Instruction Manual

HVAC Application Inverter

IMO Jaguar VXH

⚠CAUTION

Thank you for purchasing our Jaguar VXH series of inverters.

- This product is designed to drive a three-phase induction motor. Read through this instruction manual and be familiar with the handling procedure for correct use.
- Improper handling might result in incorrect operation, a short life, or even a failure of this product as well as the motor.
- Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.
- For how to use an optional device, refer to the instruction and installation manuals for that optional device.

IMO Precision Controls Ltd. **VXH-MANUAL**

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Preface

Thank you for purchasing our JAGUAR VXH series of inverters. This product is designed to drive a three-phase induction motor.

This instruction manual provides only minimum requisite information for wiring and operation of the product. Read through this manual before use.

For details about this product, refer to the JAGUAR VXH User's Manual that contains the precautions, detailed functions and specifications, wiring, configuration and maintenance.

Related documentation

- JAGUAR VXH User's Manual

These materials are subject to change without notice. Be sure to obtain the latest editions for use.

We plan to make the latest edition of the User's Manual available for download from the following URL:

www.imopc.com

■ Safety precautions

Read this manual thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection. Ensure you have sound knowledge of the device and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.

Safety precautions are classified into the following two categories in this manual.

⚠WARNING	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries.
⚠CAUTION	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in minor or light bodily injuries and/or substantial property damage.

Failure to heed the information contained under the CAUTION title can also result in serious consequences. These safety precautions are of utmost importance and must be observed at all times.

Application

⚠WARNING

- This product is designed to drive a three-phase induction motor. Do not use it for single-phase motors or for other purposes.
  Fire or an accident could occur.
- This product may not be used for a life-support system or other purposes directly related to the human safety.
- Though the product is manufactured under strict quality control, install safety devices for applications where serious accidents or property damages are foreseen in relation to the failure of it.
  An accident could occur.

Installation

⚠WARNING

- Install the inverter on a base made of metal or other non-flammable material.
  Otherwise, a fire could occur.
- Do not place flammable object nearby.
  Doing so could cause fire.

⚠CAUTION

- Do not support the inverter by its front cover during transportation.
  Doing so could cause a drop of the inverter and injuries.
- Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the heat sink.
- When changing the positions of the top and bottom mounting bases, use only the specified screws.
  Otherwise, a fire or an accident might result.
- Do not install or operate an inverter that is damaged or lacking parts.
  Doing so could cause fire, an accident or injuries.

Wiring

⚠WARNING⚠

- If no zero-phase current (earth leakage current) detective device such as a ground-fault relay is installed in the upstream power supply line in order to avoid the entire power supply system's shutdown undesirable to factory operation, install a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) individually to inverters to break the individual inverter power supply lines only.
  Otherwise, a fire could occur.
- When wiring the inverter to the power source, insert a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the path of each pair of power lines to inverters. Use the recommended devices within the recommended current capacity.
- Use wires in the specified size.
- Tighten terminals with specified torque.
  Otherwise, a fire could occur.
- When there is more than one combination of an inverter and motor, do not use a multicore cable for the purpose of handling their wirings together.
- Do not connect a surge killer to the inverter's output (secondary) circuit.
  Doing so could cause a fire.
- Be sure to ground the inverter's grounding terminals ⏚G.
  Otherwise, an electric shock or a fire could occur.
- Qualified electricians should carry out wiring.
- Be sure to perform wiring after turning the power OFF.
  Otherwise, an electric shock could occur.
- Be sure to perform wiring after installing the inverter unit.
  Otherwise, an electric shock or injuries could occur.
- Ensure that the number of input phases and the rated voltage of the product match the number of phases and the voltage of the AC power supply to which the product is to be connected.
- When using this product in combination with a PWM converter, refer to the instructions given in the JAGUAR VXH User's Manual.
  Otherwise, a fire or an accident could occur.
- Do not connect the power supply wires to the inverter output terminals (U, V, and W).
  Doing so could cause fire or an accident.

⚠WARNING

- In general, sheaths of the control signal wires are not specifically designed to withstand a high voltage (i.e., reinforced insulation is not applied). Therefore, if a control signal wire comes into direct contact with a live conductor of the main circuit, the insulation of the sheath might break down, which would expose the signal wire to a high voltage of the main circuit. Make sure that the control signal wires will not come into contact with live conductors of the main circuit.

  Doing so could cause an accident or an electric shock.

⚠WARNING⚠

- Before changing the switches, **turn OFF the power and wait at least 10 minutes**. Make sure that the charging lamp is turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  Otherwise, an electric shock could occur.

⚠CAUTION⚠

- The inverter, motor and wiring generate electric noise. Be careful about malfunction of the nearby sensors and devices. To prevent them from malfunctioning, implement noise control measures.

  Otherwise an accident could occur.

- The leakage current of the EMC filter built-in type of inverters is comparatively large. Be sure to perform protective grounding.

  Otherwise, an accident or an electric shock could occur.

Operation

⚠WARNING⚠

- Be sure to mount the front cover before turning the power ON. Do not remove the cover when the inverter power is ON.

  Otherwise, an electric shock could occur.

- Do not operate switches with wet hands.

  Doing so could cause electric shock.

- If the auto-reset function has been selected, the inverter may automatically restart and drive the motor depending on the cause of tripping. Design the machinery or equipment so that human safety is ensured at the time of restarting.

  Otherwise, an accident could occur.

- If the stall prevention function (current limiter), automatic deceleration (anti-regenerative control), or overload prevention control has been selected, the inverter may operate with acceleration/deceleration or frequency different from the commanded ones. Design the machine so that safety is ensured even in such cases.
- The STOP key on the keypad is effective only when the keypad operation is enabled with function code F02 (= 0, 2 or 3). When the keypad operation is disabled, prepare an emergency stop switch separately for safe operations.

  Switching the run command source from keypad (local) to external equipment (remote) by turning ON the "Enable communications link" command ***LE*** disables the STOP key. To enable the STOP key for an emergency stop, select the STOP key priority with function code H96 (= 1 or 3).
- If any of the protective functions have been activated, first remove the cause. Then, after checking that the all run commands are set to OFF, release the alarm. If the alarm is released while any run commands are set to ON, the inverter may supply the power to the motor, running the motor.

  Otherwise, an accident could occur.

⚠WARNING⚠

- If you enable the "Restart mode after momentary power failure" (Function code F14 = 3 to 5), then the inverter automatically restarts running the motor when the power is recovered.
  Design the machinery or equipment so that human safety is ensured after restarting.
- If the user configures the function codes wrongly without completely understanding this Instruction Manual and the JAGUAR VXH User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine.
  An accident or injuries could occur.
- Even if the inverter has interrupted power to the motor, if the voltage is applied to the main circuit input terminals L1/R, L2/S and L3/T, voltage may be output to inverter output terminals U, V, and W.
- Even if the motor is stopped due to DC braking, voltage is output to inverter output terminals U, V, and W.
  An electric shock may occur.
- The inverter can easily accept high-speed operation. When changing the speed setting, carefully check the specifications of motors or equipment beforehand.
  Otherwise, injuries could occur.

⚠CAUTION

- Do not touch the heat sink because it becomes very hot.
  Doing so could cause burns.
- The DC brake function of the inverter does not provide any holding mechanism.
  Injuries could occur.
- Ensure safety before modifying the function code settings.
  Run commands (e.g., "Run forward" ***FWD***, "Force to run" ***FMS***), stop commands (e.g., "Coast to a stop" ***BX***), and frequency change commands can be assigned to digital input terminals. Depending upon the assignment states of those terminals, modifying the function code setting may cause a sudden motor start or an abrupt change in speed.
- When the inverter is controlled with the digital input signals, switching run or frequency command sources with the related terminal commands (e.g., ***SS1***, ***SS2***, ***SS4***, ***SS8***, ***Hz2/Hz1***, ***Hz/PID***, ***IVS***, ***LE*** and ***FMS***) may cause a sudden motor start or an abrupt change in speed.
- Ensure safety before modifying customizable logic related function code settings (U codes and related function codes) or turning ON the "Cancel customizable logic" terminal command ***CLC***. Depending upon the settings, such modification or cancellation of the customizable logic may change the operation sequence to cause a sudden motor start or an unexpected motor operation.
- If any abnormality is found in the inverter or motor, immediately stop it and perform troubleshooting, referring to the JAGUAR VXH User's Manual.
  An accident or injuries could occur.

Maintenance and inspection, and parts replacement

⚠WARNING⚠
• Before proceeding to maintenance or inspection, **turn OFF the power and wait at least 10 minutes**. Make sure that the charging lamp is turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below). **Otherwise, an electric shock could occur.** • Maintenance, inspection, and parts replacement should be made only by qualified persons. • Take off the watch, rings and other metallic objects before starting work. • Use insulated tools. **Otherwise, an electric shock or injuries could occur.** • Never modify the inverter. **Doing so could cause an electric shock or injuries.**

Disposal

⚠CAUTION
• Treat the inverter as an industrial waste when disposing of it. **Otherwise injuries could occur.**

GENERAL PRECAUTIONS
Drawings in this manual may be illustrated without covers or safety shields for explanation of detail parts. Restore the covers and shields in the original state and observe the description in the manual before starting operation.

Icons

The following icons are used throughout this manual.

Note — This icon indicates information which, if not heeded, can result in the inverter not operating to full efficiency, as well as information concerning incorrect operations and settings which can result in accidents.

Tip — This icon indicates information that can prove handy when performing certain settings or operations.

This icon indicates a reference to more detailed information.

Conformity to the Low Voltage Directive in the EU

If installed according to the guidelines given below, inverters marked with CE are considered as compliant with the Low Voltage Directive 2006/95/EC.

Compliance with European Standards

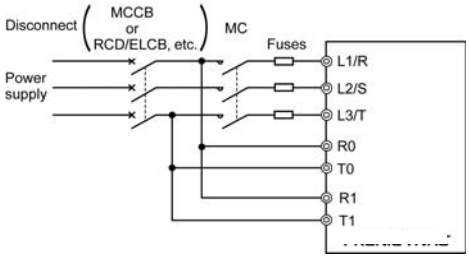
Adjustable speed electrical power drive systems (PDS).

Part 5-1: Safety requirements. Electrical, thermal and energy. IEC/EN 61800-5-1: 2007

⚠WARNING⚠

1. The ground terminal ⏚G should always be connected to the ground. Do not use only a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB)* as the sole method of electric shock protection. Be sure to use ground wires of recommended size listed on page vii.
   *With overcurrent protection.
2. To prevent the risk of hazardous accidents that could be caused by damage of the inverter, install the specified fuses in the supply side (primary side) according to the following tables.
   - Breaking capacity: Min. 10 kA
   - Rated voltage: Min. 500 V

Power supply voltage	Nominal applied motor (kW)	Inverter type	Fuse rating (A)
Three-phase 400 V	0.75	VXH2A5#-4E	4 (IEC/EN 60269-2)
	1.5	VXH4A1#-4E	6 (IEC/EN 60269-2)
	2.2	VXH5A5#-4E	10 (IEC/EN 60269-2)
	4.0	VXH9#-4E	16 (IEC/EN 60269-2)
	5.5	VXH13A5#-4E	20 (IEC/EN 60269-2)
	7.5	VXH18A5#-4E	25 (IEC/EN 60269-2)
	11	VXH24A5#-4E	35 (IEC/EN 60269-2)
	15	VXH32#-4E	50 (IEC/EN 60269-2)
	18.5	VXH39#-4E	63 (IEC/EN 60269-2)
	22	VXH45#-4E	80 (IEC/EN 60269-2)
	30	VXH60#-4E	100 (IEC/EN 60269-2)
	37	VXH75#-4E	125 (IEC/EN 60269-2)
	45	VXH91#-4E	250 (IEC60269-4)
	55	VXH112#-4E	
	75	VXH150#-4E	350 (IEC60269-4)
	90	VXH176#-4E	
	110	VXH210S-4E	
	132	VXH253S-4E	400 (IEC60269-4)
	160	VXH304S-4E	450 (IEC60269-4)
	200	VXH377S-4E	500 (IEC60269-4)
	220	VXH415S-4E	550 (IEC60269-4)
	280	VXH520S-4E	630 (IEC60269-4)
	315	VXH585S-4E	900 (IEC60269-4)
	355	VXH650S-4E	
	400	VXH740S-4E	
	500	VXH960S-4E	1250 (IEC60269-4)
	630	VXH1170S-4E	2000 (IEC60269-4)
	710	VXH1370S-4E	



Note: # Enclosure: M (IP21) or L (IP55).

3. When used with the inverter, a molded case circuit breaker (MCCB), residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) or magnetic contactor (MC) should conform to the EN or IEC standards.
4. When you use a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) for protection from electric shock in direct or indirect contact power lines or nodes, be sure to install **type B of RCD/ELCB** on the input (primary) of the inverter.
5. The inverter should be used in an environment that does not exceed Pollution Degree 2 requirements.
6. Install the inverter, AC reactor (ACR), input or output filter in an enclosure with minimum degree of protection of IP2X (Top surface of enclosure shall be minimum IP4X when it can be easily accessed), to prevent human body from touching directly to live parts of these equipment.

   Note: Does not apply to IP55 model.
7. Do not connect any copper wire directly to grounding terminals. Use crimp terminals with tin or equivalent plating to connect them.

⚠WARNING⚠
8. When you use an inverter at an altitude of more than 2000 m, you should apply basic insulation for the control circuits of the inverter. The inverter cannot be used at altitudes of more than 3000 m.

Conformity to the Low Voltage Directive in the EU (Continued)

⚠WARNING⚠

9. Use wires listed in IEC 60364-5-52.

Power supply voltage	Nominal applied motor (kW)	Inverter type	MCCB or RCD/ELCB *1 Rated current (A)	Recommended wire size (mm^2)						
				Main terminal				Control circuit	Aux. control power supply [R0, T0]	Sub main circuit power supply R1, T1
				Main power input		Inverter outputs [U, V, W] *2	DC reactor connection [P1, P(+)] *2			
				[L1/R, L2/S, L3/T] *2	Inverter's grounding [⏚G]					
Three-phase 400 V	0.75	VXH2A5#-4E	5	2.5	10	2.5	Built-in DC reactor	0.75	2.5	-
	1.5	VXH4A1#-4E								
	2.2	VXH5A5#-4E	10							
	4.0	VXH9#-4E								
	5.5	VXH13A5#-4E	15							
	7.5	VXH18A5#-4E	20							
	11	VXH24A5#-4E	30			4				
	15	VXH32#-4E	40	4		6				
	18.5	VXH39#-4E	50	6		10				
	22	VXH45#-4E		10		10				
	30	VXH60#-4E	75	25		16				
	37	VXH75#-4E	100	25		25				
	45	VXH91#-4E		25		35				2.5
	55	VXH112#-4E	125	35		50				
	75	VXH150#-4E	175	70		70				
	90	VXH176#-4E	200	70		95				
	110	VXH210S-4E	250	50×2		70×2	150			
	132	VXH253S-4E	300	70×2			70×2			
	160	VXH304S-4E	350	185		240	300			
	200	VXH377S-4E	500	300		300	120×2			
	220	VXH415S-4E				150×2	150×2			
	280	VXH520S-4E	600	240×2		240×2	240×2			
	315	VXH585S-4E	800			300×2				
	355	VXH650S-4E		300×2			300×2			
	400	VXH740S-4E	1200	240×3		240×3	300×3			
	500	VXH960S-4E		300×3		240×4	300×4			
	630	VXH1170S-4E	1400	340×4		300×4				
	710	VXH1370S-4E	1600							

Note: # Enclosure: M (IP21) or L (IP55).

*1 The frame size and model of the MCCB or RCD/ELCB (with overcurrent protection) will vary, depending on the power transformer capacity. Refer to the JAGUAR VXH User's Manual for details.

*2 The recommended wire size for main circuits is for the 70°C 600 V PVC wires used at an ambient temperature of 40°C.

10. The inverter has been tested with IEC/EN 61800-5-1 2007 Short-circuit Test under the following conditions.
Short-circuit current in the supply: 10,000 A
Maximum 480 V

Conformity with UL standards and CSA standards (cUL-listed for Canada) (Under application)

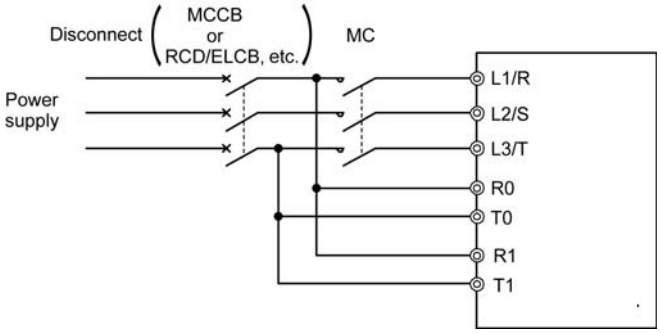
UL/cUL-listed inverters are subject to the regulations set forth by the UL standards and CSA standards (cUL-listed for Canada) by installation within precautions listed below.

⚠CAUTION

1. Solid state motor overload protection (motor protection by electronic thermal overload relay) is provided in each model. Use function codes F10 to F12 to set the protection level.
2. Use Cu wire only.
3. Use Class 1 wire only for control circuits.
4. Short circuit rating

   "Suitable For Use On A Circuit Of Delivering Not More Than 100,000 rms Symmetrical Amperes, 480 Volts Maximum when protected by Class J Fuses or a Circuit Breaker having an interrupting rating not less than 100,000 rms Symmetrical Amperes, 480 Volts Maximum.

   "Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes."
5. Field wiring connections must be made by a UL Listed and CSA Certified closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.
6. All circuits with terminals L1/R, L2/S, L3/T, R0, T0, R1, T1 must have a common disconnect and be connected to the same pole of the disconnect if the terminals are connected to the power supply.



Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued) (Under application)

⚠CAUTION

7. Install UL certified fuses or circuit breaker between the power supply and the inverter, referring to the table below.

Power supply voltage	Nominal applied motor (kW)	Inverter type	Class J fuse size	Circuit breaker trip size	Required torque lb-in (N•m)			
					Main terminal	Control circuit	Aux. control power supply	Sub main circuit power supply
Three-phase 400V	0.75	VXH2A5#-4E	3	5	15.9 (1.8)	6.1 (0.7)	10.6 (1.2)	-
	1.5	VXH4A1#-4E	6					
	2.2	VXH5A5#-4E	10	10				
	4.0	VXH9#-4E	15	10				
	5.5	VXH13A5#-4E	20	15				
	7.5	VXH18A5#-4E	25	20				
	11	VXH24A5#-4E	35	30	51.3 (5.8)			
	15	VXH32#-4E	50	40				
	18.5	VXH39#-4E	60	50				
	22	VXH45#-4E	70					
	30	VXH60#-4E	100	75	51.3 (5.8)			
	37	VXH75#-4E	125	100				
	45	VXH91#-4E	150	100	119 (13.5)			10.6 (1.2)
	55	VXH112#-4E	200	125				
	75	VXH150#-4E	250	175	239 (27)			
	90	VXH176#-4E	300	200				
	110	VXH210S-4E	350	250	239 (27)			
	132	VXH253S-4E	400	300				
	160	VXH304S-4E	500	350	425 (48)			
	200	VXH377S-4E	600	500				
	220	VXH415S-4E	700					
	280	VXH520S-4E	1000	600				
	315	VXH585S-4E	1000	800				
	355	VXH650S-4E	1200					
	400	VXH740S-4E	1400	1200				
	500	VXH960S-4E	1600					
	630	VXH1170S-4E	2000	1400				
	710	VXH1370S-4E	2200	1600				

Note: # Enclosure: M (IP21) or L (IP55).

Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued) (Under application)

⚠CAUTION

Power supply voltage	Nominal applied motor (kW)	Inverter type	Wire size AWG (mm²)				
			Main terminal		Control circuit	Aux. control power supply	Sub main circuit power supply
			L1/R, L2/S, L3/T	U, V, W			
			75°C Cu wire	75°C Cu wire			
Three-phase 400V	0.75	VXH2A5#-4E	14 (2.1)	14 (2.1)	18 (0.8)	14 (2.1)	-
	1.5	VXH4A1#-4E					
	2.2	VXH5A5#-4E					
	4.0	VXH9#-4E					
	5.5	VXH13A5#-4E					
	7.5	VXH18A5#-4E		12 (3.3)			
	11	VXH24A5#-4E	10 (5.3)	10 (5.3)			
	15	VXH32#-4E	10 (5.3)	8 (8.4)			
	18.5	VXH39#-4E	8 (8.4)				
	22	VXH45#-4E					
	30	VXH60#-4E	6 (13.3)	6 (13.3)			
	37	VXH75#-4E	4 (21.2)	2 (33.6)			
	45	VXH91#-4E	4 (21.2)	2 (33.6)			14 (2.1)
	55	VXH112#-4E	2 (33.6)	2 (33.6)			
	75	VXH150#-4E	1/0 (53.5)	1/0 (53.5)			
	90	VXH176#-4E	2/0 (67.4)	3/0 (85)			
	110	VXH210S-4E	1/0×2 (53.5×2)	1/0×2 (53.5×2)			
	132	VXH253S-4E		2/0×2 (67.4×2)			
	160	VXH304S-4E	3/0×2 (85×2)	3/0×2 (85×2)			
	200	VXH377S-4E	4/0×2 (107.2×2)	250×2 (127×2)			
	220	VXH415S-4E	250×2 (127×2)	300×2 (152×2)			
	280	VXH520S-4E	400×2 (203×2)	400×2 (203×2)			
	315	VXH585S-4E	300×2 (152×2)	350×2 (177×2)			
	355	VXH650S-4E	400×2 (203×2)	400×2 (203×2)			
	400	VXH740S-4E	500×2 (253×2)	500×2 (253×2)			
	500	VXH960S-4E	350×3 (177×3)	400×3 (203×3)			
	630	VXH1170S-4E	500×3 (253×3)	600×3 (304×2)			
	710	VXH1370S-4E	600×3 (304×3)	500×4 (253×4)			

Note: # Enclosure: M (IP21) or L (IP55).

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Chapter 1

Chapter 1 BEFORE USE

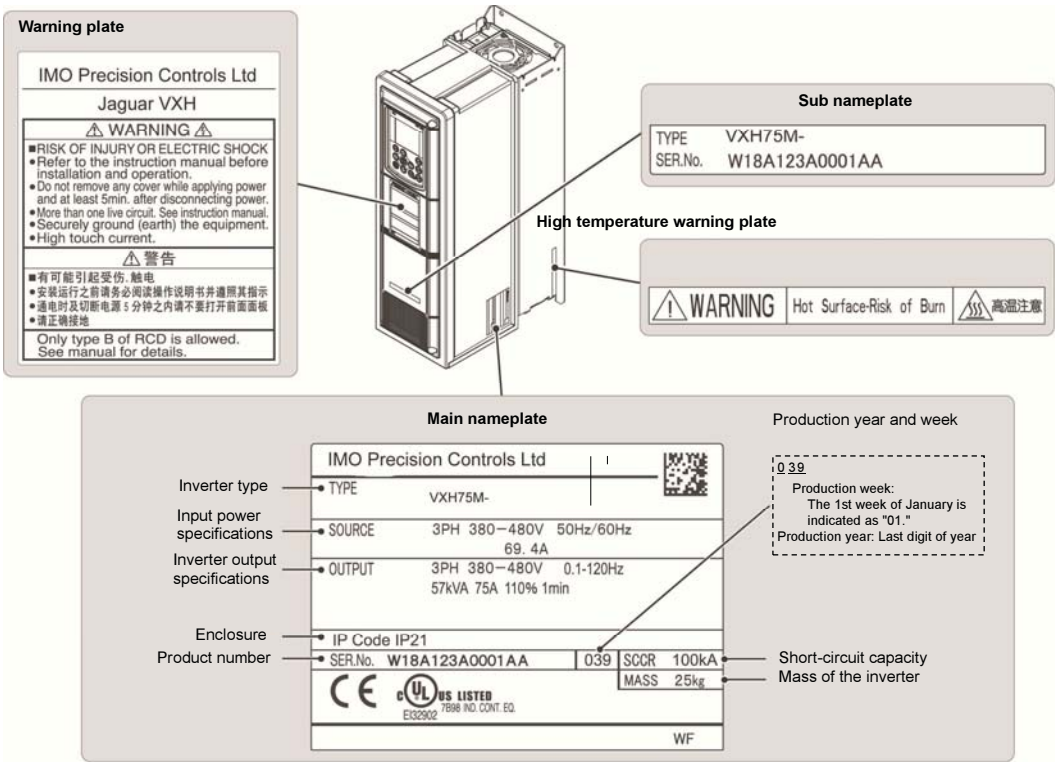
1.1 Acceptance Inspection and Appearance of Product

Unpack the package and check the following:

(1) An inverter and instruction manual (this book) are contained in the package.

(2) The inverter has not been damaged during transportation—there should be no dents or parts missing.

(3) The inverter is the type you ordered. You can check the type and specifications on the main nameplate. (A total of four nameplates and warning plates are attached to the inverter as shown below.)



Options & ordering codes

VXH	75	M	-	4E

Motor (KW)	
0.75	2A5
1.5	4A1
2.2	5A5
4	9
5.5	13A5
7.5	18A5
11	24A5
15	32
18.5	39
22	45
30	60
37	75
45	91
55	112
75	150
90	176
110	210
132	253
160	304
200	377
220	415
280	520
315	585
355	650
400	740
500	960
630	1170
710	1370

E	Integrated EMC filter

M	Enclosure - IP21
L	Enclosure - IP55
S	Enclosure - IP00

Chapter 2 MOUNTING AND WIRING THE INVERTER

2.1 Installing the Inverter

(1) Mounting base

Install the inverter on a base made of metal or other non-flammable material. Do not mount the inverter upside down or horizontally.

(2) Clearances

Ensure that the minimum clearances indicated in Figure 2.1 and Table 2.1 are maintained at all times. When installing the inverter in the panel of your system, take extra care with ventilation inside the panel as the ambient temperature easily rises. Do not install the inverter in a small panel with poor ventilation.

■ When mounting two or more inverters

When mounting two or more inverters in the same unit or panel, basically lay them out side by side. When mounting them necessarily one above the other, be sure to separate them with a partition plate or the like so that any heat radiating from an inverter will not affect the one(s) above.

Figure 2.1 Mounting Direction and Required Clearances

Table 2.1 Clearances (mm)

Inverter capacity	A	B	C
0.75 to 90 kW	10	100	100
110 to 280 kW	50		
315 to 710 kW		150	150

C: Space required in front of the inverter unit

2.2 Wiring

Before wiring, remove the front cover and wiring plate and then set cable glands or conduits on the wiring plate. After wiring, mount the wiring plate and front cover back into place. (The cable glands or conduits should be prepared by the customer.)

2.2.1 Removing and mounting the front cover and the wiring plate

(1) 90 kW or less

① Loosen the (four or six) screws on the front cover, hold the right and left ends of the front cover, and remove it towards you.

② Loosen the four screws on the wiring plate, hold the right and left ends of the wiring plate, and remove it downwards.

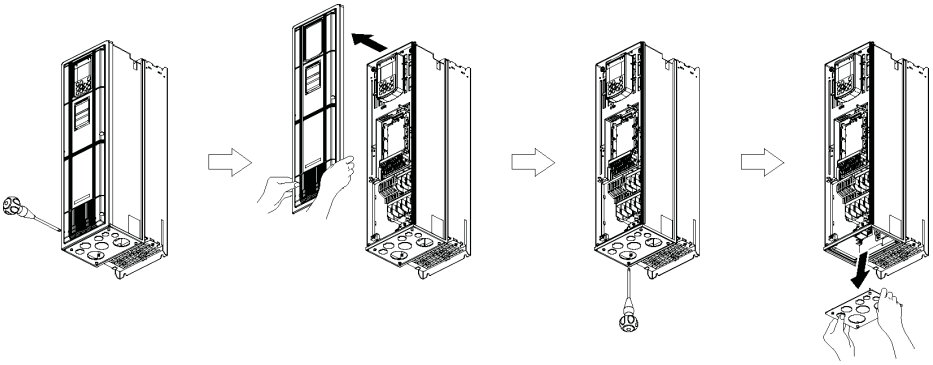


Figure 2.2 Removing the Front Cover and the Wiring Plate (VXH75M-4E)

Tip
- The wiring plate can be removed even with the front cover being mounted.
- To expose the control printed circuit board (control PCB), remove the front cover.

(2) 110 to 710 kW

① Loosen the screws on the front cover, hold the right and left ends of the front cover, and slide it up to remove it.

② After making the necessary wiring connections, align the top of the front cover with the holes on the unit and reattach the cover by reversing the process illustrated in Figure 2.3.

Tip - To expose the control printed circuit board (control PCB), open the keypad case.

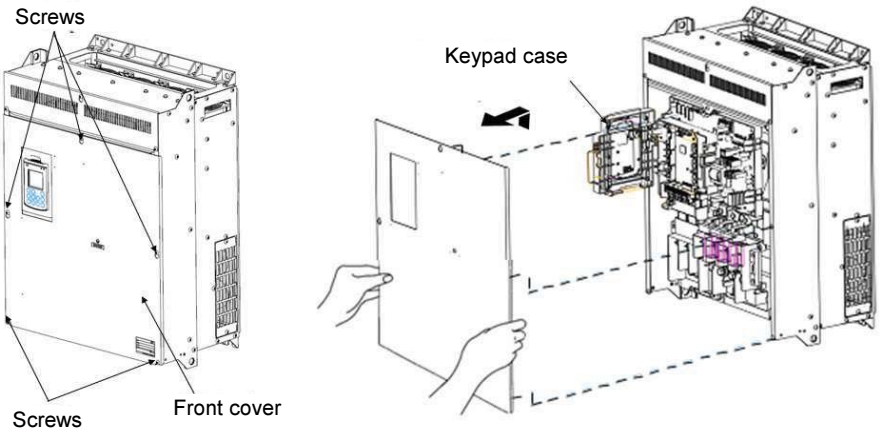


Figure 2.3 Removing the Front Cover and the Wiring Plate (VXH210S-4E)

(3) Punching out semi-perforated sections in the wiring plate and setting cable glands or conduits

① Lightly tap the semi-perforated sections from the inside of the wiring plate using the hand grip of a screwdriver or the like to punch them out.

② Set the cable glands or conduits on the wiring plate and then carry out wiring.

Note Take care not to get injured by the edge of the parts.

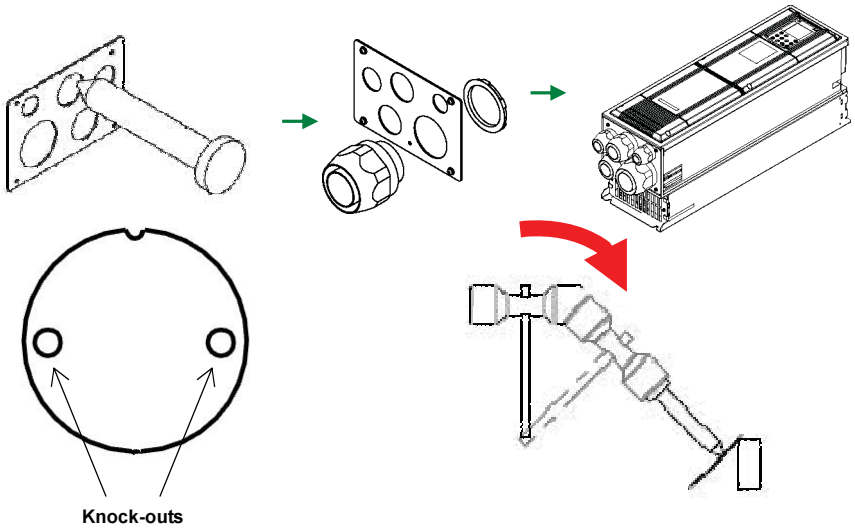


Figure 2.4 Punching Out Semi-perforated Sections in the Wiring Plate and Setting Cable Glands or Conduits

(4) Wiring the main circuit power input wires

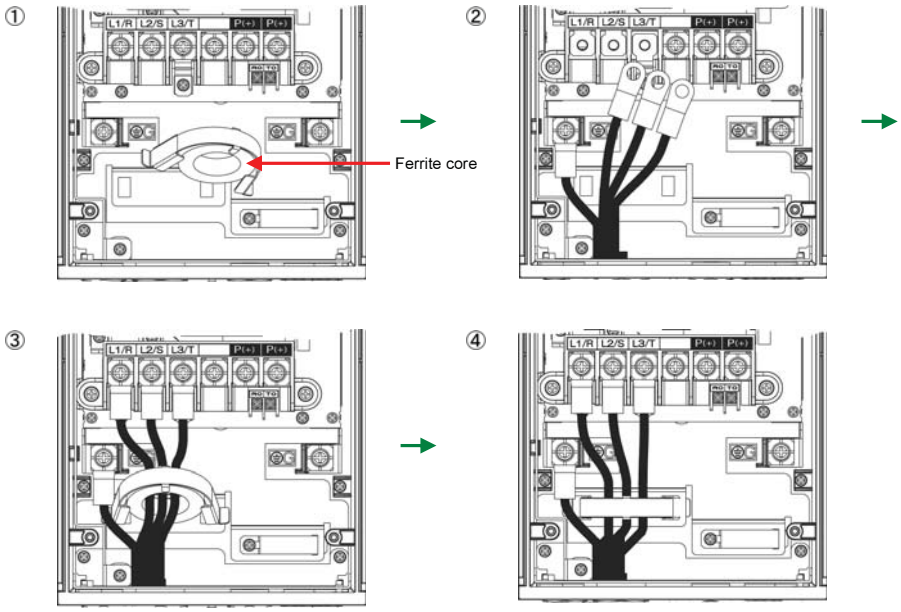
For inverters of 11 to 90 kW, follow the wiring procedure given below for smooth wiring.

① Remove the screws and press the ends of the ferrite core support inwards to release the ferrite core from the main circuit terminal block.

② Connect the inverter grounding wire.

③ Pass the main circuit power input wires of the inverter through the ferrite core and then connect those wires to the terminal block.

④ Put the ferrite core and its support back into place.



(5) Mounting the wiring plate and the front cover

After wiring, mount the wiring plate and front cover back into place. (Tightening torque: 1.8 N•m (M4), 3.5 N•m (M5))

2.2.2 Recommended wire sizes

For the recommended wire sizes for the main circuits, refer to the "Conformity to the Low Voltage Directive in the EU" and "Conformity with UL standards and CSA standards (cUL-listed for Canada) (Under application)" given in Preface. Crimp-style terminals for the main circuits should have insulation, insulation tubes, or similar treatment.

2.2.3 Terminal arrangement diagrams and screw specifications

The tables and figures given below show the screw specifications and terminal arrangement diagrams. Note that the terminal arrangements differ depending on the inverter capacity.

Note Do not make wiring to unassigned main circuit terminals that are marked with (NC) in the figures given below. Doing so may break the inverter.

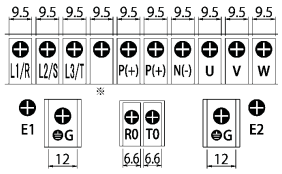
(1) Main circuit terminals

Table 2.2 Main Circuit Terminals

Power supply voltage	Nominal applied motor (kW)	Inverter type	Refer to:	Main circuit terminals		Grounding terminals		Aux. control power supply		Sub main circuit power supply [R1, T1]	
				Screw size	Tightening torque lb-in (N·m)	Screw size	Tightening torque lb-in (N·m)	Screw size	Tightening torque lb-in (N·m)	Screw size	Tightening torque lb-in (N·m)
Three-phase 400V	0.75	VXH2A5#-4E	Figure A	M4	15.9 (1.8)	M4	15.9 (1.8)	M3.5	10.6 (1.2)	-	-
	1.5	VXH4A1#-4E									
	2.2	VXH5A5#-4E									
	4.0	VXH9#-4E									
	5.5	VXH13A5#-4E									
	7.5	VXH18A5#-4E									
	11	VXH24A5#-4E	Figure B	M6	51.3 (5.8)	M6	51.3 (5.8)				
	15	VXH32#-4E									
	18.5	VXH39#-4E									
	22	VXH45#-4E									
	30	VXH60#-4E	Figure C	M6	51.3 (5.8)	M6	51.3 (5.8)				
	37	VXH75#-4E									
	45	VXH91#-4E	Figure D	M8	119 (13.5)	M8	119 (13.5)			M3.5	10.6 (1.2)
	55	VXH112#-4E									
	75	VXH150#-4E	Figure E	M10	239 (27)	M10	239 (27)				
	90	VXH176#-4E									
	110	VXH210S-4E	FigureF	M10	239 (27)	M8	119 (13.5)				
	132	VXH253S-4E									
	160	VXH304S-4E	Figure G	M12	425 (48)	M10	239 (27)				
	200	VXH377S-4E									
	220	VXH415S-4E	Figure H								
	280	VXH520S-4E									
	315	VXH585S-4E	Figure I								
	355	VXH650S-4E									
	400	VXH740S-4E									
	500	VXH960S-4E	Figure J								
	630	VXH1170S-4E	Figure K								
	710	VXH1370S-4E									

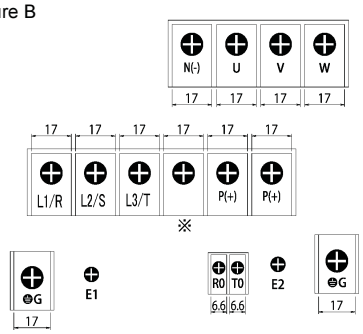
Note: # Enclosure: M (IP21) or L (IP55).

Figure A



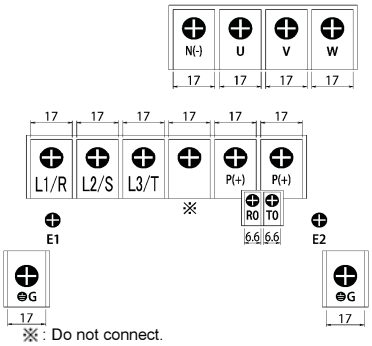
※ : Do not connect.

Figure B



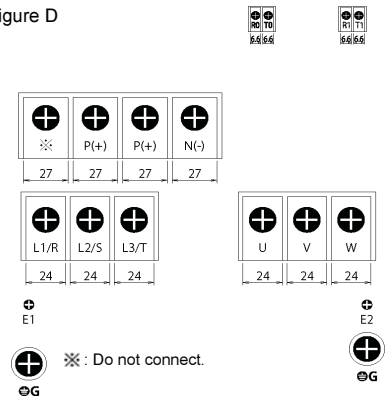
※ : Do not connect.

Figure C



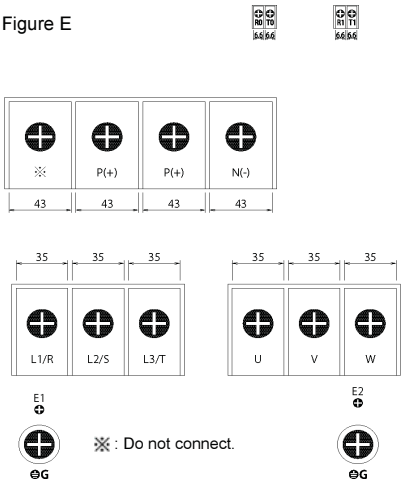
※ : Do not connect.

Figure D



※ : Do not connect.

Figure E



※ : Do not connect.

Figure F

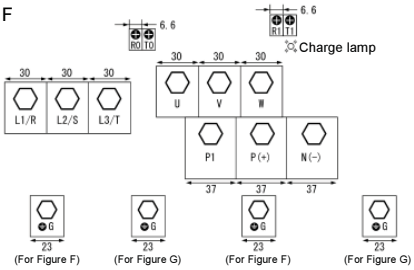


Figure G / Figure H

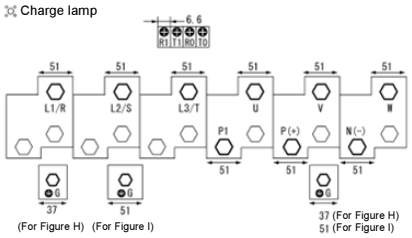


Figure I

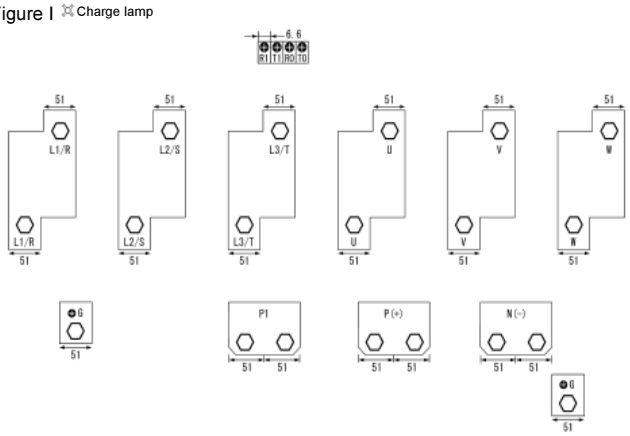


Figure J

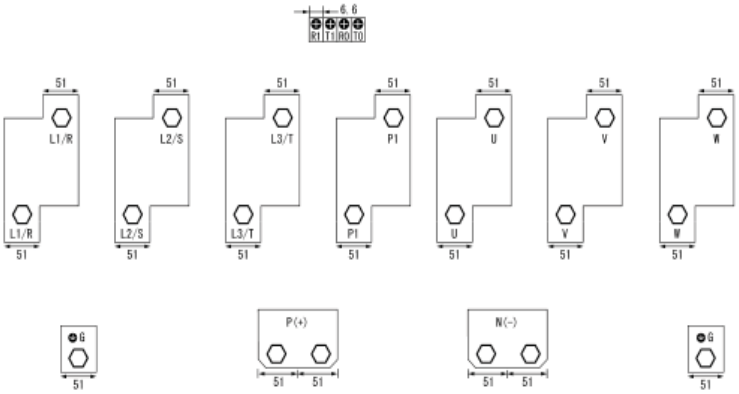
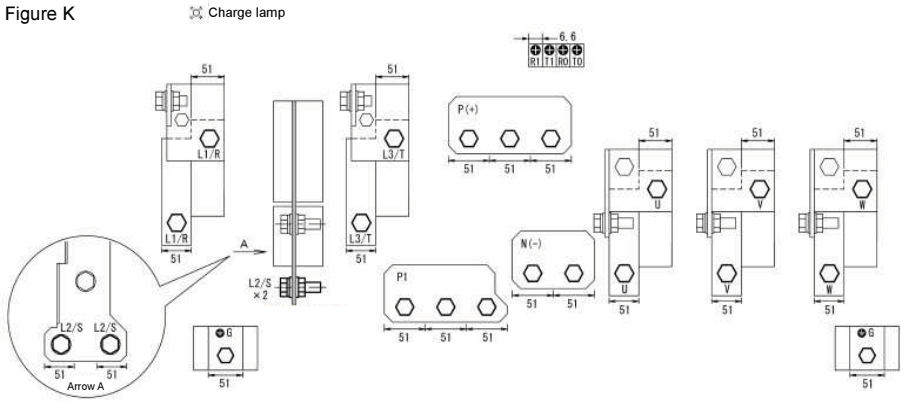
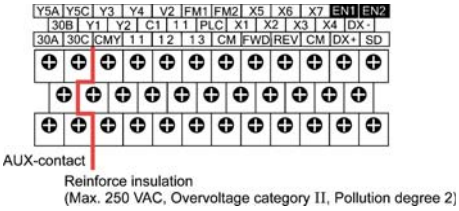


Figure K



(2) Arrangement of control circuit terminals

■ **Screw type of terminal block (common to all inverter types)**



■ **Europe type of terminal block (common to all inverter types)**

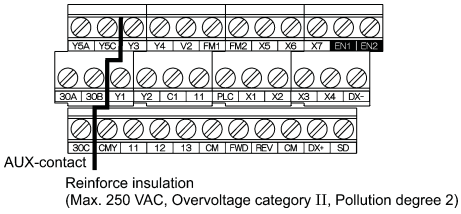


Table 2.3 Control Circuit Terminals

Terminal block type	Screw specifications		Recommended wire size (mm^2)	Type of screwdriver (tip shape)	Wire strip length	Gauge No. of wire insertion slot
	Screw size	Tightening torque				
Screw type	M3	0.7 N·m	0.75 mm^2 (AWG18)	-	-	-
Europe type		0.5 to 0.6 N·m		Flat screwdriver (0.6 mm x 3.5 mm)	6 mm	A1*

*In conformity with the IEC/EN 60947-1

2.2.4 Terminal functions and wiring order

Main circuit terminals and grounding terminals

The table below shows the order of wiring and terminal functions. Carry out wiring in the order shown below.

Table 2.4 Order of Wiring and Functions of Main Circuit Terminals

Classification	Order of wiring	Name	Symbol	Functions
Main circuit **(Note)**	①	Primary grounding terminals for inverter enclosure	⏚G	Two grounding terminals (⏚G) are not exclusive to the power supply wiring (primary circuit) or motor wiring (secondary circuit). Be sure to ground either of the two grounding terminals for safety and noise reduction.
	②	Secondary grounding terminals for motor Inverter output terminals	⏚G U, V, W	Connect the secondary grounding wire for the motor to the grounding terminal (⏚G). Connect the three wires of the 3-phase motor to terminals U, V, and W, aligning the phases each other. **(*1)**
	③	Auxiliary control power input terminals	R0, T0	Connect the same AC power as for the main circuit to these terminals as a control circuit power backup.
	④	Auxiliary main circuit power input terminals	R1, T1	It is not normally necessary to connect anything to these terminals. They are used when connecting to a DC bus. For more information, see section 4-11 of the User's Manual. (45kW or greater)
	⑤	DC reactor connection terminals	P1, P(+)	Connect a DC reactor (DCR) to improve the power factor. (110 kW or greater)
	⑥	DC link bus terminals	P(+), N(-)	A DC link bus is connectable to these terminals. When you need to use the DC link bus terminals P(+) and N(-), consult your IMO.
	⑦	Main circuit power input terminals	L1/R, L2/S, L3/T	The three-phase input power lines are connected to these terminals. **(*2)** If the power wires are connected to other terminals, the inverter will be damaged when the power is turned ON.
	⑧	Switching connectors	CN UX, CN R, CN W	These are the main circuit switching connectors. For more information, see "2.2.5 Switching connectors" in this instruction manual.
Control circuit	⑨	Control circuit terminals	See Table 2.5.	Route the wiring of the control circuit as far from that of the main circuit as possible. Otherwise, electric noise may cause malfunctions. When the Enable function is not to be used, short-circuit terminals [EN1] and [PLC] and terminals [EN2] and [PLC] using jumper wires.

(Note) Do not make wiring to unassigned main circuit terminals (marked with NC). For details about the terminal block, refer to Section 2.2.3 "Terminal arrangement diagrams and screw specifications."

■ **Wiring notes**

To make the machinery or equipment compliant with the EMC standards, wire the motor and inverter in accordance with the following.

(*1) Use shielded wires for the motor cable and route the cable as short as possible. Firmly clamp the shield to the specified point inside the inverter.

(*2) When wiring the main circuit power input lines of the inverters of 11 to 90 kW, be sure to pass them through a ferrite core.

Tip When shielded wires are not used for the motor cable, remove the motor cable clamps to prevent the cable covering from getting damaged, which makes the machinery or equipment incompliant with the EMC standards. Wiring the inverter main power input lines without passing them through a ferrite core also makes the machinery or equipment incompliant with the EMC standards due to increase of noise generated by the inverter, but it does not affect inverter basic operation.

For details about wiring, refer to Chapter 9, Section 9.3 "Compliance with EMC Standards."

Control circuit terminals

Table 2.5 Names, Symbols and Functions of the Control Circuit Terminals

Classification	Name	Symbol	Functions
Analog input	Power supply for the potentiometer	[13]	Power supply for an external frequency command potentiometer (Variable resistor: 1 to 5kΩ)
	Analog setting voltage input	[12]	External voltage input that commands the frequency externally.
	Analog setting current input PTC thermistor input	[C1]	External current input that commands the frequency externally. Connection of a PTC (Positive Temperature Coefficient) thermistor for motor protection.
	Analog setting voltage input	[V2]	External voltage input that commands the frequency externally.
	Analog common	[11]	Common terminal for analog input signals.
Digital input	Digital input 1 to Digital input 7	[X1] to [X7]	(1) Various signals such as "Coast to a stop," "Enable external alarm trip," and "Select multi-frequency" can be assigned to terminals [X1] to [X7], [FWD] and [REV] by setting function codes E01 to E07, E98, and E99. (2) Input mode, i.e. SINK/SOURCE, is changeable by using the slide switch SW1. (3) The logic value (1/0) for ON/OFF of the terminals [X1] to [X7], [FWD], or [REV] can be switched. If the logic value for ON of the terminal [X1] is "1" in the normal logic system, for example, OFF is "1" in the negative logic system and vice versa.
	Run forward command	[FWD]	Short-circuiting terminals [FWD] and [CM] runs the motor in the forward direction and opening them decelerates the motor to a stop.
	Run reverse command	[REV]	Short-circuiting terminals [REV] and [CM] runs the motor in the reverse direction and opening them decelerates the motor to a stop.
	Enable input 1 Enable input 2	[EN1] [EN2]	(1) Opening the circuit between terminals [EN1] and [PLC] or terminals [EN2] and [PLC] stops the operation of the inverter output transistor. (2) The input mode of terminals [EN1] and [EN2] is fixed at the SOURCE mode. No switching to the SINK mode is possible. (3) If either one of [EN1] and [EN2] is OFF, an alarm occurs.
	PLC signal power	[PLC]	Connects to the output signal power supply of Programmable Logic Controller (PLC).
	Digital input common	[CM]	Common terminals for digital input signals
Analog output	Analog monitor	[FM1] [FM2]	These terminals output monitor signals for analog DC voltage (0 to +10 V) or analog DC current (4 to 20 mA/0 to 20 mA).
	Analog common	[11]	Common terminal for analog output signals.
Transistor output	Transistor output 1 to Transistor output 4	[Y1] to [Y4]	Both the SINK and SOURCE modes are supported. (1) Various signals such as "Inverter running," "Frequency arrival signal," and "Motor overload early warning" can be assigned to terminals [Y1] to [Y4] by setting function code E20 to E23. (2) The logic value (1/0) for ON/OFF of the terminals between one of [Y1] to [Y4] and [CMY] can be switched. If the logic value for ON between one of [Y1] to [Y4] and [CMY] is "1" in the normal logic system, for example, OFF is "1" in the negative logic system and vice versa.
	Transistor output common	[CMY]	Common terminal for transistor output signals

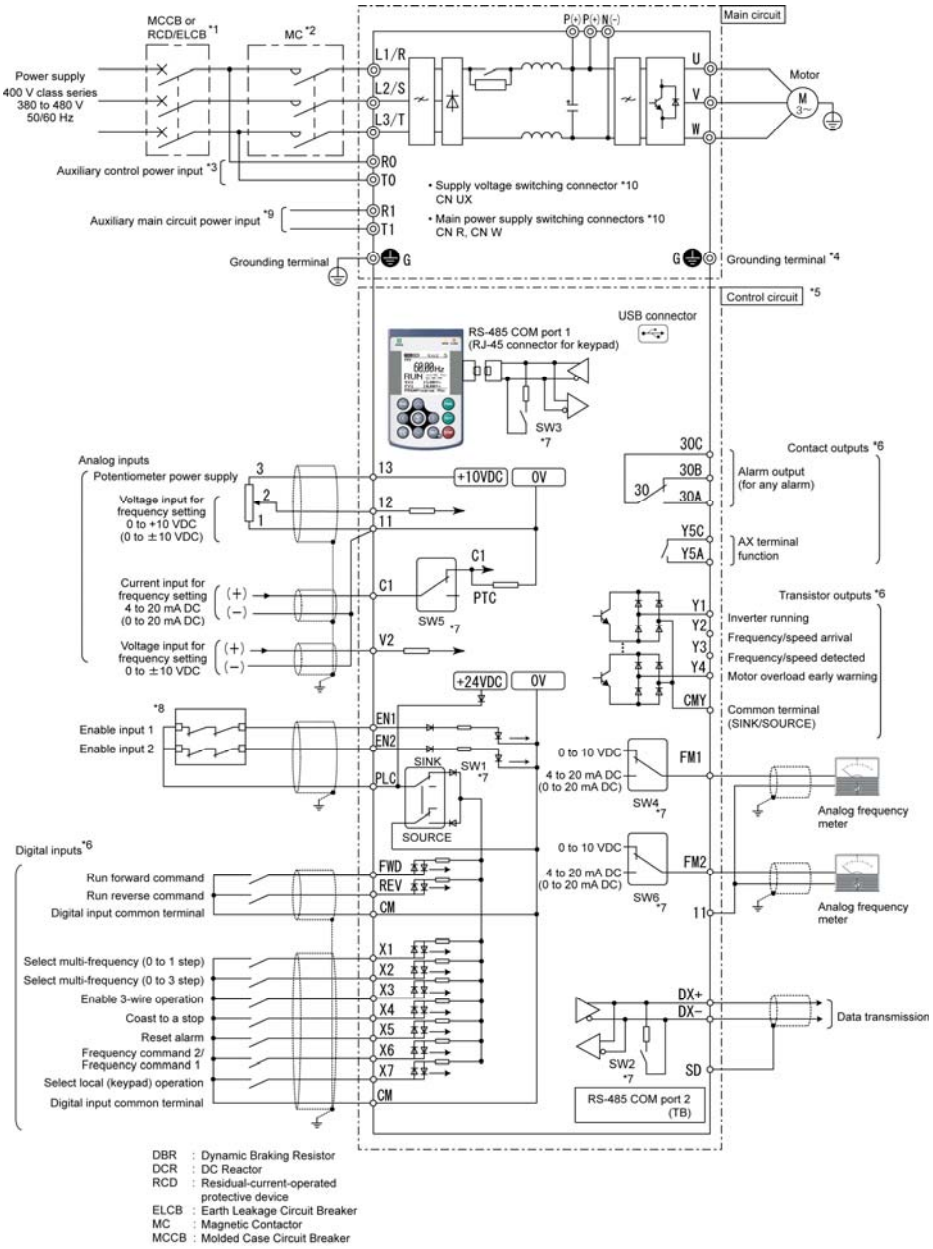
Table 2.5 Names, Symbols and Functions of the Control Circuit Terminals (Continued)

Classification	Name	Symbol	Functions
Relay output	General-purpose relay output	[Y5A/C]	(1) Any one of output signals that can be assigned to terminals [Y1] to [Y4] can also be assigned to this relay contact, as a general-purpose relay output. (2) Whether excitation or non-excitation causes this terminal to output an alarm can be switched.
	Alarm relay output (for any error)	[30A/B/C]	(1) When the protective function is activated, this terminal outputs a contact signal (1C) to stop the motor. (2) Any one of output signals that can be assigned to terminals [Y1] to [Y4] can also be assigned to this relay contact as a multipurpose relay output, to use it for signal output. (3) Whether excitation or non-excitation causes this terminal to output an alarm can be switched.
Communication	RS-485 communications port 2 (On the terminal block)	[DX+]/ [DX-]/ [SD]	These I/O terminals are used as a communications port that transmits data through the RS-485 multipoint protocol between the inverter and a computer or other equipment such as a PLC.
	RS-485 communications port 1 (For connection of the keypad)	RJ-45 connector	Used to connect the keypad to the inverter. The inverter supplies the power to the keypad via the extension cable for remote operation.
	USB port (On the control printed circuit board)	CN10	Used as a USB port connector (mini B) that connects the inverter to a computer. This connector enables connection with the inverter support loader.
Battery	Battery connection	CN11	Connector for an optional battery.

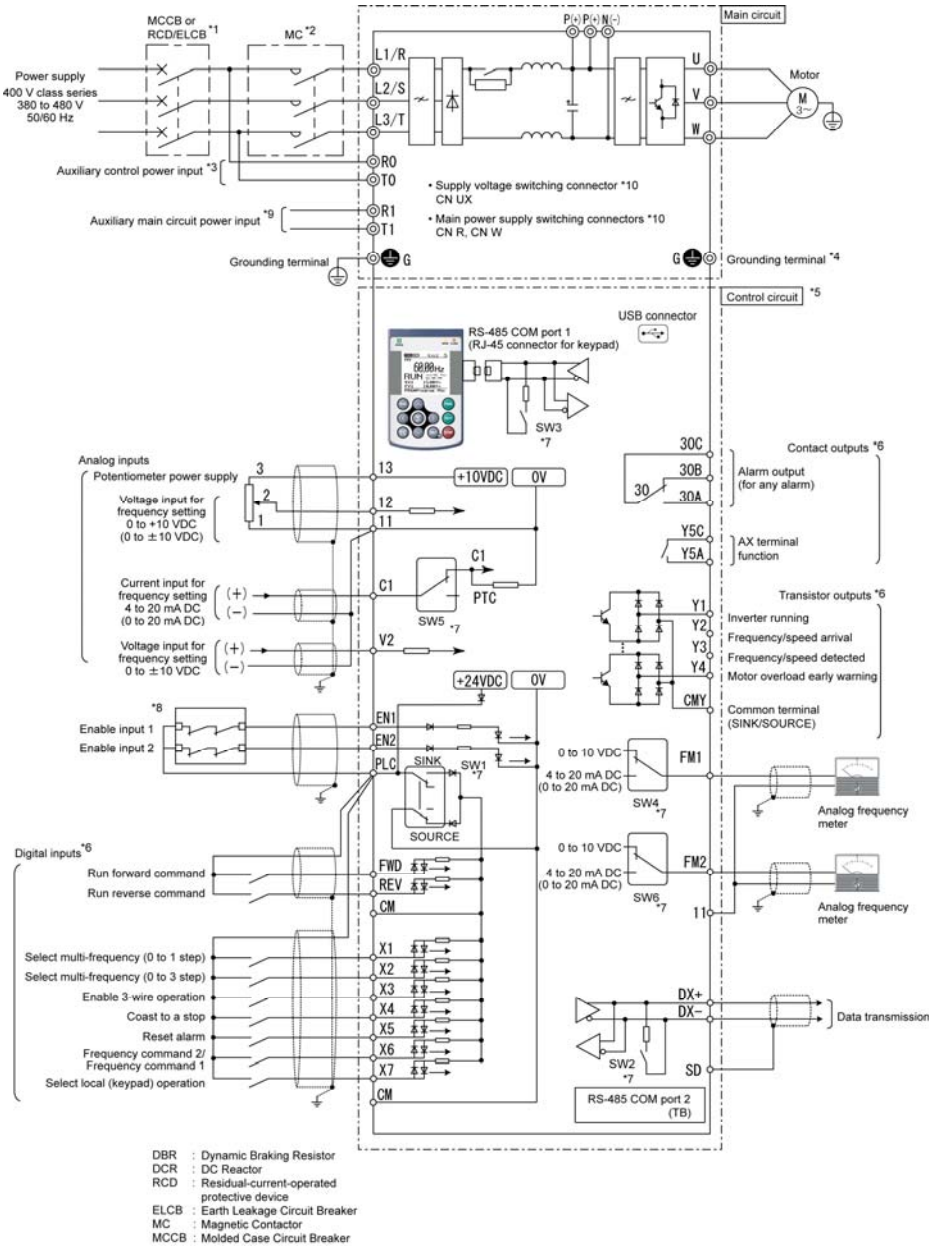
2.2.5 Connection diagrams

This section shows connection diagrams with the Enable input function used.

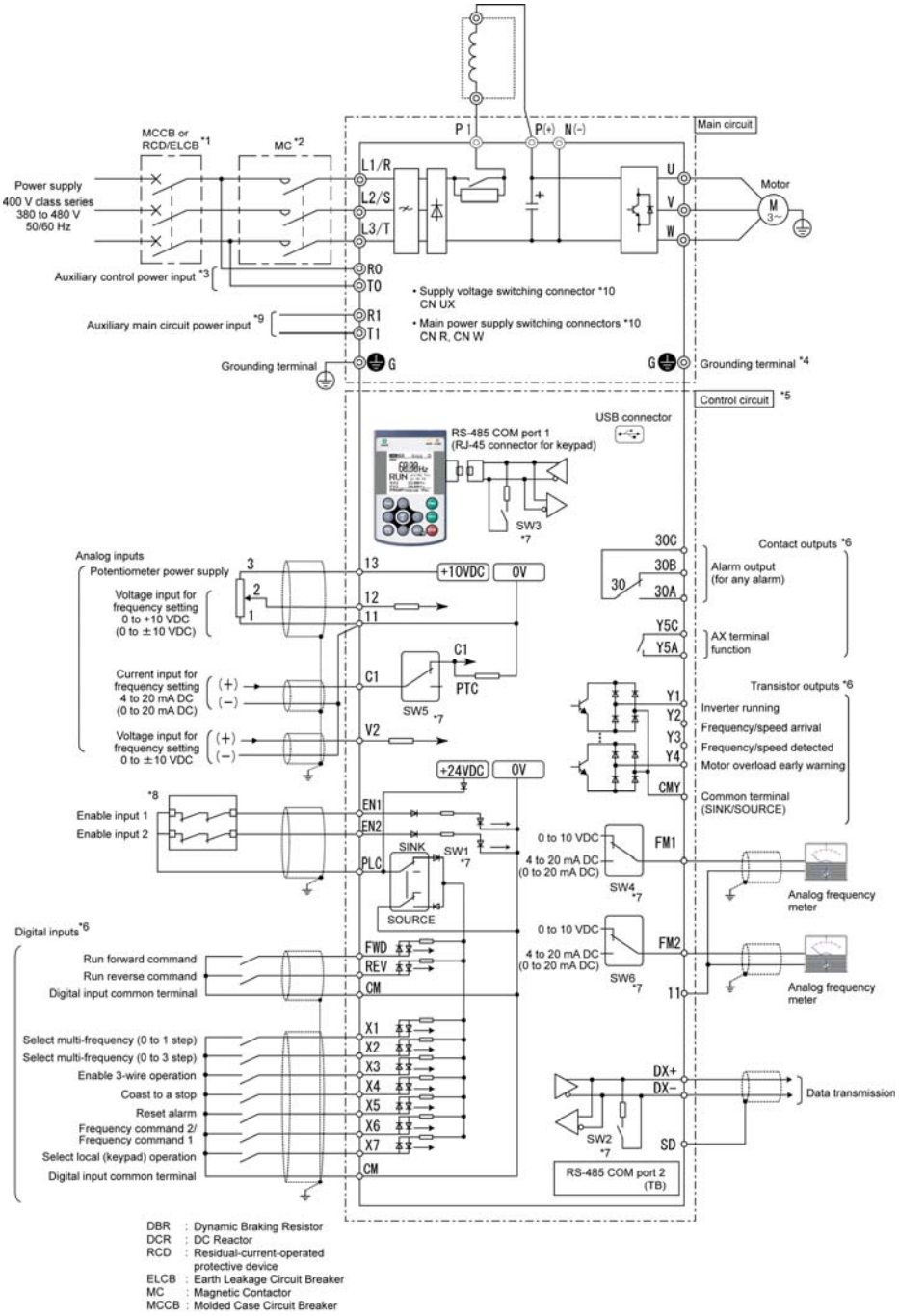
SINK mode.



SOURCE mode input by factory default.

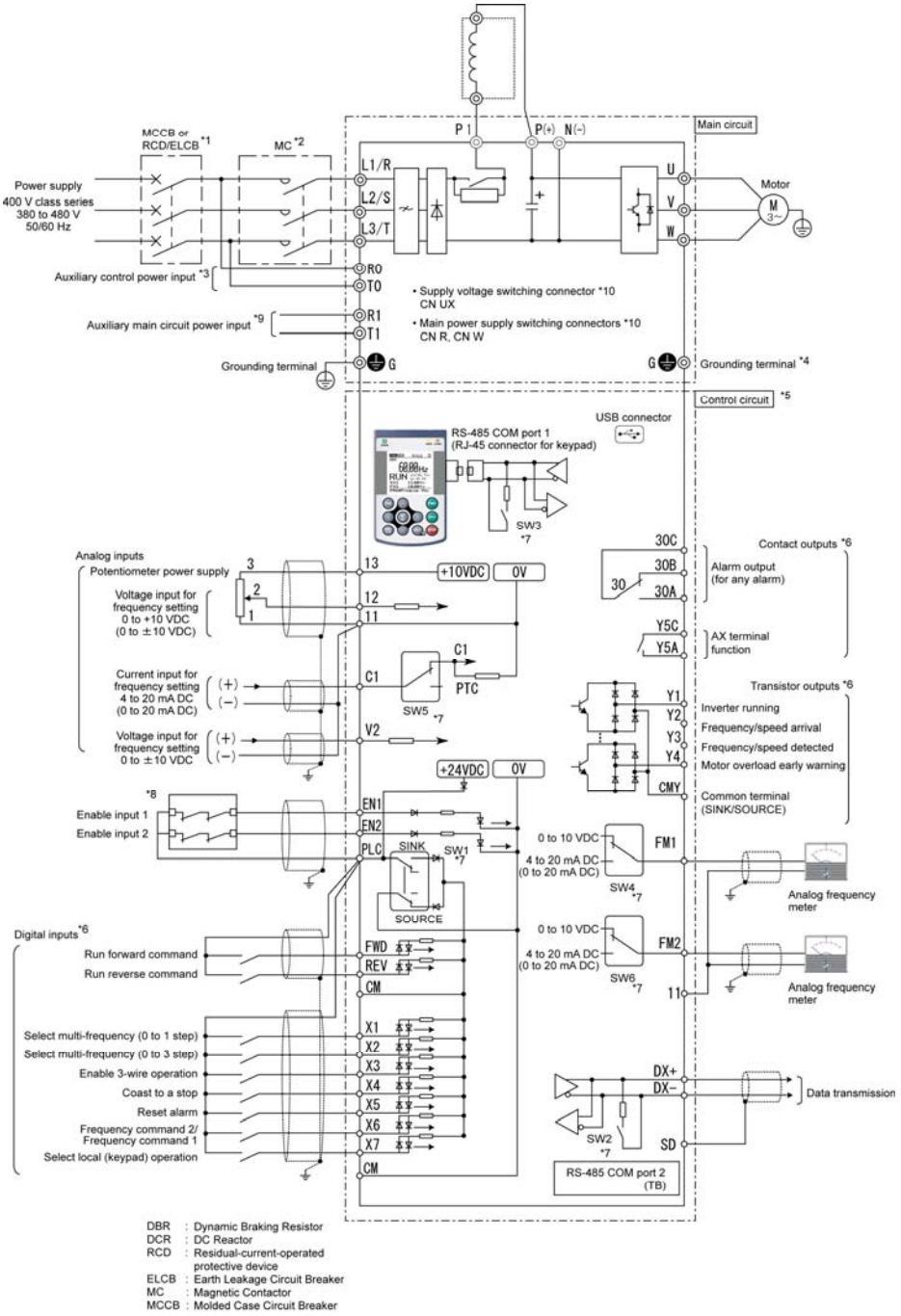


SINK mode input by factory default (110 kW or greater)



DBR : Dynamic Braking Resistor
DCR : DC Reactor
RCD : Residual-current-operated protective device
ELCB : Earth Leakage Circuit Breaker
MC : Magnetic Contactor
MCCB : Molded Case Circuit Breaker

SOURCE mode input by factory default (110 kW or greater)



DBR : Dynamic Braking Resistor
DCR : DC Reactor
RCD : Residual-current-operated protective device
ELCB : Earth Leakage Circuit Breaker
MC : Magnetic Contactor
MCCB : Molded Case Circuit Breaker

*1 Install a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection function) in the primary circuit of the inverter to protect wiring. Ensure that the circuit breaker capacity is equivalent to or lower than the recommended capacity.

*2 Install a magnetic contactor (MC) for each inverter to separate the inverter from the power supply, apart from the MCCB or RCD/ELCB, when necessary.
Connect a surge absorber in parallel when installing a coil such as the MC or solenoid near the inverter.

*3 To retain an alarm output signal ***ALM*** issued on inverter's programmable output terminals by the protective function or to keep the keypad alive even if the main power has shut down, connect these terminals to the power supply lines. Even without power supply to these terminals, the inverter can run.

When these terminals are connected to the power supply lines, shutting down the MC being used for main power ON/OFF cannot power off all live parts. Be sure to shut down all circuits with a disconnecting switch (DS).

*4 A grounding terminal for a motor. Use this terminal if needed.

*5 For control signal wires, use twisted or shielded-twisted wires. When using shielded-twisted wires, connect the shield of them to the common terminals of the control circuit. To prevent malfunction due to noise, keep the control circuit wiring away from the main circuit wiring as far as possible (recommended: 10 cm or more). Never install them in the same wire duct. When crossing the control circuit wiring with the main circuit wiring, set them at right angles.

*6 The connection diagram shows factory default functions assigned to digital input terminals [X1] to [X7], [FWD] and [REV], transistor output terminals [Y1] to [Y4], and relay contact output terminals [Y5A/C] and [30A/B/C].

*7 Slide switches on the control printed circuit board (control PCB). Use these switches to customize the inverter operations. For details, refer to Section 2.2.6 "Setting up the slide switches."

*8 When the Enable function is not to be used, short-circuit terminals [EN1] and [PLC] and terminals [EN2] and [PLC] using jumper wires. For opening and closing the hardware circuit between terminals [EN1] and [PLC] and between [EN2] and [PLC], use safety components such as safety relays and safety switches. Be sure to use shielded wires exclusive to terminals [EN1] and [PLC] and terminals [EN2] and [PLC]. (Do not put them together with any other control signal wire in the same shielded core.)

*9 It is not normally necessary to connect anything to these terminals. They are used when connecting to a DC bus. (45kW or greater)

*10 These are the main circuit switching connectors. For more information, see “2.2.5 Switching connectors” in this instruction manual.

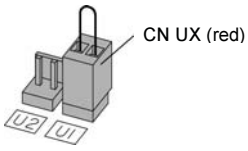
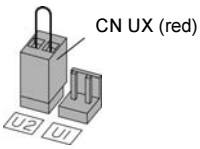
・Switching connectors

■ Supply voltage switching connector (CN UX)

Inverters with a capacity of 45 kW or greater have a supply voltage switching connector (CN UX). If the power supply being connected to the main circuit power input terminals (L1/R, L2/S, L3/T) or auxiliary main circuit power input terminals (R1, T1) satisfies the conditions listed below, change the CN UX connector to the U2 position. Otherwise, use the connector in the factory-default U1 position.

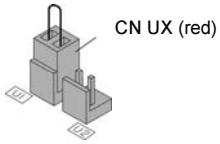
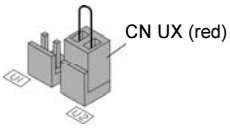
For more detailed switching guidelines, see Figures 2.5 and 2.6 on the following page.

(a) 45 to 132 kW

Setting		
Applied voltage	398 to 440 V/50 Hz, 430 to 480 V/60 Hz (Factory default)	380 to 398 V/50 Hz, 380 to 430 V/60 Hz

Note The allowable voltage fluctuation range is +10% to -15%.

(b) 160 to 710 kW

Setting		
Applied voltage	398 to 440V/50Hz, 430 to 480V/60Hz (Factory default)	380 to 398V/50Hz, 380 to 430V/60Hz

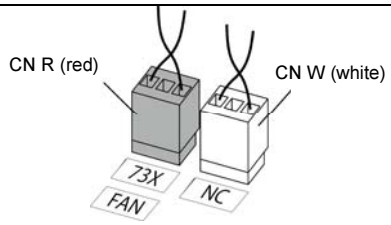
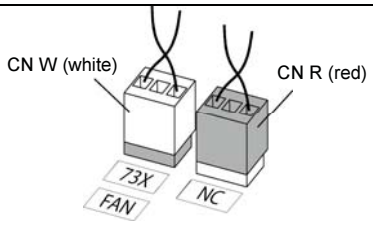
Note The allowable voltage fluctuation range is +10% to -15%.

■ Main power supply switching connectors (CN R, CN W) (45 kW or greater)

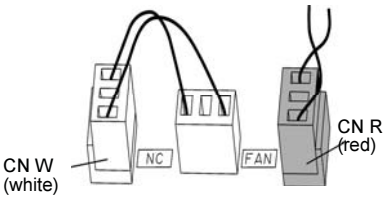
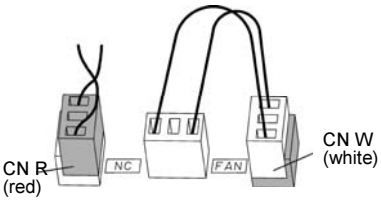
In its standard specifications, the JAGUAR VXH supports DC power supply input. However, inverters with a capacity of 45 kW or greater have components that are driven internally by an AC power supply and therefore require a supply of AC power. Consequently, when using the inverter with a DC power supply, it is necessary to switch the CN R connector to the NC position and the CN W connector to the 73X position (45 kW to 90 kW) or the FAN position (110 kW or greater), and to connect the designated AC power supply to the auxiliary main circuit power input terminals (R1, T1).

For more detailed switching guidelines, see Figures 2.5 and 2.6 on the following page.

(a) 45 to 132 kW

Setting		
Application	When not using the R1 and T1 terminals (Factory default)	When using the R1 and T1 terminals ・DC bus input type ・Used in combination with a PWM converter.

(b) 160kW to 710kW

Setting		
Application	When not using the R1 and T1 terminals (Factory default)	When using the R1 and T1 terminals ・DC bus input type ・Used in combination with a PWM converter.

Note

・In the factory-default state, the main power supply switching connector CN R is set to 73X (45 to 90 kW) or FAN (110 kW or greater), and CN W is set to NC. When not using the inverter with DC power supply input, do not switch the connectors. Use of improper main power supply switching connector settings may result in a malfunction such as a cooling fin overheat (0H1) or charging circuit error (PbF).

・When using this product in combination with a PWM converter, refer to the instructions given in the JAGUAR VXH User's Manual.

■ Connector locations

The switching connectors can be found in the following locations on the power supply printed circuit board:

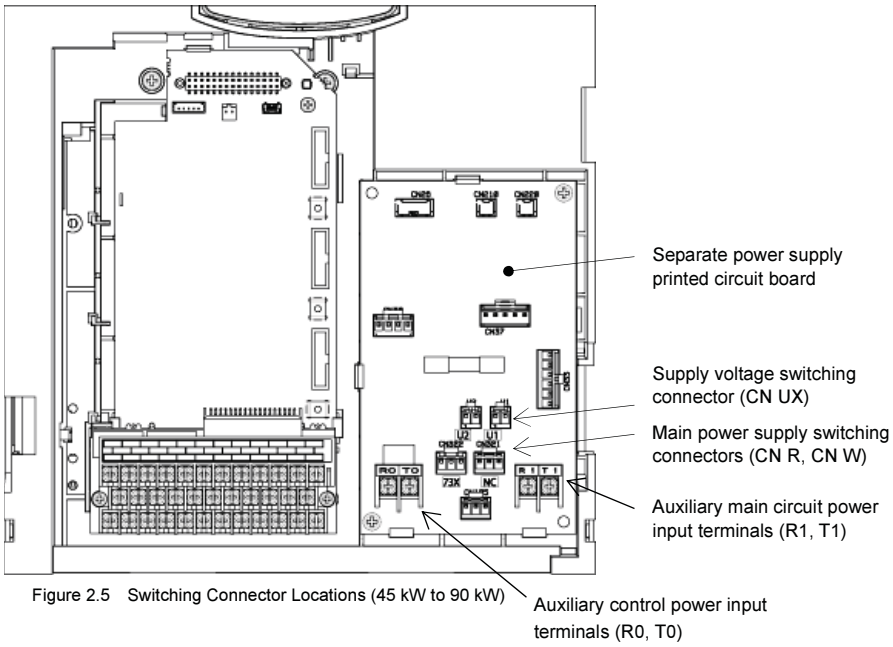


Figure 2.5 Switching Connector Locations (45 kW to 90 kW)

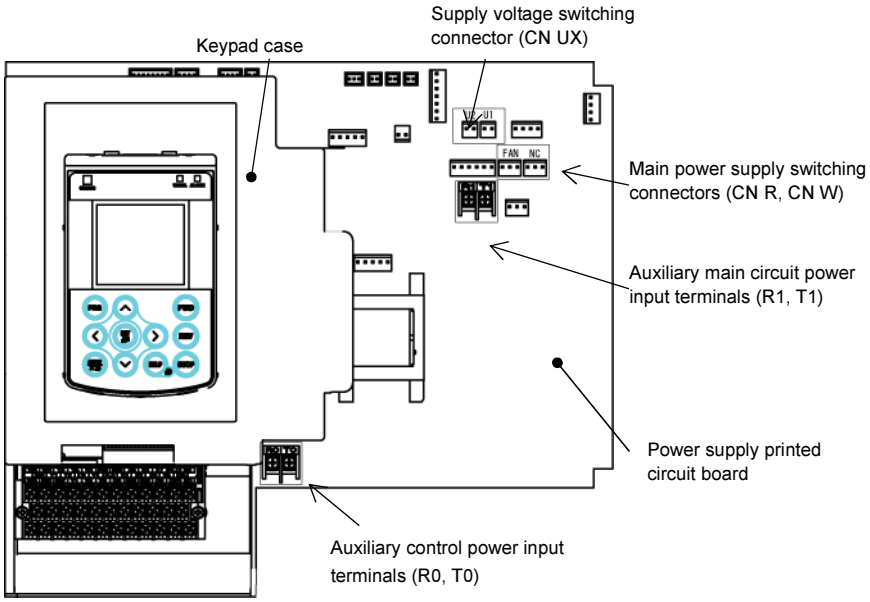


Figure 2.6 Switching Connector Locations (110 kW to 132 kW)

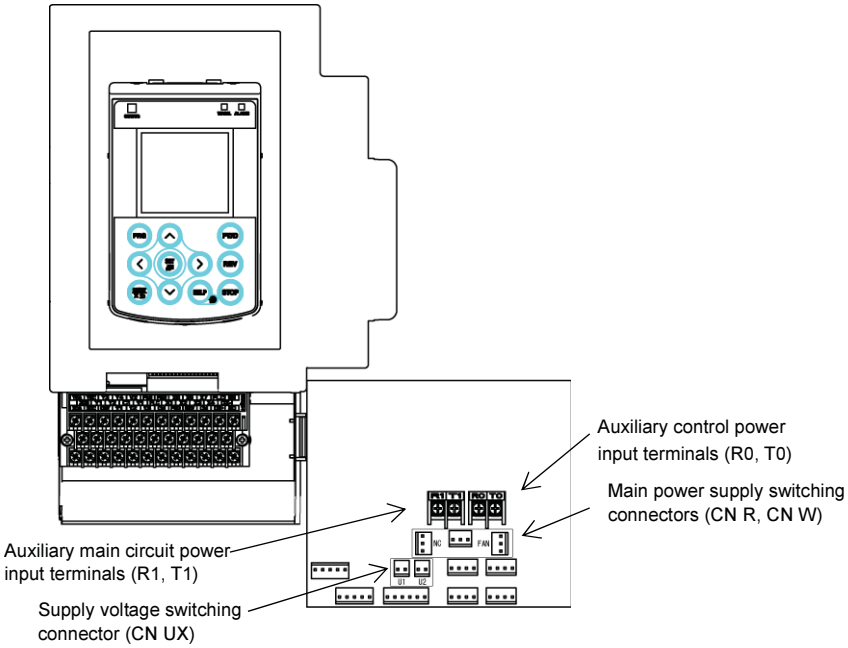


Figure 2.7 Switching Connector Locations (160 kW or greater)

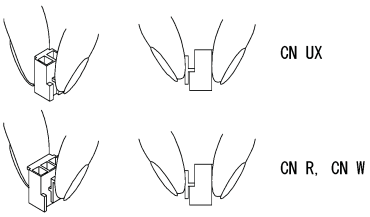


Figure 2.8 Attaching and Removing a Switching Connector (45 kW or greater)

Note To remove a connector, squeeze the top of the latch between your fingers to release the fastener and pull off the connector. To attach a connector, push it until it makes a clicking sound to ensure that the fastener is securely seated.

2.2.6 Setting the switches

Switching the slide switches located on the control PCB (see Figure 2.9) allows you to customize the operation mode of the analog output terminals, digital I/O terminals, and communications ports.

To access the slide switches, remove the front cover so that you can see the control PCB.

For details on how to remove the front cover, refer to Section 2.2.1.

Table 2.6 lists function of each slide switch.

Table 2.6 Function of Slide Switches

Switch	Function
SW1	Switches the service mode of the digital input terminals between SINK and SOURCE.
SW2	Switches the terminating resistor of RS-485 communications port on the inverter ON and OFF. (RS-485 communications port 2 on the terminal block)
SW3	Switches the terminating resistor of RS-485 communications port on the inverter ON and OFF. (RS-485 communications port 1 for connecting the keypad)
SW4	Switches the function of terminal [FM1] between VO1 and IO1.
SW5	Switches the function of terminal [C1] between C1 and PTC.
SW6	Switches the function of terminal [FM2] between VO2 and IO2.

Figure 2.9 shows the location of slide switches on the control PCB.

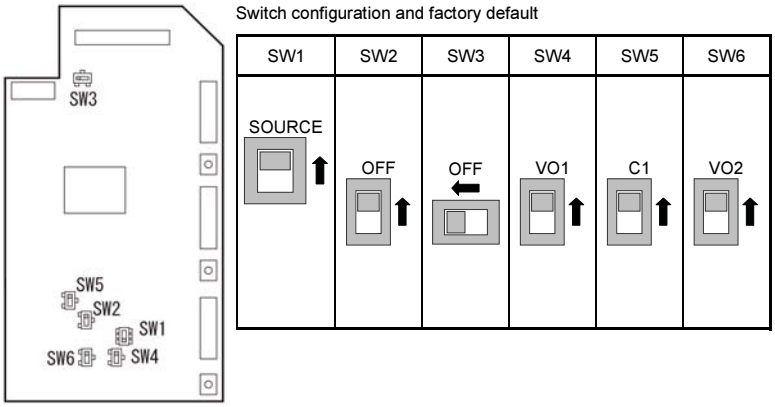
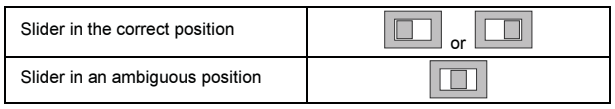


Figure 2.9 Location of the Slide Switches on the Control PCB

Note To move a switch slider, use a tool with a narrow tip (e.g., a tip of tweezers). Be careful not to touch other electronic parts, etc. If the slider is in an ambiguous position, the circuit is unclear whether it is turned ON or OFF and the digital input remains in an undefined state. Be sure to place the slider so that it contacts either side of the switch.



2.2.7 Mounting and connecting the keypad to the panel

You can remove the keypad from the inverter unit to mount it on the panel or install it at a remote site (e.g., for operation on hand). Note that the inverter with the keypad removed is rated IP00.

For detailed instructions on how to mount the keypad on the panel, refer to the JAGUAR VXH User's Manual, Chapter 5, Section 5.2 "Mounting and Connecting a Keypad to the Panel."

Chapter 3 NAMES AND FUNCTIONS OF KEYPAD COMPONENTS

1 LED Indicators

These indicators show the current running status of the inverter.

STATUS (green): Running state

WARN. (yellow): Light alarm state

ALARM (red): Alarm (heavy alarm) state

2 LCD Monitor

This monitor shows the following various information about the inverter according to the operation modes.

- Running status and run command source (e.g., Run/stop and rotation direction)
- Status icons (e.g., timer operation, PID operation, battery state, and password protection state)
- Operation guides for the current screen

3 Programming Keys

These keys are used to:

- Switch the operation modes between Running mode/Alarm mode and Programming mode.
- Reset the alarm states, discard the setting being configured, and cancel the screen transition according to the operation modes.
- Move the cursor to the digit of data to be modified, shift the setting item, and switch the screen.
- Call up the HELP screen for the current display state.

4 Operation Keys

These keys are used to:

- Start running the motor (in the forward/reverse direction).
- Stop the motor.

Chapter 5 FUNCTION CODES

This chapter contains overview tables of function codes available for the Jaguar VXH series of inverters and details of function codes.

Contents

5.1 Overview of Function Codes .....
5.2 Function Code Tables .....
5.3 Details of Function Codes .....
5.3.1 F codes (Fundamental functions) .....
5.3.2 E codes (Extension terminal functions) .....
5.3.3 C codes (Control functions) .....
5.3.4 P codes (Motor 1 parameters) .....
5.3.5 H codes (High performance functions) .....
5.3.6 H1 codes (High performance functions) .....
5.3.7 J codes (Application functions 1) .....
5.3.8 J1 codes (PID control 1) .....
5.3.9 J2 codes (PID control 2) .....
5.3.10 J5 codes (External PID control 1) .....
5.3.11 J6 codes (External PID control 2, 3) .....
5.3.12 d codes (Application functions 2) .....
5.3.13 U codes (Customizable logic functions) .....
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5.3.15 y codes (Link functions) .....
5.3.16 T codes (Timer functions) .....
5.3.17 K codes (Keypad functions) .....

5.1 Overview of Function Codes

Function codes enable the Jaguar VXH series of inverters to be set up to match your system requirements.

The function codes are classified into these groups: Fundamental Functions (F codes), Extension Terminal Functions (E codes), Control Functions (C codes), Motor 1 Parameters (P codes), High Performance Functions (H and H1 codes), Application Functions 1 (J codes), PID Control 1 (J1 codes), PID Control 2 (J2 codes), External PID Control 1 (J5 codes), External PID Control 2 and 3 (J6 codes), Application Functions 2 (d codes), Customizable Logic Functions (U and U1 codes), Link Functions (y codes), Timer Operation Functions (T codes), Keypad Functions (K codes), and Option Functions (o codes). To determine the property of each function code, set data to the function code.

This manual does not contain the descriptions of Option Functions (o codes). For o codes, refer to the instruction manual for each option.

5.2 Function Code Tables

The following descriptions supplement those given in the function code tables on page 5-3 and subsequent pages.

■ Changing, validating, and saving function code data when the inverter is running

Function codes are indicated by the following based on whether they can be changed or not when the inverter is running:

Notation	Change when running	Validating and saving function code data
Y*	Possible	If the data of the codes marked with Y* is changed with ⌃ / ⌄ / ⟨ / ⟩ keys, the change will immediately take effect; however, the change is not saved into the inverter's memory. To save the change, press the SET key. If you press the PRG key without pressing the SET key to exit the current state, then the changed data will be discarded and the previous data will take effect for the inverter operation.
Y	Possible	Even if the data of the codes marked with Y is changed with ⌃ / ⌄ / ⟨ / ⟩ keys, the change will not take effect. Pressing the SET key will make the change take effect and save it into the inverter's memory.
N	Impossible	—

■ Copying data

The keypad is capable of copying the function code data stored in the inverter's memory into the keypad's memory (PRG > 2(Function Code) > 4(Data Copy)). With this feature, you can easily transfer the data saved in a source inverter to other destination inverters.

If the specifications of the source and destination inverters differ, some code data may not be copied to ensure safe operation of your power system. Whether data will be copied or not is detailed with the following symbols in the "Data copying" column of the function code tables given on page 6-3 and subsequent pages.

Y: Will be copied unconditionally.
Y1: Will not be copied if the rated capacity differs from the source inverter.
N: Will not be copied. (The function code marked with "N" is not subject to the Verify operation, either.)

■ Using negative logic for programmable I/O terminals

The negative logic signaling system can be used for the programmable, digital input and output terminals by setting the function code data specifying the properties for those terminals. Negative logic refers to the inverted ON/OFF (logical value 1 (true)/0 (false)) state of input or output signal. An active-ON signal (the function takes effect if the terminal is short-circuited.) in the normal logic system is functionally equivalent to active-OFF signal (the function takes effect if the terminal is opened.) in the negative logic system. Active-ON signals can be switched to active-OFF signals, and vice versa, with the function code data setting, except some signals.

To set the negative logic system for an input or output terminal, enter data of 1000s (by adding 1000 to the data for the normal logic) in the corresponding function code.

Example: "Coast to a stop" command ***BX*** assigned to any of digital input terminals [X1] to [X7] using any of function codes E01 through E07.

Function code data	Description
7	Turning ***BX*** ON causes the motor to coast to a stop. (Active-ON)
1007	Turning ***BX*** OFF causes the motor to coast to a stop. (Active-OFF)

The following tables list the function codes available for the Jaguar VXH series of inverters.

F codes: Fundamental Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting
F00	Data Protection	0: Disable both data protection and digital reference protection 1: Enable data protection and disable digital reference protection 2: Disable data protection and enable digital reference protection 3: Enable both data protection and digital reference protection	Y	Y	0
F01	Frequency Command 1	0: ⌃ / ⌄ / ⌫ / ⌦ keys on keypad 1: Voltage input to terminal [12] (-10 to +10 VDC) 2: Current input to terminal [C1] (4 to 20 mA DC) 3: Sum of voltage and current inputs to terminals [12] and [C1] 5: Voltage input to terminal [V2] (0 to 10 VDC) 7: Terminal command ***UP/DOWN*** control 8: ⌃ / ⌄ / ⌫ / ⌦ keys on keypad (balanceless-bumpless switching available) 10: Pattern operation	N	Y	0
F02	Operation Method	0: FWD/REV/STOP keys on keypad (Motor rotational direction specified by terminal command ***FWD***/***REV***) 1: External signals (Terminal command ***FWD*** or ***REV***) 2: FWD/STOP keys on keypad (forward) 3: REV/STOP keys on keypad (reverse)	N	Y	0
F03	Maximum Frequency 1	25.0 to 120.0 Hz	N	Y	50.0
F04	Base Frequency 1	25.0 to 120.0 Hz	N	Y	50.0
F05	Rated Voltage at Base Frequency 1	0: Output a voltage in proportion to input voltage 160 to 500 V: Output an AVR-controlled voltage	N	Y	E: 400 A: 415 C: 380
F06	Maximum Output Voltage 1	160 to 500 V: Output an AVR-controlled voltage	N	Y	
F07	Acceleration Time 1	0.00 to 3600.00 s	Y	Y	20.00
F08	Deceleration Time 1	Note: Entering 0.00 cancels the acceleration time, requiring external soft-start.	Y	Y	20.00
F09	Torque Boost 1	0.0% to 20.0% (percentage with respect to "F05: Rated Voltage at Base Frequency 1")	Y	Y	*1
F10	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics)	1: For a general-purpose motor with shaft-driven cooling fan 2: For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan	Y	Y	1
F11	(Overload detection level)	OFF: Disable 1% to 135% of the inverter rated current	Y	Y1	*3
F12	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*2
F14	Restart Mode after Momentary Power Failure (Mode selection)	0: Trip immediately 1: Trip after a recovery from power failure 3: Continue to run, for heavy inertia or general loads 4: Restart at the frequency at which the power failure occurred, for general loads 5: Restart at the starting frequency	Y	Y	E: 0 A/C: 1
F15	Frequency Limiter (High)	0.0 to 120.0 Hz	Y	Y	70.0
F16	(Low)	0.0 to 120.0 Hz	Y	Y	0.0
F18	Bias (Frequency command 1)	-100.00% to 100.00%	Y*	Y	0.00
F20	DC Braking 1 (Braking starting frequency)	0.0 to 60.0 Hz	Y	Y	0.0
F21	(Braking level)	0% to 60% on the basis of inverter rated current	Y	Y	0
F22	(Braking time)	OFF (Disable); 0.01 to 30.00 s	Y	Y	OFF
F23	Starting Frequency 1	0.1 to 60.0 Hz	Y	Y	0.5
F24	(Holding time)	0.00 to 10.00 s	Y	Y	0.00
F25	Stop Frequency	0.1 to 60.0 Hz	Y	Y	0.2
F26	Motor Sound (Carrier frequency)	0.75 to 16 kHz (0.75 to 37 kW) 0.75 to 10 kHz (45 to 90 kW) 0.75 to 6 kHz (110 to 630 kW) 0.75 to 4 kHz (710 kW)	Y	Y	E: 15 A/C: 2
F27	(Tone)	0: Level 0 (Inactive) 1: Level 1 2: Level 2 3: Level 3	Y	Y	0
F29	Analog Output [FM1] (Mode selection)	0: Output in voltage (0 to 10 VDC) 1: Output in current (4 to 20 mA DC) 2: Output in current (0 to 20 mA DC)	Y	Y	0
F30	(Voltage adjustment)	0% to 300%	Y*	Y	100

The shaded function codes ( ) are applicable to the quick setup.

*1 The factory default differs depending upon the inverter's capacity. See Table A.

*2 5.0 min for inverters with a capacity of 22 kW or below; 10.0 min for those with 30 kW or above

*3 The motor rated current is automatically set. See Table B (function code P03).

Code	Name	Data setting range	Change when running	Data copying	Default setting	
F31	Analog Output [FM1] (Function)	Select a function to be monitored from the followings. 0: Output frequency 1 (before slip compensation) 1: Output frequency 2 (after slip compensation) 2: Output current 3: Output voltage 4: Output torque 5: Load factor 6: Input power 7: PID feedback amount 9: DC link bus voltage 10: Universal AO 13: Motor output 14: Calibration (+) 15: PID command (SV) 16: PID output (MV) 18: Inverter heat sink temperature (200°C/10 V) 20: Reference frequency 50: PID feedback amount 1 (PV1) 51: PID command 1 (SV1) 52: PID deviation 1 (ERR1) (Note 1) 53: PID final deviation (ERR) (Note 1) 54: PID feedback amount 2 (PV2) 55: PID command 2 (SV2) 56: PID deviation 2 (ERR2) (Note 1) 60: External PID feedback amount 1 (EPID1-PV) 61: External PID command 1 (EPID1-SV) 62: External PID deviation 1 (EPID1-ERR) (Note 1) 63: External PID final deviation 1 (EPID-ERR) (Note 1) 65: External PID final output 1 (EPID1-OUT) 70: External PID feedback amount 2 (EPID2-PV) 71: External PID command 2 (EPID2-SV) 72: External PID deviation 2 (EPID2-ERR) (Note 1) 75: External PID final output 2 (EPID2-OUT) 80: External PID feedback amount 3 (EPID3-PV) 81: External PID command 3 (EPID3-SV) 82: External PID deviation 3 (EPID3-ERR) (Note 1) 85: External PID final output 3 (EPID3-OUT) 111: Customizable logic output signal 1 112: Customizable logic output signal 2 113: Customizable logic output signal 3 114: Customizable logic output signal 4 115: Customizable logic output signal 5 116: Customizable logic output signal 6 117: Customizable logic output signal 7 (Note 1) Deviation output is supported only by option terminal [Ao] (o09).	Y	Y	0	
F32	Pulse Output [FM2] (Mode selection)	0: Voltage (0 to +10 VDC) 1: Current (4 to +20 mA DC) 2: Current (0 to +20 mA DC)	Y	Y	0	
F34	(Voltage adjustment)	0 to 300%	Y*	Y	0	
F35	(Function)	Same as F31.	Y	Y	0	
F37	Load Selection/ Auto Torque Boost/ Auto Energy Saving Operation 1	0: Variable torque load 1: Constant torque load 2: Auto torque boost 3: Auto energy saving (Variable torque load during ACC/DEC) 4: Auto energy saving (Constant torque load during ACC/DEC) 5: Auto energy saving (Auto torque boost during ACC/DEC)	N	Y	1	
F40	Torque Limiter 1 (Driving)	OFF: Disable	Y	Y	OFF	
F41	(Braking)	20% to 150%: Torque limiter level				
F42	Drive Control Selection 1	0: V/f control with slip compensation inactive 1: Dynamic torque vector control 2: V/f control with slip compensation active	N	Y	0	
F43	Current Limiter (Mode selection)	0: Disable (No current limiter works.) 1: Enable at constant speed (Disable during ACC/DEC) 2: Enable during ACC/constant speed operation	Y	Y	2	
F44	(Level)	20% to 120% (Assuming the inverter rated current as 100%.)	Y	Y	120	

E codes: Extension Terminal Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting
E01	Terminal [X1] Function	Selecting function code data assigns the corresponding function to terminals [X1] to [X7] as listed below. 0 (1000): Select multistep frequency (0 to 1 steps) (***SS1***) 1 (1001): Select multistep frequency (0 to 3 steps) (***SS2***) 2 (1002): Select multistep frequency (0 to 7 steps) (***SS4***) 3 (1003): Select multistep frequency (0 to 15 steps) (***SS8***) 4 (1004): Select ACC/DEC time (2 steps) (***RT1***) 5 (1005): Select ACC/DEC time (4 steps) (***RT2***) 6 (1006): Enable 3-wire operation (***HLD***) 7 (1007): Coast to a stop (***BX***) 8 (1008): Reset alarm (***RST***) 9 (1009): Enable external alarm trip (9 = Active OFF, 1009 = Active ON) (***THR***) 11 (1011): Select frequency command 2/1 (***Hz2/Hz1***) 13: Enable DC braking (***DCBRK***) 14 (1014): Select torque limiter level 2/1 (***TL2/TL1***) 15: Switch to commercial power (50 Hz) (***SW50***) 16: Switch to commercial power (60 Hz) (***SW60***) 17 (1017): UP (Increase output frequency) (***UP***) 18 (1018): DOWN (Decrease output frequency) (***DOWN***) 19 (1019): Enable data change with keypad (***WE-KP***) 20 (1020): Cancel PID control (***Hz/PID***) 21 (1021): Switch normal/inverse operation (***IVS***) 22 (1022): Interlock (***IL***) 24 (1024): Enable communications link via RS-485 or fieldbus (option) (***LE***) 25 (1025): Universal DI (***U-DI***) 26 (1026): Enable auto search for idling motor speed at starting (***STM***) 30 (1030): Force to stop (30 = Active OFF, 1030 = Active ON) (***STOP***) 33 (1033): Reset PID integral and differential components (***PID-RST***) 34 (1034): Hold PID integral component (***PID-HLD***) 35 (1035): Select local (keypad) operation (***LOC***) 38 (1038): Enable run commands (***RE***) 39: Protect motor from dew condensation (***DWP***) 40: Enable integrated sequence to switch to commercial power (50 Hz) (***ISW50***) 41: Enable integrated sequence to switch to commercial power (60 Hz) (***ISW60***) 58 (1058): Reset UP/DOWN frequency (***STZ***) 72 (1072): Count the run time of commercial power-driven motor 1 (***CRUN-M1***) 80 (1080): Cancel customizable logic (***CLC***) 81 (1081): Clear all customizable logic timers (***CLTC***) 87 (1087): Run command 2/1 (***FR2/FR1***) 88: Run forward 2 (***FWD2***) 89: Run reverse 2 (***REV2***) 100: No function assigned (***NONE***) 131 (1131): Flowrate switch (***FS***)* 132 (1132): Filter clogging reverse rotation command (***FRC***) 133 (1133): Switch PID channel (***PID2/1***) 134: Switch to fire mode (***FMS***) 171 (1171): PID multistep command 1 (***PID-SS1***) 172 (1172): PID multistep command 2 (***PID-SS2***) 181 (1181): External PID multistep command (***EPID-SS1***) 182 (1182): External PID multistep command (***EPID-SS2***) 190 (1190): Cancel timer (***TMC***) 191 (1191): Enable timer 1 (***TM1***) 192 (1192): Enable timer 2 (***TM2***) 193 (1193): Enable timer 3 (***TM3***) 194 (1194): Enable timer 4 (***TM4***) 201 (1201): External PID control 1 ON command (***EPID1-ON***) 202 (1202): Cancel external PID control 1 (***%/EPID1***) 203 (1203): Switch normal/inverse operation under external PID control 1 (***EPID1-IVS***) 204 (1204): Reset external PID1 integral and differential components (***EPID1-RST***) 205 (1205): Hold external PID1 integral component (***EPID1-HLD***) 211 (1211): External PID control 2 ON command (***EPID2-ON***) 212 (1212): Cancel external PID control 2 (***%/EPID2***) 213 (1213): Switch normal/inverse operation under external PID control 2 (***EPID2-IVS***) 214 (1214): Reset external PID2 integral and differential components (***EPID2-RST***) 215 (1215): Hold external PID2 integral component (***EPID2-HLD***)	N	Y	0
E02	Terminal [X2] Function		N	Y	1
E03	Terminal [X3] Function		N	Y	6
E04	Terminal [X4] Function		N	Y	7
E05	Terminal [X5] Function		N	Y	8
E06	Terminal [X6] Function		N	Y	11
E07	Terminal [X7] Function		N	Y	35

* Available in inverter ROM version 1500 or later.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
		221 (1221): External PID control 3 ON command (***EPID3-ON***) 222 (1222): Cancel external PID control 3 (***%/EPID3***) 223 (1223): Switch normal/inverse operation under external PID control 3 (***EPID3-IVS***) 224 (1224): Reset external PID3 integral and differential components (***EPID3-RST***) 225 (1225): Hold external PID3 integral component (***EPID3-HLD***) Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal. (True if OFF.) Setting the value of 1000s in parentheses ( ) shown above assigns a negative logic input to a terminal.				
E10	Acceleration Time 2	0.00 to 3600.00 s Note: Entering 0.00 cancels the acceleration time, requiring external soft-start and -stop.	Y	Y	20.00	
E11	Deceleration Time 2		Y	Y	20.00	
E12	Acceleration Time 3		Y	Y	20.00	
E13	Deceleration Time 3		Y	Y	20.00	
E14	Acceleration Time 4		Y	Y	20.00	
E15	Deceleration Time 4		Y	Y	20.00	
E16	Torque Limiter 2 (Driving)	OFF: Disable	Y	Y	OFF	
E17	(Braking)	20% to 150%: Torque limiter level	Y	Y	OFF	
E20	Terminal [Y1] Function	Selecting function code data assigns the corresponding function to terminals [Y1] to [Y5A/C] and [30A/B/C] as listed below.	N	Y	0	
E21	Terminal [Y2] Function	0 (1000): Inverter running (***RUN***)	N	Y	1	
E22	Terminal [Y3] Function	1 (1001): Frequency (speed) arrival signal (***FAR***)	N	Y	2	
E23	Terminal [Y4] Function	2 (1002): Frequency (speed) detected (***FDT***)	N	Y	7	
E24	Terminal [Y5A/C] Function	3 (1003): Undervoltage detected (Inverter stopped) (***LU***)	N	Y	15	
E27	Terminal [30A/B/C] Function (Relay output)	5 (1005): Inverter output limiting (***IOL***) 6 (1006): Auto-restarting after momentary power failure (***IPF***) 7 (1007): Motor overload early warning (***OL***) 10 (1010): Inverter ready to run (***RDY***) 11: Switch motor drive source between commercial power and inverter output (For MC on commercial line) (***SW88***) 12: Switch motor drive source between commercial power and inverter output (For secondary side) (***SW52-2***) 13: Switch motor drive source between commercial power and inverter output (For primary side) (***SW52-1***) 15 (1015): Select ***AX*** terminal function (For MC on primary side) (***AX***) 16 (1016): Shifted to pattern operation stage (***TU***) 17 (1017): Pattern operation cycle completed (***TO***) 18 (1018): Pattern operation stage number (***STG1***) 19 (1019): Pattern operation stage number (***STG2***) 20 (1020): Pattern operation stage number (***STG4***) 22 (1022): Inverter output limiting with delay (***IOL2***) 25 (1025): Cooling fan in operation (***FAN***) 26 (1026): Auto-resetting (***TRY***) 27 (1027): Universal DO (***U-DO***) 28 (1028): Heat sink overheat early warning (***OH***) 30 (1030): Lifetime alarm (***LIFE***) 31 (1031): Frequency (speed) detected 2 (***FDT2***) 33 (1033): Reference loss detected (***REF OFF***) 35 (1035): Inverter output on (***RUN2***) 36 (1036): Overload prevention control (***OLP***) 37 (1037): Current detected (***ID***) 42 (1042): PID alarm (***PID-ALM***) 43 (1043): Under PID control (***PID-CTL***) 44 (1044): Motor stopped due to slow flowrate under PID control (***PID-STP***)* 45 (1045): Low output torque detected (***U-TL***) 52 (1052): Running forward (***FRUN***) 53 (1053): Running reverse (***RRUN***) 54 (1054): In remote operation (***RMT***) 55 (1055): Run command entered (***AX2***) 56 (1056): Motor overheat detected by thermistor (***THM***) 59 (1059): Terminal [C1] wire break (***C1OFF***) 84 (1084): Maintenance timer (***MNT***) 87(1087): Frequency arrival signal (***FARFDT***) 95(1095): Running in fire mode (***FMRUN***) 98 (1098): Light alarm (***L-ALM***) 99 (1099): Alarm output (for any alarm) (***ALM***) 101(1101): EN terminal detection circuit error (***DECF***) 102(1102): EN terminal OFF (***ENOFF***)	N	Y	99	

* Available in inverter ROM version 1500 or later.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
		111 (1111): Customizable logic output signal 1 (***CLO1***) 112 (1112): Customizable logic output signal 2 (***CLO2***) 113 (1113): Customizable logic output signal 3 (***CLO3***) 114 (1114): Customizable logic output signal 4 (***CLO4***) 115 (1115): Customizable logic output signal 5 (***CLO5***) 116 (1116): Customizable logic output signal 6 (***CLO6***) 117 (1117): Customizable logic output signal 7 (***CLO7***) 190 (1190): In timer operation (***TMD***) 191 (1191): Timer 1 enabled (***TMD1***) 192 (1192): Timer 2 enabled (***TMD2***) 193 (1193): Timer 3 enabled (***TMD3***) 194 (1194): Timer 4 enabled (***TMD4***) 200 (1200): Under PID2 control (***PID2***) 201 (1201): PID1 alarm (***PV1-ALM***) 202 (1202): PID1 feedback error (***PV1-OFF***) 203 (1203): PID2 alarm (***PV2-ALM***) 204 (1204): PID2 feedback error (***PV2-OFF***) 211 (1211): Under external PID1 control (***EPID1-CTL***) 212 (1212): External PID1 output (***EPID1-OUT***) 213 (1213): Running under external PID1 (***EPID1-RUN***) 214 (1214): External PID1 alarm (***EPV1-ALM***) 215 (1215): External PID1 feedback error (***EPV1-OFF***) 221 (1221): Under external PID2 control (***EPID2-CTL***) 222 (1222): External PID2 output (***EPID2-OUT***) 223 (1223): Running under external PID2 (***EPID2-RUN***) 224 (1224): External PID2 alarm (***EPV2-ALM***) 225 (1225): External PID2 feedback error (***EPV2-OFF***) 231 (1231): Under external PID3 control (***EPID3-CTL***) 232 (1232): External PID3 output (***EPID3-OUT***) 233 (1233): Running under external PID3 (***EPID3-RUN***) 234 (1234): External PID3 alarm (***EPV3-ALM***) 235 (1235): External PID3 feedback error (***EPV3-OFF***) Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal. (True if OFF.) Setting the value of 1000s in parentheses ( ) shown above assigns a negative logic input to a terminal.				
E30	Frequency Arrival (Hysteresis width)	0.0 to 10.0 Hz	Y	Y	2.5	
E31	Frequency Detection 1 (Level)	0.0 to 120.0 Hz	Y	Y	50.0	
E32	(Hysteresis width)	0.0 to 120.0 Hz	Y	Y	1.0	
E34	Overload Early Warning/Current Detection (Level)	OFF: Disable 1 to 150% of inverter rated current	Y	Y1	*3	
E35	(Timer)	0.01 to 600.00s	Y	Y	10.00	
E61	Terminal [12] Extended Function	0: None	N	Y	0	
E62	Terminal [C1] Extended Function	1: Auxiliary frequency command 1	N	Y	0	
E63	Terminal [V2] Extended Function	2: Auxiliary frequency command 2 3: PID process command 1 4: PID process command 2 5: PID feedback value 1 12: Acceleration/deceleration time ratio setting 13: Upper limit frequency 14: Lower limit frequency 20: Analog signal input monitor 30: PID feedback value 2 31: Auxiliary input 1 to PID process command 32: Auxiliary input 2 to PID process command 33: Flowrate sensor* 41: External PID process command 1 42: External PID feedback value 1 43: External PID manual command 1 44: External PID process command 2 45: External PID feedback value 2 46: External PID manual command 2 47: External PID process command 3 48: External PID feedback value 3 49: External PID manual command 3	N	Y	0	
E64	Saving of Digital Reference Frequency	0: Automatic saving (when main power is turned OFF) 1: Saving by pressing (SET) key	Y	Y	1	
E65	Reference Loss Detection (Continuous running frequency)	OFF: Cancel Decel: Decelerate to stop 20% to 120%	Y	Y	OFF	
E80	Low Torque Detection (Level)	0% to 150%	Y	Y	20	

* Available in inverter ROM version 1500 or later.

*3 The motor parameters are set by capacities. See Table B (function code P03).

Code	Name	Data setting range	Change when running	Data copying	Default setting	
		Selecting function code data assigns the corresponding function to terminals [FWD] and [REV] as listed below.				
E98	Terminal [FWD] Function	0 (1000): Select multistep frequency (0 to 1 steps) (***SS1***)	N	Y	98	
E99	Terminal [REV] Function	1 (1001): Select multistep frequency (0 to 3 steps) (***SS2***)	N	Y	99	
		2 (1002): Select multistep frequency (0 to 7 steps) (***SS4***)				
		3 (1003): Select multistep frequency (0 to 15 steps) (***SS8***)				
		4 (1004): Select ACC/DEC time (2 steps) (***RT1***)				
		5 (1005): Select ACC/DEC time (4 steps) (***RT2***)				
		6 (1006): Enable 3-wire operation (***HLD***)				
		7 (1007): Coast to a stop (***BX***)				
		8 (1008): Reset alarm (***RST***)				
		9 (1009): Enable external alarm trip (9 = Active OFF, 1009 = Active ON) (***THR***)				
		11 (1011): Select frequency command 2/1 (***Hz2/Hz1***)				
		13: Enable DC braking (***DCBRK***)				
		14 (1014): Select torque limiter level 2/1 (***TL2/TL1***)				
		15: Switch to commercial power (50 Hz) (***SW50***)				
		16: Switch to commercial power (60 Hz) (***SW60***)				
		17 (1017): UP (Increase output frequency) (***UP***)				
		18 (1018): DOWN (Decrease output frequency) (***DOWN***)				
		19 (1019): Enable data change with keypad (***WE-KP***)				
		20 (1020): Cancel PID control (***Hz/PID***)				
		21 (1021): Switch normal/inverse operation (***IVS***)				
		22 (1022): Interlock (***IL***)				
		24 (1024): Enable communications link via RS-485 or fieldbus (***LE***)				
		25 (1025): Universal DI (***U-DI***)				
		26 (1026): Enable auto search for idling motor speed at starting (***STM***)				
		30 (1030): Force to stop (30 = Active OFF, 1030 = Active ON) (***STOP***)				
		33 (1033): Reset PID integral and differential components (***PID-RST***)				
		34 (1034): Hold PID integral component (***PID-HLD***)				
		35 (1035): Select local (keypad) operation (***LOC***)				
		38 (1038): Enable run commands (***RE***)				
		39: Protect motor from dew condensation (***DWP***)				
		40: Enable integrated sequence to switch to commercial power (50 Hz) (***ISW50***)				
		41: Enable integrated sequence to switch to commercial power (60 Hz) (***ISW60***)				
		58 (1058): Reset UP/DOWN frequency (***STZ***)				
		72 (1072): Count the run time of commercial power-driven motor 1 (***CRUN-M1***)				
		80 (1080): Cancel customizable logic (***CLC***)				
		81 (1081): Clear all customizable logic timers (***CLTC***)				
		87 (1087): Run command 2/1 (***FR2/FR1***)				
		88: Run forward 2 (***FWD2***)				
		89: Run reverse 2 (***REV2***)				
		98: Run forward (***FWD***)				
		99: Run reverse (***REV***)				
		100: No function assigned (***NONE***)				
		131 (1131): Flowrate switch (***FS***)*				
		132 (1132): Filter clogging reverse rotation command (***FRC***)				
		133 (1133): Switch PID channel (***PID2/1***)				
		134: Switch to fire mode (***FMS***)				
		171 (1171): PID multistep command (***PID-SS1***)				
		172 (1172): PID multistep command (***PID-SS2***)				
		181 (1181): External PID multistep command (***EPID-SS1***)				
		182 (1182): External PID multistep command (***EPID-SS2***)				
		190 (1190): Cancel timer (***TMC***)				
		191 (1191): Enable timer 1 (***TM1***)				
		192 (1192): Enable timer 2 (***TM2***)				
		193 (1193): Enable timer 3 (***TM3***)				
		194 (1194): Enable timer 4 (***TM4***)				
		201 (1201): External PID control 1 ON command (***EPID1-ON***)				
		202 (1202): Cancel external PID control 1 (***%/EPID1***)				
		203 (1203): Switch normal/inverse operation under external PID control 1 (***EPID1-IVS***)				
		204 (1204): Reset external PID1 integral and differential components (***EPID1-RST***)				
		205 (1205): Hold external PID1 integral component (***EPID1-HLD***)				

* Available in inverter ROM version 1500 or later.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
		211 (1211): External PID control 2 ON command (***EPID2-ON***) 212 (1212): Cancel external PID control 2 (***%/EPID2***) 213 (1213): Switch normal/inverse operation under external PID control 2 (***EPID2-IVS***) 214 (1214): Reset external PID2 integral and differential components (***EPID2-RST***) 215 (1215): Hold external PID2 integral component (***EPID2-HLD***) 221 (1221): External PID control 3 ON command (***EPID3-ON***) 222 (1222): Cancel external PID control 3 (***%/EPID3***) 223 (1223): Switch normal/inverse operation under external PID control 3 (***EPID3-IVS***) 224 (1224): Reset external PID3 integral and differential components (***EPID3-RST***) 225 (1225): Hold external PID3 integral component (***EPID3-HLD***) Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal. (True if OFF.) Setting the value of 1000s in parentheses ( ) shown above assigns a negative logic input to a terminal.				

C codes: Control Functions of Frequency

Code	Name	Data setting range	Change when running	Data copying	Default setting	
C01	Jump Frequency 1	0.0 to 120.0 Hz	Y	Y	0.0	
C02	2		Y	Y	0.0	
C03	3		Y	Y	0.0	
C04	(Hysteresis width)	0.0 to 30.0 Hz	Y	Y	3.0	
C05	Multistep Frequency 1	0.00 to 120.00 Hz	Y	Y	0.00	
C06	2		Y	Y	0.00	
C07	3		Y	Y	0.00	
C08	4		Y	Y	0.00	
C09	5		Y	Y	0.00	
C10	6		Y	Y	0.00	
C11	7		Y	Y	0.00	
C12	8		Y	Y	0.00	
C13	9		Y	Y	0.00	
C14	10		Y	Y	0.00	
C15	11		Y	Y	0.00	
C16	12		Y	Y	0.00	
C17	13		Y	Y	0.00	
C18	14		Y	Y	0.00	
C19	15		Y	Y	0.00	
C21	Pattern Operation (Mode selection)	0: Carry out a single cycle of the specified pattern operation and stop the inverter output 1: Carry out the specified pattern operation repeatedly and stop the inverter output upon receipt of a stop command. 2: Carry out a single cycle of the specified pattern operation and continue to run at the last reference frequency.	N	Y	0	
C22	Pattern Operation (Stage 1)	0.00 to 6000.00 s	Y	Y	0.00	
C23	(Stage 2)	FWD/RED 1 to 4			FWD 1	
C24	(Stage 3)					
C25	(Stage 4)					
C26	(Stage 5)					
C27	(Stage 6)					
C28	(Stage 7)					
C30	Frequency Command 2	0: Enable ⌃ / ⌄ keys on the keypad 1: Voltage input to terminal [12] (-10 to +10 VDC) 2: Current input to terminal [C1] (4 to 20 mA DC) 3: Sum of voltage and current inputs to terminals [12] and [C1] 5: Voltage input to terminal [V2] (0 to 10 VDC) 7: Terminal command ***UP***/***DOWN*** control 8: Enable ⌃ / ⌄ keys on the keypad (balanceless-bumpless switching available) 10: Pattern operation	N	Y	2	
C31	Analog Input Adjustment for [12] (Offset)	-5.0% to 5.0%	Y*	Y	0.0	
C32	(Gain)	0.00% to 200.00%	Y*	Y	100.00	
C33	(Filter time constant)	0.00 to 5.00 s	Y	Y	0.05	
C34	(Gain base point)	0.00% to 100.00%	Y*	Y	100.00	
C35	(Polarity)	0: Bipolar 1: Unipolar	N	Y	1	
C36	Analog Input Adjustment for [C1] (Offset)	-5.0% to 5.0%	Y*	Y	0.0	
C37	(Gain)	0.00% to 200.00%	Y*	Y	100.00	
C38	(Filter time constant)	0.00 to 5.00s	Y	Y	0.05	
C39	(Gain base point)	0.00% to 100.00%	Y*	Y	100.00	
C40	Terminal [C1] Input Range Selection	0: 4 to 20 mA 1: 0 to 20 mA	N	Y	0	
C41	Analog Input Adjustment for [V2] (Offset)	-5.0% to 5.0%	Y*	Y	0.0	
C42	(Gain)	0.00% to 200.00%	Y*	Y	100.00	
C43	(Filter time constant)	0.00 to 5.00 s	Y	Y	0.05	
C44	(Gain base point)	0.00% to 100.00%	Y*	Y	100.00	
C45	(Polarity)	0: Bipolar 1: Unipolar	N	Y	1	
C53	Selection of Normal/Inverse Operation (Frequency command 1)	0: Normal operation 1: Inverse operation	Y	Y	0	
C55	Analog Input Adjustment for Terminal [12] (Bias value)	-100.00 to 100.00%	Y	Y	0.00	
C56	(Bias base point)	0.00 to 100.00%	Y	Y	0.00	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
C58	Analog Input Adjustment for Terminal [12] (Display unit)	1: none 2: % 4: r/min 7: kW Flowrate 20: m^3/s 21: m^3/min 22: m^3/h 23: L/s 24: L/min 25: L/h Pressure 40: Pa 41: kPa 42: MPa 43: mbar 44: bar 45: mmHg 46: psi (Pound per square inch) 47: mWG 48: inWG Temperature 60: K 61: °C 62: °F Density 80: ppm	Y	Y	2	
C59	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	
C60	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	
C61	Analog Input Adjustment for Terminal [C1] (Bias value)	-100.00 to 100.00%	Y	Y	0.00	
C62	(Bias base point)	0.00 to 100.00%	Y	Y	0.00	
C64	(Display unit)	Same as C58.	Y	Y	2	
C65	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	
C66	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	
C67	Analog Input Adjustment for Terminal [V2] (Bias value)	-100.00 to 100.00%	Y	Y	0.00	
C68	(Bias base point)	0.00 to 100.00%	Y	Y	0.00	
C70	(Display unit)	Same as C58.	Y	Y	2	
C71	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	
C72	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	

Note: Alphabets in the Default setting field denote shipping destination: E (EU), A (Asia), C (China).

P codes: Motor 1 Parameters

Code	Name	Data setting range	Change when running	Data copying	Default setting	
P01	Motor 1 (No. of poles)	2 to 22 poles	N	Y1	4	
P02	(Rated capacity)	0.01 to 1000.00 kW (when P99 = 0 or 4) 0.01 to 1000.00 HP (when P99 = 1)	N	Y1	*6	
P03	(Rated current)	0.00 to 2000.00 A	N	Y1	*6	
P04	(Auto-tuning)	0: Disable 1: Tune the motor while it is stopped (%R1, %X) 2: Tune the motor while it is rotating under V/f control (%R1, %X, no-load current)	N	N	0	
P05	(Online-tuning)	0: Disable 1: Enable	Y	Y	0	
P06	(No-load current)	0.00 to 2000.00 A	N	Y1	*6	
P07	(%R1)	0.00% to 50.00%	Y	Y1	*6	
P08	(%X)	0.00% to 50.00%	Y	Y1	*6	
P10	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1	0.50	
P12	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1	*6	
P99	Motor 1 Selection	0: Motor characteristics 0 (Fuji standard motors, 8-series) 1: Motor characteristics 1 (HP rating motors) 4: Other motors	N	Y1	*6	

The shaded function codes ( ) are applicable to the quick setup.

*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table B.

H codes: High Performance Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	
H03	Data Initialization	0: Disable initialization 1: Initialize all function code data to factory defaults 2: Initialize motor 1 parameters 10: Initialize real-time clock information 11: Initialize function code data except communication function codes 12: Initialize U code data (Customizable logic function codes) 71: Initialize according to application (Compressor) 72: Initialize according to application (Fan)	N	N	0	
H04	Auto-reset (Times)	OFF: Disable; 1 to 20	Y	Y	OFF	
H05	(Reset interval)	0.5 to 60.0 s	Y	Y	5.0	
H06	Cooling Fan ON/OFF Control	0: Disable (Always in operation) 1: Enable (ON/OFF controllable)	Y	Y	1	
H07	Acceleration/Deceleration Pattern	0: Linear 1: S-curve (Weak) 2: S-curve (Strong) 3: Curvilinear	Y	Y	0	
H08	Rotational Direction Limitation	0: Disable 1: Enable (Reverse rotation inhibited) 2: Enable (Forward rotation inhibited) 3: Enable (Reverse rotation inhibited, setting only) 4: Enable (Forward rotation inhibited, setting only)	N	Y	0	
H09	Starting Mode (Auto search)	0: Disable 1: Enable (At restart after momentary power failure) 2: Enable (At restart after momentary power failure and at normal start)	N	Y	0	
H11	Deceleration Mode	0: Normal deceleration 1: Coast-to-stop	Y	Y	0	
H12	Instantaneous Overcurrent Limiting (Mode selection)	0: Disable 1: Enable	Y	Y	1	
H13	Restart Mode after Momentary Power Failure (Restart time)	0.1 to 20.0 s	Y	Y1	*2	
H14	(Frequency fall rate)	Inherit: With the selected deceleration time 0.01 to 100.00 Hz/s Auto: With the current limiter	Y	Y	Auto	
H15	(Continuous running level)	400 to 600 V	Y	Y1	470	
H16	(Allowable momentary power failure time)	0.0 to 30.0 s Auto: Automatically determined by inverter	Y	Y	Auto	
H26	Thermistor (for motor) (Mode selection)	0: Disable 1: PTC (The inverter immediately trips with OH4 displayed.) 2: PTC (The inverter issues output signal ***THM*** and continues to run.)	Y	Y	0	
H27	(Level)	0.00 to 5.00 V	Y	Y	0.35	
H30	Communications Link Function (Mode selection)	Frequency command / Run command 0: F01/C30 / F02 1: RS-485 (Port 1) / F02 2: F01/C30 / RS-485 (Port 1) 3: RS-485 (Port 1) / RS-485 (Port 1) 4: RS-485 (Port 2) / F02 5: RS-485 (Port 2) / RS-485 (Port 1) 6: F01/C30 / RS-485 (Port 2) 7: RS-485 (Port 1) / RS-485 (Port 2) 8: RS-485 (Port 2) / RS-485 (Port 2)	Y	Y	0	
H42	Capacitance of DC Link Bus Capacitor	Meas (Measure initial value), Failed (Measurement failed), 2 to 65535 Indication for replacement of DC link bus capacitor	Y	N	-	
H43	Cumulative Run Time of Cooling Fan	Indication for replacement of cooling fan 0 to 99990 (in units of 10 hours)	Y	N	-	
H44	Startup Counter for Motor 1	Indication of cumulative startup count 0 to 65535	Y	N	-	
H45	Mock Alarm	0: Disable 1: Enable (Once a mock alarm occurs, the data automatically returns to 0.)	Y	N	0	
H46	Starting Mode (Auto search delay time 2)	0.1 to 20.0 s	Y	Y1	*6	
H47	Initial Capacitance of DC Link Bus Capacitor	Meas (Measure initial value), Failed (Measurement failed), 2 to 65535 Indication for replacement of DC link bus capacitor	Y	N	-	
H48	Cumulative Run Time of Capacitors on Printed Circuit Boards	Indication for replacement of capacitors 0 to 99990 (in units of 10 hours)	Y	N	-	
H49	Starting Mode (Auto search delay time 1)	0.0 to 10.0 s	Y	Y	0.0	

*2 The factory default differs depending upon the inverter's capacity. See Table A.
*6 The motor rated current is automatically set. See Table B.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
H50	Non-linear V/f Pattern 1 (Frequency)	OFF: Cancel, 0.1 to 120.0 Hz	N	Y	*7	
H51	(Voltage)	0 to 500: Output an AVR-controlled voltage	N	Y1	*8	
H52	Non-linear V/f Pattern 2 (Frequency)	OFF: Cancel, 0.1 to 120.0 Hz	N	Y	OFF	
H53	(Voltage)	0 to 500: Output an AVR-controlled voltage	N	Y1	0	
H56	Deceleration Time for Forced Stop	0.00 to 3600 s	Y	Y	20.0	
H61	Multistep Frequency + UP/DOWN Control (Initial frequency setting)	1: Last UP/DOWN command value on releasing the run command 13 to 106: Multistep frequency + UP/DOWN command (Initial value to be preserved)	N	Y	1	
H63	Low Limiter (Mode selection)	0: Limit by F16 (Frequency limiter: Low) and continue to run 1: If the output frequency lowers below the one limited by F16 (Frequency limiter: Low), decelerate to stop the motor.	Y	Y	0	
H64	(Lower limiting frequency)	Inherit: Depends on F16 (Frequency limiter, Low) 0.1 to 60.0 Hz	Y	Y	2.0	
H68	Slip Compensation 1 (Operating conditions)	0: Enable during ACC/DEC and at base frequency or above 1: Disable during ACC/DEC and enable at base frequency or above 2: Enable during ACC/DEC and disable at base frequency or above 3: Disable during ACC/DEC and at base frequency or above	N	Y	0	
H69	Automatic Deceleration (Mode selection)	0: Disable 2: Torque limit control with Force-to-stop if actual deceleration time exceeds three times the specified one 3: DC link bus voltage control with Force-to-stop if actual deceleration time exceeds three times the specified one 4: Torque limit control with Force-to-stop disabled 5: DC link bus voltage control with Force-to-stop disabled	Y	Y	0	
H70	Overload Prevention Control	OFF: Cancel Inherit: Follow the selected deceleration time 0.01 to 100.00 Hz/s	Y	Y	OFF	
H71	Deceleration Characteristics	0: Disable 1: Enable	Y	Y	0	
H72	Main Power Down Detection (Mode selection)	0: Disable 1: Enable	Y	Y	1	
H76	Torque Limiter for Braking (Frequency increment limit)	0.0 to 120.0 Hz	Y	Y	5.0	
H77	Service Life of DC Link Bus Capacitor (Remaining time)	0 to 43800 (in units of 10 hours)	Y	N	-	
H78	Maintenance Interval (M1)	OFF: Disable 10 to 99990 (in units of 10 hours)	Y	N	43800	
H79	Preset Startup Count for Maintenance (M1)	OFF: Disable 1 to 65535	Y	N	OFF	
H80	Output Current Fluctuation Damping Gain for Motor 1	0.00 to 1.00	Y	Y	0.20	
H89	Reserved *9	0, 1	Y	Y	1	
H90	Reserved *9	0, 1	Y	Y	0	
H91	Current Input Wire Break Detection	OFF: Disable, 0.1 to 60.0 s	Y	Y	OFF	
H92	Continuity of Running (P)	0.000 to 10.000 times Auto	Y	Y1	Auto	
H93	(I)	0.010 to 10.000 s Auto	Y	Y1	Auto	
H94	Cumulative Motor Run Time 1	0 to 99990 (The cumulative run time can be modified or reset in units of 10 hours.)	N	N	-	
H95	DC Braking (Braking response mode)	0: Slow 1: Quick	Y	Y	1	
H96	STOP Key Priority/Start Check Function	Data STOP key priority Start check function 0: Disable Disable 1: Enable Disable 2: Disable Enable 3: Enable Enable	Y	Y	0	
H97	Clear Alarm Data	0: Disable 1: Enable (Setting "1" clears alarm data and then returns to "0.")	Y	N	0	
H98	Protection/Maintenance Function (Mode selection)	0 to 255 Bit 0: Lower the carrier frequency automatically (0: Disabled; 1: Enabled) Bit 1: Detect input phase loss (0: Disabled; 1: Enabled) Bit 2: Detect output phase loss (0: Disabled; 1: Enabled) Bit 3: Select life judgment threshold of DC link bus capacitor (0: Factory default level; 1: User setup level) Bit 4: Judge the life of DC link bus capacitor (0: Disabled; 1: Enabled) Bit 5: DC fan lock detection (0: Disabled; 1: Enabled) Bit 7: Switch IP21/IP55 enclosure (0: IP21; 1: IP55)	Y	Y	VXH-M (IP21) 19 VXH-L (IP55) 147	

*7 0.0 (Cancel) for inverters with a capacity of 22 kW or below; 5.0 Hz for those with 30 kW or above.
*8 0 V for inverters with a capacity of 22 kW or below; 40 V for inverters with 30 kW or above, respectively.
*9 These function codes are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
H104	Number-of-retry Clear Time	0.5 to 5.0 (min)	Y	Y	5.0	
H105	Retry Target Selection	0 to 255 Bit 0: OC1 to OC3 Bit 1: OV1 to OV3 Bit 2: OH1 OH3 OLU Bit 3: - Bit 4: OL1 Bit 5: OH4 Bit 6: - Bit 7: -	Y	Y	225	
H106	Retry Target Selection 2	0 to 255 Bit 0: OH2 Bit 1: LV Bit 2: - Bit 3: - Bit 4: - Bit 5: - Bit 6: - Bit 7: -	Y	Y	0	
H110	Input Phase Loss Protection Avoidance Operation (Mode selection)	0: Disable 1: Enable (Decrease output frequency)	Y	Y	0	
H112	Voltage Shortage Avoidance Operation (Mode selection)	0: Disable 1: Enable (Decrease output frequency)	Y	Y	0	
H114	Automatic Deceleration (Operation level)	0.0 to 50.0% Auto	Y	Y	Auto	
H116	Fire Mode (Mode selection)	0: FMS: ON 1: FMS toggle method 2: FMS latch method	N	Y	0	
H117	(Confirmation time)	0.5 to 10.0 s * Set ON/OFF setting time for FMS signals.	Y	Y	3.0	
H118	(Reference frequency)	Inherit: Follow the ordinary reference frequency specified with F01, etc. 0.1 to 120.0 Hz	Y	Y	Inherit	
H119	(Rotation direction)	0: Follow the run command specified with F02, etc. 2: Forward rotation 3: Reverse rotation	N	Y	0	
H120	(Start method)	0: Follows the start methods specified with instant power failure restart 1: Auto search	Y	Y	0	
H121	(Reset interval)	0.5 to 20.0 s	Y	Y	5.0	
H181	Light Alarm Selection 1	0 to 255 Bit 0: - Bit 1: OH2 Bit 2: OH3 Bit 3: - Bit 4: - Bit 5: OL1 Bit 6: - Bit 7: -	Y	Y	0	
H182	Light Alarm Selection 2	0 to 255 Bit 0: - Bit 1: - Bit 2: Er4 Bit 3: Er5 Bit 4: Er8 Bit 5: ErP Bit 6: - Bit 7: -	Y	Y	0	
H183	Light Alarm Selection 3	0 to 255 Bit 0: - Bit 1: - Bit 2: - Bit 3: CoF, PV1, PV2, PVA, PVb, PVC Bit 4: FAL Bit 5: OL Bit 6: OH Bit 7: LiF	Y	Y	0	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
H184	Light Alarm Selection 4	0 to 255 Bit 0: rEF Bit 1: PA1, PA2, PAA, PAb, PAC Bit 2: UTL Bit 3: PTC Bit 4: rTE Bit 5: CnT Bit 6: - Bit 7: Lob, dtL	Y	Y	128	
H197	User Password 1 (Mode selection)	0: Disclose all function codes but prohibit any change 1: Disclose function codes selected for quick setup only and allow change * This specifies the protection of user password 1.	Y	Y	0	

J codes: Application Functions 1

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J21	Dew Condensation Prevention (Duty)	1% to 50%	Y	Y	1	
J22	Commercial Power Switching Sequence	0: Keep inverter operation (Stop due to alarm) 1: Automatically switch to commercial-power operation	N	Y	0	

J1 codes: PID Control 1

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J101	PID Control 1 (Mode selection)	0: Disable 1: Enable (Process control, normal operation) 2: Enable (Process control, inverse operation)	N	Y	0	
J102	(Command selection)	0: Keypad (⌃/⌄ key) 1: PID command 1 (Analog input: Terminals [12], [C1] and [V2]) 3: ***UP/DOWN*** 4: Command via communications link (Use function code S13)	N	Y	0	
J103	(Feedback selection)	1: PID control 1 feedback value 10: Addition (PID control 1 feedback value + PID control 2 feedback value) 11: Difference (PID control 1 feedback value - PID control 2 feedback value) 12: Average (PID control 1 feedback value, PID control 2 feedback value) 13: Maximum (PID control 1 feedback value, PID control 2 feedback value) 14: Minimum (PID control 1 feedback value, PID control 2 feedback value)	N	Y	1	
J104	(Deviation selection)	0: (J102)-(J103) 1: Selection of maximum (selection of maximum for PID control 1 and 2 deviation) 2: Selection of minimum (selection of minimum for PID control 1 and 2 deviation)	N	Y	0	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J105	PID Control 1 (Display unit)	0: Based on the unit/scale of the PID control 1 feedback amount 1: none 2: % 4: r/min 7: kW Flowrate 20: m^3/s 21: m^3/min 22: m^3/h 23: L/s 24: L/min 25: L/h Pressure 40: Pa 41: kPa 42: MPa 43: mbar 44: bar 45: mmHg 46: psi (Pound per square inch) 47: mWG 48: inWG Temperature 60: K 61: °C 62: °F Density 80: ppm	N	Y	0	
J106	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	
J107	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	
J108	(Tuning)	0: Disable 1: Short-time response 2: Long-time response	Y	Y	0	
J109	(Tuning manipulated value)	10 to 100% (Maximum frequency = 100%)	Y	Y	10%	
J110	P (Gain)	0.000 to 30.000 times	Y	Y	0.100	
J111	I (Integral time)	0.0 to 3600.0 s	Y	Y	0.0	
J112	D (Differential time)	0.00 to 600.00 s	Y	Y	0.00	
J113	(Feedback filter)	0.0 to 900.0 s	Y	Y	0.5	
J114	(Anti-reset wind-up)	OFF: Disable 0.01 to 9990.00 *10	Y	Y	OFF	
J118	(Upper limit of PID process output)	0.0 to 120.0 Hz; Inherit (Depends on setting of F15)	Y	Y	Inherit	
J119	(Lower limit of PID process output)	0.0 to 120.0 Hz; Inherit (Depends on setting of F16)	Y	Y	Inherit	
J121	(Alarm output selection)	0: Absolute-value alarm 1: Absolute-value alarm (with Hold) 2: Absolute-value alarm (with Latch) 3: Absolute-value alarm (with Hold and Latch) 4: Deviation alarm 5: Deviation alarm (with Hold) 6: Deviation alarm (with Latch) 7: Deviation alarm (with Hold and Latch)	Y	Y	0	
J122	(Upper level alarm (AH))	-999.00 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J124	(Lower level alarm (AL))	-999.00 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J127	(Feedback failure detection (Mode selection))	0: Disable (Turns ON output signals (PV1-OFF) and continues operation.) 1: Enable (Free run stop (PV1 trip)) 2: Enable (Deceleration and stop (PV1 trip)) 3: Enable (Continuation of operation at the maximum frequency (upper limit frequency)) 4: Enable (Continuation of operation at the minimum frequency (lower limit frequency)) 5: Enable (Continuation of operation at the frequency used when failure is detected.) 6: Enable (Shift to PID control 2 (PID control 1 is restored when failure is recovered from.))	Y	Y	0	

*10 The upper and lower level values are restricted by the maximum and minimum scales.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J128	(Feedback failure continuation duration)	0 to 3600 s; Cont. Cont. (Mode selection: continuation of operation specified with J127. PV1 trip after stop (output shutoff).)	Y	Y	Cont.	
J129	(Feedback failure upper-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: 105% equivalent	Y	Y	Auto	
J130	(Feedback failure lower-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: -5% equivalent	Y	Y	Auto	
J131	(Feedback failure detection time)	0.0 to 300.0 s	Y	Y	0.1	
J136	PID Multistep Command (Multistep command 1)	-999.00 to 0.00 to 9990.00	Y	Y	0.00	
J137	(Multistep command 2)		Y	Y	0.00	
J138	(Multistep command 3)		Y	Y	0.00	
J149	Slow Flowrate Stop Function * (Mode selection)	0: Disable (OFF displayed) 1: Manual operation (stop judgment: MV) 2: Manual operation (stop judgment: PV) 11: Auto operation 1 (stop judgment: MV): Deviation detection method 12: Auto operation 1 (stop judgment: PV): Deviation detection method 21: Auto operation 2 (stop judgment: MV): Flowrate sensor detection method 22: Auto operation 2 (stop judgment: PV): Flowrate sensor detection method	N	Y	OFF	
J150	* (Operation level)	J149 = MV: 0.00 to 120.00 Hz, Auto J149 = PV: 0.00 to 9990.00, Auto *10	Y	Y	Auto	
J151	* (Elapsed time)	0 to 60 s	Y	Y	0	
J152	* (Auto-operation frequency lower-limit)	0.0 to 120.0 Hz	Y		0.0	
J153	* (Pressurization starting frequency)	0.0 to 120.0 Hz	Y	Y	0.0	
J154	* (Pressurizing time)	0 to 60 s	Y	Y	0	
J156	* (Initiation inhibition time)	0 to 3600 s	Y	Y	0	
J157	* (Cancel frequency)	OFF 0.0 to 120.0 Hz	Y		0.0	
J158	* `(Cancel deviation level 1)	OFF: Disable 0.01 to 9990.00 *10	Y	Y	OFF	
J159	* (Cancel delay timer)	0 to 3600s	Y	Y	0	
J160	* (Cancel deviation level 2)	OFF: Disable 0.01 to 9990.00 *10	Y	Y	OFF	
J163	Flowrate Sensor (Input selection) *	0: Inherit Follow analog input selected by E61, E62, and E63. 1: PV1 20: m^3/s 21: m^3/min 22: m^3/h 23: L/s 24: L/min 25: L/h **Note:** Data 20 or above is to be used for connection of customizable logic.	N	Y	0	
J164	* (ON level)	0.00 to 9990.00 *10 OFF **Note:** If J163 = 20 or above, no scale can be defined, so the setting range should be from the minimum to maximum.	Y	Y	OFF	
J165	* (OFF level)	0.00 to 9990.00 *10 OFF **Note:** If J163 = 20 or above, no scale can be defined, so the setting range should be from the minimum to maximum.	Y	Y	OFF	
J166	* (Input filter)	0.00 to 5.00s	Y	Y	0.20	
J188	Filter Clogging Prevention/ Anti Jam Function (Input selection)	0: Disable 1: Enable (Anti jam protection, inverter stop with rLo trip) 2: Enable (Filter clogging trouble, inverter stop with FoL trip) 3: Enable (While warning (filter clogging trouble) is output, operation is continued.)	Y	Y	0	
J189	Filter Clogging Prevention Function (Reverse operation cycle time)	OFF: Disable 1 to 10000 h	Y	Y	OFF	
J190	(Load resistance current)	OFF: Disable 1% to 150% of the inverter rated current	Y	Y	OFF	
J191	(Load resistance PV signal)	-999.00 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J192	(Load resistance detection timer)	0 to 600 s	Y	Y	0	

* J149-J166 are available in inverter ROM version 1500 or later.

*10 The upper and lower level values are restricted by the maximum and minimum scales.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J193	Filter Clogging Prevention/ Anti Jam Function (Reverse rotation running frequency)	0.0 to 120.0 Hz	Y	Y	5.0	
J194	(Reverse rotation running time)	0 to 600 s	Y	Y	0	
J195	(Number of allowable reverse runs)	1 to 10 times	Y	Y	3	
J198	Wet-bulb temperature presumption control	OFF: Disable 0.01 to 120.00 Hz/min	Y	Y	OFF	

J2 codes: PID Control 2

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J201	PID Control 2 (Mode selection)	0: Disable 1: Enable (Process control, normal operation) 2: Enable (Process control, inverse operation)	N	Y	0	
J202	(Command selection)	0: Keypad (⌃/⌄ key) 1: PID command 1 (Analog input: Terminals [12], [C1] and [V2]) 2: PID command 2 (Analog input: Terminals [12], [C1] and [V2]) 3: ***UP*/*DOWN*** 4: Command via communications link (Use function code S13) 101: Command under PID control 1 (J102)	N	Y	0	
J203	(Feedback selection)	1: PID control 1 feedback value 2: PID control 2 feedback value 13: Maximum (PID control 1 feedback value, PID control 2 feedback value)	N	Y	2	
J205	(Display unit)	0: Based on the unit/scale of the PID control 2 feedback amount. 1: none 2: % 4: r/min 7: kW <u>Flowrate</u> 20: m^3/s 21: m^3/min 22: m^3/h 23: L/s 24: L/min 25: L/h <u>Pressure</u> 40: Pa 41: kPa 42: MPa 43: mbar 44: bar 45: mmHg 46: psi (Pound per square inch) 47: mWG 48: inWG <u>Temperature</u> 60: K 61: °C 62: °F <u>Density</u> 80: ppm	N	Y	0	
J206	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	
J207	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	
J208	(Tuning)	0: Disable 1: For short-time response 2: For long-time response	Y	Y	0	
J209	(Tuning manipulated value)	10 to 100% (Maximum frequency = 100%)	Y	Y	10%	
J210	P (Gain)	0.000 to 30.000 times	Y	Y	0.100	
J211	I (Integral time)	0.0 to 3600.0 s	Y	Y	0.0	
J212	D (Differential time)	0.00 to 600.00 s	Y	Y	0.00	
J213	(Feedback filter)	0.0 to 900.0 s	Y	Y	0.5	
J214	(Anti-reset wind-up)	OFF: Disable 0.01 to 9990.00 *10	Y	Y	OFF	
J218	(Upper limit of PID process output)	0.0 to 120.0 Hz; Inherit (Depends on setting of F15)	Y	Y	Inherit	
J219	(Lower limit of PID process output)	0.0 to 120.0 Hz; Inherit (Depends on setting of F16)	Y	Y	Inherit	

*10 The upper and lower level values are restricted by the maximum and minimum scales.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J221	PID Control 2 (Alarm output selection)	0: Absolute-value alarm 1: Absolute-value alarm (with Hold) 2: Absolute-value alarm (with Latch) 3: Absolute-value alarm (with Hold and Latch) 4: Deviation alarm 5: Deviation alarm (with Hold) 6: Deviation alarm (with Latch) 7: Deviation alarm (with Hold and Latch) 50: Absolute value alarm (Cancel PID control)	Y	Y	0	
J222	(Upper level alarm (AH))	-999 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J223	(Upper level alarm detection hysteresis width)	0.00 to 9990.00 *10	Y	Y	0.00	
J224	(Lower level alarm (AL))	-999 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J225	(Upper level alarm detection hysteresis width)	0.00 to 9990.00 *10	Y	Y	0.00	
J227	(Feedback failure detection (Mode selection))	0: Disable (Turns ON output signals (PV2-ERR) and continues operation.) 1: Enable (Free run stop (PV2 trip)) 2: Enable (Deceleration and stop (PV2 trip)) 3: Enable (Continuation of operation at the maximum frequency (upper limit frequency)) 4: Enable (Continuation of operation at the minimum frequency (lower limit frequency)) 5: Enable (Continuation of operation at the frequency used when failure is detected.)	Y	Y	0	
J228	(Feedback failure continuation duration)	0 to 3600 s; Cont. Cont.: After detection of the failure, continue to run as specified by J227. After stop (output shutoff), cause a PV2 trip.	Y	Y	Cont.	
J229	(Feedback failure upper-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: 105% equivalent	Y	Y	Auto	
J230	(Feedback failure lower-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: -5% equivalent	Y	Y	Auto	
J231	(Feedback failure detection time)	0.0 to 300.0 s	Y	Y	0.1	
J249	Slow Flowrate Stop Function * (Mode selection)	0: Disable (OFF displayed) 1: Manual operation (stop judgment: MV) 2: Manual operation (stop judgment: PV)	N	Y	0	
J250	* (Operation level)	J249 = MV: 0.00 to 120.00 Hz, Auto J249 = PV: 0.00 to 9990.00, Auto *10	Y	Y	Auto	
J251	* (Elapsed time)	0 to 60 s	Y	Y	0	
J256	* (Initiation inhibition time)	0 to 3600 s	Y	Y	0	
J257	* (Cancel frequency)	0.0 to 120.0 Hz OFF	Y	Y	0.0	
J258	* (Cancel deviation level 1)	OFF: Disable 0.01 to 9990.00 *10	Y	Y	OFF	
J259	* (Cancel delay timer)	0 to 3600 s	Y	Y	0	
J260	* (Cancel deviation level 2)	OFF: Disable 0.01 to 9990.00 *10	Y	Y	OFF	

* J249-J260 are available in inverter ROM version 1500 or later.
*10 The upper and lower level values are restricted by the maximum and minimum scales.

J5 codes: External PID Function 1

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J501	External PID Control 1 (Mode selection)	0 Disable 1: Enable process control (Normal operation) 2: Enable process control (Inverse operation) 11: Enable process control, interlocking with inverter running (Normal operation) 12: Enable process control, interlocking with inverter running (Inverse operation) 21: Enable process control by external digital signal (Normal operation) 22: Enable process control by external digital signal (Inverse operation) 31: Enable process control by external digital signal, interlocking with inverter running (Normal operation) 32: Enable process control by external digital signal, interlocking with inverter running (Inverse operation)	N	Y	0	
J502	(Remote command selection)	0: Keypad (⌃/⌄ key) 3: ***UP/DOWN*** 4: Command via communications link (Use function code S13) 51: External PID command 1 (Analog input: Terminals [12], [C1] and [V2])	N	Y	0	
J503	(Feedback selection)	51: External PID feedback value 1 60: Addition (External PID feedback value 1 + External PID feedback value 2) 61: Difference External PID feedback value 1 - External PID feedback value 2) 62: Average (External PID feedback value 1, External PID feedback value 2) 63: Maximum (External PID feedback value 1, External PID feedback value 2) 64: Minimum (External PID feedback value 1, External PID feedback value 2)	N	Y	51	
J504	(Deviation selection)	0: (J5-02) - (J5-03) 51: Maximum (Maximum deviation between external PID control 1 and 2) 52: Minimum (Minimum deviation between external PID control 1 and 2)	N	Y	0	
J505	(Display unit)	0: Based on the unit/scale of the PID control 1 feedback amount 1: none 2: % 4: r/min 7: kW <u>Flowrate</u> 20: m^3/s 21: m^3/min 22: m^3/h 23: L/s 24: L/min 25: L/h <u>Pressure</u> 40: Pa 41: kPa 42: MPa 43: mbar 44: bar 45: mmHg 46: psi (Pound per square inch) 47: mWG 48: inWG <u>Temperature</u> 60: K 61: °C 62: °F <u>Density</u> 80: ppm	N	Y	0	
J506	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100.00	
J507	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J510	External PID Control 1 P (Gain)	0.000 to 30.000 times ON/OFF: ON/OFF control	Y	Y	0.100	
J511	I (Integral time)	0.0 to 3600.0 s	Y	Y	0.0	
J512	D (Differential time)	0.00 to 600.00 s	Y	Y	0.00	
J513	(Feedback filter)	0.0 to 900.0 s	Y	Y	0.5	
J514	(Anti-reset wind-up)	OFF: Disable 0.00 to 9990.00 *10	Y	Y	OFF	
J515	(ON/OFF control hysteresis width)	0.00 to 9990.00 *10	Y	Y	0.00	
J516	(Proportional operation output convergent value)	0 to 150%	Y	Y	0	
J517	(Proportional cycle)	1 to 150 s	Y	Y	30	
J518	(Upper limit of PID process output)	-10 to +110%	Y	Y	100	
J519	(Lower limit of PID process output)	-10 to +110%	Y	Y	0	
J520	(Upper and lower limits)	0: Limit PID output with J518, J519 1: 110%, -10% of PID output with J518 exceeded or less than J519	Y	Y	0	
J521	(Alarm output selection)	0: Absolute-value alarm (PV) 1: Absolute-value alarm (PV) (with Hold) 2: Absolute-value alarm (PV) (with Latch) 3: Absolute-value alarm (PV) (with Hold and Latch) 4: Deviation alarm (PV) 5: Deviation alarm (PV) (with Hold) 6: Deviation alarm (PV) (with Latch) 7: Deviation alarm (PV) (with Hold and Latch 8: Absolute-value alarm (SV) 9: Absolute-value alarm (SV) (with Hold) 10: Absolute-value alarm (SV) (with Latch) 11: Absolute-value alarm (SV) (with Hold and Latch) 12: Absolute-value alarm (MV) 13: Absolute-value alarm (MV) (with Hold) 14: Absolute-value alarm (MV) (with Latch) 15: Absolute-value alarm (MV) (with Hold and Latch)	Y	Y	0	
J522	(Upper level alarm (AH))	-999.00 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J524	(Lower level alarm (AL))	-999.00 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J527	(Feedback error detection mode)	0: Disable (Turns ON output signals (EPV1-ERR) and continues operation.) 1: Enable (Free run stop (PVA trip)) 2: Enable (Deceleration and stop (PVA trip))	Y	Y	0	
J529	(Feedback error upper-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: 105% equivalent	Y	Y	Auto	
J530	(Feedback error lower-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: -5% equivalent	Y	Y	Auto	
J531	(Feedback error detection time)	0.0 to 300.0 s	Y	Y	0.1	
J540	(Manual command)	0: Keypad (⋀/⋁ key) 8: Keypad (⋀/⋁ key) (Balanceless-bumpless) 51: External PID command 1 (Analog input: Terminals [12], [C1] and [V2])	N	Y	0	
J550	External PID Multistep Command (Mode selection)	Bit 0: Enable multistep command under external PID control 1 Bit 1: Enable multistep command under external PID control 2 Bit 2: Enable multistep command under external PID control 3	N	Y	0	
J551	(Multistep command 1)	-999.00 to 0.00 to 9990.00	Y	Y	0.00	
J552	(Multistep command 2)	-999.00 to 0.00 to 9990.00	Y	Y	0.00	
J553	(Multistep command 3)	-999.00 to 0.00 to 9990.00	Y	Y	0.00	

*10 The upper and lower level values are restricted by the maximum and minimum scales.

J6 codes: External PID Function 2/3

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J601	External PID Control 2 (Mode selection)	0: Disable 1: Enable process control (Normal operation) 2: Enable process control (Inverse operation) 11: Enable process control, interlocking with inverter running (Normal operation) 12: Enable process control, interlocking with inverter running (Inverse operation) 21: Enable process control by external digital signal (Normal operation) 22: Enable process control by external digital signal (Inverse operation) 31: Enable process control by external digital signal, interlocking with inverter running (Normal operation) 32: Enable process control by external digital signal, interlocking with inverter running (Inverse operation)	N	Y	0	
J602	(Remote command selection)	0: Keypad (⌃/⌄ key) 3: ***UP/DOWN*** 4: Command via communications link 51: External PID command 1 (Analog input terminals [12], [C1] and [V2]) 52: External PID command 2 (Analog input terminals [12], [C1] and [V2]) 111: Apply external PID control 1 commands	N	Y	0	
J603	(Feedback selection)	51: External PID feedback value 1 52: External PID feedback value 2	N	Y	52	
J605	(Display unit)	0: Based on the unit/scale of the PID control 1 feedback amount 1: none 2: % 4: r/min 7: kW <u>Flowrate</u> 20: m^3/s 21: m^3/min 22: m^3/h 23: L/s 24: L/min 25: L/h <u>Pressure</u> 40: Pa 41: kPa 42: MPa 43: mbar 44: bar 45: mmHg 46: psi (Pound per square inch) 47: mWG 48: inWG <u>Temperature</u> 60: K 61: °C 62: °F <u>Density</u> 80: ppm	N	Y	0	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J606	External PID Control 2 (Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100.00	
J607	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	
J610	P (Gain)	0.000 to 30.000 times ON/OFF control	Y	Y	0.100	
J611	I (Integral time)	0.0 to 3600.0 s	Y	Y	0.0	
J612	D (Differential time)	0.00 to 600.00 s	Y	Y	0.00	
J613	(Feedback filter)	0.0 to 900.0 s	Y	Y	0.5	
J614	(Anti-reset wind-up)	OFF: Disable 0.01 to 9990.00 *10	Y	Y	OFF	
J615	(ON/OFF control hysteresis width)	0.00 to 9990.00 *10	Y	Y	0.00	
J616	(Proportional operation output convergent value)	0 to 150%	Y	Y	0	
J617	(Proportion cycle)	1 to 150 s	Y	Y	30	
J618	(Upper limit of PID process output)	-10 to 110%	Y	Y	100	
J619	(Lower limit of PID process output)	-10 to 110%	Y	Y	0	
J620	(Upper and lower limits)	0: Limit PID output with J618, J619 1: 110%, -10% of PID output with J618 exceeded or less than J619	Y	Y	0	
J621	(Alarm output selection)	0: Absolute-value alarm (PV) 1: Absolute-value alarm (PV) (with Hold) 2: Absolute-value alarm (PV) (with Latch) 3: Absolute-value alarm (PV) (with Hold and Latch) 4: Deviation alarm (PV) 5: Deviation alarm (PV) (with Hold) 6: Deviation alarm (PV) (with Latch) 7: Deviation alarm (PV) (with Hold and Latch 8: Absolute-value alarm (SV) 9: Absolute-value alarm (SV) (with Hold) 10: Absolute-value alarm (SV) (with Latch) 11: Absolute-value alarm (SV) (with Hold and Latch) 12: Absolute-value alarm (MV) 13: Absolute-value alarm (MV) (with Hold) 14: Absolute-value alarm (MV) (with Latch) 15: Absolute-value alarm (MV) (with Hold and Latch)	Y	Y	0	
J622	(Upper level alarm (AH))	-999.00 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J624	(Lower level alarm (AL))	-999.00 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J627	(Feedback error detection mode)	0: Disable (Turns ON output signals (EPV2-ERR) and continues operation.) 1: Enable (Free run stop (PVb trip)) 2: Enable (Deceleration and stop (PVb trip))	Y	Y	0	
J629	(Feedback error upper-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: 105% equivalent	Y	Y	Auto	
J630	(Feedback error lower-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: -5% equivalent	Y	Y	Auto	
J631	(Feedback error detection time)	0.0 to 300.0 s	Y	Y	0.1	
J640	(Manual command)	0: Keypad (⌃/⌄ key) 8: Keypad (⌃/⌄ key) (Balanceless-bumpless) 51: External PID manual command 1(Analog input: Terminals [12], [C1] and [V2]) 52: External PID manual command 2(Analog input: Terminals [12], [C1] and [V2]) 111: Apply external PID control 1 manual command	N	Y	0	
J651	External PID Control 3 (Mode selection)	0: Disable 1: Enable process control (Normal operation) 2: Enable process control (Inverse operation) 11: Enable process control, interlocking with inverter running (Normal operation) 12: Enable process control, interlocking with inverter running (Inverse operation) 21: Enable process control by external digital signal (Normal operation) 22: Enable process control by external digital signal (Inverse operation) 31: Enable process control by external digital signal, interlocking with inverter running (Normal operation) 32: Enable process control by external digital signal, interlocking with inverter running (Inverse operation)	N	Y	0	

*10 The upper and lower level values are restricted by the maximum and minimum scales.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
J652	External PID Control 3 (Remote command selection)	0: Keypad (⌃/⌄ key) 3: ***UP/DOWN*** 4: Command via communications link (Use function code S32) 51: External PID process command 1 (Analog input: Terminals [12], [C1] and [V2]) 52: External PID process command 2 (Analog input: Terminals [12], [C1] and [V2]) 53: External PID process command 3 (Analog input: Terminals [12], [C1] and [V2]) 111: Apply external PID control 1 commands 112: Apply external PID control 2 commands	N	Y	0	
J653	(Feedback selection)	51: External PID feedback value 1 52: External PID feedback value 2 53: External PID feedback value 3	N	Y	53	
J655	(Display unit)	See J605.	N	Y	0	
J656	(Maximum scale)	-999.00 to 0.00 to 9990.00	N	Y	100	
J657	(Minimum scale)	-999.00 to 0.00 to 9990.00	N	Y	0.00	
J660	P (Gain)	0.000 to 30.000 times ON/OFF: ON/OFF control	Y	Y	0.100	
J661	I (Integral time)	0.0 to 3600.0 s	Y	Y	0.0	
J662	D (Differential time)	0.00 to 600.00 s	Y	Y	0.00	
J663	(Feedback filter)	0.0 to 900.0 s	Y	Y	0.5	
J664	(Anti-reset wind-up)	0.00 to 9990.00 *10 OFF: Disable	Y	Y	OFF	
J665	(ON/OFF control hysteresis width)	0.00 to 9990.00 *10	Y	Y	0.00	
J666	(Proportional operation output convergent value)	0 to 150%	Y	Y	0	
J667	(Proportion cycle)	1 to 150 s	Y	Y	30	
J668	(Upper limit of PID process output)	-10 to +110%	Y	Y	100	
J669	(Lower limit of PID process output)	-10 to +110%	Y	Y	0	
J670	(Upper and lower limits)	0: Limit PID output with J618, J619 1: 110%, -10% of PID output with J618 exceeded or less than J619	Y	Y	0	
J671	(Alarm output selection)	0: Absolute-value alarm (PV) 1: Absolute-value alarm (PV) (with Hold) 2: Absolute-value alarm (PV) (with Latch) 3: Absolute-value alarm (PV) (with Hold and Latch) 4: Deviation alarm 5: Deviation alarm (PV) (with Hold) 6: Deviation alarm (PV) (with Latch) 7: Deviation alarm (PV) (with Hold and Latch 8: Absolute-value alarm (SV) 9: Absolute-value alarm (SV) (with Hold) 10: Absolute-value alarm (SV) (with Latch) 11: Absolute-value alarm (SV) (with Hold and Latch) 12: Absolute-value alarm (MV) 13: Absolute-value alarm (MV) (with Hold) 14: Absolute-value alarm (MV) (with Latch) 15: Absolute-value alarm (MV) (with Hold and Latch)	Y	Y	0	
J672	(Upper level alarm (AH))	-999.00 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J674	(Lower level alarm (AL))	-999.00 to 0.00 to 9990.00 *10 OFF	Y	Y	OFF	
J677	(Feedback error detection mode)	0: Disable (Turns ON output signals (EPV3-ERR) and continues operation.) 1: Enable (Free run stop (PVC trip)) 2: Enable (Deceleration and stop (PVC trip))	Y	Y	0	
J679	(Feedback error upper-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: 105% equivalent	Y	Y	Auto	
J680	(Feedback error lower-limit)	-999.00 to 0.00 to 9990.00 *10 Auto: -5% equivalent	Y	Y	Auto	
J681	(Feedback error detection time)	0.0 to 300.0 s	Y	Y	0.1	
J690	(Manual commands)	0: Keypad (⌃/⌄ key) 8: Keypad (⌃/⌄ key) (Balanceless-bumpless) 51: External PID manual command 1 (Analog input: Terminals [12], [C1] and [V2]) 52: External PID manual command 2 (Analog input: Terminals [12], [C1] and [V2]) 53: External PID manual command 3 (Analog input: Terminals [12], [C1] and [V2]) 111: Apply external PID control 1 manual commands 112: Apply external PID control 2 manual commands	N	Y	0	

*10 The upper and lower level values are restricted by the maximum and minimum scales.

d codes: Application Functions 2

Code	Name	Data setting range	Change when running	Data copying	Default setting	
d51	Reserved *9	0 to 500	N	Y	-	
d55	Reserved *9	0000H to 00FFH	N	Y	0	
d69	Reserved *9	30.0 to 100.0 Hz	Y	Y	30.0	
d98	Reserved *9	0000H to FFFFH	Y	Y	0	
d99	Reserved *9	0 to 3	Y	Y	0	

*9 These function codes are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

U codes: Customizable Logic Function

Code	Name	Data setting range	Change when running	Data copying	Default setting	
U00	Customizable Logic (Mode selection)	0: Disable 1: Enable (Customizable logic operation) Changing this code data from "1" to "0" causes an ECL alarm.	Y	Y	0	
U01	Customizable Logic: Step 1 (Control function)	0: No function assigned 10: Through output + General-purpose timer 20: ANDing + General-purpose timer 30: ORing + General-purpose timer 40: XORing + General-purpose timer 50: Set priority flip-flop + General-purpose timer 60: Reset priority flip-flop + General-purpose timer 70: Rising edge detector + General-purpose timer 80: Falling edge detector + General-purpose timer 90: Rising & falling edges detector + General-purpose timer 100: Hold + General-purpose timer 110: Increment counter 120: Decrement counter 130: Timer with reset input 2001-3002: Analog input 4001-5114: Analog + digital	N	Y	0	
U02 U03	(Input 1)	0 (1000): Inverter running (***RUN***) 1 (1001): Frequency (speed) arrival signal (***FAR***) 2 (1002): Frequency (speed) detected (***FDT***) 3 (1003): Undervoltage detected (Inverter stopped) (***LU***) 5 (1005): Inverter output limiting (***IOL***) 6 (1006): Auto-restarting after momentary power failure (***IPF***) 7 (1007): Motor overload early warning (***OL***) 10 (1010): Inverter ready to run (***RDY***) 11: Switch motor drive source between commercial power and inverter output (For MC on commercial line) (***SW88***) 12: Switch motor drive source between commercial power and inverter output (For secondary side) (***SW52-2***) 13: Switch motor drive source between commercial power and inverter output (For primary side) (***SW52-1***) 15 (1015): Select ***AX*** terminal function (For MC on primary side) (***AX***) 16 (1016): Shifted to pattern operation stage (***TU***) 17 (1017): Pattern operation cycle completed (***TO***) 18 (1018): Pattern operation stage number (***STG1***) 19 (1019): Pattern operation stage number (***STG2***) 20 (1020): Pattern operation stage number (***STG4***) 22 (1022): Inverter output limiting with delay (***IOL2***) 25 (1025): Cooling fan in operation (***FAN***) 26 (1026): Auto-resetting (***TRY***) 27 (1027): Universal DO (***U-DO***) 28 (1028): Heat sink overheat early warning (***OH***) 30 (1030): Lifetime alarm (***LIFE***) 33 (1033): Reference loss detected (***REF OFF***) 35 (1035): Inverter output on (***RUN2***) 36 (1036): Overload prevention control (***OLP***) 37 (1037): Current detected (***ID***) 42 (1042): PID alarm (***PID-ALM***) 43 (1043): Under PID control (***PID-CTL***) 44 (1044): Motor stopped due to slow flowrate under PID control (***PID-STP***)* 45 (1045): Low output torque detected (***U-TL***) 52 (1052): Running forward (***FRUN***) 53 (1053): Running reverse (***RRUN***)	N	Y	100	

* Available in inverter ROM version 1500 or later.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
		54 (1054): In remote operation (***RMT***) 55 (1055): Run command entered (***AX2***) 56 (1056): Motor overheat detected by thermistor (***THM***) 59 (1059): Terminal [C1] wire break (***C1OFF***) 84 (1084): Maintenance timer (***MNT***) 87(1087): Frequency arrival signal (***FARFDT***) 95(1095): Running in fire mode (***FMRUN***) 98 (1098): Light alarm (***L-ALM***) 99 (1099): Alarm output (for any alarm) (***ALM***) 101(1101): EN terminal detection circuit error (***DECF***) 102(1102): EN terminal OFF (***ENOFF***) 111 (1111): Customizable logic output signal 1 (***CLO1***) 112 (1112): Customizable logic output signal 2 (***CLO2***) 113 (1113): Customizable logic output signal 3 (***CLO3***) 114 (1114): Customizable logic output signal 4 (***CLO4***) 115 (1115): Customizable logic output signal 5 (***CLO5***) 116 (1116): Customizable logic output signal 6 (***CLO6***) 117 (1117): Customizable logic output signal 7 (***CLO7***) 190 (1190): In timer operation (***TMD***) 191 (1191): Timer 1 enabled (***TMD1***) 192 (1192): Timer 2 enabled (***TMD2***) 193 (1193): Timer 3 enabled (***TMD3***) 194 (1194): Timer 4 enabled (***TMD4***) 200 (1200): Under PID2 control (***PID2***) 201 (1201): PID1 alarm (***PV1-ALM***) 202 (1202): PID1 feedback error (***PV1-OFF***) 203 (1203): PID2 alarm (***PV2-ALM***) 204 (1204): PID2 feedback error (***PV2-OFF***) 211 (1211): Under external PID1 control (***EPID1-CTL***) 212 (1212): External PID1 output (***EPID1-OUT***) 213 (1213): External PID1 output (***EPID1-RUN***) 214 (1214): External PID1 alarm (***EPV1-ALM***) 215 (1215): External PID1 feedback error (***EPV1-OFF***) 221 (1221): Under external PID2 control (***EPID2-CTL***) 222 (1222): External PID2 output (***EPID2-OUT***) 223 (1223): External PID2 output (***EPID2-RUN***) 224 (1224): External PID2 alarm (***EPV2-ALM***) 225 (1225): External PID2 feedback error (***EPV2-OFF***) 231 (1231): Under external PID3 control (***EPID3-CTL***) 232 (1232): External PID3 output (***EPID3-OUT***) 233 (1233): External PID3 output (***EPID3-RUN***) 234 (1234): External PID3 alarm (***EPV3-ALM***) 235 (1235): External PID3 feedback error (***EPV3-OFF*** 2001 (3001): Output of step 1 (***SO01***) 2002 (3002): Output of step 2 (***SO02***) 2003 (3003): Output of step 3 (***SO03***) 2004 (3004): Output of step 4 (***SO04***) 2005 (3005): Output of step 5 (***SO05***) 2006 (3006): Output of step 6 (***SO06***) 2007 (3007): Output of step 7 (***SO07***) 2008 (3008): Output of step 8 (***SO08***) 2009 (3009): Output of step 9 (***SO09***) 2010 (3010): Output of step 10 (***SO10***) 2011 (3011): Output of step 11 (***SO11***) 2012 (3012): Output of step 12 (***SO12***) 2013 (3013): Output of step 13 (***SO13***) 2014 (3014): Output of step 14 (***SO14***) 4001 (5001): Terminal [X1] input signal (***X1***) 4002 (5002): Terminal [X2] input signal (***X2***) 4003 (5003): Terminal [X3] input signal (***X3***) 4004 (5004): Terminal [X4] input signal (***X4***) 4005 (5005): Terminal [X5] input signal (***X5***) 4006 (5006): Terminal [X6] input signal (***X6***) 4007 (5007): Terminal [X7] input signal (***X7***) 4010 (5010): Terminal [FWD] input signal (***FWD***) 4011 (5011): Terminal [REV] input signal (***REV***) 6000 (7000): Final run command (***FL_RUN***) 6001 (7001): Final FWD run command (***FL_FWD***) 6002 (7002): Final REV run command (***FL_REV***) 6003 (7003): During acceleration (***DACC***) 6004 (7004): During deceleration (***DDEC***) 6005 (7005): Under anti-regenerative control (***REGA***) 6007 (7007): Alarm factor presence (***ALM_ACT***)				

Code	Name	Data setting range	Change when running	Data copying	Default setting	
		8000: Output frequency 1 (before slip compensation) 8001: Output frequency 2 (after slip compensation) 8002: Output current 8003: Output voltage 8004: Output torque 8005: Load factor 8006: Input power 8007: PID feedback amount 8009: DC link bus voltage 8010: Universal AO 8013: Motor output 8014: Calibration (+) 8015: PID command (SV) 8016: PID output (MV) 8018: Inverter heat sink temperature ... 200°C/10 V 8020: Reference frequency 8050: PID feedback amount 1 (PV1) 8051: PID command 1 (SV1) 8054: PID feedback amount 2 (PV2) 8055: PID command 2 (SV2) 8060: External PID feedback amount 1 (EPID1-PV) 8061: External PID command 1 (EPID1-SV) 8065: External PID final output 1 (EPID1-OUT) 8070: External PID feedback amount 2 (EPID2-PV) 8071: External PID command 2 (EPID2-SV) 8075: External PID final output 2 (EPID2-OUT) 8080: External PID feedback amount 3 (EPID3-PV) 8081: External PID command 3 (EPID3-SV) 8085: External PID final output 3 (EPID3-OUT) Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal. (True if OFF.) Setting the value of 1000s in parentheses ( ) shown above assigns a negative logic input to a terminal.				
U04	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U05	(Function 2)		N	Y	0.00	
U06	Customizable Logic: Step 2 (Control function)	See U01.	N	Y	0	
U07	(Input 1)	See U02.	N	Y	0	
U08	(Input 2)	See U02.	N	Y	0	
U09	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U10	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U11	Customizable Logic: Step 3 (Control function)	See U01.	N	Y	0	
U12	(Input 1)	See U02.	N	Y	0	
U13	(Input 2)	See U02.	N	Y	0	
U14	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U15	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U16	Customizable Logic: Step 4 (Control function)	See U01.	N	Y	0	
U17	(Input 1)	See U02.	N	Y	0	
U18	(Input 2)	See U02.	N	Y	0	
U19	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U20	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U21	Customizable Logic: Step 5 (Control function)	See U01.	N	Y	0	
U22	(Input 1)	See U02.	N	Y	0	
U23	(Input 2)	See U02.	N	Y	0	
U24	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U25	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U26	Customizable Logic: Step 6 (Control function)	See U01.	N	Y	0	
U27	(Input 1)	See U02.	N	Y	0	
U28	(Input 2)	See U02.	N	Y	0	
U29	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U30	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U31	Customizable Logic: Step 7 (Control function)	See U01.	N	Y	0	
U32	(Input 1)	See U02.	N	Y	0	
U33	(Input 2)	See U02.	N	Y	0	
U34	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U35	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
U36	Customizable Logic: Step 8 (Control function)	See U01.	N	Y	0	
U37	(Input 1)	See U02.	N	Y	0	
U38	(Input 2)	See U02.	N	Y	0	
U39	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U40	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U41	Customizable Logic: Step 9 (Control function)	See U01.	N	Y	0	
U42	(Input 1)	See U02.	N	Y	0	
U43	(Input 2)	See U02.	N	Y	0	
U44	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U45	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U46	Customizable Logic: Step 10 (Control function)	See U01.	N	Y	0	
U47	(Input 1)	See U02.	N	Y	0	
U48	(Input 2)	See U02.	N	Y	0	
U49	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U50	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U51	Customizable Logic: Step 11 (Control function)	See U01.	N	Y	0	
U52	(Input 1)	See U02.	N	Y	0	
U53	(Input 2)	See U02.	N	Y	0	
U54	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U55	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U56	Customizable Logic: Step 12 (Control function)	See U01.	N	Y	0	
U57	(Input 1)	See U02.	N	Y	0	
U58	(Input 2)	See U02.	N	Y	0	
U59	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U60	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U61	Customizable Logic: Step 13 (Control function)	See U01.	N	Y	0	
U62	(Input 1)	See U02.	N	Y	0	
U63	(Input 2)	See U02.	N	Y	0	
U64	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U65	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U66	Customizable Logic: Step 14 (Control function)	See U01.	N	Y	0	
U67	(Input 1)	See U02.	N	Y	0	
U68	(Input 2)	See U02.	N	Y	0	
U69	(Function 1)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U70	(Function 2)	-9990.00 to 0.00 to 9990.00	N	Y	0.00	
U71	Customizable Logic Output Signal 1 (Output selection)	0: Disable 1: Output of step 1 (***SO01***)	N	Y	0	
U72	Customizable Logic Output Signal 2	2: Output of step 2 (***SO02***)	N	Y	0	
U73	Customizable Logic Output Signal 3	3: Output of step 3 (***SO03***)	N	Y	0	
U74	Customizable Logic Output Signal 4	4: Output of step 4 (***SO04***)	N	Y	0	
U75	Customizable Logic Output Signal 5	5: Output of step 5 (***SO05***)	N	Y	0	
U76	Customizable Logic Output Signal 6	6: Output of step 6 (***SO06***)	N	Y	0	
U77	Customizable Logic Output Signal 7	7: Output of step 7 (***SO07***) 8: Output of step 8 (***SO08***) 9: Output of step 9 (***SO09***) 10: Output of step 10 (***SO10***) 11: Output of step 11 (***SO11***) 12: Output of step 12 (***SO12***) 13: Output of step 13 (***SO13***) 14: Output of step 14 (***SO14***)	N	Y	0	
U81	Customizable Logic Output Signal 1 (Function selection)	0 (1000): Select multistep frequency (0 to 1 step) (***SS1***) 1 (1001): Select multistep frequency (0 to 3 steps) (***SS2***)	N	Y	100	
U82	Customizable Logic Output Signal 2	2 (1002): Select multistep frequency (0 to 7 steps) (***SS4***)	N	Y	100	
U83	Customizable Logic Output Signal 3	3 (1003): Select multistep frequency (0 to 15 steps) (***SS8***)	N	Y	100	
U84	Customizable Logic Output Signal 4	4 (1004): Select ACC/DEC time (2 steps) (***RT1***)	N	Y	100	
U85	Customizable Logic Output Signal 5	5 (1005): Select ACC/DEC time (4 steps) (***RT2***)	N	Y	100	
U86	Customizable Logic Output Signal 6	6 (1006): Enable 3-wire operation (***HLD***)	N	Y	100	
U87	Customizable Logic Output Signal 7	7 (1007): Coast to a stop (***BX***) 8 (1008): Reset alarm (***RST***) 9 (1009): Enable external alarm trip (9 = Active OFF, 1009 = Active ON) (***THR***) 11 (1011): Select frequency command 2/1 (***Hz2/Hz1***) 13: Enable DC braking (***DCBRK***) 14 (1014): Select torque limiter level 2/1 (***TL2/TL1***) 15: Switch to commercial power (50 Hz) (***SW50***) 16: Switch to commercial power (60 Hz) (***SW60***)	N	Y	100	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
		17 (1017): UP (Increase output frequency) (***UP***) 18 (1018): DOWN (Decrease output frequency) (***DOWN***) 20 (1020): Cancel PID control (***Hz/PID***) 21 (1021): Switch normal/inverse operation (***IVS***) 22 (1022): Interlock (***IL***) 24 (1024): Enable communications link via RS-485 or fieldbus (***LE***) 25 (1025): Universal DI (***U-DI***) 26 (1026): Enable auto search for idling motor speed at starting (***STM***) 30 (1030): Force to stop (***STOP***) (30 = Active OFF, 1030 = Active ON) 33 (1033): Reset PID integral and differential components (***PID-RST***) 34 (1034): Hold PID integral component (***PID-HLD***) 35 (1035): Select local (keypad) operation (***LOC***) 38 (1038): Enable run commands (***RE***) 39: Protect motor from dew condensation (***DWP***) 40: Enable integrated sequence to switch to commercial power (50 Hz) (***ISW50***) 41: Enable integrated sequence to switch to commercial power (60 Hz) (***ISW60***) 58 (1058): Reset UP/DOWN frequency (***STZ***) 72 (1072): Count the run time of commercial power-driven motor 1 (***CRUN-M1***) 81 (1081): Clear all customizable logic timers (***CLTC***) 87 (1087): Run command 2/1 (***FR2/FR1***) 88: Run forward 2 (***FWD2***) 89: Run reverse 2 (***REV2***) 98: Run forward (***FWD***) 99: Run reverse (***REV***) 100: No function assigned (***NONE***) 131 (1131): Flowrate switch (***FS***)* 132 (1132): Filter clogging reverse rotation command (***FRC***) 133 (1133): Switch PID channel (***PID2/1***) 171 (1171): PID multistep command (***PID-SS1***) 172 (1172): PID multistep command (***PID-SS2***) 181 (1181): External PID multistep command (***EPID-SS1***) 182 (1182): External PID multistep command (***EPID-SS2***) 190 (1190): Cancel timer (***TMC***) 191 (1191): Enable timer 1 (***TM1***) 192 (1192): Enable timer 2 (***TM2***) 193 (1193): Enable timer 3 (***TM3***) 194 (1194): Enable timer 4 (***TM4***) 201 (1201): External PID control 1 ON command (***EPID1-ON***) 202 (1202): Cancel external PID control 1 (***%/EPID1***) 203 (1203): Switch normal/inverse operation under external PID control 1 (***EPID1-IVS***) 204 (1204): Reset external PID1 integral and differential components (***EPID1-RST***) 205 (1205): Hold external PID1 integral component (***EPID1-HLD***) 211 (1211): External PID control 2 ON command (***EPID2-ON***) 212 (1212): Cancel external PID control 2 (***%/EPID2***) 213 (1213): Switch normal/inverse operation under external PID control 2 (***EPID2-IVS***) 214 (1214): Reset external PID2 integral and differential components (***EPID2-RST***) 215 (1215): Hold external PID2 integral component (***EPID2-HLD***) 221 (1221): External PID control 3 ON command (***EPID3-ON***) 222 (1222): Cancel external PID control 3 (***%/EPID3***) 223 (1223): Switch normal/inverse operation under external PID control 3 (***EPID3-IVS***) 224 (1224): Reset external PID3 integral and differential components (***EPID3-RST***) 225 (1225): Hold external PID3 integral component (***EPID3-HLD***) 8001: Auxiliary frequency command 1 8002: Auxiliary frequency command 2 8003: PID process command 1 8004: PID process command 2				

* Available in inverter ROM version 1500 or later.

Code	Name	Data setting range	Change when running	Data copying	Default setting	
		8005: PID feedback value 1 8012: Acceleration/deceleration time ratio setting 8013: Upper limit frequency 8014: Lower limit frequency 8030: PID feedback value 2 8031: Auxiliary input 1 to PID process command 8032: Auxiliary input 2 to PID process command 8033: Flowrate sensor* 8041: External PID process command 1 8042: External PID feedback value 1 8043: External PID manual command 1 8044: External PID process command 2 8045: External PID feedback value 2 8046: External PID manual command 2 8047: External PID process command 3 8048: External PID feedback value 3 8049: External PID manual command 3 Setting the value of 1000s in parentheses ( ) shown above assigns a negative logic input to a terminal.				
U91	Customizable Logic Timer Monitor (Step selection)	0: Disable monitoring 1: Step 1 2: Step 2 3: Step 3 4: Step 4 5: Step 5 6: Step 6 7: Step 7 8: Step 8 9: Step 9 10: Step 10 11: Step 11 12: Step 12 13: Step 13 14: Step 14	Y	Y	1	
U92	Customizable Logic Calculation Coefficient (Mantissa of calculation coefficient K_{A1})	-9.999 to 9.999	N	Y	0.00	
U93	(Exponent of calculation coefficient K_{A1})	-5 to 5	N	Y	0	
U94	(Mantissa of calculation coefficient K_{B1})	-9.999 to 9.999	N	Y	0.00	
U95	(Exponent of calculation coefficient K_{B1})	-5 to 5	N	Y	0.	
U96	(Mantissa of calculation coefficient K_{C1})	-9.999 to 9.999	N	Y	0.00	
U97	(Exponent of calculation coefficient K_{C1})	-5 to 5	N	Y	0	

* Available in inverter ROM version 1500 or later.

U1 codes: Custom Logic Function

Code	Name	Data setting range	Change when running	Data copying	Default setting	
U101	Customizable Logic Conversion point 1 (X1)	-999.00 to 0.00 to 9990.00	Y	Y	0.00	
U102	(Y1)		Y	Y	0.00	
U103	Conversion point 2 (X2)		Y	Y	0.00	
U104	(Y2)		Y	Y	0.00	
U105	Conversion point 3 (X3)		Y	Y	0.00	
U106	(Y3)		Y	Y	0.00	
U107	Automatic Calculation of Conversion Coefficients (X3)	0: Disable 1: Execute calculation (Conversion 1)	N	Y	0	

y codes: Link Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	
y01	RS-485 Communication 1 (Station address)	0 to 255 * Set 1 when other than BACnet is 0. * Set 127 when BACnet is 128 or above.	N	Y	1	
y02	(Communications error processing)	0: Immediately trip with alarm Er8 1: Trip with alarm Er8 after running for the period specified by timer y03 2: Retry during the period specified by timer y03. If the retry fails, trip with alarm Er8. If it succeeds, continue to run. 3: Continue to run	Y	Y	0	
y03	(Timer)	0.0 to 60.0 s	Y	Y	2.0	
y04	(Baud rate)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	Y	Y	3	
y05	(Data length)	0: 8 bits 1: 7 bits	Y	Y	0	
y06	(Parity check)	0: None (2 stop bits) 1: Even parity (1 stop bit) 2: Odd parity (1 stop bit) 3: None (1 stop bit)	Y	Y	0	
y07	(Stop bits)	0: 2 bits 1: 1 bit	Y	Y	0	
y08	(No-response error detection time)	OFF: No detection, 1 to 60 s	Y	Y	OFF	
y09	(Response interval)	0.00 to 1.00 s	Y	Y	0.01	
y10	(Protocol selection)	0: Modbus RTU protocol 1: SX protocol (loader protocol) 2: IMO general-purpose inverter protocol 3: Metasys N2 protocol 5: BACnet protocol	Y	Y	1	
y11	RS-485 Communication 2 (Station address)	0 to 255	N	Y	1	
y12	(Communications error processing)	0: Immediately trip with alarm ErP 1: Trip with alarm ErP after running for the period specified by timer y13 2: Retry during the period specified by timer y13. If the retry fails, trip with alarm ErP. If it succeeds, continue to run. 3: Continue to run	Y	Y	0	
y13	(Timer)	0.0 to 60.0 s	Y	Y	2.0	
y14	(Baud rate)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	Y	Y	3	
y15	(Data length)	0: 8 bits 1: 7 bits	Y	Y	0	
y16	(Parity check)	0: None (2 stop bits) 1: Even parity (1 stop bit) 2: Odd parity (1 stop bit) 3: None (1 stop bit)	Y	Y	0	
y17	(Stop bits)	0: 2 bits 1: 1 bit	Y	Y	0	
y18	(No-response error detection time)	OFF: No detection, 1 to 60 s	Y	Y	OFF	
y19	(Response interval)	0.00 to 1.00 s	Y	Y	0.01	
y20	(Protocol selection)	0: Modbus RTU protocol 1: SX protocol (loader protocol) 2: IMO general-purpose inverter protocol 3: Metasys N2 protocol 5: BACnet protocol	Y	Y	0	
y95	Data Clear Processing for Communications Error	0: Do not clear the data of function codes Sxx when a communications error occurs. (compatible with the conventional inverters) 1: Clear the data of function codes S01/S05/S19 when a communications error occurs. 2: Clear the run command assigned bit of function code S06 when a communications error occurs. 3: Clear both data of S01/S05/S19 and run command assigned bit of S06 when a communications error occurs. * Related alarms: Er8, ErP, Er4, Er5, ErU	Y	Y	0	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
y98	Bus Link Function (Mode selection)	Frequency command / Run command 0: Follow H30 data / Follow H30 data 1: Via fieldbus option / Follow H30 data 2: Follow H30 data / Via fieldbus option 3: Via fieldbus option / Via fieldbus option	Y	Y	0	
y99	Loader Link Function (Mode selection)	Frequency command / Run command 0: Follow H30 and y98 data / Follow H30 and y98 data 1: Via RS-485 link (IMO Loader) / Follow H30 and y98 data 2: Follow H30 and y98 data / Via RS-485 link (IMO Loader) 3: Via RS-485 link (IMO Loader) / Via RS-485 link (IMO Loader)	Y	N	0	

T codes: Timer Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	
T01	Timer 1 Operation (Operating mode)	0: Disable 1: Enable (Run inverter) 2: Enable (Output digital signal) 3: Enable (Run inverter + Output digital signal)	N	Y	0	
T02	(Start time)	Possible to specify in the special menu.	N	Y	0	
T03	(End time)	Possible to specify in the special menu.	N	Y	0	
T04	(Start day of the week)	Possible to specify in the special menu.	N	Y	0	
T06	Timer 2 Operation (Operating mode)	Same as T01.	N	Y	0	
T07	(Start time)	Possible to specify in the special menu.	N	Y	0	
T08	(End time)	Possible to specify in the special menu.	N	Y	0	
T09	(Start day of the week)	Possible to specify in the special menu.	N	Y	0	
T11	Timer 3 Operation (Operating mode)	Same as T01.	N	Y	0	
T12	(Start time)	Possible to specify in the special menu.	N	Y	0	
T13	(End time)	Possible to specify in the special menu.	N	Y	0	
T14	(Start day of the week)	Possible to specify in the special menu.	N	Y	0	
T16	Timer 4 Operation (Operating mode)	Same as T01.	N	Y	0	
T17	(Start time)	Possible to specify in the special menu.	N	Y	0	
T18	(End time)	Possible to specify in the special menu.	N	Y	0	
T19	(Start day of the week)	Possible to specify in the special menu.	N	Y	0	
T51	Timer Operation (Pause date 1)	Possible to specify in the special menu.	N	Y	2210H	
T52	(Pause date 2)		N	Y	2210H	
T53	(Pause date 3)		N	Y	2210H	
T54	(Pause date 4)		N	Y	2210H	
T55	(Pause date 5)		N	Y	2210H	
T56	(Pause date 6)		N	Y	2210H	
T57	(Pause date 7)		N	Y	2210H	
T58	(Pause date 8)		N	Y	2210H	
T59	(Pause date 9)		N	Y	2210H	
T60	(Pause date 10)		N	Y	2210H	
T61	(Pause date 11)		N	Y	2210H	
T62	(Pause date 12)		N	Y	2210H	
T63	(Pause date 13)		N	Y	2210H	
T64	(Pause date 14)		N	Y	2210H	
T65	(Pause date 15)		N	Y	2210H	
T66	(Pause date 16)		N	Y	2210H	
T67	(Pause date 17)		N	Y	2210H	
T68	(Pause date 18)		N	Y	2210H	
T69	(Pause date 19)		N	Y	2210H	
T70	(Pause date 20)		N	Y	2210H	

K codes: Keypad Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	
K01	LCD Monitor (Language selection)	0: Japanese 1: English 2: German 3: French 4: Spanish 5: Italian 6: Chinese 8: Russian (Available soon) 9: Greek (Available soon) 10: Turkish (Available soon) 11: Polish 12: Czech 13: Swedish 14: Portuguese (Available soon) 15: Dutch (Available soon) 16: Malay 17: Vietnamese (Available soon) 18: Thai (Available soon) 19: Indonesian (Available soon) 100: User-customized language (Available soon)	Y	Y	1	
K02	Backlight OFF Time	OFF: Always OFF 1 to 30 min.: Automatic OFF time	Y	Y	5	
K03	LCD Monitor (Backlight brightness control)	0 (Dark) to 10 (Light)	Y	Y	5	
K04	(Contrast control)	0 (Light) to 10 (Dark)	Y	Y	5	
K08	LCD Monitor Status Display/Hide Selection	0: Hide 1: Display	Y	Y	1	
K10	Main Monitor (Display item selection)	0: Speed monitor (select by K11) 13: Output current 14: Output voltage 18: Calculated torque 19: Input power 25: Load factor 26: Motor output 27: Analog input monitor in physical quantity 35: Input watt-hour (The unit depends on K31.) 50: PID command (final) in physical quantity 51: PID feedback amount (final) in physical quantity 52: PID output 53: PID control 1 command in physical quantity 54: PID control 1 feedback amount in physical quantity 55: PID control 2 command in physical quantity 56: PID control 2 feedback amount in physical quantity 60: External PID control 1 command (final) in physical quantity 61: External PID control 1 feedback amount (final) in physical quantity 62: External PID control 1 output in % 63: External PID control 1 manual command in % 64: External PID control 1 command in physical quantity 65: External PID control 1 feedback amount in physical quantity 70: External PID control 2 command in physical quantity 71: External PID control 2 feedback amount in physical quantity 72: External PID control 2 output in % 73: External PID control 2 manual command in % 80: External PID control 3 command in physical quantity 81: External PID control 3 feedback amount in physical quantity 82: External PID control 3 output in % 83: External PID control 3 manual command in %	Y	Y	0	
K11	Main Monitor (Speed monitor item)	1: Output frequency 1 (before slip compensation) 2: Output frequency 2 (after slip compensation) 3: Reference frequency 4: Motor speed in r/min 5: Load shaft speed in r/min 8: Display speed in %	Y	Y	1	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
K12	Main Monitor (Display when stopped)	0: Reference value 1: Output value	Y	Y	0	
K15	Sub Monitor (Display type)	0: Numeric values 1: Bar charts	Y	Y	0	
K16	Sub Monitor 1 (Display item selection)	*Refer to K10 (= 13 to 83) and K11 (= 1 to 8).	Y	Y	13	
K17	Sub Monitor 2 (Display item selection)		Y	Y	19	
K20	Bar Chart 1 (Display item selection)	1: Output frequency 1(before slip compensation) 13: Output current 14: Output voltage 18: Calculated torque 19: Input power 25: Load factor 26: Motor output	Y	Y	1	
K21	Bar Chart 2 (Display item selection)		Y	Y	13	
K22	Bar Chart 3 (Display item selection)		Y	Y	19	
K29	Display Filter	0.0 to 5.0 s	Y	Y	0.5	
K30	Coefficient for Speed Indication	0.01 to 200.00	Y	Y	30.00	
K31	Display Unit for Input Watt-hour Data	0: kWh 1: MWh	Y	Y	0	
K32	Display Coefficient for Input Watt-hour Data	OFF: Cancel or reset 0.001 to 9999.000	Y	Y	0.010	
K33	Long-term, Input Watt-hour Data Monitor	OFF: Cancel or reset 1: Hourly 2: Daily 3: Weekly 4: Monthly	Y	Y	4	
K81	Date Format	0: Y/M/D (year/month/day) 1: D/M/Y (day/month/year) 2: M/D/Y (month/day/year) 3: MD, Y (Month day, year)	Y	Y	1	
K82	Time Format	0: 24-hour format (Time : Minute : Second) 1: 12-hour format (Time : Minute : Second AM/PM) 2: 12-hour format (AM/PM Time : Minute : Second)	Y	Y	0	
K83	Daylight Saving Time (Summer time)	0: Disable 1: Enable (+ 1 hour) 2: Enable (+ 30 minutes)	Y	Y	0	
K84	(Start date)	Possible to specify in the special menu.	Y	Y	0800H	
K85	(End date)		Y	Y	0800H	
K91	Shortcut Key Function for ⟨ in Running Mode (Selection screen)	0: OFF (Disable) 11 to 99	Y	Y	OFF	
K92	Shortcut Key Function for ⟩ in Running Mode (Selection screen)	0: OFF (Disable) 11 to 99	Y	Y	64	

o codes: Option Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	
o01	Terminal [Y6A/B/C] Function (Relay output)	Same as E20.	N	Y	10	
o02	Terminal [Y7A/B/C] Function		N	Y	6	
o03	Terminal [Y8A/B/C] Function		N	Y	25	
o04	Terminal [Y9A/B/C] Function		N	Y	26	
o05	Terminal [Y10A/B/C] Function		N	Y	28	
o06	Terminal [Y11A/B/C] Function		N	Y	36	
o07	Terminal [Y12A/B/C] Function		N	Y	37	
o09	Pt Channel (Display unit)	Temperature 60: K 61: °C 62: °F	Y	Y	61	
o10	Pt Channel 1 (Sensor type)	0: Jpt100 1: Pt100 2 : Ni100 3 : Pt1000 4 : Ni1000	Y	Y	0	
o11	(Extended functions)	0: No extended function assigned 5: PID feedback value 1 30: PID feedback value 2 42: External PID feedback value 1 45: External PID feedback value 2 48: External PID feedback value 3	N	Y	0	
o12	(Filter)	0.0 to 100.0 s	Y	Y	1.0	
o15	Pt Channel 2 (Sensor type)	Same as o10.	N	Y	0	
o16	(Extended functions)	Same as o11.	N	Y	0	
o17	(Filter)	Same as o12.	Y	Y	1.0	
o27	Communications Error Processing	0: Immediately trip with alarm Er5 1: Run for the period specified by timer o28 and then trip with alarm Er5 2: Retry during the period specified by timer o28. If the retry fails, immediately trip with alarm Er5. 3: Continue to run. After recovery from the error, run according to communications command 4 to 9: Same as o27 = 0. 10: Decelerate to a stop and trip with alarm Er5 11: Run for the period specified by timer o28, decelerate to a stop, and then trip with alarm Er5 12: Retry during the period specified by timer o28. If the retry fails, decelerate to a stop. If it succeeds, continue to run according to communications command 13 to 15: Same as when o27 = 3.	Y	Y	0	
o28	(Timer)	0.0 to 60.0 s	Y	Y	0.0	
o30	Bus configuration parameter 01	0 to 255 Functions of o30 to o39 differ depending upon the bus option type. For details, refer to the instruction manual of each bus option.	N	Y	0	
o31	Bus configuration parameter 02	Same as o30.	N	Y	0	
o32	Bus configuration parameter 03		N	Y	0	
o33	Bus configuration parameter 04		N	Y	0	
o34	Bus configuration parameter 05		N	Y	0	
o35	Bus configuration parameter 06		N	Y	0	
o36	Bus configuration parameter 07		N	Y	0	
o37	Bus configuration parameter 08		N	Y	0	
o38	Bus configuration parameter 09		N	Y	0	
o39	Bus configuration parameter 10		N	Y	0	
o40	Function Code Assignment 1 for Write	0, 1 to 65535 0: No assignment Data mapped I/O (write) Whether or not to support the I/O or the number of supports differs depending upon the bus option type. For the data configuration procedure, refer to the instruction manual of each bus option.	N	Y	0	

Code	Name	Data setting range	Change when running	Data copying	Default setting	
o41	Function Code Assignment 2 for Write	Same as o40.	N	Y	0	
o42	Function Code Assignment 3 for Write		N	Y	0	
o43	Function Code Assignment 4 for Write		N	Y	0	
o44	Function Code Assignment 5 for Write		N	Y	0	
o45	Function Code Assignment 6 for Write		N	Y	0	
o46	Function Code Assignment 7 for Write		N	Y	0	
o47	Function Code Assignment 8 for Write		N	Y	0	
o48	Function Code Assignment 1 for Read	0, 1 to 65535 0: No assignment Data mapped I/O (read) Whether or not to support the I/O or the number of supports differs depending upon the bus option type. For the data configuration procedure, refer to the instruction manual of each bus option.	N	Y	0	
o49	Function Code Assignment 2 for Read	Same as o48.	N	Y	0	
o50	Function Code Assignment 3 for Read		N	Y	0	
o51	Function Code Assignment 4 for Read		N	Y	0	
o52	Function Code Assignment 5 for Read		N	Y	0	
o53	Function Code Assignment 6 for Read		N	Y	0	
o54	Function Code Assignment 7 for Read		N	Y	0	
o55	Function Code Assignment 8 for Read		N	Y	0	
o56	Function Code Assignment 9 for Read		N	Y	0	
o57	Function Code Assignment 10 for Read		N	Y	0	
o58	Function Code Assignment 11 for Read		N	Y	0	
o59	Function Code Assignment 12 for Read		N	Y	0	
o60	Terminal [32] (Function)	Same as E61.	N	Y	0	
o61	(Offset)	-5.0 to 5.0%	Y	Y	0.0	
o62	(Gain)	0.00 to 200.00%	Y	Y	100.00	
o63	(Filter setting)	0.00 to 5.00 s	Y	Y	0.05	
o64	(Gain base point)	0.00 to 100.00%	Y	Y	100.00	
o65	(Polarity)	0: Bipolar 1: Unipolar	N	Y	1	
o66	(Bias value)	-100.00 to 100.00%	Y	Y	0.00	
o67	(Bias base point)	0.00 to 100.00%	Y	Y	0.00	
o69	(Display unit)	Same as J105. (Note that the data setting range starts with "1.")	N	Y	2	
o70	(Maximum scale)	-999 to 0.00 to 9990	N	Y	100	
o71	(Minimum scale)	-999 to 0.00 to 9990	N	Y	0.00	
o75	Terminal [C2] (Current range)	0: 4-20 mA 1: 0-20 mA	N	Y	0	
o76	(Function)	Same as E61.	N	Y	0	
o77	(Offset)	-5.0 to 5.0%	Y	Y	0.0	
o78	(Gain)	0.00 to 200.00%	Y	Y	100.00	
o79	(Filter time constant)	0.00 to 5.00 s	Y	Y	0.05	
o81	(Gain reference point)	0.00 to 100.00%	Y	Y	100.00	
o82	(Bias value)	-100.00 to 100.00%	Y	Y	0.00	
o83	(Bias base point)	0.00 to 100.00%	Y	Y	0.00	
o85	(Display unit)	Same as J105. (Note that the data setting range starts with "1.")	N	Y	2	
o86	(Maximum scale)	-999 to 0.00 to 9990	N	Y	100	
o87	(Minimum scale)	-999 to 0.00 to 9990	N	Y	0.00	
o90	Terminal [Ao/CS2] Function (Function)	Same as F31.	Y	Y	0	
o91	(Output gain)	0 to 300%	Y	Y	100	
o93	(Polarity)	0: Bipolar 1: Unipolar	N	Y	1	
o96	Terminal [CS/CS1] Function (Function)	Same as F31.	Y	Y	0	
o97	(Output gain)	0 to 300 %	Y	Y	100	

Table A Factory Defaults Depending upon Inverter Capacity

Inverter capacity (kW)	Torque boost 1 F09	Auto-restart after momentary power failure (Restart time) H13
0.75	6.5	0.5
1.5	4.9	
2.2	4.5	
3.7	4.1	
5.5	3.4	
7.5	2.7	
11	2.1	1.0
15	1.6	
18.5	1.3	
22	1.1	
30	0.0	
37		
45		1.5
55		
75		
90		
110		
132		2.0
160		
200		2.5
220		
280		
315		4.0
355		
400		5.0
500		
630		
710		

Table B (1) Motor Parameters

■ When standard motors, 8-series" or "Other motors" is selected (P99 = 0 or 4)

Motor capacity (kW) P02	Nominal applied motor (kW)	Rated current (A) P03	No-load current (A) P06	%R1 (%) P07	%X (%) P08	Rated slip frequency P12	Starting mode (Auto search delay time 2) H46
0.01 to 0.09	0.06	0.22	0.20	13.79	11.75	1.77	0.5
0.10 to 0.19	0.1	0.35	0.27	12.96	12.67	1.77	
0.20 to 0.39	0.2	0.65	0.53	12.95	12.92	2.33	
0.40 to 0.74	0.4	1.15	0.83	10.20	13.66	2.40	
0.75 to 1.49	0.75	1.80	1.15	8.67	10.76	2.33	
1.50 to 2.19	1.5	3.10	1.51	6.55	11.21	2.00	
2.20 to 3.69	2.2	4.60	2.43	6.48	10.97	1.80	0.6
3.70 to 5.49	3.7	7.50	3.84	5.79	11.25	1.93	0.8
5.50 to 7.49	5.5	11.50	5.50	5.28	14.31	1.40	1.0
7.50 to 10.99	7.5	14.50	6.25	4.50	14.68	1.57	1.2
11.00 to 14.99	11	21.00	8.85	3.78	15.09	1.07	1.3
15.00 to 18.49	15	27.50	10.00	3.25	16.37	1.13	2.0
18.50 to 21.99	18.5	34.00	10.70	2.92	16.58	0.87	
22.00 to 29.99	22	39.00	12.60	2.70	16.00	0.90	
30.00 to 36.99	30	54.00	19.50	2.64	14.96	0.80	2.3
37.00 to 44.99	37	65.00	20.80	2.76	16.41	0.80	2.5
45.00 to 54.99	45	78.00	23.80	2.53	16.16	0.80	2.5
55.00 to 74.99	55	95.00	29.30	2.35	16.20	0.94	2.6
75.00 to 89.99	75	130.0	41.60	1.98	16.89	0.80	2.8
90.00 to 109.99	90	155.0	49.60	1.73	16.03	0.80	3.2
110.00 to 131.99	110	188.0	45.60	1.99	20.86	0.66	3.5
132.00 to 159.99	132	224.0	57.60	1.75	18.90	0.66	4.1
160.00 to 199.99	160	272.0	64.50	1.68	19.73	0.66	4.5
200.00 to 219.99	200	335.0	71.50	1.57	20.02	0.66	4.7
220.00 to 249.99	220	365.0	71.80	1.60	20.90	0.58	4.7
250.00 to 279.99	250	415.0	87.90	1.39	18.88	0.54	5.0
280.00 to 314.99	280	462.0	93.70	1.36	19.18	0.54	5.5
315.00 to 354.99	315	520.0	120.0	0.84	16.68	0.45	5.6
355.00 to 399.99	355	580.0	132.0	0.83	16.40	0.43	5.6
400.00 to 449.99	400	670.0	200.0	0.62	15.67	0.29	7.5
450.00 to 499.99	450	770.0	270.0	0.48	13.03	0.23	9.8
500.00 to 559.99	500	835.0	270.0	0.51	12.38	0.18	9.8
560.00 to 629.99	560	940.0	270.0	0.57	13.94	0.20	9.8
630.00 to 709.99	630	1050.0	355.0	0.46	11.77	0.17	10.5
710.00 or above	710	1150.0	290.0	0.54	14.62	0.21	10.5

Table B (2) Motor Parameters (Continued)

■ When "HP rating motors" is selected (P99 = 1)

Motor capacity (HP) P02	Nominal applied motor (HP)	Rated current (A) P03	No-load current (A) P06	%R1 (%) P07	%X (%) P08	Rated slip frequency P12	Starting mode (Auto search delay time 2) H46
0.01 to 0.11	0.1	0.22	0.20	13.79	11.75	2.50	0.5
0.12 to 0.24	0.12	0.34	0.27	12.96	12.67	2.50	
0.25 to 0.49	0.25	0.70	0.56	11.02	13.84	2.50	
0.50 to 0.99	0.5	1.00	0.61	6.15	8.80	2.50	
1.00 to 1.99	1	1.50	0.77	3.96	8.86	2.50	
2.00 to 2.99	2	2.90	1.40	4.29	7.74	2.50	
3.00 to 4.99	3	4.00	1.79	3.15	20.81	1.17	
5.00 to 7.49	5	6.30	2.39	3.34	23.57	1.50	0.8
7.50 to 9.99	7.5	9.30	3.12	2.65	28.91	1.17	1.0
10.00 to 14.99	10	12.7	4.37	2.43	30.78	1.17	1.2
15.00 to 19.99	15	18.7	6.36	2.07	29.13	1.00	1.3
20.00 to 24.99	20	24.6	4.60	2.09	29.53	1.00	2.0
25.00 to 29.99	25	30.0	8.33	1.75	31.49	1.00	
30.00 to 39.99	30	36.2	9.88	1.90	32.55	1.00	
40.00 to 49.99	40	45.5	6.80	1.82	25.32	0.47	2.3
50.00 to 59.99	50	57.5	9.33	1.92	24.87	0.58	2.5
60.00 to 69.99	60	68.7	10.4	1.29	26.99	0.35	2.5
75.00 to 99.99	75	86.9	14.3	1.37	27.09	0.35	2.6
100.00 to 124.99	100	113.0	18.7	1.08	23.80	0.23	2.8
125.00 to 149.99	125	134.0	14.9	1.05	22.90	0.35	3.2
150.00 to 174.99	150	169.0	45.2	0.96	21.61	0.39	3.5
175.00 to 199.99	175	169.0	45.2	0.96	21.61	0.39	4.1
200.00 to 249.99	200	231.0	81.8	0.72	20.84	0.23	4.5
250.00 to 299.99	250	272.0	41.1	0.71	18.72	0.35	4.7
300.00 to 324.99	300	323.0	45.1	0.53	18.44	0.23	4.7
325.00 to 349.99	325	323.0	45.1	0.53	18.44	0.23	5.0
350.00 to 399.99	350	375.0	68.3	0.99	19.24	0.46	5.5
400.00 to 449.99	400	429.0	80.7	1.11	18.92	0.46	5.6
450.00 to 499.99	450	481.0	85.5	0.95	19.01	0.48	5.6
500.00 to 599.99	500	534.0	99.2	1.05	18.39	0.45	7.5
600.00 to 699.99	600	638.0	140.0	0.85	18.38	0.39	9.8
700.00 to 749.99	700	756.0	140.0	0.85	18.38	0.39	9.8
750.00 to 799.99	750	806.0	164.0	1.02	21.92	0.70	9.8
800.00 to 849.99	800	870.0	144.0	1.15	24.53	0.53	9.8
850.00 to 899.99	850	923.0	209.0	1.17	21.69	0.45	10.5
900.00 or above	900	994.0	172.0	1.34	25.44	0.60	10.5

Chapter 5 Details of Function Codes

This section provides the details of the function codes. The descriptions are, in principle, arranged in the order of function code groups and in numerical order. However, highly relevant function codes are collectively described where one of them first appears.

5.1.1 F codes (Fundamental functions)

F00	Data Protection

F00 specifies whether to protect function code data (except F00) and digital reference data (such as frequency command and PID command) from accidentally getting changed by pressing the ⌃ / ⌄ / ⌫ / ⌦ keys on the keypad.

Data for F00	Changing function code data		Changing digital reference data with the ⌃ / ⌄ / ⌫ / ⌦ keys
	From the keypad	Via communications link	
0	Allowed	Allowed	Allowed
1	Not allowed *	Allowed	Allowed
2	Allowed	Allowed	Not allowed
3	Not allowed *	Allowed	Not allowed

*Only F00 data can be modified with the keypad, while all other function codes cannot.

To change F00 data, simultaneous keying of STOP + ⌃ (from 0 to 1) or STOP + ⌄ (from 1 to 0) keys is required.

For similar purposes, ***WE-KP***, a signal enabling editing of function code data from the keypad is provided as a terminal command for digital input terminals. (Refer to the descriptions of E01 through E07. data = 19)

The relationship between the terminal command ***WE-KP*** and F00 data are as shown below.

WE-KP	Changing function code data	
	From the keypad	Via communications link
OFF	Not allowed	Follow the F00 setting
ON	Follow the F00 setting	

Note

- If you mistakenly assign a ***WE-KP*** to any digital input terminal, you can no longer edit or modify function code data. In such a case, temporarily turn this ***WE-KP***-assigned terminal ON and reassign the ***WE-KP*** to a correct command.
- ***WE-KP*** is only a signal that allows you to change function code data, so it does not protect the frequency settings or PID command specified by the ⌃ / ⌄ / ⌫ / ⌦ keys.

F01	Frequency Command 1	F18 (Bias, Frequency command 1) C30 (Frequency Command 2) C31 to C35 (Analog Input Adjustment for [12]) C36 to C39 (Analog Input Adjustment for [C1]) C41 to C45 (Analog Input Adjustment for [V2]) C50 (Bias (Frequency command 1), Bias base point) H61 (*UP/DOWN* Control, Initial frequency setting) C21 to C28 (Pattern operation)

F01 or C30 sets the command source that specifies reference frequency 1 or reference frequency 2, respectively.

Data for F01, C30	Function
0	Enable ⌃ / ⌄ / ⌫ / ⌦ keys on the keypad. (Refer to the procedure given below.)
1	Enable the voltage input to terminal [12] (0 to ±10 VDC, maximum frequency obtained at ±10 VDC).
2	Enable the current input to terminal [C1] (+4 to +20 mA DC or 0 to +20 mA DC, maximum frequency obtained at +20 mA DC).
3	Enable the sum of voltage (0 to ±10 VDC) and current inputs (+4 to +20 mA DC or 0 to +20 mA DC) given to terminals [12] and [C1], respectively. See the two items listed above for the setting range and the value required for maximum frequencies. Note: If the sum exceeds the maximum frequency (F03), the maximum frequency will apply.
5	Enable the voltage input to terminal [V2] (0 to ±10 VDC, maximum frequency obtained at ±10 VDC). (SW5 on the control circuit board should be turned to the V2 position (factory default).)
7	Enable ***UP*** and ***DOWN*** commands assigned to digital input terminals. The ***UP*** and ***DOWN*** should be assigned to any of digital input terminals [X1] to [X7] beforehand with any of E01 to E07 (data = 17, 18).
8	Enable ⌃ / ⌄ / ⌫ / ⌦ keys on the keypad (balanceless-bumpless switching available).
10	Enable a pattern operation in which the inverter automatically runs the motor according to the preset running period, rotation direction, acceleration/ deceleration time, and reference frequency. For details, refer to the description of C21 to C28.

Setting up a reference frequency

[1] Using the keypad (F01 = 0 (factory default) or 8)

(1) Set F01 data to "0" or "8." This can be done only when the inverter is in Running mode.

(2) Press the ⌃ / ⌄ / ⌫ / ⌦ key to display the current reference frequency. The lowest digit on the LCD monitor will blink.

(3) To change the reference frequency, press the ⌃ / ⌄ / ⌫ / ⌦ key again. To save the new setting into the inverter's memory, press the SET key (when E64 = 1 (factory default)). When the power is turned ON next time, the new setting will be used as an initial reference frequency.

Tip
- In addition to the saving with the SET key described above, auto-saving is also available (when E64 = 0).

Tip

- When you start accessing the reference frequency or any other parameter with the ⌃ / ⌄ / ⟨ / ⟩ key, the least significant digit on the display blinks, indicating that the cursor lies in the least significant digit. Holding down the ⌃ / ⌄ / ⟨ / ⟩ key changes data in the least significant digit and generates a carry, while the cursor remains in the least significant digit.
- While the least significant digit is blinking by pressing the ⌃ / ⌄ / ⟨ / ⟩ key once, pressing the ⟨ / ⟩ key moves the cursor. This cursor movement allows you to easily move the cursor to the desired digit and change the data in higher digits.
- Setting F01 data to "8" enables the balanceless-bumpless switching. When the frequency command source is switched to the keypad from any other source, the inverter inherits the current frequency that has applied before switching, providing smooth switching and shockless running.

[2] Using analog input (F01 = 1 to 3, or 5)

When any analog input (voltage input to terminals [12] and [V2], or current input to terminal [C1]) is selected by F01 (Frequency Command 1) or C30 (Frequency Command 2), it is possible to arbitrarily specify the reference frequency by multiplying the gain and adding the bias. The polarity can be selected and the filter time constant and offset can be adjusted.

Adjustable elements of frequency command 1 (F01)

Data for F01	Input terminal	Input range	Bias		Gain		Polarity	Filter time constant	Offset	Input range selection
			Bias	Base point	Gain	Base point				
1	[12]	0 to +10 V, -10 to +10V	F18	C50	C32	C34	C35	C33	C31	-
2	[C1]	4 to 20 mA 0 to 20 mA	F18	C50	C37	C39	-	C38	C36	C40
3	[12] + [C1] (Sum of the two values)	0 to +10 V, -10 to +10 V	F18	C50	C32	C34	C35	C33	C31	-
		4 to 20 mA 0 to 20 mA	F18	C50	C37	C39	-	C38	C36	C40
5	[V2]	0 to +10 V, -10 to +10 V	F18	C50	C42	C44	C45	C43	C41	-

Adjustable elements of frequency command 2 (C30)

Data for C30	Input terminal	Input range	Bias		Gain		Polarity	Filter time constant	Offset	Input range selection
			Bias	Base point	Gain	Base point				
1	[12]	0 to +10 V, -10 to +10V	C55	C56	C32	C34	C35	C33	C31	-
2	[C1]	4 to 20 mA 0 to 20 mA	C61	C62	C37	C39	-	C38	C36	C40
3	[12] + [C1] (Sum of the two values)	0 to +10 V, -10 to +10 V	C55	C56	C32	C34	C35	C33	C31	-
		4 to 20 mA 0 to 20 mA	C61	C62	C37	C39	-	C38	C36	C40
5	[V2]	0 to +10 V, -10 to +10 V	C67	C68	C42	C44	C45	C43	C41	-

Switching between frequency command 1 (F01) and 2 (C30)

Frequency command 1 (F01) and 2 (C30) can be switched by the external input signal *Hz2/Hz1* ("Select frequency command 2/1") assigned to any digital input terminal.

📖 For details about *Hz2/Hz1*, refer to the description of E01 through E07 (data = 11).

Digital input signal *Hz2/Hz1*	Frequency command source
OFF	Frequency command 1 (F01)
ON	Frequency command 2 (C30)

■ Offset (C31, C36, C41)

C31, C36 or C41 specifies an offset for analog input voltage or current. The offset also applies to signals sent from the external equipment.

■ Filter time constant (C33, C38, C43)

C33, C38, or C43 specifies a filter time constant for analog input voltage or current. Choose an appropriate value for the time constant taking into account the response speed of the machinery system since a large time constant slows down the response. When the input voltage fluctuates due to noise, specify a larger time constant.

■ Polarity (C35, C45)

C35 or C45 specifies the input range for analog input voltage.

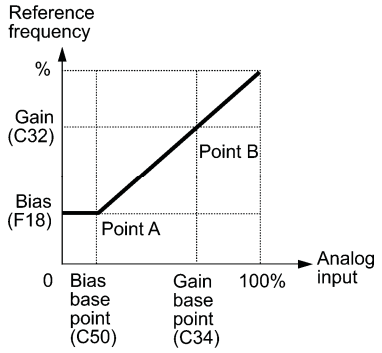
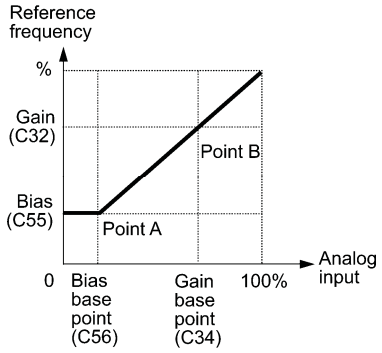
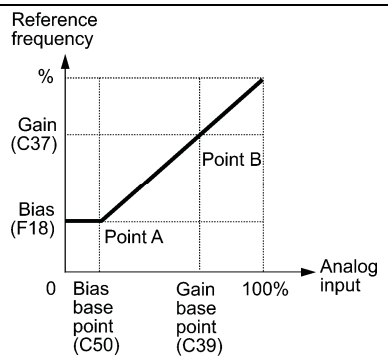
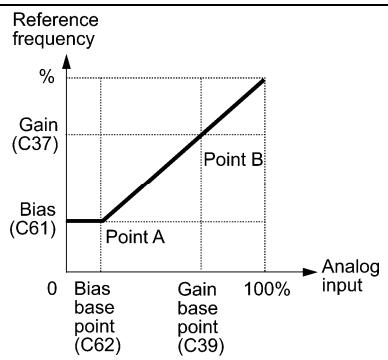
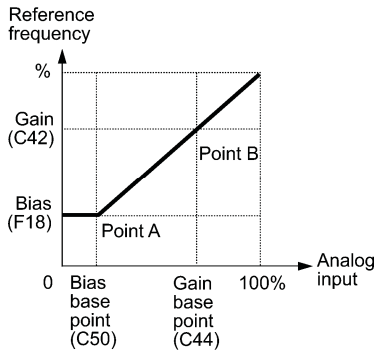
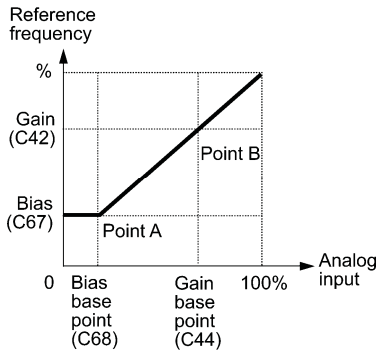
Data for C35/C45	Terminal input specifications
0	-10 to +10 VDC
1	0 to +10 VDC (negative value of voltage is regarded as 0 V)

■ Terminal [C1] Input Range Selection (C40)

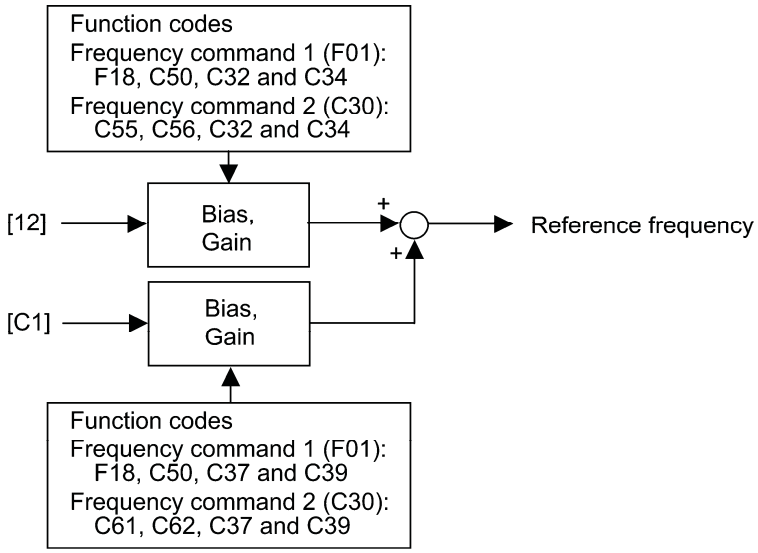
C40 specifies the input range of terminal [C1] (analog input current).

Data for C40	Terminal [C1] input range
0	4 to 20 mA (factory default)
1	0 to 20 mA

■ Gain and bias

Input terminal	Frequency command 1 (F01)	Frequency command 2 (C30)
[12]		
[C1]		
[V12]		

Note If F01 = 3 (the sum of [12] + [C1] is enabled), the bias and gain are independently applied to each of the voltage and current inputs given to terminals [12] and [C1], and the sum of the two values is applied as the reference frequency.



In the case of unipolar input
(terminal [12] with C35 = 1, terminal [C1], terminal [V2] with C45 = 1)

As shown in the graphs above, the relationship between the analog input and the reference frequency specified by **frequency command 1 (F01)** is determined by points "A" and "B." Point "A" is defined by the combination of the bias (F18) and its base point (C50); Point "B," by the combination of the gain and its base point (C32 and C34, C37 and C39, or C42 and C44).

The relationship between the analog input and the reference frequency specified by **frequency command 2 (C30)** is determined by points "A" and "B." Point "A" is defined by the combination of the bias and its base point (C55 and C56, C61 and C62, or C67 and C68), Point "B," by the combination of the gain and its base point (C32 and C34, C37 and C39, or C42 and C44).

The combination of C32 and C34 applies to terminal [12], that of C37 and C39, to [C1], and that of C42 and C44, to [V2].

Configure the bias and its gain, assuming the maximum frequency as 100%, and the bias base point and gain base point, assuming the full scale (10 VDC or 20 mA DC) of analog input as 100%.

Note

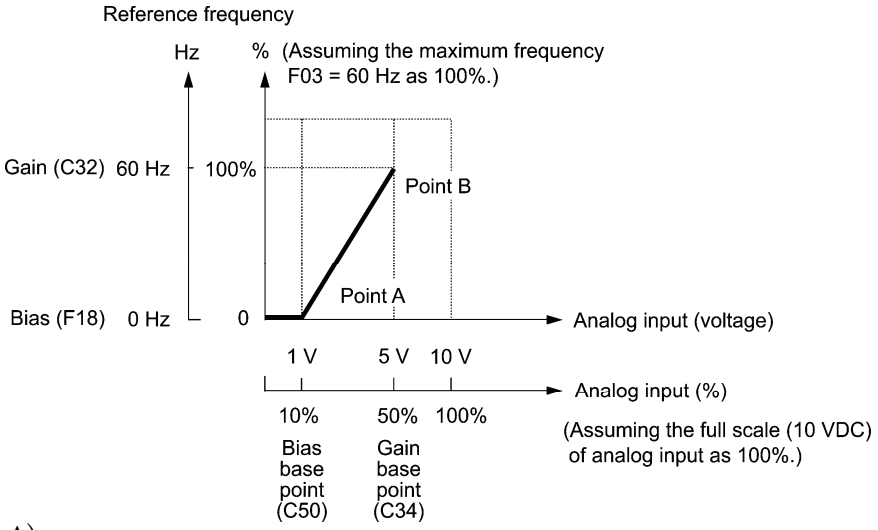
Frequency command 1 (F01)

- The analog input less than the bias base point (C50) is limited by the bias value (F18).
- Specifying that the data of the bias base point (C50) is equal to or greater than that of each gain base point (C34, C39 or C44) will be interpreted as invalid, so the inverter will reset the reference frequency to 0 Hz.

Frequency command 2 (C30)

- The analog input less than the bias base point (C56, C62 or C68) is limited by the bias value (C55, C61 or C67).
- Specifying that the data of the bias base point (C56, C62 or C68) is equal to or greater than that of each gain base point (C34, C39 or C44) will be interpreted as invalid, so the inverter will reset the reference frequency to 0 Hz.

Example: Setting the bias, gain, and their base points when the reference frequency 0 to 60 Hz follows the analog input of 1 to 5 VDC applied on terminal [12] with the maximum frequency 60 Hz (F03)



(Point A)

Frequency command 1 (F01)

To set the reference frequency to 0 Hz for an analog input being at 1 V, set the bias to 0% (F18 = 0). Since 1 V is the bias base point and it is equal to 10% of 10 V (full scale of terminal [12]), set the bias base point to 10% (C50 = 10).

Frequency command 2 (C30)

Just as frequency command 1, set the bias to 0% (C55 = 0) and the bias base point, to 10% (C56 = 10).

(Point B)

Frequency command 1 (F01), Frequency command 2 (C30)

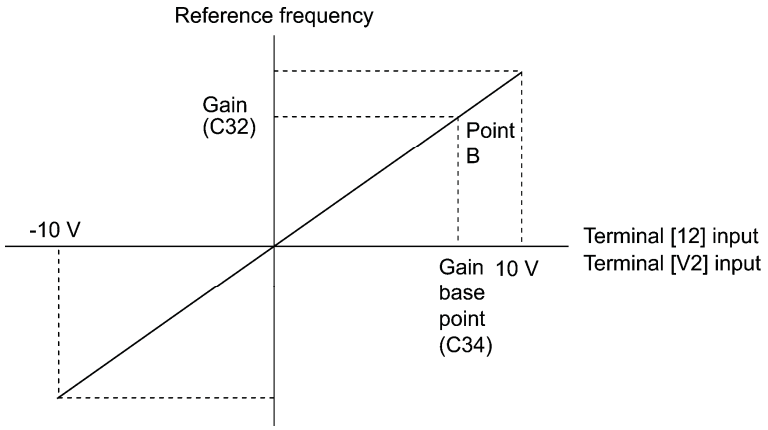
To specify the maximum frequency equal to the reference frequency for an analog input being at 5 V, set the gain to 100% (C32 = 100). Since 5 V is the gain base point and it is equal to 50% of 10 V (full scale of terminal [12]), set the gain base point to 50% (C34 = 50).

Note The setting procedure for specifying a gain or bias alone without changing any base points is the same as that of IMO conventional inverters of Jaguar VXM/VXG series, VXR series, etc.

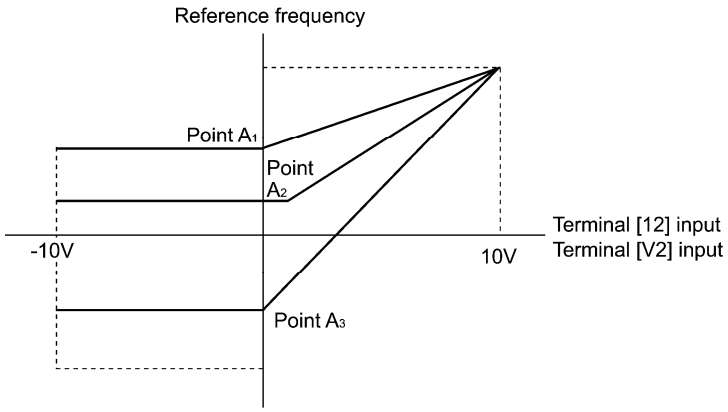
In the case of bipolar input
(terminal [12] with C35 = 0, terminal [V2] with C45 = 0)

Setting C35 and C45 data to "0" enables terminals [12] and [V2] to be used for bipolar input (-10 V to +10 V), respectively.

When both the bias (F18, C55 or C67) and its base point (C50, C56 or C68) are set to "0," the negative and positive voltage inputs produce reference frequencies symmetric about the origin point as shown below.



Note
- Configuring the bias (F18, C55 or C67) and its base point (C50, C56 or C68) to specify an arbitrary value (Points A1, A2, and A3) gives the bias as shown below.



Note
- To input bipolar analog voltage (0 to ±10 VDC) to terminals [12] and [V2], set C35 and C45 data to "0." Setting C35 and C45 data to "1" enables the voltage range from 0 to +10 VDC and interprets the negative polarity input from 0 to -10 VDC as 0 V.
- A reference frequency can be specified not only with the frequency (Hz) but also with other menu items, depending on the setting of function code E48 (= 3 to 5, or 7).

[3] Using digital input signals *UP/DOWN* (F01 = 7)

When *UP/DOWN* control is selected for frequency setting, turning the terminal command *UP* or *DOWN* ON causes the output frequency to increase or decrease, respectively, within the range from 0 Hz to the maximum frequency as listed below.

To enable *UP/DOWN* control for frequency setting, it is necessary to set F01 data to "7" and assign the *UP* and *DOWN* commands to any of digital input terminals [X1] to [X7], [FWD] and [REV] with any of E01 to E07 (data = 17, 18).

UP	***DOWN***	Function
Data = 17	Data = 18	
OFF	OFF	Keep the current output frequency.
ON	OFF	Increase the output frequency with the acceleration time currently specified.
OFF	ON	Decrease the output frequency with the deceleration time currently specified.
ON	ON	Keep the current output frequency.

F02 Operation Method

F02 selects the source that specifies a run command. The table below lists the run command sources and the rotational directions of the motor.

Data for F02		Description
0	Keypad	Enable the FWD / REV / STOP keys to run and stop the motor.
1	External signals (Digital input terminal commands)	Enable terminal command ***FWD*** and ***REV*** to run and stop the motor.
2	Keypad (Forward rotation)	Enable FWD / STOP keys to run and stop the motor. Note that this run command enables only the forward rotation. There is no need to specify the rotational direction.
3	Keypad (Reverse rotation)	Enable REV / STOP keys to run and stop the motor. Note that this run command enables only the reverse rotation. There is no need to specify the rotational direction.

Terminal commands ***FWD*** ("Run forward") and ***REV*** ("Run reverse") must be assigned to terminals [FWD] and [REV], respectively.

📖 For details about ***FWD*** and ***REV***, refer to E98 and E99 (data = 98 or 99).

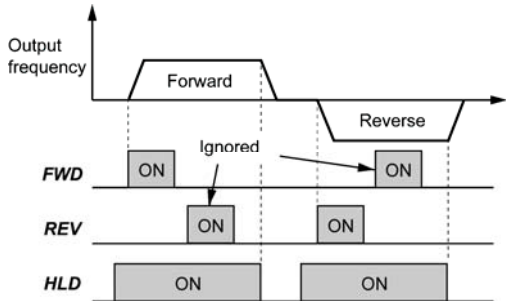
Note
- When the ***FWD*** or ***REV*** is ON, the F02 data cannot be changed.
- When changing terminal command assignments to terminals [FWD] and [REV] from commands other than the ***FWD*** and ***REV*** to the ***FWD*** or ***REV*** with F02 being set to "1," be sure to turn the target terminal OFF beforehand; otherwise, the motor may unintentionally rotate.

■ 3-wire operation with external input signals (digital input terminal commands)

The default setting of the ***FWD*** and ***REV*** are 2-wire. Assigning the terminal command ***HLD*** self-holds the forward ***FWD*** or reverse ***REV*** run command, to enable 3-wire inverter operation.

📖 For details about ***HLD***, refer to E01 to E07 (data = 6).

Short-circuiting the ***HLD***-assigned terminal and [CM] (i.e., when ***HLD*** is ON) self-holds the first ***FWD*** or ***REV*** at its rising edge. Turning the ***HLD*** OFF releases the self-holding. When no ***HLD*** is assigned, 2-wire operation involving only ***FWD*** and ***REV*** takes effect.



In addition to the run command sources described above, higher priority command sources including remote and local modes (see Chapter 5 Section 5.5.4) and communications link are provided

.

F03	Maximum Frequency 1

F03 specifies the maximum frequency to limit the output frequency. Specifying the maximum frequency exceeding the rating of the equipment driven by the inverter may cause damage or a dangerous situation. Make sure that the maximum frequency setting matches the equipment rating.

- Data setting range: 25.0 to 120.0 (Hz)

⚠WARNING

The inverter can easily accept high-speed operation settings. When changing the speed setting, carefully check the specifications of motors or equipment beforehand.

Otherwise injuries could occur.

Note Modifying F03 data to allow a higher output frequency requires also changing F15 data specifying a frequency limiter (high).

F04, F05 F06	Base Frequency 1, Rated Voltage at Base Frequency 1, Maximum Output Voltage 1 H50, H51 (Non-linear V/f Pattern 1, Frequency and Voltage) H52, H53 (Non-linear V/f Pattern 2, Frequency and Voltage)

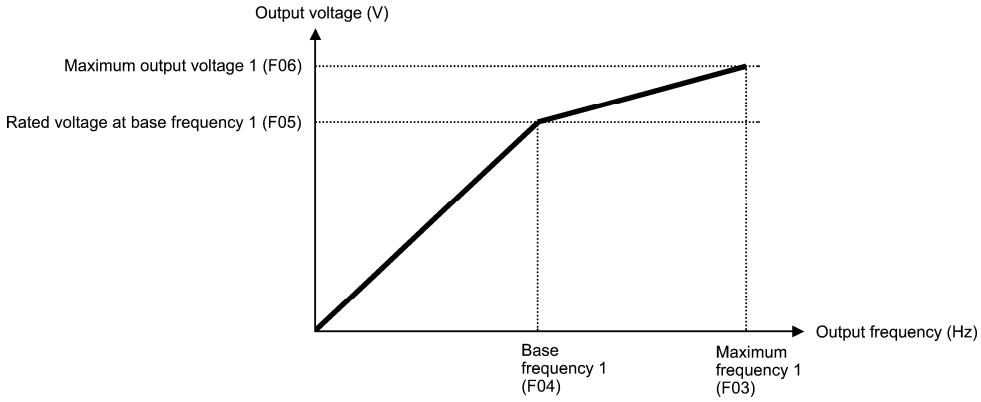
These function codes specify the base frequency and the voltage at the base frequency essentially required for running the motor properly. If combined with the related function codes H50 through H53, these function codes may profile the non-linear V/f pattern suitable for the load by specifying increase or decrease in voltage at any point on the V/f pattern.

The following descriptions include setups required for the non-linear V/f patterns.

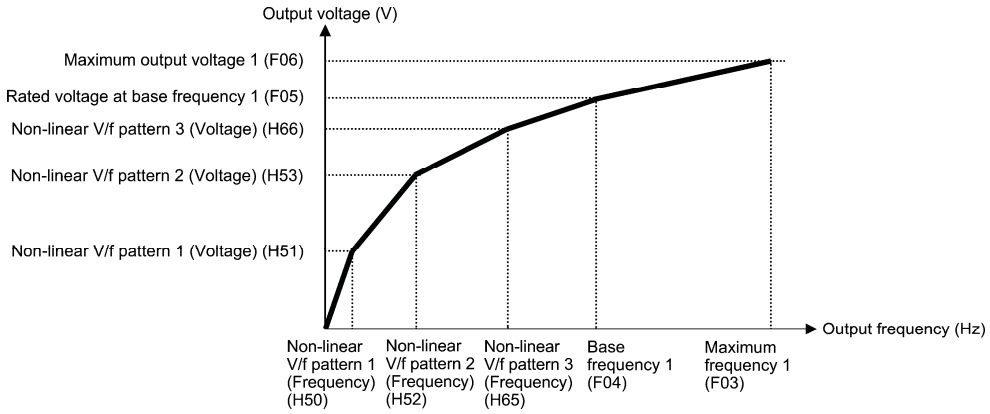
At high frequencies, the motor impedance may increase, resulting in an insufficient output voltage and a decrease in output torque. To prevent this problem, use F06 (Maximum Output Voltage 1) to increase the voltage. Note, however, that the inverter cannot output voltage exceeding its input power voltage.

V/f point	Function code		Remarks
	Frequency	Voltage	
Maximum frequency	F03	F06	The setting of the maximum output voltage is disabled when the auto torque boost or torque vector control is selected.
Base frequency	F04	F05	
Non-linear V/f pattern 2	H52	H53	Disabled when the auto torque boost or torque vector control is selected.
Non-linear V/f pattern 1	H50	H51	

■ Normal (linear) V/f pattern


Output voltage (V)
Maximum output voltage 1 (F06)
Rated voltage at base frequency 1 (F05)
Output frequency (Hz)
Base frequency 1 (F04)
Maximum frequency 1 (F03)

■ V/f pattern with three non-linear points



■ Base Frequency 1 (F04)

Set F04 data to the rated frequency printed on the nameplate labeled on the motor.

- Data setting range: 25.0 to 120.0 (Hz)

■ Rated Voltage at Base Frequency 1 (F05)

Set F05 data to "0" or the rated voltage printed on the nameplate labeled on the motor.

- Data setting range:
  OFF : Disable the Automatic Voltage Regulator (AVR).
  160 to 500 (V) : Output an AVR-controlled voltage
- If F05 = OFF, the rated voltage at base frequency is at the same level as the inverter input voltage. The output voltage will fluctuate in line with the input voltage fluctuation.
- If F05 = an arbitrary value other than "OFF," the inverter automatically keeps the output voltage constant in line with the setting. When any control function such as auto torque boost, auto energy saving, slip compensation, etc. is enabled, the F05 data should be equal to the rated voltage of the motor (printed on the nameplate of the motor).

Note The voltage the inverter can output is at the same level as the inverter input voltage. Configure these voltages correctly in accordance with the motor specifications.

■ Non-linear V/f Patterns 1 and 2 for Frequency (H50 and H52)

H50 or H52 specifies the frequency component at an arbitrary point in the non-linear V/f pattern.

- Data setting range: OFF (cancel)
  0.1 to 120.0 (Hz)

Note Setting "OFF" to H50 or H52 disables the non-linear V/f pattern operation.

■ Non-linear V/f Patterns 1 and 2 for Voltage (H51 and H53)

H51 or H53 specifies the voltage component at an arbitrary point in the non-linear V/f pattern.

- Data setting range:
  0 to 500 (V): Output an AVR-controlled voltage

Note The factory default values for H50 and H51 differ depending on the inverter capacity. Refer to the following table.

Capacity	30 kW or below	37 kW or above
H50	0.0	5.0 (Hz)
H51	0	40 (V)

■ Maximum Output Voltage 1 (F06)

F06 specifies the voltage for the maximum frequency 1 (F03).

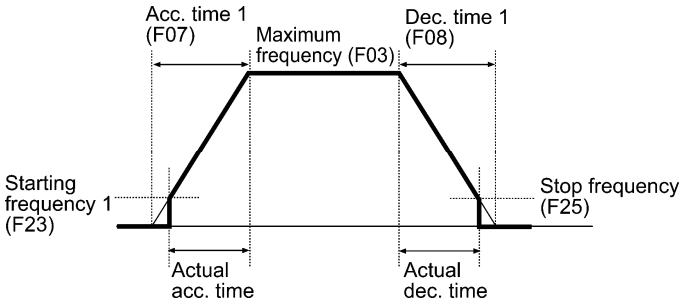
- Data setting range:
  160 to 500 (V): Output an AVR-controlled voltage

Note If F05 (Rated Voltage at Base Frequency 1) is set to "OFF," settings of H50 through H53 and F06 do not take effect. (When the non-linear point is below the base frequency, the linear V/f pattern applies; when it is above, the output voltage is kept constant.)

F07, F08	**Acceleration Time 1, Deceleration Time 1** **E10, E12, E14 (Acceleration Time 2, 3 and 4)** **E11, E13, E15 (Deceleration Time 2, 3 and 4)** **H07 (Acceleration/Deceleration Pattern)** **H56 (Deceleration Time for Forced Stop)**

F07 specifies the acceleration time, the length of time the frequency increases from 0 Hz to the maximum frequency. F08 specifies the deceleration time, the length of time the frequency decreases from the maximum frequency down to 0 Hz.

- Data setting range: 0.00 to 3600.00 (s)



■ Acceleration/deceleration time

Acceleration/ deceleration time	Function code		Switching factor of acceleration/deceleration time (📖 Refer to the descriptions of E01 to E07.)		
	ACC time	DEC time	***RT2***	***RT1***	
Acceleration/ deceleration time 1	F07	F08	OFF	OFF	The combinations of ON/OFF states of the two terminal commands ***RT2*** and ***RT1*** offer four choices of acceleration/ deceleration time 1 to 4. (Data = 4, 5) If no terminal command is assigned, only the acceleration/deceleration time 1 (F07/F08) is effective.
Acceleration/ deceleration time 2	E10	E11	OFF	ON	
Acceleration/ deceleration time 3	E12	E13	ON	OFF	
Acceleration/ deceleration time 4	E14	E15	ON	ON	
Force to stop	-	H56	If terminal command ***STOP*** (data = 30) is turned OFF, the inverter decelerates to a stop with the deceleration time specified by H56. After that, the inverter displays alarm Er6 and enters an alarm state.		

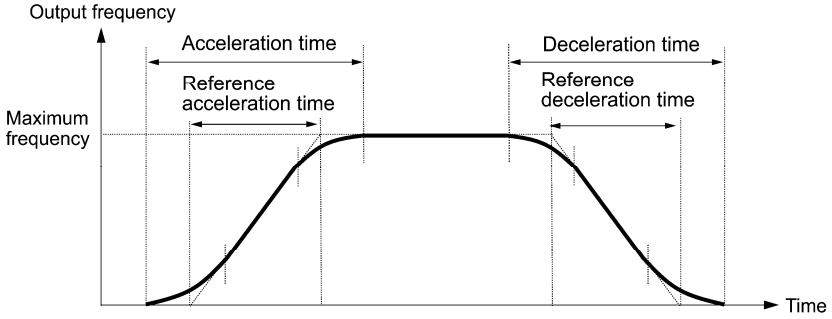
■ Acceleration/Deceleration pattern (H07)

H07 specifies the acceleration and deceleration patterns (patterns to control output frequency).

Data for H07	Acceleration/ deceleration pattern	Motion		Function code
0	Linear	The inverter runs the motor with the constant acceleration and deceleration.		-
1	S-curve (Weak)	To reduce an impact that acceleration/deceleration would make on the machine, the inverter gradually accelerates or decelerates the motor in both the starting and ending zones of acceleration or deceleration.	Weak: The acceleration/deceleration rate to be applied to all of the four inflection zones is fixed at 5% of the maximum frequency.	-
2	S-curve (Strong)		Strong: The acceleration/deceleration rate to be applied to all of the four inflection zones is fixed at 10% of the maximum frequency.	-
3	Curvilinear	Acceleration/deceleration is linear below the base frequency (constant torque) but it slows down above the base frequency to maintain a certain level of load factor (constant output). This acceleration/deceleration pattern allows the motor to accelerate or decelerate with the maximum performance of the motor.		-

S-curve acceleration/deceleration

To reduce an impact that acceleration/deceleration would make on the machine, the inverter gradually accelerates or decelerates the motor in both the starting and ending zones of acceleration or deceleration. Two types of S-curve acceleration/deceleration rates are available; applying 5% (weak) and 10% (strong) of the maximum frequency to all of the four inflection zones. The reference acceleration/deceleration time determines the duration of acceleration/deceleration in the linear period; hence, the actual acceleration/deceleration time is longer than the reference acceleration/deceleration time.



	Acceleration		Deceleration	
	Starting zone	Ending zone	Starting zone	Ending zone
S-curve (Weak)	5%	5%	5%	5%
S-curve (Strong)	10%	10%	10%	10%

<S-curve acceleration/deceleration (weak): when the frequency change is 10% or more of the maximum frequency>

Acceleration or deceleration time (s)= (2 × 5/100 + 90/100+ 2 × 5/100) × (reference acceleration or deceleration time)
= 1.1 × (reference acceleration or deceleration time)

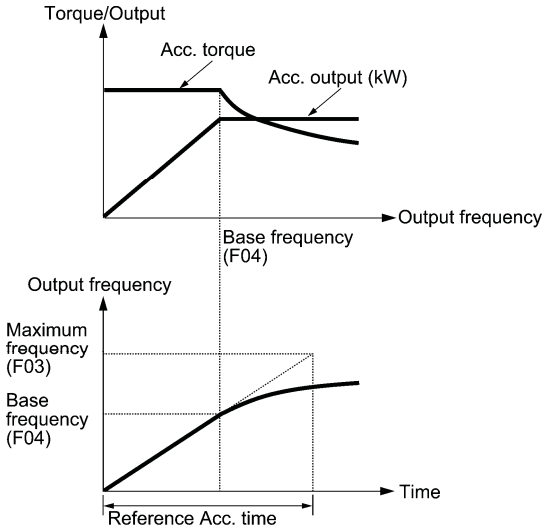
<S-curve acceleration/deceleration (strong): when the frequency change is 20% or more of the maximum frequency--10% at the leading edge and 20% at the trailing edge>

Acceleration or deceleration time (s)= (2 × 10/100 + 80/100 + 2 × 10/100) × (reference acceleration or deceleration time)
= 1.2 × (reference acceleration or deceleration time)

Curvilinear acceleration/deceleration

Acceleration/deceleration is linear below the base frequency (constant torque) but it slows down above the base frequency to maintain a certain level of load factor (constant output).

This acceleration/deceleration pattern allows the motor to accelerate or decelerate with its maximum performance.



The figures at left show the acceleration characteristics. Similar characteristics apply to the deceleration.

Note

- If you choose S-curve acceleration/deceleration or curvilinear acceleration/deceleration in Acceleration/Deceleration Pattern (H07), the actual acceleration/deceleration times are longer than the specified ones.
- Specifying an improperly short acceleration/deceleration time may activate the current limiter, torque limiter, or anti-regenerative control (automatic deceleration), resulting in a longer acceleration/deceleration time than the specified one.

F09	Torque Boost 1 (Refer to F37.)

Refer to the description of F37.

F10 to F12	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics, Overload detection level, Thermal time constant)

F10 through F12 specify the thermal characteristics of the motor for its electronic thermal overload protection that is used to detect overload conditions of the motor inside the inverter.

F10 selects the motor cooling mechanism to specify its characteristics, F11 specifies the overload detection current, and F12 specifies the thermal time constant.

Upon detection of overload conditions of the motor, the inverter shuts down its output and issues a motor overload alarm **OL1** to protect motor 1.

Note

Thermal characteristics of the motor specified by F10 and F12 are also used for the overload early warning. Even if you need only the overload early warning, set these characteristics data to these function codes. (📖 Refer to the description of E34.)
To disable the electronic thermal overload protection, set F11 data to "OFF."

Note

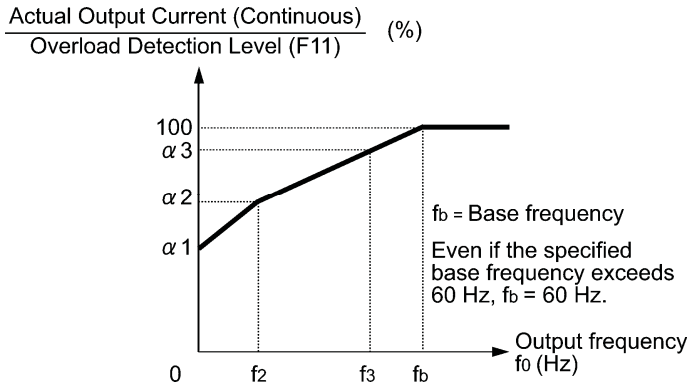
For motors with PTC thermistor, connecting the PTC thermistor to the terminal [C1] enables the motor overheat protective function. For details, refer to the description of H26.

■ Select motor characteristics (F10)

F10 selects the cooling mechanism of the motor--shaft-driven or separately powered cooling fan.

Data for F10	Function
1	For a general-purpose motor with shaft-driven cooling fan (The cooling effect will decrease in low frequency operation.)
2	For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan (The cooling effect will be kept constant regardless of the output frequency.)

The figure below shows operating characteristics of the electronic thermal overload protection when F10 = 1. The characteristic factors α1 through α3 as well as their corresponding output frequencies f2 and f3 differ depending on the characteristics of the motor. The tables below list the factors of the motor selected by P99 (Motor 1 Selection).



Cooling Characteristics of Motor with Shaft-driven Cooling Fan

Nominal Applied Motor and Characteristic Factors when P99 (Motor 1 selection) = 0 or 4

Nominal applied motor (kW)	Thermal time constant τ (Factory default)	Reference current for setting the thermal time constant (Imax)	Output frequency for motor characteristic factor		Characteristic factor (%)		
			f2	f3	α1	α2	α3
0.4, 0.75	5 min	Allowable continuous drive current × 150%	5 Hz	7 Hz	75	85	100
1.5 to 3.7					85	85	100
5.5 to 11				6 Hz	90	95	100
15				7 Hz	85	85	100
18.5, 22				5 Hz	92	100	100
30 to 45	10 min		Base frequency × 33%	Base frequency × 83%	54	85	95
55 to 90					51	95	95
110 or above					53	85	90

Nominal Applied Motor and Characteristic Factors when P99 (Motor 1 Selection) = 1

Nominal applied motor (kW)	Thermal time constant τ (Factory default)	Reference current for setting the thermal time constant (Imax)	Output frequency for motor characteristic factor		Characteristic factor (%)		
			f2	f3	α1	α2	α3
0.2 to 22	5 min	Allowable continuous drive current × 150%	Base frequency × 33%	Base frequency × 33%	69	90	90
30 to 45	10 min			Base frequency × 83%	54	85	95
55 to 90					51	95	95
110 or above					53	85	90

If F10 is set to "2," changes of the output frequency do not affect the cooling effect. Therefore, the overload detection level (F11) remains constant.

■ Overload detection level (F11)

F11 specifies the level at which the electronic thermal overload protection becomes activated.

- Data setting range:1 to 135% of the rated current (allowable continuous drive current) of the inverter

In general, set the F11 data to the allowable continuous current of motor when driven at the base frequency (i.e. 1.0 to 1.1 times of the rated current of the motor.) To disable the electronic thermal overload protection, set the F11 data to "OFF" (Disable).

■ Thermal time constant (F12)

F12 specifies the thermal time constant of the motor. If the current of 150% of the overload detection level specified by F11 flows for the time specified by F12, the electronic thermal overload protection becomes activated to detect the motor overload. The thermal time constant for general-purpose motors including Fuji motors is approx. 5 minutes for motors of 22 kW or below and 10 minutes for motors of 30 kW or above by factory default.

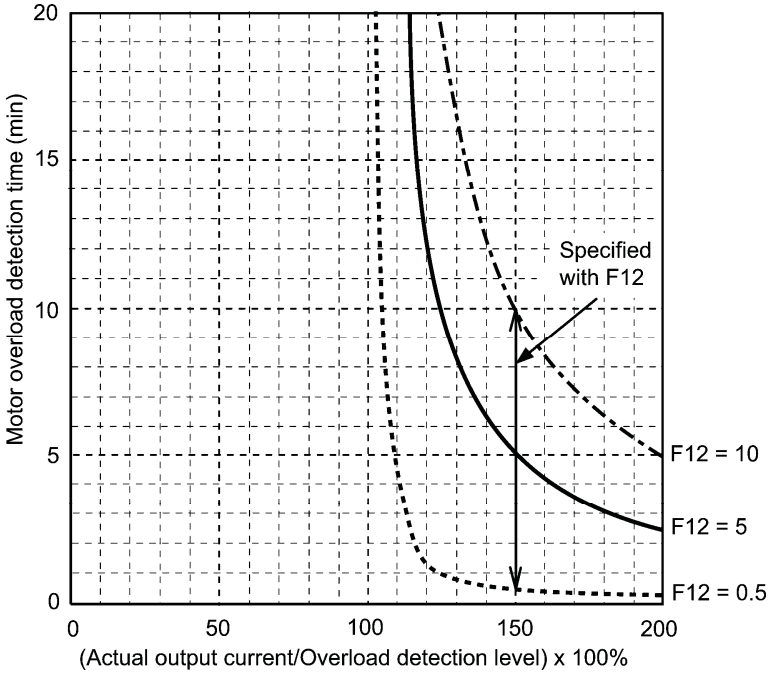
- Data setting range: 0.5 to 75.0 (minutes)

(Example) When the F12 data is set at 5 minutes

As shown on the next page, the electronic thermal overload protection is activated to detect an alarm condition (alarm code **OL1**) when the output current of 150% of the overload detection level (specified by F11) flows for 5 minutes, and 120% for approx. 12.5 minutes.

The actual time required for issuing a motor overload alarm tends to be shorter than the specified value, taking into account the time period from when the output current exceeds the allowable continuous drive current (100%) until it reaches 150% of the overload detection level.

Example of Thermal Overload Detection Characteristics



F14	**Restart Mode after Momentary Power Failure (Mode selection)** **H13 (Restart time)** **H14 (Frequency fall rate)** **H15 (Continuous running level)** **H16 (Allowable momentary power failure time)** **H92 and H93 (Continuity of Running, P and I)**

F14 specifies the action to be taken by the inverter such as trip and restart in the event of a momentary power failure.

■ Restart mode after momentary power failure (Mode selection) (F14)

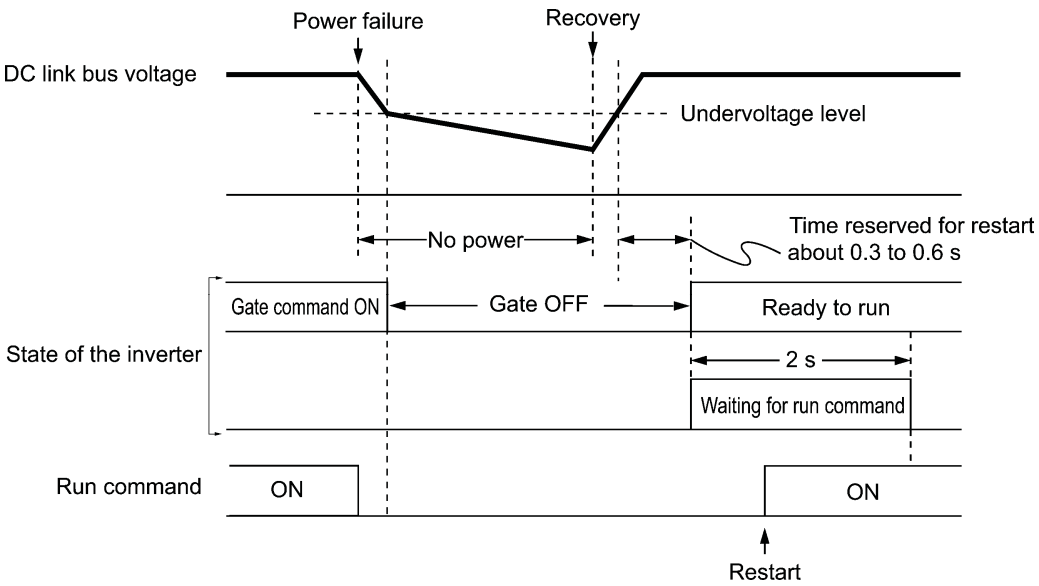
Data for F14	Description	
	Auto search disabled	Auto search enabled
0: Trip immediately	As soon as the DC link bus voltage drops below the undervoltage level due to a momentary power failure, the inverter issues undervoltage alarm **LV** and shuts down its output so that the motor enters a coast-to-stop state.	
1: Trip after recovery from power failure	As soon as the DC link bus voltage drops below the undervoltage level due to a momentary power failure, the inverter shuts down its output so that the motor enters a coast-to-stop state, but it does not enter the undervoltage state or issue undervoltage alarm **LV**. The moment the power is restored, an undervoltage alarm **LV** is issued, while the motor remains in a coast-to-stop state.	
3: Continue to run (for heavy inertia or general loads)	As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, continuous running control is invoked. Continuous running control regenerates kinetic energy from the load's moment of inertia, continues running, and waits the recovery of power. When an undervoltage condition is detected due to a lack of energy to be regenerated, the output frequency at that time is saved, the output of the inverter is shut down, and the motor enters a coast-to-stop state.	
	If a run command has been input, restoring power restarts the inverter at the output frequency saved when undervoltage was detected.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
	This setting is ideal for fan applications with a large moment of inertia.	
4: Restart at the frequency at which the power failure occurred (for general loads)	As soon as the DC link bus voltage drops below the undervoltage level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state.	
	If a run command has been input, restoring power restarts the inverter at the output frequency saved when undervoltage was detected.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
	This setting is ideal for applications with a moment of inertia large enough not to slow down the motor quickly, such as fans, even after the motor enters a coast-to-stop state upon occurrence of a momentary power failure.	
5: Restart at the starting frequency	As soon as the DC link bus voltage drops below the undervoltage level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state.	
	If a run command has been input, restoring power restarts the inverter at the starting frequency specified by function code F23.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
	This setting is ideal for heavy load applications such as pumps, having a small moment of inertia, in which the motor speed quickly goes down to zero as soon as it enters a coast-to-stop state upon occurrence of a momentary power failure.	
Auto search is enabled by turning ON the digital terminal command ***STM*** ("Enable auto search for idling motor speed at starting") or setting the H09 data to "1" or "2." For details about the digital terminal command ***STM*** and auto search, refer to the description of H09 (Starting Mode, Auto search).		

■ Restart mode after momentary power failure (Basic operation: Auto search disabled)

The inverter recognizes a momentary power failure upon detecting the condition that DC link bus voltage goes below the undervoltage level, while the inverter is running. If the load of the motor is light and the duration of the momentary power failure is extremely short, the voltage drop may not be great enough for a momentary power failure to be recognized, and the motor may continue to run uninterrupted.

Upon recognizing a momentary power failure, the inverter enters the restart mode (after a recovery from momentary power failure) and prepares for restart. When power is restored, the inverter goes through an initial charging stage and enters the ready-to-run state. When a momentary power failure occurs, the power supply voltage for external circuits such as relay sequence circuits may also drop so as to turn the run command OFF. In consideration of such a situation, the inverter waits 2 seconds for a run command input after the inverter enters a ready-to-run state. If a run command is received within 2 seconds, the inverter begins the restart processing in accordance with the F14 data (Mode selection). If no run command has been received within 2-second wait period, the inverter cancels the restart mode (after a recovery from momentary power failure) and needs to be started again from the ordinary starting frequency. Therefore, ensure that a run command is entered within 2 seconds after recovery of power or held with an off-delay timer or a mechanical latch relay.

When run commands are entered via the keypad, the above operation is also necessary for the mode (F02 = 0) in which the rotational direction is determined by the terminal command, ***FWD*** or ***REV***. In the modes where the rotational direction is fixed (F02 = 2 or 3), the run command is retained inside the inverter so that the restart will begin as soon as the inverter enters the ready-to-run state.



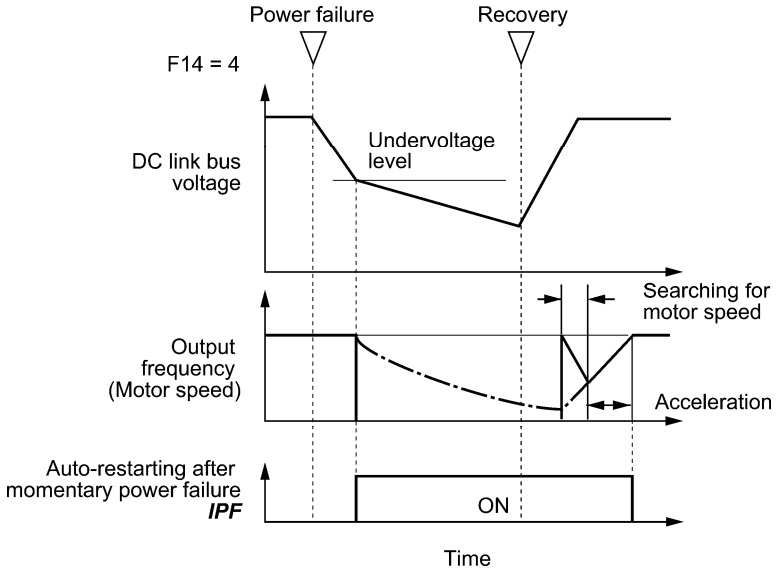
Note

- When the power is restored, the inverter will wait 2 seconds for input of a run command. However, if the allowable momentary power failure time (H16) has elapsed after the power failure was recognized, the inverter will no longer wait 2 seconds for input of a run command and start operation in the normal starting sequence.
- If the terminal command ***BX*** ("Coast to a stop") is entered during the power failure, the inverter gets out of the restart mode and enters the normal running mode. When a run command is entered with power supply applied, the inverter will start from the normal starting frequency.
- The inverter recognizes a momentary power failure by detecting an undervoltage condition when the voltage of the DC link bus goes below the lower limit. In a configuration where a magnetic contactor is installed on the output side of the inverter, the inverter may fail to recognize a momentary power failure because the momentary power failure shuts down the operating power of the magnetic contactor, causing the contactor circuit to open. When the contactor circuit is open, the inverter is cut off from the motor and load so that the voltage drop in the DC link bus may not be great enough to be recognized as a power failure. In such an event, the restart after a recovery from momentary power failure does not work properly as designed. To solve this, connect the auxiliary contact of the magnetic contactor to the inverter terminal which the ***IL*** ("Interlock") is assigned to so that a momentary power failure can sure be detected.

  📖 For details about ***IL***, refer to E01 to E07 (data = 22).

IL	Description
OFF	No momentary power failure has occurred.
ON	A momentary power failure has occurred. (Restart after a momentary power failure enabled)

During a momentary power failure, the motor slows down. After power is restored, the inverter restarts at the frequency just before the momentary power failure. Then, the current limiting function works and the output frequency of the inverter automatically decreases. When the output frequency matches the motor speed, the motor accelerates up to the original output frequency. See the figure below. In this case, the instantaneous overcurrent limiting must be enabled (H12 = 1).



・Auto-restarting after momentary power failure ***IPF***

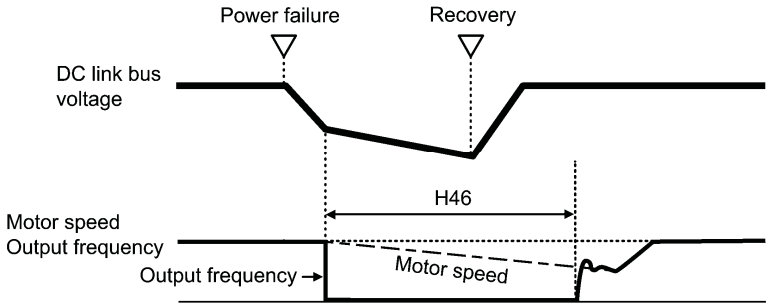
This output signal is ON during the period after the occurrence of momentary power failure until the completion of a restart sequence (until the output reaches the reference frequency). When the ***IPF*** is ON, the motor slows down, so perform necessary operations.

📖 For details about ***IPF***, refer to E01 through E07 (data = 6).

■ Restart mode after momentary power failure (Basic operation: Auto search enabled)

Auto search for idling motor speed will become unsuccessful if it is done while the motor retains residual voltage. It is, therefore, necessary to leave the motor for the time (auto search delay time) enough to discharge the residual voltage. The delay time is specified by H46 (Starting Mode (Auto search delay time 2)).

The inverter will not start unless the time specified by H46 has elapsed, even if the starting conditions are satisfied. (📖 For details, refer to H09.)



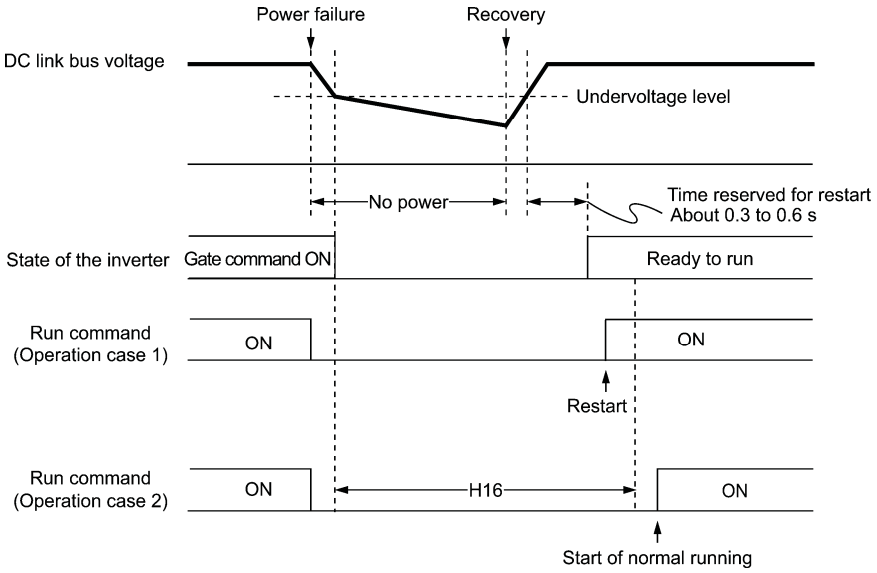
Note

- To use auto search for idling motor speed, it is necessary to tune the inverter beforehand.
- When the estimated speed exceeds the maximum frequency or the upper limit frequency, the inverter disables auto search and starts running the motor with the maximum frequency or the upper limit frequency, whichever is lower.
- During auto search, if an overcurrent or overvoltage trip occurs, the inverter restarts the suspended auto search.
- Perform auto search at 60 Hz or below.
- Note that auto search may not fully provide the performance depending on load conditions, motor parameters, wiring length, and other external factors.
- When the inverter is equipped with any of output circuit filters in the secondary lines, it cannot perform auto search. Use the filter instead.

■ Restart mode after momentary power failure (Allowable momentary power failure time) (H16)

H16 specifies the maximum allowable duration (0.0 to 30.0 seconds) from an occurrence of a momentary power failure (undervoltage) until the restart of the inverter. Specify the coast-to-stop time during which the machine system and facility can be tolerated.

If the power is restored within the specified duration, the inverter restarts in the restart mode specified by F14. If not, the inverter recognizes that the power has been shut down so that the inverter does not apply the restart mode and starts normal running.



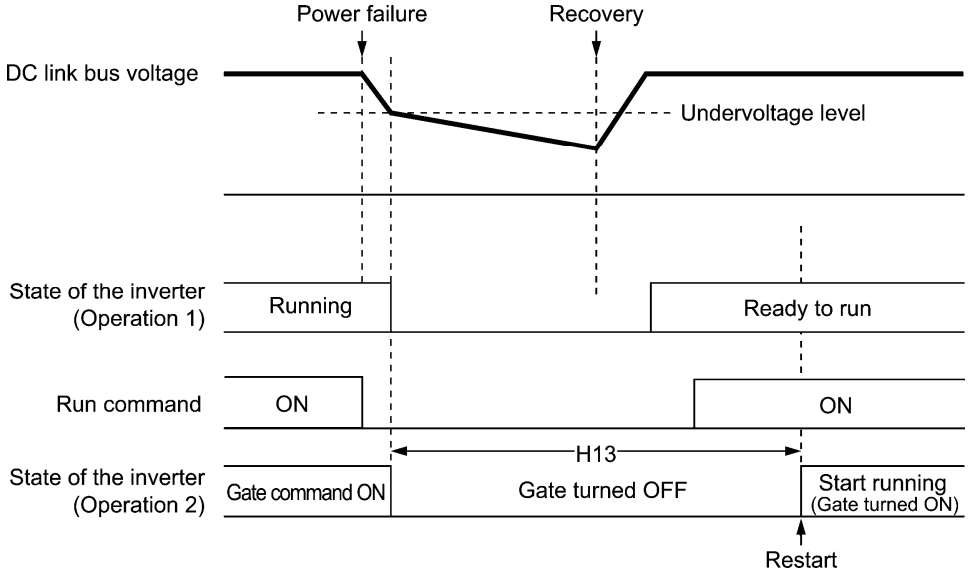
If H16 (Allowable momentary power failure time) is set to "Auto," restart will take place until the DC link bus voltage drops down to the allowable voltage (100 V) for restart after a momentary power failure. If the DC link bus voltage drops below the allowable voltage, the inverter recognizes that the power has been shut down so that the inverter does not apply the restart mode and starts normal running.

Note The time required from when the DC link bus voltage drops from the threshold of undervoltage until it reaches the allowable voltage for restart after a momentary power failure, greatly varies depending on the inverter capacity, the presence of options, and other factors.

■ Restart mode after momentary power failure (Restart time) (H13)

H13 specifies the time period from an occurrence of a momentary power failure until the restart of the inverter. (When auto search is enabled, H46 (Auto search delay time 2) applies.)

If the inverter starts the motor while motor's residual voltage is still in a high level, a high inrush current may flow or an overvoltage alarm may occur due to an occurrence of temporary regeneration. For safety, therefore, it is advisable to set H13 to a certain level so that the restart will take place only after the residual voltage has dropped to a low level. Note that even when power is restored, restart will not take place until the restart time (H13) has elapsed.



Factory default

By factory default, H13 is set to the value suitable for the standard motor (see Table A given in Section 6.2 "Function Code Tables"). Basically, it is not necessary to change H13 data. However, if the long restart time causes the flow rate of the pump to overly decrease or causes any other problem, you might as well reduce the setting to about a half of the default value. In such a case, make sure that no alarm occurs.

Note The restart time specified by H13 also applies to the switching operation (terminal commands ***ISW50***/***ISW60***) between line and inverter. Refer to E01 through E07 (data = 40, 41) for terminals [X1] to [X7].

■ Restart mode after momentary power failure (Frequency fall rate) (H14)

During restart after a momentary power failure, if the inverter output frequency and the idling motor speed cannot be harmonized with each other, an overcurrent will flow, activating the overcurrent limiter. If it happens, the inverter automatically reduces the output frequency to match the idling motor speed according to the reduction rate (Frequency fall rate: Hz/s) specified by H14.

Data for H14	Inverter's action for the output frequency fall
Inherit	Fall frequency with the selected deceleration time
0.01 to 100.00 (Hz/s)	Follow the frequency fall rate specified by H14
Auto	Follow the setting of the PI processor in the current limiter. (The PI constant is prefixed inside the inverter.)

Note If the frequency fall rate is too high, regeneration may take place at the moment the motor speed matches the inverter output frequency, causing an overvoltage trip. On the contrary, if the frequency fall rate is too low, the time required for the output frequency to match the motor speed (duration of current limiting action) may be prolonged, triggering the inverter overload prevention control.

■ Restart after momentary power failure (Continuous running level) (H15)
Continuity of running (P and I) (H92, H93)

・Trip after decelerate-to-stop (F14 = 2)

If a momentary power failure occurs when F14 is set to "2" (Trip after decelerate-to-stop), the inverter enters the control sequence of the decelerate-to-stop when the DC link bus voltage drops below the continuous running level specified by H15.

Under decelerate-to-stop control, the inverter decelerates its output frequency keeping the DC link bus voltage constant using the PI processor. P (proportional) and I (integral) components of the PI processor are specified by H92 and H93, respectively.

For normal inverter operation, it is not necessary to modify data of H15, H92 or H93.

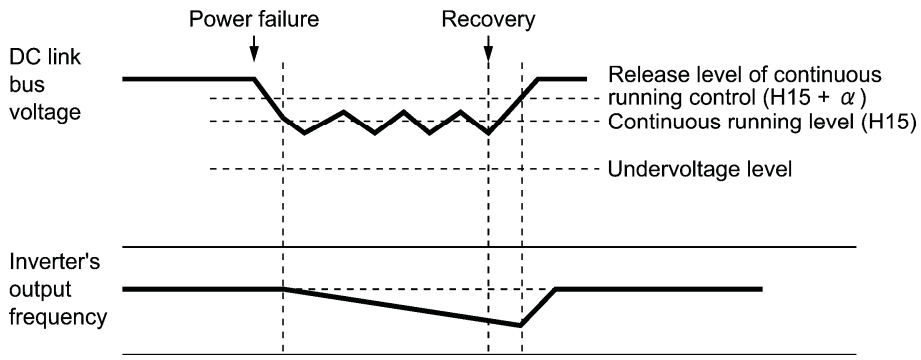
・Continue to run (F14 = 3)

If a momentary power failure occurs when F14 is set to "3" (Continue to run), the inverter enters the control sequence of the continuous running when the DC link bus voltage drops below the continuous running level specified by H15.

Under the continuous running control, the inverter continues to run keeping the DC link bus voltage constant using the PI processor.

P (proportional) and I (integral) components of the PI processor are specified by H92 and H93, respectively.

For normal inverter operation, it is not necessary to modify data of H15, H92 or H93.



α	
22 kW or below	30 kW or above
10 V	20 V

Note

Even if you select "Trip after decelerate-to-stop" or "Continue to run," the inverter may not be able to do so when the load's inertia is small or the load is heavy, due to undervoltage caused by a control delay. In such a case, when "Trip after decelerate-to-stop" is selected, the inverter allows the motor to coast to a stop; when "Continue to run" is selected, the inverter saves the output frequency being applied when the undervoltage alarm occurred and restarts at the saved frequency after a recovery from the momentary power failure.

When the input power voltage for the inverter is high, setting the continuous running level high makes the control more stable even if the load's inertia is relatively small. Raising the continuous running level too high, however, might cause the continuous running control activated even during normal operation.

When the input power voltage for the inverter is extremely low, continuous running control might be activated even during normal operation, at the beginning of acceleration or at an abrupt change in load. To avoid this, lower the continuous running level. Lowering it too low, however, might cause undervoltage that results from voltage drop due to a control delay.

Before you change the continuous running level, make sure that the continuous running control will be performed properly, by considering the fluctuations of the load and the input voltage.

F15, F16	Frequency Limiter (High and Low)	H63 (Low Limiter, Mode selection)

■ Frequency Limiter (High and Low) (F15, F16)

F15 and F16 specify the upper and lower limits of the output frequency or reference frequency, respectively. The object to which the limit is applied differs depending on the control system.

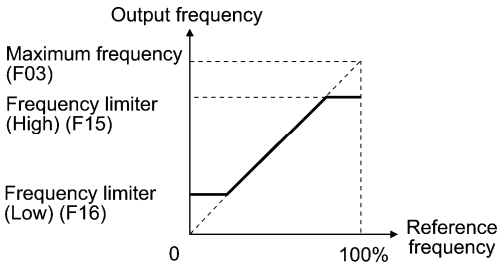
Frequency Limiter		Object to which the limit is applied	
Frequency Limiter (High)	F15	Output frequency	Reference speed (reference frequency)
Frequency Limiter (Low)	F16	Reference frequency	Reference speed (reference frequency)
Note	When the limit is applied to the reference frequency or reference speed, delayed responses of control may cause an overshoot or undershoot, and the frequency may temporarily go beyond the limit level.		

- Data setting range: 0.0 to 120.0 (Hz)

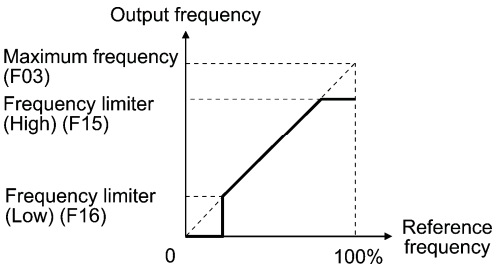
■ Low Limiter (Mode selection) (H63)

H63 specifies the operation to be carried out when the reference frequency drops below the low level specified by F16, as follows:

Data for H63	Operation
0	The output frequency will be held at the low level specified by F16.
1	The inverter decelerates to stop the motor.



(H63 = 0)



(H63 = 1)

Note

- When you change the frequency limiter (High) (F15) in order to raise the reference frequency, be sure to change the maximum frequency (F03) accordingly.
- Maintain the following relationship among the data for frequency control:

  F15 > F16, F15 > F23, and F15 > F25
  F03 > F16

  where, F23 and F25 specify the starting and stop frequencies, respectively.

  If you specify any wrong data for these function codes, the inverter may not run the motor at the desired speed, or cannot start it normally.

F18	Bias (Frequency command 1)	Refer to F01.

Refer to the description of F01.

F20 to F22 H95	DC Braking 1 (Braking starting frequency, Braking level and Braking time) DC Braking (Braking response mode)

These function codes specify the DC braking that prevents motor 1 from running by inertia during decelerate-to-stop operation.

If the motor enters a decelerate-to-stop operation by turning OFF the run command or by decreasing the reference frequency below the stop frequency, the inverter activates the DC braking by flowing a current at the braking level (F21) for the braking time (F22) when the output frequency goes down to the DC braking starting frequency (F20).

Setting the braking time to "OFF" disables the DC braking.

■ Braking starting frequency (F20)

F20 specifies the frequency at which the DC braking starts its operation during motor decelerate-to-stop state.

- Data setting range: 0.0 to 60.0 (Hz)

■ Braking level (F21)

F21 specifies the output current level to be applied when the DC braking is activated. The function code data should be set, assuming the rated output current of the inverter as 100%, in increments of 1%.

- Data setting range: 0 to 60 (%)

Note The inverter rated output current differs between the HD and MD/LD modes.

■ Braking time (F22)

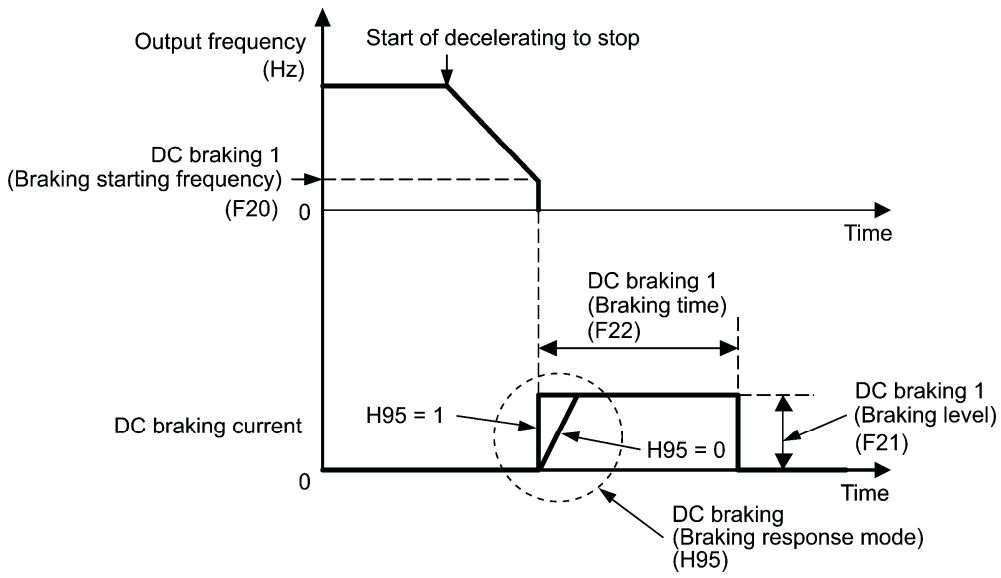
F22 specifies the braking period that activates DC braking.

- Data setting range: 0.01 to 30.00 (s)
  OFF (Disable)

■ Braking response mode (H95)

H95 specifies the DC braking response mode.

Data for H95	Characteristics	Note
0	Slow response. Slows the rising edge of the current, thereby preventing reverse rotation at the start of DC braking.	Insufficient braking torque may result at the start of DC braking.
1	Quick response. Quickens the rising edge of the current, thereby accelerating the build-up of the braking torque.	Reverse rotation may result depending on the moment of inertia of the mechanical load and the coupling mechanism.



Tip

It is also possible to use an external digital input signal as the terminal command ***DCBRK*** ("Enable DC braking").

As long as the ***DCBRK*** is ON, the inverter performs DC braking, regardless of the braking time specified by F22.

📖 For details about ***DCBRK***, refer to E01 through E07 (data = 13).

Turning the ***DCBRK*** ON even when the inverter is in a stopped state activates the DC braking. This feature allows the motor to be excited before starting, resulting in smoother acceleration (quicker build-up of acceleration torque).

Note

In general, specify data of function code F20 at a value close to the rated slip frequency of motor. If you set it at an extremely high value, control may become unstable and an overvoltage alarm may result in some cases.

⚠CAUTION
The DC braking function of the inverter does not provide any holding mechanism. **Injuries could occur.**

F23 to F25	Starting Frequency 1, Starting Frequency 1 (Holding time), and Stop Frequency

At the startup of an inverter, the initial output frequency is equal to the starting frequency. The inverter stops its output when the output frequency reaches the stop frequency.

Set the starting frequency to a level at which the motor can generate enough torque for startup. Generally, set the motor's rated slip frequency as the starting frequency.

■ Starting Frequency 1 (F23)

F23 specifies the starting frequency at the startup of an inverter.

- Data setting range: 0.1 to 60.0 (Hz)

■ Starting Frequency 1 (Holding time) (F24)

F24 specifies the holding time during which the inverter runs at the starting frequency 1 at the time of startup.

- Data setting range: 0.00 to 10.00 (s)

■ Stop Frequency (F25)

F25 specifies the stop frequency at the stop of the inverter.

- Data setting range: 0.1 to 60.0 (Hz)

Note If the starting frequency is lower than the stop frequency, the inverter does not output any power as long as the reference frequency does not exceed the stop frequency.

F26, F27	Motor Sound (Carrier frequency and Tone) H98 (Protection/Maintenance Function, Mode selection)

■ Motor Sound (Carrier frequency) (F26)

F26 controls the carrier frequency so as to reduce an audible noise generated by the motor or electromagnetic noise from the inverter itself, and to decrease a leakage current from the main output (secondary) wirings.

Item	Characteristics	Remarks
Carrier frequency	0.75 to 16 kHz	0.75 to 37 kW
	0.75 to 10 kHz	45 to 90 kW
	0.75 to 6 kHz	110 to 630 kW
	0.75 to 4 kHz	710 kW
Motor sound noise emission	High ↔ Low	
Motor temperature (due to harmonics components)	High ↔ Low	
Ripples in output current waveform	Large ↔ Small	
Leakage current	Low ↔ High	
Electromagnetic noise emission	Low ↔ High	
Inverter loss	Low ↔ High	

Note

Basically, do not change the carrier frequency from the default value (2 kHz). Increasing it requires derating of the output current. For details, refer to Chapter 2, Section 2.6 "Derating of Rated Output Current."

When a high carrier frequency is specified, the temperature of the inverter may rise due to an ambient temperature rise or an increase of the load. If it happens, the inverter automatically decreases the carrier frequency to prevent the inverter overload alarm **OLV**. With consideration for motor noise, the automatic reduction of carrier frequency can be disabled. Refer to the description of H98.

■ Motor Sound (Tone) (F27)

F27 changes the motor running sound tone. This setting is effective when the carrier frequency specified by function code F26 is 7 kHz or lower. Changing the tone level may reduce the high and harsh running noise from the motor.

Data for F27	Function
0	Disable (Tone level 0)
1	Enable (Tone level 1)
2	Enable (Tone level 2)
3	Enable (Tone level 3)

Note

If the tone level is set too high, the output current may become unstable, or mechanical vibration and noise may increase. Also, this function code may not be very effective for certain types of motor.

F29 to F31	Analog Output [FM1] (Mode selection, Voltage adjustment, Function) F35 ([FM2] (Function))

These function codes allow terminal [FM1] to output monitored data such as the output frequency and the output current in an analog DC voltage or current. The magnitude of such analog voltage or current is adjustable.

■ Mode selection (F29)

F29 specifies the output form of the terminal [FM1]. You need to set switch SW4 on the control printed circuit board (control PCB).

For details of the slide switches on the control PCB, refer to Chapter 2 "SPECIFICATIONS."

Data for F29	[FM1] output form	Position of slide switch SW4 mounted on the control PCB
0	Voltage (0 to +10 VDC)	VO1
1	Current (4 to +20 mA DC)	IO1
2	Current (0 to +20 mA DC)	IO1

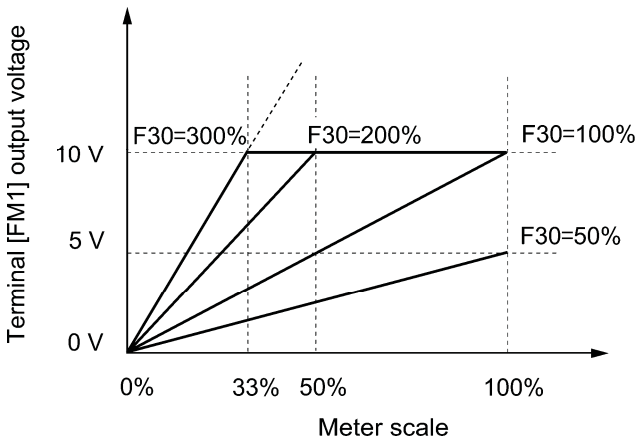
Note

The output current is not isolated from analog input, and does not have an isolated power supply. Therefore, if an electrical potential relationship between the inverter and peripheral equipment has been established, e.g., by connecting an analog, cascade connection of a current output device is not available.

Keep the connection wire length as short as possible.

■ Voltage adjustment (F30)

F30 allows you to adjust the output voltage within the range of 0 to 300%.



■ Function (F31, F35)

F31 or F35 specifies what is output to analog output terminal [FM1] or [FM2], respectively.

Data for F31, F35	[FM1] output	Function (Monitor the following)	Meter scale (Full scale at 100%)
0	Output frequency 1 (before slip compensation)	Output frequency of the inverter (Equivalent to the motor synchronous speed)	Maximum frequency (F03)
1	Output frequency 2 (after slip compensation)	Output frequency of the inverter	Maximum frequency (F03)
2	Output current	Output current (RMS) of the inverter	Twice the inverter rated current
3	Output voltage	Output voltage (RMS) of the inverter	500 V
4	Output torque	Motor shaft torque	Twice the rated motor torque
5	Load factor	Load factor (Equivalent to the indication of the load meter)	Twice the rated motor load
6	Input power	Input power of the inverter	Twice the rated output of the inverter
7	PID feedback amount	Feedback amount under PID control	100% of the feedback amount
9	DC link bus voltage	DC link bus voltage of the inverter	1000 V
10	Universal AO	Command via communications link (📖 Refer to the RS-485 Communication User's Manual.)	20000 as 100%
13	Motor output	Motor output (kW)	Twice the rated motor output
14	Calibration (+)	Full scale output for the meter calibration	This always outputs the full-scale (100%).
15	PID command (SV)	Command value under PID control	100% of the feedback amount
16	PID output (MV)	Output level of the PID processor under PID control (Frequency command)	Maximum frequency (F03)
18	Inverter heat sink temperature	Heat sink temperature inside the inverter unit	200°C
20	Reference frequency	Frequency command input to the inverter	Maximum frequency (F03)
50	PID feedback amount 1 (PV1)	Feedback amount under PID control	100% of the feedback amount
51	PID command 1 (SV1)	Command value 1 under PID control	100% of the feedback amount
52	PID deviation 1 (ERR1)	Deviation 1 under PID control (SV1 - PV1) (*1)	100% of the feedback amount
53	PID final deviation (ERR)	Final deviation under PID control (ERR1, ERR2) (*1)	100% of the feedback amount
54	PID feedback amount 2 (PV2)	Feedback amount 2 under PID control	100% of the feedback amount
55	PID command 2 (SV2)	Command value 2 under PID control	100% of the feedback amount
56	PID deviation 2 (ERR2)	Deviation 2 (SV2-PV2) under PID control (*1)	100% of the feedback amount
60	External PID feedback amount 1 (EPID1-PV)	Feedback amount under external PID control 1	100% of the feedback amount
61	External PID command 1 (EPID1-SV)	Command value under external PID control 1	100% of the feedback amount

Data for F31, F35	[FM1] output	Function (Monitor the following)	Meter scale (Full scale at 100%)
62	External PID deviation 1 (EPID1-ERR)	Deviation under external PID control 1 (*1)	100% of the feedback amount
63	External PID final deviation 1 (EPID-ERR)	Final deviation under external PID control 1 (*1)	100% of the feedback amount
65	External PID final output 1 (EPID1-OUT)	Final output under external PID control 1	100% of the feedback amount
70	External PID feedback amount 2 (EPID2-PV)	Feedback amount under external PID control 2	100% of the feedback amount
71	External PID command 2 (EPID2-SV)	Command value under external PID control 2	100% of the feedback amount
72	External PID deviation 2 (EPID2-ERR)	Deviation under external PID control 2 (*1)	100% of the feedback amount
75	External PID final output 2 (EPID2-OUT)	Final output under external PID control 2	100% of the feedback amount
80	External PID feedback amount 3 (EPID3-PV)	Feedback amount under external PID control 3	100% of the feedback amount
81	External PID command 3 (EPID3-SV)	Command value under external PID control 3	100% of the feedback amount
82	External PID deviation 3 (EPID3-ERR)	Deviation under external PID control 3 (*1)	100% of the feedback amount
85	External PID final output 3 (EPID3-OUT)	Final output under external PID control 3	100% of the feedback amount
111	Customizable logic output signal 1	--	100% of the feedback amount
112	Customizable logic output signal 2	--	100% of the feedback amount
113	Customizable logic output signal 3	--	100% of the feedback amount
114	Customizable logic output signal 4	--	100% of the feedback amount
115	Customizable logic output signal 5	--	100% of the feedback amount
116	Customizable logic output signal 6	--	100% of the feedback amount
117	Customizable logic output signal 7	--	100% of the feedback amount

(*1)Deviation output is supported only by option terminal [Ao]. (Function code o90)

F32, F34, F35	Pulse Output [FM2] (Mode selection, Voltage adjustment, Function)

These function codes allow terminal [FM2] to output monitored data such as the output frequency and the output current in an analog DC voltage or current. The magnitude of such analog voltage or current is adjustable.

■ Mode selection (F32)

F29 specifies the output form of the terminal [FM2]. You need to set switch SW6 on the control printed circuit board (control PCB).

For details of the slide switches on the control PCB, refer to Chapter 2 "SPECIFICATIONS."

Data for F32	[FM2] output form	Position of slide switch SW6 mounted on the control PCB
0	Voltage (0 to +10 VDC)	VO2
1	Current (4 to +20 mA DC)	IO2
2	Current (0 to +20 mA DC)	IO2

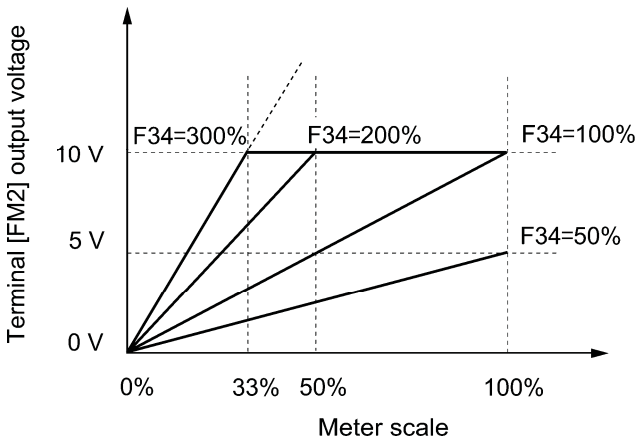
Note

The output current is not isolated from analog input, and does not have an isolated power supply. Therefore, if an electrical potential relationship between the inverter and peripheral equipment has been established, e.g., by connecting an analog, cascade connection of a current output device is not available.

Keep the connection wire length as short as possible.

■ Voltage adjustment (F34)

F34 allows you to adjust the output voltage within the range of 0 to 300%.



■ Function (F35)

F35 specifies what is output to analog output terminal [FM2]. The monitor objects are the same as for F31. Refer to the description of F31.

F37	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1 F09 (Torque Boost 1)

F09 specifies the torque boost level in order to assure sufficient starting torque.

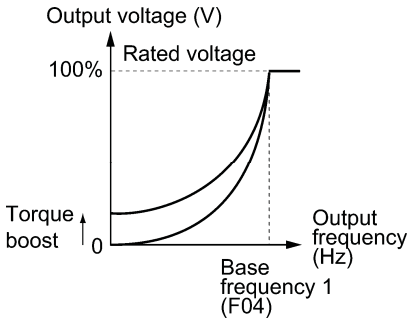
F37 specifies V/f pattern, torque boost type, and auto energy saving operation in accordance with the characteristics of the load.

Data for F37	V/f pattern	Torque boost	Auto energy saving	Applicable load
0	Variable torque V/f pattern	Torque boost specified by F09	Disable	Variable torque load (General-purpose fans and pumps)
1	Linear V/f pattern			Constant torque load
2		Auto torque boost		Constant torque load (To be selected if a motor may be over-excited at no load.)
3	Variable torque V/f pattern	Torque boost specified by F09	Enable	Variable torque load (General-purpose fans and pumps)
4	Linear V/f pattern			Constant torque load
5		Auto torque boost		Constant torque load (To be selected if a motor may be over-excited at no load.)

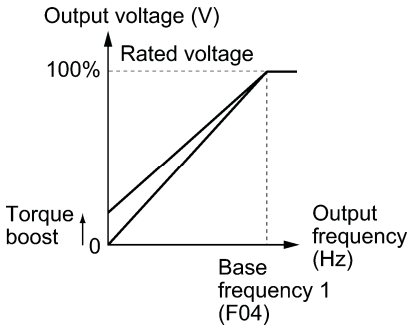
Note If a required "load torque + acceleration toque" is more than 50% of the motor rated torque, it is recommended to select the linear V/f pattern (factory default).

■ V/f characteristics

The Jaguar VXH series of inverters offer a variety of V/f patterns and torque boosts, which include V/f patterns suitable for variable torque load such as general fans and pumps and for constant torque load (including special pumps requiring high starting torque). Two types of torque boosts are available: manual and automatic.



Variable torque V/f pattern (F37 = 0)

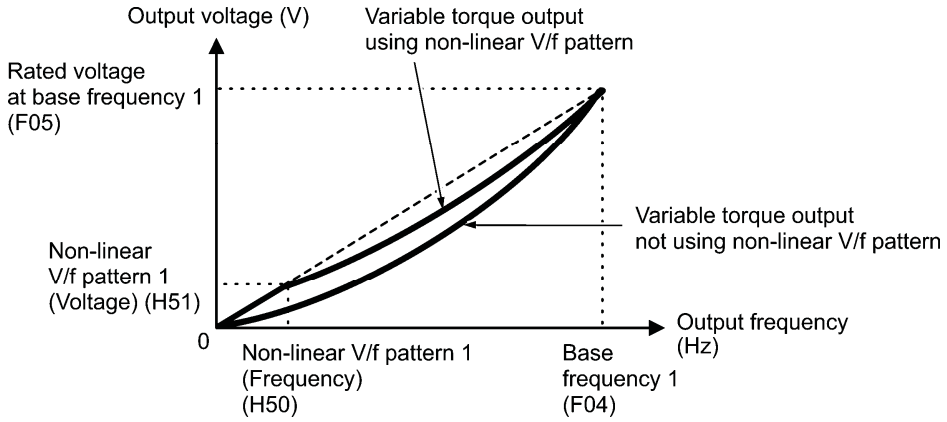


Linear V/f pattern (F37 = 1)

Tip

When the variable torque V/f pattern is selected (F37 = 0 or 3), the output voltage may be low at a low frequency zone, resulting in insufficient output torque, depending on the characteristics of the motor and load. In such a case, it is recommended to increase the output voltage at the low frequency zone using the non-linear V/f pattern.

Recommended value: H50 = 1/10 of the base frequency
H51 = 1/10 of the voltage at base frequency



■ Torque boost

• Manual torque boost (F09)

- Data setting range: 0.0 to 20.0 (%), (100%/Rated voltage at base frequency)

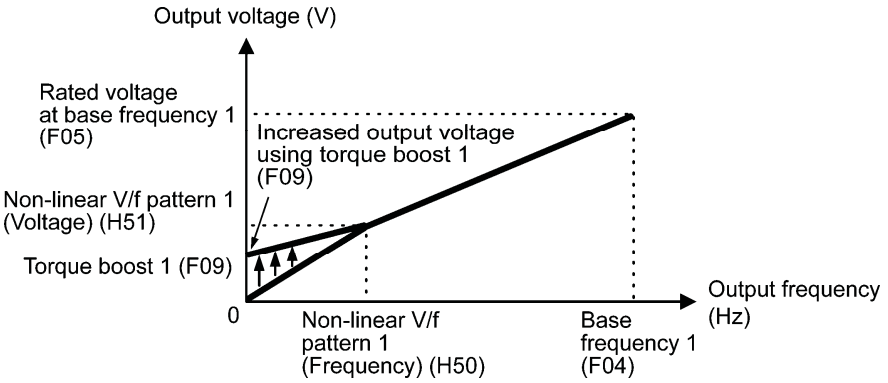
In torque boost using F09, constant voltage is added to the basic V/f pattern, regardless of the load. To secure a sufficient starting torque, manually adjust the output voltage to optimally match the motor and its load by using F09. Specify an appropriate level that guarantees smooth start-up and yet does not cause over-excitation at no or light load.

Torque boost using F09 ensures high driving stability since the output voltage remains constant regardless of the load fluctuation.

Specify the F09 data in percentage to the rated voltage at base frequency 1 (F05). At factory shipment, F09 is preset to a level that assures approx. 50% of starting torque.

Note

- Specifying a high torque boost level will generate a high torque, but may cause overcurrent due to over-excitation at no load. If you continue to drive the motor, it may overheat. To avoid such a situation, adjust torque boost to an appropriate level.
- When the non-linear V/f pattern and the torque boost are used together, the torque boost takes effect below the frequency on the non-linear V/f pattern's point.



• Auto torque boost

This function automatically optimizes the output voltage to fit the motor with its load. Under light load, auto torque boost decreases the output voltage to prevent the motor from over-excitation. Under heavy load, it increases the output voltage to increase the output torque of the motor.

Note

- Since this function relies also on the characteristics of the motor, set the base frequency 1 (F04), the rated voltage at base frequency 1 (F05), and other pertinent motor parameters (P01 through P03 and P06 through P99) in line with the motor capacity and characteristics, or else perform auto-tuning (P04).
- When a special motor is driven or the load does not have sufficient rigidity, the maximum torque might decrease or the motor operation might become unstable. In such cases, do not use auto torque boost but choose manual torque boost using F09 (F37 = 0 or 1).

■ Auto energy saving operation

This feature automatically controls the supply voltage to the motor to minimize the total power loss of motor and inverter. (Note that this feature may not be effective depending upon the motor or load characteristics. Check the advantage of energy saving before you actually apply this feature to your machinery.)

Auto energy saving operation applies only to constant speed operation. During acceleration/deceleration, torque boost specified by F09 or auto torque boost applies depending upon the setting of F37.

If auto energy saving operation is enabled, the response to a motor speed change from constant speed operation may be slow. Do not use this feature for such machinery that requires quick acceleration/deceleration.

Note

- Use auto energy saving only where the base frequency is 60 Hz or lower. If the base frequency is set at 60 Hz or higher, you may get a little or no energy saving advantage. The auto energy saving operation is designed for use with the frequency lower than the base frequency. If the frequency becomes higher than the base frequency, the auto energy saving operation will be invalid.
- Since this function relies also on the characteristics of the motor, set the base frequency 1 (F04), the rated voltage at base frequency 1 (F05), and other pertinent motor parameters (P01 through P03 and P06 through P99) in line with the motor capacity and characteristics, or else perform auto-tuning (P04).

F40, F41	Torque Limiter 1 (Driving, Braking) E16 and E17 (Torque Limiter 2 (Driving, Braking)) H76 (Torque Limiter for Braking, Frequency increment limit)

If the inverter's output torque exceeds the specified levels of the torque limiters (F40, F41, E16 and E17), the inverter controls the output frequency and limits the output torque for preventing a stall.

To use the torque limiters, it is necessary to configure the function codes listed in the table below.

Note In braking, the inverter increases the output frequency to limit the output torque. Depending on the conditions during operation, the output frequency could dangerously increase. H76 (Frequency increment limit) is provided to limit the increasing frequency component.

■ Torque limiters 1 and 2 (F40, F41, E16 and E17)

Data setting range: 20 to 150 (%), OFF (Disable)

These function codes specify the operation level at which the torque limiters become activated, as the percentage of the motor rated torque.

Function code	Name	Torque limit feature
F40	Torque limiter 1 (Driving)	Driving torque current limiter 1
F41	Torque limiter 1 (Braking)	Braking torque current limiter 1
E16	Torque limiter 2 (Driving)	Driving torque current limiter 2
E17	Torque limiter 2 (Braking)	Braking torque current limiter 2

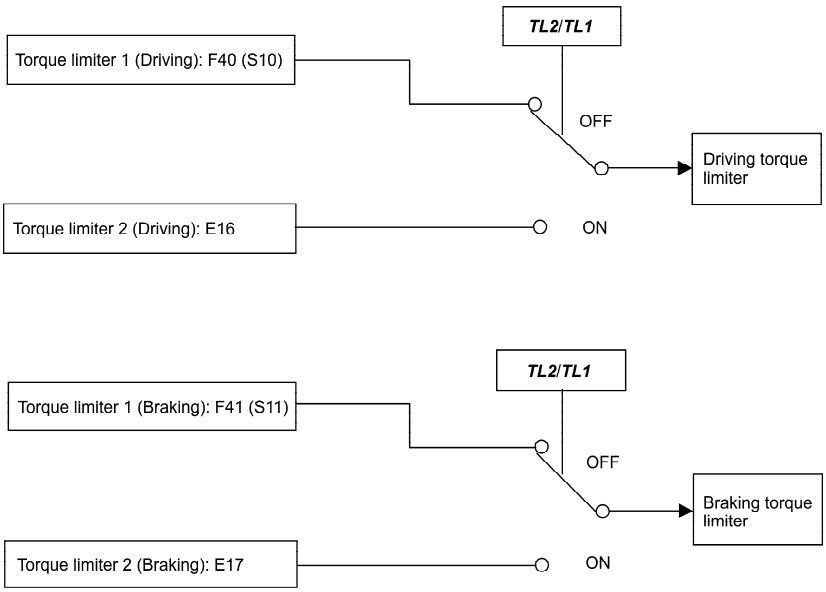
■ Torque limiter levels specified via communications link (S10, S11)

The torque limiter levels can be changed via the communications link. Function codes S10 and S11 exclusively reserved for the communications link respond to function codes F40 and F41.

■ Switching torque limiters

The torque limiters can be switched by the function code setting and the terminal command *TL2/TL1* ("Select torque limiter level 2/1") assigned to any of the digital input terminals.

To assign the *TL2/TL1* as the terminal function, set any of E01 through E07 to "14." If no *TL2/TL1* is assigned, torque limiter level 1 (F40 and F41) take effect by default.



■ Torque limiter for braking (Frequency increment limit) (H76)

Data setting range: 0.0 to 120.0 (Hz)

H76 specifies the increment limit of the frequency in limiting torque for braking. The factory default is 5.0 Hz. If the increasing frequency during braking reaches the limit value, the torque limiters no longer function, resulting in an overvoltage trip. Such a problem may be avoided by increasing the setting value of H76.

Note

The torque limiter and current limiter are very similar in function. If both are activated concurrently, they may conflict with each other and cause hunting (undesirable oscillation of the system). Avoid concurrent activation of these limiters.

F42	Drive Control Selection 1	H68 (Slip Compensation 1, Operating conditions)

F42 specifies the motor drive control.

Data for F42	Drive control	Basic control	Speed feedback	Speed control
0	V/f control with slip compensation inactive	V/f control	Disable	Frequency control
1	Dynamic torque vector control (with slip compensation and auto torque boost)			Frequency control with slip compensation
2	V/f control with slip compensation active			

■ V/f control with slip compensation inactive

Under this control, the inverter controls a motor with the voltage and frequency according to the V/f pattern specified by function codes. This control disables all automatically controlled features such as the slip compensation, so no unpredictable output fluctuation occurs, enabling stable operation with constant output frequency.

■ V/f control with slip compensation active

Applying any load to an induction motor causes a rotational slip due to the motor characteristics, decreasing the motor rotation. The inverter's slip compensation function first presumes the slip value of the motor based on the motor torque generated and raises the output frequency to compensate for the decrease in motor rotation. This prevents the motor from decreasing the rotation due to the slip.

That is, this function is effective for improving the motor speed control accuracy.

Function code		Operation
P12	Rated slip frequency	Specify the rated slip frequency.
P10	Slip compensation response time	Specify the slip compensation response time. Basically, there is no need to modify the default setting.

To improve the accuracy of slip compensation, perform auto-tuning.

H68 enables or disables the slip compensation function according to the motor driving conditions.

Data for H68	Motor driving conditions		Motor driving frequency zone	
	Accel/Decel	Constant speed	Base frequency or below	Above the base frequency
0	Enable	Enable	Enable	Enable
1	Disable	Enable	Enable	Enable
2	Enable	Enable	Enable	Disable
3	Disable	Enable	Enable	Disable

■ Dynamic torque vector control

To get the maximal torque out of a motor, this control calculates the motor torque matched to the load applied and uses it to optimize the voltage and current vector output.

Selecting this control automatically enables the auto torque boost and slip compensation function so that it is effective for improving the system response to external disturbances such as load fluctuation, and the motor speed control accuracy.

Note that the inverter may not respond to a rapid load fluctuation since this control is an open-loop V/f control that does not perform current control, unlike vector control. Other advantage of this control is that the maximum torque per output current is larger than that of vector control.

Note

Since slip compensation and dynamic torque vector control use motor parameters, the following conditions should be satisfied to obtain full control performance.

- A single motor is controlled per inverter.
- Motor parameters P02, P03, P06 to P12 are properly configured. Or, auto-tuning (P04) is performed.
- Under dynamic torque vector control, the capacity of the motor to be controlled is two or more ranks lower than that of the inverter. Otherwise, the inverter may not control the motor due to decrease of the current detection resolution.
- The wiring distance between the inverter and motor is 50 m or less. If it is longer, the inverter may not control the motor due to leakage current flowing through stray capacitance to the ground or between wires. Especially, small capacity inverters whose rated current is also small may be unable to control the motor correctly even if the wiring is less than 50 m. In that case, make the wiring length as short as possible or use a wire with small stray capacitance (e.g., loosely-bundled cable) to minimize the stray capacitance.

F43, F44	Current Limiter (Mode selection and Level) H12 (Instantaneous Overcurrent Limiting, Mode selection)

When the output current of the inverter exceeds the level specified by the current limiter (F44), the inverter automatically manages its output frequency to prevent a stall and limits the output current. The default of the current limiter level is 120%. Do not change the factory default except when necessary.

The current limiter mode is selected with F43. If F43 = 1, the current limiter is enabled only during constant speed operation. If F43 = 2, it is enabled during both of acceleration and constant speed operation. Choose F43 = 1 if you need to run the inverter at full capability during acceleration and to limit the output current during constant speed operation.

■ Mode selection (F43)

F43 selects the motor running state in which the current limiter becomes activated.

Data for F43	Running states that enable the current limiter		
	During acceleration	During constant speed	During deceleration
0	Disable	Disable	Disable
1	Disable	Enable	Disable
2	Enable	Enable	Disable

■ Level (F44)

F44 specifies the operation level at which the output current limiter becomes activated, in ratio to the inverter rating.

- Data setting range: 20 to 120 (%) (in ratio to the inverter rating)

■ Instantaneous Overcurrent Limiting (Mode selection) (H12)

H12 specifies whether the inverter invokes the current limit processing or enters the overcurrent trip when its output current exceeds the instantaneous overcurrent limiting level. Under the current limit processing, the inverter immediately turns OFF its output gate to suppress the further current increase and continues to control the output frequency.

Data for H12	Function
0	Disable An overcurrent trip occurs at the instantaneous overcurrent limiting level.
1	Enable

If any problem could occur when the motor torque temporarily drops during current limiting processing, it is necessary to cause an overcurrent trip (H12 = 0) and actuate a mechanical brake at the same time.

Note

- Since the current limit operation with F43 and F44 is performed by software, it may cause a delay in control. If you need a quick response current limiting, also enable the instantaneous overcurrent limiting with H12.

Note

- If an excessive load is applied when the current limiter operation level is set extremely low, the inverter will rapidly lower its output frequency. This may cause an overvoltage trip or dangerous turnover of the motor rotation due to undershooting. Depending on the load, extremely short acceleration time may activate the current limiting to suppress the increase of the inverter output frequency, causing hunting (undesirable oscillation of the system) or activating the inverter overvoltage trip (alarm OU). When specifying the acceleration time, therefore, you need to take into account machinery characteristics and moment of inertia of the load.
- The torque limiter and current limiter are very similar in function. If both are activated concurrently, they may conflict with each other and cause hunting. Avoid concurrent activation of these limiters.

5.1.2 E codes (Extension terminal functions)

E01 to E07	Terminal [X1] to [X7] Functions E98 and E99 (Terminal [FWD] and [REV] Functions)

E01 to E07, E98 and E99 assign commands (listed below) to general-purpose, programmable, digital input terminals, [X1] to [X7], [FWD], and [REV].

These function codes can also switch the logic system between normal and negative to define how the inverter logic interprets the ON or OFF state of each terminal. The factory default setting is normal logic system "Active ON." So, descriptions that follow are given in normal logic system. They are, in principle, arranged in the numerical order of assigned data. However, highly relevant signals are collectively described where one of them first appears. Refer to the function codes in the "Related function codes" column, if any.

⚠CAUTION

- Ensure safety before modifying the function code settings.
  Run commands (e.g., "Run forward" ***FWD*** and "Fire mode" ***FMS***), stop commands (e.g., "Coast to a stop" ***BX***), and frequency change commands can be assigned to digital input terminals. Depending upon the assignment states of those terminals, modifying the function code setting may cause a sudden motor start or an abrupt change in speed.
- When the inverter is controlled with the digital input signals, switching run or frequency command sources with the related terminal commands (e.g., ***SS1***, ***SS2***, ***SS4***, ***SS8***, ***Hz2/Hz1***, ***Hz/PID***, ***IVS***, ***LE*** and ***FMS***) may cause a sudden motor start or an abrupt change in speed.

An accident or physical injury may result.

Function code data		Terminal commands assigned	Symbol	Related function codes
Active ON	Active OFF			
0	1000	Select multistep frequency (0 to 15 steps)	***SS1***	C05 to C19
1	1001		***SS2***	
2	1002		***SS4***	
3	1003		***SS8***	
4	1004	Select ACC/DEC time (2 steps)	***RT1***	F07, F08, E10 to E15
5	1005	Select ACC/DEC time (4 steps)	***RT2***	
6	1006	Enable 3-wire operation	***HLD***	F02
7	1007	Coast to a stop	***BX***	—
8	1008	Reset alarm	***RST***	—
1009	9	Enable external alarm trip	***THR***	—
11	1011	Select frequency command 2/1	***Hz2/Hz1***	F01, C30
13	—	Enable DC braking	***DCBRK***	F20 to F22
14	1014	Select torque limiter level 2/1	***TL2/TL1***	F40, F41, E16, E17
15	—	Switch to commercial power (50 Hz)	***SW50***	—
16	—	Switch to commercial power (60 Hz)	***SW60***	—
17	1017	UP (Increase output frequency)	***UP***	Frequency setting: F01, C30 PID command: J101, J201
18	1018	DOWN (Decrease output frequency)	***DOWN***	
19	1019	Enable data change with keypad	***WE-KP***	F00
20	1020	Cancel PID control	***Hz/PID***	J101 to J131 J201 to J231

Function code data		Terminal commands assigned	Symbol	Related function codes
Active ON	Active OFF			
21	1021	Switch normal/inverse operation	***IVS***	J101, J201
22	1022	Interlock	***IL***	F14
24	1024	Enable communications link via RS-485 or fieldbus (option)	***LE***	H30, y98
25	1025	Universal DI	***U-DI***	—
26	1026	Enable auto search for idling motor speed at starting	***STM***	H09
1030	30	Force to stop	***STOP***	F07, H56
33	1033	Reset PID integral and differential components	***PID-RST***	J101 to J131 J201 to J231
34	1034	Hold PID integral component	***PID-HLD***	
35	1035	Select local (keypad) operation	***LOC***	(See Section 5.5.4.)
38	1038	Enable run commands	***RE***	
39	—	Protect motor from dew condensation	***DWP***	J21
40	—	Enable integrated sequence to switch to commercial power (50 Hz)	***ISW50***	J22
41	—	Enable integrated sequence to switch to commercial power (60 Hz)	***ISW60***	
58	1058	Reset UP/DOWN frequency	***STZ***	F01, H61
72	1072	Count the run time of commercial power-driven motor 1	***CRUN-M1***	H44, H94
80	1080	Cancel customizable logic	***CLC***	E01 to E07 U81 to U87
81	1081	Clear all customizable logic timers	***CLTC***	
87	1087	Run command 2/1	***FR2/FR1***	
88	—	Run forward 2	***FWD2***	
89	—	Run reverse 2	***REV2***	
98	—	Run forward	***FWD***	F02
99	—	Run reverse	***REV***	F02
100	—	No function assigned	***NONE***	
131	1131	Flowrate switch	***FS***	J163 to J166
132	1132	Filter clogging reverse rotation command	***FRC***	J188 to J195
133	1133	Switch PID channel	***PID2/1***	J101, J201
134	—	Switch to fire mode	***FMS***	H116 to H121
171	1171	PID multistep command	***PID-SS1***	J136 to J138
172	1172	PID multistep command	***PID-SS2***	
181	1181	External PID multistep command	***EPID-SS1***	J550 to J553
182	1182	External PID multistep command	***EPID-SS2***	
190	1190	Cancel timer	***TMC***	T01 to T19
191	1191	Enable timer 1	***TM1***	T01 to T04
192	1192	Enable timer 2	***TM2***	T06 to T09
193	1193	Enable timer 3	***TM3***	T11 to T14
194	1194	Enable timer 4	***TM4***	T16 to T19

Function code data		Terminal commands assigned	Symbol	Related function codes
Active ON	Active OFF			
201	1201	External PID control 1 ON command	***EPID1-ON***	J501
202	1202	Cancel external PID control 1	***%/EPID1***	J501 to J540
203	1203	Switch normal/inverse operation under external PID control 1	***EPID1-IVS***	
204	1204	Reset external PID 1 integral and differential components	***EPID1-RST***	J501 to J540
205	1205	Hold external PID 1 integral component	***EPID1-HLD***	
211	1211	External PID control 2 ON command	***EPID2-ON***	J601
212	1212	Cancel external PID control 2	***%/EPID2***	J601 to J640
213	1213	Switch normal/inverse operation under external PID control 2	***EPID2-IVS***	
214	1214	Reset external PID 2 integral and differential components	***EPID2-RST***	J601 to J640
215	1215	Hold external PID 2 integral component	***EPID2-HLD***	
221	1221	External PID control 3 ON command	***EPID3-ON***	J651
222	1222	Cancel external PID control 3	***%/EPID3***	J651 to J690
223	1223	Switch normal/inverse operation under external PID control 3	***EPID3-IVS***	
224	1224	Reset external PID 3 integral and differential components	***EPID3-RST***	J651 to J690
225	1225	Hold external PID 3 integral component	***EPID3-HLD***	

Note

Any negative logic (Active OFF) command cannot be assigned to the functions marked with "—" in the "Active OFF" column.

The "Enable external alarm trip" (data = 1009) and "Force to stop" (data = 1030) are fail-safe terminal commands. In the case of "Enable external alarm trip," when data = 1009, "Active ON" (alarm is triggered when ON); when data = 9, "Active OFF" (alarm is triggered when OFF).

Terminal function assignment and data setting

■ Select multistep frequency (0 to 15 steps) -- ***SS1***, ***SS2***, ***SS4***, and ***SS8***
(Function code data = 0, 1, 2, and 3)

The combination of the ON/OFF states of digital input signals *SS1*, *SS2*, *SS4* and *SS8* selects one of 16 different frequency commands defined beforehand by 15 function codes C05 to C19 (Multistep frequency 0 to 15). With this, the inverter can drive the motor at 16 different preset frequencies.

🕮 Refer to C05 through C19.

■ Select ACC/DEC time -- ***RT1*** and ***RT2*** (Function code data = 4 and 5)

These terminal commands switch between ACC/DEC time 1 to 4 (F07, F08 and E10 through E15).

🕮 Refer to F07 and F08.

■ Enable 3-wire operation -- ***HLD*** (Function code data = 6)

Turning this terminal command ON self-holds the forward *FWD* or reverse *REV* run command, to enable 3-wire inverter operation.

🕮 Refer to F02.

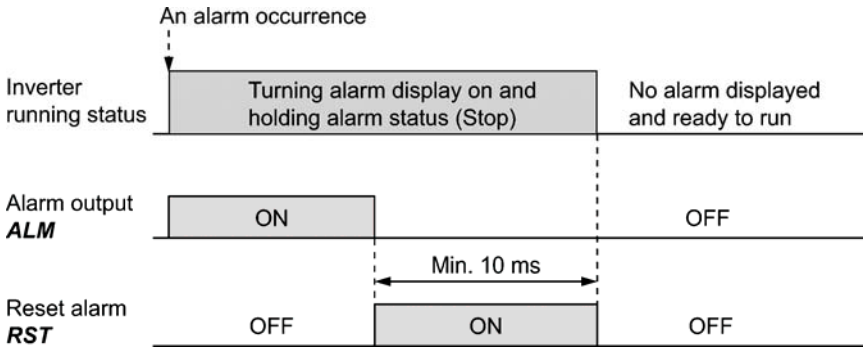
■ Coast to a stop -- ***BX*** (Function code data = 7)

Turning this terminal command ON immediately shuts down the inverter output so that the motor coasts to a stop, without issuing any alarms.

■ Reset alarm -- ***RST*** (Function code data = 8)

Turning this terminal command ON clears the *ALM* state--alarm output (for any alarm). Turning it OFF erases the alarm display and clears the alarm hold state.

When you turn the *RST* command ON, keep it ON for 10 ms or more. This command should be kept OFF for the normal inverter operation.



■ Enable external alarm trip -- ***THR*** (Function code data = 9)

Turning this terminal command OFF immediately shuts down the inverter output (so that the motor coasts to a stop), displays the alarm OH2, and issues the alarm output (for any alarm) *ALM*. The *THR* command is self-held, and is reset when an alarm reset takes place.

Tip: Use this alarm trip command from external equipment when you have to immediately shut down the inverter output in the event of an abnormal situation in peripheral equipment.

■ Select frequency command 2/1 -- ***Hz2***/***Hz1*** (Function code data = 11)

Turning this terminal command ON and OFF switches the frequency command source between frequency command 1 (F01) and frequency command 2 (C30).

🕮 Refer to F01.

■ Enable DC braking -- ***DCBRK*** (Function code data = 13)

This terminal command gives the inverter a DC braking command through the inverter's digital input.

(Requirements for DC braking must be satisfied.)

🕮 Refer to F20 through F22.

■ Select torque limiter level 2/1 -- ***TL2***/***TL1*** (Function code data = 14)

This terminal command switches between torque limiter 1 (F40 and F41) and torque limiter 2 (E16 and E17).

🕮 Refer to F40 and F41.

■ Switch to commercial power for 50 Hz or 60 Hz -- ***SW50*** and ***SW60*** (Function code data = 15 and 16)

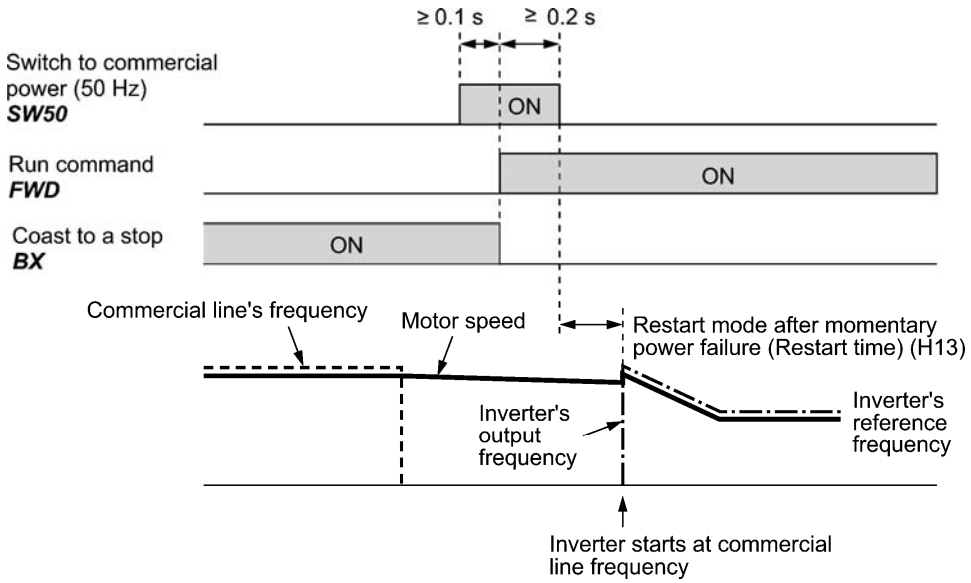
When an external sequence switches the motor drive power from the commercial line to the inverter, the terminal command ***SW50*** or ***SW60*** enables the inverter to start running the motor with the current commercial power frequency, regardless of settings of the reference/output frequency in the inverter. A running motor driven by commercial power is carried on into inverter operation. This command helps you smoothly switch the motor drive power source from the commercial power to the inverter.

For details, refer to the table below, the operation scheme and an example of external sequence and its operation time scheme on the following pages.

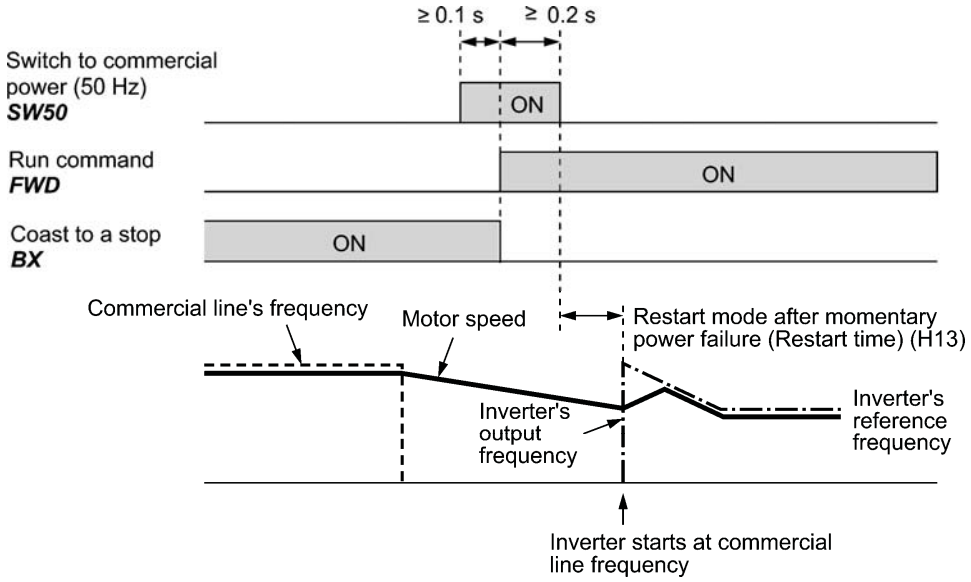
Assignment	The inverter:	Description
SW50	Starts at 50 Hz.	Note Do not concurrently assign both ***SW50*** and ***SW60***.
SW60	Starts at 60 Hz.	

Operation Schemes

・When the motor speed remains almost the same during coast-to-stop:



・When the motor speed decreases significantly during coast-to-stop (with the current limiter activated):

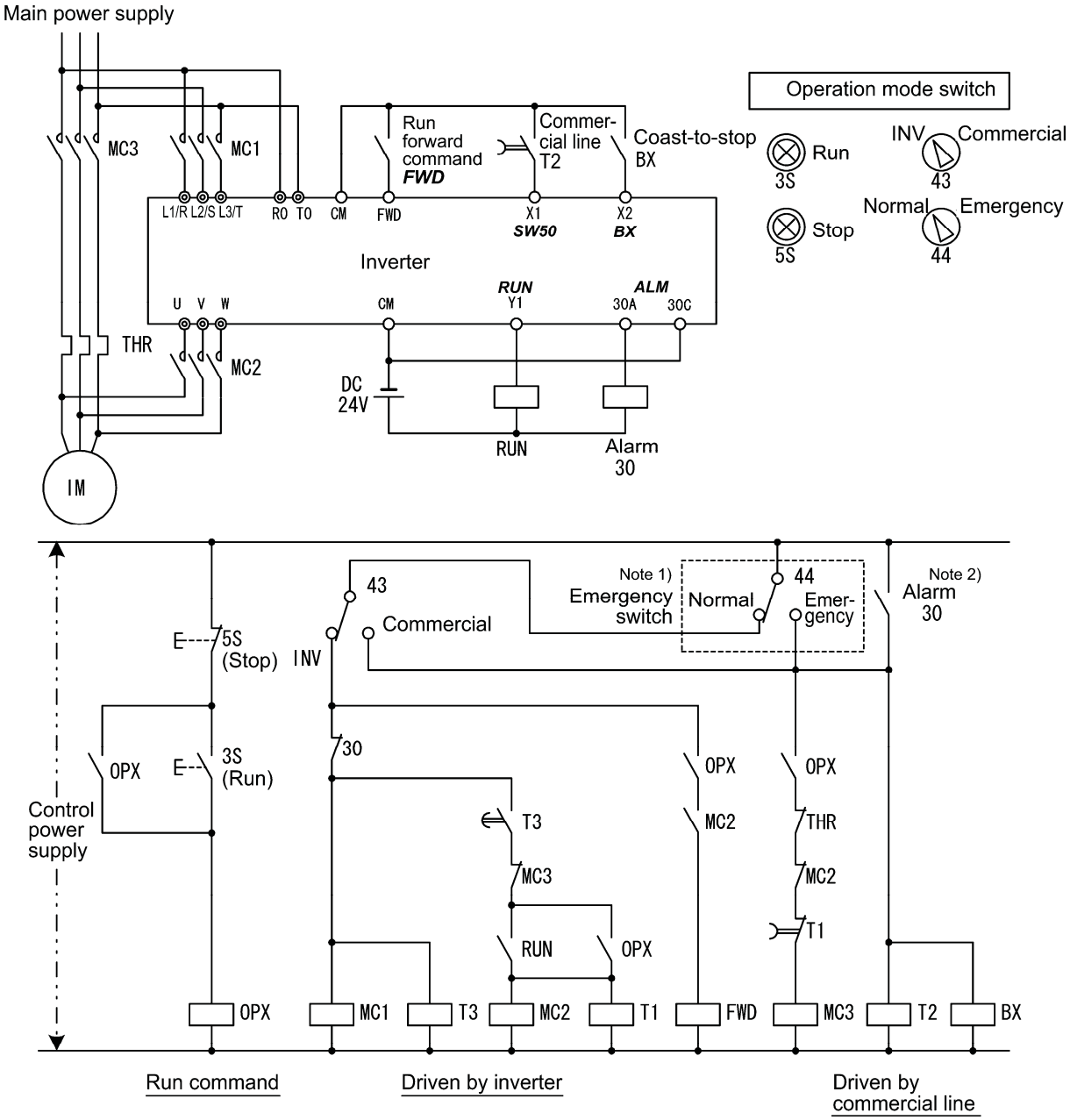


Note

- Secure more than 0.1 second after turning ON the "Switch to commercial power" signal before turning ON a run command.
- Secure more than 0.2 second of an overlapping period with both the "Switch to commercial power" signal and run command being ON.
- If an alarm has been issued or ***BX*** has been ON when the motor drive source is switched from the commercial power to the inverter, the inverter will not be started at the commercial power frequency and will remain OFF. After the alarm has been reset or ***BX*** turned OFF, operation at the frequency of the commercial power will not be continued, and the inverter will be started at the ordinary starting frequency.

  If you wish to switch the motor drive source from the commercial line to the inverter, be sure to turn ***BX*** OFF before the "Switch to commercial power" signal is turned OFF.
- When switching the motor drive source from the inverter to commercial power, adjust the inverter's reference frequency at or slightly higher than that of the commercial power frequency beforehand, taking into consideration the motor speed down during the coast-to-stop period produced by switching.
- Note that when the motor drive source is switched from the inverter to the commercial power, a high inrush current will be generated, because the phase of the commercial power usually does not match the motor speed at the switching. Make sure that the power supply and all the peripheral equipment are capable of withstanding this inrush current.
- If you have enabled "Restart after momentary power failure" (F14 = 3, 4, or 5), keep ***BX*** ON during commercial power driven operation to prevent the inverter from restarting after a momentary power failure.

Example of Sequence Circuit

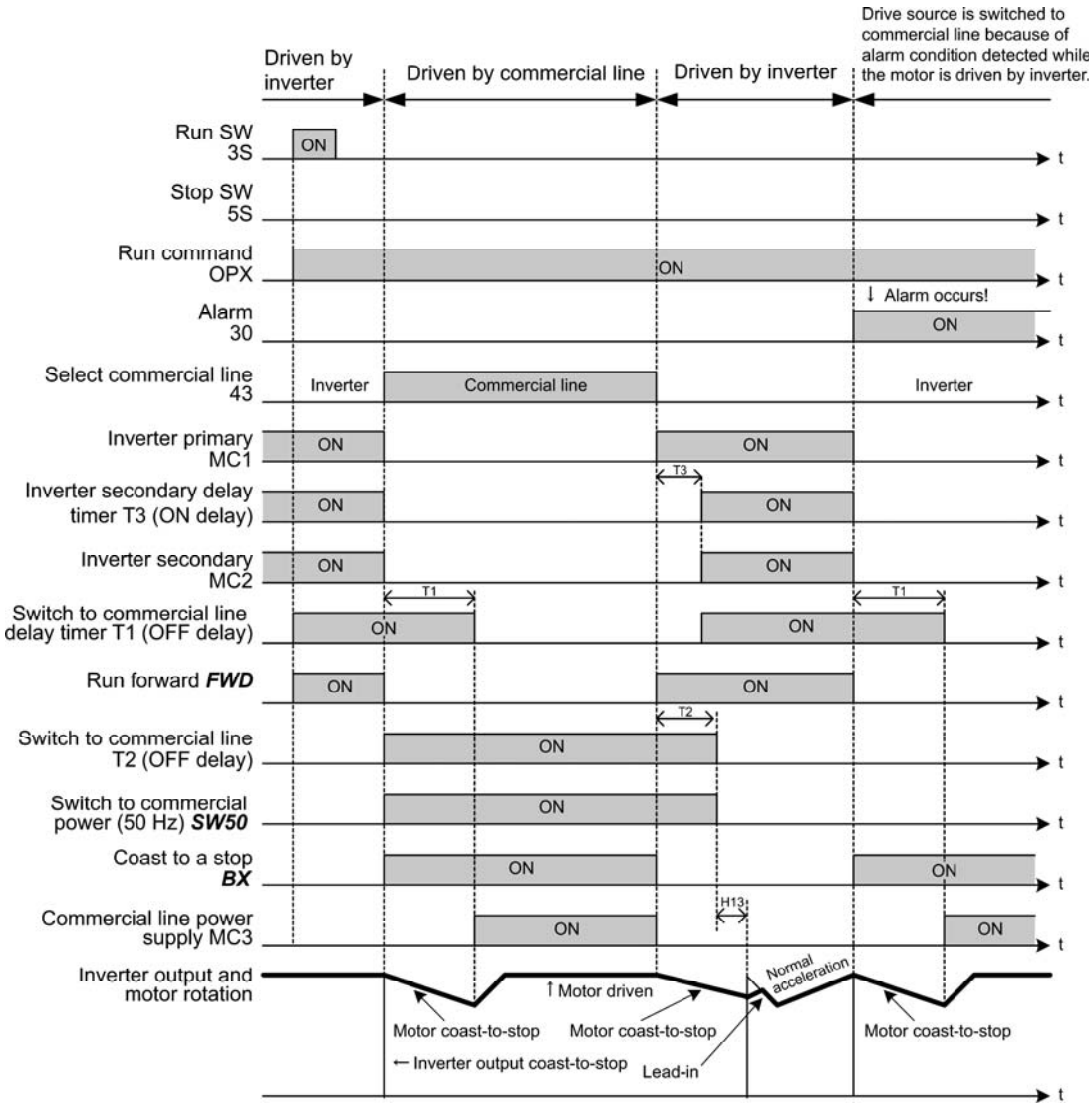


Note 1) Emergency switch

Manual switch provided for the event that the motor drive source cannot be switched normally to the commercial power due to a serious problem of the inverter

Note 2) When any alarm has occurred inside the inverter, the motor drive source will automatically be switched to the commercial power.

Example of Operation Time Scheme



Tip

Alternatively, you may use the integrated sequence by which some of the actions above are automatically performed by the inverter itself. For details, refer to the description of ***ISW50*** and ***ISW60***.

■ UP (Increase output frequency) and DOWN (Decrease output frequency) commands -- ***UP*** and ***DOWN*** (Function code data = 17 and 18)

・Frequency setting

Turning the terminal command *UP* or *DOWN* ON causes the output frequency to increase or decrease, respectively, within the range from 0 Hz to the maximum frequency.

🕮 Refer to F01 (data = 7).

・PID command

Turning the terminal command *UP* or *DOWN* ON causes the PID command value to increase or decrease, respectively, within the range from 0 to 100%.

🕮 Refer to J102 (data = 3).

■ Enable data change with keypad -- ***WE-KP*** (Function code data = 19)

Turning the terminal command *WE-KP* OFF protects function code data from accidentally getting changed by pressing the keys on the keypad.

Only when this terminal command is ON, you can change function code data from the keypad.

🕮 Refer to F00.

■ Cancel PID control -- ***Hz/PID*** (Function code data = 20)

Turning this terminal command ON disables PID control.

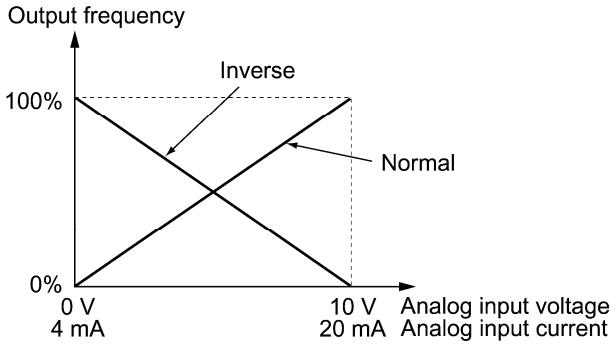
If the PID control is disabled with this command, the inverter runs the motor with the reference frequency manually set by any of the multistep frequency, keypad, analog input, etc.

Terminal command ***Hz/PID***	Function
OFF	Enable PID control
ON	Disable PID control/Enable manual settings

🕮 Refer to J101 through J131 and J201 through J231.

■ Switch normal/inverse operation -- ***IVS*** (Function code data = 21)

This terminal command switches the output frequency control between normal (proportional to the input value) and inverse in analog frequency setting or under PID process control. To select the inverse operation, turn the *IVS* ON.



Tip

The normal/inverse switching operation is useful for air-conditioners that require switching between cooling and heating. In cooling, the speed of the fan motor (output frequency of the inverter) is increased to lower the temperature. In heating, it is reduced to lower the temperature. This switching is realized by the ***IVS***.

• When the inverter is driven by an external analog frequency command sources (terminals [12], [C1] and [V2]):

Switching normal/inverse operation can apply only to the analog frequency command sources (terminals [12], [C1] and [V2]) in frequency command 1 (F01) and does not affect frequency command 2 (C30) or UP/DOWN control.

As listed below, the combination of the "Selection of normal/inverse operation for frequency command 1" (C53) and the terminal command *IVS* determines the final operation.

Combination of C53 and ***IVS***

Data for C53	***IVS***	Final operation
0: Normal operation	OFF	Normal
	ON	Inverse
1: Inverse operation	OFF	Inverse
	ON	Normal

• When process control is performed by the PID processor integrated in the inverter:

The terminal command *Hz/PID* ("Cancel PID control") can switch PID control between enabled (process is to be controlled by the PID processor) and disabled (process is to be controlled by the manual frequency setting). In either case, the combination of the "PID control" (J101, J201) or "Selection of normal/inverse operation for frequency command 1" (C53) and the terminal command *IVS* determines the final operation as listed below.

When PID control is enabled:

The normal/inverse operation selection for the PID processor output (reference frequency) is as follows.

PID control (Mode selection) (J101, J201)	*IVS*	Final operation
1: Enable (normal operation)	OFF	Normal
	ON	Inverse
2: Enable (inverse operation)	OFF	Inverse
	ON	Normal

When PID control is disabled:

The normal/inverse operation selection for the manual reference frequency is as follows.

Selection of normal/inverse operation for frequency command 1 (C53)	*IVS*	Final operation
0: Normal operation	–	Normal
1: Inverse operation	–	Inverse

Note

When process control is performed by the PID control facility integrated in the inverter, the *IVS* is used to switch the PID processor output (reference frequency) between normal and inverse, and has no effect on any normal/inverse operation selection of the manual frequency setting.

🕮 Refer to the descriptions of J101 through J138 and J201 through J231.

■ Interlock -- *IL* (Function code data = 22)

In a configuration where a magnetic contactor (MC) is installed in the power output (secondary) circuit of the inverter, the momentary power failure detection feature provided inside the inverter may not be able to accurately detect a momentary power failure by itself. Using a digital signal input with the interlock command *IL* assures the accurate detection.

🕮 Refer to F14.

Terminal command *IL*	Meaning
OFF	No momentary power failure has occurred.
ON	A momentary power failure has occurred. (Restart after a momentary power failure enabled)

■ Enable communications link via RS-485 or fieldbus (option)
-- *LE* (Function code data = 24)

Turning this terminal command ON gives priorities to frequency commands or run commands received via the RS-485 communications link (H30) or the fieldbus option (y98).

No *LE* assignment is functionally equivalent to the *LE* being ON.

🕮 Refer to H30 (Communications link function) and y98 (Bus link function).

■ Universal DI -- ***U-DI*** (Function code data = 25)

Using *U-DI* enables the inverter to monitor digital signals sent from the peripheral equipment via an RS-485 communications link or a fieldbus option by feeding those signals to the digital input terminals. Signals assigned to the universal DI are simply monitored and do not operate the inverter.

🕮 For an access to universal DI via the RS-485 or fieldbus communications link, refer to their respective Instruction Manuals.

■ Enable auto search for idling motor speed at starting -- ***STM*** (Function code data = 26)

This digital terminal command determines, at the start of operation, whether or not to search for idling motor speed and follow it.

🕮 Refer to H09 (Starting mode).

■ Force to stop -- ***STOP*** (Function code data = 30)

Turning this terminal command OFF causes the motor to decelerate to a stop in accordance with the H56 data (Deceleration time for forced stop). After the motor stops, the inverter enters the alarm state with the alarm **Er6** displayed.

🕮 Refer to F07.

■ Reset PID integral and differential components -- ***PID-RST*** (Function code data = 33)

Turning this terminal command ON resets the integral and differential components of the PID processor.

🕮 Refer to J101 through J131 and J201 through J231.

■ Hold PID integral component -- ***PID-HLD*** (Function code data = 34)

Turning this terminal command ON holds the integral components of the PID processor.

🕮 Refer to J101 through J131 and J201 through J231.

■ Select local (keypad) operation -- ***LOC*** (Function code data = 35)

This terminal command switches the sources of run and frequency commands between remote and local.

🕮 For details of switching between remote and local modes, refer to Chapter 5, Section 5.5.4 "Remote and local modes."

■ Enable run commands -- ***RE*** (Function code data = 38)

Once this terminal command is assigned to any digital input terminal, the inverter no longer starts running with a run command only. Upon receipt of a run command, the inverter gets ready to run and outputs an *AX2* signal ("Run command entered").

Entering an *RE* signal ("Enable run commands") when the inverter is ready for running starts the inverter to run.

Input		Output	Inverter status
Run command (e.g., FWD)	Enable run commands ***RE***	Run command entered ***AX2***	
OFF	OFF	OFF	Stopped
OFF	ON	OFF	Stopped
ON	OFF	ON	Stopped
ON	ON	ON	Running

Typical operation sequence of ***RE***

(1) A run command ***FWD*** is given to the inverter.

(2) When the inverter gets ready for running, it outputs an ***AX2*** signal ("Run command entered").

(3) Upon receipt of the ***AX2***, the upper equipment gets ready to operate the peripherals (e.g., opening a damper).

(4) Upon completion of preparation of the peripherals, the upper equipment gives an ***RE*** signal ("Enable run command") to the inverter.

(5) Upon receipt of the ***RE***, the inverter starts running.

■ Protect motor from dew condensation -- ***DWP*** (Function code data = 39)

Turning this terminal command ON supplies a DC current to the motor in a stopped state in order to generate heat, preventing dew condensation.

🕮 Refer to J21.

■ Enable integrated sequence to switch to commercial power for 50 Hz and 60 Hz -- ***ISW50*** and ***ISW60*** (Function code data = 40 and 41)

With the terminal command *ISW50* or *ISW60* assigned, the inverter controls the magnetic contactor that switches the motor drive source between the commercial power and the inverter output according to the integrated sequence.

This control is effective when not only *ISW50* or *ISW60** has been assigned to the input terminal but also the *SW88* and *SW52-2* signals have been assigned to the output terminals. (It is not essential to assign the *SW52-1* signal.)

* The *ISW50* or *ISW60* should be selected depending upon the frequency of the commercial power; the former for 50 Hz and the latter for 60 Hz.

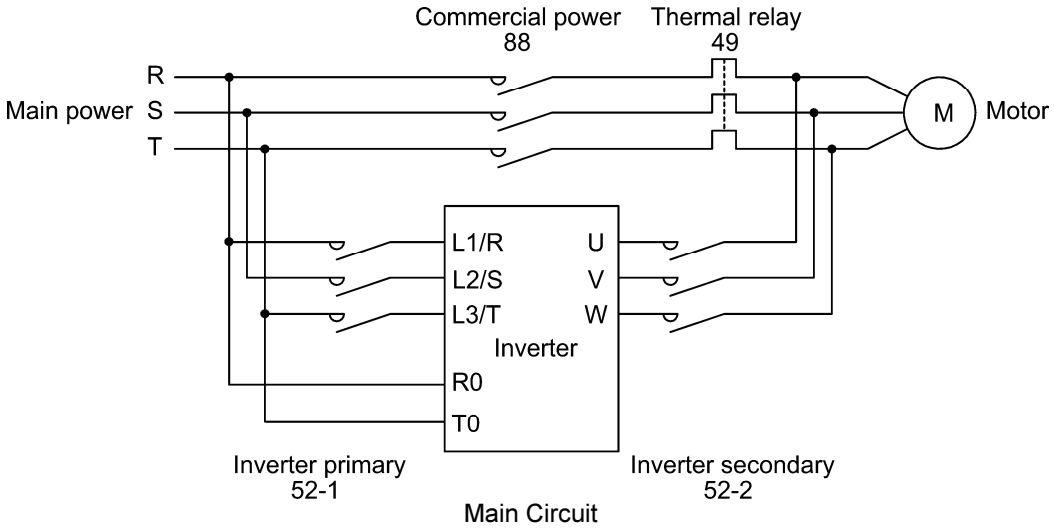
🕮 For details about *SW88* and *SW52-2* ("Switch motor drive source between commercial power and inverter output"), refer to E20 to E27.

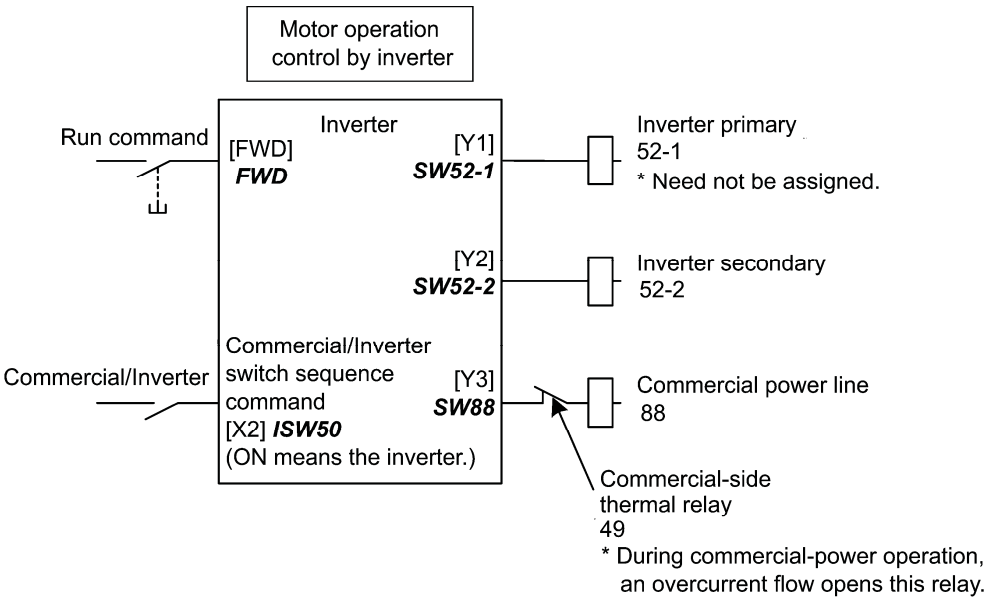
For details of these commands, refer to the circuit diagrams and timing schemes on the following pages.

Terminal command assigned	Operation (Switching from commercial power to inverter)
ISW50 Enable integrated sequence to switch to commercial power (50 Hz)	Start at 50 Hz.
ISW60 Enable integrated sequence to switch to commercial power (60 Hz)	Start at 60 Hz.

Note: Do not assign both ***ISW50*** and ***ISW60*** at the same time. Doing so cannot guarantee the result.

Circuit Diagram and Configuration





Configuration of Control Circuit

Summary of Operation

Input		Output (Status signal and magnetic contactor)			Inverter operation
ISW50 or ***ISW60***	Run command	***SW52-1*** 52-1	***SW52-2*** 52-2	***SW88*** 88	
OFF (Commercial power)	ON	OFF	OFF	ON	OFF
	OFF			OFF	
ON (Inverter)	ON	ON	ON	OFF	ON
	OFF				OFF

Timing Scheme

Switching from inverter operation to commercial-power operation
ISW50/ISW60: ON → OFF

(1) The inverter output is shut OFF immediately (Power gate IGBT OFF)

(2) The inverter primary circuit ***SW52-1*** and the inverter secondary side ***SW52-2*** are turned OFF immediately.

(3) If a run command is present after an elapse of t1 (0.2 sec + time specified by H13), the commercial power circuit ***SW88*** is turned ON.

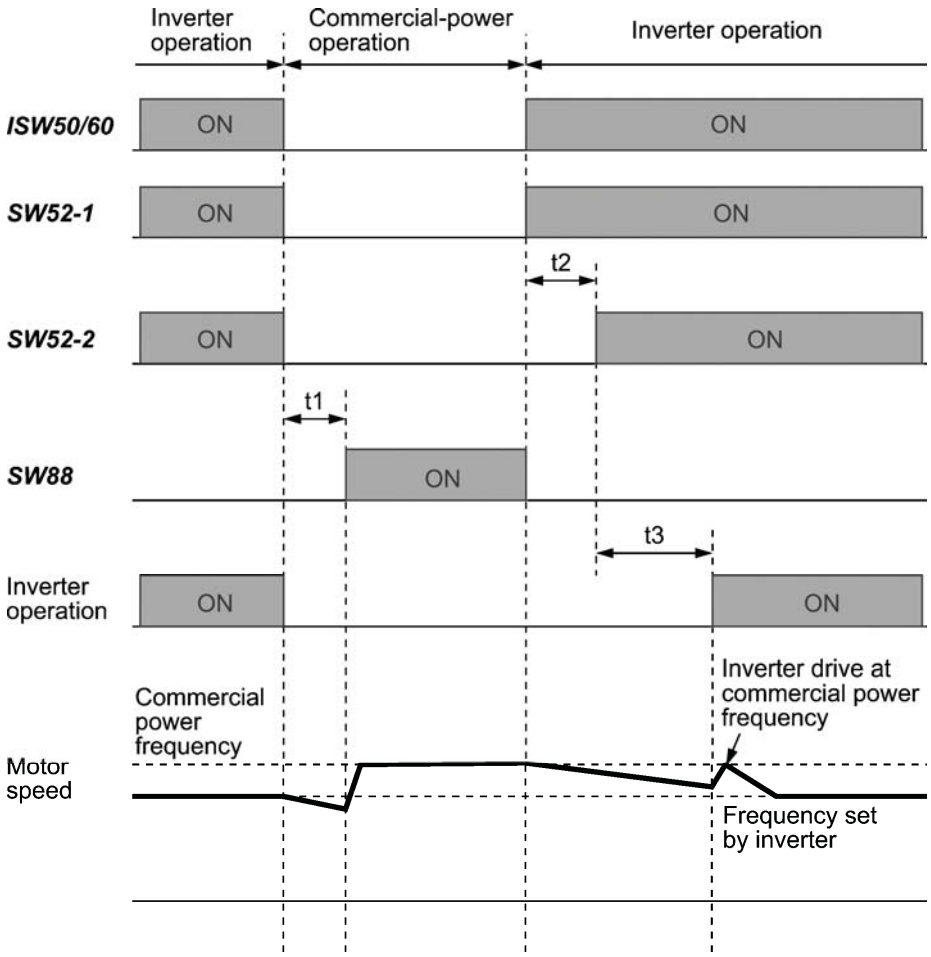
Switching from commercial-power operation to inverter operation
ISW50/ISW60: OFF → ON

(1) The inverter primary circuit ***SW52-1*** is turned ON immediately.

(2) The commercial power circuit ***SW88*** is turned OFF immediately.

(3) After an elapse of t2 (0.2 sec + time required for the main circuit to get ready) from when ***SW52-1*** is turned ON, the inverter secondary circuit ***SW52-2*** is turned ON.

(4) After an elapse of t3 (0.2 sec + time specified by H13) from when ***SW52-2*** is turned ON, the inverter harmonizes once the motor that has been freed from the commercial power to the commercial power frequency. Then the motor returns to the operation driven by the inverter.



t1: 0.2 sec + Time specified by H13 (Restart mode after momentary power failure)

t2: 0.2 sec + Time required for the main circuit to get ready

t3: 0.2 sec + Time specified by H13 (Restart mode after momentary power failure)

Selection of Commercial Power Switching Sequence

J22 specifies whether or not to automatically switch to commercial-power operation when an inverter alarm occurs.

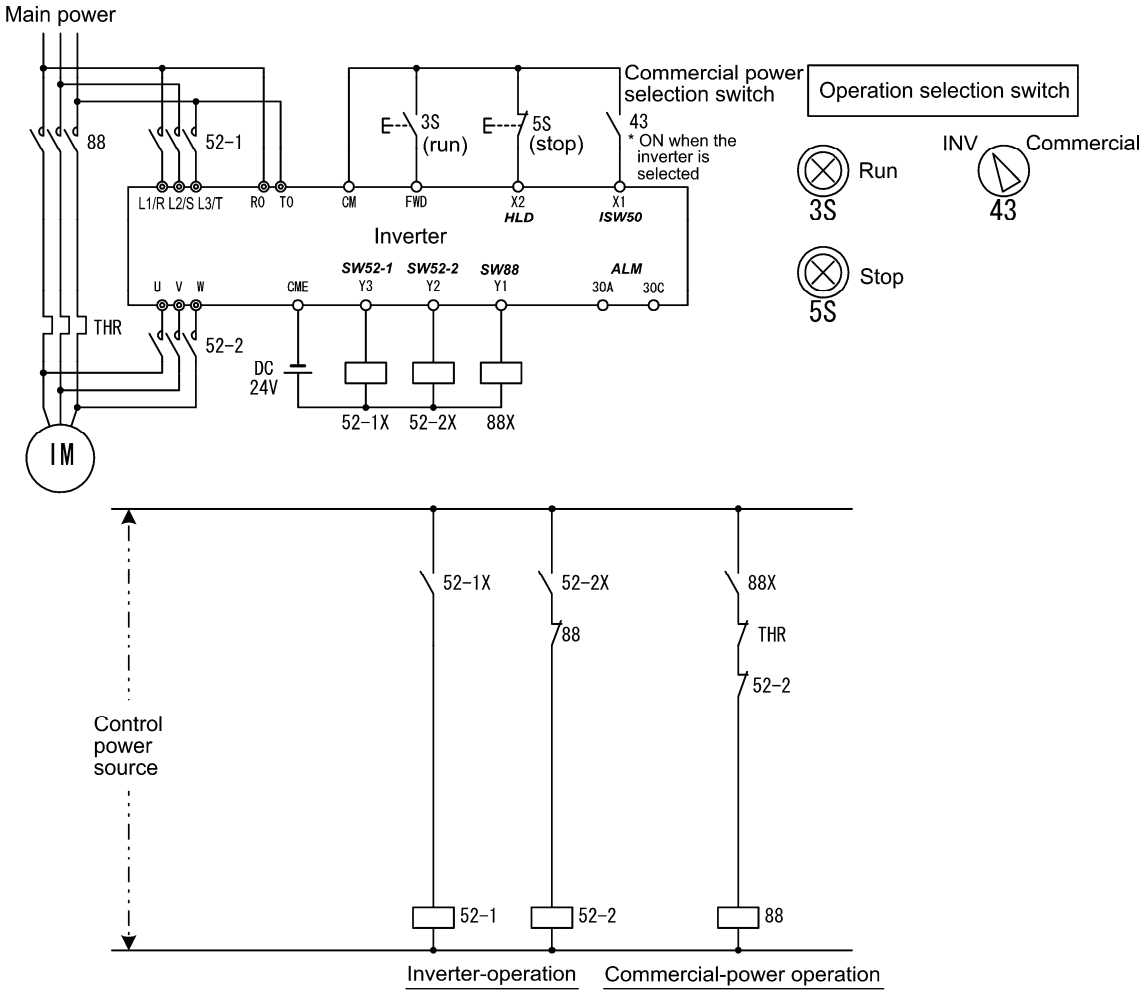
Data for J22	Sequence (upon occurrence of an alarm)
0	Keep inverter-operation (Stop due to alarm.)
1	Automatically switch to commercial-power operation

Note

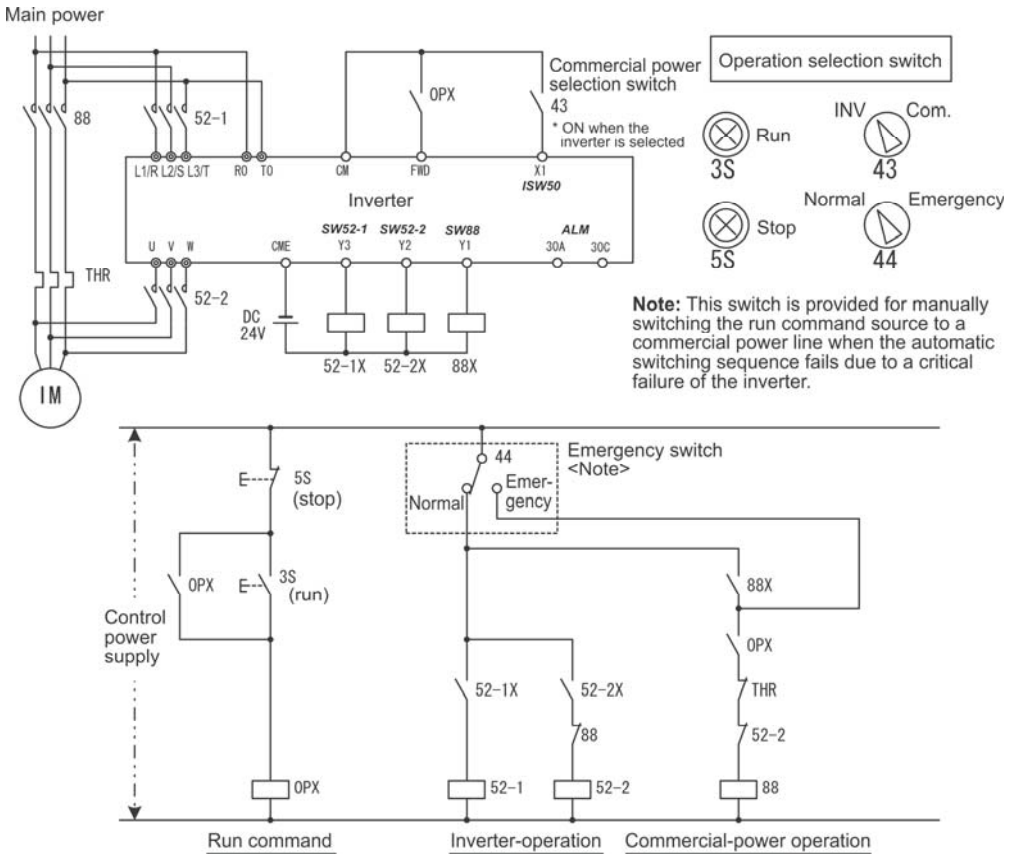
- The sequence operates normally also even when ***SW52-1*** is not used and the main power of the inverter is supplied at all times.
- Using ***SW52-1*** requires connecting the input terminals [R0] and [T0] for an auxiliary control power. Without the connection, turning ***SW52-1*** OFF loses also the control power.
- The sequence operates normally even if an alarm occurs in the inverter except when the inverter itself is broken. Therefore, for a critical facility, be sure to install an emergency switching circuit outside the inverter.
- Turning ON both the magnetic contactor MC (88) at the commercial-power side and the MC (52-2) at the inverter output side at the same time supplies main power mistakenly from the output (secondary) side of the inverter, which may damage the inverter. To prevent it, be sure to set up an interlocking logic outside the inverter.

Examples of Sequence Circuits

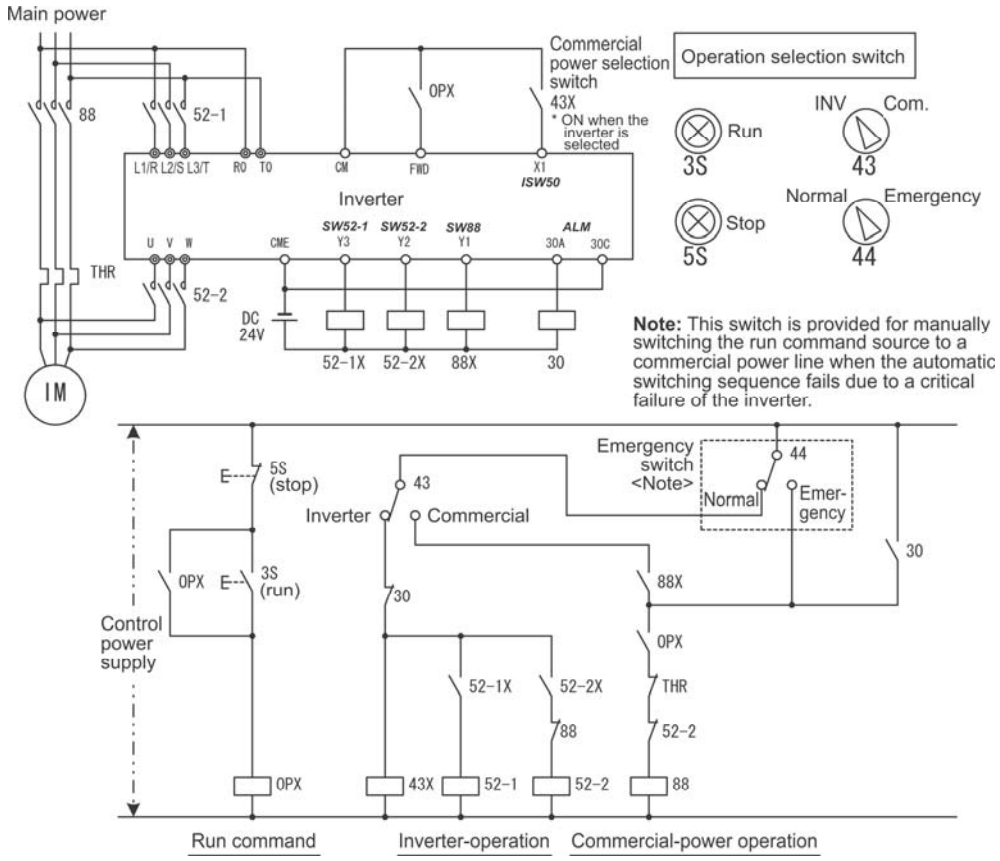
1) Standard sequence



2) Sequence with an emergency switching function



3) Sequence with an emergency switching function --Part 2 (Automatic switching by the alarm output issued by the inverter)



■ Reset UP/DOWN frequency -- ***STZ*** (Function code data = 58)

Turning the *STZ* ON clears the frequency increase or decrease from the "Multistep frequency + UP/DOWN control." (This command merely clears the increase or decrease so that the reference frequency may not come to be 0 Hz.)

📖 Refer to F01 and H61.

■ Count the run time of commercial power-driven motor 1
-- ***CRUN-M1*** (Function code data = 72)

The *CRUN-M1* enables the inverter to count the cumulative run time of motor 1 even when it is driven by commercial power (not by the inverter).

When the *CRUN-M1* is ON, the inverter judges that motor 1 is driven by commercial power and counts the run time of the motor.

■ Cancel customizable logic -- ***CLC*** (E01 to E07, data = 80)

The *CLC* disables the customizable logic temporarily. Use it to run the inverter without using the customizable logic circuit or timers for maintenance or other purposes.

CLC	Function
OFF	Enable customizable logic (Depends on the U00 setting)
ON	Disable customizable logic

Note: Before changing the setting of ***CLC***, ensure safety. Turning ***CLC*** ON disables the sequence of the customizable logic, causing a sudden motor start depending upon the settings.

■ Clear all customizable logic timers -- ***CLTC*** (E01 to E07, data = 81)

Assigning *CLTC* to any of the general-purpose digital input terminals and turning it ON resets all of the general-purpose timers and counters in the customizable logic. Use this command when the timings between the external sequence and the internal customizable logic do not match due to a momentary power failure or other reasons so that resetting and restarting the system is required.

CLTC	Function
OFF	Ordinary operation
ON	Reset all of the general-purpose timers and counters in the customizable logic. (To operate the timers and counters again, revert ***CLTC*** to OFF.)

■ Run command 2/1 -- ***FR2/FR1*** (Function code data = 87)

The *FR2/FR1* switches between the run command source selected by Run command (*FWD* and *REV*) and the one selected by Run command 2 (*FWD2* and *REV2*).

■ Run forward 2 -- ***FWD2*** (Function code data = 88)

Turning the *FWD2* ON runs the motor in the forward direction; turning it OFF decelerates it to a stop.

Tip The ***FWD2*** can be assigned by any of E01 to E07, E98 and E99.

■ Run reverse 2 -- ***REV2*** (Function code data = 89)

Turning the *REV2* ON runs the motor in the reverse direction; turning it OFF decelerates it to a stop.

Tip The ***REV2*** can be assigned by any of E01 to E07, E98 and E99.

■ Run forward -- ***FWD*** (Function code data = 98)

Turning the *FWD* ON runs the motor in the forward direction; turning it OFF decelerates it to a stop.

Tip The ***FWD*** can be assigned by E98 or E99 only.

■ Run reverse -- ***REV*** (Function code data = 99)

Turning the *REV* ON runs the motor in the reverse direction; turning it OFF decelerates it to a stop.

Tip The ***REV*** can be assigned by E98 or E99 only.

■ No function assigned (Function code data = 100)

Use this when no function is to be assigned to general-purpose, digital input terminals or the customizable logic function disables terminal functions.

■ Flowrate switch -- ***FS*** (Function code data = 131)

Turning the *FS* ON uses the flowrate sensor as a flowrate switch for detecting the dry pump or the end of curve.

🕮 Refer to J163 through J166.

■ Filter clogging reverse rotation command -- ***FRC*** (Function code data = 132)

Turning the *FRC* ON activates the filter clogging prevention to run the motor in the forward and reverse directions repeatedly according to the reverse rotation running time (J194).

🕮 Refer to J188 through J196.

■ Switch PID channel -- ***PID2/1*** (Function code data = 133)

The *PID2/1* switches between PID control 1 (J101 through J131) and PID control 2 (J201 through J231).

🕮 Refer to J101 through J131 and J201 through J231.

■ Switch to fire mode -- ***FMS*** (Function code data = 134)

Turning the *FMS* this terminal command ON switches to the fire mode to be used in an emergency, in which the inverter runs the motor at the predetermined speed.

🕮 Refer to H116 through H121.

■ PID multistep command
-- *PID-SS1*, *PID-SS2* (Function code data = 171, 172)

Turning the *PID-SS1* and *PID-SS2* ON/OFF selectively switches the PID multistep commands (preset by J136 through J138) in three steps. This command is available for both PID control 1 and PID control 2.

🕮 Refer to J136 through J138.

■ External PID multistep command
-- ***EPID-SS1***, ***EPID-SS2*** (Function code data = 181, 182)

Turning the *EPID-SS1* and *EPID-SS2* ON/OFF selectively switches the external PID multistep commands (preset by J551 through J553) in three steps.

🕮 Refer to J550 through J553.

■ Cancel timer -- ***TMC*** (Function code data = 190)

Turning the *TMC* ON cancels timer operation.

🕮 Refer to T01 through T19.

■ Enable timer 1 to 4 -- ***TM1*** to ***TM4*** (Function code data = 191 to 194)

Turning the *TM1* to *TM4* ON/OFF selectively enables timers 1 to 4, as listed below..

🕮 Refer to T01 through T19.

External input signal status				Timers selected
TM1	TM2	TM3	TM4	
OFF	OFF	OFF	OFF	
ON	OFF	OFF	OFF	Timer 1
OFF	ON	OFF	OFF	Timer 2
OFF	OFF	ON	OFF	Timer 3
OFF	OFF	OFF	ON	Timer 4
ON	ON	OFF	OFF	Timers 1 + 2
ON	OFF	ON	OFF	Timers 1 + 3
ON	OFF	OFF	ON	Timers 1 + 4
OFF	ON	ON	OFF	Timers 2 + 3
OFF	ON	OFF	ON	Timers 2 + 4
OFF	OFF	ON	ON	Timers 3 + 4
ON	ON	ON	OFF	Timers 1 + 2 + 3
ON	ON	OFF	ON	Timers 1 + 2 + 4
ON	OFF	ON	ON	Timers 1 + 3 + 4
OFF	ON	ON	ON	Timers 2 + 3 + 4
ON	ON	ON	ON	Timers 1 + 2 + 3 + 4

■ External PID control 1 ON command -- ***EPID1-ON*** (Function code data = 201)

Turning the *EPID1-ON* ON enables external PID control 1.

🕮 Refer to J501.

■ Cancel external PID control 1 -- ***%/EPID1*** (Function code data = 202)

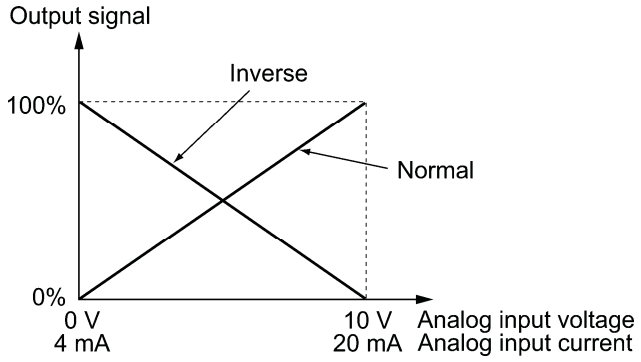
Turning the *%/EPID1* ON switches from external PID control 1 to manual commands (running at the frequency selected from the keypad or analog input).

Terminal command *%/EPID1*	Function
OFF	Enable external PID control 1
ON	Disable external PID control 1 (Enable manual commands)

🕮 Refer to J540.

■ Switch normal/inverse operation under external PID control 1
-- ***EPID1-IVS*** (Function code data = 203)

The *EPID1-IVS* switches the output signal of external PID control 1 between normal and inverse operations.



■ Reset external PID1 integral and differential components
-- ***EPID1-RST*** (Function code data = 204)

Turning the *EPID1-RST* ON resets the integral and differential terms of the PID processor of external PID control 1.

🕮 Refer to J501 through J540.

■ Hold external PID1 integral component -- ***EPID1-HLD*** (Function code data = 205)

When the *EPID1-HLD* is ON, the inverter holds the integral term of the PID processor of external PID control 1.

🕮 Refer to J501 through J540.

■ External PID control 2 ON command -- ***EPID2-ON*** (Function code data = 211)

Turning the *EPID2-ON* ON enables external PID control 2.

🕮 Refer to J601.

■ Cancel external PID control 2 -- ***%/EPID2*** (Function code data = 212)

Turning the *%/EPID2* ON switches from external PID control 2 to manual commands (running at the frequency selected from the keypad, analog input, or PID control 1).

Terminal command *%/EPID2*	Function
OFF	Enable External PID control 2
ON	Disable External PID control 2 (Enable manual frequency settings)

🕮 Refer to J601 to J640.

■ Switch normal/inverse operation under external PID control 2
-- ***EPID2-IVS*** (Function code data = 213)

The *EPID2-IVS* switches the output signal of external PID control 2 between normal and inverse operations.

■ Reset external PID2 integral and differential components
-- ***EPID2-RST*** (Function code data = 214)

Turning the *EPID2-RST* ON resets the integral and differential terms of the PID processor of external PID control 2.

🕮 Refer to J601 through J640.

■ Hold external PID2 integral component -- ***EPID2-HLD*** (Function code data = 215)

When the *EPID2-HLD* is ON, the inverter holds the integral term of the PID processor of external PID control 1.

🕮 Refer to J601 through J640.

■ External PID control 3 ON command -- ***EPID3-ON*** (Function code data = 221)

Turning the *EPID3-ON* ON enables external PID control 3.

🕮 Refer to J651.

■ Cancel external PID control 3 -- ***%/EPID3*** (Function code data = 222)

Turning the *%/EPID3* ON switches from external PID control 3 to manual commands (running at the frequency selected from the keypad, analog input, PID control 1 or 2).

Terminal command *%/EPID3*	Function
OFF	Enable External PID control 3
ON	Disable External PID control 3 (Enable manual frequency settings)

🕮 Refer to J651 to J690.

■ Switch normal/inverse operation under external PID control 3
-- ***EPID3-IVS*** (Function code data = 223)

The *EPID3-IVS* switches the output signal of external PID control 3 between normal and inverse operations.

■ Reset external PID3 integral and differential components
-- ***EPID3-RST*** (Function code data = 224)

Turning the *EPID3-RST* ON resets the integral and differential terms of the PID processor of external PID control 3.

📖 Refer to J651 through J690.

■ Hold external PID3 integral component -- ***EPID3-HLD*** (Function code data = 225)

When the *EPID3-HLD* is ON, the inverter holds the integral term of the PID processor of external PID control 3.

📖 Refer to J651 through J690.

E10 to E15	Acceleration Time 2 to 4, Deceleration Time 2 to 4	(Refer to F07)

Refer to the description of F07.

E16, E17	Torque Limiter 2	(Refer to F40.)

Refer to the description of F40.

E20 to E23 E24, E27	**Terminal [Y1] to [Y4] Functions** **Terminal [Y5A/C] and [30A/B/C] Functions (Relay output)**

E20 through E24 and E27 assign output signals (listed on the following pages) to general-purpose, programmable output terminals, [Y1] to [Y4], [Y5A/C] and [30A/B/C].

These function codes can also switch the logic system between normal and negative to define how the inverter interprets the ON or OFF state of each terminal. The factory default setting is normal logic system "Active ON."

Terminals [Y1] to [Y4] are transistor outputs and terminals [Y5A/C] and [30A/B/C] are relay contact outputs. In normal logic, if an alarm occurs, the relay will be energized so that [30A] and [30C] will be closed, and [30B] and [30C] opened. In negative logic, the relay will be deenergized so that [30A] and [30C] will be opened, and [30B] and [30C] closed. This may be useful for the implementation of failsafe power systems.

Note

- When negative logic is employed, all output signals are active (e.g. an alarm would be recognized) while the inverter is powered OFF. To avoid causing system malfunctions by this, interlock these signals to keep them ON using an external power supply. Furthermore, the validity of these output signals is not guaranteed for approximately 1.5 seconds (for 22 kW or below) or 3 seconds (for 30 kW or above) after power-ON, so introduce such a mechanism that masks them during the transient period.
- Terminals [Y5A/C] and [30A/B/C] use mechanical contacts that cannot stand frequent ON/OFF switching. Where frequent ON/OFF switching is anticipated (for example, limiting a current by using signals subjected to inverter output limit control such as switching to commercial power line or direct-on-line starting), use transistor outputs [Y1], [Y2], [Y3] and [Y4] instead. The service life of a relay is approximately 200,000 times if it is switched ON and OFF at one-second intervals.

The tables given on the following pages list functions that can be assigned to terminals [Y1] to [Y4], [Y5A/C], and [30A/B/C].

The descriptions are, in principle, arranged in the numerical order of assigned data. However, highly relevant signals are collectively described where one of them first appears. Refer to the function codes or signals in the "Related function codes/signals (data)" column, if any.

Explanations of each function are given in normal logic system "Active ON."

Function code data		Functions assigned	Symbol	Related function codes/signals (data)
Active ON	Active OFF			
0	1000	Inverter running	***RUN***	—
1	1001	Frequency (speed) arrival signal	***FAR***	E30
2	1002	Frequency (speed) detected	***FDT***	E31, E32
3	1003	Undervoltage detected (Inverter stopped)	***LU***	—
5	1005	Inverter output limiting	***IOL***	—
6	1006	Auto-restarting after momentary power failure	***IPF***	F14
7	1007	Motor overload early warning	***OL***	E34, F10, F12
10	1010	Inverter ready to run	***RDY***	—
11	—	Switch motor drive source between commercial power and inverter output (For MC on commercial line)	***SW88***	E01 to E07 ***ISW50*** (40) ***ISW60*** (41) J22
12	—	Switch motor drive source between commercial power and inverter output (For secondary side)	***SW52-2***	
13	—	Switch motor drive source between commercial power and inverter output (For primary side)	***SW52-1***	
15	1015	Select AX terminal function (For MC on primary side)	***AX***	—
16	1016	Shifted to pattern operation stage	***TU***	C21 to C28
17	1017	Pattern operation cycle completed	***TO***	
18	1018	Pattern operation stage number	***STG1***	
19	1019	Pattern operation stage number	***STG2***	
20	1020	Pattern operation stage number	***STG4***	
22	1022	Inverter output limiting with delay	***IOL2***	***IOL*** (5)
25	1025	Cooling fan in operation	***FAN***	H06
26	1026	Auto-resetting	***TRY***	H04, H05
27	1027	Universal DO	***U-DO***	—
28	1028	Heat sink overheat early warning	***OH***	—
30	1030	Lifetime alarm	***LIFE***	H42
33	1033	Reference loss detected	***REF OFF***	E65
35	1035	Inverter output on	***RUN2***	***RUN*** (0)
36	1036	Overload prevention control	***OLP***	H70
37	1037	Current detected	***ID***	E34, E35
42	1042	PID alarm	***PID-ALM***	J121 to J124 J221 to J225
43	1043	Under PID control	***PID-CTL***	J101, J201
44	1044	Motor stopped due to slow flowrate under PID control	***PID-STP***	J149 to J160 J249 to J260
45	1045	Low output torque detected	***U-TL***	E80, E81
52	1052	Running forward	***FRUN***	—
53	1053	Running reverse	***RRUN***	—

Function code data		Functions assigned	Symbol	Related function codes/signals (data)
Active ON	Active OFF			
54	1054	In remote operation	***RMT***	(See Section 5.5.4.)
55	1055	Run command entered	***AX2***	
56	1056	Motor overheat detected by thermistor	***THM***	H26, H27
59	1059	Terminal [C1] wire break	***C1OFF***	—
84	1084	Maintenance timer	***MNT***	H44, H78, H79
87	1087	Frequency arrival signal	***FARFDT***	
95	1095	Running in fire mode	***FMRUN***	H116 to H121
98	1098	Light alarm	***L-ALM***	H181 to H184
99	1099	Alarm output (for any alarm)	***ALM***	—
101	1101	EN terminal detection circuit error	***DECF***	
102	1102	EN terminal OFF	***ENOFF***	
111	1111	Customizable logic output signal 1	***CLO1***	U71 to U77 U81 to U87
112	1112	Customizable logic output signal 2	***CLO2***	
113	1113	Customizable logic output signal 3	***CLO3***	
114	1114	Customizable logic output signal 4	***CLO4***	
115	1115	Customizable logic output signal 5	***CLO5***	
116	1116	Customizable logic output signal 6	***CLO6***	
117	1117	Customizable logic output signal 7	***CLO7***	
190	1190	In timer operation	***TMD***	T01 to T19
191	1191	Timer 1 enabled	***TMD1***	
192	1192	Timer 2 enabled	***TMD2***	
193	1193	Timer 3 enabled	***TMD3***	
194	1194	Timer 4 enabled	***TMD4***	
200	1200	Under PID2 control	***PID2***	J101, J201
201	1201	PID1 alarm	***PV1-ALM***	J121, J122, J124
202	1202	PID1 feedback error	***PV1-OFF***	J127 to J131
203	1203	PID2 alarm	***PV2-ALM***	J221 to J225
204	1204	PID2 feedback error	***PV2-OFF***	J227 to J231
211	1211	Under external PID1 control	***EPID1-CTL***	J501
212	1212	External PID1 output	***EPID1-OUT***	
213	1213	Running under external PID1	***EPID1-RUN***	
214	1214	External PID1 alarm	***EPV1-ALM***	J521, J522, J524
215	1215	External PID1 feedback error	***EPV1-OFF***	J529 to J531
221	1221	Under external PID2 control	***EPID2-CTL***	J601
222	1222	External PID2 output	***EPID2-OUT***	
223	1223	Running under external PID2	***EPID2-RUN***	
224	1224	External PID2 alarm	***EPV2-ALM***	J621, J622, J624
225	1225	External PID2 feedback error	***EPV2-OFF***	J629 to J631

Function code data		Functions assigned	Symbol	Related function codes/signals (data)
Active ON	Active OFF			
231	1231	Under external PID3 control	***EPID3-CTL***	J651
232	1232	External PID3 output	***EPID3-OUT***	
233	1233	Running under external PID3	***EPID3-RUN***	
234	1234	External PID3 alarm	***EPV3-ALM***	J671, J672, J674
235	1235	External PID3 feedback error	***EPV3-OFF***	J679 to J681

Note Any negative logic (Active OFF) command cannot be assigned to the functions marked with "—" in the "Active OFF" column.

■ Inverter running -- ***RUN*** (Function code data = 0)
Inverter output on -- ***RUN2*** (Function code data = 35)

These output signals tell the external equipment that the inverter is running at a starting frequency or higher.

If assigned in negative logic (Active OFF), these signals can be used to tell the "Inverter being stopped" state.

Output signal	Basic function	Remarks
RUN	These signals come ON when the inverter is running. Under V/f control: These signals come ON if the inverter output frequency exceeds the starting frequency, and go OFF if it drops below the stop frequency. The ***RUN*** signal can also be used as a "Speed valid" signal ***DNZS***.	Goes OFF even during DC braking or dew condensation prevention.
RUN2		Comes ON even during DC braking, pre-exciting, zero speed control, or dew condensation prevention.

Under vector control, both ***RUN*** and ***RUN2*** come ON also when zero speed control or servo-lock function is enabled.

■ Frequency (speed) arrival signal -- ***FAR*** (Function code data = 1)

These output signals come ON when the difference between the output frequency (detected speed) and reference frequency (reference speed) comes within the frequency arrival hysteresis width specified by E30.

📖 Refer to E30.

■ Frequency (speed) detected -- ***FDT*** (Function code data = 2)

This output signal comes ON when the output frequency (detected speed) exceeds the frequency detection level specified by E31, and it goes OFF when the output frequency (detected speed) drops below the "Frequency detection level (E31) - Hysteresis width (E32)."

📖 Refer to E31 and E32.

■ Undervoltage detected (Inverter stopped) -- ***LU*** (Function code data = 3)

This output signal comes ON when the DC link bus voltage of the inverter drops below the specified undervoltage level, and it goes OFF when the voltage exceeds the level.

When this signal is ON, the inverter cannot run even if a run command is given.

This signal is ON also when the undervoltage protective function is activated so that the motor is in an abnormal stop state (e.g., tripped).

■ Inverter output limiting -- ***IOL*** (Function code data = 5)
Inverter output limiting with delay -- ***IOL2*** (Function code data = 22)

The output signal *IOL* comes ON when the inverter is limiting the output frequency by activating any of the following actions (minimum width of the output signal: 100 ms). The output signal *IOL2* comes ON when any of the following output limiting operation continues for 20 ms or more.

・Torque limiting (F40, F41, E16 and E17, Maximum internal value)
・Current limiting by software (F43 and F44)
・Instantaneous overcurrent limiting by hardware (H12 = 1)
・Automatic deceleration (Anti-regenerative control) (H69)

Note When the ***IOL*** is ON, it may mean that the output frequency may have deviated from the reference frequency because of the limiting functions above.

■ Auto-restarting after momentary power failure -- ***IPF*** (Function code data = 6)

This output signal is ON either during continuous running after a momentary power failure or during the period from when the inverter detects an undervoltage condition and shuts down its output until the completion of a restart sequence (until the output reaches the reference frequency).

🕮 Refer to F14.

■ Motor overload early warning -- ***OL*** (Function code data = 7)

This output signal is used to issue a motor overload early warning that enables you to take an corrective action before the inverter detects a motor overload alarm **OL1** and shuts down its output.

🕮 Refer to E34.

■ Inverter ready to run -- ***RDY*** (Function code data = 10)

This output signal comes ON when the inverter becomes ready to run by completing hardware preparation (such as initial charging of DC link bus capacitors and initialization of the control circuit) and no protective functions are activated.

■ Switch motor drive source between commercial power and inverter output
-- ***SW88***, ***SW52-2*** and ***SW52-1*** (Function code data = 11, 12, and 13)

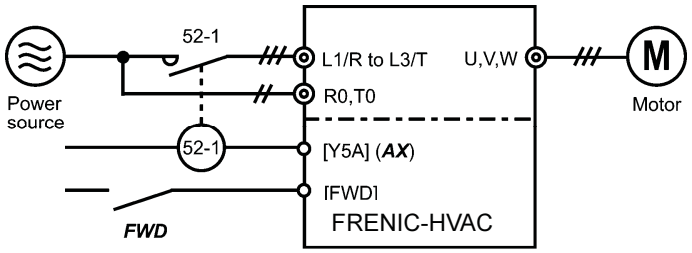
Assigning these output signals to transistor output terminals [Y1], [Y2], [Y3] and [Y4] enables the terminal command *ISW50* or *ISW60* that controls the magnetic contactor for switching the motor drive source between the commercial power and the inverter output according to the integrated sequence.

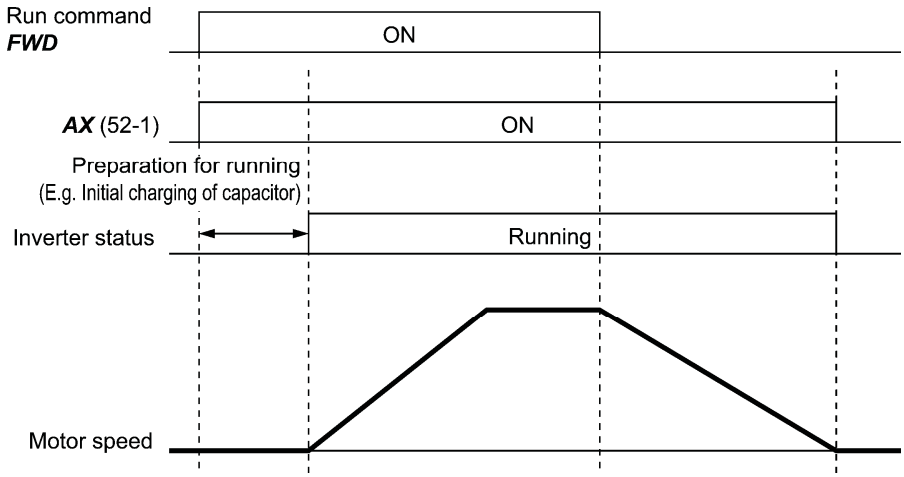
🕮 Refer to E01 through E07 (data = 40 and 41).

■ Select ***AX*** terminal function -- ***AX*** (Function code data = 15)

In response to a run command *FWD*, this output signal controls the magnetic contactor on the commercial-power supply side. It comes ON when the inverter receives a run command and it goes OFF after the motor decelerates to stop with a stop command received.

This signal immediately goes OFF upon receipt of a coast-to-stop command or when an alarm occurs.





■ Shifted to pattern operation stage -- ***TU*** (Function code data = 16)

When the stage is shifted in pattern operation, the inverter issues a one-shot ON signal (100 ms), telling the shift of the stage.

🕮 Refer to C21 through C28.

■ Pattern operation cycle completed -- ***TO*** (Function code data = 17)

Upon completion of all stages (1 to 7) in pattern operation, the inverter issues a one-shot ON signal (100 ms), telling the completion of all stages.

🕮 Refer to C21 through C28.

■ Pattern operation stage number
-- ***STG1***, ***STG2***, and ***STG4*** (Function code data = 18, 19, and 20)

With the combination of *STG1*, *STG2* and *STG4*, the inverter outputs the current operating stage.

🕮 Refer to C21 through C28.

Pattern operation stage number	Output terminal		
	STG1	STG2	STG3
Stage 1	ON	OFF	OFF
Stage 2	OFF	ON	OFF
Stage 3	ON	ON	OFF
Stage 4	OFF	OFF	ON
Stage 5	ON	OFF	ON
Stage 6	OFF	ON	ON
Stage 7	ON	ON	ON

The inverter issues no signal from any of these terminals when a pattern operation is not carried out (no stage is selected).

■ Cooling fan in operation -- ***FAN*** (Function code data = 25)

With the cooling fan ON/OFF control enabled (H06 = 1), this output signal is ON when the cooling fan is in operation, and OFF when it is stopped. This signal can be used to make the cooling system of peripheral equipment interlocked for an ON/OFF control.

🕮 Refer to H06.

■ Auto-resetting -- ***TRY*** (Function code data = 26)

This output signal comes ON when auto resetting (resetting alarms automatically) is in progress.

🕮 Refer to H04 and H05.

■ Universal DO -- ***U-DO*** (Function code data = 27)

Assigning this output signal to an inverter's output terminal and connecting the terminal to a digital input terminal of peripheral equipment via the RS-485 communications link or the fieldbus, allows the inverter to send commands to the peripheral equipment.

The universal DO can be used as an output signal independent of the inverter operation.

🕮 For the procedure for access to Universal DO via the RS-485 communications link or fieldbus, refer to the respective instruction manual.

■ Heat sink overheat early warning -- ***OH*** (Function code data = 28)

This output signal is used to issue a heat sink overheat early warning that enables you to take a corrective action before an overheat trip *OH1* actually happens.

This signal comes ON when the temperature of the heat sink exceeds the "overheat trip temperature minus 5°C," and it goes OFF when it drops down to the "overheat trip temperature minus 8°C."

■ Lifetime alarm -- ***LIFE*** (Function code data = 30)

This output signal comes ON when it is judged that the service life of any one of capacitors (DC link bus capacitors and electrolytic capacitors on the printed circuit boards), cooling fan, and real-time clock battery (option) has expired.

This signal should be used as a guide for replacement of these parts. If this signal comes ON, use the specified maintenance procedure to check the service life of these parts and determine whether the parts should be replaced or not.

🕮 Refer to H42.

■ Reference loss detected -- ***REF OFF*** (Function code data = 33)

This output signal comes ON when an analog input used as a frequency command source is in a reference loss state (as specified by E65) due to a wire break or a weak connection. This signal goes OFF when the normal operation under the analog input is resumed.

🕮 Refer to E65.

■ Overload prevention control -- ***OLP*** (Function code data = 36)

This output signal comes ON when overload prevention control is activated. The minimum ON-duration is 100 ms.

🕮 Refer to H70.

■ Current detected -- ***ID*** (Function code data = 37)

This output signal comes ON when the output current of the inverter exceeds the level specified by E34 (Current detection (Level)) for the period specified by E35 (Current detection (Timer)). The minimum ON-duration is 100 ms.

🕮 Refer to E34 and E35.

■ PID alarm -- ***PID-ALM*** (Function code data = 42)

Assigning this output signal enables PID control to output absolute-value alarm or deviation alarm.

🕮 Refer to J121 through J124 and J221 through J225.

■ Under PID control -- ***PID-CTL*** (Function code data = 43)

This output signal comes ON when PID control is enabled ("Cancel PID control" (*Hz/PID*) = OFF) and a run command is ON.

🕮 Refer to J101 and J201.

Note

When PID control is enabled, the inverter may stop function with the ***PID-CTL*** signal being ON. As long as the ***PID-CTL*** signal is ON, PID control is effective, so the inverter may abruptly resume its operation, depending on the feedback value in PID control.

⚠WARNING

When PID control is enabled, even if the inverter stops its output during operation because of sensor signals or other reasons, operation will resume automatically.

Design your machinery so that safety is ensured even in such cases.

Otherwise, an accident could occur.

■ Motor stopped due to slow flowrate under PID control -- ***PID-STP*** (Function code data = 44)

This output signal is ON when the inverter is stopped due to the slow flowrate stop function under PID control.)

🕮 Refer to J149 through J160 and J249 through J260.

■ Low output torque detected -- ***U-TL*** (Function code data = 45)

This output signal comes ON when the torque value calculated by the inverter or torque command drops below the level specified by E80 (Low torque detection (Level)) for the period specified by E81 (Low torque detection (Timer)). The minimum ON-duration is 100 ms.

🕮 Refer to E80 and E81.

■ Running forward -- ***FRUN*** (Function code data = 52)
Running reverse -- ***RRUN*** (Function code data = 53)

Output signal	Assigned data	Running forward	Running reverse	Inverter stopped
FRUN	52	ON	OFF	OFF
RRUN	53	OFF	ON	OFF

■ In remote operation -- ***RMT*** (Function code data = 54)

This output signal comes ON when the inverter switches from local to remote mode.

🕮 For details of switching between remote and local modes, refer to Chapter 5, Section 5.5.4 "Remote and local modes."

■ Run command entered -- ***AX2*** (Function code data = 55)

This output signal comes ON the moment the inverter is ready to run after receipt of a run command.

🕮 Refer to E01 through E07, Function code data = 38.

■ Motor overheat detected by thermistor -- ***THM*** (Function code data = 56)

Even when the PTC thermistor on the motor detects an overheat, the inverter turns this signal ON and continues to run, without entering the alarm **OH4** state. This feature applies only when H26 data is set to "2."

🕮 Refer to H26 and H27.

■ Terminal [C1] wire break -- ***C1OFF*** (Function code data = 59)

This output signal comes ON when the inverter detects that the input current to terminal [C1] drops below 2 mA interpreting it as the terminal [C1] wire broken.

■ Maintenance timer -- ***MNT*** (Function code data = 84)

Once the inverter's cumulative run time or the startup times for the motor 1 exceeds the previously specified count, this output signal comes ON.

🕮 Refer to H44, H78 and H79.

■ Frequency arrival signal (with frequency detection) -- ***FARFDT*** (Function code data = 87)

This output signal comes ON when both the ***FAR*** (Frequency arrival signal) and ***FDT*** (Frequency detected) come ON. (The ***FARFDT*** is an AND condition signal of the ***FAR*** and ***FDT***.)

■ Running in fire mode -- ***FMRUN*** (Function code data = 95)

This output signal comes ON in fire mode.

🕮 Refer to H116 through H121.

■ Light alarm -- ***L-ALM*** (Function code data = 98)

This output signal comes ON when a light alarm occurs.

🕮 Refer to H181 through H184.

■ Alarm output (for any alarm) -- ***ALM*** (Function code data = 99)

This output signal comes ON if any of the protective functions is activated and the inverter enters Alarm mode.

■ EN terminal detection circuit error -- ***DECF*** (Function code data = 101)

This output signal comes ON when an error is detected in the Enable circuit.

As necessary, make use of ***DECF*** in wiring that feeds back the ***DECF***-assigned transistor output of the inverter to the reset input of an upper safety relay unit in order to turn the Enable command OFF and shut down the inverter output.

■ EN terminal OFF -- ***ENOFF*** (Function code data = 102)

This output signal comes ON when Enable inputs to terminals [EN1] and [EN2] are OFF.

*1 These signals do not guarantee the detection of all signal alarms. (Compliant with EN ISO13849-1 PL = d Cat. 3)

Logic Table of DECF and ENOFF Signals

Power supply L1/R, L2/S, L3/T	Enable input		Transistor output or alarm output (for any alarm) *2		Output
	EN1-PLC	EN2-PLC	DECF	ENOFF	
OFF	√	√	OFF	OFF	Shutdown (Safe Torque OFF *3)
ON	OFF	OFF	OFF	ON	Shutdown (Safe Torque OFF *3)
	ON	ON	OFF	OFF	Waiting for a run command
	ON	OFF	ON *4	OFF	Shutdown (Safe Torque OFF *3)
	OFF	ON	ON *4	OFF	Shutdown (Safe Torque OFF *3)

√: The output level is determined independent of the states.

*2 To use this function, it is necessary to set the software parameter to DECF/ENOFF = 101/102 (negative logic).

*3 Safe Torque OFF (STO) defined by IEC61800-5-2.

*4 If either one of Enable inputs to [EN1] and [EN2] is OFF, an alarm (ECF) occurs. (If the status is kept exceeding 50 ms, it is judged as mismatch.) This alarm can be removed only by restarting the inverter.

■ Cancel timer -- ***TMD*** (Function code data = 190)

■ Timer 1 to Timer 4 enabled -- ***TMD1*** to ***TMD4*** (Function code data = 191 to 194)

With the combination of *TMD1* to *TMD4*, the inverter outputs the current state of timer operation.

🕮 Refer to T01 through T19.

Timer operation state	Output status of external output signals				
	TMD	***TMD1***	***TMD2***	***TMD3***	***TMD4***
Timer operation disabled (no setting or being canceled)	OFF	OFF	OFF	OFF	OFF
Timer operation time invalid	OFF	OFF	OFF	OFF	OFF
Timer 1	ON	ON	OFF	OFF	OFF
Timer 2		OFF	ON	OFF	OFF
Timer 3		OFF	OFF	ON	OFF
Timer 4		OFF	OFF	OFF	ON
Timers 1 + 2		ON	ON	OFF	OFF
Timers 1 + 3		ON	OFF	ON	OFF
Timers 1 + 4		ON	OFF	OFF	ON
Timers 2 + 3		OFF	ON	ON	OFF
Timers 2 + 4		OFF	ON	OFF	ON
Timers 3 + 4		OFF	OFF	ON	ON
Timers 1 + 2 + 3		ON	ON	ON	OFF
Timers 1 + 2 + 4		ON	ON	OFF	ON
Timers 1 + 3 + 4		ON	OFF	ON	ON
Timers 2 + 3 + 4		OFF	ON	ON	ON
Timers 1 + 2 + 3 + 4		ON	ON	ON	ON

■ Under PID2 control -- ***PID2*** (Function code data = 200)

This output signal comes ON when PID control 2 is selected.

🕮 Refer to J101 and J201.

■ PID1 alarm -- ***PV1-ALM*** (Function code data = 201)

This output signal comes ON when a PID1 alarm occurs.

🕮 Refer to J121, J122, and J124.

■ PID1 feedback error -- ***PV1-OFF*** (Function code data = 202)

This output signal comes ON when a feedback (PV) level error occurs.

🕮 Refer to J127 through J131.

■ PID2 alarm -- ***PV2-ALM*** (Function code data = 203)

This output signal comes ON when a PID2 alarm occurs.

🕮 Refer to J221 through J225.

■ PID2 feedback error -- ***PV2-OFF*** (Function code data = 204)

This output signal comes ON when a feedback (PV) level error occurs.

🕮 Refer to J227 through J231.

■ Under external PID1 to PID3 control-- ***EPID1-CTL***, ***EPID2-CTL***, and ***EPID3-CTL*** (Function code data = 211, 221, and 231)

These signals come ON when external PID control 1 to 3 are selected, respectively.

🕮 Refer to J501, J601, and J651.

■ External PID1 to PID3 output -- ***EPID1-OUT***, ***EPID2-OUT***, and ***EPID3-OUT*** (Function code data = 212, 222, and 232)

These signals are duty output of external PID control 1 to 3.

🕮 Refer to J501, J601, and J651.

■ Running under external PID1 to PID3 -- ***EPID1-RUN***, ***EPID2-RUN***, and ***EPID3-RUN*** (Function code data = 213, 223, and 233)

These signals come ON when external PID control 1 to 3 are activated, respectively.

🕮 Refer to J501, J601, and J651.

■ External PID1 to PID3 alarm -- ***EPV1-ALM***, ***EPV2-ALM***, and ***EPV3-ALM*** (Function code data = 214, 224, and 234)

These signals come ON when external PID1 to PID3 alarms occur with external PID control 1 to 3 selected.

🕮 Refer to J521, J522, J524, J621, J622, J624, J671, J672, and J674.

■ External PID1 to PID3 feedback error -- ***EPV1-OFF***, ***EPV2-OFF***, ***EPV3-OFF*** (Function code data = 215, 225, and 235)

These signals come ON when a feedback (PV) level error occurs when external PID control 1 to 3 are selected, respectively.

🕮 Refer to J529 through J531, J629 through J631, and J679 through J681.

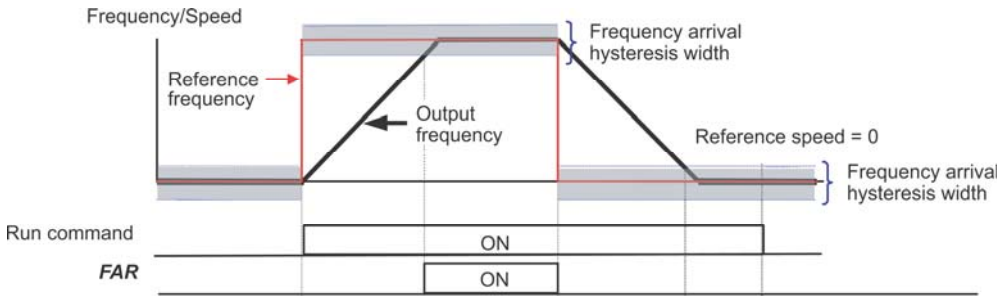
E30	Frequency Arrival (Hysteresis width)

E30 specifies the detection level (hysteresis width) for the "Frequency (speed) arrival signal" ***FAR***.

Output signal	Data assigned to output terminal	Operating condition 1	Operating condition 2
Frequency (speed) arrival signal ***FAR***	1	Both signals come ON when the difference between the output frequency and the reference frequency comes within the frequency arrival hysteresis width specified by E30.	***FAR*** always goes OFF when the run command is OFF or the reference speed is "0."

- Data setting range: 0.0 to 10.0 (Hz)

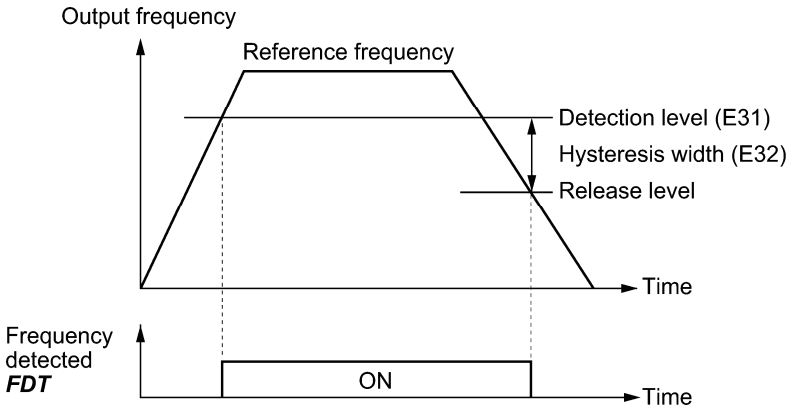
The operation timings of each signal are as shown below.



E31, E32 Frequency Detection (Level and Hysteresis width)

When the output frequency (estimated/detected speed) exceeds the frequency detection level specified by E31, the "Frequency (speed) detected signal" comes ON; when it drops below the "Frequency detection level minus Hysteresis width specified by E32," it goes OFF.

Output signal	Data assigned to output terminal	Operation level	Hysteresis width
		Range: 0.0 to 120.0 Hz	Range: 0.0 to 120.0 Hz
Frequency (speed) detected signal ***FDT***	2	E31	E32



E34, E35 Overload Early Warning/Current Detection (Level and Timer)

These function codes define the detection level and time for the "Motor overload early warning" *OL* and "Current detected" *ID*.

Output signal	Data assigned to output terminal	Operation level	Timer	Motor characteristics	Thermal time constant
		Range: See below	Range: 0.01 to 600.00 s	Range: See below	Range: 0.5 to 75.0 min
OL	7	E34	-	F10	F12
ID	37	E34	E35	-	-

- Data setting range

  Operation level: OFF (Disable), 1 to 150% of inverter rated current

  Motor characteristics 1: Enable (For a general-purpose motor with shaft-driven cooling fan)

  2: Enable (For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan)

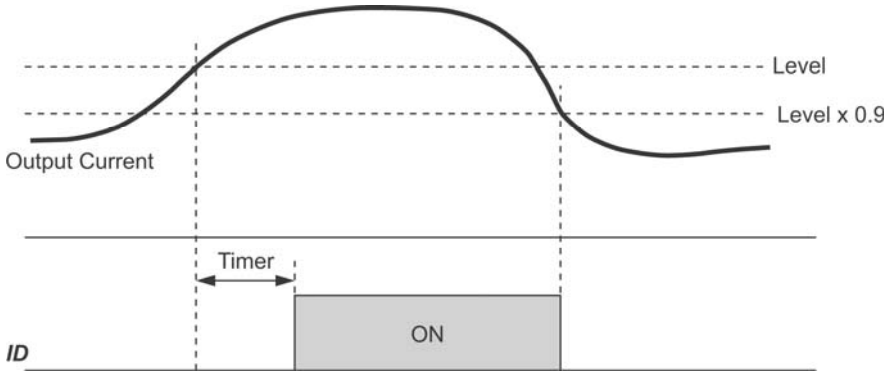
■ Motor overload early warning signal -- ***OL***

The *OL* signal is used to detect a symptom of an overload condition (alarm code **OL1**) of the motor so that the user can take an appropriate action before the alarm actually happens.

The *OL* signal turns ON when the inverter output current exceeds the level specified by E34. In typical cases, set E34 data to 80 to 90% against F11 data (Electronic thermal overload protection for motor 1, Overload detection level). Specify also the thermal characteristics of the motor with F10 (Select motor characteristics) and F12 (Thermal time constant).

■ Current detected -- ***ID***

When the inverter output current exceeds the level specified by E34 for the period specified by E35, the *ID* signal turns ON, respectively. When the output current drops below 90% of the rated operation level, the *ID* turns OFF. (The minimum ON-duration is 100 ms.)



E61 to E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function

E61, E62, and E63 define the function of the terminals [12], [C1], and [V2], respectively.

There is no need to set up these terminals if they are to be used for frequency command sources.

Data for E61, E62, or E63	Input assigned to [12], [C1] and [V2]:	Description
0	None	—
1	Auxiliary frequency command 1	Auxiliary frequency input to be added to the reference frequency given by frequency command 1 (F01). Will not be added to any other reference frequency given by frequency command 2 and multistep frequency commands, etc.
2	Auxiliary frequency command 2	Auxiliary frequency input to be added to all reference frequencies given by frequency command 1, frequency command 2, multistep frequency commands, etc.
3	PID process command 1	Inputs command sources such as temperature and pressure under PID control 1 or 2. Function code setting also required: J102/202 = 1
4	PID process command 2	Inputs the second command sources under PID control 1 or 2. Function code setting also required: J102/202 = 1
5	PID feedback value 1	Inputs feedback amounts such as temperature and pressure under PID control 1 or 2.
12	Acceleration/deceleration time ratio setting	To be used for making ratio setting by analog input to acceleration/deceleration time.
13	Upper limit frequency	To be used for limiting the output frequency by analog input.
14	Lower limit frequency	
20	Analog signal input monitor	By inputting analog signals from various sensors such as the temperature sensors in air conditioners to the inverter, you can monitor the state of external devices via the communications link. By using an appropriate display coefficient, you can also have various values to be converted into physical quantities such as temperature and pressure before they are displayed.
30	PID feedback value 2	Inputs the 2nd feedback amounts under PID control 1 or 2.
31	Auxiliary input 1 to PID process command	Auxiliary analog input to be added to the process command under PID control 1 or 2.
32	Auxiliary input 2 to PID process command	2nd auxiliary analog input to be added to the process command under PID control 1 or 2.
33	Flowrate sensor	Input from the flowrate sensor.
41	External PID process command 1	Inputs command sources such as temperature and pressure under external PID control 1, 2 or 3. Function code setting also required: J502/J602/J652
42	External PID feedback value 1	Inputs feedback amounts such as temperature and pressure under external PID control 1, 2 or 3.
43	External PID manual command 1	To be used for setting PID output (MV) manually when external PID control 1 is canceled.

Data for E61, E62, or E63	Input assigned to [12], [C1] and [V2]:	Description
44	External PID process command 2	Inputs the 2nd command sources such as temperature and pressure under external PID control 2 or 3. Function code setting also required: J602/J652
45	External PID feedback value 2	Inputs the 2nd feedback amounts such as temperature and pressure under external PID control 2 or 3. Under external PID control 1, external PID feedback value 1 and addition, difference, average, maximum and minimum can be calculated.
46	External PID manual command 2	To be used for setting PID output (MV) manually when external PID control 2 is canceled.
47	External PID process command 3	Inputs the 3rd command sources such as temperature and pressure under external PID control 3. Function code setting also required: J652
48	External PID feedback value 3	Inputs the 3rd feedback amounts such as temperature and pressure under external PID control 3.
49	External PID manual command 3	To be used for setting PID output (MV) manually when external PID control 3 is canceled.

Note If these terminals have been set up to have the same data, the operation priority is given in the following order:

E61 > E62 > E63

E64 Saving of Digital Reference Frequency

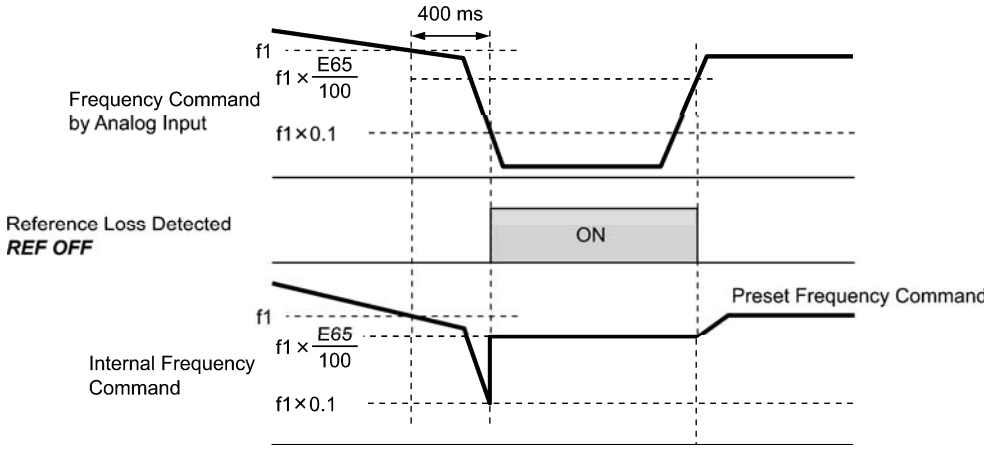
E64 specifies how to save the reference frequency specified in digital formats by the ⌃ / ⌄ / ⌫ / ⌦ keys on the keypad as shown below.

Data for E64	Function
0	Auto saving when the main power is turned OFF The reference frequency will be automatically saved when the main power is turned OFF. At the next power-on, the reference frequency at the time of the previous power-off applies.
1	Saving by pressing SET key Pressing the SET key saves the reference frequency. If the control power is turned OFF without pressing the SET key, the data will be lost. At the next power-ON, the inverter uses the reference frequency saved when the SET key was pressed last.

E65	Reference Loss Detection (Continuous running frequency)

When the analog frequency command (setting through terminal [12], [C1], or [V2]) has dropped below 10% of the reference frequency within 400 ms, the inverter presumes that the analog frequency command wire has been broken and continues its operation at the frequency determined by the ratio specified by E65 to the reference frequency. 🕮 Refer to E20 through E24 and E27 (data = 33).

When the frequency command level (in voltage or current) returns to a level higher than that specified by E65, the inverter presumes that the broken wire has been fixed and continues to run following the frequency command.



In the diagram above, f1 is the level of the analog frequency command sampled at any given time. The sampling is repeated at regular intervals to continually monitor the wiring connection of the analog frequency command.

- Data setting range: Decel (Decelerate to stop)
  20 to 120 %
  OFF (Cancel)

Note

Avoid an abrupt voltage or current change for the analog frequency command. An abrupt change may be interpreted as a wire break.

When E65 = OFF (Cancel), the inverter issues the ***REF OFF*** signal ("Reference loss detected") but does not change the reference frequency so that it runs at the analog frequency command as specified.

When E65 = "Decel" or OFF, the reference frequency level at which the broken wire is recognized as fixed is "f1 × 0.2."

When E65 = "100" (%) or higher, the reference frequency level at which the wire is recognized as fixed is "f1 × 1."

The reference loss detection is not affected by the setting of analog input adjustment (filter time constants: C33, C38, and C43).

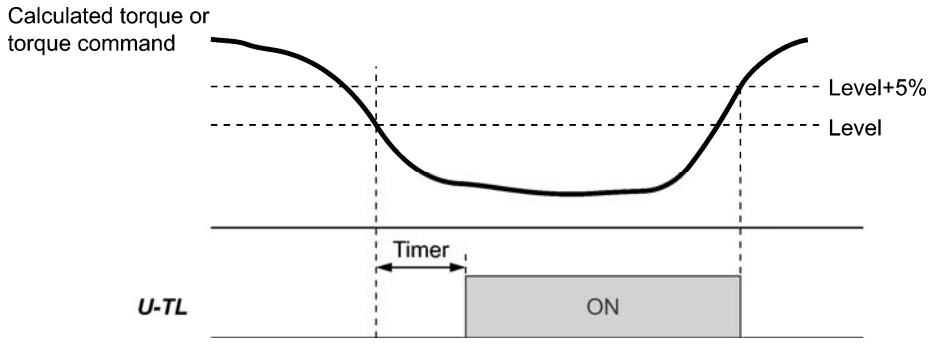
E80, E81 Low Torque Detection (Level and Timer)

E80 and E81 specify the operation level and the timer for the output signal *U-TL*, respectively.

Output signal	Assigned data	Operation level	Timer
		Range: 0 to 150%	Range: 0.01 to 600.00 s
U-TL	45	E80	E81

■ Low output torque detected -- ***U-TL***

This output signal comes ON when the torque value calculated by the inverter or torque command drops below the level specified by E80 (Low torque detection (Level)) for the period specified by E81 (Low torque detection (Timer)). The signal turns OFF when the calculated torque exceeds "the level specified by E80 plus 5% of the motor rated torque." The minimum ON-duration is 100 ms.



In the inverter's low frequency operation, as a substantial error in torque calculation occurs, no low torque can be detected within the operation range at less than 20% of the base frequency (F04). (In this case, the result of recognition before entering this operation range is retained.)

The *U-TL* signal goes off when the inverter is stopped.

Since the motor parameters are used in the calculation of torque, it is recommended that auto-tuning be applied by function code P04 to achieve higher accuracy.

E98, E99 Terminal [FWD] Function / Terminal [REV] Function (Refer to E01 to E07.)

For details about the configuration of terminals [FWD] and [REV], refer to the descriptions of E01 to E07.

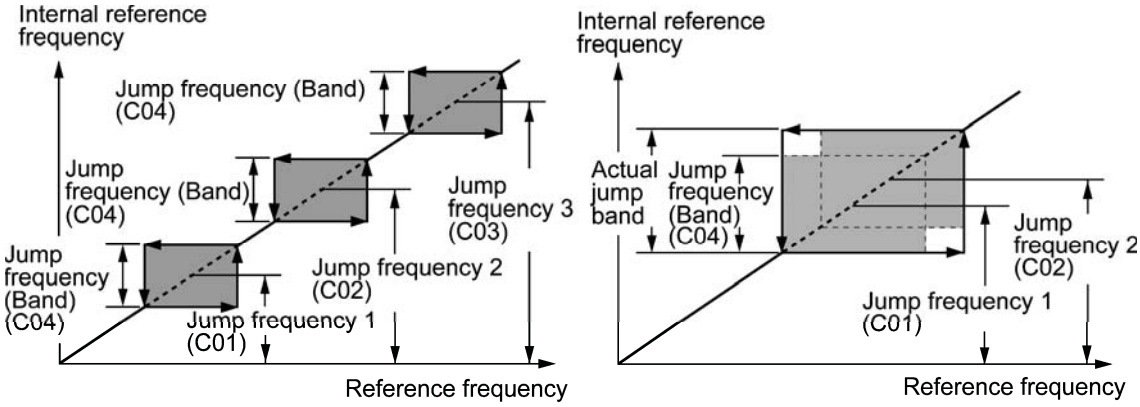
When [FWD] or [REV] is ON, it is not possible to change the E98 or E99 data, respectively.

5.1.3 C codes (Control functions)

C01 to C03 C04	Jump Frequency 1, 2 and 3 Jump Frequency (Hysteresis width)

These function codes enable the inverter to jump over three different points on the output frequency in order to skip resonance caused by the motor speed and natural frequency of the driven machinery (load).

- When the inverter is increasing the reference frequency, the moment the reference frequency reaches the bottom of the jump frequency band, the inverter keeps the output at that bottom frequency. When the reference frequency exceeds the upper limit of the jump frequency band, the internal reference frequency takes on the value of the reference frequency. When the inverter is decreasing the reference frequency, the situation will be reversed.
- When more than two jump frequency bands overlap, the inverter actually takes the lowest frequency within the overlapped bands as the bottom frequency and the highest as the upper limit. Refer to the figure on the lower right.



■ Jump frequencies 1, 2 and 3 (C01, C02 and C03)

Specify the center of the jump frequency band.

- Data setting range: 0.0 to 120.0 (Hz) (Setting to 0.0 results in no jump frequency band.)

■ Jump frequency hysteresis width (C04)

Specify the jump frequency hysteresis width.

- Data setting range: 0.0 to 30.0 (Hz) (Setting to 0.0 results in no jump frequency band.)

C05 to C19	Multistep frequency 1 to 15

These function codes specify 15 frequencies to apply when switching frequencies by turning terminal commands *SS1*, *SS2*, *SS4* and *SS8* ON or OFF selectively, as listed below.

Using this feature requires assigning *SS1*, *SS2*, *SS4* and *SS8* ("Select multistep frequency") to digital input terminals (data = 0, 1, 2, and 3) with E01 to E07 beforehand.

■ Multistep frequency 1 to 15 (C05 through C19)

- Data setting range: 0.00 to 120.00 (Hz)

The combination of *SS1*, *SS2*, *SS4* and *SS8* and the selected frequencies are as follows.

SS8	*SS4*	*SS2*	*SS1*	Selected frequency command
OFF	OFF	OFF	OFF	Other than multistep frequency *
OFF	OFF	OFF	ON	C05 (Multistep frequency 1)
OFF	OFF	ON	OFF	C06 (Multistep frequency 2)
OFF	OFF	ON	ON	C07 (Multistep frequency 3)
OFF	ON	OFF	OFF	C08 (Multistep frequency 4)
OFF	ON	OFF	ON	C09 (Multistep frequency 5)
OFF	ON	ON	OFF	C10 (Multistep frequency 6)
OFF	ON	ON	ON	C11 (Multistep frequency 7)
ON	OFF	OFF	OFF	C12 (Multistep frequency 8)
ON	OFF	OFF	ON	C13 (Multistep frequency 9)
ON	OFF	ON	OFF	C14 (Multistep frequency 10)
ON	OFF	ON	ON	C15 (Multistep frequency 11)
ON	ON	OFF	OFF	C16 (Multistep frequency 12)
ON	ON	OFF	ON	C17 (Multistep frequency 13)
ON	ON	ON	OFF	C18 (Multistep frequency 14)
ON	ON	ON	ON	C19 (Multistep frequency 15)

* "Other than multistep frequency" includes frequency command 1 (F01), frequency command 2 (C30) and other command sources except multistep frequency commands.

■ When PID control is disabled (***Hz/PID*** = ON)

Multistep frequency commands (15 steps) can also be used for a manual speed command.

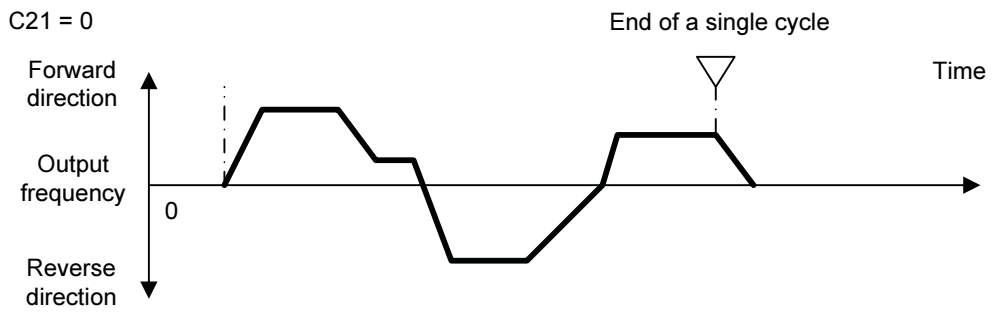
C21	Pattern Operation (Mode selection)

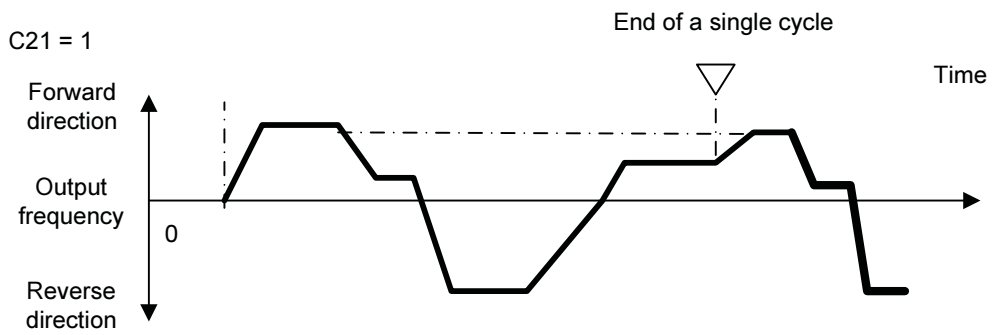
C21 specifies the mode of a pattern operation in which the inverter automatically runs the motor according to the preset running period, rotation direction, acceleration/deceleration time and reference frequency.

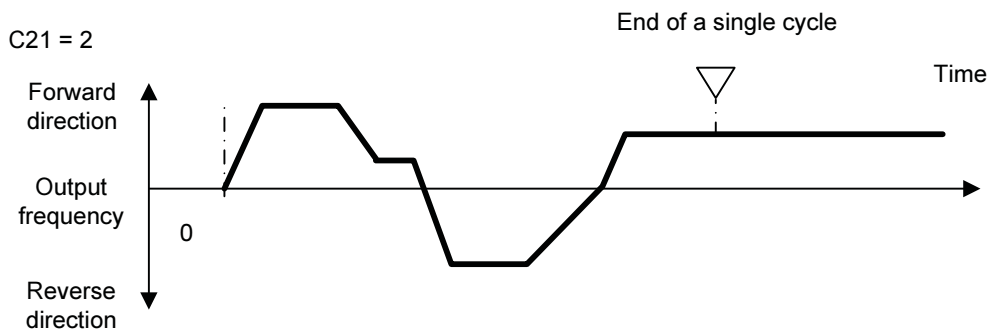
To use this function, set both F01 (Frequency command 1) and C30 (Frequency command 2) to "10" (Pattern operation).

The following three pattern operation modes are available.

Data for C21	Pattern Operation Modes
0	Carry out a single cycle of the specified pattern operation and stop the inverter output.
1	Carry out the specified pattern operation repeatedly and stop the inverter output upon receipt of a stop command.
2	Carry out a single cycle of the specified pattern operation and continue to run at the last reference frequency.







C22 to C28 Pattern Operation (Stages 1 to 7)

C22 to C28 configure stages 1 to 7, respectively, by setting the run time, motor rotation direction and acceleration/deceleration time for each stage.

The inverter runs in the order of stages 1 to 7 (in the order of C22 to C28).

Items to be Configured for Each Stage	Data Setting Range
Run time	0.00 to 6000.00 s (*)
Motor rotation direction	FWD: Forward direction (clockwise) REV: Reverse direction (counterclockwise)
Acceleration/deceleration time	1: F07 (Acceleration time 1), F08 (Deceleration time 1)
	2: E10 (Acceleration time 2), E11 (Deceleration time 2)
	3: E12 (Acceleration time 3), E13 (Deceleration time 3)
	4: E14 (Acceleration time 4), E15 (Deceleration time 4)

(*) The number of significant figures for the run time is 3. Upper three digits can be set.

Example: 100 F 3

- 3: Acceleration/deceleration time: Acceleration time 3, Deceleration time 3
- F: Motor rotation direction: Forward direction (counterclockwise)
- 100: Run time: 100 s

Setting the run time at "0.00 s" skips the corresponding stage to the next one.

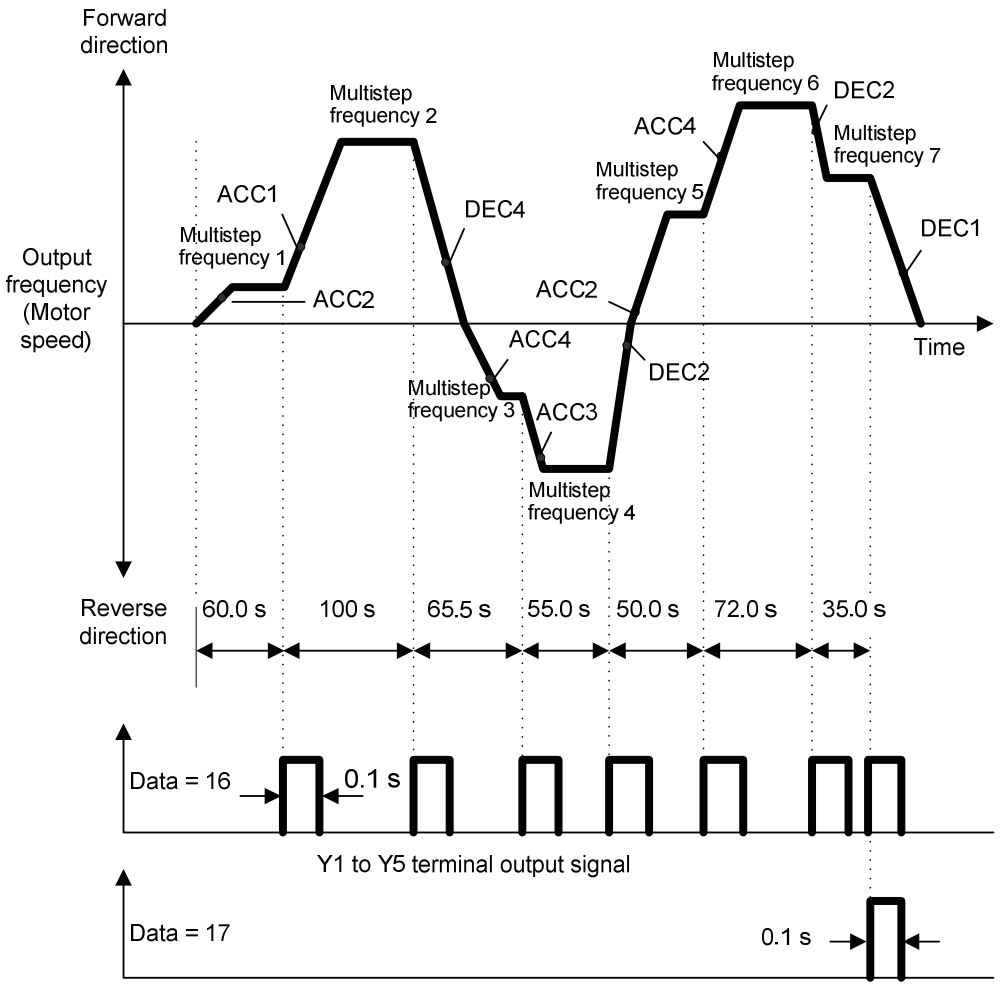
Reference frequencies to be applied in a pattern operation are multistep frequencies 1 to 7 (C05 to C11) assigned to stages 1 to 7, respectively, as listed below. Specify multistep frequencies with C05 to C11.

Stage No.	Reference frequency
Stage 1	C05 (Multistep frequency 1)
Stage 2	C06 (Multistep frequency 2)
Stage 3	C07 (Multistep frequency 3)
Stage 4	C08 (Multistep frequency 4)
Stage 5	C09 (Multistep frequency 5)
Stage 6	C10 (Multistep frequency 6)
Stage 7	C11 (Multistep frequency 7)

■ Pattern Operation Configuration Example

Function code	Setting data	Reference frequency
C21 (Mode selection)	1	--
C22 (Stage 1)	60.00 s FWD 2	C05 Multistep frequency 1
C23 (Stage 2)	100.00 s FWD 1	C06 Multistep frequency 2
C24 (Stage 3)	65.50 s REV 4	C07 Multistep frequency 3
C25 (Stage 4)	55.00 s REV 3	C08 Multistep frequency 4
C26 (Stage 5)	50.00 s FWD 2	C09 Multistep frequency 5
C27 (Stage 6)	72.00 s FWD 4	C10 Multistep frequency 6
C28 (Stage 7)	35.00 s FWD 2	C11 Multistep frequency 7

The above configuration example produces the operation shown in the chart below.



To start or stop a pattern operation, use the FWD / STOP keys on the keypad or turn the related input terminals ON/OFF.

When using the keypad, for example, press the FWD key to start a pattern operation. To stop the current stage temporarily, press the STOP key. Press the FWD key again to start the pattern operation from the stopped point of that stage.

Halfway through a pattern operation, to run the inverter from Stage 1 (C22), enter a stop command and then press the RESET key.

If the inverter stops due to an alarm, press the RESET key to cancel the inverter protective function and then press the FWD key again. The stopped stage starts again.

Note: Entry of a reverse rotation command with the (REV) key or terminal [REV] cancels the run command and produces no inverter operation. The rotation direction should be specified by the data of C21 to C28.

Note: When an pattern operation is commanded via input terminals, the self-hold function of a run command does not work. Use an alternate switch if necessary.

Note: After completion of a cycle of pattern operation, the inverter decelerates to a stop with the deceleration time specified by F08 (Deceleration time 1).

C30	Frequency Command 2 (Refer to F01.)

For details of frequency command 2, refer to the description of F01.

C31 to C35 C36 to C39 C41 to C45 C40	Analog Input Adjustment for [12] (Offset, Gain, Filter time constant, Gain base point, Polarity) Analog Input Adjustment for [C1] (Offset, Gain, Filter time constant, Gain base point) Analog Input Adjustment for [V2] (Offset, Gain, Filter time constant, Gain base point, Polarity) Terminal [C1] Input Range Selection F01 (Frequency Command 1)

Setting up a reference frequency using analog input

You can adjust the gain, polarity, filter time constant, and offset which are applied to analog inputs (voltage inputs to terminals [12] and [V2], and current input to terminal [C1]).

Adjustable items for analog inputs

Input terminal	Input range	Gain		Polarity	Filter time constant	Offset	Terminal [C1] input range
		Gain	Base point				
[12]	0 to +10 V, -10 to +10 V	C32	C34	C35	C33	C31	—
[C1]	4 to 20 mA	C37	C39	—	C38	C36	C40
[V2]	0 to +10 V, -10 to +10 V	C42	C44	C45	C43	C41	—

■ Offset (C31, C36, C41)

C31, C36 or C41 configures an offset for an analog voltage/current input. The offset also applies to signals sent from the external equipment.

- Data setting range: -5.0 to +5.0 (%)

■ Filter time constant (C33, C38, C43)

C33, C38 or C43 configures a filter time constant for an analog voltage/current input. The larger the time constant, the slower the response. Specify the proper filter time constant taking into account the response speed of the machine (load). If the input voltage fluctuates due to line noises, increase the time constant.

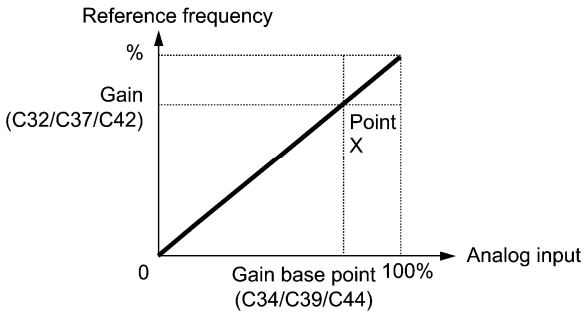
- Data setting range: 0.00 to 5.00 (s)

■ Polarity (C35, C45)

C35 and C45 configure the input range for analog input voltage.

Data for C35 and C45	Specifications for terminal inputs
0	-10 to +10 V
1	0 to +10 V (A minus component of the input will be regarded as 0 VDC.)

■ Gain (C32, C37, C42)



Note To input bipolar analog voltage (0 to ±10 VDC) to terminals [12] and [V2], set C35 and C45 data to "0." Setting C35 and C45 data to "1" enables the voltage range from 0 to +10 VDC and interprets the negative polarity input from 0 to -10 VDC as 0 V.

■ Terminal [C1] input range selection (C40)

C40 specifies the input range of terminal [C1] (analog input current).

Data for C40	Terminal [C1] input range
0	4 to 20 mA (factory default)
1	0 to 20 mA

C53 Selection of Normal/Inverse Operation (Frequency command 1)

C53 switches the reference frequency sourced by frequency command 1 (F01) between normal and inverse.

📖 For details, refer to E01 through E07 (data = 21) for the terminal command *IVS* ("Switch normal/inverse operation").

C55 Analog Input Adjustment for Terminal [12] (Bias value) (Refer to F01.)

C55 specifies a bias value to apply to terminal [12] input of reference frequency 2, analog input monitor and PID control input. For details, refer to the description of F01.

C56 Analog Input Adjustment for Terminal [12] (Bias base point) (Refer to F01.)

C56 specifies a bias base point for Reference frequency 2 and analog input monitor terminal [12]. For details, refer to the description of F01.

C58 Analog Input Adjustment for Terminal [12] (Display unit)

C58 specifies the display unit for analog input monitor, PID control commands and feedback amounts on terminal [12].

The specified display unit appears when analog input monitor, SV and PV are displayed on the main or sub monitor.

Data for C58	Display unit	Data for C58	Display unit	Data for C58	Display unit
1	No display unit	24	L/min (Flowrate)	46	Psi (Pressure)
2	%	25	L/h (Flowrate)	47	mWG (Pressure)
4	r/min	40	Pa (Pressure)	48	inWG (Pressure)
7	kW	41	kPa (Pressure)	60	K (Temperature)
20	m^3/s (Flowrate)	42	MPa (Pressure)	61	°C (Temperature)
21	m^3/min (Flowrate)	43	mbar (Pressure)	62	°F (Temperature)
22	m^3/h (Flowrate)	44	bar (Pressure)	80	ppm (Density)
23	L/s (Flowrate)	45	mmHg (Pressure)		

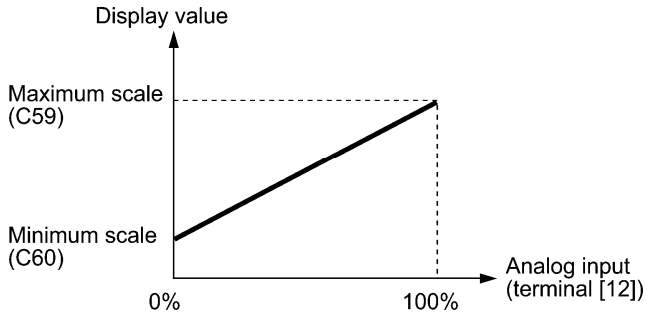
<u>Setting up an analog input monitor for terminal [12]</u>

1) Input monitor
   Set E61 (Terminal [12] extended function) to "20."
2) Display section
   Set any of K10 (Main monitor display), K16 (Sub monitor 1 display) and K17 (Sub monitor 2 display) to "27" (Analog input monitor).
   For details, refer to Chapter 5, Section 5.5.1 "Monitoring the running status."
3) Display unit
   Select the desired display unit with C58.
4) Scale
   - Maximum scale (C59): Set a physical quantity to be displayed when the analog input value is 100%.
   - Minimum scale (C60): Set a physical quantity to be displayed when the analog input value is 0%.

C59, C60 Analog Input Adjustment for Terminal [12] (Maximum scale, Minimum scale)

C59 and C60 specify the maximum and minimum scales to display easy-to-understand physical quantity converted from analog input on terminal [12].

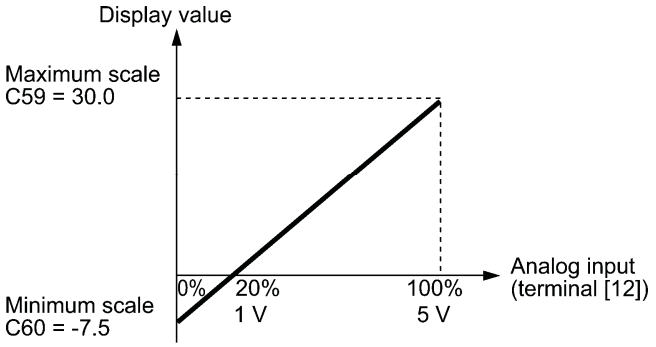
- Data setting range: -999.00 to 0.00 to 9990.00 for maximum and minimum scales



Example: To detect 0 to 30 kPa with 1 to 5 V output of the pressure sensor

1) Input monitor
   Set E61 (Terminal [12] extended function) to "20."
2) Gain
   To interpret 5V as 100%, set the gain to 200% (C32 = 100%, C34 = 50%).
3) Scale
   - Maximum scale (C59): Set 30.0 to be displayed when the analog input value on terminal [12] is 100%.
   - Minimum scale (C60): Set -7.5 to be displayed when the analog input value on terminal [12] is 0%.

*The display unit should be selected with C58.



C61	Analog Input Adjustment for Terminal [C1] (Bias value) (Refer to F01.)

C61 specifies a bias value to Reference frequency 2 and analog input monitor terminal [C1]. For details, refer to the description of F01.

C62	Analog Input Adjustment for Terminal [C1] (Bias base point) (Refer to F01.)

C62 specifies a bias base point for Reference frequency 2 and analog input monitor terminal [C1]. For details, refer to the description of F01.

C64 Analog Input Adjustment for Terminal [C1] (Display unit)

C64 specifies the display unit for analog input monitor, PID control commands and feedback amounts on terminal [C1].

The specified display unit appears when analog input monitor, SV and PV are displayed on the main or sub monitor.

Data for C64	Display unit	Data for C64	Display unit	Data for C64	Display unit
1	No display unit	24	L/min (Flowrate)	46	Psi (Pressure)
2	%	25	L/h (Flowrate)	47	mWG (Pressure)
4	r/min	40	Pa (Pressure)	48	inWG (Pressure)
7	kW	41	kPa (Pressure)	60	K (Temperature)
20	m^3/s (Flowrate)	42	MPa (Pressure)	61	°C (Temperature)
21	m^3/min (Flowrate)	43	mbar (Pressure)	62	°F (Temperature)
22	m^3/h (Flowrate)	44	bar (Pressure)	80	ppm (Density)
23	L/s (Flowrate)	45	mmHg (Pressure)		

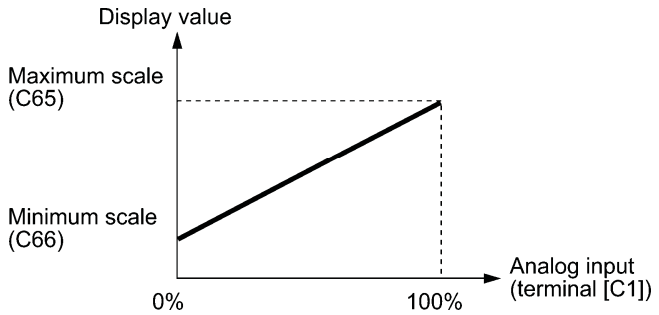
<u>Setting up an analog input monitor for terminal [C1]</u>

1) Input monitor
   Set E62 (Terminal [C1] extended function) to "20."
2) Display section
   Set any of K10 (Main monitor display), K16 (Sub monitor 1 display) and K17 (Sub monitor 2 display) to "27" (Analog input monitor).
   For details, refer to Chapter 5, Section 5.5.1 "Monitoring the running status."
3) Display unit
   Select the desired display unit with C64.
4) Scale
   - Maximum scale (C65): Set a physical quantity to be displayed when the analog input value is 100%.
   - Minimum scale (C66): Set a physical quantity to be displayed when the analog input value is 0%.

C65, C66 Analog Input Adjustment for Terminal [C1] (Maximum scale, Minimum scale)

C65 and C66 specify the maximum and minimum scales to display easy-to-understand physical quantity converted from analog input on terminal [C1].

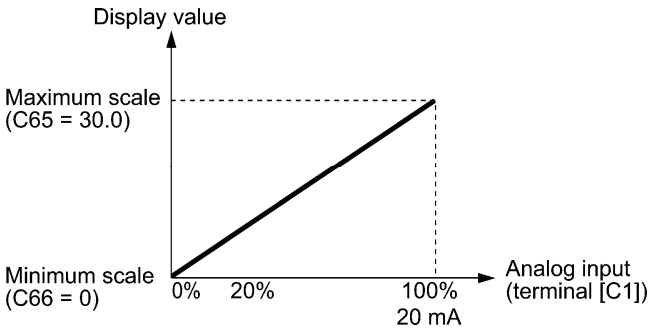
- Data setting range: -999.00 to 0.00 to 9990.00 for maximum and minimum scales



Example: To detect 0 to 30 kPa with 4 to 20 mA output of the pressure sensor

1) Input monitor
   Set E62 (Terminal [C1] extended function) to "20."
2) Scale
   - Maximum scale (C65): Set 30.0 to be displayed when the analog input value on terminal [C1] is 100%.
   - Minimum scale (C66): Set 0 to be displayed when the analog input value on terminal [C1] is 0%.

*The display unit should be selected with C64.



C67	Analog Input Adjustment for Terminal [V2] (Bias value) (Refer to F01.)

C67 specifies a bias value to Reference frequency 2 and analog input monitor terminal [V2]. For details, refer to the description of F01.

C68	Analog Input Adjustment for Terminal [V2] (Bias base point) (Refer to F01.)

C68 specifies a bias base point for Reference frequency 2 and analog input monitor terminal [V2]. For details, refer to the description of F01.

C70	Analog Input Adjustment for Terminal [V2] (Display unit)

C70 specifies the display unit for analog input monitor, PID control commands and feedback amounts on terminal [V2].

The specified display unit appears when analog input monitor, SV and PV are displayed on the main or sub monitor.

Data for C70	Display unit	Data for C70	Display unit	Data for C70	Display unit
1	No display unit	24	L/min (Flowrate)	46	Psi (Pressure)
2	%	25	L/h (Flowrate)	47	mWG (Pressure)
4	r/min	40	Pa (Pressure)	48	inWG (Pressure)
7	kW	41	kPa (Pressure)	60	K (Temperature)
20	m^3/s (Flowrate)	42	MPa (Pressure)	61	°C (Temperature)
21	m^3/min (Flowrate)	43	mbar (Pressure)	62	°F (Temperature)
22	m^3/h (Flowrate)	44	bar (Pressure)	80	ppm (Density)
23	L/s (Flowrate)	45	mmHg (Pressure)		

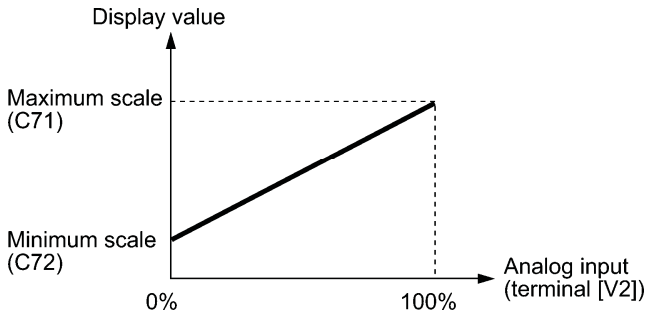
Setting up an analog input monitor for terminal [V2]

1) Input monitor
   Set E63 (Terminal [V2] extended function) to "20."
2) Display section
   Set any of K10 (Main monitor display), K16 (Sub monitor 1 display) and K17 (Sub monitor 2 display) to "27" (Analog input monitor).
   For details, refer to Chapter 5, Section 5.5.1 "Monitoring the running status."
3) Display unit
   Select the desired display unit with C70.
4) Scale
   - Maximum scale (C71): Set a physical quantity to be displayed when the analog input value is 100%.
   - Minimum scale (C72): Set a physical quantity to be displayed when the analog input value is 0%.

C71, C72	Analog Input Adjustment for Terminal [V2] (Maximum scale, Minimum scale)

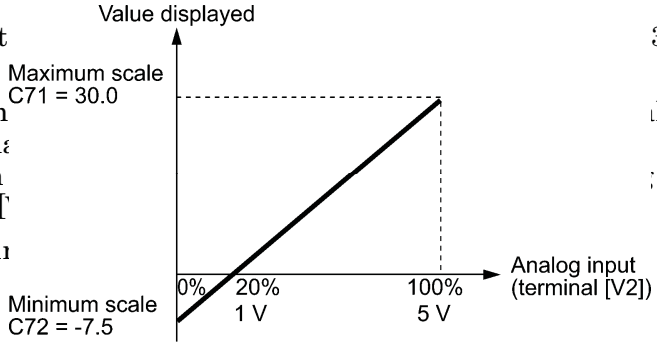
C71 and C72 specify the maximum and minimum scales to display easy-to-understand physical quantity converted from analog input on terminal [V2].

- Data setting range: -999.00 to 0.00 to 9990.00 for maximum and minimum scales



Example: To detect 0 to 30 kPa with 1 to 5 V output of the pressure sensor

1) Input monitor
   Set E63 (Terminal [V2] extended function) to "20."
2) Gain
   To interpret 34 = 50%).
3) Scale
   - Maximum log input value on termina
   - Minimum input value on terminal [
*The display u



5.1.4 P codes (Motor 1 parameters)

To use the integrated automatic control functions such as auto torque boost, torque calculation monitoring, torque limiter, automatic deceleration (anti-regenerative control), auto search for idling motor speed, slip compensation, and torque vector control, it is necessary to build a motor model in the inverter by specifying proper motor parameters including the motor capacity and rated current.

P01	Motor 1 (No. of poles)

P01 specifies the number of poles of the motor. Enter the value given on the nameplate of the motor. This setting is used to display the motor speed on the LCD monitor and to control the speed (refer to E43). The following expression is used for the conversion.

$$\text{Motor speed (r/min)} = \frac{120}{\text{No. of poles}} \times \text{Frequency (Hz)}$$

- Data setting range: 2 to 22 (poles)

P02	Motor 1 (Rated capacity)

P02 specifies the rated capacity of the motor. Enter the rated value given on the nameplate of the motor.

Data for P02	Unit	Dependency on function code P99
0.01 to 1000.00	kW	When P99 (Motor 1 Selection) = 0 or 4
	HP	When P99 (Motor 1 Selection) = 1

When accessing P02 with the keypad, take into account that the P02 data automatically updates data of P03, P06 through P12, and H46.

P03	Motor 1 (Rated current)

P03 specifies the rated current of the motor. Enter the rated value given on the nameplate of the motor.

- Data setting range: 0.00 to 2000.00 (A)

P04 Motor 1 (Auto-tuning)

The inverter automatically detects the motor constants and saves them as parameters in its internal memory. Basically, no tuning is required as long as a standard motor is used with standard connection with the inverter.

There are two types of auto-tuning as listed below. Select appropriate one considering the limitations in your equipment and control mode.

Data for P04	Auto-tuning	Operation	Motor parameters to be tuned
0	Disable	N/A	N/A
1	Tune the motor while it is stopped	Tunes while the motor is stopped.	Primary resistance (%R1) (P07) Leakage reactance (%X) (P08)
2	Tune the motor while it is rotating under V/f control	After tuning the motor in a stopped state, retunes it running at 50% of the base frequency.	No-load current (P06) Primary resistance (%R1) (P07) Leakage reactance (%X) (P08)

📖 For details of auto-tuning, refer to the Chapter 4 "Preparation and Test Run."

Note In any of the following cases, perform auto-tuning since the motor parameters are different from standard ones so that the full performance may not be obtained under some controls.

- The motor to be driven is non-standard.
- Cabling between the motor and the inverter is long. (Generally, 20 m or longer)
- A reactor is inserted between the motor and the inverter.

Note When the terminal command ***RST*** ("Reset alarm") is ON, it is not possible to change the P04 setting. Turn the ***RST*** OFF beforehand.

📖 Refer to E01 to E07, E98 and E99 (data = 8).

■ Functions in which the motor parameters affect the running capability

Function	Related function codes (representative)
Auto torque boost	F37
Output torque monitor	F31, F35
Load factor monitor	F31, F35
Auto energy saving operation	F37
Torque limiter	F40, F41, E16, E17
Anti-regenerative control (Automatic deceleration)	H69
Auto search	H09
Slip compensation	F42
Dynamic torque vector control	F42

P05	Motor 1 (Online tuning)

Long run under "Dynamic torque vector control" or "Slip compensation control" causes motor temperature change, varying the motor parameters. This changes the motor speed compensation amount, resulting in motor speed deviation from the initial rpm.

Enabling online tuning (P05 = 1) identifies motor parameters covering the motor temperature change to decrease the motor speed fluctuation.

To perform online tuning enabled with P05, set P04 (Auto-tuning) to "2."

Note: Online tuning can be performed only when F42 = 1 (Dynamic torque vector control) or when F42 = 2 (V/f control with slip compensation active) and F37 = 2 or 5 (Auto torque boost).

P06 to P08	Motor 1 (No-load current, %R1 and %X)

P06 through P08 specify no-load current, %R1 and %X, respectively. Obtain the appropriate values from the test report of the motor or by calling the motor manufacturer.

Performing auto-tuning automatically sets these parameters.

■ No-load current (P06)

Enter the value obtained from the motor manufacturer.

■ %R1 (P07)

Enter the value calculated by the following expression.

$$\%R1 = \frac{R1 + \text{Cable } R1}{V / (\sqrt{3} \times I)} \times 100\ (\%)$$

where,

R1: Primary resistance of the motor (Ω)
Cable R1: Resistance of the output cable (Ω)
V: Rated voltage of the motor (V)
I: Rated current of the motor (A)

■ %X (P08)

Enter the value calculated by the following expression.

$$\%X = \frac{X1 + X2 \times XM / (X2 + XM) + \text{Cable } X}{V / (\sqrt{3} \times I)} \times 100\ (\%)$$

where,

X1: Primary leakage reactance of the motor (Ω)
X2: Secondary leakage reactance of the motor (converted to primary) (Ω)
XM: Exciting reactance of the motor (Ω)
Cable X: Reactance of the output cable (Ω)
V: Rated voltage of the motor (V)
I: Rated current of the motor (A)

Note: For reactance, use the value at the base frequency (F04).

P10 Motor 1 (Slip compensation response time)

P10 determines the response time for slip compensation. Basically, there is no need to modify the default setting. If you need to modify it, consult your IMO.

📖 For details about slip compensation control, refer to the description of F42.

P12 Motor 1 (Rated slip frequency)

P12 specifies rated slip frequency. Obtain the appropriate values from the test report of the motor or by calling the manufacturer of the motor. Performing auto-tuning automatically sets these parameters.

・Rated slip frequency: Convert the value obtained from the motor manufacturer to Hz using the following expression and enter the converted value.

(Note: The motor rating given on the nameplate sometimes shows a larger value.)

$$\text{Rated slip frequency (Hz)} = \frac{\text{(Synchronous speed - Rated speed)}}{\text{Synchronous speed}} \times \text{Base frequency}$$

📖 For details about slip compensation control, refer to the description of F42.

P99 Motor 1 Selection

P99 specifies the type of motor 1 to be used.

Data for P99	Motor type
0	Motor characteristics 0 (Fuji standard motors, 8-series)
1	Motor characteristics 1 (HP rating motors)
4	Other motors

To select the motor drive control or to run the inverter with the integrated automatic control functions such as auto torque boost and torque calculation monitoring, it is necessary to specify the motor parameters correctly.

First select the Fuji standard motors 8-series with P99, next specify the motor rated capacity with P02, and then initialize the motor parameters with H03. This process automatically configures the related motor parameters (P01, P03, P06 through P08, P10, P12, and H46).

The data of F09 (Torque boost 1), H13 (Restart Mode after Momentary Power Failure (Restart time)), and F11 (Electronic thermal overload protection for motor 1 (Overload detection level)) depends on the motor capacity, but the process stated above does not change them. Specify and adjust the data during a test run if needed.

5.1.5 H codes (High performance functions)

H03	Data Initialization

This code initializes the current function code data to the factory defaults. To change function code H03 data, it is necessary to press STOP + ⌃ keys or STOP + ⌄ keys (simultaneous keying).

Data for H03	Function
0	Disable initialization (Settings manually made by the user will be retained.)
1	Initialize all function code data to factory defaults
2	Initialize motor 1 parameters in accordance with P02 (Rated capacity) and P99 (Motor 1 selection)
10	Initialize real-time clock information
11	Initialize function code data except communication function codes
12	Initialize U codes (Customizable logic function codes)
71	Initialize according to application (Compressor)
72	Initialize according to application (Fan)

■ Initialize all function code data to factory defaults (H03 = 1)

Initialize all function code data to the factory defaults.

■ Initialize motor 1 parameters (H03 = 2)

Set function codes as follows.

(1) Function code P99 (motor 1 selection): Selects the motor type.

(2) Function code P02 (motor 1 (capacity): Sets the motor capacity (kW).

(3) Function code H03 (data initialization): H03 = 2

⇒ Function codes to be initialized: P01, P03, P06 to P12, H46

- Upon completion of the initialization, the H03 data reverts to "0" (factory default).
- If function code P02 data is set to a value other than the standard nominal applied motor rating, data initialization internally converts the specified value forcibly to the standard nominal applied motor rating. (See Table B given on the last page in Section 5.1 "Function Code Tables.")
- The motor parameters to be initialized are those regarding the voltage and frequency settings below. When the base frequency, rated voltage, and the number of poles are different from those of the listed motors, or when non-standard motors are used, change the rated current data to that printed on the motor nameplate.

Motor selection		V/f setting
Data = 0 or 4	Fuji standard motors, 8-series	4 poles 400 V/50 Hz
Data = 1	HP rating motors	4 poles 460 V/60 Hz

Note When accessing function code P02 with the keypad, take into account that P02 data automatically updates data of function codes P03, P06 through P12, and H46.

■ Initialize real-time clock information (H03 = 10)

Initializes the real-time clock (RTC) information set by PRG > 1(Start-up) > 2(Date/Time) > 1(Adjust).

■ Initialize function code data except communication function codes (H03 = 11)

The function codes other than the communication function codes (y codes) are initialized.

■ Initialize U code data (H03 = 12)

Initializes the customizable logic (U code) data. Any other function code data are not initialized.

■ Initialize according to application (H03 = 71, 72)

H03 initializes data of the specified function codes to the values required for application such as drive control and control objects. Function codes for quick setup also change according to application.

This application-specific initialization is convenient for pump control.

H03 initializes data of function codes not listed below will be initialized to the factory defaults.

When H03 = 71 (Initialize according to application (Compressor))

Object function codes	Initialize to:
F02: Operation Method	1: External signals (Terminal command ***FWD*** or ***REV***)
F07: Acceleration Time 1	20.0 s (3.00 s in early versions)
F08: Deceleration Time 1	20.0 s (3.00 s in early versions)
F14: Restart Mode after Momentary Power Failure (Mode selection)	3: Continue to run, for heavy inertia or general loads
F15: Frequency Limiter (High)	50.0 Hz
F16: Frequency Limiter (Low)	25.0 Hz
F26: Motor Sound (Carrier frequency)	3 kHz
F35: Pulse Output [FM2] (Function)	2: Output current
F42: Drive Control Selection 1	1: Dynamic torque vector control
E06: Terminal [X6] Function	171: PID multistep command 1 (***PID-SS1***)
E07: Terminal [X7] Function	172: PID multistep command 2 (***PID-SS2***)
E62: Terminal [C1] Extended Function	5: PID feedback value 1
E63: Terminal [V2] Extended Function	32: Auxiliary input 2 to PID process command
C64: Analog Input Adjustment for Terminal [C1] (Display unit)	44: bar
C65: Analog Input Adjustment for Terminal [C1] (Maximum scale)	10.00
H09: Starting Mode (Auto search)	2: Enable (At restart after momentary power failure and at normal start)
H91: Current Input Wire Break Detection	0.5 s
J101: PID Control 1 (Mode selection)	1: Enable (Process control, normal operation)
J110: PID Control 1 P (Gain)	2.500 times
J111: PID Control 1 I (Integral time)	0.2 s
K10: Main Monitor (Display item selection)	51: PID feedback amount (final) in physical quantity
K16: Sub Monitor 1 (Display item selection)	50: PID command (final) in physical quantity
K17: Sub Monitor 2 (Display item selection)	1: Output frequency (51: PID feedback amount in early versions)
K91: Shortcut Key Function	61: PID monitor
K92: Shortcut Key Function	32: Operation monitor

When H03 = 72 (Initialize according to application (Fan))

Object function codes	Initialize to:
F02: Operation Method	1: External signals (Terminal command ***FWD*** or ***REV***)
F07: Acceleration Time 1	20.0 s (3.00 s in early versions)
F08: Deceleration Time 1	20.0 s (3.00 s in early versions)
F14: Restart Mode after Momentary Power Failure (Mode selection)	3: Continue to run, for heavy inertia or general loads
F15: Frequency Limiter (High)	50.0 Hz
F16: Frequency Limiter (Low)	20.0 Hz
F26: Motor Sound (Carrier frequency)	3 kHz
F35: Pulse Output [FM2] (Function)	2: Output current
F37: Load Selection	3: Auto energy saving (Variable torque load during ACC/DEC)
F42: Drive Control Selection 1	1: Dynamic torque vector control
H09: Starting Mode (Auto search)	2: Enable (At restart after momentary power failure and at normal start)
H69: Automatic Deceleration (Mode selection)	5: DC link bus voltage control with Force-to-stop disabled
H71: Deceleration Characteristics	1: Enable
K91: Shortcut Key Function	61: PID monitor
K92: Shortcut Key Function	32: Operation monitor

Function codes for quick setup, subject to application-specific initialization

The table below lists function codes for quick setup which are subject to application-specific initialization.

Y: Target for quick setup

Object function codes	Data for H03	
	71	72
F01: Frequency Command 1	Y	Y
F02: Operation Method	Y	Y
F03: Maximum Frequency 1	Y	Y
F04: Base Frequency 1	Y	Y
F05: Rated Voltage at Base Frequency 1	Y	Y
F06: Maximum Output Voltage 1	Y	Y
F07: Acceleration Time 1	Y	Y
F08: Deceleration Time 1	Y	Y
F09: Torque Boost 1	-	-
F14: Restart Mode after Momentary Power Failure (Mode selection)	Y	Y
F15: Frequency Limiter (High)	Y	Y
F16: Frequency Limiter (Low)	Y	Y
F35: Pulse Output [FM2] (Function)	Y	Y
F37: Load Selection	Y	Y
C64: Analog Input Adjustment for Terminal [C1] (Display unit)	Y	Y

Object function codes	Data for H03	
	71	72
C65: Analog Input Adjustment for Terminal [C1] (Maximum scale)	Y	Y
C66: Analog Input Adjustment for Terminal [C1] (Minimum scale)	Y	Y
P02: Motor 1 (Rated capacity)	Y	Y
P03: Motor 1 (Rated current)	Y	Y
P04: Motor 1 (Auto-tuning)	Y	Y
P99: Motor 1 Selection	Y	Y
H09: Starting Mode (Auto search)	Y	Y
H69: Automatic Deceleration (Mode selection)	-	Y
H71: Deceleration Characteristics	-	Y
J102: PID Control 1 (Command selection)	Y	-
J103: PID Control 1 (Feedback selection)	Y	-
J110: PID Control 1 P (Gain)	Y	-
J111: PID Control 1 I (Integral time)	Y	-
K16: Sub Monitor 1 (Display item selection)	Y	Y
K17: Sub Monitor 2 (Display item selection)	Y	Y

H04, H05 Auto-reset (Times and Reset interval)

H04 and H05 specify the auto-reset function that makes the inverter automatically attempt to reset the tripped state and restart without issuing an alarm output (for any alarm) even if any protective function subject to reset is activated and the inverter enters the forced-to-stop state (tripped state).

If the protective function is activated in excess of the times specified by H04, the inverter will issue an alarm output (for any alarm) and not attempt to auto-reset the tripped state.

Listed below are the protective functions subject to auto-reset.

Protective function	Alarm codes	Protective function	Alarm codes
Overcurrent protection	OC1, OC2 or OC3	Undervoltage	LV
Overvoltage protection	OV1, OV2 or OV3	Motor overheat	OH4
Heat sink overheat	OH1	External alarm	OH2
Inverter internal overheat	OH3	Motor overload	OL1
Inverter overload	OLU		

■ Number of reset times (H04)

H04 specifies the number of reset times for the inverter to automatically attempt to escape the tripped state. When H04 = 0, the auto-reset function will not be activated.

- Data setting range: OFF (Disable), 1 to 20 (times)

⚠WARNING

If the "auto-reset" function has been specified, the inverter may automatically restart and run the motor stopped due to a trip fault, depending on the cause of the tripping.

Design the machinery so that human body and peripheral equipment safety is ensured even when the auto-resetting succeeds.

Otherwise an accident could occur.

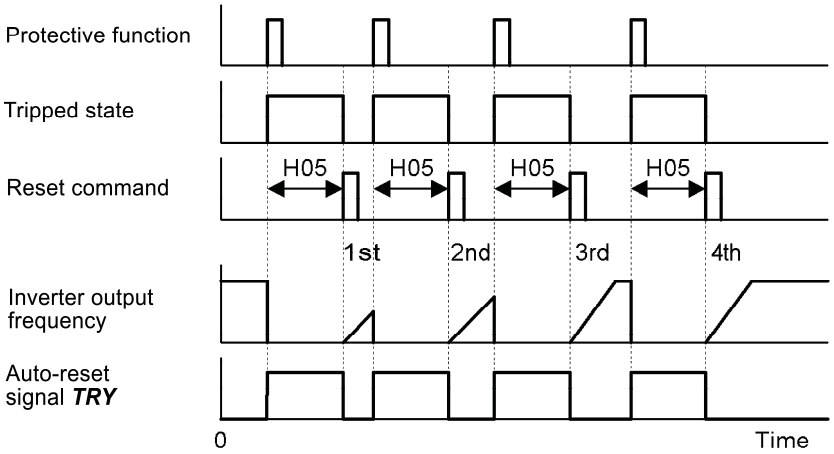
■ Reset interval (H05)

- Data setting range: 0.5 to 600.0 (s)

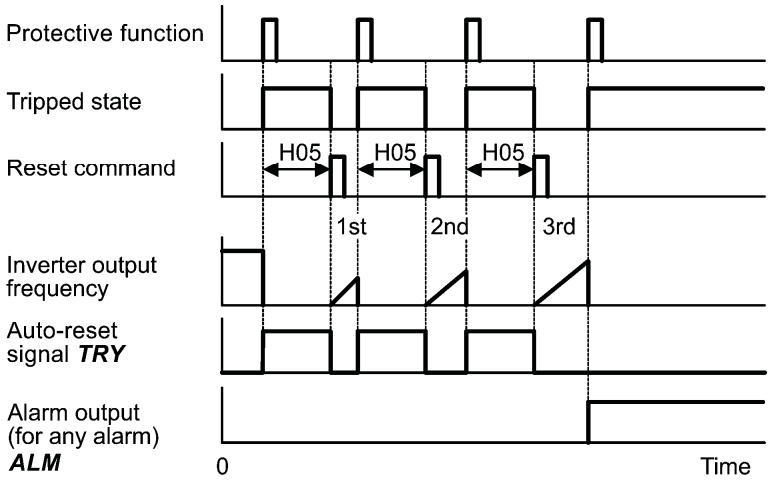
H05 specifies the reset interval time from when the inverter enters the tripped state until it issues the reset command to attempt to auto-reset the state. Refer to the timing scheme diagrams below.

<Operation timing scheme>

・In the figure below, normal operation restarts in the 4th retry.



・In the figure below, the inverter fails to restart normal operation within the number of reset times specified by H04 (in this case, 3 times (H04 = 3)), and issues the alarm output (for any alarm) *ALM*.



The auto-reset operation can be monitored from the external equipment by assigning the digital output signal *TRY* to any of the programmable, output terminals [Y1] to [Y4], [Y5A/C], and [30A/B/C] with any of E20 through E24 and E27 (data = 26).

H06 Cooling Fan ON/OFF Control

To prolong the service life of the cooling fan and reduce fan noise during running, the cooling fan stops when the temperature inside the inverter drops below a certain level while the inverter stops.

H06 specifies whether to keep running the cooling fan all the time or to control its ON/OFF.

Data for H06	Cooling fan ON/OFF
0	Disable (Always in operation)
1	Enable (ON/OFF controllable)

■ Cooling fan in operation -- ***FAN*** (E20 to E24 and E27, data = 25)

With the cooling fan ON/OFF control enabled (H06 = 1), this output signal is ON when the cooling fan is in operation, and OFF when it is stopped. This signal can be used to make the cooling system of peripheral equipment interlocked for an ON/OFF control

H07 Acceleration/Deceleration Pattern (Refer to F07.)

For details, refer to the description of F07.

H08 Rotational Direction Limitation

H08 inhibits the motor from running in an unexpected rotational direction due to miss-operation of run commands, miss-polarization of frequency commands, or other mistakes.

Data for H08	Function
0	Disable
1	Enable (Reverse rotation inhibited, both of setting and output)
2	Enable (Forward rotation inhibited, both of setting and output)
3	Enable (Reverse rotation inhibited, setting only)
4	Enable (Forward rotation inhibited, setting only)

H09 Starting Mode (Auto search) H49 (Starting Mode, Auto search delay time 1) H46 (Starting Mode, Auto search delay time 2)

H09 specifies the starting mode--whether to enable the auto search for idling motor speed to run the idling motor without stopping it.

The auto search can apply to the restart of the inverter after a momentary power failure and the normal startup of the inverter individually.

If the terminal command ***STM*** ("Enable auto search for idling motor speed at starting") is assigned to a digital input terminal with any of E01 to E07 (data = 26), then the combination of the H09 data and the ***STM*** status switches the starting modes (whether auto search is enabled or disabled). If no ***STM*** is assigned, the inverter interprets ***STM*** as being OFF by default.

■ H09 (Starting mode, auto search) and terminal command ***STM***
("Enable auto search for idling motor speed at starting")

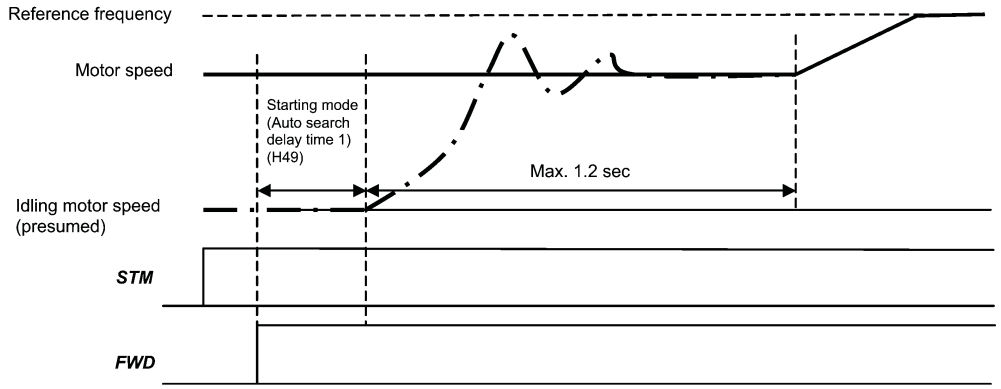
The combination of H09 data and the *STM* status determines whether to perform auto search as listed below.

STM	Data for H09	Auto search for idling motor speed at starting	
		For restart after momentary power failure (F14 = 3 to 5)	For normal startup
OFF	0: Disable	Disable	Disable
	1: Enable	Enable	Disable
	2: Enable	Enable	Enable
ON	—	Enable	Enable

When *STM* is ON, auto search for idling motor speed at starting is enabled regardless of the H09/d67 setting. 🕮 Refer to E01 to E07 (data = 26).

Auto search for idling motor speed

Starting the inverter (with a run command ON, *BX* OFF, auto-reset, etc.) with *STM* being ON searches for the idling motor speed for a maximum of 1.2 seconds to run the idling motor without stopping it. After completion of the auto search, the inverter accelerates the motor up to the reference frequency according to the frequency command and the preset acceleration time.



Auto search for idling motor speed to follow

■ Starting Mode (Auto search delay time 1) (H49)

- Data setting range: 0.0 to 10.0 (s)

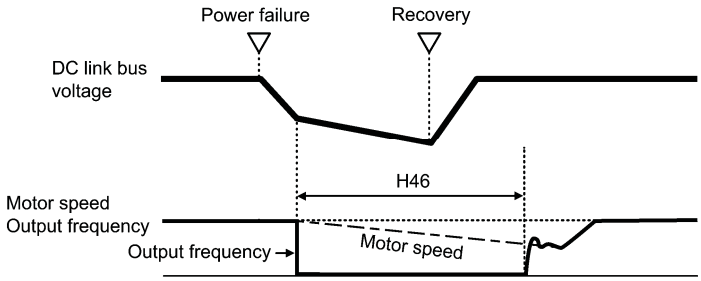
Auto search for the idling motor speed will become unsuccessful if it is done while the motor retains residual voltage. It is, therefore, necessary to leave the motor for an enough time for residual voltage to disappear. H49 specifies that time (0.0 to 10.0 sec.).

At the startup triggered by a run command ON, auto search starts with the delay specified by H49. Using H49, therefore, eliminates the need of the run command timing control when two inverters drive a single motor alternately, allow the motor to coast to a stop, and restart it under auto search control at each time of inverter switching.

■ Starting Mode (Auto search delay time 2) (H46)

- Data setting range: 0.0 to 10.0 (s) (ROM version earlier than 2000)
  0.0 to 20.0 (s) (ROM version 2000 or later)

At the restart after a momentary power failure, at the start by turning the terminal command *BX* ("Coast to a stop") OFF and ON, or at the restart by auto-reset, the inverter applies the delay time specified by H46. The inverter will not start unless the time specified by H46 has elapsed, even if the starting conditions are satisfied.



Under auto search control, the inverter searches the motor speed with the voltage applied at the motor start and the current flowing in the motor, based on the model built with the motor parameters. Therefore, the search is greatly influenced by the residual voltage in the motor.

H46 is available for motor 1 only.

At factory shipment, H46 data is preset to a correct value according to the motor capacity for the general-purpose motor, and basically there is no need to modify the data.

Depending on the motor characteristics, however, it may take time for residual voltage to disappear (due to the secondary thermal time constant of the motor). In such a case, the inverter starts the motor with the residual voltage remaining, which will cause an error in the speed search and may result in occurrence of an inrush current or an overvoltage alarm.

If it happens, increase the value of H46 data and remove the influence of residual voltage. (If possible, it is recommended to set the value around two times as large as the factory default value allowing a margin.)

Note

- Be sure to auto-tune the inverter preceding the start of auto search for the idling motor speed.
- When the estimated speed exceeds the maximum frequency or the upper limit frequency, the inverter disables auto search and starts running the motor with the maximum frequency or the upper limit frequency, whichever is lower.
- During auto search, if an overcurrent or overvoltage trip occurs, the inverter restarts the suspended auto search.
- Perform auto search at 60 Hz or below.
- Note that auto search may not fully provide the performance depending on load conditions, motor parameters, wiring length, and other external factors.

H11 Deceleration Mode

H11 specifies the deceleration mode to be applied when a run command is turned OFF.

Data for H11	Function
0	Normal deceleration
1	Coast-to-stop The inverter immediately shuts down its output, so the motor stops according to the inertia of the motor and machinery (load) and their kinetic energy losses.

Note When reducing the reference frequency, the inverter decelerates the motor according to the deceleration commands even if H11 = 1 (Coast-to-stop).

H12 Instantaneous Overcurrent Limiting (Mode selection) (Refer to F43.)

Refer to the descriptions of F43 and F44.

H13, H14 H15, H16 Restart Mode after Momentary Power Failure (Restart time, Frequency fall rate, Continuous running level, and Allowable momentary power failure time) (Refer to F14.)

For how to set these function codes (Restart time, Frequency fall rate, Continuous running level and Allowable momentary power failure time), refer to the description of F14.

H26, H27 Thermistor (for motor) (Mode selection and Level)

These function codes specify the PTC (Positive Temperature Coefficient) thermistor embedded in the motor. The thermistor is used to protect the motor from overheating or output an alarm signal.

■ Thermistor (for motor) (Mode selection) (H26)

H26 selects the function operation mode (protection or alarm) for the PTC thermistor as shown below.

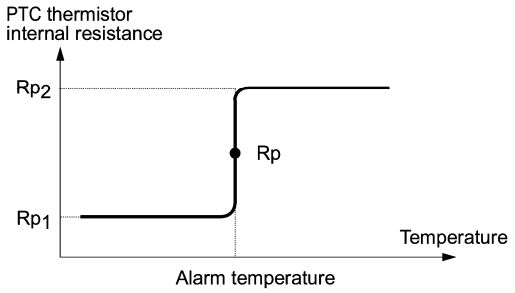
Data for H26	Action
0	Disable
1	Enable When the voltage sensed by PTC thermistor exceeds the detection level, the motor protective function (alarm OH4) is triggered, causing the inverter to enter an alarm stop state.
2	Enable When the voltage sensed by the PTC thermistor exceeds the detection level, a motor alarm signal is output but the inverter continues running. You need to assign the "Motor overheat detected by thermistor" signal (***THM***) to one of the digital output terminals beforehand, by which a temperature alarm condition can be detected by the thermistor (PTC) (E20 to E24 and E27, data = 56).

■ Thermistor (for motor) (Level) (H27)

H27 specifies the detection level (expressed in voltage) for the temperature sensed by the PTC thermistor.

- Data setting range: 0.00 to 5.00 (V)

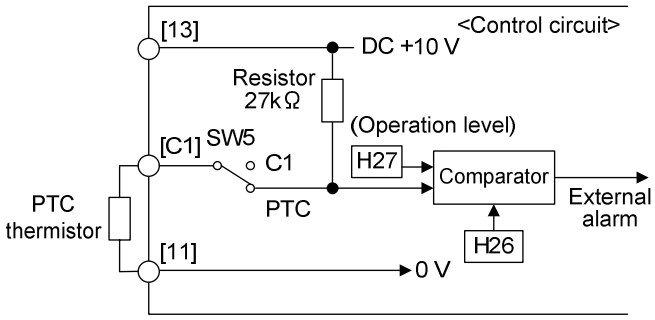
The alarm temperature at which the overheat protection becomes activated depends on the characteristics of the PTC thermistor. The internal resistance of the thermistor will significantly change at the alarm temperature. The detection level (voltage) is specified based on the change of the internal resistance.



Suppose that the internal resistance of the PTC thermistor at the alarm temperature is Rp, the detection level (voltage) V_{v2} is calculated by the expression below. Set the result V_{v2} to function code H27.

$$V_{V2} = \frac{R_p}{27000 + Rp} \times 10.5 \text{ (V)}$$

Connect the PTC thermistor as shown below. The voltage obtained by dividing the input voltage on terminal [C1] with a set of internal resistors is compared with the detection level voltage specified by H27.

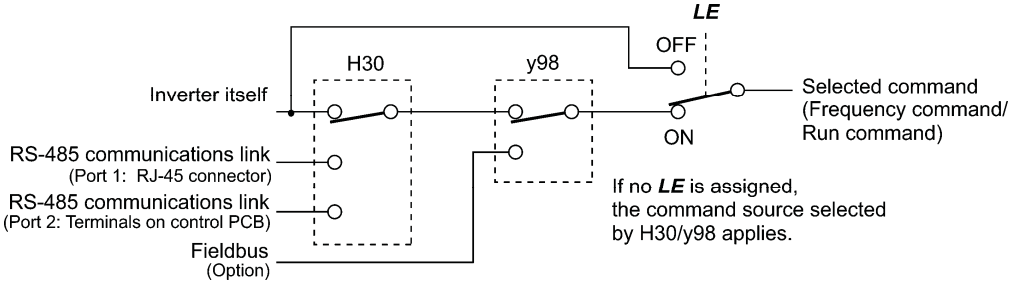


Note When using the terminal [C1] for PTC thermistor input, also turn SW5 on the control printed circuit board to the PTC side. For details, refer to Chapter 8, "SPECIFICATIONS."

H30	Communications Link Function (Mode selection) y98 (Bus Link Function, Mode selection)

Using the RS-485 communications link (standard/option) or fieldbus (option) allows you to issue frequency commands and run commands from a computer or PLC at a remote location, as well as monitor the inverter running information and the function code data.

H30 and y98 specify the sources of those commands--"inverter itself" or "computers or PLCs via the RS-485 communications link or fieldbus." H30 is for the RS-485 communications link; y98 for the fieldbus.



Command sources selectable

Command sources	Description
Inverter itself	Sources except RS-485 communications link and fieldbus Frequency command source: Specified by F01/C30, or multistep frequency command Run command source: Via the keypad or digital input terminals selected by F02
RS-485 communications link (port 1)	Via the standard RJ-45 port used for connecting a keypad
RS-485 communications link (port 2)	Via the terminals DX+, DX- and SD on the control PCB
Fieldbus (option)	Via fieldbus (option) using protocol such as DeviceNet or PROFIBUS DP

Command sources specified by H30 (Communications link function, Mode selection)

Data for H30	Frequency command	Run command
0	Inverter unit (F01/C30)	Inverter unit (F02)
1	RS-485 communications link (port 1)	Inverter unit (F02)
2	Inverter unit (F01/C30)	RS-485 communications link (port 1)
3	RS-485 communications link (port 1)	RS-485 communications link (port 1)
4	RS-485 communications link (port 2)	Inverter unit (F02)
5	RS-485 communications link (port 2)	RS-485 communications link (port 1)
6	Inverter unit (F01/C30)	RS-485 communications link (port 2)
7	RS-485 communications link (port 1)	RS-485 communications link (port 2)
8	RS-485 communications link (port 2)	RS-485 communications link (port 2)

Note

Run commands contain digital input via terminals [X1] to [X7] in addition to ***FWD*** and ***REV*** via terminals [FWD] and [REV]. No concurrent run command input from the inverter unit (***FWD***/***REV***) and the RS-485 communications link (digital input via [X1] to [X7]) is possible.

Command sources specified by y98 (Bus link function, Mode selection)

Data for y98	Frequency command	Run command
0	Follow H30 data	Follow H30 data
1	Via fieldbus (option)	Follow H30 data
2	Follow H30 data	Via fieldbus (option)
3	Via fieldbus (option)	Via fieldbus (option)

Combination of command sources

		Frequency command			
		Inverter itself	Via RS-485 communications link (port 1)	Via RS-485 communications link (port 2)	Via fieldbus (option)
Run command source	Inverter itself	H30 = 0 y98 = 0	H30 = 1 y98 = 0	H30=4 y98=0	H30=0 (1 or 4) y98=1
	Via RS-485 communications link (port 1)	H30 = 2 y98 = 0	H30 = 3 y98 = 0	H30=5 y98=0	H30=2 (3 or 5) y98=1
	Via RS-485 communications link (port 2)	H30 = 6 y98 = 0	H30 = 7 y98 = 0	H30=8 y98=0	H30=6 (7 or 8) y98=1
	Via fieldbus (option)	H30 = 0 (2 or 6) y98 = 2	H30 = 1 (3 or 7) y98 = 2	H30 = 4 (5 or 8) y98 = 2	H30 = 0 (1 to 8) y98 = 3

📖 For details, refer to the RS-485 Communication User's Manual or the Field Bus Option Instruction Manual.

- When the terminal command *LE* ("Enable communications link via RS-485 or fieldbus") is assigned to a digital input terminal, turning *LE* ON makes the settings of H30 and y98 enabled. When *LE* is OFF, those settings are disabled so that both frequency commands and run commands specified from the inverter itself take control.

  (Refer to the descriptions of E01 through E07, data = 24.)

  No *LE* assignment is functionally equivalent to the *LE* being ON.

H42, H43 H48	**Capacitance of DC Link Bus Capacitor, Cumulative Run Time of Cooling Fan Cumulative Run Time of Capacitors on Printed Circuit Boards** **H47 (Initial Capacitance of DC Link Bus Capacitor)** **H98 (Protection/Maintenance Function)**

■ Life prediction function

The inverter has the life prediction function for some parts which measures the discharging time or counts the voltage applied time, etc. The function allows you to monitor the current lifetime state on the LCD monitor and judge whether those parts are approaching the end of their service life.

The life prediction function can also issue early warning signals if the lifetime alarm command *LIFE* is assigned to any of the digital output terminals by any of E20 through E24 and E27.

The predicted values should be used only as a guide since the actual service life is influenced by the ambient temperature and other usage environments.

Object of life prediction	Prediction function	End-of-life criteria	Prediction timing	On the LCD monitor
DC link bus capacitor	Measurement of discharging time Measures the discharging time of the DC link bus capacitor when the main power is shut down and calculates the capacitance.	85% or lower of the initial capacitance at shipment (See "[1] Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment" on the next page.)	At periodic inspection (H98: Bit 3 = 0)	PRG > 3 > 4[2/7] 3. Inverter information 4. Maintenance information (2 of 7 page) ⇒ Cap (capacity)
		85% or lower of the reference capacitance under ordinary operating conditions at the user site (See "[2] Measuring the capacitance of DC link bus capacitor under ordinary operating conditions" given later.)	During ordinary operation (H98: Bit 3 = 1)	
	ON-time counting Counts the time elapsed when the voltage is applied to the DC link bus capacitor, while correcting it according to the capacitance measured above.	Exceeding 43,500 hours (five years) For inverters of 110 kW or above: Exceeding 87,000 hours (10 years)	During ordinary operation	PRG > 3 > 4[2/7] 3. Inverter information 4. Maintenance information (2 of 7 page) ⇒ Enet (Energization period) ⇒ Remt (Remaining time)
Electrolytic capacitors on printed circuit boards	Counts the time elapsed when the voltage is applied to the capacitors, while correcting it according to the ambient temperature.	Exceeding 43,500 hours (five years) For inverters of 110 kW or above: Exceeding 87,000 hours (10 years)	During ordinary operation	PRG > 3 > 4[3/7] 3. Inverter information 4. Maintenance information (3 of 7 page) ⇒ Enet (Energization period) ⇒ Life (Indication of life)
Cooling fans	Counts the run time of the cooling fans.	Exceeding 43,500 hours (five years) For inverters of 110 kW or above: Exceeding 87,000 hours (10 years)	During ordinary operation	

■ Capacitance measurement of DC link bus capacitor (H42)

Calculating the capacitance of DC link bus capacitor

- The discharging time of the DC link bus capacitor depends largely on the inverter's internal load conditions, e.g. options attached or ON/OFF of digital I/O signals. If actual load conditions are so different from the ones at which the initial/reference capacitance is measured that the measurement result falls out of the accuracy level required, then the inverter does not perform measuring.
- The capacitance measuring conditions at shipment are extremely restricted, e.g., all input terminals being OFF in order to stabilize the load and measure the capacitance accurately. Those conditions are, therefore, different from the actual operating conditions in almost all cases. If the actual operating conditions are the same as those at shipment, shutting down the inverter power automatically measures the discharging time; however, if they are different, no automatic measurement is performed. To perform it, put those conditions back to the factory default ones and shut down the inverter. For the measuring procedure, see [1] given below.
- To measure the capacitance of the DC link bus capacitor *under ordinary operating conditions* when the power is turned OFF, it is necessary to set up the load conditions for ordinary operation and measure the reference capacitance (initial setting) when the inverter is introduced. For the reference capacitance setup procedure, see [2] on the next page. Performing the setup procedure automatically detects and saves the measuring conditions of the DC link bus capacitor.

  Setting bit 3 of H98 data to 0 restores the inverter to the measurement in comparison with the initial capacitance measured at shipment.

Note: When the inverter uses an auxiliary control power input, the load conditions widely differ so that the discharging time cannot be accurately measured. In this case, measuring of the discharging time can be disabled with the function code H98 (Bit 4 = 0) for preventing unintended measuring.

ON-time counting of DC link bus capacitor

- In a machine system where the inverter main power is rarely shut down, the inverter does not measure the discharging time. For such an inverter, the ON-time counting is provided. If the capacitance measurement is made, the inverter corrects the ON-time according to the capacitance measured.

  The ON-time counting result can be represented as "elapsed time" and "remaining time before the end of life."

[1] Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment

When bit 3 of H98 data is 0, the measuring procedure given below measures the capacitance of DC link bus capacitor in comparison with initial one at shipment when the power is turned OFF. The measuring result can be displayed on the keypad as a ratio (%) to the initial capacitance.

---------- Capacitance measuring procedure ----------

1) To ensure validity in the comparative measurement, put the condition of the inverter back to the state at factory shipment.
   - Remove the option card (if already in use) from the inverter.
   - In case another inverter is connected via the DC link bus to the P(+) and N(-) terminals of the main circuit, disconnect the wires. (You do not need to disconnect a DC reactor (optional), if any.)
   - Disconnect power wires for the auxiliary input to the control circuit (R0, T0).
   - Turn OFF all the digital input signals fed to terminals [FWD], [REV], and [X1] through [X7] of the control circuit.
   - If a potentiometer is connected to terminal [13], disconnect it.

- If an external apparatus is attached to terminal [PLC], disconnect it.
- Ensure that transistor output signals ([Y1] to [Y4]) and relay output signals ([Y5A] - [Y5C], and [30A/B/C]) will not be turned ON.
- Disable the RS-485 communications link.

Note If negative logic is specified for the transistor output and relay output signals, they are considered ON when the inverter is not running. Specify positive logic for them.

- Keep the ambient temperature within 25 ±10°C.

2) Turn ON the main circuit power.
3) Confirm that the inverter is in a stopped state.
4) Turn OFF the main circuit power.
5) The inverter automatically starts the measurement of the capacitance of the DC link bus capacitor. Check that "Capacitor capacitance measurement" is shown on the LCD monitor.

Note In a case where "Capacitor capacitance measurement" is not shown on the LCD monitor, measurement is not yet started.

6) After " . . . . " has disappeared from the LCD monitor, turn ON the main circuit power again.
7) Select PRG > 3(INV Info) > 4(Maintenance) in Programming mode and note the reading (relative capacitance (%) of the DC link bus capacitor).

---

[2] Measuring the capacitance of DC link bus capacitor under ordinary operating conditions

When bit 3 of H98 data is 1, the inverter automatically measures the capacitance of the DC link bus capacitor under ordinary operating conditions when the power is turned OFF. This measurement requires setting up the load conditions for ordinary operation and measuring the reference capacitance when the inverter is introduced to the practical operation, using the setup procedure given below.

Function code	Name	Data
H42	Capacitance of DC link bus capacitor	• Capacitance of DC link bus capacitor (measured value) • Start of initial capacitance measuring mode under ordinary operating conditions (Meas) • Measurement failure (Failed)
H47	Initial capacitance of DC link bus capacitor	• Initial capacitance of DC link bus capacitor (measured value) • Start of initial capacitance measuring mode under ordinary operating conditions (Meas) • Measurement failure (Failed)

When replacing parts, clear or modify the H42 and H47 data. For details, refer to the documents for maintenance.

---------- Reference capacitance setup procedure ----------

1) Set function code H98 (Protection/maintenance function) to enable the user to specify the judgment criteria for the service life of the DC link bus capacitor (Bit 3 = 1) (refer to function code H98).
2) Turn OFF all run commands.
3) Make the inverter ready to be turned OFF under ordinary operating conditions.
4) Set both function codes H42 (Capacitance of DC link bus capacitor) and H47 (Initial capacitance of DC link bus capacitor) to "Meas." (Setting H47 to "Meas" automatically sets H42 to "Meas.")

5) Turn OFF the inverter, and the following operations are automatically performed.

The inverter measures the discharging time of the DC link bus capacitor and saves the result in function code H47 (Initial capacitance of DC link bus capacitor).

The conditions under which the measurement has been conducted will be automatically collected and saved.

During the measurement, "Capacitor capacitance measurement" is shown on the screen of the keypad.

6) Turn ON the inverter again.

Confirm that H42 (Capacitance of DC link bus capacitor) and H47 (Initial capacitance of DC link bus capacitor) hold right values. Select PRG > 3(INV Info) > 4(Maintenance) in Programming mode and confirm that the relative capacitance (ratio to full capacitance) is 100%.

Note If the measurement has failed, "Failed" is entered into both H42 and H47. Remove the factor of the failure and conduct the measurement again.

Hereafter, each time the inverter is turned OFF, it automatically measures the discharging time of the DC link bus capacitor if the above conditions are met. Periodically check the relative capacitance of the DC link bus capacitor (%) with PRG > 3(INV Info) > 4(Maintenance) in Programming mode.

Note The condition given above tends to produce a rather large measurement error. If this mode gives you a lifetime alarm, set H98 (Protection/maintenance function) back to the default setting (Bit 3 (Select life judgment threshold of DC link bus capacitor) = 0) and conduct the measurement under the condition at the time of factory shipment.

■ Cumulative Run Time of Capacitors on Printed Circuit Boards (H48)

Function code	Name	Description
H48	Cumulative run time of capacitors on printed circuit boards	Displays the cumulative run time of capacitor on the printed circuit board in units of ten hours. • Data setting range: 0 to 9999 (0 to 99990 hours in increments of 10 hours)

When replacing capacitors on printed circuit boards, clearing or modifying H48 data is required. For details, refer to the materials for maintenance.

■ Cumulative Run Time of Cooling Fan (H43)

Function code	Name	Description
H43	Cumulative run time of cooling fan	Displays the cumulative run time of cooling fan in units of ten hours. • Data setting range: 0 to 9999 (0 to 99990 hours in increments of 10 hours)

When replacing the cooling fan, clearing or modifying H43 data is required. For details, refer to the maintenance related documents.

H44 Startup Counter for Motor 1

H44 counts the number of inverter startups and displays it in decimal format. Check the displayed number on the maintenance screen of the keypad, and use it as a guide for maintenance timing for parts such as belts. To start the counting over again, e.g. after a belt replacement, set the H44 data to "0000."

H45	Mock Alarm	H97 (Clear Alarm Data)

H45 causes the inverter to generate a mock alarm in order to check whether external sequences function correctly at the time of machine setup.

Setting the H45 data to "1" displays mock alarm Err on the LCD monitor. It also issues alarm output (for any alarm) *ALM* (if assigned to a digital output terminal by any of E20 to E24 and E27). (Accessing the H45 data requires simultaneous keying of "STOP key + ∧ key.") After that, the H45 data automatically reverts to "0," allowing you to reset the alarm.

Just as data (alarm history and relevant information) of those alarms that could occur in running the inverter, the inverter saves mock alarm data, enabling you to confirm the mock alarm status.

To clear the mock alarm data, use H97. (Accessing the H97 data requires simultaneous keying of "STOP key + ∧ key.") H97 data automatically returns to "0" after clearing the alarm data.

Tip A mock alarm can be issued also by simultaneous keying of STOP key + SET key on the keypad for 5 seconds or more."

H46	Starting Mode (Auto search delay time 2)	(Refer to H09.)

For details, refer to the description of H09.

H47, H48	Initial Capacitance of DC Link Bus Capacitor Cumulative Run Time of Capacitors on Printed Circuit Boards	(Refer to H42.)

For details, refer to the description of H42.

H49	Starting Mode (Auto search delay time 1)	(Refer to H09.)

For details, refer to the description of H09.

H50, H51 H52, H53	Non-linear V/f Pattern 1 (Frequency and Voltage) Non-linear V/f Pattern 2 (Frequency and Voltage)	(Refer to F04.)

For details, refer to the description of F04.

H56	Deceleration Time for Forced Stop	(Refer to F07.)

For details, refer to the description of F07.

H61	Multistep Frequency + *UP/DOWN* Control (Refer to F01.)

Terminal commands ***UP*** ("Increase output frequency") and ***DOWN*** ("Decrease output frequency") determine the reference frequency by increasing and decreasing the multistep frequency command being selected, respectively.

H61 provides a choice of terminal command ***UP/DOWN*** operation modes as listed below.

Setting the H61 at "13" or above and turning any of ***SS1*** to ***SS8*** ("Select multistep frequency") ON enables "Multistep frequency + ***UP/DOWN*** control."

When no multistep frequency is selected (that is, when F01/C30 applies except F01/C30 = 7), both ***UP*** and ***DOWN*** commands do not take effect.

When "Multistep frequency + ***UP/DOWN*** control" is enabled, the acceleration/deceleration time 4 specified by E14/E15 applies.

Run command OFF: When the run command is turned OFF, the inverter saves the ***UP/DOWN*** frequency.

Inverter power OFF: When the power is turned OFF, the inverter saves the ***UP/DOWN*** frequency.

Multistep frequency switching: When a multistep frequency is entered, the inverter saves the ***UP/DOWN*** frequency.

Save ***UP/DOWN*** frequency with respect to each multistep frequency: The inverter saves the ***UP/DOWN*** frequency with respect to each multistep frequency.

Clear ***UP/DOWN*** frequency with respect to each multistep frequency: The inverter clears the ***UP/DOWN*** frequency by an STZ signal with respect to each multistep frequency.

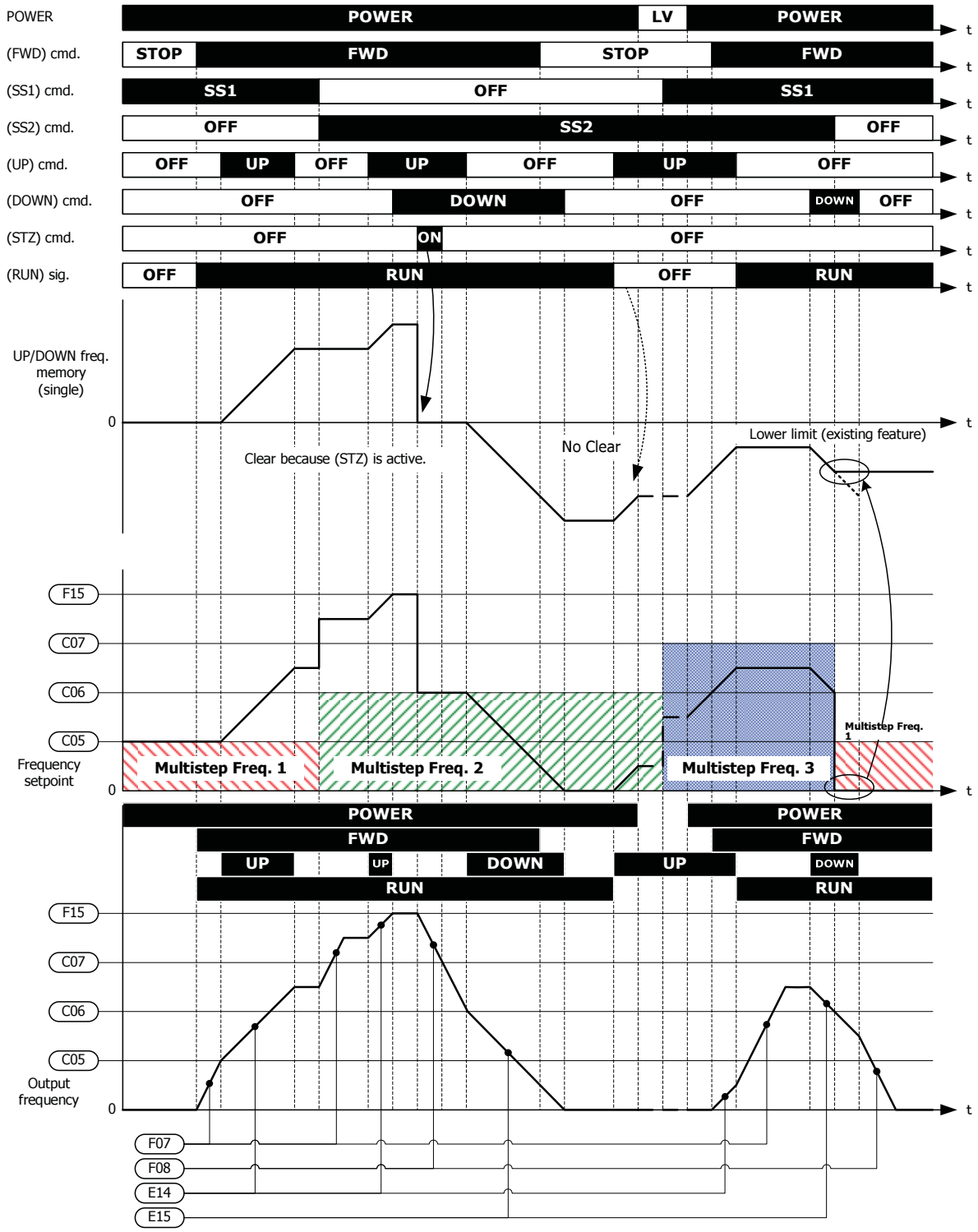
To use the ***UP/DOWN*** frequency, you need to assign terminal commands ***UP*** and ***DOWN*** to general-purpose digital input terminals beforehand (📖 E01 to E07, data = 17, 18)

When H61 = 1, it is necessary to set F01 to "7" (Terminal command ***UP/DOWN*** control); when H61 ≥ 13, it is not.

H61	***UP/DOWN* operation modes**					
	Multistep frequency + ***UP/DOWN*** control	***UP/DOWN*** frequency saving conditions			Save ***UP/DOWN*** frequency with respect to each multistep frequency	Clear ***UP/DOWN*** frequency with respect to each multistep frequency (STZ signal)
		Run command OFF	Inverter power OFF	Multistep frequency switching		
1	☐	The inverter internally saves the last output frequency applied under ***UP/DOWN*** control and applies the held frequency as an initial value at the next restart.				
13	☑	☐	☐	☐	☐	☐
14		☑	☐	☐	☐	☐
16		☑	☑	☐	☐	☐
23		☐	☐	☑	☐	☐
24		☑	☐	☑	☐	☐
26		☑	☑	☑	☐	☐
53		☐	☐	☑	☑	☐
54		☑	☐	☑	☑	☐
56		☑	☑	☑	☑	☐
103		☐	☐	☑	☑	☑
104		☑	☐	☑	☑	☑
106		☑	☑	☑	☑	☑

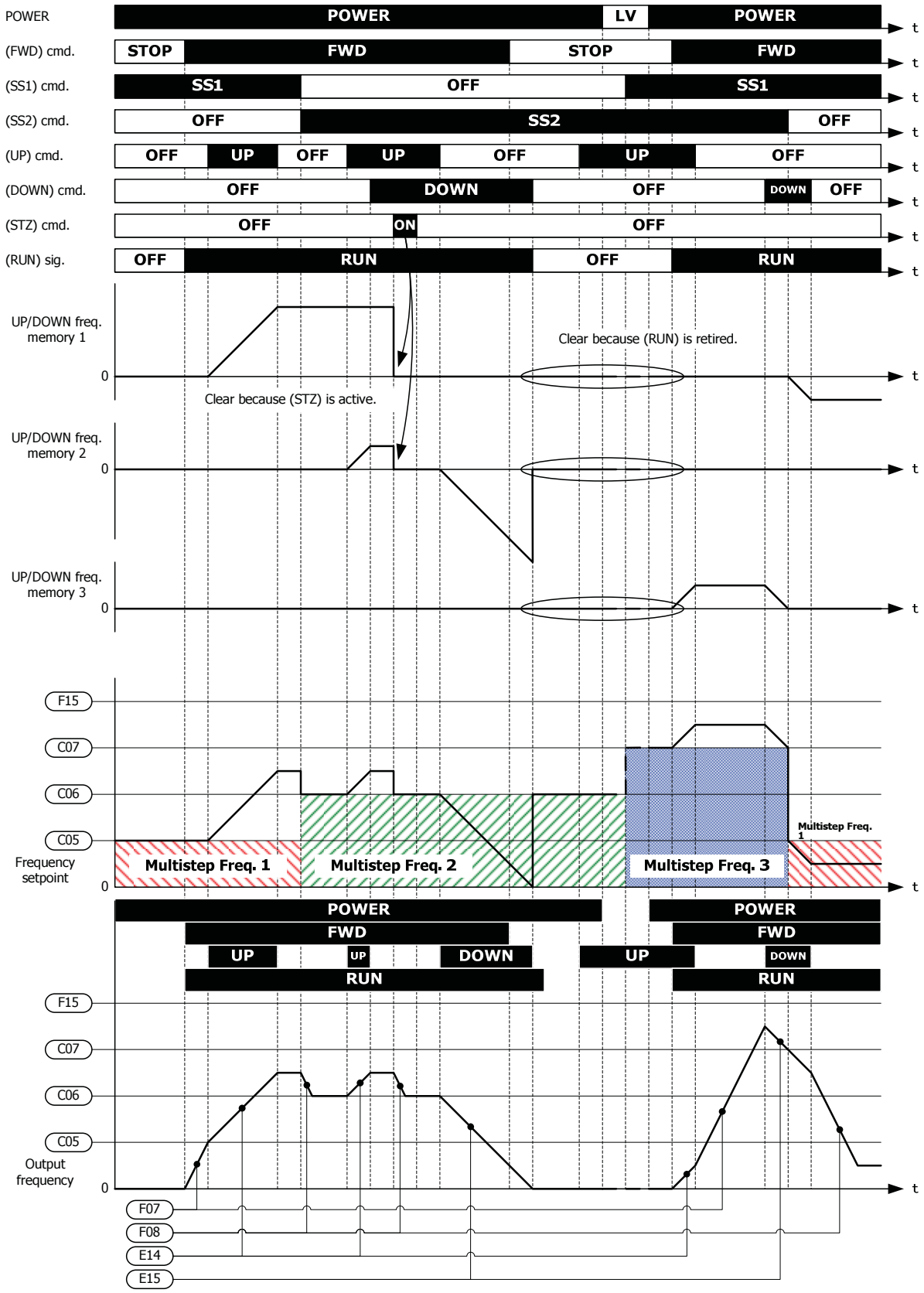
☑: Active, ☐: Inactive

When H61 = 26



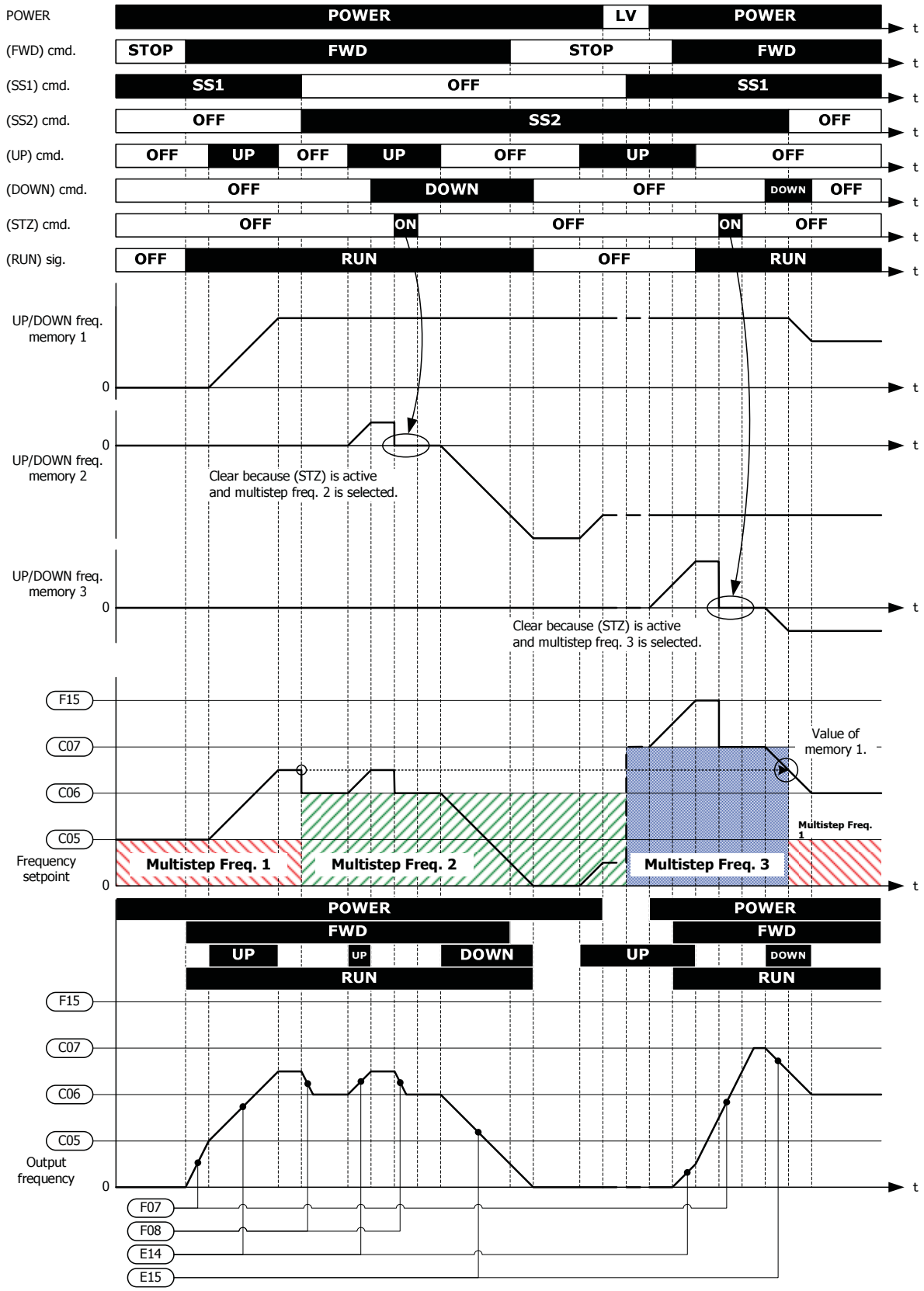
Multistep Frequency combined with UP/DOWN control overview (H61 = 26)

When H61 = 53



Multistep Frequency combined with UP/DOWN control overview (H61 = 53)

When H61 = 106



Multistep Frequency combined with UP/DOWN control overview (H61 = 106)

H63	Low Limiter (Mode selection) (Refer to F15.)

For details, refer to the description of F15.

H64	Low Limiter (Lower limiting frequency)

H64 specifies the lower limit of frequency to be applied when the current limiter, torque limiter, automatic deceleration (anti-regenerative control), or overload prevention control is activated. Normally, it is not necessary to change this data.

- Data setting range: Inherit, 0.0 to 60.0 (Hz)

H69	Automatic Deceleration (Mode selection) H76 (Torque Limiter for Braking, Frequency increment limit)

H69 toggles anti-regenerative control on and off.

In the inverter not equipped with a PWM converter or braking unit, if the regenerative energy returned exceeds the inverter's braking capability, an overvoltage trip occurs.

To avoid such an overvoltage trip, enable the automatic deceleration (anti-regenerative control) with this function code, and the inverter controls the output frequency to keep the braking torque around 0 N·m in both the acceleration/deceleration and constant speed running phases.

The FRENIC-HVAC series of inverters have two braking control modes; torque limit control and DC link bus voltage control. Understand the feature of each control and select the suitable one.

Control mode	Control process	Operation mode	Features
Torque limit control (H69=2 or 4)	Output frequency is controlled so that the braking torque is kept at the regeneration avoidance operation level (H114).	Enabled during acceleration, running at the constant speed, and deceleration.	Quick response. Causes less overvoltage trip with heavy impact load.
DC link bus voltage control (H69=3 or 5)	Control the output frequency to lower the DC link bus voltage if the voltage exceeds the limiting level.	Enabled during deceleration. Disabled during running at the constant speed.	Shorter deceleration time by making good use of the inverter's regenerative capability.

In addition, during deceleration triggered by turning the run command OFF, anti-regenerative control increases the output frequency so that the inverter may not stop the load depending on the load state (huge moment of inertia, for example). To avoid that, H69 provides a choice of cancellation of anti-regenerative control to apply when three times the specified deceleration time is elapsed, thus decelerating the motor forcibly.

Data for H69	Function	
	Control mode	Force-to-stop with actual deceleration time exceeding three times the specified one
0	Disable automatic deceleration	—
2	Torque limit control	Enable
3	DC link bus voltage control	Enable
4	Torque limit control	Disable
5	DC link bus voltage control	Disable

■ Torque Limiter for braking (Frequency increment limit) (H76)

- Data setting range: 0.0 to 500.0 (Hz)

Since increasing the output frequency too much in the torque limit control mode is dangerous, the inverter has a torque limiter (Frequency increment limit for braking) that can be specified by H76. The torque limiter limits the inverter's output frequency to less than "Reference frequency + H76 setting."

Note that the torque limiter activated restrains the anti-regenerative control, resulting in an overvoltage trip in some cases. Increasing the H76 data improves the anti-regenerative control capability.

■ Automatic deceleration (Operation level) (H114)

- Data setting range: Auto, 0.0 to 50.0 (%)

H114 specifies the anti-regenerative control operation level under torque limit control. The inverter controls the output frequency to keep the braking torque at the value specified with H114. When H114 = Auto (factory default), the anti-regenerative control starts with the inverter internal fixed value (approx. 2% to 5%). Do not change the factor default except when necessary.

Note

- Enabling the automatic deceleration (anti-regenerative control) may automatically increase the deceleration time.
- If the set deceleration time is too short, the DC link bus voltage of the inverter rises quickly, and consequently, the automatic deceleration may not follow the voltage rise. If this is the case, set longer deceleration time.

H70 Overload Prevention Control

H70 specifies the decelerating rate of the output frequency to prevent a trip from occurring due to an overload. This control decreases the output frequency of the inverter before the inverter trips due to a heat sink overheat or inverter overload (with an alarm indication of OH1 or OLV, respectively). It is useful for equipment such as pumps where a decrease in the output frequency leads to a decrease in the load and it is necessary to keep the motor running even when the output frequency drops.

Data for H70	Function
Inherit	Decelerate the motor with the preset deceleration time
0.01 to 100.0	Decelerate the motor by deceleration rate from 0.01 to 100.0 (Hz/s)
OFF	Cancel overload prevention control

■ Overload prevention control -- ***OLP***
(E20 to E24 and E27, data = 36)

This output signal comes ON when the overload prevention control is activated and the output frequency changed.

Note In equipment where a decrease in the output frequency does not lead to a decrease in the load, the overload prevention control is of no use and should not be enabled.

H71 Deceleration Characteristics

Setting the H71 data to "1" enables forced brake control. If regenerative energy produced during the deceleration of the motor and returned to the inverter exceeds the inverter's braking capability, an overvoltage trip will occur. The forced brake control increases the motor energy loss during deceleration, increasing the deceleration torque.

Data for H71	Function
0	Disable
1	Enable

Note This function is aimed at controlling the torque during deceleration; it has no effect if there is a braking load.
Enabling the automatic deceleration (anti-regenerative control, H69 = 2 or 4) in the torque limit control mode disables the deceleration characteristics specified by H71.

H72 Main Power Down Detection (Mode selection)

H72 monitors the inverter alternate-current input power source, and disables the inverter operation if it is not established.

Data for H72	Function
0	Disable
1	Enable

In cases where the power is supplied via a PWM converter or the inverter is connected via the DC link bus, there is no alternate-current input. In such cases, set H72 data to "0," otherwise the inverter cannot operate.

Note If you use a single-phase power supply, contact your Fuji Electric representative.

H76 Torque Limiter for Braking (Frequency increment limit) (Refer to H69.)

For details, refer to the description of H69.

H77	Service Life of DC Link Bus Capacitor (Remaining time)

H77 displays the remaining time before the service life of DC link bus capacitor expires in units of ten hours.

At the time of a printed circuit board replacement, transfer the service life data of the DC link bus capacitor to the new board.

- Data setting range: 0 to 4380 (in units of ten hours, 0 to 43,800 hours)

H78 H94	Maintenance Interval (M1) Cumulative Motor Run Time 1

H78 specifies the maintenance interval in units of ten hours.

The maximum setting is 9999 × 10 hours.

- Data setting range: OFF (Disable)
  1 to 9999 (99990 hours, in units of ten hours)

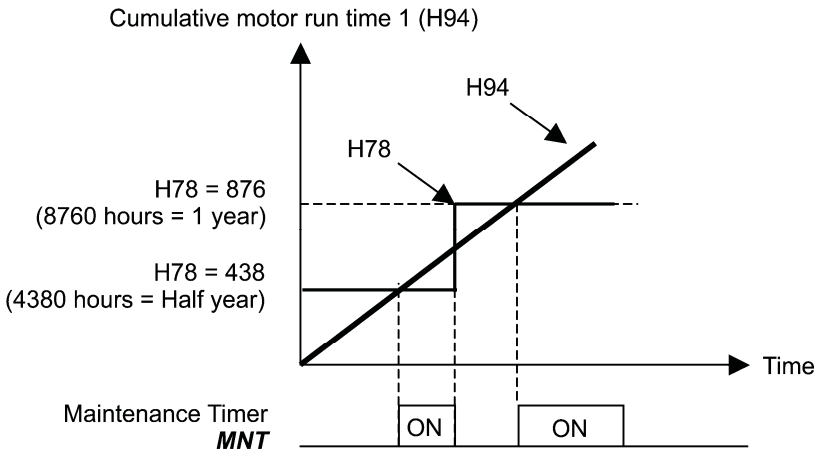
■ Maintenance timer -- ***MNT*** (E20 to E24 and E27, data = 84)

When the cumulative motor run time 1 (H94) reaches the setting specified by H78, the inverter outputs the maintenance timer signal *MNT* (if assigned to any digital terminal with any of E20 to E24 and E27) to remind the user of the need of the maintenance of the machinery.

■ Cumulative motor run time 1 (H94)

Operating the keypad can display the cumulative run time of the 1st motor. This feature is useful for management and maintenance of the machinery. Using H94 can modify the cumulative run time to the desired value to be used as an arbitrary initial data on which the replacement timing of machine parts or inverter is based. Specifying "blank" clears the cumulative run time of the motor.

<Biannual maintenance>



Note: If the maintenance interval counter reaches the specified value, set a new value for the next maintenance in H78 and press the (SET) key to reset the output signal and restart counting. This function is exclusively applied to the 1st motor.

■ Count the run time of commercial power-driven motor 1 -- ***CRUN-M1*** (E01 to E07, data = 72)

Even when a motor is driven by commercial power, not by the inverter, it is possible to count the cumulative motor run time 1 (H94) by detecting the ON/OFF state of the auxiliary contact of the magnetic contactor for switching to the commercial power line.

Note Check the cumulative motor run time with PRG > 3(INV Info) > 4(Maintenance) on the keypad.

H79	Preset Startup Count for Maintenance (M1) H44 (Startup Counter for Motor 1)

H79 specifies the number of inverter startup times to determine the next maintenance timing, e.g., for replacement of a belt.

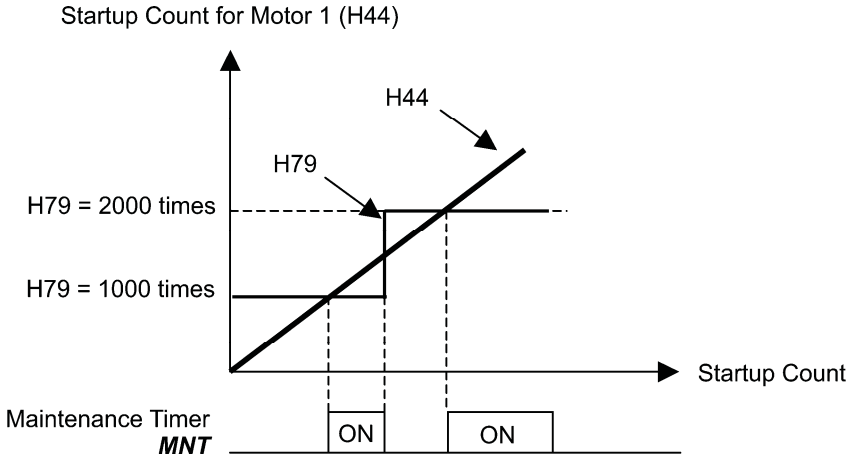
Set the H79 and H44 data in hexadecimal. The maximum setting count is 65,535.

- Data setting range: OFF (Disable), 1 to 65,535

■ Maintenance timer -- ***MNT*** (E20 to E24 and E27, data = 84)

When the startup counter for motor 1 (H44) reaches the number specified by H79 (Preset startup count for maintenance (M1)), the inverter outputs the maintenance timer signal *MNT* (if assigned to any digital terminal with any to E20 to E24 and E27) to remind the user of the need of the maintenance of the machinery.

< Maintenance every 1,000 times of startups >



Note If the startup counter reaches the specified value, set a new value for the next maintenance in H79 and press the SET key to reset the output signal and restart counting. This function is exclusively applied to motor 1.

H80	Output Current Fluctuation Damping Gain for Motor 1

The inverter output current driving the motor may fluctuate due to the motor characteristics and/or backlash in the machinery (load). Modifying the H80 data adjusts the controls in order to suppress such fluctuation. However, as incorrect setting of this gain may cause larger current fluctuation, do not modify the default setting unless it is necessary.

- Data setting range: 0.00 to 1.00

H89 to H90	Reserved

These function codes and their data appear on the LCD monitor, but they are reserved for particular manufacturers. Do not access them.

H91	Current Input Wire Break Detection

Using terminal [C1] (current input) enables wire break detection and alarm (CoF) issuance. H91 specifies whether to enable the wire break detection, and the duration of detection. (The inverter judges an input current of less than 2 mA on terminal [C1] as a wire break.)

- Data setting range: OFF (Disable alarm detection)
  0.1 to 60.0 s (Detect wire break and issue CoF alarm within the time)

H92, H93	Continuity of Running (P and I)	(Refer to F14.)

Refer to the description of F14.

H94	Cumulative Motor Run Time 1	(Refer to H78.)

Refer to the description of H78.

H95	DC Braking (Braking response mode)	(Refer to F20 through F22.)

Refer to the descriptions of F20 through F22.

H96 STOP Key Priority/Start Check Function

H96 specifies a functional combination of "STOP key priority" and "Start check function" as listed below.

Data for H96	STOP key priority	Start check function
0	Disable	Disable
1	Enable	Disable
2	Disable	Enable
3	Enable	Enable

■ STOP key priority

Even when a run command is entered from a digital input terminal or via the RS-485 communications link (link operation), pressing the STOP key forces the inverter to decelerate to stop the motor. After that, an Er6 alarm occurs.

■ Start check function

For safety, this function checks whether any run command has been turned ON or not in each of the following situations. If any has been turned ON, the inverter does not start up with alarm code Er6 displayed.

- When the power to the inverter is turned ON.
- When the RESET key is pressed to release an alarm status or when the digital input terminal command *RST* ("Reset alarm") is turned ON.
- When the run command source is switched by a digital input terminal command such as *LE* ("Enable communications link via RS-485 or fieldbus") or *LOC* ("Select local (keypad) operation").

H97 Clear Alarm Data H45 (Mock Alarm)

H97 clears alarm data (alarm history and relevant information) stored in the inverter. To clear alarm data, simultaneous keying of "STOP key + ∧ key" is required.

Data for H97	Function
0	Disable
1	Enable (Setting "1" clears alarm data and then returns to "0.")

H98	Protection/Maintenance Function (Mode selection)

H98 specifies whether to enable or disable automatic lowering of carrier frequency, input phase loss protection, output phase loss protection, judgment threshold on the life of DC link bus capacitor, judgment on the life of DC link bus capacitor, DC fan lock detection, and IP21/IP55 switching, in combination (Bit 0 to Bit 7).

Automatic lowering of carrier frequency (Bit 0)

This function should be used for important machinery that requires keeping the inverter running.

Even if a heat sink overheat or overload occurs due to excessive load, abnormal ambient temperature, or cooling system failure, enabling this function lowers the carrier frequency to avoid tripping (OH1, OH3 or OLU). Note that enabling this function results in increased motor noise.

Input phase loss protection (Lin) (Bit 1)

Upon detection of an excessive stress inflicted on the apparatus connected to the main circuit due to phase loss or line-to-line voltage unbalance in the three-phase power supplied to the inverter, this protection feature stops the inverter and displays an alarm Lin.

Note In configurations where only a light load is driven, phase loss or line-to-line voltage unbalance may not be detected because of the relatively small stress on the apparatus connected to the main circuit.

Output phase loss protection (OPL) (Bit 2)

Upon detection of output phase loss while the inverter is running, this feature stops the inverter and displays an alarm OPL.

Note Where a magnetic contactor is installed in the inverter output circuit, if the magnetic contactor goes OFF during operation, all the phases will be lost. In such a case, this protection feature does not work.

Judgment threshold on the life of DC link bus capacitor (Bit 3)

Bit 3 is used to select the threshold for judging the life of the DC link bus capacitor--the factory default level or a user-defined one.

Note Before specifying a user-defined threshold, measure and confirm the reference level in advance. 📖 Refer to H42.

Judgment on the life of DC link bus capacitor (Bit 4)

Whether the DC link bus capacitor has reached its life is judged by measuring the discharging time after power OFF. The discharging time is determined by the capacitance of the DC link bus capacitor and the load inside the inverter. Therefore, if the load inside the inverter fluctuates significantly, the discharging time cannot be accurately measured, and as a result, it may be mistakenly determined that the DC link bus capacitor has reached the end of its life. To avoid such an error, you can disable the judgment based on the discharging time. (Even if it is disabled, the judgment based on the "ON-time counting" while the voltage is applied to the DC link bus capacitor is continued.)

📖 For details about the life prediction function, refer to H42.

Since load may fluctuate significantly in the following cases, disable the judgment on the life during operation. During periodical maintenance, either conduct the measurement with the judgment enabled under appropriate conditions or conduct the measurement under the operating conditions matching the actual ones.

- Auxiliary input for control power is used.
- An option card is used.
- Another inverter or equipment such as a PWM converter is connected to terminals of the DC link bus.

DC fan lock detection (Bit 5) (for IP00-rated inverters of 110 kW or above, IP21-rated ones of 45 kW or above, and IP55-rated ones of 11 kW or above)

The inverter contains an internal air circulation DC fan. When the inverter detects that the DC fan is locked by a failure or other cause, you can select either continuing the inverter operation or having the inverter enter into the alarm state.

Entering alarm state: The inverter issues the alarm OH1 and allows the motor to coast to a stop.

Continuing operation: The inverter does not enter the alarm state and continues to run the motor.

Note that, however, the inverter turns ON the ***OH*** and ***LIFE*** signals on the transistor output terminals whenever the DC fan lock is detected regardless of your selection.

Note: If the ON/OFF control of the cooling fan is enabled (H06 = 1), the cooling fan may stop depending on the operating condition of the inverter. In this case, the DC fan lock detection feature is considered normal (e.g., the cooling fan is normally stopped by the stop fan command.) so that the inverter may turn OFF the ***LIFE*** or ***OH*** signal output, or enable to cancel the alarm OH1, even if the internal air circulation DC fan is locked due to a failure etc. (When you start the inverter in this state, it automatically issues the run fan command. Then the inverter detects the DC fan lock state, and turns ON the ***LIFE*** or ***OH*** output or enters the alarm OH1 state.)

Note that, operating the inverter with the DC fan being locked for a long time may shorten the service life of electrolytic capacitors on the PCBs due to local high temperature inside the inverter. Be sure to check with the ***LIFE*** signal etc., and replace the broken fan as soon as possible.

IP21/IP55 switch (Bit 7)

Switch this when changing the protection structure from IP21 to IP55. With respect to protection coordination, a protection level which suits for IP55 is resulted.

To set data of function code H98, assign the setting of each function to each bit and then convert the 8-bit binary to the decimal number.

Refer to the assignment of each function to each bit and a conversion example below.

Bit	Function	Data setting range	Factory default	
			IP21	IP55
0	Lower the carrier frequency automatically	0: Disable 1: Enable	1: Enable	1: Enable
1	Detect input phase loss	0: Continue to run 1: Enter alarm processing	1: Enter alarm processing	1: Enter alarm processing
2	Detect output phase loss	0: Continue to run 1: Enter alarm processing	0: Continue to run	0: Continue to run
3	Select life judgment threshold of DC link bus capacitor	0: Factory default 1: User-defined setting	0: Factory default	0: Factory default
4	Judge the life of DC link bus capacitor	0: Disable 1: Enable	1: Enable	1: Enable
5	DC fan lock detection (Available for IP00-rated inverters of 110 kW or above, IP21-rated ones of 45 kW or above, and IP55-rated ones of 11 kW or above)	0: Enable 1: Disable	0: Enable	0: Enable
6	--	--	--	--
7	Switch IP21/IP55 enclosure	0: IP21 1: IP55	0: IP21	1: IP55

5.1.6 H1 codes (High performance functions)

H104	Number-of-resets Clear Time H04, H05 (Auto-reset (Times and Reset interval))

H104 specifies the time for clearing the number of resets counted.

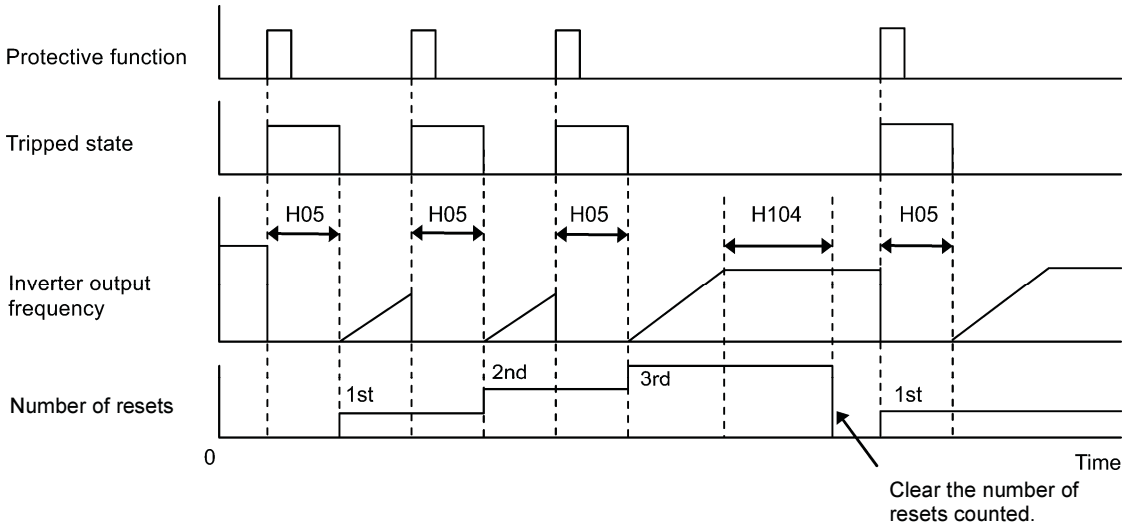
The inverter clears the number of retries counted if

After restart following a reset, if the inverter output frequency comes to be constant and an alarm that causes a reset does not occur during the number-of-resets clear time (H104), then the inverter clears the number of resets counted.

- Data setting range: 0.5 to 5.0 (min)

<Operation timing scheme>

- In the figure below, normal operation restarts in the 3rd retry. (An alarm that causes a reset does not occur during the time specified by H104.)



H105 H106	Retry Target Selection H04, H05 (Auto-reset (Times and Reset interval)) H104 (Number-of-retry Clear Time)

To set and display the retry alarm factors in binary format, each retry alarm factor has been assigned to bits 0 to 7 as listed in Table 6.1 and Table 6.2.

■ Retry target selection 1 (H105)

Table 6.1 H105 Retry Target Selection 1, Bit Assignment of Selectable Factors

Indication on the LCD	0	0	0	0	0	0	0	0
Bit	7	6	5	4	3	2	1	0
Protective function	-	-	Motor overheat	Motor overload	-	Overheat protection	Overvoltage protection	Overcurrent protection
Alarm code	-	-	OH4	OL1	-	OH1 OH3 OLU	OU1 OU2 OU3	OC1 OC2 OC3

- Data setting range: 00000000 to 11111111 (binary)

■ Retry target selection 2 (H106)

Table 6.2 H106 Retry Target Selection 2, Bit Assignment of Selectable Factors

Indication on the LCD	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Bit	7	6	5	4	3	2	1	0
Protective function	-	-	-	-	-		Undervoltage	External alarm
Alarm code	-	-	-	-	-		LV	OH2

- Data setting range: 00000000 to 11111111 (binary)

H110 Input Phase Loss Protection Avoidance Operation (Mode selection)

If phase loss or line-to-line voltage unbalance is detected in the three-phase power supplied to the inverter, the input phase loss protection (Lin, on Bit 1 of H98) is activated.

H110 specifies whether to avoid activating the protection by automatically decreasing the output frequency or stop the inverter due to an alarm Lin.

- Data setting range: 0 (Disable), 1 (Enable)

H112 Voltage Shortage Avoidance Operation (Mode selection)

H98 (Protection/Maintenance Function (Mode selection))

If the inverter output voltage level drops below the commanded value (under V/f control) due to insufficient three-phase power, the output current may increase depending upon the load state.

H112 specifies whether to avoid such an event by automatically decreasing the output frequency until the inverter can output the commanded voltage.

Note: Under V/f control, decreasing the output voltage decreases the output voltage (command value) proportionally.

- Data setting range: 0 (Disable), 1 (Enable)

H114 Automatic Deceleration (Operation level) (See H69.)

Settings for automatic deceleration (operation level) are detailed in the section for function code H69.

H116 **H117** **H118** **H119** **H120** **H121**	**Fire Mode (Mode selection)** **(Confirmation time)** **(Reference frequency)** **(Rotation direction)** **(Start method)** **(Reset interval)**

Set when enabling forced operation (Fire Mode). In an emergency, operation at a specified speed can be performed. Even when an alarm of the inverter is generated, operation is continued. In such a case where instant overcurrent protection occurs, the retry function is to be used to restart the operation.

Assigning the ***FMS*** to a digital input terminal and turning the ***FMS*** ON enables forced operation (Fire Mode). (Function code E01 to E07; data = 134)

Note: Running the inverter with the ***FMS*** ON means that the inverter runs without the protective function. Canceling an alarm and continuing to run the inverter, therefore, may break the inverter or cause a fire.

■ Fire Mode (Mode selection) (H116)

- Data setting range: 0 to 2

Turning ***FMS*** ON enables forced operation (Fire Mode). Three different operation selections are possible.

Data 0: Enabled with ***FMS*** ON; disabled with "FMS" OFF

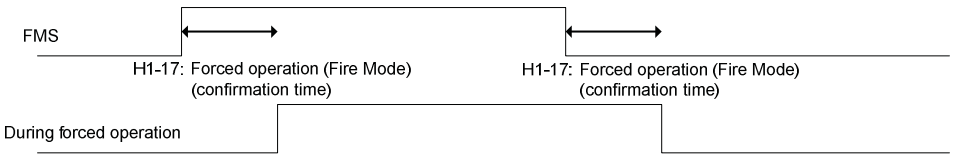
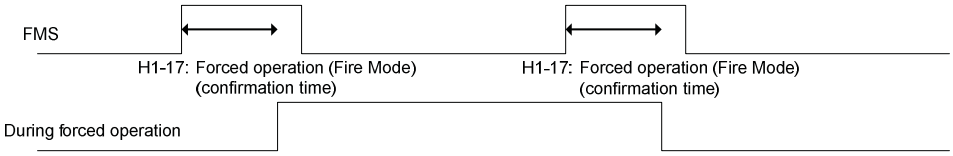
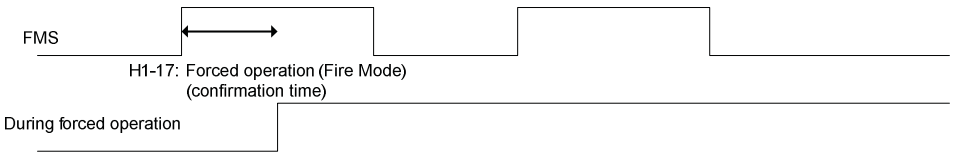
Data 1: Toggle method Enabled with ***FMS*** ON/OFF; disabled with the next ***FMS*** ON/OFF

Data 2: Latch method Enabled with ***FMS*** ON (This status is kept.)

■ Fire Mode (Confirmation time) (H117)

- Data setting range: 0.5 to 10.0 (s)

Set ON/OFF setting time for ***FMS*** signals. If ***FMS*** is turned ON/OFF in time shorter than the specified value, forced operation (Fire Mode) is not enabled. ***FMS*** signals are to be kept ON longer than the H117 confirmation time.

H116 data	
0 FMS: ON	
1 FMS toggle method	
2 FMS latch method	

■ Fire Mode (Reference frequency) (H118)

- Data setting range: Inherit, 0.1 to 120.0 (Hz)

Specify speed (reference frequency) at which operation is to be performed when forced operation (Fire Mode) is enabled.

H118 data	Function
Inherit	The frequency selected through frequency setting 1 (F01) and 2 (C30) is followed.
0.1 to 120.0	Arbitrary frequencies can be set in 0.1 Hz steps.

■ Fire Mode (Rotation direction) (H119)

- Data setting range: 0, 2, 3

Set an operation instruction (rotation direction) to be followed when forced operation (Fire Mode) is enabled.

H119 data	Function
0	Follows the operation instruction selected through drive operation (F02). * When the operation instruction is OFF, operation is not performed at the frequency specified with H118 (reference frequency). Note, however, that the mode at that time is forced operation execution status.
2	Operation through forward rotation (FWD) * Forward rotation is forcibly performed irrespective of presence and absence of an operation instruction.
3	Operation through reverse rotation (REV) * Reverse rotation is forcibly performed irrespective of presence and absence of an operation instruction.

■ Fire Mode (Start method) (H120)

- Data setting range: 0, 1

Set the start method to be followed when Fire Mode is enabled.

H120 data	Function
0	Follows the start methods specified with instant power failure restart (F14) and H09 (starting mode).
1	STM mode (auto search for idling motor speed to run the idling motor without stopping it)

■ Fire Mode (Reset interval) (H121)

- Data setting range: 0.5 to 20.0 (s)

Set time delay to auto cancel of trip status for a case where the inverter enters trip status and stops during forced operation (Fine Mode).

H181 H182 H183 H184	**Light Alarm Selection 1** **Light Alarm Selection 2** **Light Alarm Selection 3** **Light Alarm Selection 4**

If a detected abnormal state represents a minor failure, an alarm (display and general-purpose output terminal) is output and operation can be continued without inverter trip. When an minor failure occurs, an alarm icon which designates its occurrence is shown on an LCD monitor and the WARN. LED blinks. What is to be subjected to this function can be selected with function codes H181, H182, H183, and H184. If minor failure "LALM" (data = 98) is assigned to a general-purpose output terminal (function code E20 to E24, E27), minor failure "LALM" signals are output to the terminal when a minor failure occurs.

The table below lists alarms selectable as minor failure factors.

Code	Name	Description
OH2	External alarm	An error that has occurred in peripheral equipment turned the external alarm signal ***THR*** ON.
OH3	Inverter internal overheat	The temperature inside the inverter abnormally has increased.
OL1	Overload of motor 1	Motor temperature calculated with the inverter output current reached the trip level.
Er4	Option communications error	Communications error between the inverter and an option.
Er5	Option error	An option judged that an error occurred.
Er8 ErP	RS-485 communications error (COM port 1) RS-485 communications error (COM port 2)	RS-485 communications error between the COM ports 1 and 2.
CoF	Current input wire break	Wire connected to terminal [C1] (current input) is broken.
PV1 PV2 PVA PVb PVC	PID feedback error detection	Error in PID feedback signals (PID control 1, PID control 2, External PID control 1 to 3)
FAL	DC fan locked	Failure of the air circulation DC fan inside the inverter. (For IP00 rated inverters of 110 kW or above, IP21 rated ones of 45 kW or above, and IP55 rated ones of 110 kW or above)
OL	Motor overload early warning	Early warning before a motor overload
OH	Heat sink overheat early warning	Early warning before a heat sink overheat trip
LiF	Lifetime alarm	It is judged that the service life of any one of the capacitors (DC link bus capacitors and electrolytic capacitors on the printed circuit boards) and cooling fan has expired. Or, failure of the air circulation DC fan inside the inverter. (IP55 only)
rEF	Reference command loss detected	Analog frequency command was lost.
PA1 PA2 PAA PAb PAC	PID alarm	Warning related to PID control (absolute-value alarm or deviation alarm) (PID control 1, PID control 2, External PID control 1 to 3)
UTL	Low torque output	Output torque drops below the low torque detection level for the specified period.

Code	Name	Description
PTC	PTC thermistor activated	The PTC thermistor on the motor detected a temperature.
rTE	Inverter life (Cumulative motor run time)	The motor cumulative run time reached the specified level.
CnT	Inverter life (Number of startups)	Number of startups reached the specified level.
Lob dtL	Low battery alarm Real-time clock (RTC) info lost	- Low battery charge of RTC backup battery (option) - Date and time info was lost.

■ Selecting light alarm factors

To set and display the light alarm factors in binary format, each light alarm factor has been assigned to bits 0 to 7 as listed in Tables 6.3 through 6.6. Set the bit that corresponds to the desired light alarm factor to "1."

- Data setting range: 00000000 to 11111111 (binary)

■ Light Alarm Selection 1 (H181)

Table 6.3 Light Alarm Selection 1 (H181), Bit Assignment of Selectable Factors

Indication on the LCD	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Bit	7	6	5	4	3	2	1	0
Protective function	-	-	Overload of motor 1	-	-	Inverter internal overheat	External alarm	-
Alarm code	-	-	OL1	-	-	OH3	OH2	-

■ Light Alarm Selection 2 (H182)

Table 6.4 Light Alarm Selection 2 (H182), Bit Assignment of Selectable Factors

Indication on the LCD	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Bit	7	6	5	4	3	2	1	0
Protective function	-	-	RS-485 communi-cations error (COM port 2)	RS-485 communi-cations error (COM port 1)	Option error	Option communi-cations error	-	-
Alarm code	-	-	ErP	Er8	Er5	Er4	-	-

■ Light Alarm Selection 3 (H183)

Table 6.5 Light Alarm Selection 3 (H183), Bit Assignment of Selectable Factors

Indication on the LCD	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Bit	7	6	5	4	3	2	1	0
Protective function	Lifetime alarm	Heat sink overheat early warning	Motor overload early warning	DC fan locked	Current input detection, wire break detection PID feedback error	-	-	-
Alarm code	LiF	OH	OL	FAL	CoF, PV1 PV2, PVA PVb, PVC	-	-	-

■ Light Alarm Selection 4 (H184)

Table 6.6 Light Alarm Selection 4 (H184), Bit Assignment of Selectable Factors

Indication on the LCD	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Bit	7	6	5	4	3	2	1	0
Protective function	Low battery alarm, Real-time clock lost	-	Inverter life (Number of startups)	Inverter life (Cumulative motor run time)	PTC thermistor activated	Low torque output	PID alarm	Reference command loss detected
Alarm code	Lob dtL	-	CnT	rTE	PTC	UTL	PA1, PA2 PAA, PAb PAC	rEF

Note

When H26 (thermistor (mode selection))= 1 (PTC (The inverter immediately trips with OH4 displayed and stops)), the inverter stops without minor failure operations, regardless of the assignment of bit 3 (PTC thermistor activated) by H184 (Light Alarm Selection 4).

■ Light alarm--***L-ALM*** (E20 to E24 and E27, data = 98)

This output signal comes ON when a light alarm occurs.

H197 User Password 1 (Mode selection)

H197 specifies the password function to apply when password 1 is set.

Data for H197	Function
0	Disclose all function codes but prohibit any change
1	Disclose function codes selected for quick setup and allow change

5.1.7 J codes (Application functions 1)

J21	Dew Condensation Prevention (Duty)

When the inverter is stopped, dew condensation on the motor can be prevented, by feeding DC power to the motor at regular intervals to keep the temperature of the motor above a certain level.

■ Enabling Dew Condensation Prevention

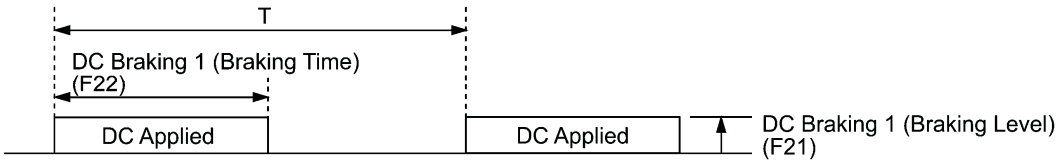
To utilize this feature, you need to assign the terminal command *DWP* ("Protect motor from dew condensation") to one of the general-purpose digital input terminals.

(📖 E01 to E07, data = 39)

■ Dew Condensation Prevention (Duty) (J21)

The magnitude of the DC power applied to the motor is the same as the setting of F21 (DC braking 1, Braking level) and its duration of each interval is the same as the setting of F22 (DC braking 1, Braking time). Interval T is determined so that the ratio of the duration of the DC power to T is the value (Duty) set for J21.

$$\text{Duty for condensation prevention (J21)} = \frac{F22}{T} \times 100\,(\%)$$



Condensation Prevention Cycle

J22	Commercial Power Switching Sequence	(Refer to E01 through E07.)

Refer to the description of *ISW50* and *ISW60* (Enable integrated sequence to switch to commercial power) in E01 through E07.

5.1.8 J1 codes (PID control 1)

J101	PID Control 1 (Mode selection)	J202 (PID Control 2 (Mode selection))

Under PID control, the inverter detects the state of a control target object with a sensor or the similar device and compares it with the commanded value (e.g., temperature control command). If there is any deviation between them, PID control operates to minimize it. That is, it is a closed loop feedback system that matches controlled variable (feedback amount). PID control expands the application area of the inverter to process control (e.g., flow control, pressure control, and temperature control).

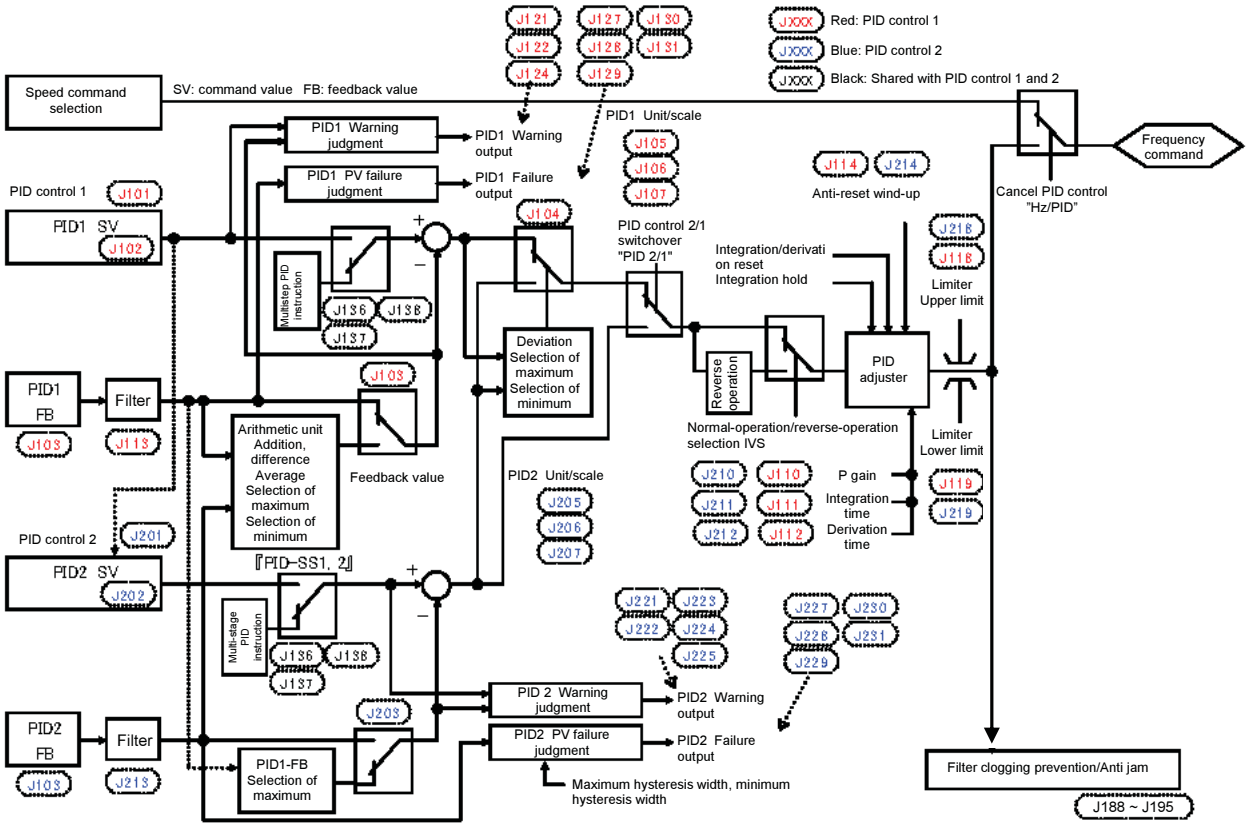
If PID control is enabled (J101, J201 = 1, 2), the frequency control of the inverter is switched from the drive frequency command generator block to the PID command generator block.

■ Mode Selection (J101, J201)

- Data setting range: 0 to 2

Data for J101, J201	Function
0	Disable
1	Enable (Process control, normal operation)
2	Enable (Process control, inverse operation)

PID process control block diagram



- Using J01 enables switching between normal and inverse operations against the PID process control output, so you can specify an increase/decrease of the motor rotating speed to the difference (error component) between the commanded (input) and feedback amounts, making it possible to apply the inverter to air conditioners. The terminal command ***IVS*** can also switch operation between normal and inverse.

📖 For details about the switching of normal/inverse operation, refer to the description of Switch normal/inverse operation ***IVS*** (E01 to E07, data = 21).

- Switchover of PID control

  Different from PID control 1, assigned values and feedback values can be input for PID control 2. PID control 1 and PID control 2 can be switched. Signals (PID channel switchover PID2/1) assigned to the digital input terminal from external equipment are to be used to switch.

Input signal PID2/1	PID control to be selected
OFF	PID control 1
ON	PID control 2

Switching PID control 1 and PID control 2 causes the codes shown in the table below to be switched.

Control Code Name	PID Control 1	PID Control 2
Operation selection	J101	J201
Command selection	J102	J202
Feedback selection	J103	J203
Deviation selection	J104	Disabled under PID control 2.
Display units	J105	J205
Max. scale, min. scale	J106, J107	J206, J207
P (Gain)	J110	J210
I (Integral time)	J111	J211
D (Differential time)	J112	J212
Feedback filter	J113	J213
Anti-reset windup	J114	J214
PID output limiter max., min.	J118, J119	J218, J219
Alarm output	J121, J122, J124	J221 through J225
Feedback error detection	J127 through J131	J227 through J231
PID multistep command	J136 through J138	PID control 1 settings take effect even under PID control 2.
Slow flowrate stop	J149 through J154 J156 through J160	J249 through J251 J256 through J260
Flowrate sensor selection	J163 through J166	PID control 1 settings take effect even under PID control 2.
Filter clogging prevention/anti-jam	J188 through J195	Filter clogging prevention is disabled under PID control 2. For anti-jam, PID control 1 settings take effect even under PID control 2.
Wet-bulb temperature presumption control	J198	Disabled under PID control 2

J102	PID Control 1 (Command selection) J202 (PID Control 2 (Command selection))

Select a method for setting a command value for PID control 1 and 2.

- Data setting range: 0 to 101

Data for J102	Data for J102	Function
0	0	PID commands with the keypad PID commands with the ⌃ / ⌄ keys on the keypad
1	1	PID command 1 (Analog input: Terminals [12], [C1] and [V2]) Voltage input to the terminal [12] (0 to ±10 VDC, 100% PID command/±10 VDC) Current input to the terminal [C1] (4 to 20 mA DC, 100% PID command/20 mA DC) (0 to 20 mA DC, 100% PID command/20 mA DC) Voltage input to the terminal [V2] (0 to ±10 VDC, 100% PID command/±10 VDC)
-	2	PID command 2 (Analog input: Terminals [12], [C1] and [V2]) Voltage input to the terminal [12] (0 to ±10 VDC, 100% PID command/±10 VDC) Current input to the terminal [C1] (4 to 20 mA DC, 100% PID command/20 mA DC) (0 to 20 mA DC, 100% PID command/20 mA DC) Voltage input to the terminal [V2] (0 to ±10 VDC, 100% PID command/±10 VDC)
3	3	PID commands with ***UP***/***DOWN*** commands With ***UP*** and ***DOWN*** commands, a command value for PID control can be set by increasing/decreasing between the minimum and maximum scales.
4	4	Command via communications link Communications function code (S13): Communications data 20000 (decimal)/100% of the PID command.
-	101	Uses PID control 1 command (J102)

[1] PID command with the ⌃ / ⌄ keys on the keypad (J102, J202 = 0, factory default)

Using the ⌃ / ⌄ key on the keypad, you can set the control value at 0 to 100% of the PID control command, display units, scale and physical volume, in an easy-to-understand, converted command format.

For details of operation, refer to Chapter 5, Section 5.5.3 "Setting up frequency and PID commands".

📖 For scale setting for terminal [12], refer to function codes C59 and C60.
For scale setting for terminal [C1], refer to function codes C65 and C66.
For scale setting for terminal [V2], refer to function codes C71 and C72.

[2] PID command by analog inputs 1 (J102, J202 = 1, 2)

When any analog input (voltage input to terminals [12] and [V2], or current input to terminal [C1]) for PID command 1 (J02 = 1) is used, it is possible to arbitrary specify the PID command by multiplying the gain and adding the bias. The polarity can be selected and the filter time constant and offset can be adjusted. In addition to J102 and J202 settings, it is necessary to select PID process commands 1 and 2 for analog input (specified by any of function codes E61 to E63). For details, refer to the descriptions of E61 to E63.

Adjustable elements of PID command

Input terminal	Input range	Bias		Gain		Polarity	Filter time constant	Offset	Range selection
		Bias	Base point	Gain	Base point				
[12]	0 to +10 V, -10 to +10V	C55	C56	C32	C34	C35	C33	C31	-
[C1]	4 to 20 mA	C61	C62	C37	C39	-	C38	C36	C40
[V2]	0 to +10 V, -10 to +10 V	C67	C68	C42	C44	C45	C43	C41	-

■ Offset (C31, C36, C41)

C31, C36 or C41 configures an offset for an analog voltage/current input. The offset also applies to signals sent from the external equipment.

■ Filter time constant (C33, C38, C43)

C33, C38, and C43 provide the filter time constants for the voltage and current of the analog input. Choose appropriate values for the time constants considering the response speed of the machinery system, as large time constants slow down the response. If the input voltage fluctuates because of noise, specify large time constants.

■ Polarity (C35, C45)

C35 and C45 specify the input range for analog input voltage.

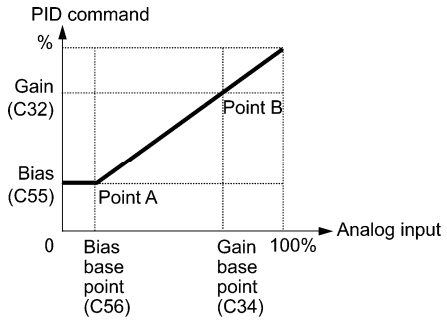
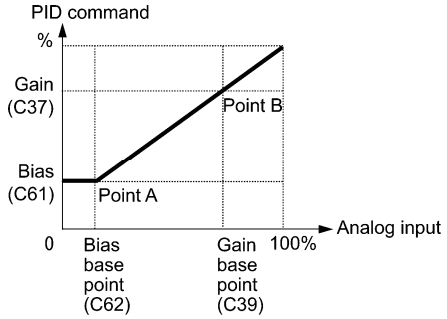
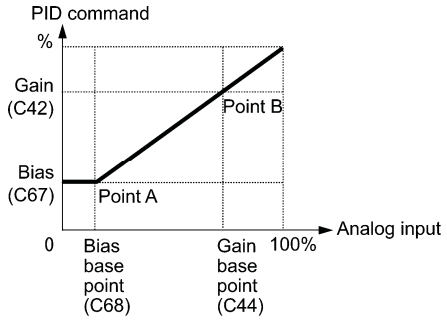
Data for C35 and C45	Terminal input specifications
0	-10 to +10 V
1	0 to +10 V (negative value of voltage is regarded as 0 V)

■ Range selection: Terminal [C1]

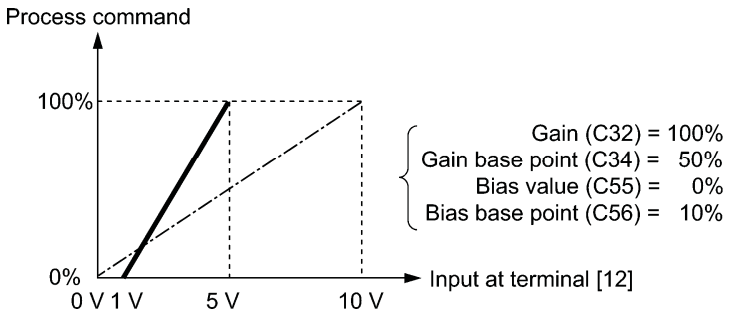
Set an input range for terminal [C1] (analog input current).

Data for C40	Terminal input specifications
0	4 to 20 mA (factory default)
1	0 to 20 mA

■ Gain and bias

Terminal	Content
[12]	
[C1]	
[V2]	

(Example) Mapping the range of 1 through 5 V at terminal [12] to 0 through 100%



[3] PID command with ***UP/DOWN*** control (J102, J202 = 3)

When the *UP/DOWN* control is selected as a PID command, turning the terminal command *UP* or *DOWN* ON causes the PID command to change within the range from minimum scale to maximum scale.

This can be set using a physical unit by means of display unit (J105) and scale (J106, J107).

To select the *UP/DOWN* control as a PID command, the *UP* and *DOWN* should be assigned to the digital input terminals [X1] to [X7]. (🕮 E01 to E07, data = 17, 18)

UP	*DOWN*	Function
Data = 17	Data = 18	
OFF	OFF	Retain PID command value.
ON	OFF	Increase PID command value at a rate between 0.1%/0.1 s and 1%/0.1 s.
OFF	ON	Decrease PID command value at a rate between 0.1%/0.1 s and 1%/0.1 s.
ON	ON	Retain PID command value.

Note Setting commands via the ***UP/DOWN*** control is the same as for external PID controls 1, 2 and 3 (J501, J601 and J651).

[4] PID command via communications link (J102, J202 = 4)

Use function code S13 that specifies the communications-linked PID command. The transmission data of 20000 (decimal) is equal to 100% (maximum frequency) of the PID command. For details of the communications format, refer to the RS-485 Communication User's Manual.

Selecting Feedback Terminals

For feedback control, determine the connection terminal according to the type of the sensor output.

- If the sensor is a current output type, use the current input terminal [C1] of the inverter.
- If the sensor is a voltage output type, use the voltage input terminal [12] of the inverter, or switch over the terminal [V2] to the voltage input terminal and use it.

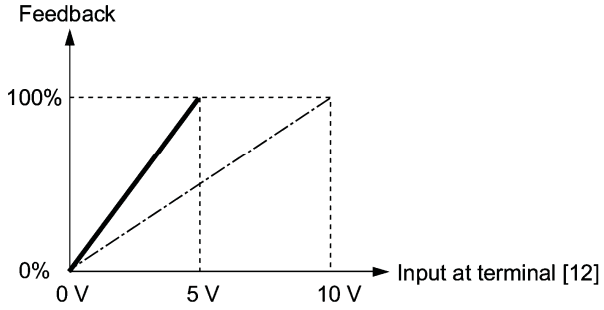
🕮 For details, refer to the descriptions of E61 through E63.

Application example: Process control (for air conditioners, fans and pumps)

The operating range for PID process control is internally controlled as 0% through 100%. For the given feedback input, determine the operating range to be controlled by means of gain adjustment.

(Example) When the output level of the external sensor is within the range of 1 to 5 V:

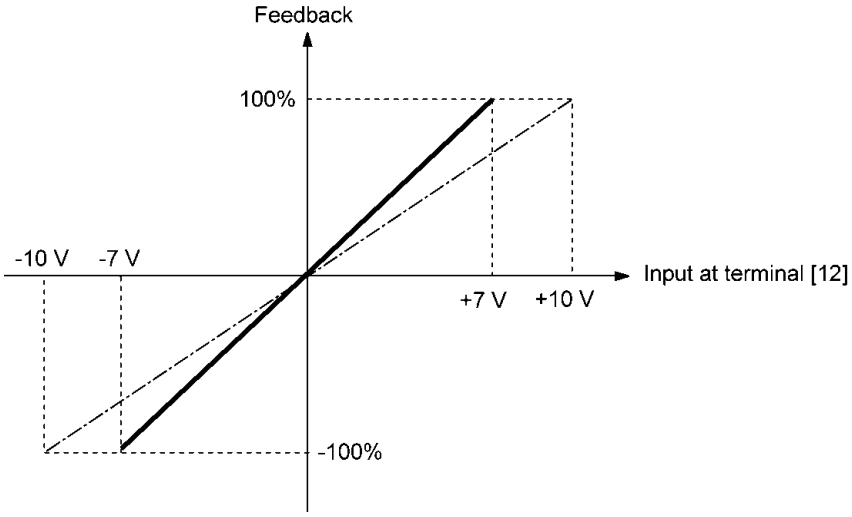
- Use terminal [12] designed for voltage input.
- Set the gain (C32 for analog input adjustment) at 200% in order to make the maximum value (5 V) of the external sensor's output correspond to 100%. Note that the input specification for terminal [12] is 0 to 10 V corresponding to 0 to 100%; thus, a gain factor of 200% (= 10 V ÷ 5 V × 100) should be specified.


Feedback
100%
0%
0 V
5 V
10 V
Input at terminal [12]

(Example 1) When the output level of the external sensor is ±7 VDC:

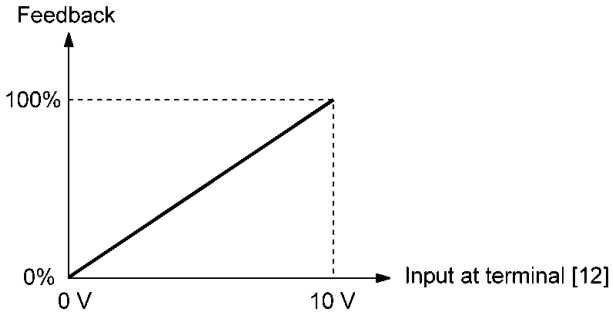
- Use terminal [12] since the voltage input is of bipolar.
- When the external sensor's output is of bipolar, the inverter controls the speed within the range of +100% to -10%. To convert the output +7 VDC to +100%, set the gain (C32 for analog input adjustment) at 143% as calculated below.

$$\frac{10\ \text{V}}{7\ \text{V}} \approx 143\%$$



(Example 2) When the output level of the external sensor is 0 to 10 VDC:

- Use terminal [12] designed for voltage input.
- When the external sensor's output is of unipolar, the inverter controls the speed within the range of 0 to 100%.



In this example, it is recommended that the dancer reference position be set around the +5 V (50%) point.

PID Display Coefficient and Monitoring

To monitor the PID command and its feedback value, set a display unit, maximum scale, and minimum scale to convert the values into easy-to-understand physical quantities (such as temperature).

- Function code of display unit, maximum scale, and minimum scale, for each terminal

	Display unit	Maximum scale	Minimum scale
Terminal [12]	C58	C59	C60
Terminal [C1]	C64	C65	C66
Terminal [V2]	C70	C71	C72

📖 For the monitor, refer to function code K10.

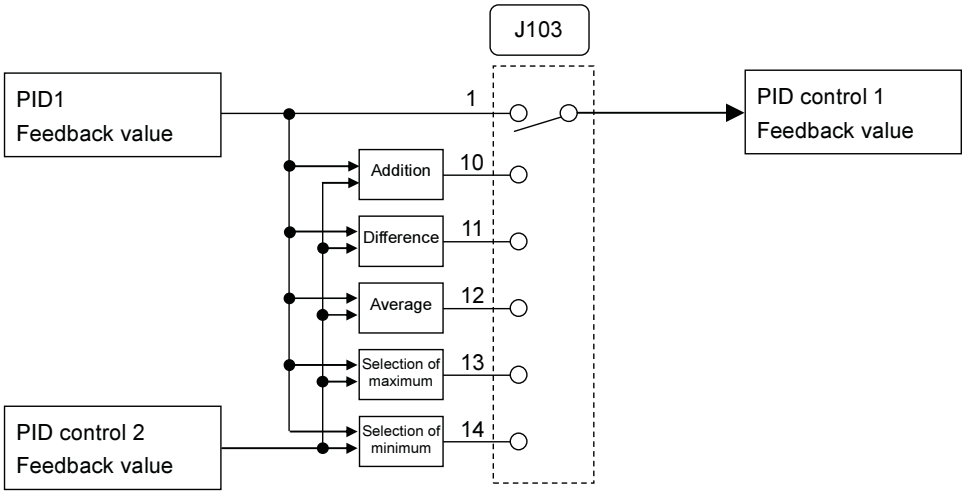
J103	PID Control 1 (Feedback selection) J203 (PID Control 2 (Feedback selection))

Select a feedback value for PID controls 1 and 2.

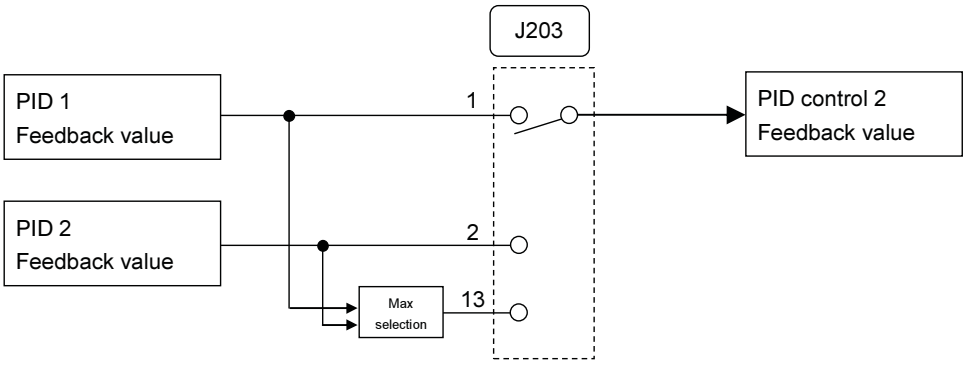
- Data setting range: 1 to 14

Data for J103	Data for J203	Function
1	1	PID control 1 feedback value
--	2	PID control 2 feedback value
10	--	Addition (PID control 1 feedback value + PID control 2 feedback value)
11	--	Difference (PID control 1 feedback value - PID control 2 feedback value)
12	--	Average ((PID control 1 feedback value + PID control 2 feedback value) / 2)
13	13	Maximum (Use larger of PID control 1 or 2 feedback values)
14	--	Minimum (Use smaller of PID control 1 or 2 feedback values)

PID control 1 feedback selection block diagram



PID control 2 feedback selection block diagram



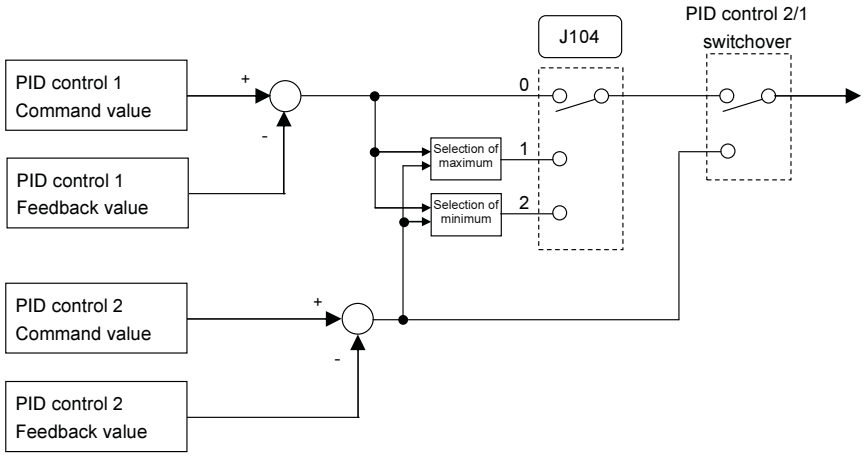
J104	PID Control 1 (Deviation selection)

Select a deviation value for PID control 1.

- Data setting range: 0 to 2

Data for J104	Function
0	PID control 1 command value (J102) - PID control 1 feedback value (J103)
1	Selection of maximum (Use larger of PID control 1 or 2 deviation)
2	Selection of minimum (Use smaller of PID control 1 or 2 deviation)

PID control 1 deviation selection section block diagram



J105	PID Control 1 (Display unit)	J205 (PID Control 2 (Display unit))

Select a display unit for PID control. Set PID control 1 and PID control 2 with function codes J105 and J205 respectively. During PID control, the keypad shows PID command values (SV), feedback values (PV), operation amount (MV), and others. Set the display units for these values.

For monitor display settings, see 5.5.1 Monitoring operation status in Chapter 5 Operation Preparation and Test Operation.

When PID control is to be performed using the same unit and scale as of feedback values, the J105 and J205 settings need not be changed. (Factory default: The unit and scale for feedback values are used.)

Set here when PID control is to be performed using a unit and scale which are different from those for feedback values.

- Data setting range: 1 to 80

Data for J105/J205	Display unit	Data for J105/J205	Display unit	Data for J105/J205	Display unit
0: Inherit	* (Factory default)	23	L/s (flow quantity)	45	mmHg (pressure)
1	No unit	24	L/min (flow quantity)	46	Psi (pressure)
2	%	25	L/h (flow quantity)	47	mWG (pressure)
4	r/min	40	Pa (pressure)	48	inWG (pressure)
7	kW	41	kPa (pressure)	60	K (temperature)
20	m^3/s (flow quantity)	42	MPa (pressure)	61	°C (temperature)
21	m^3/min (flow quantity)	43	mbar (pressure)	62	°F (temperature)
22	m^3/h (flow quantity)	44	bar (pressure)	80	ppm (density)

* The unit and scale for feedback values are used.

📖 For feedback value selection, see function codes E61 to E63.

📖 The table below shows function codes to be used for setting a unit and scale for feedback values.

	Display unit	Maximum scale	Minimum scale
Terminal [12]	C58	C59	C60
Terminal [C1]	C64	C65	C66
Terminal [V2]	C70	C71	C72

J106 J107 — PID Control 1 (Maximum scale, Minimum scale)

J206, J207 (PID Control 2 (Maximum scale, Minimum scale))

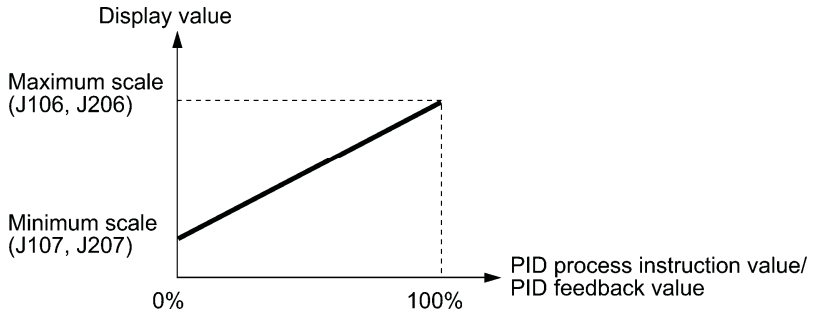
PID control values can be converted into easily recognizable physical quantity and displayed. Set PID control 1 with function codes J106 and J107 and PID control 2 with function codes J205 and J207.

Set the maximum scale "PID command value/ display for 100% of a PID feedback value" with J106 and J206, and the minimum scale "PID command value/ display for 0% of a PID feedback value" with J107 and J207.

Values to be displayed are as below.

Display value = (PID command value or PID feedback value (%))/100 x (Maximum scale - Minimum scale) + Minimum scale

- Data setting range: (Maximum scale and minimum scale) -999.00 to 0.00 to 9990.00



J108 J109	PID Control 1 (Tuning) (Tuning manipulated value)	J110 (PID Control 1 (P (Gain)) J111 (PID Control 1 (I (Integral time)) J112 (PID Control 1 (D (Differential time))
J208 J209	PID Control 2 (Tuning) (Tuning manipulated value)	J210 (PID Control 2 (P (Gain)) J211 (PID Control 2 (I (Integral time)) J212 (PID Control 2 (D (Differential time))

In tuning, the inverter forcibly changes MV under actual load to repeatedly make a speed step change several times, monitors changes in the feedback signals, estimates P, I, and D constants for PID control, and writes them to the corresponding function codes automatically.

Depending upon the time constant of feedback signals, short-time or long-time response is available. It is possible to specify step change values as tuning manipulated values.

If a tuning error occurs, the inverter posts the error code to J108 or J208. According to the error contents, take any measure. For P, I, and D constants, refer to the description of the corresponding function codes.

Upon the successful completion of tuning, the inverter continues running under PID control.

■ PID control 1, 2 (Tuning) (J108, J208)

Data for J108, J208	Function
0	Disable (No tuning)
1	For short-time response. Time constant: approx. 30 s or less. (It takes approx. 10 seconds to 8 minutes.)
2	For long-time response. Time constant: approx. 30 s or more. (It takes approx. 30 to 90 minutes.)
If tuning ends abnormally, the inverter posts any of the following values to J108 or J208.	
100	Tuning canceled: Tuning has been canceled due to a run command OFF, PID cancel, fire mode, alarm, etc.
101	Mode unmatched: The time constant was too large or small. If tuning was performed with J108 (J208) being set to "1" ("2"), change the setting from "1" ("2") to "2" ("1") to perform tuning again.
102	MV too small: Almost no change in feedback signals. Increase the setting of J109 (J209) and perform tuning again.
103	MV too large: Too large change in feedback signals. Decrease the setting of J109 (J209) and perform tuning again.
104	MV change: The torque limiter (F40, F41), current limiter (F43) or any other limiter had been activated so that the speed changed and no normal tuning was performed. Disable those limiters, increase their limit values, or increase the setting of J109 (J209). Canceling tuning may also cause this error.
105	PV too small or large: The feedback signal PV is out of the range from 0 to 100% so that no tuning is possible. Investigate the scaling.
106	PV unstabilized: To stabilize PV, increase the setting of J113 (J213) or that of C33 or C38 (Filter time constant).
107	Other factors: Tuning impossible. Tuning has been started with no PV-assigned terminal or during running with the upper limit frequency.

■ PID control 1, 2 (Tuning manipulated value) (J109, J209)

J109 (J209) specifies a speed change value to apply during tuning. The moment you specify the change value, the inverter outputs the "current frequency + J109 (J209) setting."

- Data setting range: 10 to 100% (Maximum frequency = 100%, Initial value 10%)

Requisites for PID tuning

To perform tuning, observe the following beforehand.

- Make a trial run under speed control and confirm that there is no problem for inverter running under actual load.
- Make feedback signal settings and confirm that the inverter can monitor the signal levels.
- Make PID control related settings to make the inverter ready for PID control.
- Since tuning changes the speed step by step, investigate the tuning manipulated value so that PV (feedback signal) does not drop below 0% or exceed 100%. Post the result to J108 (J208).
- Change the speed under speed control beforehand to figure out an approximate time constant of feedback signals for determining whether to perform short-time or long-time response tuning.

PID tuning procedure

(1) Enter a run command to run the inverter.

(2) Put the inverter into a feedback signal (PV) stabilized state under PID control.

(3) Set J108 (J208) to "1" (Short-time response) or "1" (Long-time response)>

(4) Wait for tuning to complete, checking the progress bar on the LCD monitor.

(5) If tuning ends normally, the setting of J108 (J208) reverts to "0." If any error occurs, the error code is posted to J108 (J208). Remove the error cause and perform tuning again.

PID tuning notes

- Since tuning changes the speed step by step, to deal with unexpected incidents, get ready to immediately shut down run commands or enter a coast-to-stop command.
- To perform tuning with J108 (J208) being set to "2" (Long-time response), increase the setting of J113 (J213) (Feedback filter) to stabilize feedback signals (PV). Unstabilized PV may result in a long-time waiting state for stabilized PV.

J110	PID Control 1 P (Gain)	J210 (PID Control 2 (P (gain))
J111	I (Integral time)	J211 (PID Control 2 (I (integral time))
J112	D (Differential time)	J212 (PID Control 2 (D (differential time))
J113	(Feedback filter)	J213 (PID Control 2 (feedback filter))

■ P gain (PID control 1: J110 / PID control 2: J210)

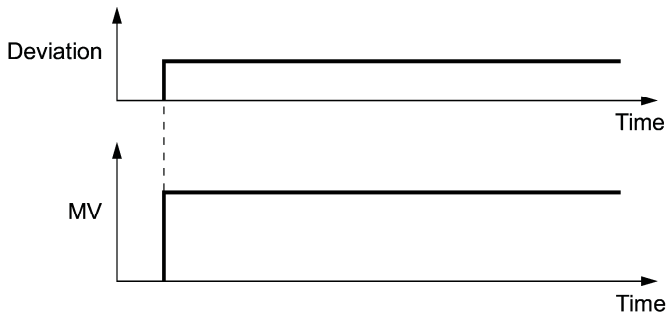
J110 specifies the gain for the PID processor.

- Data setting range: 0.000 to 30.000 (times)

P (Proportional) action

An operation in which the MV (manipulated value: output frequency) is proportional to the deviation is called P action, which outputs the MV in proportion to deviation. However, the P action alone cannot eliminate deviation.

Gain is data that determines the system response level against the deviation in P action. An increase in gain speeds up response, but an excessive gain may oscillate the inverter output. A decrease in gain delays response, but it stabilizes the inverter output.



■ I integral time (PID control 1: J111 / PID control 2: J211)

J04 specifies the integral time for the PID processor.

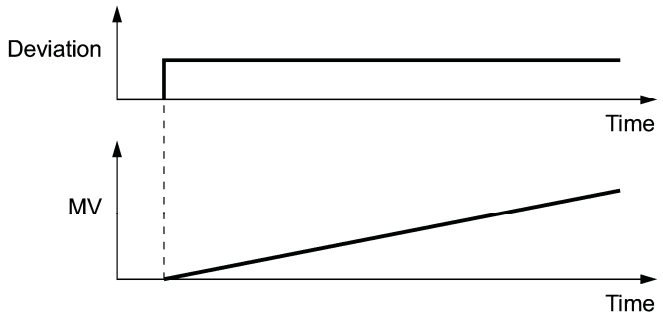
- Data setting range: 0.0 to 3600.0 (s)

  0.0 means that the integral component is ineffective.

I (Integral) action

An operation in which the change rate of the MV (manipulated value: output frequency) is proportional to the integral value of deviation is called I action, which outputs the MV that integrates the deviation. Therefore, I action is effective in bringing the feedback amount close to the commanded value. For the system whose deviation rapidly changes, however, this action cannot make it react quickly.

The effectiveness of I action is expressed by integral time as parameter, that is J04 data. The longer the integral time, the slower the response. The reaction to the external disturbance also becomes slow. The shorter the integral time, the faster the response. Setting too short integral time, however, makes the inverter output tend to oscillate against the external disturbance.



■ D differential time (PID control 1: J112 / PID control 2: J212)

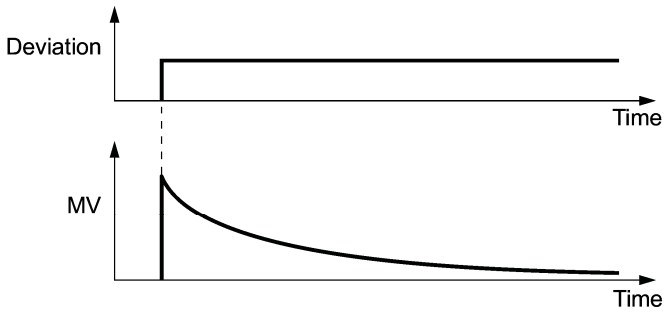
J112/J212 specifies the differential time for the PID processor.

- Data setting range: 0.00 to 600.00 (s)
  0.00 means that the differential component is ineffective.

D (Differential) action

An operation in which the MV (manipulated value: output frequency) is proportional to the differential value of the deviation is called D action, which outputs the MV that differentiates the deviation. D action makes the inverter quickly react to a rapid change of deviation.

The effectiveness of D action is expressed by differential time as a parameter. Setting a long differential time will quickly suppress oscillation caused by P action when a deviation occurs. Too long differential time makes the inverter output oscillation more. Setting short differential time weakens the suppression effect when the deviation occurs.



The combined uses of P, I, and D actions are described below.

(1) PI control

PI control, which is a combination of P and I actions, is generally used to minimize the remaining deviation caused by P action. PI control always acts to minimize the deviation even if a commanded value changes or external disturbance steadily occurs. However, the longer the integral time, the slower the system response to quick-changed control.

P action can be used alone for loads with very large part of integral components.

(2) PD control

Under PD control, the moment that a deviation occurs, the control rapidly generates greater MV (manipulated value) than that generated by D action alone, to suppress the deviation increase. When the deviation becomes small, the behavior of P action becomes small.

A load including the integral component in the controlled system may oscillate due to the action of the integral component if P action alone is applied. In such a case, use PD control to reduce the oscillation caused by P action, for keeping the system stable. That is, PD control is applied to a system that does not contain any damping actions in its process.

(3) PID control

PID control is implemented by combining P action with the deviation suppression of I action and the oscillation suppression of D action. PID control features minimal control deviation, high precision and high stability.

In particular, PID control is effective to a system that has a long response time to the occurrence of deviation.

Follow the procedure below to set data to PID control function codes.

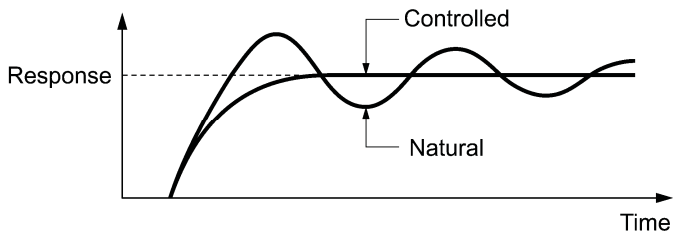
It is highly recommended that you adjust the PID control value while monitoring the system response waveform with an oscilloscope or equivalent. Repeat the following procedure to determine the optimal solution for each system.

- Increase the data of function code J110/J210 (PID control P (Gain)) within the range where the feedback signal does not oscillate.
- Decrease the data of function code J111/J211 (PID control I (Integral time)) within the range where the feedback signal does not oscillate.
- Increase the data of J112/J212 (PID control D (Differential time)) within the range where the feedback signal does not oscillate.

Refining the system response waveforms is shown below.

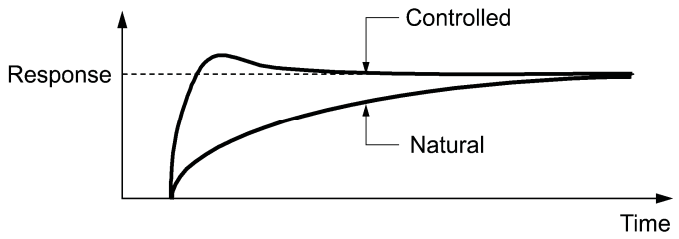
1) Suppressing overshoot

   Increase the data of function code J111/J211 (Integral time) and decrease that of J112/J212 (Differential time).



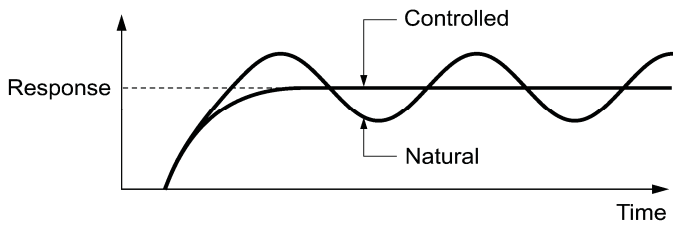
2) Quick stabilizing (moderate overshoot allowable)

   Decrease the data of J110/J210 (Gain) and increase that of J112/J212 (Differential time).



3) Suppressing oscillation whose period is longer than the integral time specified by function code J111/J211

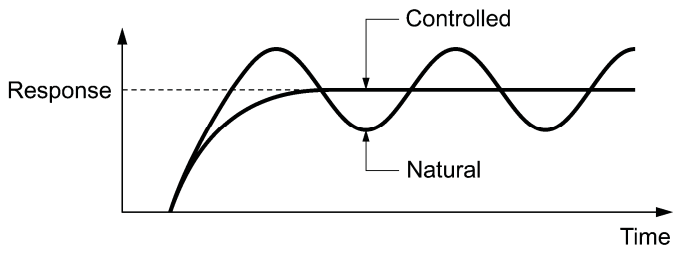
   Increase the data of J111/J211 (Integral time).



4) Suppressing oscillation whose period is approximately the same as the time specified by function code J112/J212 (Differential time)

   Decrease that of J112/J212 (Differential time).

   Decrease the data of function code J110/J210 (Gain), if the oscillation cannot be suppressed even though the differential time is set at 0 sec.



■ Feedback filter (PID control 1: J113 / PID control 2: J213)

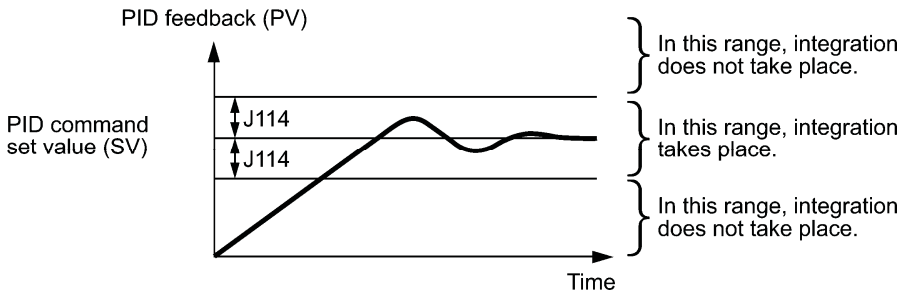
J113/J213 specifies the time constant of the filter for feedback signals under PID control.

- Data setting range: 0.0 to 900.0 (s)
- This setting is used to stabilize the PID control loop. Setting too long a time constant makes the system response slow.

J114	PID Control 1 (Anti-reset wind-up)	J214 (PID Control 2 (Anti-reset wind-up))

J114 suppresses overshoot under control using a PID processor. Set PID control 1 and PID control 2 with function codes J114 and J214, respectively. As long as the deviation between the PID command and its feedback is out of the preset range, the integrator holds its value and does not perform integration operation.

- Data setting range: OFF (Disable), 0.01 to 9990.00 (Setting range is limited by the maximum and minimum scales.)



J118 J119	**PID Control 1 (Upper limit of PID process output)** **(Lower limit of PID process output)** **J218 (PID Control 2 (upper limit of PID process output))** **J219 (PID Control 2 (upper limit of PID process output))**

The upper and lower limiters can be specified to the PID output, exclusively used for PID control. Set PID control 1 with function codes J118 and J119 and PID control 2 with function codes J218 and J219. The settings are ignored when terminal command ***Hz/PID*** ("Cancel PID control") is ON and the inverter runs at the reference frequency previously specified. (📖 E01 to E07, data = 20)

■ PID Control 1 (Upper limit of PID process output) (J118, J218)

J118 specifies the upper limit of the PID processor output limiter in %. If you specify "Inherit," the setting of the frequency limiter (High) (F15) serves as the upper limit.

■ PID Control 1 (Lower limit of PID process output) (J119, J219)

J119 specifies the lower limit of the PID processor output limiter in %. If you specify "Inherit," the setting of the frequency limiter (Low) (F16) serves as the lower limit.

J121 J122 J124	**PID Control 1 (Alarm output selection)** **(Upper level alarm (AH))** **(Lower level alarm (AL))** **J221 (PID Control 2 (Alarm output selection))** **J222 (PID Control 2 (Upper level alarm (AH)))** **J224 (PID Control 2 (Lower level alarm (AL)))**

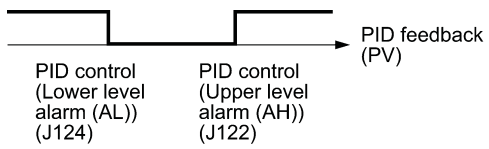
The inverter can output absolute-value and deviation alarms associated with PID control. To output alarms, digital output signals ***PID-ALM*** or ***PV1-ALM*** and ***PV2-ALM*** must be assigned to any of E20 through E24 and E27 (data = 42 and 201, 203). To generate the "light alarm," light alarm selection 4 (H184) must be set to the first bit. However, even if light alarm selection 4 (H184) is not set, the above-mentioned digital output signal can be isolated. Please refer to pages describing function codes H181 through H184 for a detailed explanation of setting the light alarm.

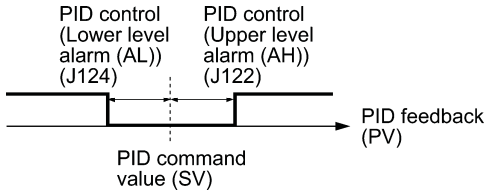
J121 and J221 specify the alarm types. J122, J222 and J124, J224 specify the upper and lower limits for alarms. J223 and J225 set their upper and lower output hiss ranges.

■ PID controls 1 and 2 (Alarm output selection) (J121, J221)

J121 and J221 specify the alarm type. The table below lists the alarms selectable.

The physical quantities that can be set depend on the display units and scale.

Data for J121	Data for J221	Alarm	Description
0	0	Absolute-value alarm	While PV < AL or AH < PV, ***PID-ALM*** is ON. 
1	1	Absolute-value alarm (with Hold)	Same as above (with Hold)
2	2	Absolute-value alarm (with Latch)	Same as above (with Latch)

Data for J121	Data for J221	Alarm	Description
3	3	Absolute-value alarm (with Hold and Latch)	Same as above (with Hold and Latch)
--	50	Absolute-value alarm (PID control cancel)	Same as above (PID control cancel) This function is available only on PID control 2
4	4	Deviation alarm	While PV < SV - AL or SV + AH < PV, ***PID-ALM*** is ON. 
5	5	Absolute-value alarm (with Hold)	Same as above (with Hold)
6	6	Absolute-value alarm (with Latch)	Same as above (with Latch)
7	7	Absolute-value alarm (with Hold and Latch)	Same as above (with Hold and Latch)

Hold: During the power-on sequence, the alarm output is kept OFF (disabled) even when the monitored quantity is within the alarm range. Once it goes out of the alarm range, and comes into the alarm range again, the alarm is enabled.

Latch: Once the monitored quantity comes into the alarm range and the alarm is turned ON, the alarm will remain ON even if it goes out of the alarm range. To release the latch, perform a reset by using the (RESET) key or turning the terminal command ***RST*** ON. Resetting can be done by the same way as resetting an alarm.

PID control cancel:
While ***PID-ALM*** is ON, as when ***Hz/PID*** is ON, switches from PID control to manual frequency setting (operates according to multi-frequency, keypad, analog input or other set frequencies).

■ PID control 1, 2 (upper level alarm (AH)) (J122, J222)

Set the upper limit (AH) for alarms with physical quantity.

- Data setting range: -999.00 to 0.00 to 9990.00

■ PID control 2 (upper level alarm detection hysteresis range (J223)

Set the hysteresis range for the upper limit (AH) detection (J222) for alarms with physical quantity. Please set a value smaller than the upper limit alarm (AH) (J222).

- Data setting range: 0.00 to 9990.00

■ PID control 1, 2 (lower level alarm (AL)) (J124, J224)

Set the lower limit (AL) for alarms with physical quantity.

- Data setting range: -999.00 to 0.00 to 9990.00

■ PID control 2 (lower level alarm detection hysteresis range (J225)

Set the hysteresis range for the lower limit (AL) detection (J222) for alarms with physical quantity. Please set a value larger than the lower limit alarm (AL) (J224).

- Data setting range: 0.00 to 9990.00

Upper level alarm (AH) and lower level alarm (AL) also apply to the following alarms.

Alarm	Description	How to handle the alarm:	
		Select alarm output (J121, J221)	Parameter setting
Upper limit (absolute)	ON when AH < PV	Absolute-value alarm	AL = 0
Lower limit (absolute)	ON when PV < AL		AH = 100%
Upper limit (deviation)	ON when SV + AH < PV	Deviation alarm	AL = 100%
Lower limit (deviation)	ON when PV < SV - AL		AH = 100%
Upper/lower limit (deviation)	ON when |SV - PV| > AL		AL = AH
Upper/lower range limit (deviation)	ON when SV - AL < PV < SV + AL	Deviation alarm	A negative logic signal should be assigned to ***PID-ALM***.
Upper/lower range limit (absolute)	ON when AL < PV < AH	Absolute-value alarm	
Upper/lower range limit (deviation)	ON when SV - AL < PV < SV + AH	Deviation alarm	

J127 **J128** **J129** **J130** **J131**	**PID Control 1 (Feedback failure detection (Mode selection))** **(Feedback failure continuation duration)** **(Feedback failure upper-limit)** **(Feedback failure lower-limit)** **(Feedback failure detection time)** **J227 (PID control 2 (Feedback failure detection (Mode selection)))** **J228 (PID control 2 (Feedback failure continuation duration))** **J229 (PID control 2 (Feedback failure upper-limit))** **J230 (PID control 2 (Feedback failure lower-limit))** **J231 (PID control 2 (Feedback failure detection time))**

PID control 1, 2: Abnormal feedback values (PV values) can be detected. When PV signals' abnormal level (upper limit: J129, J229 / lower limit: J130, J230) is continued for the set time (J131, J231), failure is recognized.

If Mode selection (J127, J227) is 3 through 6, when failure has been detected, the speed is reduced followed by stop of the operation, based on the Mode selection (J127, J227), after the failure continuation duration value (J128, J228) elapses. If the PV value is returned to the normal range (upper limit: J129, J229 / lower limit: J130, J230) during operations for failure continuation duration, PID control is restored.

■ PID control 1, 2 (feedback failure detection Mode selection) (J127, J227)

Select an operation to be performed after failure is detected.

Physical values that can be set depend on display unit and scale.

- Data setting range: 0 to 6

Data for J127	Data for J227	J128, J228	Operation description
0	0	Disable	Disable: Turns ON digital output signals (PV1-OFF) and (PV2-OFF) and continues operation.
1	1	Disable	Enable: Free run stop (PV1, PV2 trip)
2	2	Disable	Enable: Deceleration and stop (PV1, PV2 trip) *After deceleration and stop, PV1, PV2 trip
3	3	Enable	Enable: Continuation of operation at the maximum frequency (upper limit frequency)
4	4	Enable	Enable: Continuation of operation at the minimum frequency (lower limit frequency)
5	5	Enable	Enable: Continuation of operation at the frequency used when failure is detected.
6	--	Enable	Enable: Shift to PID control 2 (PID control 1 is restored when failure is recovered from.) In this case, even if (PID2/1) is not allocated, even if (PID2/1) is OFF, transitions to PID control 2. However, in the case of J201 =0 (disable), operates as J127 = 1.

📖 Operations regarding PID1, 2 feedback failure "PV1-OFF" and "PV2-OFF" can be monitored from external equipment, using Y1 to Y4, Y5A/C, or 30A/B/C. Set function codes E20 to E24 or E27 data to 202, 204.

■ PID control 1, 2 (feedback failure continuation duration) (J128, J228)

Set how long operation which conforms to Mode selection (J127, J227) is to be continued after failure is detected. When this time elapses, the inverter decelerates to stop. (J127, J227: 3 to 6)

- Data setting range: Cont., 0 to 3600 (s)

  Cont. (Mode selection: continuation of operation specified with J127, J227. PV1, PV2 trip after stop (output shutoff).)

■ PID control 1, 2 (feedback failure upper-limit) (J129, J229)

Set the upper limit for failure with physical quantity. Settable physical quantity conforms to display unit (J105) and scale (J106, J107).

- Data setting range: -999.00 to 0.00 to 9990.00, Auto = 105%

■ PID control 1, 2 (feedback failure lower-limit) (J130, J230)

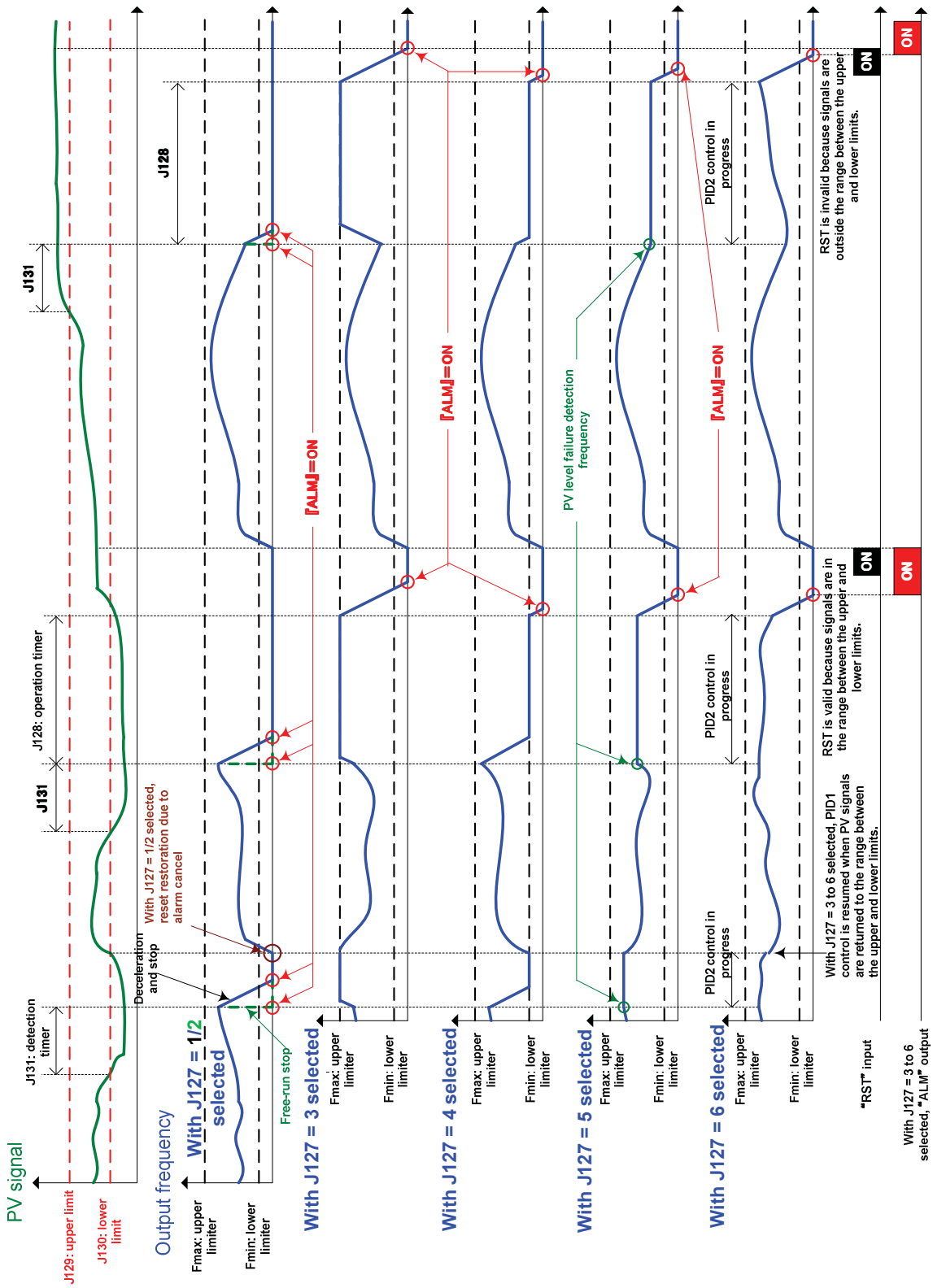
Set the lower limit for failure with physical quantity. Settable physical quantity conforms to display unit (J105) and scale (J106, J107).

- Data setting range: -999.00 to 0.00 to 9990.00, Auto = -5%

■ PID control 1, 2 (feedback failure detection time) (J131, J231)

Set abnormal-level (upper limit: J129, J229 / lower limit: J130, J230) continuation duration. When the set continuation duration value elapses, failure is recognized.

- Data setting range: 0 to 300.0 (s)


PV signal
J129: upper limit
J130: lower limit
J131: detection timer
J131
J128: operation timer
J131
J128
Output frequency
Fmax: upper limiter
Fmin: lower limiter
Deceleration and stop
With J127 = 1/2 selected, reset restoration due to alarm cancel
With J127 = 1/2 selected
Free-run stop
[ALM]=ON
With J127 = 3 selected
Fmax: upper limiter
Fmin: lower limiter
[ALM]=ON
With J127 = 4 selected
Fmax: upper limiter
Fmin: lower limiter
PV level failure detection frequency
With J127 = 5 selected
Fmax: upper limiter
Fmin: lower limiter
[ALM]=ON
PID2 control in progress
PID2 control in progress
PID2 control in progress
With J127 = 6 selected
Fmax: upper limiter
Fmin: lower limiter
With J127 = 3 to 6 selected, PID1 control is resumed when PV signals are returned to the range between the upper and lower limits.
RST is valid because signals are in the range between the upper and lower limits.
RST is invalid because signals are outside the range between the upper and lower limits.
"RST" input
ON
ON
ON
With J127 = 3 to 6 selected, "ALM" output

J136 J137 J138	**PID Multistep Command (Multistep command 1)** **(Multistep command 2)** **(Multistep command 3)**

Under PID control, a multistep frequency command can be specified as a preset value (3 different frequencies). This command is available under PID control 1 and 2.

・PID command

PID-SS2	*PID-SS1*	Command
OFF	OFF	Command by J102
OFF	ON	J136 (Multistep command 1)
ON	OFF	J137 (Multistep command 2)
ON	ON	J138 (Multistep command 3)

- Data setting range: -999.00 to 0.00 to 9990.00

J149	**Slow Flowrate Stop Function (Mode selection)**	**J249**
J150	**(Operation level)**	**J250**
J151	**(Elapsed time)**	**J251**
J152	**(Auto-operation frequency lower-limit)**	
J153	**(Pressurization starting frequency)**	
J154	**(Pressurizing time)**	
J156	**(Initiation inhibition time)**	**J256**
J157	**(Cancel frequency)**	**J257**
J158	**(Cancel deviation level 1)**	**J258**
J159	**(Cancel delay timer)**	**J259**
J160	**(Cancel deviation level 2)**	**J260**

The inverter can be stopped when the discharge pressure of the pump rises, causing the volume of water to decrease. When the discharge pressure has increased, decreasing the reference frequency (output of the PID processor) below the stop frequency for slow flowrate level (for PID control 1, J150; for PID control 2, J250) for the period of slow flowrate level stop latency (for PID control 1, J151; for PID control 2, J251), the inverter decelerates to stop. However, PID control itself continues to operate. The inverter resumes operation when the discharge pressure decreases, increasing the reference frequency (output of the PID processor) above the cancel frequency (for PID control 1, J157; for PID control 2, J257) or when SV (command value) minus PV (feedback value) exceeds the cancel deviation level (for PID control 1, J158/J160; for PID control 2, J258/J260).

Specifying J153 (Pressurization starting frequency) and J154 (Pressurizing time) enables pressurization control when the frequency drops below the level specified by J150 (Stop frequency for slow flowrate) after the period specified by J151. During the pressurization, the PID control is in the hold state. This function prolongs the stopping time of equipment with a bladder tank by pressurizing immediately before the frequency drops below the level at which the inverter stops the motor, thus enabling energy saving operation.

Because the pressurization starting frequency can be specified with a parameter, pressurization setting suitable for the equipment is possible.

■ Slow flowrate stop function (Mode selection) (J149, J249)

Select slow flowrate function operation. Set PID control 1 and PID control 2 with function codes J149 and J249 respectively. As an item for judging about slow flowrate level stop, you can select PID control operation quantity (MV) or feedback value (PV). If slow flowrate level stop (mode selection) (J149, J249) = automatic operation 1 (11, 12), the feedback value (PV) if the deviation goes from plus to minus or the output frequency are stored, and that value is taken as the stop condition for the running level. If the slow flowrate level stop (mode selection) (J149, J249) = automatic operation 2 (21, 22), when the flowrate sensor is turned from ON to OFF, the feedback value (PV) or the output frequency are stored, and that value is taken as the stop condition for the running level. (In this case, the flowrate sensor must be set; refer to the page on J163 for details.) Also, during the above-mentioned automatic operation, if only PID control 1 is enabled and PID control 2 is selected at (PID2/1), the value is not stored and the stop condition is determined in accordance with the J249 setting.

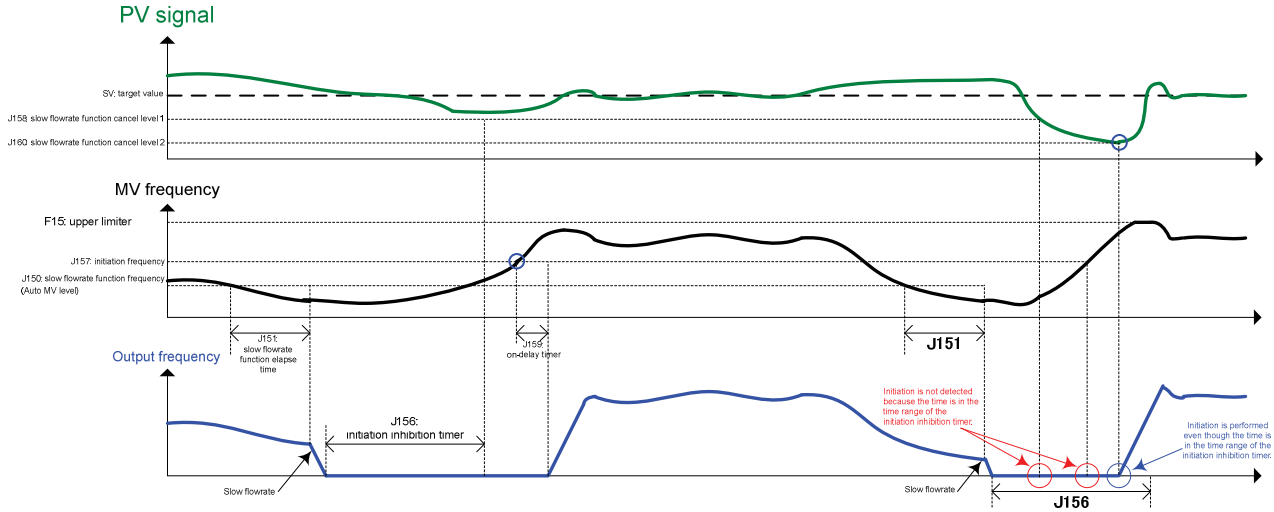
Note Even if the slow flowrate level stop (mode selection) (J149, J249) is set to automatic operation 2 (21, 22), function code J163: 0 (analog input selection), E01 to E07: 131 (flowrate switch) is disabled when unset.

Also, if function code J163: 0 (analog input selection) is set, if the ON/OFF level of J164, J165 is OFF, the function code is disabled.

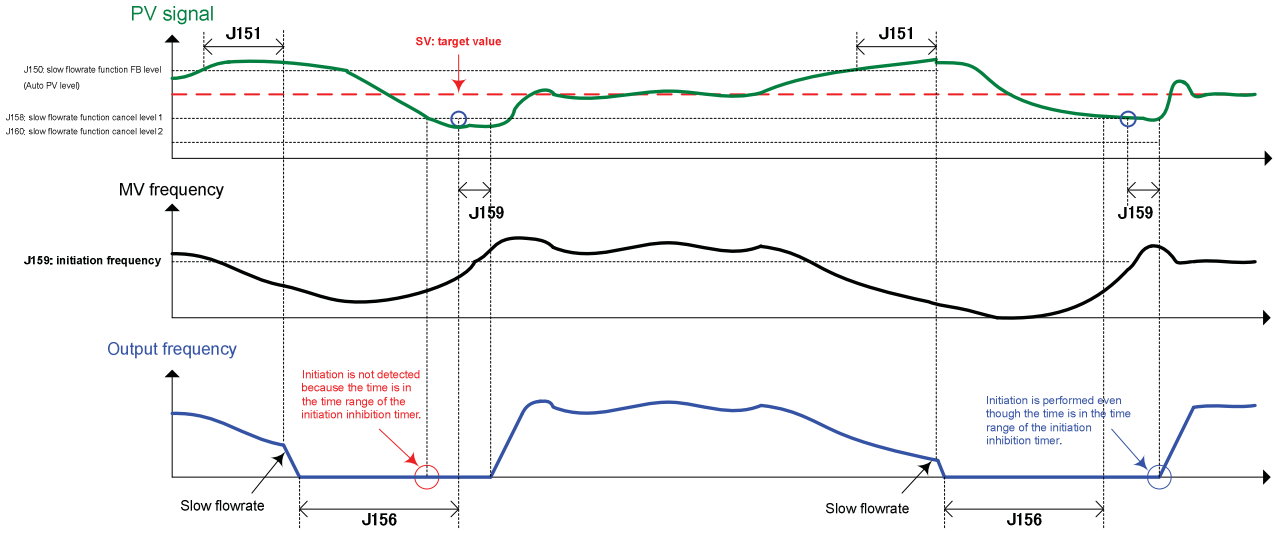
- Data setting range: 0 to 22

Data for J149	Data for J249	Operation description	Stop condition
0	0	Disable (display of OFF)	-
1	1	Manual operation (stop judgment: MV)	Operation quantity (MV) ≤ operation level (J150)
2	2	Manual operation (stop judgment: PV)	Feedback value (PV) ≤ operation level (J150)
11	-	Auto operation 1 (stop judgment: MV): Deviation detection method	Operation quantity (MV) ≤ deviation value automatically detected
12	-	Auto operation 1 (stop judgment: PV): Deviation detection method	Feedback value (PV) ≥ deviation value automatically detected
21	-	Auto operation 2 (stop judgment: MV): Flowrate sensor detection method	Operation quantity (MV) ≤ flowrate automatically detected
22	-	Auto operation 2 (stop judgment: PV): Flowrate sensor detection method	Feedback value (PV) ≥ flowrate automatically detected

With J149 = 1, 11, or 21 (frequency) selected



With J149 = 2, 12, or 22 (frequency) selected



■ Slow flowrate stop function (Operation level) (J150, J250)

Select an operation level to be used as the slow flowrate stop condition. Set PID control 1 and PID control 2 with function codes J150 and J250 respectively.

- Data setting range: See the table below.

Data for J149 and J249	Setting range for J150 and J250	Remarks
1, 11, 21	Auto	Automatically calculates the best value from the maximum frequency (F03)
2, 12, 22		Automatically calculates the best value from SV
1, 11, 21	0.0 to 120.0 Hz	Setting with a frequency
2, 12, 22	0.00 to 9990.00	Setting with physical quantity PID control 1: display unit (J105), scale (J106, J107) PID control 2: display unit (J205), scale (J206, J207) (Setting range is limited by maximum scale and minimum scale.)

■ Slow flowrate stop function (Elapsed time) (J151, J251)

Set time delay from PID output's satisfaction of the stop conditions specified with Mode selection (J149, J249) and operation level (J150, J250) until the inverter starts to decelerate and stop. Set PID control 1 and PID control 2 with function codes J151 and J251 respectively.

- Data setting range: 0 to 60 (s)

■ Slow flowrate stop function (Auto-operation frequency lower-limit) (J152)

J152 specifies the lower limit of the stop judgment level (output frequency) to be recorded by shutoff operation when J149 = 11 or 21.

- Data setting range: 0.0 to 120.0 (Hz)

■ Slow flowrate stop function (Pressurization starting frequency) (J153)

- Data setting range: 0.0 to 120.0 (Hz)

■ Slow flowrate stop function (Pressurizing time) (J154)

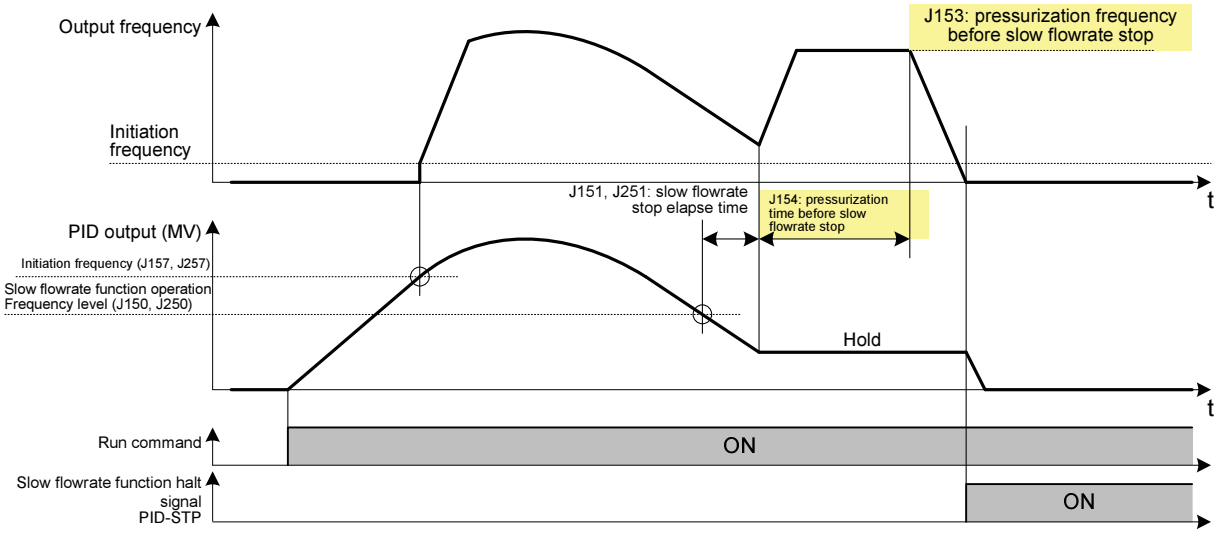
- Data setting range: 0 to 60 (s)

Specifying J153 (Pressurization starting frequency) and J154 (Pressurizing time) enables pressurization control when the frequency drops below the level specified by J149 (Stop frequency for slow flowrate) for the period specified by J151. During the pressurization, PID control is in the hold state.

This function prolongs the stopping time of equipment with a bladder tank by pressurizing immediately before the frequency drops below the level at which the inverter stops the motor, thus enabling energy saving operation.

Because the pressurization starting frequency (J153) can be specified with a parameter, pressurization setting suitable for the equipment is possible.

For pressurization control, see the chart below.



■ Slow flowrate stop function (Initiation inhibition time) (J156, J256)

Set how long initiation is to be inhibited after stop due to slow flowrate. Set PID control 1 and PID control 2 with function codes J156 and J256 respectively.

- Data setting range: 0 to 3600 (s)

■ Slow flowrate stop function (Cancel frequency) (J157, J257)

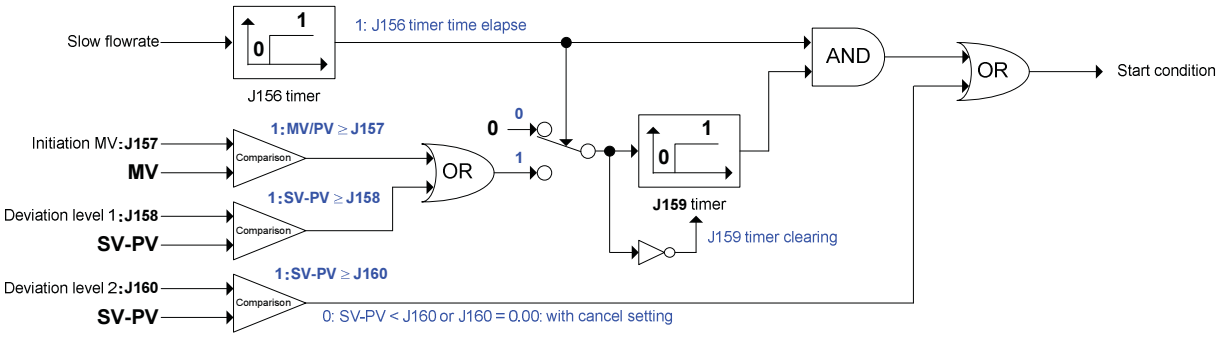
Set a cancel frequency. The cancel (start) conditions for slow flowrate level stop are as below. Set PID control 1 and PID control 2 with function codes J157 and J257 respectively.

- Data setting range: 0.0 to 120.0 (Hz), OFF

When the initiation inhibition time (J156, J256) elapses	When the initiation inhibition time (J156, J256) does not elapse
If one of the conditions below is satisfied, the function is canceled. • Operation quantity (MV) ≥ Cancel frequency (J157, J257) • SV - PV ≥ Cancel deviation level 1 (J158, J258)	• SV - PV ≥ Cancel deviation level 1 (J160, J260)

* MV: operation quantity SV: command value PV: feedback value

<Slow flowrate cancel condition block diagram>



■ Slow flowrate stop function (Cancel deviation level 1) (J158, J258)

Set a cancel deviation level to be used as a cancel condition. Set PID control 1 and PID control 2 with function codes J158 and J258 respectively.

- Data setting range: 0.01 to 9990.00, OFF

■ Slow flowrate stop function (Cancel delay timer) (J159, J259)

Set time delay from satisfaction of slow flowrate's cancel conditions (J157, J257) until initiation of the inverter. Set PID control 1 and PID control 2 with function codes J159 and J259 respectively.

- Data setting range: 0 to 3600 (s)

■ Slow flowrate stop function (Cancel deviation level 2) (J160, J260)

In a case where water supply is needed until the initiation inhibition time (J156, J256) elapses, set a cancel deviation level as a cancel (initiation) condition for water stoppage prevention. Set PID control 1 and PID control 2 with function codes J160 and J260 respectively.

Set a value so that the following is resulted: cancel deviation level 1 (J158, J258) < cancel deviation level 2 (J160, J260).

If a value is set so that the cancel deviation level 1 (J158, J258) exceeds the cancel deviation level 2 (J160, J260), the cancel deviation level 2 (J160, J260) is used as the cancel condition even when the initiation inhibition time (J156, J256) elapses.

- Data setting range: 0.01 to 9990.00, OFF

■ Assignment of PID-STP ("Motor stopped due to slow flowrate under PID control") (function codes E20 to E24 and E27, data = 44)

With respect to PID slow flowrate stop, ON signals are output when the inverter stops due to the slow flowrate during PID control. When signals which indicate inverter stop status are needed, PID-STP has to be assigned.

J163 J164 J165 J166	**Flowrate Sensor**	**(Input selection)** **(ON level)** **(OFF level)** **(Input filter)**

Flowrate sensor judgment can be used for slow flowrate stop, dry pump detection and end of curve detection. The flowrate sensor uses digital signal ON (flowing) and OFF (not flowing) as detection results. The flowrate sensor can be used for detection with either a digital input or an analog input. If not set, the flowrate sensor is taken to be OFF.

If the flowrate sensor is set with a digital input, the digital input ***FS*** is the flowrate sensor.

If the flowrate sensor is set with an analog input, the results of comparing the analog value selected for the flowrate sensor (input selection) (J163) and flowrate sensor (ON level) (J164), (OFF level) (J165) becomes the flowrate sensor.

■ Flowrate sensor (input selection) (J163)

- Data setting range: 0 to 25

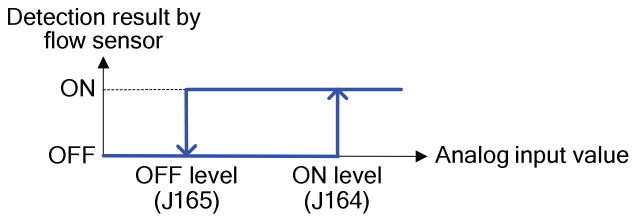
Data for J163	Content	Data for J163	Content
0 Inherit	The analog input selection is followed (E61, E62, and E63).	22	m^3/h
1	PV1 (feedback value)	23	L/s
20	m^3/s	24	L/min
21	m^3/min	25	L/h

* Data 20 or larger is to be used for connection of customizable logic.

■ Flowrate sensor (ON level) (J164), (OFF level) (J165)

If the flowrate sensor is set with an analog input, the flowrate sensor ON/OFF levels are set. If the analog input value exceeds the flowrate sensor (ON level) (J164), the flowrate sensor is recognized as ON. If the analog input value is below that of the flowrate sensor (OFF level) (J165), the flowrate sensor is recognized as OFF.

- Data setting range: 0.00 to 9990.00, OFF (Setting range is limited by maximum scale and minimum scale.)



■ Flowrate sensor (Input filter) (J166)

Sets the input filter if flowrate switches are connected to terminals X1 to X7. If the flowrate sensor has an analog input, this filter does not work.

📖 Please set the flowrate switch ***FS*** (data = 131) to function codes E01 to E07.

- Data setting range: 0.00 to 5.00 (s)

J188	Filter Clogging Prevention/Anti Jam Function (Input selection)
J189	Filter Clogging Prevention Function (Reverse operation cycle time)
J190	Filter Clogging Prevention Function (Load resistance current)
J191	Filter Clogging Prevention Function (Load resistance PV signal)
J192	Filter Clogging Prevention Function (Load resistance detection timer)
J193	Filter Clogging Prevention/ Anti Jam Function (Reverse rotation running frequency)
J194	Filter Clogging Prevention/ Anti Jam Function (Reverse rotation running time)
J195	Filter Clogging Prevention/ Anti Jam Function (Number of allowable reverse runs)

<Anti jam function>

When organic substance such as sand jams in the impeller of a submersible pump, the anti jam function expels it through reverse rotation operation and then starts normal water supply through normal rotation operation.

<Filter clogging prevention function>

When a fan's filter is clogged with coarse-grained dust, the filter clogging prevention function expels the dust through reverse rotation operation, break it up, and then starts air blow through normal rotation operation.

Note: Only PID control 1 is valid for the filter clogging prevention function. When switch from PID control 1 to PID control 2 is made, count values for the number of times and time length for the filter clogging prevention function are cleared.

■ Filter clogging prevention/Anti jam function (input selection) (J188)

- Data setting range: 0 to 3

Data for J188	Operation description
0	Disable
1	Enable: Alarm (anti jam protection, inverter stop with rLo trip)
2	Enable: Alarm (filter clogging trouble, inverter stop with FoL trip)
3	Enable: While warning (filter clogging trouble) is output, operation is continued.

<J188 = 1 (alarm: anti jam protection, inverter stop with rLo trip)>

When overcurrent protection (OC) becomes active during normal rotation operation, the anti jam function operates. The number of reset times is counted up, and PID control is canceled after the reset interval (H05). Then retry operation is performed with the reverse operation frequency (J193) during the reverse rotation operation time (J194), followed by restoration through normal rotation operation (PID control).

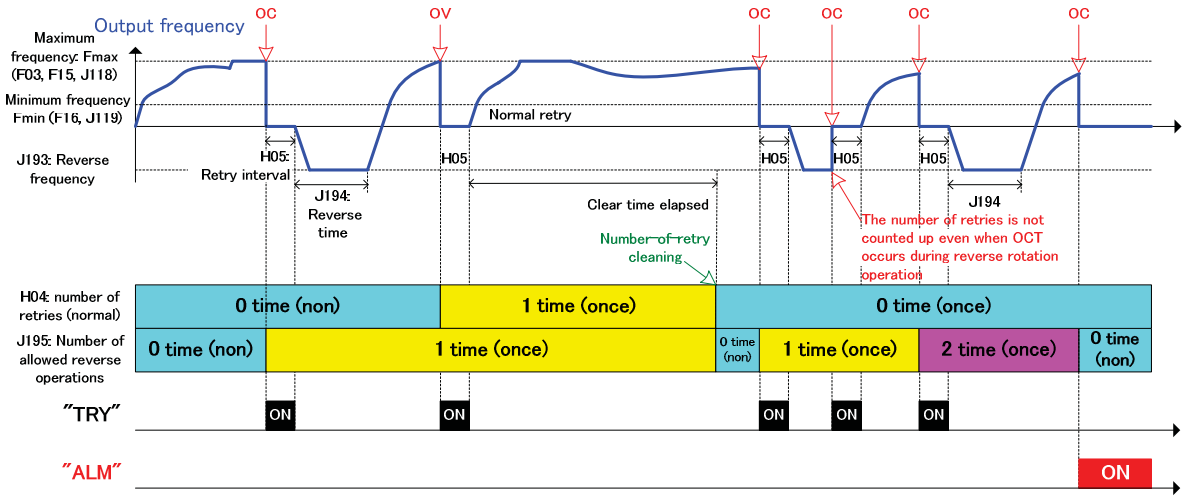
When overcurrent protection (OC) becomes active during reverse rotation operation, retry operation is performed through normal rotation operation (PID control) after the reset interval (H05). When overcurrent protection (OC) becomes active again after the number of reset times reaches the number of allowed reverse operations (J195), alarm stop (rLo trip) is resulted.

The number of reset times is cleared when operation is continued during the number-of-reset-times clearing time (H104) after the reverse rotation operation frequency (J193) is reached at the time of reverse rotation operation.

Note:
- When overcurrent protection (OC) becomes active during reverse rotation operation, the number of reset times is not counted up.
- To use this function, you must disable the function that prevents generation of overcurrent protection (OC). To do so, the following settings are needed.

  Torque limit value 1 (drive) (F40) = OFF: Disable
  Current limiting (mode selection) (F43) = 0: Disable
  Torque limit value 2 (drive) (E16) = OFF: Disable
  Instantaneous overcurrent limiting (mode selection) (H12) = 0: Disable

Example: With H04 = J195 = 2 (number of times) selected



<J188 = 2 (alarm: filter clogging trouble, inverter stop with FoL trip)>

When the amount of air which passes through the filter decreases due to filter clogging, the rotation load of the air-cooling fan decreases, causing load resistance current values to decrease. Contrary, pressure increase is induced before the filter because air does not pass through smoothly. This characteristic is detected with the condition in (1) or (2) below. When one of the conditions is satisfied and the load resistance detection timer value (J192) elapses, the filter clogging prevention function operates.

(1) With load resistance current selected

"Output current ≥ load resistance current (J190)"

(2) With load resistance PV signal selected

"Feedback PV value ≥ load resistance PV signal (J191)"

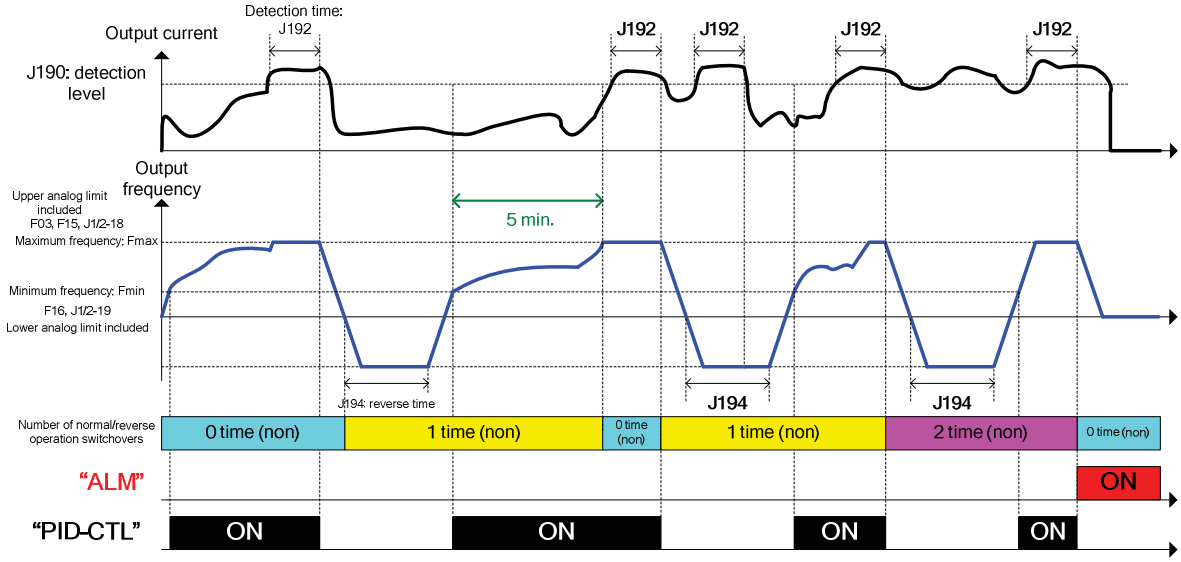
When the filter clogging prevention function operates, PID control is canceled, and reverse rotation operation is performed with the reverse rotation operation frequency (J193). (The number of filter clogging is counted up.)

After reverse rotation operation is started and continued during the reverse rotation operation time (J194), normal rotation operation (PID control) is restored. When filter clogging is detected again after the number of reverse rotation operations reaches the number of allowed reverse operations (J195), alarm stop (FoL trip) is resulted.

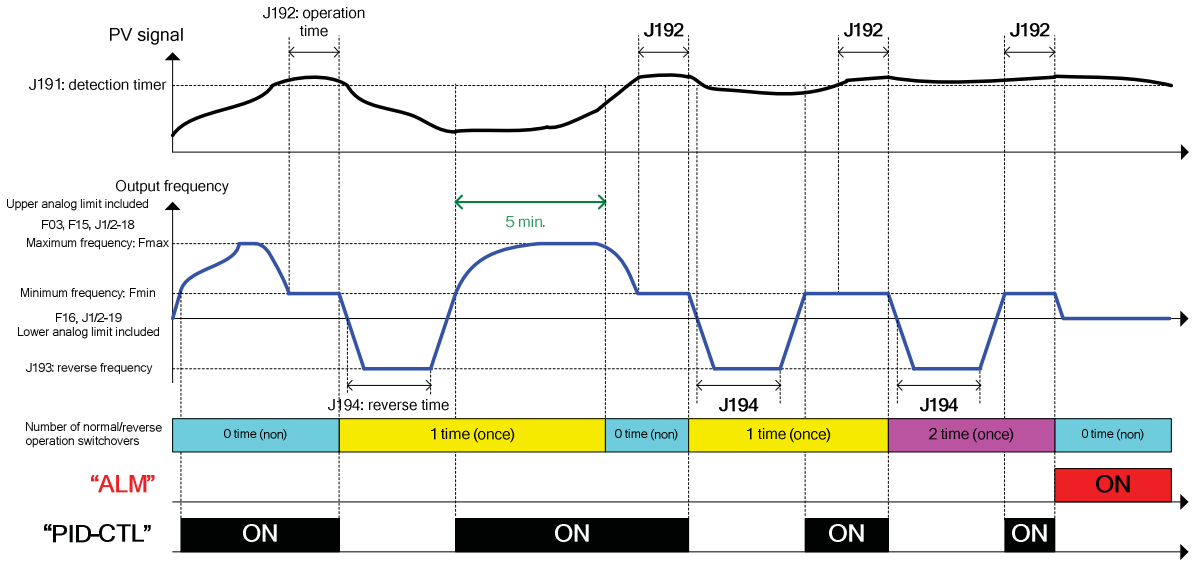
<J188 = 3 (While warning (filter clogging trouble) is output, operation is continued.)>

While the detection operation is the same as the one in (2) above, warning is output and operation is continued (rather than alarm stop) when filter clogging is detected again after the number of allowed reverse operations (J195) is reached. Operation for the filter clogging prevention function is performed and reverse rotation operation is continued.

<Operation example of load resistance current level detection with J188 = 2 (filter clogging prevention) and J195 = 2 (number of times) selected>



<Operation example of PV signal level detection with J188 = 2 (filter clogging prevention) and J195 = 2 (number of times) selected>

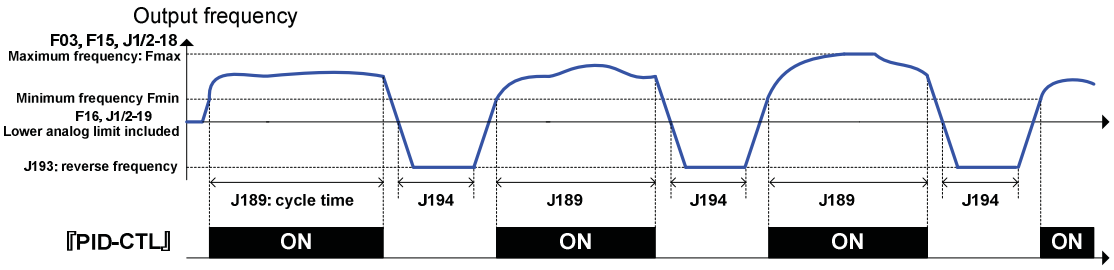


■ Filter clogging prevention (Reverse operation cycle time) (J189)

PID control is canceled and reverse rotation operation is performed with the reverse rotation operation frequency (J193) in accordance with the reverse operation cycle time (J189). After reverse rotation operation is continued during the reverse rotation operation time (J194), normal rotation operation (PID control) is restored. While this function is operating, the detection processing regarding input selection "J188 =2/3" is disabled. When reverse rotation operation is being performed with input selection "J188 =2/3" made active, this function is canceled and disabled until the next cycle time.

- Data setting range: 1 to 10000 (h), OFF

<Reverse cycle operation example with J188 = 2 or 3 (filter clogging prevention) and J189 ≠ 0 selected>



■ Filter clogging prevention (Load resistance current) (J190)

Set load resistance current as a detection condition.

- Data setting range: OFF (Disable), 1% to 150% of the inverter rated current

■ Filter clogging prevention (Load resistance PV signal) (J191)

Set load resistance PV signal as a detection condition, with physical quantity.

- Data setting range: -999.00 to 0.00 to 9990.00, OFF

(The setting range is limited by the maximum scale and minimum scale.)

■ Filter clogging prevention (Load resistance detection timer) (J192)

Set how long the detection condition is to be continued (load resistance detection timer).

- Data setting range: 0 to 600 (s)

■ Filter clogging prevention/Anti jam (Reverse rotation operation frequency) (J193)

Set output frequency for reverse rotation operation.

- Data setting range: 0.0 to 120.0 (Hz)

■ Filter clogging prevention/Anti jam (Reverse rotation operation time) (J194)

Set how long reverse rotation operation it to be performed.

- Data setting range: 0 to 600 (s)

■ Filter clogging prevention/Anti jam (Number of allowed reverse operations) (J195)

Set the number of times by which reverse rotation operation is to be allowed. After the number of allowed reverse operations is reached, the individual prevention functions operate when the detection condition is satisfied next time.

- Data setting range: 1 to 10 (times)

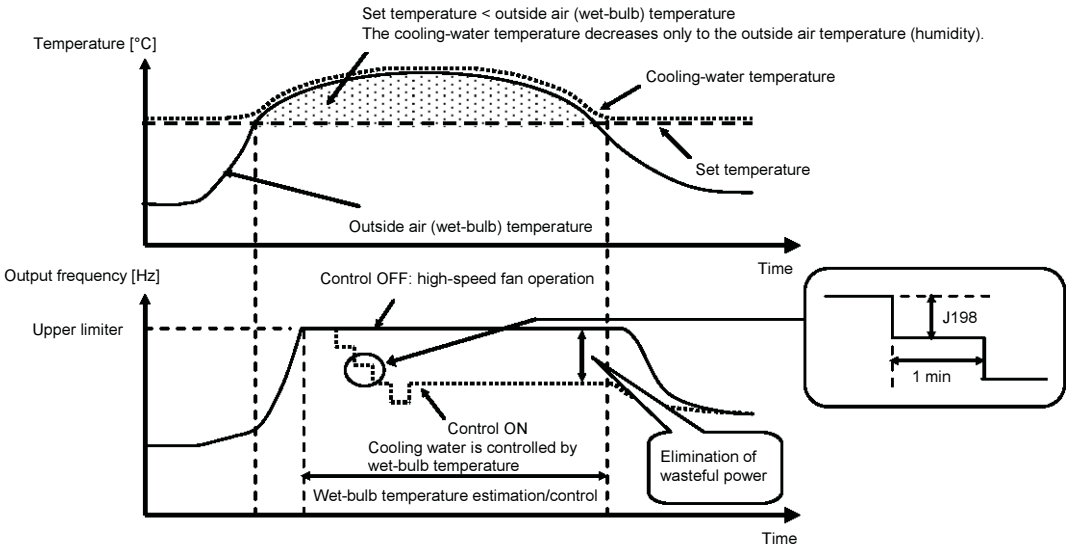
J198	Wet-bulb temperature presumption control

This function is to be used mainly for fan control of a cooling tower. On days when outside air temperature (humidity) is especially high, the wet-bulb temperature becomes higher than the set temperature, preventing water temperature from reaching the set temperature. As a result, the fan continues operating at high speed, resulting in no energy-saving effect. With this function activated, the wet-bulb temperature is automatically estimated, and the fan is controlled so that cooling water is adjusted according to outside air temperature (humidity), resulting in reduction of wasteful power consumption.

■ Wet-bulb temperature presumption control (J198)

Set a frequency reduction value per minute in terms of wet-bulb temperature estimation.

- Data setting range: 0.01 to 120.00 (Hz/min), OFF



5.1.9 J2 codes (PID control 2)

J201	PID Control 2 (Mode selection)	(Refer to J101.)

For details about PID control 2 (mode selection) setting, refer to function code J101.

J202	PID Control 2 (Command selection)	(Refer to J102.)

For details about PID control 2 (command selection) setting, refer to function code J102.

J203	PID Control 2 (Feedback selection)	(Refer to J103.)

For details about PID control 2 (feedback selection) setting, refer to function code J103.

J205	PID Control 2 (Display unit)	(Refer to J105.)

For details about PID control 2 (display unit) setting, refer to function code J105.

J206 J207	PID Control 2 (Maximum scale, Minimum scale)	(Refer to J106 and J107.)

For details about PID control 2 (maximum scale, minimum scale) setting, refer to function codes J106 and J107.

J210	PID Control 2 P (gain)	(Refer to J110.)
J211	I (Integral time)	(Refer to J111.)
J212	D (Differential time)	(Refer to J112.)
J213	Feedback filter	(Refer to J113.)

For details about PID control 2 (P, I, D, feedback filter) setting, refer to function code J110 to J113.

J214	PID Control 2 (Anti-reset wind-up)	(Refer to J114.)

For details about PID control 2 (anti-reset wind-up) setting, refer to function code J114.

J218	PID Control 2	(Upper limit of PID process output)	(Refer to J118.)
J219		(Lower limit of PID process output)	(Refer to J119.)

For details about PID control 2 (upper and lower limit of PID process output) setting, refer to function codes J118 and 119.

J221	PID Control 2	(Alarm output selection)	(Refer to J121.)
J222		(Upper level alarm (AH))	(Refer to J122.)
J223		(Upper level alarm detection hysteresis width)	
J224		(Lower level alarm (AL))	(Refer to J124.)
J225		(Lower level alarm detection hysteresis width)	

For details about PID control 2 (alarm output selection) setting, refer to function code J121.

J227	PID Control 2	(Feedback failure detection (Mode selection))	(Refer to J127.)
J228		(Feedback failure continuation duration)	(Refer to J128.)
J229		(Feedback failure upper-limit)	(Refer to J129.)
J230		(Feedback failure lower-limit)	(Refer to J130.)
J231		(Feedback failure detection time)	(Refer to J131.)

For details about PID control 2 (feedback failure detection) setting, refer to function code J127.

J249	Slow Flowrate Stop Function	(Mode selection)	(Refer to J149.)
J250		(Operation level)	(Refer to J150.)
J251		(Elapsed time)	(Refer to J151.)
J256		(Initiation inhibition time)	(Refer to J156.)
J257		(Cancel frequency)	(Refer to J157.)
J258		(Cancel deviation level 1)	(Refer to J158.)
J259		(Cancel delay timer)	(Refer to J159.)
J260		(Cancel deviation level 2)	(Refer to J160.)

For details about the slow flowrate stop function under PID control 2, refer to the descriptions of J146 to J160.

5.1.10 J5 codes (External PID control 1)

J501	External PID Control 1 (Mode selection) J601 (External PID Control 2 (Mode selection)) J651 (External PID Control 3 (Mode selection))

Apart from PID control specified by J101/J210, the inverter has three channels of PID control to control external devices such as dampers and valves so that no external PID controllers are required.

Under PID control, the inverter detects the state of a control target object with a sensor or the similar device and compares it with the commanded value (e.g., temperature control command). If there is any deviation between them, PID control operates to minimize it. That is, it is a closed loop feedback system that matches controlled variable (feedback amount). PID control expands the application area of the inverter to process control (e.g., flow control, pressure control, and temperature control).

- Data setting range: 0 to 32

Data for J501/J601/J651	Function
0	Disable
1	Enable process control (Normal operation)
2	Enable process control (Inverse operation)
11	Enable process control, interlocking with inverter running (Normal operation) When the output signal ***RUN*** ("Inverter running") is ON, the process control operates.
12	Enable process control, interlocking with inverter running (Inverse operation) When the output signal ***RUN*** ("Inverter running") is ON, the process control operates.
21	Enable process control by external digital signal (Normal operation) Turning ON the terminal command "External PID control ON command" operates the process control.
22	Enable process control by external digital signal (Inverse operation) Turning ON the terminal command "External PID control ON command" operates the process control.
31	Enable process control by external digital signal, interlocking with inverter running (Normal operation) Turning ON the terminal command "External PID control ON command" when the output signal ***RUN*** ("Inverter running") is ON, the process control operates.
32	Enable process control by external digital signal, interlocking with inverter running (Inverse operation) Turning ON the terminal command "External PID control ON command" when the output signal ***RUN*** ("Inverter running") is ON, the process control operates.

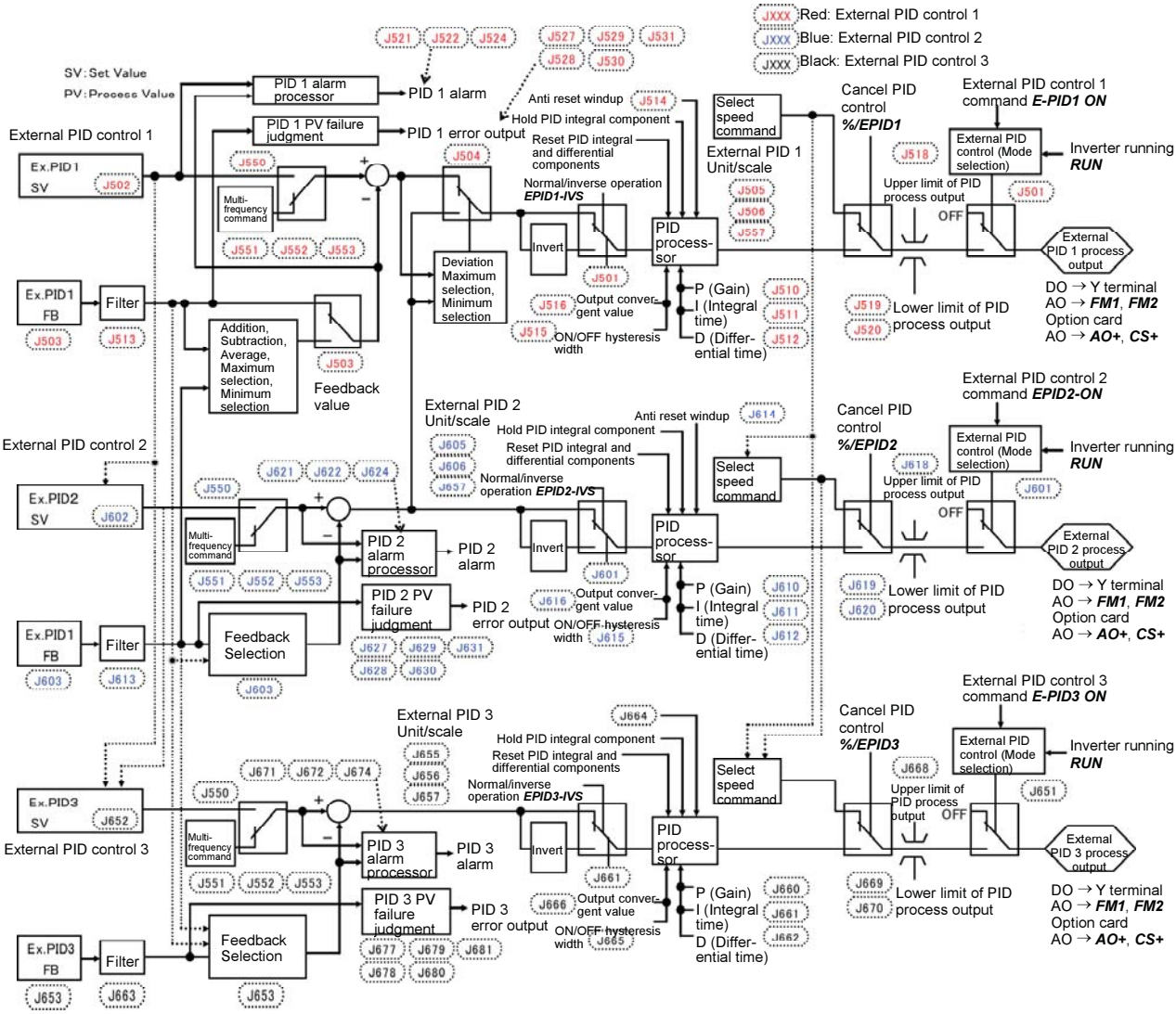
To use "External PID control 1 ON command" to "External PID control 3 ON command," you need to assign the terminal command ***EPID1-ON*** to ***EPID3-ON*** to any of the general-purpose digital input terminals, respectively. (📖 E01 to E07)

External PID control 1: "External PID control 1 ON command" ***EPID1-ON*** (data = 201)
External PID control 2: "External PID control 2 ON command" ***EPID2-ON*** (data = 211)
External PID control 3: "External PID control 3 ON command" ***EPID3-ON*** (data = 221)

Note

- If data 11, 12, 31, 32 are set, during inverter deceleration the PID control is put on hold (I item hold). PID control is put on hold only during decelerating to stop when the run command is OFF. PID control is not put on hold when decelerating to stop if the set frequency is changed.

<u>External PID process control block diagram</u>



Command value (SV), Feedback value (PV)
Analog input [12], [C1] and [V2]
Option card [32] and [C2]

J502	External PID Control 1 (Remote command selection) J602 (External PID Control 2 (Remote command selection)) J652 (External PID Control 3 (Remote command selection))

J502, J602, or J652 selects the source that specifies external PID control command 1, 2 or 3, respectively. The table below lists the external PID control command sources.

- Data setting range: 0 to 112

Data for			External PID control command sources
J502	J602	J652	
0	0	0	Keypad Specify the external PID command by using the ⌃ / ⌄ keys on the keypad.
3	3	3	Terminal command ***UP***/***DOWN*** With the ***UP*** and ***DOWN*** commands, 0 to 100% of an external PID control command value can be set as a value converted into physical quantity in terms of the display unit and scale.
4	4	4	Command via communications link For J502, use function code S30. The transmission data of 20000 (decimal) is equal to 100% of the PID command. For J602, use function code S31. The transmission data of 20000 (decimal) is equal to 100% of the PID command. For J652, use function code S32. The transmission data of 20000 (decimal) is equal to 100% of the PID command.
51	51	51	External PID command 1 (Analog input: Terminals [12], [C1] and [V2]) Voltage input to terminal [12] (0 to ±10 VDC, 100% PID command/ ±10 VDC) Current input to terminal [C1] (4 to 20 mA DC, 100% PID command/ 20 mA DC (0 to 20 mA DC, 100% PID command/ 20 mA DC) Voltage input to the terminal [V2] (0 to ±10 VDC, 100% PID command/ ±10 VDC)
-	52	52	External PID command 2 (Analog input: Terminals [12], [C1] and [V2])
-	-	53	External PID command 3 (Analog input: Terminals [12], [C1] and [V2])
-	111	111	Command under external PID control 1 (J502)
-	-	112	Command under external PID control 2 (J602)

[1] External PID command with the ⌃ / ⌄ keys on the keypad (J502/J602/J652, data = 0 (factory default))

With the ⌃ / ⌄ keys on the keypad, 0 to 100% of an external PID control command value can be set as a value converted into easy-to-understand, physical quantity in terms of the display unit and scale.

📖 For scale setting for terminals [12], [C1] or [V2], refer to function codes C59 and C60, C65 and C66, or C71 and C72, respectively.

[2] External PID command with ***UP/DOWN*** control (J502/J602/J652, data = 3)

When the UP/DOWN control is selected as an external PID command, turning the terminal command UP or DOWN ON causes the external PID command to change between the minimum scale and maximum scale.

External PID control 1 (J502 = 3)

The PID command can be specified in mnemonic physical quantities with the display unit (J505) and scale (J506/J507).

External PID control 2 (J602 = 3)

The PID command can be specified in mnemonic physical quantities with the display unit (J605) and scale (J606/J607).

External PID control 3 (J652 = 3)

The PID command can be specified in mnemonic physical quantities with the display unit (J655) and scale (J656/J657).

To select the ***UP/DOWN*** control as an external PID command, the ***UP*** and ***DOWN*** should be assigned to the digital input terminals [X1] to [X7]. (📖 E01 to E07, data = 17, 18)

UP	***DOWN***	Function
Data = 17	Data = 18	
OFF	OFF	Retain the current external PID command value.
ON	OFF	Increase external PID command value at a rate between 0.1%/0.1 s and 1%/0.1 s.
OFF	ON	Decrease external PID command value at a rate between 0.1%/0.1 s and 1%/0.1 s.
ON	ON	Retain the current external PID command value.

Note Command settings via the UP/DOWN control are common to PID control 1, 2 (J102, J202).

[3] External PID command via communications link (J502/J602/J652, data = 4)

External PID control 1 (J502, J602, J652 = 4)

Use function code S30 that specifies the communications function code. The transmission data of 20000 (decimal) is equal to 100% of the PID command.

📖 For details of the communications format, refer to the RS-485 Communication User's Manual.

[4] External PID command by analog inputs (J502/J602/J652, data = 51)

When any analog input (voltage input to terminals [12] and [V2], or current input to terminal [C1]) for an external PID command is used, it is possible to arbitrary specify the PID command by multiplying the gain and adding the bias. The polarity can be selected and the filter time constant and offset can be adjusted. In addition to J502, J602 and J652 settings, it is necessary to select external PID command 1, 2 or 3 for analog input (specified by any of E61 to E63, function code data = 3). For details, refer to the descriptions of E61 to E63.

Adjustable elements of PID command

Input terminal	Input range	Bias		Gain		Polarity	Filter time constant	Offset	Input range
		Bias	Base point	Gain	Base point				
[12]	0 to +10 V, -10 to +10 V	C55	C56	C32	C34	C35	C33	C31	-
[C1]	4 to 20 mA, 0 to 20 mA	C61	C62	C37	C39	-	C38	C36	C40
[V2]	0 to +10 V, -10 to +10 V	C67	C68	C42	C44	C45	C43	C41	-

■ Offset (C31, C36, C41)

C31, C36 or C41 configures an offset for an analog voltage/current input. The offset also applies to signals sent from the external equipment.

■ Filter time constant (C33, C38, C43)

C33, C38, and C43 provide the filter time constants for the voltage and current of the analog input. Choose appropriate values for the time constants considering the response speed of the machinery system, as large time constants slow down the response. If the input voltage fluctuates because of noise, specify large time constants.

■ Polarity (C35, C45)

C35 and C45 specify the input range for analog input voltage.

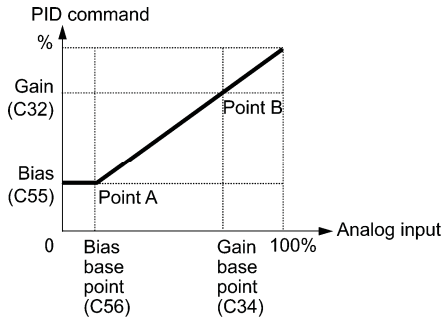
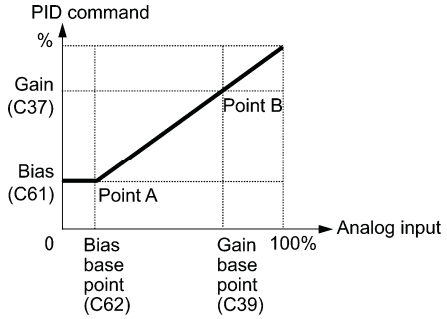
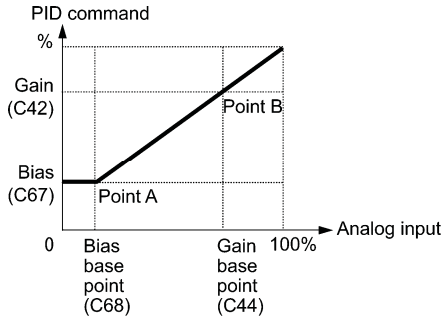
Data for C35/C45	Terminal input specifications
0	-10 to +10V
1	0 to +10V (negative value of voltage is regarded as 0 V)

■ Terminal [C1] input range selection (C40)

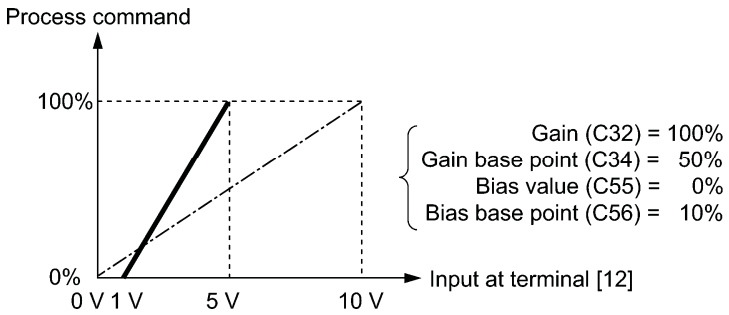
C40 specifies the input range for terminal [C1] (analog input current).

Data for C40	Terminal input range
0	4 to 20 mA (factory default)
1	0 to 20 mA

■ Gain and bias

Terminal	Action
[12]	
[C1]	
[V2]	

(Example) Mapping the range of 1 through 5 V at terminal [12] to 0 through 100%



Selecting Feedback Terminals

For feedback control, determine the connection terminal according to the type of the sensor output.

- If the sensor is a current output type, use the current input terminal [C1] of the inverter.
- If the sensor is a voltage output type, use the voltage input terminal [12] of the inverter, or switch over the terminal [V2] to the voltage input terminal and use it.

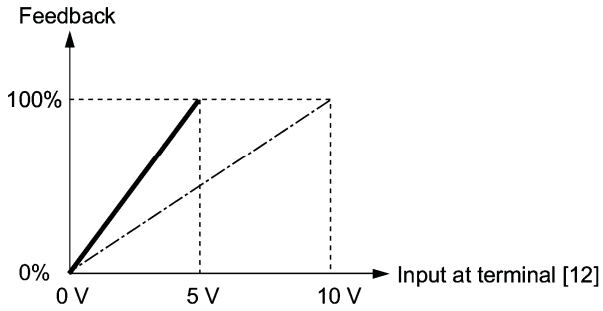
📖 For details, refer to the descriptions of E61 through E63.

Application example: Process control (for air conditioners, fans and pumps)

The operating range for PID process control is internally controlled as 0% through 100%. For the given feedback input, determine the operating range to be controlled by means of gain adjustment.

(Example) When the output level of the external sensor is within the range of 1 to 5 V:

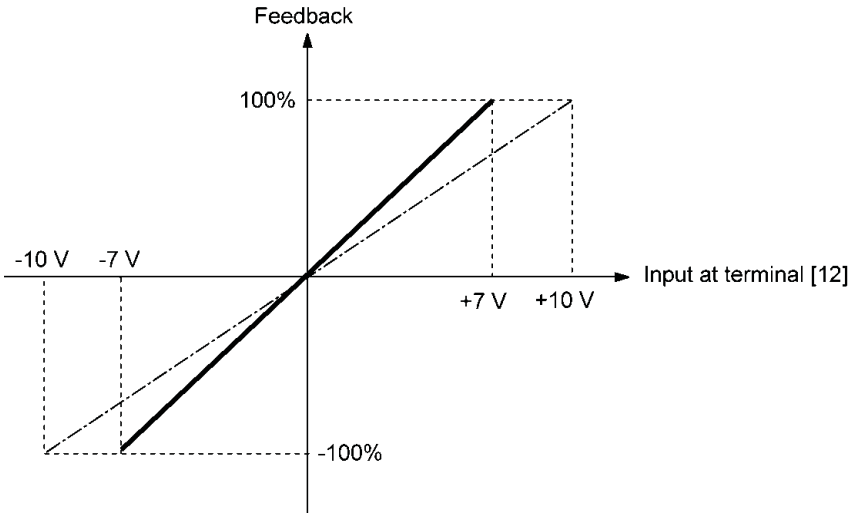
- Use terminal [12] designed for voltage input.
- Set the gain (C32 for analog input adjustment) at 200% in order to make the maximum value (5 V) of the external sensor's output correspond to 100%. Note that the input specification for terminal [12] is 0 to 10 V corresponding to 0 to 100%; thus, a gain factor of 200% (= 10 V ÷ 5 V × 100) should be specified. Note also that any bias setting does not apply to feedback control.



(Example 1) When the output level of the external sensor is ±7 VDC:

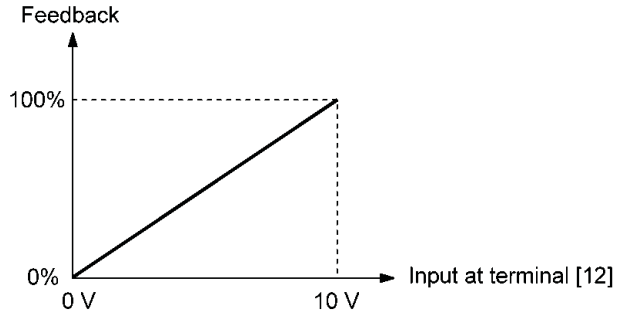
- Use terminal [12] since the voltage input is of bipolar.
- When the external sensor's output is of bipolar, the inverter controls the speed within the range of ±100%. To convert the output ±7 VDC to ±100%, set the gain (C32 for analog input adjustment) at 143% as calculated below.

$$\frac{10\ \text{V}}{7\ \text{V}} \approx 143\%$$



(Example 2) When the output level of the external sensor is 0 to 10 VDC:

- Use terminal [12] designed for voltage input.
- When the external sensor's output is of unipolar, the inverter controls the speed within the range of 0 to 100%.



PID Display Coefficient and Monitoring

To monitor the PID command and its feedback value, set a display unit, maximum scale, and minimum scale to convert the values into easy-to-understand physical quantities (such as temperature).

- Function code of display unit, maximum scale, and minimum scale, for each terminal

	Display unit	Maximum scale	Minimum scale
Terminal [12]	C58	C59	C60
Terminal [C1]	C64	C65	C66
Terminal [V2]	C70	C71	C72

📖 For the monitor, refer to function code K10.

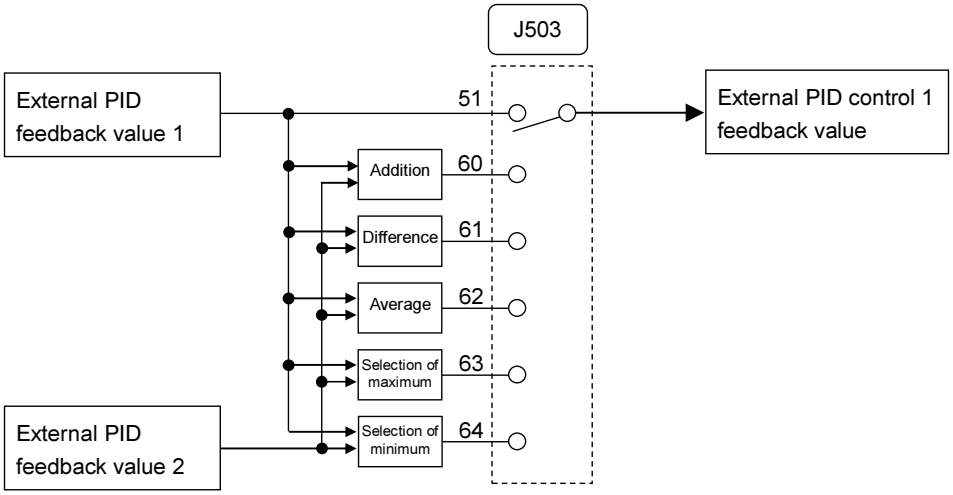
J503	External PID Control 1 (Feedback selection) J603 (External PID Control 2 (Feedback selection)) J653 (External PID Control 3 (Feedback selection))

J503, J603 or J653 selects a feedback value for external PID control 1, 2 or 3, respectively.

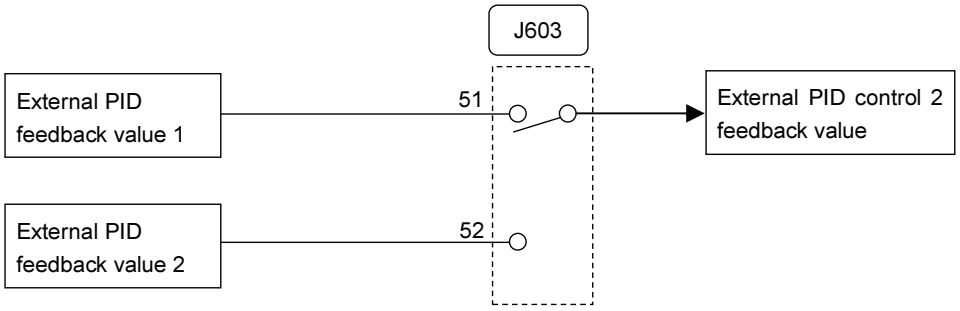
- Data setting range: 51 to 64

J503	J603	J653	Function
51	51	51	External PID feedback value 1
-	52	52	External PID feedback value 2
-	-	53	External PID feedback value 3
60	-	-	Addition (External PID feedback value 1 + External PID feedback value 2)
61	-	-	Difference (External PID feedback value 1 - External PID feedback value 2)
62	-	-	Average (External PID feedback value 1 + External PID feedback value 2) / 2
63	-	-	Maximum (Uses the larger of external PID feedback value 1 or external PID feedback value 2)
64	-	-	Minimum (Uses the smaller of external PID feedback value 1 or external PID feedback value 2)

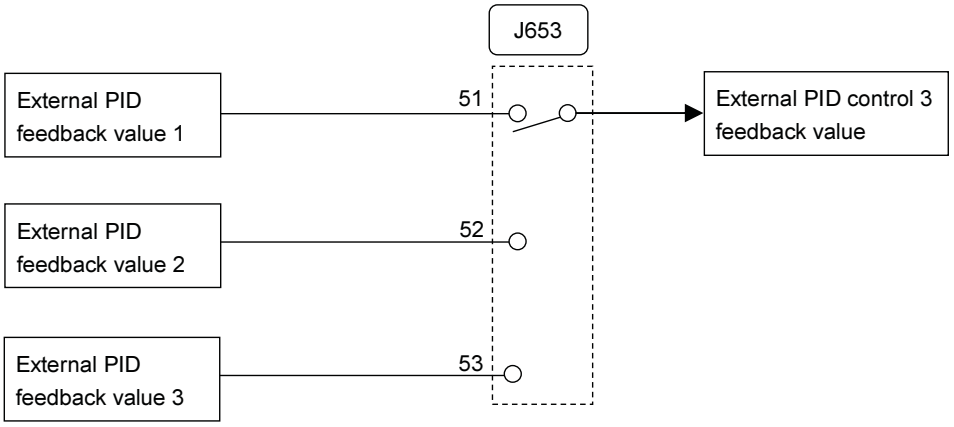
External PID control 1 feedback selection (J503) block diagram



External PID control 2 feedback selection (J603) block diagram



External PID control 3 feedback selection (J653) block diagram



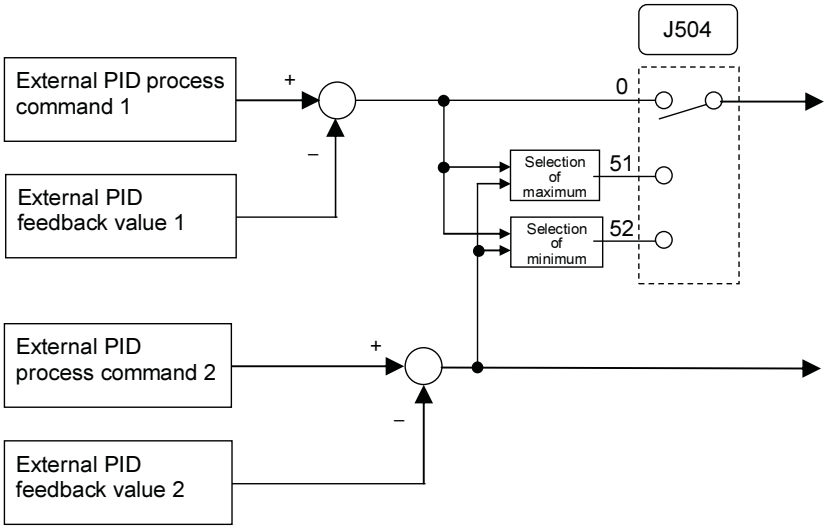
J504	External PID Control 1 (Deviation selection)

J504 selects a deviation value for external PID control 1.

- Data setting range: 0, 51, 52

Data for J504	Function
0	External PID control 1 command value (J502) - External PID control 1 feedback value (J503)
51	Selection of maximum (Uses the maximum deviation between external PID control 1 and 2)
52	Selection of minimum (Uses the minimum deviation between external PID control 1 and 2)

External PID control 1 deviation selection block diagram



J505	External PID Control 1 (Display unit) J605 (External PID Control 2 (Display unit)) J655 (External PID Control 3 (Display unit))

J505, J605 or J655 selects a display unit for external PID control 1, 2 or 3, respectively.

Under external PID control, the external PID command setting value (SV), feedback value (PV), manipulated value (MV) and others can be monitored on the keypad. For these values, select the display units.

For the setting procedure of the monitor display, refer to Chapter 5, Section 5.5.1 "Monitoring the running status."

Note

When external PID control is to be performed with the same unit and scale as for feedback values, the J505/J605/J655 settings need not be changed. (Factory default: In accordance with the unit and scale used for feedback values)

Configure the J505/J605/J655 to use different unit and scale from feedback values.

- Data setting range: 0 (Inherit) to 80

Data for J505/J605/J655	Display unit	Data for J505/J605/J655	Display unit	Data for J505/J605/J655	Display unit
0: Inherit	(Factory default)*	24	L/min (flowrate)	46	Psi (pressure)
1	No unit	25	L/h (flowrate)	47	mWG (pressure)
2	%	40	Pa (pressure)	48	inWG (pressure)
4	r/min	41	kPa (pressure)	60	K (temperature)
7	kW	42	MPa (pressure)	61	°C (temperature)
20	m^3/s (flowrate)	43	mbar (pressure)	62	°F (temperature)
21	m^3/min (flowrate)	44	bar (pressure)	80	ppm (density)
22	m^3/h (flowrate)	45	mmHg (pressure)		

* In accordance with the unit and scale used for feedback values

For feedback value selection, see function codes E61 to E63.

The table below lists function codes to be used for setting a unit and scale for feedback values.

	Display unit	Maximum scale	Minimum scale
Terminal [12]	C58	C59	C60
Terminal [C1]	C64	C65	C66
Terminal [V2]	C70	C71	C72

J506 J507	**External PID Control 1 (Maximum scale, Minimum scale)** **J606, J607 (External PID Control 2 (Maximum scale, Minimum scale))** **J656, J657 (External PID Control 3 (Maximum scale, Minimum scale))**

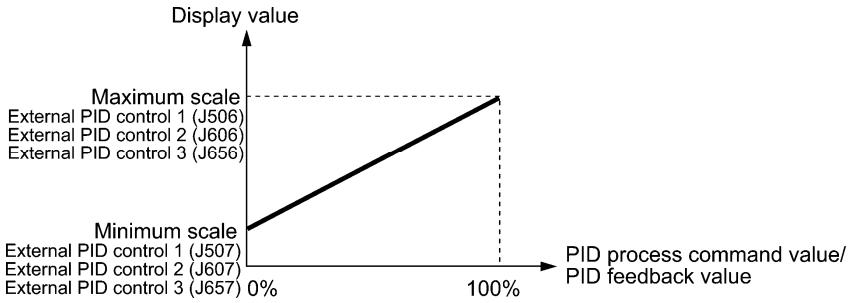
J506/J507, J606/J607, or J656/J657 specify the maximum/minimum scale for external PID control 1, 2 or 3, respectively.

Set the maximum scale "External PID command value / Display value at 100% of external PID feedback value" with J506/J606/J656, and the minimum scale "External PID command value / Display value at 0% of external PID feedback value" with J507/J607/J657.

Display values are calculated with the following expression.

Display value =
(External PID control value (%)) / 100 x (Maximum scale - Minimum scale) + Minimum scale

- Data setting range: (Maximum scale and minimum scale) -999.00 to 0.00 to 9990.00



Note

When external PID control is to be performed with the same unit and scale as for feedback values, the J506/J606/J656 or J507/J607/J657 settings need not be changed. (Factory default: In accordance with the unit and scale used for feedback values. Refer to J505/J605/J655.)

Configure the J506/J606/J656 and J507/J607/J657 to use different unit and scale from feedback values.

J510 **J511** **J512** **J513**	**External PID Control 1**	
		J515 (PID Control 1 (ON/OFF control hysteresis width)
	P (Gain)	**J610 (PID Control 2 (P (Gain))**
	I (Integral time)	**J611 (PID Control 2 (I (Integral time))**
	D (Differential time)	**J612 (PID Control 2 (D (Differential time))**
	(Feedback filter)	**J613 (PID Control 2 (Feedback filter))**
		J615 (PID Control 2 (ON/OFF control hysteresis width)
	P (Gain)	**J660 (PID Control 3 (P (Gain))**
	I (Integral time)	**J661 (PID Control 3 (I (Integral time))**
	D (Differential time)	**J662 (PID Control 3 (D (Differential time))**
	(Feedback filter)	**J663 (PID Control 3 (Feedback filter))**
		J665 (PID Control 3 (ON/OFF control hysteresis width)

The table below lists function codes to be used for setting the P (gain), I (integral time), D (differential time) and feedback filter for external PID controls.

	P (gain)	I (integral time)	D (differential time)	Feedback filter
External PID control 1	J510	J511	J512	J513
External PID control 2	J610	J611	J612	J613
External PID control 3	J660	J661	J662	J663

For details of P action, I action, D action, as well as their coordinated controls and adjusting method, see the description of J110, J111, J112, J210, J211, and J212. Note that the P (gain) of External PID (J510, J610, J660) correspond to J110 and J210. Also, I (integral time) (J511, J611, J661) correspond to J111 and J211, and the D (differential time) (J512, J612, J662) correspond to J112 and J212.

■ P gain (External PID control 1: J510, External PID control 2: J610, External PID control 3: J660)

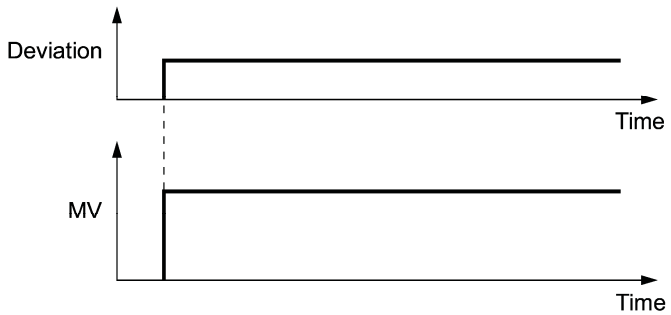
J510/J610/J660 specifies the gain for the external PID processor.

- Data setting range: 0.000 to 30.000 (times), ON/OFF

<u>P (Proportional) action (0.000 to 30.000 times)</u>

An operation in which the MV (manipulated value: output frequency) is proportional to the deviation is called P action, which outputs the MV in proportion to deviation. However, the P action alone cannot eliminate deviation.

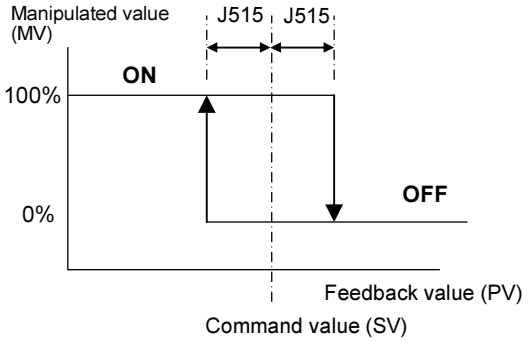
Gain is data that determines the system response level against the deviation in P action. An increase in gain speeds up response, but an excessive gain may oscillate the inverter output. A decrease in gain delays response, but it stabilizes the inverter output.



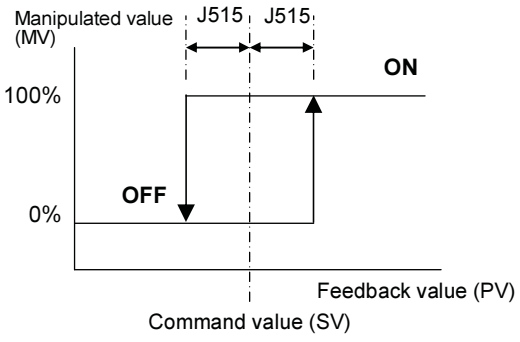
ON/OFF (ON/OFF control)

Setting the P gain (J510/J610/J660) to "OFF" enables ON/OFF control. If the feedback value (PV) exceeds the threshold value "Command setting value SV + Hysteresis width (J515)," the manipulated value (MV) switches between two positions 0% and 100%.

● Normal operation



● Reverse operation



■ I integral time (External PID control 1: J511, External PID control 2: J611, External PID control 3: J661)

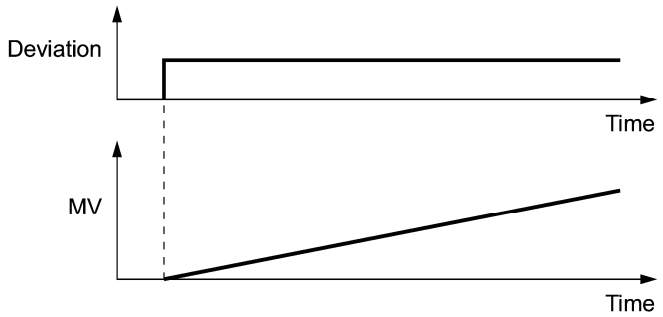
J511/J611/J661 specifies the integral time for the external PID processor.

- Data setting range: 0.0 to 3600.0 (s)
  0.0 means that the integral component is ineffective.

I (Integral) action

An operation in which the change rate of the MV (manipulated value: output frequency) is proportional to the integral value of deviation is called I action, which outputs the MV that integrates the deviation. Therefore, I action is effective in bringing the feedback amount close to the commanded value. For the system whose deviation rapidly changes, however, this action cannot make it react quickly.

The effectiveness of I action is expressed by integral time as parameter, that is J511/J611/J661 data. The longer the integral time, the slower the response. The reaction to the external disturbance also becomes slow. The shorter the integral time, the faster the response. Setting too short integral time, however, makes the inverter output tend to oscillate against the external disturbance.



■ D differential time (External PID control 1: J512, External PID control 2: J612, External PID control 3: J662)

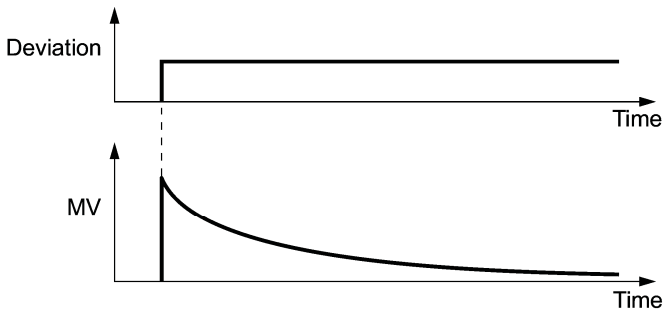
J512/J612/J662 specifies the differential time for the external PID processor.

- Data setting range: 0.00 to 600.00 (s)
  0.00 means that the differential component is ineffective.

D (Differential) action

An operation in which the MV (manipulated value: output frequency) is proportional to the differential value of the deviation is called D action, which outputs the MV that differentiates the deviation. D action makes the inverter quickly react to a rapid change of deviation.

The effectiveness of D action is expressed by differential time as a parameter. Setting a long differential time will quickly suppress oscillation caused by P action when a deviation occurs. Too long differential time makes the inverter output oscillation more. Setting short differential time weakens the suppression effect when the deviation occurs.



The combined uses of P, I, and D actions are described below.

(1) PI control

PI control, which is a combination of P and I actions, is generally used to minimize the remaining deviation caused by P action. PI control always acts to minimize the deviation even if a commanded value changes or external disturbance steadily occurs. However, the longer the integral time, the slower the system response to quick-changed control.

P action can be used alone for loads with very large part of integral components.

(2) PD control

Under PD control, the moment that a deviation occurs, the control rapidly generates greater MV (manipulated value) than that generated by D action alone, to suppress the deviation increase. When the deviation becomes small, the behavior of P action becomes small.

A load including the integral component in the controlled system may oscillate due to the action of the integral component if P action alone is applied. In such a case, use PD control to reduce the oscillation caused by P action, for keeping the system stable. That is, PD control is applied to a system that does not contain any damping actions in its process.

(3) PID control

PID control is implemented by combining P action with the deviation suppression of I action and the oscillation suppression of D action. PID control features minimal control deviation, high precision and high stability.

In particular, PID control is effective to a system that has a long response time to the occurrence of deviation.

Follow the procedure below to set data to external PID control function codes.

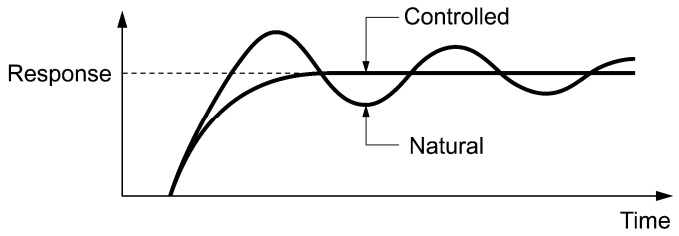
It is highly recommended that you adjust the external PID control value while monitoring the system response waveform with an oscilloscope or equivalent. Repeat the following procedure to determine the optimal solution for each system.

- Increase the data of function code J510/J610/J660 (External PID control P (Gain)) within the range where the feedback signal does not oscillate.
- Decrease the data of function code J511/J611/J661 (External PID control I (Integral time)) within the range where the feedback signal does not oscillate.
- Increase the data of J512/J612/J662 (External PID control D (Differential time)) within the range where the feedback signal does not oscillate.

Refining the system response waveforms is shown below.

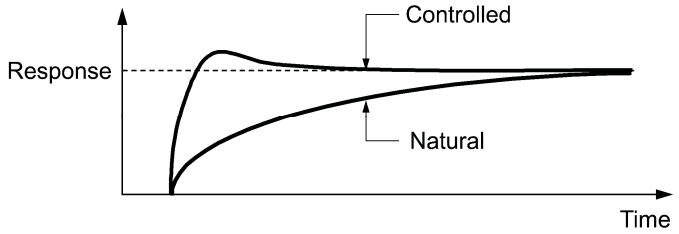
1) Suppressing overshoot

   Increase the data of function code J511/J611/J661 (Integral time) and decrease that of J512/J612/J662 (Differential time).



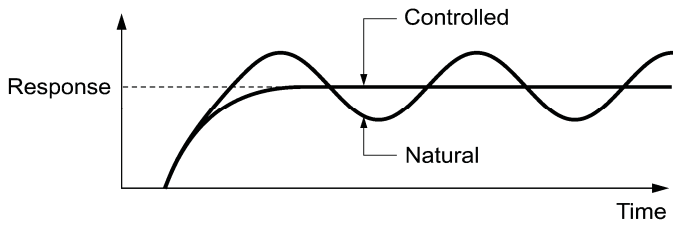
2) Quick stabilizing (moderate overshoot allowable)

   Decrease the data of J510/J610/J660 (Gain) and increase that of J512/J612/J662 (Differential time).



3) Suppressing oscillation whose period is longer than the integral time specified by function code J511/J611/J661

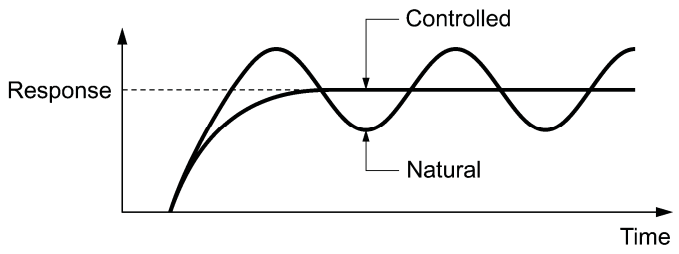
   Increase the data of J511/J611/J661 (Integral time).



4) Suppressing oscillation whose period is approximately the same as the time specified by function code J512/J612/J662 (Differential time)

   Decrease that of J512/J612/J662 (Differential time).

   Decrease the data of function code J510/J610/J660 (Gain), if the oscillation cannot be suppressed even though the differential time is set at 0 sec.



■ Feedback filter (External PID control 1: J513, External PID control 2: J613), External PID control 3: J663)

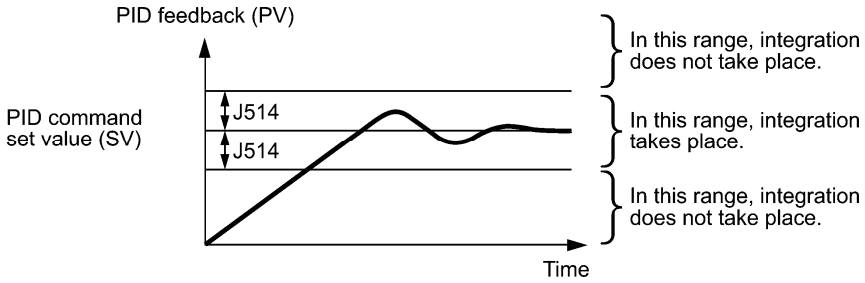
J513/J613/J663 specifies the time constant of the filter for feedback signals under the external PID control.

- Data setting range: 0.0 to 900.0 (s)
- This setting is used to stabilize the PID control loop. Setting too long a time constant makes the system response slow.

J514	External PID Control 1 (Anti-reset wind-up) J614 (External PID Control 2 (Anti-reset wind-up)) J664 (External PID Control 3 (Anti-reset wind-up))

J514, J614 or J664 suppresses overshoot under external PID control 1, 2 or 3 using an external PID processor, respectively. As long as the deviation between the PID command and its feedback is out of the preset range, the integrator holds its value and does not perform integration operation.

- Data setting range: OFF, 0.01 to 9990.00 (The setting range is restricted by the maximum scale and minimum scale.)



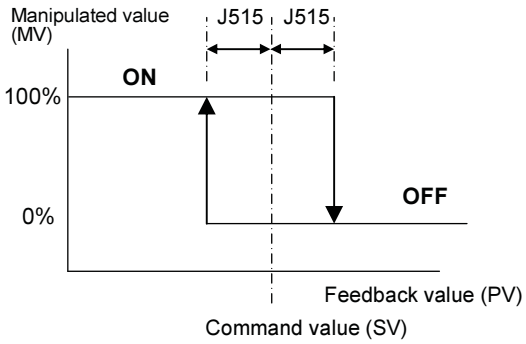
J515	External PID Control 1 (ON/OFF control hysteresis width) J615 (External PID Control 2 (ON/OFF hysteresis width)) J665 (External PID Control 3 (ON/OFF hysteresis width))

J515, J615 or J665 specifies the hysteresis width for ON/OFF control under external PID control 1, 2 or 3 in a physical quantity, respectively.

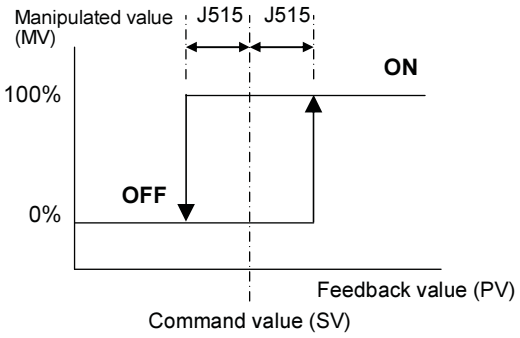
Setting the P gain (J510/J610/J660) to "OFF" enables ON/OFF control. If the feedback value (PV) exceeds the threshold value "Command setting value SV + Hysteresis width (J515)," the manipulated value (MV) switches between two positions 0% and 100%.

- Data setting range: 0.00 to 9990.00 (The setting range is restricted by the maximum scale and minimum scale.)

● Normal operation



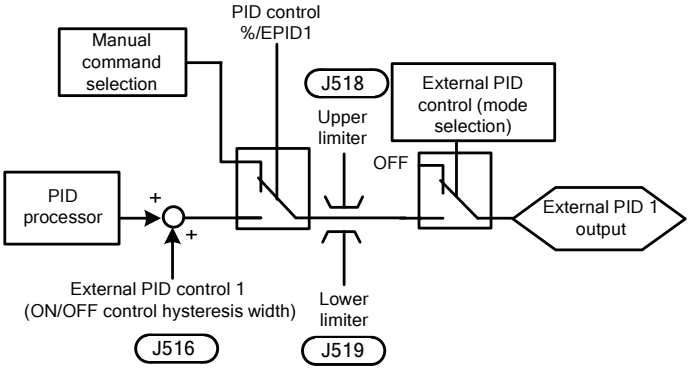
● Reverse operation



J516	External PID Control 1 (Proportional operation output convergent value) J616 (External PID Control 2 (Proportional operation output convergent value)) J666 (External PID Control 3 (Proportional operation output convergent value))

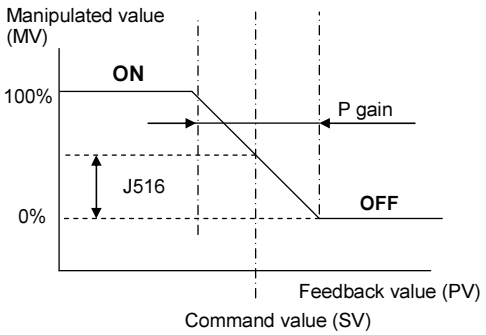
Exclusively for external PID control, this setting value can be added to the external PID output. J516/J616/J666 sets external PID controls 1/2/3 respectively.

- Data setting range: 1 to 150 (%)

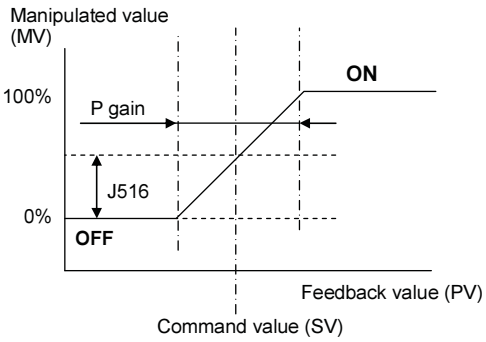


Also, by disabling I (integral time) and D (differential time) to enable only P (gain) and this value, the following comparison is possible.

● Normal operation



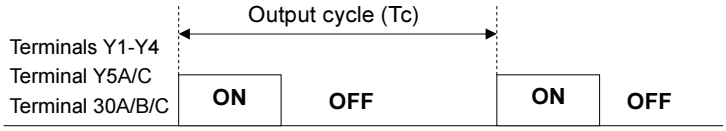
● Reverse operation



J517	External PID Control 1 (Proportional cycle) J617 (External PID Control 2 (Proportional cycle)) J667 (External PID Control 3 (Proportional cycle))

J517, J617 or J667 specifies the output cycle (Tc) of pulse outputs under output duty control for external PID control 1, 2 or 3, respectively.

- Data setting range: 1 to 150 (s)



The ON and OFF times are calculated by the following expressions.

ON time = Output cycle (Tc) x Manipulated value (MV) / 100

OFF time = Output cycle (Tc) - ON time

(Example) If output cycle (Tc) = 60 s, MV = 35%

ON time = 60 s x 35% / 100 = 21 s

OFF time = 60 s -21 s = 39 s

To use the proportional cycle, it is necessary to assign ***EPID1-OUT***, ***EPID2-OUT*** or ***EPID3-OUT*** to any of digital output terminals as duty control output with any of E20 to E24 and E27.

- External PID control 1: ***EPID1-OUT*** (E20 to E24 and E27, data = 212)
- External PID control 2: ***EPID2-OUT*** (E20 to E24 and E27, data = 222)
- External PID control 3: ***EPID3-OUT*** (E20 to E24 and E27, data = 232)

J518 **J519** **J520**	**External PID Control 1 (Upper limit of PID process output)** **(Lower limit of PID process output)** **(Upper and lower limits)** **J618 (External PID Control 2 (Upper limit of PID process output))** **J619 (External PID Control 2 (Upper limit of PID process output))** **J620 (External PID Control 2 (Upper and lower limits)** **J668 (External PID Control 3 (Upper limit of PID process output))** **J669 (External PID Control 3 (Upper limit of PID process output))** **J670 (External PID Control 3 (Upper and lower limits)**

J518/J519/J520, J618/J619/J620 or J668/J669/J670 define the upper and lower limiters for the external PID output, which exclusively apply to external PID control 1, 2 or 3, respectively.

When external PID control is canceled with %/*EPID1*, %/*EPID2* or %/*EPID3* and manual command is used to operate, the upper and lower limiters are effective.

📖 E01 to E07, data = 202 (*%/EPID1*), 212 (*%/EPID2*), 222 (*%/EPID3*)

■ PID Control 1 to 3 (Upper limit of PID process output) (J518, J618, J668)

- Data setting range: -10 to 110 (%)

J518/J618/J668 specifies the upper limit of the external PID processor output limiter in %.

■ PID Control 1 to 3 (Lower limit of PID process output) (J519, J619, J669)

- Data setting range: -10 to 110 (%)

J519/J619/J669 specifies the lower limit of the external PID processor output limiter in %.

■ PID Control 1 to 3 (Upper and lower limits) (J520, J620, J670)

- Data setting range: 0, 1

J520/J620/J670 specifies the upper and lower limits of the external PID processor output limiter.

Data for J520/J620/J670	PID control	PID output limiter	
		Upper limit	Lower limit
0	External PID control 1	J518	J519
	External PID control 2	J618	J619
	External PID control 3	J668	J669
1	External PID control 1	J518 data or above ⇒ 110%	Less than J519 data ⇒ -10%
	External PID control 2	J618 data or above ⇒ 110%	Less than J619 data ⇒ -10%
	External PID control 3	J668 data or above ⇒ 110%	Less than J669 data ⇒ -10%

J521 J522 J524	**External PID Control 1 (Alarm output selection)** **(Upper level alarm (AH))** **(Lower level alarm (AL))** **J621 (External PID Control 2 (Alarm output selection))** **J622 (External PID Control 2 (Upper level alarm (AH))** **J624 (External PID Control 2 (Lower level alarm (AL))** **J671 (External PID Control 3 (Alarm output selection))** **J672 (External PID Control 3 (Upper level alarm (AH))** **J674 (External PID Control 3 (Lower level alarm (AL))**

J521/J522/J524, J621/J622/J624, J671/J672/J674 define two types of alarm signals (absolute-value and deviation alarms) that the inverter can output for external PID control 1, 2 or 3, respectively.

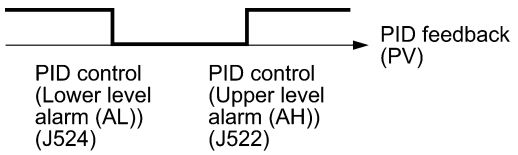
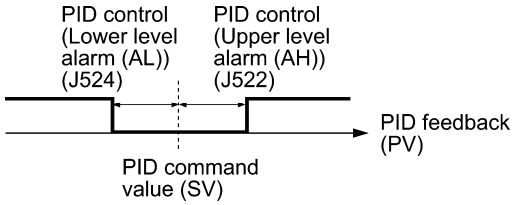
To use the alarm output, it is necessary to assign ***EPV1-ALM***, ***EPV2-ALM*** or ***EPV3-ALM*** to any of digital output terminals as duty control output with any of E20 to E24 and E27. To generate a light alarm, the following digital output signals can be extracted without setting the light alarm selection 4 (H184). For details of light alarms, see the description of function codes H181 to H184.

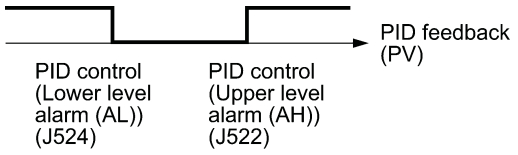
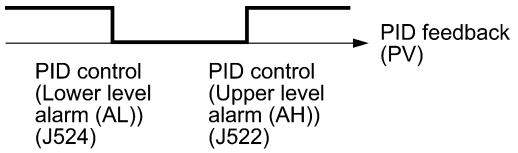
- External PID control 1: ***EPV1-ALM*** (E20 to E24 and E27, data = 214)
- External PID control 2: ***EPV2-ALM*** (E20 to E24 and E27, data = 224)
- External PID control 3: ***EPV3-ALM*** (E20 to E24 and E27, data = 234)

J521/J621/J671 specifies the alarm output types. J522/J622/J672 and J524/J624/J674 specify the upper and lower limits for alarms, respectively.

■ PID control 1 to 3 (Alarm output selection) (J521, J621, J671)

J521/J621/J671 specifies one of the following alarms available.

Data for J521/J621/J671	Alarm	Description
0	Absolute-value alarm (PV)	While PV < AL or AH < PV, ***EPV1-ALM*** is ON. 
1	Absolute-value alarm (PV) (with Hold)	Same as above (with Hold)
2	Absolute-value alarm (PV) (with Latch)	Same as above (with Latch)
3	Absolute-value alarm (PV) (with Hold and Latch)	Same as above (with Hold and Latch)
4	Deviation alarm (PV)	While PV < SV - AL or SV + AH < PV, ***EPV1-ALM*** is ON. 

Data for J521/J621/J671	Alarm	Description
5	Deviation alarm (PV) (with Hold)	Same as above (with Hold)
6	Deviation alarm (PV) (with Latch)	Same as above (with Latch)
7	Deviation alarm (PV) (with Hold and Latch)	Same as above (with Hold and Latch)
8	Absolute-value alarm (SV)	While SV < AL or AH < SV, ***EPV1-ALM*** is ON. 
9	Absolute-value alarm (SV) (with Hold)	Same as above (with Hold)
10	Absolute-value alarm (SV) (with Latch)	Same as above (with Latch)
11	Absolute-value alarm (SV) (with Hold and Latch)	Same as above (with Hold and Latch)
12	Absolute-value alarm (MV)	While MV < AL or AH < MV, ***EPV1-ALM*** is ON. 
13	Absolute-value alarm (MV) (with Hold)	Same as above (with Hold)
14	Absolute-value alarm (MV) (with Latch)	Same as above (with Latch)
15	Absolute-value alarm (MV) (with Hold and Latch)	Same as above (with Hold and Latch)

SV: Process command value, PV: Feedback value, MV: Manipulated value

Hold: During the power-on sequence, the alarm output is kept OFF (disabled) even when the monitored quantity is within the alarm range. Once it goes out of the alarm range, and comes into the alarm range again, the alarm is enabled.

Latch: Once the monitored quantity comes into the alarm range and the alarm is turned ON, the alarm will remain ON even if it goes out of the alarm range. To release the latch, perform a reset by using the (RESET ×5) key or turning the terminal command ***RST*** ON. Resetting can be done by the same way as resetting an alarm.

■ External PID control 1 (Upper level alarm (AH) (J522, J622, J672)

J522/J622/J672 specifies the upper limit (AH) for alarms in a physical quantity.

- Data setting range: OFF, -999.00 to 0.00 to 9990.00

The physical quantity is dependent on the display unit and maximum/minimum scale specified by the following function codes.

	Display unit	Maximum scale	Minimum scale
External PID control 1	J505	J506	J507
External PID control 2	J605	J606	J607
External PID control 3	J655	J656	J657

■ External PID control 1 (Lower level alarm (AL) (J524, J624, J674)

J524/J624/J674 specifies the lower limit (AL) for alarms in a physical quantity. The physical quantity is dependent on the display unit and maximum/minimum scale specified by the function codes listed above.

- Data setting range: OFF, -999.00 to 0.00 to 9990.00

Upper level alarm (AH) and lower level alarm (AL) also apply to the following alarms.

Alarm	Description	How to handle the alarm:	
		Select alarm output (J521/J621/J671)	Parameter setting
Upper limit (absolute)	ON when AH < PV ON when AH < SV ON when AH < MV	Absolute-value alarm	AL = 0
Lower limit (absolute)	ON when PV < AL ON when SV < AL ON when MV < AL		AH = 100%
Upper limit (deviation)	ON when SV + AH < PV	Deviation alarm	AL = 100%
Lower limit (deviation)	ON when PV < SV - AL		AH = 100%
Upper/lower limit (deviation)	ON when |SV - PV| > AL		AL = AH
Upper/lower range limit (deviation)	ON when SV - AL < PV < SV + AL	Deviation alarm	A negative logic signal should be assigned to ***EPV1-ALM***, ***EPV2-ALM***, or ***EPV3-ALM***
Upper/lower range limit (absolute)	ON when AL < PV < AH ON when AL < SV < AH ON when AL < MV < AH	Absolute-value alarm	
Upper/lower range limit (deviation)	ON when SV - AL < PV < SV + AH	Deviation alarm	

J527 **J529** **J530** **J531**	**External PID Control 1 (Feedback error detection mode)** **(Feedback error upper-limit)** **(Feedback error lower-limit)** **(Feedback error detection time)** **J627 (External PID Control 2 (Feedback error detection mode)** **J629 (External PID Control 2 (Feedback error upper-limit)** **J630 (External PID Control 2 (Feedback error lower-limit)** **J631 (External PID Control 2 (Feedback error detection time)** **J677 (External PID Control 3 (Feedback error detection mode)** **J679 (External PID Control 3 (Feedback error upper-limit)** **J680 (External PID Control 3 (Feedback error lower-limit)** **J681 (External PID Control 3 (Feedback error detection time)**

Under external PID control, the inverter can detect abnormal feedback values (PV).

In the case of external PID control 1, if the error level of a PV signal (Upper limit: J529, Lower limit: J53) is kept for the feedback error detection time (J531), the inverter regards it as an error, then stops or continues running according to the mode specified by J527.

The table below lists the function codes available for external PID control 1, 2 and 3.

	Feedback error detection mode	Feedback error upper limit	Feedback error lower limit	Error detection time
External PID control 1	J527	J529	J530	J531
External PID control 2	J627	J629	J630	J631
External PID control 3	J677	J679	J680	J681

■ External PID control 1 to 3 (Feedback error detection mode) (J527, J627, J677)

J527/J627/J677 specifies the error processing to be performed if a feedback error occurs.

- Data setting range: 0 to 2

Data for J527/J627/J677	Error processing
0	Disable: Turn ON the following output signal and continue to run. ***EPV1-OFF*** for external PID control 1 ***EPV2-OFF*** for external PID control 2 ***EPV3-OFF*** for external PID control 3
1	Enable: Coast to a stop (PVA trip)
2	Enable: Decelerate to a stop and cause a PVA trip.

Feedback errors can be monitored from the external equipment by assigning the digital output signal ***EPV1-OFF***, ***EPV2-OFF*** or ***EPV3-OFF*** to any of the output terminals [Y1] to [Y4], [Y5A/C], and [30A/B/C] with any of E20 through E24 and E27.

- External PID control 1: ***EPV1-OFF*** (E20 to E24 and E27, data = 215)
- External PID control 2: ***EPV2-OFF*** (E20 to E24 and E27, data = 225)
- External PID control 3: ***EPV3-OFF*** (E20 to E24 and E27, data = 235)

■ External PID control 1 to 3 (Feedback error lower-limit) (J529, J629, J679)

J529/J629/J679 specifies the upper limit for feedback errors in a physical quantity.

- Data setting range: -999.00 to 0.00 to 999.00, Auto = 105%

The physical quantity is dependent on the display unit and maximum/minimum scale specified by the following function codes.

	Display unit	Maximum scale	Minimum scale
External PID control 1	J505	J506	J507
External PID control 2	J605	J606	J607
External PID control 3	J655	J656	J657

■ External PID control 1 to 3 (Feedback error lower-limit) (J530, J630, J680)

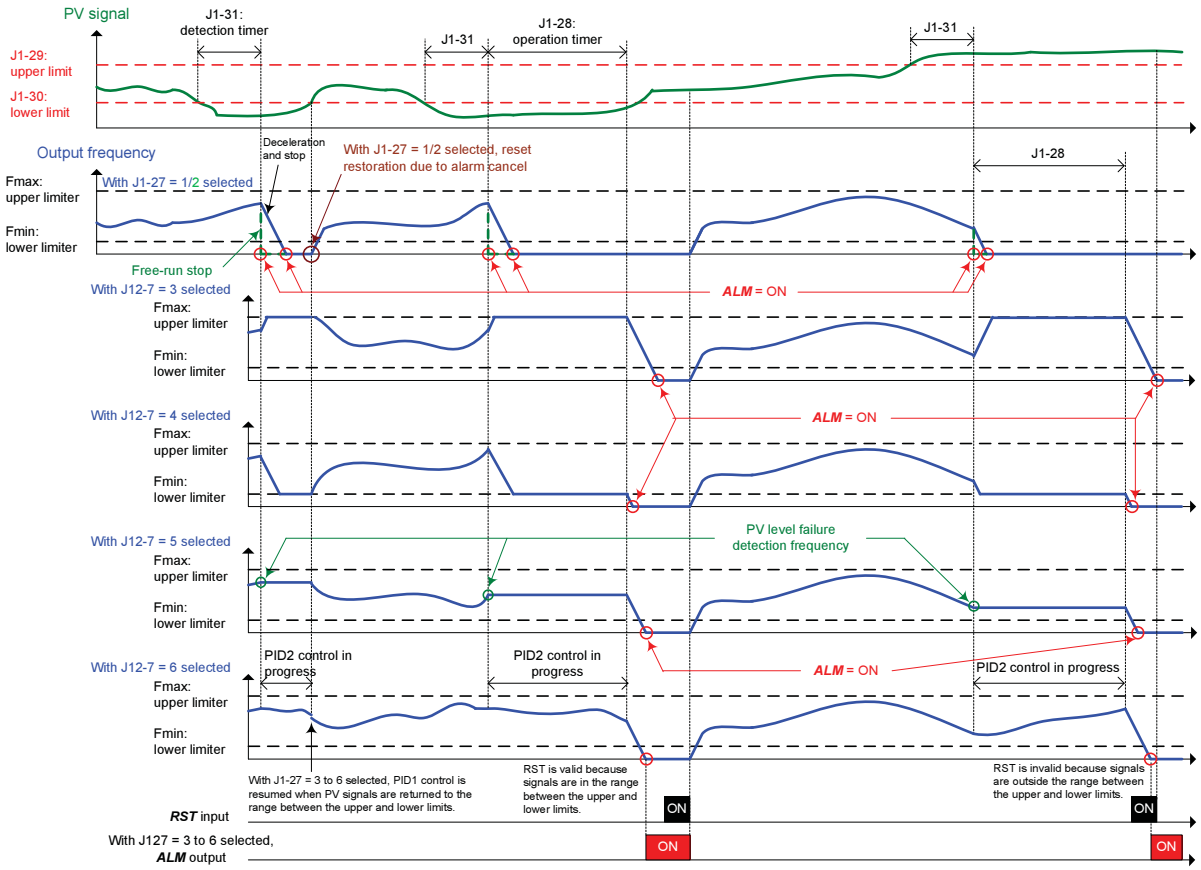
J530/J630/J680 specifies the lower limit for feedback errors in a physical quantity. The physical quantity is dependent on the display unit and maximum/minimum scale specified by the function codes listed above.

- Data setting range: -999.00 to 0.00 to 999.00, Auto = -5%

■ External PID control 1 to 3 (Feedback error detection time) (J531, J631, J681)

J531/J631/J681 specifies the feedback error detection time for the upper-limit (J529/J629/J679) and lower-limit (J530/J630/J680). If the detection time has elapsed after a feedback error occurred, the inverter regards it as an error.

- Data setting range: 0 to 300.0 (s)



J540	External PID Control 1 (Manual command) J640 (External PID Control 2 (Manual command) J690 (External PID Control 3 (Manual command)

■ External PID control 1 to 3 (Manual command) (J540, J640, J690)

J540/J640/J690 specifies the source that specifies a manual command to apply when external PID command is canceled.

- Data setting range: 0, 8, 51, 52, 53, 111, 112

Data for J540/J640/J690	J540	J640	J690	Manual command sources
0	√	√	√	Keypad Specify the external PID command by using the ⌃ / ⌄ keys on the keypad.
8	√	√	√	Keypad (Balanceless-bumpless) Specify the external PID command by using the ⌃ / ⌄ keys on the keypad.
51	√	√	√	External PID command 1 (Analog input: Terminals [12], [C1] and [V2]) Function codes E61 to E63 (terminal [12], [C1], [V2] Extended function selection): Data = 43 Voltage input to terminal [12] (0 to ±10 VDC, 100% PID command/ ±10 VDC) Current input to terminal [C1] (4 to 20 mA DC, 100% PID command/ 20 mA DC (0 to 20 mA DC, 100% PID command/ 20 mA DC) Voltage input to the terminal [V2] (0 to ±10 VDC, 100% PID command/ ±10 VDC)
52	-	√	√	External PID command 2 (Analog input: Terminals [12], [C1] and [V2]) Function codes E61 to E63 (terminal [12], [C1], [V2] Extended function selection): Data = 43
53	-	-	√	External PID command 3(Analog input: Terminals [12], [C1] and [V2]) Function codes E61 to E63 (terminal [12], [C1], [V2] Extended function selection): Data = 43
111	-	√	√	External PID control 1's manual command value Uses the manual command value (data: 0, 8, 51) specified by function code J540
112	-	-	√	External PID control 2's manual command value Uses the manual command value (data: 0, 8, 51, 52, 111) specified by function code J640

📖 To cancel external PID controls, assign digital input signals ***%/EPID1***, ***%/EPID2***, and ***%/EPID3*** to digital input terminals with E01 to E07 (data = 202, 212, 222) beforehand.

J550 J551 J552 J553	External PID Multistep Command (Mode selection) (Multistep command 1) (Multistep command 2) (Multistep command 3)

J550, J551, J552 and J553 define an external PID control command as a preset value (3 steps).

■ External PID multistep command (Mode selection) (J550)

J550 selects an external PID control under which an external PID multistep command takes effect.

- Data setting range: 0 bit, 1 bit, 2 bits

Data for J550	Function
0-2 bit = 0	Disable multistep command
0 bit = 1	Enable multistep command under external PID control 1
1 bit = 1	Enable multistep command under external PID control 2
2 bits = 1	Enable multistep command under external PID control 3

■ External PID multistep command (Multistep command 1 to 3) (J551, J552, J553)

J551/J552/J553 specifies a multistep command in a physical quantity.

- Data setting range: -999.00 to 0.00 to 9990.00

・External PID command

EPID-SS2	*EPID-SS1*	Command
OFF	OFF	Command by J550
OFF	ON	J551 (Multistep 1)
ON	OFF	J552 (Multistep 2)
ON	ON	J553 (Multistep 3)

The physical quantity is dependent on the display unit and maximum/minimum scale specified by the following function codes.

	Display unit	Maximum scale	Minimum scale
External PID control 1	J505	J506	J507
External PID control 2	J605	J606	J607
External PID control 3	J655	J656	J657

Note: Factory default value is set at J505, J605, J655=0 (according to the PID control 1 feedback value unit/scale).

5.1.11 J6 codes (External PID control 2, 3)

J601	External PID Control 2 (Mode selection)	(Refer to J501.)

For details of External PID Control 2 (Mode selection), refer to the description of J501.

J602	External PID Control 2 (Remote command selection)	(Refer to J502.)

For details of External PID Control 2 (Remote command selection), refer to the description of J502.

J603	External PID Control 2 (Feedback selection)	(Refer to J503.)

For details of External PID Control 2 (Feedback selection), refer to the description of J503.

J605	External PID Control 2 (Display unit)	(Refer to J505.)

For details of External PID Control 2 (Display unit), refer to the description of J505.

J606, J607	External PID Control 2 (Maximum scale, Minimum scale)	(Refer to J506, J507.)

For details of External PID Control 2 (Maximum scale, Minimum scale), refer to the description of J506 to J507.

J610	External PID Control 2 P (Gain)	(Refer to J510.)
J611	I (Integral time)	(Refer to J511.)
J612	D (Differential time)	(Refer to J512.)
J613	Feedback filter	(Refer to J513.)

For details of External PID Control 2 (P (Gain), I (Integral time), D (Differential time), Feedback filter), refer to the description of J510 to J513.

J614	External PID Control 2 (Anti-reset wind-up)	(Refer to J514.)

For details of External PID Control 2 (Anti-reset wind-up), refer to the description of J514.

J615	External PID Control 2 (ON/OFF control hysteresis width)	(Refer to J515.)

For details of External PID Control 2 (ON/OFF control hysteresis width), refer to the description of J515.

J616	**External PID Control 2 (Proportional operation output convergent value)** **(Refer to J516.)**

For details of External PID Control 2 (Proportional operation output convergent value), refer to the description of J516.

J617	**External PID Control 2 (Proportion cycle)** **(Refer to J517.)**

For details of External PID Control 2 (Proportion cycle), refer to the description of J517.

J618	**External PID Control 2 (Upper limit of PID process output)**	**(Refer to J518.)**
J619	**(Lower limit of PID process output)**	**(Refer to J519.)**
J620	**(Upper and lower limits)**	**(Refer to J520.)**

For details of External PID Control 2 (Upper limit of PID process output, Lower limit of PID process output, Upper and lower limits), refer to the description of J518 to J520.

J621	**External PID Control 2 (Alarm output selection)**	**(Refer to J521.)**
J622	**(Upper level alarm (AH))**	**(Refer to J522.)**
J624	**(Lower level alarm (AL))**	**(Refer to J524.)**

For details of External PID Control 2 (Alarm output selection, Upper level alarm (AH), Lower level alarm (AL)), refer to the description of J521 to J524.

J627	**External PID Control 2 (Feedback error detection mode)**	**(Refer to J527.)**
J629	**(Feedback error upper-limit)**	**(Refer to J529.)**
J630	**(Feedback error lower-limit)**	**(Refer to J530.)**
J631	**(Feedback error detection time)**	**(Refer to J531.)**

For details about external PID control 2 (Feedback error detection mode, Feedback error continuation duration, Feedback error upper-limit, Feedback error lower-limit, Feedback failure detection time), refer to the descriptions of J527 to J531.

J640	**External PID Control 2 (Manual command)** **(Refer to J540.)**

For details of External PID Control 2 (Manual command), refer to the description of J540.

J651	**External PID Control 3 (Mode selection)** **(Refer to J501.)**

For details of External PID Control 3 (Mode selection), refer to the description of J501.

J652	External PID Control 3 (Remote command selection) (Refer to J502.)

For details of External PID Control 3 (Remote command selection), refer to the description of J502.

J653	External PID Control 3 (Feedback selection) (Refer to J503.)

For details of External PID Control 3 (Feedback selection), refer to the description of J503.

J655	External PID Control 3 (Display unit) (Refer to J505.)

For details of External PID Control 3 (Display unit), refer to the description of J505.

J656, J657	External PID Control 3 (Maximum scale, Minimum scale) (Refer to J506, J507.)

For details of External PID Control 3 (Maximum scale, Minimum scale), refer to the description of J506 to J507.

J660	External PID Control 3 P (Gain)	(Refer to J510.)
J661	I (Integral time)	(Refer to J511.)
J662	D (Differential time)	(Refer to J512.)
J663	Feedback filter	(Refer to J513.)

For details of External PID Control 3 (P (Gain), I (Integral time), D (Differential time), Feedback filter), refer to the description of J510 to J513.

J664	External PID Control 3 (Anti-reset wind-up) (Refer to J514.)

For details of External PID Control 3 (Anti-reset wind-up), refer to the description of J514.

J665	External PID Control 3 (ON/OFF control hysteresis width) (Refer to J515.)

For details of External PID Control 3 (ON/OFF control hysteresis width), refer to the description of J515.

J666	External PID Control 3 (Proportional operation output convergent value) (Refer to J516.)

For details of External PID Control 3 (Proportional operation output convergent value), refer to the description of J516.

J667	**External PID Control 3 (Proportion cycle)**	**(Refer to J517.)**

For details of External PID Control 3 (Proportion cycle), refer to the description of J517.

J668	**External PID Control 3 (Upper limit of PID process output)**	**(Refer to J518.)**
J669	**(Lower limit of PID process output)**	**(Refer to J519.)**
J670	**(Upper and lower limits)**	**(Refer to J520.)**

For details of External PID Control 3 (Upper limit of PID process output, Lower limit of PID process output, Upper and lower limits), refer to the description of J518 to J520.

J671	**External PID Control 3 (Alarm output selection)**	**(Refer to J521.)**
J672	**(Upper level alarm (AH))**	**(Refer to J522.)**
J674	**(Lower level alarm (AL))**	**(Refer to J524.)**

For details of External PID Control 3 (Alarm output selection, Upper level alarm (AH), Lower level alarm (AL)), refer to the description of J521 to J524.

J677	**External PID Control 3 (Feedback error detection mode)**	**(Refer to J527.)**
J679	**(Feedback error upper-limit)**	**(Refer to J529.)**
J680	**(Feedback error lower-limit)**	**(Refer to J530.)**
J681	**(Feedback error detection time)**	**(Refer to J531.)**

For details of External PID Control 3 (Feedback failure detection (Mode selection), Feedback error continuation duration, Feedback error upper-limit, Feedback error lower-limit, Feedback error detection time), refer to the description of J527 to J531.

J690	**External PID Control 3 (Manual commands)**	**(Refer to J540.)**

For details of External PID Control 3 (Manual command), refer to the description of J540.

5.1.12 d codes (Application functions 2)

d51, d55, d69, d98, d99	**Reserved for particular manufacturers**

Function codes d51, d55, d69, d98 and d99 appear on the monitor, but they are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

5.1.13 U codes (Customizable logic functions)

U00	**Customizable Logic (Mode selection)**
U01 to U70	**Customizable Logic: Step 1 to 14 (Setting)**
U71 to U77	**Customizable Logic Output Signal 1 to 7 (Output selection)**
U81 to U87	**Customizable Logic Output Signal 1 to 7 (Function selection)**
U92 to U97	**Customizable Logic Conversion Coefficients**

The customizable logic function allows the user to form logic circuits and calculation circuits with respect to digital and analog I/O signals, process signals arbitrarily, and establish simplified relay sequences in the inverter.

In the customizable logic, the following can be specified as one step (component) to establish sequences using 14 steps in total:

(1) Digital 2 inputs/digital 1 output + logic calculation (including timer)

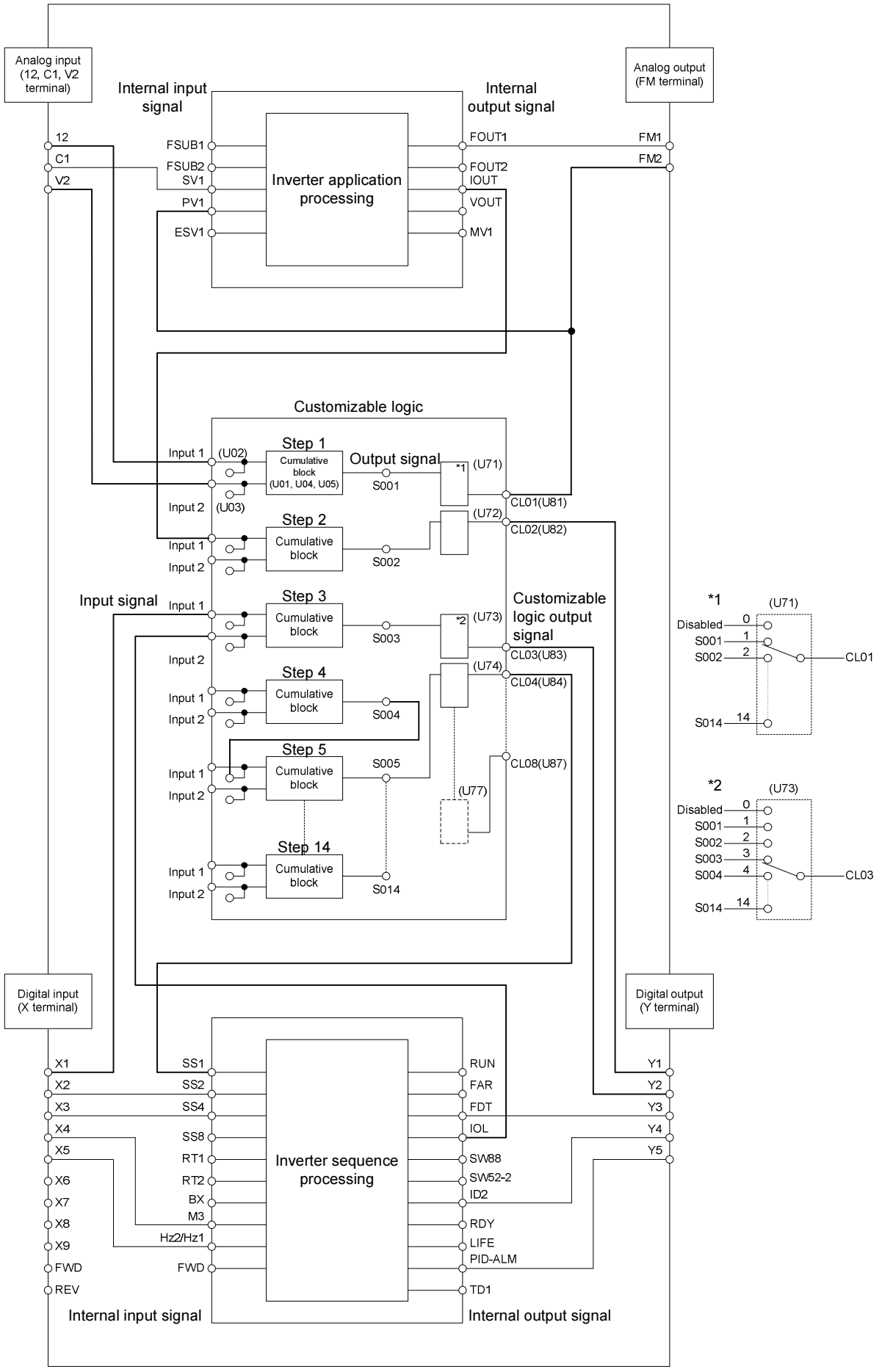
(2) Analog 2 inputs/analog 1 output/digital 1 output + value calculation

(3) Analog 1 input/1 digital input/analog 1 output + value calculation/logic calculation

■ Specifications

Item	Specifications		
Input signal	Digital 2 inputs	Analog 2 inputs	Analog 1 input Digital 1 input
Operation block	Logical operation, counter, etc.: 13 types Timer: 5 types	23 types such as value calculation, comparator and limiter	6 types such as selector and hold
Output signal	Digital 1 output	Analog 1 output/ digital 1 output	Analog 1 output
Number of steps	14 steps		
Customizable logic output signal	7 outputs		
Customizable logic processing time	5 ms		

■ Block diagram



■ Customizable Logic (Mode selection) (U00)

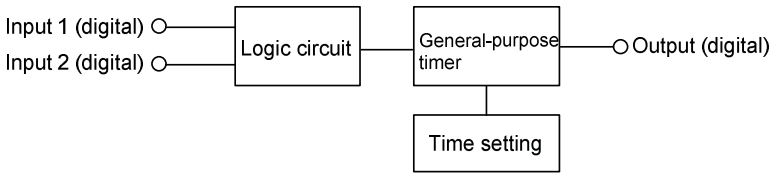
U00 specifies whether to enable the sequence configured with the customizable logic function or disable it to run the inverter only via its input terminals and others.

Data for U00	Function
0	Disable
1	Enable (Customizable logic operation)

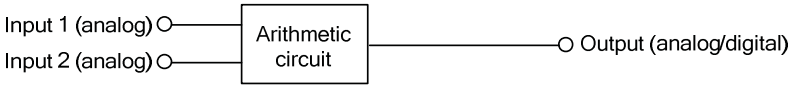
■ Customizable Logic (Setting) (U01 to U70)

The components in one step of the customizable logic are classified into the following three block diagrams.

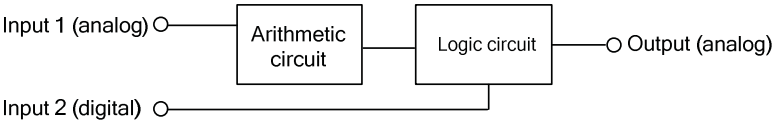
[Input: Digital] U01, U06, U16, etc. = 1 to 1999



[Input: Analog] U01, U06, U16, etc. = 2001 to 3999



[Input: Digital, analog] U01, U06, U16, etc. = 4001 to 5999



Configuration of function codes for each step

Step No.	Logic circuit	Input selection	Input selection	Function 1	Function 2	Output (Note)
Step 1	U01	U02	U03	U04	U05	***SO01***
	= 1 to 1999	Digital input 1	Digital input 2	Time setting	Not required	Digital output
	= 2001 to 3999	Analog input 1	Analog input 2	Value 1	Value 2	Analog/digital output
	= 4001 to 5999	Analog input 1	Digital input 2	Value 1	Value 2	Analog output
Step 2	U06	U07	U08	U09	U10	***SO02***
Step 3	U11	U12	U13	U14	U15	***SO03***
Step 4	U16	U17	U18	U19	U20	***SO04***
Step 5	U21	U22	U23	U24	U25	***SO05***
Step 6	U26	U27	U28	U29	U30	***SO06***
Step 7	U31	U32	U33	U34	U35	***SO07***
Step 8	U36	U37	U38	U39	U40	***SO08***
Step 9	U41	U42	U43	U44	U45	***SO09***
Step 10	U46	U47	U48	U49	U50	***SO10***
Step 11	U51	U52	U53	U54	U55	***SO11***
Step 12	U56	U57	U58	U59	U60	***SO12***
Step 13	U61	U62	U63	U64	U65	***SO13***
Step 14	U66	U67	U68	U69	U70	***SO14***

(Note) These items shown in this column are output signals, not function codes.

Setting of [Input: Digital]

■ Logic circuit (U01, etc.)

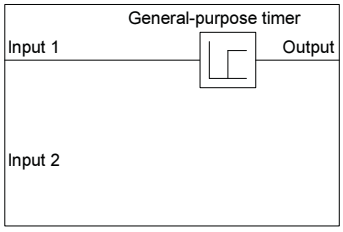
Any of the following functions is selectable as a logic circuit (with general-purpose timer).

Data	Function	Description
0	No function assigned	Output is always OFF.
10	Through output + General-purpose timer (No timer)	Only a general-purpose timer. No logic circuit exists.
11	(On-delay timer)	Turning an input signal ON starts the on-delay timer. When the period specified by the timer has elapsed, an output signal turns ON. Turning the input signal OFF turns the output signal OFF.
12	(Off-delay timer)	Turning an input signal ON turns an output signal ON. Turning the input signal OFF starts the off-delay timer. When the period specified by the timer has elapsed, the output signal turns OFF.
13	(One-shot pulse output)	Turning an input signal ON issues a one-shot pulse whose length is specified by the timer.
14	(Retriggerable timer)	Turning an input signal ON issues a one-shot pulse whose length is specified by the timer. If an input signal is turned ON again during the preceding one-shot pulse length, however, the logic circuit issues another one-shot pulse.
15	(Pulse train output)	If an input signal turns ON, the logic circuit issues ON and OFF pulses (whose lengths are specified by the timer) alternately and repeatedly. This function is used to flash a luminescent device.
20 to 25	ANDing + General-purpose timer	AND circuit with 2 inputs and 1 output, plus general-purpose timer.
30 to 35	ORing + General-purpose timer	OR circuit with 2 inputs and 1 output, plus general-purpose timer.
40 to 45	XORing + General-purpose timer	XOR circuit with 2 inputs and 1 output, plus general-purpose timer.
50 to 55	Set priority flip-flop + General-purpose timer	Set priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
60 to 65	Reset priority flip-flop + General-purpose timer	Reset priority flip-flop with 2 inputs and 1 output, plus general-purpose timer.
70, 72, 73	Rising edge detector + General-purpose timer	Rising edge detector with 1 input and 1 output, plus general-purpose timer. This detects the rising edge of an input signal and outputs the ON signal for 5 ms.
80, 82, 83	Falling edge detector + General-purpose timer	Falling edge detector with 1 input and 1 output, plus general-purpose timer. This detects the falling edge of an input signal and outputs the ON signal for 5 ms.
90, 92, 93	Rising & falling edges detector + General-purpose timer	Rising and falling edges detector with 1 input and 1 output, plus general-purpose timer. This detects both the falling and rising edges of an input signal and outputs the ON signal for 5 ms.

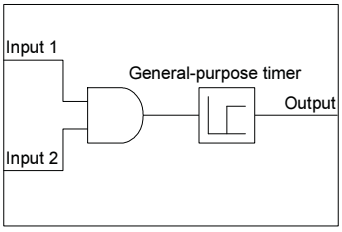
Data	Function	Description
100 to 105	Hold + General-purpose timer	Hold function of previous values of 2 inputs and 1 output, plus general-purpose timer. If the hold control signal is OFF, the logic circuit outputs input signals; if it is ON, the logic circuit retains the previous values of input signals.
110	Increment counter	Increment counter with reset input. By the rising edge of an input signal, the logic circuit increments the counter value by one. When the counter value reaches the target one, the output signal turns ON. Turning the reset signal ON resets the counter to zero.
120	Decrement counter	Decrement counter with reset input. By the rising edge of an input signal, the logic circuit decrements the counter value by one. When the counter value reaches zero, the output signal turns ON. Turning the reset signal ON resets the counter to the initial value.
130	Timer with reset input	Timer output with reset input. If an input signal turns ON, the output signal turns ON and the timer starts. When the period specified by the timer has elapsed, the output signal turns OFF, regardless of the input signal state. Turning the reset signal ON resets the current timer value to zero and turns the output OFF.

The block diagrams for individual functions are given below.

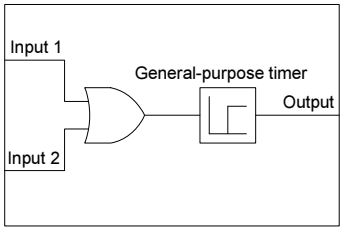
(data = 1□) Through output



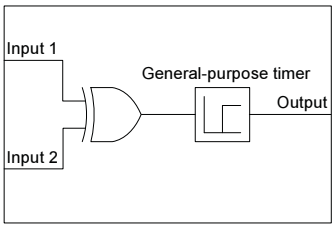
(data = 2□) AND



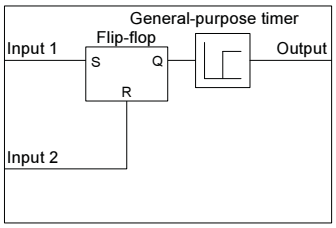
(data = 3□) OR



(data = 4□) XOR

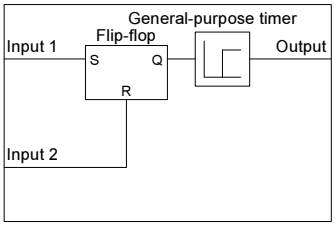


(data = 5□) Set priority flip-flop



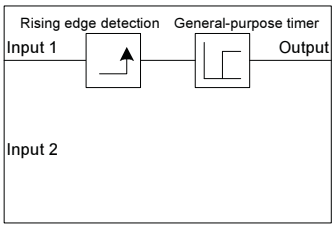
Input 1	Input 2	Previous output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value

(data = 6□) Reset priority flip-flop

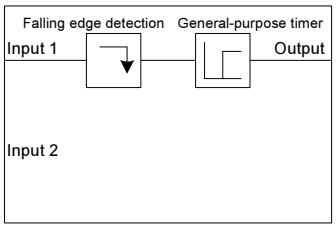


Input 1	Input 2	Previous output	Output	Remarks
OFF	OFF	OFF	OFF	Hold previous value
		ON	ON	

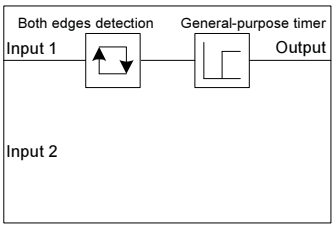
(data = 7□) Rising edge detector



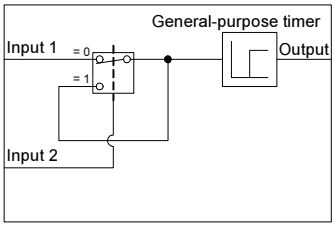
(data = 8□) Falling edge detector



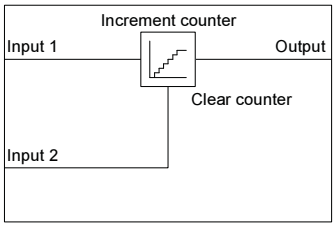
(data = 9□) Rising & falling edges detector



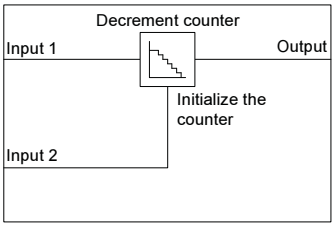
(data = 10□) Hold



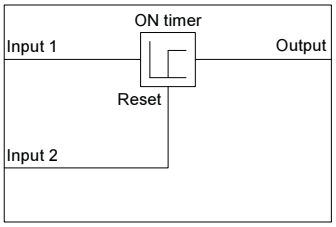
(data = 110) Increment counter

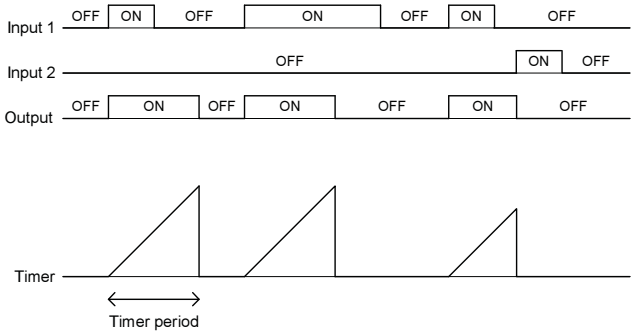


(data = 120) Decrement counter



(data = 130) Timer with reset input

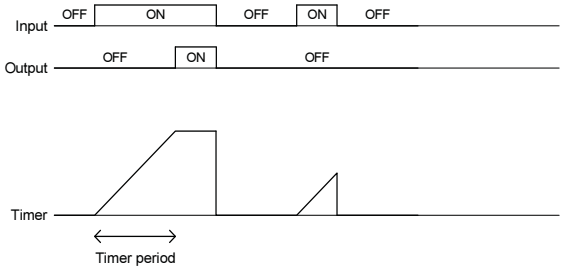




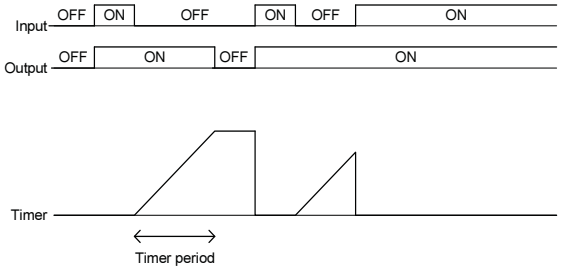
■ General-purpose timer

The operation schemes for individual timers are shown below.

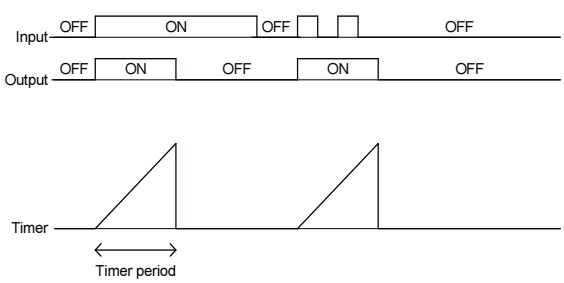
(end 1) On-delay timer



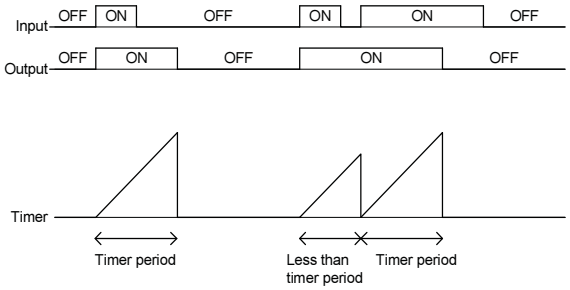
(end 2) Off-delay timer



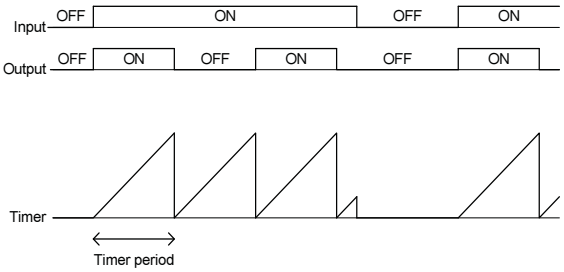
(end 3) One-shot pulse output



(end 4) Retriggerable timer



(end 5) Pulse train output



■ Digital inputs 1 and 2 (U02, U03, etc.)

The following signals are available as input signals.

Data	Selectable Signals
0000 (1000) | 0235 (1235)	General-purpose output signals Same as the ones specified by E20, e.g., ***RUN*** (Inverter running), ***FAR*** (Frequency (speed) arrival signal), ***FDT*** (Frequency (speed) detected), ***LU*** (Undervoltage detected (Inverter stopped)), ***B/D*** (Torque polarity detected) **Note:** 27 (Universal DO) is not available. **Note:** 111 (1111) to 117 (1117) are not available.
2001 (3001)	Output of step 1 ***SO01***
2002 (3002)	Output of step 2 ***SO02***
2003 (3003)	Output of step 3 ***SO03***
2004 (3004)	Output of step 4 ***SO04***
2005 (3005)	Output of step 5 ***SO05***
2006 (3006)	Output of step 6 ***SO06***
2007 (3007)	Output of step 7 ***SO07***

Data	Selectable Signals	
2008 (3008)	Output of step 8	***SO08***
2009 (3009)	Output of step 9	***SO09***
2010 (3010)	Output of step 10	***SO10***
2011 (3011)	Output of step 11	***SO11***
2012 (3012)	Output of step 12	***SO12***
2013 (3013)	Output of step 13	***SO13***
2014 (3014)	Output of step 14	***SO14***
4001 (5001)	Terminal [X1] input signal	***X1***
4002 (5002)	Terminal [X2] input signal	***X2***
4003 (5003)	Terminal [X3] input signal	***X3***
4004 (5004)	Terminal [X4] input signal	***X4***
4005 (5005)	Terminal [X5] input signal	***X5***
4006 (5006)	Terminal [X6] input signal	***X6***
4007 (5007)	Terminal [X7] input signal	***X7***
4010 (5010)	Terminal [FWD] input signal	***FWD***
4011 (5011)	Terminal [REV] input signal	***REV***
6000 (7000)	Final run command (ON when "frequency command ≠ 0" and a run command is given)	***FL_RUN***
6001 (7001)	Final FWD run command (ON when "frequency command ≠ 0" and a run forward command is given)	***FL_FWD***
6002 (7002)	Final REV run command (ON when "frequency command ≠ 0" and a run reverse command is given)	***FL_REV***
6003 (7003)	During acceleration (ON during acceleration)	***DACC***
6004 (7004)	During deceleration (ON during deceleration)	***DDEC***
6005 (7005)	Under anti-regenerative control (ON under anti-regenerative control)	***REGA***
6007 (7007)	Alarm factor presence (ON when there is no alarm factor)	***ALM_ACT***

■ Time setting (U04, etc.)

U04 and other related function codes specify the general-purpose timer period or the increment/decrement counter value.

Data	Function	Description
0.00 to +600.00	Timer period	The period is specified by seconds.
	Counter value	The specified value is multiplied by 100 times. (If 0.01 is specified, it is converted to 1.)
-9990.00 to -0.01	--	The timer period or counter value is regarded as 0.00. (No timer)
+601.00 to +9990.00	--	The timer period or counter value is regarded as 600.

Setting of [Input: Analog]

■ Calculation circuit (U01, U04, U05, etc)

The following functions can be selected as a calculation circuit.

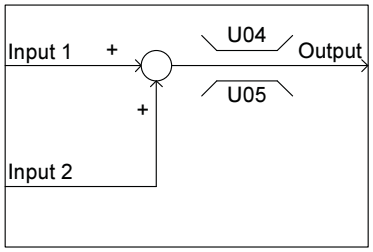
Furthermore, when upper and lower limit values are the same values, they operate as without upper and lower limits.

Data for U01	Function	Description	Such as U04	Such as U05
0	No function	Output is always 0% (or OFF).	No object	No object
2001	Addition	2 inputs 1 output summing circuit	Upper limit	Lower limit
2002	Subtraction	2 inputs 1 output subtraction circuit	Upper limit	Lower limit
2003	Multiplication	2 inputs 1 output multiplication circuit	Upper limit	Lower limit
2004	Division	Division circuit of 2 inputs 1 output	Upper limit	Lower limit
2005	Limiter	Upper and lower limit limiter circuit of 1 input 1 output	Upper limit	Lower limit
2006	Absolute value	Absolute value circuit of 1 input 1 output	Upper limit	Lower limit
2007	Inversion addition	Inversion circuit of 1 input 1 output	Addition value (former clause)	Addition value (latter clause)
2051	Comparison 1	Output the comparison of 2 input deviations digitally.	Deviation	Hysteresis width
2052	Comparison 2	Output the comparison of 2 input deviations digitally.	Deviation	Hysteresis width
2053	Comparison 3	Output the comparison of 2 input deviations (absolute value) digitally.	Deviation	Hysteresis width
2054	Comparison 4	Output the comparison of 2 input deviations (absolute value) digitally.	Deviation	Hysteresis width
2055	Comparison 5	Output the comparison between 1 input and 1 reference value digitally.	Reference value	Hysteresis width
2056	Comparison 6	Output the comparison between 1 input and 1 reference value digitally.	Reference value	Hysteresis width
2071	Window comparison 1	Output the comparison between 1 input and upper/lower threshold value.	Upper threshold value	Lower threshold value
2072	Window comparison 2	Output the comparison between 1 input and upper/lower threshold value.	Upper threshold value	Lower threshold value
2101	Maximum selection	Circuit to output the maximum value of 2 inputs.	Upper limit	Lower limit
2102	Minimum selection	Circuit to output the minimum value of 2 inputs.	Upper limit	Lower limit
2103	Average	Circuit to output the average of 2 inputs.	Upper limit	Lower limit
2151	Function code	The value of function code S13 (%) shall be input.	Maximum scale	Minimum scale
2201	Scale inverse transformation	Circuit to convert 1 analog input to 0-100.00 with scale set value. Use this circuit for connection to analog output terminals. Up to two steps can be used.	Maximum scale	Minimum scale
2202	Scale transformation	Circuit to convert 0-100.00 of analog 1 input with scale set value. For input 1, 8000-8085 only are available. Up to two steps can be used.	Maximum scale	Minimum scale

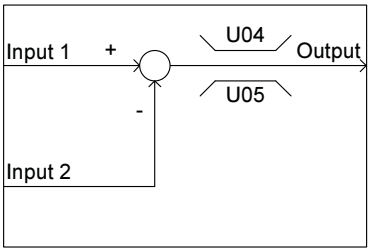
Data for U01	Function	Description	Such as U04	Such as U05
3001	Conversion 1	$\sqrt{\text{Input1}} \times K_A + \sqrt{\text{Input2}} \times K_B + K_C$ Use coefficient group (1) A single step, 3001 or 3002, can be used. $K_A \times (\text{Input1})^2 + K_B \times \text{Input1} + K_C$ Use coefficient group (1) A single step, 3001 or 3002, can be used.	Upper limit	Lower limit
3002	Conversion 2	$\sqrt{\frac{\text{Input1} + K_A}{K_B}} \times K_C$ Use coefficient group (1) A single step, 3001 or 3002, can be used.	Upper limit	Lower limit

The block diagrams of individual functions are shown below.

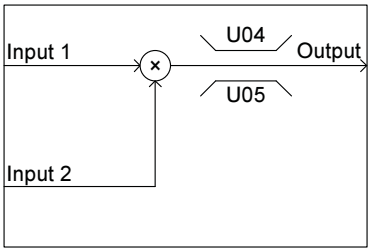
(2001) Addition



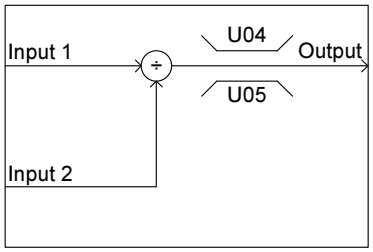
(2002) Subtraction



(2003) Multiplication

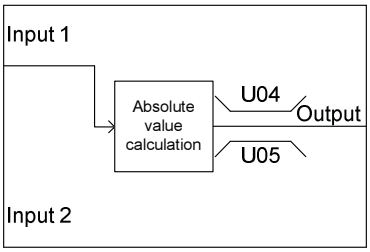


(2004) Division

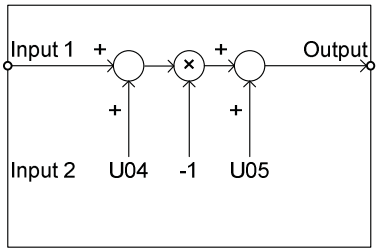


(2005) Limiter

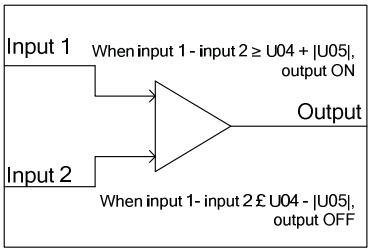
(2006) Absolute value



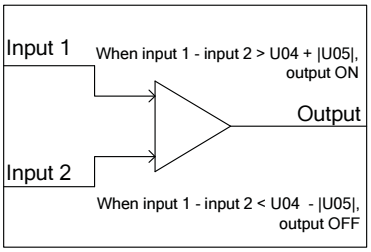
(2007) Inversion addition



(2051) Comparison 1

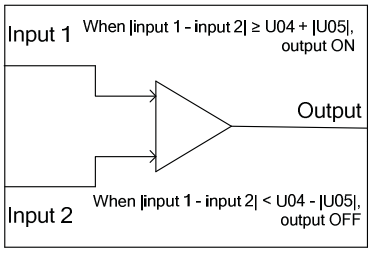


(2052) Comparison 2

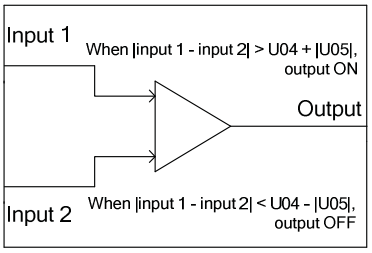


If both conditions are satisfied, "output ON" has priority.

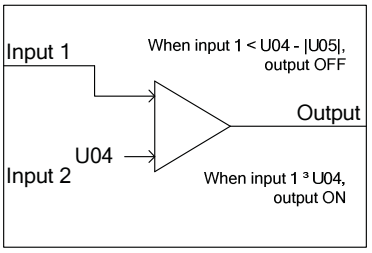
(2053) Comparison 3



(2054) Comparison 4

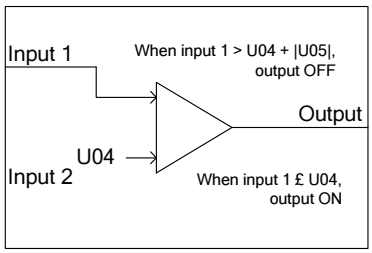


(2055) Comparison 5

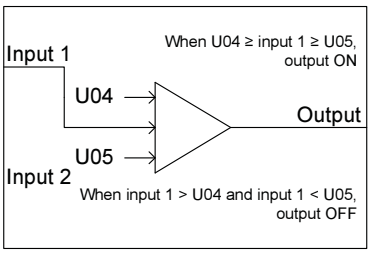


If both conditions are satisfied, "output ON" has priority

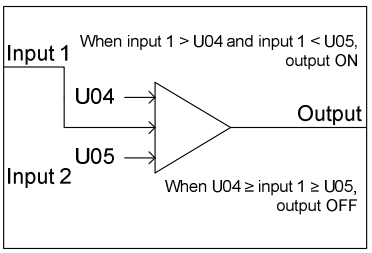
(2056) Comparison 6



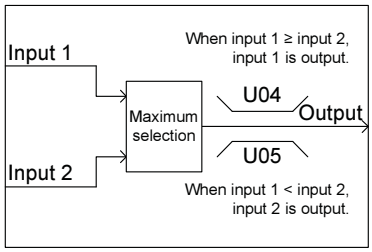
(2071) Window comparison 1



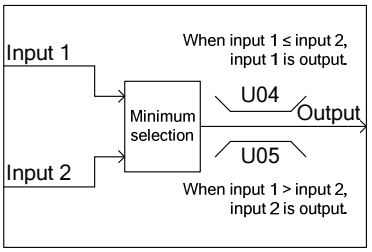
(2072) Window comparison 2



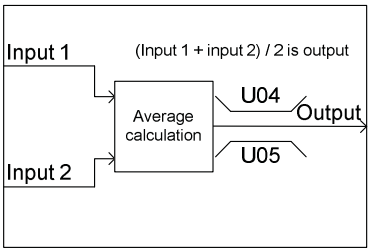
(2101) Maximum selection



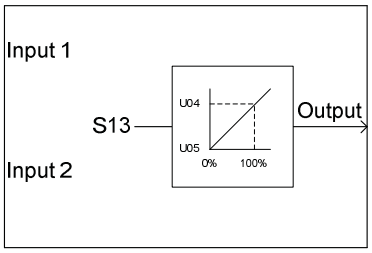
(2102) Minimum selection



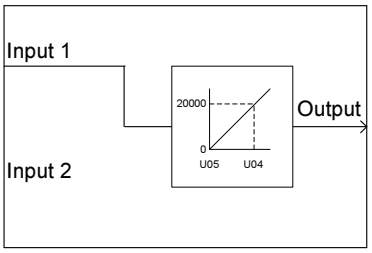
(2103) Average



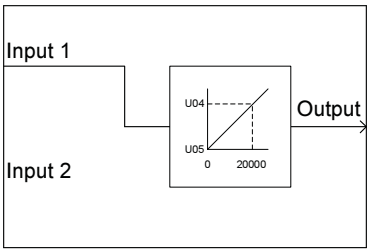
(2151) Function code input



(2201) Scale inverse transformation



(2202) Scale transformation



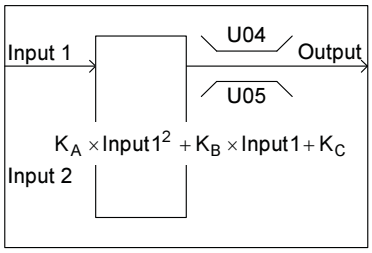
* To be used for connection to analog output terminals.

* Up to 2 steps can be used.

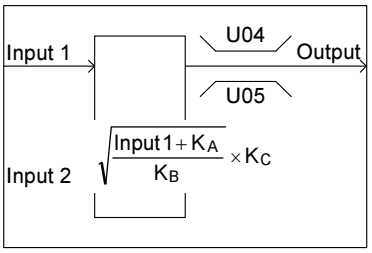
* For input 1, 8000-8085 only are available.

* Up to 2 steps can be used.

(3001) Conversion 1



(3002) Conversion 2



* A single step, 3001 or 3002, can be used.

■ Analog inputs 1 and 2 (U02, U03, etc.)

The following signals are available as input signals.

Data	Selectable Signals
8000 | 8085	Analog general-purpose output signal (same with signals selected with F31, F35: output frequency 1, output current, output torque, electric power consumption, direct-current intermediate circuit voltage, etc) Example: In the case of the maximum frequency with output frequency 1, 100.00 is input as 100%. Example: In the case of output current, 100.00 is input when the current is 200% of the inverter rated value. **Note:** 10 (universal AO) cannot be selected.
2001	Output of step 1 ***SO01***
2002	Output of step 2 ***SO02***
2003	Output of step 3 ***SO03***
2004	Output of step 4 ***SO04***
2005	Output of step 5 ***SO05***
2006	Output of step 6 ***SO06***
2007	Output of step 7 ***SO07***
2008	Output of step 8 ***SO08***
2009	Output of step 9 ***SO09***
2010	Output of step 10 ***SO10***
2011	Output of step 11 ***SO11***
2012	Output of step 12 ***SO12***
2013	Output of step 13 ***SO13***
2014	Output of step 14 ***SO14***
9001	Analog 12 terminal input signal ***12***
9002	Analog 12 terminal input signal ***C1***
9003	Analog 12 terminal input signal ***V2***
9004	Analog 32 terminal input signal ***32***
9005	Analog C2 terminal input signal ***C2***
9006	Temperature detection Pt channel 1
9007	Temperature detection Pt channel 2

■ Value setting (U04, U05, etc)

The upper and lower limits of calculation circuit are specified.

Data	Function	Description
-9990.00 to 0.00 to +9990.00	Reference value Hysteresis width Upper limit Lower limit Upper threshold value Lower threshold value Set value Maximum scale Minimum scale	Set value in accordance with the calculation circuit selected in mode setting such as U01.

■ Setting of conversion coefficient (U92 to U97)

The coefficients of calculation circuit conversion functions (3001 and 3002) are specified.

Function code	Name	Data setting range	Factory default
U92	Mantissa of calculation coefficient K_A	Mantissa: -9.999 to 9.999	0.000
U93	Exponent of calculation coefficient K_A	Exponent: -5 to 5	0
U94	Mantissa of calculation coefficient K_B		0.000
U95	Exponent of calculation coefficient K_B		0
U96	Mantissa of calculation coefficient K_C		0.000
U97	Exponent of calculation coefficient K_C		0

Setting of [Input: Digital, analog]

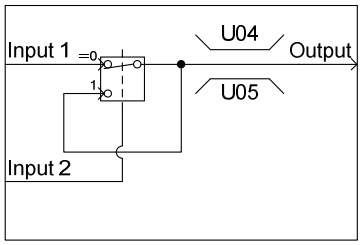
■ Calculation circuit/logic circuit (U01, U04, U05, etc)

The following functions can be selected as a calculation circuit/logic circuit.

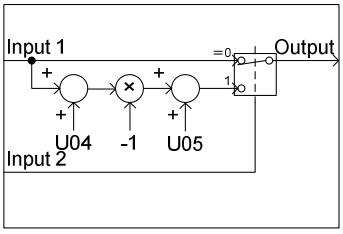
Furthermore, when upper and lower limit values are the same values, they operate as without upper and lower limits.

Data for U01	Function	Description	Such as U04	Such as U05
4001	Hold	Circuit to hold 1 analog input based on 1 input.	Upper limit	Lower limit
4002	Inversion addition switching	Circuit to invert 1 analog input based on 1 digital input.	Addition value (former clause)	Addition value (latter clause)
4003	Selection 1	Circuit to select 1 analog input and the set value based on 1 digital input.	Set value	No object
4004	Selection 2	Circuit to select the set value 1/2 based on 1 digital input.	Set value 1	Set value 2
5001	Selection 3-1	Circuit to select 2 analog inputs based on "SO01".	No object	No object
⋮	⋮	⋮		
5014	Selection 3-14	Circuit to select 2 analog inputs based on "SO14".	No object	No object
5101	Selection 4-1	Circuit to select 1 analog input and "SO01" based on 1 digital input.	No object	No object
⋮	⋮	⋮		
5114	Selection 4-14	Circuit to select 1 analog input and "SO14" based on 1 digital input.	No object	No object

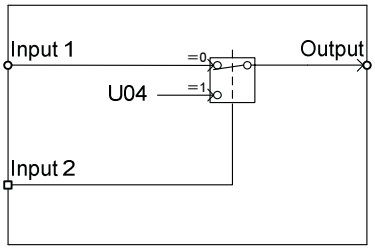
(4001) Hold



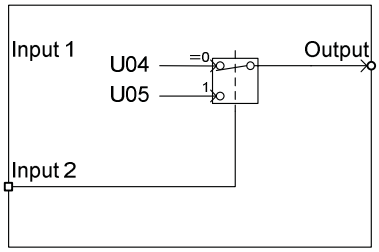
(4002) Inversion addition switching



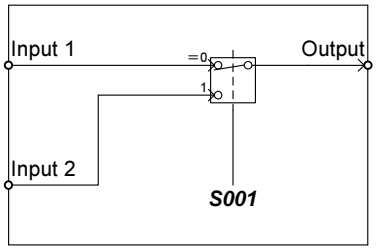
(4003) Selection 1



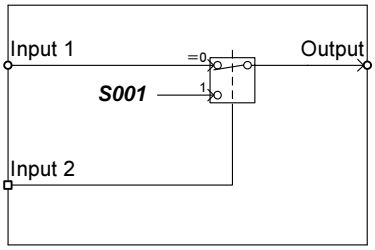
(4004) Selection 2



(5001 to 5014)
Selection 3-1 to Selection 3-14



(5101 to 5114)
Selection 4-1 to Selection 4-14



■ Output signals

The output of each step of the customizable logic is output to SO01 to SO14.

The outputs SO01 to SO14 differ in configuration depending on the connection mate as shown in the table below. (When establishing connection with any function other than the customizable logic, establish connection through the customizable logic output (CL01 to CL07).

If the connection destination is:	Configuration	Function codes
Customizable logic input	Select internal step output signals ***SO01*** to ***SO14*** in customizable logic input setting.	U02, U03, etc.
Input to the inverter's sequence processor (e.g., "Select multistep frequency" ***SS1***, "Run forward" ***FWD***)	Select one of the internal step output signals ***SO01*** to ***SO14*** to be connected to customizable logic output signals 1 to 7 (***CLO1*** to ***CLO7***).	U71 to U77
	Select an inverter's sequence processor input function to which one of the customizable logic output signals 1 to 7 (***CLO1*** to ***CLO7***) is to be connected. (Same as in E01)	U81 to U87
Analog input (Frequency auxiliary setting, PID process command, etc)	Select the internal step outputs ***SO01*** to ***SO14*** to be connected to the customizable logic output signals 1 ***CL01*** to 7 ***CL07***.	U71 to U77
	Select the analog input function to be connected to the customizable logic output signals 1 ***CL01*** to 7 ***CL07***. (Same with E61)	U81 to U87
General-purpose digital output (Y terminals)	Select the internal step outputs ***SO01*** to ***SO14*** to be connected to the customizable logic output signals 1 ***CL01*** to 7 ***CL07***.	U71 to U77
	To specify the general-purpose digital output (terminal [Y]) to be connected to the customizable logic output signals 1 ***CL01*** to 7 ***CL07***, select ***CL01*** to ***CL07*** on the function selection side of the general-purpose digital output (terminal [Y]).	E20 to E24, E27

If the connection destination is:	Configuration	Function codes
General-purpose analog output (terminal [FM])	Select the internal step outputs ***SO01*** to ***SO14*** to be connected to the customizable logic output signals 1 ***CL01*** to 7 ***CL07***.	U71 to U77
	To specify the general-purpose analog output (terminal [FM]) to be connected to the customizable logic output signals 1 ***CL01*** to 7 ***CL07***, select ***CL01*** to ***CL07*** on the function selection side of the general-purpose analog output (terminal [FM]).	F31, F35

Note For the general-purpose digital output (terminal [Y]), the data is renewed over a 5-ms cycle. To securely output a customizable logic signal via Y terminals, include on- or off-delay timers in the customizable logic. Otherwise, short ON or OFF signals may not be reflected on those terminals.

Function code	Name	Data setting range	Default setting
U71	Customizable logic output signal 1 (Output selection)	0: Disable 1: Output of step 1, ***SO01*** 2: Output of step 2, ***SO02*** 3: Output of step 3, ***SO03*** 4: Output of step 4, ***SO04*** 5: Output of step 5, ***SO05*** 6: Output of step 6, ***SO06*** 7: Output of step 7, ***SO07*** 8: Output of step 8, ***SO08*** 9: Output of step 9, ***SO09*** 10: Output of step 10, ***SO10*** 11: Output of step 11, ***SO11*** 12: Output of step 12, ***SO12*** 13: Output of step 13, ***SO13*** 14: Output of step 14, ***SO14***	0
U72	Customizable logic output signal 2 (Output selection)		0
U73	Customizable logic output signal 3 (Output selection)		0
U74	Customizable logic output signal 4 (Output selection)		0
U75	Customizable logic output signal 5 (Output selection)		0
U76	Customizable logic output signal 6 (output selection)		0
U77	Customizable logic output signal 7 (output selection)		0

Function code	Name	Data setting range	Default setting
U81	Customizable logic output signal 1 (Function selection)	■ When step outputs are digital: 0 (1000): Select multistep frequency (0 to 1 step) ***SS1*** 1 (1001): Select multistep frequency (0 to 3 steps) ***SS2*** 2 (1002): Select multistep frequency (0 to 7 steps) ***SS4*** 3 (1003): Select multistep frequency (0 to 15 steps) ***SS8*** 4 (1004): Select ACC/DEC time (2 steps) ***RT1*** 5 (1005): Select ACC/DEC time (4 steps) ***RT2*** 6 (1006): Enable 3-wire operation ***HLD*** 7 (1007): Coast to a stop ***BX*** 8 (1008): Reset alarm ***RST*** 9 (1009): Enable external alarm trip ***THR*** (9 = Active OFF/ 1009 = Active ON) 11 (1011): Select frequency command 2/1 ***Hz2/Hz1*** 13: Enable DC braking ***DCBRK*** 14 (1014): Select torque limiter level 2/1 ***TL2/TL1*** 15: Switch to commercial power (50 Hz) ***SW50*** 16: Switch to commercial power (60 Hz) ***SW60*** 17 (1017): UP (Increase output frequency) ***UP*** 18 (1018): DOWN (Decrease output frequency) ***DOWN*** 20 (1020): Cancel PID control ***Hz/PID*** 21 (1021): Switch normal/inverse operation ***IVS*** 22 (1022): Interlock ***IL*** 24 (1024): Enable communications link via RS-485 or fieldbus ***LE*** 25 (1025): Universal DI ***U-DI*** 26 (1026): Enable auto search for idling motor speed at starting ***STM*** 30 (1030): Force to stop ***STOP*** (30 = Active OFF/ 1030 = Active ON)	100
U82	Customizable logic output signal 2 (Function selection)		100
U83	Customizable logic output signal 3 (Function selection)		100
U84	Customizable logic output signal 4 (Function selection)		100
U85	Customizable logic output signal 5 (Function selection)		100
U86	Customizable logic output signal 6 (Function selection)		100
U87	Customizable logic output signal 7 (Function selection)		100

Function code	Name	Data setting range	Default setting
	(U81 to U87 continued)	33 (1033): Reset PID integral and differential components ***PID-RST*** 34 (1034): Hold PID integral component ***PID-HLD*** 35 (1035): Select local (keypad) operation ***LOC*** 38 (1038): Enable run commands ***RE*** 39: Protect motor from dew condensation ***DWP*** 40: Enable integrated sequence to switch to commercial power (50 Hz) ***ISW50*** 41: Enable integrated sequence to switch to commercial power (60 Hz) ***ISW60*** 58 (1058): Reset UP/DOWN frequency ***STZ*** 72 (1072): Count the run time of commercial power-driven motor 1 ***CRUN-M1*** 81 (1081): Clear all customizable logic timers ***CLTC*** 87 (1087): Run command 2/1 ***FR2/FR1*** 88: Run forward 2 ***FWD2*** 89: Run reverse 2 ***REV2*** 98: Run forward ***FWD*** 99: Run reverse ***REV*** 100: No function assigned ***NONE*** 132 (1132): Filter clogging reverse rotation command ***FRC*** 133 (1133): Switch PID channel ***PID2/1***	

Function code	Name	Data setting range	Default setting
	(U81 to U87 continued)	171 (1171): PID multistep command ***PID-SS1*** 172 (1172): PID multistep command ***PID-SS2*** 181 (1181): External PID multistep command ***EPID-SS1*** 182 (1182): External PID multistep command ***EPID-SS2*** 190 (1190): Cancel timer ***TMC*** 191 (1191): Enable timer 1 ***TM1*** 192 (1192): Enable timer 2 ***TM2*** 193 (1193): Enable timer 3 ***TM3*** 194 (1194): Enable timer 4 ***TM4*** 201 (1201): External PID control 1 ON command ***EPID1-ON*** 202 (1202): Cancel external PID control 1 ***%/EPID1*** 203 (1203): Switch normal/inverse operation under external PID control 1 ***EPID1-IVS*** 204 (1204): Reset external PID1 integral and differential components ***EPID1-RST*** 205 (1205): Hold external PID1 integral component ***EPID1-HLD*** 211 (1211): External PID control 2 ON command ***EPID2-ON*** 212 (1212): Cancel external PID control 2 ***%/EPID2*** 213 (1213): Switch normal/inverse operation under external PID control 2 ***EPID2-IVS*** 214 (1214): Reset external PID2 integral and differential components ***EPID2-RST*** 215 (1215): Hold external PID2 integral component ***EPID2-HLD***	

Function code	Name	Data setting range	Default setting
	(U81 to U87 continued)	221 (1221): External PID control 3 ON command ***EPID3-ON*** 222 (1222): Cancel external PID control 3 ***%/EPID3*** 223 (1223): Switch normal/inverse operation under external PID control 3 ***EPID3-IVS*** 224 (1224): Reset external PID3 integral and differential components ***EPID3-RST*** 225 (1225): Hold external PID3 integral component ***EPID3-HLD*** ■ When step outputs are analog 8001: Auxiliary frequency command 1 8002: Auxiliary frequency command 2 8003: PID process command 1 8004: PID process command 2 8005: PID feedback value 1 8012: Acceleration/ deceleration time ratio setting 8013: Upper limit frequency 8014: Lower limit frequency 8030: PID feedback value 2 8031: Auxiliary input 1 to PID process command 8032: Auxiliary input 2 to PID process command 8033: Flowrate sensor 8041: External PID process command 1 8042: External PID feedback value 1 8043: External PID manual command 1 8044: External PID process command 2 8045: External PID feedback value 2 8046: External PID manual command 2 8047: External PID process command 3 8048: External PID feedback value 3 8049: External PID manual command 3	

■ Notes for using a customizable logic

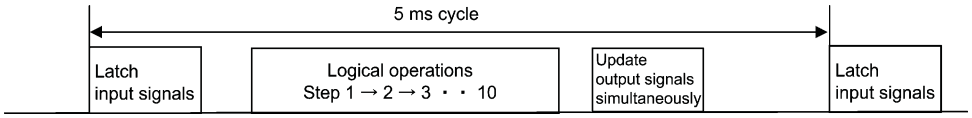
The customizable logic is calculated for every 5 ms and processed in the following procedure.

(1) At the start of processing, latch the external input signals to all customizable logics in steps 1 to 14 to ensure concurrency.

(2) Execute the logic calculations from steps 1 to 14.

(3) If an output of a particular step applies to an input at the next step, the output of the step having processing priority can be used in the same processing.

(4) The customizable logic updates 7 output signals at a time.



When configuring a logic circuit, take into account the processing order of the customizable logic. Otherwise, a delay in processing of logical operation leads to a signal delay problem, resulting in no expected output, slow processing, or a hazard signal issued.

⚠CAUTION

Ensure safety before modifying customizable logic related function code settings (U codes and related function codes) or turning ON the "Cancel customizable logic" terminal command ***CLC***. Depending upon the settings, such modification or cancellation of the customizable logic may change the operation sequence to cause a sudden motor start or an unexpected motor operation.

An accident or injuries could occur.

■ Customizable logic timer monitor (step selection) (U91, X89 to X93)

The monitor function code can be used to monitor the input/output state in the customizable logics and timer operation status.

Selecting a timer to be monitored

Function code	Function	Remarks
U91	0: Disable monitoring (Monitor data is set to 0.) 1 to 14: Specify the step number to be monitored.	Turning the power off zero-clears the setting value.

Monitoring

Monitored by:	Related function code and LCD monitor display	Monitor item
Communications link	X89 customizable logic (Digital input/output)	Digital I/O data of the step specified with U91 (monitor-specific)
	X90 Customizable logic (Timer monitor)	Timer/counter value specified with U91 (monitor-specific)
	X91 customizable logic (Analog input 1)	Analog input 1 data of the step specified with U91 (monitor-specific)
	X92 customizable logic (Analog input 2)	Analog input 2 data of the step specified with U91 (monitor-specific)
	X93 customizable logic (Analog output)	Analog output data of the step specified with U91 (monitor-specific)

■ Cancel customizable logic -- ***CLC*** (E01 to E07, data = 80)

This terminal command disables the customizable logic temporarily. Use it to run the inverter without using the customizable logic circuit or timers for maintenance or other purposes.

CLC	Function
OFF	Enable customizable logic (Depends on the U00 setting)
ON	Disable customizable logic

Note

Before changing the setting of ***CLC***, ensure safety. Turning ***CLC*** ON disables the sequence of the customizable logic, causing a sudden motor start depending upon the settings.

■ Clear all customizable logic timers -- ***CLTC*** (E01 to E07, data = 81)

Assigning ***CLTC*** to any of the general-purpose digital input terminals and turning it ON resets all of the general-purpose timers and counters in the customizable logic. Use this command when the timings between the external sequence and the internal customizable logic do not match due to a momentary power failure or other reasons so that resetting and restarting the system is required.

CLTC	Function
OFF	Ordinary operation
ON	Reset all of the general-purpose timers and counters in the customizable logic. (To operate the timers and counters again, revert ***CLTC*** to OFF.)

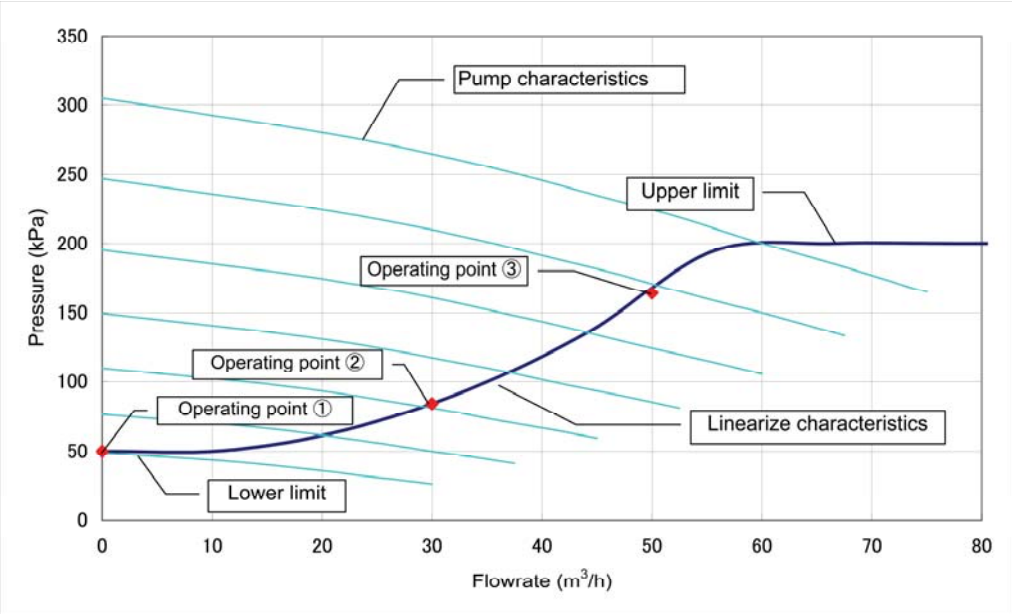
5.1.14 U1 codes (Customizable logic functions)

U101 to U106	Customizable Logic (Conversion point 1 (X1, Y1), Conversion point 2 (X2, Y2), Conversion point 3 (X3, Y3))

U101 to U106 specify the three operating points for automatically calculating coefficients (K_A, K_B and K_C) in conversion 1 ($K_A \times$ Input $1^2 + K_B \times$ Input 1 + K_C). Input signals (e.g., flowrate signal) and coefficients (K_A, K_B and K_C) produce target signals (e.g., target pressure). (Linearize function)

- Data setting range: -999.00 to 0.00 to 9990.00

Linearize characteristics example



U107	Customizable Logic (Automatic calculation of conversion coefficients)

U107 automatically calculates conversion coefficients (K_A, K_B and K_C) according to the three operating points defined by U101 to U106.

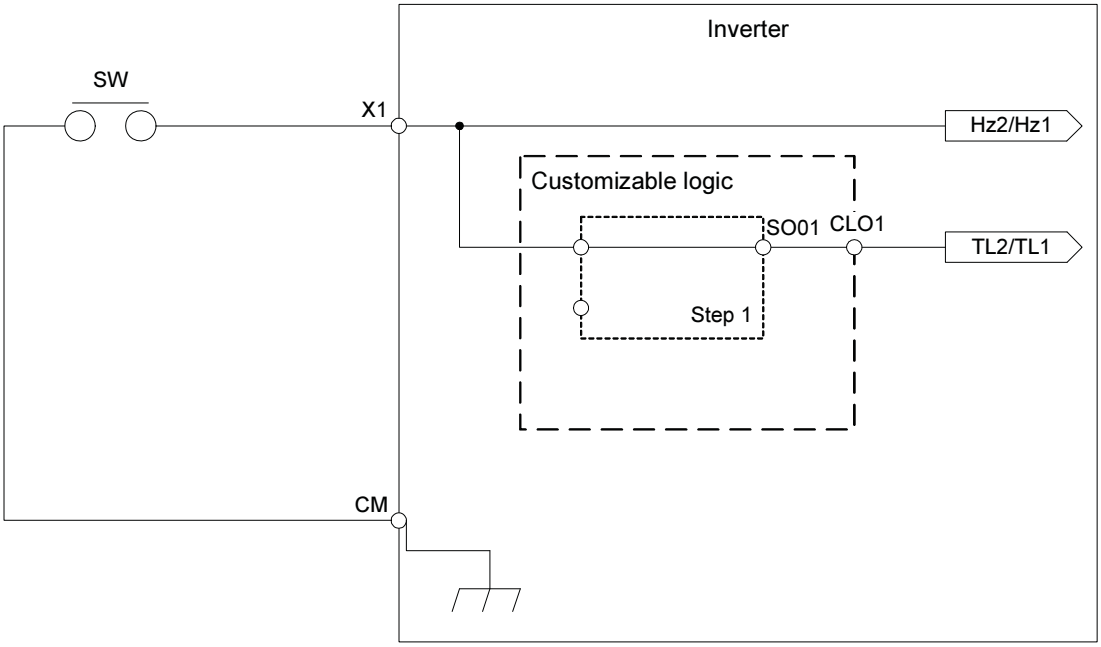
The calculation results will be saved in U92 to U97. U107 automatically reverts to "0."

Data for U107	Function
0	Disable
1	Execute calculation (Arithmetic circuit: Conversion 1 (3001) $K_A \times$ Input $1^2 + K_B \times$ Input 1 + K_C

■ Customizable logic configuration samples

Configuration sample 1: Switch two or more signals using a single switch

When switching between ***Hz2/Hz1*** (Select frequency command 2/1) and ***TL2/TL1*** (Select torque limiter level 2/1) with a single switch, using a customizable logic instead of a conventional external circuit reduces the number of the required general-purpose input terminals to one as shown below.

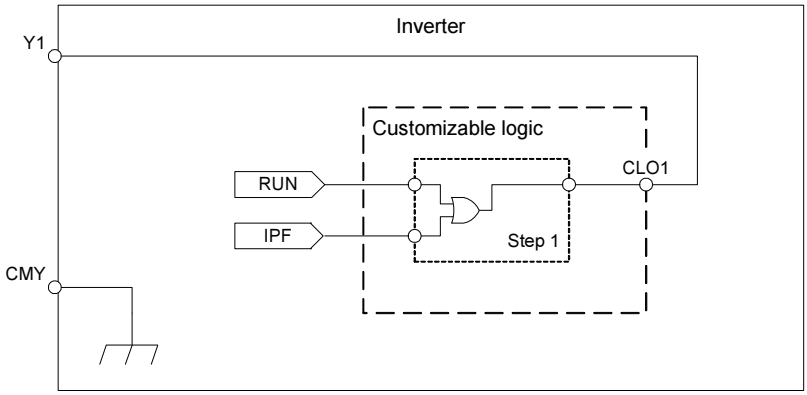


To configure the above customizable logic, set function codes as listed below. The "Type of timer" and "Time setting" require no modification unless otherwise specified.

Function Code			Setting Data	Function	Remarks
E01	Terminal [X1] Function		12	Select frequency command, ***Hz2/Hz1***	Concurrently usable also as a general-purpose input terminal.
U00	Customizable Logic (Mode selection)		1	Enable	
U01	Customizable Logic: Step 1	(Input 1)	4001	Terminal [X1] input signal, ***X1***	
U03		(Logic circuit)	1	Through output + General-purpose timer	Operation selection
U71	Customizable Logic: Output Signal 1	(Output selection)	1	Output of step 1, ***SO01***	
U81		(Function selection)	14	Select torque limiter level 2/1, ***TL2/TL1***	

Configuration sample 2: Put two or more output signals into one

When putting two or more output signals into one, using a customizable logic instead of a conventional external circuit reduces the number of the required general-purpose output terminals and eliminates external relays as shown below.

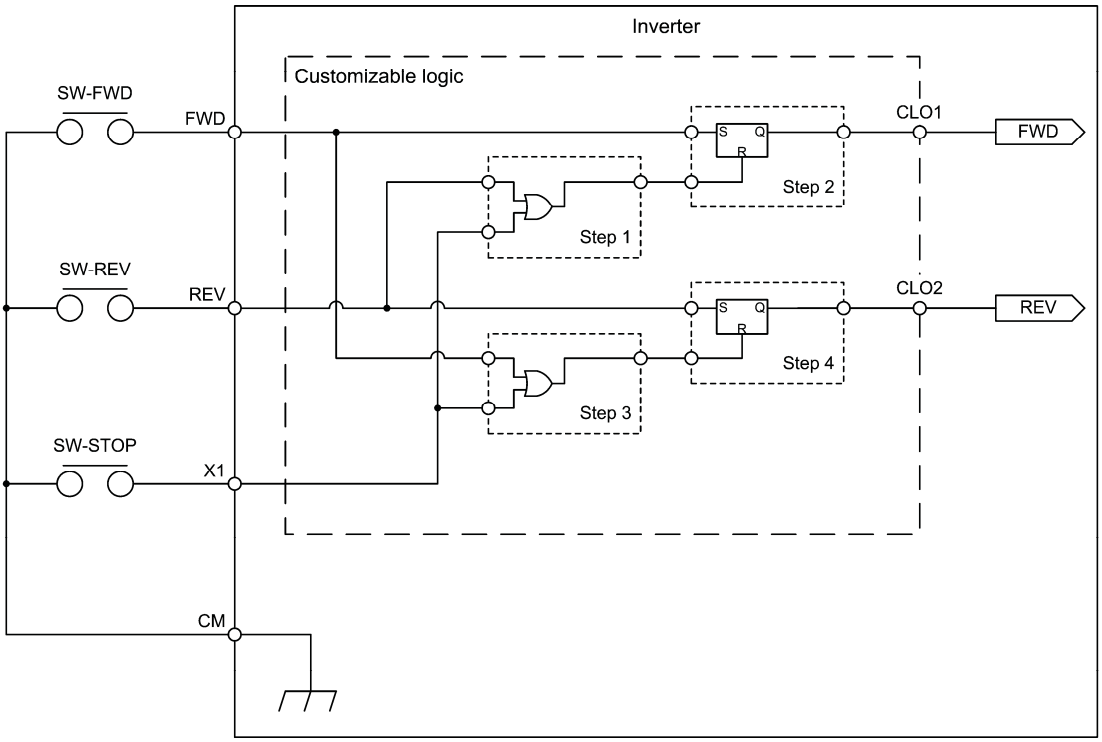


To configure the above customizable logic, set function codes as listed below. The "Type of timer" and "Time setting" require no modification unless otherwise specified.

Function Code			Setting Data	Function	Remarks
E20	Terminal [Y1] Function		111	Customizable logic output signal 1, ***CLO1***	
U00	Customizable Logic (Mode selection)		1	Enable	
U01	Customizable Logic: Step 1	(Input 1)	0	Inverter running, ***RUN***	
U02		(Input 2)	6	Auto-restarting after momentary power failure, ***IPF***	
U03		(Logic circuit)	3	ORing + General-purpose timer	Operation selection
U71	Customizable Logic: Output Signal 1	(Output selection)	1	Output of step 1, ***SO01***	
U81		(Function selection)	100	No function assigned, ***NONE***	

Configuration sample 3: One-shot operation

When starting the inverter by short-circuiting the SW-FWD or SW-REV switch and stopping it by short-circuiting the SW-STOP switch (which are functionally equivalent to depression of the FWD/REV key or STOP key on the keypad, respectively), using a customizable logic instead of a conventional external circuit simplifies the external circuit as shown below.



To configure the above customizable logic, set function codes as listed below. The "Type of timer" and "Time setting" require no modification unless otherwise specified.

Function Code			Setting Data	Function	Remarks
E01	Terminal [X1] Function		100	No function assigned, ***NONE***	
E98	Terminal [FWD] Function		100	No function assigned, ***NONE***	
E99	Terminal [REV] Function		100	No function assigned, ***NONE***	
U00	Customizable Logic (Mode selection)		1	Enable	
U01	Customizable Logic: Step 1	(Input 1)	4011	Terminal [REV] input signal, ***REV***	
U02		(Input 2)	4001	Terminal [X1] input signal, ***X1***	
U03		(Logic circuit)	3	ORing + General-purpose timer	Operation selection
U06	Customizable Logic: Step 2	(Input 1)	4010	Terminal [FWD] input signal, ***FWD***	
U07		(Input 2)	2001	Output of step 1, ***SO01***	
U08		(Logic circuit)	6	Reset priority flip-flop + General-purpose timer	Operation selection

Function Code			Setting Data	Function	Remarks
U11	Customizable Logic: Step 3	(Input 1)	4010	Terminal [FWD] input signal, ***FWD***	
U12		(Input 2)	4001	Terminal [X1] input signal, ***X1***	
U13		(Logic circuit)	3	ORing + General-purpose timer	Operation selection
U16	Customizable Logic: Step 4	(Input 1)	4011	Terminal [REV] input signal, ***REV***	
U17		(Input 2)	2003	Output of step 3, ***SO03***	
U18		(Logic circuit)	6	Reset priority flip-flop + General-purpose timer	Operation selection
U71	Customizable Logic: Output Signal 1	(Output selection)	2	Output of step 2, ***SO02***	***FWD*** command
U72	Customizable Logic: Output Signal 2		4	Output of step 4, ***SO04***	***REV*** command
U81	Customizable Logic: Output Signal 1	(Function selection)	98	Run forward, ***FWD***	
U82	Customizable Logic: Output Signal 2		99	Run reverse, ***REV***	

5.1.15 y codes (Link functions)

y01 to y20	RS-485 Communication 1 and 2

Up to two RS-485 communications ports are available as listed below.

Port	Route	Function code	Applicable equipment
Port 1	RS-485 communications link (via the RJ-45 connector prepared for keypad connection)	y01 through y10	Standard keypad IMO Loader Host equipment
Port 2	RS-485 communications link (via terminals DX+, DX- and SD on the control PCB)	y11 through y20	Inverter support loader (IMO loader)

To connect any of the applicable devices, follow the procedures shown below.

(1) Standard keypad

The standard keypad allows you to run and monitor the inverter.
It can be used independent of the y code setting.

(2) FRENIC Loader

Connecting your computer running IMO Loader to the inverter via the RS-485 communications link (port 1 and 2), you can monitor the inverter's running status information, edit function codes, and test-run the inverters.

For the setting of y codes, refer to the descriptions of y01 to y20.

Note

Jaguar VXH series of inverters has a USB port.

To use the IMO Loader via the USB port, simply set the station address (y01 or y20) to "1" (factory default).

(3) Host equipment

The inverter can be managed and monitored by connecting host equipment such as a PC and PLC to the inverter. Modbus RTU, Metasys N2, BACnet and IMO general-purpose inverter protocol are available for communications protocols.

For details, refer to the RS-485 Communication User's Manual.

■ Station address (y01 for port 1 and y11 for port 2)

y01 or y11 specifies the station address for the RS-485 communications link. The table below lists the protocols and the station address setting ranges.

Protocol	Station address	Broadcast address
Modbus RTU protocol	1 to 247	0
SX protocol (IMO Loader command protocol)	1 to 255	-
IMO Loader protocol	1 to 255	None
IMO general-purpose inverter protocol	1 to 31	99
Metasys N2	0 to 255	-
BACnet	0 to 127	255

- If any wrong address beyond the above range is specified, no response is returned since the inverter will be unable to receive any enquiries except the broadcast message.
- To use IMO Loader via the RS-485 communications link (port 1 and 2), set the station address that matches the connected computer.

■ Communications error processing (y02 for port 1 and y12 for port 2)

y02 or y12 specifies the error processing to be performed if an RS-485 communications error occurs.

RS-485 communications errors include logical errors (e.g., address error, parity error, framing error), transmission protocol error, and physical errors (e.g., no-response error specified by y08 and y18). The inverter can recognize such an error only when it is configured with a run or frequency command sourced through the RS-485 communications link and it is running.

Data for y02, y12	Function
0	Immediately trip, displaying an RS-485 communications error (Er8 for y02 and ErP for y12). (The inverter stops with alarm issue.)
1	Run during the period specified by the error processing timer (y03, y13), display an RS-485 communications error (Er8 for y02 and ErP for y12), and then stop operation. (The inverter stops with alarm issue.)
2	Retry communication during the period specified by the error processing timer (y03, y13). If a communications link is recovered, continue operation. Otherwise, display an RS-485 communications error (Er8 for y02 and ErP for y12) and stop operation. (The inverter stops with alarm issue.)
3	Continue to run even when a communications error occurs.

For details, refer to the RS-485 Communication User's Manual.

■ Timer (y03 for port 1 and y13 for port 2)

y03 or y13 specifies an error processing timer.

If the specified timer count has elapsed due to no response from the other end when a query has been issued, the inverter interprets it as an error occurrence. See the "No-response error detection time (y08, y18)" given on the next page.

- Data setting range: 0.0 to 60.0 (s)

■ Baud rate (y04 for port 1 and y14 for port 2)

y04 or y14 specifies the transmission speed for RS-485 communication.

For IMO Loader (via the RS-485 communications link), specify the transmission speed that matches the connected computer.

Data for y04 and y14	Transmission speed (bps)
0	2400
1	4800
2	9600
3	19200
4	38400

■ Data length (y05 for port 1 and y15 for port 2)

y05 or y15 specifies the character length for RS-485 communication.

For IMO Loader (via the RS-485 communications link), no setting is required since Loader automatically sets 8 bits. (The same applies to the Modbus RTU protocol.)

Data for y05 and y15	Data length
0	8 bits
1	7 bits

■ Parity check (y06 for port 1 and y16 for port 2)

y06 or y16 specifies the property of the parity bit.

For IMO Loader, no setting is required since Loader automatically sets the even parity.

Data for y06 and y16	Parity
0	None (2 stop bits for Modbus RTU)
1	Even parity (1 stop bit for Modbus RTU)
2	Odd parity (1 stop bit for Modbus RTU)
3	None (1 stop bit for Modbus RTU)

■ Stop bits (y07 for port 1 and y17 for port 2)

y07 or y17 specifies the number of stop bits.

For IMO Loader, no setting is required since Loader automatically sets 1 bit.

For the Modbus RTU protocol, no setting is required since the stop bits are automatically determined associated with the property of parity bits.

Data for y07 and y17	Stop bit(s)
0	2 bits
1	1 bit

■ No-response error detection time (y08 for port 1 and y18 for port 2)

y08 or y18 specifies the timeout period for receiving a response from the host equipment (such as a computer or PLC) in RS-485 communication, in order to detect network breaks. This applies to the machinery that accesses the host equipment at the predetermined intervals.

If a response timeout occurs, the inverter starts communications error processing.

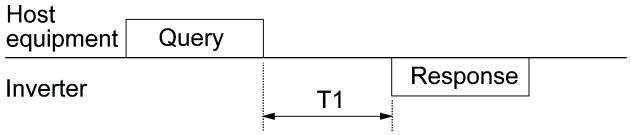
For communications error processing, refer to y02 and y12.

Data for y08 and y18	No-response error detection
OFF	No detection
1 to 60	1 to 60 s

■ Response interval (y09 for port 1 and y19 for port 2)

y09 or y19 specifies the latency time after the end of receiving a query sent from the host equipment (such as a computer or PLC) until the start of sending the response. This enables the inverter to control the response timing to match the host equipment that is slow in processing.

- Data setting range: 0.00 to 1.00 (s)



T1 = Response interval + α

where α is the processing time inside the inverter. α may vary depending on the processing status and the command processed in the inverter.

For details, refer to the RS-485 Communication User's Manual.

Note

When configuring the inverter with IMO Loader via the RS-485 communications link, pay sufficient attention to the performance and configuration of the PC and protocol converter such as USB–RS-485 converter. Some protocol converters monitor the communications status and switch between sending and receiving of transmission data with a timer.

■ Protocol selection (y10, y20)

y10 specifies the communications protocol for port 1.

For IMO Loader (via the RS-485 communications link), only y10 can be used for protocol selection. Set the y10 data at "1."

Data for y10, y20	Protocol
0	Modbus RTU protocol
1	SX protocol (loader protocol)
2	IMO general-purpose inverter protocol
3	Metasys N2 protocol
5	BACnet protocol
50	Communications link pump control protocol (y20-specific)

y95 Data Clear Processing for Communications Error

Data for y95	Function
0	Do not clear the data of function codes Sxx when a communications error occurs. (compatible with the conventional inverters)
1	Clear the data of function codes S01/S05/S19 when a communications error occurs.
2	Clear the run command assigned bit of function code S06 when a communications error occurs.
3	Clear both data of S01/S05/S19 and run command assigned bit of S06 when a communications error occurs.

* Related alarms: Er8, ErP, Er4, Er5

y98	Bus Link Function (Mode selection) (Refer to H30.)

Refer to the description of H30.

y99	Loader Link Function (Mode selection)

This is a link switching function for IMO Loader. Rewriting the data of y99 to enable RS-485 communications from Loader helps Loader send the inverter the frequency and/or run commands. Since the data to be set in the function code of the inverter is automatically set by Loader, no keypad operation is required.

With Loader being selected as a run command source, if the computer runs out of control and cannot be stopped by a stop command sent from Loader, disconnect the RS-485 communications cable from the port 1 or the USB cable, connect a keypad instead, and reset the y99 data to "0." The setting of "0" in y99 means that the run and frequency command source specified by H30 takes place instead of IMO Loader.

Note that the inverter cannot save the setting of y99. When the power is turned off, the data in y99 is lost (y99 is reset to "0").

Data for y99	Function	
	Frequency command	Run command
0	Follow H30 and y98 data	Follow H30 and y98 data
1	Via RS-485 link (IMO Loader)	Follow H30 and y98 data
2	Follow H30 and y98 data	Via RS-485 link (IMO Loader)
3	Via RS-485 link (IMO Loader)	Via RS-485 link (IMO Loader)

5.1.16 T codes (Timer functions)

T codes configure timer operation.

The timer operation can be configured easily in Programming mode as follows.
PRG > 2(Function Code) > 5(Timer Setup) > 1 to 6(Sub menu #)
For detailed setting procedure, refer to Chapter 5, Section 5.6.3.5 "Configuring Timer Operation."

T01	Timer 1 Operation (Operating mode)	T06: Timer 2 Operation (Operating mode) T11: Timer 3 Operation (Operating mode) T16: Timer 4 Operation (Operating mode)

The inverter supports timer operation to run/stop the motor and output digital signals according to the preset schedule when the real-time clock is enabled, making use of the date & time information.

It is possible to:
- set the day of the week and start/end times for a maximum of four timers,
- set a maximum of 20 pause dates per year,
- select whether to run the inverter or output external signals for each timer, and
- enable/disable timer operation or cancel timer operation by digital input signals *TM1* to *TM4* or *TMC*, respectively.

Note: To use digital input signals *TM1* to *TM4* and *TMC*, it is necessary to assign them to digital input terminals with E01 to E07 (data = 190 to 194) beforehand.

- Data setting range: 0 to 3

Data for T01	Function
0	Disable
1	Enable (Inverter run) At the set time, the inverter runs. (Input of a run command and frequency command is separately required.)
2	Enable (Digital output signals) At the set time, the related one of digital output signals ***TMD***, ***TMD1*** to ***TMD4*** comes ON. (No input of a run command or frequency command is required.)
3	Enable (Inverter run + Digital output signals) At the set time, the inverter runs and the related one of digital output signals ***TMD***, ***TMD1*** to ***TMD4*** comes ON. (Input of a run command and frequency command is separately required.)

Note: To use digital output signals *TMD*, *TMD1* to *TMD4*, it is necessary to assign them to digital output terminals with E20 to E24 and E27 beforehand.
- "In timer operation" signal: *TMD* (E20 to E24 and E27, data = 190)
- "Timer 1 enabled" signal: *TMD1* (E20 to E24 and E27, data = 191)
- "Timer 2 enabled" signal: *TMD2* (E20 to E24 and E27, data = 192)
- "Timer 3 enabled" signal: *TMD3* (E20 to E24 and E27, data = 193)
- "Timer 4 enabled" signal: *TMD4* (E20 to E24 and E27, data = 194)

For details of the setting procedure, refer to Chapter 5, Section 5.6.3.5 "Configuring the timer operation."

T02 **T03** **T04**	**Timer 1 Operation (Start time)** **(End time)** **(Start day of the week)** **T07: Timer 2 (Start time)** **T08: Timer 2 (End time)** **T09: Timer 2 (Start day of the week)** **T12: Timer 3 (Start time)** **T13: Timer 3 (End time)** **T14: Timer 3 (Start day of the week)** **T17: Timer 4 (Start time)** **T18: Timer 4 (End time)** **T19: Timer 4 (Start day of the week)**

These function codes specify the start time, end time, and start day of the week for timer operation; T02 to T4 for Timer 1, T07 to T09 for Timer 2, T12 to T14 for Timer 3, and T17 to T19 for Timer 4.

■ Timer Operation (Start time/End time) (T02/T03, T07/T08, T12/T13, T17/T18)

These function codes specify the start time and end time of timer operation. (Possible to specify in the special menu)

The magnitude relation between the start and end times and the timer operation are as follows.

Magnitude relation	Timer operation
Start time < End time (Ex. Start time: 8:00, End time: 18:00)	Timer operation starts at the start time of the effective day of the week and continues to the end time of that day.
Start time ≥ End time (Ex. Start time: 16:00, End time: 3:00)	Timer operation starts at the start time of the effective day of the week and continues to the end time of the next day (even if the next day is not an effective day of the week).

■ Timer Operation (Start day of the week) (T04, T09, T14, T19)

These function codes specify the start day of the week for timer operation. More than one day of the week can be specified. (Possible only on the dedicated menu)

6 bit	5 bit	4 bit	3 bit	2 bit	1 bit	0 bit
Sunday	Saturday	Friday	Thursday	Wednesday	Tuesday	Monday

For details of the setting procedure, refer to Chapter 5, Section 5.6.3.5 "Configuring the timer operation."

T06	Timer 2 Operation (Operating mode)	(Refer to T01.)

For details of the setting procedure, refer to the description of T01.

T07	Timer 2 Operation (Start time)	(Refer to T02.)
T08	(End time)	(Refer to T03.)
T09	(Start day of the week)	(Refer to T04.)

For details of the setting procedure, refer to the descriptions of T02 to T04.

T11	Timer 3 Operation (Operating mode)	(Refer to T01.)

For details of the setting procedure, refer to the description of T01.

T12	Timer 3 Operation (Start time)	(Refer to T02.)
T13	(End time)	(Refer to T03.)
T14	(Start day of the week)	(Refer to T04.)

For details of the setting procedure, refer to the descriptions of T02 to T04.

T16	Timer 4 Operation (Operating mode)	(Refer to T01.)

For details of the setting procedure, refer to the description of T01.

T17	Timer 4 Operation (Start time)	(Refer to T02.)
T18	(End time)	(Refer to T03.)
T19	(Start day of the week)	(Refer to T04.)

For details of the setting procedure, refer to the descriptions of T02 to T04.

T51 to T70 Timer Operation (Pause date 1) to (Pause date 20)

These function codes specify a maximum of 20 pause dates per year for preventing the inverter exceptionally from running, e.g., on holidays even if timer operation is enabled. On pause dates specified, no timer operation is performed even during timer operation period.

It is also possible to enable or disable each pause date setting.

The following two choices of pause date settings are available.
- Setting the month and day (e.g., January 1)
- Setting the day of the week (e.g., January, 2nd Sunday)

Function code	Item to be set		Function (Setting range)
T51 to T70	Pause day (Month and day)		0 to 65535
	bit 15	Mode selection	0: Disable pause date setting 1: Enable pause dates setting
	bit 14	--	-
	bit 13	Configuration format	0: Date, 1: Day of the week
	bit 12	Month	• January to December
	bit 11		
	bit 10		
	bit 9		
	bit 8	Day or week *1	• 1st to 31st (when bit 13 = 0 (Date)) • 1st to 4th week, final week (when bit 13 = 1 (Day of the week))
	bit 7		
	bit 6		
	bit 5		
	bit 4		
	bit 3	Day of the week	• Monday to Sunday (when bit 13 = 1 (Day of the week))
	bit 2		
	bit 1		
	bit 0		

*1 The content differs depending upon the setting on bit 3.

For details, refer to Chapter 5, Section 5.6.3.5 "Configuring timer operation."

5.1.17 K codes (Keypad functions)

K01	LCD Monitor (Language selection)

K01 selects the language to be display on the LCD.

- Data setting range: 0 to 19, 100

Data for K01	Language	Data for K01	Language	Data for K01	Language
0	Japanese	-	-	14	Portuguese
1	English	8	Russian	15	Dutch
2	German	9	Greek	16	Malay
3	French	10	Turkish	17	Vietnamese
4	Spanish	11	Polish	18	Thai
5	Italian	12	Czech	19	Indonesian
6	Chinese	13	Swedish	100	User-customized language

Language selection can be made easily in Programming mode as follows.
PRG > 1(Start-up) > 1(Language)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.1 "Setting the display language."

K02	Backlight OFF Time

K02 specifies the backlight OFF time of the LCD on the keypad.

When no keypad operation is performed during the time specified by K02, the backlight goes OFF.

- Data setting range: 1 to 30 (min.), OFF

Data for K02	Function
OFF	Always turn the backlight OFF
1 to 30 (min.)	Turn the backlight OFF automatically after no keypad operation is performed during the backlight OFF time.

The backlight OFF time can be configured easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 1 to 18(Sub menu number)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K03 K04	LCD monitor (Backlight brightness control) (Contrast control)

These function codes control the backlight brightness and contrast.

- Data setting range: 0 to 10

■ Backlight brightness control (K03)

Data for K03	0, 1, 2, • 8, 9, 10
0	Dark ←——————————→ Light

■ Contrast control (K04)

Data for K04	0, 1, 2, • 8, 9, 10
0	Light ←——————————→ Dark

The backlight brightness and contrast can be controlled easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 15(Brightness)
PRG > 1(Start-up) > 4(Disp Setting) > 16(Contrast)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

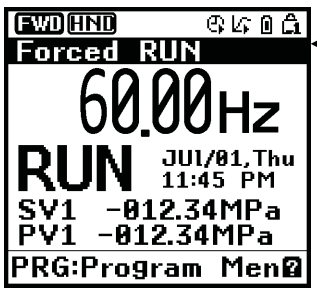
K08	LCD Monitor Status Display/Hide Selection

K08 selects whether to display or hide the status messages to be monitored on the LCD monitor on the keypad.

- Data setting range: 0, 1

Data for K08	Function
0	Hide status messages
1	Display status messages (factory default)

<LCD on the keypad>



Status messages
Capacitor lifetime being measured
Undervoltage
No input to EN
No input to RE
Input to BX
Fire mode stopped
In restart mode after momentary power failure
During retry
Rotation direction limited
Running in fire mode
Being driven by commercial power
Dew condensation prevention in operation
Under output limiting
Under overload prevention control
Anti-jam function being activated
Filter clogging prevention
Boost function
In recovery operation from PV level error
Under wet-bulb temperature presumption control
Motor stopped due to slow flowrate
Load factor being measured

K10	Main Monitor (Display item selection) K16: Sub monitor 1 (Display item selection) K17: Sub monitor 2 (Display item selection)

K10, K16 and K17 specify the running status item to be monitored and displayed on the main monitor, sub monitor 1 and sub monitor 2, respectively.

Data setting range: Main monitor (K10) 1 to 83
Sub monitor 1 (K16) 1 to 83 ("Speed monitor" not selectable)
Sub monitor 2 (K17) 1 to 83 ("Speed monitor" not selectable)

LCD screen on the keypad

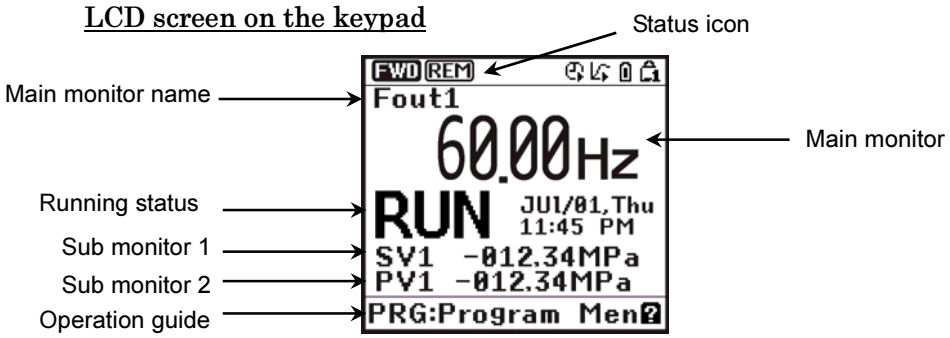


Table 6.7 Monitor Items (Selectable anytime)

Monitor item	Monitor name	LCD indication	Unit	Meaning of displayed value	Function code data for K10
Speed monitor	Function code K11 specifies what to be displayed on the main monitor.				0
Output frequency 1 (before slip compensation)	Output frequency (Synchronous)	Output f1	Hz	Output frequency (Hz)	(K11 = 1)
Output frequency 2 (after slip compensation)	Output frequency (Primary)	Output f2	Hz	Output frequency (Hz)	(K11 = 2)
Reference frequency	Reference frequency	Setting f	Hz	Reference frequency (Hz)	(K11 = 3)
Motor speed	Motor speed	Motor	r/min	Output frequency (Hz) x $\frac{120}{P01}$	(K11 = 4)
Load shaft speed	Load shaft speed	Machine	r/min	Output frequency (Hz) x K30	(K11 = 5)
Display speed (%)	Display speed (%)	Speed %	%	$\frac{\text{Output frequency}}{\text{Maximum frequency}}$ x 100	(K11 = 8)
Output current	Output current	Output I	A	Current output from the inverter in RMS	13
Output voltage	Output voltage	Output V	V	Voltage output from the inverter in RMS	14
Calculated torque	Calculated torque	Torque	%	Motor output torque in % (Calculated value)	18
Input power	Input power	Consumption W	kW	Input power to the inverter	19

Monitor item	Monitor name	LCD indication	Unit	Meaning of displayed value	Function code data for K10
Load factor	Load factor	Load factor	%	Load factor of the motor in % as the rated output being at 100%	25
Motor output	Motor output	M output	kW	Motor output in kW	26
Analog input (Note 1)	Analog input	AMon	-	An analog input to the inverter in a format suitable for a desired scale. Refer to function codes below. Terminal [12]: C59, C60 Terminal [C1]: C65, C66 Terminal [V2]: C71, C72	27
Input watt-hour	Input watt-hour	Cumula-tive W	-	$\frac{\text{Input watt-hour (kWh)}}{100}$ Refer to function code K31 for details.	35

The following monitor items appear only when the related PID control or external PID control is enabled. Items for the PID control and external PID control being disabled cannot be displayed.

Table 6.8 Monitor Items (Selectable when PID control or external PID control is enabled)

Monitor item	Monitor name	LED indicator	Unit	Meaning of displayed value	Function code data for K10
PID command (Note 2)	PID final SV	SV	J105 J205	PID command and its feedback converted into physical quantities of the object to be controlled. The display unit can be selected with Function code J105 and J205.	50
PID feedback amount (Note 2)	PID final PV	PV	--		51
PID output (Note 2)	PID MV	MV	%	PID output in %, assuming the maximum frequency (F01) as 100%	52
PID control 1 command (Note 3)	PID1 SV	SV1	--	PID control 1 command and its feedback converted into physical quantities of the object to be controlled. The display unit can be selected with Function code J105.	53
PID control 1 feedback amount (Note 3)	PID1 PV	PV1	--		54
PID control 2 command (Note 3)	PID2 SV	SV2	--	PID control 2 command and its feedback converted into physical quantities of the object to be controlled. The display unit can be selected with Function code J205.	55
PID control 2 feedback amount (Note 3)	PID2 PV	PV2	--		56
External PID control 1 command value (Note 4)	External PID1, final SV	E. SV1F			60
External PID control 1 feedback amount (Note 4)	External PID1, final PV	E. PV1F			61

Monitor item	Monitor name	LED indicator	Unit	Meaning of displayed value	Function code data for K10
External PID control 1 output (Note 4)	External PID1, MV	E. MV1	--	PID output in %, assuming the maximum frequency (F01) as 100% The display unit can be selected with Function code J505.	62
External PID control 1 manual command (Note 5)	External PID1, manual	E. MU1	%		63
External PID control 1 command (Note 6)	External PID1 SV	E. SV1	%		64
External PID control 1 feedback amount (Note 6)	External PID1 PV	E. PV1	--	The display unit can be selected with Function code J505.	65
External PID control 2 command (Note 7)	External PID2 SV	E. SV2	%		70
External PID control 2 feedback amount (Note 7)	External PID2 PV	E. PV2	--	The display unit can be selected with Function code J605.	71
External PID control 2 output (Note 7)	External PID2 MV	E. MV2	--	The display unit can be selected with Function code J605.	72
External PID control 2 manual command (Note 8)	External PID2, manual	E. MU2	%		73
External PID control 3 command (Note 9)	External PID3 SV	E. SV3	%		80
External PID control 3 feedback amount (Note 9)	External PID3 PV	E. PV3	--	The display unit can be selected with Function code J655.	81
External PID control 3 output (Note 9)	External PID1 MV	E. MV3	--	The display unit can be selected with Function code J655.	82
External PID control 3 manual command (Note 10)	External PID3, manual	E. MU3	%		83

(Note 1) The analog input monitor appears only when it is assigned to terminal [12], [C1] or [V2] with any of E61 to E63 (data = 20).

(Note 2) These items appear when J101 (PID control 1) or J201 (PID control 2) ≠ 0. The $\sqrt{1}$ or $\sqrt{2}$ appears on the status icon field, indicating that the internal PID is selected.

(Note 3) These items appear when:
- J101 (PID control 1) or J201 (PID control 2) ≠ 0
- J101 (PID control 1) or J104 (PID control 1) ≠ 0

(Note 4) These items appear when J501 (External PID control 1) ≠ 0.

(Note 5) These items appear when J501 (External PID control 1) ≠ 0 and ***%/EPID1*** ("Cancel external PID control 1") is assigned to any digital input terminal.

(Note 6) These items appear when J501 or J504 (External PID control 1) ≠ 0.

(Note 7) These items appear when J601 (External PID control 2) ≠ 0.

(Note 8) This item appears when J601 (External PID control 1) ≠ 0 and ***%/EPID2*** ("Cancel external PID control 2") is assigned to any digital input terminal.

(Note 9) These items appear when J651 (External PID control 3) ≠ 0.

(Note 10) This item appears when J651 (External PID control 3) ≠ 0 and ***%/EPID3*** ("Cancel external PID control 3") is assigned to any digital input terminal.

The monitor items can be selected easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 2(Main Monitor)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K11 Main Monitor (Speed monitor item) (Refer to K10.)

For details about the speed monitor items, refer to the description of K10.

The monitor items can be selected easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 3(Speed Monitor)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K12 Main Monitor (Display when stopped)

K12 specifies whether the specified value (data = 0) or the output value (data = 1) to be displayed on the main monitor when the inverter is stopped. The monitored item depends on the K11 (Main monitor, Speed monitor item) setting as shown below.

Data for K11	Monitored item	What to be displayed when the inverter stopped	
		K12 = 0: Specified value	K12 = 1: Output value
1	Output frequency 1 (before slip compensation)	Reference frequency	Output frequency 1 (before slip compensation)
2	Output frequency 2 (after slip compensation)	Reference frequency	Output frequency 2 (after slip compensation)
3	Reference frequency	Reference frequency	Reference frequency
4	Motor speed	Reference motor speed	Motor speed
5	Load shaft speed	Reference load shaft speed	Load shaft speed
8	Display speed (%)	Reference display speed	Display speed

The monitor items can be selected easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 3(Speed Monitor)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

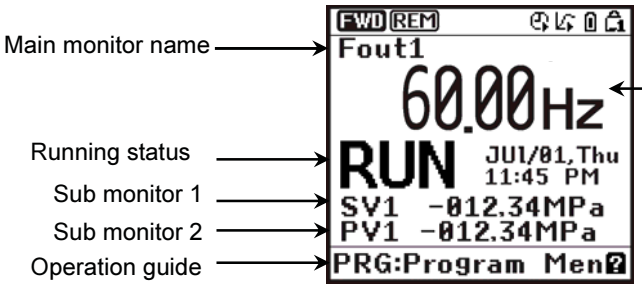
K15	Sub Monitor (Display type)

K15 selects the display type of the LCD sub monitor on the keypad--Numeric values (= 0) or Bar charts (= 1).

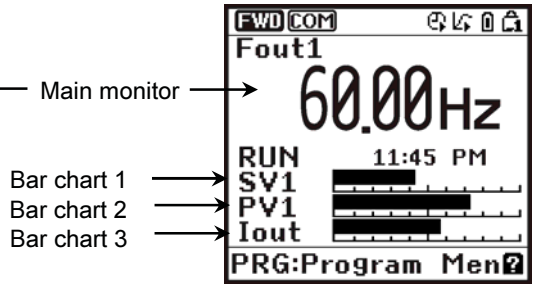
- Data setting range: 0, 1

Data for K15	Function
0	Numeric values (factory default)
1	Bar charts

<u>Sub monitor: Numeric values (K15 = 0)</u>



<u>Sub monitor: Bar charts (K15 = 1)</u>



The display type can be selected easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 1(Disp Mode)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K16 K17	Sub Monitor 1 (Display item selection) (Refer to K10.) Sub Monitor 2 (Display item selection) (Refer to K10.)

For details about sub monitor, refer to the description of Function code K10.

The monitor items of sub monitors 1 and 2 can be selected easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 5(Sub Monitor 1)
PRG > 1(Start-up) > 4(Disp Setting) > 6(Sub Monitor 2)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K20 K21 K22	**Bar Chart 1 (Display item selection)** **Bar Chart 2 (Display item selection)** **Bar Chart 3 (Display item selection)**

These function codes specify the items to be displayed in bar graphs 1 to 3 on the LCD monitor.

- Data setting range: 1 to 26

Data for K20 to K22	Monitor item	Monitor name	LCD indicator	Unit	Meaning of displayed value
1	Output frequency 1 (before slip compensation)	Output frequency (synchronous)	Output f1	Hz	Reference frequency (Hz)
13	Output current	Output current	Output I	A	Current output from the inverter in RMS
14	Output voltage	Output voltage	Output V	V	Voltage output from the inverter in RMS
18	Calculated torque	Calculated torque	Torque	%	Motor output torque in % (Calculated value)
19	Input power	Input power	Consump-tion W	kW	Input power to the inverter
25	Load factor	Load factor	Load factor	%	Load factor of the motor in % as the rated output being at 100%
26	Motor output	Motor output	M output	kW	Motor output in kW

The monitor items for bar charts 1 to 3 can be selected easily in Programming mode as follows.

PRG > 1(Start-up) > 4(Disp Setting) > 7(Bar Gage 1)

PRG > 1(Start-up) > 4(Disp Setting) > 8(Bar Gage 2)

PRG > 1(Start-up) > 4(Disp Setting) > 9(Bar Gage 3)

For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K29 Display Filter

K29 specifies a filter time constant to be applied for displaying the output frequency, output current and other running status on the LCD monitor of the keypad. If the display varies unstably so as to be hard to read due to load fluctuation or other causes, increase this filter time constant.

- Data setting range: 0.0 to 5.0 (s)

The display filter can be defined easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 10(Disp Filter)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K30 Coefficient for Speed Indication

K30 specifies the coefficient that is used when the load shaft speed is displayed on the LCD monitor (see K10).

Load shaft speed (r/min) = (K30 Coefficient for speed indication) x (Frequency in Hz)

- Data setting range: 0.01 to 200.00

The coefficient can be specified easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 11(Speed Coef)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K31 Display Unit for Input Watt-hour Data

K31 specifies the display unit for input watt-hour (K10 = 35) calculated by the inverter.

The data can be checked by accessing PRG > 3(INV Info) > 4(Maintenance) in Programming mode.

- Data setting range: 0, 1

Data for K31	Unit
0	kWh
1	MWh

The display unit can be specified easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 12(WattHour Unit)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K32 Display Coefficient for Input Watt-hour Data

K32 specifies a display coefficient for displaying the input watt-hour data.

The data can be checked by accessing PRG > 3(INV Info) > 4(Maintenance) in Programming mode.

Input watt-hour data = Display coefficient (K32 data) x Input watt-hour (kWh)

- Data setting range: OFF (Cancel or reset), 0.001 to 9999.00

Note: Setting K32 data to OFF clears the input watt-hour and its data to "0." After clearing, be sure to restore the K32 data to the previous value; otherwise, input watt-hour data will not be accumulated.

The display coefficient can be specified easily in Programming mode as follows.
PRG > 1(Start-up) > 4(Disp Setting) > 13(WattHour Coef)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

K33 Long-term, Input Watt-hour Data Monitor

K33 selects the cumulative period for input watt-hour data calculated by the inverter from Hourly, Daily, Weekly and Monthly.

The inverter can save up to 48 sets of the cumulative data. If Monthly is selected, for example, it is possible to check a maximum of 48-month (4-year) input watt-hour data.

The data can be checked by accessing PRG > 3(INV Info) > 4(Maintenance) in Programming mode.

- Data setting range: OFF, 0 to 4

Data for K32	Cumulative period
OFF	Cancel and reset
1	Hourly
2	Daily
3	Weekly
4	Monthly

K81 Date Format

K81 selects the date format to be displayed on the LCD monitor.

- Data setting range: 0 to 3

Data for K81	Date format
0	Y/M/D (year/month/day)
1	D/M/Y (day/month/year)
2	M/D/Y (month/day/year)
3	MD, Y (Month day, year)

The date format can be specified easily in Programming mode as follows.
PRG > 1(Start-up) > 3(Date/Time) > 3(Disp Format)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.3 "Setting the date/time."

K82 Time Format

K82 selects the time format to be displayed on the LCD monitor.

- Data setting range: 0 to 2

Data for K82	Time Format
0	24-hour format (Time : Minute : Second)
1	12-hour format (Time : Minute : Second AM/PM)
2	12-hour format (AM/PM Time : Minute : Second)

The time format can be specified easily in Programming mode as follows.
PRG > 1(Start-up) > 3(Date/Time) > 3(Disp Format)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.3 "Setting the date/time."

K83 Daylight Saving Time (Summer time)

K83 selects the correction time for daylight saving time (DST) to be displayed on the LCD monitor.

- Data setting range: 0 to 2

Data for K83	Correction time for daylight saving time
0	Disable
1	Enable (+ 1 hour)
2	Enable (+ 30 minutes)

The correction time can be specified easily in Programming mode as follows.
PRG > 1(Start-up) > 3(Date/Time) > 2(DST Setting)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.3 "Setting the date/time."

K84 K85	**Daylight Saving Time (Start date)** **Daylight Saving Time (End date)**

K84 and K85 specify the start and end dates of daylight saving time (DST).

- Data setting range: 0000 to FFFF

Data for K84, K85	Start/end date
bit 0-1	Minute (in increments of 15 minutes, 0 to 45 minutes)
bit 2-4	Hour (in increments of 1 hour, 0 to 7 hours)
bit 5-7	Day/Day of the week
bit 8-10	Day/Week; Final week
bit 11-14	Month
bit 15	0: Month and day, 1: Day of the week

The start and end dates can be specified easily in Programming mode as follows.
PRG > 1(Start-up) > 3(Date/Time) > 2(DST Setting)
For detailed setting procedure, refer to Chapter 5, Section 5.6.2.3 "Setting the date/time."

K91 K92	**Shortcut Key Function for ⟨ in Running Mode** **Shortcut Key Function for ⟩ in Running Mode**

These function codes define "jump-to" menus on the ⟨ and ⟩ keys as a shortcut key. Pressing the shortcut keys ⟨ or ⟩ in Running mode jumps the screen to the previously defined menu.

Assigning frequently-used menus to the shortcut keys allows a single touch of the shortcut key to open the target menu screen.

- Data setting range: 0 (Disable), 11 to 99

Example: Data 1 1

Sub menu #

Menu #

Data for K91, K92	Jump to:		Data for K91, K92	Jump to:	
	Menu	Sub menu		Menu	Sub menu
0	-- (Disable)	--	41	Alarm Info	Alarm History
11	Start-up	Language	42		Warn. History
12		App Select	43		Retry History
13		Date/Time	51	User Config	Select Q. Setup
14		Disp Setting	52		Password
21	Function Codes	Data Set	61	Tools	PID Monitor
22		Data Check	62		Multi-Op Mon
23		Changed Data	63		CLogic Monitor
24		Data Copy	64		Resonant Avd.
25		Timer Setup	65		Load Factor
26		Initialize	66		COM Debug
31	INV Info	Energy Monitor			
32		Op Monitor			
33		I/O Check			
34		Maintenance			
35		Unit Info			

The shortcut functions for ⟨ and ⟩ can be defined easily in Programming mode as follows.

PRG >1(Start-up) > 4(Disp Setting) > 17(Shortcut "<")

PRG >1(Start-up) > 4(Disp Setting) > 18(Shortcut ">")

For detailed setting procedure, refer to Chapter 5, Section 5.6.2.4 "Specifying the running status item to be monitored."

Chapter 6 TROUBLESHOOTING

Alarm Codes

Table 6.1 Quick List of Alarm Codes

Code	Name	Description
OC1 OC2 OC3	Instantaneous overcurrent	The inverter momentary output current exceeded the overcurrent level. OC1: Overcurrent during acceleration OC2: Overcurrent during deceleration OC3: Overcurrent during running at a constant speed
EF	Ground fault	A ground-fault current flowed from the inverter's output terminals.
OV1 OV2 OV3	Overvoltage	The DC link bus voltage exceeded the overvoltage detection level. OV1: Overvoltage during acceleration OV2: Overvoltage during deceleration OV3: Overvoltage during running at a constant speed
LV	Undervoltage	The DC link bus voltage dropped below the undervoltage detection level.
Lin	Input phase loss	An input phase loss occurred or the Interphase voltage unbalance rate was large.
OPL	Output phase loss	An output phase loss occurred.
OH1	Heat sink overheat	The temperature around the heat sink has risen abnormally.
OH2	External alarm	The external alarm ***THR*** was entered. (when the ***THR*** "Enable external alarm trip" has been assigned to any digital input terminal)
OH3	Inverter internal overheat	The temperature inside the inverter has exceeded the allowable limit.
OH4	Motor protection (PTC thermistor)	The temperature of the motor has risen abnormally.
FUS	Fuse trip	An internal short-circuit tripped a fuse (110 kW or greater).
PbF	Charging circuit malfunction	No power was supplied to the charging resistance short-circuit electromagnetic contactor (45 kW or greater).
OL1	Overload of motor 1	The electronic thermal protection for motor overload detection was activated.
OLU	Inverter overload	The temperature inside the inverter has risen abnormally.
Er1	Memory error	An error has occurred in writing data to the memory in the inverter.
Er2	Keypad communications error	A communications error has occurred between the keypad and the inverter.
Er3	CPU error	A CPU error or LSI error has occurred.
Er4	Option communications error	A communications error has occurred between the connected option card and the inverter.
Er5	Option error	An error was detected by the connected option card (not by the inverter).
Er6	Operation protection	An incorrect operation was attempted.
Er7	Tuning error	Auto-tuning has failed, resulting in abnormal tuning results.
Er8 ErP	RS-485 communications error (COM port 1) RS-485 communications error (COM port 2)	A communications error has occurred during RS-485 communication.
ErF	Data saving error during undervoltage	When the undervoltage protection was activated, the inverter failed to save data, showing this error.
ErH	Hardware error	The LSI on the power printed circuit board has malfunctioned due to noise, etc.
PV1 PV2 PVA PVb PVC	PID feedback error	The PID feedback signal wire is broken under PID control.
CoF	Current input break detection	A break was detected in the current input.
ECF	Enable circuit failure	The Enable circuit was diagnosed as a circuit failure.
ECL	Customizable logic error	A customizable logic configuration error has caused an alarm.
rLo	Stuck prevention	The inverter failed to start due to overcurrent.
FoL	Filter clogging error	An overload state was detected under PID control.
LoK	Password protection	A wrong password has been entered exceeding the predetermined number of times.
Err	Mock alarm	A mock alarm has been generated intentionally by keypad operation.

Chapter 7 MAINTENANCE AND INSPECTION

Perform daily and periodic inspections to avoid trouble and keep reliable operation of the inverter for a long time.

7.1 Daily Inspection

Visually inspect the inverter for operation errors from the outside without removing the covers when the inverter is ON or operating.

- Check that the expected performance (satisfying the standard specifications) is obtained.
- Check that the surrounding environment satisfies the environmental requirements given in Chapter 8, Section 8.1 "Standard Model."
- Check that the keypad displays normally.
- Check for abnormal noise, odor, or excessive vibration.
- Check for traces of overheat, discoloration and other defects.

7.2 Periodic Inspection

Before starting periodic inspections, be sure to stop the motor, shut down the power, and wait at least 10 minutes. Make sure that the charging lamp is turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the main circuit terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

Table 7.1 List of Periodic Inspections

Check part		Check item	How to inspect	Evaluation criteria
Environment		1) Check the ambient temperature, humidity, vibration and atmosphere (dust, gas, oil mist, or water drops). 2) Check that tools or other foreign materials or dangerous objects are not left around the equipment.	1) Check visually or measure using apparatus. 2) Visual inspection	1) The standard specifications must be satisfied. 2) No foreign or dangerous objects are left.
Input voltage		Check that the input voltages of the main and control circuit are correct.	Measure the input voltages using a multimeter or the like.	The standard specifications must be satisfied.
Keypad		1) Check that the display is clear. 2) Check that there is no missing part in the displayed characters.	1), 2) Visual inspection	1), 2) The display can be read and there is no fault.
Structure such as frame and cover		Check for: 1) Abnormal noise or excessive vibration 2) Loose bolts (at clamp sections). 3) Deformation and breakage 4) Discoloration caused by overheat 5) Contamination and accumulation of dust or dirt	1) Visual or auditory inspection 2) Retighten. 3), 4), 5) Visual inspection	1), 2), 3), 4), 5) No abnormalities
Main circuit	Common	1) Check that bolts and screws are tight and not missing. 2) Check the devices and insulators for deformation, cracks, breakage and discoloration caused by overheat or deterioration. 3) Check for contamination or accumulation of dust or dirt.	1) Retighten. 2), 3) Visual inspection	1), 2), 3) No abnormalities
	Conductors and wires	1) Check conductors for discoloration and distortion caused by overheat. 2) Check the sheath of the wires for cracks and discoloration.	1), 2) Visual inspection	1), 2) No abnormalities

Table 7.1 List of Periodic Inspections (Continued)

Check part		Check item	How to inspect	Evaluation criteria
Main circuit	Terminal blocks	Check that the terminal blocks are not damaged.	Visual inspection	No abnormalities
	DC link bus capacitor	1) Check for electrolyte leakage, discoloration, cracks and swelling of the casing. 2) Check that the safety valve does not protrude remarkably. 3) Measure the capacitance if necessary.	1), 2) Visual inspection 3) Measure the discharge time with capacitance probe.	1), 2) No abnormalities 3) The discharge time should not be shorter than the one specified by the replacement manual.
	Transformer and reactor	Check for abnormal roaring noise and odor.	Auditory, visual, and olfactory inspection	No abnormalities
	Magnetic contactor and relay	1) Check for chatters during operation. 2) Check that contact surface is not rough.	1) Auditory inspection 2) Visual inspection	1), 2) No abnormalities
Control circuit	Printed circuit board	1) Check for loose screws and connectors. 2) Check for odor and discoloration. 3) Check for cracks, breakage, deformation and remarkable rust. 4) Check the capacitors for electrolyte leaks and deformation.	1) Retighten. 2) Olfactory and visual inspection 3), 4) Visual inspection	1), 2), 3), 4) No abnormalities
Cooling system	Cooling fan	1) Check for abnormal noise and excessive vibration. 2) Check for loose bolts. 3) Check for discoloration caused by overheat.	1) Auditory and visual inspection, or turn manually (be sure to turn the power OFF). 2) Retighten. 3) Visual inspection	1) Smooth rotation 2), 3) No abnormalities
	Ventilation path	Check the heat sink, intake and exhaust ports for clogging and foreign materials.	Visual inspection	No abnormalities

Remove dust accumulating on the inverter with a vacuum cleaner. If the inverter is stained, wipe it off with a chemically neutral cloth.

7.3 List of Periodic Replacement Parts

The inverter consists of many electronic parts including semiconductor devices. Table 7.2 lists replacement parts that should be periodically replaced for preventive maintenance (Use the lifetime judgment function as a guide). These parts are likely to deteriorate with age due to their constitution and properties, leading to the decreased performance or failure of the inverter.

When the replacement is necessary, consult IMO.

Table 7.2 Replacement Parts

Part name	Standard replacement intervals (See Notes below.)	
	0.75 to 90kW	110 to 710kW
DC link bus capacitor	5 years	10 years
Electrolytic capacitors on printed circuit boards	5 years	10 years
Cooling fans	5 years	10 years
Fuse	–	10 years

(Notes) ・These replacement intervals are based on the inverter's service life estimated at an ambient temperature of 30°C (IP55) or 40°C (IP21) at full load (100% of the inverter rated current). These replacement intervals are based on the inverter's service life estimated at an ambient temperature of 40°C (IP00) and a load factor of 80% of the inverter's rated current. Replacement intervals may be shorter when the ambient temperature exceeds 30°C (IP55) or 40°C (IP00/IP21) or when the inverter is used in an excessively dusty environment.

・Standard replacement intervals mentioned above are only a guide for replacement, not a guaranteed service life.

7.4 Inquiries about Product and Guarantee

7.4.1 When making an inquiry

Upon breakage of the product, uncertainties, failure or inquiries, inform your IMO of the following information.

1) Inverter type (Refer to Chapter 1, Section 1.1.)
2) SER No. (serial number of the product) (Refer to Chapter 1, Section 1.1.)
3) Function codes and their data that you changed (Refer to the JAGUAR VXH User's Manual, Chapter 6, Section 5.6.3.2.)
4) ROM version (Refer to JAGUAR VXH User's Manual, Chapter 6.)
5) Date of purchase
6) Inquiries (for example, point and extent of breakage, uncertainties, failure phenomena and other circumstances)

7.4.2 Product warranty

Terms of IMO 5 year warranty.

- IMO Jaguar Inverters are covered by a 5 year warranty from date of despatch.
- In the event of failure due to faulty components or inferior workmanship, the Inverter will be replaced or repaired free Warranty replacements and repaired units will be despatched free of charge, all costs related to faulty units being returned to IMO for inspection/repair are the responsibility of the sender.
- In circumstances where it is viable for the Inverter to be repaired in situ due to size (>30kw), an Engineer from IMO or contracted to represent IMO can be supplied. Site visits are chargeable at IMO's current service rate, any warranty parts will be replaced free of charge.
- All Inverters require a Returns Authorisation reference to be supplied with the Inverter upon returning the drive to IMO, this reference can be obtained from our website www.imopconline.com by registering and following the returns instructions.

Warranty restrictions.

- Incorrect, or unsafe installation.
- Poor condition due to abuse, neglect or improper maintenance.
- Modifications, repairs performed by anyone other than IMO or without prior written agreement.
- Inverter used in incorrect application or used for function other than for which it is designed.
- Any alterations, which may invalidate the Inverters CE declaration.
- Non IMO options or ancillary devices used.

Liability.

- Regardless whether a breakdown occurs during or after the warranty period, IMO shall not be liable for any loss of opportunity, loss of profits, penalty clauses or damages arising from any special circumstances, secondary damages, accident compensation to another company, damages to any equipment, or personal injury.

Chapter 8 SPECIFICATIONS

8.1 Standard Model

Three-phase 400 V class series

(0.75 to 37 kW)

Item			Specifications											
Type: (VXH---#**4E) (*1)			2A5	4A1	5A5	9	13A5	18A5	24A5	32	39	45	60	75
Nominal applied motor (kW) (*2)			0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37
Output ratings	Rated capacity (kVA) (*9)		1.9	3.1	4.1	6.8	10	14	18	24	29	34	45	57
	Rated capacity (kW)		0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37
	Voltage (V) (*10)		3-phase, 380 to 480 V (with AVR function)											
	Rated current (A) (*3)		2.5	4.1	5.5	9.0	13.5	18.5	24.5	32	39	45	60	75
	Overload capability		110%-1 min (Overload interval: Compliant with IEC/EN 61800-2)											
Input power	Main power supply (number of phases, voltage, frequency)		3-phase, 380 to 480 V, 50/60 Hz											
	Auxiliary control power supply input (number of phases, voltage, frequency)		Single-phase, 380 to 480 V, 50/60 Hz											
	Allowable voltage/frequency		Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) (*6), Frequency: +5 to -5%											
	Rated current (A) (*4)		1.6	3.0	4.3	7.4	10.3	13.9	20.7	27.9	34.5	41.1	55.7	69.4
	Required capacity (kVA)		1.2	2.1	3.0	5.2	7.2	9.7	15	20	24	29	39	49
Braking	Braking torque [%] (*11)		20										10 to 15	
	DC braking		Braking start frequency: 0.0 to 60.0 Hz; braking time: 0.0 to 30.0 s; braking operation level: 0 to 60%											
EMC filter (IEC/EN 61800-3: 2004)			Compliant with EMC Directives, Emission and Immunity: Category C2 (2nd Env.)											
DC reactor (DCR)			Built-in (IEC/EN 61000-3-2, IEC/EN 61000-3-12)											
Power factor (at the rated load)	Fundamental wave power factor		> 0.98											
	Total power factor		≥ 0.90											
Efficiency (at the rated load) (%)			95	96	96	96	97	97	97	97	97	97	97	97
Safety standard compliance			UL508C, C22.2 No. 14 (pending), IEC/EN 61800-5-1:2007											
Enclosure (IEC/EN 60529)			IP21/IP55											
Cooling method			Fan cooling											
Weight / Mass (kg)		IP21	10	10	10	10	10	10	18	18	18	18	23	23
		IP55	10	10	10	10	10	10	18	18	18	18	23	23
Environmental Requirements	Site location		Indoors											
	Ambient temperature	IP00/IP21	-10 to +50°C											
		IP55	-10 to +40°C											
	Relative humidity		5 to 95% (No condensation)											
	Atmosphere		The inverter must not be exposed to dust, direct sunlight, corrosive gases, flammable gases, oil mist, vapor or water drops. Pollution degree 2 (IEC/EN 60664-1) (*7) The atmosphere can contain a small amount of salt. (0.01 mg/cm^2 or less per year) The inverter must not be subjected to sudden changes in temperature that will cause condensation to form.											
	Altitude		1,000 m max. (*8)											
	Atmospheric pressure		86 to 106 kPa											
	Vibration		3 mm 2 to less than 9 Hz 10 m/s^2 9 to less than 200 Hz											

(*1) # Enclosure: M (IP21) or L (IP55).

(*2) 4-pole standard motor.

(*3) When running the inverter at the carrier frequency 4 kHz or above, it is necessary to derate the current rating.

(*4) When the inverter is connected to the power supply of 400 V, 50 Hz, Rsce = 120.

(*5) 4.0 kW for the EU.

(*6)

$$\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67 \text{ (IEC/EN 61800 - 3)}$$

If this value is 2 to 3%, use an optional AC reactor (ACR). *Applies to all models, regardless of capacity.
Even if the voltage drops down to -20%, the inverter can run (operation guaranteed) provided that the load current is within the inverter rated current range. *Applies only to models with a capacity of 37 kW or less.

(*7) Do not install the inverter in an environment where it may be exposed to lint, cotton waste or moist dust or dirt which will clog the heat sink of the inverter. If the inverter is to be used in such an environment, install it in a dustproof panel of your system.

(*8) If you use the inverter in an altitude above 1000 m, you should apply an output current derating factor as listed in the table below.

Altitude	1000 m or lower	1000 to 1500 m	1500 to 2000 m	2000 to 2500 m	2500 to 3000 m
Output current derating factor	1.00	0.97	0.95	0.91	0.88

(*9) Applies to inverters with a rated capacity of 440 V.

(*10) The inverter cannot output a voltage higher than the supply voltage.

(*11) Indicates average braking torque value for motor alone (varies with motor efficiency).

(45 to 710 kW)

Item			Specifications															
Type Type: (VXH---#**4E) (*1)			91	112	150	176	210	253	304	377	415	520	585	650	740	960	1170	1370
Nominal applied motor (kW) (*2)			45	55	75	90	110	132	160	200	220	280	315	355	400	500	630	710
Output ratings	Rated capacity (kVA) (*9)		69	85	114	134	160	193	231	287	316	396	445	495	563	731	891	1044
	Rated capacity (kW)		45	55	75	90	110	132	160	200	220	280	315	355	400	500	630	710
	Voltage (V) (*10)		3-phase, 380 to 480 V (with AVR function)															
	Rated current (A) (*3)		91	112	150	176	210	253	304	377	415	520	585	650	740	960	1170	1370
	Overload capability		110%-1 min (Overload interval: Compliant with IEC/EN 61800-2)															
Input power	Main power supply (number of phases, voltage, frequency)		3-phase, 380 to 440 V, 50 Hz 3-phase, 380 to 480 V, 60 Hz															
	Auxiliary control power supply input (number of phases, voltage, frequency)		Single-phase, 380 to 480 V, 50/60 Hz															
	Auxiliary main power supply input (number of phases, voltage, frequency) (*5)		Single -phase, 380 to 440 V, 50 Hz Single -phase, 380 to 480 V, 60 Hz															
	Allowable voltage/frequency		Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) (*6), Frequency: +5 to -5%															
	Rated current (A) (*4)		83.1	102	136	162	201	238	286	357	390	500	559	628	705	881	1115	1256
	Required capacity (kVA)		58	71	95	113	140	165	199	248	271	347	388	436	489	611	773	871
Braking	Braking torque [%] (*11)		10 to 15															
	DC braking		Braking start frequency: 0.0 to 60.0 Hz; braking time: 0.0 to 30.0 s; braking operation level: 0 to 60%															
EMC filter (IEC/EN 61800-3: 2004)			C2/2nd.				Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.)											
DC reactor (DCR)			Built-in				Standard accessory											
Power factor (at the rated load)	Fundamental wave power factor		> 0.98															
	Total power factor		≥ 0.90															
Efficiency (at the rated load) (%)			97	97	97	97	97	97	98	98	98	98	98	98	98	98	98	98
Safety standard compliance			UL508C, C22.2 No. 14 (pending), IEC/EN 61800-5-1:2007															
Enclosure (IEC/EN 60529)			IP21/IP55				IP00											
Cooling method			Fan cooling															
Weight / Mass (kg)		IP21	50	50	70	70	-											
		IP55	50	50	70	70												
		IP00	-				62	64	94	98	129	140	245	245	245	330	530	530
Environmental Requirements	Site location		Indoors															
	Ambient temperature	IP00/IP21	-10 to +50°C															
		IP55	-10 to +40°C															
	Relative humidity		5 to 95% (No condensation)															
	Atmosphere		The inverter must not be exposed to dust, direct sunlight, corrosive gases, flammable gases, oil mist, vapor or water drops. Pollution degree 2 (IEC/EN 60664-1) (*7) The atmosphere can contain a small amount of salt. (0.01 mg/cm^2 or less per year) The inverter must not be subjected to sudden changes in temperature that will cause condensation to form.															
	Altitude		1,000 m max. (*8)															
	Atmospheric pressure		86 to 106 kPa															
	Vibration		3 mm 2 to 9 Hz 10 m/s^2 9 to less than 200 Hz					3 mm 2 to less than 9 Hz 2 m/s^2 20 to less than 55 Hz 1 m/s^2 55 to less than 200 Hz										

(*1) # Enclosure: S (IP00), M (IP21) or L (IP55)

(*2) 4-pole standard motor

(*3) Current must be reduced for inverters with a capacity of 90 kW or less when operated at a carrier frequency of 4 kHz or greater. Similarly, current must be reduced for inverters with a capacity of 110 kW or greater when operated at a carrier frequency of 5 kHz or greater.

(*4) When the inverter is connected to the power supply of 400 V, 50 Hz, Rsce = 120.

(*5) If using inverters with DC power input, supply AC power to the internal circuits.

(*6)
$$\text{Voltage unbalance (\%)} = \frac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67 \text{ (IEC/EN 61800 - 3)}$$

If this value is 2 to 3%, use an optional AC reactor (ACR).

(*7) Do not install the inverter in an environment where it may be exposed to lint, cotton waste or moist dust or dirt which will clog the heat sink of the inverter. If the inverter is to be used in such an environment, install it in a dustproof panel of your system.

(*8) If you use the inverter in an altitude above 1000 m, you should apply an output current derating factor as listed in the table below.

Altitude	1000 m or lower	1000 to 1500 m	1500 to 2000 m	2000 to 2500 m	2500 to 3000 m
Output current derating factor	1.00	0.97	0.95	0.91	0.88

(*9) Applies to inverters with a rated capacity of 440 V.

(*10) The inverter cannot output a voltage higher than the supply voltage.

(*11) Indicates average braking torque value for motor alone (varies with motor efficiency).

8.1 External Dimensions

Rated voltage	Inverter type	Refer to:	Dimensions (mm)											
			W	H	D	D1	D2	W1	W2	H1	H2	H3	M	N
Three-phase 400V	VXH2A5M-4E	Figure 1	150	465	262	162	100	115	17.5	451	7	-	2×ϕ8	8
	VXH4A1M-4E													
	VXH5A5M-4E													
	VXH9M-4E													
	VXH13A5M-4E													
	VXH18A5M-4E													
	VXH24A5M-4E		203	585				158	22.5	571				
	VXH32M-4E													
	VXH39M-4E													
	VXH45M-4E													
	VXH60M-4E			645						631				
	VXH75M-4E													
	VXH91M-4E	Figure 2	265	736	284	184.5	99.5	180	42.5	716	12	8	2×ϕ10	10
	VXH112M-4E													
	VXH150M-4E		300	885	367.9	240.8	127.1	215		855	15.5	14.5	2×ϕ15	15
	VXH176M-4E													
	VXH210M-4E	Figure 3	530	740	315	135	180	430	50	710	15.5	14.5	2×ϕ15	15
	VXH253M-4E													
	VXH304M-4E			1000	360	180				970				
	VXH377M-4E													
	VXH415M-4E	Figure 4	680					290					3×ϕ15	
	VXH520M-4E													
	VXH585M-4E			1400	440	260				1370				
	VXH650M-4E													
	VXH740M-4E													
	VXH960M-4E	Figure 5	880					260					4×ϕ15	
	VXH1170M-4E		1000	1550	500	313.2	186.8	300	49.5	1520				
	VXH1370M-4E													

Note # Enclosure: S (IP00), M (IP21) or L (IP55)

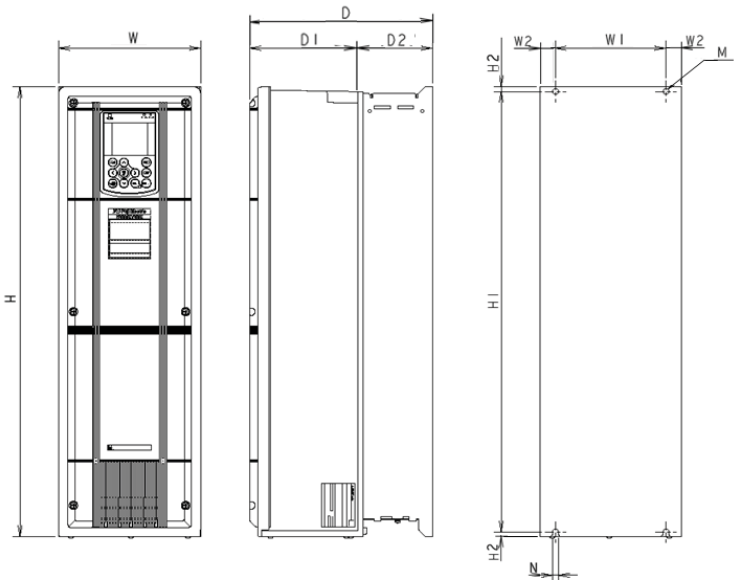


Figure 1 External Dimensions of the Inverter (VXH2A5#-4E to VXH75#-4E)

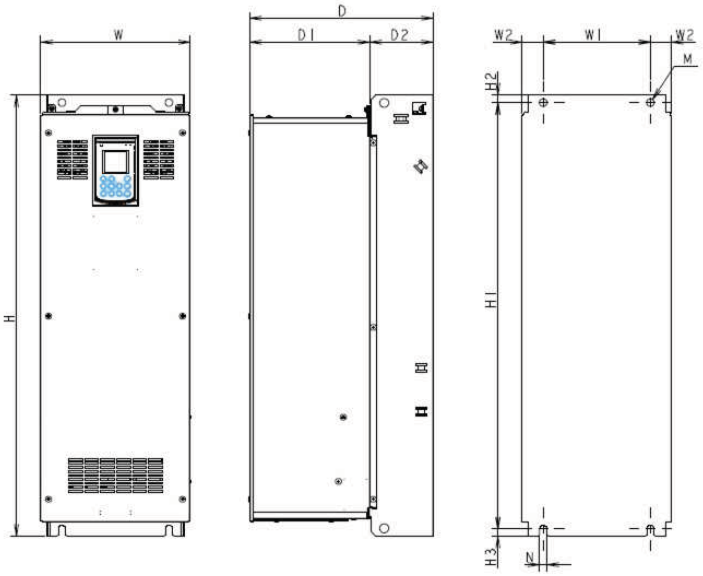


Figure 2 External Dimensions of the Inverter (VXH91#-4E to VXH176#-4E)

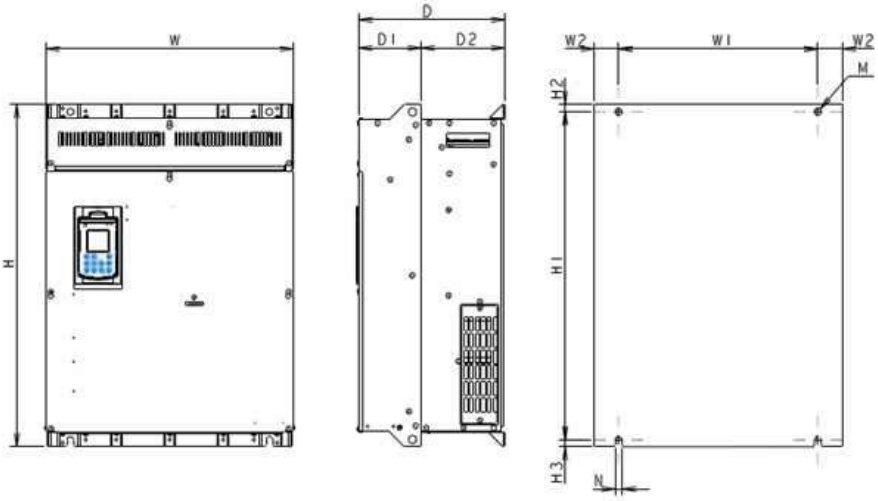


Figure 3 External Dimensions of the Inverter (VXH210#-4E to VXH377#-4E)

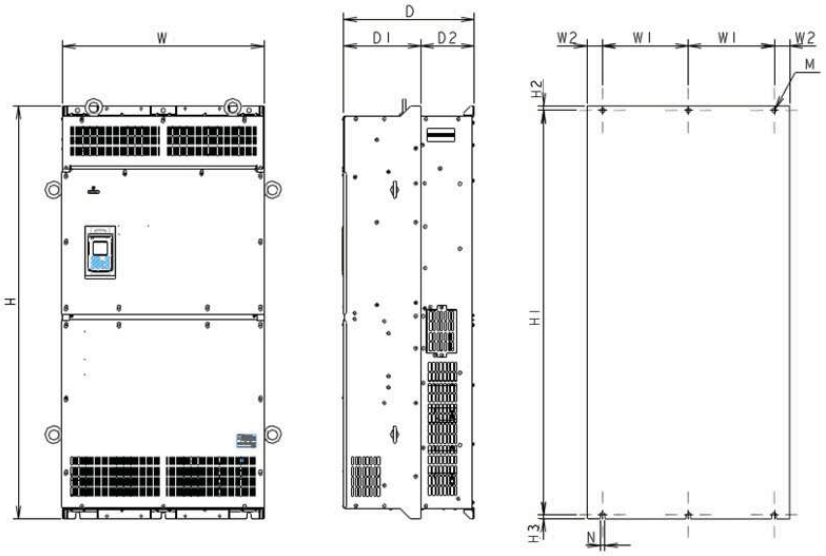


Figure 4 External Dimensions of the Inverter (VXH415#-4E to VXH740#-4E)

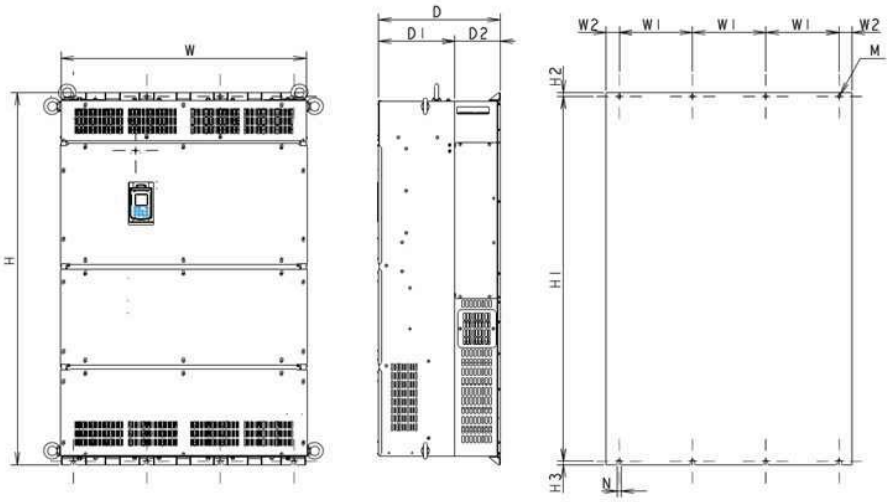


Figure 5 External Dimensions of the Inverter (VXH960#-4E to VXH1370#-4E)

Chapter 9 CONFORMITY WITH STANDARDS

9.1 Compliance with European Standards

The CE marking on IMO products indicates that they comply with the essential requirements of the Electromagnetic Compatibility (EMC) Directive 2004/108/EC and Low Voltage Directive 2006/95/EC which are issued by the Council of the European Communities.

The products comply with the following standards

Table 9.1 Standalone Standard Compliance

		VXH2A5#-4E to VXH176#-4E	VXH210S-4E to VXH1370S-4E
Low Voltage Directive		IEC/EN 61800-5-1: 2007	
EMC Directives		IEC/EN 61800-3: 2004	
	Immunity	Second environment (Industrial)	
	Emission	Category C2	Category C3

Table 9.2 Standard Compliance When Used with an EMC Filter

Inverter alone		VXH210S-4E to VXH520S-4E	VXH585S-4E to VXH1370S-4E
EMC filter		FS or FN series (optional; see Table 9.4)	
Low Voltage Directive		IEC/EN 61800-5-1: 2007	
EMC Directives		IEC/EN 61800-3: 2004	
	Immunity	Second environment (Industrial)	
	Emission	Category C2	Category C3

Note # Enclosure: M (IP21) or L (IP55).

9.2 Conformity to the Lower Voltage Directive in the EU

To use IMO inverters as a product conforming to the Lower Voltage Directive in the EU, refer to guidelines given on pages vi to viii.

9.3 Compliance with EMC Standards

9.3.1 General

The CE marking on inverters does not ensure that the entire equipment including our CE-marked products is compliant with the EMC Directive. Therefore, CE marking for the equipment shall be the responsibility of the equipment manufacturer. For this reason, IMO's CE mark is indicated under the condition that the product shall be used within equipment meeting all requirements for the relevant Directives. Instrumentation of such equipment shall be the responsibility of the equipment manufacturer.

Generally, machinery or equipment includes not only our products but other devices as well. Manufacturers, therefore, shall design the whole system to be compliant with the relevant Directives.

Tip

EMC certification testing is performed using the following wiring distances between the inverter and motor (shielded wire):

VXH2A5#-4E to VXH176#-4E:	75 m
VXH210S-4E to VXH1370S-4E (inverter alone):	10 m
VXH210S-4E to VXH1370S-4E (with filter):	20 m

9.3.2 Recommended installation procedure

To make the machinery or equipment fully compliant with the EMC Directive, have certified technicians wire the motor and inverter in strict accordance with the procedure given below.

1) Use shielded wires for the motor cable and route the cable as short as possible. Firmly clamp the shield to the specified point or the grounded metal plate inside the inverter. Further, connect the shielding layer electrically to the grounding terminal of the motor.
2) For the inverters of 11 to 90 kW, be sure to pass the main circuit power input lines of the inverter through a

ferrite core in wiring.

📖 For wiring of the main circuit power input lines, refer to Chapter 2, Section 2.2.1 "(4) Wiring the main circuit power input wires."

3) Connect the grounding wires to the grounding terminals without passing them through the ferrite core.

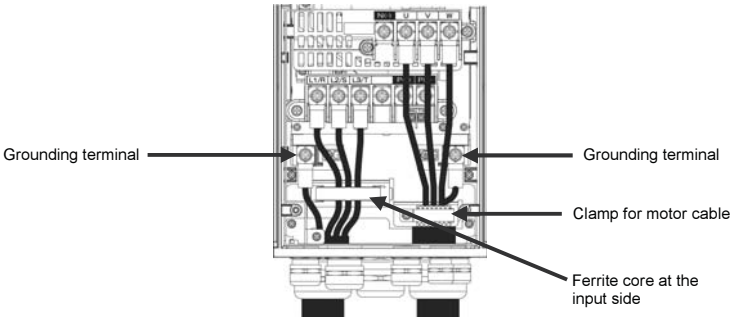


Figure 9.1 Wiring to Main Circuit Terminals for Inverters of 30/37 kW

4) For connection to inverter's control terminals and for connection of the RS-485 communication signal cable, use shielded wires. As with the motor, clamp the shields firmly to the specified point or the grounded metal plate inside the inverter.

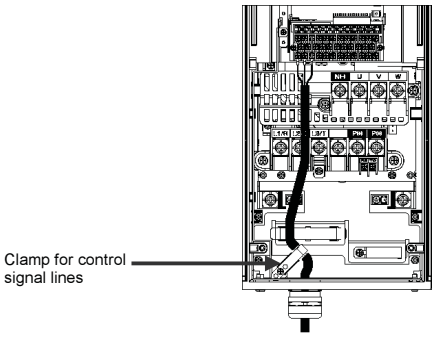


Figure 9.2 Wiring to Control Circuit Terminals for Inverters of 30/37 kW

5) When using an externally connected EMC filter (optional), place the inverter and filter on a grounded metal plate such as the surface of a panel, as shown in Figure 9.3. If noise emissions exceed the standard, place the inverter and any peripheral equipment inside a metal panel. For more information about how to use the inverter in combination with a filter, see Table 9.4.

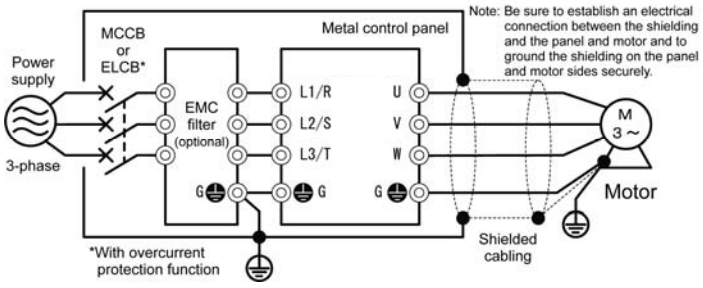


Figure 9.3 Installation inside a Panel

9.3.3 Leakage current of the EMC filter

This product uses grounding capacitors for noise suppression which increase the leakage current. Check whether there is no problem with electrical systems. When using an EMC filter, the leakage current listed in Table 9.4 is added. Before adding the filter, consider whether the additional leakage current is allowable in the context of the overall system design.

Table 9.3 Inverter Leakage Current

Input power	Inverter type	Leakage current (mA)
Three-phase 400 V	VXH2A5#-4E	55
	VXH4A1#-4E	
	VXH5A5#-4E	
	VXH9#-4E	
	VXH13A5#-4E	
	VXH18A5#-4E	
	VXH24A5#-4E	135
	VXH32#-4E	
	VXH39#-4E	
	VXH45#-4E	
	VXH60#-4E	111
	VXH75#-4E	
	VXH91#-4E	119
	VXH112#-4E	

Input power	Inverter type	Leakage current (mA)
Three-phase 400 V	VXH150#-4E	148
	VXH176#-4E	
	VXH210S-4E	3
	VXH253S-4E	
	VXH304S-4E	
	VXH377S-4E	
	VXH415S-4E	
	VXH520S-4E	
	VXH585S-4E	
	VXH650S-4E	
	VXH740S-4E	
	VXH960S-4E	
	VXH1170S-4E	
	VXH1370S-4E	

* Calculated based on these measuring conditions: 400 V, 50 Hz, neutral grounding in Y-connection, interphase voltage unbalance ratio 2%.

Table 9.4 EMC Filter (Optional) Use and Leakage Currents

Input power	Inverter type	Filter model	EMC filter leakage current (mA)
Three-phase 400 V	VXH210S-4E	FS5536-250-99-1	59
	VXH253S-4E		
	VXH304S-4E	FS5536-400-99-1	78
	VXH377S-4E		
	VXH415S-4E		
	VXH520S-4E	FN3359-600-99	38
	VXH585S-4E		
	VXH650S-4E	FN3359-800-99	38
	VXH740S-4E		
	VXH960S-4E	FN3359-1000-99	39
	VXH1170S-4E	FN3359-1600-99	38
	VXH1370S-4E		

9.4 Harmonic Component Regulation in the EU

9.4.1 General comments

When general-purpose industrial inverters are used in the EU, the harmonics emitted from inverters to the power lines are strictly regulated as stated below.

If an inverter whose rated input is 1 kW or less is connected to the public low-voltage power supply, it is regulated by the harmonics emission regulation IEC/EN 61000-3-2. If an inverter whose input current is 16 A or above and 75 A or below is connected to the public low-voltage power supply, it is regulated by the harmonics emission regulation IEC/EN 61000-3-12.

Note that connection to the industrial low-voltage power lines is an exception. (See Figure 9.3.)

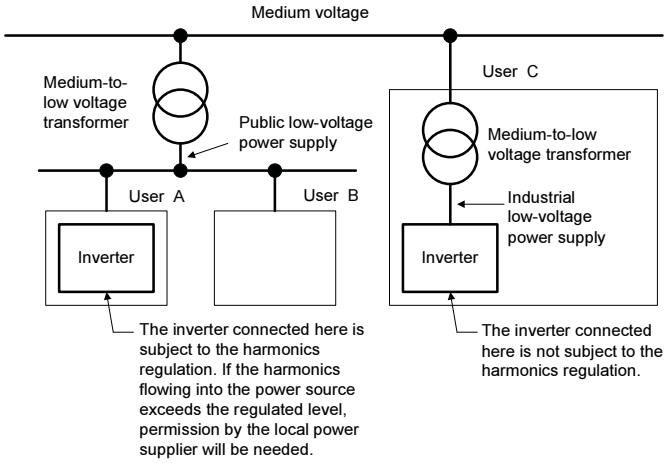


Figure 9.4 Power Source and Regulation

9.4.2 Compliance with IEC/EN 61000-3-2

The VXH2A5#-4E satisfies the IEC/EN 61000-3-2, so it can be connected to the public low-voltage power supply.

9.4.3 Compliance with IEC/EN 61000-3-12

To bring the VXH2A5#-4E to VXH75#-4E into compliance with the IEC/EN 61000-3-12, connect them to the power supply whose short-circuit ratio Rsce is 120 or above.

9.5 Compliance with UL Standards and Canadian Standards (cUL certification) Under application)

9.5.1 General

Originally, the UL standards were established by Underwriters Laboratories, Inc. as private criteria for inspections/investigations pertaining to fire/accident insurance in the USA. The UL marking on IMO products is related to the UL Standard UL508C.

cUL certification means that UL has given certification for products to clear CSA Standards. cUL certified products are equivalent to those compliant with CSA Standards. The cUL marking on IMO products is related to the CSA Standard C22.2 No. 14.

9.5.2 Considerations when using JAGUAR VXH in systems to be certified by UL and cUL

If you want to use the JAGUAR VXH series of inverters as a part of UL Standards or CSA Standards (cUL certified) certified product, refer to the related guidelines described on pages ix to xi.

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2013-02 S.Mc (Issue 1)

HVAC Application Inverter.

Jaguar VXH

Instruction Manual

First Edition, Feb 2013

IMO Precision Controls Ltd

The purpose of this instruction manual is to provide accurate information in handling, setting up and operating of the JAGAUR VXH series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will IMO Precision Controls Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.