

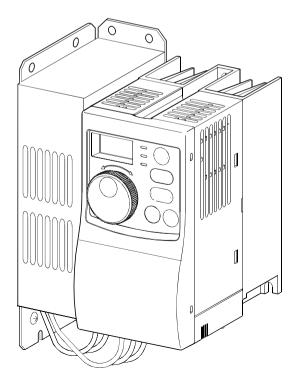
## TRANSISTORIZED INVERTER

FR-F500J

**INSTRUCTION MANUAL (Detailed)** 

**AIR-CONDITIONING INVERTER** 

FR-F520J-0.4K to 15K (F) FR-F540J-0.4K to 15K (F)



WIRING Chapter 1

FUNCTIONS Chapter 2

PROTECTIVE FUNCTIONS Chapter 3

SPECIFICATIONS Chapter 4

Thank you for choosing this Mitsubishi Transistorized inverter.

This instruction manual (detailed) provides instructions for advanced use of the FR-F500J series inverters.

Incorrect handling might cause an unexpected fault. Before using the inverter, always read this instruction manual and the instruction manual (basic) [IB-0600129E] packed with the product carefully to use the equipment to its optimum.

## 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 (basic) 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 (detailed), the safety instruction levels are classified into "WARNING" and "CAUTION".

**MARNING** 

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

**⚠** CAUTION

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

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

#### 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. Also, the inverter's ability to withstand earthquakes will deteriorate.
- Even if power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, switch power off, wait for more than at least 10 minutes and check for the presence of any residual voltages with a meter etc.
- This inverter must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical codes. (JIS, NEC section 250, IEC 536 class 1 and other applicable standards)
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.
- Perform setting dial and key operations with dry hands to prevent an electric shock.
   You may get an electric shock.
- •Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise you may get an electric shock.
- •Do not change the cooling fan while power is on. It is dangerous to change the cooling fan while power is on.

#### 2. Fire Prevention

## **↑** CAUTION

- Mount the inverter (filter pack) to 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

## **ACAUTION**

- •Apply only the voltage specified in the instruction manual to each terminal to prevent damage, etc.
- •Always connect to the correct terminal to prevent damage, etc.
- •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 break register 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 (filter pack) is damaged or has parts missing.
- When carrying the inverter, do not hold it by the front cover or setting dial; it may fall off or fail.
- •Do not stand or rest heavy objects on the inverter.
- Check the inverter mounting orientation is correct.
- Prevent screws, wire fragments, other conductive bodies, oil or other flammable substances from entering the inverter (filter pack).
- •As the inverter (filter pack) is a precision instrument, do not drop or subject it to impact.
- Use the inverter under the following environmental conditions: This could cause the inverter (filter pack) damage.

Environment	Ambient Temperature	-10°C to +50°C (non-freezing)	
	numuity	90%RH maximum (non-condensing)	
	temperature	-20°C to +65°C *1	
		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> or less *2 (conforming to JIS C 0040)	

- \*1 Temperatures applicable for a short time, e.g. in transit.
- \*2 When using with the filter pack installed on the rear panel of the FR-F520J-15K or FR-F540J-15K, do not install this combination on moving objects or places that have vibrations exceeding 1.96m/s<sup>2</sup>.

## **ACAUTION**

- Do not fit capacitive equipment such as power factor correction capacitor, radio noise filter (option FR-BIF) 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

## **ACAUTION**

- •Check all parameters, and ensure that the machine will not be damaged by a sudden start-up.
- ●When the load GD² is small (at the motor GD or smaller) for 400V from 1.5K to 3.7K, the output current may vary when the output frequency is in the 20Hz to 30Hz range. If this is a problem, set the Pr.72 "PWM frequency selection" to 6kHz or higher. (When setting the PWM to a higher frequency, check for noise or leakage current problem and take countermeasures against it.)

#### (4) Operation

## **WARNING**

- •When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.
- The [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.

## **ACAUTION**

- 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 a 400V class motor is inverter-driven, it should be insulation-enhanced or surge voltages suppressed. Surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- •When parameter clear or all clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation.
- The inverter can be easily set for high-speed operation. Before changing its setting, fully examine the performances of the motor and machine.
- ●In addition to the inverter's holding function, install a holding device to ensure safety.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation.

#### (5) Emergency stop

## **ACAUTION**

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

#### (6) Maintenance, inspection and parts replacement

## **ACAUTION**

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

#### (7) Disposing of the inverter

## **ACAUTION**

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 run the inverter in this status. Always replace the cover and follow this instruction manual when operating the inverter.

## **CONTENTS**

1.1 S	pecifications of wiring and terminals	2
1.1.1	Terminal connection diagram	2
1.1.2	Explanation of main circuit terminals	3
1.2 N	lain circuit terminals	7
1.2.1	Layout and wiring of main circuit terminals	7
1.2.2	Cables, wiring length, and crimping terminals	
1.2.3	Wiring instructions	
1.2.4	Selection of peripheral devices	
1.2.5	Leakage current and installation of earth leakage circuit breaker	. 11
1.2.6	Power-off and magnetic contactor (MC)	. 15
1.2.7	Regarding the installation of the power factor improving reactor	
1.2.8	Regarding noise and the installation of a noise filter	
1.2.9	Earthing (Grounding) precautions	
	Regarding Japanese power harmonics	
1.2.11	Japanese power harmonic suppression guideline	
	Inverter-driven 400V class motor	
1.3 H	ow to use the control circuit terminals	24
1.3.1	Terminal block layout	
1.3.2	Wiring instructions	
1.3.3	Changing the control logic	
1.4 Ir	put terminals	27
1.4.1	Run (start) and stop (STF, STR, STOP)	. 27
1.4.2	Connection of frequency setting potentiometer and	
	output frequency meter (10, 2, 5, 4, AU)	
1.4.3	External frequency selection (REX, RH, RM, RL)	
1.4.4	Indicator connection and adjustment (FM)	
1.4.5	Control circuit common terminals (SD, 5, SE)	
1.4.6	Signal inputs by contactless switches	. 35
	ow to use the input signals (assigned terminals AU, RM, RH,	
S	TR)	36
1.5.1	Multi-speed setting (RL, RM, RH, REX signals):	
	Pr. 60 to Pr. 63 setting "0, 1, 2, 8"	
	Remote setting (RL, RM, RH signals):	
150	Pr. 60 to Pr. 63 setting "0, 1, 2"	
1.5.2	Second function selection (RT signal): Pr. 60 to Pr. 63 setting "3"	
1.5.3 1.5.4	Current input selection "AU signal": Pr. 60 to Pr. 63 setting "4"	
1.5.4	Output shut-off (MRS signal): Pr. 60 to Pr. 63 setting '5'	
1.5.6	External thermal relay input: Pr. 60 to Pr. 63 setting "7"	
1.0.0	1	. 50

•	5.7 Jog operation (JOG signal): Pr. 60 to Pr. 63 setting "9"	38
•	5.8 Reset signal: Pr. 60 to Pr. 63 setting "10"	
	5.9 PID control valid terminal: Pr. 60 to Pr. 63 setting "14"	
•	5.10 PU operation/external operation switching: Pr. 60 to Pr. 63 setting "16"	40
1.6	Connection to the Stand-Alone Option	41
•	5.1 Connection of the brake unit (FR-BU)	41
•	Connection of the brake unit (BU type)	
•	Connection of the high power factor converter (FR-HC)	
•	6.4 Connection of the power regeneration common converter (FR-CV)	
1.7	Handling of the RS-485 connector	45
•	'.1 Connection of the parameter unit (FR-PU04)	45
•	7.2 Wiring of RS-485 communication	45
1.8	Design information	49
2 F	NCTIONS	51
<b>4.</b> 1	10110110	
2.′	Function (Parameter) list	52
2.2	List of parameters classified by purpose of use	64
2.3	Explanation of functions (parameters)	66
2	3.1 Torque boost (Pr. 0 , Pr. 46 )	
2	3.2 Maximum and minimum frequency (Pr. 1 , Pr. 2 )	
2	Base frequency, base frequency voltage (Pr.3, Pr.19, Pr.47)	68
2	8.4 Multi-speed operation (Pr. 4, Pr. 5, Pr. 6, Pr. 24 to Pr. 27, Pr. 80 to Pr. 87	•
	3.5 Acceleration/deceleration time (Pr. 7, Pr. 8, Pr. 20, Pr. 44, Pr. 45)	
	8.6 Electronic overcurrent protection (Pr. 9)	
	3.7 DC injection brake (Pr. 10 , Pr. 11 , Pr. 12 )	
	3.8 Starting frequency (Pr. 13)	
	8.9 Load pattern selection (Pr. 14)	
	3.11 RUN key rotation direction selection (Pr.17)	
	3.12 Stall prevention function and current limit function (Pr. 21)	
	3.13 Stall prevention (Pr. 22 , Pr. 23 , Pr. 28 )	
	3.14 Acceleration/deceleration pattern (Pr. 29)	
	3.15 Extended function display selection (Pr. 30)	
	3.16 Frequency jump (Pr. 31 to Pr. 36)	
	3.17 Speed display (Pr. 37 )	83
2	3.18 Biases and gains of the frequency setting voltage	QΛ
•	(current) (Pr. 38, Pr. 39, C2 to C7)	
2.4	Output terminal function parameters	
	1.1 Up-to-frequency sensitivity (Pr. 41)	
	2 Output frequency detection (Pr. 42 Pr. 43)	

2.5	Current detection function parameters	90
2.5.	Output current detection functions (Pr. 48 , Pr. 49 )	90
2.5.2	Zero current detection (Pr. 50 , Pr. 51 )	91
2.6	Display function parameters	92
2.6.	1 Monitor display (Pr. 52 , Pr. 54 )	92
2.6.2	2 Setting dial function selection (Pr. 53)	93
2.6.3	Monitoring reference (Pr. 55, Pr. 56)	94
2.7	Restart operation parameters	94
2.7.	1 Restart setting (Pr. 57 , Pr. 58 )	94
2.8	Additional function parameters	96
2.8.	1 Remote setting function selection (Pr. 59)	96
2.9	Terminal function selection parameters	99
2.9.	1 Input terminal function selection (Pr. 60 , Pr. 61 , Pr. 62 , Pr. 63 )	99
2.9.2	Output terminal function selection (Pr. 64 , Pr. 65 )	101
2.10	Operation selection function parameters	102
2.10	0.1 Retry function (Pr. 66 , Pr. 67 , Pr. 68 , Pr. 69 )	102
2.10	0.2 PWM carrier frequency (Pr. 70, Pr. 72)	103
2.10	0.3 Applied motor (Pr. 71)	105
	0.4 Voltage input selection (Pr. 73)	
	0.5 Input filter time constant (Pr. 74)	
	0.6 Reset selection/PU stop selection (Pr. 75)	
	0.7 Cooling fan operation selection (Pr. 76 )	
	0.8 Parameter write disable selection (Pr. 77)	
	9.9 Reverse rotation prevention selection (Pr. 78)	
	0.10 Operation mode selection (Pr. 79 )	
	0.11PID control (Pr. 88 to Pr. 94)	
	Auxiliary function parameters	
	.1 Slip compensation (Pr. 95 , Pr. 96 , Pr. 97 )	
	.2 Automatic torque boost selection (Pr. 98)	
2.11	.3 Motor primary resistance (Pr. 99)	123
2.12	Maintenance function parameters	123
2.12	2.1 Maintenance output function (H1, H2)	123
2.13	Calibration parameters	124
2.13	3.1 Meter (frequency meter) calibration (C1)	124
2.14	Clear parameters	127
2.14	.1 Parameter clear (CLr )	127
	.2 Alarm history clear (ECL)	
2.15	Communication parameters	128
2.15	5.1 Communication settings (n1 to n7, n11)	130
	2 Operation and speed command source (n8 n9)	144

2.15.3	Link startup mode selection (n10)	145
2.15.4	E2PROM write selection (n12)	147
2.16 F	arameter unit (FR-PU04) setting	148
2.16.1	PU display language selection (n13)	148
	PU buzzer control (n14 )	
	PU contrast adjustment (n15)	
2.16.4	PU main display screen data selection (n16)	149
2.16.5	PU disconnection detection/PU setting lock selection (n17)	150
3. PROT	ECTIVE FUNCTIONS	151
3.1 E	rrors (Alarms)	152
3.1.1	Error (alarm) definitions	153
3.1.2	To know the operating status at the occurrence of alarm (Only w	
	is used)	
3.1.3	Correspondence between digital and actual characters	161
3.1.4	Resetting the inverter	161
3.2 T	roubleshooting	162
3.2.1	Motor remains stopped	162
3.2.2	Motor rotates in opposite direction	163
3.2.3	Speed greatly differs from the setting	
3.2.4	Acceleration/deceleration is not smooth	
3.2.5	Motor current is large	
3.2.6	Speed does not increase	
3.2.7	Speed varies during operation	
3.2.8	Operation mode is not changed properly	
3.2.9	Operation panel display is not operating	
3.2.10	•	
3.2.11	Motor produces annoying sound	164
4. SPEC	IFICATIONS	165
4.1 S	pecification list	166
4.1.1	Ratings	166
4.1.2	Common specifications	
4.2	Outline drawings	
APPEN	DIX	175
		_
APPEN	IDIX 1 PARAMETER DATA CODE LIST	176

# 1. WIRING

This chapter explains the basic "wiring" for use of this product. Always read the instructions before use.

For description of "installation", refer to the instruction manual (basic).

1.1	Specifications of wiring and terminals	2
1.2	Main circuit terminals	7
1.3	How to use the control circuit terminals	24
1.4	Input terminals	27
1.5	How to use the input signals (assigned terminals AU, RM, RH, STR)	36
1.6	Connection to the Stand-Alone Option	41
1.7	Handling of the RS-485 connector	45
1.8	Design information	49

#### <Abbreviations>

#### •PU

Operation panel and parameter unit (FR-PU04)

Inverter

Mitsubishi transistorized inverter FR-F500J series

•FR-F500J

Mitsubishi transistorized inverter FR-F500J series

•Pr.

Parameter number

Filter pack

FR-BFP

## Chapter 1

Chapter 2

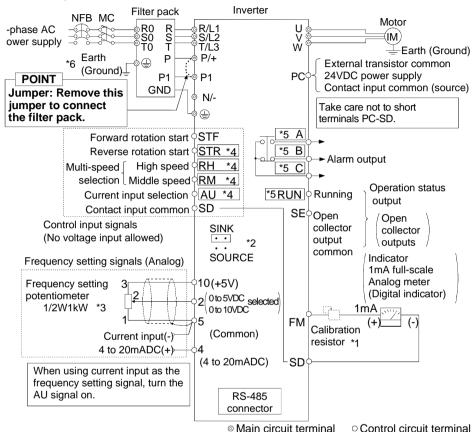
Chapter 3

Chapter 4

## 1.1 Specifications of wiring and terminals

## 1.1.1 Terminal connection diagram

With filter pack



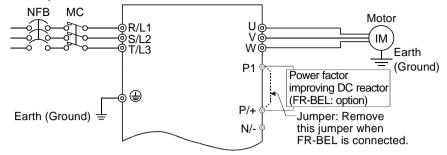
## REMARKS

- \*1. Not needed when the setting dial is used for calibration. Used when calibration must be made near the frequency meter for such a reason as a remote frequency meter. However, the frequency meter needle may not deflect to full-scale if the calibration resistor is connected. In this case, use this resistor and setting dial together.
- \*2. You can switch the position of sink and source logic. Refer to page 25.
- \*3. When the setting potentiometer is used frequently, use a 2W1kΩ potentiometer.
- \*4. The terminal functions change with input terminal function selection (Pr. 60 to Pr. 63). (Refer to page 99.) (RES, RL, RM, RH, RT, AU, STOP, MRS, OH, REX, JOG, X14, X16, (STR) signal selection)
- \*5. The terminal function changes with the setting of output terminal function selection (Pr. 64, Pr. 65). (Refer to page 101.) (RUN, SU, OL, FU, RY, Y12, Y13, FDN, FUP, RL, Y95, LF, ABC signal selection)
- \*6. Connect the GND cable of the filter pack to the earth (ground) terminal of the inverter. Use the earth (ground) terminal of the filter pack to earth (ground). For inverter earthing (grounding), earth (ground) the inverter through the filter pack.

#### CAUTION

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

Without filter pack



## 1.1.2 Explanation of main circuit terminals

## (1) Main circuit

#### Inverter

Terminal Symbol	Terminal Name	Description
		Connect the R, S, T cables of the filter pack to these terminals.
R/L1, S/L2, T/L3	3 AC power input	REMARKS For the inverter without filter pack, connect these to the commercial power supply.
U, V, W	Inverter output	Connect to a three-phase squirrel-cage motor.
N/-	N/-  DC voltage common terminal. This is not insulate the power and inverter output.	
	Filter pack connection	Remove the jumper across terminals P-P1 and connect the P and P1 cables of the filter pack.
P/+, P1		REMARKS  For the inverter without filter pack, remove the jumper across terminals P-P1 and connect the optional power factor improving DC reactor (FR-BEL).
	Earth (Ground)	For earthing (grounding) the inverter chassis.  Connect the GND cable of the filter pack.  REMARKS  Earth (Ground) the inverter without filter pack.

## ●Filter pack

Terminal Symbol	Terminal Name	Description
R0, S0, T0	Commercial power supply input	Connect to the commercial power supply.
Earth (Ground)		For earthing (grounding) the filter pack. Must be earthed (grounded).

Crimping Terminal Symbol	Terminal Name	Cable Color	Description
R, S, T	Inverter power supply	Black	Connect to the R, S, T of the inverter.
P, P1	DC reactor terminal	Red	Remove the jumper across terminals P-P1 and connect to the P and P1 terminals of the inverter.
GND	Inverter earth (ground) connection	Green and yellow stripes	Connect to the earth (ground) terminal of the inverter. (Refer to page 2.)

## (2) Control circuit

5	Symbol		Terminal Name	Definition		
		STF	Forward rotation start	Turn on the STF signal to start forward rotation and turn it off to stop.	signals are	usly, the stop
	ut	STR	Reverse rotation start	Turn on the STR signal to start reverse rotation and turn it off to stop.		
	Contact input	RH RM	Multi-speed selection	Turn on the RH and RM signappropriate combinations to multiple speeds. The priorities of the speed of are in order of jog, multi-speed (RH, RM, RL, REX) and AU	select commands eed setting	The terminal functions change with input terminal function selection (Pr. 60 to Pr. 63).
		AU	Current input selection	Only when the AU signal is t the inverter can be operated to 20mADC frequency settin Turning the AU signal on mal input (across terminals 2-5)	with the 4 g signal. kes voltage nvalid.	
Input signals		SD *1)	Contact input common (sink)	Common to the contact input terminals (STF, STR, RI AU) and terminal FM. (*7)		(STF, STR, RH, RM,
	24VDC power and external transistor PC common (*1) Contact input common (source)		24VDC power and external transistor common Contact input common (source)	When connecting the transistor output (open collector output), such as a programmable controller (PLC), connect the positive external power supply for transistor output to this terminal to prevent a malfunction caused by undesirable currents. This terminal can be used as a 24VDC, 0.1A power output across terminals PC-SD.  When source logic has been selected, this terminal serves as a contact input common.		
	10 Frequency setting power supply		Frequency setting power supply	5VDC, Permissible load cur	rent 10mA.	
	etting	2	Frequency setting (voltage)	By entering 0 to 5VDC (0 to 10VDC), the maximum out speed is reached at 5V (10V) and I/O are proportional. between 5V and 10V using Pr. 73 "0-5V, 0-10V selectio Input resistance 10kΩ. Maximum permissible input volta 20V		proportional. Switch 0-10V selection".
	Frequency setting	4	Frequency setting (current)	Input 4 to 20mADC. It is fac $60$ Hz for $20$ mA. Maximum permissible input approximately $250\Omega$ . Turn ON signal AU for curre Turning the AU signal on make Pr. $60$ to Pr. $63$ (input terminal signal.	current 30r ent input. es voltage in	nA. Input resistance put invalid. Use any of
	5 Frequency setting input common			Frequency setting signal (te (*7)	rminal 2, 4)	common terminal.

Symbol		bol	Terminal Name	Definition		
		A B C	Alarm output	1 contact output which indicates that the protective function of the inverter is activated to stop output. 230VAC 0.3A, 30VDC 0.3A. Alarm: discontinuity across B-C (continuity across A-C), Normal: continuity across B-C (discontinuity across A-C).(*6)	Output terminal function selection (Pr.64, Pr.65)	
Output signals	Open collector	RUN	Inverter running	Switched low when the inverter output frequency is equal to or higher than the starting frequency (factory set to 0.5Hz variable). Switched high during stop or DC injection brake operation. (*2) Permissible load 24VDC 0.1A	changes the terminal functions. (*5)	
0	,	SE	Open collector common	Common terminal for inverter running terminal RUN. (*7)		
	Indicator	FM	For meter	The output signal across terminals FM-SD 1mA at 60Hz and is proportional to the co frequency. Since output voltage is pulse sl can be connected.  Frequency permissible load current 1m Pulse specification 1440 pulses/s at 60	rresponding output hape, a digital meter A	
Communication	_		RS-485 connector (*3)	Using the parameter unit connection ca 205), the parameter unit (FR-PU04) car Communication operation can be perfo	n be connected.	

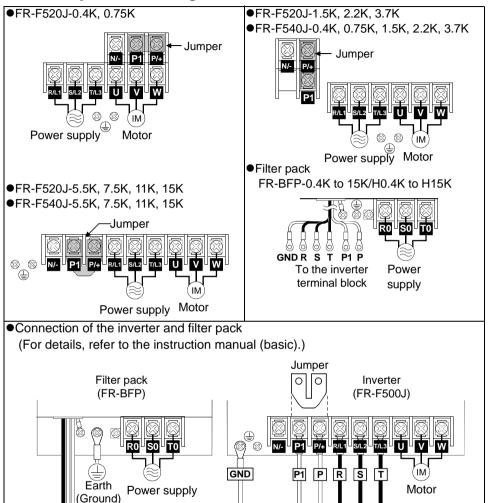
- \*1. Do not connect terminals SD and PC each other or to the ground.

  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 25 for switching method.)
- \*2. Low indicates that the open collector output transistor is on (conducts). High indicates that the transistor is off (does not conduct).
- \*3. For details of RS-485 communication, refer to the separately available instruction manual (detailed).
- \*4. RL, RM, RH, RT, AU, STOP, MRS, OH, REX, JOG, RES, X14, X16, (STR) signal selection
- \*5. RUN, SU, OL, FU, RY, Y12, Y13, FDN, FUP, RL, Y95, LF, ABC signal selection
- \*6. To be compatible with the European Directive (Low Voltage Directive), the operating capacity of relay outputs (A, B, C) should be 30VDC 0.3A.
- \*7. Terminals SD, SE and 5 are isolated from each other. Do not earth (ground). Avoid connecting the terminal SD and 5 and the terminal SE and 5.

## 1.2 Main circuit terminals

## 1.2.1 Layout and wiring of main circuit terminals



#### CAUTION

- •Make sure the power cables are connected to the R0, S0, T0 of the filter pack (FR-BFP) (If using the inverter without filter pack, connect to the R, S, T of the inverter). Never connect the power cable to the U, V, W of the inverter. Doing so will damage the inverter. (Phase need not be matched)
- •Connect the motor to U, V, W. At this time, turning on the forward rotation switch (signal) rotates the motor in the counterclockwise direction when viewed from the motor shaft.
- When connecting the filter pack, make sure the jumper across the terminals P1-P of the inverter is removed.

## 1.2.2 Cables, wiring length, and crimping terminals

The following table indicates a selection example for the wiring length of 20m. <200V class>

Applicable	Termi- nal	Tight- ening	Crimping Terminal			Ca		PVC Insulation Cable		
Inverter	Screw	Torque	ien	ierminai		mm <sup>2</sup>		VG	mm <sup>2</sup>	
	size	N⋅m	R, S, T	U, V, W	R, S, T	U, V, W	R, S, T	U, V, W	R, S, T	U, V, W
FR-F520J-0.4K to 0.75K	M3.5	1.2	2-3.5	2-3.5	2	2	14	14	2.5	2.5
FR-F520J- 1.5K, 2.2K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-F520J-3.7K	M4	1.5	5.5-4	5.5-4	3.5	3.5	12	12	4	2.5
FR-F520J-5.5K	M5	2.5	5.5-5	5.5-5	5.5	5.5	10	10	6	6
FR-F520J-7.5K	M5	2.5	14-5	8-5	14	8	6	8	16	10
FR-F520J-11K	M5	2.5	14-5	14-5	14	14	6	6	16	16
FR-F520J-15K	M6	4.4	22-6	22-6	22	22	4	4	25	25

#### <400V class>

Applicable Inverter	Termi- nal	Tight- ening	Crimping Terminal			Cal	PVC Insulation Cable			
	Screw	Torque			mm <sup>2</sup>		AWG		mm <sup>2</sup>	
	size	N⋅m	R, S, T	U, V, W	R, S, T	U, V, W	R, S, T	U, V, W	R, S, T	U, V, W
FR-F540J-0.4K to 3.7K	M4	1.5	2-4	2-4	2	2	14	14	2.5	2.5
FR-F540J-5.5K	M4	1.5	5.5-4	2-4	3.5	2	12	14	4	2.5
FR-F540J-7.5K	M4	1.5	5.5-4	5.5-4	3.5	3.5	12	12	4	4
FR-F540J-11K	M4	1.5	5.5-4	5.5-4	5.5	5.5	10	10	6	6
FR-F540J-15K	M6	4.4	14-6	8-6	14	8	6	8	16	10

<sup>\*</sup>The terminal screw size of the filter pack (FR-BFP) is the same as that of the inverter. Wiring length

- FR-F540J-0.4K ......50m or less
- FR-F520J-0.4K to 3.7K
  - FR-F540J-0.75K to 3.7K ...... 100m or less
- FR-F520J-5.5K to 15K
  - FR-F540J-5.5K to 15K .....500m or less

#### CAUTION

- •If the wiring length of the FR-F540J-0.4K or 0.75K is 30m or more, use the carrier frequency of 1kHz.
- •When automatic torque boost is selected in Pr. 98 "automatic torque boost selection (motor capacity)", the wiring length must be 30m maximum. (Refer to page 122.)
- •If the wiring distance between the inverter and motor is long, the motor torque will decrease due to the voltage drop of the main circuit cable (especially at low-frequency output).

Use thick cables so that a voltage drop is 2% or less.

## 1.2.3 Wiring instructions

- 1) Use insulation-sleeved crimping terminals for the power supply and motor cables.
- 2) Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.
- After wiring, wire off-cuts must not be left in the inverter (filter pack).
   Wire off-cuts can cause an alarm, failure or malfunction. Always keep the inverter clean.
  - When drilling a control box etc., take care not to let wire off-cuts enter the inverter.
- 4) Use cables of the recommended size to make a voltage drop 2% maximum. If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low frequency.
- 5) For long distance wiring, the fast-response current limit function may be reduced or the devices connected to the secondary side may malfunction or become faulty under the influence of a charging current due to the stray capacity of wiring. Therefore, note the maximum overall wiring length.
- 6) Electromagnetic wave interference The input/output (main circuit) of the inverter includes harmonic components, which may interfere with the communication devices (such as AM radios) used near the inverter. When using the inverter without the filter pack, install a FR-BIF optional radio noise filter (for use on the input side only) or FR-BSF01 or FR-BLF line noise filter to minimize interference.
- 7) Do not install a power capacitor, surge suppressor or radio noise filter (FR-BIF option) in the output side of the inverter. This will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices are connected, remove them.
- 8) Before starting wiring and other work after the inverter is operated, switch power off, wait for more than at least 10 minutes and check for presence of any residual voltage with a meter, etc. The capacitor is charged with high voltage for some time after power off and it is dangerous.

## 1.2.4 Selection of peripheral devices

Check the capacity of the motor applicable to the inverter you purchased. Appropriate peripheral devices must be selected according to the capacity.

Refer to the following list and prepare appropriate peripheral devices:

#### <200V class>

Motor Output	Inverter Type	No-fuse Brea Earth Leak Breaker (	age Circuit	Magnetic Contactor	Cable (mm <sup>2</sup> ) (*2)		
(kW)		With filter pack	Without filter pack	(MC)	R,S,T	U,V,W	
0.4	FR-F520J-0.4K	30AF/5A	30AF/5A	S-N10	2	2	
0.75	FR-F520J-0.75K	30AF/10A	30AF/10A	S-N10	2	2	
1.5	FR-F520J-1.5K	30AF/15A	30AF/15A	S-N10	2	2	
2.2	FR-F520J-2.2K	30AF/15A	30AF/20A	S-N10	2	2	
3.7	FR-F520J-3.7K	30AF/30A	30AF/30A	S-N20,S-N21	3.5	3.5	
5.5	FR-F520J-5.5K	50AF/40A	50AF/50A	S-N25	5.5	5.5	
7.5	FR-F520J-7.5K	50AF/50A	100AF/60A	S-N35	14	8	
11	FR-F520J-11K	100AF/75A	100AF/75A	S-N50	14	14	
15	FR-F520J-15K	100AF/100A	225AF/125A	S-N65	22	22	

#### <400V class>

Motor Output (kW)	Inverter Type	No-fuse Brea Earth Leak Breaker (	age Circuit	Magnetic Contactor	Cable (mm <sup>2</sup> ) (*2)		
		With filter pack		(MC)	R, S, T	U, V, W	
0.4	FR-F540J-0.4K	30AF/5A	30AF/5A	S-N10	2	2	
0.75	FR-F540J-0.75K	30AF/5A	30AF/5A	S-N10	2	2	
1.5	FR-F540J-1.5K	30AF/10A	30AF/10A	S-N10	2	2	
2.2	FR-F540J-2.2K	30AF/10A	30AF/15A	S-N10	2	2	
3.7	FR-F540J-3.7K	30AF/15A	30AF/20A	S-N20, S-N21	2	2	
5.5	FR-F540J-5.5K	30AF/20A	30AF/30A	S-N20, S-N21	3.5	2	
7.5	FR-F540J-7.5K	30AF/30A	30AF/30A	S-N20, S-N21	3.5	3.5	
11	FR-F540J-11K	50AF/40A	50AF/50A	S-N25	5.5	5.5	
15	FR-F540J-15K	50AF/50A	100AF/60A	S-N35	14	8	

<sup>\*1. •</sup>Select the NFB type according to the power supply capacity.

- •Install the NFB according to the inverter capacity.
- •When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage of the inner parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.
- •For installations in the United States or Canada, the circuit breaker must be inverse time or instantaneous trip type.
- \*2. The size of the cable indicated assumes the wiring length of 20m.

## 1.2.5 Leakage current and installation of earth 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 leakage relays unnecessarily.

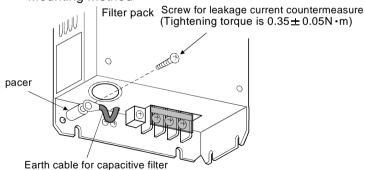
#### Countermeasures

- If the carrier frequency setting is high, decrease the carrier frequency (Pr. 72) of the inverter.
  - Note that motor noise increases. Selection of Soft-PWM control (Pr. 70) will make it unoffending. (Factory setting)
- By using earth leakage circuit breakers designed for harmonic and surge suppression in the inverter's own line and other line, operation can be performed with the carrier frequency kept high (with low noise).

#### **REMARKS**

When the filter pack is provided, leakage current can be reduced by removing the earth (ground) cable for the capacitive filter and securing it with the supplied screw for leakage current countermeasure and spacer. However, the noise reduction effect of the capacitive filter is lost. (Pull out the earth cable for the capacitive filter a little to wire.)

## <Mounting method>

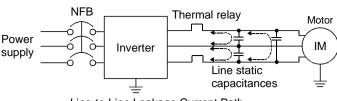


#### CAUTION .

If the earth cable for the capacitive filter is removed, it is charged while power is on or shortly after power off. Do not touch the earth cable as you may get an electric shock.

## (2) Line-to-line leakage currents

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



Line-to-Line Leakage Current Path

#### Countermeasures

- Use the electronic overcurrent protection of the inverter.
- Decrease the carrier frequency. Note that motor noise increases. Selection of Soft-PWM (Pr. 70) makes it unoffending.

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

Install a no-fuse breaker (NFB) on the power receiving side to protect the wiring of the inverter primary side. Select the NFB according to the power supply side power factor (which depends on the power supply voltage, output frequency and load). Especially for a completely electromagnetic NFB, one of a slightly large capacity must be selected since its operation characteristic varies with harmonic currents. (Check it in the data of the corresponding breaker.) As an earth (ground) leakage breaker, use the Mitsubishi earth (ground) leakage breaker designed for harmonics and surges. (Refer to page 10 for the recommended models.)

#### CAUTION .

- •Choose the NFB type according to the power supply capacity.
- •The inverter has a protective function based on electronic overcurrent protection to protect the motor from overheating. However, when running multiple motors with one inverter or operating a multi-pole motor, provide a thermal relay (OCR) between the inverter and motor. In this case, set the electronic overcurrent protection of the inverter to 0A. And for the setting of the thermal relay, add the line-to-line leakage current (refer to page 13) to 1.0 times the current value at 50Hz on the motor rating plate or to 1.1 times the current value at 60Hz.
- •When the FR-BFP (filter pack) is used, leakage current is 4mA.(8mA for 400V class.) (equivalent to one-phase of cable for the three-phase three wire  $\bot$  connection.)

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

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

 Breaker for harmonic and surge Rated sensitivity current: I∆n ≥ 10 x (Ig1+Ign+Ig2+Igm)

 Standard breaker Rated sensitivity current:

Idn  $\geq$  10 × {lg1+lgn+3 × (lg2+lgm)}

lg1, lg2 : Leakage currents of cable path during commercial

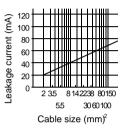
power supply operation

lgn : Leakage current of noise
filter on inverter input side

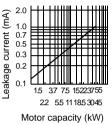
lgm : Leakage current of motor during commercial power

supply operation

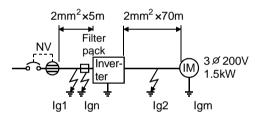
Example of leakage current per 1km in cable path during commercial power supply operation when the CV cable is routed in metal conduit (200V 60Hz)



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



<Example>



	Breaker for harmonic and surge	Standard breaker				
Leakage current (Ig1) (mA)	20 × 5n	= 0.10				
Leakage current (Ign) (mA)	0 (without filter pack)					
Leakage current (Ig2) (mA)	20 × 70i	<b>–</b> 1 40				
Motor leakage current (Igm) (mA)	0.	16				
Total leakage current (mA)	1.66	4.78				
Rated sensitivity current (mA) (≥ lg × 10)	30	100				

#### CAUTION

- •The earth leakage circuit breaker should be installed to the primary (power supply) side of the inverter.
- •In the  $\bot$  connection neutral point grounded system, the sensitivity current becomes worse for ground faults on the inverter secondary side. Hence, the protective grounding of the load equipment should be 10 $\Omega$  or less.
- •When the breaker is installed on the secondary side of the inverter, it may be unnecessarily operated by harmonics if the effective value is less than the rating. In this case, do not install the breaker since the eddy current 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 leakage relay (except NV-ZH), NV with 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

## 1.2.6 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 10 for selection.):

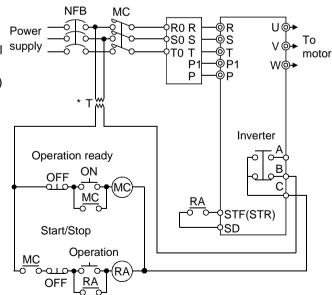
- 1) To release the inverter from the power supply when the inverter's protective function is activated or when the drive is not functioning (e.g. emergency stop operation).
- 2) To prevent an accident caused by an automatic restart made at power restoration after an inverter stop due to a power failure.
- 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.

#### **REMARKS**

The MC may be switched on/off to start/stop the inverter. However, since reapeated inrush currents at power-on will shorten the life of the converter circuit (switching life is about 100,000 times), frequent starts and stops must be avoided. Turn on/off the inverter start controlling terminals (STF, STR) to run/stop the inverter.

#### Inverter Start/Stop Circuit Example

As shown on the right, always use the start signal (ON or OFF across terminals STF or STR-SD) to make a start or stop. (Refer to page 27.)



#### REMARKS

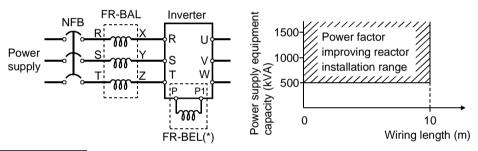
\*: For the 400V class power supply, install a voltage-reducing transformer.

## (2) Handling of secondary side magnetic contactor

In principle, do not provide a magnetic contactor between the inverter and motor and switch it from off to on during operation. If it is switched on during inverter operation, a large inrush current may flow, stopping the inverter due to overcurrent shut-off. When an MC is provided for switching to the commercial power supply, for example, switch it on/off after the inverter and motor have stopped.

## 1.2.7 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). Since the filter pack includes a power factor improving DC reactor, a reactor need not be installed separately.



#### **REMARKS**

\* When connecting the FR-BEL (filter pack), remove the jumper across terminals P-P1. The wiring length between the FR-BEL and the 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 8)

#### 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.

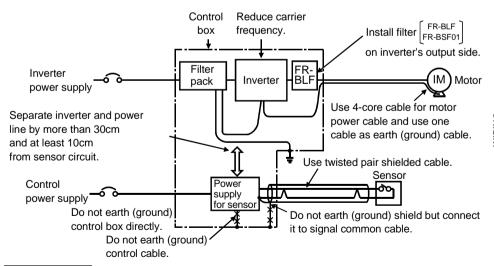
## 1.2.8 Regarding noise and the installation of a noise filter

Some noise enters the inverter causing it to malfunction and others are generated by the inverter causing the malfunction of peripheral devices. Though the inverter is designed to be insusceptible to noise, 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 and motor, through which leakage currents flow to cause the earth leakage circuit breaker, earth 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 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.

#### <Noise reduction examples>



#### **REMARKS**

For the inverter without filter pack, install a line noise filter (FR-BLF, FR-BSF01) or radio noise filter (FR-BIF) on the inverter input side as a noise reduction measure.

## 1.2.9 Earthing (Grounding) precautions

 Leakage currents flow in the inverter (filter pack). To prevent an electric shock, the inverter (filter pack) and motor must be earthed (grounded). Earthing (grounding) must conform to the requirements of national and local safety regulations and electrical codes.

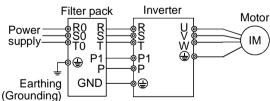
(JIS, NEC section 250, IEC 536 class 1 and other applicable standards)

- Use the dedicated earth (ground) terminal to earth (ground) the inverter (filter pack).
   (Do not use the screw in the casing, chassis, etc.)
   Use a tinned\* crimping terminal to connect the earth (ground) cable. When tightening the screw, be careful not to break 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 in the following table, and minimize the cable length.
  The earthing (grounding) point should be as near as possible to the inverter.

Motor Capacity	Earth (Ground) Cable Size (Unit: mm <sup>2</sup> )						
wotor Capacity	200V class	400V class					
2.2kW or less	2 (2.5)	2 (2.5)					
3.7kW	3.5 (4)	2 (4)					
5.5kW	5.5 (6)	3.5 (4)					
7.5kW	14 (16)	3.5 (4)					
11kW	14 (16)	5.5 (6)					
15kW	22 (25)	14 (16)					

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

 As a noise reduction technique, use one wire of the four-core cable with the earth (ground) terminal of the motor, and earth (ground) at one point from the filter pack side via the inverter. (Refer to page 2.)



(For the type without filter pack, earth (ground) the motor with the inverter at one point on the inverter side.)

#### CAUTION

When the inverter is run in the low acoustic noise mode, more leakage currents occur than in the non-low acoustic noise mode due to high-speed switching operation. Always earth (ground) the inverter, motor and filter pack before use.

## 1.2.10 Regarding Japanese 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 countermeasure suppression techniques.

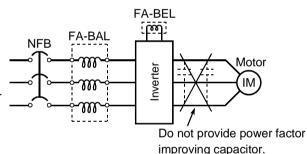
The following table indicates differences between harmonics and noise:

Item	Harmonics	Noise
Frequency	Normally 40th to 50th degrees or less (up to 3kHz or less)	High frequency (several 10kHz to MHz 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 maker's equipment specifications
Suppression example	Provide reactor.*	Increase distance.

<sup>\*</sup>The filter pack (FR-BFP) produces the same effect as when the power factor improving DC reactor (FR-BEL) is connected.

#### 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 (FR-BEL or FR-BAL) 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 on the inverter's primary side or DC circuit. For full information, refer to page 16.

## 1.2.11 Japanese 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.

- "Guideline for house hold appliance and general-purpose products" The "harmonic suppression guideline for household appliances and general-purpose products" was issued by the Ministry of Economy, Trade and Industry (formerly Ministry of International Trade and Industry) in September, 1994. This guideline applies to the three-phase 200V class 3.7K or less. By installing the power factor improving reactor (FR-BEL or FR-BAL) or filter pack (FR-BFP), this product conforms to the "harmonic suppression technique for transistorized inverters (input current 20A or less)" set forth by the Japan Electrical Manufactures' 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
6.6 kV	3.5	2.5	1.6	1.3	1.0	0.9	0.76	0.70
22 kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33 kV	1.2	0.86	0.55	0.46	0.35	0.32	0.26	0.24

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

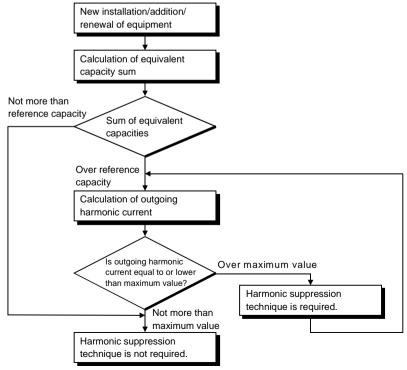


Table 2 Conversion Factors for FR-F500J Series

Class		Circuit Type			
	3-phase bridge 3 (Capacitor-	Without reactor	K31 = 3.4		
		With reactor (AC side)	K32 = 1.8		
	smoothed)	With reactor (DC side) or filter pack	K33 = 1.8		
	(35555)	With reactors (AC, DC sides)	K34 = 1.4		

**Table 3 Equivalent Capacity Limits** 

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

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

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

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

## $P0=\Sigma$ (Ki × Pi) [kVA]

Ki: Conversion factor (refer to Table 2)

Pi: Rated capacity of harmonic generating equipment\* [kVA]

i: Number indicating the conversion circuit type

- \* Rated capacity: Determined by the Table 2) capacity of the applied motor and found in Table 5. It should be noted that the rated capacity used here is used to calculate a generated harmonic amount and is different from the power supply capacity required for actual inverter drive.
- 2) Calculation of outgoing harmonic current

  Outgoing harmonic current = fundamental wave current (value converterd from received power voltage) × operation ratio × harmonic content
  - Operation ratio: Operation ratio = actual load factor × operation time ratio during 30 minutes
  - Harmonic content: Found in Table 4.

Table 5 Rated Capacities and Outgoing Harmonic Currents for Inverter Drive (with filter pack)

Applied Motor	Rated Current [A]	6.6kV Equivalent of Fundamental	Rated	(			e Curre ck, 10				
(kW)	400V	Wave Current (mA)	(kVA)	5th	7th	11th	13th	17th	19th	23rd	25th
0.4	0.81	49	0.57	14.7	6.37	4.12	2.45	2.30	1.57	1.47	1.08
0.75	1.37	83	0.97	24.9	10.76	6.97	4.15	3.90	2.66	2.49	1.83
1.5	2.75	167	1.95	50.10	21.71	14.03	8.35	7.85	5.34	5.01	3.67
2.2	3.96	240	2.81	72.00	31.20	20.16	12.00	11.28	7.68	7.20	5.28
3.7	6.50	394	4.61	118.2	51.2	33.10	19.70	18.52	12.61	11.82	8.67
5.5	9.55	579	6.77	173.7	75.27	48.64	28.95	27.21	18.53	17.37	12.74
7.5	12.8	776	9.07	232.8	100.9	65.18	38.80	36.47	24.83	23.28	17.07
11	18.5	1121	13.1	336.3	145.7	94.16	56.05	52.69	35.87	33.63	24.66
15	24.9	1509	17.6	452.7	196.2	126.8	75.45	70.92	48.29	45.27	33.20

# 3) Harmonic suppression technique requirement If the outgoing harmonic current is higher than; maximum value per 1kW (contract power) x 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. (The DC reactor has already been installed in the type with filter pack.)		
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 $\bot$ - $\Delta$ , $\Delta$ - $\Delta$ combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.		
4	Passive (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	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.		

#### 1.2.12 Inverter-driven 400V class motor

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

#### Measures

It is recommended to take either of the following measures:

## (1) Rectifying the motor insulation

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

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

#### = CAUTION

When the wiring length between the motor and inverter is 40m or more, take the above countermeasure and also set the long wiring mode in Pr. 70 "Soft-PWM setting". (Refer to page 103 for Pr. 70.)

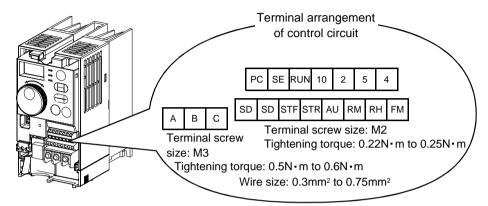
## (2) Suppressing the surge voltage on the inverter side

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

## 1.3 How to use the control circuit terminals

## 1.3.1 Terminal block layout

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



## 1.3.2 Wiring instructions

- Terminals SD, SE and 5 are common to the I/O signais isolated from each other. Do not earth them.
  - Avoid connecting the terminal SD and 5 and the terminal SE and 5.
- 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.

Introduced products (as of August, 2002): Phoenix Contact Co., Ltd.

Terminal Screw Size	Bar Terminal Model (With Insulation Sleeve)	Bar Terminal Model (Without Insulation Sleeve)	Wire Size (mm <sup>2</sup> )
M3 (A, B, C terminals)	AI 0.5-6WH	A 0.5-6	0.3 to 0.5
IVIS (A, D, C terminals)	AI 0.75-6GY	A 0.75-6	0.5 to 0.75
M2 (Other than the above)	AI 0.5-6WH	A 0.5-6	0.3 to 0.5

\*Bar terminal crimping terminal: CRIMPFOX ZA3 (Phoenix Contact Co., Ltd.)

CAUTION

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



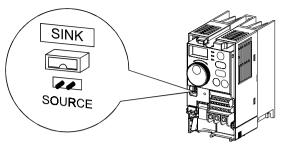
<sup>\*</sup>Information on bar terminals

## 1.3.3 Changing the control logic

The input signals are set to sink logic.

To change the control logic, the jumper connector under the setting dial 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.

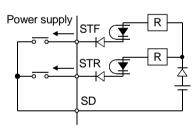
•The front cover is fitted with the capacity plate and the inverter unit with the rating plate. Since these plates have the same serial numbers, always replace the removed cover onto the original inverter.

•The sink-source logic change-over jumper 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.

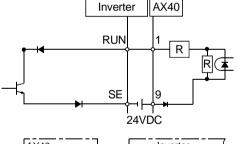
Sink logic type

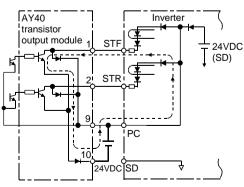
 In this logic, a signal switches on when a current flows out of the corresponding signal input terminal.

Terminal SD is common to the contact input signals. Terminal SE is common to the open collector output signals.



 Connecting a positive terminal of the 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 a undesirable current.)

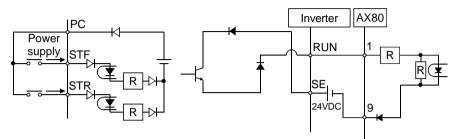




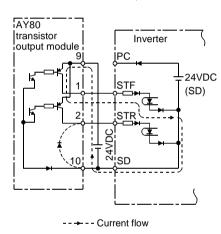
----- Current flow

- 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.



## 1.4 Input terminals

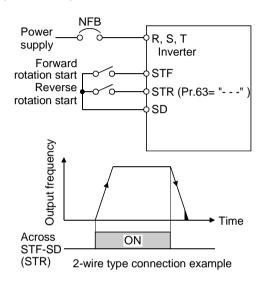
## 1.4.1 Run (start) and stop (STF, STR, STOP)

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.

## (1) Two-wire type connection (STF, STR)

A two-wire type connection is shown on the right.

- 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 either be given by entering 0 to 5VDC (or 0 to 10VDC) across frequency setting input terminals 2-5 or by setting the required values in Pr. 4 to Pr. 6 "multispeed setting" (high, middle, low speeds). (For multi-speed operation, refer to page 31.)



- 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, operation may not be started due to insufficient torque until the inverter output frequency reaches about 3 to 6Hz.
  - 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 without going through the stop mode.

## (2) Three-wire type connection (STF, STR, STOP)

A three-wire type connection is shown on the right. Assign the start self-holding Power signal (STOP) to any of the input terminals. To make a reverse rotation start, set Pr. 63 to "- - -" (factory setting).

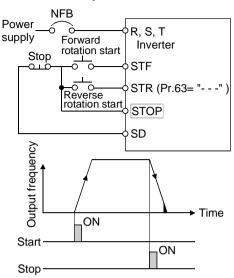
1) Short the signals STOP-SD to enable the start self-holding function. In this case, the forward/reverse rotation signal functions only as a start signal.

(Note) Assign the stop signal to any of Pr. 60 to Pr. 62 (input terminal function selection).

2) If the start signal terminals STF (STR)-SD are shorted once, then opened, the start signal is kept on and starts the inverter. To change the rotation direction, short the start signals STR (STF)-SD once, then open it.

(Note) Assign the stop signal to any of Pr. 60 to Pr. 62 (input terminal function selection).

3) The inverter is decelerated to a stop by opening the signals STOP-SD once. For the frequency setting signal and the operation of DC injection brake at a stop time, refer to paragraphs 2) to 4) in (1) Two-wire type connection. The right diagram shows 3-wire type connection.



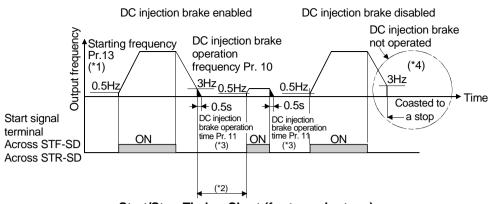
3-wire type connection example

- 4) When the signals JOG-SD are shorted, the STOP signal is invalid and the JOG signal has precedence.
- 5) If the output stop signals MRS-SD are shorted, the self-holding function is not deactivated.

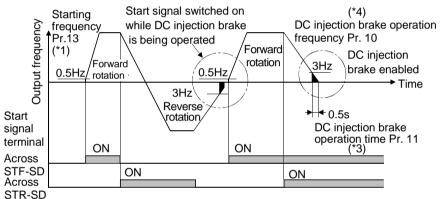
## DC Injection Brake and Coasting to Stop functionality

Operation Mode	Oper	ion or Combined ration )", "2", "3"	PU Operation or Combined 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	
DC injection brake enabled	injection brake	DC injection brake operated at 0.5Hz or less.	injection brake	DC injection brake operated at 0.5Hz or less.	
DC injection brake disabled		Coasted to a stop at 0.5Hz or less.		Coasted to a stop at 0.5Hz or less.	

<sup>\*1:</sup> Also stopped by the  $\frac{\text{STOP}}{\text{RESET}}$  key. Refer to page 106.



### Start/Stop Timing Chart (for two-wire type)



Forward-Reverse Rotation Switch-Over Timing Chart

### **REMARKS**

- The "starting frequency" in Pr. 13 (factory-set to 0.5Hz) may be set between 0 and 60Hz.

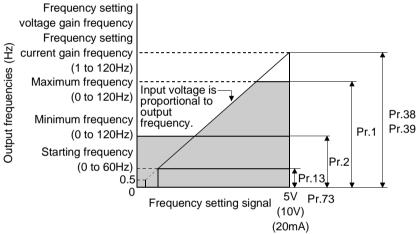
  If the next start signal is given during DC injection brake operation, the DC injection brake \*2. is disabled and restart is made.
- \*3. The "DC injection brake operation time" in Pr. 11 (factory-set to 0.5s) may be set between 0 and 10s.
- The frequency at which the motor is coasted to a stop is not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

## 1.4.2 Connection of frequency setting potentiometer and output frequency meter (10, 2, 5, 4, AU)

The analog frequency setting input signals that may be entered are voltage and current signals.

For the relationships between the frequency setting input voltages (currents) and output frequencies, refer to the following diagram. The frequency setting input signals are proportional to the output frequencies. Note that when the input signal is less than the starting frequency, the output frequency of the inverter is 0Hz.

If the input signal of 5VDC (or 10V, 20mA) or higher is entered, the output frequency does not exceed the maximum output frequency.



## Relationships between Frequency Setting Inputs and Output Frequencies

### **REMARKS**

For the way to calibrate the output frequency meter, refer to the instruction manual (basic).

## (1) Voltage input (10, 2, 5)

Enter the frequency setting input signal of 0 to 5VDC (or 0 to 10VDC) across the frequency setting input terminals 2-5. The maximum output frequency is reached when 5V (10V) is input across terminals 2-5.

The power supply used may either be the inverter's built-in power supply or an external power supply. For the built-in power supply, terminals 10-5 provide 5VDC output.

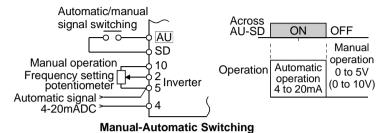
For operation at 0 to 5VDC, set "0" in Pr. 73 to the 0 to 5VDC input. Use terminal 10 for the built-in power supply.

●For operation at 0 to 10VDC, set "1" in Pr. 73 to the 0 to 10VDC input.

## (2) Current input (4, 5, AU)

To automatically perform operation under constant pressure or temperature control using a fan, pump etc., enter the controller output signal of 4 to 20mADC across terminals 4-5.

Terminals AU-SD must be shorted to use the 4 to 20mADC signal for operation. When the multi-speed signal is input, the current input is ignored.



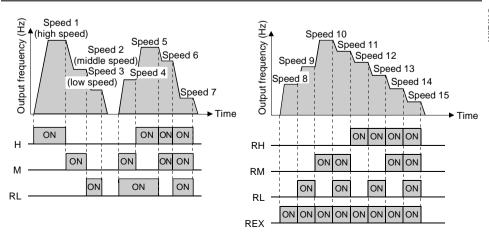
## 1.4.3 External frequency selection (REX, RH, RM, RL)

Up to 15 speeds (\*) may be selected for an external command forward rotation start or up to 7 speeds for an external command reverse rotation start according to the combination of connecting the multi-speed select terminals REX, RH, RM and RL-SD, and multi-speed operation can be performed as shown below by shorting the start signal terminal STF (STR)-SD.

Speeds (frequencies) may be specified as desired from the operation panel or parameter unit as listed below.

- \* Change the setting of Pr. 63 "STR terminal function selection" to "8", and assign and use as the 15-speed select signal (REX).

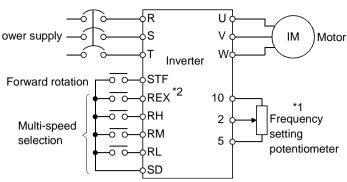
  Change the setting of Pr. 60 "AU terminal function selection" to "0", and assign and use as the low-speed operation command (RL).
- •Has precedence over the main speed setting signal (0 to 5V, 0 to 10V, 4 to 20mADC).



### **Multi-Speed Setting**

	Te	ermina	al Inn	ut	wuiti-Spee			
Speed	REX-	RH-	RM-	RL-	Parameter	Set Frequency	Remarks	
	SD*	SD	SD	SD*		Range		
Speed 1								
(high	OFF	ON	OFF	OFF	Pr. 4	0 to 120Hz	<del></del>	
speed)								
Speed 2			l					
(middle	OFF	OFF	ON	OFF	Pr. 5	0 to 120Hz		
speed) Speed 3								
(low	OFF	OFF	OFF	ON	Pr. 6	0 to 120Hz		
speed)	011	011	011	ON	F1. 0	0 10 120112		
specu)							Lower frequency between Pr. 5	
Speed 4	OFF	OFF	ON	ON	Pr. 24		and Pr. 6 when Pr. 24=""	
			0.1	0.1			(factory setting is Pr. 6)	
							Lower frequency between Pr. 4	
Speed 5	OFF	ON	OFF	ON	Pr. 25		and Pr. 6 when Pr. 25=""	
							(factory setting is Pr. 6)	
							Lower frequency between Pr. 4	
Speed 6	OFF	ON	ON	OFF	Pr. 26 Pr. 27		and Pr. 5 when Pr. 26=""	
							(factory setting is Pr. 5)	
	0						Lowest frequency among Pr. 4, Pr. 5 and Pr. 6 when Pr. 27="	
Speed 7	OFF	ON	ON	ON				
0	011	055	OFF	055	D: 00		"(factory setting is Pr. 6)	
Speed 8	Į	OFF		OFF	Pr. 80		0Hz when Pr. 80=""	
Speed 9	_	OFF	OFF	ON	Pr. 81	0 to 120Hz,	Pr. 6 setting when Pr. 81=""	
Speed 10	ON	OFF	ON	OFF	Pr. 82	, , , , , , , , , , , , , , , , , , , ,	Pr. 5 setting when Pr. 82=""	
							Lower frequency between Pr. 5	
Speed 11	ON	OFF	ON	ON	Pr. 83		and Pr. 6 when Pr. 83=""	
							(factory setting is Pr. 6)	
Speed 12	ON	ON	OFF	OFF	Pr. 84		Pr. 4 setting when Pr. 84=""	
				l			Lower frequency between Pr. 4	
Speed 13	ON	ON	OFF	ON	Pr. 85		and Pr. 6 when Pr. 85=""	
							(factory setting is Pr. 6)	
Coood 4.4	ON	ON		OFF	Dr 96		Lower frequency between Pr. 4	
Speed 14	ON	ON	ON	OFF	Pr. 86		and Pr. 5 when Pr. 86="" (factory setting is Pr. 5)	
							Lowest frequency among Pr. 4,	
Speed 15	ON	ON	ON	ON	Pr. 87		Pr. 5 and Pr. 6 when Pr. 87=""	
- pood 10	OIV	OIV	UIV	UIV			(factory setting is Pr. 6)	
Foot some : 1					Frequency		( ,	
External	OFF	OFF	OFF	OFF	setting	0 to max. setting		
setting					potentiometer			
*\^/b.o		. DI	ا امما	<del></del>	oianala ara u	and (1E annuals		

<sup>\*</sup>When the RL and REX signals are used (15 speeds), a reverse rotation start under external command and frequency setting using 4 to 20mA current input signal cannot be made.



**Multi-Speed Operation Connection Example** 

### REMARKS

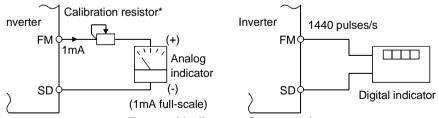
- \*1. When the frequency setting potentiometer is connected, the input signal of the frequency setting potentiometer is ignored if the multi-speed select signal is switched on. (This also applies to the 4 to 20mA input signal.)
- \*2. For a reverse rotation start, set Pr. 63 to "- -" (factory setting) to make the STR signal of terminal STR valid.

## 1.4.4 Indicator connection and adjustment (FM)

The output frequency, etc. of the inverter can be indicated by a DC ammeter of 1mA full-scale deflection and maximum  $300\Omega$  internal resistance or a commercially available digital indicator which is connected across terminals FM-SD.

The indicator can be calibrated from the operation panel or parameter unit. Note that the reading varies according to the wiring distance if the indicator is placed away from the inverter. In this case, connect a calibration resistor in series with the indicator as shown below and adjust until the reading matches the operation panel or parameter unit indication (indicator monitoring mode).

Install the indicator within 200m (50m for the digital indicator) of the inverter and connect them by at least 0.3mm<sup>2</sup> twisted or shielded cables.



Types of Indicators Connected

## **REMARKS**

\* Not needed when calibration is made using the calibration parameter C1 "FM terminal calibration". This resistor is used when calibration must be made near the frequency meter for such a reason as a remote frequency meter. Note that the needle of the frequency meter may not deflect to full-scale when the calibration resistor is connected. In this case, use both the resistor and calibration parameter "C1".

#### CAUTION

•Refer to page 124 for the procedure of indicator adjustment.

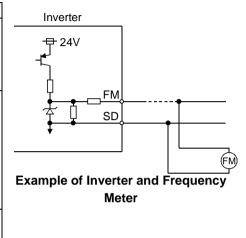
## **Output waveform of terminal FM**

The output signal of terminal FM has a pulse waveform as shown in the table below and the number of its pulses is proportional to the inverter output frequency.

The output voltage (average voltage) is also proportional to the output frequency.

### **Terminal FM Output Voltage**

	Specifications	
Output waveform	alibration parameter C1 (Pr. 900)	
	Max. 2400 pulses/s	
Number of Set a full-scale value which		
output	achieves 1440 pulses/s.	
pulses	Pr. 55: frequency monitoring	
(pulses/	reference	
second)	Pr. 56: current monitoring	
	reference	
Output	0 to 8VDC max. (*1)	
voltage	(Approx. 5V at 1440 pulses/s)	



\*1. 0.5V or less when a DC ammeter of  $300\Omega$  or less internal resistance is connected to measure the output voltage.

## Adjustment

### Analog meter

To adjust the reading of an analog indicator (ammeter), turn the calibration resistor to change the current.

When using the operation panel or parameter unit for adjustment, change the pulse width of the output waveform (calibration parameter "C1") (adjust the current through the adjustment of the output voltage) to adjust the reading. (For details, refer to page 124.)

### **REMARKS**

It is not recommended to use a voltage type indicator because it is easily affected by a voltage drop, induction noise, etc. and may not provide correct reading if the wiring distance is long.

### Digital indicator

Since the digital indicator counts and displays the number of pulses, adjust it from the operation panel or parameter unit.

The inverter output, at which the reference pulses of 1440 pulses/s are output, can be set in Pr. 55 when frequency monitoring is used as reference, or in Pr. 56 when current monitoring is used as reference.

- [Example] 1. To set the output across FM-SD to 1440 pulses/s at the inverter output frequency of 120Hz, set "120" (Hz) in Pr. 55. (Factory setting: 60Hz)
  - To set the output across FM-SD to 1440 pulses/s at the inverter output current of 15A, set "15" (A) in Pr. 56. (Factory setting: rated inverter current)

## 1.4.5 Control circuit common terminals (SD, 5, SE)

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

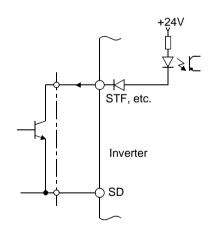
Terminal SD is a common terminal for the contact input terminals (STF, STR, RH, RM, AU) and frequency output signal (FM).

Terminal 5 is a common terminal for the frequency setting analog input signals. It should be protected from external noise using a shielded or twisted cable.

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

## 1.4.6 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, AU.



External signal input using transistor

### **REMARKS**

- 1. 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 25.)
- 2.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.

## 1.5 How to use the input signals (assigned terminals AU, RM, RH, STR)

	Pr. 60 "AU terminal function selection"	
	Pr. 61 "RM terminal function selection"	Page 99
setting Pr. 60 to Pr. 63.	Pr. 62 "RH terminal function selection"	rage 99
	Pr. 63 "STR terminal function selection"	

## 1.5.1 Multi-speed setting (RL, RM, RH, REX signals):

Pr. 60 to Pr. 63 setting "0, 1, 2, 8"

Remote setting (RL, RM, RH signals):

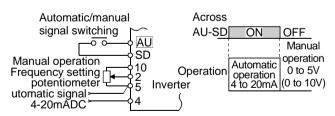
Pr. 60 to Pr. 63 setting "0, 1, 2"

- By entering frequency commands into the RL, RM, RH and REX signals and turning on/off the corresponding signals, you can perform multi-speed operation (15 speeds). (For details, refer to page 31.)
- If the operation panel is away from the control box, you can perform continuous variable-speed operation with signal contacts, without using analog signals. (For details, refer to page 96.)

## 1.5.2 Second function selection (RT signal): Pr. 60 to Pr. 63 setting "3"

## 1.5.3 Current input selection "AU signal": Pr. 60 to Pr. 63 setting "4"

When a fan, pump etc. is used to perform operation of constant- pressure/ temperature control, automatic operation can be performed by entering the 4-20mADC output signal of a regulator into across terminals 4-5.



When the 4-20mADC signal is used to perform operation, always short the AU signal.

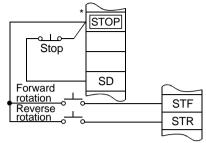
## REMARKS

The current input is ignored if the multi-speed signal is input.

## 1.5.4 Start self-holding selection (STOP signal): Pr. 60 to Pr. 63 setting "5"

This connection example is used when you want to self-hold the start signal (forward rotation, reverse rotation).

\* Connected to the STOP signal to avoid forward or reverse rotation if forward or reverse rotation and stop are turned on simultaneously.



(Wiring example for sink logic)

## 1.5.5 Output shut-off (MRS signal): Pr. 60 to Pr. 63 setting "6"

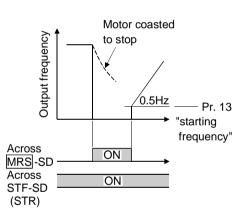
Short the output stop terminal MRS-SD during inverter output to cause the inverter to immediately stop the output. Open terminals MRS-SD to resume operation in about 10ms. Terminal MRS may be used as described below:

(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.

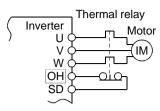


## (3) To coast the motor to stop

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.

## 1.5.6 External thermal relay input: Pr. 60 to Pr. 63 setting "7"

When the external thermal relay or thermal relay built in the motor 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 is shorted for more than 0.1s and then opened or power-on reset is performed.



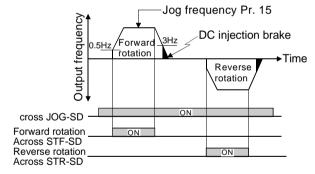
The function may therefore be used as an external emergency stop signal input.

## 1.5.7 Jog operation (JOG signal): Pr. 60 to Pr. 63 setting "9"

## (1) Jog operation using external signals

Jog operation can be started/stopped by shorting the jog mode select terminals JOG-SD and shorting/opening the start signal terminals STF or STR-SD. The jog frequency and jog acceleration/deceleration time are set in Pr. 15 (factory setting 5Hz, variable between 0 and 120Hz) and Pr. 16 (factory setting 0.5s, variable between 0 and 999s), respectively, and their settings can be changed from the operation panel or parameter unit.

The JOG signal has precedence over the multi-speed signal. (External)



## 1.5.8 Reset signal: Pr. 60 to Pr. 63 setting "10"

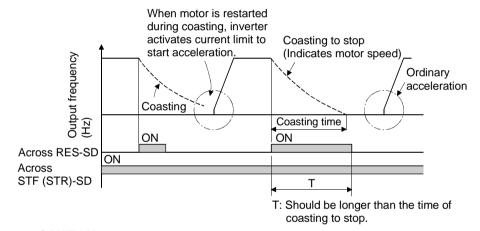
Used to reset the alarm stop state established when the inverter's protective function is activated. The reset signal immediately sets the control circuit to the initial (cold) status, e.g. initializes the electronic overcurrent protection circuit. It shuts off the inverter output at the same time. During 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.

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 "1" or "15" in reset selection Pr. 75 allows the accidental input of the reset signal during operation to be unaccepted.

(For details, refer to page 106.)



#### CAUTION

Frequent resetting will make electronic overcurrent protection invalid.

## 1.5.9 PID control valid terminal: Pr. 60 to Pr. 63 setting "14"

To exercise PID control, turn on the X14 signal. When this signal is off, ordinary inverter operation is performed. For more information, refer to page 113.

### →Related parameters →

Pr. 88 "PID action selection", Pr. 89 "PID proportional band", Pr. 90 "PID integral time", Pr. 91 "PID upper limit", Pr. 92 "PID lower limit", Pr. 93 "PID control set point for PU operation", Pr. 94 "PID differential time" (Refer to page 113.)

## 1.5.10 PU operation/external operation switching: Pr. 60 to Pr. 63 setting "16"

You can change the operation mode.

With "8" set in Pr. 79 "operation mode selection", turning on the X16 signal shifts the operation mode to the external operation mode and turning off the X16 signal shifts it to the PU operation mode. For details, refer to page 110.

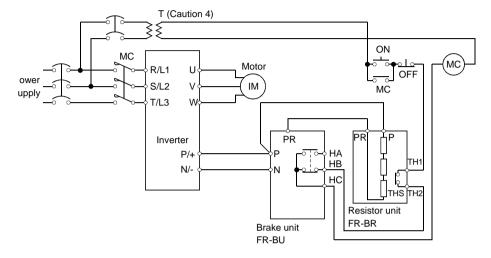
### - ♦ Related parameters ♦

Pr. 79 "operation mode selection" (Refer to page 110.)

## 1.6 Connection to the Stand-Alone Option

## 1.6.1 Connection of the brake unit (FR-BU)

Connect the optional FR-BU brake unit as shown below to improve the braking capability during deceleration.

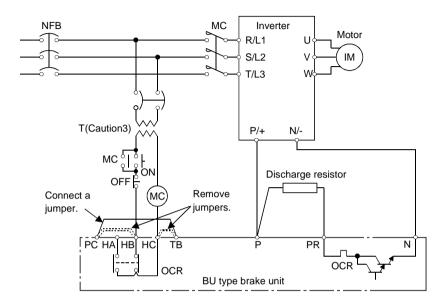


#### CAUTION =

- 1. Connect the inverter terminals (P, N) and FR-BU type brake unit terminals so that their terminal signals match with each other. (Incorrect connection will damage the inverter.)
- The wiring distance between the inverter, brake unit and resistor unit should be within 5m. If twisted wires are used, the distance should be within 10m.
- 3. If a transistor in the brake unit should become faulty, the resistor can be unusually hot. Therefore, install a magnetic contactor on the inverter's power supply side to shut off a current in case of fault.
- 4. For the power supply of 400V class, install a voltage-reducing transformer.

## 1.6.2 Connection of the brake unit (BU type)

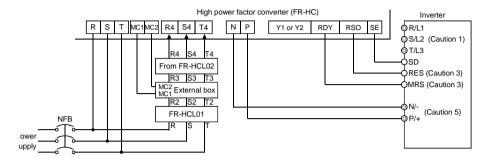
Connect the BU type brake unit correctly as shown on the right. Incorrect connection will damage the inverter. Remove the jumpers from terminals HB-PC and TB-HC and fit a jumper across terminals PC-TB of the brake unit.



- 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 become faulty, the resistor can be unusually hot, causing a fire. Therefore, install a magnetic contactor on the inverter's power supply side to shut off a current in case of fault.
- 3. For the power supply of 400V class, install a voltage-reducing transformer.

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

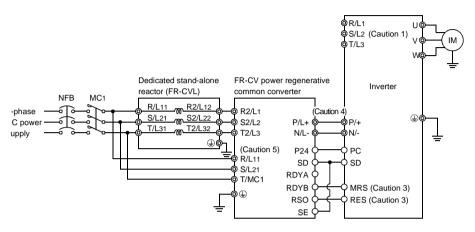
When connecting the high power factor converter (FR-HC) to suppress power harmonics, perform wiring securely as shown below. Incorrect connection will damage the high power factor converter and inverter.



- The power input terminals R, S, T must be open. Accidental 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 (input terminal function selection) to assign the terminals used for the RES and MRS signals.
- 4. Use sink logic (factory setting) when the FR-HC is connected. The FR-HC cannot be connected when source logic is selected.
- 5. Do not insert NFB between terminals P-N (P P/+, N N/-)
- 6. Do not connect the filter pack.

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

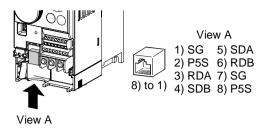
When connecting the FR-CV type power regeneration common converter, connect the inverter terminals (P/+, N/-) and FR-CV type power regeneration common converter terminals as shown below so that their signals match with each other.



- 1. The power input terminals R/L1, S/L2, T/L3 must be open. Accidental 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 (input terminal function selection) to assign the terminals used for the RES and MRS signals.
- 4. Do not insert NFB between terminals P-N (P/L+ P/+, N/L- N/-)
- Make sure to connect the terminal R/L11, S/L21, T/MC1 to the power supply. Running the inverter without connecting the terminals will damage the power regeneration common converter.
- 6. Do not connect the filter pack.

## 1.7 Handling of the RS-485 connector

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



### CAUTION

- 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 130 for the communication parameters.

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

When connecting the parameter unit to the RS-485 connector, use the optional parameter unit connection cable (FR-CB2 $\square$ ).

### CAUTION

When the parameter unit is used, the operation other than the stop key  $(\frac{\text{STOP}}{\text{RESET}})$  key) of the operation panel is disabled.

PRefer to page 148 for the parameters related to parameter unit setting.

## 1.7.2 Wiring of RS-485 communication

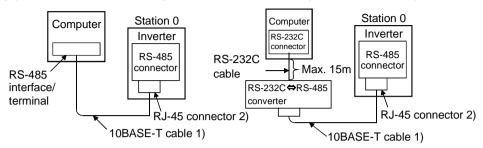
Use the RS-485 connector to perform communication operation from a personal computer etc.

By connecting the RS-485 connector to a computer such as a personal computer, Factory Automation unit or other computer, by the communication cable, you can operate/monitor the inverter and read/write the parameter values using user programs. For parameter setting, refer to page 128.

- Conforming standard: EIA Standard RS-485
- Transmission format: Multidrop link system
- Communication speed: Max. 19200bps
- Overall extension: 500m
- Refer to page 128 for the setting related to RS-485 communication operation.

## <System configuration examples>

## (1) Connection of computers and inverters (1:1 connection)



Cable for connection between computer and inverter Refer to the following for the cable (RS-232C⇔RS-485 converter) for connection of the computer having the RS-232C interface with the inverter. Example of product available on the market (as of July, 2002)

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

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

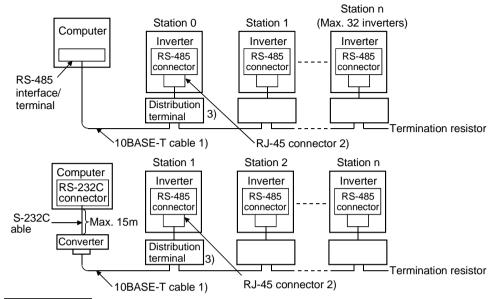
### **REMARKS**

Refer to the following when fabricating the cable on the user side.

Example of product available on the market (as of July, 2002)

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

## (2) Combination of computer and multiple inverters (1:n connection)



### **REMARKS**

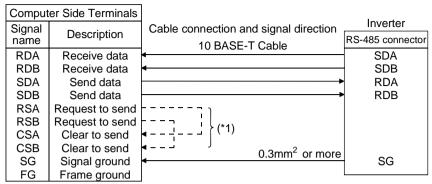
Refer to the following when fabricating the cable on the user side. Example of product available on the market (as of July, 2002)

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

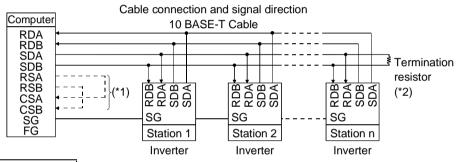
<sup>\*</sup> Do not use pins No. 2, 8 (P5S).

## <Wiring methods>

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



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

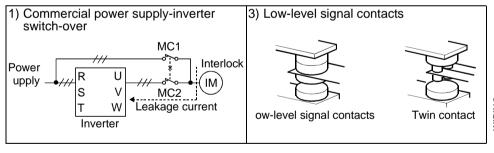


### **REMARKS**

- \*1. Make connection in accordance with the instruction manual of the computer to be used with. Fully check the terminal numbers of the computer since they change with the model.
- \*2. The inverters may be affected by reflection depending on the transmission speed or transmission distance. If this reflection hinders communication, provide a termination resistor. When the RS-485 connector is used for connection, a termination resistor cannot be fitted, so use a distributor. Connect the termination resistor to only the inverter remotest from the computer. (Termination resistor: 100Ω)

## 1.8 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.
- Since the input signals to the control circuit are on a low level, use two or more parallel micro signal contacts or a twin contact for contact inputs to prevent a contact fault.
- 4) Do not apply a large voltage to the contact input terminals (e.g. STF) of the control circuit.
- 5) Always apply a voltage to the alarm output terminals (A, B, C) via a relay coil, lamp etc.
- 6) Make sure that the specifications and rating match the system requirements.



## **MEMO**

# 2. FUNCTIONS

This chapter explains the "functions" for use of this product. 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. Refer to the instruction manual (basic) for the operation procedures. Always read the instructions before using the functions.

2.1	Function (Parameter) list	52
2.2	List of parameters classified by purpose of use	64
2.3	Explanation of functions (parameters)	66
2.4	Output terminal function parameters	88
2.5	Current detection function parameters	90
2.6	Display function parameters	92
2.7	Restart operation parameters	94
2.8	Additional function parameters	96
2.9	Terminal function selection parameters	99
2.10	Operation selection function parameters	102
2.11	Auxiliary function parameters	121
2.12	Maintenance function parameters	123
2.13	Calibration parameters	124
2.14	Clear parameters	127
2.15	Communication parameters	128
2.16	Parameter unit (FR-PU04) setting	148

As the contact input terminals AU, RM, RH, STR, open collector output terminal RUN and contact output terminals A, B, C 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**

Parameter copy

CAUTION

Use of the parameter unit (FR-PU04) allows the parameter values to be copied to another FR-F500J series inverter. 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).

Chapter 1

Chapter 2

Chapter 3

Chapter 4

## 2.1 Function (Parameter) list

= CAUTION

indicates that the setting can be changed during operation if Pr. 77 "parameter write disable selection" has been set to "0" (factory setting). (Note that the Pr. 53, Pr. 70 and Pr. 72 values can be changed only during PU operation.)

Parameter	Indic tion		Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Cus- tomer Setting
0	ρ (	O	Torque boost	0 to 15%	0.1%	6%/5%/ 4%/3%/ 2% (*1)	66	
1	Р	1	Maximum frequency	0 to 120Hz	0.1Hz	60Hz	67	
2	ρ,	2	Minimum frequency	0 to 120Hz	0.1Hz	0Hz	67	
3	Ρ.	3	Base frequency	0 to 120Hz	0.1Hz	60Hz	68	
4	P	Ч	Multi-speed setting (high speed)	0 to 120Hz	0.1Hz	60Hz	69	
5	P	כ	Multi-speed setting (middle speed)	0 to 120Hz	0.1Hz	30Hz	69	
6	Q.	8	Multi-speed setting (low speed)	0 to 120Hz	0.1Hz	10Hz	69	
7	P	-5	Acceleration time	0 to 999s	0.1s	5s/15s (*2)	70	
8	Р (	8	Deceleration time	0 to 999s	0.1s	10s/30s (*2)	70	
9	P.	9	Electronic thermal O/L relay	0 to 100A	0.1A	Rated output current	72	
30	P38	Ū	Extended function display selection	0, 1	1	0	82	
79	P7;	9	Operation mode selection	0 to 4, 7, 8	1	0	110	

<sup>\*1.</sup> The factory setting varies according to the inverter capacity.

<sup>&</sup>lt;200V class>

<sup>0.4</sup>K to 3.7K: 6%, 5.5K, 7.5K: 4%, 11K, 15K: 3%

<sup>&</sup>lt;400V class>

<sup>0.4</sup>K, 0.75K: 6%, 1.5K, 2.2K: 5%, 3.7K: 4%, 5.5K, 7.5K: 3%, 11K, 15K: 2%

<sup>\*2.</sup> The factory setting varies according to the inverter capacity.

Pr. 7 ..... 7.5K or less: 5s, 11K or more: 15s Pr. 8 ..... 7.5K or less: 10s, 11K or more: 30s

The extended function parameters are made valid by setting "1" in Pr. 30 "extended function display selection". (For full information on the way to set Pr. 30, refer to the instruction manual (basic).)

	Para- meter		lica- on	Name	Setting Range	Minimum Setting Increments	Factory Setting	To:	Cus- tomer Setting
	10	ρ	10	DC injection brake operation frequency	0 to 120Hz	0.1Hz	3Hz	73	
	11	P		DC injection brake operation time	0 to 10s	0.1s	0.5s	73	
	12	$\bar{\rho}$		brake voltage	0 to 15%	0.1%	4%/2% (*3)	73	
	13	ρ	13	Starting frequency	0 to 60Hz	0.1Hz	0.5Hz	74	
	14		רו	selection	For constant-torque loads,     For variable-torque loads,     For vertical lift loads,     For vertical lift loads	1	1	75	
Suc	15	ρ	15	Jog frequency	0 to 120Hz	0.1Hz	5Hz	76	
ion functic	16	ρ	18	Jog acceleration/ deceleration time	0 to 999s	0.1s	0.5s	76	
Standard operation functions	17	<u>ρ</u>	ויו	RUN key rotation direction selection	0: Forward rotation, 1: Reverse rotation	1	0	76	
tanda	19	ρ	19	voilage	0 to 800V, 888,	1V		68	
S S	20	ρ, _	20	Acceleration/ deceleration reference frequency	1 to 120Hz	0.1Hz	60Hz	70	
	21	ρ,	2 ;	Stall prevention function selection	0 to 31, 100	1	0	77	
	22	ρ,	22	Stall prevention operation level	0 to 150%	1%	120%	79	
	23	P.	23	Stall prevention operation level compensation factor at double speed	0 to 200%,	1%		79	

<sup>\*3</sup> The factory setting varies with the inverter capacity.

<sup>0.4</sup>K to 7.5K..... 4%

<sup>11</sup>K, 15K...... 2%

Func- tion	Para- meter	Indica- tion	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Cus- tomer Setting
	24	P24	(speed 4)	0 to 120Hz,	0.1Hz		69	
	25	P25	Multi-speed setting (speed 5)	0 to 120Hz,	0.1Hz		69	
	26	P26	Multi-speed setting (speed 6)	0 to 120Hz,	0.1Hz		69	
	27	P27	(speed 7)	0 to 120Hz,	0.1Hz		69	
	28	P28	Stall prevention operation reduction starting frequency	0 to 120Hz	0.1Hz	60Hz	79	
Standard operation functions	29	P29	Acceleration/ deceleration pattern	O: Linear acceleration/ deceleration,  1: S-pattern acceleration/ deceleration A,  2: S-pattern acceleration/ deceleration B	1	0	81	
oper	31	P3 I	Frequency jump 1A	0 to 120Hz,	0.1Hz		82	
ndard	32	P32	Frequency jump 1B	0 to 120Hz,	0.1Hz		82	
Star	33	P33	Frequency jump 2A	0 to 120Hz,	0.1Hz		82	
	34	P34	Frequency jump 2B	0 to 120Hz,	0.1Hz		82	
	35	P35	Frequency jump 3A	0 to 120Hz,	0.1Hz		82	
	36	P38	Frequency jump 3B	0 to 120Hz,	0.1Hz		82	
	37	P37	Speed display	0, 0.1 to 999	0.1	0	83	
	38	P38	Frequency setting voltage gain frequency	1 to 120Hz	0.1Hz	60Hz	84	
	39	P39	Frequency setting current gain frequency	1 to 120Hz	0.1Hz	60Hz	84	
	40	P40	Start-time ground fault detection selection	0: Not detected 1: Detected	1	0	88	

	Para- meter	Indica- tion	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Cus- tomer Setting
ctions	41	P4 !	Up-to- frequency sensitivity	0 to 100%	1%	10%	88	
inal fur	42	P45	Output frequency detection	0 to 120Hz	0.1Hz	6Hz	89	
Output terminal functions	43	P43	Output frequency detection for reverse rotation	0 to 120Hz,	0.1Hz		89	
Suc	44	PYY	Second acceleration/ deceleration time	0 to 999s	0.1s	5s	70	
Second functions	45	PYS	Second deceleration time	0 to 999s,	0.1s		70	
econ	46	P48	Second torque boost	0 to 15%,	0.1%		66	
Ö	47	PYT	Second V/F (base frequency)	0 to 120Hz,	0.1Hz		68	
	48	P48	Output current detection level	0 to 150%	1%	120%	90	
etection	49	P49	Output current detection period	0 to 10s	0.1s	0s	90	
Current detection	50	P50	Zero current detection level	0 to 150%	1%	5%	91	
์ บั	51	P5 !	Zero current detection period	0.05 to 1s	0.01s	0.5s	91	

Func- tion	Para- meter	Indica- tion	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Cus- tomer Setting
	52	P52	Operation panel display data selection	O: Output frequency,     Output current,     Oo:Set frequency     during stop/output     frequency during     operation	1	0	92	
Display functions	53	PS3	Frequency setting operation selection	Setting dial frequency setting mode     Setting dial potentiometer mode	1	0	93	
Display	54	P54	FM terminal function selection	Output frequency     monitor     1: Output current     monitor	1	0	92	
	55	P55	Frequency monitoring reference	0 to 120Hz	0.1Hz	60Hz	94	
	56	P58	Current monitoring reference	0 to 100A	0.1A	Rated output current	94	
c restart ions	57	P57	Restart coasting time	0 to 5s,	0.1s		94	
Automatic restart functions	58	P58	Restart cushion time	0 to 60s	0.1s	1s	94	
Additional function	59		Remote setting function selection	O: Without remote setting function 1: With remote setting function With frequency setting storage function 2: With remote setting function Without frequency setting storage function  Without frequency setting storage function	1	0	96	

Func- tion	Para- meter	Indica- tion	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Cus- tomer Setting
	60	P60	AU terminal function selection	0: RL, 1: RM, 2: RH, 3: RT, 4: AU, 5: STOP, 6:	1	4	99	
tion	61	P6 I	RM terminal function selection	MRS, 7: OH, 8: REX, 9: JOG, 10: RES, 14: X14,	1	1	99	
on selec	62	P62	RH terminal function selection	16: X16, : STR (May be assigned to the STR terminal only)	1	2	99	
Terminal function selection	63	P63	STR terminal function selection		1		99	
Termir	64	P64	RUN terminal function selection	0:RUN, 1:SU, 3:OL, 4:FU, 11:RY, 12:Y12, 13:Y13, 14:FDN, 15:FUP, 16:RL, 95:Y95 98:LF, 99:ABC	1	0	101	
	65	P85	A, B, C terminal function selection		1	99	101	
unctions	66	P68	Retry selection	0: OC1 to 3, OV1 to 3, THM, THT, GF, OHT, OLT, PE, OPT 1: OC1 to 3, 2: OV1 to 3, 3: OC1 to 3, OV1 to 3	1	0	102	
Operation selection functions	67	P67	Number of retries at alarm occurrence	0: No retry 1 to 10: Without alarm output during retry operation 101 to 110: With alarm output during retry operation	1	0	102	
	68	P68	Retry waiting time	0.1 to 360s	0.1s	1s	102	
	69	P69	Retry count display erase	0: Cumulative count erase	1	0	102	

Func- tion	Para- meter	Indica- tion	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Cus- tomer Setting
Operation selection functions	70	P10	Soft-PWM setting	Presence/absence of Soft-PWM control and long wiring mode can be selected. When Soft-PWM is valid, the metallic tone of motor noise can be changed into unoffending composite tone. In the long wiring mode, surge voltages can be suppressed independently of the wiring length.  Soft- Long wiring mode in Presence Absence 1 Presence Absence 10 Absence Presence 11 Presence Presence	1	11	103	
	71	P7 I		Thermal characteristic for standard motor     Thermal characteristic for Mitsubishi constant-torque motor	1	0	105	
	72		PWM frequency selection	0 to 15	1	1	103	
	73		0-5V/0-10V selection	0: For 0 to 5VDC input 1: For 0 to 10VDC input	1	0	105	
	74	РЛЧ	Input filter time constant	0: 2-step moving average processing 1 to 8: Exponential average value of 2n at the setting of n	1	1	106	

	Para- meter	Indica- tion	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Cus- tomer Setting
Operation selection functions	75	P75	Reset selection/PU stop selection	O: Reset normally enabled/PU stop key disabled 1: Enabled at alarm occurrence only/PU stop key disabled 14: Reset normally enabled/normally decelerated to stop 15: Enabled at alarm occurrence only/ normally decelerated to stop  15: Enabled at ostop  16: Enabled at ostop  17: Enabled at ostop  18: Enabled at ostop  19: Enabled at ostop  19: Enabled at ostop	1	14	106	
	76	P78	Cooling fan operation selection	O: Operation started at power-on     Cooling fan ON/     OFF control	1	0	108	
	77	PTT	Parameter write disable selection	O: Write is enabled only during a stop 1: Write disabled (except some parameters) 2: Write during operation enabled	1	0	109	
	78	P78	Reverse rotation prevention selection	O: Both forward rotation and reverse rotation enabled,  1: Reverse rotation disabled,  2: Forward rotation disabled	1	0	110	
unction	80	P80	8)	0 to 120Hz,	0.1Hz		69	
Multi-speed operation function	81	P8 :	9)	0 to 120Hz,	0.1Hz		69	
	82	P82	10)	0 to 120Hz,	0.1Hz		69	
Multi-sp	83	P83	Multi-speed setting (speed 11)	0 to 120Hz,	0.1Hz		69	

Func- tion	Para- meter	Indica- tion	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Cus- tomer Setting
unction	84	P84	12)	0 to 120Hz,	0.1Hz		69	
Multi-speed operation function	85	P85	13)	0 to 120Hz,	0.1Hz		69	
do peed	86	P86	14)	0 to 120Hz,	0.1Hz		69	
Multi-s	87	P81	15)	0 to 120Hz,	0.1Hz		69	
	88	P88	PID action selection	20: PID reverse action, 21: PID forward action	1	20	113	
	89	P89	PID proportional band	0.1 to 999%,	0.1%	100%	113	
_	90	P90	PID integral time	0.1 to 999s,	0.1s	1s	113	
PID control	91	P9 I	PID upper limit	0 to 100%,	0.1%		113	
PID	92	P92	PID lower limit	0 to 100%,	0.1%		113	
	93	P93	PID action set point for PU operation	0 to 100%	0.01%	0%	113	
	94	Pgy	PID differential time	0.01 to 10s,	0.01s		113	
_	95	P95	Rated motor slip	0 to 50%,	0.01%		121	
pensatio	96	P98	Slip compensation time constant	0.01 to 10s	0.01s	0.5s	121	
Slip compensation	97	Pgn	Constant- output region slip compensation selection	0,	1		121	
torque boost	98	P98	Automatic torque boost selection (Motor capacity)	0.2 to 15kW,	0.01kW		122	
Automatic torque bo	99	P99	Motor primary resistance	0 to 50Ω,	0.01Ω		123	

## Maintenance function parameters

Func- tion	Mainte- nance parame- ters		di- ion	Name	Setting Range	Minimum Setting Incre- ments	Factory Setting	To:	Cus- tomer Setting
ance eter	H1 (503)	Н		Maintenance timer	0 to 999	1 (1000h)	0	123	
Maintenanc parameter	H2 (504)	Н	2	Maintenance timer alarm output set time	0 to 999,	1 (1000h)	87 (87600h)	123	

## Calibration parameters

Func- tion	Calibra- tion parame- ters	Indi- catio	n Name	Setting Range	Minimum Setting Incre- ments	Factory Setting	Refer To:	Cus- tomer Setting
	C1 (900)	IJ	FM terminal calibration				124	
2	C2 (902)		bias frequency	0 to 60Hz	0.1Hz	0Hz	84	
mete	C3 (902)	_	Frequency setting voltage bias	0 to 300%	0.1%	0% (*4)	84	
para	C4 (903)	Ε .	Frequency setting voltage gain	0 to 300%	0.1%	96% (*4)	84	
Calibration parameters	C5 (904)	<i>E</i> !	Frequency setting current bias frequency	0 to 60Hz	0.1Hz	0Hz	84	
Cal	C6 (904)		current blas	0 to 300%	0.1%	20% (*4)	84	
	C7 (905)	[ '	Frequency setting current gain	0 to 300%	0.1%	100% (*4)	84	
	C8 (269)	[ 8	Parameter set by	manufacturer. Do	not set.			
Clear parameters	CLr	EL	- Parameter clear	0: Not executed 1: parameter clear 10: all clear	1	0	127	
	ECL	88	Alarm history clear	0: Not cleared, 1: Alarm history clear	1	0	127	

<sup>\*4.</sup> Factory settings may differ because of calibration parameters.

## Communication Parameters

Func tion	Commu- nication Parame- ter	Indic tio		Name	Setting Range	Minimum Setting Incre- ments	Factory Setting	Refer To:	Cus- tomer Setting
	n1 (331)	n	;	Communication station number	0 to 31: Specify the station number of the inverter.	1	0	130	
	n2 (332)	C	2	Communication speed	48: 4800bps, 96: 9600bps, 192: 19200bps	1	192	130	
	n3 (333)	n	3	Stop bit length	0, 1: (Data length 8), 10, 11: (Data length 7)	1	1	130	
	n4 (334)	c	ч	Parity check presence/ absence	0: Absent, 1: With odd parity check, 2: With even parity check	1	2	130	
	n5 (335)	n	5	Number of communication retries	0 to 10,	1	1	130	
ters	n6 (336)	n	8	Communication check time interval	0 to 999s,	0.1s	0s	130	
rame	n7 (337)	_	7	Waiting time setting	0 to 150ms,	1		130	
Communication Parameters	n8 (338)	n	8	Operation command source	Command     source is     computer,     Command     source is     external     terminal	1	0	144	
	n9 (339)	n	9	Speed command source	source is external terminal	1	0	144	
	n10 (340)	n 1	10	Link startup mode selection	<ul><li>0: As set in Pr. 79.</li><li>1: Started in computer link operation mode.</li></ul>	1	0	145	
	n11 (341)	n 1	1 1	CR/LF selection	0: Without CR/LF, 1: With CR, without LF 2: With CR/LF	1	1	130	
	n12 (342)	n i	12	E <sup>2</sup> PROM write selection	0: Write to RAM and E <sup>2</sup> PROM 1: Write to RAM only	1	0	147	

### PU parameters

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

	accepted	.,						
Func tion	Commu- nication Parame- ter	Indica- tion	Name	Setting Range	Minimum Setting Incre- ments	Factory Setting	Refer To:	Cus- tomer Setting
	n13 (145)	n 13	PU display language selection	0: Japanese, 1: English, 2: German, 3: French, 4: Spanish, 5: Italian, 6: Swedish, 7: Finish	1	0	148	
	n14 (990)	n 14	PU buzzer control	0: Without sound, 1: With sound	1	1	148	
	n15 (991)	n 15	PU contrast adjustment	0 (Light) 63 (Dark)	1	58	149	
PU parameters	n16 (992)	n 16	PU main display screen data selection	O: Selectable between output frequency and output current 100: (during stop): Set frequency, output current (during operation): Output frequency, output current	1	0	149	
	n17 (993)	n 17	PU disconnection detection/PU setting lock	0: Without PU disconnection error, 1: Error at PU disconnection, 10: Without PU disconnection error (PU operation disable)	1	0	150	

### **REMARKS**

- 1.The parameter numbers within parentheses are those for use of the parameter unit (FR-PU04).
- 2. Set "9999" when setting a value "- -" using the parameter unit (FR-PU04).
- 3. The decimal places of a value 100 or more (3 digits or more) cannot be displayed.

## 2.2 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	
	r di pose di ose	Parameter numbers which must be set	
	Use of extended function parameters	Pr. 30	
	Operation mode selection	Pr. 53, Pr. 79	
	Operation mode selection	(Communication parameters n10, n17)	
	Acceleration/deceleration time/pattern	Pr. 7, Pr. 8, Pr. 16, Pr. 20, Pr. 29, Pr. 44,	
	adjustment	Pr. 45	
	Selection of output characteristics	Pr. 3, Pr. 14, Pr. 19	
	optimum for load characteristics		
	Output frequency restriction (limit)	Pr. 1, Pr. 2	
_	Operation over 60Hz	Pr. 1, Pr. 38, Pr. 39,	
Ę.	Operation over our iz	Calibration parameter C4, C7	
era	Adjustment of frequency setting signals	Pr. 38, Pr. 39, Pr. 73,	
9	and outputs	Calibration parameter C2 to C7	
Related to operation	Motor output torque adjustment	Pr. 0, Pr. 98	
tec	Brake operation adjustment	Pr. 10, Pr. 11, Pr. 12	
ela	Multi-speed operation	Pr. 1, Pr. 2, Pr. 4, Pr. 5, Pr. 6, Pr. 24, Pr. 25, Pr.	
~		26, Pr. 27, Pr. 80, Pr. 81, Pr. 82, Pr. 83, Pr. 84,	
		Pr. 85, Pr. 86, Pr. 87	
	Jog operation	Pr. 15, Pr. 16	
	Frequency jump operation	Pr. 31, Pr. 32, Pr. 33, Pr. 34, Pr. 35, Pr. 36	
	Automatic restart operation after	Pr. 57, Pr. 58	
	instantneous power failure	F1. 37, F1. 30	
	Slip compensation setting	Pr. 95 to Pr. 97	
	Setting of output characteristics matching	Pr. 3, Pr. 19, Pr. 71	
	the motor	. ,	
u	Electromagnetic brake operation timing	Pr. 42, Pr. 64, Pr. 65	
atic	Sub-motor operation	Pr. 0, Pr. 3, Pr. 7, Pr. 8, Pr. 44, Pr. 45,	
olic	_	Pr. 46, Pr. 47	
Related to application	Operation in communication with perasonal computer	Communication parameters n1 to n12	
5 5	perasonal computer	·	
ted	Operation under PID control	Pr. 60 to Pr. 65, Pr. 73, Pr. 79, Pr. 88	
ela	·	to Pr. 94	
œ	Noise reduction	Pr. 70, Pr. 72	

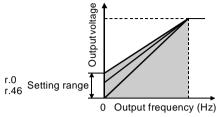
		Dumana of Han	Parameter Numbers
	Purpose of Use		Parameter numbers which must be set
d to	ing	Frequency meter calibration	Pr. 54, Pr. 55, Pr. 56, Calibration parameter C1
Related	nonitor	Frequency meter calibration  Display of monitor on operation panel or parameter unit (FR-PU04)  Display of speed, etc.	Pr. 52, Communication parameter n16
œ	⊔	Display of speed, etc.	Pr. 37, Pr. 52
rect	ntion	Function write prevention	Pr. 77
incor	prever	Reverse rotation prevention	(Pr. 17), Pr. 78
od to	ration p	Current detection	Pr. 48 to Pr. 51, Pr. 64, Pr. 65
Related to incorrect	operat	Motor stall prevention	Pr. 21, Pr. 22, Pr. 23, Pr. 28
		Input terminal function assignment	Pr. 60 to Pr. 63
		Output terminal function assignment	Pr. 64, Pr. 65
		Increased cooling fan life	Pr. 76
Ų.	2	Motor protection from overheat	Pr. 9, Pr. 71
Others	2	Automatic restart operation at alarm stop	Pr. 66 to Pr. 69
Ċ	)	Setting of ground fault overcurrent protection	Pr. 40
		Inverter reset selection	Pr. 75
		Maintenance timer output	Maintenance parameters H1, H2

## 2.3 Explanation of functions (parameters)

## 2.3.1 Torque boost (Pr. 0 🕮, Pr. 46 🕮)

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



Parameter	Name	Factory Setting	Setting Range	Remarks
0	Torque boost	6%/5%/4%/3%/ 2%(*)	0 to 15%	<ul> <li>* The factory setting varies with the inverter capacity. (Refer to the following table for details.)</li> </ul>
1 4h	Second torque boost			: Function invalid. Setting is enabled when Pr. 30 = "1".

#### <Setting>

Assuming that the base frequency voltage is 100%, set the 0Hz voltage in %.
 Use the RT signal to switch between two different torque boosts. (Turn on the RT signal to make Pr. 46 valid(\*).)

#### REMARKS

- \* The RT signal acts as the second function selection signal and makes the other second functions valid.
- When using an inverter-dedicated motor (constant-torque motor), make setting as indicated below.

(If the factory set Pr. 71 value is changed to the setting for use with a constant-torque motor, the Pr. 0 setting changes to the corresponding value in the following table.)

#### <200V class>

Inverter Capacity	Factory Setting	Constant-torque Motor Setting	
0.4K, 0.75K	6%	6% (no change)	
1.5K to 3.7K	0 70	4%	
5.5K, 7.5K	4%	3%	
11K, 15K	3%	2%	

#### <400V class>

Inverter Capacity	Factory Setting	Constant-torque Motor Setting
0.4K, 0.75K	6%	6% (no change)
1.5K	5%	4%
2.2K	370	3%
3.7K	4%	3%
5.5K, 7.5K	3%	2%
11K, 15K	2%	2% (no change)

#### CAUTION

- •Selecting automatic torque boost control makes this parameter setting invalid.
- A too large setting may cause the motor to overheat or result in an overcurrent trip. The guideline is about 10% at the greatest.

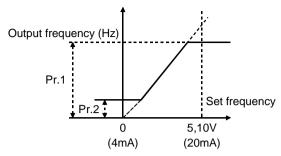
#### ♦ Related parameters ◆

- RT signal (second function "Pr. 46") setting Pr. 60 to Pr. 63 "input terminal function selection" (refer to page 99)
- Constant-torque motor setting ⇒ Pr. 71 "applied motor" (refer to page 105)
- Automatic torque boost control selection 

  Pr. 98 "automatic torque boost selection (motor capacity)" (refer to page 122)

## 2.3.2 Maximum and minimum frequency (Pr. 1 21, Pr. 2 22)

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**

When using the potentiometer (frequency setting potentiometer) connected across terminals 2-5 to perform operation above 60Hz, change the Pr. 1 and Pr. 38 (Pr. 39 when using the potentiometer across terminals 4-5) values.

## **!**CAUTION

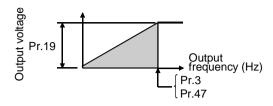
If the Pr. 2 setting is higher than the Pr. 13 "starting frequency" value, note that the motor will run at the set frequency according to the acceleration time setting by merely switching the start signal on, without entry of the command frequency.

## - ♦Related parameters ♦ -

- Starting frequency setting ⇒ Pr. 13 "starting frequency" (refer to page 74)
- Maximum frequency setting using external potentiometer
- ⇒Pr. 30 "extended function display selection" (refer to page 82), Pr. 38 "frequency setting voltage gain frequency", Pr. 39 "frequency setting current gain frequency" (refer to page 84)

# 2.3.3 Base frequency, base frequency voltage (Pr.3 2 , Pr.19 Pr.47 2 )

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



Parameter	Name	Factory Setting	Setting Range	Remarks
3	Base frequency	60Hz	0 to 120Hz	
19	Base frequency voltage		0 to 800V, 888,	888: 95% of power supply voltage: Same as power supply voltage Setting is enabled when Pr. 30 = "1".
4/	Second V/F (base frequency)		0 to 120Hz,	: Function invalid Setting is enabled when Pr. 30 = "1".

#### <Setting>

•In Pr. 3 and Pr. 47, set the base frequency (motor's rated frequency). Use the RT signal to switch between these two different base frequencies. (Turn on the RT signal to make Pr. 47 valid.) (\*)

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. Special care must be taken when "1" is set in Pr. 14 "load pattern selection".

• Set the base voltage (e.g. rated voltage of motor) in Pr. 19.

#### CAUTION =

- Set 60Hz in Pr. 3 "base frequency" when using a Mitsubishi constant-torque motor.
- 2. When automatic torque boost is selected, Pr. 47 is invalid. When automatic torque boost is selected, setting "- -" or "888" in Pr. 19 uses the rated output voltage.

## **REMARKS**

\* The RT signal serves as the second function selection signal and makes the other second functions valid.

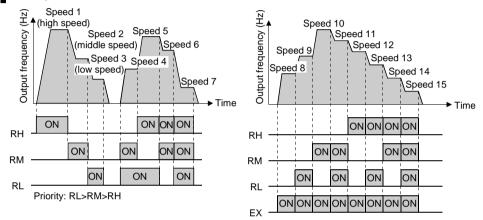
#### ◆Related parameters ◆

- When rated motor frequency is "50Hz" ⇒ Pr. 14 "load pattern selection" (refer to page 75)
- RT signal (second function "Pr. 47") setting ⇒ Pr. 60 to Pr. 63 (input terminal function selection) (refer to page 99)
- Motor setting ⇒ Pr. 71 "applied motor" (refer to page 105)
- Automatic torque boost selection ⇒ Pr. 98 "automatic torque boost selection (motor capacity)" (refer to page 122)

# 2.3.4 Multi-speed operation (Pr. 4 2 4 , Pr. 5 2 5 , Pr. 6 2 8 , Pr. 24 2 to Pr. 27 2 7 , Pr. 80 2 to Pr. 87 2 7 )

Used to switch between the predetermined running speeds.

- Any speed can be selected by merely switching on/off the corresponding contact signals (RH, RM, RL, REX signals).
- ■By using these functions with Pr. 1 "maximum frequency" and Pr. 2 "minimum frequency", up to 17 speeds can be set.
- This function is valid in the external operation mode or in the combined operation mode which is available when Pr. 79 = "3" or "4".



Parameter	Name	Factory Setting	Setting Range	Remarks
4	Multi-speed setting (high speed)	60Hz	0 to 120Hz	
5	Multi-speed setting (middle speed)	30Hz	0 to 120Hz	
6	Multi-speed setting (low speed)	10Hz	0 to 120Hz	
24 to 27	Multi-speed setting (speeds 4 to 7)		0 to 120Hz,	"" = no setting. Setting enabled when Pr. 30 = "1".
80 to 87	Multi-speed setting (speeds 8 to 15)		0 to 120Hz,	"" = no setting. Setting enabled when Pr. 30 = "1".

## <Setting>

• Set the running frequencies in the corresponding parameters.

Each speed (frequency) can be set as desired between 0 and 120Hz during inverter operation.

When the parameter of any multi-speed setting is read, turn the setting dial of the change the setting.

In this case, press the (SET) key (WRITE key) to store the frequency. (This is also enabled in the external mode.)

The setting is reflected by pressing the (SET) key (WRITE] key).

• Assign the terminals used for signals RH, RM, RL and REX using Pr. 60 to Pr. 63.(\*)

#### CAUTION

- 1. The multi-speed settings override the main speeds (across terminals 2-5, 4-5, setting dial). When the multi-speed settings and setting dial are used in the combined operation mode (Pr. 79=3), the multi-speed settings have precedence.
- 2. The multi-speeds can also be set in the PU or external operation mode.
- 3. For 3-speed setting, if two or three speeds are simultaneously selected, priority is given to the frequency setting of the lower signal.
- 4. Pr. 24 to Pr. 27 and Pr. 80 to Pr. 87 settings have no priority between them.
- 5. The parameter values can be changed during operation.
- 6. When using this function with the jog signal, the jog signal has precedence.

#### REMARKS

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

The frequency-set external terminals have the following priority: Jog > multi-speed operation > AU (terminal 4) > terminal 2

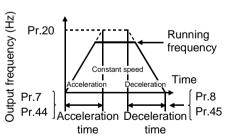
#### ♦ Related parameters ♦

- Maximum, minimum frequency setting ⇒ Pr. 1 "maximum frequency", Pr. 2 "minimum frequency" (refer to page 67)
- Assignment of signals RH, RM, RL, REX to terminals ⇒ Pr. 60 to Pr. 63 (input terminal function selection) (refer to page 99)
- External operation mode setting ⇒ Pr. 79 "operation mode selection" (refer to page 110)
- Computer link mode ⇒ Pr. 79 "operation mode selection" (refer to page 110), communication parameter n10 "link startup mode selection" (refer to page 145)
- Speed command source ⇒ Communication parameter n9 "speed command source" (refer to page 144)

# 2.3.5 Acceleration/deceleration time (Pr. 7 24, Pr. 8 28, Pr. 20 224, Pr. 44 244, Pr. 45 245)

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	Remarks
7	Acceleration time	10s/30s	0 to 999s	7.5K or less: 5s, 11K or more: 15s
8	Deceleration time	5s	0 to 999s	7.5K or less: 10s, 11K or more: 30s
_	Acceleration/ deceleration reference frequency	60Hz		Setting is enabled when Pr. 30 = "1".
44	Second acceleration/ deceleration time	5s	0 to 999s	Setting is enabled when Pr. 30 = "1".
45	Second deceleration time		0 to 999s,	: Setting is enabled when deceleration time. Pr. 30 = "1".

## <Setting>

- •Use Pr. 7 and Pr. 44 to set the acceleration time required to reach the frequency set in Pr. 20 from 0Hz
- •Use Pr. 8 and Pr. 45 to set the deceleration time required to reach 0Hz from the frequency set in Pr. 20.
- Pr. 44 and Pr. 45 are valid when the RT signal is on. (When the RT signal is on, the other second functions (Pr. 44, Pr. 45, Pr. 46, Pr. 47) are also selected.)
- Set "- -" in Pr. 45 to make the deceleration time equal to the acceleration time (Pr. 44).

#### CAUTION =

- 1. In S-shaped acceleration/deceleration pattern A (refer to page 81), the set time is the period required to reach the base frequency set in Pr. 3.
  - Acceleration/deceleration time calculation expression when the set frequency is the base frequency or higher

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

T: Acceleration/deceleration time setting (s)

f : Set frequency (Hz)

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

Frequency setting (Hz)  Acceleration/ deceleration time (s)	60	120
5	5	12
15	15	35

2. If the Pr. 20 setting is changed, the settings of calibration functions Pr. 38 and Pr. 39 (frequency setting signal gains) remain unchanged.

To adjust the gains, adjust calibration functions Pr. 38 and Pr. 39.

- 3. When the setting of Pr. 7, Pr. 8, Pr. 44 or Pr. 45 is "0", the acceleration/ deceleration time is 0.04s.
- 4. 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 (inertia moment) and motor torque.

#### - ♦ Related parameters ♦

- Base frequency setting ⇒ Pr. 3 "base frequency" (refer to page 68)
- Acceleration/deceleration pattern, S-pattern acceleration/deceleration A
   Pr. 29 "acceleration/deceleration pattern" (refer to page 81)
- Calibration function ⇒ Pr. 38 "frequency setting voltage gain frequency"
   Pr. 39 "frequency setting current gain frequency" (refer to page 84)
- RT signal setting ⇒ Pr. 60 to Pr. 63 (input terminal function selection) (refer to page 99)
- Jog acceleration/deceleration time ⇒ Pr. 16 "jog acceleration/deceleration time" (refer to page 76)

## 2.3.6 Electronic overcurrent protection (Pr. 9 Ell)

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 100A

<sup>\* 0.75</sup>K or less is set to 85% of the rated inverter current.

#### <Setting>

- Set the rated current [A] of the motor.
   (Normally set the rated current at 50Hz.)
- •Setting "0" in Pr. 9 disables electronic overcurrent protection (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". (This provides a 100% continuous torque characteristic in the low-speed region.) Then, set the rated current of the motor in Pr. 9 "electronic thermal O/L relay".

#### CAUTION =

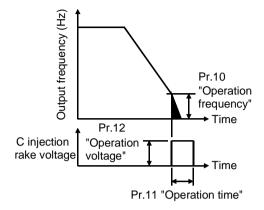
- •When two or more motors are connected to the inverter, they cannot be protected by the electronic overcurrent protection. Install an external thermal relay to each motor.
- •When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics 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 105)

## 2.3.7 DC injection brake (Pr. 10 PH, Pr. 11 PH, Pr. 12 PR)

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	Remarks
	DC injection brake operation frequency	3Hz		Setting is enabled when Pr. 30 = "1".
	DC injection brake operation time	0.5s	0 to 10s	(When Pr. 11 is set to "0s" or Pr. 12 is set to "0%", DC injection brake is not
12	DC injection brake voltage	ake voltage 4%/2%(*) 0	0 to 15%	operated.)

<sup>\*</sup> The factory setting varies according to the inverter capacity. (Refer to the following table for details.)

## <Setting>

- •Use Pr. 10 to set the frequency at which the DC injection brake operation is started.
- •Use Pr. 11 to set the period during when the brake is operated.
- •Use Pr. 12 to set the percentage of the power supply voltage.
- •When using an inverter dedicated motor (constant-torque motor), set the following value. (If the Pr. 71 value is changed to the setting for use with a constant-torque motor without changing the Pr. 12 value from the factory setting, the Pr. 12 setting is automatically changed to the following.)

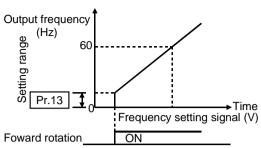
<b>Inverter Capacity</b>	Factory Setting	Constant-torque Motor Setting
0.4K to 3.7K	4%	4% (no change)
5.5K, 7.5K	4%	2%
11K, 15K	2%	2% (no change)

# **ACAUTION**

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

## 2.3.8 Starting frequency (Pr. 13 ETB)

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	Remarks
13	Starting frequency	0.5Hz	0 to 60Hz	Setting is enabled when Pr. 30 = "1".

#### 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 motor will not start running until the frequency setting signal reaches 5Hz.

## **ACAUTION**

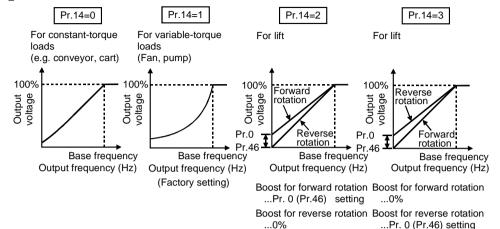
Note that when Pr. 13 is set to any value lower than Pr. 2 "minimum frequency", simply turning on the start signal will run the motor at the preset frequency if the command frequency is not input.

#### ◆Related parameters ◆

• Minimum frequency setting ⇒ Pr. 2 "minimum frequency" (refer to page 67)

## 2.3.9 Load pattern selection (Pr. 14 PH)

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



Parameter	Name	Factory Setting	Setting Range	Remarks	
14	Load pattern selection	1	0, 1, 2, 3	1: For variable-torque loads	Setting is enabled when Pr. 30 = "1".

#### CAUTION

- 1. When automatic torque boost control is selected, this parameter setting is ignored.
- 2. Pr. 46 "second torque boost" is made valid when the RT signal turns on.

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

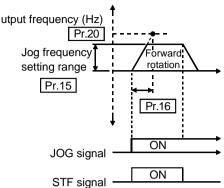
#### ♦ Related parameters ♦

- ◆Automatic torque boost ⇒ Pr. 98 "automatic torque boost selection (motor capacity)" (refer to page 122)
- Boost setting ⇒ Pr. 0 "torque boost", Pr. 46 "second torque boost" (refer to page 66)
- Assignment of RT signal to terminal when second torque boost is used
   ⇒ Pr. 60 to Pr. 63 (input terminal function selection) (refer to page 99)

## 2.3.10 Jog operation (Pr.15 **PB**. Pr.16 **PB**)

To start/stop jog operation in the external operation mode, choose the iog operation function in input terminal function selection, turn on the jog signal, and turn on/off the start signal (STF. STR).

You can choose the jog operation mode from the parameter unit (FR-PU04) and perform jog operation using the | FWD | or | REV | kev.



(Can be read as the basic parameters when the FR-PU04 is connected.)

Set the frequency and acceleration/deceleration time for iog operation

Parameter	Name	Factory Setting	Setting Range	Remarks
15	Jog frequency	5Hz	0 to 120Hz	Setting is enabled when
16	Jog acceleration/ deceleration time	0.5s		Pr. 30 = "1".

#### CAUTION

- •In S-shaped acceleration/deceleration pattern A, the acceleration/deceleration time is the period of time required to reach Pr. 3 "base frequency", not Pr. 20 "acceleration/deceleration reference frequency".
- The acceleration time and deceleration time cannot be set separately for jog operation.
- •The value set in Pr. 15 "jog frequency" should be equal to or greater than the
- Pr. 13 "starting frequency" setting.

  •Assign the jog signal using any of Pr. 60 to Pr. 63 (input terminal function selection).

#### ♦ Related parameters ♦ -

- Assignment of jog signal to terminal ⇒ Pr. 60 to Pr. 63 (input terminal function selection) (refer to page 99)
- Acceleration/deceleration pattern S-shaped acceleration/deceleration A
  - ⇒ Pr. 29 "acceleration/deceleration pattern" (refer to page 81)

#### 2.3.11 RUN) key rotation direction selection (Pr.17 PP)

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

Parameter	Name	Factory Setting	Setting Range	Remarks	
1 1/	RUN key rotation direction selection	0	() 1		Setting is enabled when Pr. 30 = "1".

P 19 ➡ Refer to P 3 (page 68)

P20 **►** Refer to P 7, P 8 (page 70)

OL Signal Output  $\bigcirc$ : Operation continued •: Operation not continued(\*)

 $\bigcirc$ 

 $\bigcirc$ 

## 2.3.12 Stall prevention function and current limit function (Pr. 21 🕮 )

You can make settings to disable stall prevention caused by overcurrent and to disable the fast-response current limit (which limits the current 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	Remarks
- 71	Stall prevention function selection	0	0 to 31, 100	Setting is enabled when Pr. 30 = "1".

Pr. 21 Set- ting	Fast- Response Current Limit ():	Ope Sele ⊖: Act •: acti	venticeration ection ivate Not vated	n n d	OL Signal Output  : Operation continued : Operation	Pr. Se	21 t-ting	Fast- Response Current Limit (): Activated	Ope Sele ○: Acti •:N activ	ention ration ction	n n d
	Not activated	Acceleration	Constant speed	Deceleration	not continued (*)			●:Not activated	Acceleration	Constant speed	Deceleration
0	Q	Q	Q	Q	0		16	Q	Q	Q	Q
1		Q	O .	Ŏ	Q		17		Q	Q	Ŏ
2	Q	•	<u>O</u>	Q	Q		18	Q	•	Q	Ŋ
3			Ŏ	Ŏ	Q		19	•	•	Ŏ	LΩ
4	0	$\bigcirc$	•	$\bigcirc$			20	0	$\bigcirc$	•	Ų
5	•	$\overline{\bigcirc}$	<u> </u>	$\bigcirc$	0		21	•	$\bigcirc$	•	$\stackrel{\square}{\bowtie}$
6	<u> </u>	-		$\bigcirc$	0		22	Q		•	$\bigcup$
7				$\bigcirc$	Q		23				$\Box$
8	$\overline{Q}$	$\vee$	$\downarrow \bigcirc$	•	$\bigcirc$		24 25	<u> </u>	$\bigcirc$	$\bigcirc$	2
		$\square$	$\stackrel{\square}{\bowtie}$	<u> </u>	$\bigcirc$		-		$\overline{Q}$	$\vee$	
10 11		-	$\stackrel{\square}{\sim}$	7	$\bigcirc$		26 27	$\overline{Q}$	-	$\stackrel{\smile}{\sim}$	
12				<u> </u>			2 <i>1</i> 28			$\overline{Q}$	Y
13		$\vdash \bigcirc$	7	<u> </u>			28 29		$\vee$	-	7
14		$\square$	-	-			29 30		$\subseteq$	-	2
15		-	-	7			31		7	7	-
_	"Operation	not o	onting	uod f	or OL signal	<b>⊢</b> `		_			
outpu	ıt" is selected	d, the	"OL	Γ" ala		00	Driving	0	0	0	0
		· ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '									

output" is selected, the "OLT" alarm code (stopped by stall prevention) is displayed and operation stopped.

(Alarm stop display "[][[[[]]]")

#### CAUTION

- •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 140% 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 gravity drop.

## **ACAUTION**

⚠ Always perform test operation.

Stall prevention operation performed during acceleration may increase the acceleration time.

Stall prevention operation performed during constant speed may cause sudden speed changes.

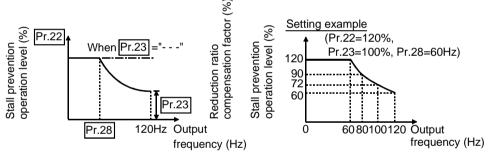
Stall prevention operation performed during deceleration may increase the deceleration time, increasing the deceleration distance.

## 2.3.13 Stall prevention (Pr. 22 222, Pr. 23 223, Pr. 28 223)

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

During high-speed operation above the rated motor frequency, acceleration may not be made because the motor current does not increase. To improve the operating characteristics of the motor in this case, the stall prevention level can be reduced in the high frequency region. This function is effective for performing operation up to the high speed range on a centrifugal separator etc. Normally, set 60Hz in Pr. 28 "stall prevention operation reduction starting frequency" and 100% in Pr. 23.

Parameter	Name	Factory Setting	Setting Range	Rem	arks
//	Stall prevention operation level	120%	0 to 150%		Setting is
23	Stall prevention operation level compensation factor at double speed		0 to 200%,	: Pr. 22 equally	enabled when Pr. 30 = "1".
	Stall prevention operation reduction starting frequency	60Hz	0 to 120Hz		11.00 - 11.



## <Setting>

- Generally, set 120% (factory setting) in Pr. 22 "stall prevention operation level". Setting "0" in Pr. 22 disables stall prevention operation.
- •To reduce the stall prevention operation level in the high frequency range, set the reduction starting frequency in Pr. 28 "stall prevention operation reduction starting frequency" and the reduction ratio compensation factor in Pr. 23. Calculation expression for stall prevention operation level

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

where, A = 
$$\frac{\text{Pr. 28 (Hz)} \times \text{Pr. 22 (\%)}}{\text{output frequency (Hz)}}$$
, B =  $\frac{\text{Pr. 28 (Hz)} \times \text{Pr. 22 (\%)}}{120\text{Hz}}$ 

•By setting "- - -" (factory setting) in Pr. 23, the stall prevention operation level is constant at the Pr. 22 setting up to 120Hz.

#### **REMARKS**

When the fast-response current limit is set in Pr. 21 "stall prevention function selection" (factory setting), do not set any value above 140% in Pr. 22. The torque will not be developed by doing so.

If the Pr. 22 value is set to higher than 140%, make setting in Pr. 21 to disable the fast-response current limit.

In vertical lift applications, make setting so the fast-response current limit is not activated. Torque may not be produced, causing a gravity drop.

## **A CAUTION**

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

Test operation must be performed.

Stall prevention operation during acceleration may increase the acceleration time.

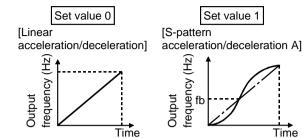
Stall prevention operation during constant speed may change the speed suddenly.

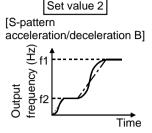
Stall prevention operation during deceleration may increase the deceleration time, increasing the deceleration distance.

 P24 to P27
 ▶ Refer to P4 to P5 (page 69)

## 2.3.14 Acceleration/deceleration pattern (Pr. 29 228)

Set the acceleration/deceleration pattern.





Parameter	Name	Factory Setting	Setting Range	Remarks
1 29	Acceleration/ deceleration pattern	0	0, 1, 2	Setting is enabled when Pr. 30 = "1".

## <Setting>

Pr. 29 Setting	Function	Description
0	Linear acceleration/ deceleration	Acceleration is made to the set frequency linearly. (Factory setting)
1	S-pattern acceleration/ deceleration A (*)	For machine tool spindle applications, etc. Used when acceleration/deceleration must be made in a short time to a high-speed region of not lower than the base frequency. Acceleration/deceleration is made in a pattern where fb (base frequency) acts as the inflection point of an S shape, and you can set the acceleration/deceleration time which matches the motor torque reduction in the constant-output operation region of not lower than the base frequency.
2	S-pattern acceleration/ deceleration B	For conveyor and other load collapse prevention applications, etc. Since acceleration/deceleration is always made in an S shape from f2 (current frequency) to f1 (target frequency), this function eases shock produced at acceleration/deceleration and is effective for load collapse prevention, etc.

#### CAUTION

\* As the acceleration/deceleration time, set the time taken to reach the Pr. 3 "base frequency" value, not the Pr. 20 "acceleration/deceleration reference frequency" value.

#### ♦Related parameters ♦ -

- Base frequency (acceleration/deceleration time setting) setting ⇒ Pr. 3 "base frequency" (refer to page 68)
- Pr. 20 "acceleration / deceleration reference frequency" ⇒ refer to page 70
- For setting of "1" (S-pattern acceleration/deceleration A)
   Pr. 44 "second acceleration/deceleration time", Pr. 45 "second deceleration time" (refer to page 70)

## 2.3.15 Extended function display selection (Pr. 30 Em)

Used to display the extended function parameters.

- Refer to page 52 for the extended function parameter list.
- Refer to the instruction manual (basic) for the parameter setting method.

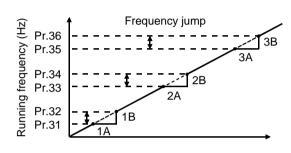
Parameter	Name	Factory Setting	Setting Range	Remarks
30	Extended function display selection	0	() 1	0: Without display, 1: With display

## 2.3.16 Frequency jump (Pr. 31 2 to Pr. 36 2 )

When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped. Up to three areas may be set, with the jump frequencies set to either the top or bottom point of each area.

The value set to 1A, 2A or 3A is a jump point and operation

is performed at this frequency.



Parameter	Setting		Setting Range	Remarks
31	Frequency jump 1A		0 to 120Hz,	
32	Frequency jump 1B		0 to 120Hz,	
33	Frequency jump 2A			•: Function invalid •Setting is enabled when Pr.
34	Frequency jump 2B		0 to 120Hz,	30 = "1"
35	Frequency jump 3A		0 to 120Hz,	
36	Frequency jump 3B		0 to 120Hz,	

## <Setting>

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

Pr.33:35Hz ----Pr.34:30Hz ----

#### CAUTION

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

#### **REMARKS**

Write inhibit error " $\xi$ ," occurs if the frequency jump setting ranges overlap.

## 2.3.17 Speed display (Pr. 37 22)

You can change the output frequency indication or set frequency of the operation panel and parameter unit (FR-PU04) to the motor speed or machine speed.

Parameter	Name	Factory Setting	Setting Range	Rem	arks
37	Speed display	0	0, 0.1 to 999	•	Setting is enabled when Pr. 30 = "1".

## <Setting>

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

#### CAUTION

- •The motor speed is converted from the output frequency and does not match the actual speed.
- •When you want to change the monitor (PU main display) of the operation panel, refer to Pr. 52 "operation panel display data selection" and communication parameter n16 "PU main display screen data selection".
- •Since the operation panel indication is 3 digits, make a setting so that the monitor value does not exceed "999". If the Pr. 1 value is higher than 60Hz and Pr. 1 value × Pr. 37 value > 60Hz × 999

 $\xi \cap \zeta^{\prime}$  (write error) occurs when Pr. 1 or Pr. 37 is written.

#### REMARKS

When the speed is set in Pr. 37 (Pr. 37  $\neq$  0), the speed is monitored and displayed in the monitor/frequency setting mode.

At this time, setting can be made in the minimum setting (display) increments of 0.01r/min. Due to the limitations on the resolution of the set frequency, the indication in the second decimal place may differ from the setting.

## **♠CAUTION**

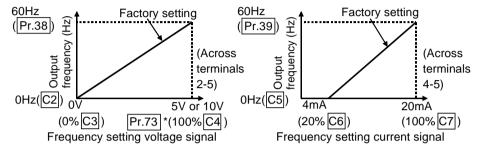
🗥 Make sure that the running speed setting is correct. Otherwise, the motor might run at extremely high speed, damaging the machine.

## ◆Related parameters ◆

- To choose running speed monitor display ⇒ Pr. 52 "operation panel display data selection" (refer to page 92)
- FR-PU04 display switching ⇒ Communication parameter n16 "PU main display screen data selection" (refer to page 149)

# 2.3.18 Biases and gains of the frequency setting voltage (current) (Pr. 38 BB, Pr. 39 BB, C2 BB to C7 BB)

You can set the magnitude (slope) of the output frequency as desired in relation to the external frequency setting signal (0 to 5V, 0 to 10V or 4 to 20mADC). The "bias" and "gain" functions are used to adjust the relationship between the input signal entered from outside the inverter to set the output frequency, e.g. 0 to 5V, 0 to 10V or 4 to 20mADC, and the output frequency.



Parameter	Name	Factory Setting	Setting Range	Remarks
38	Frequency setting voltage gain frequency	60Hz	1 to 120Hz	
39	Frequency setting current gain frequency	60Hz	1 to 120Hz	
1 (:) (90)	Frequency setting voltage bias frequency	0Hz	0 to 60Hz	Setting is enabled
C3 (902)	Frequency setting voltage bias	0% *	0 to 300%	when Pr. 30 = "1".
C4 (903)	Frequency setting voltage gain	96% *	0 to 300%	
C5 (904)	Frequency setting current bias frequency	0Hz	0 to 60Hz	
C6 (904)	Frequency setting current bias	20% *	0 to 300%	
C7 (905)	Frequency setting current gain	100% *	0 to 300%	

<sup>\*1.</sup>Factory settings may differ because of calibration parameters.

#### POINT

- •Bias setting for 0-5VDC (0-10VDC) input → Use calibration parameters C2, C3 for setting.
- •Gain setting for 0-5VDC (0-10VDC) input → Use Pr. 38, calibration parameter C4 for setting.
- •Bias setting for 4-20mADC input
- Use calibration parameters C5, C6 for setting.
- •Gain setting for 4-20mADC input
- Use Pr. 39, calibration parameter C7 for setting.

(For 4 to 20mADC input, turn on the AU signal.)

<sup>\*2.</sup>The parameter numbers within parentheses are those for use of the parameter unit (FR-PU04).

## <Setting>

- (1) How to change the highest frequency
- (2) Adjusting the deviation of the highest frequency from the Pr. 38 (Pr. 39) setting. (2)-1) Make adjustment with a voltage applied directly across terminals 2-5 (with a current flowing across terminals 4-5)
  - (2)-2) Make adjustment at any point without a voltage applied across terminals 2-5 (without a current flowing across terminals 4-5)

Changing example When you want to use the 0 to 5VDC input frequency setting potentiometer to change the 5V frequency from 60Hz(factory setting) to 50Hz

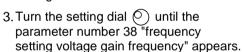
#### POINT

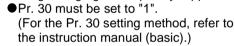
- •Pr. 38 is an extended function parameter. Pr. 30 must be set to "1".
- •Change Pr. 38 "frequency setting voltage gain frequency" to 50Hz.

## (1) How to change the highest frequency

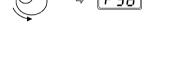
# Operation — Display— 1. Confirm the RUN indication and operation mode indication.

- •The inverter must be at a stop.
- The inverter must be in the PU operation mode. (Press the  $\frac{PU}{EXI}$  key.)
- 2. Press the work key to choose the parameter setting mode.





- 4. Pressing the (SET) key shows the currently set value. (60Hz)
- 5. Turn the setting dial (2) to change the set value to "50.0". (50Hz)
- 6. Press the (set) key to set the value.



The parameter

number read

previously appears.







Flicker ... Parameter setting complete!!

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

# ? The monitor/frequency setting indication cannot be changed to just 50Hz ... Why?

\*The calibration parameter C4 "frequency setting voltage gain" value must be set. (Refer to next page (2).)

#### REMARKS

To change the value to more than 60Hz, Pr. 1 "maximum frequency" must be set to more than 60Hz.

Changing example Changing the calibra voltage gain" value	ation parameter C4 "frequency setting
POINT POINT	<del></del>
The calibration parameter C4 is an extended f	
(2) Adjusting a deviation of the highest fr (2)-1 Making adjustment with a terminals 2-5 (with a currer Operation	requency from the Pr. 38 (Pr. 39) setting.  I voltage applied directly across nt flowing across terminals 4-5)  ———————————————————————————————————
<ol> <li>Confirm the RUN indication and operation mode indication.</li> <li>The inverter must be at a stop.</li> <li>The inverter must be in the PU operation (Press the (PU)/EXT) key)</li> </ol>	
<ol> <li>Press the key to choose the paramet setting mode.</li> </ol>	,
3. Turn the setting dial ○ to show "ℂ ".  ● Pr. 30 must be set to "1".  (For the Pr. 30 setting method, refer to the instruction manual (basic).)	
4. Press the (SET) key to show "[ -".	(SET)   □  □  □  □  □  □  □  □  □  □  □  □  □
When adjusting Pr. 38	
<ol> <li>Turn the setting dial O until the calibration parameter C4 "frequency setting voltage gain" appears.</li> </ol>	on
6. Press the (set) key to show the analog voltage value (%).	(Analog voltage value (%) across terminals 2-5
<ol> <li>Apply a 5V voltage.         (Turn the external potentiometer connected to across terminals 2-5 to     </li> </ol>	100 <sup>*</sup>
the maximum (any position).)  — CAUTION	*The value is nearly 100 (%) in the maximum position of the potentiometer.
After performing operation in step 7, do completion of calibration.	o not touch the setting dial O until
. Press the $(set)$ key to set the value.	SET DO TO

## Flicker ... Parameter setting complete!! (Adjustment complete)

\*The value is nearly 100 (%) in the maximum position of the potentiometer.

- By turning the setting dial , you can read another parameter.
- Press the (SET) key to return to the [ -indication (step 4).
- Press the (SET) key twice to show the next parameter ([ [ ] ).
- ? The frequency meter (indicator) connected to across terminals FM-SD does not indicate just 50Hz ... Why?
  - The calibration parameter C1 "FM terminal calibration" value must be set. (For the setting method, refer to the instruction manual (basic).)
- ? When write is performed, an error (६, ३) is displayed.

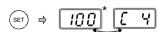
  The gain and bias frequency settings are too close.

# (2)-2 Making adjustment at any point with a voltage not applied across terminals 2-5 (with a current not flowing across terminals 4-5)

#### Operation -Display 1. Confirm the RUN indication and operation mode indication. •The inverter must be at a stop. •The inverter must be in the PU operation mode. (Press the (PV) key) The parameter 2. Press the (MODE) key to choose the parameter number read previously setting mode. appears. 3. Turn the setting dial (2) to show ": ". Pr. 30 must be set to "1". (For the Pr. 30 setting method, refer to the instruction manual (basic).) 4. Press the (SET) key to show "; -". When adjusting Pr. 38 5. Turn the setting dial (2) until the calibration parameter C4 "frequency setting voltage gain" appears. 6. Press the (SET) key to show the analog voltage value (%). Current (The maximum value can be displayed by operation merely turning the setting dial Oclockwise or 0.0Analog voltage counterclockwise in this status by one value (%) pulse's worth of turns (there is tactile feedback because of the notch type).)

- 7. Turn the setting dial (2) to the maximum value (100%) or any point.
  - Ilue (100%) or any point.

    \*The value is 100 (%) in the maximum position of the potentiometer.
- 8. Press the (SET) key to set the value.



Flicker ... Parameter setting complete!!
\*The value is 100 (%) in the maximum position of the potentiometer.

- Turn the setting dial O to read another parameter.
- Press the (SET) key to return to the [ -indication (step 4).
- Press the (SET) key twice to show the next parameter ([[], -).

#### **REMARKS**

For the way to change the output frequency setting of the frequency setting potentiometer, refer to the instruction manual (basic).

## 2.3.19 Start-time ground fault detection selection (Pr. 40 PM)

You can choose whether to make ground fault detection valid or invalid at a start.

Ground fault detection is executed only right after the start signal is input to the inverter.

Parameter	Name	Factory Setting	Setting Range	Remarks
40	Start-time ground fault detection selection	0	0.1	Ground fault detection for protection is not executed.     Ground fault detection for protection is executed.     Setting is enabled when Pr. 30 = "1".

#### CAUTION

- 1. If a ground fault is detected with "1" set in Pr. 40, alarm output " $\mathcal{L}F$ " is detected and the output is shut off.
- 2. If the motor capacity is less than 0.1kW, ground fault protection may not be provided.

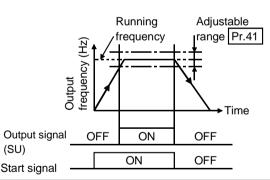
#### **REMARKS**

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

## 2.4 Output terminal function parameters

## 2.4.1 Up-to-frequency sensitivity (Pr. 41 PM)

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



Parameter	Name	Factory Setting	Setting Range	Remarks
41	Up-to-frequency sensitivity	10%	0 to 100%	Setting is enabled when Pr. 30 = "1".

#### **REMARKS**

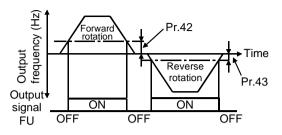
Using Pr. 64 or Pr. 65 to change terminal assignment may affect the other functions. Make setting after confirming the function of each terminal. (Refer to page 101.)

#### - ♦ Related parameters ♦

Assignment of SU signal to terminal ⇒ Pr. 64 "RUN terminal function selection", Pr. 65 "A, B, C terminal function selection" (refer to page 101)

## 2.4.2 Output frequency detection (Pr. 42 2 , Pr. 43 2 )

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



This function is effective for switching the timing of electromagnetic brake operation between forward rotation (rise) and reverse rotation (fall) during vertical lift operation, etc.

Parameter	Name	Factory Setting	Setting Range	Rema	rks
42	Output frequency detection	6Hz	0 to 120Hz		Setting is
43	Output frequency detection for reverse rotation		0 to 120Hz,	: Same as Pr. 42 setting	enabled when Pr. 30 = "1".

## <Setting>

Refer to the above chart and set the corresponding parameters.

- •When Pr. 43 "output frequency detection for reverse rotation" ≠ "- -", the Pr.42 setting applies to forward rotation and the Pr.43 setting applies to reverse rotation.
- •Use Pr. 64 or Pr. 65 (output terminal function selection) to assign the terminal used for FU signal output.

#### CAUTION =

Using Pr. 64 or Pr. 65 to change terminal assignment may affect the other functions. Make setting after confirming the function of each terminal.

- ♦Related parameters ♦

Assignment of FU signal to terminal ⇒ Pr. 64 "RUN terminal function selection", Pr. 65 "A, B, C terminal function selection" (refer to page 101)

 P44, P45
 ➡
 Refer to P 7, P 8 (page 70).

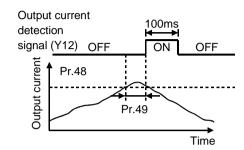
유덕동 **>** Refer to 유 용 (page 66).

 P47
 ▶ Refer to P 3 (page 68).

## 2.5 Current detection function parameters

# 2.5.1 Output current detection functions (Pr. 48 EE , Pr. 49 EE )

If the output remains higher than the Pr. 48 setting during inverter operation for longer than the time set in Pr. 49, the output current detection signal (Y12) is output from the inverter's open collector output terminal.



Parame ter	Name	Factory Setting	Setting Range	Remarks
1 48	Output current detection level	120%	0 to 150%	Setting is enabled when Pr. 30 = "1"
1 44	Output current detection period	0s	0 to 10s	Country to chabled when it is 50 = 1

## <Setting>

Parameter Number	Description				
48	Set the output current detection level. 100% is the rated inverter current.				
49	Set the output current detection time. Set the time from when the output current has risen above the Pr. 48 setting until the output current detection signal (Y12) is output.				

#### CAUTION

- •Once turned on because the current has risen above the preset detection level, the output current detection signal is held on for at least 100ms (approximately).
- •Using Pr. 64 or Pr. 65 (output terminal function selection) to change terminal assignment may affect the other functions. Make setting after confirming the function of each terminal.

#### ◆Related parameters ◆ -

Assignment of Y12 signal to terminal ⇒ Pr. 64 "RUN terminal function selection", Pr. 65 "A, B, C terminal function selection" (refer to page 101)

## 2.5.2 Zero current detection (Pr. 50 BB, Pr. 51 BB)

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

OFF ON Start signal Pr.50 "zero current **♦** Pr.50 Output detection 100ms current 0 [A] level" **OFF** OFF: Zero current detection signal output (Y13) Pr.51 Pr.51 detection period detection period

To prevent this, the output current "zero" signal can be output from the inverter to close the mechanical brake when the output current has fallen to "0[A]".

Parameter	Name	Factory Setting	Setting Range	Remarks
50	Zero current detection level	5%	0 to 150%	Setting is enabled when Pr. 30
51	Zero current detection period	0.5s	0.05 to 1s	= "1"

#### POINT

If the output is lower than the Pr. 50 setting for longer than the time set in Pr. 51 during inverter operation, the zero current detection (Y13) signal is output from the inverter's open collector output terminal.

## <Setting>

Parameter	Description
50	Set the zero current detection level.  Set the level of zero current detection in terms of the percentage of the rated inverter current from the output current value of 0 [A].
51	Set the zero current detection period.  Set a period of time from when the output current falls to or below the Pr. 50 setting to when the zero current detection signal (Y13) is output.

#### CAUTION

- •If the current falls below the preset detection level but the timing condition is not satisfied, the zero current detection signal is held on for about 100ms.
- •When the terminal functions are changed using Pr. 64, Pr. 65, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

#### ♦Related parameters ♦ -

Assignment of Y13 signal to terminal ⇒ Pr. 64 "RUN terminal function selection", Pr. 65 "A, B, C terminal function selection" (refer to page 101)

## 2.6 Display function parameters

## 2.6.1 Monitor display (Pr. 52 252, Pr. 54 252)

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

Parameter	Name	Factory Setting	Setting Range	Remarks
52	Operation panel display data selection	0	0, 1, 100	Setting is enabled when Pr. 30 = "1"
54	FM terminal function selection	0	0, 1	

#### POINT

- •You can also use the (SET) key to change the display. (Refer to the instruction manual (basic) for the operation procedure.)
- •The pulse train output terminal FM is available for signal output. (Make selection using the Pr. 54 "FM terminal function selection" value.)

## <Setting>

		Paramete	er Setting	
Signal Type	Unit	Pr. 52	Pr. 54	Full-Scale Value of FM
oigilal type	Onit	Operation panel LED	FM terminal	Level Meter
Output frequency	Hz	0/100	0	Pr. 55 "frequency monitoring reference"
Output current	Α	1	1	Pr. 56 "current monitoring reference"

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

	Pr. 52				
	0 100				
	During running/stop	During stop	During running		
Output frequency	Output 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 the communication parameter n16 "PU main display screen data selection". (Page 149)

#### CAUTION

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

#### ◆Related parameters ◆

- Speed display ⇒ Pr. 37 "speed display" (refer to page 83)
- Adjustment of FM level meter full-scale value ⇒ Calibration parameter C1 "FM terminal calibration" (refer to page 124)
- Monitoring reference ⇒Pr. 55 "frequency monitoring reference", Pr. 56 "current monitoring reference" (refer to page 94)

## 2.6.2 Setting dial function selection (Pr. 53 ES)

You can use the dial like a potentiometer to perform operation.

Parameter	Name	Factory Setting	Setting Range	Remark	s
53	Frequency setting operation selection	0	0, 1	Setting dial frequency setting mode     Setting dial potentiometer mode	Setting is enabled when Pr. 30 = "1"

#### Using the setting dial like a potentiometer to perform operation

#### POINT

- •Set "1" (extended function parameter valid) in Pr. 30 "extended function display selection".
- •Set "1" (setting dial potentiometer mode) in Pr. 53 "frequency setting operation selection".

Operation example Changing the frequency from 0Hz to 60Hz during operation

### Operation -

Display

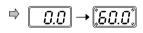
B.B

- 1. Mode/monitor check
  - Choose monitor/frequency monitor. ( MODE) key)
  - The inverter must be in the PU operation mode. (Press the (PU)/(PXT) key.)
  - ●Pr. 30 must be set to "1".
  - Pr. 53 must be set to "1".
- 2. Press the RUN key to start the inverter.



 Turn the setting dial Oclockwise until "60.0" appears. The flickering frequency is the set frequency. You need not press the (SET) key.





Flickers for 3s.

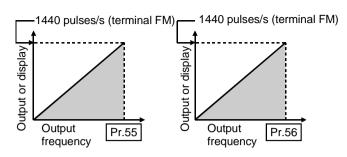
## REMARKS

- •If flickering "60.0" turns to "0.0", the Pr. 53 "frequency setting operation selection" setting may not be "1".
- •Independently of whether the inverter is running or at a stop, the frequency can be set by merely turning the dial.
- •When the frequency is changed, it will be stored as the set frequency after 10s.

**₽5**4 **▶** Refer to **₽5**2 (page 92).

## 2.6.3 Monitoring reference (Pr. 55 1998, Pr. 56 1998)

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



Parameter	Name	Factory Setting	Setting Range	Remarks
55	Frequency monitoring reference	60Hz	0 to 120Hz	Setting is enabled when
56	Current monitoring reference	Rated output current	0 to 100A	Pr. 30 = "1"

### <Setting>

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

Pr. 55 is set when Pr. 54 "FM terminal function selection" = "0" and Pr. 56 is set when Pr. 54 = "1".

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

#### CAUTION

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

## 2.7 Restart operation parameters

## 2.7.1 Restart setting (Pr. 57 251, Pr. 58 258)

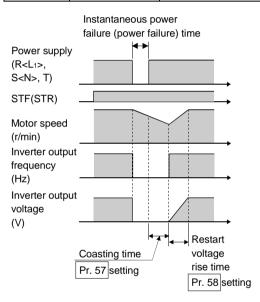
At power restoration after an instantaneous power failure, you can restart the inverter without stopping the motor (with the motor coasting).

Parameter	Name	Factory Setting	Setting Range	Remarks
5/	Restart coasting time		0 to 5s,	Setting is enabled when Pr. 30 = "1"
58	Restart cushion time	1s	0 to 60s	octaing is chabled when it is so = 1

## <Setting>

Refer to the following table and set the parameters:

Parameter	J		Description		
		0.4K to 1.5K	Coasting time of 0.5s	Generally, this setting will pose	
	0	2.2K to 7.5K	Coasting time of 1.0s	no problems.	
57		11K or more	Coasting time of 3.0s	nio problems.	
0.	0.1 to 5s		Waiting time for inverter-triggered restart after power is restored		
			from an instantaneous power failure. (Set this time between 0.1		
			and 5s according to the inertia moment (J) and torque of the load.)		
	No r		No restart		
58	0 to 60s		Normally the motor may be run with the factory settings. These values are adjustable to the load (inertia moment, torque).		



#### CAUTION

- Automatic restart operation after instantaneous power failure is a reduced voltage starting system in which the output voltage is risen gradually at the preset frequency independently of the coasting speed of the motor.
- It is a system which outputs the output frequency before an instantaneous power failure, unlike the motor coasting speed detection system (speed search system) used by the FR-E500 series Mitsubishi transistorized inverters. Hence, if the instantaneous power failure time is 0.2s or longer, the frequency before an instantaneous power failure cannot be stored in memory and the inverter restarts at 0Hz.
- The SU and FU signals are not output during a restart. They are output after the restart cushion time has elapsed.

## **CAUTION**

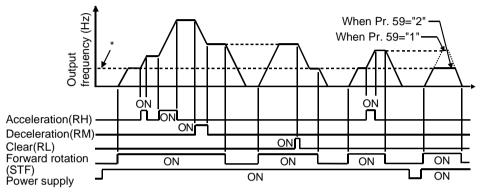
- Mhen automatic restart after instantaneous power failure has been selected, the motor and machine will start suddenly (after the restart coasting time has elapsed) after occurrence of an instantaneous power failure. Stay away from the motor and machine.

  When you have selected automatic restart after instantaneous power.
  - When you have selected automatic restart after instantaneous power failure, apply in easily visible places the CAUTION stickers supplied to the instruction manual (basic).
- The motor is coasted to a stop as soon as you turn off the start signal or press the (STOP) key during the restart cushion time after instantaneous power failure.

## 2.8 Additional function parameters

## 2.8.1 Remote setting function selection (Pr. 59 [15])

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



 External operation frequency or PU operation frequency other than at multiple speeds

Parameter	Name	Factory Setting	Setting Range	Remarks
50	Remote setting function selection	0	0, 1, 2	Setting is enabled when Pr. 30 = "1"

#### **REMARKS**

- •For the RL (clear) signal, set "0" in either Pr. 60 or Pr. 63 (input terminal function selection) and assign the signal to terminal AU or STR.
- •By merely setting this parameter, you can use the acceleration, deceleration and setting clear functions of the motorized speed setter (FR-FK).
- •When the remote function is used, the output frequency of the inverter can be compensated for as follows:

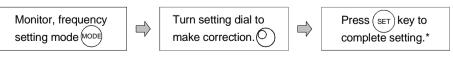
External operation mode Frequency set by RH/RM operation plus external analog

frequency command

PU operation mode Frequency set by RH/RM operation plus setting dial or PU

digital preset frequency

<Operation panel operation procedure>



\* When you have set "1" in Pr. 53 "frequency setting operation selection", you need not press the (SET) key.

## <Setting>

	Operation			
Pr. 59 Setting	Remote setting function	Frequency setting storage function (E <sup>2</sup> PROM)		
0	No	<del></del>		
1	Yes	Yes		
2	Yes	No		

•Use Pr. 59 to select whether the remote setting function is used or not and whether the frequency setting storage function\* in the remote setting mode is used or not. When "remote setting function - yes" is selected, the functions of terminals RH, RM and RL are changed to acceleration (RH), deceleration (RM) and clear (RL).

Use Pr. 60 to Pr. 62 (input terminal function selection) to set the signals RH, RM, RL.

The remote setting frequency (frequency set by RH/RM operation) is stored in memory.

When power is switched off once and then on again, the inverter resumes running at this setting of output frequency. (Pr. 59="1")

<sup>\*</sup> Frequency setting storage function

## <Frequency setting storage conditions>

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

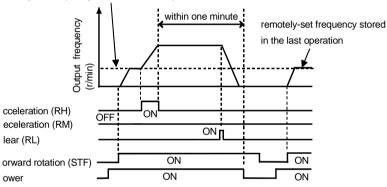
#### **REMARKS**

•This function is invalid under jog operation and PID control operation.

Setting frequency is "0"

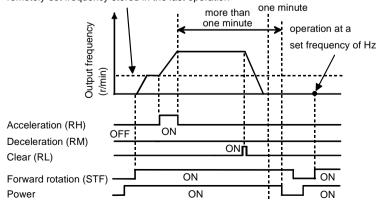
•Even when the remotely-set frequency is cleared by turning on the RL (clear) signal after turn off (on) of both the RH and RM signals, the inverter operates at the remotely-set frequency stored in the last operation if power is reapplied before one minute has elapsed since turn off (on) of both the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





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

remotely-set frequency stored in the last operation



#### CAUTION :

- •The frequency can be varied by RH (acceleration) and RM (deceleration) between 0 and the maximum frequency (Pr. 1 setting).
- •When the acceleration or deceleration signal switches on, the set frequency varies according to the slope set in Pr. 44 "second acceleration/deceleration time" or Pr. 45 "second deceleration time". The output frequency acceleration and deceleration times are as set in Pr. 7 "acceleration time" and Pr. 8 "deceleration time", respectively. Therefore, the longer preset times are used to vary the actual output frequency.
- •If the start signal (STF or STR) is off, turning on the acceleration (RH) or deceleration (RM) signal varies the preset frequency.

# **!**CAUTION

Mhen selecting this function, re-set the maximum frequency according to the machine.

#### ♦ Related parameters ♦

- RH, RM, RL signal terminal assignment ⇒ Pr. 60 to Pr. 62 (input terminal function selection) (Refer to page 99.)
- Maximum frequency setting ⇒ Pr. 1 "maximum frequency" (Refer to page 67.)
- Output frequency acceleration/deceleration time ⇒ Pr. 7 "acceleration time",
   Pr. 8 "deceleration time" (Refer to page 70.)
- Time setting for acceleration/deceleration ⇒ Pr. 44 "second acceleration/deceleration time", Pr. 45 "second deceleration time" (Refer to page 70.)

## 2.9 Terminal function selection parameters

# 2.9.1 Input terminal function selection (Pr. 60 255, Pr. 61 255, Pr. 62 255, Pr. 63 255)

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

Parameter	Name	Factory Setting	Setting Range	Remarks
60	AU terminal function selection	4		
61	RM terminal function selection	1	0 to 10, 14, 16	Setting is enabled when Pr. 30 = "1"
62	RH terminal function selection	2		Setting is enabled when Pt. 30 = 1
63	STR terminal function selection		0 to 10, 14, 16,	

#### <Setting>

Refer to the following table and set the parameters:

Setting	Signal Name	Fund	ctions	Related Parameters
0	RL	Pr. 59 = "0"	Low-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 80 to Pr. 87
0	KL	Pr. 59 = "1", "2" (*1)	Remote setting (setting clear)	Pr. 59
1	RM	Pr. 59 = "0"	Middle-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 80 to Pr. 87
'	IXIVI	Pr. 59 = "1", "2" (*1)	Remote setting (deceleration)	Pr. 59
2	RH	Pr. 59 = "0"	High-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 80 to Pr. 87
2	IXII	Pr. 59 = "1", "2" (*1)	Remote setting (acceleration)	Pr. 59
3	RT	Second function selection	ction	Pr. 44 to Pr. 47
4	AU	Current input selectio	n	
5	STOP	Start self-holding sele	ection	
6	MRS	Output shut-off stop		
7	ОН	External thermal relay The inverter stops wh provided thermal rela protection, motor's en relay etc. is actuated.	en the externally y for overheat nbedded temperature	Refer to page 155.
8	REX	15-speed selection (combination with 3 speeds RL, RM, RH) (*3)		Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 80 to Pr. 87
9	JOG	Jog operation selection	on	Pr. 15, Pr. 16
10	RES	Reset		Pr. 75
14	X14	PID control presence	absence selection	Pr. 88 to Pr. 94
16	X16	PU-external operation	n switch-over	Pr. 79 (setting: 8)
	STR	Reverse rotation start	· 	(can be assigned to STR terminal (Pr. 63) only)

<sup>\*1.</sup>When Pr. 59 = "1 or 2", the functions of the RL, RM and RH signals change as listed above.

#### **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.
- •The speed command priorities are higher in order of jog, multi-speed setting (RH, RM, RL, REX) and AU.
- •Use common terminals to assign multi-speeds (7 speeds) and remote setting. They cannot be set individually.
- (Common terminals are used since these functions are designed for speed setting and need not be set at the same time.)

<sup>\*2.</sup>Actuated when the relay contact "opens".

<sup>\*3.</sup> When using the REX signal, an external command cannot be used to make a reverse rotation start.

# 2.9.2 Output terminal function selection (Pr. 64 254, Pr. 65 255)

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

Parameter	Name	Factory Setting	Setting Range	Remarks	
64	RUN terminal function selection	0	0, 1, 3, 4,	Setting is enabled when Pr. 30 = "1"	
65	A, B, C terminal function selection	99	98, 99	when Pr. 30 = "1"	

# <Setting>

Setting	Signal Name	Function	Operation	Parameters Referred to
0	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above the starting frequency.	Pr. 2, Pr. 13
1	SU	Up to frequency	Output when the output frequency is reached.	Pr. 41
3	OL	Overload alarm	Output while stall prevention function is activated.	Pr. 21, Pr. 22, Pr. 23, Pr. 28
4	FU	Output frequency detection	Output when the output frequency rises to or above the setting.	Pr. 42, Pr. 43
11	RY	Inverter operation ready	Output when the inverter is ready to be started by switching the start signal on.	_
12	Y12	Output current detection	Output when the output current rises to or above the setting.	Pr. 48, Pr. 49
13	Y13	Zero current detection	Output when the output current reaches 0.	Pr. 50, Pr. 51
14	FDN	PID lower limit		
15	FUP	PID upper limit	Outputs the detection signal under	
16	RL	PID forward- reverse rotation output	PID control.	Pr. 88 to Pr. 94
95	Y95	Maintenance timer alarm	Output when Pr. H1 is greater than Pr. H2.	Pr. H1, Pr. H2
98	LF	Minor fault output	Output when a minor fault (fan failure or communication error warning) occurs.	Pr. 76, Pr. n5
99	ABC	Alarm output	Output when the inverter's protective function is activated to stop the output (major fault).	

#### **REMARKS**

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

# 2.10 Operation selection function parameters

# 2.10.1 Retry function (Pr. 66 255, Pr. 67 251, Pr. 68 255 , Pr. 69 252)

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

Parameter	Name	Factory Setting	Setting Range	Remarks
66	Retry selection	0	0 to 3	
67	Number of retries at alarm occurrence	0	0, 1 to 10, 101 to 110	Setting is enabled when Pr. 30 = "1"
68	Retry waiting time	1s	0.1 to 360s	oetting is enabled when it is 50 = 1
69	Retry count display erase	0	0	

#### <Setting>

•Use Pr. 66 to choose the protective functions (major faults) for retries.

Pr. 66		Protective Functions (Major Faults) for Retries											
Setting	OCT	OVT	THM	THT	FIN	GF	OHT	OLT	PE	PUE	RET	CPU	OPT
0	•	•	•	•		•	•	•	•				•
1	•												
2		•											
3	•	•											

<sup>\* •</sup> Indicates the retry items selected. (OCT denotes any of OC1 to OC3 and OVT any of OV1 to OV3.)

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

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

<sup>\*</sup> If the retry count is exceeded, " - F, " (retry count excess) is displayed.

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

#### CAUTION

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

# **ACAUTION**

riangle When you have selected the retry function, stay away from the motor and machine unless required. They will start suddenly (after the reset time has elapsed) after occurrence of an alarm.

When you have selected the retry function, apply in easily visible places the CAUTION stickers supplied to the instruction manual (basic).

# 2.10.2 PWM carrier frequency (Pr. 70 . Pr. 72 .

You can change the motor sound.

Parameter	Name	Factory Setting	Setting Range	Remarks
70	Soft-PWM setting	11	0, 1, 10,11	Setting is enabled when
72	PWM frequency selection	1		Pr. 30 = "1"

# <Setting>

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

Pr.70		Description					
Setting	Soft-PWM	Long wiring mode	Remarks				
0	Invalid	Invalid					
1	Valid (When Pr. 72 setting = any of "0" to "5")	Invalid					
10	Invalid	Valid	When Pr. 72 "PWM frequency selection" = 0 or 1, the PWM carrier frequency is constant at 0.7kHz.				
11	Invalid	Valid	<ul> <li>When Pr. 72 "PWM frequency selection" = 2 or more, the PWM carrier frequency is constant at 1kHz.</li> </ul>				

#### CAUTION

- 1. The output voltage at the rated frequency drops by a maximum of 5V.
- 2. For the 400V class, use an insulation-rectified motor.

Refer to page 23 for an inverter-driven 400V class motor.

Pr.72 Setting Description				
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 17.).
- •Metallic sound may be generated from the motor at sudden deceleration but it is not a fault.
- •If low acoustic noise operation is performed at higher PWM frequency, performing continuous operation at 75% or more of the rated current may increase motor noise, but it is not a failure.

# 2.10.3 Applied motor (Pr. 71 2011)

Set the motor used.

#### **POINT**

•When using the Mitsubishi constant-torque motor, set "1" in Pr. 71 for either V/F control or automatic torque boost control.

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	Remarks
71	Applied motor	0	0, 1	Setting is enabled when Pr. 30 = "1"

#### <Setting>

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

Pr. 71 Setting Electronic Overcurrent Protection Thermal Characteristic					
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.

# 2.10.4 Voltage input selection (Pr. 73 2011)

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

Parameter	Name	Factory Setting	Setting Range	Remarks	
73	0-5V/0-10V selection	0	- /	IO: O-5VIDC. INDIT	Setting is enabled when Pr. 30 = "1"

#### CAUTION

- •The acceleration/deceleration time, which is a slope up/down to the acceleration/deceleration reference frequency, is not affected by the change in Pr. 73 setting.
- •When connecting a frequency setting potentiometer across terminals 10-2-5 for operation, always set "0" in this parameter.

# 2.10.5 Input filter time constant (Pr. 74 PR)

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

• Effective for eliminating noise in the frequency setting circuit.

Parameter	Name	Factory Setting	Setting Range	Remarks
74	Input filter time constant	1	0 to 8	Setting is enabled when Pr. 30 = "1"

#### <Setting>

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

# 2.10.6 Reset selection/PU stop selection (Pr. 75 PS)

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 (STOP) RESET) key.

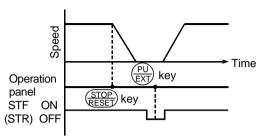
Parameter	Name	Factory Setting	Setting Range	Remarks
75	Reset selection/ PU stop selection	14	0, 1, 14, 15	Setting is enabled when Pr. 30 = "1"

#### <Setting>

Pr. 75 Setting	Reset Selection	PU Stop Selection		
0	Reset input normally enabled.	The PU stop key is invalid. Note that the RESET key is valid only in the PU operation mode or combined operation mode (Pr. 79 = "4").		
1	Enabled only when the protective function is activated.			
14	Reset input normally enabled.	Pressing the (STOP) key decelerates the inverter to		
	Enabled only when the protective function is activated.	a stop in any of the PU, external and communication operation modes.		

# (1) How to make a restart after a stop by the STOP key input from the operation panel (Restarting method with [95] shown)

- After completion of deceleration to a stop, switch off the STF or STR signal.
- 2. Press the PU key to show PU (P5 canceled)
- 3. Press the  $\frac{PU}{EXT}$  key to return to  $\frac{EXT}{EXT}$ .
- 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 (all) 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 PS and  $\Pi\Pi$ . An alarm is not output.

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

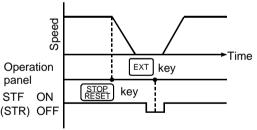
STOP RESET **key** 

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

2. Press the EXT key.

(**P5** 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 reset or resetting the inverter with the inverter's reset terminal.

#### **REMARKS**

- •By entering the reset signal (RES) during operation, the inverter shuts off output while it is reset, the data of the electronic overcurrent protection and regenerative brake duty are reset, and the motor coasts.
- •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 (all) 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

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

# 2.10.7 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	Remarks
76	Cooling fan operation	0	0, 1	0: Operation is performed with Setting is enabled when
	selection			1: Cooling fan ON/OFF control Pr. 30 = "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  Always on during inverter operation  During stop (reset or error), the inverter status is monitored and the fan is switched on/off according to the temperature.  Heatsink temperature is less than 40°C

#### REMARKS

In either of the following cases, fan operation is regarded as faulty,  $F_{n}$  is shown on the operation panel, and the minor fault (LF) signal is output. Use any of Pr. 64, Pr. 65 (output terminal function selection) to allocate the terminal used to output the LF signal.\*

•Pr. 76 = "0"

When the fan comes to a stop with power on.

When the inverter is running and the fan stops during fan ON command.

#### CAUTION

\* When the terminal assignment is changed using Pr. 64, Pr. 65, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

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

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	Remarks
77	Parameter write disable selection	0	0, 1, 2	Setting is enabled when Pr. 30 = "1"

# <Setting>

Pr. 77 Setting	Function
0	Write is enabled only during a stop in the PU operation mode. (*)
1	Write disabled.
'	Values of Pr. 22, Pr. 30, Pr. 75, Pr. 77 and Pr. 79 can be written.
2	Write is enabled even during operation. Write is enabled independently of
2	the operation mode.

#### CAUTION

- •\* The shaded parameters in the parameter list can be set at any time. Note that the Pr. 70 and Pr. 72 values may be changed during PU operation only.
- •If Pr. 77 = 2, the values of Pr. 17, Pr. 23, Pr. 28, Pr. 60 to Pr. 63, Pr. 71, Pr. 79, Pr. 98, Pr. 99, CLr cannot be written during operation. Stop operation when changing their parameter settings.
- •By setting "1" in Pr. 77, the following clear operations can be inhibited:
  - Parameter clear
  - All clear

# 2.10.9 Reverse rotation prevention selection (Pr. 78 PR)

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

#### POINT

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

Parameter	Name	Factory Setting	Setting Range	Remarks
78	Reverse rotation prevention selection	0	0, 1, 2	Setting is enabled when Pr. 30 = "1"

#### <Setting>

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

# 2.10.10 Operation mode selection (Pr. 79 PR)

Used to select the operation mode of the inverter.

The inverter can be run from the control panel or parameter unit (PU operation), with external signals (external operation), or by combination of PU operation and external operation (external/PU combined 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, 7, 8

#### <Setting>

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

		.L				
Pr. 79 Setting		Function	LED Indication *	EXT		
0	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 (PU key) or parameter unit PU EXT key). For each mode, refer to the columns of settings 1 and 2.			Refe settir "1" a "2".	r to	
1		ion Setting from operation		Off: Stop without start	On (Off)	Off
2	mode External operation mode	panel or FR-PU04  External signal input (across terminals 2(4)-5, multi-speed selection, jog)	External signal input (terminal STF, STR)	Forward rotation: On	Off	On
3	External/ PU combined operation mode 1	Dial of operation panel, digital setting by parameter unit key operation, or external signal input (multi- speed setting, across terminals 4-5 (valid when AU signal is on))	External signal input (terminal STF, STR)	With start command Without frequency setting	On	On
4	External/ PU combined operation mode 2	External signal input (across terminals 2(4)-5, multi-speed selection, jog)	RUN key			
7	External operation mode (PU operation interlock) MRS signal ON Switching to PU operation mode				Refe settir	ngs
8	during operation X16 signal Of	de change using external signa on) N Switched to external op- mode F Switched to PU operation	eration		"2".	ΠÜ

#### REMARKS

- •In other than the PU operation mode, the stop function (PU stop selection) activated by pressing (STOP) of the PU (operation panel/FR-PU04) is valid. (Refer to page 106.)
- •PU operation/external combined operation is available in two ways by setting values of "3" and "4". They are differ in starting method.
- •Refer to page 128 for the computer link operation mode.
- \*When the FR-PU04 is connected, the LED indicators (PU, EXT) are not lit. In the computer operation mode, the LED indicators (PU, EXT) flicker slowly.

#### (1) PU operation interlock

PU operation interlock forces the operation mode to be changed to the external operation mode when the MRS signal switches off. This function prevents the inverter from being inoperative by the external command if the mode is accidentally left unswitched from the PU operation mode.

#### 1) Preparation

- •Set "7" in Pr. 79 (PU operation interlock).
- Set the terminal used for MRS signal input with any of Pr. 60 to Pr. 63 (input terminal function selection).

Refer to page 99 for Pr. 60 to Pr. 63 (input terminal function selection).

#### **REMARKS**

When terminal assignment is changed using Pr. 60 to Pr. 63, the other functions may be affected.

Check the functions of the corresponding terminals before making settings.

#### 2) Function

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

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

Operating Condition		MRS	Operation		Parameter	Switching to
Operation mode	Status	Signal	Mode (*2)	Operating Status	Write	PU Operation Mode
	During stop	ON → OFF (*1)		During stop	Allowed → disallowed	Disallowed
PU	During operation	ON → OFF (*1)	PU → External	If external operation frequency setting and start signal are entered, operation is performed in that status.	Allowed → disallowed	Disallowed
	During	OFF → ON		During stop	Disallowed → disallowed	Allowed
External	stop	$ON \rightarrow OFF$	External	During stop	Disallowed → disallowed	Disallowed
LAIGIIIdi	During	OFF → ON		During operation → output stop	Disallowed → disallowed	Disallowed
	operation	$ON \rightarrow OFF$		Output stop → operation	Disallowed → disallowed	Disallowed

#### REMARKS

- •If the MRS signal is on, the operation mode cannot be switched to the PU operation mode when the start signal (STF, STR) is on.
- \*1. The operation mode switches to the external operation mode independently of whether the start signal (STF, STR) is on or off.
  - Therefore, the motor is run in the external operation mode when the MRS signal is switched off with either of STF and STR on.
- \*2. Switching the MRS signal on and rewriting the Pr. 79 value to other than "7" in the PU operation mode causes the MRS signal to act as the ordinary MRS function (output stop). Also as soon as "7" is set in Pr. 79, the signal acts as the PU interlock signal.

# (2) Operation mode switching by external signal

1) Preparation

Set "8" (switching to other than external operation mode) in Pr. 79. Use any of Pr. 60 to Pr. 63 (input terminal function selection) to set the terminal used for X16 signal input.

#### REMARKS

When terminal assignment is changed using Pr. 60 to Pr. 63, the other functions may be affected.

Check the functions of the corresponding terminals before making settings.

For details refer to page 99.

#### 2) Function

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

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

P80 to P80  $\Rightarrow$  Refer to P4 to [5] (page 69).

# 2.10.11 PID control (Pr. 88 BB to Pr. 94 BB)

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

The voltage input signal (0 to +5V or 0 to +10V) or Pr. 93 setting is used as a set point and the 4 to 20mADC current input signal used as a feedback value to constitute a feedback system for PID control.

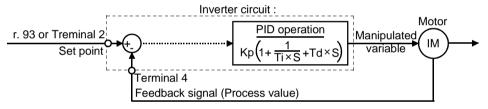
#### POINT

Made valid by turning on the X14 signal. Use Pr. 60 to Pr. 63 (input terminal function selection) to make assignment.

Parameter	Name	Factory Setting	Setting Range	Remarks
88	PID action selection	20	20, 21	
89	PID proportional band	100%	0.1 to 999 %,	
90	PID integral time	1s	0.1 to 999s,	
91	PID upper limit		0 to 100%,	Setting is enabled when Pr. 30 = "1"
92	PID lower limit		0 to 100%,	
93	PID action set point for PU operation	0%	0 to 100%	
94	PID differential time		0.01 to 10s,	

#### <Setting>

## (1) Basic PID control configuration



Kp: Proportion constant Ti: Integral time S: Operator Td: Differential time

# (2) PID action overview

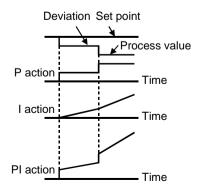
#### 1) PI action

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

#### **REMARKS**

PI action is the sum of P and I actions.

#### [Operation example for stepped A combination of proportional control changes of process value]



#### 2) PD action

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

#### **REMARKS**

PD action is the sum of P and D actions.

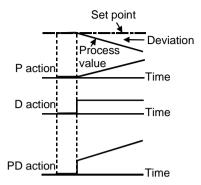
PID action
 The PI action and PD action are combined to utilize the advantages of both actions for control.

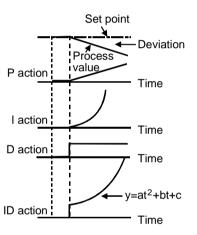
#### **REMARKS**

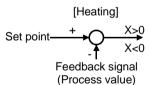
The PID action is the sum of P, I and D actions.

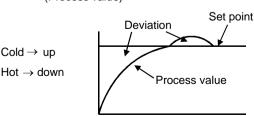
4) Reverse action Increases the manipulated variable (output frequency) if deviation X = (set point - process value) is positive, and decreases the manipulated variable if deviation is negative.

# [Operation example for proportional changes of process value]



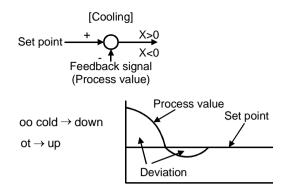






# 5) Forward action Increases the manipulated variable (output frequency) if deviation X = (set point process value) is negative, and decreases the manipulated

variable if deviation is positive.



#### Relationships between deviation and manipulated variable (output frequency)

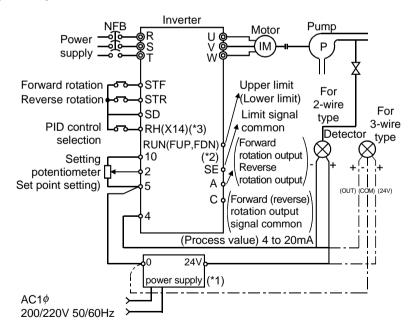
	Deviation		
	Positive Negative		
Reverse action	7	Ä	
Forward action	Ä	7	

#### (3) Wiring example



•Pr. 64 = 15

•Pr. 65 = 16 •Pr. 88 = 20



#### CAUTION

<sup>\*1.</sup>The power supply must be selected in accordance with the power specifications of the detector used.

<sup>\*2.</sup>The output signal terminals used depends on the Pr. 64, Pr. 65 settings. \*3.The input signal terminal used depends on the setting of Pr. 60 to Pr. 63.

<sup>•</sup>The contact input signal (AU Signal) need not be turned on.

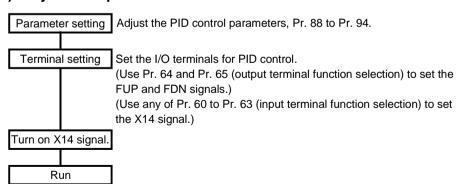
# (4) I/O signals

Sign	nal	<b>Terminal Used</b>	Function	Description
	X14	Depending on	PID control	Turn on X14 to exercise PID control.
	A14	Pr. 60 to Pr. 63	selection	Tulli on X14 to exercise FID control.
Input	2	2	Set point input	Enter the set point for PID control.
	4	4	Process value	Enter the 4 to 20mADC process value
	4	4	input	signal from the detector.
	FUP		Upper limit output	Output to indicate that the process value
	FUF		Opper iiinii output	signal exceeded the upper limit value.
	FDN		Lower limit output	Output to indicate that the process value
Output	I DIN	Depending on	Lower minit output	signal exceeded the lower limit value.
Output		Pr. 64, Pr. 65	Forward (reverse)	"Hi" is output to indicate that the output
	Б.			indication of the parameter unit is forward
	RL		rotation direction	rotation (FWD) or "Low" to indicate that it is
			output	reverse rotation (REV) or stop (STOP).

- Enter the set point across inverter terminals 2-5 or in Pr. 93 and enter the process value signal across inverter terminals 4-5.
- To exercise PID control, turn on the X14 signal. When this signal is off, PID control is not exercised.

Item	Entry	Description			
		Set 0V as 0% and 5V as 100%.	When "0" is set in Pr. 73 (5V		
	Across	Set ov as 0% and 5v as 100%.	selected for terminal 2).		
Set point	terminals 2-5	Set 0V as 0% and 10V as 100%.	When "1" is set in Pr. 73 (10V		
		Set ov as 0% and 10v as 100%.	selected for terminal 2).		
	Pr. 93	Set the set point (%) in Pr. 93.			
Process	Across	Am A is equivalent to 0% and 20m A to 100%			
value	terminals 4-5	4mA is equivalent to 0% and 20mA to 100%.			

# (5) Adjustment procedure

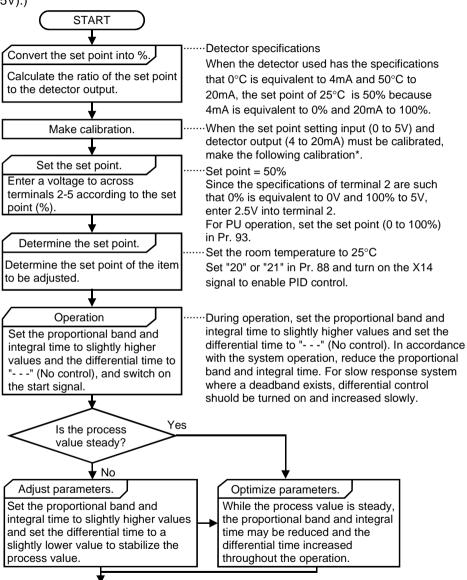


# (6) Parameter setting

Parameter Number	Name	Setting	Description		
	PID action	20	For heating, pressure control, etc.	PID reverse action	
88	selection	21	For cooling, etc.	PID forward action	
89	PID proportional band		If the proportional band is narrow (psmall), the manipulated variable vaslight change of the process value. proportional band narrows, the responding improves but the stability dethunting occurs.  Gain K = 1/proportional band	ries greatly with a Hence, as the conse sensitivity	
			No proportional control		
90	PID integral time	0.1 to 999s	Time required for the integral (I) ac same manipulated variable as that (P) action. As the integral time deci is reached earlier but hunting occur	for the proportional reases, the set point	
			No integral control.		
91	91 PID upper 0 to 100°		Set the upper limit. If the feedback value exceeds the setting, the FUP signal is output. (Process value of 4mA is equivalent to 0% and 20mA to 100%.)		
			No function		
92	PID lower limit	0 to 100%	Set the lower limit. (If the feedback setting, the FDN signal is output. In process value of 4mA is equivalent 100%.)	this case, the	
			No function  Valid only when Pr. 79 = "3" (n9 = 0)	) for computer link	
93	PID action set point for PU operation	0 to 100%	operation) under the PU command or PU/external combined mode. (Whas the speed command write in thoperation mode (NET)) For external operation, the voltage point. (C3 value is equivalent to 0% and 0	in the PU operation /hen the computer e computer link across 2-5 is the set C4 value to 100%.)	
94	PID differential time	0.01 to 10s	Time required for the differential (D the same process value as that for action. As the differential time increresponse is made to a deviation ch No differential control.	) action to provide the proportional (P) ases, greater	

# (7) Calibration example

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



\*When calibration → Use Pr. 38 and calibration parameters C2 to C4 (terminal 2) is required and Pr. 39 and calibration parameters C5 to C7 (terminal 4) to calibrate the detector output and set point setting input.

Make calibration in the PU mode when the inverter is at a stop.

**END** 

#### <Set point input calibration>

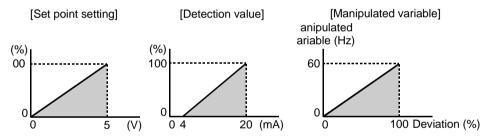
- 1. Apply the input voltage of 0% set point setting (e.g. 0V) across terminals 2-5.
- Make calibration using the calibration parameters C2, C3. At this time, enter in C2 the frequency which should be output by the inverter at the deviation of 0% (e.g. 0Hz). (When using the FR-PU04, make calibration with Pr. 902.)
- 3. Apply the voltage of 100% set point (e.g. 5V) to across terminals 2-5.
- 4. Make calibration using Pr. 38 and calibration parameter C4. At this time, enter in Pr. 38 the frequency which should be output by the inverter at the deviation of 100% (e.g. 60Hz). (When using the FR-PU04, make calibration with Pr. 903.)

#### <Detector output calibration>

- 1. Apply the output current of 0% detector setting (e.g. 4mA) across terminals 4-5.
- 2. Make calibration using the calibration parameter C6. (When using the FR-PU04, make calibration with Pr. 904.)
- 3. Apply the output current of 100% detector setting (e.g. 20mA) across terminals 4-5.
- Make calibration using the calibration parameter C7. (When using the FR-PU04, make calibration with Pr. 905.)

Note: The frequencies set in the calibration parameter C5 and Pr. 39 should be equal to those set in the calibration parameter C2 and Pr. 38, respectively.

The results of the above calibration are as shown below:



#### **REMARKS**

- •If the multi-speed (RH, RM, RL) signal or jog operation (jog signal) is entered, PID control is stopped and multi-speed or jog operation is started.
- •When the terminal functions are changed using Pr. 60 to Pr. 65, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.
- •When PID control is selected, the minimum frequency is the frequency set in the calibration parameter C2 and the maximum frequency is the frequency set in Pr. 38. (The Pr. 1 "maximum frequency" and Pr. 2 "minimum frequency" settings are also valid.)

#### - ♦Related parameters ♦

- X14 signal assignment ⇒ Pr. 60 to Pr. 63 (input terminal function selection) (refer to page 99)
- FUP, FDN and RL signal assignment ⇒ Pr. 64 "RUN terminal function selection", Pr. 65 "A, B, C terminal function selection" (refer to page 101)
- Voltage input selection (0 to ±5V, 0 to ±10V) ⇒ Pr. 73 "0-5V/0-10V voltage input selection" (refer to page 105)
- Operation mode selection ⇒ Pr. 79 "operation mode selection" (refer to page 110)
- Making terminal calibration ⇒ Pr. 38, Pr. 39, C2 to C7 (calibration parameters) (refer to page 84)

# 2.11 Auxiliary function parameters

# 2.11.1 Slip compensation (Pr. 95 23, Pr. 96 23, Pr. 97 23)

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

Parameter	Name	Factory Setting	Setting Range	Remarks
95	Rated motor slip		0 to 50%,	
96	Slip compensation time constant	0.5s		Setting is enabled when Pr. 30 = "1"
97	Constant-output region slip compensation selection		0,	Wilei 1 1. 30 = 1

# <Setting>

# Rated slip = Synchronous speed at base frequency - rated speed ×100[%]

Parameter	Setting	Function	
95 0.01 to 50%		Used to set the rated motor slip.	
93	0,	Slip compensation is not made.	
96	0.01 to 10s	Used to set the slip compensation response time. (*)	
97	0	Slip compensation is not made in the constant output range (frequency range above the frequency set in Pr. 3).	
		Slip compensation is made in the constant output range.	

<sup>\*</sup>When this value is made smaller, response will be faster.

However, as load inertia is greater, a regenerative overvoltage (OVT) error is more liable to occur.

#### **REMARKS**

When making slip compensation at 60Hz, set the maximum frequency (Pr. 1) to slightly higher than 60Hz.

In the factory setting status, it is clamped at 60Hz.

# 2.11.2 Automatic torque boost selection (Pr. 98 PR)

You can choose automatic torque boost control.

• Automatic torque boost control

Not only gives the motor the optimum excitation but also provides high torque even in a low speed range.

Parameter	Name	Factory Setting	Setting Range	Remarks
98	Automatic torque boost selection (motor capacity)			Setting is enabled when Pr. 30 = "1"

#### <Operating conditions>

- •The number of motor poles should be any of 2, 4 and 6 poles.
- Single-motor operation (One motor for one inverter)
- •The wiring length from inverter to motor should be within 30m.

# <Setting>

Parameter	Setting Description		
		Ordinary V/F control and torque boost (Pr. 0, Pr. 46) are valid.	
98	0.2 to 15kW	Automatic torque boost control valid	
	U.2 10 15KVV	(Set the applied motor capacity or one rank lower motor capacity.)	

- Also when the Pr. 98 setting is other than "- -", Pr. 3 "base frequency" and Pr. 19 "base frequency voltage" are valid.
- When "- -" or "888" is set in Pr. 19, the rated output voltage is selected.

#### CAUTION

\* During operation using automatic torque boost, write to Pr. 3 and Pr. 19 is disabled if "2" is set in Pr. 77.

#### ◆Related parameters ◆ -

- Torque boost ⇒ Pr. 0 "torque boost", Pr. 46 "second torque boost" (refer to page 66)
- Base frequency ⇒ Pr. 3 "base frequency", Pr. 19 "base frequency voltage" (refer to page 68)
- Applied motor setting ⇒ Pr. 71 "applied motor" (refer to page 105)
- Motor primary resistance ⇒ Pr. 99 "motor primary resistance" (refer to page 123)

# 2.11.3 Motor primary resistance (Pr. 99 PS)

Generally this parameter need not be set. At the factory setting of "- - -", the standard motor constant of the motor capacity set in Pr. 98 (including that of the constant-torque motor) is used.

Parameter	Name	Factory Setting	Setting Range	Remarks
99	Motor primary resistance		0 to $50\Omega$ ,	Setting is enabled when Pr. 30 = "1"

#### ◆Related parameters◆

- Applied motor setting ⇒ Pr. 71 "applied motor" (refer to page 105)
- Automatic torque boost selection ⇒ Pr. 98 "automatic torque boost selection (motor capacity)" (refer to page 122)

# 2.12 Maintenance function parameters

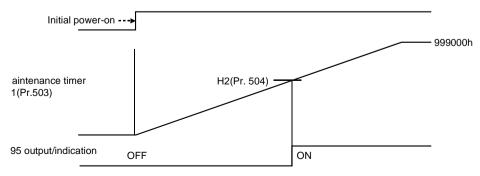
# 2.12.1 Maintenance output function (H1 HT, H2 H 2)

The maintenance timer alarm signal (Y95) is output when the cumulative energization time (H1 "maintenance timer") of the inverter reaches the time set in H2 "maintenance alarm output set time". (Used to alert the operator of the main circuit smoothing capacitor life expiration, for example.)

Parameter	Name	Factory Setting	Setting Range	Rem	arks
H1(503)	Maintenance timer	0	0 to 999		Setting can be made when Pr.
H2(5()4)	Maintenance alarm output set time	0 (87600h)	1 () to 999	l Function as	30 = "1"

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

# <Setting>



- 1) H1 (Pr. 503) "maintenance timer"
  - •The cumulative energization time of the inverter is stored into the E<sup>2</sup>PROM every hour and indicated in 1000h increments. (Cannot be written.)
  - •The maintenance timer is clamped at 999 (999000h).
- 2) H2 (Pr. 504) "maintenance alarm output set time"
  - •Set the time when the maintenance timer alarm signal (Y95) is output.
  - •The setting unit is 1000h.

#### REMARKS

The factory setting (87600h) is the guideline for the main circuit smoothing capacitor life (about 10 years in the operating environment of 40°C ambient temperature, 24h/day, and 365 days/year) of the inverter. The lifetime changes depending on the operating environment of the inverter.

- 3) Maintenance timer alarm signal (Y95)
  - Made valid by setting "95" (maintenance timer alarm output signal) in Pr. 64 or Pr.
     65 (output terminal function selection).
  - •If the value set in H2 is equal to or greater than the H1 setting, the maintenance timer alarm output (Y95) turns off.

#### ♦ Related parameters ♦

 Y95 signal terminal assignment Pr. 64 "RUN terminal function selection", Pr. 65 "A, B, C terminal function selection" (Refer to page 101)

# 2.13 Calibration parameters

# 2.13.1 Meter (frequency meter) calibration (C1

- By using the operation panel or parameter unit, you can calibrate an analog meter connected to terminal FM to full scale deflection.
- Terminal FM provides the pulse output. By setting the calibration parameter C1, you can use the parameter to calibrate the analog meter connected to the inverter without providing a calibration resistor.

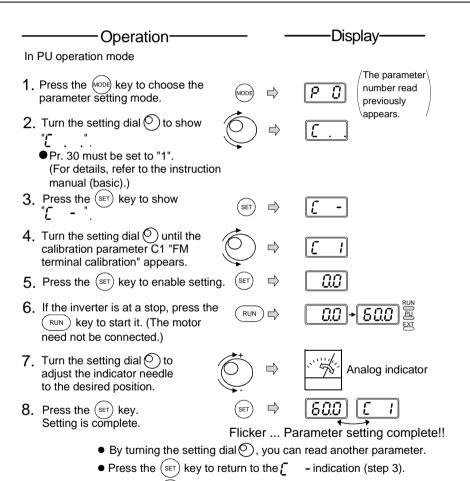
Parameter	Name	Factory Setting	Setting Range	Remarks
C1 (900)	FM terminal calibration			Setting is enabled when Pr. 30 = "1"

The parameter number in parentheses applies to when the parameter unit (FR-PU04) is used.

Changing example | Deflecting the meter (analog indicator) to full-scale (1mA) at the preset frequency of 60Hz (for frequency setting, refer to the instruction manual (basic).)

#### POINT

- •The calibration parameters "C1" can be made to be ready by setting "1" (extended function parameter valid) in Pr. 30 "extended function display selection".
- •Set the value of the calibration parameter C1 "FM terminal calibration".



#### **REMARKS**

- •Depending on the set value, it may take some time for the needle to move.
- •If "1" is set in Pr. 30 "extended function display selection", the calibration parameter C1 "FM terminal calibration" can also be set in the external operation mode.
- •C1 is factory-set to 1mA full-scale or 1440 pulses/s FM output frequency at 60Hz. The maximum pulse train output of terminal FM is 2400 pulses/s.
- •When a frequency meter is connected to across terminals FM-SD to monitor the running frequency, the FM terminal output is filled to capacity at the factory setting if the maximum output frequency reaches or exceeds 100Hz. In this case, the Pr. 55 setting must be changed to the maximum frequency.
- •When the FR-PU04 is used, make calibration with Pr. 900.

#### POINT

By setting the Pr. 54 "FM terminal function selection" value, preset Pr. 55 "frequency monitoring reference" or Pr. 56 "current monitoring reference" to the running frequency or current value at which the output signal is 1440 pulses/s.

At 1440 pulses/s, the meter generally deflects to full-scale.

#### ◆Related parameters◆

Choosing signal to be output to FM terminal ⇒ Pr. 54 "FM terminal function selection" (refer to page 92)

Reference values of frequency and current values ⇒ Pr. 55 "frequency monitoring reference",
Pr. 56 "current monitoring reference"
(refer to page 94)

[ 2] to [ 7] → Refer to [ 938], [ 939] (page 84).

# 2.14 Clear parameters

# 2.14.1 Parameter clear (CLr III)

Initializes the parameter values to the factory settings. Clear the parameters during a stop in the PU operation mode.

Parameter	Name	Factory Setting	Setting Range	Remarks	
CLr	Parameter clear	0	0, 1, 10	C7 are not cleared) 10: All clear *2	Setting is enabled when Pr. 30 = "1"

<sup>\*1.</sup>Parameters are not cleared by setting "1" in Pr. 77 "parameter write disable selection".

- Pr. 75 "reset selection/PU stop selection", Pr. 38, Pr. 39, Pr. 53, Pr. 60 to Pr. 65, Pr. 99, maintenance function parameters H1, H2, calibration parameters C1 to C7 and communication parameters n13, n15 are not cleared.
- \*2.Pr. 75 "reset selection/PU stop selection", maintenance function parameter H1 "maintenance timer" and communication parameter n13 "PU display language selection" are not cleared.

#### **REMARKS**

\*1. For details of the operation procedure, refer to the instruction manual (basic).

# 2.14.2 Alarm history clear (ECL EEL)

Erases the alarm history.

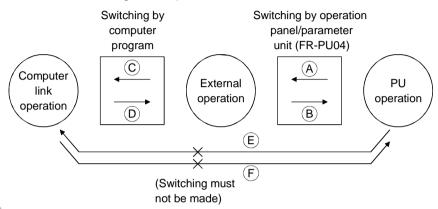
Parameter	Name	Factory Setting	Setting Range	Remarks	
ECL	Alarm history clear	0	() 1	0: Not cleared 1: Alarm history clear	Setting is enabled when Pr. 30 = "1"

# 2.15 Communication parameters

You can perform communication operation from the RS-485 connector of the inverter through RS-485.

#### (1) Operational functions

1) Operation mode switching [Operation mode switching method]



Symbol	Switching Type		Switching M	ethod	
A	IONATATION	Using the PU key of the operation panel or PU EXT key of the parameter unit (FR-PU04)			
B	IONERATION	Using the $(EXT)$ key of the operation panel or $(EXT)$ key of the parameter unit (FR-PU04)			
©	External operation to computer link operation	Using the computer program	Read (H7B)/	H0000: Communication operation	
D		Using the computer program	Write (HFB)	H0001: External operation	
Ē	PU operation to computer link operation	Switching must not be made (External operation may be selected at (A) and then switched to computer link operation at (C)*)			
Ē	Computer link operation to PU operation	Switching must not be made (External operation may be selected at ① and then switched to PU operation at ⑧*)			

<sup>\*</sup> When "1" is set in the communication parameter n10 "link startup mode selection", the inverter is placed in the computer link operation mode at power-on or inverter reset. (Note that it is overridden by the Pr. 79 "operation mode selection" setting.)

#### **REMARKS**

Unlike the other inverters, the FR-F500J series is not the type of inverter whose operation panel is removed to make communication.

Parameter setting using setup S/W is not enabled in the PU operation mode and external / PU combined operation mode (Pr. 79 = 1, 3, 4). Also, pressing the RUN key on the operation panel starts the inverter in the external / PU combined operation mode. (Pr. 79=1, 3)

#### 2) Operation mode-based functions

Operation	Operation Mode			
Location	Item	PU operation	External operation	Computer link operation
Operation panel or FR-PU04	Run command (start)	Enabled	Enabled (Combined operation mode)	Disabled
	Running frequency setting	Enabled	Enabled (Combined operation mode)	Disabled
	Monitoring	Enabled	Enabled	Enabled
	Parameter write	Enabled (*4)	Disabled	Disabled
	Parameter read	Enabled	Enabled	Enabled
	Inverter reset	Enabled	Enabled	Enabled
	Stop command	Enabled	Enabled (*3)	Enabled (*3)
On-computer	Run command	Disabled	Disabled	Enabled (*1)
user program by RS-485	Running frequency setting (*)	Disabled	Disabled	Enabled (*1)
communication	Monitoring	Enabled	Enabled	Enabled
	Parameter write	Disabled	Disabled	Enabled (*4)
	Parameter read	Enabled	Enabled	Enabled
	Inverter reset	Disabled	Disabled	Enabled (*2)
	Stop command	Disabled	Disabled	Enabled
Control circuit	Inverter reset	Enabled	Enabled	Enabled
external terminal	Run command	Enabled (Combined operation mode)	Enabled	Enabled (*1)
	Running frequency setting	Enabled (Combined operation mode)	Enabled	Enabled (*1)

<sup>\*1.</sup> As set in the communication parameters n8 "operation command source" and n9 "speed command source". (refer to page 144)

#### CAUTION

\* When the user program of the computer is used to make the running frequency setting by RS-485 communication, setting can be made in the minimum setting increments of 0.01Hz, but the setting may be written to the inverter in increments of 0.1Hz. (0 is written in the second decimal place.)

#### POINT

To perform parameter write, give an operation command, make inverter reset, etc. using RS-485 communication, the operation mode must be changed to the "computer link operation mode".

Set "0", "2", "7" or "8" in Pr. 79 "operation mode selection" to select the external operation mode, and change the operation mode to the "computer link operation mode" in either of the following methods.

- 1) Set "1" in the communication parameter n10 "link startup mode selection" to start the inverter in the "computer link operation mode" at power-on. (Refer to page 145 for the communication parameter n10.)
- 2) Using operation mode write (instruction code HFB), write H0000 to choose the "computer link operation mode". (Refer to page 138 for operation mode write.)

<sup>\*2.</sup> At occurrence of RS-485 communication error, the inverter cannot be reset from the computer.

<sup>\*3.</sup> As set in Pr. 75 "reset selection/PU stop selection".

<sup>\*4.</sup> As set in Pr. 77 "parameter write disable selection".

# 2.15.1 Communication settings (n1 and to n7 and, n11 and)

#### Communication-related parameters

Parameter	Name	Factory Setting	Setting Range	Remarks	Reflection Timing
n1(331)	Communication station number	0	0 to 31		After reset
n2(332)	Communication speed	192	48,96,192		After reset
n3(333)	Stop bit length	1	0,1,10,11		After reset
n4(334)	Parity check presence/absence	2	0,1,2		After reset
n5(335)	Number of communication retries	1	00 to 10,	Setting is enabled when Pr. 30 = "1"	Immediately
n6(336)	Communication check time interval (*)	0s	0, 0.1 to 999s,		Immediately
n7(337)	Waiting time setting		0 to 150ms,		After reset
n11(341)	CR/LF selection	1	0,1,2		After reset

- The parameter numbers within parentheses are those for use of the parameter unit (FR-PU04).
- Refer to page 176 for the instruction codes.

# POINTS

\* When making RS-485 communication, set any value other than 0 in the communication parameter n6 "communication check time interval". RS-485 communication is disabled if n6 remains unchanged from the factory setting "0s".

#### Communication specifications

	ltem		Computer		
Confor	ming star	ndard	RS-485 Standard		
Number of inverters connected		ters	1:N (max. 32 inverters)		
Comm	unication	speed	Selected between 19200, 9600 and 4800bps		
Contro	l protocol		Asynchronous		
Comm	Communication method		Half-duplex		
no S	Character system		ASCII (7 bits/8 bits) selectable		
atic	Stop bit	length	Selectable between 1 bit and 2 bits.		
nic Sati	Terminat	or	CR/LF (presence/absence selectable)		
	Parity check		Selectable between presence (even/odd) and absence		
Communication specifications	Check system Sum check		Presence		
Waiting	time set	ting	Selectable between presence and absence		

#### REMARKS

- •For computer link operation, set 65520 (HFFF0) as the value "888" and 65535 (HFFFF) as the value "---".
- •Refer to page 45 for handling the RS-485 connector.
- •Refer to the "parameter data code list" (page 176) for the data codes of the parameters.

#### <Setting>

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

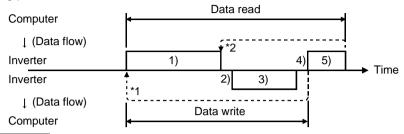
Note: After making the initial setting of the parameters, always reset the inverter. After you have changed the communication-related parameters, communication cannot be made until the inverter is reset.

Parameter	Description	Setti		Description
n1	Communication station number	0 to	31	Station number specified for communication from the RS-485 connector. Set the inverter station numbers when two or more inverters are connected to one personal computer.
		48	}	4800bps
n2	Communication	96	3	9600bps
	speed	19	2	19200bps
		8 bits	0	Stop bit length 1 bit
n3	Ctop hit langth	8 DIIS	1	Stop bit length 2 bits
113	Stop bit length	7 bits	10	Stop bit length 1 bit
		7 DILS	11	Stop bit length 2 bits
	Parity check	0		Absent
n4	presence/	1		Odd parity present
	absence	2		Even parity present
	Number of communication retries (6553)		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 (OPT).
n5			35)	If a communication error occurs, the inverter will not come to an alarm stop. At this time, the inverter can be coasted to a stop by MRS or RES input. During a communication error (H0 to H5), the minor fault signal (LF) is switched on. Allocate the used terminal with any of Pr. 64, Pr. 65 (output terminal function selection).
		0		No communication
n6	Communication check time interval	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 (OPT).
				Communication check suspension.
n7	Waiting time setting	0 to 150		Set the waiting time between data transmission to the inverter and response.
	Journa			Set with communication data.
		0		Without CR/LF
n11	CR/LF selection	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 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.	Oper	ation	Run Command	Running Frequency	Parameter Write	Inverter Reset	Monitor- ing	Parame- ter Read
1)	Communication is sent to the accordance user prograr computer.	inverter in with the	A'	A (A")*1	A (A")*2	А	В	В
	Inverter data time	processing	Present	Present	Present	Absent	Present	Present
3)	Reply data from the inverter.(Da	No error* (Request accepted)	С	С	С	Absent	E, E' (E")*1	E (E")*2
3)	ta 1) is checked for error)	With error (request rejected)	D	D	D	Absent	F	F
4)	Computer pr delay time	ocessing	Absent	Absent	Absent	Absent	Absent	Absent
	Answer from computer in	No error* (No inverter processing)	Absent	Absent	Absent	Absent	G (Absent)	G (Absent)
5)	response to reply data 3). (Data 3) is checked for error)	With error. (Inverter outputs 3) again.)	Absent	Absent	Absent	Absent	I	Н

<sup>\*</sup> 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 135.)

#### **REMARKS**

- \*1. Setting any of "0.1" to "999" in Pr. 37 "speed display" and "1" in instruction code "HFF" sets the data format to A" or E" (6-digit data). Also, the output frequency turns to a speed display, which is valid in 0.01r/min increments. (The third decimal place is invalid.) If the instruction code "HFF" is other than "1", the display is in 1r/min increments and a 4-digit data format can be used. Reply data is given in format E if the requested monitor data has 4 digits, in format E' if the data has 2 digits, or in format E" if the data has 6 digits.
- \*2. The data format to read/write Pr. 37 "speed display" is always E"/A" (6-digit data).

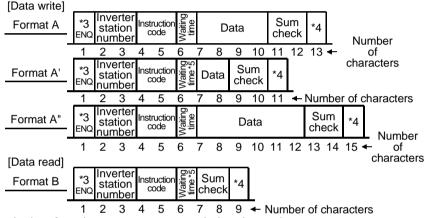
#### (3) Data format

Data used is hexadecimal.

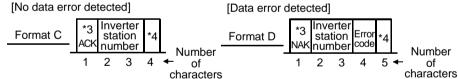
Data is automatically transferred in ASCII between the computer and inverter.

Data format types

1) Communication request data from computer to inverter

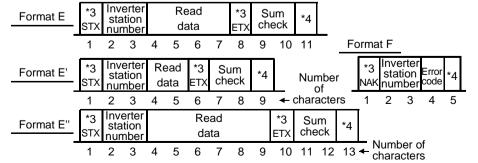


2) Reply data from inverter to computer during data write

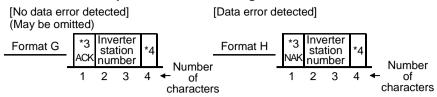


 Reply data from inverter to computer during data read [No data error detected]

[Data error detected]



#### 4) Send data from computer to inverter during data read



#### **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 n11.

 $\bullet$ At \*5, when communication parameter n7 "waiting time setting"  $\neq$  - - -, 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

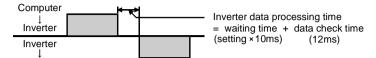
Specify the processing request, e.g. operation, monitoring, given by the computer to the inverter. Hence, the inverter can be run and monitored in various ways by specifying the instruction code as appropriate. (Refer to page 176.)

#### 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 176.)

#### 5) Waiting time

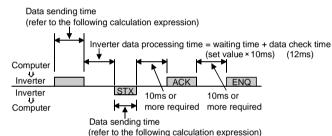
Specify the waiting time between the receipt of data at the inverter from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments (e.g., 1 = 10ms, 2 = 20ms).



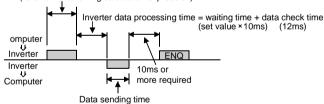
#### **REMARKS**

When communication parameter n7 "waiting time setting"  $\neq$  "- --", 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)



(refer to the following calculation expression)

[Data sending time calculation expression]

1 Communication speed x Number of data characters (Refer to page 133) x (See below) Communication specification (Total number of bits) = Data sending time (s)

Communication specification

Name	Number of Bits	
Stop bit le	1 bit 2 bits	
Data len	gth	7 bits 8 bits
Parity check	Yes	1 bit
ranty check	No	0 bits

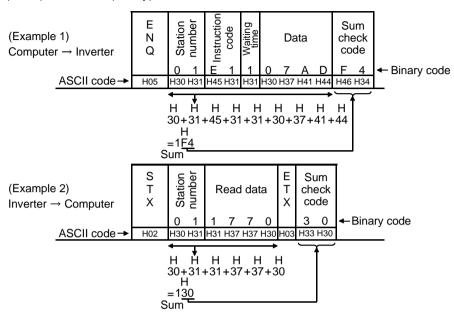
In addition to the bits in the above table, 1 bit is required for the start bit.

Minimum total number of bits ... 9 bits

Maximum total number of bits ... 12 bits

#### 7) Sum check code

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



#### 8) Error code

If any error is found in the data received by the inverter, its definition is sent back to the computer together with the NAK code. (Refer to page 142.)

#### **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.
- 3.When the parameter setting is read or written, the data of the link parameter expansion setting changes depending on the parameter. For the data, refer to the parameter data code list on page 176.

#### **^**CAUTION

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

#### <Setting items and set data>

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

No.		Item		Instruction Code		Description					
	Rea Operatio d			Н7В	HOC	10000: Communication operation 10001: External operation					
1		node	147.4			10002: PU operation 10000: Communication operation					
			Writ	HFB		000: Commi 001: Externa		ation			
			е				F: Output free	nuency in (	) 01Hz		
						ements	1. Output free	quondy in c	J.01112		
					_	37 = 0 (facto	rv settina)			4 11 14	
		Outpu	t				F: Speed in 1r	min increm	nents	4 digits	
		freque	ncy	H6F					parameter (HFF)		
		[speed	1]		= 0						
							FFFF: Speed				
						en Pr. 37 = "(	0.1 to 999", exp	pansion link	parameter (HFF)	6 digits	
		0 :			= 1			. 0			
		Outpu curren		H70		100 to HFFF ements	F: Output cur	rent (nexad	decimal) in 0.01A	4 digits	
		curren	ι				F: Two most	recent alar	m definitions		
					H0000 to HFFFF: Two most recent alarm definitions Alarm definition display example (instruction code H74)						
						b15 b8b7 b0					
	ng					001100001010000					
2	Monitoring					0 0	1 1 0 0 0 0	1 0 1 0 0	0 0 0		
-	oni				Previous alarm Most recent alarm						
	Σ					Pre	vious alarm i (H30)				
						Alarm data	(1130)	(HA0	')		
						Data	Description	Data	Description		
		Alarm		H74 to H75	L	H00	No alarm	H40	FIN	4 digits	
		definit	ion			H10	OC1	H60	OLT	. a.g.to	
					L	H11	OC2	H80	GF		
					L	H12	OC3	H90	OHT		
					l L	H20	OV1	HA0	OPT		
					L	H21	OV2	HB0	PE		
					L	H22	OV3	HB1	PUE		
						H30	THT	HB2	RET		
						H31	THM	HC0	CPU*		
					* Er	ror code ma	ay not be retur	ned.			

No.	Item	Instruction Code	Description	Number of Data Digits
3	Run command	HFA	b7 b0 b0 :————————————————————————————————	2 digits
4	Inverter status monitor	Н7А	b7 b0 b0: Inverter running (RUN)* b1: Forward rotation b2: Reverse rotation b3: Up to frequency (SU) b4: Overload (OL) b5: — b6: Frequency detection (FU) b7: Alarm occurrence*  * Function change can be made using Pr. 64 and Pr. 65 (output terminal function selection).	2 digits

No.	Item	Instruction Code	Description	Number of Data Digits
	Set frequency read (RAM)	H6D	When Pr. 37 = "0" (factory setting) The set frequency (RAM or E <sup>2</sup> PROM) is read. H0000 to H2EE0: 0.01Hz increments When Pr. 37 = "0.1 to 999", expansion link parameter (HFF) = 0 The set speed is read. H0000 to H03E7: 1r/min increments	4 digits
	Set frequency read (E <sup>2</sup> PROM)	H6E	•When Pr. 37 = "0.1 to 999", expansion link parameter (HFF) = 1 The set speed is read. (The number of data digits is 6 digits.) H0000 to HF3E58: 0.001r/min increments	(6 digits)
5	Set frequency write (RAM only)	HED	When Pr. 37 = "0" (factory setting) H0000 to H2EE0 (0 to 120.00Hz): Set frequency in 0.01Hz increments When changing the set frequency continuously, write it to the inverter RAM (instruction code: HED). The minimum setting increments are 0.01Hz but setting can be made in only 0.1Hz increments.  When Pr. 37 = "0.1 to 999", expansion link parameter (HFF) = 0 H0000 to H03E7 (0 to 999): Set speed in 1r/min increments	4 digits (6 digits)
	Set frequency write (RAM and E <sup>2</sup> PROM)	HEE	•When Pr. 37 = "0.1 to 999", expansion link parameter (HFF) = 1 H0000 to HF3E58 (0 to 999.000): Set speed in 0.001r/min increments Set the number of data digits as 6 digits. The minimum setting increments are 0.001r/min but setting can be made in only 0.01r/min increments.	
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

No.	Item	1	Instruction Code		Description					
				Any of fo	neters returr ur different of g to the data	all clear o	•	•	med	
				Pr. Data	Commu- nication Pr.	Calibra -tion Pr	Other Pr.*	HEC HFF		
	All param	eter		H9696		×	0	0		
8	clear	ictoi	HFC	H9966		0	0	0		4 digits
	oloui			H5A5A		×	0	0		
				H55AA	\ ×	0	0	0		
				H9966, c return to set the pa	parameter ommunication the factory arameters as not cleared	ion-related settings. V Igain.	d paramet	er settings	s also	
u	Paramete write	er	H80 to HFD	Refer to the "Data Code List" (page 176) and write and/ or read the values as required.						4 digits
1()	Paramete read	er	H00 to H7B							4 digits
11	Link parameter	Read	H7F		of H00 to H0 Is of the set					2 digits
11	expansion setting	Write	HFF	code list	For details of the settings, refer to the parameter data code list (page 176).					
	Second parame- ter	Read	H6C	HDE to H H00: Fred H01: Ana	When setting the bias/gain (data codes H5E to H61, HDE to HE1) parameters H00: Frequency (*1) H01: Analog					O distin
	ing (Code HFF = 1)	chang- ng (Code Write HFC			<ul> <li>H02: Analog value of terminal (*2)</li> <li>*1. The gain frequencies may also be written using Pr. 38 and Pr. 39 (data codes A6 and A7).</li> <li>*2. When a voltage is given to the external terminal to make bias or gain calibration, the data value written is 4 digits.</li> </ul>					2 digits

#### REMARKS

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

#### <Error Code List>

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

Error Code	Item	Definition	Inverter Operation
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than allowed number of retries.	
H1	Parity error	The parity check result does not match the specified parity	Brought to an
H2	Sum check error	The sum check code in the computer does not match that of the data received by the inverter.	alarm stop (OPT) if error occurs
НЗ	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.	continuously more than the allowable number
H4	Framing error	The stop bit length is not as specified by initialization.	of retries.
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
НВ	Instruction code error The specified command does not exist.		received data but is not brought to
НС	Data range error	Invalid data has been specified for parameter write, frequency setting, etc.	alarm stop.
HD			
HE			
HF			<del></del>

#### (5) Operation at alarm occurrence

			Operation Mode			
Fault Location	Statu	ıs	Communication Operation (RS-485 connector)	External Operation		
	Inverter operati		Stop	Stop		
Inverter fault	Communication RS-485 connector		Continued	Continued		
Communication error	Inverter operati	on	Stop/continued (*3)	Continued		
(Communication from RS-485 connector)	Communication RS-485 connector		Stop	Stop		

<sup>\*3:</sup> Can be selected using the corresponding parameter (factory-set to stop).

#### (6) Communication error

Fault Location	Error Message (Operation panel)	Remarks
Communication error (Communication from RS-485 connector)	OPT	Error code is OPT

#### (7) Program example

To change the operation mode to computer link operation

#### Program

Line number

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

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

Send data setting

Sum code calculation

50 D\$="01FB10000"

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 NEXT I

120 D\$=CHR\$(&H5)+D\$+RIGHT\$(HEX\$(S),2)

130 PRINT#1,D\$

140 GOTO 50

★ Addition of control and sum codes

Data send Interrupt data receive

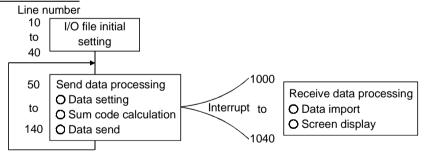
★ Interrupt occurrence during data receive

1000 \*REC 1010 IF LOC(1)=0 THEN RETURN

1020 PRINT"RÉCEIVE DATA" 1030 PRINT INPUT\$(LOC(1),#1)

1040 RETURN

#### General flowchart



#### 2.15.2 Operation and speed command source (n8 📶 8, n9 📆 9)

Used to make valid the operation and speed commands from the computer or external terminals.

Parameter	Name	Factory Setting	Setting Range	Remarks
n8 (338)	Operation command source	0	0, 1	Setting is enabled when Pr. 30 = "1"
n9 (339)	Speed command source	0	0, 1	Setting is chabled when the 50 = 1

The parameter numbers within parentheses are those for use of the parameter unit (FR-PU04).

#### <Setting>

In the computer operation mode, commands from the external terminals and computer are as listed below.

(Refer to page 99 for Pr. 60 to Pr. 63 (input terminal function selection).)

			Pr. 338) "operation	0:	0:	1:	1:	
Oper		command source"		Computer	Computer	External	External	Remarks
	location selection		Pr. 339) "speed	0:	1:	0:	1:	Remarks
30100	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		nmand source"	Computer	External	Computer	External	
Fixed		(ST	,	Computer	Computer	External	External	
functi (Term equiv	ninal-		nputer link operation uency	Computer	_	Computer	1	
functi			2		External	_	External	
	,		4		External		External	
		0	Low-speed operation command (RL)	Computer	External	Computer	External	Pr. 59 = "0"
		1	Middle-speed operation command (RM)	Computer	External	Computer	External	Pr. 59 = "0"
		2	High-speed operation command (RH)	Computer	External	Computer	External	Pr. 59 = "0"
		3	Second function selection (RT)	Computer	Computer	External	External	
_	sɓu	4	Current input selection (AU)	_	Combined	_	Combined	
nctior	settings	5	Start self-holding selection (STOP)	_	_	External	External	
ţ.	63	6	Output stop (MRS)	Combined	Combined	External	External	Pr. 79 ≠ "7"
Selection function	to Pr.	7	External thermal relay input (OH)	External	External	External	External	
Sele	Pr. 60 to	8	15-speed selection (REX)	Computer	External	Computer	External	Pr. 59 = "0"
	Ф	9	Jog operation selection (JOG)	_	_	External	External	
		10	Reset (RES)	Combined	Combined	Combined	Combined	
		14	PID control valid terminal (X14)	Computer	External	Computer	External	
		16	PU-external operation switch-over (X16)	External	External	External	External	
			Reverse rotation command (STR)	Computer	Computer	External	External	

Operation location	n8 (Pr. 338) "operation command source"	0: Computer	0: Computer	1: External	1: External	Remarks
selection	n9 (Pr. 339) "speed command source"	0: Computer	1: External	0: Computer	1: External	Nemarks
RH, RM,	Remote setting	Computer	External	Computer	External	
RL, REX	(RH, RM, RL)	o o p ato.				Pr. 59 =
selection	15-speed selection (REX)				_	"1", "2"
function	(					
MRS						
selection	PU operation interlock (MRS)	External	External	External	External	Pr. 79 = "7"
function	(MIXO)					

#### [Explanation of table]

External : Operation is valid only from external terminal signal.

Computer : Operation is valid only from computer.

Combined : Operation is valid from either of external terminal and computer.

: Operation is invalid from either of external terminal and computer.

#### CAUTION =

When Pr. 79 "operation mode selection" is set to "7" (PU operation interlock function), only the external terminal is made valid independently of the n8 and n9 settings because the MRS terminal is shared.

#### 2.15.3 Link startup mode selection (n10 5 H)

You can choose the operation mode established at power-on or at power restoration after instantaneous power failure.

Set "1" in n10 to select the computer link operation mode.

After a link start, parameter write is enabled with a program.

Parameter	Name	Factory Setting	Setting Range	Pomarke
n10 (340)	Link startup mode selection	0	0, 1	Setting is enabled when Pr. 30 = "1"

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

#### <Setting>

n10 Setting	Pr. 79 Setting	Operation Mode at Power-on or Power Restoration	Remarks
	0	External operation mode	Can be changed to the computer link operation mode by RS-485 communication.
	1	PU operation mode	Operation mode cannot be changed.
	2	External operation mode	Can be changed to the computer link operation mode by RS-485 communication.
	3	External/PU combined mode	Operation made connet be abanged
0	4	External/PU combined mode	Operation mode cannot be changed.
(Factory setting)	7	External operation mode (PU operation interlock)	MRS signal ONCan be changed to PU operation by RS-485 communication. MRS signal OFFOperation mode cannot be changed.
	8	•X16 signal ON Started in the external operation mode.	Operation mode cannot be changed.
	J	•X16 signal OFF Started in the PU operation mode.	Can be changed to the computer link operation mode by RS-485 communication.
	0	Computer link operation mode	Can be changed to the external operation mode by RS-485 communication.
	1	PU operation mode	Operation mode cannot be changed.
	2	Computer link operation mode	Can be changed to the external operation mode by RS-485 communication.
	3	External/PU combined mode	Operation mode cannot be changed.
	4	External/PU combined mode	operation mode calmot be changed.
1	7	PU operation interlock  MRS signal ON Started in the computer link operation mode.	Can be changed to external operation by RS-485 communication.
		Started in the external operation mode.	Operation mode cannot be changed.
	8	•X16 signal ON Started in the computer link operation mode.	Can be changed to external operation by RS-485 communication.
	0	•X16 signal OFF Started in the PU operation mode.	Operation mode cannot be changed.

- n10 can be changed independently of the operation mode of the operation panel.
- Setting of n10 = "1" is made valid when "0" or "2" is set in Pr. 79 "operation mode selection".

Refer to [7] to [7] (page 130)

#### 2.15.4 E<sup>2</sup>PROM write selection (n12 12)

You can choose whether the parameters are stored into the  $\rm E^2PROM$  or not at the parameter setting for computer communication. When performing parameter write frequently, write them to the RAM.

Parameter	Name	Factory Setting	Setting Range	Remarks	
n12 (342)	E <sup>2</sup> PROM write selection	0	0, 1	0: Written to RAM and E <sup>2</sup> PROM 1: Written to RAM only Not written to E <sup>2</sup> PROM* Setting is enabled when Pr. 30 = "1"	

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

#### **REMARKS**

When the parameter setting is "not written to the  $E^2PROM$ " (setting = 1), the settings return to the original values (values saved in the  $E^2PROM$ ) at power-on reset or terminal reset.

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

#### 2.16 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 ( $\frac{\text{STOP}}{\text{RFSFT}}$ ) key) is valid)

#### 2.16.1 PU display language selection (n13 5 5)

By setting the communication parameter n13 "PU display language selection", you can switch the display language of the parameter unit to another.

Parameter	Name	Factory Setting	Setting Range	Remarks	
n13 (145)	PU display language selection	0	0 to 7	Setting is enabled when Pr. 30 = "1"	

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

#### <Setting>

n13 Setting	Display Language
0	Japanese (factory setting)
1	English
2	German
3	French
4	Spanish
5	Italian
6	Swedish
7	Finish

#### 2.16.2 PU buzzer control (n14 RIB)

By setting the communication parameter n14 "PU buzzer control", you can control "beep" produced when any of the parameter unit (FR-PU04) keys is operated.

Parameter	Name	Factory Setting	Setting Range	Remarks	
n14 (990)	PU buzzer control	1	0, 1	0: Without sound 1: With sound (factory setting) Setting is enabled when Pr. 30 = "1"	

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

#### 2.16.3 PU contrast adjustment (n15 📶)

By setting the communication parameter n15 "PU contrast adjustment", you can adjust the LCD contrast of the parameter unit (FR-PU04). When using the FR-PU04, adjust the numerical value to any darkness with the left keys and define that brightness with the write key of the parameter unit.

Parameter	Name	Factory Setting	_	Remarks
n15 (991)	PU contrast adjustment	58	0 to 63	Setting is enabled when Pr. 30 = "1"

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

— CAUTION

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

#### 2.16.4 PU main display screen data selection (n16 📶)

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

Parameter	Name	Factory Setting	Setting Range	Remarks
n16 (992)	PU main display screen data selection	0	0, 100	Setting is enabled when Pr. 30 = "1"

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

#### <Setting>

When you set 100 in n16, the monitor value changes depending on whether the inverter is at a stop or running.

	n16					
	0		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.

#### ♦ Related parameters ♦ -

•Speed display ⇒ Pr. 37 "speed display" (refer to page 83)

### 2.16.5 PU disconnection detection/PU setting lock selection (n17 5.19)

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 operation : Operation performed to perform running,

frequency setting or parameter setting from the

parameter unit (FR-PU04).

Parameter	Name	Factory Setting	Setting Range	Remarks
n17 (993)	PU disconnection detection/PU setting lock	0	() 1 1()	Setting is enabled when Pr. 30 = "1"

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

#### <Setting>

n17 Setting	PU Disconnection Detection	PU Setting Lock
0	Operation is continued as-is if the PU is disconnected (without PU disconnection detection)  Inverter output is shut off when the PU is disconnected (with PU disconnection detection)	
1		
10	Operation is continued as-is if the PU is disconnected (without PU disconnection detection)	PU operation invalid*

<sup>\*</sup> The monitor display and STOP key are valid.

#### **REMARKS**

When RS-485 communication operation is performed through the RS-485 connector, the reset selection/PU stop selection function is valid but the PU disconnection detection function 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.

# 3. PROTECTIVE FUNCTIONS

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

Always read the instructions before using the equipment.

3.1	Errors (Alarms)	152
3.2	Troubleshooting	156

Chapter 1

Chapter 2

Chapter 3

Chapter 4

#### 3.1 Errors (Alarms)

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

If your fault does not correspond to any of the following errors or if you have any other problem, please contact your sales representative.

Retention of alarm output signal ..... When the magnetic contactor (MC) provided on the power supply side of the inverter is opened at the activation of the protective function, the inverter's control power will be lost and the alarm output will not be held.

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

#### 3.1.1 Error (alarm) definitions

#### (1) Major failures

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

Operation Panel Indication	OC1	00	1	FR-PU04	OC During Acc
Name	Overcurrent co	ut-off durin	g ac	celeration	
Description	When the inverter output current reaches or exceeds approximately 150% of the rated inverter current during acceleration, the protective circuit is activated to stop the inverter output.				
Check point	Check for sudden acceleration. Check that the downward acceleration time is not long in vertical lift application. Check for output short-circuit/ground fault.				
Corrective action	Increase the acceleration time.  Shorten the downward acceleration time in vertical lift application.				

Operation Panel Indication	OC2	002	FR-PU04	Stedy Spd OC		
Name	Overcurrent cut-off during constant speed					
Description	When the inverter output current reaches or exceeds approximately 150% 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.					

Operation Panel Indication	осз	003	FR-PU04	OC During Dec	
Name	Overcurrent cut-off during deceleration				
Description	When the inverter output current reaches or exceeds approximately 150% 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	Check for sudden speed reduction. Check for output short-circuit/ground fault. Check for too fast operation of motor's mechanical brake.				
Corrective action	Increase the deceleration time. Adjust brake operation.				

Operation Panel Indication	OV1	Ūu.	1	FR-PU04	OV During Acc
Name	Regenerative overvoltage cut-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. (e.g. during downward acceleration in vertical lift load)				
Corrective action	Decrease the acceleration time.     Install a power factor improving reactor.				

Operation Panel Indication	OV2	002	FR-PU04	Stedy Spd OV		
Name	Regenerative	Regenerative overvoltage cut-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	Keep load stable.     Install a power factor improving reactor.					

Operation Panel Indication	OV3	003	FR-PU04	OV During Dec	
Name	Regenerative	overvoltage cu	t-off during dec	eleration 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> <li>Increase the deceleration time. (Set the deceleration time wh matches the inertia moment of the load)</li> <li>Decrease the braking duty.</li> <li>Install a power factor improving reactor.</li> </ul>				

Operation Panel Indication	ТНМ	: HI	FR-PU04	Motor Overload	
Name	Motor overload cut-off (electronic 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 on 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> <li>For the cons</li> </ul>	<ul> <li>Check the motor for use under overload.</li> <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>			

Operation Panel Indication	THT	[H]	FR-PU04	Inv. Overload	
Name	Inverter overload cut-off (electronic overcurrent protection) (* 1)				
Description	If a current of more than 120% of the rated output current flows and overcurrent shut-off does not occur (150% 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 loa	ad weight.			

\*1. Resetting the inverter initializes the internal heat integrating data of the electronic overcurrent protection.

Operation Panel Indication	FIN	Flo	FR-PU04	H/Sink O/Temp	
Name	Fin overheat				
Description	If the heatsink overheats, the temperature sensor is actuated to stop the inverter output.				
Check point	Check for too high ambient temperature.     Check for heatsink clogging.				
Corrective action	Set the ambier	nt temperature	to within the sp	ecifications.	

Operation Panel Indication	GF	SF	FR-PU04	Ground Fault
Name	Start-time output side ground fault overcurrent protection			
Description	This function stops the inverter output if a ground fault overcurrent flows due to a ground fault which occurred on 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.			

Operation Panel Indication	ОНТ	OHF	FR-PU04	OH Fault	
Name	External thermal relay (*2)				
•	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.				
	<ul> <li>Check for motor overheating.</li> <li>Check that the value of 7 (OH signal) is set correctly in any of P 60 to Pr. 63 (input terminal function selection).</li> </ul>				
Corrective action	Reduce the lo	ad and operatir	ng duty.		

<sup>\*2.</sup> Functions only when any of Pr. 60 to Pr. 63 (input terminal function selection) is set to OH.

Operation Panel Indication	OLT	OLI	FR-PU04	Stil Prev STP
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.			

Operation Panel Indication	ОРТ	OPF	FR-PU04	Option Fault	
Name	Communication error				
Description	Stops the inverter output if a setting error or connection (connector) fault occurs during use of the RS-485 communication function.				
Check point	Check that the connector is plugged securely.				
Corrective action	Make connection securely. Please contact your sales representative.				

Operation Panel Indication	PE	PE	FR-PU04	Corrupt Memory
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.			

Operation Panel Indication	PUE	PUE	FR-PU04	PU Leave Out
Name	Parameter Un	it disconnection	า	
Description	Stops the inverter output if communication between inverter and PU is suspended, e.g. if the PU is disconnected with "1" set in the communication parameter n17 "PU disconnection detection/PU setting lock".			
Check point	Check that the FR-PU04 is fitted securely.     Check the setting of the communication parameter n17 "PU disconnection detection".			
Corrective action	Fit the FR-PU04 securely.			

Operation Panel Indication	RET	-61	FR-PU04	Retry No Over
Name	Retry count excess			
Description	If operation cannot be resumed properly within the number of retries set, this function stops the inverter output.			
Check point	Find the cause of alarm occurrence.			
Corrective action	Eliminate the cause of the error preceding this error indication.			

Operation Panel Indication	CPU	[PU	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 failures

When the protective function is activated, the output is not shut off. You can make parameter setting to output the light fault signal. (Set "98" in any of Pr. 64, Pr. 65 (output terminal function selection). Refer to page 101.)

Operation Panel Indication	FN	Fn	FR-PU04	FN
Name	Fan trouble			
Description	For the inverter which contains a cooling fan, $F_{\Box}$ appears on the operation panel when the cooling fan stops due to a fault.			
Check point	Check the cooling fan for a fault.			
Corrective action	Replace the fa	ın.		

#### (3) Warnings

Operation Panel Indication	0L	0L	FR-PU04	OL
Name	Stall prevention	n (overcurrent)		
	During acceleration	If a current of more than 120% (* 3) 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 120%, this function increases the frequency again.  If a current of more than 120% (* 3) 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 120%, this function increases the frequency up to the set value.		
Description	During constant- speed operation			
	During deceleration	If a current of more than 120% (* 3) 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 120%, this function decreases the frequency again.		notor, this function ncy until the overload e inverter from off. When the overload 20%, this function
Check point	Check the motor for use under overload.			
Corrective action	<ul> <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>			

<sup>\*3.</sup> The stall prevention operation current can be set as desired. It is factory-set to 120%.

Operation Panel Indication	oL	οĹ	FR-PU04	oL
Name	Stall prevention	n (overvoltage)	)	
Description	During	If the regenerative energy of the motor increases too much to exceed the brake capability, this function stops the decrease in frequency to preve overvoltage shut-off. As soon as the regenerative energy has reduced, deceleration resumes.		e capability, this n frequency to prevent a as the regenerative
Check point	Check for sudden speed reduction.			
Corrective action	The deceleration time may change. Increase the deceleration time using Pr. 8 "deceleration time".			

Operation Panel Indication	PS	<i>P</i> 5	FR-PU04	PS
Name	PU stop			
Description	Pr. 75 "reset selection/PU stop selection" had been set and a stop was made by pressing the STOP RESET 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 (STOP) key of the operation panel during external operation.			
Corrective action	Refer to page	106.		

Operation Panel Indication	UV / F5J	Uu/FSJ
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 150VAC (below about 300VAC for the three phase 400V power input series), this function stops the inverter output.  When undervoltage occurrs during inverter operation, $Uu$ and $F S U$ are displayed on the operation panel alternately.	
Check point	<ul> <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 166.).</li> </ul>	
Corrective action	Check the pov supply.	ver supply system equipment such as the power

#### (4) Write errors

Operation Panel Indication	Er1	Er	1	FR-PU04	Control Mode
Name	Write disable	error			
Description	<ul> <li>Write was performed with "1" (write disable) set in Pr. 77 "parameter write disable selection".</li> <li>Frequency jump setting range overlapped.</li> <li>Parameter write was performed though the operation panel does not have the write precedence.</li> </ul>				
Corrective action	<ul> <li>Check the setting of Pr. 77 "parameter write disable selection". (Refer to page 109.)</li> <li>Check the settings of Pr. 31 to 36 (frequency jump). (Refer to page 82.)</li> <li>When the FR-PU04 is fitted and n17 = "0" or "1", the operation the operation panel is invalid.</li> <li>For RS-485 connector (RS-485) communication, the operation the operation panel is invalid.</li> </ul>			ncy jump). (Refer to	

Operation Panel Indication	Er2	8-2	FR-PU04	In PU/EXT Mode OPERATOR ERR
Name	Write-while-running error/mode designation error			
Description	<ul> <li>Write was performed during operation.</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.</li> </ul>			
Corrective action	<ul> <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 110.)</li> </ul>			J operation mode",

Operation Panel Indication	Er3	E-3	FR-PU04	Incr I/P
Name	Calibration error			
Description	Analog input bias and gain calibration values are too close.			s are too close.
Corrective action	Check the settings of C3, C4, C6 and C7 (calibration functions). (Refer to page 84.)			

## 3.1.2 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).)

#### 3.1.3 Correspondence between digital and actual characters

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

Actual	Display
0	
1	
2	
3	<u> </u>
4	<u>-</u>
5	5
6	8
7	7
8	
9	9

יַב	yeu on me	operation
	Actual	Display
	A	<i>P</i>
	B	
	C	
	D	8
	E	E
	F	E
	G	
	H	H
	J	

Actual	Display
M	[7]
N	<sub>[-]</sub>
0	
0	
P	
S	<u> 5</u>
Ⅱ	
U	
V	
r	
<u>-</u>	<u>-</u>

#### 3.1.4 Resetting the inverter

Performing any of the following operations resets the inverter. Note that performing a reset clears (erases) the internal thermal integral value of the electronic overcurrent protection and the number of retries.

It takes about 1s from when reset is canceled until operation is restored.

F54(F5J) and Frr (Err) appears alternately on the operation panel during reset.

Operation 1 ...... Using the operation panel, perform a reset with the (STOP) key.

(Enabled only when the inverter protective function is activated (major failure))

Operation 2...... Cut (off) power once, then switch it on again.

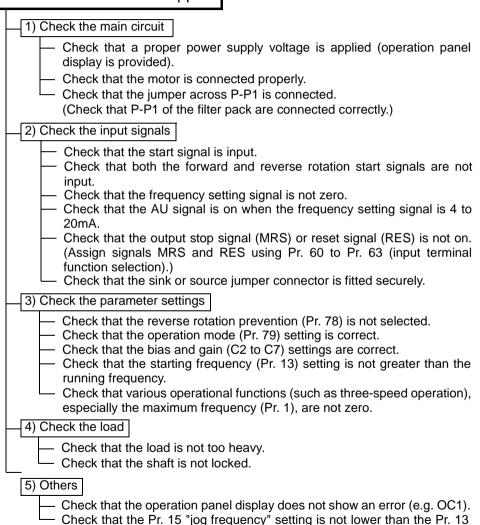
Operation 3 ...... Turn on the reset signal (RES). (Assign this signal to any of Pr. 60 to Pr. 63.) (Refer to page 39, 99.)

#### 3.2 Troubleshooting

#### **POINTS**

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.

#### 3.2.1 Motor remains stopped



"starting frequency" value.

322	Motor rotates in opposite direction
0.2.2	violor rotates in opposite direction

- Check that the phase sequence of output terminals U, V and W is correct.
- Check that the start signals (forward rotation, reverse rotation) are connected properly.
- Check the setting of Pr. 17 "RUN key rotation direction selection".

#### 3.2.3 Speed greatly differs from the setting

- Check that the frequency setting signal is correct. (Measure the input signal level.)
- Check that the following parameter settings are correct (Pr. 1, Pr. 2, Pr. 19,
  - Pr. 38, Pr. 39, Pr. 95, C2 to C7).
- Check that the input signal lines are not affected by external noise. (Use shielded cables)
- Check that the load is not too heavy.

#### 3.2.4 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.

#### 3.2.5 Motor current is large

- Check that the load is not too heavy.
- Check that the torque boost setting is not too large.

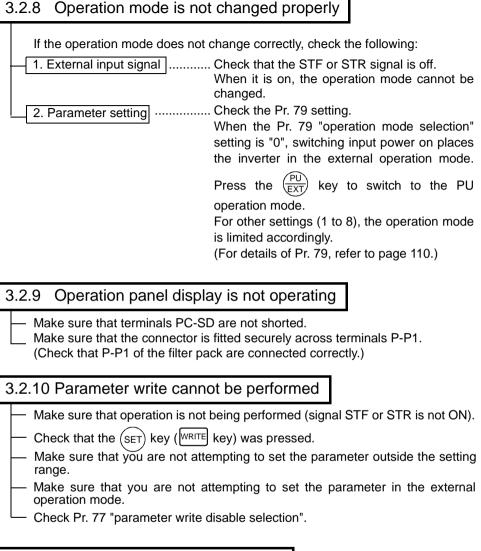
#### 3.2.6 Speed does not increase

- Check that the maximum frequency setting is correct.
- Check that the load is not too heavy. (In agitators, etc., load may become heavier in winter.)
- Check that the torque boost setting is not too large to activate the stall prevention function.

#### 3.2.7 Speed varies during operation

When slip compensation is selected, the output frequency varies with load fluctuation between 0 and 2Hz. This is a normal operation and is not a fault.

- 1) Inspection of load
  - Check that the load is not varying.
- 2) Inspection of input signal
  - Check that the frequency setting signal is not varying.
  - Check that the frequency setting signal is not affected by noise.
  - Check for a malfunction due to an undesirable current when the transistor output unit is connected. (Refer to page 25.)
  - 3) Others
    - Check that the wiring length is not too long.
      - Check that GD<sup>2</sup> load is not small. (at the motor GD<sup>2</sup> or smaller) ...... FR-F540J-1.5K to 3.7K
      - If so, set the Pr. 72 "PWM frequency selection" to 6kHz or higher. (When setting the PWM to a higher frequency, check for noise or leakage current problem and take countermeasures against it.)



#### 3.2.11 Motor produces annoying sound

Check the Pr. 70 "Soft-PWM setting" and Pr. 72 "PWM frequency selection" settings.

Make sure that the deceleration time is not too short.

# 4. SPECIFICATIONS

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

4.1	Specification list	166
4.2	Outline drawings	170

Chapter 1

Chapter 2

Chapter 3

Chapter 4

#### 4.1 Specification list

#### 4.1.1 Ratings

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

			ln	verter							
Ту	pe FR-F520J-□	K	0.4	0.75 1.5 2.2 3.7 5.5 7.5 11 15						15	
Αp	plicable motor	capacity (kW) (*1)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
	Rated capacity	(kVA) (*2)	1.0	1.6	2.8	4.0	6.6	9.1	12.1	17.1	22.1
put	Rated current	(A)	2.5	4.1	7.0	10	16.5	23.8	31.8	45	58
Output	Overload curre	ent rating (*3)	120	% 60s,	150%	0.5s	(invers	se time	chara	cteris	tics)
	Voltage (*4)			Thr	ee-pha	ase 20	0 to 2	40V 50	)Hz/60	Hz	
	Rated input AC voltage/frequency		Three-phase 200 to 240V 50Hz/60Hz								
<u>&gt;</u>	Permissible AC	ble AC voltage fluctuation 170 to 264V 50Hz/60Hz									
supply	Permissible fre	quency fluctuation				Wi	thin ±5	5%		11 17.1 2 45 acteristic DHz DHz 20 16 pe (IP00	
Power si	Power supply system	Without filter pack	1.2	2.1	4.0	5.0	8.8	12	17	20	27
A	capacity (kVA) (*5)	With filter pack	0.8	1.2	2.6	3.4	5.5	8.4	11	16	19
Pr	otective structur	e (JEM1030)	Enclosed type (IP20) (*6) Open type (IP00)					00)			
Co	ooling system		Self-c	ooling			Force	d air c	ooling		
Αp	proximate weig	ht (kg)	8.0	0.9	1.5	1.5	2.1	3.8	3.8	5.1	7.5

Filter pack											
Type FR-BFP-	□K	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	
Approximate w	eight (kg)	1.3	1.4	2.0	2.2	2.8	3.8	4.5 6.7 7.0			
Power factor im	nprovement reactor		to 959						under 1	100%	
Noise filter	Zero-phase reactor	Insta	ıll a fer	rite co	re on t	he inp	ut side				
14013C IIIICI	Capacitive filter	Abou	ıt 4mA	of cap	acitor	leakag	ge curr	ent (*7	7)		

- \*1. The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.
- \*2. The rated output capacity indicated assumes that the output voltage is 220V.
- \*3. The % value of the overload capacity indicates the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
- \*4. The maximum output voltage does not exceed the power supply voltage. You can set the maximum output voltage to any value below the power supply voltage. However, the pulse voltage value of the inverter output side voltage remains unchanged at about √2 that of the power supply.
- \*5. The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).
- \*6. The inverter with filter pack is open type (IP00).
- \*7. The leakage current indicated is equivalent to one-phase of cable for the three-phase three wire  $\downarrow$  connection.

#### (2) 3-phase 400V power supply

			In	verter							
Ту	pe FR-F540J-□	K	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
Αŗ	plicable motor c	apacity (kW) (*1)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
	Rated capacity	(kVA) (*2)	0.9	1.6	2.8	3.7	6.2	9.1	12.4	17.5	22.5
put	Rated current (A	A)	1.1	2.1	3.7	4.8	8.1	12	16.3	23	29.5
Output	Overload currer	nt rating (*3)	120	% 60s,	150%	0.5s	invers	e time	chara	cterist	ics)
	Voltage (*4)			Thr	ee-pha	se 38	0 to 48	30V 50	)Hz/60	11 15 17.5 22. 23 29. acteristics) OHz OHz 20 28 16 19 pe (IP00)	
	Rated input AC voltage/frequency		Three-phase 380 to 480V 50Hz/60Hz								
Š	Permissible AC voltage fluctuation										
supply	Permissible free	quency fluctuation			325 to 528V 50Hz/60Hz Within ±5%						
Power s	Power supply system	Without filter pack	1.1	2.2	4.2	4.8	8.6	12	17	20	28
Po	capacity (kVA) (*5)	With filter pack	0.7	1.3	2.7	3.3	5.4	8.5	11	16	19
Pr	otective structure	e (JEM1030)	Enclosed type (IP20) (*6) Open type (IP00)					00)			
Co	ooling system		Self-c	ooling			Force	d air c	ooling		
Αŗ	proximate weigh	nt (kg)	1.5	1.5	1.5	1.6	1.7	3.8	3.8	5.0	7.5

Filter pack										
Type FR-BFP-H	I□K	0.4	0.75	75         1.5         2.2         3.7         5.5         7.5         11         15					15	
Approximate weight (kg)			1.6 1.7 1.9 2.3 2.6 4.5 5.0 7.0 8.2						8.2	
Power factor im	provement reactor	Install the DC reactor on the DC side. (93% to 95% of power supply power factor under 100% load)					100%			
Noise filter	Zero-phase reactor	Insta	II a fer	rite co	re on t	he inp	ut side			
Noise ilitei	Capacitive filter	About 8mA of capacitor leakage current (*7)								

- \*1. The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.
- \*2. The rated output capacity indicated assumes that the output voltage is 440V.
- \*3. The % value of the overload capacity indicates the ratio of the overload current to the inverter's rated output current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
- \*4. The maximum output voltage does not exceed the power supply voltage. You can set the maximum output voltage to any value below the power supply voltage. However, the pulse voltage value of the inverter output side voltage remains unchanged at about √2 that of the power supply.
- \*5. The power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and cables).
- \*6. The inverter with filter pack is open type (IP00).
- \*7. The leakage current indicated is equivalent to one-phase of cable for the three-phase three wire  $\bot$  connection.

#### 4.1.2 Common specifications

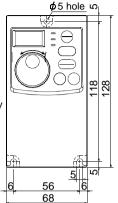
	Co	ntrol system		Selectable between Soft-PWM control and high c frequency PWM control, selectable between V/F c automatic torque boost control.				
	Ou ran	tput frequenc	СУ	0.5 to 120Hz (starting frequency variable between 0 and 60Hz)				
	Fre	quency ting		5VDC input: 1/500 of max. set frequency, 10V, 4 to 20mADC input: 1/1000 of max. set frequency				
	res	olution		Digital input: 0.1Hz (less than 100Hz), 1Hz (100Hz	z or higher)			
		equency curacy		Analog input: Within ±1% of max. output frequency(25°C±10°C) Digital input: Within ±0.5% of set output frequency (when set by the setting dial)				
	Tor	que boost		Manual torque boost, automatic torque boost				
		celeration/de e setting	celeration	0, 0.1 to 999s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode can be selected.				
			Regeneration	15% torque/continuity				
ns	DC injection torque injection brake			Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 15%)				
atio		Frequency	Analog input	0 to 5VDC, 0 to 10VDC, 4 to 20mA				
ecifica		setting signal	Digital input	Entered from operation panel				
sbe				Forward and reverse rotation, start signal				
Control specifications		Start signal	STF, STR	automatic self-holding input (3-wire input) can be selected.				
ပိ		Alarm reset		Used to reset alarm output provided when protective function is activated.				
	als	Multi-speed selection		Up to 15 speeds can be selected. (Each speed can be set between 0 and 120Hz, running speed can be changed during operation from the operation panel.)				
	Input signals	Second fund	ction selection	Used to select second functions (acceleration time, deceleration time, torque boost, base frequency, electronic overcurrent protection).	Use Pr. 60 to			
	ΙI	Output stop		Instantaneous shut-off of inverter output (frequency, voltage)	Pr. 63 for selection			
		Current inpu	ıt selection	Used to select second functions (acceleration time, deceleration time, torque boost, base frequency, electronic overcurrent protection).				
		External the	rmal relay	Thermal relay contact input for use whne the				
		input		inverter is stopped by the thermal relay.				
		Jog signal		Jog operation mode selection				
		PID control		Selection for exercising PID control				
		PU operatio operationsw		Used to switch between PU operation and external operation from outside the inverter.				
	L	1		I The state of the				

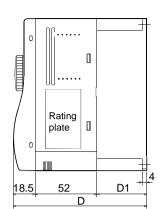
so.		erational ctions	Maximum and minimum frequency settings, frequency jump operation, external thermal relay input selection, automatic restart after instantaneous power failure, forward/reverse rotation prevention, slip compensation, operation mode selection, PID control, computer link					
Control specifications	Output signals	Operating Status	operation (RS-485).  1 open collector signal can be selected from among inverter running, up-to-frequency, frequency detection, overload warning, zero current detection, output current detection, PID upper limit, PID lower limit, PID forward/reverse rotation, operation ready, maintenance output, minor failure and alarm. 1 contact output (1 contact, 230V 0.3AAC, 30V 0.3ADC) signal can be selected.	Use Pr. 64 and Pr. 65 for selection				
		For meter	1 signal can be selected from output frequency and motor current. Pulse train output (1440 pulses/s, 1mA full scale)					
Pro	otect	ive/warning function	Overcurrent shut-off (during acceleration, deceleration, constant speed), regenerative overvoltage shut-off (during acceleration, deceleration, constant speed), overload shut-off (electronic overcurrent protection), heatsink overheat, fan failure (*2), stall prevention, start-time output side ground fault protection (*3), external thermal relay (*4), parameter storage device alarm, PU disconnection, retry count excess, CPU error, PU stop (*5), undervoltage (*1)					
		bient nperature	-10°C to +50°C (non-freezing)					
_	Am	bient humidity	90%RH or less (non-condensing)					
nment	Storage temperature (*6)		-20°C to +65°C					
Environment	Atmosphere		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)					
	Maximum 1000m above seal level, 5.9m/s <sup>2</sup> or lead (conforms to JIS C 0040)	ss (*7)						

- \*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 the external operation mode)
- \*2. Compatible with only the product having the built-in cooling fan.
- \*3. Activated only when "1" is set in Pr. 40 "start-time ground fault detection selection".
- \*4. Activated only when external thermal relay input (OH) is selected in any of Pr. 60 to Pr. 63 (input terminal function selection).
- \*5. This function is activated only when "14 or 15" is set in Pr. 75 "Reset selection/PU stop selection".
- \*6. Temperature applicable for a short period such as transportation.
- \*7. When using with the filter pack installed on the rear panel of the FR-F520J-15K or FR-F540J-15K, do not install this combination on moving objects or places that have vibrations exceeding 1.96m/s<sup>2</sup>.

#### 4.2 Outline drawings

● FR-F520J-0.4K,0.75K



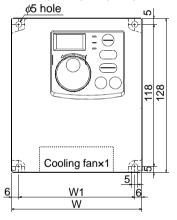


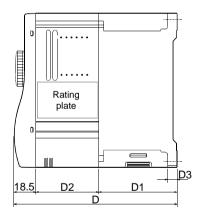
• 3-phase 200V power supply

Capacity	D	D1	
0.4K	112.5	42	
0.75K	132.5	62	

(Unit: mm)

- ●FR-F520J-1.5K,2.2K,3.7K
- FR-F540J-0.4K,0.75K,1.5K,2.2K,3.7K





• 3-phase 200V power supply

•						
Capacity	W	W1	D	D1	D2	D3
1.5K,2.2K	108	96	135.5	65	52	8
3.7K	170	158	142.5	72	52	5

• 3-phase 400V power supply

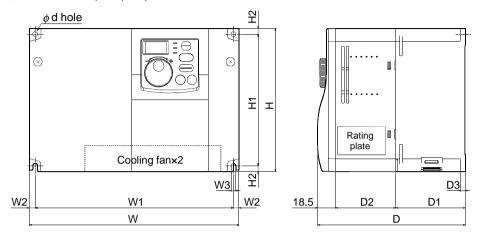
o pridoc root potroi cappiy									
Capacity	W	W1	D	D1	D2	D3			
0.4K,0.75K	108	96	129.5	59	52	5			
1.5K	108	96	135.5	65	52	8			
2.2K	108	96	155.5	65	72	8			
3.7K	108	96	165.5	65	82	8			

(Unit: mm)

#### REMARKS

The FR-F540-J-0.4K and 0.75K are not provided with a cooling fan.

- ●FR-F520J-5.5K,7.5K,11K,15K
- ●FR-F540J-5.5K,7.5K,11K,15K



• 3-phase 200V,400V power supply

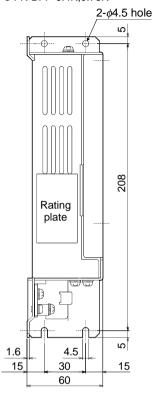
Capacity	W	W1	W2	WЗ	Н	H1	H2	d	D	D1	D2	D3
5.5K,7.5K												
11K,15K	220	195	12.5	6	260	245	7.5	6	190	90	81.5	10

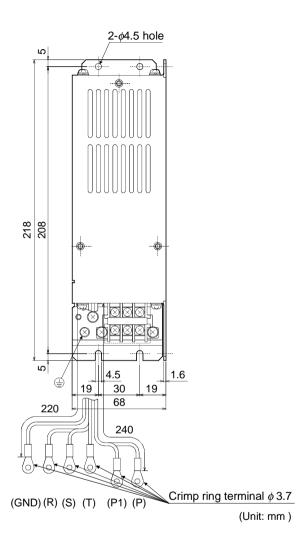
(Unit: mm)

#### REMARKS

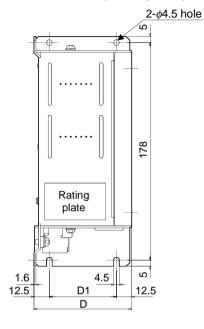
The 11K and 15K have a cooling fan in the upper part.

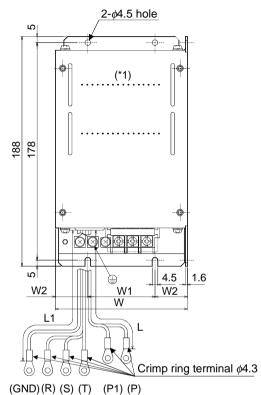
#### ● FR-BFP-0.4K,0.75K





- ●FR-BFP-1.5K, 2.2K, 3.7K
- ●FR-BFP-H0.4K, H0.75K, H1.5K, H2.2K, H3.7K





#### ●200V power supply

Capacity	W	W1	W2	D	D1	L	L1
1.5K, 2.2K	108	55	26.5	80	55	200	220
3.7K	170	120	25	65	40	220	240

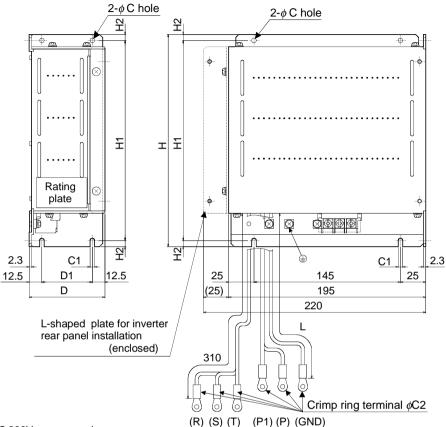
#### ● 400V power supply

1 117							
Capacity	W	W1	W2	D	D1	L	L1
H0.4K, H0.75K	108	55	26.5	55	30	200	220
H1.5K, H2.2K, H3.7K	108	55	26.5	80	55	200	220

(Unit: mm)

<sup>\*1</sup> The 400V class H0.4K and H0.75K have no slit.

- ●FR-BFP-5.5K, 7.5K, 11K, 15K
- ●FR-BFP-H5.5K, H7.5K, H11K, H15K



#### ● 200V power supply

Capacity	Н	H1	H2	D	D1	С	C1	C2	L
5.5K, 7.5K	210	198	6	75	50	4.5	4.5	5.3	270
11K	320	305	7.5	85	60	6	6	5.3	280
15K	320	305	7.5	85	60	6	6	6.4	260

(Unit: mm)

#### ● 400V power supply

Capacity	Н	H1	H2	D	D1	С	C1	C2	L
H5.5K, H7.5K	210	198	6	75	50	4.5	4.5	4.3	270
H11K	320	305	7.5	85	60	6	6	4.3	280
H15K	320	305	7.5	85	60	6	6	6.4	260

(Unit: mm)

## **APPENDIX**

APPENDIX 1	PARAMETER DATA CODE LIST	. 176

#### **APPENDIX 1 PARAMETER DATA CODE LIST**

			Data	Code	Computer	Link Parameter
Func- tion	Parameter Number	Name	Read	Write	Link Data Setting Increments*	Extension Setting (Instruction Code 7F/FF)
	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
ctions	5	Multi-speed setting (middle speed)	05	85	0.01Hz	0
Basic functions	6	Multi-speed setting (low speed)	06	86	0.01Hz	0
asic	7	Acceleration time	07	87	0.1s	0
ä	8	Deceleration time	80	88	0.1s	0
	9	Electronic thermal O/L relay	09	89	0.01A	0
	30	Extended function display selection	1E	9E	1	0
	79	Operation mode selection	4F	None	1	0

The extended function parameters are made valid by setting "1" in Pr. 30 "extended function display selection".

			Data	Code	Computer	Link Parameter
Func- tion	Parameter Number	Name	Read	Write	Link Data Setting Increments *	Extension Setting (Instruction Code 7F/FF)
	10	DC injection brake operation frequency	0A	8A	0.01Hz	0
	11	DC injection brake operation time	0B	8B	0.1s	0
suc	12	DC injection brake voltage	0C	8C	0.1%	0
čţi	13	Starting frequency	0D	8D	0.01Hz	0
ξţ	14	Load pattern selection	0E	8E	1	0
e E	15	Jog frequency	0F	8F	0.01Hz	0
Standard operation functions	16	Jog acceleration/ deceleration time	10	90	0.1s	0
ard op	17	RUN key rotation direction selection	11	91	1	0
l g	19	Base frequency voltage	13	93	0.1V	0
Sta	20	Acceleration/deceleration reference frequency	14	94	0.01Hz	0
	21	Stall prevention function selection	15	95	1	0
	22	Stall prevention operation level	16	96	0.1%	0

			Data	Code	Computer	Link Parameter
Func- tion	Parameter Number	Name	Read	Write	Link Data Setting Increments *	Extension Setting (Instruction Code 7F/FF)
	23	Stall prevention operation level compensation factor at double speed	17	97	0.1%	0
	24	Multi-speed setting (speed 4)	18	98	0.01Hz	0
	25	Multi-speed setting (speed 5)	19	99	0.01Hz	0
	26	Multi-speed setting (speed 6)	1A	9A	0.01Hz	0
ons	27	Multi-speed setting (speed 7)	1B	9B	0.01Hz	0
Standard operation functions	28	Stall prevention operation reduction starting frequency	1C	9C	0.01Hz	0
eratic	29	Acceleration/deceleration pattern	1D	9D	1	0
do	31	Frequency jump 1A	1F	9F	0.01Hz	0
ard	32	Frequency jump 1B	20	A0	0.01Hz	0
ğ	33	Frequency jump 2A	21	A1	0.01Hz	0
Sta	34	Frequency jump 2B	22	A2	0.01Hz	0
	35	Frequency jump 3A	23	A3	0.01Hz	0
	36	Frequency jump 3B	24	A4	0.01Hz	0
	37	Speed display	25	A5	0.001	0
	38	Frequency setting voltage gain frequency	26	A6	0.01Hz	0
	39	Frequency setting current gain frequency	27	A7	0.01Hz	0
	40	Start-time ground fault detection selection	28	A8	1	0
	41	Up-to-frequency sensitivity	29	A9	0.1%	0
Output terminal functions	42	Output frequency detection	2A	AA	0.01Hz	0
Our term func	43	Output frequency detection for reverse rotation	2B	АВ	0.01Hz	0
7 8	44	Second acceleration/ deceleration time	2C	AC	0.1s	0
onc ion	45	Second deceleration time	2D	AD	0.1s	0
Second	46	Second torque boost	2E	AE	0.1%	0
o, 크	47	Second V/F (base frequency)	2F	AF	0.01Hz	0

			Data	Code	Computer	Link Parameter
Func- tion	Parameter Number	Name	Read	Write	Link Data Setting Increments *	Extension Setting (Instruction Code 7F/FF)
tion	48	Output current detection level	30	В0	0.1%	0
Current detection	49	Output current detection period	31	B1	0.1s	0
rent o	50	Zero current detection level	32	B2	0.1%	0
Cur	51	Zero current detection period	33	В3	0.01s	0
s s	52	Operation panel display data selection	34	B4	1	0
Display functions	53	Frequency setting operation selection	35	B5	1	0
ıy fun	54	FM terminal function selection	36	B6	1	0
Jispla	55	Frequency monitoring reference	37	B7	0.01Hz	0
	56	Current monitoring reference	38	B8	0.01A	0
Automatic restart functions	57	Restart coasting time	39	В9	0.1s	0
Automatic restart functions	58	Restart cushion time	ЗА	ВА	0.1s	0
Additional function	59	Remote setting function selection/Frequency setting storage function selection	3B	BB	1	0
	60	RL terminal function selection	3C	вс	1	0
	61	RM terminal function selection	3D	BD	1	0
Terminal functions selection	62	RH terminal function selection	3E	BE	1	0
Tern funci sele	63	STR terminal function selection	3F	BF	1	0
	64	RUN terminal function selection	40	C0	1	0
	65	A, B, C terminal function selection	41	C1	1	0
uc	66	Retry selection	42	C2	1	0
Operation selection functions	67	Number of retries at alarm occurrence	43	C3	1	0
tio S	68	Retry waiting time	44	C4	0.1s	0
ation sele functions	69	Retry count display erase	45	C5	1	0
era f	70	Soft-PWM setting	46	C6	1	0
opi	71	Applied motor	47	C7	1	0

			Data	Code	Computer	Link Parameter
Func- tion	Parameter Number	Name	Read	Write	Link Data Setting Increments *	Extension Setting (Instruction Code 7F/FF)
SU	72	PWM frequency selection	48	C8	1	0
) High	73	0-5V/0-10V selection	49	C9	1	0
Š	74	Input filter time constant	4A	CA	1	0
tion f	75	Reset selection/PU stop selection	4B	СВ	1	0
selec	76	Cooling fan operation selection	4C	CC	1	0
Operation selection functions	77	Parameter write disable selection	4D	None	1	0
Oper	78	Reverse rotation prevention selection	4E	CE	1	0
	80	Multi-speed setting (speed 8)	50	D0	0.01Hz	0
_	81	Multi-speed setting (speed 9)	51	D1	0.01Hz	0
Multi-speed operation	82	Multi-speed setting (speed 10)	52	D2	0.01Hz	0
9 об	83	Multi-speed setting (speed 11)	53	D3	0.01Hz	0
-sbee	84	Multi-speed setting (speed 12)	54	D4	0.01Hz	0
Multi	85	Multi-speed setting (speed 13)	55	D5	0.01Hz	0
	86	Multi-speed setting (speed 14)	56	D6	0.01Hz	0
	87	Multi-speed setting (speed 15)	57	D7	0.01Hz	0
	88	PID action selection	58	D8	1	0
	89	PID proportional band	59	D9	0.1%	0
2	90	PID integral time	5A	DA	0.1s	0
out	91	PID upper limit	5B	DB	0.1%	0
PID control	92	PID lower limit	5C	DC	0.1%	0
₫	93	PID action set point for PU operation	5D	DD	0.01%	0
	94	PID differential time	5E	DE	0.01s	0
	95	Rated motor slip	5F	DF	0.01%	0
Sc	96	Slip compensation time constant	60	E0	0.01s	0
Sub functions	97	Constant-output region slip compensation selection	61	E1	1	0
Sub	98	Automatic torque boost selection (Motor capacity)	62	E2	0.01kW	0
	99	Motor primary resistance	63	E3	0.001Ω	0

	Parameter Number	Name	Data Code		Computer	Link Parameter
Func- tion			Read	Write	Link Data Setting Increments *	Extension Setting (Instruction Code 7F/FF)
Maintenance function	H1 (503)	Maintenance timer	03	_	1	5
	H1 (504)	Maintenance timer alarm output set time	04	84	1	5
Calibration parameters	C1 (900 (901))	FM terminal calibration	5C	DC	_	1
	C2(902)	Frequency setting voltage bias frequency	5E	DE	0.01Hz	1 (6C/EC=0)
	C3(902)	Frequency setting voltage bias	5E	DE	0.1%	1 (6C/EC=1)
	C4(903)	Frequency setting voltage gain	5F	DF	0.1%	1 (6C/EC=1)
	C5(904)	Frequency setting current bias frequency	60	E0	0.01Hz	1 (6C/EC=0)
	C6(904)	Frequency setting current bias	60	E0	0.1%	1 (6C/EC=1)
	C7(905)	Frequency setting current gain	61	E1	0.1%	1 (6C/EC=1)
	C8(269)	Parameter set by manufacturer. Do not set.				
Clear parameters	CLr	Parameter clear		FC	1	_
	ECL	Alarm history clear		F4	1	_

	Parameter Number	Name	Data Code		Computer	Link Parameter
Func- tion			Read	Write	Link Data Setting Increments *	Extension Setting (Instruction Code 7F/FF)
Communication parameters	n1 (331)	Communication station number	1F	9F	1	3
	n2 (332)	Communication speed	20	A0	1	3
	n3 (333)	Stop bit length	21	A1	1	3
	n4 (334)	Parity check presence/ absence	22	A2	1	3
	n5 (335)	Number of communication retries	23	А3	1	3
	n6 (336)	Communication check time interval	24	A4	0.1s	3
	n7 (337)	Waiting time setting	25	A5	1	3
	n8 (338)	Operation command write	26	A6	1	3
	n9 (339)	Speed command write	27	A7	1	3
	n10 (340)	Link startup mode selection	28	A8	1	3
	n11 (341)	CR/LF selection	29	A9	1	3
	n12 (342)	E <sup>2</sup> PROM write selection	2A	AA	1	3
	n13 (145)	PU display language selection	2D	AD	1	1
	n14 (990)	PU buzzer control	5A	DA	1	9
	n15 (991)	PU contrast adjustment	5B	DB	1	9
	n16 (992)	PU main display screen data selection	5C	DC	1	9
	n17 (993)	PU disconnection detection/PU setting lock	5D	DD	1	9

The parameter numbers within parentheses are those for use of the parameter unit (FR-PU04).

<sup>\*</sup> Though parameter setting by RS-485 communication can be made in the setting increments indicated in the table, note that the valid setting increments are as indicated in the parameter list (page 52).

#### **REVISIONS**

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

		number is given on the bottom left of the back cover.
Print Date	*Manual Number	Revision
Oct., 2002	IB(NA)-0600130E-A	
Dec.,2002	IB(NA)-0600130E-B	Addition
	(,	Three-phase 200V power supply input specifications