



# TRANSISTORIZED INVERTER

## FR-C500

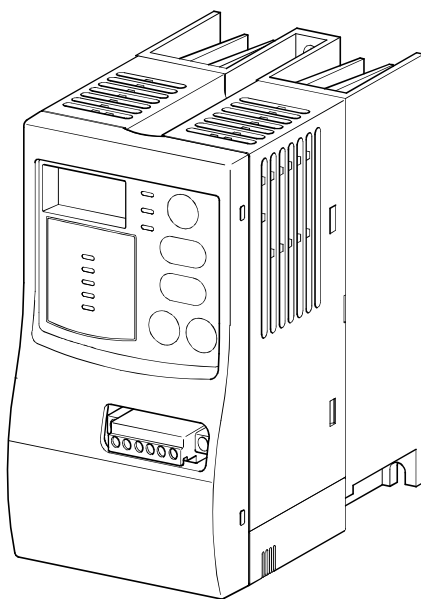
### INSTRUCTION MANUAL

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INVERTER WITH BUILT-IN PLC FUNCTION

(plus *CC-Link* COMMUNICATION COMPATIBILITY)

# FR-C520-0.1K to 3.7K



INSTALLATION AND  
WIRING

Chapter 1

OPERATION AND  
CONTROL

Chapter 2

INVERTER  
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PLC FUNCTION

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CC-Link  
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This instruction manual gives handling information and precautions for use of this product.

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 instruction manual, the safety instruction levels are classified into "WARNING" and "CAUTION".



### **WARNING**

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



### **CAUTION**

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

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

## **1. Electric Shock Prevention**



### **WARNING**

- While power is on or when the inverter is running, do not open the front cover. 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 at least 10 minutes and check for the presence of any residual voltage with a meter, etc.
- Earth (ground) the inverter in a class D or higher protective earthing (grounding) method.
- 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 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 with power on. It is dangerous to change the cooling fan while power is on.

## **2. Fire Prevention**



### **CAUTION**

- Mount the inverter on incombustible material. Mounting it to or near combustible material can cause a fire.
- If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
- Do not connect a resistor directly to the DC terminals P(+), N(+). This could cause a fire.

### 3. Injury Prevention

#### CAUTION

- Apply only the voltage specified in the instruction manual to each terminal 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 or 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; 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, oil or other flammable substances from entering the inverter.
- Do not drop the inverter, or subject it to impact.
- Use the inverter under the following environmental conditions:

Environment	Ambient temperature	-10°C to +50°C (non-freezing)
	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	Max. 1000m above sea level 5.9m/s <sup>2</sup> {0.6G} or less (conforming to JIS C 0040)

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

#### (2) Wiring

#### CAUTION

- Do not fit capacitive equipment such as 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**

- The [STOP] key is valid only when the appropriate function setting has been made. Prepare an emergency stop switch separately.
- Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart the motor suddenly.
- The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the 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 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 the 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 status. Always replace the cover and follow this instruction manual when operating the inverter.

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# 1. INSTALLATION AND WIRING

This chapter explains the "installation and wiring" for use of this product.

Always read the instructions before use.

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<Trademarks>

- CC-Link is a registered trademark of CC-Link Partner Association.
- Other company and product names herein are the trademarks or registered trademarks of their respective owners.

Chapter 1

Chapter 2

Chapter 3

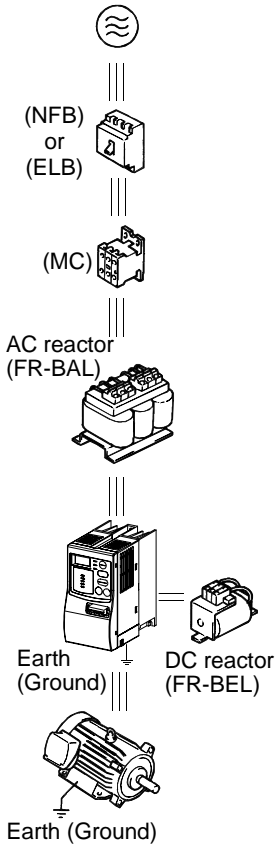
Chapter 4

Chapter 5

Chapter 6

Chapter 7

# 1.1 Basic Configuration



### Power supply

Use within the permissible power supply specifications of the inverter. (Refer to page 178.)

### No-fuse breaker or earth leakage circuit breaker

The breaker must be selected carefully since an inrush current flows in the inverter at power-on. (Refer to page 22.)

### Magnetic contactor

Do not use this magnetic contactor to start and stop the inverter. Doing so will cause the inverter life to be shorter. (Refer to page 22.)

### Installation of reactors

The reactors must be used when the power factor is to be improved or the inverter is installed near a large power supply system (500kVA or more and wiring distance within 10m). Make selection carefully. (Refer to page 22.)

### Inverter

The inverter life is influenced by ambient temperature. The ambient temperature should be as low as possible within the permissible range. (Refer to page 4.)

Wrong wiring might lead to damage of the inverter. The control signal wires must be kept fully away from the main circuit to protect them from noise. (Refer to page 5.)

### Devices connected to the output

Do not connect a power factor correction capacitor, surge suppressor or radio noise filter to the output side.

### Earth (Ground)

To prevent an electric shock, always earth (ground) the motor and inverter.

For reduction of induction noise from the power line of the inverter, it is recommended to wire the earth (ground) cable by returning it to the earth (ground) terminal of the inverter.

(For details of noise reduction techniques, refer to page 28.)

### **REMARKS**

- When using the PLC function, refer to page 35 for wiring and to page 98 for details.
- When using the CC-Link function, refer to page 36 for wiring and to page 140 for details.

## 1.2 Precautions for Use

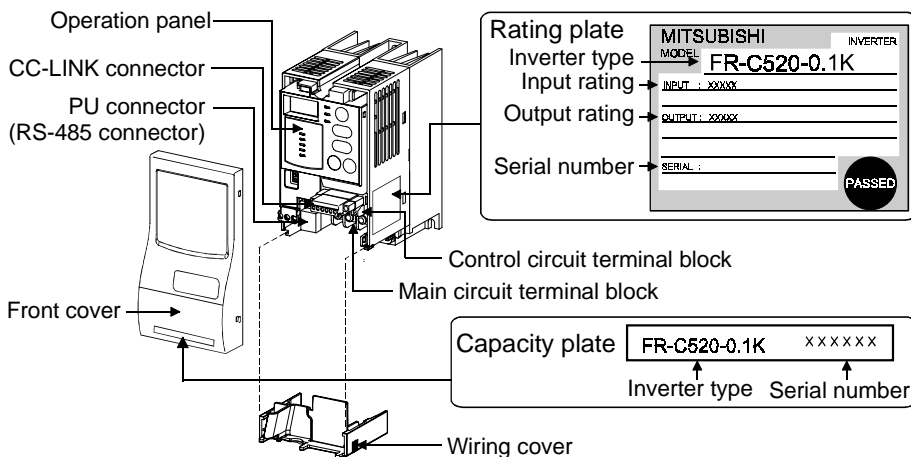
### Harmonic Suppression Guideline

The "harmonic suppression guideline for household appliances and general-purpose products" issued by the Ministry of Economy, Trade and Industry (formerly Ministry of International Trade and Industry) in September, 1994 applies to the FR-C500 series. By installing the FR-BEL or FR-BAL power factor improving reactor, this product complies with the "harmonic suppression techniques for transistorized inverters (input current 20A or less)" established by the Japan Electrical Manufacturers' Association.

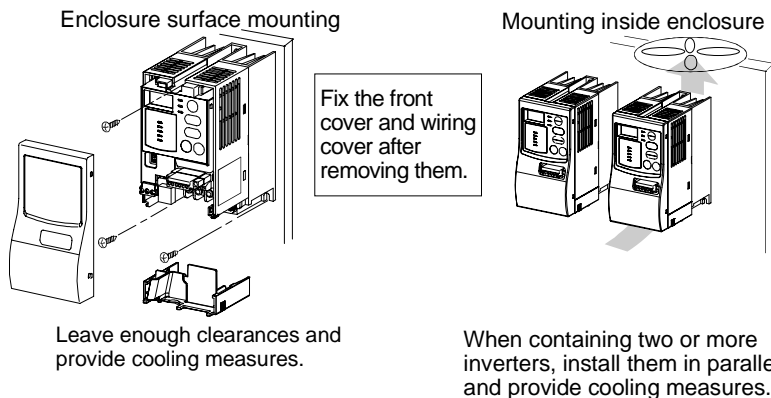
### Product Checking and Parts Identification

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

#### ● Part names and plates

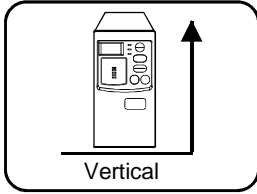


## 1.3 Installation of the Inverter

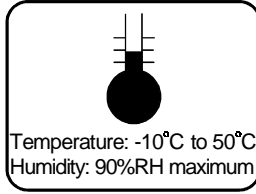


- Install the inverter under the following conditions:

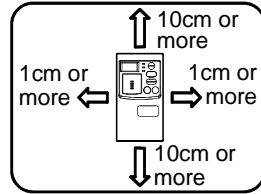
Vertical mounting



Ambient temperature and humidity



Clearances



Clearances also necessary for changing the cooling fan. (1.5K or more)

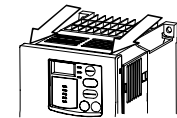
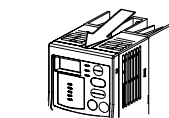
- The inverter consists of precision mechanical and electronic parts. Never install or handle it in any of the following conditions as doing so could cause an operation fault or failure.

<p>Direct sunlight</p>	<p>Vibration (5.9m/s<sup>2</sup> max.)</p>	<p>High temperature, high humidity</p>	<p>Horizontal placement</p>
<p>Vertical mounting (When mounted inside enclosure)</p>	<p>Transportation by holding front cover</p>	<p>Oil mist, flammable gas, corrosive gas, fluff, dust, etc.</p>	<p>Mounting to combustible material</p>

- Removal and reinstallation of the front cover

Remove the front cover by pulling it toward you in the direction of arrow.

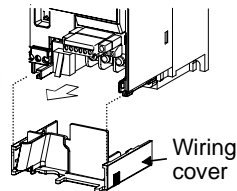
To reinstall, match the cover to the inverter front and install it straight.



- Removal and reinstallation of the wiring cover

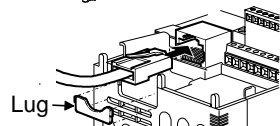
The cover can be removed easily by pulling it toward you.

To reinstall, fit the cover to the inverter along the guides.



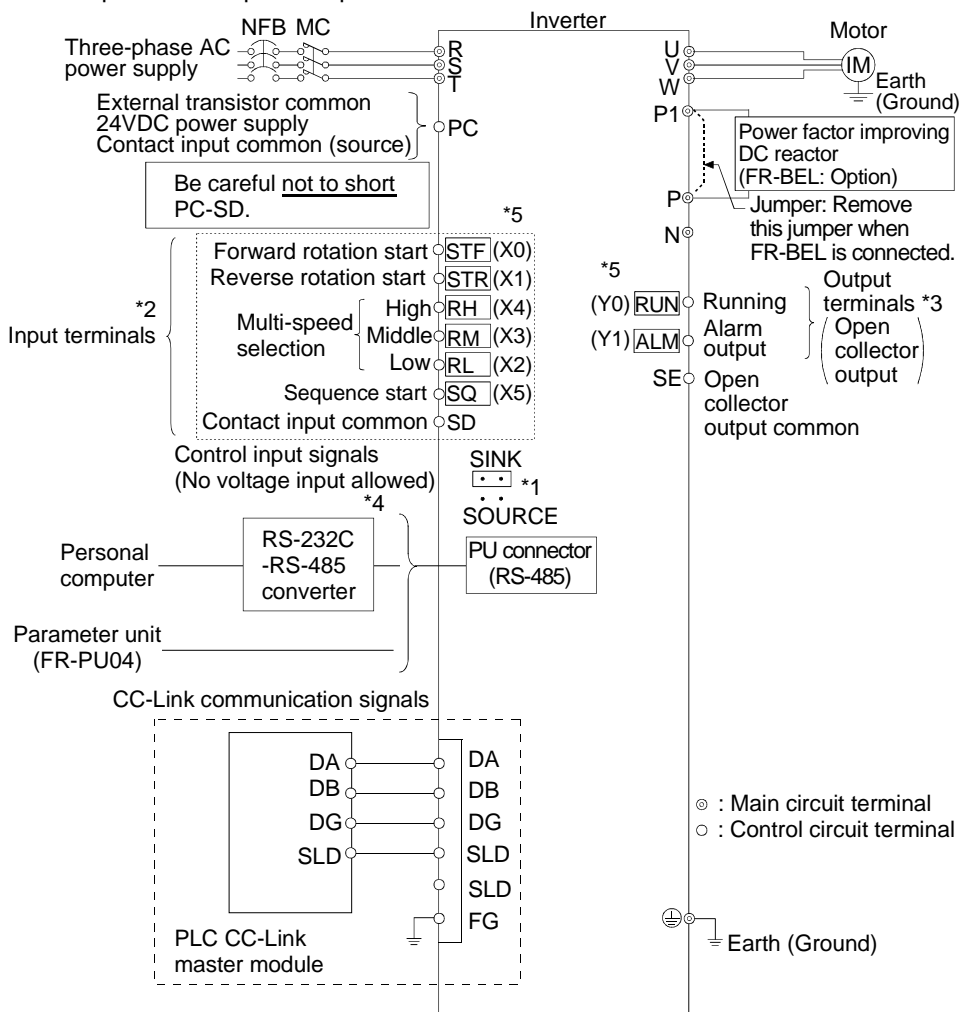
- Wiring of the RS-485 communication connector

When using the RS-485 connector to wire the cable, you can cut off the lug of the wiring cover to wire it.



# 1.4 Terminal Connection Diagram

- Three-phase 200V power input



## REMARKS


- \*1. You can change the control logic between sink and source logic. Refer to page 12 for details.
- \*2. The terminal functions change with input terminal function selection (Pr. 60 to Pr. 63, Pr. 65, Pr. 505). (Refer to page 68)  
(RES, RL, RM, RH, MRS, OH, STR, STF, SQ signal, without function selection)
- \*3. The terminal functions change with output terminal function selection (Pr. 64, Pr. 506). (Refer to page 69.) (RUN, OL, ALM signal, without function selection)
- \*4. Only either the personal computer (e.g. GX Developer) or parameter unit can be connected to the PU connector.
- \*5. For details of the I/O device, refer to page 109.

## CAUTION

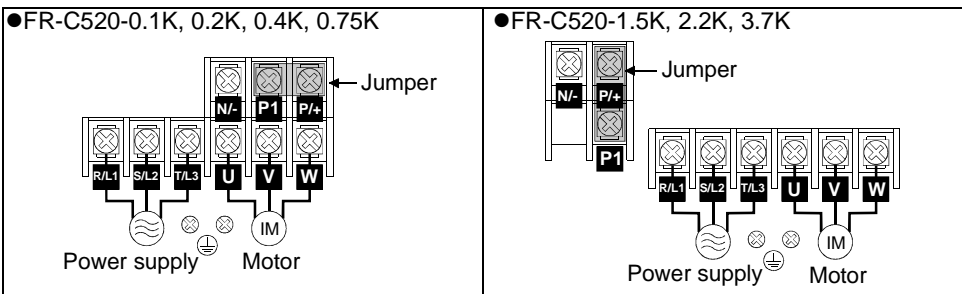
To prevent a malfunction due to noise, keep the signal cables more than 10cm away from the power cables.

## 1.5 Wiring of the Power Supply and Motor

### 1.5.1 Description of the main circuit terminals

Symbol	Terminal Name	Description
R/L1, S/L2, T/L3	Power input	Connect to the commercial power supply.
U, V, W	Inverter output	Connect a three-phase squirrel-cage motor.
N/-	DC voltage common	DC voltage common terminal. Not isolated from the power supply and inverter output.
P/+, P1	Power factor improving DC reactor connection	Disconnect the jumper from terminals P-P1 and connect the optional power factor improving DC reactor (FR-BEL).
	Earth (Ground)	For earthing (grounding) the inverter chassis. Must be earthed (grounded).

### 1.5.2 Layout and wiring of the main circuit terminals



#### CAUTION

- Always connect the power supply cables to R/L1, S/L2 and T/L3. Never connect them to U, V and W since it will damage the inverter. (The phase sequence need not be matched.)
- Connect the motor to U, V and W. When the forward rotation switch (signal) is turned on at this time, the motor rotates in the counterclockwise direction as viewed from the load shaft.

### 1.5.3 Cables, wiring lengths, crimping terminals, etc.

The following selection example assumes the wiring length of 20m.

1) FR-C520-0.1K to 3.7K

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	U, V, W	R, S, T	U, V, W	R, S, T	U, V, W
FR-C520-0.1K to 0.75K	M3.5	1.2	2-3.5	2-3.5	2	2	14	14	2.5	2.5
FR-C520-1.5K, 2.2K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-C520-3.7K	M4	1.5	5.5-4	5.5-4	3.5	3.5	12	12	4	2.5

- Wiring length  
100m maximum

**CAUTION**

- When the wiring length of the 0.1K or 0.2K is 30m or more, use the carrier frequency at 1kHz.
- If the inverter-to-motor wiring distance is long, the motor torque will decrease due to a voltage drop in the main circuit cables especially at low frequency output. Use thick cables for wiring to make a voltage drop less than 2%.

## 1.6 Earthing (Grounding) Precautions

- Leakage currents flow in the inverter. To prevent an electric shock, the inverter and motor must be earthed (grounded). (Class D earthing (grounding), earthing (grounding) resistance 100Ω maximum)
- Use the dedicated earth (ground) terminal to earth (ground) the inverter. (Do not use the screw in the casing, chassis, etc.)  
Use a tin plated\* crimping terminal to connect the earth (ground) cable. When tightening the screw, be careful not to damage the threads.  
\*Plating should not include zinc.
- Use the thickest possible earth (ground) cable. Use the cable whose size is equal to or greater than that indicated below, and minimize the cable length. The earthing (grounding) point should be as near as possible to the inverter.

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

Motor Capacity	Earth (Ground) Cable Size
	200V class
2.2kW or less	2(2.5)
3.7kW	3.5(4)

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

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

**CAUTION**

**If the inverter is run in the low acoustic noise mode, more leakage currents flow due to fast switching operations than in the non-low acoustic noise mode. Always use the inverter and motor after earthing (grounding) them. When earthing (grounding) the inverter, always use its earth (ground) terminal.**



## 1.7 Control Circuit

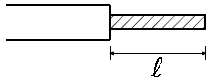

### 1.7.1 Description of the control circuit terminals

Symbol		Terminal Name	Description		Rating Specifications
Input signals	Contact input	<b>STF</b> <b>Forward rotation start</b>	Turn on the STF signal to start forward rotation and turn it off to stop.	A stop command is given if STF and STR signals turn on at the same time.  The terminal functions change with input terminal function selection (Pr. 60 to Pr. 63, Pr. 65, Pr. 505). (*3)	Input resistance 4.7kΩ Open-time voltage 21 to 27VDC Short-time current 4 to 6mADC Controlled by open collector output or 0V contact signal
		<b>STR</b> <b>Reverse rotation start</b>	Turn on the STR signal to start reverse rotation and turn it off to stop.		
		<b>RH</b> <b>RM</b> <b>RL</b> <b>Multi-speed selection</b>	You can select multiple speeds (three speeds).		
		<b>SQ</b> <b>Sequence start</b>	Turn on the SQ signal to execute the built-in PLC function. (RUN state of the PLC) Turn off the SQ signal to stop the built-in PLC function. (STOP state of the PLC)		
	<b>SD (*1)</b> <b>Contact input common (sink)</b>	Common terminal for contact inputs (terminals STF, STR, RH, RM, RL, SQ). Isolated from terminal SE.		—	
<b>PC (*1)</b> <b>External transistor common 24VDC power supply Contact input common (source)</b>	When connecting the transistor output (open collector output) of a programmable controller (PLC), etc., connect the positive external power supply for transistor output to this terminal to prevent a malfunction due to undesirable current. It can be used as a 24V 0.1A DC power output across PC-SD terminals. Acts as the common terminal of the contact input signals when source logic is selected.		Voltage range 18 to 26VDC Permissible load current 0.1A		
Output signals	Open collector	<b>ALM</b> <b>Alarm output</b>	Low when the inverter protective function is activated and High when the inverter is not in error. (*2)	The terminal functions change with output terminal function selection (Pr. 64, Pr. 506). (*4)	Permissible load 24VDC 0.1A
		<b>RUN</b> <b>Inverter running</b>	Low when the inverter output frequency is the starting frequency or higher (factory-set to 0.5Hz and changeable), and High during stop or DC injection brake operation. (*2)		Permissible load 24VDC 0.1A
	<b>SE</b> <b>Open collector common</b>	Common terminal for inverter running terminal RUN. Isolated from terminal SD.		—	

Symbol	Terminal Name	Description	Rating Specifications
Communication —	<b>RS-485 connector</b>	<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>	—

- \*1. Do not connect terminals SD and PC each other or to the ground.  
For sink logic (factory setting), terminal SD acts as the common terminal of contact input. For source logic, terminal PC acts as the common terminal of contact input. (Refer to page 12 for the way to switch between them.)
- \*2. Low indicates that the open collector output transistor is on (conducts). High indicates that the transistor is off (does not conduct).
- \*3. RL, RM, RH, MRS, OH, RES, STF, STR, SQ signal, without function selection (Refer to page 68 for input terminal function selection.)
- \*4. RUN, OL, ALM signal, without function selection (Refer to page 69 for output terminal function selection.)

## 1.7.2 Layout and wiring of the control circuit terminals

Control circuit terminal block	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td>STF</td><td>STR</td><td>RL</td><td>RM</td><td>RH</td><td>SQ</td><td>RUN</td><td>ALM</td> </tr> </table>	STF	STR	RL	RM	RH	SQ	RUN	ALM	<p>Cable stripping size</p> 
	STF	STR	RL	RM	RH	SQ	RUN	ALM		
<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td>SD</td><td>PC</td><td>SE</td> </tr> </table>	SD	PC	SE							
SD	PC	SE								
<p>Loosen the terminal screw and insert the cable into the terminal.</p> <p>☞ Screw size: M3 (SD, PC, SE terminals), M2 (other than on the left)</p> <p>☞ Tightening torque: 0.5N•m to 0.6N•m (SD, PC, SE terminals) 0.22N•m to 0.25N•m (other than the above)</p> <p style="text-align: center;"><b>CAUTION</b></p> <p><b>Undertightening can cause cable disconnection or malfunction. Overtightening can cause a short circuit or malfunction due to damage to the screw or unit.</b></p> <p>☞ Cable size: 0.3mm<sup>2</sup> to 0.75mm<sup>2</sup></p> <p>☞ Screwdriver: Small  screwdriver (Tip thickness: 0.4mm/tip width: 2.5mm)</p>		<p>Wire the stripped cable after twisting it to prevent it from becoming loose. In addition, do not solder it. *</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">ℓ (mm)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">SD, PC, SE terminals</td> <td style="text-align: center;">6</td> </tr> <tr> <td style="text-align: center;">Other than the above</td> <td style="text-align: center;">5</td> </tr> </tbody> </table>		ℓ (mm)	SD, PC, SE terminals	6	Other than the above	5		
	ℓ (mm)									
SD, PC, SE terminals	6									
Other than the above	5									

\*Information on bar terminals

Introduced products (as of April, '02): Phoenix Contact Co., Ltd.

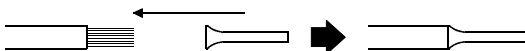
Terminal Screw Size	Bar Terminal Model (With insulating sleeve)	Bar Terminal Model (Without insulating sleeve)	Wire Size (mm <sup>2</sup> )
<b>M3 (SD, PC, SE terminals)</b>	AI 0.5-6WH	A 0.5-6	0.3 to 0.5
	AI 0.75-6GY	A 0.75-6	0.5 to 0.75
<b>M2 (other than above)</b>	AI 0.5-6WH	A 0.5-6	0.3 to 0.5

☞ Bar terminal crimping tool: CRIMPFOX ZA3 (Phoenix Contact Co., Ltd.)

- 1) Terminals SD and SE are common terminals of the I/O signals. Do not earth (ground) these common terminals.
- 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 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.

### CAUTION

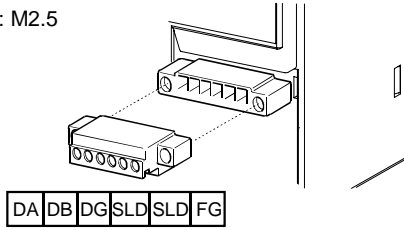
When using the bar terminal (without insulating sleeve), use care so that the twisted wires do not come out.



### 1.7.3 Layout and wiring of the CC-Link terminals

The terminal block is laid out as shown below.

Terminal screw size: M2.5

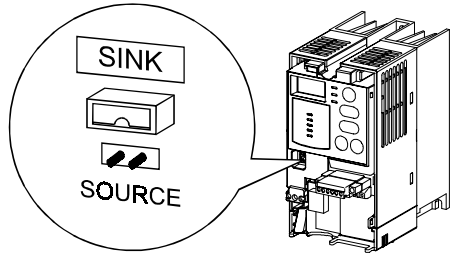


Refer to page 36 for details.

## 1.7.4 Changing the control logic

The input signals are set to sink logic. To change the control logic, the jumper connector must be moved to the other position.

- Change the jumper connector position using tweezers, a pair of long-nose pliers, etc. Change the jumper connector position before switching power on.

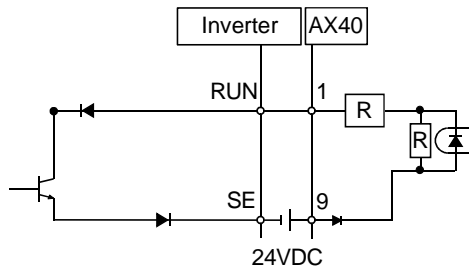
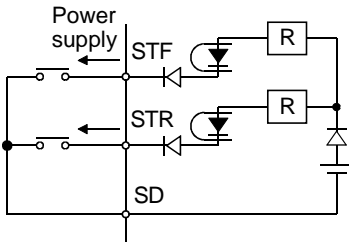


### CAUTION

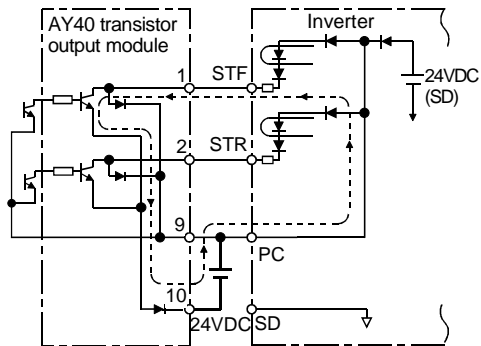
- Make sure that the front cover is installed securely.
- The front cover is fitted with the capacity plate and the inverter unit with the rating plate. Since these plates have the same serial numbers, always replace the removed cover onto the original inverter.
- The sink-source logic change-over connector must be fitted in only one of those positions. If it is fitted in both positions at the same time, the inverter may be damaged.

#### 1) 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 open collector output signals.



- Connecting a positive external power supply for transistor output to terminal PC prevents a malfunction caused by an undesirable current. (Do not connect terminal SD of the inverter with terminal 0V of the external power supply. When using terminals PC-SD as a 24VDC power supply, do not install an external power supply in parallel with the inverter. Doing so may cause a malfunction in the inverter due to an undesirable current.)

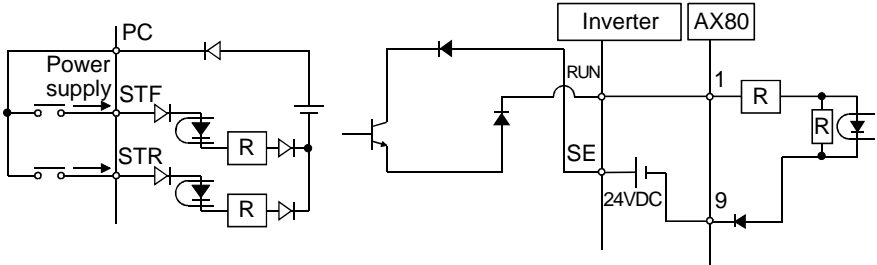


--- Current flow

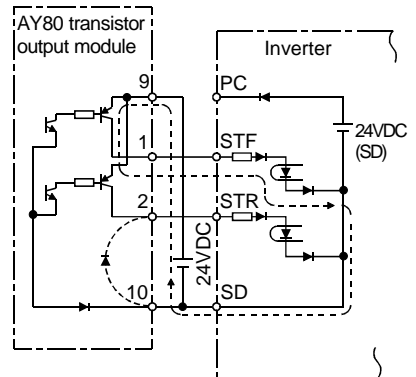
## 2) Source logic type

- In this logic, a signal switches on when a current flows into the corresponding signal input terminal.

Terminal PC is common to the contact input signals. For the open collector output signals, terminal SE is a positive external power supply terminal.

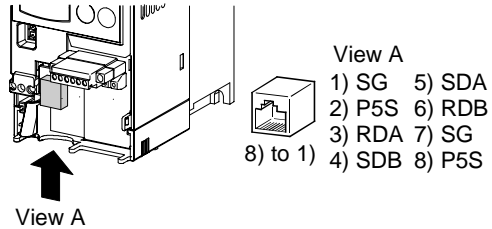


- Connecting the 0V terminal of the external power supply for transistor output to terminal SD prevents a malfunction caused by an undesirable current.



## 1.7.5 RS-485 Connector

<RS-485 connector pin layout>  
View A of the inverter (receptacle side)



### CAUTION

1. Do not plug the connector to a computer LAN board, fax modem socket, telephone modular connector, etc. As they are different in electrical specifications, the inverter may be damaged.
2. Pins 2 and 8 (P5S) are provided for the parameter unit power supply. Do not use them for any other purpose or when making parallel connection by RS-485 communication.
3. Refer to page 79 for the communication parameters.

### REMARKS

- The PU connector (PS-485) automatically recognizes whether the FR-PU04 or RS-485 communication is connected.
- Refer to page 38 for wiring of the inverter and computer using user program for RS-485 communication.
- Refer to page 35 for wiring of the inverter and personal computer using GX Developer for RS-485 communication.

## 1.7.6 Connection of the parameter unit (FR-PU04)

Use the FR-CB2 □□ parameter unit connection cable.

### REMARKS

- Refer to page 93 for the parameters related to parameter unit setting.

## 1.8 Input Terminals

### 1.8.1 Run (start) and stop (STF, STR)

To start and stop the motor, first switch on the input power supply of the inverter (switch on the magnetic contactor, if any, in the input circuit during preparation for operation), then start the motor with the forward or reverse rotation start signal.

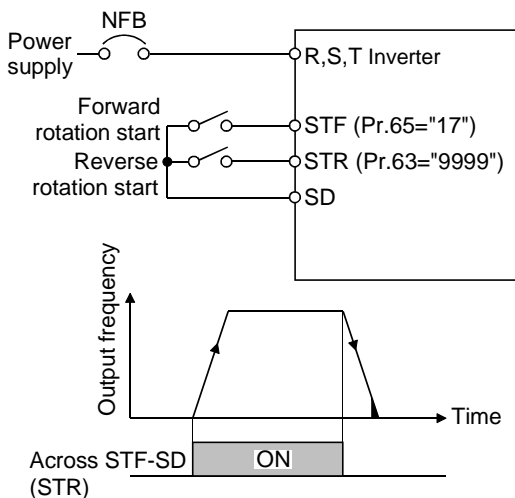
#### POINT

With "1" factory-set in Pr. 507 "inverter operation lock mode setting", the start signal is not enabled unless the SQ signal is on.  
Set "0" in Pr. 507 when performing inverter operation only.  
(Refer to page 138 for Pr. 507.)

#### (1) STF, STR

A connection is shown on the right.

- 1) The forward/reverse rotation signal is used as both the start and stop signals. Switch on either of the forward and reverse rotation signals to start the motor in the corresponding direction. Switch on both or switch off the start signal during operation to decelerate the inverter to a stop.
- 2) The frequency setting signal may be given by setting the required values in Pr. 4 to Pr. 6 "three-speed setting" (high, middle, low speeds), by setting using a sequence ladder, or by setting from CC-Link. (For three-speed operation, refer to page 17.)



#### Connection Example

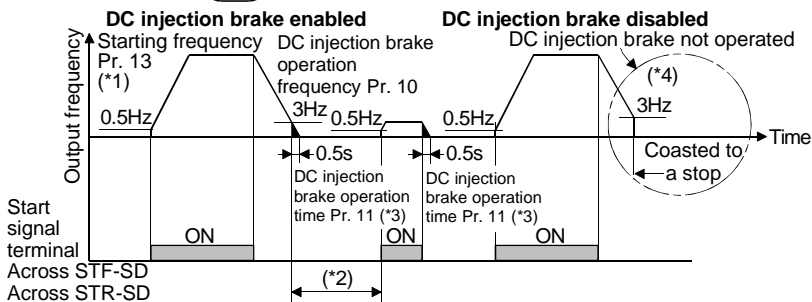
- 3) After the start signal has been input, the inverter starts operating when the frequency setting signal reaches or exceeds the "starting frequency" set in Pr. 13 (factory-set to 0.5Hz). If the motor load torque is large or the "torque boost" set in Pr. 0 is small, the inverter may be overloaded due to insufficient torque. If the "minimum frequency" set in Pr. 2 (factory setting = 0Hz) is 6Hz, for example, merely entering the start signal causes the running frequency to reach the minimum frequency of 6Hz according to the "acceleration time" set in Pr. 7.
- 4) To stop the motor, operate the DC injection brake for the period of "DC injection brake operation time" set in Pr. 11 (factory setting = 0.5s) at not more than the DC injection brake operation frequency or at not more than 0.5Hz. To disable the DC injection brake function, set 0 in either of Pr. 11 "DC injection brake operation time" and Pr. 12 "DC injection brake voltage". In this case, the motor is coasted to a stop at not more than the frequency set in Pr. 10 "DC injection brake operation frequency" (0 to 120Hz variable) or at not more than 0.5Hz (when the DC injection brake is not operated).
- 5) If the reverse rotation signal is input during forward rotation or the forward rotation signal is input during reverse rotation, the inverter is decelerated and then switched to the opposite output polarity without going through the stop mode.



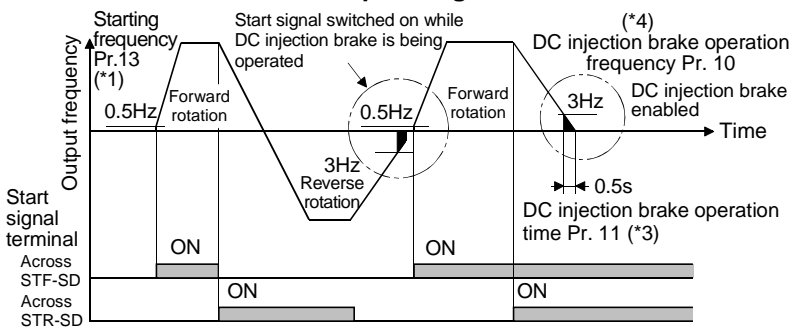
## DC Injection Brake and Coasting to Stop

Operation Mode	External Operation Pr. 79= "0", "2", "3"	PU Operation Pr. 79= "0", "1", "4"		
DC Injection Brake	Terminals STF (STR)-SD disconnected (*1)	Set frequency changed to 0Hz	Stop key	Set frequency changed to 0Hz
<b>DC injection brake enabled</b>	DC injection brake operated at not more than "DC injection brake operation frequency" set in Pr. 10	DC injection brake operated at 0.5Hz or less.	DC injection brake operated at not more than "DC injection brake operation frequency" set in Pr. 10	DC injection brake operated at 0.5Hz or less.
<b>DC injection brake disabled</b>	Coasted to a stop at not more than "DC injection brake operation frequency" set in Pr. 10	Coasted to a stop at 0.5Hz or less.	Coasted to a stop at not more than "DC injection brake operation frequency" set in Pr. 10	Coasted to a stop at 0.5Hz or less.

\*1: Also stopped by the key. Refer to page 71.



**Start/Stop Timing Chart**



**Forward-Reverse Rotation Switch-Over Timing Chart**

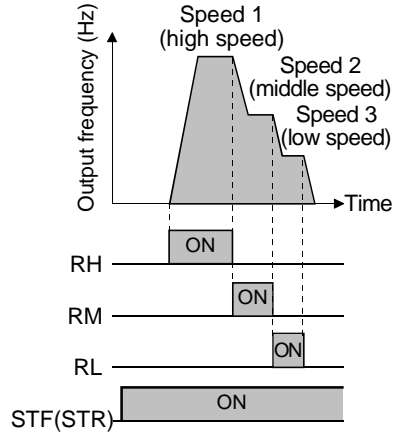
### REMARKS

- \*1. The "starting frequency" in Pr. 13 (factory-set to 0.5Hz) may be set between 0 and 60Hz.
- \*2. If the next start signal is given during DC injection brake operation, the DC injection brake is disabled and restart is made.
- \*3. The "DC injection brake operation time" in Pr. 11 (factory-set to 0.5s) may be set between 0 and 10s.
- \*4. The frequency at which the motor is coasted to a stop is not more than the "DC injection brake operation frequency" set in Pr. 10 (factory setting = 3Hz; may be set between 0 and 120Hz) or not more than 0.5Hz.
- \*5. The "starting frequency" in Pr. 13, "DC injection brake operation time" in Pr. 11 and "DC injection brake operation frequency" in Pr. 10 are the factory-set values.

### 1.8.2 External frequency selection (RH, RM, RL)

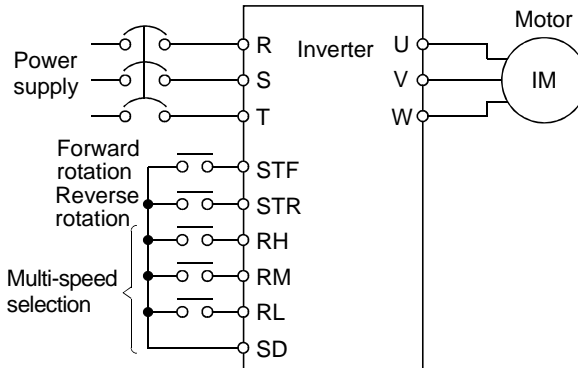
Up to three speeds may be selected for an external command start according to the combination of connecting the multi-speed select terminals RH, RM and RL-SD, and multi-speed operation can be performed as shown on the right by shorting the start signal terminal STF (STR)-SD.

Speeds (frequencies) may be specified as desired as listed below using Pr. 4 to Pr. 6.



Multi-Speed Setting

Speed	Terminal Input			Parameter	Set Frequency Range	Reference Page
	RH-SD	RM-SD	RL-SD			
Speed 1 (high speed)	ON	OFF	OFF	Pr.4	0 to 120Hz	59
Speed 2 (middle)	OFF	ON	OFF	Pr.5	0 to 120Hz	
Speed 3 (low speed)	OFF	OFF	ON	Pr.6	0 to 120Hz	



Multi-Speed Operation Connection Example

**CAUTION**

For three-speed setting, selection of two or more speeds sets the frequency of the lower speed signal.

### 1.8.3 Control circuit common terminals (SD, SE)

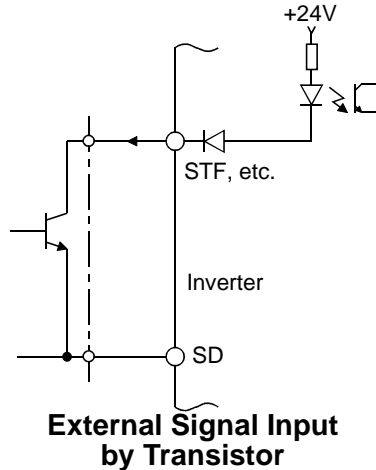
Terminals SD and SE are both common terminals (0V) for I/O terminals and are isolated from each other.

Terminal SD is a common terminal for the contact input terminals (STF, STR, RH, RM, RL, SQ).

Terminal SE is a common terminal for the open collector output terminals (RUN, ALM).

### 1.8.4 Signal inputs by contactless switches

If a transistor is used instead of a contacted switch as shown on the right, the input signals of the inverter can control terminals STF, STR, RH, RM, RL, SQ.



**External Signal Input by Transistor**

#### REMARKS

- When using an external transistor connected with the external power supply, use terminal PC to prevent a malfunction from occurring due to a leakage current. (Refer to page 12.)
- Note that an SSR (solid-state relay) has a relatively large leakage current at OFF time and it may be accidentally input to the inverter.

## 1.9 How to Use the Input Signals (Assigned Terminals RL, RM, RH, STR, SQ)

These terminals can be changed in function by setting Pr. 60 to Pr. 63, Pr. 65, Pr. 505.

Pr. 60 "RL terminal function selection"	<b>Page 68</b>
Pr. 61 "RM terminal function selection"	
Pr. 62 "RH terminal function selection"	
Pr. 63 "STR terminal function selection"	
Pr. 65 "STF terminal function selection"	
Pr. 505 "SQ terminal function selection"	

### 1.9.1 Multi-speed setting (RL, RM, RH signals): Pr. 60 to Pr. 63, Pr. 65, Pr. 505 setting "0, 1, 2"

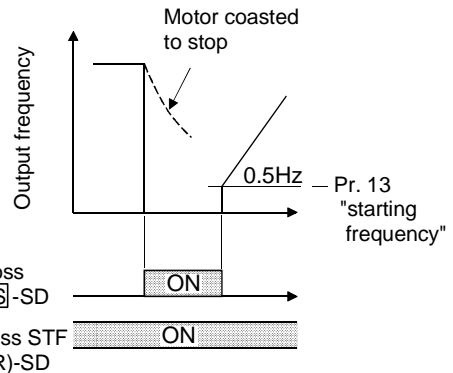
- By entering frequency commands into the RL, RM and RH signals and turning on/off the corresponding signals, you can perform multi-speed operation (three speeds). (For details, refer to page 17.)

### 1.9.2 Output shut-off (MRS signal): Pr. 60 to Pr. 63, Pr. 65, Pr. 505 setting "6"

Short the output stop terminal MRS-SD during inverter output to cause the inverter to immediately stop the output. Open terminals MRS-SD to resume operation in about 10ms. Terminal MRS may be used as described below:

#### (1) To stop the motor by mechanical brake (e.g. electromagnetic brake)

Terminals MRS-SD must be shorted when the mechanical brake is operated and be opened before motor restart.



#### (2) To provide interlock to disable operation by the inverter

After MRS-SD have been shorted, the inverter cannot be operated if the start signal is given to the inverter.

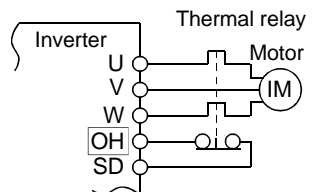
#### (3) To coast the motor to stop

The motor is decelerated according to the preset deceleration time and is stopped by operating the DC injection brake at 3Hz or less. By using terminal MRS, the motor is coasted to a stop.

### 1.9.3 External thermal relay input: Pr. 60 to Pr. 63, Pr. 65, Pr. 505 setting "7"

When the external thermal relay or thermal relay built in the motor (e.g. thermal protector) is actuated, the inverter output is shut off and an alarm signal is given to keep the motor stopped to protect the motor from overheat. If the thermal relay contact is reset, the motor is not restarted unless the reset terminal RES-SD are shorted for more than 0.1s and then opened or power-on reset is performed.

The function may therefore be used as an external emergency stop signal input.



### 1.9.4 Reset signal: Pr. 60 to Pr. 63, Pr. 65, Pr. 505 setting "10"

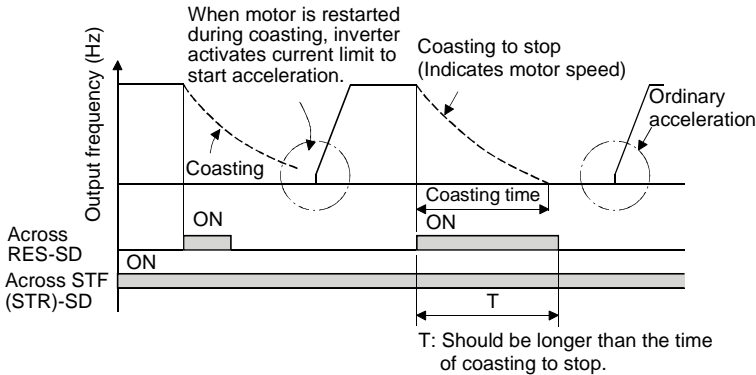
Used to reset the alarm stop state established when the inverter's protective function is activated. The reset signal immediately sets the control circuit to the initial (cold) status, e.g. initializes the electronic overcurrent protection circuit. It shuts off the inverter output at the same time. During reset, the inverter output is kept shut off. To give this reset input, short terminals RES-SD for more than 0.1s. When the shorting time is long, the operation panel or parameter unit displays the initial screen, which is not a fault.

Operation is enabled after terminals RES-SD are opened (after about 1s).

The reset terminal is used to reset the inverter alarm stop state. If the reset terminal is shorted, then opened while the inverter is running, the motor may be restarted during coasting (refer to the timing chart below) and the output may be shut off due to overcurrent or overvoltage.

Setting either of "1" and "15" in reset selection Pr. 75 allows the accidental input of the reset signal during operation to be ignored.

(For details, refer to page 71.)



#### CAUTION

Frequent resetting will make electronic overcurrent protection invalid.

### 1.9.5 Start (forward rotation) signal: Pr. 65 setting "17"

Turn the signal on or off to bring the motor to a forward rotation start or stop.

(Refer to page 15 for details.)

### **1.9.6 Sequence start:** Pr. 60 to Pr. 63, Pr. 65, Pr. 505 setting "50"

Used to execute/stop (RUN/STOP) the built-in PLC function.  
Short SQ-SD to execute (RUN) and open SQ-SD to stop (STOP).  
Refer to page 100 for details.

### **1.9.7 No function:** Pr. 60 to Pr. 63, Pr. 65, Pr. 505 setting "9998"

Disables the input terminal functions.

#### **REMARKS**

Refer to page 127 for the no function setting of the external terminal inputs in device D9149 "inverter operation status control enable/disable setting".

### **1.9.8 Start (reverse rotation) signal:** Pr. 63 setting "9999"

Turn the signal on or off to bring the motor to a reverse rotation start or stop.  
(Refer to page 15 for details.)

## 1.10 Peripheral Devices

### 1.10.1 Peripheral device list

**Selection of peripheral devices (Selection changes depending on the power input specifications of the inverter.)**

- FR-C520-0.1K to 3.7K

Motor Output (kW)	Inverter Model	No-Fuse Breaker (NFB *1) or Earth Leakage Circuit Breaker (ELB) (*4)	Power Factor Improving AC Reactor	Power Factor Improving DC Reactor	Magnetic Contactor (MC)	Cables (mm <sup>2</sup> ) (*2)	
						R, S, T	U, V, W
0.1	FR-C520-0.1K	30AF/5A	FR-BAL-0.4K (*3)	FR-BEL-0.4K (*3)	S-N10	2	2
0.2	FR-C520-0.2K	30AF/5A	FR-BAL-0.4K (*3)	FR-BEL-0.4K (*3)	S-N10	2	2
0.4	FR-C520-0.4K	30AF/5A	FR-BAL-0.4K	FR-BEL-0.4K	S-N10	2	2
0.75	FR-C520-0.75K	30AF/10A	FR-BAL-0.75K	FR-BEL-0.75K	S-N10	2	2
1.5	FR-C520-1.5K	30AF/15A	FR-BAL-1.5K	FR-BEL-1.5K	S-N10	2	2
2.2	FR-C520-2.2K	30AF/20A	FR-BAL-2.2K	FR-BEL-2.2K	S-N10	2	2
3.7	FR-C520-3.7K	30AF/30A	FR-BAL-3.7K	FR-BEL-3.7K	S-N20, S-N21	3.5	3.5

\*1. Choose the NFB type that meets the power supply capacity.

\*2. The sizes of the cables assume that the wiring length is 20m.

\*3. The power factor may be slightly less.

\*4. For installations in the United States or Canada, select the UL/cUL-listed breaker.

#### REMARKS

Secondary side measuring instruments

If the wiring length between the inverter and motor is long, the measuring instruments and CT may generate heat due to line-to-line leakage currents. Therefore, select the devices that have sufficient current ratings.

### 1.10.2 Leakage current and installation of earth (ground) leakage circuit breaker

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

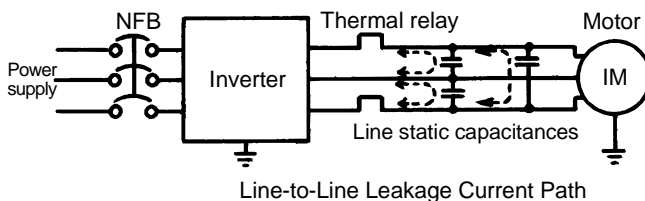
#### (1) To-earth (ground) leakage currents

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

- Countermeasures
  - If the carrier frequency setting is high, decrease the carrier frequency (Pr. 72) of the inverter.
  - Note that motor noise increases.
  - Using earth leakage circuit breakers designed for harmonic and surge suppression in the inverter's own line and other line, operation can be performed with the carrier frequency kept high (with low noise).

## (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.
  - To ensure that the motor is protected against line-to-line leakage currents, it is recommended to use a temperature sensor to directly detect motor temperature.
- Installation and selection of no-fuse breaker
 

On the power receiving side, install a no-fuse breaker (NFB) to protect the primary wiring of the inverter. Which NFB to choose depends on the power supply side power factor (which changes with the power supply voltage, output frequency and load) of the inverter. Especially as the completely electromagnetic type NFB changes in operational characteristic with harmonic currents, you need to choose the one of a little larger capacity. (Check the data of the corresponding breaker.) For the earth leakage circuit breaker, use our product designed for harmonic and surge suppression. (Refer to page 25 for the recommended models.)

### CAUTION

- Choose the NFB type according to the power supply capacity.
- To protect the motor from overheat, the inverter has protective functions with electronic thermal relay. However, when operating two or more motors with a single inverter or running a multi-pole motor, for example, provide an overcurrent relay (OCR) between the inverter and motor. In this case, set the electronic thermal relay of the inverter for 0A, and set the overcurrent relay for 1.0 time the current value at 50Hz on the motor rating plate, or 1.1 times the current value at 60Hz, plus the line-to-line leakage current.



### (3) Selecting the rated sensitivity current for the earth (ground) leakage breaker

#### CAUTION

- On the power receiving side, install a no-fuse breaker (NFB) to protect the primary wiring of the inverter. Selection of NFB depends on the power supply side power factor (which changes with the power supply voltage, output frequency and load) of the inverter. Especially as the completely electromagnetic type NFB changes in operational characteristic with harmonic currents, you need to choose the one of a little larger capacity. For the earth (ground) leakage circuit breaker, use our product designed for harmonic and surge suppression.

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

- Products designed for harmonic and surge suppression

Rated sensitivity current

$$I_{\Delta n} \geq 10 \times (I_{g1} + I_{gn} + I_{g2} + I_{gm})$$

- General products

Rated sensitivity current

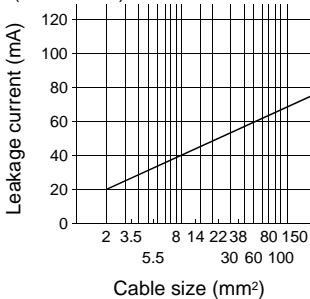
$$I_{\Delta n} \geq 10 \times \{I_{g1} + I_{gn} + 3 \times (I_{g2} + I_{gm})\}$$

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

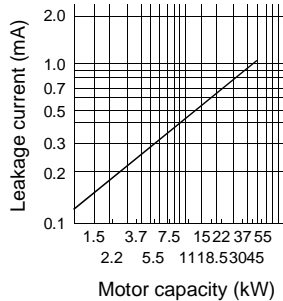
$I_{gn}^*$ : Leakage current of noise filter on inverter input side

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

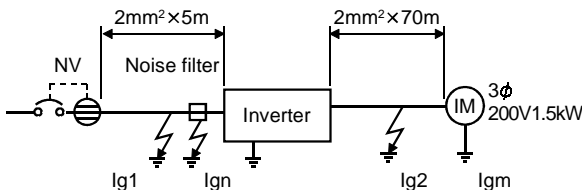
Example of leakage current per 1km in cable path during commercial power supply operation when the CV cable is routed in metal conduit (200V 60Hz)



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



<Example>



**CAUTION**

- The earth (ground) leakage circuit breaker should be installed to the primary (power supply) side of the inverter.
- In the  $\Delta$  connection neutral point grounding system, the sensitivity current becomes worse for earth (ground) faults in the inverter secondary side. Hence, the protective earthing (grounding) of the load equipment should be  $10\Omega$  or less.
- When the breaker is installed in 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 and hysteresis loss increase and the temperature rises.
- General products indicate the following models: BV-C1, BC-V, NVB, NV-L, NV-G2N, NV-G3NA, NV-2F, earth (ground) leakage relay (except NV-ZH), NV with single-phase, three-wire neutral conductor/open-phase protection  
The other models are designed for harmonic and surge suppression:NV-C/ NV-S/MN series, NV30-FA, NV50-FA, BV-C2, earth leakage alarm breaker, NV-ZH

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

	Product designed for harmonic and surge suppression	General product
Leakage current $I_{g1}$ (mA)	$20 \times \frac{5m}{1000m} = 0.10$	
Leakage current $I_{gn}$ (mA)	0 (without noise filter)	
Leakage current $I_{g2}$ (mA)	$20 \times \frac{70m}{1000m} = 1.40$	
Motor leakage current $I_{gm}$ (mA)	0.14	
Total leakage current (mA)	1.66	4.78
Rated sensitivity current (mA) ( $\geq I_g \times 10$ )	30	100

### 1.10.3 Power-off and magnetic contactor (MC)

#### (1) Inverter's primary side magnetic contactor (MC)

On the inverter's primary side, it is recommended to provide an MC for the following purposes (refer to page 22 for selection):

- 1) To release the inverter from the power supply when the inverter's protective function is activated or when the drive is not functioning (e.g. emergency stop operation).
- 2) When the external terminal (terminal STF or STR) is used for operation, provide an MC in the primary side to prevent an accident caused by an automatic restart made at power restoration after an instantaneous power failure, etc. and to ensure safety during maintenance work. When the parameter unit is used for operation, an MC cannot be used to make a start since an automatic restart is not made after power restoration. Though the inverter can be stopped with the primary side MC, it is coasted to a stop.
- 3) To rest the inverter for a long time.  
The control power supply for inverter is always running and consumes a little power. When stopping the inverter for a long time, switching inverter power off saves power slightly.
- 4) To separate the inverter from the power supply to ensure safety of maintenance/inspection work.  
As the inverter's primary MC is used for the above purposes, select the one of class JEM1038-AC3 for the inverter input side current when making an emergency stop during normal operation.

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#### CAUTION

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**Do not start and stop the inverter frequently using a magnetic contactor. Such operation can cause the inverter to fail. (The switching life in the inverter input circuit is about 100,000 times).**

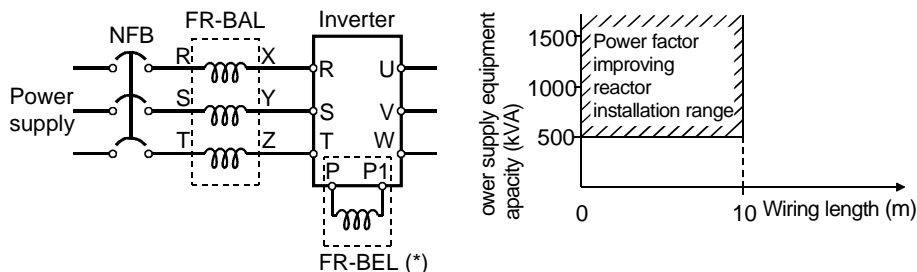
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#### (2) Handling of the inverter's secondary side magnetic contactor

In principle, a magnetic contactor provided between the inverter and motor should not be switched from OFF to ON during operation. Doing so may cause a large inrush current to flow, leading to a stop due to overcurrent shutoff. If an MC is provided for such purposes as switch-over to a commercial power supply, the MC should be switched on/off after the inverter and motor have stopped.

### 1.10.4 Regarding the installation of the power factor improving reactor

When the inverter is installed near a large-capacity power transformer (500kVA or more at the wiring length of 10m or less) or the power capacitor is to be switched, an excessive peak current will flow in the power supply input circuit, damaging the converter circuit. In such a case, always install the power factor improving reactor (FR-BEL or FR-BAL).



#### REMARKS

- \* When connecting the FR-BEL, remove the jumper across terminals P<+>-P1.  
The wiring length between FR-BEL and inverter should be 5m maximum and as short as possible.  
Use the cables which are equal in size to those of the main circuit. (Refer to page 6)

#### CAUTION

- The power factor improving capacitor and surge suppressor on the inverter output side may be overheated or damaged by the harmonic components of the inverter output. Also, since an excessive current flows in the inverter to activate overcurrent protection, do not insert a capacitor and surge suppressor. Use a power factor improving reactor for power factor improvement.
- If a surge voltage occurs in the power supply system, this surge energy may flow into the inverter, causing the inverter to display OV1, OV2 or OV3 and come to an alarm stop. In such a case, also install the optional FR-BEL or FR-BAL power factor improving reactor.

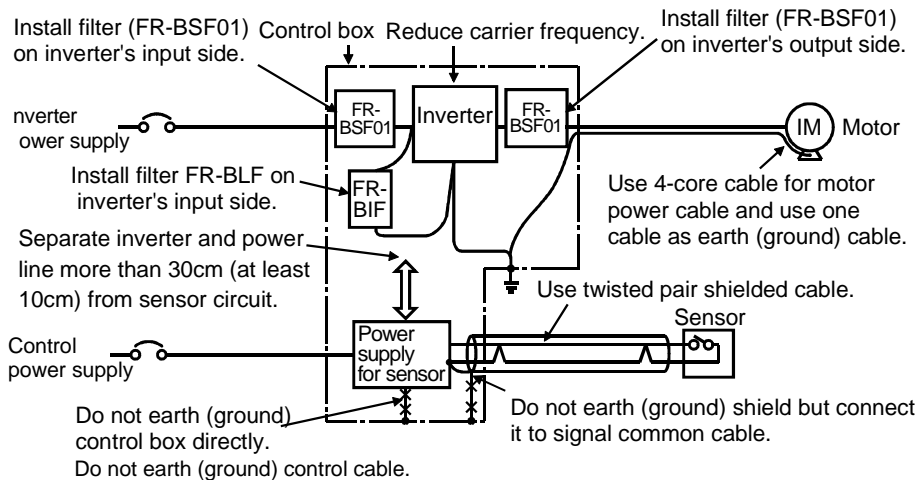
### 1.10.5 Regarding noises and the installation of the noise filter

Some noises enter the inverter causing it to malfunction and others are generated by the inverter causing peripheral devices to malfunction. Though the inverter is designed to be insusceptible to noises, it handles low-level signals, so it requires the following general countermeasures to be taken.

#### (1) General countermeasures

- Do not run the power cables (I/O cables) and signal cables of the inverter in parallel with each other and do not bundle them.
- Use twisted shield cables for the detector connecting and control signal cables and connect the sheathes of the shield cables to terminal SD.
- Earth (Ground) the inverter, motor, etc. at one point.
- Capacitances exist between the inverter's I/O wiring, other cables, earth (ground) and motor, through which leakage currents flow to cause the earth (ground) leakage circuit breaker, earth (ground) leakage relay and external thermal relay to operate unnecessarily. To prevent this, take appropriate measures, e.g. set the carrier frequency in Pr. 72 to a low value, use an earth (ground) leakage circuit breaker designed for suppression of harmonics and surges, and use the electronic overcurrent protection built in the inverter.
- The input and output of the inverter main circuit include high-degree harmonics, which may disturb communication devices (AM radios) and sensors used near the inverter. In this case, disturbance can be reduced by mounting the FR-BIF radio noise filter (for input side only) or FR-BSF01 line noise filter (for input side only) or FR-BSF01 line noise filter.

Noise reduction technique examples



### 1.10.6 Power harmonics

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

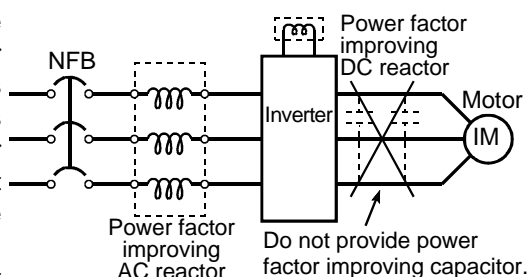
●The following table indicates differences between harmonics and noise:

Item	Harmonics	Noise
Frequency	Normally 40th to 50th degrees or less (up to 3kHz or less)	High frequency (several 10kHz to 1GHz order)
Environment	To-electric channel, power impedance	To-space, distance, wiring path
Quantitative understanding	Theoretical calculation possible	Random occurrence, quantitative grasping difficult
Generated amount	Nearly proportional to load capacity	Change with current variation ratio (larger as switching speed increases)
Affected equipment immunity	Specified in standard per equipment	Different depending on manufacturer's equipment specifications
Suppression example	Provide reactor	Increase distance

#### ●Suppression technique

Harmonic currents produced on the power supply side by the inverter change with such conditions as whether there are wiring impedances and a power factor improving reactor and the magnitudes of output frequency and output current on the load side.

For the output frequency and output current, we understand that they should be calculated in the conditions under the rated load at the maximum operating frequency.



#### CAUTION

The power factor improving capacitor and surge suppressor on the inverter output side may be overheated or damaged by the harmonic components of the inverter output. Also, since an excessive current flows in the inverter to activate overcurrent protection, do not provide a capacitor and surge suppressor on the inverter output side when the motor is driven by the inverter. To improve the power factor, insert a power factor improving reactor in the inverter's primary side or DC circuit. For more detailed information, refer to page 27.

### 1.10.7 Power 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 harmonics.

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

The "harmonic suppression guideline for household appliances and general-purpose products" issued by Ministry of Economy, Trade and Industry (formerly Ministry of International Trade and Industries) in September, 1994 applies to the FR-C500 series. By installing the FR-BEL or FR-BAL power factor improving reactor, this product complies with the "harmonic suppression techniques for transistorized inverters (input current 20A or less)" established by the Japan Electrical Manufacturers' Association.

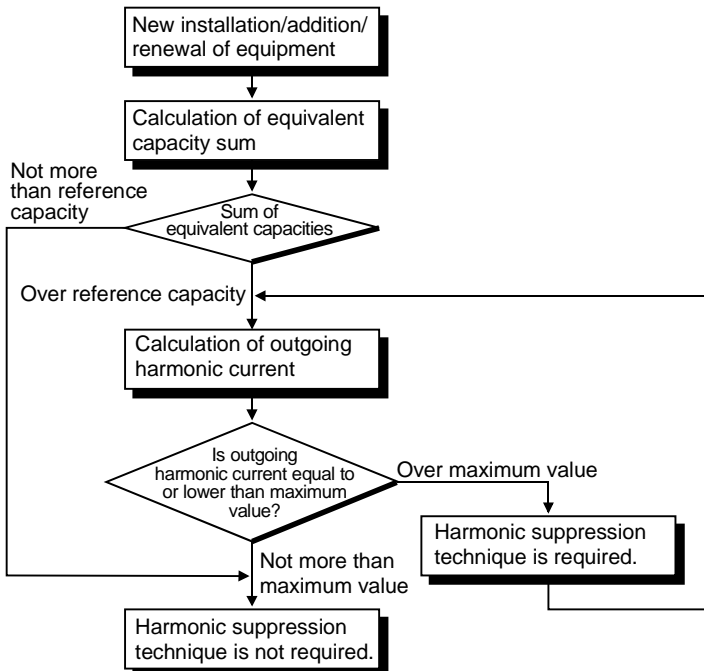
2) [Harmonic suppression guideline for specific consumers]

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
22kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33kV	1.2	0.86	0.55	0.46	0.35	0.32	0.26	0.24

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



**Table 2 Conversion Factors for FR-C<sub>500</sub> 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

**Table 3 Equivalent Capacity Limits**

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

**Table 4 Harmonic Content (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 P<sub>0</sub> 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:

$$P_0 = \sum (K_i \times P_i) \text{ [kVA]}$$

K<sub>i</sub>: Conversion factor (refer to Table 2)

P<sub>i</sub>: 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 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 contents: Found in Table 4.




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

Applied Motor (kW)	Rated Current [A]	6.6kV Fundamental Wave Current Converted (mA)	Rated Capacity (kVA)	Outgoing Harmonic Current Converted from 6.6kV (mA) (No reactor, 100% operation ratio)								
	400V			5th	7th	11th	13th	17th	19th	23rd	25th	
0.4	0.81	49	0.57	31.85	20.09	4.165	3.773	2.107	1.519	1.274	0.882	
0.75	1.37	83	0.97	53.95	34.03	7.055	6.391	3.569	2.573	2.158	1.494	
1.5	2.75	167	1.95	108.6	68.47	14.20	12.86	7.181	5.177	4.342	3.006	
2.2	3.96	240	2.81	156.0	98.40	20.40	18.48	10.32	7.440	6.240	4.320	
3.7	6.50	394	4.61	257.1	161.5	33.49	30.34	16.94	12.21	10.24	7.092	

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.

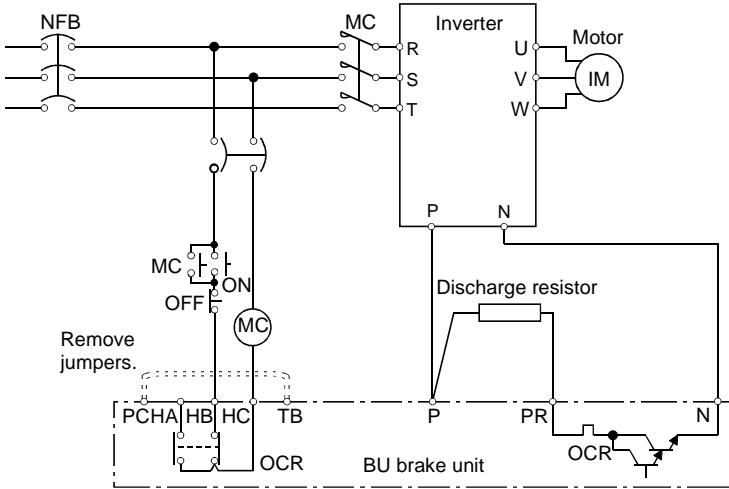
4) Harmonic suppression techniques

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	Installation of power factor improving capacitor	When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents.
3	Transformer multi-phase operation	Use two transformers with a phase angle difference of 30° as in  -Δ, Δ-Δ combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
4	AC filter	A capacitor and a reactor are used together to reduce impedances at specific frequencies, producing a great effect of absorbing harmonic currents.
5	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.

## 1.11 Connection of Stand-Alone Option Units

### 1.11.1 Connection of the conventional BU brake unit (option)

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

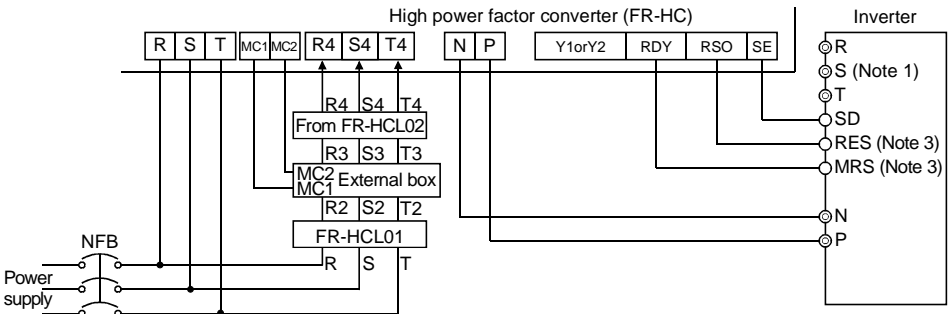


### CAUTION

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 can be extremely hot, causing a fire. Therefore, install a magnetic contactor on the inverter's power supply side to shut off a current in case of failure.

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

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

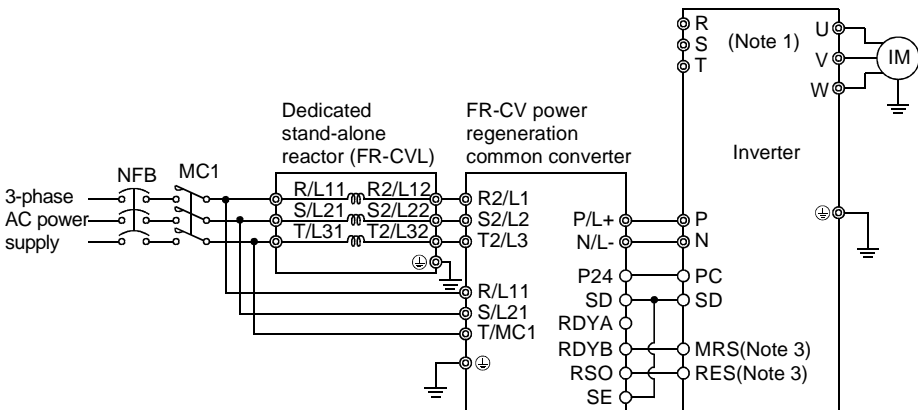


**CAUTION**

1. Always keep the power input terminals R, S and T open. Incorrect connection will damage the inverter. Opposite polarity of terminals N/-, P/+ will damage the inverter.
2. The voltage phases of terminals R, S, T and terminals R4, S4, T4 must be matched before connection.
3. Use Pr. 60 to Pr. 63, Pr. 65 and Pr. 505 (input terminal function selection) to assign the terminals used for the MRS and RES signals.
4. When the FR-HC is connected, use sink logic (factory setting). For source logic, the FR-HC cannot be connected.

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

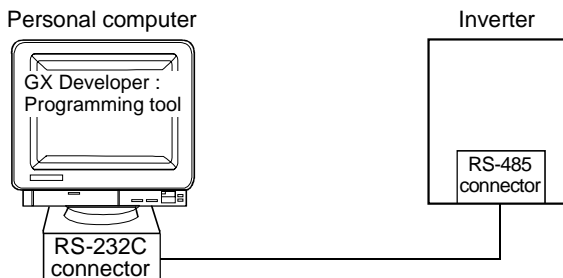
When connecting the FR-CV power regeneration common converter, connect the inverter terminals (P/+, N/-) and FR-CV power regeneration common converter terminals as shown below so that their symbols match with each other.



**CAUTION**

1. Always keep R/L1, S/L2 and T/L3 of the inverter open. Incorrect connection will damage the inverter. Opposite polarity of terminals N/-, P/+ will damage the inverter.
2. The voltage phases of terminals R/L11, S/L21, T/MC1 and terminals R2/L1, S2/L2, T2/L3 must be matched before connection.
3. Use Pr. 60 to Pr. 63, Pr. 65 and Pr. 505 (input terminal function selection) to assign the terminals used for the RES and MRS signals.

## 1.12 Wiring of the Inverter and Personal Computer Using GX Developer for RS-485 Communication



- Personal computer - inverter connection cable  
Make connection after conversion between RS-232C and RS-485.

Examples of commercially available products (as of April, '02)

Type	Maker
FA-T-RS40□ (with connectors and cable)	Mitsubishi Electric Engineering Co., Ltd.

\*The telephone numbers are subject to change without notice.

### REMARKS

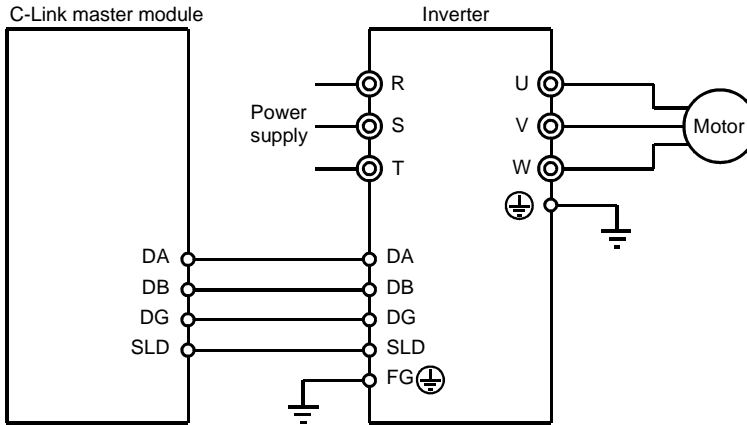
When fabricating the cable on the user side, refer to page 39.

- Refer to page 98 for details of the PLC function.

## 1.13 Wiring for CC-Link Communication

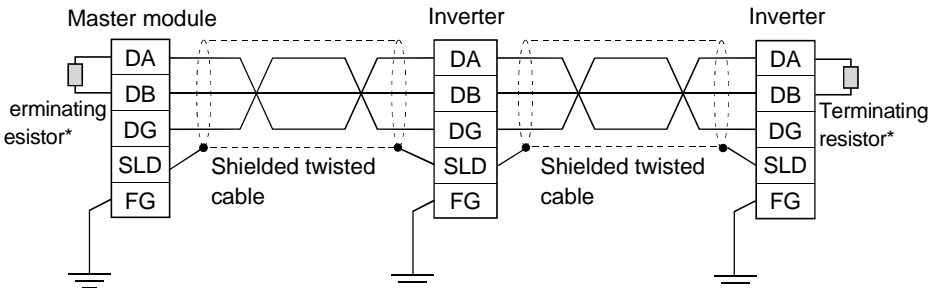
### (1) Wiring method

Wiring of the inverter and CC-Link master module is shown below.



### (2) Connection of multiple inverters

Multiple inverters can be Factory-Automated by sharing a link system as one remote device station of CC-Link and monitoring control with a PLC user program.



\*Use the terminating resistors supplied with the PLC.

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

When there are other modules, the following conditions must be satisfied since the number of occupied stations changes depending on the modules.

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

a: Number of one-station occupying modules    c: Number of three-station occupying modules

b: Number of two-station occupying modules    d: Number of four-station occupying modules

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

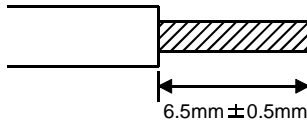
A: Number of remote I/O stations  $\leq 64$  stations

B: Number of remote device stations  $\leq 42$  stations

C: Number of local, standby master and intelligent device stations  $\leq 26$  stations

### (3) Wiring method

- 1) Use CC-Link dedicated cables and strip off their sheaths. A too long strip-off length may cause a short circuit with the adjacent cable. A tool short strip-off length may cause the cable to come off. Use the recommended cable. For details, refer to the CC-Link catalog or visit the MELFANSweb home page of Mitsubishi Electric FA Equipment Technology Information Service at <http://www.nagoya.melco.co.jp/>. (Introduced in Product details (FA network) - CC-Link.)  
Recommended tightening torque: 0.22N•m to 0.25N•m  
Use a small screwdriver (tip thickness: 0.6mm/overall length: 3.5mm).



### (4) Recommendation of bar terminal

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

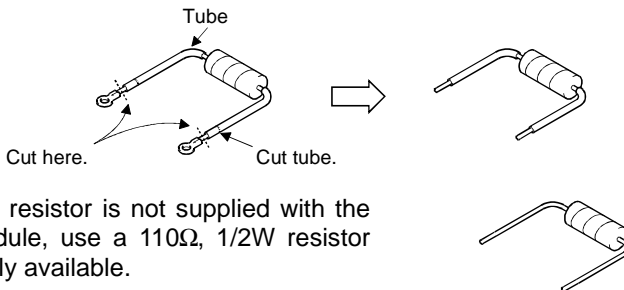
The following terminal and tool are recommended for use of bar terminals.

- 1) Recommended bar terminal, crimping tool
  - Contact: Phoenix Contact Co., Ltd....045-931-5602
  - Bar terminal type: AI-TWIN2×0.5-8WH
  - Crimping tool type: CRIMPFOX UD6, ZA3

#### 2) Connection of terminating resistor

Connect a terminating resistor between terminals DA-DB of the inverter at a termination.

Use the terminating resistor supplied with the PLC master module after working on it.

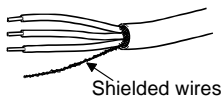


Note: If the resistor is not supplied with the master module, use a 110Ω, 1/2W resistor commercially available.

#### 3) Connection of the shielded wires of the CC-Link dedicated cable

Connect the shielded wires of the CC-Link dedicated cable to terminal SLD after twisting them.

Shielded wires



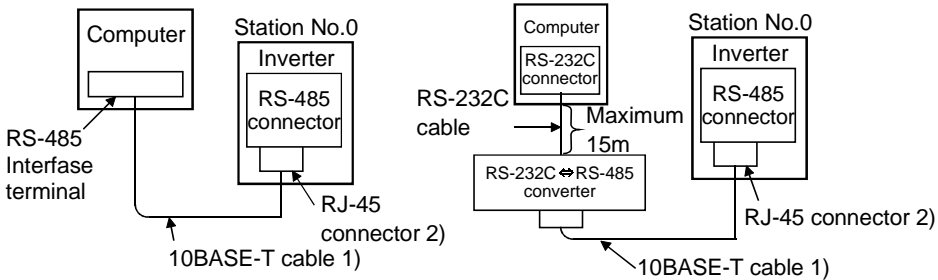
Note: The two SLD terminals are connected inside the inverter.

●Refer to page 140 for details of CC-Link communication.

## 1.14 Wiring of the Inverter and Computer Using RS-485 communication

☞ Refer to page 79 for the setting related to RS-485 communication operation.  
 <System configuration example>

### (1) Connection of a computer to the inverter (one-to-one connection)



#### ●Computer - inverter connection cable

For a connection cable between the computer having RS-232C and the inverter (RS-232C  $\leftrightarrow$  RS-485 converter), refer to the table below.

Examples of commercially available products (as of July, '02)

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

\* You can not connect multiple inverters with a converter cable (a computer and an inverter are one-to-one connection). As the RS-232C cable and the RS-485 cable (10BASE-T+RJ-45 connector) are provided with a product, no need to prepare a cable and a connector separately. Contact a maker for details of the product.

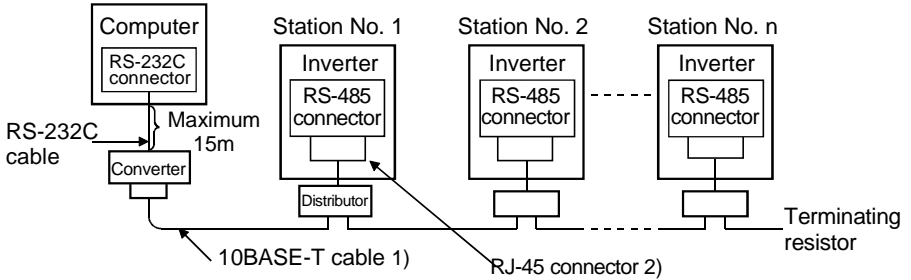
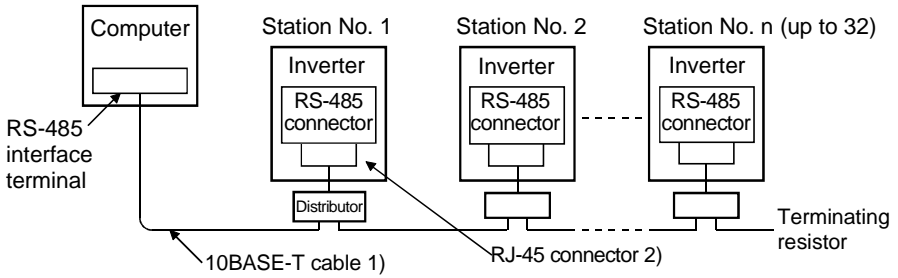
### REMARKS

When fabricating the cable on the user side, see below.

Examples of commercially available products (as of July, '02)

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

## (2) Connection of a computer to multiple inverters (one-to-n connection)



### REMARKS

When fabricating the cable on the user side, see below.

Examples of commercially available products (as of July, '02)

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

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



# 1.15 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.

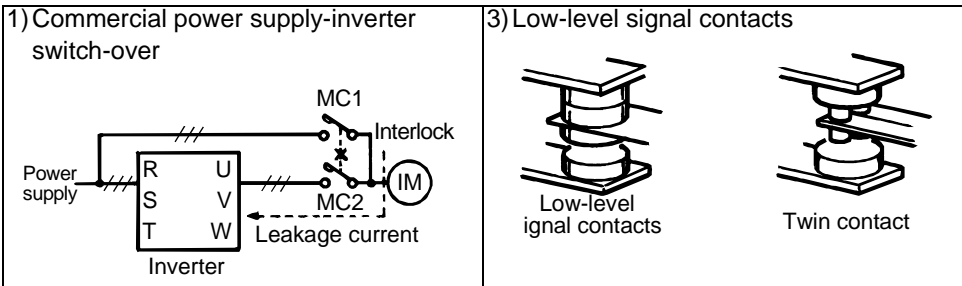
2) If the machine must not be restarted when power is restored after a power failure, provide a magnetic contactor in the inverter's primary circuit and also make up a sequence which will not switch on the start signal.

If the start signal (start switch) remains on after a power failure, the inverter will automatically restart as soon as the power is restored.

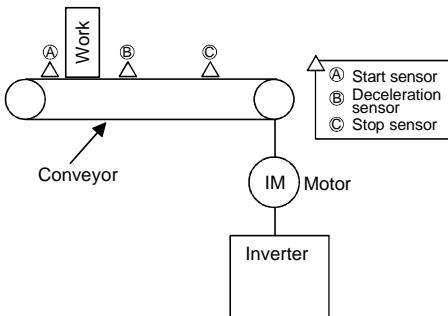
3) Since the input signals to the control circuit are on a low level, use two parallel micro signal contacts or a twin contact for contact inputs to prevent a contact fault.

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

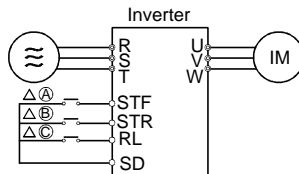
5) Make sure that the specifications and rating match the system requirements.



6) For use in the following application where speed control is performed using a sensor input-based conveyor program with the signals of sensors (A), (B) and (C) entered into the STF, STR and RL terminals, respectively, and the built-in PLC function set for terminal function disable (D9148), the built-in PLC function is not set for terminal function disable but for STF, STR and RL terminal function enable in the factory setting status (Pr. 507=0) when the built-in PLC function is in a STOP status or there is no program, and the inverter operates if any of the sensors is blocked. (Refer to page 138 for Pr. 507 "inverter operation lock mode setting".)



<Connection diagram>



# 2. OPERATION AND CONTROL

This chapter describes "operation and control" for use of this product.

Always read the instructions before use.

<b>2.1</b>	<b>Parts Identification and Functions of the Operation Panel .....</b>	<b>42</b>
<b>2.2</b>	<b>Operation Mode Switching .....</b>	<b>42</b>
<b>2.3</b>	<b>Monitor Transition .....</b>	<b>43</b>
<b>2.4</b>	<b>Monitoring the Output Current.....</b>	<b>43</b>
<b>2.5</b>	<b>Displaying the CC-Link Data (Station Number, Baudrate).....</b>	<b>43</b>
<b>2.6</b>	<b>LED On/Off Operations .....</b>	<b>44</b>

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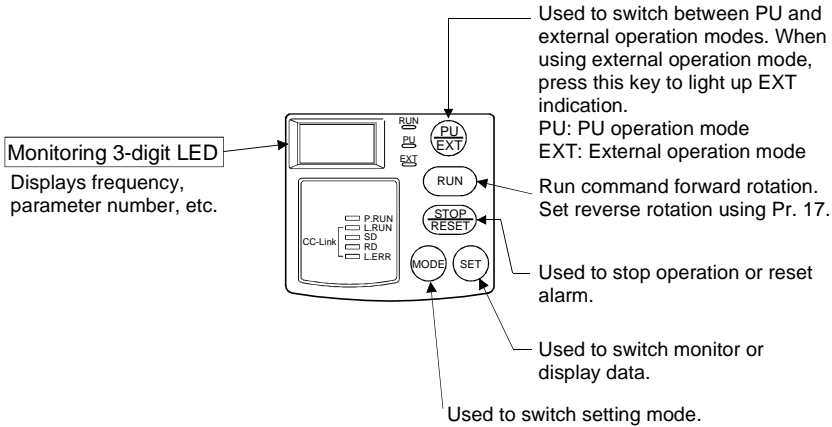
Chapter 5

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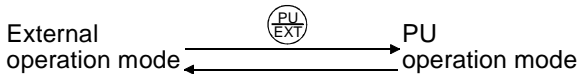
## 2.1 Parts Identification and Functions of the Operation Panel

The operation panel cannot be removed from the inverter.



## 2.2 Operation Mode Switching


Using , switch between the "PU operation mode" and "external operation mode".



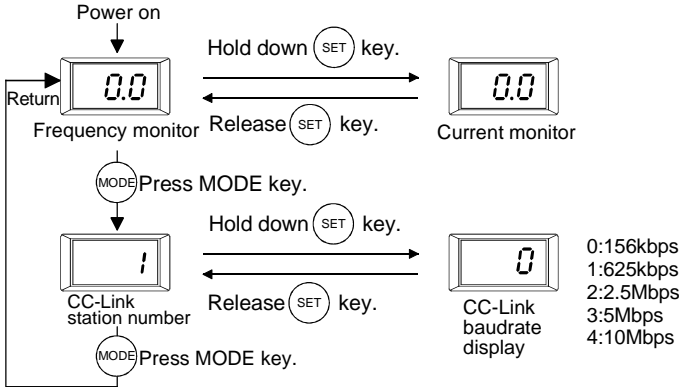
The PU indication is lit in the PU operation mode.

The EXT indication is lit in the external operation mode.

### REMARKS

Operation mode switching that can be performed using  is disabled if the Pr. 79 setting is other than 0 (factory setting). (Refer to page 75.)

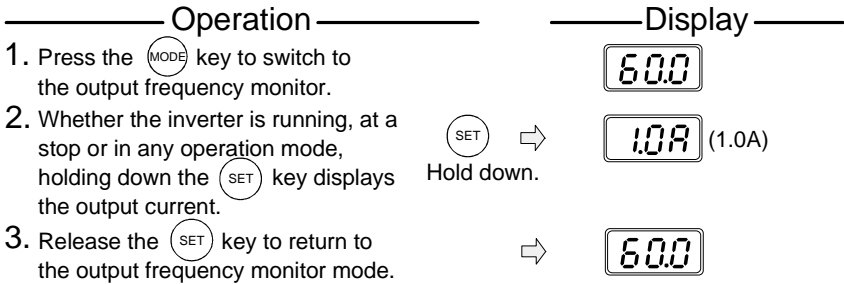
## 2.3 Monitor Transition



## 2.4 Monitoring the Output Current

### POINT

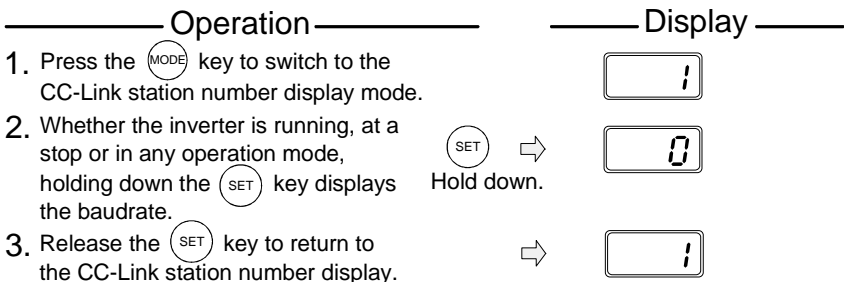
Hold down the **SET** key in the monitor mode to switch from the output current to the frequency.




## 2.5 Displaying the CC-Link Data (Station Number, Baudrate)

### POINT

Hold down the **SET** key in the CC-Link display mode to switch from the station number to the baudrate.



## 2.6 LED On/Off Operations

LED	Description	
RUN	On: During forward rotation operation Slow flicker (1.4s intervals): During reverse rotation operation Fast flicker (0.2s intervals): Indicates that the inverter is not operating but is given the  or start command.	
PU	On: PU operation mode • In the CC-Link operation mode, the PU and EXT LEDs flicker slowly.	
EXT	On: External operation mode • In the CC-Link operation mode, the PU and EXT LEDs flicker slowly.	
P.RUN	• On during PLC function operation. (Turned on when the SQ-SD terminals are shorted. (Refer to page 100.)) • Flickers when a PLC self-diagnostic error occurs.	
CC-Link communication	L.RUN	On during CC-Link communication.
	SD	On during CC-Link data send.
	RD	On during CC-Link data receive.
	L.ERR	Turned on when a CC-Link communication error occurs.

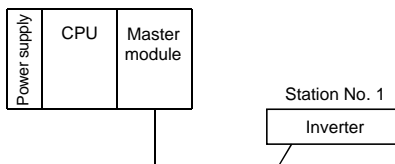
### REMARKS

\*When the FR-PU04 is connected, the LEDs (PU, EXT) are not lit.

## 2.6.1 How to check the LED lamps for CC-Link communication errors

### (1) When one inverter is connected

The following table indicates the fault causes that can be determined from the inverter LED states under the condition that the SW, M/S and PRM LEDs of the master module are off (the master module has been set properly) in the system configuration where one inverter is connected.

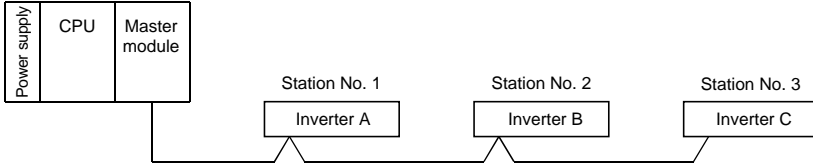


LED States				Cause
L.RUN	SD	RD	L.ERR	
●	◎	◎	◎	Normal communication is made but CRC error occurred due to noise.
●	◎	◎	○	Normal communication
●	◎	○	◎	Hardware fault
●	◎	○	○	Hardware fault
●	○	◎	◎	Receive data is in CRC error and response cannot be made.
●	○	◎	○	Data addressed to the host does not arrive.
●	○	○	◎	Hardware fault
●	○	○	○	Hardware fault
○	◎	◎	◎	Polling response is made but refresh receive is in CRC error.
○	◎	◎	○	Hardware fault
○	◎	○	◎	Hardware fault
○	◎	○	○	Hardware fault
○	○	◎	◎	Data addressed to the host is in CRC error.
○	○	◎	○	Data addressed to the host does not exist or cannot be received due to noise.
○	○	○	◎	Hardware fault
○	○	○	○	Data cannot be received due to cable breakage, etc.
○	○	◎○	●	Baudrate or station number setting illegal.
●	◎	◎	◎	Baudrate or station number changed midway.
○	○	○	○	WDT error (hardware fault), power off, power supply section fault

● : On, ○ : Off, ◎ : Flicker

**(2) When two or more inverters are connected**

The following table indicates the fault causes and corrective actions that can be determined from the inverter LED states under the condition that the SW, M/S and PRM LEDs of the master module are off (the master module has been set properly) in the following system configuration.



LED States				Cause	Corrective Action
Master module	Inverters				
	Station No. 1	Station No. 2	Station No. 3		
	L.RUN ● SD ● RD ● L.ERR ○	L.RUN ● SD ● RD ● L.ERR ○	L.RUN ● SD ● RD ● L.ERR ○	Normal	—
	L.RUN ○ SD ○ RD ○ L.ERR ○	L.RUN ● SD ● RD ● L.ERR ○	L.RUN ● SD ● RD ● L.ERR ○	Poor contact of the inverter and CC-Link connectors	Check the connectors.
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 No. 2 inverters are off, cable breakage occurred in the transmission cable between the remote I/O modules A and B, or the cable is disconnected from the terminal block.	Refer to the LED on/off states, search for the position of cable breakage, and repair.
	L.RUN ○ SD * RD * L.ERR ○	L.RUN ○ SD * RD * L.ERR ○	L.RUN ○ SD * RD * L.ERR ○	The transmission cable is shorted.	Search for the shorted wires of the three wires in the transmission cable, and repair.
	L.RUN ○ SD * RD * L.ERR *	L.RUN ○ SD * RD * L.ERR *	L.RUN ○ SD * RD * L.ERR *	The transmission cable is wired incorrectly.	Check the wiring of the inverter's terminal block and remedy the incorrectly wired portion.

● : On, ○ : Off, ◎ : Flicker, \* : Any of on, flicker and off

**(3) When communication stops during operation**

- Check that the CC-Link dedicated cables are connected properly.  
(Check for poor contact, cable breakage, etc.)
- Check that the PLC program is executed without fault.
- Check that data communication is made without interruption due to an instantaneous power failure, etc.

LED States				Cause	Corrective Action
Master module	Inverters				
	Station No. 1	Station No. 2	Station No. 3		
	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 No. 1 and 3 inverters are off, the station numbers of station No. 1 and 3 inverters are the same.	Switch power on again after assigning different station numbers to the inverters having the same station numbers.
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 and SD LEDs of station No. 2 inverter are off, the transmission speed setting of station No. 2 inverter is incorrect within the setting range (0 to 4).	Set correct transmission speed and power 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.ERR LED of station No. 3 inverter is flickering, the station number (Pr. 503) of station No. 3 inverter was changed during normal operation.	Return the station number (Pr. 503) of the inverter to the original value and power 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.ERR LED of station No. 2 inverter is on, station No. 1 inverter is affected by noise. (The L.RUN LED may become off.)	Securely earth the FG terminals of the inverters and master module.
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 LEDs of station No. 2 and 3 inverters are on, the transmission cable between these inverters is affected by noise. (The L.RUN LED may become off.)	Check the connection of SLD of the transmission cable. Also, run the cable as far away as possible from the power line. (More than 100mm)
	L.RUN ● SD ● RD ● L.ERR ○	L.RUN ● SD ● RD ● L.ERR ○	L.RUN ● SD ● RD ● L.ERR ●	You forgot to fit the terminating resistor. (The L.RUN LED may become off.)	Check whether the terminating resistor is fitted or not.

● : On, ○ : Off, ◎ : Flicker, \*: Any of on, flicker and off



# MEMO

# 3. INVERTER FUNCTIONS

This chapter explains the inverter functions (inverter parameters). For simple variable-speed operation of the inverter, the factory settings of the parameters may be used as they are. Set the necessary parameters to meet the load and operational specifications. Always read the instructions before using the functions.

<b>3.1 Function (Parameter) List</b> .....	<b>50</b>
<b>3.2 List of Parameters Classified by Purpose of Use</b> .....	<b>55</b>
<b>3.3 Basic Functions</b> .....	<b>56</b>
<b>3.4 Operation Panel Display Selection</b> .....	<b>67</b>
<b>3.5 I/O Terminal Function Selection</b> .....	<b>68</b>
<b>3.6 Operation Selection Function Parameters</b> .....	<b>70</b>
<b>3.7 Computer Link Operation Setting</b> .....	<b>79</b>
<b>3.8 Parameter Unit (FR-PU04) Setting</b> .....	<b>93</b>

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## CAUTION

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As the contact input terminals RL, RM, RH, STF, STR and open collector output terminals RUN, SQ, ALM can be changed in functions by parameter setting, their signal names used for the corresponding functions are used in this chapter (with the exception of the wiring examples). Note that they are not terminal names.

---

## REMARKS

Using the parameter unit (FR-PU04), parameter copy allows the parameter values to be copied to another inverter (only the FR-C500 series).

After batch-reading the parameters of the copy source inverter, you can connect the parameter unit to the copy destination inverter and batch-write the parameters.

For the operation procedure, refer to the instruction manual of the parameter unit (FR-PU04).

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### 3.1 Function (Parameter) List

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Factory Setting	Reference Page	Customer Setting
Basic	0	Torque boost	0 to 15%	0.1%	6%	56	
	1	Maximum frequency	0 to 120Hz	0.1Hz	60Hz	57	
	2	Minimum frequency	0 to 120Hz	0.1Hz	0Hz	57	
	3	Base frequency	0 to 120Hz	0.1Hz	60Hz	58	
	4*	Multi-speed setting (high speed)	0 to 120Hz	0.1Hz	60Hz	59	
	5*	Multi-speed setting (middle speed)	0 to 120Hz	0.1Hz	30Hz	59	
	6*	Multi-speed setting (low speed)	0 to 120Hz	0.1Hz	10Hz	59	
	7	Acceleration time	0 to 999s	0.1s	5s	60	
	8	Deceleration time	0 to 999s	0.1s	5s	60	
	9	Electronic thermal O/L relay	0 to 50A	0.1A	Rated output current	61	
	10	DC injection brake operation frequency	0 to 120Hz	0.1Hz	3Hz	61	
	11	DC injection brake operation time	0 to 10s	0.1s	0.5s	61	
	12	DC injection brake voltage	0 to 15%	0.1%	6%	61	
	13	Starting frequency	0 to 60Hz	0.1Hz	0.5Hz	62	
	17	RUN key rotation direction selection	0: Forward rotation, 1: Reverse rotation	1	0	63	
	21	Stall prevention function selection	0 to 31, 100	1	0	63	
	22*	Stall prevention operation level	0 to 200%	1%	150%	65	
40	Start-time ground fault detection selection	0: Not detected 1: Detected	1	0	66		
Display	52*	Operation panel display data selection	0: Output frequency 1: Output current 100: Set frequency during stop/ output frequency during operation	1	0	67	

- The parameters marked \* can be changed in setting during operation if "0" (factory setting) is set in Pr. 77 "parameter write disable selection". (Note that Pr. 72 may be changed only during PU operation.)
- ○ indicates the terminal function parameters. Note them when clearing the parameters. (Refer to pages 89, 125.)

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Factory Setting	Reference Page	Customer Setting
I/O terminal function selection	60	RL terminal function selection	0:RL, 1:RM, 2:RH, 6:MRS, 7:OH, 10:RES, 50:SQ, 9998: No function	1	0	68	
	61	RM terminal function selection		1	1	68	
	62	RH terminal function selection		1	2	68	
	63	STR terminal function selection	0:RL, 1:RM, 2:RH, 6:MRS, 7:OH, 10:RES, 50:SQ, 9998: No function, 9999:STR	1	9999	68	
	64	RUN terminal function selection	0:RUN, 3:OL, 99:ALM, 9998: No function	1	0	69	
	65	STF terminal function selection	0:RL, 1:RM, 2:RH, 6:MRS, 7:OH, 10:RES, 17:STF, 50:SQ, 9998: No function	1	17	68	
—	70	Parameter set by the manufacturer. Do not set.					
Operation selection	71	Applied motor	0: Thermal characteristic for standard motor 1: Thermal characteristic for Mitsubishi constant-torque motor	1	0	70	
	72*	PWM frequency selection	0 to 15	1	1	70	
	75*	Reset selection /PU stop selection	0: Reset normally accepted/PU stop key disabled 1: Accepted only at reset alarm occurrence/PU stop key disabled 14: Reset normally accepted/normally decelerated to stop 15: Accepted only at reset alarm occurrence/normally decelerated to stop	1	14	71	
	76	Cooling fan operation selection	0: Operation performed with power on 1: Cooling fan ON/OFF control	1	1	73	

**Function (Parameter) List**

Parameter List


Function	Parameter	Name	Setting Range	Minimum Setting Increments	Factory Setting	Reference Page	Customer Setting
Operation selection	77*	Parameter write disable selection	0: Write enabled only during stop 1: Write disabled (except some) 2: Write enabled during operation	1	0	74	
	79	Operation mode selection	0: PU/external switchable 1: PU 2: External 3: External/PU combined 4: External/PU combined	1	0	75	
FR-PU04	145	PU display language selection	0: Japanese 1: English 2: German 3: French 4: Spanish 5: Italian 6: Swedish 7: Finish	1	0	93	
Computer link	331	RS-485 communication station number setting	0 to 31: Specify the station number of the inverter.	1	0	79	
	332	RS-485 communication speed	48:4800bps, 96:9600bps 192:19200bps	1	96	79	
	333	Stop bit length	0: Data length 8, stop bit 1 1: Data length 8, stop bit 2 10: Data length 7, stop bit 1 11: Data length 7, stop bit 2	1	0	79	
	334	Parity check presence/absence	0: Absence 1: With odd parity check 2: With even parity check	1	1	79	
	335	Number of communication retries	0 to 10, 9999	1	1	79	
	336	Communication check time interval	0 to 999s, 9999	0.1s	9999	79	
	337	Waiting time setting	0 to 150ms, 9999	1	9999	79	

•  indicates the communication parameters. Note them when clearing the parameters. (Refer to pages 89, 125.)

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Factory Setting	Reference Page	Customer Setting
Computer link	338	Operation control command source (CC-Link)	0: Command source from CC-Link 1: Command source from external terminal	1	0	76	
	339	Speed command source (CC-Link)	0: Command source from CC-Link 1: Command source from external terminal	1	0	76	
	340	Link start up mode selection (CC-Link)	0: As set in Pr. 79 1: Started in CC-Link operation mode	1	0	76	
	341	CR/LF selection	0: Without CR/LF 1: With CR, without LF 2: With CR/LF	1	1	79	
	342	E <sup>2</sup> PROM write selection	0: Write to RAM and E <sup>2</sup> PROM 1: Write to RAM only	1	0	92	
CC-Link	503	CC-Link station number setting	Set the station number for inverter/CC-Link operation. 1 to 64	1	1	143	
	504	CC-Link baudrate setting	Set the baudrate for CC-Link operation. 0:156kbps 1:625kbps 2:2.5Mbps 3:5Mbps 4:10Mbps	1	0	143	
Sequence	505	SQ terminal function selection	0:RL, 1:RM, 2:RH, 6:MRS, 7:OH, 10:RES, 50:SQ, 9998: No function	1	50	68	
	506	ALM terminal function selection	0:RUN, 3:OL, 99:ALM, 9998: No function	1	99	69	
	507	Inverter operation lock mode setting	0: STF and STR commands are valid regardless of RUN/STOP of the sequence. 1: STF and STR commands are valid only during RUN of the sequence, and invalid during STOP.	1	0	138	
	510 to 529	User parameters		1	0	135	
	530	Forced I/O selection	1: CC-Link remote input 2: CC-Link remote output 3: Control input terminal (external) 4: Control output terminal (external) 9999: Function invalid	1	9999	136	

**Function (Parameter) List**

Parameter List

Function	Parameter	Name	Setting Range	Minimum Setting Increments	Factory Setting	Reference Page	Customer Setting
Sequence	531	Forced I/O setting L	0 to 255, 9999	1	9999	136	
	532	Forced I/O setting H	0 to 255, 9999	1	9999	136	
	533	Internal address	0 to 65534	1	0	137	
FR-PU04	990*	PU buzzer control	0: Without sound, 1: With sound	1	1	93	
	991*	PU contrast adjustment	 0 (Pale) 63 (Deep)	1	58	94	
	992*	PU main display screen data selection	0: Selectable between output frequency and output current 100: During stop: Set frequency/output current During operation: Output frequency/output current	1	0	94	
	993	PU disconnection detection/PU setting lock	0: Without PU disconnection error 1: Error at PU disconnection 10: Without PU disconnection error (PU operation invalid)	1	0	95	

## 3.2 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 that must be set
Related to operation	Operation mode selection	Pr.79
	Acceleration/deceleration time adjustment	Pr.7, Pr.8
	Selection of output characteristics optimum for load characteristics	Pr.3, Pr.71
	Output frequency restriction (limit)	Pr.1, Pr.2
	Operation over 60Hz	Pr.1
	Motor output torque adjustment	Pr.0
	Brake operation adjustment	Pr.10 to Pr.12
	Multi-speed operation	Pr.1, Pr.2, Pr.4 to Pr.6
Related to application operation	Electromagnetic brake operation timing	Pr.64, Pr.506
	CC-Link communication	Pr.338 to Pr.340, Pr.503, Pr.504
	Operation in communication with personal computer	Pr.331 to Pr.337, Pr.341, Pr.342
	Noise reduction	Pr.72
Related to monitoring	Display of monitor on operation panel or parameter unit (FR-PU04)	Pr.52, Pr.992
Related to incorrect operation prevention	Inverter parameter rewrite prevention	Pr.77
	Motor stall prevention	Pr.21, Pr.22
Other	Input terminal function assignment	Pr.60 to Pr.63, Pr.65, Pr.505
	Output terminal function assignment	Pr.64, Pr.506
	Increased cooling fan life	Pr.76
	Motor protection from overheat	Pr.9, Pr.71
	Setting of ground fault overcurrent protection	Pr.40
	Inverter reset selection	Pr.75

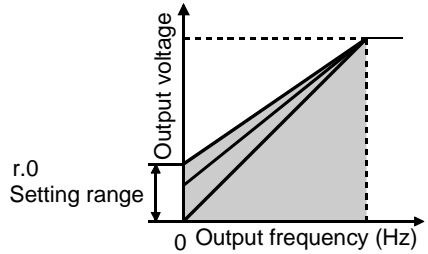


## 3.3 Basic Functions

### 3.3.1 Torque boost (Pr. 0)

Increase this value for use when the inverter-to-motor distance is long or motor torque is insufficient in the low speed range (stall prevention is activated).

- Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque.



Parameter	Name	Factory Setting	Setting Range
0	Torque boost	6%	0 to 15%

#### <Setting>

- Assuming that the base frequency voltage is 100%, set the 0Hz voltage in %.
  - When using an inverter-dedicated motor (constant-torque motor), make setting as indicated below:
  - FR-C520-0.1K to 0.75K ... 6%, FR-C520-1.5K to 3.7K ..... 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.

#### CAUTION

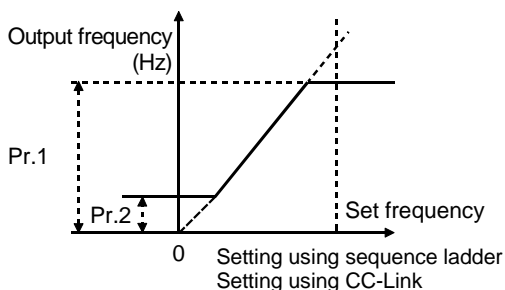
- **A too large setting may cause the motor to overheat or result in an overcurrent trip. The guideline is about 10% at the greatest.**

#### ◆ Related parameters ◆

- Constant-torque motor setting ⇒ Pr. 71 "applied motor" (refer to page 70)

### 3.3.2 Maximum and minimum frequencies (Pr. 1, Pr. 2)

You can clamp the upper and lower limits of the output frequency.



Parameter	Name	Factory Setting	Setting Range
1	Maximum frequency	60Hz	0 to 120Hz
2	Minimum frequency	0Hz	0 to 120Hz

#### <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.
- Use Pr. 2 to set the lower limit of the output frequency.

#### REMARKS

Change the Pr. 1 value when performing operation over 60Hz.

## ⚠ CAUTION

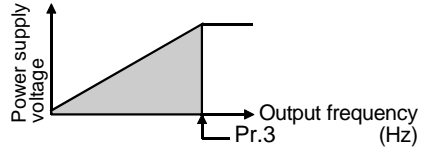
⚠ When the Pr. 2 setting is higher than the Pr. 13 "starting frequency" value, note that the motor will run at the set frequency by merely switching the start signal on, without entering the command frequency.

#### ◆ Related parameters ◆

- Starting frequency setting ⇒ Pr. 13 "starting frequency" (refer to page 62)

### 3.3.3 Base frequency (Pr. 3)

Used to adjust the inverter output (frequency) to the motor rating.



Parameter	Name	Factory Setting	Setting Range
3	Base frequency	60Hz	0 to 120Hz

#### <Setting>

- In Pr. 3, set the base frequency (motor's rated frequency).

When running the standard motor, generally set the "base frequency" to the rated frequency of the motor. When running the motor using commercial power supply-inverter switch-over operation, set the base frequency to the same value as the power supply frequency.

When the frequency given on the motor's rating plate is only "50Hz", always set the "base frequency" to "50Hz".

Leaving the base frequency unchanged from "60Hz" may make the voltage too low and the torque insufficient, resulting in an overload trip.

#### CAUTION

Set 60Hz in Pr. 3 "base frequency" when using a Mitsubishi constant-torque motor.

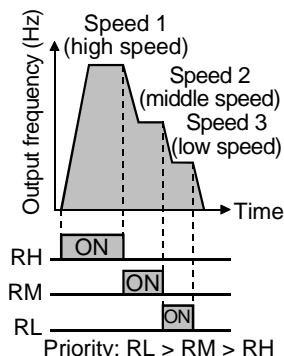
#### ◆ Related parameters ◆

- Motor setting ⇒ Pr. 71 "applied motor" (refer to page 70)

### 3.3.4 Multi-speed operation (Pr. 4, Pr. 5, Pr. 6)

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, signals).
- Using these functions with Pr. 1 "maximum frequency" and Pr. 2 "minimum frequency", up to five speeds can be set.
- Valid in the external operation mode.



Parameter	Name	Factory Setting	Setting Range
4	3-speed setting (high speed)	60Hz	0 to 120Hz
5	3-speed setting (middle speed)	30Hz	0 to 120Hz
6	3-speed setting (low speed)	10Hz	0 to 120Hz

#### <Setting>

- Set the running frequencies in the corresponding parameters. Each speed (frequency) can be set as desired between 0 and 120Hz during inverter operation.
- Assign the terminals used for signals RH, RM and RL using Pr. 60 to Pr. 63, Pr. 65 and Pr. 505. (\*)

#### CAUTION

1. The multi-speeds can also be set in the PU or external operation mode.
2. For 3-speed setting, if two or more speeds are simultaneously selected, priority is given to the frequency setting of the lower signal.
3. The parameter values be changed during operation.

#### REMARKS

- \* When terminal assignment is changed using Pr. 60 to Pr. 63, Pr. 65 and Pr. 505, the other functions may be affected. Check the functions of the corresponding terminals before making setting.

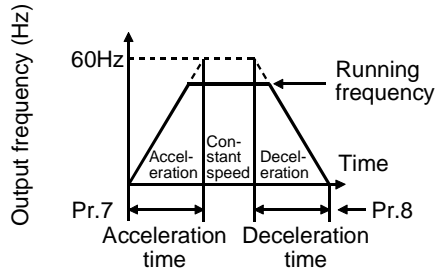
#### ◆ Related parameters ◆

- Maximum, minimum speed setting ⇒ Pr. 1 "maximum frequency", Pr. 2 "minimum frequency" (Refer to page 57.)
- Assignment of signals RH, RM, RL to terminals ⇒ Pr. 60 to Pr. 63, Pr. 65, Pr. 505 (input terminal function assignment) (Refer to page 68.)
- External operation mode setting ⇒ Pr. 79 "operation mode selection" (Refer to page 75.)
- CC-Link mode ⇒ Pr. 79 "operation mode selection" (Refer to page 75.), Pr. 340 "link start up mode selection" (Refer to page 75.)
- Speed command source ⇒ Pr. 339 "speed command source" (Refer to page 75.)

### 3.3.5 Acceleration/deceleration time (Pr. 7, Pr. 8)

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	Name	Factory Setting	Setting Range
7	Acceleration time	5s	0 to 999s
8	Deceleration time	5s	0 to 999s

#### <Setting>

- Use Pr. 7 to set the acceleration time required to reach the set frequency of 60Hz from 0Hz.
- Use Pr. 8 to set the deceleration time required to reach 0Hz from 60Hz.

#### CAUTION

1. If the Pr. 7/Pr. 8 setting is "0", the acceleration/deceleration time is 0.04s.
2. If the acceleration/deceleration time is set to the shortest value, the actual motor acceleration/deceleration time cannot be made shorter than the shortest acceleration/deceleration time which is determined by the mechanical system's J (moment of inertia) and motor torque.

### 3.3.6 Electronic thermal O/L relay (Pr. 9)

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	Name	Factory Setting	Setting Range
9	Electronic thermal O/L relay	Rated output current*	0 to 50A

\*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 value at 50Hz if the motor has both 50Hz and 60Hz rated currents.)
- Setting "0" in Pr. 9 disables the electronic thermal O/L relay (motor protective function). (The protective function of the inverter is activated.)
- When using a Mitsubishi constant-torque motor, first set "1" in Pr. 71 "applied motor" to choose the 100% continuous torque characteristic in the low-speed range. Then, set the rated motor current in Pr. 9 "electronic thermal O/L relay".

#### CAUTION

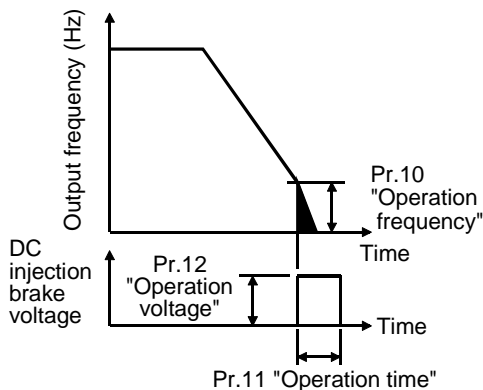
- **When two or more motors are connected to the inverter, they cannot be protected by the electronic overcurrent protection. Install an external thermal relay to each motor.**
- **When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic overcurrent protection will be deteriorated. In this case, use an external thermal relay.**
- **A special motor cannot be protected by the electronic overcurrent protection. Use an external thermal relay.**

#### ◆ Related parameters ◆

- When constant-torque motor is used ⇒ Pr. 71 "applied motor" (Refer to page 70.)

### 3.3.7 DC injection brake (Pr. 10, Pr. 11, Pr. 12)

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	Name	Factory Setting	Setting Range
10	DC injection brake operation frequency	3Hz	0 to 120Hz
11	DC injection brake operation time	0.5s	0 to 10s
12	DC injection brake voltage	6%	0 to 15%

(When Pr. 11 is set to "0s" or Pr. 12 is set to "0%", DC injection brake is not operated.)

**<Setting>**

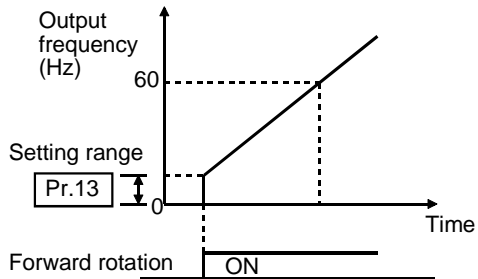
- Use Pr. 10 to set the frequency at which the DC injection brake application is started.
- Use Pr. 11 to set the period during when the brake is operated.
- Use Pr. 12 to set the percentage to the power supply voltage.
- Set 4% in Pr. 12 when using the inverter-dedicated motor (constant-torque motor).  
If the Pr. 12 value remains unchanged from the factory setting and Pr. 71 is changed to the setting for use of a constant-torque motor, the Pr. 12 setting is automatically changed to 4%.

**⚠ CAUTION**

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

**3.3.8 Starting frequency (Pr. 13)**

The starting frequency at which the start signal is turned on can be set in the range 0 to 60Hz.



Parameter	Name	Factory Setting	Setting Range
13	Starting frequency	0.5Hz	0 to 60Hz

**CAUTION**

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 inverter starts outputting when the frequency setting reaches 5Hz.

**⚠ CAUTION**

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

- ◆ Related parameters ◆
- Minimum frequency setting ⇒ Pr. 2 "minimum frequency" (Refer to page 57.)

### 3.3.9 RUN key rotation direction selection (Pr. 17)

Used to choose the direction of rotation by operating the RUN key of the operation panel.

Parameter	Name	Factory Setting	Setting Range	Remarks
17	RUN key rotation direction selection	0	0, 1	0: Forward rotation 1: Reverse rotation

### 3.3.10 Stall prevention function and current limit function (Pr. 21, Pr. 22)

You can make setting to disable stall prevention caused by overcurrent and to prevent the inverter from resulting in an overcurrent trip if an excessive current occurs due to sudden load variation or ON-OFF, etc. in the output side of the running inverter.

- 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	Name	Factory Setting	Setting Range
21	Stall prevention function selection	0	0 to 31, 100

Pr. 21 Setting	Fast-Response Current Limit ○: Activated ●: Not activated	Stall Prevention Operation Selection			OL Signal Output ○: Operation continued ●: Operation not continued (*)
		○: Activated	●: Not activated	●: Not activated	
		Acceleration	Constant speed	Deceleration	
0	○	○	○	○	○
1	●	○	○	○	○
2	○	●	○	○	○
3	●	●	○	○	○
4	○	○	●	○	○
5	●	○	●	○	○
6	○	●	●	○	○
7	●	●	●	○	○
		Acceleration	Constant speed	Deceleration	
9	●	○	○	●	○
10	○	●	○	●	○
11	●	●	○	●	○
12	○	○	●	●	○
13	●	○	●	●	○
14	○	●	●	●	○
15	●	●	●	●	○
16	○	○	○	○	●



Pr. 21 Setting	Fast-Response Current Limit ○: Activated ●: Not activated	Stall Prevention Operation Selection ○: Activated ●: Not activated			OL Signal Output ○: Operation continued ●: Operation not continued (*)
		Acceleration	Constant speed	Deceleration	
8	○	○	○	●	○
18	○	●	○	○	●
19	●	●	○	○	●
20	○	○	●	○	●
21	●	○	●	○	●
22	○	●	●	○	●
23	●	●	●	○	●
24	○	○	○	●	●

Pr. 21 Setting	Fast-Response Current Limit ○: Activated ●: Not activated	Stall Prevention Operation Selection ○: Activated ●: Not activated			OL Signal Output ○: Operation continued ●: Operation not continued (*)
		Acceleration	Constant speed	Deceleration	
17	●	○	○	○	●
25	●	○	○	●	●
26	○	●	○	●	●
27	●	●	○	●	●
28	○	○	●	●	●
29	●	○	●	●	●
30	○	●	●	●	●
31	●	●	●	●	●
100	Driving	○	○	○	○
	Regenerative	●	●	●	○

## Stall prevention (Pr. 22)

Set the output current level at which the output frequency will be adjusted to prevent the inverter from stopping due to overcurrent, etc.

Parameter	Name	Factory Setting	Setting Range
22	Stall prevention operation level	150%	0 to 200%

### <Setting>

- Generally, set 150% (factory setting) in Pr. 22 "stall prevention operation level". Setting "0" in Pr. 22 disables stall prevention operation.

### CAUTION

- \* When "Operation not continued for OL signal output" is selected, the "OLT" alarm code (stopped by stall prevention) is displayed and operation stopped.

(Alarm stop display "OLr")

- 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. 21 and stall prevention operation level.
- When the fast-response current limit has been set in Pr. 21 (factory setting), torque will not be provided at the Pr. 22 setting of 170% or higher. At this time, make setting so that the fast-response current limit is not activated.
- In vertical lift applications, make setting so that the fast-response current limit is not activated. Torque may not be produced, causing a drop due to gravity.

## CAUTION

- ⚠ Do not set a small value as the stall prevention operation current. Otherwise, torque generated will reduce.
- ⚠ Test operation must be performed.
  - 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.

### 3.3.11 Start-time earth (ground) fault detection selection (Pr. 40)

You can choose whether to make earth (ground) fault detection valid or invalid at a start. Earth (Ground) fault detection is executed only right after the start signal is input to the inverter.

If an earth (ground) fault occurs during operation, the protective function is not activated.

Parameter	Name	Factory Setting	Setting Range	Remarks
40	Start-time earth (ground) fault detection selection	0	0, 1	0: Earth (Ground) fault detection for protection is not executed. 1: Earth (Ground) fault detection for protection is executed.

#### CAUTION

1. If an earth (ground) fault is detected with "1" set in Pr. 40, alarm output " $\square F$ " is detected and the output is shut off.
2. If the motor capacity is less than 0.1kW, earth (ground) fault protection may not be provided.

#### REMARKS

- When an earth (ground) fault is detected with "1" set in Pr. 40, an approximate 20ms delay occurs at every start.

## 3.4 Operation Panel Display Selection

### 3.4.1 Monitor display (Pr. 52)

You can choose the display of the operation panel "monitor/frequency setting screen".

Parameter	Name	Factory Setting	Setting Range
52	Operation panel display data selection	0	0, 1, 100

#### POINT

- You can also use the **SET** key to change the display. (Refer to page 42 for the operation procedure.)

#### <Setting>

Signal Type	Unit	Parameter Setting
		Operation panel LED
Output frequency	Hz	0/100
Output current	A	1

When "100" is set in Pr. 52, the monitor value changes depending on whether the inverter is during stop or running.

	0		100	
	During running/stop	During stop	During stop	During running
Output frequency	Output frequency	Set frequency	Set frequency	Output frequency

#### REMARKS

- During an error, its definition appears.
- During reset, the values displayed are the same as during a stop.
- For selection of the parameter unit (FR-PU04) monitor display, refer to Pr. 992 "PU main display screen data selection". (Page 94)

#### CAUTION

The unit displayed on the operation panel is only A and other units are not displayed.

## 3.5 I/O Terminal Function Selection

### 3.5.1 Input terminal function selection (Pr. 60, Pr. 61, Pr. 62, Pr. 63, Pr. 65, Pr. 505)

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

Parameter	Name	Factory Setting	Setting Range
60	RL terminal function selection	0	0 to 2, 6, 7, 10, 50, 9998
61	RM terminal function selection	1	
62	RH terminal function selection	2	
63	STR terminal function selection	9999	0 to 2, 6, 7, 10, 50, 9998, 9999
65	STF terminal function selection	17	0 to 2, 6, 7, 10, 17, 50, 9998
505	SQ terminal function selection	50	0 to 2, 6, 7, 10, 50, 9998

#### <Setting>

Refer to the following table and set the parameters:

Setting	Signal Name	Functions	Reference Page
0	RL	Low-speed operation command	59
1	RM	Middle-speed operation command	
2	RH	High-speed operation command	
6	MRS	Output shut-off stop	—
7	OH	External thermal relay input (*) The inverter stops when the externally provided overheat protection thermal relay, motor's embedded temperature relay, etc. is actuated.	—
10	RES	Reset	71
17	STF	Forward rotation start (can be assigned to STF terminal only)	—
50	SQ	Sequence start	100
9998		No function (Can be used as a general-purpose input terminal using the PLC function.)	—
9999	STR	Reverse rotation start (can be assigned to STR terminal only)	—

\* Actuated when the relay contact "opens".

#### REMARKS

- One function can be assigned to two or more terminals. In this case, the function is activated when one of the multiple terminals used for assignment turns on.
- Refer to page 127 for the no function setting of the external terminal inputs in device D9149 "inverter operation status control enable/disable setting".

### 3.5.2 Output terminal function selection (Pr. 64, Pr. 505)

You can change the functions of the open collector and contact output terminals.

Parameter	Name	Factory Setting	Setting Range
64	RUN terminal function selection	0	0, 3, 99, 9998
506	ALM terminal function selection	99	

#### <Setting>

Setting	Signal Name	Function	Operation	Reference Page
0	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above the starting frequency.	58, 62
3	OL	Overload alarm	Output while stall prevention function is activated.	63
99	ALM	Alarm output	Output when the inverter's protective function is activated to stop the output (major fault).	—
9998	—	No function	No function (Can be used as a general-purpose input terminal using the PLC function.)	—

#### REMARKS

The same function may be set to more than one terminal.

## 3.6 Operation Selection Function Parameters

### 3.6.1 Applied motor (Pr. 71)

Set the motor used.

#### POINT

- When using the Mitsubishi constant-torque motor, set "1" in Pr. 71.  
The electronic overcurrent protection is set to the thermal characteristic of the constant-torque motor.
- When you selected the Mitsubishi constant-torque motor, the values of the following parameters are automatically changed. (For factory settings only)  
Pr. 0 "torque boost", Pr. 12 "DC injection brake voltage"


Parameter	Name	Factory Setting	Setting Range
71	Applied motor	0	0, 1

#### <Setting>

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

Pr. 71 Setting	Thermal Characteristics of Electronic Overcurrent Protection
0	Thermal characteristics matching a standard motor
1	Thermal characteristics matching the Mitsubishi constant-torque motor

## CAUTION

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

### 3.6.2 PWM carrier frequency (Pr. 72)

You can change the motor sound.

Parameter	Name	Factory Setting	Setting Range
72	PWM frequency selection	1	0 to 15

#### <Setting>

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.

#### REMARKS

- An increased PWM frequency will decrease motor noise but noise and leakage current will increase. Take proper action. (Refer to page 28.)
- Metallic sound may be generated from the motor at sudden deceleration but it is not a fault.

### 3.6.3 Reset selection/PU stop selection (Pr. 75)

You can make reset input acceptance selection and choose the stop function from the operation panel (PU).

- Reset selection : You can choose the reset function input (RES signal) timing.
- PU stop selection : When an alarm, etc. occurs in any operation mode, you can make a stop from the operation panel by pressing the



Parameter	Name	Factory Setting	Setting Range
75	Reset selection/ PU stop selection	14	0, 1, 14, 15

#### <Setting>

Pr. 75 Setting	Reset Selection	PU Stop Selection
0	Reset input normally enabled.	The PU stop key is invalid.
1	Enabled only when the protective function is activated.	Note that the  key is valid in the PU operation mode.
14	Reset input normally enabled.	Pressing the  key decelerates the inverter to a stop in any of the PU, external, communication and PLC function operation modes.
15	Enabled only when the protective function is activated.	

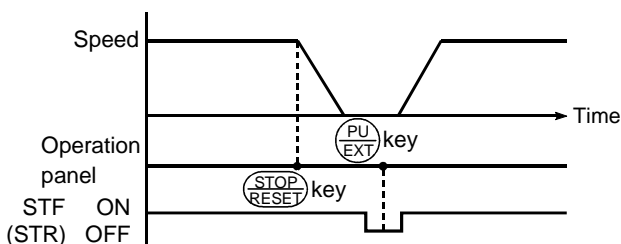
#### (1) How to make a restart after a stop by the key input from the operation panel (Restarting method with shown)

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

2) Press the key to show ..... ( canceled)

3) Press the key to return to .

4) Switch on the STF or STR signal.



Stop and restart example for external operation

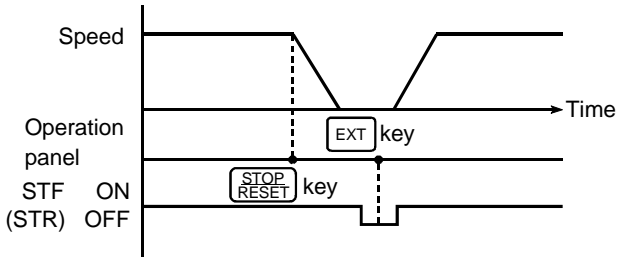
#### REMARKS

- By entering the reset signal (RES) during operation, the inverter shuts off its output while it is reset, the internal thermal summation value of the electronic overcurrent protection and the number of retries are reset, and the motor coasts.
- The Pr. 75 value can be set any time. Also, if parameter clear is executed, this setting will not return to the initial value.
- When the inverter is stopped by the PU stop function, the display alternates between and . An alarm is not output.



**(2) How to make a restart when a stop is made by the STOP  
RESET key input from the PU**

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



Stop and restart example for external operation

Besides the above operations, a restart can be made by performing a power-on rest or resetting the inverter with the inverter's reset terminal.

**REMARKS**

- By entering the reset signal (RES) during operation, the inverter shuts off its output while it is reset, the data of the electronic overcurrent protection are reset, and the motor coasts.
- To resume operation, reset the inverter after confirming that the PU is connected securely.
- The Pr. 75 value can be set any time. Also, if parameter clear is executed, this setting will not return to the initial value.
- When the inverter is stopped by the PU stop function, PS is displayed but an alarm is not output.

**⚠ CAUTION**

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

### 3.6.4 Cooling fan operation selection (Pr. 76)

You can control the operation of the cooling fan built in the inverter. (Whether there is a cooling fan or not depends on the model.)

Parameter	Name	Factory Setting	Setting Range
76	Cooling fan operation selection	1	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 <ul style="list-style-type: none"> <li>● Always on during inverter operation</li> <li>● During stop (rest or error), the inverter status is monitored and the fan is switched on/off according to the temperature.                             <ul style="list-style-type: none"> <li>• Heat sink temperature is less than 40°C ..... Cooling fan off</li> <li>• Heat sink temperature is not less than 40°C ..... Cooling fan on</li> </ul> </li> </ul>

#### REMARKS

In either of the following cases, fan operation is regarded as faulty and  $F_n$  is shown on the operation panel.

- Pr. 76 = "0"  
When the fan comes to a stop with power on.

- Pr. 76 = "1"  
When the inverter is running and the fan stops during fan ON command or the fan starts during fan OFF command.

### 3.6.5 Parameter write disable selection (Pr. 77)

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	Name	Factory Setting	Setting Range
77	Parameter write disable selection	0	0, 1, 2

#### <Setting>

Pr. 77 Setting	Function
0	Parameter values may only be written during a stop in the PU operation mode.*
1	<ul style="list-style-type: none"> <li>• Write disabled. (Values of Pr. 22, Pr. 75, Pr. 77 and Pr. 79 can be written.)</li> <li>• Parameter clear and all parameter clear are also inhibited.</li> </ul>
2	<ul style="list-style-type: none"> <li>• Write enabled even during operation. (Values of Pr. 17, Pr. 60 to Pr. 65, Pr. 71, Pr. 79, Pr. 505, Pr. 506 and Pr. 507 cannot be written during operation. These values can be changed only during a stop.)</li> <li>• Write enabled regardless of the operation mode.</li> </ul>

#### CAUTION

•\*The parameters \* screened in the parameter list can be set at any time. Note that the Pr. 72 value may be changed during PU operation only.

#### REMARKS

The user parameters (Pr. 510 to Pr. 529) can be set any time independently of Pr. 77.

### 3.6.6 Operation mode and command source (Pr. 79, Pr. 338, Pr. 339, Pr. 340)





Used to select the operation mode, operation command source and speed command source of the inverter.

The inverter can be run from the operation panel or parameter unit or by RS-485 communication (PU operation), with external signals (external operation), and by CC-Link communication (CC-Link operation).

The inverter is placed in the external operation mode at power-on (factory setting).

Parameter	Name	Factory Setting	Setting Range
79	Operation mode selection	0	0 to 4
338	Operation command source (CC-Link)	0	0, 1
339	Speed command source (CC-Link)	0	0, 1
340	link start up mode selection (CC-Link)	0	0, 1

In the following table, operation using the operation panel, parameter unit or RS-485 communication is abbreviated to PU operation.

Pr. 79 Setting	Function		
0 (Factory setting)	At power-on, the inverter is put in the external operation mode. The operation mode can be changed between the PU and external operation modes from the operation panel (  key) or parameter unit (  key). For each mode, refer to the columns of settings 1 and 2.		
	<b>Operation mode</b>	<b>Running frequency</b>	<b>Start command</b>
1	PU operation mode	<ul style="list-style-type: none"> <li>Digital setting of FR-PU04</li> <li>RS-485 communication</li> <li>Sequence program</li> </ul>	Operation panel (  key) FR-PU04 (FWD/REV key) RS-485 communication
2	External operation mode	External RH, RM, RL signals (Three-speed setting)	External STF/STR signal
3	External/PU combined operation mode 1	<ul style="list-style-type: none"> <li>Digital setting of FR-PU04</li> <li>RS-485 communication</li> <li>Sequence program</li> <li>External RH, RM, RL signals</li> </ul>	External STF/STR signal
4	External/PU combined operation mode 2	External RH, RM, RL signals (Three-speed setting)	Operation panel (  key) FR-PU04 (FWD/REV key) RS-485 communication

3

INVERTER FUNCTIONS

#### REMARKS

A stop function (PU stop selection) by  key of the operation panel or PU (FR-PU04) is made valid during operation other than the PU operation mode. (Refer to page 71.)

### (1) Operation using the PLC function

The "P.RUN" LED that indicates the PLC function operation is lit when the SQ signal is turned on. When the following setting is to be made in the sequence program, the PU operation mode (Pr. 79 = 0, 1 or 3) must be selected.

- Running frequency write
- Inverter parameter rewrite
- Inverter parameter clear or all clear

### (2) Operation using CC-Link communication

CC-Link communication operation cannot be performed unless the "PU" and "EXT" LEDs on the operation panel flicker slowly.

In either of the following two methods, light up the "L.RUN" LED.

#### POINT

Set "0" (factory setting) or "2" in Pr. 79 "operation mode selection".

<Method 1: Set "H0000" in device D9143 "operation mode selection write".>

- Create an operation mode setting program using GX Developer. (Refer to page 122.)

#### REMARKS

The operation mode can also be set using an RS-485 communication user program. (Refer to page 79.)

#### POINT

- Priority of X5 and X15 (SQ signal)

Always short X5-SD to execute (RUN) the built-in PLC of the inverter.

RUN/STOP of the built-in PLC can be controlled by turning on/off X15 via CC-Link. To perform this control, the external input terminal X5-SD must be shorted in advance. When the X5 terminal is off, the X15 command is ignored.

Also note that when the built-in PLC is in a STOP status with Pr. 338 "operation command source" set for CC-Link (setting "0"), X5-SD shorted, and X15 off, the sequence program will run as soon as Pr. 338 "operation command source" is switched to external input (setting "1").

<Method 2: Set "1" in Pr. 340 "link start up mode selection".>

- 1) The parameter setting can be changed using the FR-PU04 (option).



#### POINT

Switch power on again. After power is restored, the inverter is placed in the CC-Link operation mode, the "PU" and "EXT" LEDs flicker slowly, and the operation and start commands using CC-Link communication are made valid. (The setting is not made valid unless power is switched on again.)

- 2) Using GX Developer, change the setting of the inverter parameter (Pr. 340). (Refer to page 131.)

#### REMARKS

The Pr. 340 setting can also be made using an RS-485 communication user program. (Refer to page 79.)

Relationships between Pr. 79 and Pr. 340

Pr. 340 Setting	Pr. 79 Setting	Operation Mode at Power On or Power Restoration	Remarks
0 (Factory setting)	0	External operation mode	Can be switched to the CC-Link operation mode by CC-Link communication.
	1	PU operation mode	Operation mode cannot be switched.
	2	External operation mode	Can be switched to the CC-Link operation mode by CC-Link communication.
	3	External/PU combined operation mode	Operation mode cannot be switched.
	4	External/PU combined operation mode	
1	0	CC-Link operation mode	Can be switched to the external operation mode by CC-Link communication.
	1	PU operation mode	Operation mode cannot be switched.
	2	CC-Link operation mode	Can be switched to the external operation mode by CC-Link communication.
	3	External/PU combined operation mode	Operation mode cannot be switched.
	4	External/PU combined operation mode	

● **Setting of running frequency and start command source (Pr. 338, Pr. 339)**

Set the following parameters when you want to give a running frequency or start command using the signal connected to the external terminal in the CC-Link operation mode.

(Refer to page 68 for Pr. 60 to Pr. 63, Pr. 65, Pr. 505 (input terminal function selection).)

Operation location selection		Pr. 338 "operation command source"		0:	0:	1:	1:
		Pr. 339 "speed command source"		CC-Link	CC-Link	External	External
				0:	1:	0:	1:
				CC-Link	External	CC-Link	External
Selection function	Pr. 60 to Pr. 63, Pr. 65, Pr. 505 settings	0	Low-speed operation command (RL)	CC-Link	External	CC-Link	External
		1	Middle-speed operation command (RM)	CC-Link	External	CC-Link	External
		2	High-speed operation command (RH)	CC-Link	External	CC-Link	External
		6	Output stop (MRS)	Combined	Combined	External	External
		7	External thermal relay input (OH)	External	External	External	External
		10	Reset (RES)	Combined	Combined	Combined	Combined
		17	Forward rotation command (STF)	CC-Link	CC-Link	External	External
		50	Sequence start (SQ)	External and CC-Link	External and CC-Link	External	External
		9999	Reverse rotation command (STR)	CC-Link	CC-Link	External	External
MRS selection function		PU operation interlock (MRS)		External	External	External	External

**[Explanation of table]**

- External : Operation is valid only from external terminal signal.
- CC-Link : Operation is valid from PLC via CC-Link.
- Combined : Operation is valid from either of external terminal and CC-Link communication.
- External and CC-Link: Operation is valid under AND condition of external terminal input and CC-Link input.

◆ **Related parameters** ◆

- Pr. 75 "PU stop selection" (Refer to page 71.)


Pr.145 ➡ Refer to page 93.

## 3.7 Computer Link Operation Setting

You can perform computer link operation from the RS-485 connector of the inverter by RS-485 communication (PU operation mode).

### 3.7.1 Communication settings (Pr. 331 to Pr. 337, Pr. 341)

#### POINT

- When performing operation or parameter write, set "1" (PU operation mode) in Pr. 79 "operation mode selection", or if Pr. 79 = "0" (factory setting), switch to the PU operation mode by RS-485 communication (refer to page 87) or switch to the PU operation mode by pressing  of the operation panel (refer to page 42).
- When making communication, set any value other than 0 in Pr. 336 "communication check time interval".

#### ●Communication-related parameters

Parameter	Name	Setting Range	Factory Setting	Reflection Timing
331	Communication station number	0 to 31	0	After reset
332	Communication speed	48, 96, 192	96	After reset
333	Stop bit length	0, 1, 10, 11	0	After reset
334	Parity check presence/absence	0, 1, 2	1	After reset
335	Number of communication retries	0 to 10, 9999	1	Immediately
336	Communication check time interval*	0, 0.1 to 999s, 9999	9999	Immediately
337	Wait time setting	0 to 150ms, 9999	9999	After reset
341	CR/LF selection	0, 1, 2	1	After reset

- Refer to page 87 for the instruction codes.

#### ●Communication specifications

Item		Computer	
Conforming standard		RS-485 Standard	
Number of inverters connected		1:N (maximum 32)	
Communication speed		Selected 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	Presence
Wait time setting		Selectable between presence and absence	

3

INVERTER FUNCTIONS

#### REMARKS

- For computer link operation, set 65520 (HFFF0) as the value "8888" and 65535 (HFFFF) as "9999".
- Refer to page 38 for wiring.
- For the data codes of the parameters, refer to the "parameter data codes for computer link operation using RS-485 communication" (page 184).



**<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.

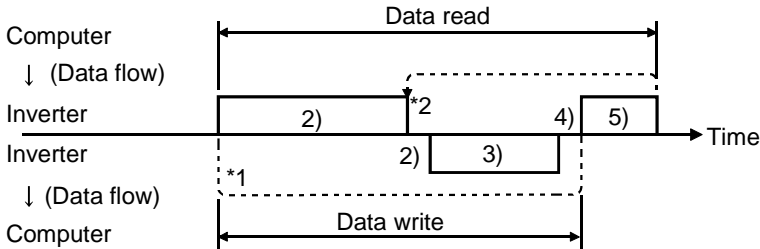
\* After making the initial setting of the parameters, always reset the inverter. After you have changed the communication-related parameters, communication cannot be made until the inverter is reset.

Parameter	Name	Setting	Description	
331	Communication station number	0 to 31	Station number specified for RS-485 communication from the PU connector. Set the inverter station numbers when two or more inverters are connected to one personal computer.	
332	Communication speed	48	4800bps	
		96	9600bps	
		192	19200bps	
333	Stop bit length/ data length	0	Stop bit length 1 bit	Data length 8 bits
		1	Stop bit length 2 bits	
		10	Stop bit length 1 bit	Data length 7 bits
		11	Stop bit length 2 bits	
334	Parity check presence/ absence	0	Absent	
		1	Odd parity present	
		2	Even parity present	
335	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 (E.PUE).	
		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.	
336	Communication check time interval	0	No communication	
		0.1 to 999	Set the communication check time [s] interval. If a no-communication state persists for longer than the permissible time, the inverter will come to an alarm stop (E.PUE).	
		9999	Communication check suspension	
337	Wait time setting	0 to 150	Set the waiting time between data transmission to the inverter and response.	
		9999	Set with communication data.	
341	CR/LF selection	0	Without CR/LF	
		1	With CR, without LF	
		2	With CR/LF	

## <Computer programming>

### (1) Communication protocol

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



#### REMARKS

- \*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 (PUE) 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") *1	A (A") *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") *1	E (E") *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 (Absent)	G (Absent)
		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 83.)

**(3) Data format**

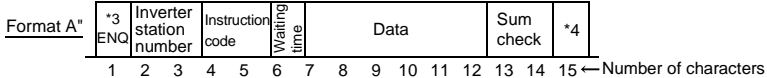
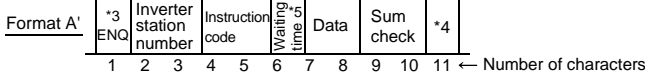
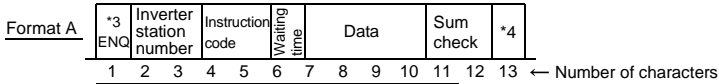
Data used is hexadecimal.

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

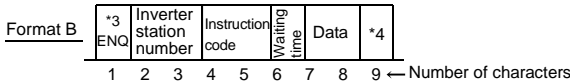
●Data format types

1) Communication request data from computer to inverter

[Data write]

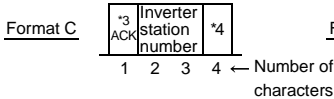


[Data read]

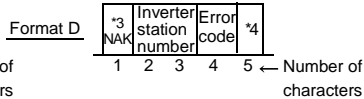


2) Replay data from inverter to computer during data write

[No data error detected]

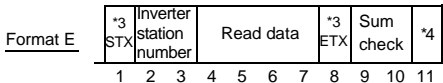


[Data error detected]

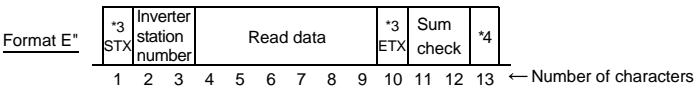
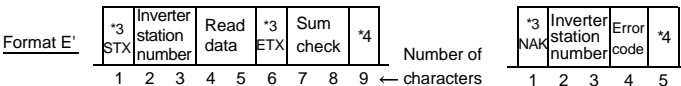


3) Replay data from inverter to computer during data read

[No data error detected]



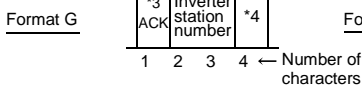
[Data error detected]



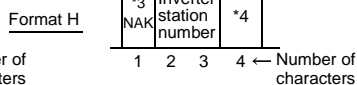
4) Send data from computer to inverter during data read

[No data error detected]

May be omitted)



[Data error detected]



**REMARKS**

- The inverter station numbers may be set between H00 and H1F (stations 0 and 31) in hexadecimal.
  - \*3 indicates the control code.
  - \*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. 341.
- At \*5, when Pr. 337 "waiting time setting" is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters is decremented by 1.)

**(4) Data definitions****1) Control codes**

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

**2) Inverter station number**

Specify the station number of the inverter which communicates with the computer.

**3) Instruction code**

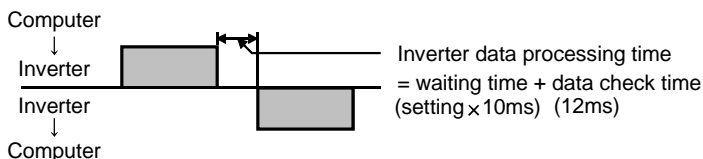
Specify the processing request, e.g. operation, monitoring, given by the computer to the inverter. Hence, the inverter can be run and monitored in various ways by specifying the instruction code as appropriate. (Refer to page 87.)

**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 184.)

**5) Waiting time**

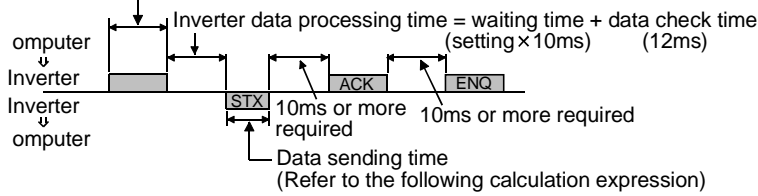
Specify the waiting time between the receipt of data at the inverter from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments (e.g. 1 = 10ms, 2 = 20ms).

**REMARKS**

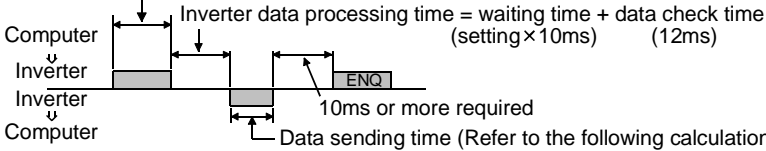
When Pr. 337 "waiting time setting" ≠ "9999", create the communication request data without "waiting time" in the data format. (The number of characters is decremented by 1.)

### 6) Response time

Data sending time (Refer to the following calculation expression)



Data sending time (Refer to the following calculation expression)



[Data sending time calculation expression]

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

(Refer to page 82) (See below)

• Communication specifications

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

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

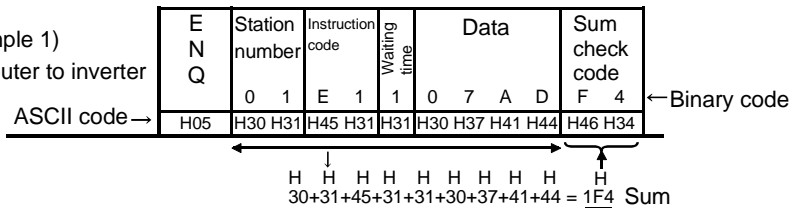
Minimum total number of bits ... 9 bits  
Maximum total number of bits ... 12 bits

### 7) Sum chck code

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

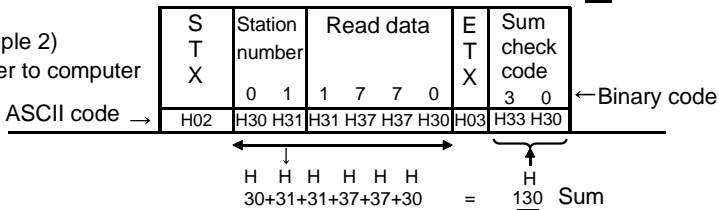
(Example 1)

Computer to inverter



Example 2)

Inverter to computer



## 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 90.)

### REMARKS

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.

## (5) Programming instructions

- 1) When the data from the computer has an error, the inverter will not accept that data. Hence, always insert a retry program for data error in the user program.
- 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) Program example  
To change the operation mode to communication operation

```

10 OPEN "COM1:9600,E,8,2,HD" AS #1
20 COMST1,1,1:COMST1,2,1
30 ON COM(1)GOSUB'REC
40 COM(1)ON
50 D$="01FB10002"
60 S=0
70 FOR I=1 TO LEN(D$)
80 A$=MID$(D$,I,1)
90 A=ASC(A$)
100 S=S+A
110 NEXTI
120 D$=CHR$(&H5)+D$+RIGHT$(HEX$(S),2)
130 PRINT#1,D$
140 GOTO 50
1000 'REC
1010 IF LOC(1)=0 THEN RETURN
1020 PRINT "RECEIVE DATA"
1030 PRINT INPUT$(LOC(1),#1)
1040 RETURN
    
```

Initial setting of I/O file

: Opening the communication file  
 : ON/OFF setting of circuit control signals (RS, ER)  
 : Interrupt definition for data receive  
 : Interrupt enable

End data setting

Sum code calculation

: Addition of control and sum codes

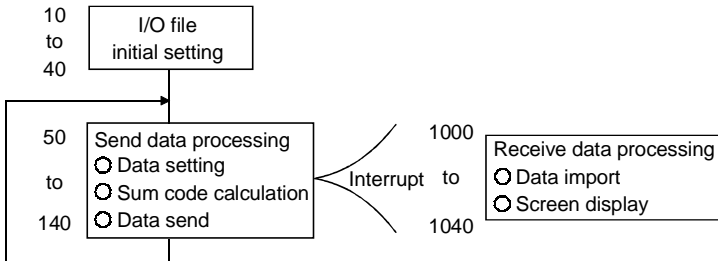
Data send

Interrupt data receive

: Interrupt occurrence during data receive

**General sequence**

Line number



## ⚠ CAUTION

- ⚠ When the inverter's communication check time interval is not set, interlocks are provided to disable operation to prevent hazardous conditions. Always set the communication check time interval before starting operation.
- ⚠ Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage, etc., the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter will come to an alarm stop (PUE).  
The inverter can be coasted to a stop by switching on its RES signal or by switching power off.
- ⚠ If communication is broken due to signal cable breakage, computer fault, etc., the inverter does not detect such a fault. This should be fully noted.

### <Setting items and set data>

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

No.	Item	Instruc tion Code	Description	Number of Data Digits
1	Operation mode	Read	H7B H0000: CC-Link operation H0001: External operation H0002: PU (RS-485 communication)	4 digits
		Write	HFB H0000: CC-Link operation H0001: External operation H0002: PU (RS-485 communication)	



No.	Item	Instruc tion Code	Description	Number of Data Digits																																																								
2	Output frequency [speed]	H6F	H0000 to HFFFF: Output frequency (hexadecimal) in 0.01Hz increments	4 digits																																																								
	Output current	H70	H0000 to HFFFF: Output current (hexadecimal) in 0.01A increments	4 digits																																																								
	Monitoring  Alarm definition	H74 to H75	<p>H0000 to HFFFF: Two most recent alarm definitions Alarm definition display example (instruction code H74)</p> <p style="text-align: center;"> <span style="margin-right: 100px;">b15</span> <span style="margin-right: 100px;">b8b7</span> <span>b0</span> </p> <table border="1" style="margin: auto; text-align: center;"> <tr> <td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> </table> <p style="text-align: center;"> <span style="margin-right: 100px;">Previous alarm (H30)</span> <span>Most recent alarm (HA0)</span> </p> <p>Alarm data</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Data</th> <th>Description</th> <th>Data</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>H00</td><td>No alarm</td><td>H40</td><td>FIN</td></tr> <tr><td>H10</td><td>OC1</td><td>H60</td><td>OLT</td></tr> <tr><td>H11</td><td>OC2</td><td>H80</td><td>GF</td></tr> <tr><td>H12</td><td>OC3</td><td>H90</td><td>OHT</td></tr> <tr><td>H20</td><td>OV1</td><td>HB0</td><td>PE</td></tr> <tr><td>H21</td><td>OV2</td><td>HB1</td><td>PUE</td></tr> <tr><td>H22</td><td>OV3</td><td>HB2</td><td>RET</td></tr> <tr><td>H30</td><td>THT</td><td>HC0</td><td>CPU*</td></tr> <tr><td>H31</td><td>THM</td><td></td><td></td></tr> </tbody> </table> <p>*Error code may not be returned.</p>	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	Data	Description	Data	Description	H00	No alarm	H40	FIN	H10	OC1	H60	OLT	H11	OC2	H80	GF	H12	OC3	H90	OHT	H20	OV1	HB0	PE	H21	OV2	HB1	PUE	H22	OV3	HB2	RET	H30	THT	HC0	CPU*	H31	THM			4 digits
0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0																																													
Data	Description	Data	Description																																																									
H00	No alarm	H40	FIN																																																									
H10	OC1	H60	OLT																																																									
H11	OC2	H80	GF																																																									
H12	OC3	H90	OHT																																																									
H20	OV1	HB0	PE																																																									
H21	OV2	HB1	PUE																																																									
H22	OV3	HB2	RET																																																									
H30	THT	HC0	CPU*																																																									
H31	THM																																																											
3	Run command	HFA	<p style="text-align: center;"> <span style="margin-right: 100px;">b7</span> <span>b0</span> </p> <table border="1" style="margin: 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] H02 ... Forward rotation</p> <p>[Example 2] H00 ... Stop</p> <p>b0: _____ b1: Forward rotation(STF) b2: Reverse rotation(STR) b3: _____ b4: _____ b5: _____ b6: _____ b7: _____</p>	0	0	0	0	0	0	1	0	2 digits																																																
0	0	0	0	0	0	1	0																																																					
4	Inverter status monitor	H7A	<p style="text-align: center;"> <span style="margin-right: 100px;">b7</span> <span>b0</span> </p> <table border="1" style="margin: 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] H02 ... During forward rotation</p> <p>[Example 2] H80 ... Stop due to alarm</p> <p>b0: Inverter running (RUN)* b1: Forward rotation b2: Reverse rotation (STR) b3: _____ b4: Overload (OL) b5: _____ b6: _____ b7: Alarm occurrence (ALM)*</p> <p>* Function change can be made using Pr. 64 and Pr. 506 (output terminal function selection).</p>	0	0	0	0	0	0	1	0	2 digits																																																
0	0	0	0	0	0	1	0																																																					

No.	Item	Instruction Code	Description	Number of Data Digits																					
5	Set frequency read (E <sup>2</sup> PROM)	H6E	Reads the set frequency (RAM or E <sup>2</sup> PROM). H0000 to H2EE0: 0.01Hz increments (hexadecimal)	4 digits																					
	Set frequency read (RAM)	H6D																							
	Set frequency write (RAM and E <sup>2</sup> PROM)	HEE	H0000 to H2EE0: 0.01Hz increments (hexadecimal) (0 to 120.00Hz)* To change the set frequency consecutively, write data to the inverter RAM. (Instruction code: HED) * The minimum setting increments are 0.01Hz but setting may be made in 0.1Hz increments only.	4 digits																					
	Set frequency write (RAM only)	HED																							
6	Inverter reset	HFD	H9696: Resets the inverter. As the inverter is reset on start of communication by the computer, the inverter cannot send reply data back to the computer.	4 digits																					
7	Alarm definition batch clear	HF4	H9696: Alarm history batch clear	4 digits																					
8	All parameter clear	HFC	All parameters return to the factory settings. Any of four different all clear operations is performed according to the data.	4 digits																					
			<table border="1"> <thead> <tr> <th rowspan="2">Name</th> <th>Parameters</th> <th rowspan="2">Communication Parameters</th> <th rowspan="2">Other Parameters</th> </tr> <tr> <th>Data</th> </tr> </thead> <tbody> <tr> <td>Parameter clear</td> <td>H9696</td> <td>○</td> <td>○*1</td> </tr> <tr> <td>All parameter clear</td> <td>H9966</td> <td>○</td> <td>○*2</td> </tr> <tr> <td>Parameter clear</td> <td>H5A5A</td> <td>×</td> <td>○*1</td> </tr> <tr> <td>All parameter clear</td> <td>H55AA</td> <td>×</td> <td>○*2</td> </tr> </tbody> </table>		Name	Parameters	Communication Parameters	Other Parameters	Data	Parameter clear	H9696	○	○*1	All parameter clear	H9966	○	○*2	Parameter clear	H5A5A	×	○*1	All parameter clear	H55AA	×	○*2
			Name			Parameters			Communication Parameters	Other Parameters															
					Data																				
			Parameter clear		H9696	○	○*1																		
			All parameter clear		H9966	○	○*2																		
Parameter clear	H5A5A	×	○*1																						
All parameter clear	H55AA	×	○*2																						
*1 The terminal function parameters and Pr. 75 are not cleared.																									
*2 Pr. 75 is not cleared.																									
When parameter clear is executed for H9696 or H9966, communication-related parameter settings also return to the factory settings. When resuming operation, set the parameters again.																									
<table border="1"> <tr> <td><b>REMARKS</b></td> </tr> </table> <p>Check the terminal function parameters and communication-related parameters in the parameter list (page 51).</p>	<b>REMARKS</b>																								
<b>REMARKS</b>																									
9	Parameter write	H80 to HFD	Refer to the parameter data codes for computer link operation using RS-485 communication (page 184), and write and/or read values as required.	4 digits																					
10	Parameter read	H00 to H7B																							

No.	Item	Instruction Code	Description	Number of Data Digits
11	Link parameter expansion setting	Read H7F	H00 to H6C and H80 to HEC parameter values are changed. H00: Pr. 0 to Pr. 99 values are accessible. H01: Pr. 145 value is accessible. H03: Pr. 331 to Pr. 342 values are accessible. H05: Pr. 503 to Pr. 533 values are accessible. H09: Pr. 990 to Pr. 993 values are accessible.	2 digits
		Write HFF		

**REMARKS**

For the instruction code HFF, its set value is held once it is written, but changed to 0 when the inverter is reset or all clear is performed.

**<Error Code List>**

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

Error Code	Item	Definition	Inverter Operation
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than allowed number of retries.	Brought to an alarm stop (PUE) if error occurs continuously more than the allowable number of retries.
H1	Parity error	The parity check result does not match the specified parity.	
H2	Sum check error	The sum check code in the computer does not match that of the data received by the inverter.	
H3	Protocol error	Data received by the inverter is in wrong protocol, data receive is not completed within given time, or CR and LF are not as set in the parameter.	
H4	Framing error	The stop bit length is not as specified by initialization.	
H5	Overrun error	New data has been sent by the computer before the inverter completes receiving the preceding data.	
H6	—	—	—
H7	Character error	The character received is invalid (other than 0 to 9, A to F, control code).	Does not accept received data but is not brought to alarm stop.
H8	—	—	—
H9	—	—	—
HA	Mode error	Parameter write was attempted in other than the computer link operation mode or during inverter operation.	Does not accept received data but is not brought to alarm stop.
HB	Instruction code error	The specified command does not exist.	
HC	Data range error	Invalid data has been specified for parameter write, frequency setting, etc.	

Error Code	Item	Definition	Inverter Operation
HD	—	—	—
HE	—	—	—
HF	—	—	—

### (6) Operation at alarm occurrence

Fault Location	Description	Operation Mode	
		Communication operation (RS-485 connector)	External operation
Inverter fault	Inverter operation	Stop	Stop
	Communication   PU connector	Continued	Continued
Communication error (Communication from PU connector)	Inverter operation	Stop/continued (*3)	Continued
	Communication   PU connector	Stop	Stop

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

### (7) Communication error

Fault Location	Error Message (Operation Panel)	Remarks
Communication error (Communication from RS-485 connector)	PUE	Error code is E.PUE.

Pr. 338 to Pr. 340  Refer to page 76.

### 3.7.2 E<sup>2</sup>PROM write selection (Pr. 342)

You can choose whether the parameters are stored into E<sup>2</sup>PROM or not at the parameter setting for CC-Link or RS-485 communication.

Parameter	Name	Factory Setting	Setting Range
342	E <sup>2</sup> PROM write selection	0	0, 1

Pr. 342 Setting	Description
0	Written to RAM and E <sup>2</sup> PROM
1	Written to RAM only. Not written to E <sup>2</sup> PROM.*

\*When reset is performed, the parameter value will be the value of E<sup>2</sup>PROM.\*

#### REMARKS

When E<sup>2</sup>PROM write disable (setting value=1) is set in parameter, the set value is returned to the original value (the value stored in E<sup>2</sup>PROM) by power on reset or terminal reset.

Pr.503, Pr.504 ➡ Refer to page 143.

Pr.505 ➡ Refer to page 68.

Pr.506 ➡ Refer to page 69.

Pr.507 ➡ Refer to page 138.

Pr.510 to Pr. 529 ➡ Refer to page 135.


Pr. 530 to Pr. 532 ➡ Refer to page 136.

Pr.533 ➡ Refer to page 137.

## 3.8 Parameter Unit (FR-PU04) Setting

When the optional parameter unit (FR-PU04) is connected to the RS-485 connector of the inverter, you can make the environment setting of the parameter unit.

### CAUTION

When the parameter unit (FR-PU04) is used, operation from the operation panel is not accepted. (The stop key ( key) is valid.)

### 3.8.1 Parameter display language selection (Pr. 145)

You can switch the display language of the parameter unit to another.




Pr. 145 Setting	Display Language
0 (Factory setting)	Japanese
1	English
2	German
3	French
4	Spanish
5	Italian
6	Swedish
7	Finish

### 3.8.2 PU buzzer control (Pr. 990)

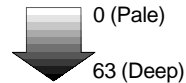
You can control "beep" produced when any of the parameter unit (FR-PU04) keys is operated.

Pr. 990 Setting	Description
0	With sound
1 (Factory setting)	Without sound


### 3.8.3 PU contrast adjustment (Pr. 991)

You can adjust the LCD contrast of the parameter unit (FR-PU04). When using the FR-PU04, adjust the numerical value to any depth of a color with the / keys and define that color with the  key of the parameter unit.

Parameter	Name	Factory Setting	Setting Range
991	PU contrast adjustment	58	0 to 63



#### CAUTION

When using the FR-PU04, you should press the  key to store the LCD contrast setting.

### 3.8.4 PU main display screen data selection (Pr. 992)

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

When you set 100 in Pr. 992, the monitor value changes depending on whether the inverter is at a stop or running.

	Pr.992		
	0 (Factory setting)	100	
	During operation/stop	During stop	During operation
Output frequency	Output frequency	Set frequency	Output frequency
Output current	Output current		
Alarm display	Alarm display		

#### REMARKS

- During an error, the output frequency at error occurrence appears.
- During MRS, the values displayed are the same as during a stop.

### 3.8.5 PU disconnection detection/PU setting lock (Pr. 993)


You can choose the connector disconnection detection function of the parameter unit (FR-PU04) and the operation write of the parameter unit (FR-PU04).

- PU disconnection detection
  - : This function detects that the parameter unit (FR-PU04) has been disconnected from the inverter for longer than 1s and causes the inverter to provide an alarm output (PUE) and come to an alarm stop. When the PU has been disconnected since before power-on, it is not judged as an alarm.
- PU setting lock: This function disables (enables) operation, frequency setting or parameter setting from the parameter unit (FR-PU04).

Parameter	Name	Factory Setting	Setting Range
993	PU disconnection detection/PU setting lock	0	0, 1, 10

#### <Setting>

Pr. 993 Setting	PU Disconnection Detection	PU Setting Lock
0	Operation is continued as-is if the PU is disconnected (without PU disconnection detection)	PU operation valid
1	Inverter output is shut off when the PU is disconnected (with PU disconnection detection)	
10	Operation is continued as-is if the PU is disconnected (without PU disconnection detection)	PU operation invalid*

\*The monitor display, frequency setting, parameter setting and  key are valid.

#### REMARKS

When RS-485 communication operation is performed through the PU connector or when GX Developer is used, the reset selection/PU stop selection function (Pr. 75) is valid but the PU disconnection detection function (Pr. 993) is invalid.

## CAUTION



**Do not reset the inverter while the start signal is being input.**

**Doing so will cause the inverter to start immediately after a reset, leading to hazardous conditions.**



# MEMO

# 4. PLC FUNCTION

This chapter describes the "PLC function" for use of this product. Always read the instructions before use.

<b>4.1</b>	<b>System Configuration .....</b>	<b>98</b>
<b>4.2</b>	<b>Prior to Sequence Program Creation .....</b>	<b>99</b>
<b>4.3</b>	<b>Function Block Diagram .....</b>	<b>102</b>
<b>4.4</b>	<b>PLC Instructions.....</b>	<b>104</b>
<b>4.5</b>	<b>Device Map.....</b>	<b>109</b>
<b>4.6</b>	<b>Inputs/Outputs.....</b>	<b>114</b>
<b>4.7</b>	<b>Inverter Status Monitoring, Special Registers for Control.....</b>	<b>117</b>
<b>4.8</b>	<b>Inverter Parameter Read/Write Method .....</b>	<b>129</b>
<b>4.9</b>	<b>User Area Read/Write Method .....</b>	<b>135</b>
<b>4.10</b>	<b>Debugging Mode Specifications .....</b>	<b>136</b>
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<b>4.12</b>	<b>Inverter Operation Lock Mode Setting .....</b>	<b>138</b>

Chapter 1

Chapter 2

Chapter 3

**Chapter 4**

Chapter 5

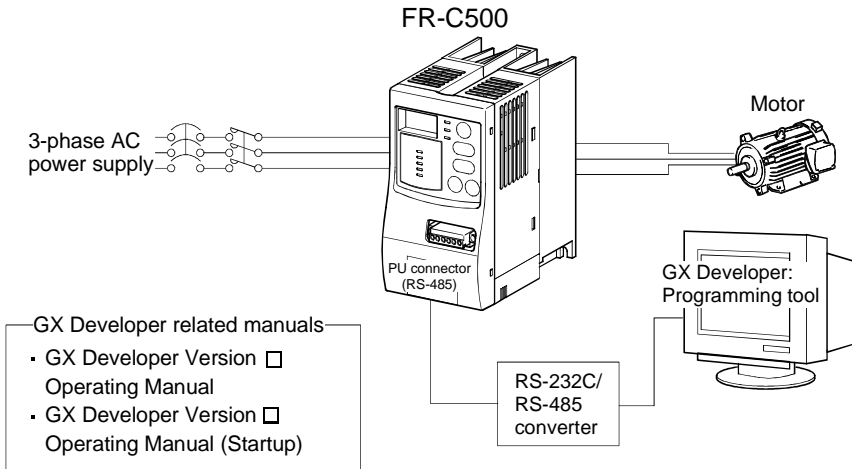
Chapter 6

Chapter 7

## 4.1 System Configuration

The following shows the system configuration for use of the PLC function.

### <System configuration example>



### Communication specifications (the following settings are factory-set)

Inverter Parameter	Setting	Reference Page
Pr. 332 "communication speed"	96 (9600bps)	79
Pr. 333 "stop bit length"	0 (data length: 8 bits, stop bit: 1 bit)	
Pr. 334 "parity check presence/absence"	1 (with odd parity check)	
Pr. 336 "communication check time interval"	9999 (without communication check)	

#### POINT

#### GX Developer Setting

PLC series	<b>ACPU</b>
PLC type	<b>A0J2H</b>

[Project data list]→[Parameter]→[PLC parameter]→[A parameter] →«Memory capacity» tab→"Program capacity"→"Sequence"→"main"	<b>1k step</b>
--	----------------

#### REMARKS

- Refer to page 35 for wiring.
- Refer to the GX Developer manuals for the specifications related to GX Developer and the personal computer that uses GX Developer.
- The programming tool that can be used is GX Developer only. (The A6GPP, A7PHP, etc. cannot be used.)

## 4.2 Prior to Sequence Program Creation

### 4.2.1 Precautions for sequence program creation

#### POINT

- Online change of the sequence program and access to other stations are not allowed.  
In addition, program read/write from other stations and all PLC memory clear cannot be performed.
- Back up the ladder configured with the protective function of GX Developer.

If any of the instructions (refer to page 104) and devices (refer to page 180) that cannot be used with the built-in PLC function exists in a sequence program, an instruction code error occurs at the execution of that instruction.

Error code	D9008=10
Operation error step	D9010 D9011

#### REMARKS

- Refer to page 118 for the error codes.

### 4.2.2 Usable main GX Developer functions

- Parameter or sequence program read/write
- Ladder monitor
- Device monitor
- Device test
- All device memory clear

#### CAUTION

Device test ([Online] - [Debug] - [Device test]) of GX Developer can be performed, but if devices corresponding to control terminal (e.g. STF, STR) signals are tested, the devices turn on in the sequence but the inverter does not perform the corresponding operation.

When you want to operate the inverter actually, refer to 4.10 Debugging Mode Specifications (page 136).

### 4.2.3 Sequence program execution key

The sequence program execution key (STOP/RUN) of the PLC is switched by turning off/on the SQ signal.

#### POINT

**SQ-SD must be shorted to execute the built-in PLC function. (Built-in sequence signal: X5 ON)**

#### CAUTION

**If the SQ signal is not turned on, the start signal of the inverter is designed to become valid by the factory setting of Pr. 507 "inverter operation lock mode setting". (Refer to page 40.)**

Open (STOP) the SQ signal-SD terminals when writing a sequence program, for example.

When executing the sequence program, short (RUN) the SQ signal-SD terminals.

Remote run/stop of the built-in PLC function can be executed in any of the following methods:

- Setting using the built-in PLC function parameter (contact)
- Using GX Developer
- Via CC-Link communication (refer to page 143)

#### REMARKS

- Refer to page 8 for the SQ terminal specifications.
- The validity limit of the SQ terminal can be controlled using Pr. 507 "inverter operation lock mode setting". (Refer to page 138.)

#### CAUTION

**The outputs (Y) are cleared by turning the SQ signal off (STOP) after sequence program execution (SQ signal on).**

**The other devices retain the device data prior to STOP. When you want to clear the remaining device data, power off or reset (short RES-SD for 0.1s, then open) the inverter.**

## 4.2.4 Sequence program write

### POINT

Sequence program write can be performed in any operation mode. (Refer to page 75.)

When rewriting the PLC function parameters and sequence program using GX Developer, check the following:

- 1) Check that the sequence program execution key is in the STOP position (signal SQ-SD is off) (refer to page 100).
- 2) Check that the inverter is at a stop (RUN indicator is off) (refer to page 42).
- 3) Check that the communication specification setting parameters (Pr. 332 to Pr. 336) are set correctly (refer to page 98). If any of these parameters is set incorrectly, communication with GX Developer cannot be made.

### REMARKS

Though the communication specification parameters (Pr. 332 to Pr. 336) are factory-set to enable communication with GX Developer, use the parameter unit (FR-PU04) to confirm and/or rewrite them. (Refer to the FR-PU04 instruction manual for the handling of the FR-PU04.) GX Developer and the FR-PU04 cannot be connected and used simultaneously.

- 4) Check the PLC series and sequence program capacity in the GX Developer parameters (refer to page 98).
- 5) Refer to the GX Developer manual and write the sequence program.

### CAUTION

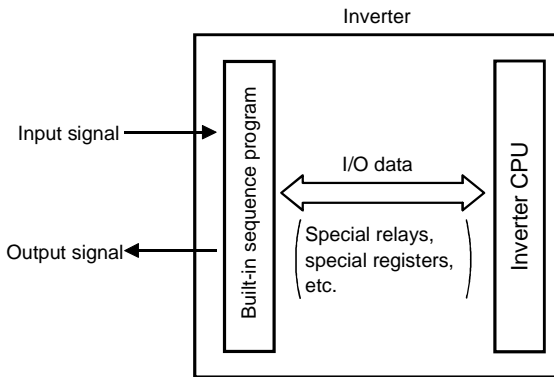
- **A sequence program cannot be written with its steps specified. If written, the sequence program does not run. (The program outside the specified range is initialized.)**
- **Do not read the built-in PLC function parameters and sequence program without writing them to the inverter once using GX Developer. Since the inverter does not have normal data, always write the built-in PLC function parameters and sequence program once.**
- **Since the built-in PLC function parameters and sequence program are written to the flash ROM, there are restrictions on the number of write times. (Approximately 100,000 times)**

## 4.3 Function Block Diagram

How I/O data are transferred to/from the inverter by the built-in PLC function is explained using function blocks.

- (1) I/O data read, write, etc. can be performed by accessing the inverter in the predetermined method using special relays, special registers, etc.
- (2) Operation, parameter read/write, etc. can be performed in accordance with the created sequence programs (built in the inverter) using input data from the control input terminals.

With the output signals, output data can be output to outside the inverter from the control output terminals as not only the inverter's status signals but also pilot lamp on/off, interlock and other control signals set freely by the user.



### 4.3.1 Setting list of built-in PLC function parameter

The built-in PLC function parameters are designed to specify the ranges of using the PLC function, e.g. program capacity, device assignment and various functions.

Item	GX Developer Default	Setting Range <Usable device range>
Sequence program capacity	6k steps	1k step
File register capacity	None	Cannot be set (default)
Comment capacity	None	Cannot be set (default)
Status latch	None	Cannot be set (default)
Sampling trace	None	Cannot be set (default)
Microcomputer program capacity	None	Cannot be set (default)
Latch range setting	L1000 to 2047	Cannot be set (invalid if set)
Link range setting	None	Cannot be set (default)
I/O assignment	None	Cannot be set (default)
Internal relay, latch relay, step relay setting	M0 to 999 L1000 to 2047 None for S	L and S cannot be set. (Operates as M if set) <M0 to 63>
Watchdog timer setting	200ms	10 to 2000ms
Timer setting	100ms: T0 to 199 10ms: T200 to 255 (100ms timers since only T0 to 7 are available)	8 points (set in units of 16 points) for 100ms, 10ms and retentive timers. Timers have consecutive numbers. <T0 to T7>
Counter setting	Without interrupt counters	Cannot be set (default) <C0 to C7>
Remote run/pause	None	Can be set using X0 to 1F. Otherwise invalid. Pause does not function.
Error-time operation mode	Fuse blow: Continued	Setting invalid (since there are no fuses)
	I/O verify error: Stop	Setting invalid (since there are no I/O modules)
	Operation error: Continued	Setting invalid (since there are no operation check errors)
	Special function module check error: Stop	Setting invalid (since there are no special modules)
STOP → RUN output mode	Operation status prior to STOP is re-output.	Prior to STOP/after operation execution
Print title registration	None	Cannot be set
Keyword registration	None	Online setting cannot be made but parameter setting is valid.

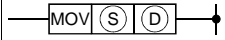

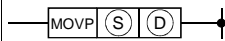

#### REMARKS

- The following functions are not supported.
  1. Constant scan, 2. Latch (device data backup for power failure), 3. Pause, 4. Status latch, 5. Sampling trace, 6. Offline switch
 For the operation processing outline, I/O control method, device explanation and other details, refer to the FR-C500 Series Programming Manual.
- If parameter clear of the inverter is performed, the above built-in PLC function parameters are not cleared.
- For the built-in PLC function parameter setting operation, refer to the GX Developer Operating Manual.



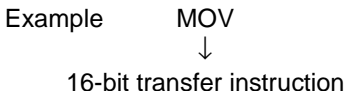
## 4.4 PLC Instructions

### 4.4.1 How to use the instruction list

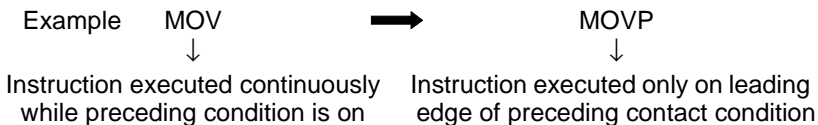
Classification	Instruction Symbol	Symbol	Processing	Execution Condition	Number of Steps
Transfer	MOV		(S) → (D)		5
	MOVP				
	1)	2)	3)	4)	5)
					6)

- 1).....Classifies the instruction by application.
- 2).....Indicates the instruction symbol used for programming.

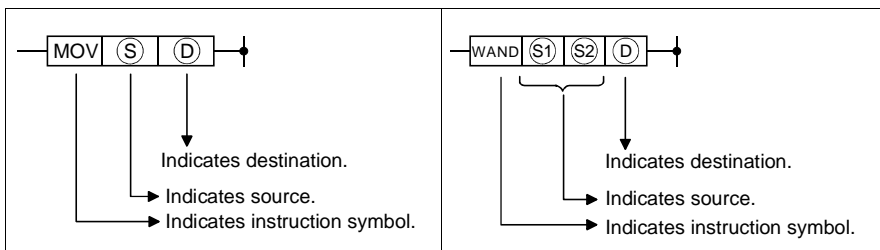
The instructions are based on 16-bit data instructions.



- Add P to the end of the instruction to define it as executed only on the leading edge of the preceding condition.



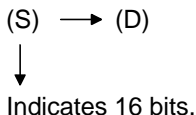
- 3).....Indicates the symbol used in the ladder diagram.







Destination: ..... Indicates the destination of the operation result.

Source:..... Indicates the source of the data for the operation.

4)..... Indicates the operation.



5)..... Indicates the condition of execution for each instruction as described below:

Symbol	Execution Condition
No entry	The instruction is always executed independently of whether its preceding condition is on or off. When the preceding condition is off, the instruction is off.
	The instruction is executed continuously only while its preceding condition is on. When the preceding condition is off, the instruction is not executed and not processed.
	The instruction is executed once only when the preceding condition turns from off to on. If the condition remains on after that, the instruction is not executed and not processed.
	The instruction is executed continuously only while its preceding condition is off. When the preceding condition is on, the instruction is not executed and not processed.
	The instruction is executed once only when the preceding condition turns from on to off. If the condition remains off after that, the instruction is not executed and not processed.

6)..... Indicates the number of program steps required for each instruction.  
The number of steps that changes depending on conditions is two.

**REMARKS**

For full information on the instructions, refer to the FR-C500 Series Programming Manual.

### 4.4.2 PLC instruction list

Classification	Instruction Symbol	Symbol	Processing	Execution Condition	Number of Steps
Contacts	LD		Logical operation start (Operation start at N/O contact)		1
	LDI		Logical NOT operation start (Operation start at N/C contact)		1
	AND		Logical product (N/O contact series connection)		1
	ANI		Logical product NOT (N/C contact series connection)		1
	OR		Logical sum (N/O contact parallel connection)		1
	ORI		Logical sum NOT (N/C contact parallel connection)		1
Connection	ANB		AND between logical blocks (series connection between blocks)		1
	ORB		OR between logical blocks (parallel connection between blocks)		1
	MPS		Stores the operation result.		1
	MRD		Reads the operation result stored in MPS.		1
	MPP		Reads and resets the operation result stored in MPS.		1
Outputs	OUT		Outputs device.		1 3
	SET		Sets device.		1 3
	RST		Resets device.		1 3
	PLS		Produces a pulse lasting one program scan time on the leading edge of input signal.		3
	PLF		Produces a pulse lasting one program scan time on the trailing edge of input signal.		3
Shift	SFT		1-bit device shift		3
	SFTP				3

Classification	Instruction Symbol	Symbol	Processing	Execution Condition	Number of Steps
Master control	MC		Master control start		5
	MCR		Master control reset		3
Program end	END	—	Must be written at the end of sequence program to return to step 0.		1
No operation	NOP	—	No operation For program deletion or space		1
	NOPLF	—	No operation Line feed instruction for printer output		1
16-bit data comparison	LD=		Continuity when (S1) = (S2) Non-continuity when (S1) ≠ (S2)		5 7
	AND=				5 7
	OR=				5 7
	LD<>		Continuity when (S1) ≠ (S2) Non-continuity when (S1) = (S2)		5 7
	AND<>				5 7
	OR<>				5 7
	LD>		Continuity when (S1) > (S2) Non-continuity when (S1) ≤ (S2)		5 7
	AND>				5 7
	OR>				5 7
	LD≤		Continuity when (S1) ≤ (S2) Non-continuity when (S1) > (S2)		5 7
	AND≤				5 7
	OR≤				5 7
	LD<		Continuity when (S1) < (S2) Non-continuity when (S1) ≥ (S2)		5 7
	AND<				5 7
	OR<				5 7

Classification	Instruction Symbol	Symbol	Processing	Execution Condition	Number of Steps
16-bit data comparison	LD>=		Continuity when $(S1) \geq (S2)$ Non-continuity when $(S1) < (S2)$		5 7
	AND>=				5 7
	OR>=				5 7
Transfer	MOV		$(S) \rightarrow (D)$		5
	MOVP				5
Logical product	WAND		$(D) \wedge (S) \rightarrow (D)$		5
	WANDP				5
	WAND		$(S1) \wedge (S2) \rightarrow (D)$		7
	WANDP				7
Logical sum	WOR		$(D) \vee (S) \rightarrow (D)$		5
	WORP				5
	WOR		$(S1) \vee (S2) \rightarrow (D)$		7
	WORP				7

**REMARKS**

For full information on the instructions, refer to the FR-C500 Series Programming Manual.

## 4.5 Device Map

### 4.5.1 I/O device map

	Device No.	Name	Remarks	Device No.	Name	Remarks			
External I/O	X0	STF terminal	External terminal	Y0	RUN terminal	External terminal			
	X1	STR terminal	External terminal	Y1	ALM terminal	External terminal			
	X2	RL terminal	External terminal	Y2	Empty				
	X3	RM terminal	External terminal	Y3					
	X4	RH terminal	External terminal	Y4					
	X5	SQ terminal	External terminal	Y5					
	X6	Empty		Y6					
	X7		Y7						
	X8		Y8						
	X9		Y9						
	XA		YA						
	XB		YB						
	XC		YC						
	XD		YD						
	XE		YE						
	XF		YF						
	CC-Link I/O remote I/O		X10	STF terminal		CC-Link	Y10	RUN terminal	CC-Link
			X11	STR terminal		CC-Link	Y11	ALM terminal	CC-Link
X12			RL terminal	CC-Link		Y12	Empty		
X13			RM terminal	CC-Link	Y13				
X14			RH terminal	CC-Link	Y14				
X15			SQ terminal	CC-Link	Y15				
X16			Empty		Y16				
X17		Y17							
X18		Y18							
X19		Y19							
X1A		Y1A							
X1B		Y1B							
X1C		Y1C							
X1D		Y1D							
X1E		Y1E							
X1F		Y1F							

Device No.	Name	Remarks	Device No.	Name	Remarks
X20	Operation mode setting read completion	D9140	Y20	Operation mode setting read command	D9140
X21	Set frequency read completion (RAM)	D9141	Y21	Set frequency read command (RAM)	D9141
X22	Set frequency read completion (E <sup>2</sup> PROM)	D9142	Y22	Set frequency read command (E <sup>2</sup> PROM)	D9142
X23	Operation mode setting write completion	D9143	Y23	Operation mode setting write command	D9143
X24	Set frequency write completion (RAM)	D9144	Y24	Set frequency write command (RAM)	D9144
X25	Set frequency write completion (E <sup>2</sup> PROM)	D9145	Y25	Set frequency write command (E <sup>2</sup> PROM)	D9145
X26	Alarm definition batch clear completion	D9146	Y26	Alarm definition batch clear command	D9146
X27	Parameter clear completion	D9147	Y27	Parameter clear command	D9147
X28	Parameter read completion (RAM)	D50 to 93	Y28	Parameter read request (RAM)	D50 to 93
X29	Parameter write completion (RAM)	D50 to 93	Y29	Parameter write request (RAM)	D50 to 93
X2A	Parameter read completion (E <sup>2</sup> PROM)	D50 to 93	Y2A	Parameter read request (E <sup>2</sup> PROM)	D50 to 93
X2B	Parameter write completion (E <sup>2</sup> PROM)	D50 to 93	Y2B	Parameter write request (E <sup>2</sup> PROM)	D50 to 93
X2C	System area		Y2C	System area	
X2D			Y2D		
X2E			Y2E		
X2F			Y2F		

**CAUTION**

X2C to X2F and Y2C to Y2F are system areas. Do not use them.

### 4.5.2 Internal relay (M) device map

Device No.	Description
M0 to M63	Use freely on user side.

### 4.5.3 Data register (D) device map

Data Register (D)	Inverter Pr. Number	Parameter Name	Reference Page
D0 to D49	Use freely on user side.		—
D50 to D93	—	Can be used freely by user when the following inverter parameters are not used.	129
D50	0	Torque boost	56
D51	1	Maximum frequency	57
D52	2	Minimum frequency	

Data Register (D)	Inverter Pr. Number	Parameter Name	Reference Page
D53	3	Base frequency	58
D54	4	Multi-speed setting (high speed)	59
D55	5	Multi-speed setting (middle speed)	
D56	6	Multi-speed setting (low speed)	
D57	7	Acceleration time	60
D58	8	Deceleration time	60
D59	9	Electronic thermal O/L relay	61
D60	79	Operation mode	75
D61	10	DC injection brake operation frequency	61
D62	11	DC injection brake operation time	
D63	12	DC injection brake voltage	
D64	13	Starting frequency	62
D65	21	Stall prevention function selection	63
D66	22	Stall prevention operation level	
D67	60	RL terminal function selection	68
D68	61	RM terminal function selection	
D69	62	RH terminal function selection	
D70	63	STR terminal function selection	69
D71	64	RUN terminal function selection	
D72	65	STF terminal function selection	68
D73	331	Communication station number	79
D74	332	Communication speed	
D75	333	Stop bit length	
D76	334	Parity check presence/absence	
D77	335	Communication retry count	
D78	336	Communication check time interval	
D79	337	Wait time setting	
D80	338	CC-Link operation command source	75
D81	339	CC-Link speed command source	
D82	340	CC-Link link start up mode selection	
D83	341	CR/LF selection	79
D84	342	E <sup>2</sup> PROM write selection	92
D85	503	CC-Link station number setting	143
D86	504	CC-Link baudrate setting	
D87	505	SQ terminal function selection	68
D88	506	ALM terminal function selection	69
D89	507	Inverter operation lock mode setting	138
D90	990	PU buzzer control	93
D91	991	PU contrast adjustment	94
D92	992	PU main display screen data selection	94
D93	993	PU disconnection detection/PU setting lock	95
D94 to D99	Use freely on user side.		—
D100 to D119	Pr.510 to Pr.529	User parameters. Use freely on user side.	135



### 4.5.4 Special relays

The special relays are internal relays with special applications and therefore should not be switched on-off in the program.

Number	Name	Description
M9008	Self-diagnostic error	Turned on by self-diagnosed error.
M9010	Operation error flag	Turned on by an instruction execution error. Turned off when error is removed.
M9011	Operation error flag	Turned on by an instruction execution error. Remains on after normal status is restored.
M9036	Normally ON	M9036 and M9037 are turned on and off independently of STOP or RUN.
M9037	Normally OFF	
M9038	On only for 1 scan after RUN	M9038 and M9039 change depending on the STOP or RUN status. In other than the STOP status, M9038 is on for one scan only and M9039 is off for one scan only.
M9039	Off only for 1 scan after RUN	

### 4.5.5 Special registers

The special registers are data registers with special applications and therefore data should not be written to the special registers in the program.

Number	Name	Description	Page	
Special registers	D9008	Self-diagnostic error	Stores the self-diagnosed error number in BIN. (Refer to page 118 for the error codes.)	118
	D9010	Operation error step	Stores the step number in BIN, at which an instruction execution error occurred. After that, data is updated each time operation error occurs.	—
	D9011	Operation error step	Stores the step number in BIN, at which an instruction error occurred. Since data is stored into D9011 when M9011 turns from off to on, D9011 data is not updated unless M9011 is cleared by the user program.	—
	D9014	I/O control method	3 (fixed): Both input and output refreshes	—
	D9015	CPU operating status	Stores the operating status of the PLC function.  	—
	D9016	Program number	Stores the number that indicates which sequence program is currently in execution. 1 (fixed): Main program (RAM)	—
D9017	Minimum scan time (10ms units)	Stores the scan time at every END that is smaller than D9017 data, i.e. stores the minimum scan time in BIN.	—	

Number	Name	Description	Page	
Special registers	D9018	Scan time (10ms units)	Stores and updates the scan time at every END in BIN.	—
	D9019	Maximum scan time (10ms units)	Stores the scan time at every END that is greater than D9019 data, i.e. stores the maximum scan time in BIN.	—
Special registers for control	D9133	Output frequency monitor	Stores the current output frequency. 0.01Hz units	117
	D9134	Output current monitor	Stores the current output current. 0.01A units	
	D9135	Output voltage monitor	Stores the current output voltage. 0.1V units	
	D9136	Error history 1, 2	Store the errors that occurred in the inverter in order of occurrence.	117
	D9137	Error history 3, 4		
	D9140	Operation mode setting read	Stores the current operation mode.	119
	D9141	Set frequency read (RAM)	Reads and stores the set frequency (RAM).	120
	D9142	Set frequency read (E <sup>2</sup> PROM)	Reads and stores the set frequency (E <sup>2</sup> PROM).	120
	D9143	Operation mode setting write	Sets a new operation mode.	122
	D9144	Set frequency write (RAM)	Sets the running frequency (RAM).	123
	D9145	Set frequency write (E <sup>2</sup> PROM)	Sets the running frequency (E <sup>2</sup> PROM).	124
	D9146	Alarm definition batch clear	Write H9696 to clear the error history.	125
	D9147	Parameter clear	H9696 write: Parameter clear H9966 write: All clear H5A5A write:Parameter clear except communication parameters H55AA write:All clear except communication parameters	125
	D9148	Inverter operation status control	Turn on/off the corresponding bits to control the inverter operation status.	126
	D9149	Inverter operation status control enable/disable setting	Enable/disable the inverter operation status control using D9148 by turning on/off the corresponding bits.	127
D9150	Inverter parameter access error	Stores the error No. when an error occurs because the data stored in the parameter or special register is not reflected on the inverter.	128	
D9151	Inverter status	Stores the running status and operating status of the inverter.	128	
D9062 to D9069	Remote registers	Special registers for communication with the master station in CC-Link. Refer to page 145 for details.	—	

## 4.6 Inputs/Outputs

There are 48 input (X) and 48 output (Y) points.  
Refer to page 109 for details.

### 4.6.1 Input (X) assignment

Inputs are 48 points from X0 to X2F.

X0 to X5 are external input terminals. X6 to XF are usable as internal memories (contacts). When the operation command source (Pr. 338) or speed command source (Pr. 339) is on the CC-Link side in the CC-Link operation mode, X0 to X5 are disabled from the external terminal function, and enabled when the write is on the external input side. Refer to page 109 for the input terminal assignment.

X10 to X1F are CC-Link remote input signals. They are empty when CC-Link communication is not made. Since refresh for CC-Link is performed automatically, it need not be set in the parameters, etc. In the CC-Link operation mode, X10 to X15 are assigned as indicated on page 109. X16 to X1F can be used freely by the user in CC-Link communication.

When operation command source (Pr. 338) or speed command source (Pr. 339) is on the external input side, X10 to X1F can be used freely by the user in CC-Link communication.

Mode	Terminal		Pr. 338 "operation command source"		Pr. 339 "speed command source"	
	No.	Name	0:CC-Link	1: External	0:CC-Link	1: External
CC-Link operation	X0	STF	Internal memory	External	Internal memory	Internal memory
	X1	STR	Internal memory	External	Internal memory	Internal memory
	X2	RL	Internal memory	Internal memory	Internal memory	External
	X3	RM	Internal memory	Internal memory	Internal memory	External
	X4	RH	Internal memory	Internal memory	Internal memory	External
	X5	SQ	External	External	External	External
	X6 to XF	Empty	Internal memory	Internal memory	Internal memory	Internal memory
	X10	STF	CC-Link	Internal memory (CC-Link)	CC-Link	CC-Link
	X11	STR	CC-Link	Internal memory (CC-Link)	CC-Link	CC-Link
	X12	RL	CC-Link	CC-Link	CC-Link	Internal memory (CC-Link)

Mode	Terminal		Pr. 338 "operation command source"		Pr. 339 "speed command source"	
	No.	Name	0:CC-Link	1: External	0:CC-Link	1: External
CC-Link operation	X13	RM	CC-Link	CC-Link	CC-Link	Internal memory (CC-Link)
	X14	RH	CC-Link	CC-Link	CC-Link	Internal memory (CC-Link)
	X15	SQ	CC-Link	CC-Link	CC-Link	CC-Link
	X16 to X1F	Empty	Internal memory (CC-Link)	Internal memory (CC-Link)	Internal memory (CC-Link)	Internal memory (CC-Link)

External: External input terminal valid.

Internal memory: External input terminal invalid. Used as contact.

CC-Link: CC-Link terminal function valid.

Internal memory: CC-Link terminal function disable. Acts as user-set input signal in (CC-Link) CC-Link communication.

Input terminal function selection (Pr. 60 to Pr. 63, Pr. 65, Pr. 505) enables function selection.

In the factory setting, the relationships between the parameter numbers and terminals are as indicated in the following table.

Parameter	Name	External Terminal	CC-Link
60	RL terminal	X02	X12
61	RM terminal	X03	X13
62	RH terminal	X04	X14
63	STR terminal	X01	X11
65	STF terminal	X00	X10
505	SQ terminal	X05	X15

X20 to X2F are used as completion signals for read/write of data from/to the special registers, parameters and user parameters. (They cannot be used freely by the user.) For details, refer to pages 117 to 135.

#### ◆Related parameters◆

Input terminal function selection ⇒ Pr. 60 to Pr. 63, Pr. 65, Pr. 505 (Refer to page 68.)

Operation command source, speed command source ⇒ Pr. 338, Pr. 339 (Refer to page 75.)

#### REMARKS

Operation commands can also be set using the special registers D9148, D9149. (Refer to page 126.)

## 4.6.2 Output (Y) assignment

Outputs are 48 points from Y0 to Y2F.

Y0 to Y1 are external output terminals.

Y2 to YF are usable as internal relays. When the operation command source (Pr. 338) is on the CC-Link side in the CC-Link operation mode, Y0 to Y1 are disabled from the external terminal function, and enabled when the write is on the external input side. Refer to page 109 for the output terminal assignment.

Y10 to Y1F are CC-Link remote output signals. They are empty when CC-Link communication is not made. Since refresh for CC-Link is performed automatically, it need not be set in the parameters, etc. In the CC-Link operation mode, Y10 to Y11 are assigned as indicated on page 109. Y12 to Y1F can be used freely by the user in CC-Link communication.

When operation command source (Pr. 338) is on the external input side, Y10 to Y1F can be used freely by the user in CC-Link communication.

Mode	Terminal		Pr. 338 "operation command source"		Pr. 339 "speed command source"	
	No.	Name	0:CC-Link	1: External	0:CC-Link	1: External
CC-Link operation	Y0	RUN	Internal memory	External	Internal memory	External
	Y1	ALM	Internal memory	External	Internal memory	External
	Y2 to YF	Empty	Internal memory	Internal memory	Internal memory	Internal memory
	Y10	RUN	CC-Link	Internal memory (CC-Link)	CC-Link	Internal memory (CC-Link)
	Y11	ALM	CC-Link	Internal memory (CC-Link)	CC-Link	Internal memory (CC-Link)
	Y12 to Y1F	Empty	Internal memory (CC-Link)	Internal memory (CC-Link)	Internal memory (CC-Link)	Internal memory (CC-Link)

External: External output terminal valid.

Internal memory: External output terminal invalid. Used as internal relay.

Internal memory: CC-Link terminal function invalid. Acts as user-set input signal in (CC-Link) CC-Link communication.

Output terminal function selection (Pr. 64, Pr. 506) enables function selection.

In the factory setting, the relationships between the parameter numbers and terminals are as indicated in the following table.

Parameter	Name	External Terminal	CC-Link
64	RUN terminal	Y00	Y10
506	ALM terminal	Y01	Y11

Y20 to Y2F are used as request signals for read/write of data from/to the special registers, parameters and user parameters. (They cannot be used freely by the user.) For details, refer to pages 117 to 135.

### ◆ Related parameters ◆

Output terminal function selection ⇒ Pr. 64, Pr. 506 (refer to page 69)

Operation command source, speed command source ⇒ Pr. 338, Pr. 339 (refer to page 75)

## 4.7 Inverter Status Monitoring, Special Registers for Control

You can assign the data for grasping and changing the inverter's operation status to D9133 - D9147 and read/write them from the user sequence. (Refer to page 112 for the list.)

### 4.7.1 Data that can be read at all times

The following data can always be read. They are automatically refreshed every time the END instruction is executed.

#### (1) Operation monitor

The following data devices are always read-enabled (write-disabled) to allow you to monitor the output frequency, output current and output voltage of the inverter. Note the setting units.

Device No.	Name	Setting Unit	Data Example	Data Access Enable Condition
D9133	Output frequency monitor	0.01Hz	Device data 6000 → 60.00Hz	Always
D9134	Output current monitor	0.01A	Device data 200 → 2.00A	
D9135	Output voltage monitor	0.1V	Device data 1000 → 100.0V	

#### CAUTION

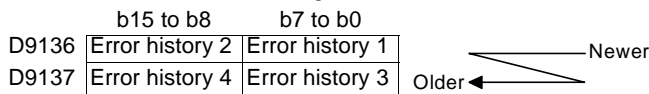
**The frequency can be set in increments of 0.01Hz but actual operation is performed in increments of 0.1Hz.**

#### (2) Error history (error codes and error definitions)

The inverter stores the error codes of the errors that occurred.

The error codes of up to four errors are stored in the order as shown below and are always read-enabled (write-disabled).

<Error code storing method details>

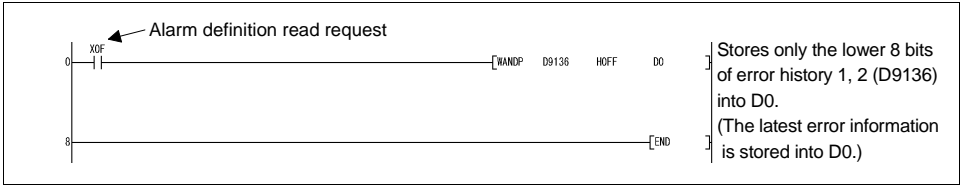


Error Code	Error Definition	Error Code	Error Definition
H00	No alarm	H31	E.THM
H10	E.OC1	H40	E.FIN
H11	E.OC2	H60	E.OLT
H12	E.OC3	H80	E.GF
H20	E.OV1	H90	E.OHT
H21	E.OV2	HB0	E.PE
H22	E.OV3	HB1	E.PUE
H30	E.THT		

Refer to page 155 for alarm definition details.

**<Alarm definition read program example>**

The following program reads the latest alarm definition of the inverter to D0.



**<Regarding the error No. and details of the self-diagnostic errors>**

During execution of a sequence program, any of the following error No. is stored into D9008 due to an operation error.

At occurrence of a self-diagnostic error, the PLC indication (LED) flickers. (Refer to page 44.)

Error No.	Error Name	Details
10	INSTRCT CODE ERR.	There is an instruction code that cannot be decoded. Unusable device is specified.
11	PARAMETER ERR	Main program capacity setting is over 1k step. Unusable function is set.
22	WDT ERR	Scan time is longer than the time that can be monitored by the watchdog timer.
24	END NOT EXECUTE	END instruction was not executed.

**CAUTION**

1. For the LD, AND, OR, logical comparison operation and OUT instructions, device checks are always made. For the other instructions (SET, RST, MOV, etc.), however, device checks are made when the execution condition holds.
2. Operation at error stop  
 The outputs (Y) are cleared.  
 The other devices hold the states prior to an error stop.  
 When you want to clear them, power off or reset (short RES-SD (0.1s), then open) the inverter.

## 4.7.2 Data that are read by controlling (OFF to ON) the read command

You can read the operation mode and set frequency of the inverter.

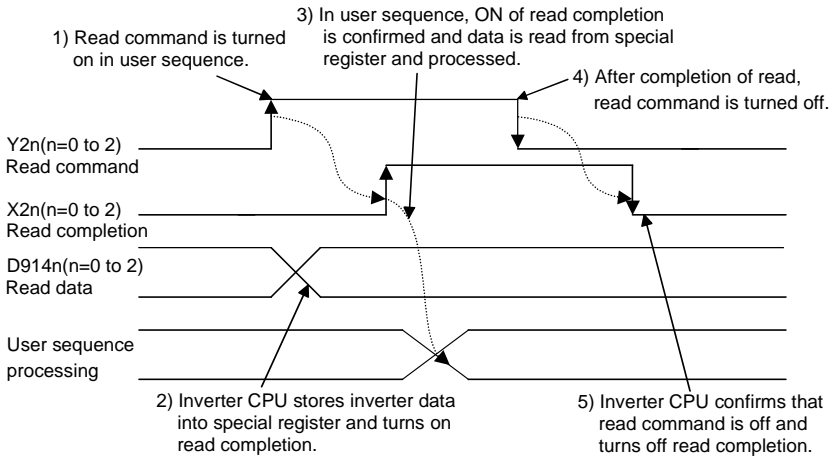
Device No.	Name	Read Command	Write Completion	Data Access Enable Condition
D9140	Operation mode setting read	Y20	X20	Always
D9141	Set frequency read (RAM)	Y21	X21	
D9142	Set frequency read (E <sup>2</sup> PROM)	Y22	X22	

Data are stored into the above data devices as soon as the read completion turns from off to on after the read command has turned from off to on.

If the read command remains on, data is not refreshed. (Data is not updated.)

Turn the device off once, then on again to refresh data.

### Data read timing chart



### (1) Operation mode setting read (D9140)

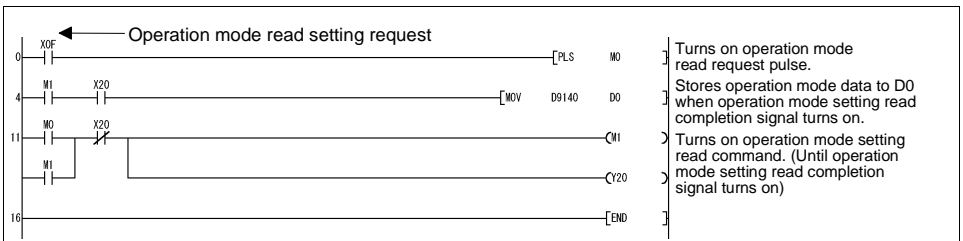
Data Setting	Operation Mode
H0000	CC-Link operation mode
H0001	External operation mode
H0002	PU operation mode

#### REMARKS

When the Pr. 79 "operation mode selection" setting is other than "0", the operation mode is as set. However, when Pr. 79="3" or "4", the operation mode is "H0002" (PU operation mode).

#### <Operation mode setting read program example>

The following program reads the operation mode data to D0.





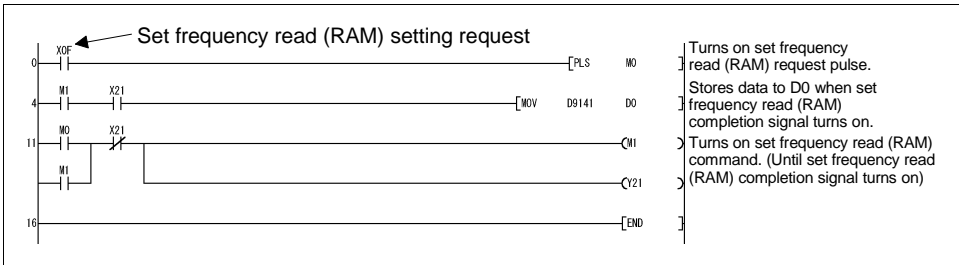
### (2) Set frequency (RAM) (D9141)

The frequency set to the RAM is read to D9141. The unit is 0.01Hz.

(For example, 6000 indicates 60.00Hz.)

#### <Set frequency (RAM) read program example>

The following program reads the set frequency (RAM) to D0.



#### REMARKS

The read frequency is not the command value of the external signal.

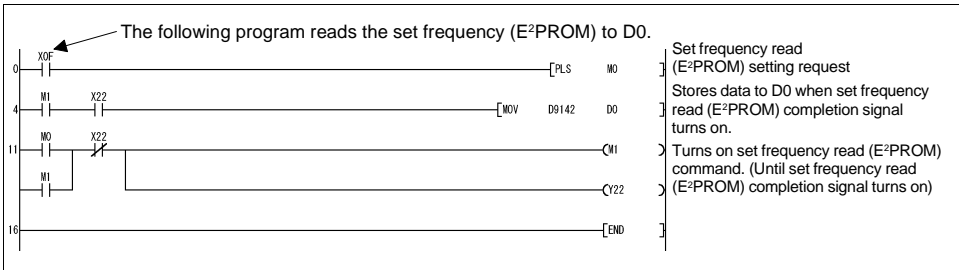
### (3) Set frequency (E<sup>2</sup>PROM) (D9142)

The frequency set to the E<sup>2</sup>PROM is read to D9142. The unit is 0.01Hz.

(For example, 6000 indicates 60.00Hz.)

#### <Set frequency read (E<sup>2</sup>PROM) program example>

The following program reads the set frequency (E<sup>2</sup>PROM) to D0.



#### REMARKS

The read frequency is not the command value of the external signal.

### 4.7.3 How to write data by controlling (OFF to ON) the write command

You can write the operation mode and set frequency to the inverter, batch-clear the alarm definitions, and clear all parameters.

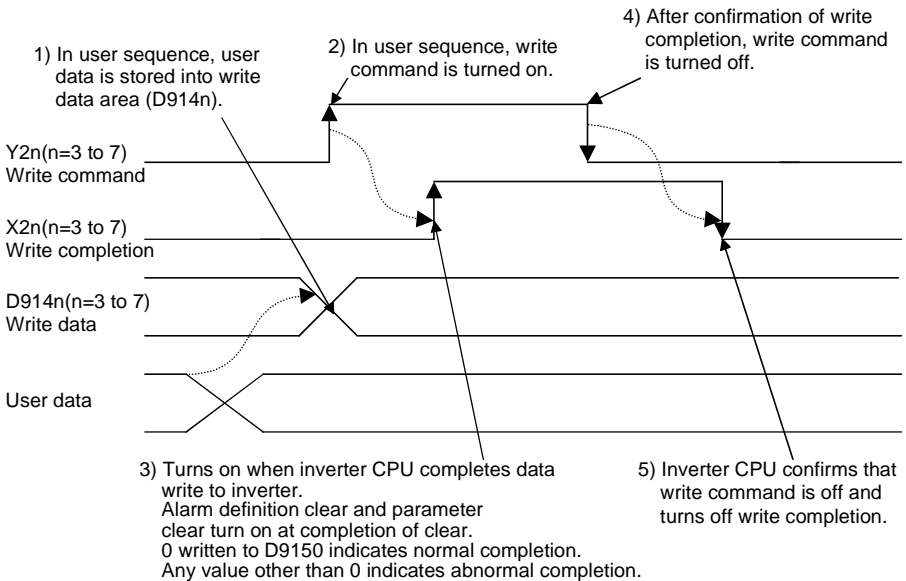
Device No.	Name	Write Command	Write Completion	Data Access Enable Condition
D9143	Operation mode setting write	Y23	X23	Pr.79=0, 2
D9144	Set frequency write (RAM)	Y24	X24	PU operation mode (PU LED on) or CC-Link operation mode (PU and EXT LEDs flicker slowly)
D9145	Set frequency write (E <sup>2</sup> PROM)	Y25	X25	
D9146	Alarm definition batch clear	Y26	X26	Always
D9147	All parameter clear	Y27	X27	As set in Pr. 77

The above data are written as soon as the write completion turns on after the write command has turned from off to on.

(Alarm definition batch clear (D9146) and all parameter clear (D9147) turn on at completion of clear.)

To write the data again, the write command must be turned off once, then on again.

#### Data write timing chart



### (1) Operation mode setting write (D9143)

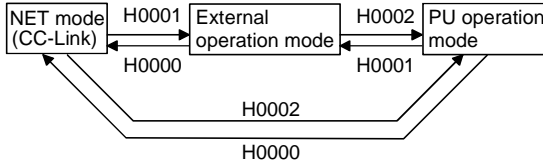
Data are as follows:

H0000: CC-Link operation mode

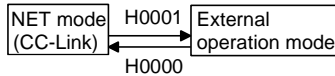
H0001: External operation mode

H0002: PU operation mode

The operation mode switching method is as shown below when the Pr. 79 "operation mode selection" value is "0".



<When Pr. 79=2, switching is performed as shown below.>



#### REMARKS

When Pr. 79 is other than 0, the mode is fixed.

There are no restrictions on operation mode switching.

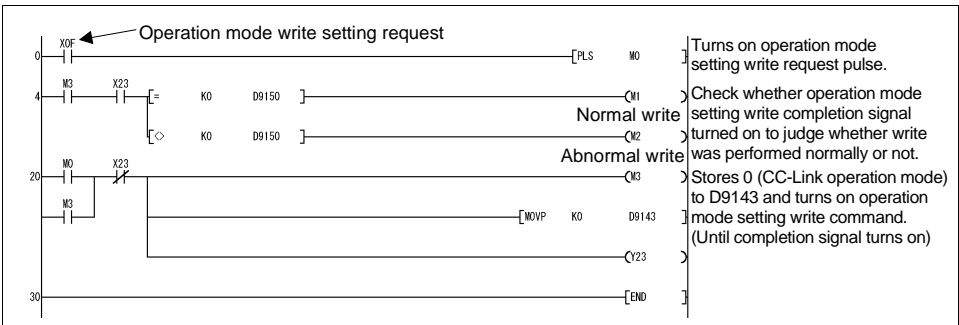
On normal completion of operation mode setting, the write completion signal (X23) turns on, and at the same time, 0 is set to D9150.

If the value written is other than H0000 to H0002 or write is performed during inverter operation, HFFFF is set to D9150 as soon as the write completion signal (X23) turns on, resulting in abnormal completion.

If abnormal completion occurs, the operation mode is not changed.

#### <Operation mode setting write program example>

The following program changes the operation mode to the NET mode.



## (2) Set frequency (RAM) (D9144)

The D9144 data is written to the RAM as a set frequency. The unit is 0.01Hz.  
(For example, 6000 indicates 60.00Hz.)

The range where the frequency can be set is 0 to 12000 (0 to 120.00Hz).

When the frequency setting is written normally, the write completion signal (X24) turns on, and at the same time, 0 is set to D9150.

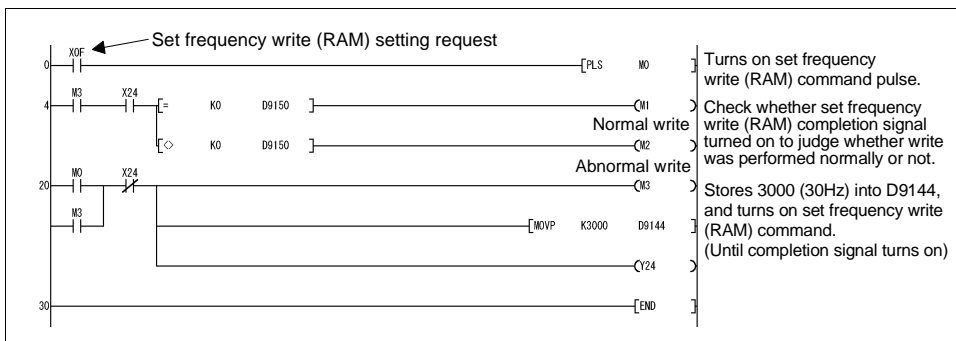
If any value outside the range is written, HFFFF is set to D9150 as soon as the write completion signal (X24) turns on, resulting in abnormal completion. If abnormal completion occurs, the set frequency is not changed.

### POINT

- Although the setting unit is 0.01Hz, the actual operation is performed in 0.1Hz units.
- The frequency can be set in the PU operation mode and CC-Link operation mode. (Refer to page 75.)

### <Set frequency write (RAM) program example>

The following program changes the set frequency (RAM) to 30Hz.



### (3) Set frequency (E<sup>2</sup>PROM) (D9145)

The D9145 data is written to the E<sup>2</sup>PROM as a set frequency. The unit is 0.01Hz. (For example, 6000 indicates 60.00Hz.)

The range where the frequency can be set is 0 to 12000 (0 to 120.00Hz).

When the frequency setting is written normally, the write completion signal (X25) turns on, and at the same time, 0 is set to D9150.

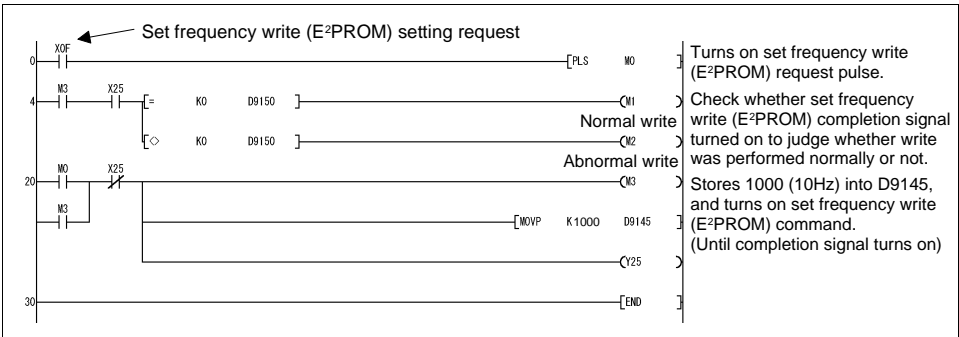
If any value outside the range is written, HFFFF is set to D9150 as soon as the write completion signal (X25) turns on, resulting in abnormal completion. If abnormal completion occurs, the set frequency is not changed.

#### POINT

- Although the setting unit is 0.01Hz, the actual operation is performed in 0.1Hz units.
- Setting is enabled in the PU operation mode and CC-Link operation mode. (Refer to page 75.)

#### <Set frequency write (E<sup>2</sup>PROM) program example>

The following program changes the set frequency (E<sup>2</sup>PROM) to 10Hz.



#### CAUTION

When rewriting the set frequency frequently, use device D9144 "set frequency (RAM)". There are restrictions on the number of write times of the E<sup>2</sup>PROM. (Approximately 100,000 times)

#### (4) Alarm definition batch clear (D9146)

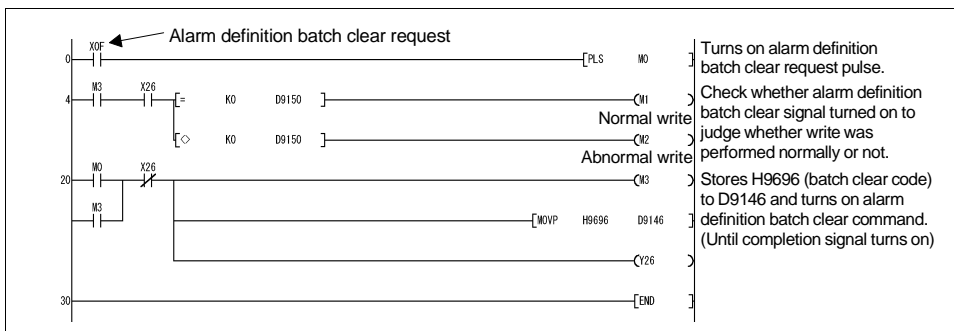
Writing H9696 to D9146 batch-clears the alarm definitions.

At completion of clear, the write completion signal (X26) turns on, and at the same time, 0 is set to D9150. If any value outside the setting range is written or write is performed during inverter operation, HFFFF is set to D9150 as soon as the write completion signal (X26) turns on, resulting in abnormal completion.

If abnormal completion occurs, the alarm definitions are not cleared.

#### <Alarm definition batch clear program example>

The following program batch-clears the alarm history.



#### (5) Parameter clear (D9147)

Writing H9696 or H9966 to D9147 clears all parameters. Writing H5A5A or H55AA to D9147 clears the parameters other than the communication parameters (pages 50 to 54).

Device No.	Setting	Description	Details
D9147	H9696	All parameter clear	Terminal functions are not cleared.
	H9966		Terminal functions are cleared.
	H5A5A	Parameters other than communication parameters are cleared.	Terminal functions are not cleared.
	H55AA		Terminal functions are cleared.

At completion of clear, the write completion signal (X27) turns on, and at the same time, 0 is set to D9150. If any value outside the setting range is written or write is performed during inverter operation, HFFFF is set to D9150 as soon as the write completion signal (X27) turns on, resulting in abnormal completion. If abnormal completion occurs, the parameters are not cleared.

#### REMARKS

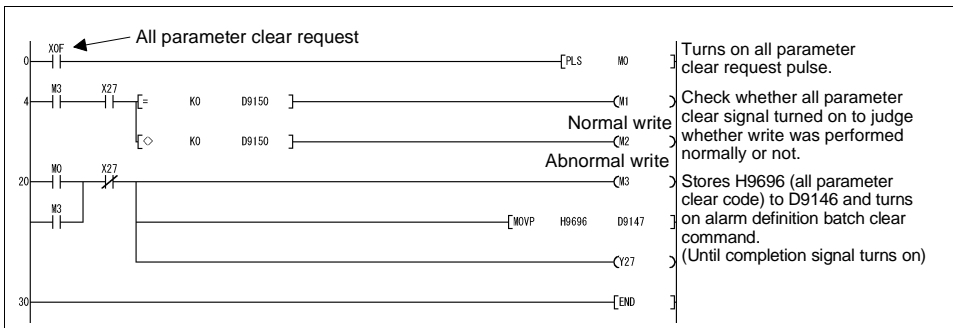
Check the terminal function parameters and communication-related parameters in the parameter list (page 50).

#### POINT

**Setting is enabled in the PU operation mode and CC-Link operation mode. (Refer to page 75.)**

### <All parameter clear program example>

The following program clears all parameters.



### ◆ Related device ◆

Device D9150: Parameter access error code (refer to page 128)

## 4.7.4 Inverter operation status control

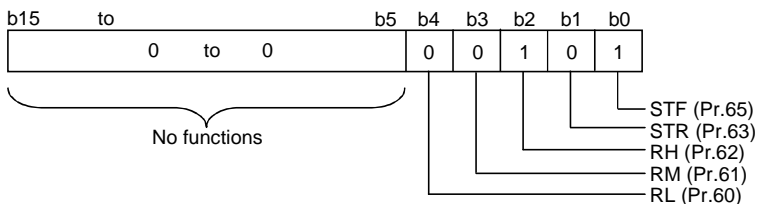
Device No.	Name	Data Access Enable Condition
D9148	Inverter operation status control	Always
D9149	Inverter operation status control enable/disable	Note that this function is enabled in the external/CC-Link operation mode. (Not enabled in the PU operation mode.)

### (1) Inverter operation status control (D9148)

Device for inverter operation status control. The operation of the inverter can be controlled by turning on/off (1, 0) bits b0 to b4 of D9148.

All bits are factory-set to "0".

Example: When 5 is set to D9148, bits b0 and b2 are 1 (ON), and STF and RH therefore turn on to give a high-speed forward rotation command.



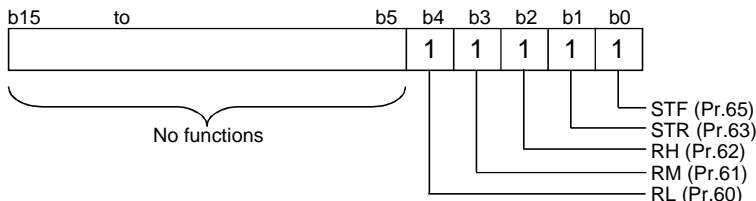
### CAUTION

As in the external input terminals, functions can be assigned to the bits of D9148 using Pr. 60 to Pr. 63 and Pr. 65. However, no function can be assigned to SQ (sequence RUN setting: 50).

## (2) Inverter operation status control enable/disable setting (D9149)

You can enable or disable D9148 "inverter operation status control". The controls of the corresponding bits of D9148 are enabled by turning on/off (1, 0) bits b0 to b4 of D9149. All bits are factory-set to "0".

Example: When H1F is set to D9149, bits b0 to b4 are 1 (ON), the external terminal inputs are therefore all disabled, and operation control using the inverter operation status control (D9148) can be performed.

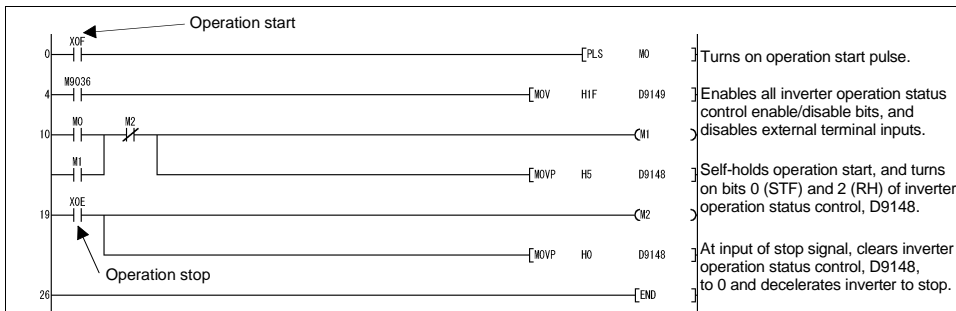


### CAUTION

**When D9148 "inverter operation status control" is enabled using D9149, the control performed by external terminal inputs and the control performed by CC-Link remote inputs are disabled for the enabled bits. (Same as when "No functions" are set to Pr. 60 to Pr. 63 and Pr. 65.)**

### <Operation command setting program example>

The following program example runs the inverter at high speed in forward rotation direction.





### 4.7.5 Inverter parameter access error (D9150)

Device No.	Name	Data Access Enable Condition
D9150	Inverter parameter access error	Always

If any value outside the setting range is written during parameter write, set frequency write, parameter clear, etc. from the sequence program of the inverter, or if write is performed when write is disabled, a write alarm occurs and the corresponding alarm code is stored into D9150.

#### <Parameter>

The parameter No. + H8000 is stored into D9150.

Example: If an error occurs during write of Pr. 0 "torque boost", H8000 (H0 + H8000) is stored into D9150.

If an error occurs during write of Pr. 10 "DC injection brake operation frequency", H800A is stored into D9150.

#### <Operation mode, set frequency, alarm definition batch clear, all parameter clear>

HFFFF is stored into D9150. (Normal 0)

**POINT**

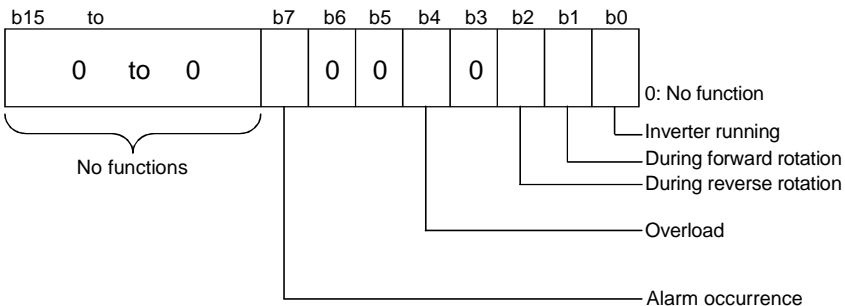
If write is completed normally after error occurrence, D9150 is not cleared (D9150 data is held at error occurrence). When using D9150 to stop operation, etc., the user must clear it.

### 4.7.6 Inverter status (D9151)

Device No.	Name	Data Access Enable Condition
D9151	Inverter status	Always

The running status and operating status of the inverter are stored.

The corresponding bits are set according to the inverter status.



## 4.8 Inverter Parameter Read/Write Method

Device No.	Name	Description				Data Access Enable Condition (Operation mode)
			Command	Completion		
D50 to D93	Inverter parameter read/write	Read	E <sup>2</sup> PROM	Y28	X28	Always
			RAM	Y29	X29	
		Write	E <sup>2</sup> PROM	Y2A	X2A	PU, CC-Link operation mode (as in Pr. 77)
			RAM	Y2B	X2D	

The inverter parameters can be accessed from the sequence program. X28 to X2B/ Y28 to Y2B are used to perform read/write between the predetermined data registers (D50 to D93) to read/write parameter values.

Refer to pages 110 and 111 for the accessible parameters and the data registers used for parameter read/write. (The other parameters are not accessible from the PLC function. Use the FR-PU04 (option) to access such parameters.)

When parameter read/write processing from the sequence program is not performed, data registers D50 to D93 can be used freely by the user as general-purpose data registers.

However, when parameter read/write processing from the sequence program is performed, D50 to D93 are updated by Y28 to Y2B and their data are overwritten. Therefore, note this point when using them on the user side.

Actual read/write processing is performed at the END processing of the sequence. Refer to page 184 for the parameter setting units.

### POINT

**The inverter must be in the PU or CC-Link operation mode to write the inverter parameters. (Refer to page 76.)**

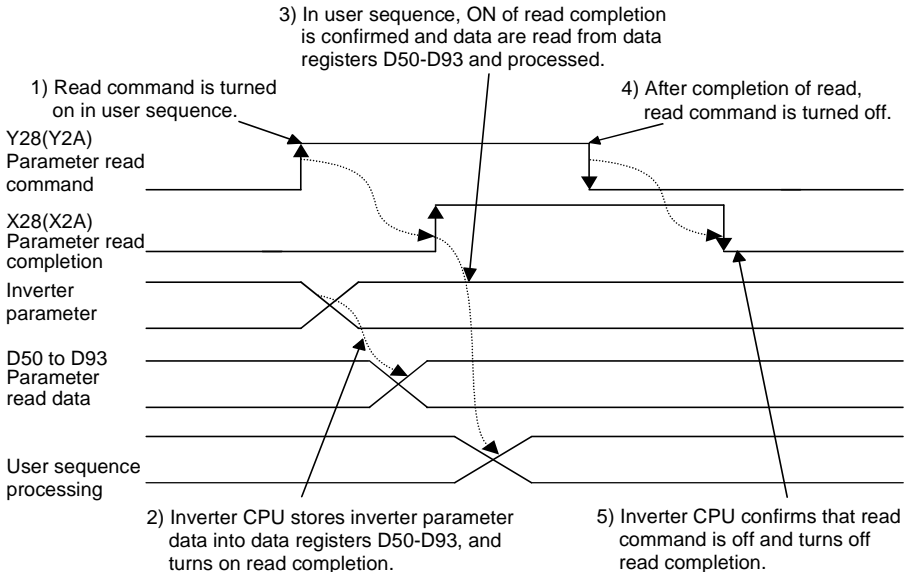
### 4.8.1 Reading the inverter parameters

When the inverter parameter read command is turned from off to on, the data of all the target parameters (refer to pages 110, 111) are stored into the data registers and the read completion is turned on.

As soon as the parameter read completion turns from off to on, the corresponding data can be read.

Command	Device No.
Parameter read command (RAM)	Y28
Parameter read completion (RAM)	X28
Parameter read command (E <sup>2</sup> PROM)	Y2A
Parameter read completion (E <sup>2</sup> PROM)	X2A

#### **Inverter parameter data read timing chart**

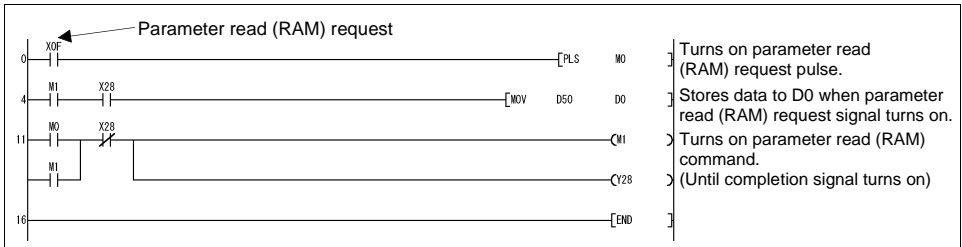


#### **CAUTION**

Since the inverter parameters given on page 110 are all read (batch-read), start read processing after setting all data to D50-D93. Read cannot be performed for one parameter.

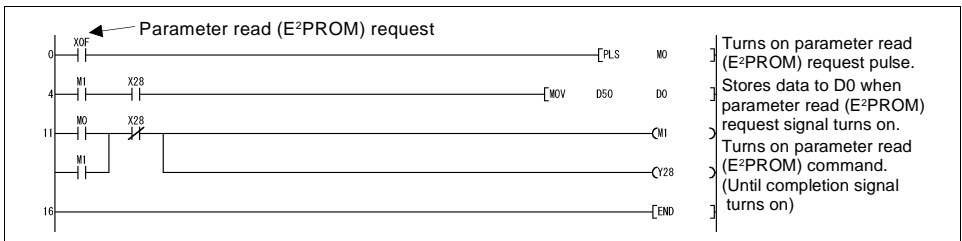
**<Inverter parameter read (RAM) program example>**

The following program reads the RAM setting of inverter parameter Pr. 0 "torque boost" to D0.



**<Inverter parameter read (E<sup>2</sup>PROM) program example>**

The following program reads the E<sup>2</sup>PROM setting of inverter parameter Pr. 0 "torque boost" to D0.



## **4.8.2 Writing the inverter parameters**

When data are stored into the corresponding registers of the inverter parameters (refer to page 110) and the parameter write command is turned from off to on, the data are written to the parameters that are the targets of all device data. (After that, the write completion is turned on.)

As soon as the inverter parameter write completion (X29 (RAM) or X2B (E<sup>2</sup>PROM)) turns on, 0 is set to D9150 on normal completion.

If an error occurs during access to the parameters, e.g. if any value outside the setting range is written or write is performed during inverter operation, the value of parameter No. + H8000 is set to D9150 as soon as the write completion signal (X29 (RAM) or X2B (E<sup>2</sup>PROM)) turns on, resulting in abnormal completion. If abnormal completion occurs, the parameters are not written. (For example, if an error occurs in the torque boost, H8000 is written to D9150.)

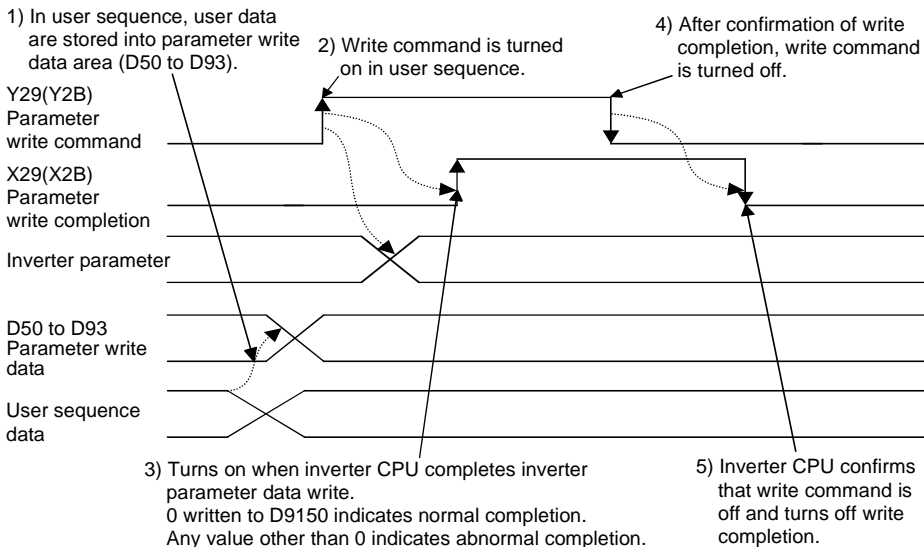
For whether inverter parameter write can be performed or not, refer to Pr. 77 "parameter write disable selection" (page 74).

<b>Command</b>	<b>Device No.</b>
Parameter write command (RAM)	Y29
Parameter write completion (RAM)	X29
Parameter write command (E <sup>2</sup> PROM)	Y2B
Parameter write completion (E <sup>2</sup> PROM)	X2B

**POINT**

**Inverter parameter write must be performed in the PU operation mode and CC-Link operation mode. (Refer to page 75.)**

## **Inverter parameter data write timing chart**

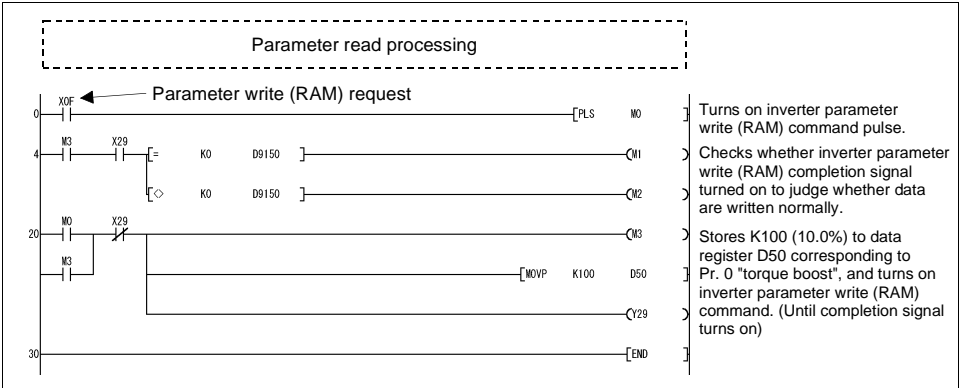


### **CAUTION**

1. Since the inverter parameters given on page 110 are all written (batch-written), start write processing after setting all data to D50-D93. As write cannot be performed for one parameter, perform parameter read processing once, then correct only the parameters you want to change, and perform write processing.
2. If write is enabled during inverter operation (Pr. 77=2), write cannot be performed for Pr. 60 to Pr. 65 and Pr. 505 to Pr. 507 during inverter operation, independently of the Pr. 77 setting.  
If the parameter write command is turned on, data are not written to the above parameters, resulting in normal completion. Always stop the inverter before performing parameter write.

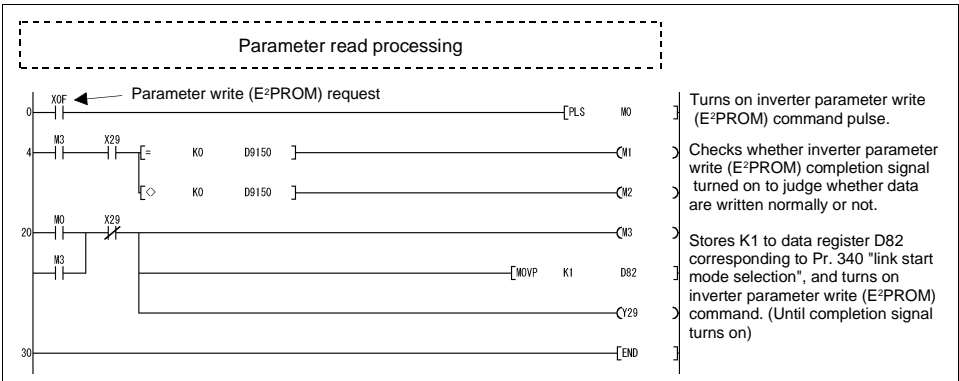
**<Inverter parameter write (RAM) program example>**

The following program changes inverter parameter Pr. 0 "torque boost" to 10% (to RAM setting).



**<Inverter parameter write (E<sup>2</sup>PROM) program example>**

The following program changes inverter parameter Pr. 340 "link start up mode selection" to "1" (to E<sup>2</sup>PROM setting).



## 4.9 User Area Read/Write Method

Inverter parameters Pr. 510 to Pr. 529 can be used as user parameters. Since this parameter area and the devices used with the PLC function, D100 to D119, are accessible to each other, the values set in Pr. 510 to Pr. 529 can be used in a sequence program. The result of operation performed in the sequence program can also be monitored using Pr. 510 to Pr. 529.

Device No.	Inverter Parameter No.	Name	Factory Setting	Setting Range	Minimum Setting Unit	Data Access
D100 to D119	510 to 529	User parameters	0	0 to 65535	1	Always enabled



### POINT

#### Example of using the user parameter area

When the timing is to be changed for machine adjustment using D100 that stores the timer setting, setting Pr. 510 without modifying the program enters the set data into D100, enabling adjustment.

### 4.9.1 User parameter read/write method

User parameter (Pr. 510 to Pr. 529) and device (D100 to D119) data can be read/written freely. Data transfer between Pr. 510 to Pr. 529 and D100 to D119 is executed automatically.

#### 1) User parameter write processing

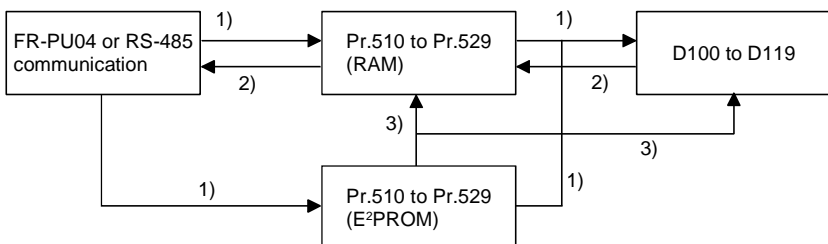
When values are written to Pr. 510 to P. 529 using the FR-PU04 or computer link communication, they are written to the parameter storing RAM area and E<sup>2</sup>PROM area, and further to D100 to D119 simultaneously.

#### 2) User parameter read processing

When values are written to D100 to D119 from the PLC function side, they are written to the parameter storing RAM area (Pr. 510 to P. 529) and read using the FR-PU04 or computer link communication. (Since data are not written to the E<sup>2</sup>PROM, making power-on reset returns the data to the original values.)

#### 3) Processing performed at inverter reset or power restoration

When the inverter is reset, the Pr. 510 to Pr. 529 values stored in the E<sup>2</sup>PROM are transferred to the RAM area and D100 to D119.





## 4.10 Debugging Mode Specifications

You can forcibly turn on/off the external I/O terminals and CC-Link remote inputs/outputs.

For inputs, the input signals from the outside or CC-Link to the inverter are ignored.

For outputs, the output signals from the inverter to the outside or CC-Link are ignored.

Inverter Parameter	Name	Factory Setting	Setting Range	Minimum Setting Unit	Remarks
530	Forced I/O selection	9999	1,2,3,4,9999	1	1: CC-Link remote inputs 2: CC-Link remote outputs 3: Control input terminals 4: Control output terminals 9999: Function disable
531	Forced I/O setting L	9999	0 to 255,9999	1	9999: Forced output off
532	Forced I/O setting H	9999	0 to 255,9999	1	9999: Forced output off

\* The parameter values set using the FR-PU04 are all decimal numbers.

\* When the control input terminals are turned on forcibly, they are enabled in the external/CC-Link operation mode.

### <Setting method>

Pr.530	Corresponding Pr.	Details (Bit String)																							
1	Pr.531	CC-Link remote inputs L <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="text-align: center;">7</td> <td colspan="6"></td> <td style="text-align: center;">to</td> <td colspan="6"></td> <td style="text-align: center;">0</td> </tr> <tr> <td>RX7</td><td>RX6</td><td>RX5</td><td>RX4</td><td>RX3</td><td>RX2</td><td>RX1</td><td>RX0</td> </tr> </table>	7							to							0	RX7	RX6	RX5	RX4	RX3	RX2	RX1	RX0
	7							to							0										
RX7	RX6	RX5	RX4	RX3	RX2	RX1	RX0																		
	Pr.532	CC-Link remote inputs H <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="text-align: center;">7</td> <td colspan="6"></td> <td style="text-align: center;">to</td> <td colspan="6"></td> <td style="text-align: center;">0</td> </tr> <tr> <td>RXF</td><td>RXE</td><td>RXD</td><td>RXC</td><td>RXB</td><td>RXA</td><td>RX9</td><td>RX8</td> </tr> </table>	7							to							0	RXF	RXE	RXD	RXC	RXB	RXA	RX9	RX8
7							to							0											
RXF	RXE	RXD	RXC	RXB	RXA	RX9	RX8																		
2	Pr.531	C-Link remote outputs L <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="text-align: center;">7</td> <td colspan="6"></td> <td style="text-align: center;">to</td> <td colspan="6"></td> <td style="text-align: center;">0</td> </tr> <tr> <td>RY7</td><td>RY6</td><td>RY5</td><td>RY4</td><td>RY3</td><td>RY2</td><td>RY1</td><td>RY0</td> </tr> </table>	7							to							0	RY7	RY6	RY5	RY4	RY3	RY2	RY1	RY0
	7							to							0										
RY7	RY6	RY5	RY4	RY3	RY2	RY1	RY0																		
	Pr.532	C-Link remote outputs H <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="text-align: center;">7</td> <td colspan="6"></td> <td style="text-align: center;">to</td> <td colspan="6"></td> <td style="text-align: center;">0</td> </tr> <tr> <td>RYF</td><td>RYE</td><td>RYD</td><td>RYC</td><td>RYB</td><td>RYA</td><td>RY9</td><td>RY8</td> </tr> </table>	7							to							0	RYF	RYE	RYD	RYC	RYB	RYA	RY9	RY8
7							to							0											
RYF	RYE	RYD	RYC	RYB	RYA	RY9	RY8																		
3	Pr.531	Control input terminals <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="text-align: center;">7</td> <td colspan="6"></td> <td style="text-align: center;">to</td> <td colspan="6"></td> <td style="text-align: center;">0</td> </tr> <tr> <td>-</td><td>-</td><td>SQ</td><td>RH</td><td>RM</td><td>RL</td><td>STR</td><td>STF</td> </tr> </table>	7							to							0	-	-	SQ	RH	RM	RL	STR	STF
7							to							0											
-	-	SQ	RH	RM	RL	STR	STF																		
4	Pr.531	Control output terminals <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="text-align: center;">7</td> <td colspan="6"></td> <td style="text-align: center;">to</td> <td colspan="6"></td> <td style="text-align: center;">0</td> </tr> <tr> <td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>ALM</td><td>RUN</td> </tr> </table>	7							to							0	-	-	-	-	-	-	ALM	RUN
7							to							0											
-	-	-	-	-	-	ALM	RUN																		

Make setting after converting a bit string (binary) into decimal.

### <Example>

When turning on control input terminals STF, RM forcibly

Bit (binary) 00001001 → 9 (decimal)

Set "3" in Pr. 530 and "9" in Pr. 531.

#### POINT

To return to function disable, set "9999" in Pr. 530.

If "9999" is not set in Pr. 530, the debugging mode signal is enabled and the control I/O terminal signals are disabled, affecting operation. Note this when using the parameter.

## 4.11 Register Display

The states of the I/O terminals (including remote terminals), internal devices and flags can be displayed from the FR-PU04.

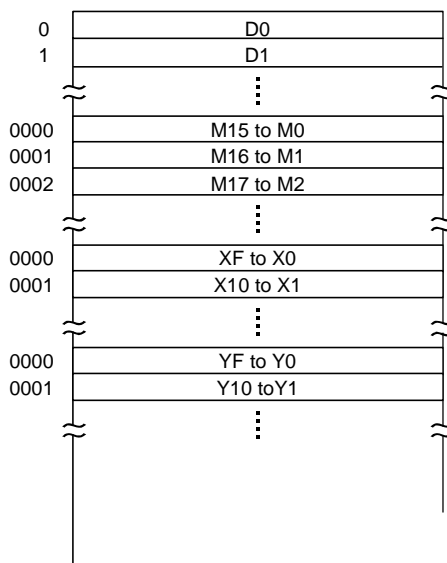
Inverter Parameter	Name	Factory Setting	Setting Range	Minimum Setting Unit	Remarks	FR-PU04 Monitor No.
533	Internal address	0	0 to 65534	1	Set the address.	9 Read from "Br Duty %"

### <Regarding address setting>

- (1) Word device (D): Set 0 + address.
- (2) Internal relay (M): Set 30000 + address.
- (3) Input (X), CC-Link remote output (RY, X10 to X1F): Set 4000 + address.
- (4) Output (Y), CC-Link remote input (RX, Y10 to Y1F): Set 5000 + address.

### Example:

- (1) For D3, entering 3 into Pr. 533 displays the data.
- (2) For M0, entering 30000 into Pr. 533 displays the bit data of M0 - M15 in decimal.
- (3) For X0, entering 40000 into Pr. 533 displays the bit data of X0 - XF in decimal.
- (4) For Y0, entering 50000 into Pr. 533 displays the bit data of Y0 - YF in decimal.



## 4.12 Inverter Operation Lock Mode Setting

You can disable a sequence program from being executed until the sequence program execution key is set to RUN (SQ signal is turned on).

### POINT

When you want to perform only inverter operation without using the PLC function, set "0" (inverter start signal enable) in this parameter.

Parameter	Name	Factory Setting	Setting Range	Minimum Setting Unit
507	Inverter operation lock mode setting	0	0, 1	1

Setting	Description
0	The inverter start signal is made valid regardless of the sequence program execution key.
1	The inverter start signal is made valid only when the sequence program execution key is set to RUN (SQ signal is turned on). When the sequence program execution key is in the STOP position (SQ signal is off), the inverter does not start if the inverter start signal STF or STR is turned on. (If the key is switched from RUN to STOP during inverter operation, the inverter is decelerated to a stop.)

### CAUTION

- Independently of the Pr. 77 setting, this parameter value cannot be rewritten during inverter operation.
- During automatic operation performed using D9148 in the sequence program, the inverter comes to a stop when the sequence is set to a STOP status with "1" set in Pr. 507. However, when "0" is set in Pr. 507, the device data are held and the operation status does not change if the sequence is set to a STOP status. (Inverter operation is continued.)

### REMARKS

This parameter setting is also valid for the start signal from the operation panel or FR-PU04 (option).

# 5. CC-Link COMMUNICATION

This chapter explains "CC-Link communication" for use of this product.

Always read the instructions before using this equipment.

<b>5.1</b>	<b>System Configuration .....</b>	<b>140</b>
<b>5.2</b>	<b>CC-Link Parameters .....</b>	<b>143</b>
<b>5.3</b>	<b>CC-Link I/O Specifications .....</b>	<b>145</b>
<b>5.4</b>	<b>Buffer Memory .....</b>	<b>148</b>

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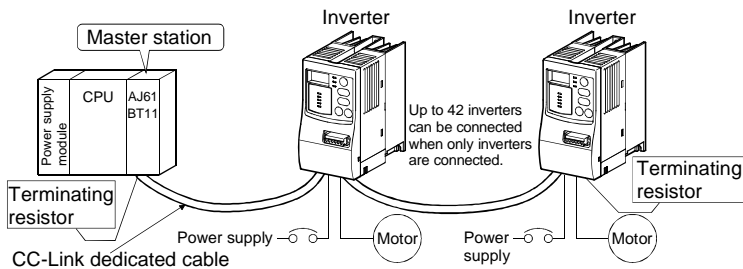
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## 5.1 System Configuration

### 5.1.1 System configuration example

- (1) PLC side  
Mount the "AJ61BT11", "A1SJ61BT11", "AJ61QBT11", "A1SJ61QBT11" or "QJ61BT11" Control & Communication Link system master/local module on the main base unit or extension base unit of the PLC CPU that will act as the master station.
- (2) Connect the PLC CC-Link module master station and inverters by CC-Link dedicated cables.



#### REMARKS

1. Refer to the following manuals for the CC-Link master station.
  - Control&Communication Link System Master/Local Module User's Manual... SH-080016
  - Control&Communication Link System Master/Local Module type AJ61QBT11/A1SJ61QBT11 User's Manual ... IB-66722
  - Control&Communication Link System Master/Local Module type AJ61BT11/A1SJ61BT11 User's Manual ... IB-66721
2. Refer to page 36 for the CC-Link communication wiring and CC-Link cables.

### 5.1.2 Regarding CC-Link Ver. 1.10

This product is compatible with CC-Link Ver. 1.10.

For the Ver. 1.10 compatible cables, refer to the manual of the CC-Link master module.

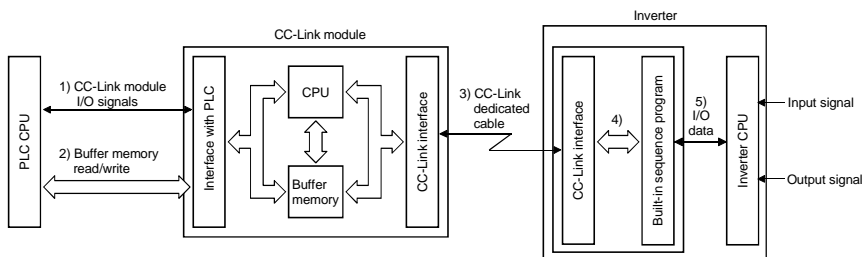
#### CAUTION

In a system where the CC-Link Ver. 1.00 and Ver. 1.10 modules and cables are used together, the maximum overall cable length and interstation cable length should conform to the CC-Link Ver. 1.00 specifications.

### 5.1.3 Function block diagram

How I/O data are transferred to/from the inverter in CC-Link will be described using function blocks.

- (1) Between the master station and inverter in the CC-Link system, link refresh is always made at 3.5 to 18ms (512 points).
- (2) I/O refresh and master station's sequence program are executed asynchronously.
- (3) Data read from the inverter are read from the buffer memory of the CC-Link system master/local module using the FROM instruction.
- (4) Data to be written to the inverter are written to the buffer memory of the CC-Link system master/local module using the TO instruction.



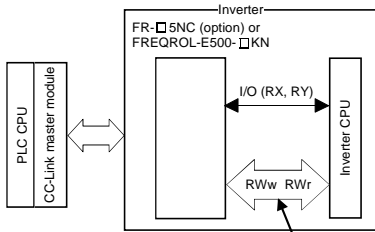
- 1) I/O signals assigned to the CC-Link system master/local module. These signals are used to make communication between the PLC CPU and CC-Link system master/local module.
- 2) Input data from the inverter can be read, and output data from the inverter can be written. Buffer memory read/write is performed using the FROM/TO instruction of the sequence program. Refer to page 148 for details of the buffer memory.
- 3) PLC link start is commanded from the sequence program. After PLC link has started, link refresh is always made asynchronously with the sequence program execution.
- 4) I/O data are transferred between the CC-Link system master/local module and inverter CPU via the sequence program.
- 5) I/O data are transferred between the inverter CPU and sequence program. (5) indicates the operation performed when CC-Link is not used, and is irrelevant to 1) to 4).)

#### REMARKS

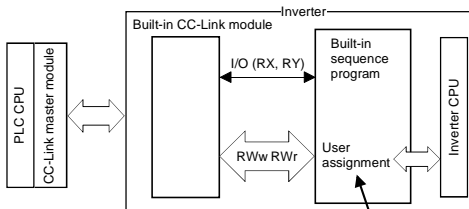
Programs cannot be read/written via CC-Link communication.

**POINT**

The following diagrams show differences in CC-Link communication between the FR-C500 series and other CC-Link compatible Mitsubishi inverters (FR-E500-KN, FR-A5NC, etc.).



Parameter read/write, monitor, operation commands, etc. have been assigned in advance.



Using built-in sequence program, parameters, monitor, etc. must be assigned.  
 Other data read/write, etc. can be assigned freely as user areas.  
 \*Operation and speed commands have been assigned in advance.

## 5.2 CC-Link Parameters

### 5.2.1 Setting of station number and baudrate (Pr. 503, Pr. 504)

Set the station number and communication baudrate of CC-Link communication.

Parameter	Name	Setting Range	Factory Setting	Remarks
503	CC-Link station number setting	1 to 64	1	—
504	CC-Link baudrate setting	0 to 4	0	0: 156kbps 1: 625kbps 2: 2.5Mbps 3: 5Mbps 4: 10Mbps

#### POINT

If you have changed either or both of these parameter settings, perform the power-on reset or reset of the inverter. (Refer to page 161 for reset.)

#### REMARKS

- Refer to page 43 for checking operation.

### 5.2.2 Regarding the operation mode

- When performing CC-Link operation, choose the operation mode other than the PU operation mode (set 0 or 2 in Pr. 79).
- Set "1" in Pr. 340 "link start up mode selection" or set "H0000" in device D9140 "operation mode selection read". (Refer to page 76.)
- In the CC-Link operation mode, the PU and EXT LEDs flicker slowly. (Refer to page 44.)

#### POINT

To start the inverter's built-in PLC in the CC-Link operation mode, short external input terminals SQ-SD and also turn on the remote output device RY5 (SQ terminal) from the master station.



### 5.2.3 Operation at CC-Link communication error occurrence

Error Location	Description	PU Operation Mode	External Operation Mode	CC-Link Operation Mode
Inverter fault	Inverter operation	Stop	Stop	Stop
	CC-Link data communication	Continued	Continued	Continued
Communication error	Inverter operation	Continued	Continued	Continued (However, operation cannot be guaranteed)
	CC-Link data communication	Stop	Stop	Stop

- (1) Inverter fault .....Refer to page 154 and remove the cause of fault.  
"ERR" on the operation panel is lit.
- (2) Communication error.....Remove the cause of error.  
(Refer to page 45.)
- (3) Inverter reset .....Resetting the inverter during CC-Link operation switches to the external operation mode. Therefore, "1" must be set in Pr. 340 or the operation mode must be switched to the CC-Link operation mode again.

### 5.3 CC-Link I/O Specifications

The device points usable in CC-Link communication are 16 input (RX) points, 16 output (RY) points, 4 remote register (RW<sub>r</sub>) points and 4 remote register (RW<sub>w</sub>) points.

The device No. usable in CC-Link communication are as follows.

**<I/O bit signals>**

For remote devices of master module for station No. 1

- Remote inputs : RX00 to RX0F → Outputs of built-in PLC function : Y10 to Y1F
- Remote outputs : RY00 to RY0F → Inputs of built-in PLC function : X10 to X1F

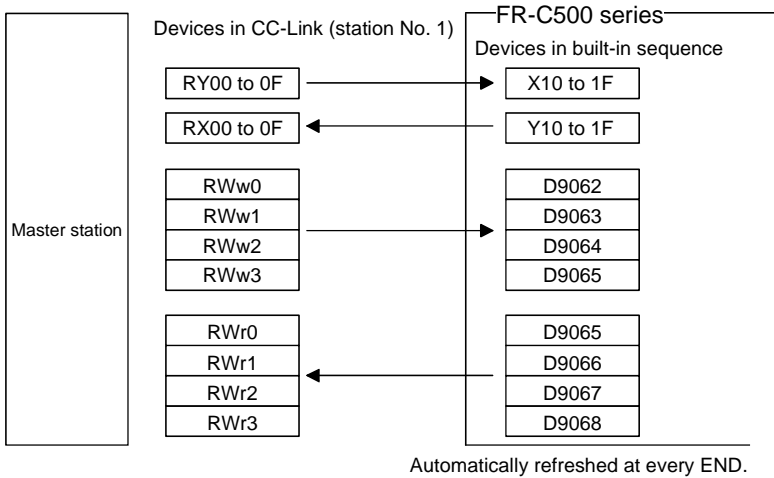
Device No.	Remote Output Device	Name	Remarks	Device No.	Remote Input Device	Name	Remarks
X10	RY00	STF terminal	CC-Link	Y10	RX00	RUN terminal	CC-Link
X11	RY01	STR terminal	CC-Link	Y11	RX01	ALM terminal	CC-Link
X12	RY02	RL terminal	CC-Link	Y12	RX02		User area
X13	RY03	RM terminal	CC-Link	Y13	RX03		
X14	RY04	RH terminal	CC-Link	Y14	RX04		
X15	RY05	SQ terminal	CC-Link	Y15	RX05		
X16	RY06		User area	Y16	RX06		
X17	RY07			Y17	RX07		
X18	RY08			Y18	RX08		
X19	RY09			Y19	RX09		
X1A	RY0A			Y1A	RX0A		
X1B	RY0B			Y1B	RX0B		
X1C	RY0C			Y1C	RX0C		
X1D	RY0D			Y1D	RX0D		
X1E	RY0E			Y1E	RX0E		
X1F	RY0F			Y1F	RX0F		

The devices other than X10 to X15 and Y10 to Y11 can be used freely by the user. When the operation command source and speed command source are on the external input side (Pr. 338, Pr. 339 = 1), X10 to 1F and Y10 to 1F are all user areas. (Refer to page 114.)

<I/O word data>

- Remote registers (master station → inverter): RWw0 to RWw3 →  
Special registrars of built-in PLC function: D9062 to D9065
- Remote registers (inverter → master station): RWr0 to RWr3 →  
Special registrars of built-in PLC function: D9066 to D9069

Device No.	Name	Description	Remarks
D9062	Remote register RWw0	Registers designed to read data received from the master station.	User area
D9063	Remote register RWw1	Received data are read to D9062 to D9065 automatically.	
D9064	Remote register RWw2		
D9065	Remote register RWw3		
D9066	Remote register RWr0	Registers designed to write data to be sent to the master station.	User area
D9067	Remote register RWr1	Data transmission from D9066 to D9069 is made automatically.	
D9068	Remote register RWr2		
D9069	Remote register RWr3		

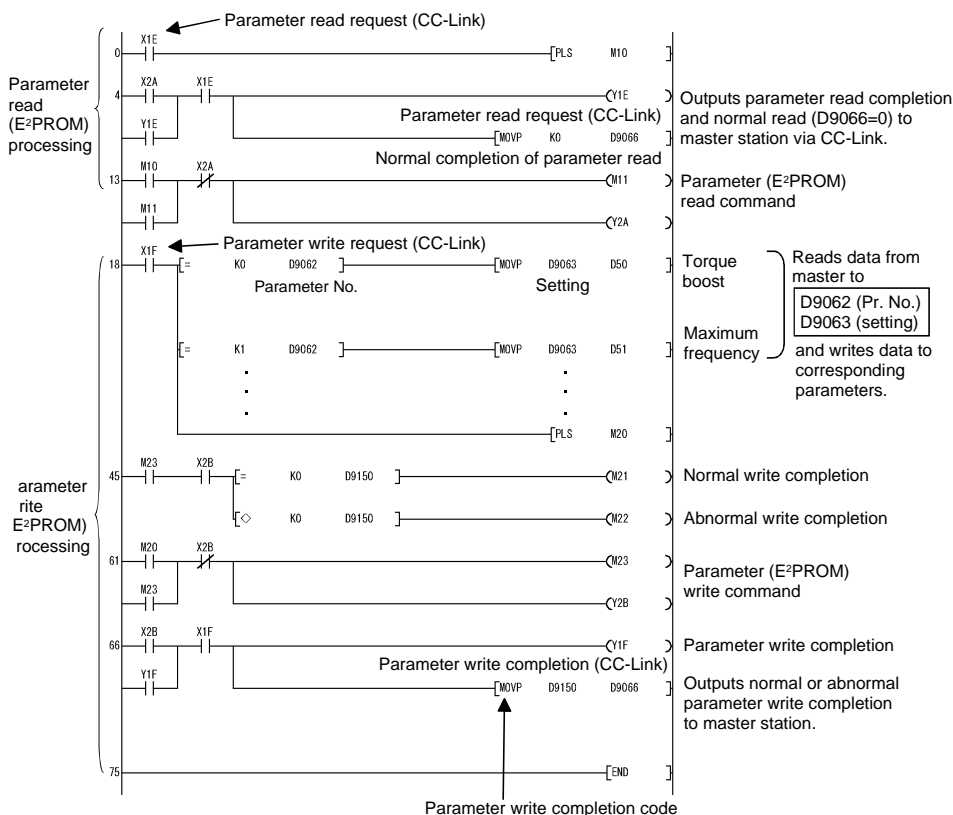


**REMARKS**

Use the remote registers freely since they are all user areas.

- Example of reading/writing parameter values using CC-Link (when read data are not required for the master station)

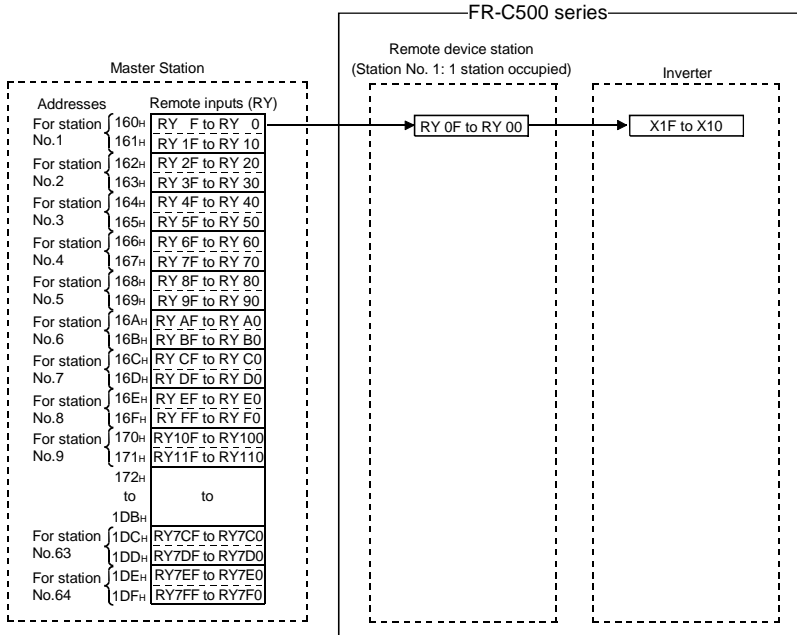
Master Station	Description	Remarks
RYE	Parameter read request	
RYF	Parameter write request	
RXE	Parameter read completion	
RXF	Parameter write completion	
RWr0	<ul style="list-style-type: none"> <li>• Answer code (inverter → master)</li> <li>• Data code at parameter read/write completion</li> <li>• New parameter value adjustment (master → inverter)</li> </ul>	0 : Normal completion Other than 0: Abnormal completion
RWw0	Parameter No.	
RWw1	Setting	



## 5.4 Buffer Memory

### 5.4.1 Remote output signals (Master module to inverter)

- Input states to the remote device station are stored.
- Two words are used for each station. (\*)



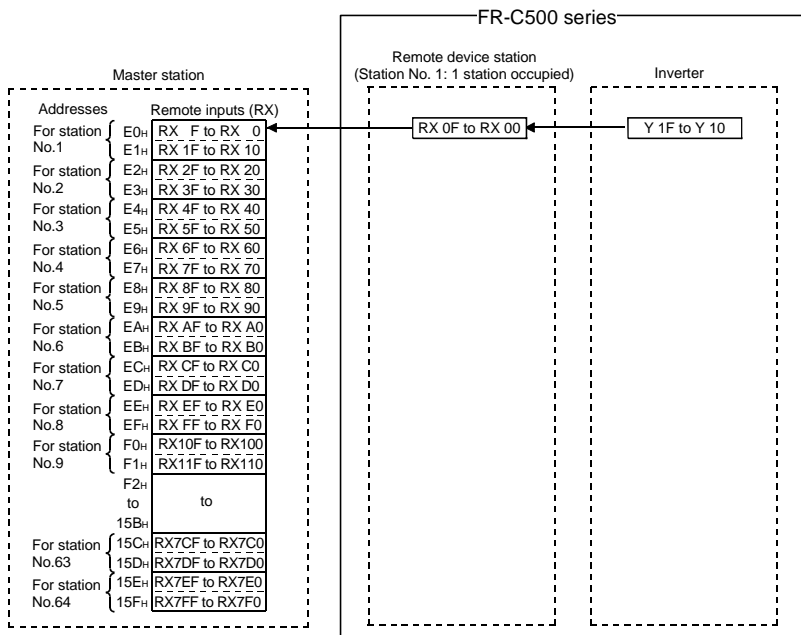
(\*) Do not use address  $16n$  ( $n = 2(X - 1) + 1$ ,  $X =$  station No.).

Correspondences between Master Station Buffer Memory Addresses and Station Numbers

Station No.	Buffer Memory Address	Station No.	Buffer Memory Address	Station No.	Buffer Memory Address	Station No.	Buffer Memory Address
1	160H	17	180H	33	1A0H	49	1C0H
2	162H	18	182H	34	1A2H	50	1C2H
3	164H	19	184H	35	1A4H	51	1C4H
4	166H	20	186H	36	1A6H	52	1C6H
5	168H	21	188H	37	1A8H	53	1C8H
6	16AH	22	18AH	38	1AAH	54	1CAH
7	16CH	23	18CH	39	1ACH	55	1CCH
8	16EH	24	18EH	40	1AEH	56	1CEH
9	170H	25	190H	41	1B0H	57	1D0H
10	172H	26	192H	42	1B2H	58	1D2H
11	174H	27	194H	43	1B4H	59	1D4H
12	176H	28	196H	44	1B6H	60	1D6H
13	178H	29	198H	45	1B8H	61	1D8H
14	17AH	30	19AH	46	1BAH	62	1DAH
15	17CH	31	19CH	47	1BCH	63	1DCH
16	17EH	32	19EH	48	1BEH	64	1DEH

## 5.4.2 Remote input signals (Inverter to master module)

- Input states from the remote device station are stored.
- Two words are used for each station. (\*)



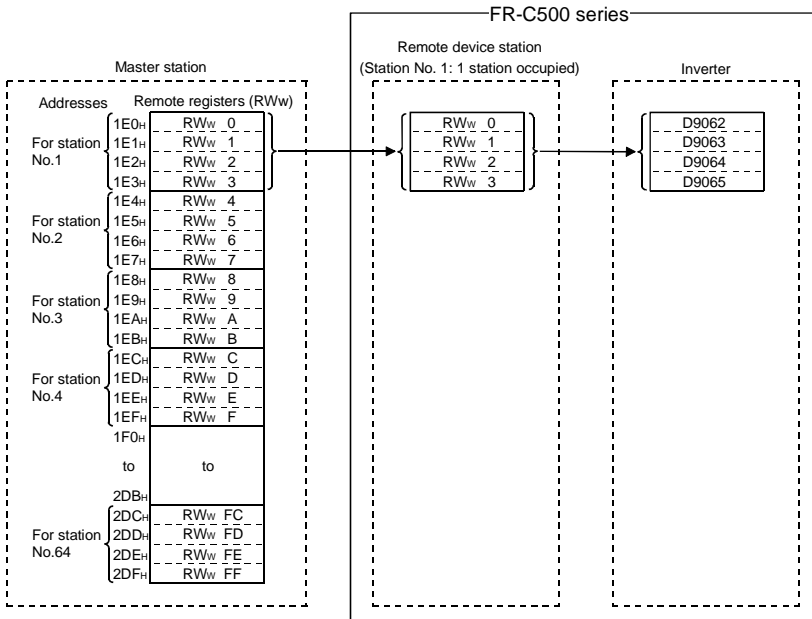
(\*) Do not use address  $E_n$  ( $n = 2(X - 1) + 1$ ,  $X =$  station No.).

Correspondences between Master Station Buffer Memory Addresses and Station Numbers

Station No.	Buffer Memory Address	Station No.	Buffer Memory Address	Station No.	Buffer Memory Address	Station No.	Buffer Memory Address
1	E0H	17	100H	33	120H	49	140H
2	E2H	18	102H	34	122H	50	142H
3	E4H	19	104H	35	124H	51	144H
4	E6H	20	106H	36	126H	52	146H
5	E8H	21	108H	37	128H	53	148H
6	EAH	22	10AH	38	12AH	54	14AH
7	ECH	23	10CH	39	12CH	55	14CH
8	EEH	24	10EH	40	12EH	56	14EH
9	F0H	25	110H	41	130H	57	150H
10	F2H	26	112H	42	132H	58	152H
11	F4H	27	114H	43	134H	59	154H
12	F6H	28	116H	44	136H	60	156H
13	F8H	29	118H	45	138H	61	158H
14	FAH	30	11AH	46	13AH	62	15AH
15	FBH	31	11CH	47	13CH	63	15CH
16	FEH	32	11EH	48	13EH	64	15EH

### 5.4.3 Remote registers (Master module to inverter)

- Data to be sent to the remote registers (RWW) of the remote device station are stored.
- Four words are used for each station. (\*)

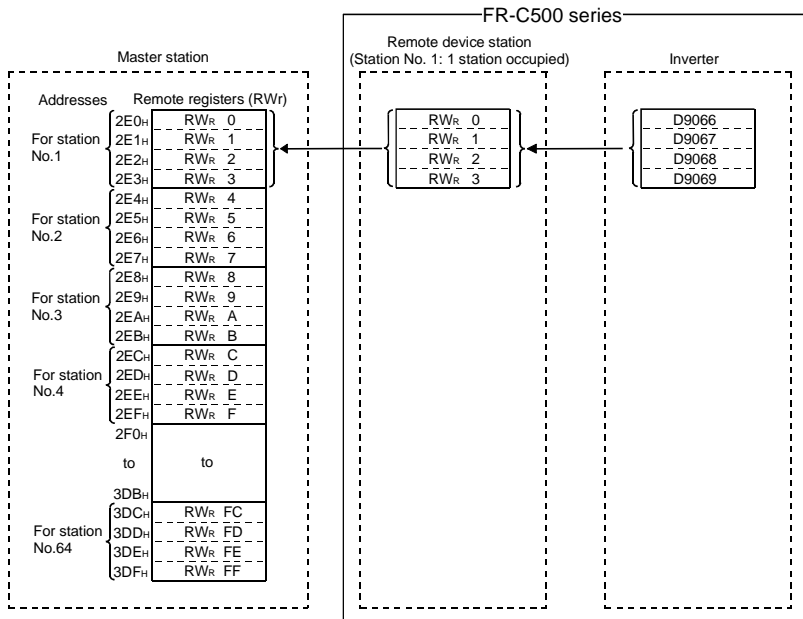


Correspondences between Master Station Buffer Memory Addresses and Station Numbers

Station No.	Buffer Memory Address	Station No.	Buffer Memory Address	Station No.	Buffer Memory Address	Station No.	Buffer Memory Address
1	1E0H to 1E3H	17	220H to 223H	33	260H to 263H	49	2A0H to 2A3H
2	1E4H to 1E7H	18	224H to 227H	34	264H to 267H	50	2A4H to 2A7H
3	1E8H to 1EBH	19	228H to 22BH	35	268H to 26BH	51	2A8H to 2ABH
4	1ECH to 1EFH	20	22CH to 22FH	36	26CH to 26FH	52	2ACH to 2AFH
5	1F0H to 1F3H	21	230H to 233H	37	270H to 273H	53	2B0H to 2B3H
6	1F4H to 1F7H	22	234H to 237H	38	274H to 277H	54	2B4H to 2B7H
7	1F8H to 1FBH	23	238H to 23BH	39	278H to 27BH	55	2B8H to 2BBH
8	1FCH to 1FFH	24	23CH to 23FH	40	27CH to 27FH	56	2BCH to 2BFH
9	200H to 203H	25	240H to 243H	41	280H to 283H	57	2C0H to 2C3H
10	204H to 207H	26	244H to 247H	42	284H to 287H	58	2C4H to 2C7H
11	208H to 20BH	27	248H to 24BH	43	288H to 28BH	59	2C8H to 2CBH
12	20CH to 20FH	28	24CH to 24FH	44	28CH to 28FH	60	2CCH to 2CFH
13	210H to 213H	29	250H to 253H	45	290H to 293H	61	2D0H to 2D3H
14	214H to 217H	30	254H to 257H	46	294H to 297H	62	2D4H to 2D7H
15	218H to 21BH	31	258H to 25BH	47	298H to 29BH	63	2D8H to 2DBH
16	21CH to 21FH	32	25CH to 25FH	48	29CH to 29FH	64	2DCH to 2DFH

### 5.4.4 Remote registers (Inverter to master module)

- Data sent from the remote registers (RWR) of the remote device station are stored.
- Four words are used for each station. (\*)



Correspondences between Master Station Buffer Memory Addresses and Station Numbers

Station No.	Buffer Memory Address	Station No.	Buffer Memory Address	Station No.	Buffer Memory Address	Station No.	Buffer Memory Address
1	2E0H to 2E3H	17	320H to 323H	33	360H to 363H	49	3A0H to 3A3H
2	2E4H to 2E7H	18	324H to 327H	34	364H to 367H	50	3A4H to 3A7H
3	2E8H to 2EBH	19	328H to 32BH	35	368H to 36BH	51	3A8H to 3ABH
4	2ECH to 2EFH	20	32CH to 32FH	36	36CH to 36FH	52	3ACH to 3AFH
5	2F0H to 2F3H	21	330H to 333H	37	370H to 373H	53	3B0H to 3B3H
6	2F4H to 2F7H	22	334H to 337H	38	374H to 377H	54	3B4H to 3B7H
7	2F8H to 2FBH	23	338H to 33BH	39	378H to 37BH	55	3B8H to 3BBH
8	2FCH to 2FFH	24	33CH to 33FH	40	37CH to 37FH	56	3BCH to 3BFH
9	300H to 303H	25	340H to 343H	41	380H to 383H	57	3C0H to 3C3H
10	304H to 307H	26	344H to 347H	42	384H to 387H	58	3C4H to 3C7H
11	308H to 30BH	27	348H to 34BH	43	388H to 38BH	59	3C8H to 3CBH
12	30CH to 30FH	28	34CH to 34FH	44	38CH to 38FH	60	3CCH to 3CFH
13	310H to 313H	29	350H to 353H	45	390H to 393H	61	3D0H to 3D3H
14	314H to 317H	30	354H to 357H	46	394H to 397H	62	3D4H to 3D7H
15	318H to 31BH	31	358H to 35BH	47	398H to 39BH	63	3D8H to 3DBH
16	31CH to 31FH	32	35CH to 35FH	48	39CH to 39FH	64	3DCH to 3DFH



# MEMO

# 6. PROTECTIVE FUNCTIONS

This chapter explains the "protective functions" for use of this product. Always read the instructions before using this equipment.

<b>6.1</b>	<b>Errors (Alarms).....</b>	<b>154</b>
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## 6.1 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 the fault does not correspond to any of the following errors or if you have any other problem, please contact your sales representative.

- Retention of alarm output signal ... When the magnetic contactor (MC) provided on the power supply side of the inverter is opened at the activation of the protective function, the inverter's control power will be lost and the alarm output will not be held.
- Alarm indication..... When the protective function is activated, the operation panel display automatically switches to the above indication.
- Resetting method ..... When the protective function is activated, the inverter output is kept stopped. Unless reset, therefore, the inverter cannot restart. Switch power off once, then on again; or apply the RES signal for more than 0.1s. If the RES signal is Kept on, "Err." appears (flickers) to indicate that the inverter is being reset.
- When the protective function is activated, take the corresponding corrective action, then reset the inverter, and resume operation.

---

### CAUTION

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**At occurrence of an inverter error, the protective function is activated to stop output. At this time, you can not stop the motor abruptly. Therefore, provide machineries and equipments which require for emergency stop with a mechanical stop and hold mechanism.**


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## 6.1.1 Error (alarm) definitions

### (1) Major failures

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

Operation Panel Indication	OC1		FR-PU04	OC During Acc
Name	Overcurrent shut-off during acceleration			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated inverter current during acceleration, the protective circuit is activated to stop the inverter output.			
Check point	Check for too slow acceleration. Check for output short-circuit/ground fault.			
Corrective action	Decrease the acceleration time.			
Error code	H10			

Operation Panel Indication	OC2		FR-PU04	Stedy Spd OC
Name	Overcurrent shut-off during constant speed			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated inverter current during constant speed operation, the protective circuit is activated to stop the inverter output.			
Check point	Check for sudden load change. Check for output short-circuit/ground fault.			
Corrective action	Keep load stable.			
Error code	H11			

Operation Panel Indication	OC3		FR-PU04	OC During Dec
Name	Overcurrent shut-off during deceleration			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated inverter current during deceleration (other than acceleration or constant speed), the protective circuit is activated to stop the inverter output.			
Check point	<ul style="list-style-type: none"> <li>• Check for sudden speed reduction.</li> <li>• Check for output short-circuit/ground fault.</li> <li>• Check for too fast operation of the motor's mechanical brake.</li> </ul>			
Corrective action	Increase the deceleration time. Adjust brake operation.			
Error code	H12			

<b>Operation Panel Indication</b>	<b>OV1</b>	<b>OV1</b>	<b>FR-PU04</b>	<b>OV During Acc</b>
Name	Regenerative overvoltage shut-off during acceleration			
Description	When the main circuit DC voltage in the inverter rises to or above the specified value due to excessive regenerative energy during acceleration, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	Check for too slow acceleration. (i.e. during descending acceleration with lifting load)			
Corrective action	<ul style="list-style-type: none"> <li>• Decrease the acceleration time.</li> <li>• Install a power factor improving reactor.</li> <li>• Use the brake unit or power regeneration common converter (FR-CV) as required.</li> </ul>			
Error code	H20			

<b>Operation Panel Indication</b>	<b>OV2</b>	<b>OV2</b>	<b>FR-PU04</b>	<b>Stedy Spd OV</b>
Name	Regenerative overvoltage shut-off during constant speed			
Description	When the main circuit DC voltage in the inverter rises to or above the specified value due to excessive regenerative energy during constant speed, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	Check for sudden load change.			
Corrective action	<ul style="list-style-type: none"> <li>• Keep load stable.</li> <li>• Install a power factor improving reactor.</li> <li>• Use the brake unit or power regeneration common converter (FR-CV) as required.</li> </ul>			
Error code	H21			

<b>Operation Panel Indication</b>	<b>OV3</b>	<b>OV3</b>	<b>FR-PU04</b>	<b>OV During Dec</b>
Name	Regenerative overvoltage shut-off during deceleration or stop			
Description	When the main circuit DC voltage in the inverter rises to or above the specified value due to excessive regenerative energy during deceleration or stop, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.			
Check point	Check for sudden speed reduction.			
Corrective action	<ul style="list-style-type: none"> <li>• Increase the deceleration time. (Set the deceleration time that matches the moment of inertia of the load)</li> <li>• Decrease the braking duty.</li> <li>• Install a power factor improving reactor.</li> <li>• Use the brake unit or power regeneration common converter (FR-CV) as required.</li> </ul>			
Error code	H22			

Operation Panel Indication	THM	<i>THM</i>	FR-PU04	Motor Overload
Name	Motor overload shut-off (electronic thermal overcurrent protection) (*1)			
Description	The electronic overcurrent protection in the inverter detects motor overheat due to overload or reduced cooling capability during low-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. Protection from burning due to motor temperature rise			
Check point	Check the motor for use under overload.			
Corrective action	<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>			
Error code	H31			

Operation Panel Indication	THT	<i>THT</i>	FR-PU04	Inv. Overload
Name	Inverter overload shut-off (electronic thermal overcurrent protection) (*1)			
Description	If a current not less than 150% of the rated output current flows and overcurrent cut-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. Output transistor protection from overheat			
Check point	Check the motor for use under overload.			
Corrective action	Reduce the load weight.			
Error code	H30			

\*1. Resetting the inverter initializes the internal heat integrating data of the electronic overcurrent protection.

Operation Panel Indication	FIN	<i>Fin</i>	FR-PU04	H/Sink O/Temp
Name	Fin overheat			
Description	If the cooling heatsink overheats, the overheat sensor is actuated to stop the inverter output.			
Check point	<ul style="list-style-type: none"> <li>• Check for too high ambient temperature.</li> <li>• Check for cooling heatsink clogging.</li> <li>• Check that the cooling fan is not at a stop.</li> </ul>			
Corrective action	Set the ambient temperature to within the specifications. Change the cooling fan.			
Error code	H40			

Operation Panel Indication	GF	<i>GF</i>	FR-PU04	Ground Fault
Name	Start-time ground fault overcurrent protection			
Description	This function stops the inverter output if a ground fault overcurrent flows due to a ground fault that occurred in the inverter's output (load) side. Made valid when Pr. 40 "start-time ground fault detection selection" = "1".			
Check point	Check for a ground fault in the motor and connection cable.			
Corrective action	Remedy the ground fault portion.			
Error code	H80			

<b>Operation Panel Indication</b>	<b>OHT</b>	<b>OHT</b>	<b>FR-PU04</b>	<b>OH Fault</b>
Name	External thermal relay (*2)			
Description	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.			
Check point	<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. 60 to Pr. 63, Pr. 65 and Pr. 505 (input terminal function selection).</li> </ul>			
Corrective action	Reduce the load and operating duty.			
Error code	H90			

\*2. Functions only when any of Pr. 60 to Pr. 63, Pr. 65 and Pr. 505 (input terminal function selection) is set to OH.

<b>Operation Panel Indication</b>	<b>OLT</b>	<b>OLT</b>	<b>FR-PU04</b>	<b>Still Prev STP</b>
Name	Stall prevention (overload)			
Description	The running frequency has fallen to 0 by stall prevention operation activated. OL appears while stall prevention is being activated.			
Check point	Check the motor for use under overload.			
Corrective action	Reduce the load weight.			
Error code	H60			

<b>Operation Panel Indication</b>	<b>PE</b>	<b>PE</b>	<b>FR-PU04</b>	<b>Corrupt Memory</b>
Name	Parameter storage device alarm			
Description	A fault occurred in parameters stored. (Example: E <sup>2</sup> PROM fault)			
Check point	Check for too many number of parameter write times.			
Corrective action	Please contact your sales representative.			
Error code	HB0			

<b>Operation Panel Indication</b>	<b>PUE</b>	<b>PUE</b>	<b>FR-PU04</b>	<b>PU Leave Out</b>
Name	PU disconnected			
Description	Stops the inverter output if communication between inverter and PU is suspended, e.g. if the PU is disconnected with "1" set in Pr. 993 "PU disconnection detection", or if a setting error or connection (connector) fault occurs when the RS-485 communication function is used.			
Check point	<ul style="list-style-type: none"> <li>• Check that the FR-PU04 is fitted securely.</li> <li>• Check the setting of Pr. 993 "PU disconnection detection".</li> <li>• Check that the connector is plugged securely.</li> <li>• Check that the communication setting is correct.</li> </ul>			
Corrective action	Fit the FR-PU04 securely.			
Error code	HB1			

Operation Panel Indication	CPU	<i>CPU</i>	FR-PU04	CPU Fault
Name	CPU error			
Description	If the arithmetic operation of the built-in CPU does not end within a predetermined period, the inverter self-determines it as an alarm and stops the output.			
Check point	—			
Corrective action	Please contact your sales representative.			

### (2) Minor failure

When the protective function is activated, the output is not shut off.

Operation Panel Indication	FN	<i>F<sub>n</sub></i>	FR-PU04	FN
Name	Fan trouble			
Description	For the inverter that contains a cooling fan, <i>F<sub>n</sub></i> appears on the operation panel when the cooling fan stops due to a fault or different operation from the setting of Pr. 76 "cooling fan operation selection".			
Check point	Check the cooling fan for a fault.			
Corrective action	Replace the fan.			

### (3) Warnings



When the protective function is activated, the output is not shut off.

Operation Panel Indication	OL	<i>OL</i>	FR-PU04	OL
Name	Stall prevention (overcurrent)			
Description	During acceleration	If a current of more than 150% (*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% (*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% (*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.		
Check point	Check the motor for use under overload.			
Corrective action	<ul style="list-style-type: none"> <li>• The acceleration/deceleration time may change.</li> <li>• Increase the stall prevention operation level with Pr. 22 "stall prevention operation level", or disable stall prevention with Pr. 21 "stall prevention function selection".</li> <li>• Check that the torque boost (Pr. 0) setting is not higher than required.</li> </ul>			

\*4. The stall prevention operation current can be set as desired. It is factory-set to 150%.



<b>Operation Panel Indication</b>	<b>oL</b>	<b>oL</b>	<b>FR-PU04</b>	<b>oL</b>
Name	Stall prevention (overvoltage)			
Description	During deceleration	If the regenerative energy of the motor increases too much to exceed the brake capability, this function stops the decrease in frequency to prevent overvoltage shut-off. As soon as the regenerative energy has reduced, deceleration resumes.		
Check point	Check for sudden speed reduction.			
Corrective action	The deceleration time may change. Increase the deceleration time using Pr. 8 "deceleration time".			

<b>Operation Panel Indication</b>	<b>PS</b>	<b>PS</b>	<b>FR-PU04</b>	<b>PS</b>
Name	PU stop			
Description	Pr. 75 "reset selection/PU stop selection" has been set and a stop was made by pressing the  key of the operation panel or parameter unit (FR-PU04) during operation in the external operation mode.			
Check point	Check for a stop made by pressing the  key of the operation panel during external operation.			
Corrective action	Refer to page 71.			

<b>Operation Panel Indication</b>	<b>UV</b>	<b>UV</b>		
Name	Undervoltage			
Description	If the power supply voltage of the inverter reduces, the control circuit will not operate properly and will result in decreased motor torque or increased heat generation. To prevent this, if the power supply voltage reduces below about 115VAC, this function stops the inverter output.			
Check point	<ul style="list-style-type: none"> <li>• Check for a start of large-capacity motor.</li> <li>• Check that the power supply capacity is as indicated in the specifications (refer to page 178).</li> </ul>			
Corrective action	Check the power supply system equipment such as the power supply.			

#### (4) Write errors

<b>Operation Panel Indication</b>	<b>Er1</b>	<b>Er1</b>	<b>FR-PU04</b>	<b>Control Mode</b>
Name	Write disable error			
Description	<ul style="list-style-type: none"> <li>• Write was performed using the parameter unit with "1" (write disable) set in Pr. 77 "parameter write disable selection".</li> </ul>			
Corrective action	<ul style="list-style-type: none"> <li>• Check the setting of Pr. 77 "parameter write disable selection". (Refer to page 74.)</li> </ul>			

<b>Operation Panel Indication</b>	<b>Er2</b>	<b>Er2</b>	<b>FR-PU04</b>	<b>In PU/EXT Mode OPERATOR ERR</b>
Name	Write-while-running error/mode designation error			
Description	<ul style="list-style-type: none"> <li>• Write was performed during operation using the parameter unit.</li> <li>• An attempt was made to change the Pr. 79 setting to the operation mode where the operation command has been input.</li> <li>• Write was performed in the external operation mode using the parameter unit.</li> </ul>			
Corrective action	<ul style="list-style-type: none"> <li>• After stopping operation, make parameter setting.</li> <li>• After setting the operation mode to the "PU operation mode", make parameter setting. (Refer to page 75.)</li> </ul>			

### 6.1.2 To know the operating status at the occurrence of alarm (Only when FR-PU04 is used)

When any alarm has occurred, the display automatically switches to the indication of the corresponding protective function (error). By pressing the **(MON)** key at this point without resetting the inverter, the display shows the output frequency. In this way, it is possible to know the running frequency at the occurrence of the alarm. It is also possible to know the current in the same manner.

After resetting, you can confirm the definitions in "Alarm History". (For details, refer to the instruction manual of the parameter unit (FR-PU04).)

### 6.1.3 Correspondences between digital and actual characters

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

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

### 6.1.4 Resetting the inverter

The inverter can be reset by performing any of the following operations. Note that the electronic overcurrent protection's internal heat calculation value and the number of retries are cleared (erased) by resetting the inverter. It takes about 1s to reset the inverter.

Operation 1..... Using the operation panel, press the **(STOP RESET)** key to reset the inverter. (Enabled only when the inverter protective function (major failure) is activated.)

Operation 2..... Switch power off once, then switch it on again.

Operation 3..... Turn on the reset signal (RES). (Assign this signal to any of Pr. 60 to Pr. 63, Pr. 65 and Pr. 505.) (Refer to page 20, 68.)

## 6.2 Troubleshooting

### POINT

Check the corresponding areas. If the cause is still unknown, it is recommended to initialize the parameters (return to factory settings), re-set the required parameter values, and check again.

### 6.2.1 Motor remains stopped

#### 1) Check the main circuit

- Check that a proper power supply voltage is applied (operation panel display is provided).
- Check that the motor is connected properly.
- Check that the connector across P1-P<+> is connected.

#### 2) Check the input signals

- For operation using the PLC function, check that the SQ signal is shorted. (Refer to page 100.)
- Check that the start signal is input.
- Check that both the forward and reverse rotation start signals are not input.
- Check that the output stop signal (MRS) or reset signal (RES) is not on. (Assign MRS and RES using Pr. 60 to Pr. 63, Pr. 65 and Pr. 505 (input terminal function selection).)
- Check that the sink or source connector is fitted securely.

#### 3) Check the parameter settings

- For inverter operation, check that the Pr. 507 "inverter operation lock mode setting" value is "0". (Refer to page 138.).
- 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 running frequencies (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 operation panel display does not show an error (e.g. OC1).
- Check that the ERR indication is not lit.

### 6.2.2 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 correctly.
- Check the setting of Pr. 17 "RUN key rotation direction selection".

### 6.2.3 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).
- Check that the input signal lines are not affected by external noise. (Use of shielded cables)
- Check that the load is not too heavy.

### 6.2.4 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.

### 6.2.5 Motor current is large

- Check that the load is not too heavy.
- Check that the torque boost setting is not too large.

### 6.2.6 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 heavy in winter.)
- Check that the torque boost setting is not too large to activate the stall prevention function.

### 6.2.7 Speed varies during operation

#### 1) Inspection of load

- Check that the load is not varying.

#### 2) Inspection of input signal


- Check for a malfunction due to an undesirable current when the transistor output unit is connected. (Refer to page 12.)

#### 3) Others

- Check that the wiring length is within the specified length.
- Check that load  $GD^2$  is small (at the motor  $GD^2$  or less).  
If so, set the Pr. 72 "PWM carrier frequency" to 6kHz or higher. (When setting the PWM to a higher frequency, check for noise or leakage current problem and take countermeasures against it.)

### **6.2.8 Operation mode is not changed properly**

If the operation mode does not change correctly, check the following:

- 1. External input signal ... Check that the STF or STR signal is off.  
When it is on, the operation mode cannot be changed.
- 2. Parameter setting ..... Check the Pr. 79 setting.  
When the setting of Pr. 79 "operation mode selection" is "0", switching input power on places the inverter in the external operation mode. Press the  key to switch to the PU operation mode. For other settings (1, 2, 3, 4), the operation mode is limited accordingly. (For details of Pr. 79, refer to page 75.)

### **6.2.9 Operation mode is not switched to CC-Link operation mode**

- Check that the inverter and CC-Link dedicated cable are fitted correctly. (Check for poor contact, cable breakage, etc.)
- Check that the station number setting is correct. (Check that the station number matches the program, does not overlap, and is not outside the range.)
- Check that the operation mode switching program is executed.
- Check that the operation mode switching program is designed correctly.

### **6.2.10 Inverter cannot be started in CC-Link operation mode**

- Check that the inverter starting program is designed correctly.
- Check that the inverter starting program is executed.
- Check that the inverter is providing output.

### **6.2.11 Operation panel display is not provided**

- Make sure that terminals PC-SD are not shorted.
- Make sure that the jumper is fitted securely across terminals P<+>-P1.

### **6.2.12 Parameter write cannot be performed**

- Check that operation is not being performed (signal STF or STR is not on).
- Check that you are not attempting to make parameter setting outside the setting range.
- Check that you are not attempting to make parameter setting in the external operation mode.
- Check the setting of Pr. 77 "parameter write inhibit selection".

### **6.2.13 Motor produces annoying sound**

- Check the Pr. 72 "PWM frequency selection" setting.
- Make sure that the deceleration time is not too short.

## 6.3 Precautions for Maintenance and Inspection

The inverter is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to adverse influence of the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

### 6.3.1 Precautions for maintenance and inspection

For some short time after the power is switched off, a high voltage remains in the smoothing capacitor. Therefore, when more than 10 minutes have elapsed after power-off, make sure that the voltage across the main circuit terminals P-N of the inverter is 30VDC or less using a meter, etc. Then, access the inverter for inspection.

### 6.3.2 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.

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#### CAUTION

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**Do not use solvent, such as acetone, benzene, toluene and alcohol, as they will cause the inverter surface paint to peel off.**

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### 6.3.3 Periodic inspection

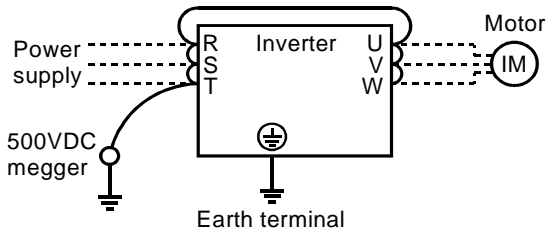
Check the areas inaccessible during operation and requiring periodic inspection.

For periodic inspection, consult your sales representative.

- 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, relay  
..... Check and change if necessary.

### 6.3.4 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.)



### 6.3.5 Pressure test

Do not conduct a pressure test. This may deteriorate the inverter.

### 6.3.6 Daily and periodic inspection

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument	Customer Check
			Daily	Periodic*					
				1 year	2 years				
<b>General</b>	Surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	○			Make measurement 5cm away from the inverter.	Ambient temperature: -10 °C to +50 °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 the main circuit voltage is normal.	○			Measure voltage across the inverter terminals R,S,T.	Within permissible AC (DC) voltage fluctuation (refer to page 178)	Meter, digital multimeter	
	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, S, T, U, V, W and earth terminal with megger. (2) Retighten. (3) Visual check.	(1) 5MΩ or more. (2), (3) No fault.	500VDC class megger	



**Precautions for Maintenance and Inspection**

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument	Customer Check
			Daily	Periodic*					
				1 year	2 years				
Main circuit	Conductors, cables	(1) Check conductors for distortion. (2) Check cable sheaths for breakage.		<input type="radio"/>		(1), (2) Visual check.	(1), (2) No fault.		
	Terminal block	Check for damage.		<input type="radio"/>		Visual check	No fault		
	Inverter module, converter module	Check resistance across terminals.			<input type="radio"/>	Disconnect cables from inverter and measure across terminals R, S, T ↔ P, N, and across U, V, W ↔ P, N with a meter in 100Ω range.	Refer to page 170.	Analog meter	
	Smoothing capacitor	(1) Check for liquid leakage. (2) Check for safety valve protection and bulge. (3) Measure electrostatic capacity.	<input type="radio"/>	<input type="radio"/>		(1), (2) Visual check. (3) Measure with capacity meter.	(1), (2) No fault. (3) 85% or more of rated capacity.	Capacity meter	
	Relay	(1) Check for chatter during operation. (2) Check for rough surface on contacts.		<input type="radio"/>		(1) Auditory check. (2) Visual check.	(1) No fault. (2) No fault.		

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument	Customer Check
			Daily	Periodic*					
				1 year	2 years				
Control circuit Protective circuit	Operation check	(1) Check balance of output voltages across phases with inverter operated independently. (2) Perform sequence protective operation test to make sure there is no fault in protective or display circuits.	<input type="radio"/>	<input type="radio"/>		(1) Measure voltage across the inverter output terminals U-V-W. (2) Simulate connection of inverter protective circuit output terminals.	(1) Phase-to-phase voltage balance within 4V for 200V. (2) Fault must occur because of sequence.	Digital multimeter, rectifier type voltmeter	
			<input type="radio"/>						
Cooling system	Cooling fan	(1) Check for unusual vibration and noise. (2) Check for loose connection.	<input type="radio"/>		<input type="radio"/>	(1) Turn by hand with power off. (2) Visual check.	No unusual vibration and noise.		
			<input type="radio"/>	<input type="radio"/>					
Display	Display	(1) Check for LED lamp blown. (2) Clean.	<input type="radio"/>			(1) Lamps indicate indicator lamps on panel. (2) Clean with rag.	(1) Check that lamps are lit.		
	Meter	Check that reading is normal.	<input type="radio"/>			Check reading of meters on panel.	Must satisfy specified and management values.	Voltmeter, ammeter, etc.	

PROTECTIVE FUNCTIONS

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument	Customer Check
			Daily	Periodic*					
				1 year	2 years				
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).			○	(1) Disconnect cables from U, V, W (including motor cables).	(1) 5MΩ or more.	500V megger	

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

**●Checking the inverter and converter modules**

**<Preparation>**

- (1) Disconnect the external power supply cables (R, S, T) 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, S, T, U, V, W, P and N, and check for continuity.

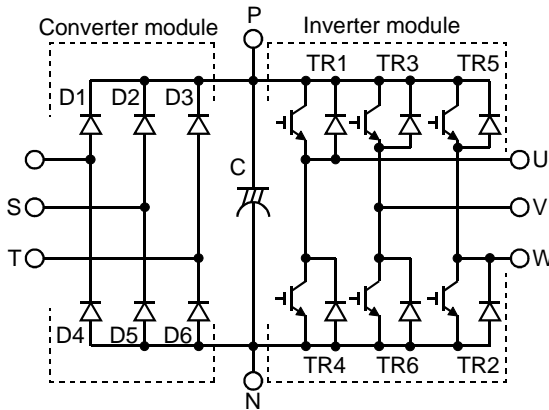
**CAUTION**

- Before measurement, check that the smoothing capacitor is discharged.
- At the time of discontinuity, the measured value is almost ∞. Note that ∞ may not be measured when power is momentarily applied due to the influence of the smothing capacitor. At the time of continuity, the measured value is several to several ten's-of ohms depending on the module type, 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	P	Discontinuity	D4	R	N	Continuity	
		P	R	Continuity		N	R	Discontinuity	
	D2	S	P	Discontinuity	D5	S	N	Continuity	
		P	S	Continuity		N	S	Discontinuity	
	D3	T	P	Discontinuity	D6	T	N	Continuity	
		P	T	Continuity		N	T	Discontinuity	
Inverter module	TR1	U	P	Discontinuity	TR4	U	N	Continuity	
		P	U	Continuity		N	U	Discontinuity	
	TR3	V	P	Discontinuity	TR6	V	N	Continuity	
		P	V	Continuity		N	V	Discontinuity	
	TR5	W	P	Discontinuity	TR2	W	N	Continuity	
		P	W	Continuity		N	W	Discontinuity	

(Assumes the use of an analog meter.)



6.3.7 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 and/or fault of the inverter. For preventive maintenance, the parts must be changed periodically.

Part Name	Standard Replacement Interval	Description
Cooling fan	2 to 3 years	Replace (as required)
Smoothing capacitor in main circuit	5 years	Replace (as required)
Smoothing capacitor on control board	5 years	Replace the board (as required).
Relays	—	Replace as required.

CAUTION

For parts replacement, consult the nearest Mitsubishi FA Center.

**(1) Cooling fan**

The cooling fan is used to cool heat-generating parts such as the main circuit semiconductors. The life of the cooling fan bearing is usually 10,000 to 35,000 hours. Hence, the cooling fan must be replaced 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-C520-1.5K, 2.2K, 3.7K	MMF-06D24DS BKO-C2416H07

● Removal

- 1) Remove the front cover and wiring cover. (Refer to page 4)
- 2) Unplug the fan connector.

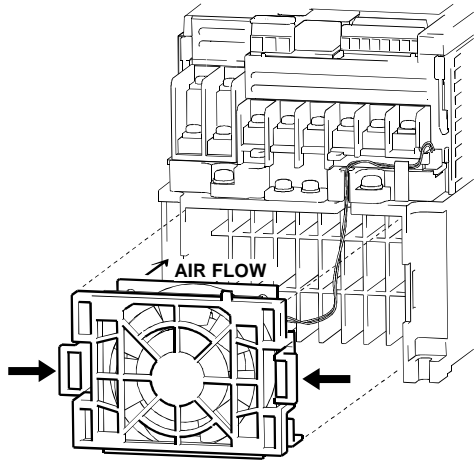
The cooling fan is connected with the cooling fan connector on the side of the inverter terminal block.

Unplug the connector to disconnect the inverter and cooling fan.

- 3) Remove the cooling fan cover. Remove the cover by disengaging the fixing catches indicated by the arrows.

- 4) Remove the cooling fan and cooling fan cover. The cooling fan is secured by the fixing catches.

Disengaging the fixing catches removes the cooling fan and cooling fan cover.

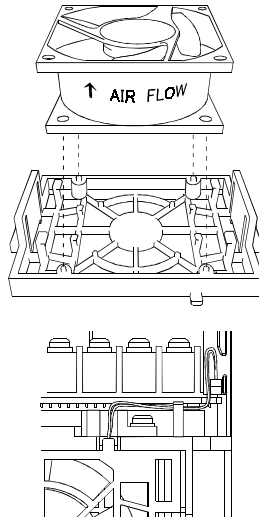


● Reinstallation

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

**CAUTION**  
**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.



## **(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) Check for external crack, discoloration, fluid leakage, etc.

Judge that the capacitor has reached its life when the measured capacitance of the capacitor reduced below 85% of the rating.

## **(3) Relays**

To prevent a contact fault, etc., relays must be replaced according to the cumulative number of switching times (switching life).

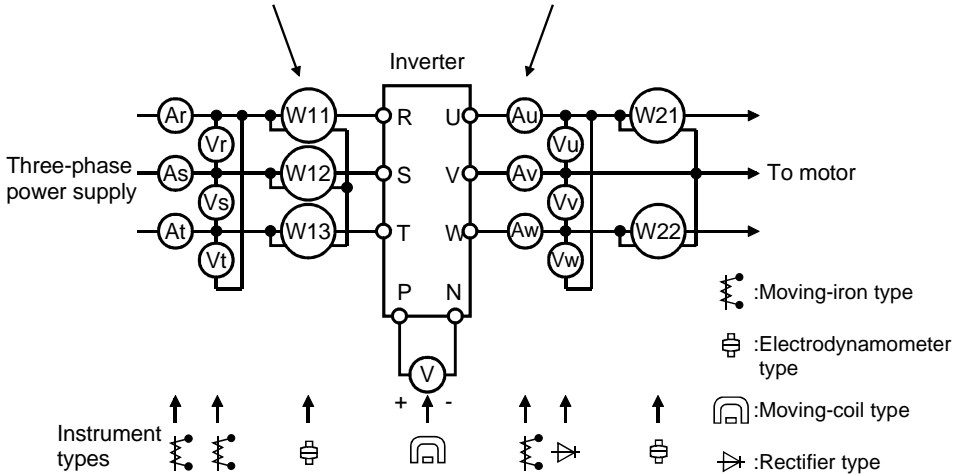
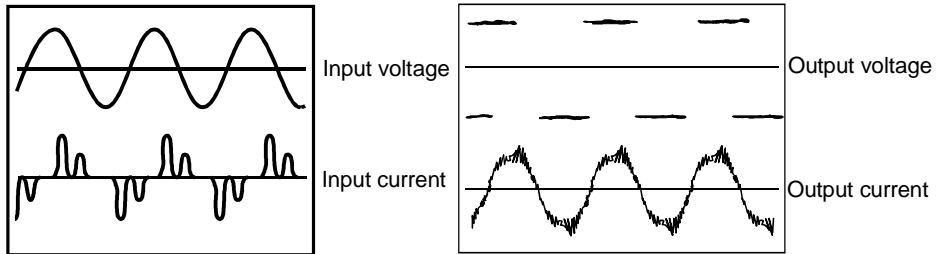
### 6.3.8 Measurement of main circuit voltages, currents and powers

● 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 with the instruments given on the next page.

Three-phase 200V power input



**Typical Measuring Points and Instruments**

**CAUTION**

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

## Measuring Points and Instruments

Item	Measuring Point	Measuring Instrument	Remarks (Reference Measurement Value)	
Power supply voltage V1	Across R-S, S-T and T-R	Moving-iron type AC voltmeter	Is commercial power supply within permissible variation of AC voltage? (refer to page 178)	
Power supply side current I1	R, S and T line currents	Moving-iron type AC ammeter		
Power supply side power P1	At R, S and T, and across R-S, S-T and T-R	Electrodynamic type single-phase wattmeter	P1 = W11 + W12 + W13 (3-wattmeter method)	
Power supply side power factor Pf1	Calculate after measuring power supply voltage, power supply side current and power supply side power. [For three-phase power supply] $Pf1 = \frac{P1}{\sqrt{3}V1 \times I1} \times 100\%$			
Output side voltage V2	Across U-V, V-W and W-U	Rectifier type AC voltmeter (Note 1) (Cannot be measured by moving-iron type)	Difference between phases is within $\pm 1\%$ of maximum output voltage.	
Output side current I2	U, V and W line currents	Moving-iron type AC ammeter (Note 2)	Current should be equal to or less than rated inverter current. Difference between phases is 10% or lower.	
Output side power P2	At U, V and W, and across U-V and V-W	Electrodynamic type single-phase wattmeter	P2=W21+W22 2-wattmeter method (or 3-wattmeter method)	
Output side power factor	Calculate in similar manner to power supply side power factor. $Pf2 = \frac{P2}{\sqrt{3}V2 \times I2} \times 100\%$			
Converter output	Across P-N	Moving-coil type (such as a meter)	Inverter LED display is lit. 1.35 × V1	
Start signal Select signal	Across STF, STR, RH, RM, RL, SQ-SD	Moving-coil type (Meter, etc. may be used) (Internal resistance: 50kΩ or larger)	20 to 30VDC when open. ON voltage: 1V or less	SD is common.

### CAUTION

1. Use an FFT to measure the output voltage accurately. A tester or general measuring instrument can not measure accurately.
2. When the carrier frequency exceeds 5kHz, do not use this instrument since using it may increase eddycurrent losses produced in metal parts inside the instrument, leading to burnout.  
In this case, use an approximate effective value type instrument.



# MEMO

# 7. SPECIFICATIONS

This chapter describes the "specifications" for use of this product. Always read the instructions before using this equipment.

<b>7.1 Ratings .....</b>	<b>178</b>
<b>7.2 Common Specifications .....</b>	<b>179</b>
<b>7.3 PLC Function Specifications.....</b>	<b>180</b>
<b>7.4 CC-Link Interface Specifications .....</b>	<b>180</b>
<b>7.5 Outline Drawings.....</b>	<b>181</b>

**Chapter 1**

**Chapter 2**

**Chapter 3**

**Chapter 4**

**Chapter 5**

**Chapter 6**

**Chapter 7**

## 7.1 Ratings

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

Type FR-C520-□K		0.1	0.2	0.4	0.75	1.5	2.2	3.7
Applicable motor capacity (kW) (*1)		0.1	0.2	0.4	0.75	1.5	2.2	3.7
Output	Rated capacity (kVA) (*2)	0.3	0.5	1.0	1.6	2.8	4.0	6.6
	Rated current (A)	0.8	1.4	2.5	4.1	7.0	10	16.5
	Overload capacity (*3)	150% 60s, 200% 0.5s (inverse time characteristics)						
	Voltage (*4)	Three phase, 200V to 240V 50Hz/60Hz						
Power supply	Rated input AC voltage, frequency	Three phase, 200V to 240V 50Hz/60Hz						
	Permissible AC voltage fluctuation	170 to 264V 50Hz/60Hz						
	Permissible frequency fluctuation	Within ±5%						
	Power supply system capacity (kVA) (*5)	0.4	0.7	1.2	2.1	4.0	5.5	9
Protective structure (JEM 1030)		Open type (IP00)						
Cooling system		Self-cooling			Forced air cooling			
Approx. weight (kg)		0.5	0.5	0.7	0.9	1.4	1.4	2.1

- \*1. The applicable motor capacity indicated is the maximum applicable capacity when a Mitsubishi 4-pole standard motor is used.
- \*2. The rated output capacity indicated assumes that the output voltage is 230V.
- \*3. The % value of the overload capacity indicates 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 PWM pulse voltage value of the inverter output side voltage remains unchanged at about  $\sqrt{2}$  that of the power supply.
- \*5. The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables).

## 7.2 Common Specifications

Control specifications	Control system		High carrier frequency PWM control selectable, V/F control	
	Output frequency range		0.5 to 120Hz (starting frequency variable between 0 and 60Hz)	
	Frequency setting resolution		0.1Hz (less than 100Hz), 1Hz (100Hz or higher)	
	Frequency accuracy		Within $\pm 0.5\%$ of set output frequency	
	Acceleration/ deceleration time setting		0, 0.1 to 999s (may be set individually for acceleration and deceleration)	
	Braking torque	Regenerative (*2)	0.1K, 0.2K ... 150%, 0.4K, 0.75K ... 100%, 1.5K ... 50%, 2.2K, 3.7 ... 20%	
		DC braking	Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 15%)	
	Input signals	Frequency setting		Set using CC-Link, sequence ladder or RS-485 communication
		Start signal	STF, STR	Forward rotation and reverse rotation can be input individually.
		Alarm reset		Used to reset alarm output provided when protective function is activated
Multi-speed selection		Up to three speeds can be selected. (Each speed can be set between 0 and 120Hz.)		
Output stop		Instantaneous shut-off of inverter output		
Sequence start		Execution/stop (RUN/STOP) of built-in PLC function		
Output signals	Running status		Three open collector outputs can be selected from among inverter running, overload warning and alarm.	
Protective/alarm functions			Overcurrent shut-off (during acceleration, deceleration, constant speed), regenerative overvoltage shut-off (during acceleration, deceleration, constant speed), overload shut-off (electronic thermal), heatsink overheat, fan failure (*3), stall prevention, start-time output side earth (ground) fault protection (*5), external thermal relay (*4), PU disconnection (*3), CPU error, undervoltage (*1), parameter error, PU stop	
Environment	Ambient temperature		-10°C to +50°C (non-freezing)	
	Ambient humidity		90%RH or less (non-condensing)	
	Storage temperature		-20°C to +65°C	
	Ambience		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt, etc.)	
	Altitude, vibration		Maximum 1000m above sea level, 5.9m/s <sup>2</sup> or less (conforming to JIS C 0040)	

\*1. When undervoltage occurs, no alarm output is provided but the output is shut off. After power restoration, the inverter may be run as it is. Depending on the running status (e.g. load magnitude), however, overcurrent, regenerative overvoltage or other protection may be activated at power restoration. (in external operation mode)

\*2. 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.

\*3. Compatible with only the product having the built-in cooling fan.

\*4. Activated only when external thermal relay input (OH) is selected in any of Pr. 60 to Pr. 63, Pr. 65 and Pr. 505 (input terminal function selection).

\*5. Activated only when "1" is set in Pr.40 "start-time earth(ground) fault detection selection".

## 7.3 PLC Function Specifications

The following table indicates the program capacity and devices of the PLC function.

		C500 Sequence Section		
Control method		Repeated operation (by stored program)		
I/O control method		Refresh		
Programming language		Relay symbolic language (ladder mode) Logic symbolic language (list mode)		
Number of instruction	PLC instructions	23		
	Basic, application instructions	28		
Processing speed		LD X:13μs, MOV:24μs(*2)		
Number of I/O points		96 (X: 48 points, Y: 48 points) (8 points installed, X: 6 points, Y: 2 points) (*1)		
Watchdog timer		10 to 2000(ms)		
Memory capacity		6k bytes used by sequence and parameters.		
Program capacity		1k step		
Devices	Internal relay (M)	64(M0 to M63)		
	Latch relay (L)	None (Can be set with parameters but will not latch)		
	Step relay (S)	None (Can be set with parameters but will operate as M)		
	Link relay (B)	None		
	Timer (T)	Points	8	
		Specifications	100ms timer: Set time 0.1 to 3276.7s (T0 to 7)	
			10ms timer: Set time 0.01 to 327.67s 100ms retentive timer: Set time 0.1 to 3276.7s	
	Counter (C)	Points	8	
		Specifications	Normal counter: Setting range 1 to 32767 (C0 to 7) Interrupt program counter: None	
	Data device (D)	120(D0 to D119)		
	Link register (W)	None		
	Annunciator (F)	None		
	File register (R)	None		
	Accumulator (A)	None		
	Index register (Z, V)	None		
Pointer (P)	None			
Interrupt pointer (I)	None			
Special relay (M)	256 (M9000 to 9255) with function limit			
Special register (D)	256 (D9000 to 9255) with function limit			

\*1 These signals use the same terminals as used by the input and output signals given in the common specifications of the inverter.

The points other than the six X points and two Y points installed can be used as internal memory. (X as contact only)

One point is always necessary for a sequence start (RUN/STOP).

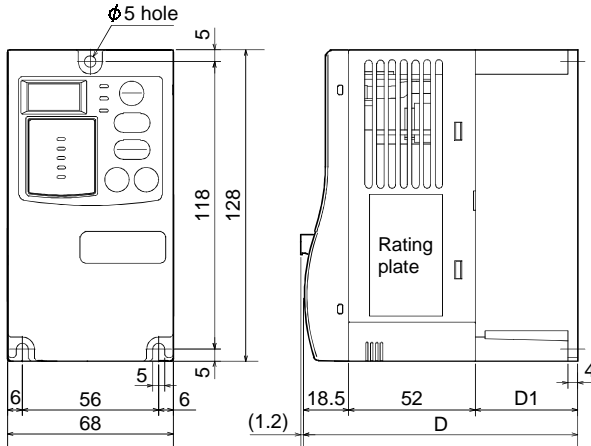
\*2 As inverter control is also performed actually, the scan time is approximately 40ms at 500 steps.

## 7.4 CC-Link Interface Specifications

Form	Terminal block connection system (can be removed/reinstalled from inverter front panel)
Power supply	5VDC supplied from inverter
Number of connected inverters	Maximum 42 (1 station occupied by 1 inverter), can be shared among C500 and other models
Connected terminal block	Six-terminal block (M3 × 6 screws)
Wire size	0.75 to 2mm <sup>2</sup>
Station type	Remote device station
Number of occupied stations	One inverter occupies one station.
Connection cable	CC-Link dedicated cable, CC-Link Ver. 1.10 compatible CC-Link dedicated cable

## 7.5 Outline Drawings

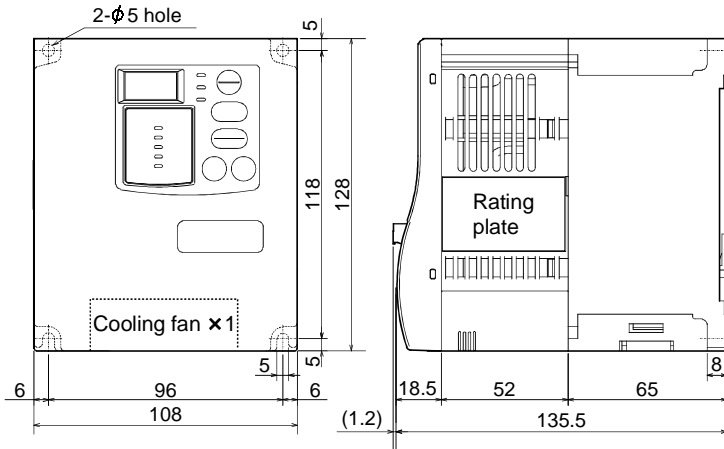
● FR-C520-0.1K,0.2K,0.4K,0.75K



Capacity	D	D1
0.1K,0.2K	80.5	10
0.4K	112.5	42
0.75K	132.5	62

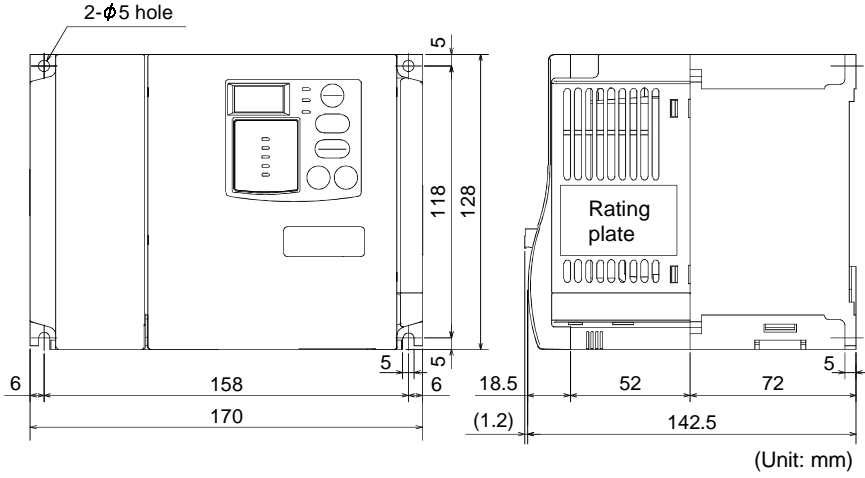
(Unit: mm)

● FR-C520-1.5K,2.2K



(Unit: mm)

● FR-C520-3.7K



# APPENDICES

<b>Appendix 1</b>	<b>Parameter Data Codes for Computer Link Operation Using RS-485 Communication..</b>	<b>184</b>
<b>Appendix 2</b>	<b>Instructions for Compliance with the European Standards .....</b>	<b>187</b>
<b>Appendix 3</b>	<b>Instructions for compliance with U.S. and Canadian Electrical Codes .....</b>	<b>189</b>



## Appendix 1 Parameter Data Codes for Computer Link Operation Using RS-485 Communication

Use the following parameter data codes for computer link operation performed using RS-485 communication.

Refer to page 129 for the data codes (data registers) used for the PLC function and CC-Link communication.

Function	Parameter	Name	Data Codes		Computer Link Data Setting Increments *	Link Parameter Extension Setting (Instruction Data Code 7F/FF)
			Read	Write		
Basic functions	0	Torque boost	00	80	0.1%	0
	1	Maximum frequency	01	81	0.01Hz	0
	2	Minimum frequency	02	82	0.01Hz	0
	3	Base frequency	03	83	0.01Hz	0
	4	Multi-speed setting (high speed)	04	84	0.01Hz	0
	5	Multi-speed setting (middle speed)	05	85	0.01Hz	0
	6	Multi-speed setting (low speed)	06	86	0.01Hz	0
	7	Acceleration time	07	87	0.1s	0
	8	Deceleration time	08	88	0.1s	0
	9	Electronic thermal O/L relay	09	89	0.01A	0
Standard operation functions	10	DC injection brake operation frequency	0A	8A	0.01Hz	0
	11	DC injection brake operation time	0B	8B	0.1s	0
	12	DC injection brake voltage	0C	8C	0.1%	0
	13	Starting frequency	0D	8D	0.01Hz	0
	17	RUN key rotation direction selection	11	91	1	0
	21	Stall prevention function selection	15	95	1	0
	22	Stall prevention operation level	16	96	0.1%	0
	40	Start-time ground fault detection selection	28	A8	1	0
Display function	52	Operation panel display data selection	34	B4	1	0

Function	Parameter	Name	Data Codes		Computer Link Data Setting Increments *	Link Parameter Extension Setting (Instruction Data Code 7F/FF)
			Read	Write		
Terminal function selection	60	RL terminal function selection	3C	BC	1	0
	61	RM terminal function selection	3D	BD	1	0
	62	RH terminal function selection	3E	BE	1	0
	63	STR terminal function selection	3F	BF	1	0
	64	RUN terminal function selection	40	C0	1	0
	65	STF terminal function selection	41	C1	1	0
Operation selection functions	71	Applied motor	47	C7	1	0
	72	PWM frequency selection	48	C8	1	0
	75	Reset selection/ PU stop selection	4B	CB	1	0
	76	Cooling fan operation selection	4C	CC	1	0
	77	Parameter write disable selection	4D	None	1	0
	79	Operation mode selection	4F	None	1	0
Parameter clear	-	Parameter clear	-	FC	1	-
	-	Alarm history clear	-	F4	1	-
Communication parameters	145	PU display language selection	2D	AD	1	1
	331	Communication station number	1F	9F	1	3
	332	Communication speed	20	A0	1	3
	333	Stop bit length	21	A1	1	3
	334	Parity check presence/ absence	22	A2	1	3
	335	Communication retry count	23	A3	1	3
	336	Communication check time interval	24	A4	0.1s	3
	337	Wait time setting	25	A5	1	3
	338	Operation command source	26	A6	1	3
	339	Speed command source	27	A7	1	3
	340	link start up mode selection	28	A8	1	3
	341	CR/LF selection	29	A9	1	3

Function	Parameter	Name	Data Codes		Computer Link Data Setting Increments *	Link Parameter Extension Setting (Instruction Data Code 7F/FF)
			Read	Write		
Communication parameters	342	E <sup>2</sup> PROM write selection	2A	AA	1	3
	503	CC-Link station number setting	03	83	1	5
	504	CC-Link baudrate setting	04	84	1	5
	505	SQ terminal function selection	05	85	1	5
	506	ALM terminal function selection	06	86	1	5
	507	Inverter operation lock mode setting	07	87	1	5
	510 to 529	User parameters	0A to 1D	8A to 9D	1	5
	530	Forced I/O selection	1E	9E	1	5
	531	Forced I/O setting L	1F	9F	1	5
	532	Forced I/O setting H	20	A0	1	5
	533	Internal address	21	A1	1	5
	990	PU buzzer control	5A	DA	1	9
	991	PU contrast adjustment	5B	DB	1	9
	992	PU main display screen data selection	5C	DC	1	9
993	PU disconnection detection/ PU setting lock	5D	DD	1	9	

\* Note that though the setting increments for parameter setting using RS-485 communication are as indicated in the table, valid setting increments are those indicated in the parameter list (page 50).

## Appendix 2 Instructions for Compliance with the European Standards

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

### (1) EMC Directive

#### 1) Our view of transistorized inverters for the EMC Directive

A transistorized inverter is a component designed for installation in a control box and for use with the other equipment to control the equipment/device. Therefore, we understand that the EMC Directive does not apply directly to transistorized inverters. For this reason, we do not place the CE mark on the transistorized inverters. (The CE mark is placed on inverters in accordance with the Low Voltage Directive.) The European power drive manufacturers' organization (CEMEP) also holds this point of view.

#### 2) Compliance

We understand that the transistorized inverters are not covered directly by the EMC Directive. However, the EMC Directive applies to machines/equipment into which transistorized inverters have been incorporated, and these machines and equipment must carry the CE marks. Hence, we prepared the European Standard-compliant noise filters and 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.

When the inverter is connected to a programmable controller (PLC), the countermeasures taken on the PLC side will be helpful. (Refer to the PLC manual.)

#### 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 conform to: EN50178).

### 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.)
- \* Use the cable sizes on pages 6 under the following conditions.
  - Ambient Temperature: 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.
- \* Use the breaker of type B (breaker which can detect both AC and DC). If not, provide double or enhanced insulation between the inverter and other equipment, or put a transformer between the main power supply and inverter.
- \* Use the inverter under the conditions of overvoltage category II and contamination level 2 or higher specified in IEC664.
- \* On the input and output of the inverter, use cables of the type and size set forth in EN60204 Appendix C.
- \* The terminals indicated as the control circuit input and output terminals on page 8 are separated 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
Muximum Altitude	1000m	1000m	10000m

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

## Appendix 3 Instructions for compliance with U.S. and Canadian Electrical Codes

(Standard to comply with :UL 508 C)



### 1. General Precaution

The bus capacitor discharge time is 10 minutes. Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage between terminal P (+) and N (-) with a meter etc., to avoid hazard of electrical shock.

### 2. Environment

Before installation, check that the environment meets following specifications.

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	Below 1000m, 5.9m/s <sup>2</sup> or less	

### 3. Installation

The below types of inverter have been approved as products for use in enclosure and approval tests were conducted under the following conditions.

Design the enclosure so that the ambient temperature, humidity and ambience of the inverter will satisfy the above specifications.

#### 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.

### 4. Short circuit ratings

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

## 5. Wiring of the power supply and motor

For wiring the input (R, S, T) and output (U, V, W) terminals of the inverter, use the UL-listed copper wires (rated at 75°C) and round crimping terminals. Crimp the crimping terminals with the crimping tool recommended by the terminal maker.

## 6. Motor overload protection

These inverters provide solid state motor overload protection.

Set parameter 9 using the following instructions,

(Pr. 9 "electronic thermal O/L relay").

### <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 using a Mitsubishi constant-torque motor, first set "1" in Pr. 71 to choose the 100% continuous torque characteristic in the low-speed range. Then, set the rated motor current in Pr. 9.

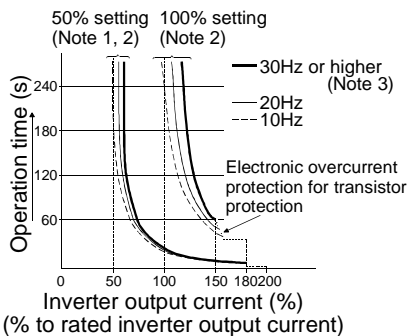
### CAUTION

- 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.
- 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 cause, use an external thermal relay.

- A special motor cannot be protected by the electronic overcurrent protection. Use an external thermal relay.

### 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.

# REVISIONS

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

Print Date	*Manual Number	Revision
Aug., 2002	IB(NA)-0600114E-A	First edition



## For Maximum Safety

- Mitsubishi transistorized inverters are not designed or manufactured to be used in equipment or systems in situations that can affect or endanger human life.
- When considering this product for operation in special applications such as machinery or systems used in passenger transportation, medical, aerospace, atomic power, electric power, or submarine repeating applications, please contact your nearest Mitsubishi sales representative.
- Although this product was manufactured under conditions of strict quality control, you are strongly advised to install safety devices to prevent serious accidents when it is used in facilities where breakdowns of the product are likely to cause a serious accident.
- Please do not use this product for loads other than three-phase induction motors.