual.)

#### **(1) Output signals (master module → inverter)**

The output signals from the master unit are indicated. (Input signals to inverter)

Device No.	Signal	Description
RY0	Forward rotation command	OFF : Stop command ON : Forward rotation start (Note 1)
RY1	Reserve rotation command	OFF : Stop command ON : Reserve rotation start (Note 1)
RY2	RH terminal function (high speed)	Functions assigned to RH/RM/RL are selected. In the factory setting, multi-speed selection can be made by the combination of RH, RM and RL. (Note 2)
RY3	RM terminal function (middle speed)	
RY4	RL terminal function (low speed)	
RY5	Unused (Note 5)	Reserved for the system.
RY6		
RY7		
RY8		
RY9	Output halt (MRS)	When the MRS signal switches on, the inverter output stops. (Note 2)
RYA	Reserved (Note 5)	Reserved for the system.
RYB		
RYC	Monitor command	When the monitor command (RYC) is switched on, the monitored value is set to remote register RW <sub>r0</sub> and monitoring (RXC) switches on. While the monitor command (RYC) is on, the monitored value is always updated.
RYD (Note 4)	Frequency setting command (RAM)	When the frequency setting command (RYD) is switched on, the set frequency (RW <sub>w1</sub> ) is written to the inverter. (Note 3) On completion of write, frequency setting completion (RXD) switches on.
RYE (Note 4)	Frequency setting command (E <sup>2</sup> PROM)	When the frequency setting command (RYE) is switched on, the set frequency (RW <sub>w1</sub> ) is written to the inverter. On completion of write, frequency setting completion (RXE) switches on.
RYF (Note 4)	Instruction code execution request	When the instruction code execution request (RYF) is switched on, processing corresponding to the instruction code set to RW <sub>w2</sub> is executed. After completion of instruction code execution, instruction code execution completion (RXF) switches on. When an instruction code execution error occurs, a value other than 0 is set to the reply code (RW <sub>r2</sub> ).
RY10	Reserved (Note 5)	Reserved for the system.
RY11		
RY12		
RY13		
RY14		
RY15		
RY16		
RY17		
RY18		
RY19		
RY1A	Error reset request flag	If the error reset request flag (RY1A) is switched on only when an inverter fault occurs, the inverter is reset and the error status flag (RX1A) switches off.

- Note:
1. Simultaneously turning on RY0 and RY1 gives a stop command.
  2. Using Pr. 180 to Pr. 183 (input terminal function selection), you can set the input signals of device No.s RY2 to RY4. For details, refer to page 132.
  3. While the set frequency designation (RYD) signal is ON, the value of the set frequency (RW<sub>w1</sub>) is always reflected.
  4. If these signals turn on at the same time, only one of them is executed.
  5. The reserved input signal should be off. (Enter 0)

## **(2) Input signals (inverter → master module)**

The input signals from the inverter to the master unit are indicated.  
(Output signals from inverter)

Device No.	Signal	Description
RX0	Forward running	OFF : Other than forward running (during stop or reverse rotation) ON : Forward running
RX1	Reverse running	OFF : Other than reverse running (during stop or forward rotation) ON : Reverse running
RX2	Running (RUN)	On while the inverter is running. (Note 1)
RX3	Up to frequency (SU)	Switched on when the output frequency reaches the set frequency ± Pr. 41.
RX4	Overload (OL)	Switched on when stall prevention operation is performed, switched off when stall prevention is canceled.
RX5	Unused	Reserved for the system.
RX6	Frequency detection (FU)	Switched on when the output frequency reaches set frequency. (Note 1)
RX7	Normal (A, B, C)	Switched on when the inverter's protective function is activated to stop the output. (Note 1)
RX8	Unused	Reserved for the system.
RX9		
RXA		
RXB		
RXC	Monitoring	Switched on when the monitored value is set to RWr0 by the monitor command (RYC) switching on. Switched off when the monitor command (RYC) is switched off.
RXD	Frequency setting command (RAM)	Switched on when the set frequency is written to the inverter by the frequency setting command (RYD) switching on. Switched off when the frequency setting command (RYD) is switched off.
RXE	Frequency setting command (E <sup>2</sup> PROM)	Switched on when the set frequency is written to the inverter by the frequency setting command (RYE) switching on. Switched off when the frequency setting command (RYE) is switched off.
RXF	Instruction code execution completion	Switched on on-completion of the processing corresponding to the instruction code (RWW2) which is executed when the instruction code execution request (RYF) switches on. Switched off when the instruction code execution completion (RXF) is switched off.
RX10	Reserved	Reserved for the system.
RX11		
RX12		
RX13		
RX14		
RX15		
RX16		
RX17		
RX18		
RX19		
RX1A	Error status flag	Switched on when an inverter error occurs (protective function is activated).
RX1B	Remote station ready (Note 2)	Switched on when the inverter goes into the ready status on completion of initial setting after power-on or hardware reset. (Used as an interlock for read/write from/to the master station.) Switched off when an inverter error occurs (protective function is activated).

Note: 1. Using Pr. 190 to Pr. 192 (output terminal function selection), you can set the output signals of device No.s RX2, RX6, RX7.

For details, refer to page 134.

2. Since operation differs with the condition setting switch (SW4) position of the master unit, use SW4 in the OFF position. If you use SW4 in the ON position, the remote station ready signal remains ON if a communication error occurs.

### 3.3.2 Assignment of remote registers

#### (1) Remote registers (master module → inverter)

Device No.	Signal	Description
RWw0	Monitor code	Set the monitor code to be referenced. (Refer to page 63) By switching on the RYC signal after setting, the specified monitored data is set to RWr0.
RWw1	Set frequency	Specify the set frequency. At this time, whether it is written to RAM or E <sup>2</sup> PROM is differentiated by the RYD and RYE signals. After setting the frequency to this register, switch on the above RYD or RYE to write the frequency. On completion of frequency write, RXD or RXE switches on in response to the input command.
RWw2	Instruction code	Set the instruction code for execution of operation mode rewrite, Pr. Read/write, error reference, error clear, etc. (refer to page 58). The corresponding instruction is executed by switching on RYF after completion of register setting. RXF switches on on completion of instruction execution.
RWw3	Write data	Set the data specified by the above instruction code. When required, switch RYF on after setting the above instruction code and this register. Set zero when the write code is not required.

Addresses	Remote Registers	Addresses	Remote Registers	Addresses	Remote Registers	Addresses	Remote Registers
1 station { 1E0H 1E1H 1E2H 1E3H	RWw0 RWw1 RWw2 RWw3	3 station { 1E8H 1E9H 1EAH 1EBH	RWw8 RWw9 RWwA RWwB	5 station { 1F0H 1F1H 1F2H 1F3H	RWw10 RWw11 RWw12 RWw13		
2 station { 1E4H 1E5H 1E6H 1E7H	RWw4 RWw5 RWw6 RWw7	4 station { 1ECH 1EDH 1EEH 1EFH	RWwC RWwD RWwE RWwF	6 station { 1F4H 1F5H 1F6H 1F7H	RWw14 RWw15 RWw16 RWw17	64 station { 2DCH 2DDH 2DEH 2DFH	RWwFC RWwFD RWwFE RWwFF

#### (2) Remote registers (inverter → master module)

Device No.	Signal	Description
RWr0	Monitored value	The monitored value specified by RWw0 (monitor code) is set.
RWr1	Output frequency	The present output frequency is always set.
RWr2	Reply code	The reply code corresponding to RWw2 (instruction code) is set. 0 is set for a normal reply and a value other than 0 is set for a data error.
RWr3	Read data	For a normal reply, the reply data to the instruction specified by the instruction code is set.

Addresses	Remote Registers	Addresses	Remote Registers	Addresses	Remote Registers	Addresses	Remote Registers
1 station { 2E0H 2E1H 2E2H 2E3H	RWr0 RWr1 RWr2 RWr3	3 station { 2E8H 2E9H 2EAH 2EBH	RWr8 RWr9 RWrA RWrB	5 station { 2F0H 2F1H 2F2H 2F3H	RWr10 RWr11 RWr12 RWr13		
2 station { 2E4H 2E5H 2E6H 2E7H	RWr4 RWr5 RWr6 RWr7	4 station { 2ECH 2EDH 2EEH 2EFH	RWrC RWrD RWrE RWrF	6 station { 2F4H 2F5H 2F6H 2F7H	RWr14 RWr15 RWr16 RWr17	64 station { 3DCH 3DDH 3DEH 3DFH	RWrFC RWrFD RWrFE RWrFF

### 3.3.3 Instruction Codes

Item	Code Number	Description	
Operation mode read	007BH	0000H: CC-Link operation 0002H: PU operation	
Operation mode write	00FBH	0000H: CC-Link operation 0002H: PU operation	
Alarm history No. 1, No. 2 read	0074H	Reads the most recent No. 1 and 2 alarms.	
Alarm history No. 3, No. 4 read	0075H	Reads the most recent No. 3 and 4 alarms.	
Alarm history No. 5, No. 6 read	0076H	Reads the most recent No. 5 and 6 alarms.	
Alarm history No. 7, No. 8 read	0077H	Reads the most recent No. 7 and 8 alarms.	
Set frequency (RAM) read	006DH	Reads the set frequency (RAM). (Note)	
Set frequency (E <sup>2</sup> PROM) read	006EH	Reads the set frequency (E <sup>2</sup> PROM). (Note)	
Set frequency (RAM) write	00EDH	Writes the set frequency to RAM. (Note)	
Set frequency (E <sup>2</sup> PROM) write	00EEH	Writes the set frequency to E <sup>2</sup> PROM. (Note)	
Parameter read	0000H to 006CH	Refer to the parameter data code list (page 173) and perform read/write as required.	
Parameter write	0080H to 00ECH	It should be noted that some parameter values cannot be read nor written.	
Batch alarm definition clear	00F4H	9696H: Batch-clears the alarm history.	
Parameter clear	00FCH	9696H: Parameter clear (Parameters other than calibration values are returned to factory settings) 9966H: All clear	
Inverter reset	00FDH	9696H: Resets the inverter.	
Link parameter expansion setting	Read	007FH	Changes the 0000H to 006CH and 0080H to 00ECH parameter values. 0000H: Pr. 0 to Pr. 99 0001H: Pr. 100 to Pr. 159 0002H: Pr. 160 to Pr. 192, Pr. 232 to Pr. 251 0003H: Pr. 342 0005H: Pr. 500 to Pr. 502 0009H: Pr. 990, Pr. 991
	Write	00FFH	

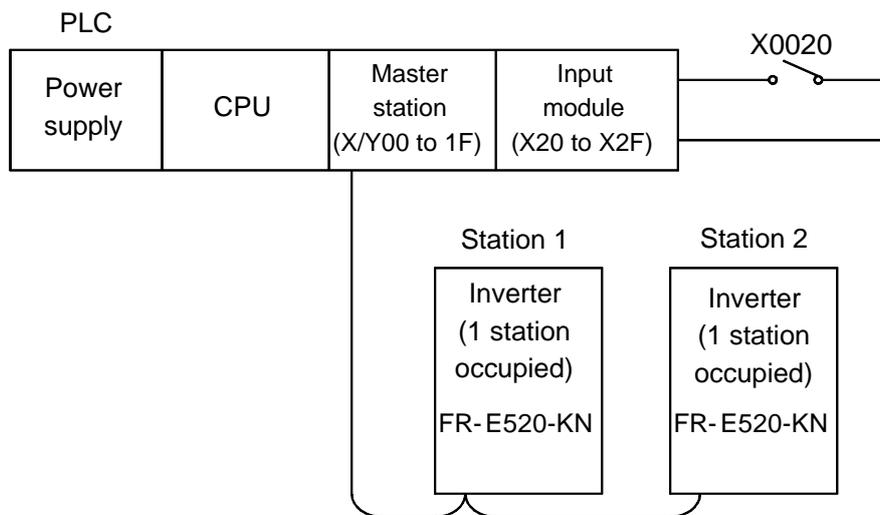
Note: Setting can be made from the remote registers.

## 3.4 Programming Examples

The following table lists program examples which control the inverter with sequence programs.

	Item	Program Example	Refer to Page
3.4.1	Reply code definitions	List of codes checked after completion of instruction code execution	59
3.4.2	Reading the inverter status	Reading the inverter status from the buffer memory of the master station	60
3.4.3	Setting the operation mode	Selecting the CC-Link operation mode	61
3.4.4	Setting the operation commands	Commanding the forward rotation and medium speed signals	62
3.4.5	Setting the monitoring function	Monitoring the output frequency	62
3.4.6	Reading the parameter value	Reading the value of Pr. 7 "acceleration time"	63
3.4.7	Writing the parameter value	Setting "3.0s" in Pr. 7 "acceleration time"	64
3.4.8	Over of the Functions "acceleration time"	Setting to 50.00Hz	65
3.4.9	Reading the alarm definitions	Reading the inverter alarms	66
3.4.10	Inverter reset	Resetting the inverter	67

System configuration for programming example



### 3.4.1 Reply code definitions

When executing the frequency setting (RYD, RYE) or instruction code execution (RYF), check the reply code (RWr2) in the remote register after execution.

Data	Item	Alarm Definition
0000H	Normal	Normal completion of instruction code execution
0001H	Write error	Parameter write was attempted during other than a stop in the CC-Link operation mode.
0002H	Parameter selection error	Unregistered code number was set.
0003H	Setting range error	Set data is outside the permissible data range.



### 3.4.3 Operation mode setting program example

Write programs as explained below to write various data to the inverters:

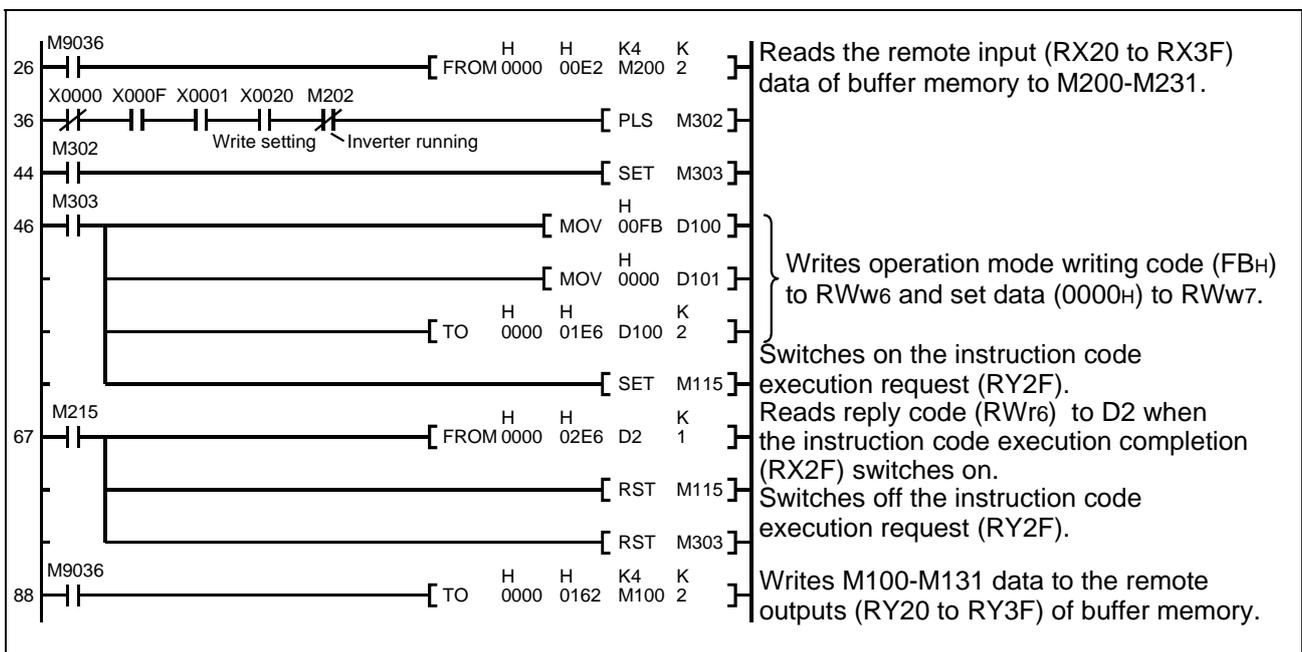
#### (1) Operation mode switching program example

1) The following program changes the operation mode of station 2 inverter to CC-Link operation.

Operation mode writing code number: FBH (hexadecimal)

CC-Link operation set data: 0000H (hexadecimal) (Refer to page 58.)

The reply code at the time of instruction code execution is set to D2. (Refer to page 59.)



\*The switching result is stored into D2.

D2 = 0000H..... Normal completion of switching

0001H..... Write error

0002H..... Parameter selection error

0003H..... Setting range error

2) Operation mode setting

Code number: FBH

Set data..... 0000H: CC-Link operation

0002H: PU operation

Note: PU operation cannot be set from the PLC.

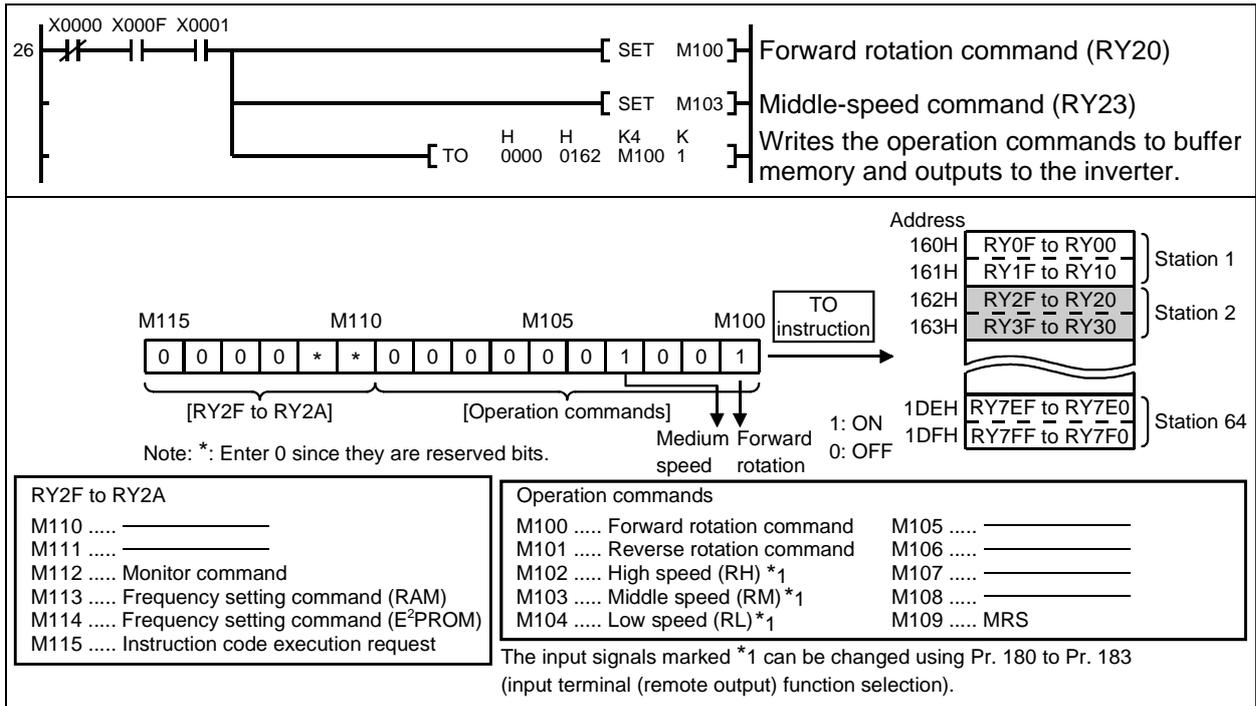
The reply code at the time of instruction code execution is set to D2. (Refer to page 59.)

### 3.4.4 Program example for setting the operation commands

Write a program as explained below to write the inverter operation commands to the master station buffer memory:

The inverter is operated in accordance with the operation commands written to the remote outputs (addresses 160H to 1DFH).

The following program outputs the commands of forward rotation and middle speed signals to the inverter of station 2:



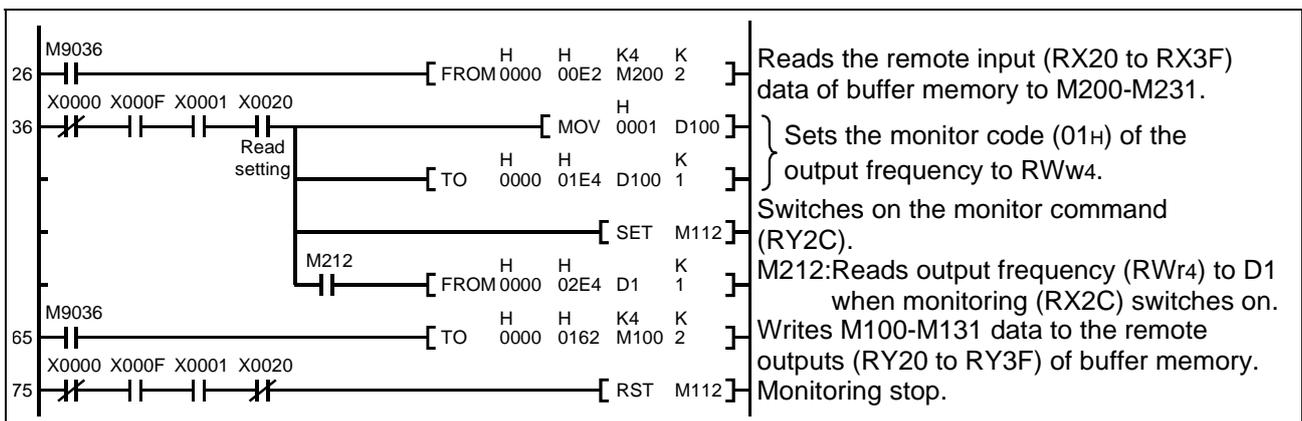
### 3.4.5 Program example for monitoring the output frequency

This section describes the program which reads the monitoring function of the inverter.

The following program reads the output frequency of the station 2 inverter to D1.

Output frequency reading code number: 0001H (hexadecimal)

Example: The output frequency of 60Hz is indicated 1770H (6000).



### Monitor codes

Code Number	Description	Increments
0000H	No monitoring (monitored value fixed to 0)	—
0001H	Output frequency (Note 1)	0.01Hz
0002H	Output current	0.01A
0003H	Output voltage	0.1V
0004H to FFFFH	No monitoring (monitored value fixed to 0)	—

Note 1: Unit for speed display is changed according to the Pr. 37 setting  
 When Pr. 37≠0, output frequency monitoring changes to speed monitoring. Speed display unit: 1r/min

\* Note that for any speed in excess of 65535 (FFFFH); 65535 (FFFFH) is shown.

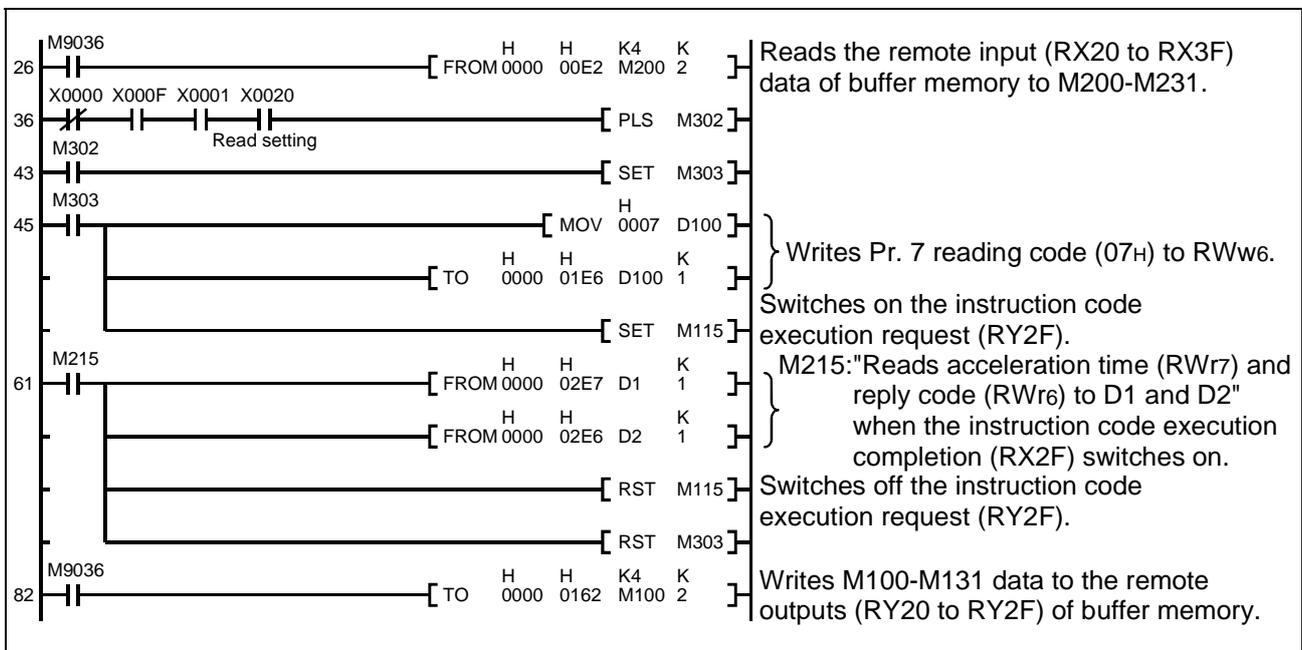
### 3.4.6 Parameter reading program example

The following program reads the Pr. 7 "acceleration time" setting of the station 2 inverter to D1.

Code number for reading Pr. 7 "acceleration time": 07H (hexadecimal)

For the parameter code numbers, refer to the inverter manual.

The reply code at the time of instruction code execution is set to D2. (Refer to page 59.)



Note: For parameters having numbers 100 and later, change their link parameter extension settings (set them to other than 0000H).

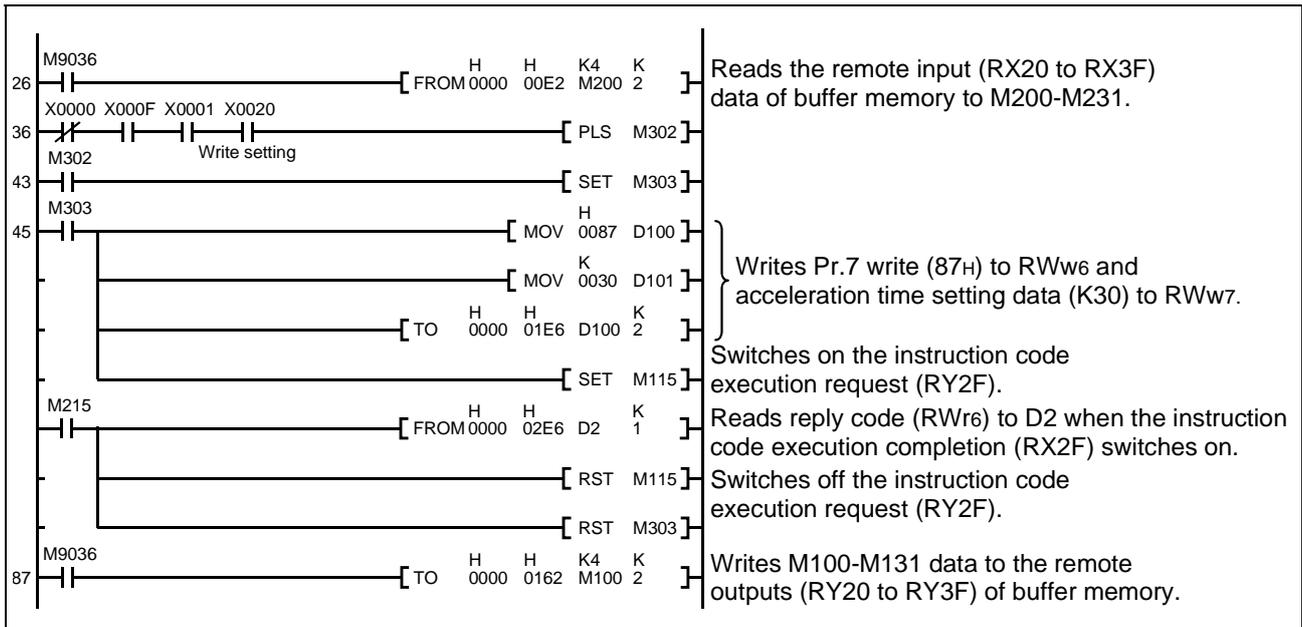
### 3.4.7 Parameter writing program example

1) Program example which changes the Pr. 7 "acceleration time" setting of station 2 inverter to 3.0s.

Acceleration time writing code number : 87H (hexadecimal)

Acceleration time set data : K30 (decimal)

The reply code at the time of instruction code execution is set to D2. (Refer to page 59)



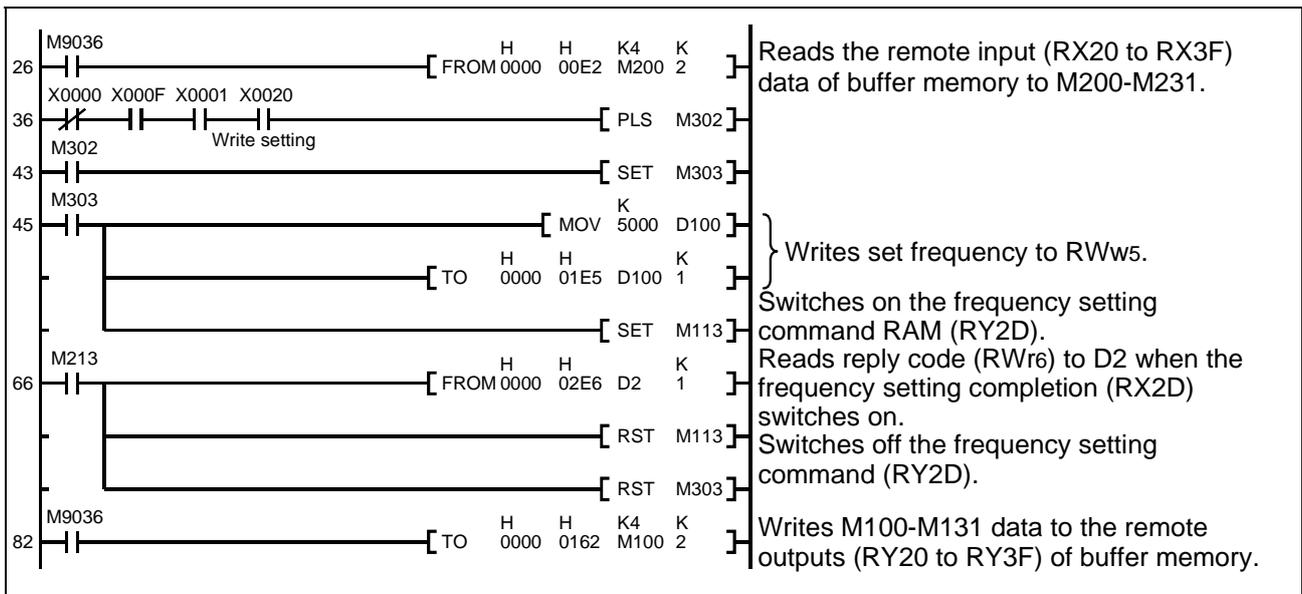
- Note: 1. For parameters having numbers 100 and later, change their link parameter extension settings (set them to other than 0000H).  
 2. For other functions, refer to the instruction codes (page 58).

### 3.4.8 Running frequency setting program example

1) The following program changes the running frequency of station 2 inverter to 50.00Hz.

Set frequency: K5000 (decimal)

The reply code at the time of instruction code execution is set to D2. (Refer to page 59.)



2) To continuously change the running frequency from PLC

When the frequency setting completion (example: RX2D) switches on, make sure that the reply code in the remote register is 0000H and change the set data (example: RWw5) continuously.

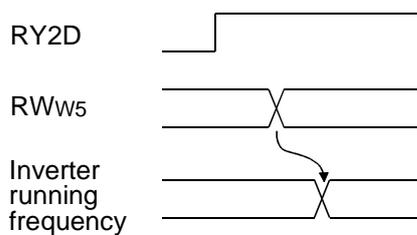
3) Program example for writing data to E<sup>2</sup>PROM

Modify the above program as follows:

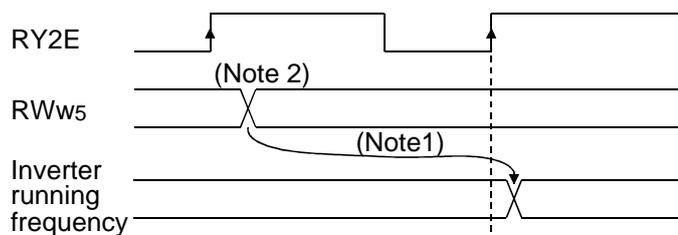
Change the frequency setting command from RY2D to RY2E.

Frequency setting completion RY2D → RY2E

<Timing chart for write to RAM>



<Timing chart for write to E<sup>2</sup>PROM>

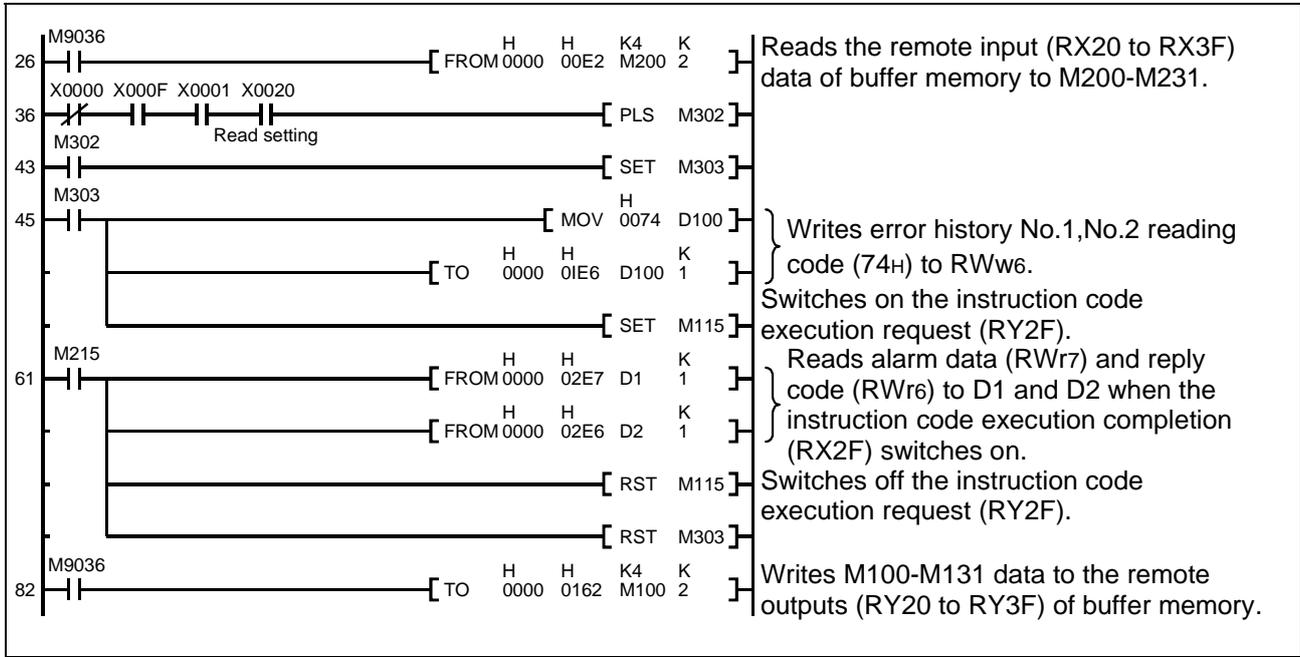


Reflected on inverter at the point when RY2E switches on

Note: 1. For E<sup>2</sup>PROM, write is made only once when RY2E is switched on.  
2. If the set data is changed with RY2E on, it is not returned on the inverter.

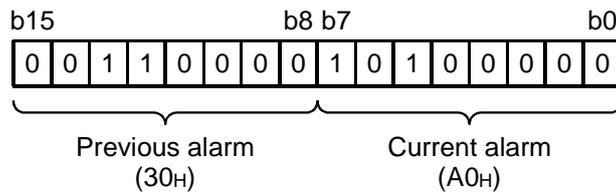
### 3.4.9 Alarm definition reading program example

- The following program reads the alarm definition of station 2 inverter to D1.  
 Error history No. 1, No. 2 reading code number: 74H (hexadecimal)  
 The reply code at the time of instruction code execution is set to D2. (Refer to page 59.)



- Alarm definition display example

Example: Read data is 30A0H — Previous alarm..... THT  
 Current alarm ..... OPT



- Alarm data

Refer to page 143.

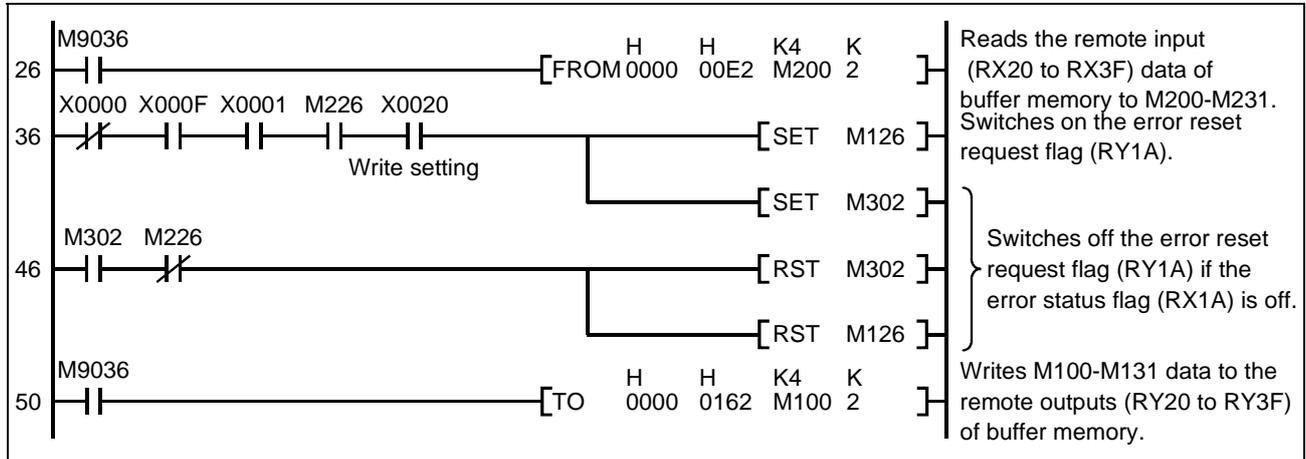
Data	Definition	Data	Definition
00H	No alarm	60H	E. OLT
10H	E. OC1	70H	E. BE
11H	E. OC2	80H	E. GF
12H	E. OC3	81H	E. LF
20H	E. OV1	90H	E. OHT
21H	E. OV2	A0H	E. OPT
22H	E. OV3	B0H	E. PE
30H	E. THT	B1H	E. PUE
31H	E. THM	B2H	E. RET
40H	E. FIN	F3H	E. 3

### 3.4.10 Inverter resetting program example

1) The following program resets the station 2 inverter.

The reply code at the time of instruction code execution is set to D2.

(Refer to page 59.)



Note: 1. The above inverter reset using RY1A may be made only when an inverter error occurs.

Also, inverter reset can be made independently of the operation mode.

2. When resetting the inverter using the instruction code execution request (RYF) with the instruction code (FDH) and data (9696H), set the operation mode to the CC-Link operation mode. (Refer to page 61 for the program example.)

### 3.4.11 Instructions

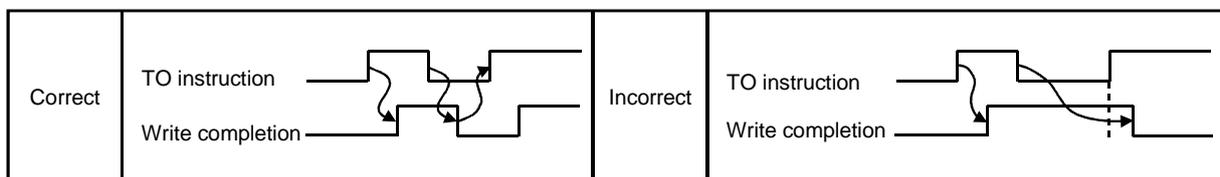
#### (1) Programming instructions

1) Since the buffer memory data of the master station is kept transferred (refreshed) to/from the inverters, the TO instruction need not be executed every scan in response to data write or read requests.

The execution of the TO instruction every scan does not pose any problem.

2) If the FROM/TO instruction is executed frequently, data may not be written reliably.

When transferring data between the inverter and sequence program via the buffer memory, perform the handshake to confirm that data has been written without fail.



#### (2) Operating and handling instructions

- 1) During CC-Link operation, the inverter only accepts commands from the PLC and ignores any external operation command and any operation command from the parameter unit.
- 2) If the same station number is set to different inverters, wrong data will be transferred and normal communication cannot be made.
- 3) The inverter is brought to an alarm stop "E.OPT" if data communication stops for more than the time set in Pr. 500 "communication error execution waiting time", due to a PLC fault, an open CC-Link dedicated cable etc. during CC-Link operation.
- 4) If the PLC (master station) is reset or PLC power is switched off during CC-Link operation, data communication stops and the inverter is brought to an alarm stop "E.OPT".
- 5) Do not set "1" in Pr. 77 "write inhibit selection" of the inverter. If the CC-Link mode is selected with this setting, all parameters will be write-disabled.

# CHAPTER 4

## 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.

4.1 Parameter List .....	69
4.2 Parameter Function Details .....	77

Note : By making parameter setting, you can change the functions of contact input terminals MRS 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 (FR-E520, FR-E540, FR-E520S, FR-E510W, DeviceNet type FR-E520-KND) inverter.

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

# 4.1 Parameter List

## PARAMETERS

### 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%	77	
	1	Maximum frequency	0 to 120Hz	0.01Hz	120Hz	78	
	2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	78	
	3	Base frequency (Note 1)	0 to 400Hz	0.01Hz	60Hz	79	
	4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	80	
	5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	80	
	6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	80	
	7	Acceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/ 0.01 s	5 s/10s (Note 2)	81	
	8	Deceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/ 0.01 s	5 s/10s (Note 2)	81	
	9	Electronic thermal O/L relay	0 to 500A	0.01A	Rated output current (Note 3)	83	
Standard operation functions	10	DC injection brake operation frequency	0 to 120Hz	0.01Hz	3Hz	84	
	11	DC injection brake operation time	0 to 10 s	0.1 s	0.5 s	84	
	12	DC injection brake voltage	0 to 30%	0.1%	6%	84	
	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	85	
	14	Load pattern selection (Note 1)	0 to 3	1	0	85	
	18	High-speed maximum frequency	120 to 400Hz	0.01Hz	120Hz	78	
	19	Base frequency voltage (Note 1)	0 to 1000V, 8888, 9999	0.1V	9999	79	
	20	Acceleration/ deceleration reference frequency	1 to 400Hz	0.01Hz	60Hz	81	
	21	Acceleration/ deceleration time increments	0, 1	1	0	81	
	22	Stall prevention operation level	0 to 200%	0.1%	150%	87	
	23	Stall prevention operation level compensation factor at double speed (Note 6)	0 to 200%, 9999	0.1%	9999	87	

**PARAMETERS**

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	9999	80	
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz	9999	80	
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz	9999	80	
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz	9999	80	
	29	Acceleration/ deceleration pattern	0, 1, 2	1	0	89	
	30	Regenerative function selection	0, 1	1	0	90	
	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	91	
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	91	
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz	9999	91	
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	91	
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz	9999	91	
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	91	
	37	Speed display	0, 0.01 to 9998	0.001 r/min	0	92	
Output Terminal functions	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	93	
	42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	93	
	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	93	
Sond functions	44	Second acceleration/ deceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/ 0.01 s	5 s	81	
	45	Second deceleration time	0 to 3600 s/ 0 to 360 s, 9999	0.1 s/ 0.01 s	9999	81	
	46	Second torque boost (Note 1)	0 to 30%, 9999	0.1%	9999	77	
	47	Second V/F (base frequency) (Note 1)	0 to 400Hz, 9999	0.01Hz	9999	79	
	48	Second electronic overcurrent protection	0 to 500A, 9999	0.01A	9999	83	

**PARAMETERS**

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer setting
Display functions	52	PU main display data selection	0, 23, 100	1	0	94	
	Automatic restart functions	57	Restart coasting time	0 to 5 s, 9999	0.1 s	9999	96
		58	Restart cushion time	0 to 60 s	0.1 s	1.0 s	96
Operation selection functions	60	Shortest acceleration/ deceleration mode	0, 1, 2, 11, 12	1	0	97	
	61	Reference I for intelligent mode	0 to 500A, 9999	0.01A	9999	97	
	62	Reference I for intelligent mode acceleration	0 to 200%, 9999	1%	9999	97	
	63	Reference I for intelligent mode deceleration	0 to 200%, 9999	1%	9999	97	
	65	Retry selection	0, 1, 2, 3	1	0	99	
	66	Stall prevention operation level reduction starting frequency (Note 4)	0 to 400Hz	0.01Hz	60Hz	87	
	67	Number of retries at alarm occurrence	0 to 10, 101 to 110	1	0	99	
	68	Retry waiting time	0.1 to 360 s	0.1 s	1 s	99	
	69	Retry count display erasure	0	1	0	99	
	70	Special regenerative brake duty	0 to 30%	0.1%	0%	90	
	71	Applied motor (Note 4)	0, 1, 3, 5, 6, 13, 15, 16, 23, 100, 101, 103, 105, 106, 113, 115, 116, 123	1	0	101	
	72	PWM frequency selection	0 to 15	1	1	102	
	75	Reset selection/ disconnected PU detection/PU stop selection	0 to 3, 14 to 17	1	14	103	
	77	Parameter write disable selection	0,2	1	0	105	
	78	Reverse rotation prevention selection	0,1,2	1	0	106	
79	Operation mode selection (Note 4)	0 to 2	1	2	107		

**PARAMETERS**

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer setting
General-purpose magnetic flux vector control	80	Motor capacity (Note 4)	0.1 to 7.5kW, 9999	0.01kW	9999	108	
	82	Motor exciting current	0 to 500A, 9999	0.01A	9999	109	
	83	Rated motor voltage (Note 4)	0 to 1000V	0.1V	200V	109	
	84	Rated motor frequency (Note 4)	50 to 120Hz	0.01Hz	60Hz	109	
	90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999	109	
	96	Auto-tuning setting/status (Note 4)	0, 1	1	0	109	
Communication functions	117	Station number	0 to 31	1	0	115	
	118	Communication speed	48, 96, 192	1	192	115	
	119	Stop bit length	0, 1 (data length 8) 10, 11 (data length 7)	1	1	115	
	120	Parity check presence/absence	0, 1, 2	1	2	115	
	121	Number of communication retries	0 to 10, 9999	1	1	115	
	122	Communication check time interval	0 to 999.8 s, 9999	0.1 s	0	115	
	123	Waiting time setting	0, 0.1 to 150, 9999	1	9999	115	
	124	CR·LF presence/absence selection	0, 1, 2	1	1	115	
Additional function	145	Parameter for option (FR-PU04).					
	146	Parameter set by manufacturer. Do not set.					
Current detection	150	Output current detection level	0 to 200%	0.1%	150%	127	
	151	Output current detection period	0 to 10 s	0.1 s	0	127	
	152	Zero current detection level	0 to 200.0%	0.1%	5.0%	128	
	153	Zero current detection period	0.05 to 1 s	0.01 s	0.5 s	128	
Sub function	156	Stall prevention operation selection	0 to 31, 100	1	0	129	

## PARAMETERS

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer setting	
Additional function	160	User group read selection	0, 1, 10, 11	1	0	131		
	168	Parameters set by manufacturer. Do not set.						
	169							
Initial monitor	171	Actual operation hour meter clear	0	—	0	132		
User functions	173	User group 1 registration	0 to 999	1	0	131		
	174	User group 1 deletion	0 to 999, 9999	1	0	131		
	175	User group 2 registration	0 to 999	1	0	131		
	176	User group 2 deletion	0 to 999, 9999	1	0	131		
Terminal (remote I/O) assignment functions	180	(RY4) function selection (Note 4)	0 to 3, 6, 8, 18	1	0	132		
	181	(RY3) function selection (Note 4)	0 to 3, 6, 8, 18	1	1	132		
	182	(RY2) function selection (Note 4)	0 to 3, 6, 8, 18	1	2	132		
	183	MRS terminal (RY9) function selection (Note 4)	0 to 3, 6 to 8, 18	1	6	132		
	190	(RX2) function selection (Note 4)	0 to 99	1	0	134		
	191	(RX6) function selection (Note 4)	0 to 99	1	4	134		
	192	A, B, C terminal (RX7) function selection (Note 4)	0 to 99	1	99	134		
Multi-speed operation	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz	9999	80		
	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz	9999	80		
	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz	9999	80		
	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz	9999	80		
	236	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz	9999	80		
	237	Multi-speed setting (speed 13)	0 to 400Hz, 9999	0.01Hz	9999	80		
	238	Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz	9999	80		
	239	Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz	9999	80		

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer setting
Sub functions	240	Soft-PWM setting	0, 1	1	1	102	
	244	Cooling fan operation selection	0, 1	1	0	135	
	245	Rated motor slip	0 to 50%, 9999	0.01%	9999	136	
	246	Slip compensation response time	0.01 to 10 s	0.01 s	0.5 s	136	
	247	Constant-output region slip compensation selection	0, 9999	1	9999	136	
	249	Ground fault detection at start	0, 1	1	0	137	
Stop selection function	250	Stop selection	0 to 100 s, 1000 to 1100 s, 8888, 9999	1	9999	138	
Additional functions	251	Output phase failure protection selection	0, 1	1	1	139	
	342	E <sup>2</sup> PROM write selection	0, 1	1	0	115	
	500	Communication error execution waiting time	0 to 999.8 s	0.1 s	0	140	
	501	Communication error occurrence count indication	0	1	0	140	
	502	Error-time stop mode selection	0, 1, 2	1	0	140	
Calibration functions	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. The setting depends on the inverter capacity: (0.1K to 3.7K) / (5.5K, 7.5K).  
 3. The rated output currents of the 0.1K to 0.75K are set to 85% of the rated inverter current.  
 4. If "2" is set in Pr. 77 (parameter write inhibit selection), the setting cannot be changed during operation.  
 5. The half-tone screened parameters allow their settings to be changed during operation if "0" (factory setting) has been set in Pr. 77 (parameter write inhibit selection). (However, the Pr. 72 and Pr. 240 values may be changed during PU operation only.)

### 4.1.2 List of parameters classified by purpose of use

Set the 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
	Acceleration/deceleration time/pattern adjustment	Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 29
	Selection of output characteristics optimum for load characteristics	Pr. 14
	Output frequency restriction (limit)	Pr. 1, Pr. 2, Pr. 18
	Operation over 60Hz	Pr. 1, Pr. 18
	Motor output torque adjustment	Pr. 0, Pr. 80
	Brake operation adjustment	Pr. 10, Pr. 11, Pr. 12
	Multi-speed operation	Pr. 4, Pr. 5, Pr. 6, Pr. 24, Pr. 25, Pr. 26, Pr. 27, Pr. 232, Pr. 234, Pr. 235, Pr. 236, Pr. 237, Pr. 238, Pr. 239
	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
Related to application operation	General-purpose magnetic flux vector control operation	Pr. 80
	Electromagnetic brake operation timing	Pr. 42
	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
	Noise reduction	Pr. 72, Pr. 240
Related to monitoring	Display of speed, etc.	Pr. 37, Pr. 52
	Clearing of inverter's actual operation time	Pr. 171
Related to false 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
	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
	Automatic restart operation at alarm stop	Pr. 65, Pr. 67, Pr. 68, Pr. 69
	Start-time ground fault overcurrent protection setting	Pr. 249
	Inverter reset selection	Pr. 75
	Output protection selection	Pr. 251

### 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 overcurrent protection	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.

## 4.2 Parameter Function Details

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

#### Pr. 0 "torque boost"

#### Pr. 46 "second torque boost"

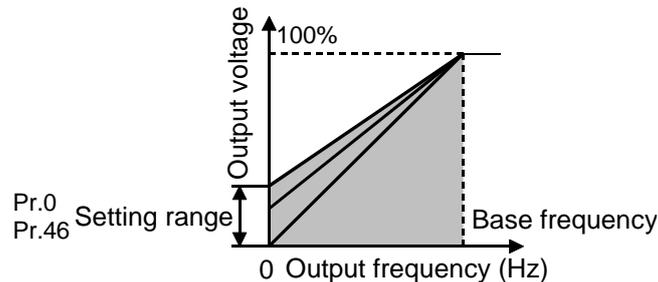
#### Related parameters

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

Increase the setting when the inverter-to-motor distance is long or motor torque in the low-speed range is insufficient, for example;

- 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%	0 to 30%	—
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-E520-0.1KN to 0.75KN ..... 6%  
 FR-E520-1.5KN to 7.5KN ..... 4%  
 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 132 for Pr. 180 to Pr. 183 (input terminal (remote output) function selection).

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

### Pr. 1 "maximum frequency"

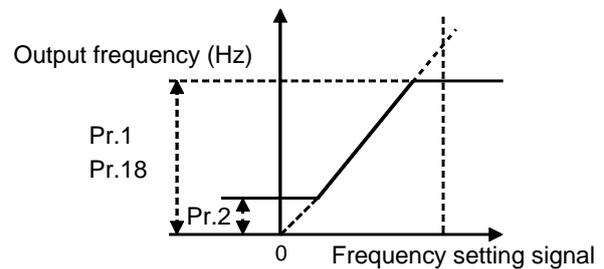
### Pr. 2 "minimum frequency"

### 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.

- 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



#### Related parameters

- Pr. 13 "starting frequency"
- Pr. 79 "operation mode selection"

### <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.

### ! CAUTION

- ! When 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 entering 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)"**

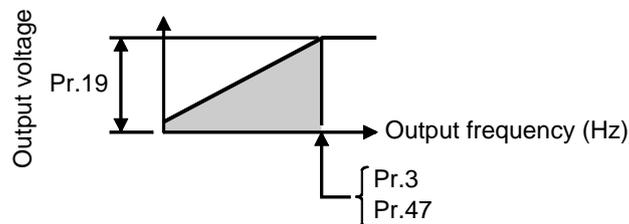
**Related parameters**

- 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 (remote output) 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 commercial power supply-inverter switch-over, 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 9999: Same as power supply voltage
47	9999	0 to 400Hz, 9999	9999: Function invalid



**<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 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 132 for Pr. 180 to Pr. 183 (input terminal (remote output) function selection).

### 4.2.4 Multi-speed operation

(Pr. 4, Pr. 5, 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)"**

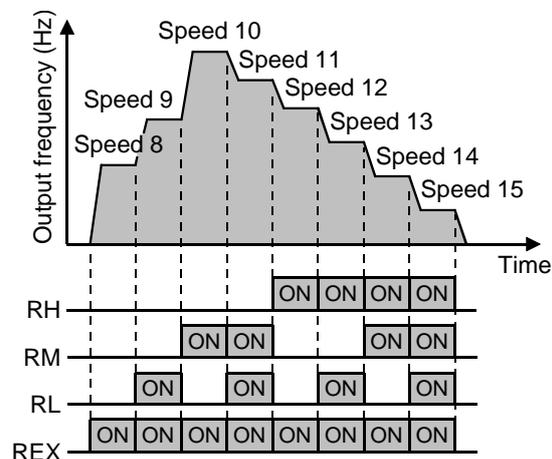
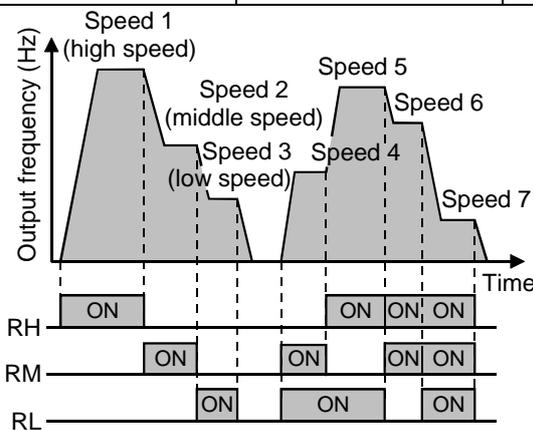
**Related parameters**

- Pr. 1 "maximum frequency"
- Pr. 2 "minimum frequency"
- Pr. 29 "acceleration/deceleration pattern"
- Pr. 79 "operation mode selection"
- Pr. 180 to Pr. 183 (input terminal (remote output) 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 CC-Link operation mode.

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.  
When the parameter unit (FR-PU04) is used, the setting can be changed by pressing the ▲/▼ key after the required multi-speed setting parameter has been read. In this case, when you release the ▲/▼ key, press the  key to store the set frequency.
- Use any of Pr. 180 to Pr. 183 to assign the terminal (remote output) used to input the REX signal.

- Note: 1. The multi-speeds can also be set in the PU or external operation mode.  
 2. For 3-speed setting, if two or three speeds are simultaneously selected, priority is given to the frequency setting of the lower signal.  
 3. Pr. 24 to Pr. 27 and Pr. 232 to Pr. 239 settings have no priority between them.  
 4. The parameter values can be changed during operation.  
 5. When terminal (remote output) assignment is changed using Pr. 180 to Pr. 183, the other functions may be affected. Check the functions of the corresponding terminals (remote output) before making setting.

### 4.2.5 Acceleration 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"

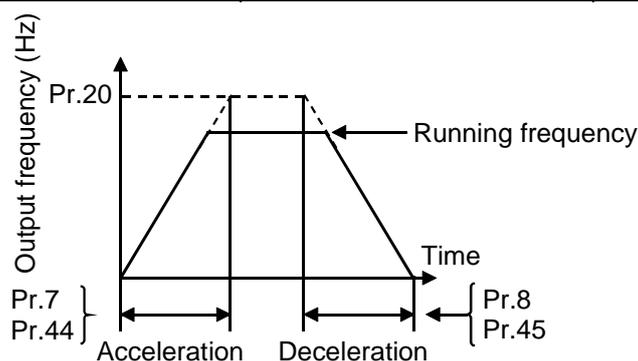
#### Pr. 45 "second deceleration time"

**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		0 to 3600s/0 to 360s	
45	9999		0 to 3600s/ 0 to 360s, 9999	9999: acceleration time = deceleration time



**<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.
- 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.
- 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 89), the set time is the period required to reach the base frequency set in Pr. 3.

- Acceleration/deceleration time calculation expression when the set frequency is the base frequency or higher

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

T: Acceleration/deceleration time setting(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. When the setting of Pr. 7, Pr. 8, Pr. 44 or Pr. 45 is "0", the acceleration/ deceleration time is 0.04 seconds. At this time, set 120Hz or less in Pr. 20.
3. When the RT signal is on, the other second functions such as second torque boost are also selected.
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 (inertia moment) and motor torque.

## 4.2.6 Electronic overcurrent protection (Pr. 9, Pr. 48)

### Pr. 9 "electronic overcurrent protection"

### Pr. 48 "second electronic overcurrent protection"

#### Related parameter

Pr. 71 "applied motor"  
Pr. 180 to Pr. 183  
(input terminal (remote output) function selection)

Set the current of the electronic overcurrent protection 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 output 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.)
- Setting "0" makes the electronic overcurrent protection (motor protective function) invalid. (The inverter's protective function is valid.)
- When Mitsubishi's constant-torque motor is used, set "1" in Pr. 71 to select the 100% continuous torque characteristic in the low speed range. Then, set the rated motor current in Pr. 9.
- Pr. 48 "Second electronic overcurrent protection" 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 overcurrent protection will be deteriorated. In this case, use an external thermal relay.

3. A special motor cannot be protected by the electronic overcurrent protection. 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 132 for Pr. 180 to Pr. 183 (input terminal (remote output) function selection).

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

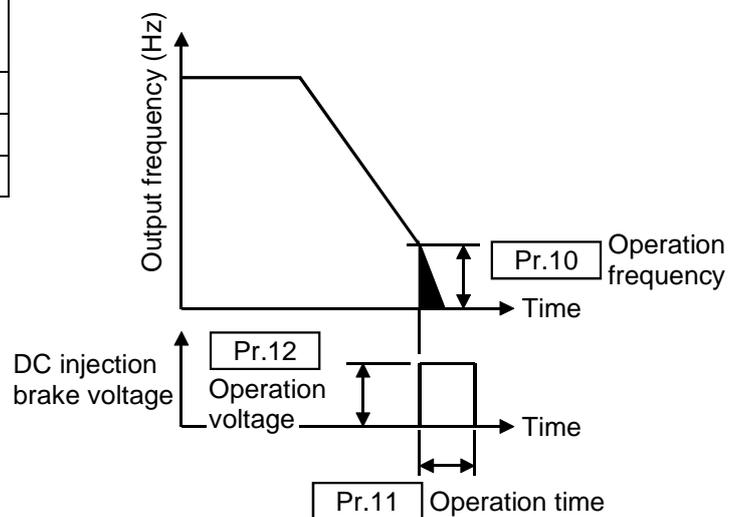
### Pr. 10 "DC injection brake operation frequency"

### 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	0.5 s	0 to 10 s
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 to 4% when using the inverter-dedicated (constant-torque motor). (Note)

Note: If you leave Pr. 12 as factory-set and change Pr. 71 to the setting for use of the constant-torque motor, the Pr. 12 setting is automatically changed to 4%.

### **! CAUTION**

**! Install a mechanical brake. No holding torque is provided.**

### 4.2.8 Starting frequency (Pr. 13)

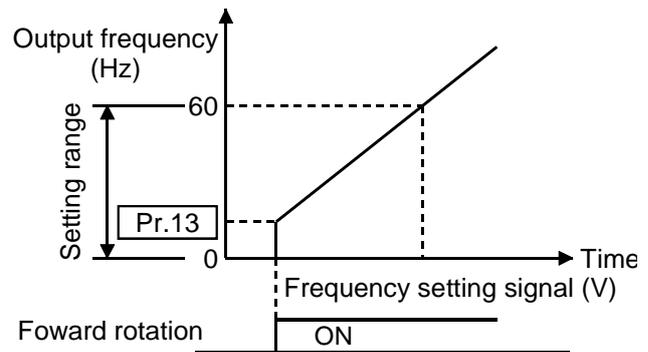
#### Pr. 13 "starting frequency"

**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**

**! When the Pr. 13 setting is equal to or less than the Pr. 2 value, note that merely switching on the start signal will start the motor at the preset frequency if the command frequency is not input.**

### 4.2.9 Load pattern selection (Pr. 14)

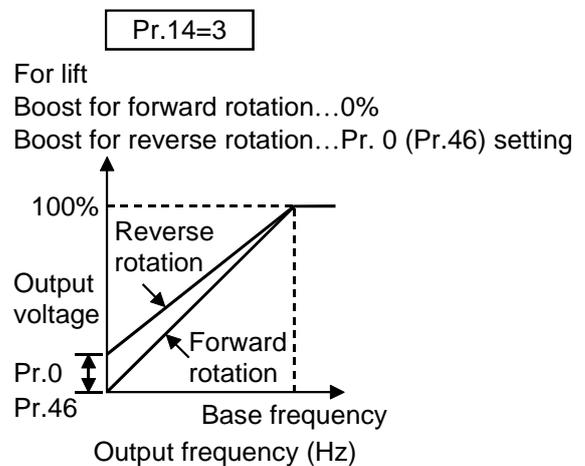
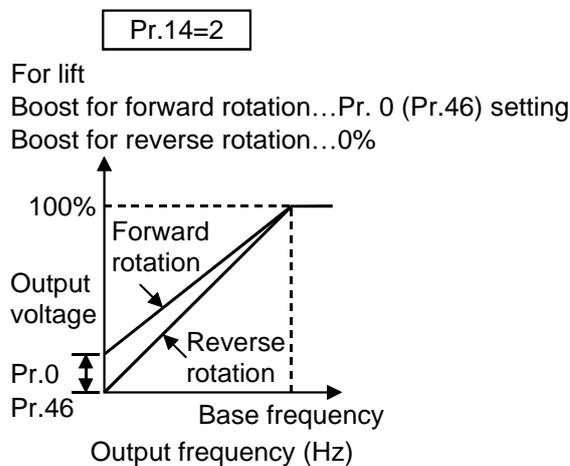
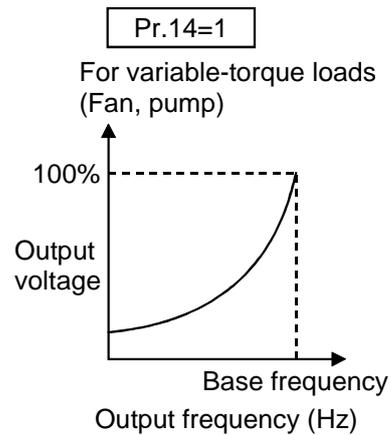
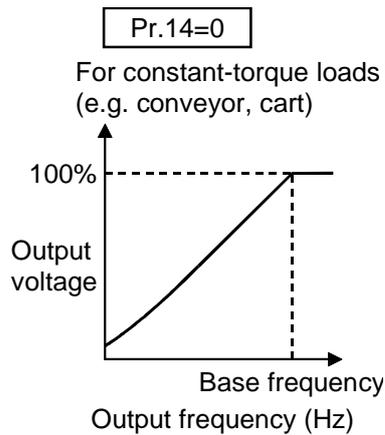
#### Pr. 14 "load pattern selection"

**Related parameters**

Pr. 0 "torque boost"  
Pr. 46 "second torque boost"  
Pr. 80 "motor capacity"  
Pr. 180 to Pr. 183  
(input terminal (remote output) 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



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 132 for Pr. 180 to Pr. 183 (input terminal (remote output) function selection).

**Pr. 18 → Refer to Pr. 1, Pr. 2.**

**Pr. 19 → Refer to Pr. 3.**

**Pr. 20, Pr. 21 → Refer to Pr. 7, Pr. 8.**

## 4.2.10 Stall prevention (Pr. 22, Pr. 23, Pr. 66)

### Pr. 22 "stall prevention operation level"

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

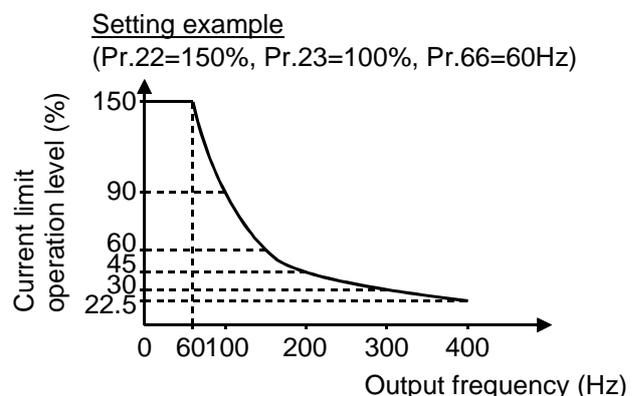
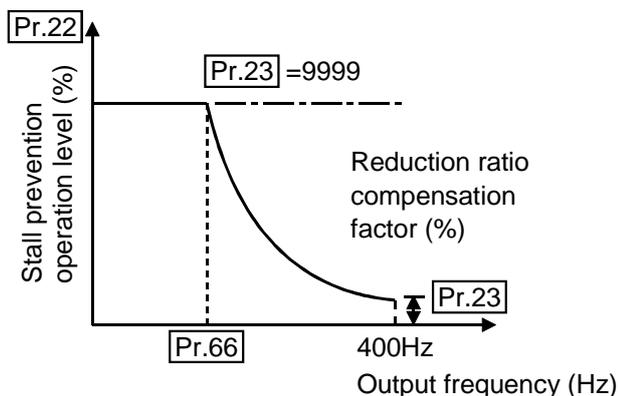
### Pr. 66 "stall prevention operation level reduction starting frequency"

- Set the output current level at which the output frequency is adjusted to prevent the inverter from coming to an alarm stop due to overcurrent or the like.
- 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.

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	



## &lt;Setting&gt;

- 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.

Calculation expression for stall prevention operation level

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

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

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

Note: 1. When the fast-response current limit has been set in Pr. 156 (factory setting), do not set the Pr. 22 value to 170% or more.

Torque will not be developed by doing so.

2. 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.**

### 4.2.11 Acceleration/deceleration pattern (Pr. 29)

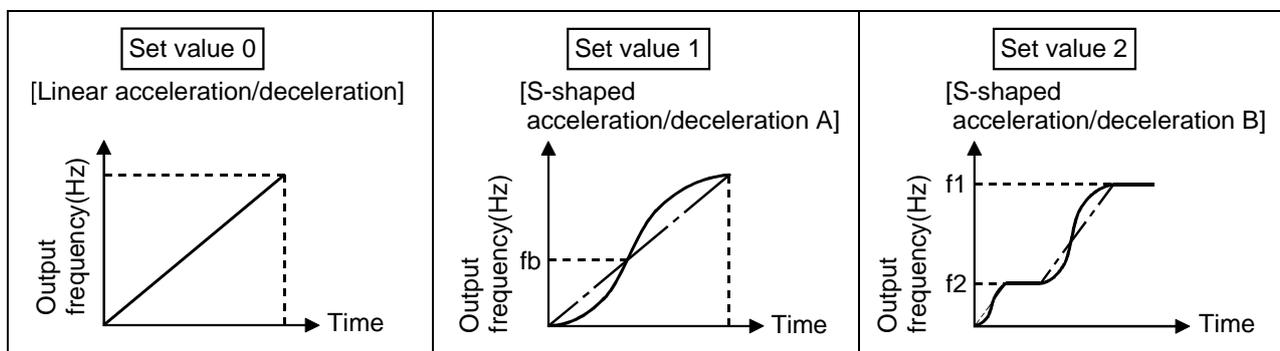
#### Pr. 29 "acceleration/deceleration pattern"

#### 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"

Set the acceleration/deceleration pattern.

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



#### <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. For details, refer to Pr. 7 and Pr. 8.

## 4.2.12 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), brake unit, high power factor converter

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

#### (2) When using the brake resistors (2 MYs 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 "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.

### 4.2.13 Frequency jump (Pr. 31 to Pr. 36)

#### Pr. 31 "frequency jump 1A"

#### Pr. 32 "frequency jump 1B"

#### Pr. 33 "frequency jump 2A"

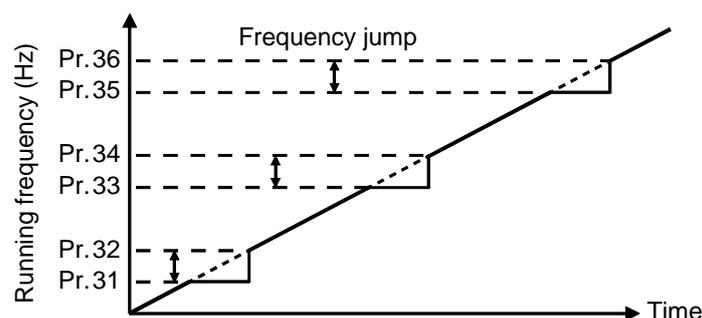
#### Pr. 34 "frequency jump 2B"

#### Pr. 35 "frequency jump 3A"

#### Pr. 36 "frequency jump 3B"

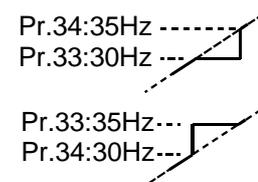
- When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped. Up to three areas may be set, with the jump frequencies set to either the top or bottom point of each area.
- The value set to 1A, 2A or 3A is 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: 1. During acceleration/deceleration, the running frequency within the set area is valid.

## 4.2.14 Speed display (Pr. 37)

### Pr. 37 "speed display"

#### Related parameter

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

The unit of the output frequency display of the control 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

### <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. Refer to Pr. 52 when you want to change the parameter unit (FR-PU04) monitor (PU main display).  
 3. 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.  
 4. 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.**

### 4.2.15 Up-to-frequency sensitivity (Pr. 41)

#### Pr. 41 "up-to-frequency sensitivity"

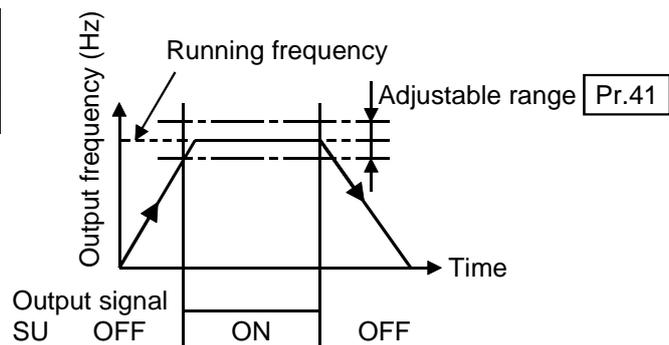
The ON range of the up-to-frequency signal (SU) output when the output frequency reaches the running frequency can be adjusted between 0 and  $\pm 100\%$  of the running frequency.

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.

#### Related parameters

- Pr. 190 "(RX2) function selection"
- Pr. 191 "(RX6) function selection"
- Pr. 192 "A, B, C terminal (RX7) function selection"

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



- Use any of Pr. 190 to Pr. 192 to allocate the terminal (remote input) used for SU signal output.
- Refer to page 134 for Pr. 190 to Pr. 192 (output terminal (remote input) function selection).

Note: When terminal (remote input) assignment is changed using Pr. 190 to Pr. 192, the other functions may be affected. Check the functions of the corresponding terminals (remote input) before making setting.

### 4.2.16 Output frequency detection (Pr. 42, Pr. 43)

#### Pr. 42 "output frequency detection"

#### Pr. 43 "output frequency detection for reverse rotation"

#### Related parameters

- Pr. 190 "(RX2) function selection"
- Pr. 191 "(RX6) function selection"
- Pr. 192 "A, B, C terminal (RX7) 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 detection of the frequency 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.

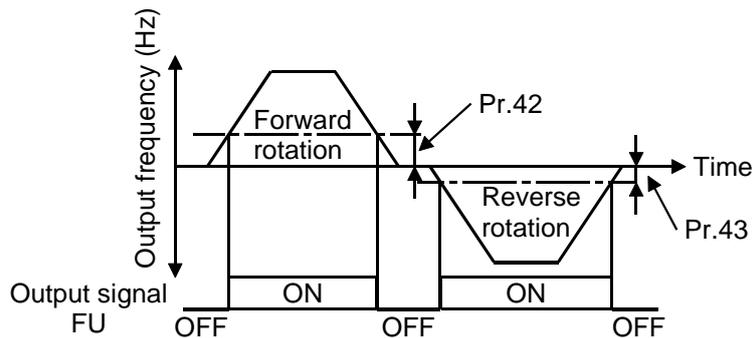
Parameter Number	Factory Setting	Setting Range	Remarks
42	6Hz	0 to 400Hz	
43	9999	0 to 400Hz, 9999	9999: Same as Pr. 42 setting

**<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 (remote input) function selection). Refer to page 134 for Pr. 190 to Pr. 192 (output terminal (remote input) function selection)

Output signal



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.**

**4.2.17 Monitor display (Pr. 52)**

**Pr. 52 "PU main display data selection"**

**Related parameters**  
Pr. 37 "speed display"  
Pr. 171 "actual operation hour meter clear"

You can select the parameter unit (FR-PU04) main display screen.

Parameter Number	Factory Setting	Setting Range
52	0	0, 23, 100

**<Setting>**

Set Pr. 52 in accordance with the following table:

Signal Type	Unit	Parameter Setting
		Pr. 52
		PU main monitor
Output frequency	Hz	0/100
Output current	A	0/100
Output voltage	—	0/100
Alarm display	—	0/100
Actual operation time	10h	23

When 100 is set in Pr. 52, the monitored values during stop and during operation differ as indicated below:

	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 SHIFT key.  
 3. 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.  
 4. 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.  
 5. The actual operation time is not calculated if the inverter has not operated for more than 1 hour continuously.

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

#### Pr. 57 "restart coasting time"

#### Pr. 58 "restart cushion time"

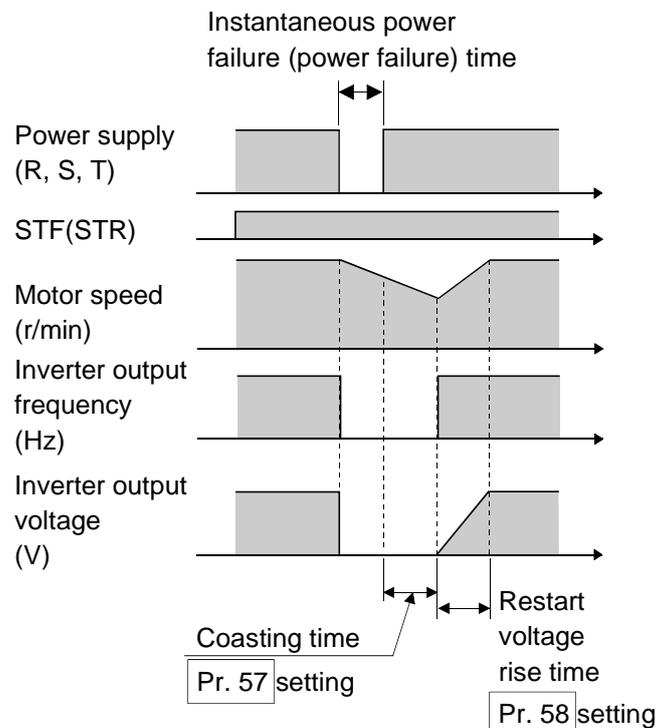
- You can restart the inverter without stopping the motor (with the motor coasting) when power is restored after an instantaneous power failure.

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	0.5 s coasting time	Generally use this setting.
		2.2K to 7.5K	1.0 s 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 inertia moment J and torque of the load.)		
	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 (inertia moment, torque).		



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, 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  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.**

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

**Pr. 60 "shortest acceleration/deceleration mode"**

**Pr. 61 "reference I for intelligent mode"**

**Pr. 62 "reference I for intelligent mode acceleration"**

**Pr. 63 "reference I for intelligent mode deceleration"**

**Related parameters**

- Pr. 7 "acceleration time"
- Pr. 8 "deceleration time"

The inverter automatically sets appropriate parameters 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 to start operation immediately without making fine parameter settings.

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 1>**

Pr. 60 Setting	Operation Mode	Description	Automatically Set Parameters
0	Ordinary operation mode	_____	_____
1, 2, 11, 12	Shortest acceleration/ deceleration mode	<p>Set to accelerate/decelerate the motor in the shortest time.                      The inverter makes acceleration/deceleration in the shortest time using its full capabilities. During deceleration, an insufficient brake capability may cause the regenerative overvoltage alarm (E.OV3).</p> <p>"1" : Stall prevention operation level 150%                      "2" : Stall prevention operation level 180%                      "11": Stall prevention operation level 150% when brake resistor or brake unit is used                      "12": Stall prevention operation level 180% when brake resistor or brake unit is used</p>	Pr. 7, Pr. 8

**<Setting 2>**

- Set these parameters to improve performance in the intelligent mode.

**(1) Pr. 61 "reference I for intelligent mode"**

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

**(2) Pr. 62 "reference I for intelligent mode acceleration"**

The reference current setting can be changed.

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 I for intelligent mode deceleration"**

The reference current setting can be changed.

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.

Note: Pr. 61 to Pr. 63 are only valid when any of "1, 2, 11, 12" are selected for Pr. 60.

## 4.2.20 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 360 s
69	0	0

### <Setting>

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

Errors Reset for Retry		Setting			
Function name		0	1	2	3
Overcurrent shut-off	During acceleration (OC1)	●	●		●
	During constant speed (OC2)	●	●		●
	During deceleration (OC3) During stop	●	●		●
Regenerative overvoltage shut-off	During acceleration (OV1)	●		●	●
	During constant speed (OV2)	●		●	●
	During deceleration (OV3) During stop	●		●	●
Overload shut-off (Electronic overcurrent protection)	Motor (THM)	●			
	Inverter (THT)	●			
Fin overheat (FIN)					
Brake transistor fault detection (BE)		●			
Output side ground fault overcurrent protection (GF)		●			
Output phase failure protection (LF)					
External thermal relay operation (OHT)		●			
Power limit stall prevention (OLT)		●			
Communication error (OPT)		●			
Parameter error (PE)		●			
PU disconnection occurrence (PUE)					
Retry count exceeded (RET)					
CPU error (CPU)					
Option fault (E. 3)					

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 360 seconds.
- Reading the Pr. 69 value provides the cumulative number of successful restart times made by retry. The setting of "0" erases the cumulative number of times.

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 control 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 over current protection, 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 seals in easily visible places.**

**Pr. 66 → Refer to Pr. 22.**

**Pr. 70 → Refer to Pr. 30.**

## 4.2.21 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 overcurrent protection is set to the thermal characteristic of the constant-torque motor.

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 Overcurrent Protection		Applied motor		
			Standard	Constant-Torque	
0, 100	Thermal characteristics matching a standard motor		○		
1, 101	Thermal characteristics matching the 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 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				○

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

RT Signal	Electronic Overcurrent Protection Thermal Characteristic (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.**

## 4.2.22 PWM carrier frequency (Pr. 72, Pr. 240)

### Pr. 72 "PWM frequency selection"

### Pr. 240 "Soft-PWM setting"

You can change the motor tone.

- By parameter setting, you can select Soft-PWM control which changes the motor tone.
- Soft-PWM control changes motor noise from a metallic tone into an unoffending complex tone.

Parameter Number	Factory Setting	Setting Range	Remarks
72	1	0 to 15	0 : 0.7kHz, 15 : 14.5kHz
240	1	0, 1	1: Soft-PWM valid

### <Setting>

- Refer to the following list and set the parameters:

Parameter Number	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.
240	0	Soft-PWM invalid
	1	When any of "0 to 5" is set in Pr. 72, Soft-PWM is made valid.

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 166.)

2. An increased PWM frequency will decrease motor noise but noise and leakage current will increase. Take proper action (refer to pages 36 to 40).

## 4.2.23 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 (FR-PU04) connector disconnection detection function and stop function.

- Reset selection : You can select the reset function input timing.
- PU disconnection detection : When it is detected that the control panel/PU (FR-PU04) is disconnected from the inverter for more than 1 second, 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  key.

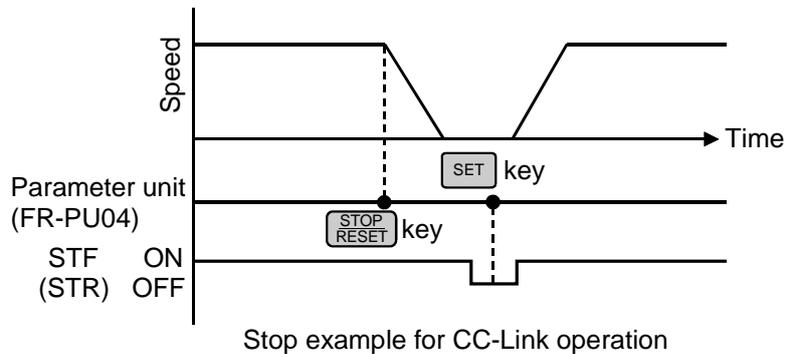
Parameter Number	Factory Setting	Setting Range
75	14	0 to 3, 14 to 17

### <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  key decelerates the inverter to a stop only in the PU operation mode.
1	Reset input enabled only when the protective function is activated.		
2	Reset input normally enabled.	When the PU is disconnected, an error is displayed on the PU and the inverter output is shut off.	Pressing the  key decelerates the inverter to a stop in either of the PU and CC-Link operation modes.
3	Reset input enabled only when the protective function is activated.		
14	Reset input normally enabled.	If the PU is disconnected, operation will be continued.	Pressing the  key decelerates the inverter to a stop in either of the PU and CC-Link operation modes.
15	Reset input enabled only when the protective function is activated.		
16	Reset input normally enabled.	When the PU is disconnected, an error is displayed on the PU and the inverter output is shut off.	Pressing the  key decelerates the inverter to a stop in either of the PU and CC-Link operation modes.
17	Reset input enabled only when the protective function is activated.		

## How to make a restart after a stop by the key on the PU

- Parameter unit (FR-PU04)
  - 1) After completion of deceleration to a stop, switch off the STF or STR signal.
  - 2) Press the  key.
  - 3) Switch on the STF or STR signal.



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. By entering the reset signal (RES) during operation, the inverter shuts off output while it is reset, the data of the electronic overcurrent protection 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 1 second. 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 on the PU 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.**

## 4.2.24 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, 2

### <Setting>

Pr. 77 Setting	Function
0	Parameter values may only be written while the inverter is at a stop in the PU or CC-Link operation mode. (Note 1)
2	Write enabled even while the inverter is running.

- Note: 1. The parameters half-tone screened in the parameter list can be set at any time.
- 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.
  - When the parameter unit (FR-PU04) is used, setting "1" in Pr. 77 can inhibit parameter write. At this time, values may be written to Pr. 75, Pr. 77 and Pr. 79.  
Parameter clear and parameter all clear are also be inhibited.

## 4.2.25 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 parameter is valid for both the PU and CC-Link 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

## 4.2.26 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. 180 to Pr. 183 (input terminal  
(remote output) function  
selection)

Used to select the operation mode of the inverter.

The inverter can be run from the parameter unit (PU operation) or by operation via CC-Link (CC-Link operation).

At power-on (factory setting), the CC-Link operation mode is selected.

Parameter Number	Factory Setting	Setting Range
79	2	0 to 2

### <Setting>

In the following table, operation from the parameter unit is abbreviated to PU operation.

Pr. 79 Setting	Function		
0	At power-on, the CC-Link operation mode is selected. Pressing the <input type="button" value="PU"/> , <input type="button" value="EXT"/> key on the parameter unit switches between the PU operation mode (PU) and CC-Link operation mode (NET). For these modes, refer to the settings 1 and 2.		
1	Operation mode	Running frequency	Start signal
	PU operation mode (PU)	Digital setting by key operation of parameter unit	<input type="button" value="FWD"/> , <input type="button" value="REV"/> key of parameter unit
2	CC-Link operation mode (NET)	CC-Link master unit	

## 4.2.27 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	9999: V/F control

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 used in Pr. 80.

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

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

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

**Pr. 82 "motor exciting 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 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 control panel or PU (FR-PU04).
  - Only a static auto tune can be performed.
  - Office auto tuning is available only when the motor is at a stop.
- Tuning data (motor constants) can be copied to another inverter with the PU (FR-PU04).

Parameter Number	Factory Setting	Setting Range	Remarks
82	9999	0 to 500A, 9999	9999: Mitsubishi standard motor
83	200V	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 motor and high-speed motor 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.

**<Setting>**

**(1) Parameter setting**

- 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.  
 Set the value given on the motor rating plate. If a standard motor etc., has more than one rated value, set the value of 200V/60Hz.  
 After tuning is over, set the Pr. 9 "electronic overcurrent protection" 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 overcurrent protection characteristics are also selected simultaneously. By setting any of "100 to 123", the electronic overcurrent protection changes to the thermal characteristic of the constant-torque motor when the RT signal switches on.

**(2) Tuning execution**

- For PU operation, press the **FWD** or **REV** key.
- For CC-Link operation, 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  
MRS, RES, STF, STR
- Output signals  
RUN, 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

- For confirmation on the CC-Link master unit, check the Pr. 96 setting.  
1: setting, 2: tuning in progress, 3: completion, 8: forced end, 9: error-activated end
- When the parameter unit (FR-PU04) is used, the Pr. 96 value is displayed during tuning on the main monitor as shown below:

- 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 10 seconds.

### (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, press the  key. For CC-Link operation, 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.)

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**

A forced end occurs when you forced the tuning to end during tuning by switching off the start signal (STF or STR) once in CC-Link operation or by pressing the  key in PU operation.

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 in 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:

		<b>Star Connection Motor</b>	<b>Delta Connection Motor</b>
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 overcurrent protection 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 exciting 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:

<b>Parameter Number</b>	<b>Name</b>	<b>Setting Range</b>	<b>Setting Increments</b>	<b>Factory Setting</b>
82	Motor exciting current	0 to 500A, 9999	0.01A	9999
90	Motor constant (R1)	0 to 10Ω, 9999	0.001Ω	9999

4. Return the Pr. 77 setting to the original value.

5. Refer to the following table and set Pr. 84:

<b>Parameter Number</b>	<b>Name</b>	<b>Setting Range</b>	<b>Setting Increments</b>	<b>Factory Setting</b>
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.

## **4.2.29 Computer link operation (Pr. 117 to Pr. 124, Pr. 342)**

**Pr. 117 "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 presence/absence selection"**

**Pr. 342 "E<sup>2</sup>PROM write selection"**

Used to perform required settings for RS-485 communication between the inverter and personal computer.

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

Communication specifications

Conforming standard		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
		Sumcheck	Present
Waiting time setting		Selectable between presence and absence	

- For the data codes of the parameters, refer to Appendix 1 "Data Code List (page 173).

### **REMARKS**

For computer link operation, set 65520 (FFF0H) as the value "8888" and 65535 (FFFFH) as the value "9999".

<b>Parameter Number</b>	<b>Factory Setting</b>	<b>Setting Range</b>
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 10, 9999
122*	0	0 to 999.8 s, 9999
123	9999	0, 0.1 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, the communication specifications must be set to the inverter initially. 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.

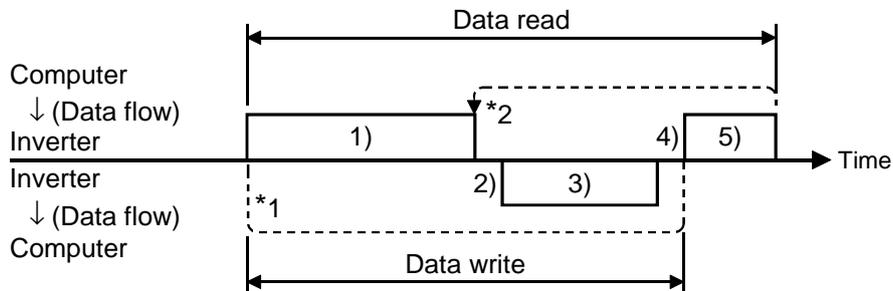
Parameter Number	Name	Setting	Description	
117	Station number	0 to 31	Station number specified for communication from the PU connector. Set the inverter station numbers when two or more inverters are connected to one personal computer.	
118	Communication speed	48	4800bps	
		96	9600bps	
		192	19200bps	
119	Stop bit length/data length	8 data 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 (0H to 5H), the light fault signal (LF) is switched on. Allocate the used terminal with any of Pr. 190 to Pr. 192 (Output (remote input) function selection).	
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 between data transmission to the inverter and response.	
		9999	Set with communication data.	
124	CR, LF instruction presence/absence	0	Without CR/LF	
		1	With CR	
		2	With CR/LF	
342*	E <sup>2</sup> PROM write selection	0	When parameter write is performed from the computer, parameters are written to E <sup>2</sup> PROM.	
		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<sup>2</sup>PROM.  
When the parameter values will be changed frequently, set "1" in Pr. 342 to choose write to RAM.

<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 120.)

Note 1. When any of "0.01 to 9998" is set in Pr. 37 "speed display" and "1" in data code "FFH", the data format is always A" or E" regardless of the data code "FFH" setting. The output frequency is the value of the speed display and its unit is 0.001r/min. If the data 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

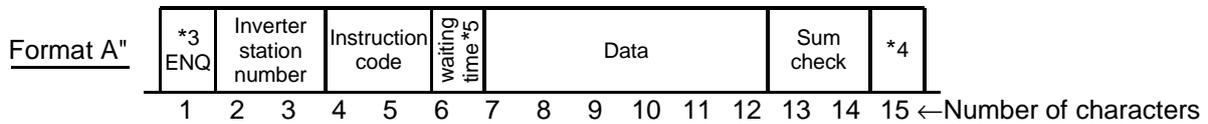
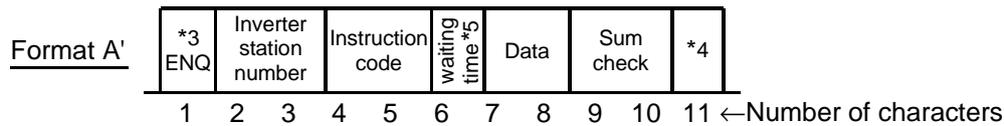
Data used is hexadecimal.

Data is automatically transferred in ASCII between the computer and inverter.

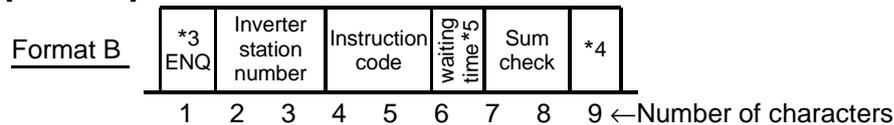
- Data format types

- 1) Communication request data from computer to inverter

[Data write]



[Data read]



Note: 1. The inverter station numbers may be set between 00H and 1FH (stations 0 and 31) in hexadecimal.

2. \*3 indicates the control code.

3. \*4 indicates the CR or LF code.

When data is transmitted from the computer to the inverter, codes CR (carriage return) and LF (line feed) 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.

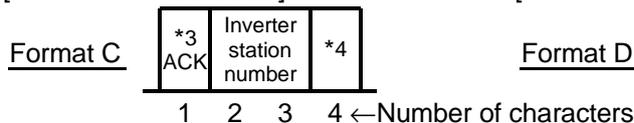
Also, the presence and absence of the CR and LF codes can be selected using Pr. 124.

4. At \*5, when Pr. 123 "waiting time setting" ≠ 9999, create the communication request data without "waiting time" in the data format.

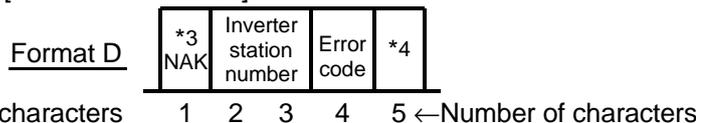
(The number of characters is decremented by 1.)

- 2) Reply data from inverter to computer during data write

[No data error detected]

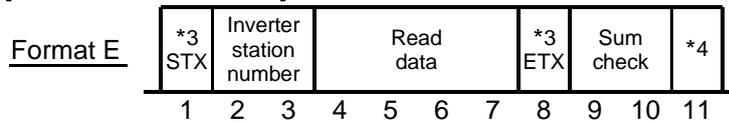


[Data error detected]

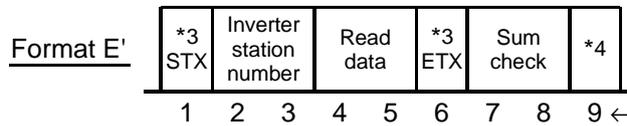


3) Reply data from inverter to computer during data read

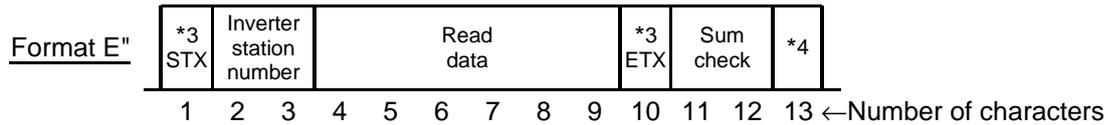
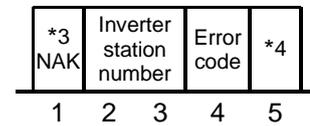
[No data error detected]



[Data error detected]

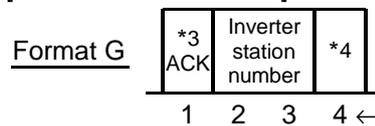


**Format F**

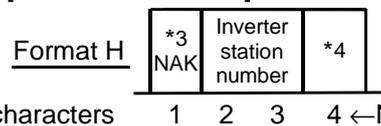


4) Send data from computer to inverter during data read

[No data error detected]



[Data error detected]



**(4) Data definitions**

1) Control codes

Signal	ASCII Code	Description
STX	02H	Start of Text (Start of data)
ETX	03H	End of Text (End of data)
ENQ	05H	Enquiry (Communication request)
ACK	06H	Acknowledge (No data error detected)
LF	0AH	Line Feed
CR	0DH	Carriage Return
NAK	15H	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, 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 58.)

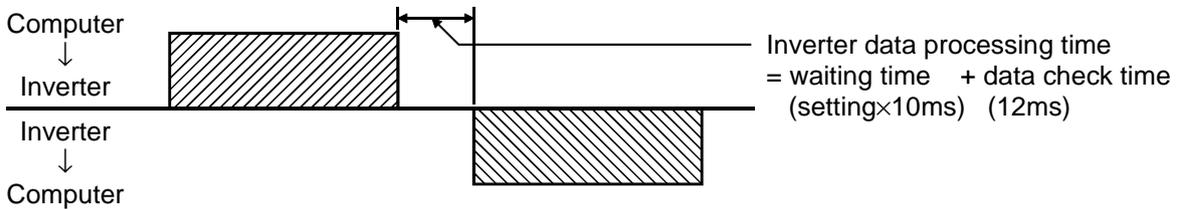
4) Data

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 173.)

5) Waiting time

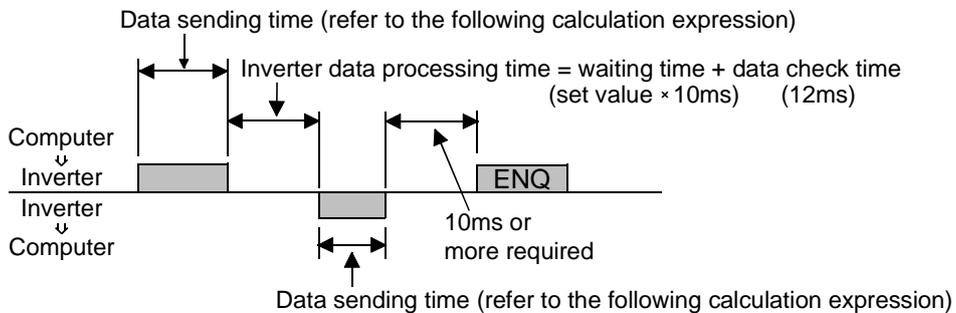
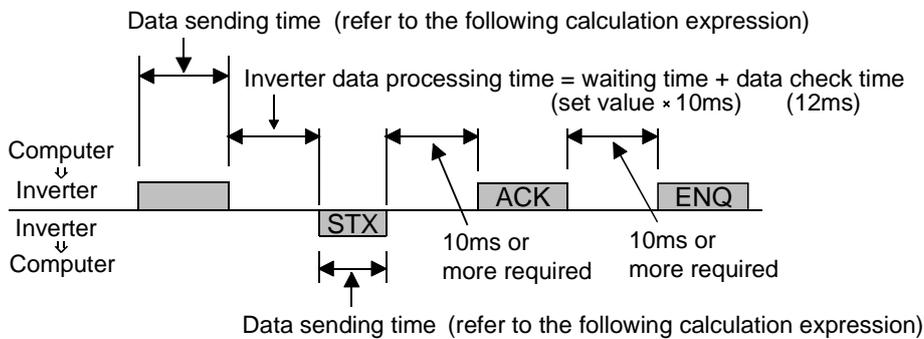
Specify the waiting time between the receipt of data at the inverter from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments

(e.g. 1 = 10ms, 2 = 20ms).



Note: If the Pr. 123 "waiting time setting" value is not 9999, create the communication request data with no "waiting time" in the data format. (The number of characters is decremented by 1.)

6) Response time



[Data sending time calculation expression]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters (Refer to page 118)} \times \text{Communication specification (Total number of bits) (See below)} = \text{Data sending time (s)}$$

● 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 bits

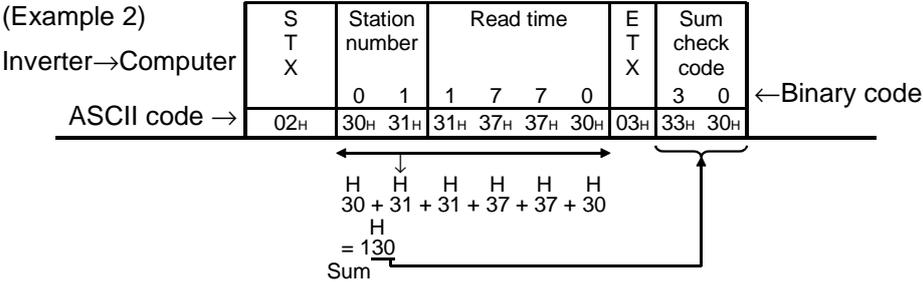
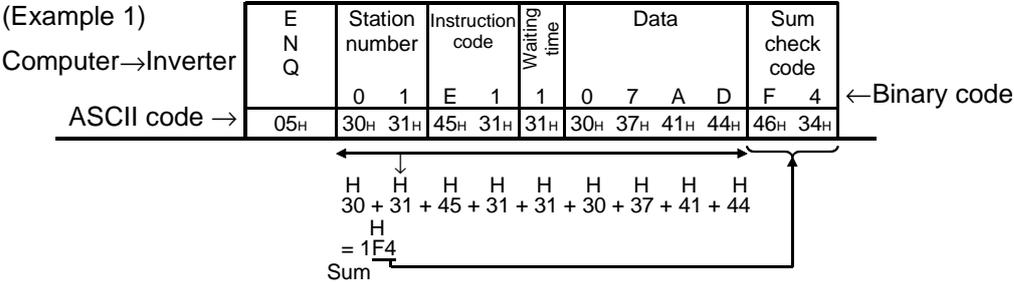
In addition to the bits in the above table, 1 bit is required for the start bit.

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 125.)

- 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 accessing the parameter settings, data for link parameter expansion setting differs between the parameters as indicated below:

		Instruction Code	Data
Link parameter expansion setting	Read	7FH	00H: Pr. 0 to Pr. 96 values are accessible. 01H: Pr. 100 to Pr. 156 values are accessible. 02H: Pr. 160 to Pr. 192 and Pr. 232 to Pr. 251 values are accessible.
	Write	FFH	03H: Pr. 342 values are accessible. 05H: Pr. 500 to Pr. 502 values are accessible. 09H: Pr. 990, Pr. 991 values are accessible.

 **CAUTION**

-  **When the inverter's permissible communication 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.**



No.	Item	Instruction Code	Description	Number of Data Digits																									
4	Inverter status monitor	7AH	<div style="display: flex; justify-content: space-between; align-items: center;"> <span>b7</span> <span>b0</span> </div> <table border="1" style="margin: 0 auto; text-align: center;"> <tr> <td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td> </tr> </table> <p style="text-align: center;">(For example 1)</p> <p>[Example 1] 02H...During forward rotation</p> <p>[Example 2] 80H...Stop due to alarm</p> <div style="margin-left: 20px;">                     b0: Inverter running (RUN)                      b1: Forward rotation                      b2: Reverse rotation                      b3: Up to frequency (SU)                      b4: Overload (OL)                      b5: _____                      b6: Frequency detection (FU)                      b7: Alarm occurrence                 </div>	0	0	0	0	0	0	1	0	2 digits																	
0	0	0	0	0	0	1	0																						
5	Set frequency read (E <sup>2</sup> PROM)	6EH	Reads the set frequency (RAM or E <sup>2</sup> PROM). 0000H to 9C40H: 0.01Hz increments (hexadecimal)	4 digits																									
	Set frequency read (RAM)	6DH																											
	Set frequency write (E <sup>2</sup> PROM)	EEH	0000H to 9C40H: 0.01Hz increments (hexadecimal) (0 to 400.00Hz) To change the set frequency consecutively, write data to the inverter RAM. (Instruction code: EDH)	4 digits																									
	Set frequency write (RAM)	EDH																											
6	Inverter reset	FDH	9696H: 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.	4 digits																									
7	Alarm definition batch clear	F4H	9696H: Batch clear of alarm history	4 digits																									
8	All parameter clear	FCH	All parameters return to the factory settings. Any of four different all clear operations is performed according to the data. <table border="1" style="margin: 10px auto; text-align: center;"> <thead> <tr> <th>Data \ Pr.</th> <th>Communication Pr.</th> <th>Calibration</th> <th>Other Pr.*</th> <th>EC<sub>H</sub> FF<sub>H</sub></th> </tr> </thead> <tbody> <tr> <td>9696H</td> <td>○</td> <td>×</td> <td>○</td> <td>○</td> </tr> <tr> <td>9966H</td> <td>○</td> <td>○</td> <td>○</td> <td>○</td> </tr> <tr> <td>5A5AH</td> <td>×</td> <td>×</td> <td>○</td> <td>○</td> </tr> <tr> <td>55AAH</td> <td>×</td> <td>○</td> <td>○</td> <td>○</td> </tr> </tbody> </table> When all parameter clear is executed for 9696H or 9966H, communication-related parameter settings also return to the factory settings. When resuming operation, set the parameters again. * Pr. 75 is not cleared.	Data \ Pr.	Communication Pr.	Calibration	Other Pr.*	EC <sub>H</sub> FF <sub>H</sub>	9696H	○	×	○	○	9966H	○	○	○	○	5A5AH	×	×	○	○	55AAH	×	○	○	○	4 digits
Data \ Pr.	Communication Pr.	Calibration	Other Pr.*	EC <sub>H</sub> FF <sub>H</sub>																									
9696H	○	×	○	○																									
9966H	○	○	○	○																									
5A5AH	×	×	○	○																									
55AAH	×	○	○	○																									
9	Parameter write	80H to FDH	Refer to the "Data Code List" (page 173) and write and/or read parameter values as required.	4 digits																									
10	Parameter read	00H to 7BH																											
11	Link parameter expansion setting	Read	7FH	00H to 6CH and 80H to EC <sub>H</sub> parameter values are changed. 00H: Pr. 0 to Pr. 96 values are accessible. 01H: Pr. 100 to Pr. 156 values are accessible. 02H: Pr. 160 to Pr. 192 and Pr. 232 to Pr. 251 values are accessible. 03H: Pr. 342 values are accessible. 05H: Pr. 500 to Pr. 502 values are accessible. 09H: Pr. 990, Pr. 991 values are accessible.	2 digits																								
		Write	FFH																										

**REMARKS**

For the instruction code FFH, its 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:

<b>Error Code</b>	<b>Item</b>	<b>Definition</b>	<b>Inverter Operation</b>
0H	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.
1H	Parity error	The parity check result does not match the specified parity.	
2H	Sum check error	The sum check code in the computer does not match that of the data received by the inverter.	
3H	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.	
4H	Framing error	The stop bit length is not as specified by initialization.	
5H	Overrun error	New data has been sent by the computer before the inverter completes receiving the preceding data.	
6H	————	————	————
7H	Character error	The character received is invalid (other than 0 to 9, A to F, control code).	Does not accept received data but is not brought to alarm stop.
8H	————	————	————
9H	————	————	————
AH	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 alarm stop.
BH	Instruction code error	The specified command does not exist.	
CH	Data range error	Invalid data has been specified for parameter write, frequency setting, etc.	
DH	————	————	————
EH	————	————	————
FH	————	————	————

**(5) Communication specifications for RS-485 communication**

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

(\*1) As set in Pr. 75.

(\*2) As set in Pr. 77.

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

**(6) Operation at alarm occurrence**

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

### 4.2.30 Output current detection function (Pr. 150, Pr. 151)

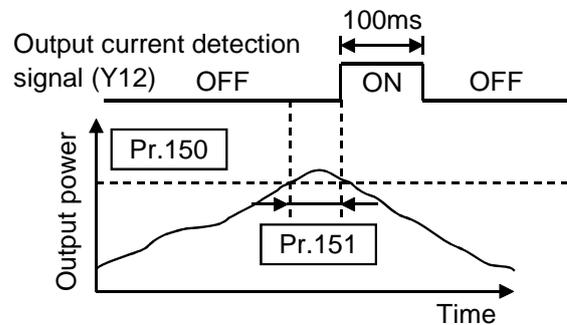
**Pr. 150 "output current detection level"**

**Pr. 151 "output current detection time"**

**Related parameters**  
 Pr. 190 to Pr. 192  
 (output terminal (remote input) 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.  
 (Use any of Pr. 190 to Pr. 192 to assign the terminal (remote input) 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 time. 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. The output current detection signal is held on for at least about 100ms if it switches on once when the output current rises to or above the preset detection level.  
 2. This function is also valid during execution of offline auto tuning.  
 3. When the terminal (remote input) functions are changed using Pr. 190 to Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals (remote input) before making setting.

### 4.2.31 Zero current detection (Pr. 152, Pr. 153)

#### Pr. 152 "zero current detection level"

#### Pr. 153 "zero current detection time"

#### Related parameters

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

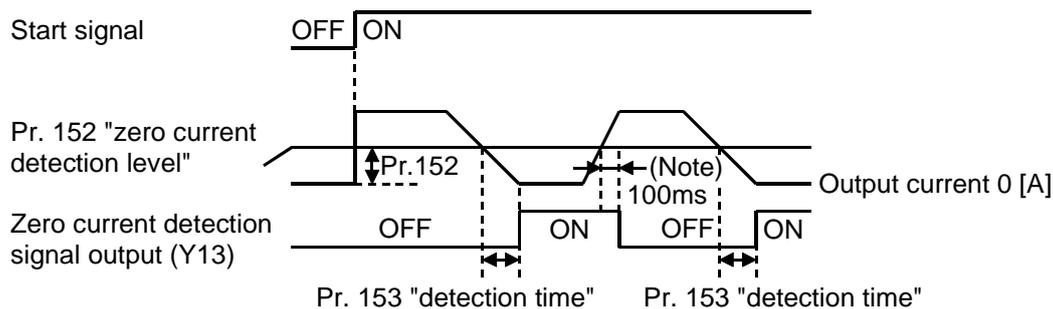
When the inverter's output current falls to "0", torque will not be generated. This may cause a gravity drop when the inverter is used in vertical lift application.

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.

(Use any of Pr. 190 to Pr. 192 to assign the terminal (remote input) 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 and the 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 (remote input) functions are changed using Pr. 190 to Pr.192, the other functions may be affected. Confirm the functions of the corresponding terminals (remote input) before making setting.

 **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.**

### 4.2.32 Stall prevention (Pr. 156)

#### Pr. 156 "stall prevention operation selection"

#### Related parameters

- Pr. 22 "stall prevention operation level"
- Pr. 23 "stall prevention operation level compensation factor at double speed"

You can make settings to disable stall prevention caused by overcurrent and to disable the inverter from an overcurrent trip if an excessive current occurs due to sudden load variation or turning the inverter's output side ON-OFF (to disable the fast-response current limit which limits the current).

- **Stall prevention**

If the current exceeds the limit value, 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.

Parameter Number	Factory Setting	Setting Range
156	0	0 to 31, 100

<Setting>

Refer to the following tables and set the parameter as required.

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	●	●	●	●	○

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	●	●	●	●	●
100	Driving	○	○	○	○
	Regenerative	●	●	●	○

Note 1: When "Operation not continued for OL signal output" is selected, the "E.OLT" alarm code (stopped by stall prevention) is displayed and operation stopped.  
 (Alarm stop display "E.OLT")  
 2: 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 stall prevention operation level.  
 3: In vertical lift applications, make setting so the fast-response current limit is not activated. Torque may not be produced, causing a gravity drop.

 CAUTION

 Always perform test operation.  
 Stall prevention operation performed during acceleration may increase the acceleration time.  
 Stall prevention operation performed during constant speed may cause sudden speed changes.  
 Stall prevention operation performed during deceleration may increase the deceleration time, increasing the deceleration distance.

### 4.2.33 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) Parameter registration to user group

Write the parameter numbers to be registered to Pr. 173 (user group 1 registration) or Pr. 175 (user group 2 registration). Write the parameter numbers one by one.

##### (2) Parameter deletion from user group

Write the parameter numbers to be deleted to Pr. 174 (user group 1 deletion) or Pr. 176 (user group 2 deletion). Write the parameter numbers one by one.

##### (3) Set the required value in Pr. 160 to make the user group or groups valid or invalid.

Pr. 160 Setting	Description
0	All parameters are accessible (factory setting)
1	Only the parameters registered to user group 1 are accessible.
10	Only the parameters registered to user group 2 are accessible.
11	Only the parameters registered to user groups 1 and 2 are accessible.

- Note: 1. The Pr. 77, Pr. 160 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.

#### 4.2.34 Actual operation hour meter clear (Pr. 171)

##### Pr. 171 "actual operation hour meter clear"

##### Related parameter

Pr. 52 "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.**

#### 4.2.35 Input terminal (remote output) function selection (Pr. 180 to Pr. 183)

##### Pr. 180 "(RY4) function selection"

##### Pr. 181 "(RY3) function selection"

##### Pr. 182 "(RY2) function selection"

##### Pr. 183 "MRS terminal (RY9) function selection"

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

Parameter Number	Terminal (Remote Output) Symbol	Factory Setting	Factory-Set Terminal Function	Setting Range
180	(RY4)	0	Low-speed operation command (RL)	0 to 3, 6, 8, 18
181	(RY3)	1	Middle-speed operation command (RM)	0 to 3, 6, 8, 18
182	(RY2)	2	High-speed operation command (RH)	0 to 3, 6, 8, 18
183	MRS(RY9)	6	Output shut-off (MRS)	0 to 3, 6 to 8, 18

**<Setting>**

Refer to the following list and set the parameters.

Setting	Terminal Name	Function	Related Parameters	Operation Command
0	RL	Low-speed operation command	Pr. 4 to Pr. 6 Pr. 24 to Pr. 27 Pr. 232 to Pr. 239	Both
1	RM	Middle-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239	Both
2	RH	High-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239	Both
3	RT	Second function selection	Pr. 44 to Pr. 50	Both
6	MRS	Output shut-off	Pr. 57, Pr. 58, Pr. 162 to Pr. 165	Both
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.	Only Pr. 183 may be set.	External
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	Both
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	Both

\*: Activated when the relay contact "opens".

[Explanation of table]

- Both : Control from both external terminal and PLC is valid.
- External : Control by signal from external terminal is only valid.

- Note: 1. One function can be assigned to two or more terminals (remote output). In this case, the terminal (remote output) inputs are ORed.
2. The speed command priorities are higher in order of multi-speed settings (RH, RM, RL, REX).
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 secondary functions are selected.
4. Pr. 180 to Pr. 183 (input terminal (remote output) function selection) do not function if the values set are other than the above.

## 4.2.36 Output terminal (remote input) function selection (Pr. 190 to Pr. 192)

### Pr. 190 "(RX2) function selection"

### Pr. 191 "(RX6) function selection"

### Pr. 192 "A, B, C terminal (RX7) function selection"

You can change the functions of the contact output terminals (remote input).

Parameter Number	Terminal (Remote Input) Symbol	Factory Setting	Factory-Set Terminal Function	Setting Range
190	(RX2)	0	Inverter running	0 to 99
191	(RX6)	4	Frequency detection	0 to 99
192	ABC(RX7)	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
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 (remote input).  
2. Pr. 190 to Pr. 192 do not function if the values set are other than the above.

**Pr. 232 to Pr. 239 → Refer to Pr. 4.**

**Pr. 240 → Refer to Pr. 72.**

#### **4.2.37 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 drawing (Refer to page 169).)

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 and the light fault (LF) signal is output. Use any of Pr. 190 to Pr. 192 (output terminal (remote input) 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 or the fan starts during fan OFF command.

**Note:** When the terminal (remote input) assignment is changed using Pr. 190 to Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals (remote input) before making setting.

## 4.2.38 Slip compensation (Pr. 245 to Pr. 247)

### Pr. 245 "rated motor slip"

### Pr. 246 "slip compensation response time"

### Pr. 247 "constant-output region 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 made

### <Setting>

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

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 10 s	Used to set the slip compensation response time. (Note)
247	0	Slip compensation is not made in the constant output range (frequency range above the frequency set in Pr. 3).
	9999	Slip compensation is made in the constant output range.

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.

## 4.2.39 Ground fault detection at start (Pr. 249)

### Pr. 249 "ground fault detection at start"

You can select whether ground fault detection at start is made or not. Ground fault detection is made only immediately after the start signal is input to the inverter.

If a 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	Ground fault detection not made
1	Ground fault detection made

- Note: 1. Since detection is made at a start, an about 20ms output delay occurs at every start.
2. When a ground fault is detected with "1" set in Pr. 249, alarm output "E.GF" is detected and the output is shut off.
3. When the motor capacity is less than 0.1kW, ground fault protection may not be provided.

## 4.2.40 Stop selection (Pr. 250)

### Pr. 250 "stop selection"

#### Related parameters

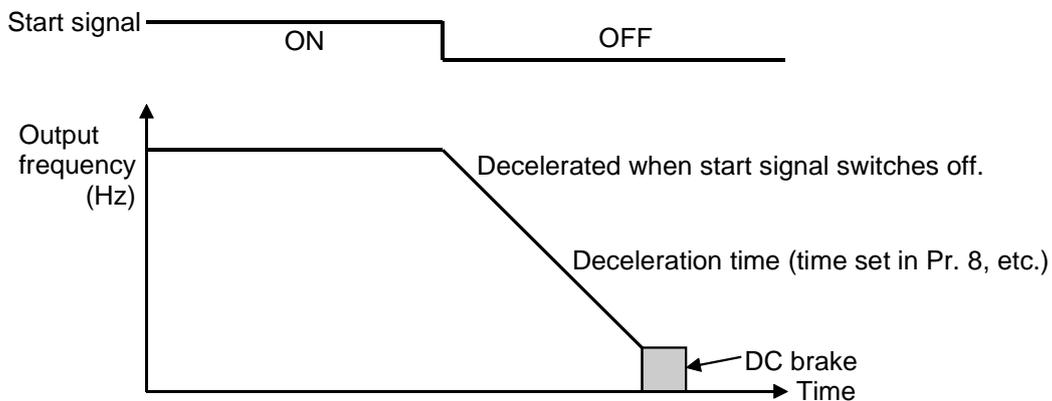
Pr. 7 "acceleration time"  
 Pr. 8 "deceleration time"  
 Pr. 44 "second acceleration/  
 deceleration time"  
 Pr. 45 "second deceleration  
 time"

Used to select the stopping method (deceleration to a stop or coasting) when the start signal (forward rotation command/reverse rotation command) switches off.

Parameter Number	Factory Setting	Setting Range
250	9999	0 to 100 s, 1000 to 1100 s, 8888, 9999

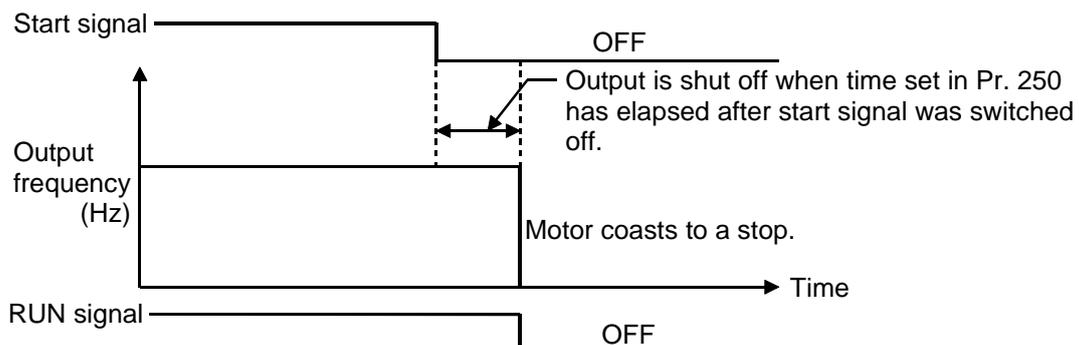
#### (1) Pr. 250 = "9999"

When the start signal switches off, the motor is decelerated to a stop.



#### (2) Pr. 250 = 0 to 100 seconds (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.

#### **4.2.41 Output phase failure protection selection (Pr. 251)**

##### **Pr. 251 "output phase failure protection selection"**

You can make invalid the output phase failure 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 failure 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 failure protection.

Parameter Number	Setting Range	Minimum Setting Increments	Factory Setting	Description
251	0, 1	1	1	0: Without output phase failure protection 1: With output phase failure protection

**Pr. 342 → Refer to Pr. 117**

## 4.2.42 Communication error "E.OPT" operation selection (Pr. 500 to Pr. 502)

### Pr. 500 "communication error execution waiting time"

### Pr. 501 "communication error occurrence count indication"

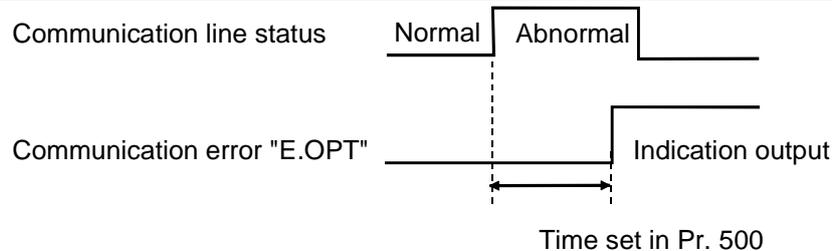
### Pr. 502 "error-time stop mode selection"

Use Pr. 500 to Pr. 502 to set the "E.OPT" operation.

#### (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.

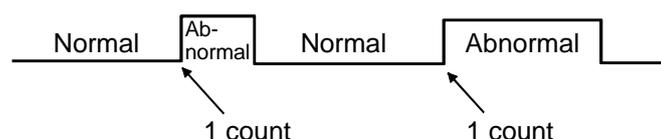
If communication is restored to normal during the set time, operation is continued without a communication error indication.

#### (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

Count timing according to communication line status



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<sup>2</sup>PROM per hour only, performing power-on reset or inverter reset causes the last value stored in E<sup>2</sup>PROM to appear in the parameter.

**(3) Pr. 502 "error-time stop mode selection"**

You can choose inverter operation to be performed if a communication line fault or CC-Link microcomputer fault occurs.

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 Pr. 500 Time			At Resolution of Fault		
		Operating status	Indication	Alarm output	Operating status	Indication	Alarm output	Operating status	Indication	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	Deceleration to stop	E.OPT lit after stop	Provided after stop	Stop held	E.OPT kept lit	Provided
	2	Continued	No	Not provided	Deceleration to stop	E.OPT lit after stop	Not provided	Restart	Normal indication	Not provided
CC-Link microcomputer	0	Coasting to stop	E.3 lit	Provided	Coasting to stop	E.3 lit	Provided	Stop held	E.3 kept lit	Provided
	1	Deceleration to stop	E.3 lit after stop	Provided after stop	Deceleration to stop	E.3 lit after stop	Provided after stop	Stop held	E.3 kept lit	Provided
	2	Deceleration to stop	E.3 lit after stop	Provided after stop	Deceleration 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 CC-Link microcomputer fault.)

# CHAPTER 5

## PROTECTIVE FUNCTIONS

This chapter explains the "protective functions" of this product.

Always read the instructions before using the equipment.

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# 5.1 Errors (Alarms)

If any fault has occurred in the inverter, the corresponding protective function is activated to bring the inverter to an alarm stop and automatically give the corresponding error (alarm) indication on the PU display.

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.
- When the protective function is activated, take the corresponding corrective action, then reset the inverter, and resume operation.

## 5.1.1 Operation at Alarm Occurrence

Fault	Operation Mode	
	CC-Link operation	PU operation
Inverter fault	Continued	Continued
Communication error	Inverter trip *Depending on Pr. 502 setting	Stop

### **(1) Inverter alarm**

Refer to page 143 and remove the cause of the alarm.

### **(2) Communication alarm**

Check the states of the operating status indicator LEDs and remove the cause.

Check the CC-Link master station. (Refer to page 151)

If any fault has occurred in the inverter, the protective function is activated, the inverter comes to an alarm stop, and the ALARM lamp is lit. When the parameter unit (FR-PU04) is used, the PU display automatically gives any of the following error (alarm) indications.

When the protective function is activated, reset the inverter.

## 5.1.2 Error (alarm) definitions

### (1) Major faults

When the protective function is activated, the inverter output is shut off and the alarm is output.

<b>FR-PU04 Indication</b>	OC During Acc
<b>Name</b>	Overcurrent shut-off during acceleration (E. OC1)
<b>Description</b>	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.
<b>Check point</b>	Check for sudden acceleration. Check for output short-circuit/ground fault. Check whether main circuit power (R, S, T) is supplied or not.
<b>Corrective action</b>	Increase the acceleration time. Supply main circuit power (R, S, T).

<b>FR-PU04 Indication</b>	Stedy Spd Oc
<b>Name</b>	Overcurrent shut-off during constant speed (E. OC2)
<b>Description</b>	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.
<b>Check point</b>	Check for sudden load change. Check for output short-circuit/ground fault.
<b>Corrective action</b>	Keep load stable.

<b>FR-PU04 Indication</b>	OC During Dec
<b>Name</b>	Overcurrent shut-off during deceleration (E. OC3)
<b>Description</b>	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.
<b>Check point</b>	Check for sudden speed reduction. Check for output short-circuit/ground fault. Check for too fast operation of motor's mechanical brake.
<b>Corrective action</b>	Increase the deceleration time. Adjust brake operation.

## PROTECTIVE FUNCTIONS

<b>FR-PU04 Indication</b>	Ov During Acc
<b>Name</b>	Regenerative overvoltage shut-off during acceleration (E. OV1)
<b>Description</b>	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.
<b>Check point</b>	Check for too slow acceleration.
<b>Corrective action</b>	Decrease the acceleration time.
<b>FR-PU04 Indication</b>	Stedy Spd Ov
<b>Name</b>	Regenerative overvoltage shut-off during constant speed (E. OV2)
<b>Description</b>	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.
<b>Check point</b>	Check for sudden load change.
<b>Corrective action</b>	<ul style="list-style-type: none"> <li>• Keep load stable.</li> <li>• Use the brake unit or power regeneration common converter (FR-CV) as required.</li> </ul>
<b>FR-PU04 Indication</b>	Ov During Dec
<b>Name</b>	Regenerative overvoltage shut-off during deceleration or stop (E. OV3)
<b>Description</b>	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.
<b>Check point</b>	Check for sudden speed reduction.
<b>Corrective action</b>	<ul style="list-style-type: none"> <li>• Increase the deceleration time. (Set the deceleration time which meets load <math>GD^2</math>)</li> <li>• Decrease the braking duty.</li> <li>• Use the brake unit or power regeneration common converter (FR-CV) as required.</li> </ul>
<b>FR-PU04 Indication</b>	Motor Overload
<b>Name</b>	Motor overload shut-off (electronic overcurrent protection) (E. THM) (Note 1)
<b>Description</b>	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 in the output side of the inverter.
<b>Check point</b>	Check the motor for use under overload.
<b>Corrective action</b>	<ul style="list-style-type: none"> <li>• Reduce the load weight.</li> <li>• For the constant-torque motor, change the Pr. 71 setting to the constant-torque motor setting.</li> </ul>

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<b>FR-PU04 Indication</b>	Inv. Overload
<b>Name</b>	Inverter overload shut-off (electronic overcurrent protection) (E. THT) (Note 1)
<b>Description</b>	If a current of more than 150% of the rated output current flows and overcurrent shut-off does not occur (200% or less), inverse-time characteristics cause the electronic overcurrent protection to be activated to stop the inverter output in order to protect the output transistors.
<b>Check point</b>	Check the motor for use under overload.
<b>Corrective action</b>	Reduce the load weight.

Note:1 Resetting the inverter initializes the internal heat integrating data of the electronic overcurrent protection.

<b>FR-PU04 Indication</b>	H/Sink O/Temp
<b>Name</b>	Fin overheat (E. FIN)
<b>Description</b>	If the cooling fin overheats, the overheat sensor is actuated to stop the inverter output.
<b>Check point</b>	<ul style="list-style-type: none"> <li>• Check for too high ambient temperature.</li> <li>• Check for cooling fin clogging.</li> </ul>
<b>Corrective action</b>	Set the ambient temperature to within the specifications.

<b>FR-PU04 Indication</b>	Br. Cct. Fault (Note)
<b>Name</b>	Brake transistor alarm detection (E. BE) (Note 2)
<b>Description</b>	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. <u>In this case, the inverter power must be switched off immediately.</u>
<b>Check point</b>	Check for improper braking duty.
<b>Corrective action</b>	Change the inverter. Please contact your sales representative.

Note:2 This function is activated only when the optional brake resistor is connected.

<b>FR-PU04 Indication</b>	Ground Fault
<b>Name</b>	Output side ground fault overcurrent protection (E. GF)
<b>Description</b>	This function stops the inverter output if a ground fault overcurrent flows due to a 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.
<b>Check point</b>	Check for a ground fault in the motor and connection cable.
<b>Corrective action</b>	Remedy the ground fault portion.

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<b>FR-PU04 Indication</b>	OH Fault
<b>Name</b>	External thermal relay operation (E. OHT) (Note 3)
<b>Description</b>	If the external thermal relay designed 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.
<b>Check point</b>	<ul style="list-style-type: none"> <li>• Check for motor overheating.</li> <li>• Check that the value of 7 (OH signal) is set correctly in any of Pr. 180 to Pr. 183 (input terminal (remote output) function selection).</li> </ul>
<b>Corrective action</b>	Reduce the load and operating duty.

Note:3 This function is activated only when OH has been set to any of Pr. 180 to Pr. 183 (input terminal (remote output) function selection).

<b>FR-PU04 Indication</b>	Still Prev STP
<b>Name</b>	Stall prevention (E. OLT)
<b>Description</b>	The running frequency has fallen to 0 by stall prevention activated. (OL while stall prevention is being activated.)
<b>Check point</b>	Check the motor for use under overload.
<b>Corrective action</b>	Reduce the load weight.

<b>FR-PU04 Indication</b>	Option alarm
<b>Name</b>	Option alarm (E. OPT)
<b>Description</b>	If a communication line fault occurs, the inverter stops the output.
<b>Check point</b>	_____
<b>Corrective action</b>	Consult your sales representative.

<b>FR-PU04 Indication</b>	Corrupt Memry
<b>Name</b>	Parameter storage device alarm (E. PE)
<b>Description</b>	A fault occurred in parameters stored (example: E <sup>2</sup> PROM fault).
<b>Check point</b>	Check for too many number of parameter write times.
<b>Corrective action</b>	Please contact your sales representative.

<b>FR-PU04 Indication</b>	PU Leave Out
<b>Name</b>	Parameter unit disconnection (E. PUE)
<b>Description</b>	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.
<b>Check point</b>	<ul style="list-style-type: none"> <li>• Check for loose fitting of the operation panel or FR-PU04.</li> <li>• Check the Pr. 75 setting.</li> </ul>
<b>Corrective action</b>	Fit the operation panel and FR-PU04 securely.

<b>FR-PU04 Indication</b>	Retry No Over
<b>Name</b>	Retry count exceeded (E. RET)
<b>Description</b>	If operation cannot be resumed properly within the number of retries set, this function stops the inverter output.
<b>Check point</b>	Find the cause of alarm occurrence.
<b>Corrective action</b>	Eliminate the cause of the error preceding this error indication.

<b>FR-PU04 Indication</b>	CPU Fault
<b>Name</b>	CPU error (E. CPU)
<b>Description</b>	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.
<b>Check point</b>	_____
<b>Corrective action</b>	Please contact your sales representative.

<b>FR-PU04 Indication</b>	Fault 3
<b>Name</b>	Option fault (E. 3)
<b>Description</b>	If a communication fault occurs in the inverter, the inverter stops output.
<b>Check point</b>	_____
<b>Corrective action</b>	Please contact your sales representative.

<b>FR-PU04 Indication</b>	E. LF
<b>Name</b>	Output phase failure protection (E. LF)
<b>Description</b>	This function stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) results in open phase.
<b>Check point</b>	<ul style="list-style-type: none"> <li>• Check the wiring (Check the motor for a fault.)</li> <li>• Check that the capacity of the used motor is not smaller than the inverter capacity.</li> </ul>
<b>Corrective action</b>	<ul style="list-style-type: none"> <li>• Wire the cables properly.</li> <li>• Check the setting of Pr. 251 "output phase failure protection selection".</li> </ul>

**(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 (remote input) function selection). Refer to page 134.)

<b>FR-PU04 Indication</b>	Fan fault
<b>Name</b>	Fan fault (FN)
<b>Description</b>	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".
<b>Check point</b>	Check the cooling fan for a fault.
<b>Corrective action</b>	Change the fan.

**(3) Warnings**

<b>FR-PU04 Indication</b>	OL (Still Prev STP)	
<b>Name</b>	Stall prevention (overcurrent) (OL)	
<b>Description</b>	During acceleration	If a current of more than 150% (Note 4) 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 4) 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 4) 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.
<b>Check point</b>	Check the motor for use under overload.	
<b>Corrective action</b>	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: 4 The stall prevention operation current can be set as desired. It is factory-set to 150%.

<b>FR-PU04 Indication</b>	oL	
<b>Name</b>	Stall prevention (overvoltage) (oL)	
<b>Description</b>	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.
	<b>Check point</b>	Check for sudden speed reduction.
<b>Corrective action</b>	The deceleration time may change. Increase the deceleration time using Pr. 8 "deceleration time".	

<b>FR-PU04 Indication</b>	PS
<b>Name</b>	PU stop (PS)
<b>Description</b>	A stop made by pressing the  key of the PU has been set in Pr. 75 "PU stop selection".
<b>Check point</b>	Check for a stop made by pressing the  key of the operation panel during external operation.
<b>Corrective action</b>	Refer to page 103.

### **5.1.3 To know the operating status at the occurrence of alarm**

When any alarm has occurred, the ALARM lamp is lit. When the parameter unit (FR-PU04) is used, the PU display automatically switches to the indication of the corresponding protective function (error) and shows the error definition and output frequency.

### 5.1.4 Correspondence between digital and actual characters

There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the control panel:

Actual	Display	Actual	Display	Actual	Display
0		A		M	
1		B		N	
2		C		O	
3		D		o	
4		E		P	
5		F		S	
6		G		T	
7		H		U	
8		I		V	
9		J		r	
		L		-	

### 5.1.5 Resetting the inverter

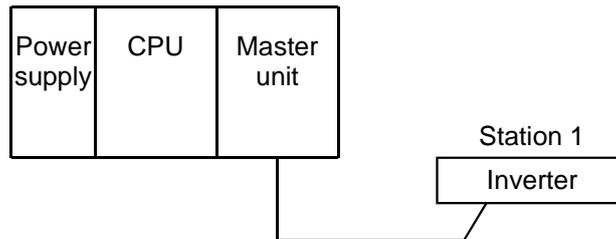
The inverter can be reset by performing any of the following operations. Note that the electronic overcurrent protection's internal heat calculation value and the number of retries are cleared (erased) by resetting the inverter.

- Operation 1 ..... Using the parameter unit (FR-PU04), press the key to reset the inverter.  
(May only be performed when the inverter protective function (major fault) is activated.)
- Operation 2 ..... Switch power off once, then switch it on again.
- Operation 3 ..... Switch on the reset signal (RES).
- Operation 4 ..... Reset the inverter in the sequence program.
- Operation 5 ..... Switch on the RES-SD signal in the sequence program.

### 5.1.6 How to Check for Error using the LEDs

#### (1) When one inverter is connected

The following example indicates the causes of faults which may be judged from the operating status indicator LED states of the inverter under the condition that the SW, M/S and PRM LEDs of the master unit are off (the master unit setting is correct) in the system configuration where one inverter is connected.

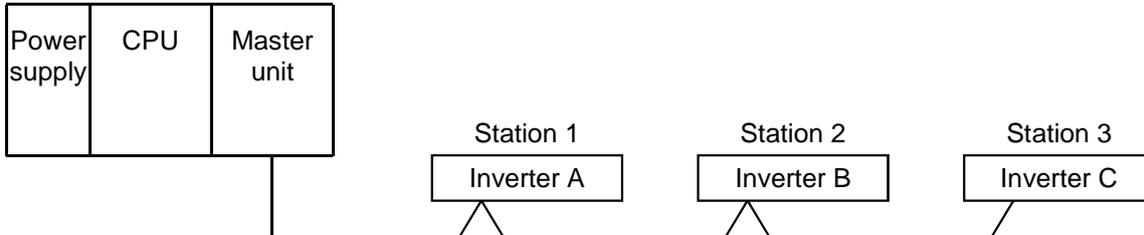


LED States				Cause
L. RUN	SD	RD	L. ERR	
●	⊙	⊙	⊙	Normal communication is made but CRC error has occurred due to noise.
●	⊙	⊙	○	Normal communication
●	⊙	○	⊙	Hardware fault
●	⊙	○	○	Hardware fault
●	○	⊙	⊙	Cannot answer due to CRC error of receive data.
●	○	⊙	○	Data sent to the host station does not reach destination.
●	○	○	⊙	Hardware fault
●	○	○	○	Hardware fault
○	⊙	⊙	⊙	Polling response is made but refresh receive is in CRC error.
○	⊙	⊙	○	Hardware fault
○	⊙	○	⊙	Hardware fault
○	⊙	○	○	Hardware fault
○	○	⊙	⊙	Data sent to the host station is in CRC error.
○	○	⊙	○	There is no data sent to the host station, or data sent to the host station cannot be received due to noise.
○	○	○	○	Hardware fault
○	○	○	○	Cannot receive data due to open cable, etc.
○	○	⊙○	●	Invalid baud rate or station number setting
●	⊙	⊙	⊙	Baud rate or station number changed during operation.
○	○	○	●	WDT error occurrence (hardware fault), power off, power supply failure

●: On, ○: Off, ⊙: Flicker

**(2) Connection of two or more inverters**

The following example indicates the causes and corrective actions for faults which may be judged from the operating status indicator LED states of the inverters under the condition that the SW, M/S and PRM LEDs of the master unit are off (the master unit setting is correct) in the following system configuration.



		LED States			Cause	Corrective Action
Master unit	Remote I/O unit					
		Station 1	Station 2	Station 3		
TIME ○ LINE ○ or TIME ● LINE ○	L. RUN ● SD ● RD ● L. ERR ○	Normal	—			
TIME ● LINE ○ or TIME ○ LINE ●	L. RUN ○ SD ○ RD ○ L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	Since the LEDs of station 1 inverter are all off, 5V power is not supplied or voltage is insufficient.	Check the voltage of the 24V power supply and supply normal power to the inverter.
TIME ● LINE ● or TIME ○ LINE ●	L. RUN ○ SD * RD * L. ERR ○	Since the L.RUN LEDs of station 2 inverter and later are off, the transmission cable between inverters A and B is open or disconnected from the terminal block.	Referring to the LED "on" condition, search for an open point and repair.			
TIME ○ LINE ●	L. RUN ○ SD * RD * L. ERR ○	The transmission cable is shorted.	Among the three wires of the transmission cable, search for the shorted wire and repair.			
	L. RUN ○ SD * RD * L. ERR *	The transmission cable is wired improperly.	Check the wiring on the inverter terminal block and correct the improper wiring point.			

●: On, ○: Off, ⊙: Flicker, \*: Any of on, flicker or off

**(3) Communication stops during operation**

- Check that the inverters and CC-Link dedicated cable are fitted properly. (Check for contact fault, open cable, etc.)
- Check that the programmable controller program is executing properly.
- Check that data communication has not stopped due to an instantaneous power failure, etc.

Master unit	LED States			Cause	Corrective Action
	Remote I/O unit				
	Station 1	Station 2	Station 3		
TIME ○ LINE ○ or TIME ● LINE ○	L. RUN ○ SD * RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ○ SD * RD ● L. ERR ○	Since the L.RUN LEDs of station 1 inverter and station 3 inverter are off, the station numbers of the inverters set as stations 1 and 3 are the same.	After correcting the repeated station numbers of the inverters, switch power on again.
	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ○ SD ○ RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	Since the L.RUN and SD LEDs of station 2 inverter are off, the transmission speed setting of station 2 inverter is wrong within the setting range (0 to 4).	After correcting the transmission speed setting, switch power on again.
	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ⊙	Since the L.ERR LED of station 3 inverter flickers, the setting switch of station 3 inverter was moved during normal operation.	After returning the setting switch of the inverter to the original position, switch on the inverter again.
	L. RUN ○ SD ○ RD ● L. ERR ●	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	Since the L.RUN and SD LEDs of station 1 inverter are off and its L.ERR LED is on, the setting switch setting of station 1 inverter is outside the range (transmission speed: 5 to 9, station number: 65 or more).	After correcting the setting switch position of the inverter, switch power on again.
TIME ● LINE ● or TIME ● LINE ○	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	Since the L.ERR LED of station 2 inverter is on, station 2 inverter itself is affected by noise. (L.RUN may go off.)	Securely connect FG of each inverter and master unit to ground.
	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ●	L. RUN ● SD ● RD ● L. ERR ●	Since the L.ERR LEDs of station 2 inverter and later are on, the transmission cable between station 2 and 3 inverters is affected by noise. (L.RUN may go off.)	Check that the transmission cable is connected to SLD. Also run it as far away as possible from the power lines. (100mm or more)
	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ○	L. RUN ● SD ● RD ● L. ERR ●	Terminal resistors are left unconnected. (L.RUN may go off.)	Check that the terminal resistors are connected.

●: On, ○: Off, ⊙: Flicker, \*: Any of on, flicker or off

## 5.2 Troubleshooting

### PROTECTIVE FUNCTIONS

Note: 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 (POWER lamp is lit).
- 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 output stop signal (MRS) or reset signal (RES) is not on.
- Check that the sink/source 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 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.

#### 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. 245).
- 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 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.

**3) Others**

- Check that the setting of the applied motor capacity (Pr. 80) is correct for the inverter and motor 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 unswitched to CC-Link operation mode**

- Check that the inverters and CC-Link dedicated cable are fitted properly (Check for contact fault, open cables, etc.).
- Check that the station number setting switches are set to the correct positions. (Check that the station number matches the program, the station numbers are not repeated, and the station number is not outside the range.)
- Check that the operation mode switching program is running.
- Check that the operation mode switching program has been written correctly.

**5.2.9 Inverter unstarted in CC-Link operation mode**

- Check that the inverter starting program has been written correctly.
- Check that the inverter starting program is running.
- Check that the inverter is providing output.

**5.2.10 Parameter write cannot be performed**

- Make sure that operation is not being performed (forward or reverse rotation signal is not ON).
- 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.
- Check Pr. 77 "parameter write inhibit selection".

## 5.3 Precautions for Maintenance and Inspection

### PROTECTIVE FUNCTIONS

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.

#### 5.3.1 Precautions for maintenance and inspection

When the maintenance/inspection of the inverter is to be performed in the CC-Link communication status, remove the terminal block for CC-Link communication signals. 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 tester, etc. Then, access the inverter for inspection.

#### 5.3.2 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 parameter unit (FR-PU04) as these sections may deform.

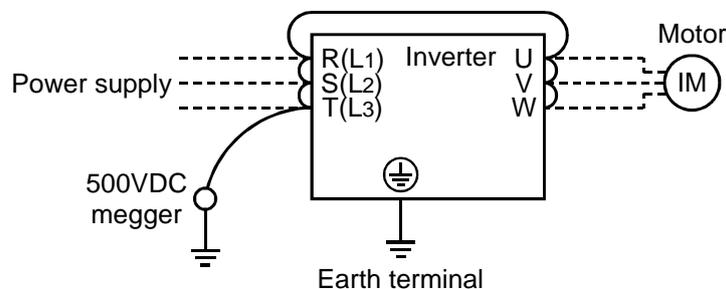
### 5.3.3 Periodic inspection

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.

### 5.3.4 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.)



### 5.3.5 Pressure test

Do not conduct a pressure test. The inverter's main circuit uses semiconductors, which may deteriorate if a pressure test is made.

**5.3.6 Daily and Periodic Inspection**

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument
			Daily	Periodic*				
				1 year	2 years			
General	Surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	○			Refer to page 11.	Ambient temperature: (constant torque) -10°C to +50°C, non-freezing. (Variable torque) -10°C to +40°C non-freezing Ambient humidity: 90% or less, non-condensing.	Thermometer, 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 166)	Meter, digital multimeter
Main circuit	General	(1) Check with megger (across main circuit terminals and 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 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 161.	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

## PROTECTIVE FUNCTIONS

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument
			Daily	Periodic*				
				1 year	2 years			
Control circuit Protective circuit	Operation check	(1) Check balance of output voltages across phases with inverter operated independently.	○	○	○	(1) Measure voltage across inverter output terminals U-V-W.	(1) Phase-to-phase voltage balance within 4V for 200V.	Digital multimeter, rectifier type voltmeter
		(2) Perform sequence protective operation test to make sure there is no fault in protective or display circuits.	○	○	○	(2) Simulate connection of inverter protective circuit output terminals.	(2) Fault must occur because of sequence.	
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 ground terminal).	○	○	○	Disconnect cables from U, V, W including motor cables.	5MΩ or more.	500V megger

\* For periodic inspection, contact you nearest Mitsubishi sales representative.

● **Checking the inverter and converter modules**

**<Preparation>**

- (1) Disconnect the external power supply cables (R(L1), S(L2), T(L3)) and motor cables (U, V, W).
- (2) Prepare a meter. (Use 100Ω range.)

**<Checking method>**

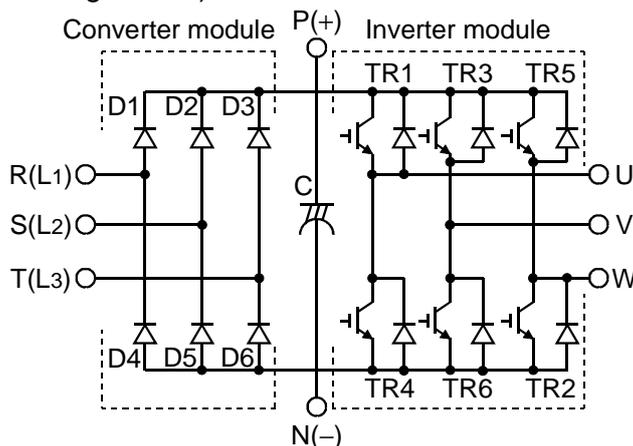
Change the polarity of the meter alternately at the inverter terminals R(L1), S(L2), T(L3), U, V, W, P(+) and N(-), and check for continuity.

Note: 1. Before measurement, check that the smoothing capacitor is discharged.  
 2. At the time of 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(L1)	P(+)	Discontinuity	D4	R(L1)	N(-)	Continuity	
		P(+)	R(L1)	Continuity		N(-)	R(L1)	Discontinuity	
	D2	S(L2)	P(+)	Discontinuity	D5	S(L2)	N(-)	Continuity	
		P(+)	S(L2)	Continuity		N(-)	S(L2)	Discontinuity	
	D3	T(L3)	P(+)	Discontinuity	D6	T(L3)	N(-)	Continuity	
		P(+)	T(L3)	Continuity		N(-)	T(L3)	Discontinuity	
Inverter module	TR1	U	P(+)	Discontinuity	TR4	U	N(-)	Continuity	
		P(+)	U	Continuity		N(-)	U	Discontinuity	
	TR3	V	P(+)	Discontinuity	TR6	V	N(-)	Continuity	
		P(+)	V	Continuity		N(-)	V	Discontinuity	
	TR5	W	P(+)	Discontinuity	TR2	W	N(-)	Continuity	
		P(+)	W	Continuity		N(-)	W	Discontinuity	

(Assumes the use of an analog meter.)



### 5.3.7 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	Change (as required)
Smoothing capacitor in main circuit	5 years	Change (as required)
Smoothing capacitor on control board	5 years	Change the board (as required).

Note: For part replacement, contact the nearest Mitsubishi FA center.

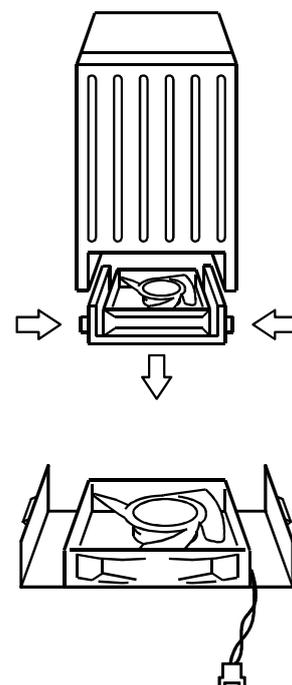
#### (1) Cooling fan

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 changed immediately.

Inverter Model No.	Fan Type
FR-E520-0.75KN	MMF-04C24DS BKO-CA1382H01
FR-E520-1.5KN, 2.2KN, 3.7KN	MMF-06D24DS BKO-C2416H07
FR-E520-5.5KN, 7.5KN	MMF-06D24ES BKO-CA1027H08

#### ● Removal

- 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 catches. Disengage the fixing catches to remove the cooling fan and cooling fan cover.

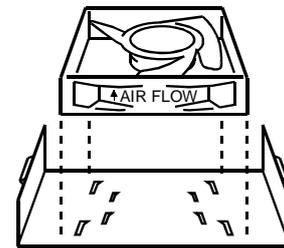
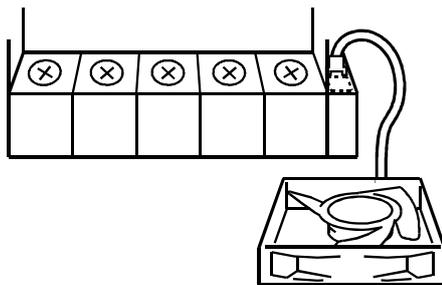


● **Reinstallation**

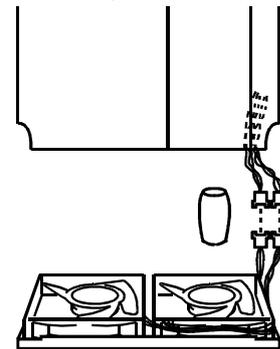
- 1) After confirming the orientation of the fan, reinstall the fan to the cover so that the arrow on the left of "AIR FLOW" faces in the opposite direction of the fan cover.

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.

**(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 85% of the rating, change the capacitor.

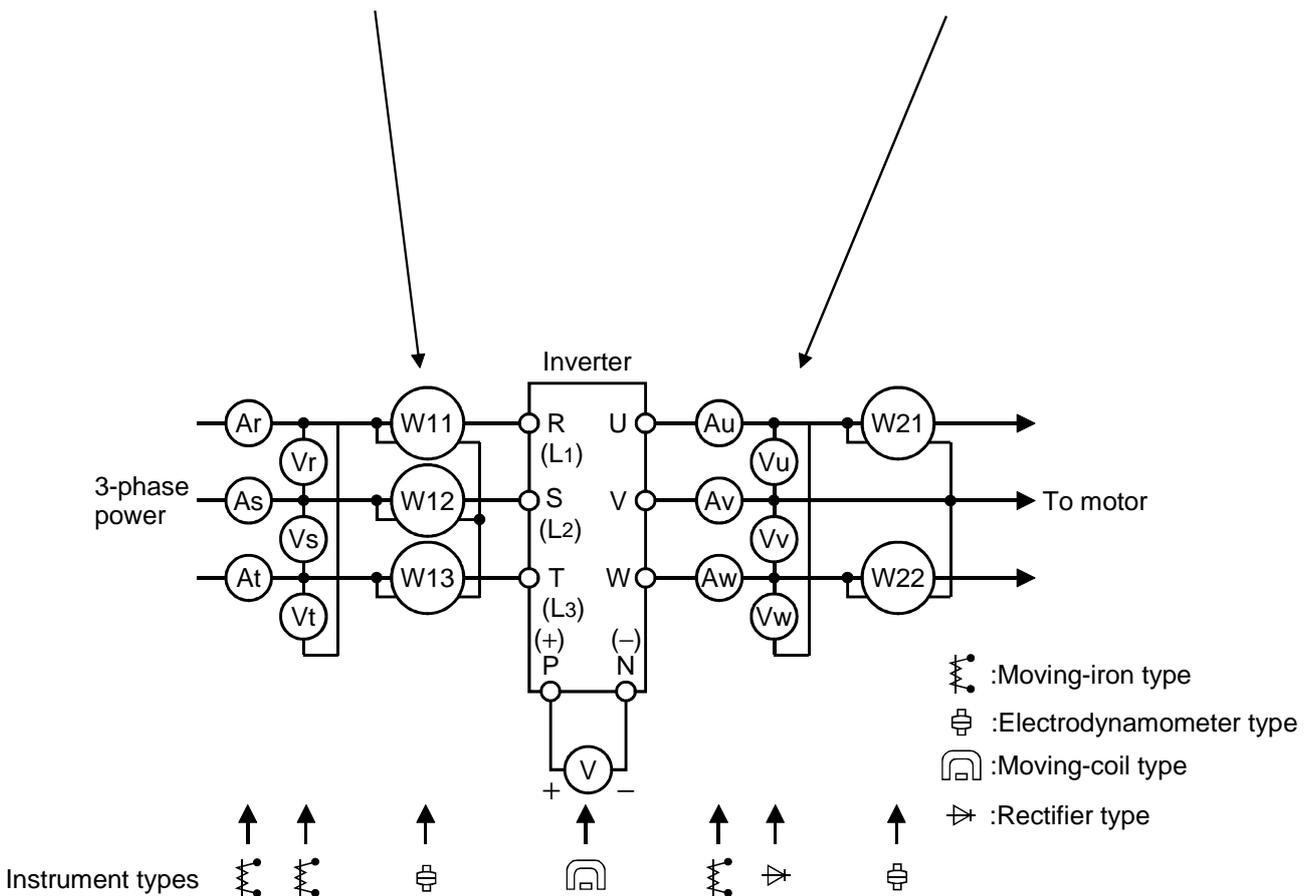
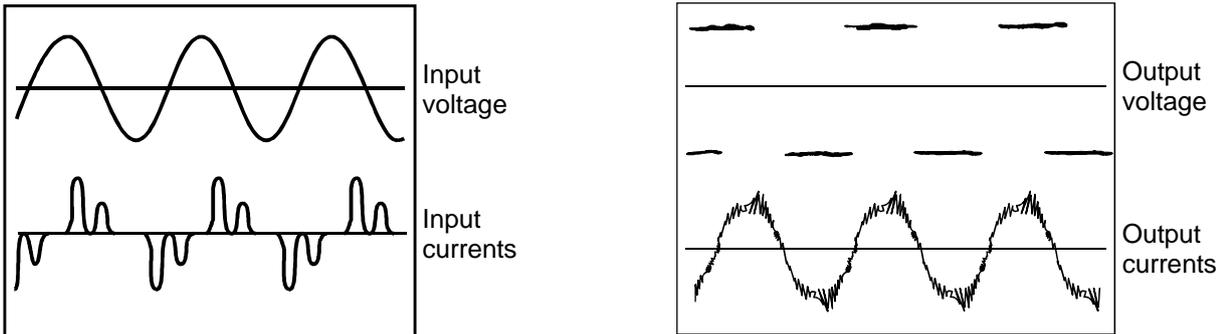
### 5.3.8 Measurement of main circuit voltages, currents and powers

● **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.

Three-phase 200V power input



**Typical Measuring Points and Instruments**

Note: Use FFT (Fast Fourier Transforms) to measure the output voltage accurately.  
It cannot be measured accurately with a meter or general instrument.



# CHAPTER 6

# SPECIFICATIONS

This chapter provides the "specifications" of this product.  
Always read the instructions before using the equipment

6.1 Standard Specifications ..... 166

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

# 6.1 Standard specifications

## 6.1.1 Model specifications

### (1) 3-phase 200V power supply

Type FR-E520- <input type="checkbox"/> KN	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 50Hz/60Hz								
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 (IP00)									
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 overload capacity indicated in % 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 cannot exceed the power supply voltage. The maximum output voltage may be set as desired below the power supply voltage. However, the crest value of the inverter output voltage remains unchanged from the DC bus voltage.
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 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.

**6.1.2 Common specifications**

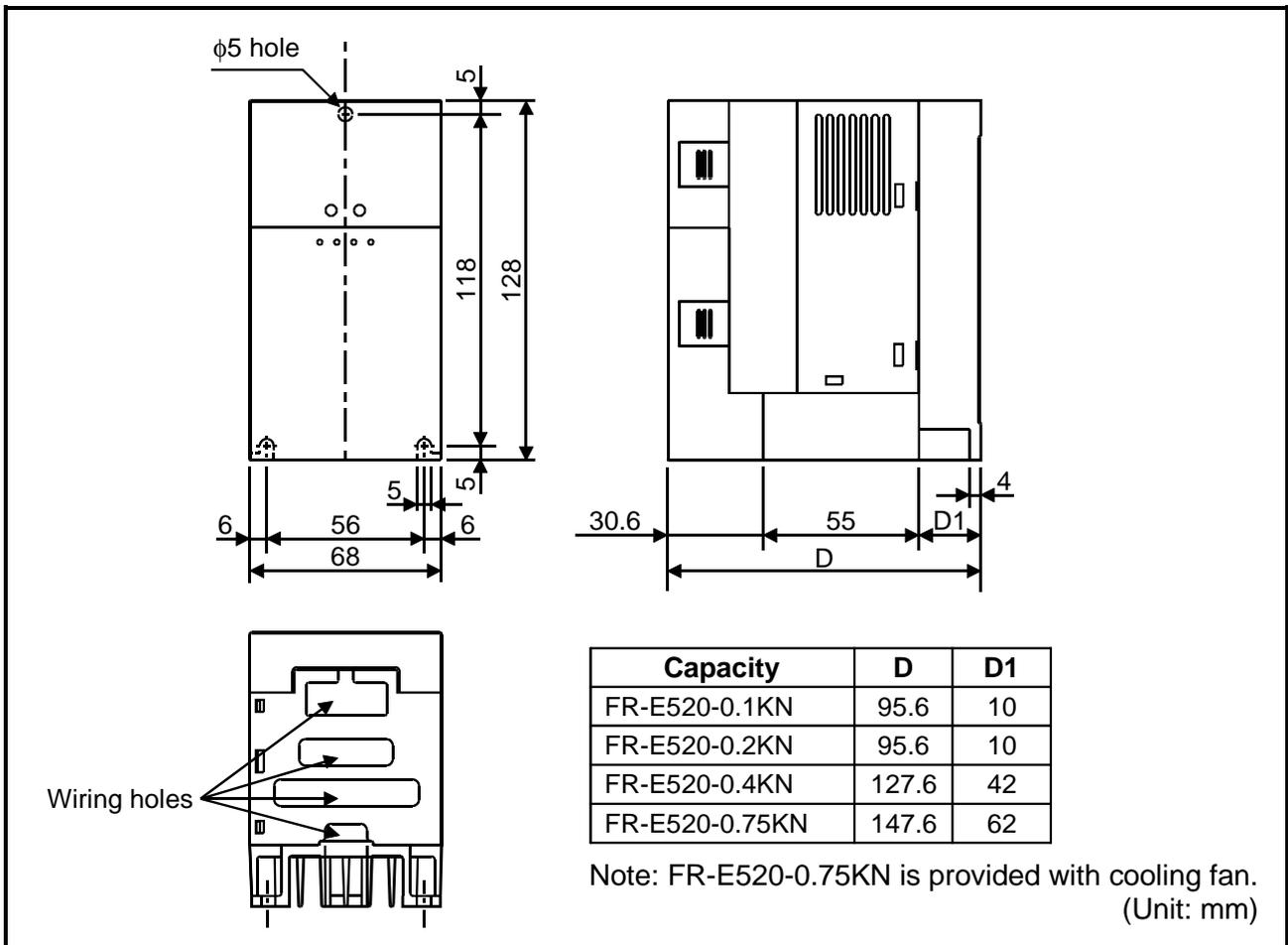
Control specifications	Control system		Soft-PWM control/high carrier frequency PWM control can be selected. V/F control or general-purpose magnetic flux vector control can be selected.		
	Output frequency range		0.2 to 400Hz (starting frequency variable between 0 and 60Hz)		
	Frequency setting resolution	Digital input	0.01Hz (less than 100Hz), 0.1Hz (100Hz or more)		
	Frequency accuracy	Digital input	Within 0.01% of set output frequency		
	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 (Note 5)	Digital input	Entered through CC-Link communication or from the parameter unit.	
		Start signal (Note 5)		Forward and reverse rotation.	Possible by CC-Link or parameter unit
Alarm reset (Note 6)		Used to reset alarm output provided when protective function is activated.	Possible by CC-Link, parameter unit or input terminal		
Multi-speed selection (Note 6)		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 control panel.)	Possible by CC-Link or input terminal		
Second function selection (Note 6)		Used to select second functions (acceleration time, deceleration time, torque boost, base frequency, electronic overcurrent protection).			
Output stop (Note 6)		Instantaneous shut-off of inverter output (frequency, voltage).			
External thermal relay input (Note 6)		Thermal relay contact input for use when the inverter is stopped by the external thermal relay (Pr. 183).			
V/F-general-purpose magnetic flux switching (Note 6)		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, CC-Link operation
	Output signals	Operating status	One signal can be selected from inverter running, up-to-frequency, frequency detection, overload alarm, zero current detection, output current detection, operation ready, minor fault and contact output (1 contact, 230VAC 0.3A, 30VDC 0.3A).
Display	Parameter unit display (option)	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), operating status (L.RUN, SD, RD, L.ERR)
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, fin overheat, fan failure (Note 4), parameter error, PU disconnection, starting-time ground fault overcurrent protection, retry count exceeded, output phase failure protection, CPU error, Option fault.
Environment	Ambient temperature		-10°C to +50°C (non-freezing)
	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, 5.9m/s <sup>2</sup> or less (conforms to JIS C 0040)

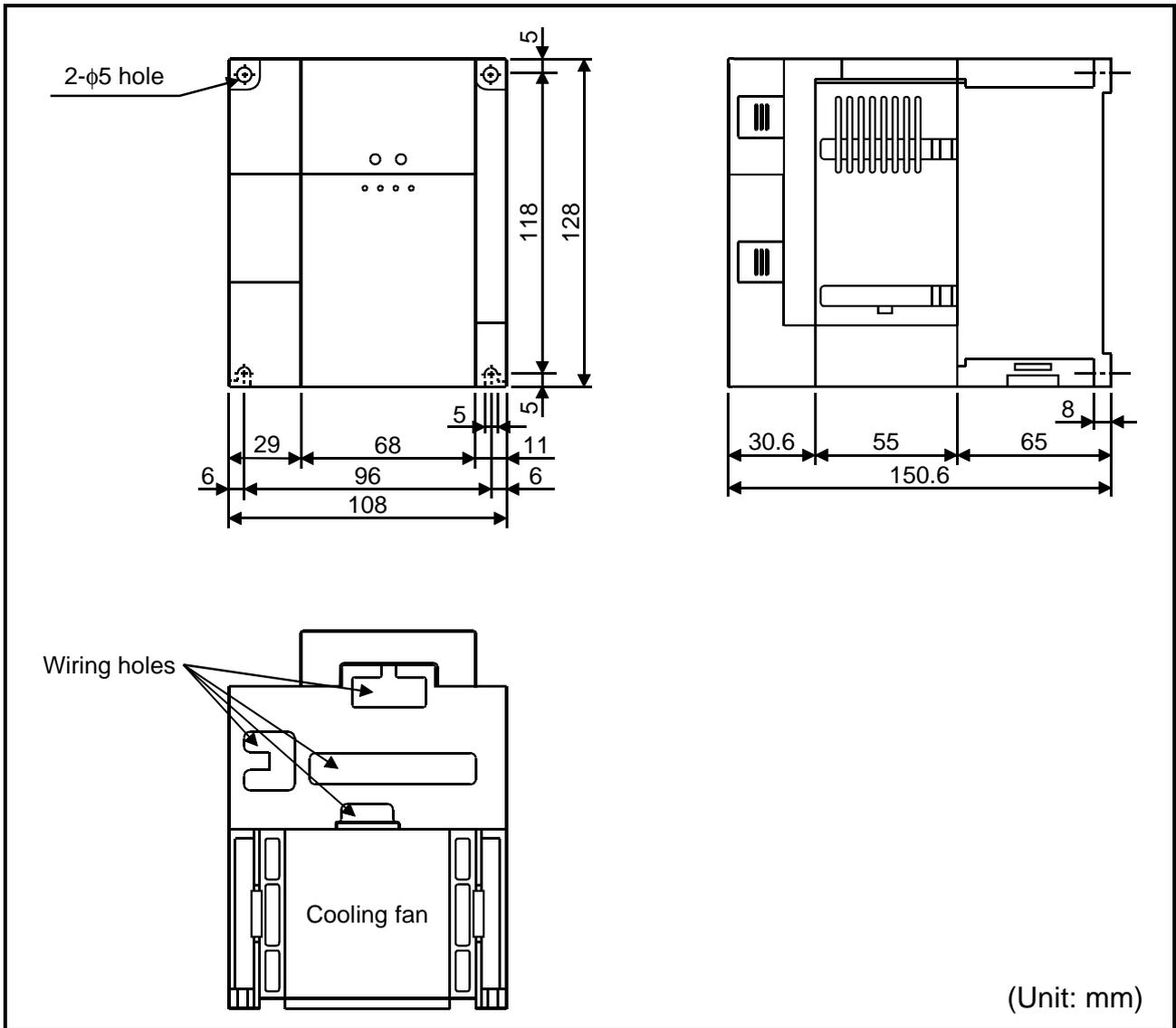
- Note:1. When undervoltage or instantaneous power failure has occurred, alarm display or alarm output is not provided but the inverter itself is protected. Overcurrent, regenerative overvoltage or other protection may be activated at power restoration according to the operating status (load size, etc.)
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-E520-0.1KN to 0.4KN which are not equipped with a cooling fan.
  5. Can be set by CC-Link communication or parameter unit (option).
  6. Can be set by CC-Link communication or input terminal (any one selected).

**6.1.3 Outline dimension drawings**

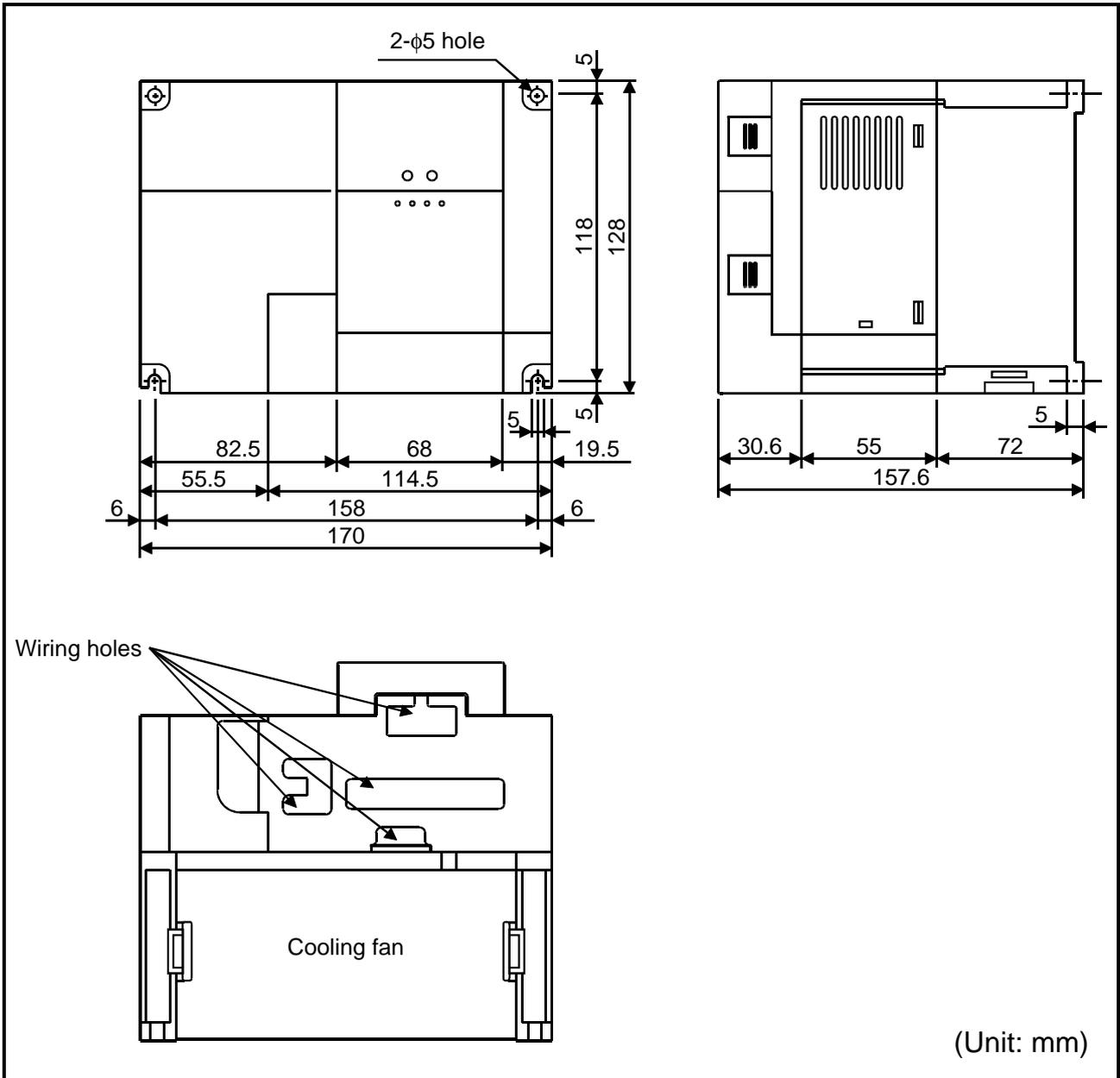
- FR-E520-0.1KN, 0.2KN, 0.4KN, 0.75KN



● **FR-E520-1.5KN, 2.2KN**



● **FR-E520-3.7KN**





# APPENDIX

This chapter provides "supplementary information" for use of this product.

Always read the instructions before using the equipment.

Appendix 1 Data Code List .....	173
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# APPENDIX 1 Data Code List

Function	Parameter Number	Name	Data Code		Link Parameter Extension Setting (Data 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
	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	
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 overcurrent protection	30	B0	0
Display functions	52	PU main display data selection	34	B4	0

Function	Parameter Number	Name	Data Code		Link Parameter Extension Setting (Data Code 7F/FF)
			Read	Write	
Automatic restart functions	57	Restart coasting time	39	B9	0
	58	Restart cushion time	3A	BA	0
Operation selection functions	60	Shortest acceleration/deceleration mode	3C	BC	0
	61	Reference I for intelligent mode	3D	BD	0
	62	Reference I for intelligent mode acceleration	3E	BE	0
	63	Reference I for intelligent mode 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
	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
82		Motor exciting 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	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 presence/absence selection	18	98	1
Additional function	145	Parameter unit language switch over	2D	AD	1
	146	Parameter set by manufacturer. Do not set.			
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

Function	Parameter Number	Name	Data Code		Link Parameter Extension Setting (Data Code 7F/FF)
			Read	Write	
Additional function	160	User group read selection	00	80	2
Initial monitor	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	Ground fault detection at start	39	B9	2

Function	Parameter Number	Name	Data Code		Link Parameter Extension Setting (Data Code 7F/FF)
			Read	Write	
Stop selection function	250	Stop selection	3A	BA	2
Additional function	251	Output phase failure protection selection	3B	BB	2
Computer link function	342	E <sup>2</sup> PROM write selection	2A	AA	3
Additional Function	500	Communication error execution waiting time	00	80	5
	501	Communication error occurrence count indication	01	81	5
	502	Error-time stop mode selection	02	82	5
Calibration functions	990	Buzzer beep control	5A	DA	9
	991	LCD contrast	5B	DB	9



## **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 3-phase induction motors.

## REVISIONS

\*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Jul., 1998	IB(NA)-66864-A	First edition
Mar., 2000	IB(NA)-66864-B	<div data-bbox="603 412 754 450" style="border: 1px solid black; padding: 2px;">Additions</div> <ul style="list-style-type: none"> <li>• Instructions for compliance with U.S. and Canadian Electrical Codes</li> <li>• Instructions for compliance with the European Standards</li> <li>• Communication error "E.OPT" operation selection (Pr. 500 to Pr. 502)</li> </ul> <div data-bbox="603 645 807 683" style="border: 1px solid black; padding: 2px;">Modifications</div> <ul style="list-style-type: none"> <li>• Programming example</li> </ul>
Sep., 2001	IB(NA)-66864-C	<div data-bbox="603 736 754 775" style="border: 1px solid black; padding: 2px;">Additions</div> <ul style="list-style-type: none"> <li>• CC-Link Ver. 1.10 specifications</li> <li>• Pr. 251 "output phase failure protection selection"</li> <li>• Pr. 342 "E<sup>2</sup>PROM write selection"</li> </ul> <div data-bbox="603 898 807 936" style="border: 1px solid black; padding: 2px;">Modifications</div> <ul style="list-style-type: none"> <li>• Instructions for compliance with U.S. and Canadian Electrical Codes</li> </ul>