

# FRENIC 5000VG7S USER'S MANUAL

High-performance, Vector Control Inverter

**FRENIC**  
5000VG7S Series

# Introduction

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Thank you for examining or purchasing Fuji's high-performance, vector control type inverter FRENIC 5000VG7S Series. This user's manual provides all the information on FRENIC5000VG7S including its installation, standard functions, and optional functions. Carefully read this manual for proper use. Incorrect handling of the inverter will prevent proper operation of the inverter or related equipment, shorten their lives, or cause troubles.

The table below lists the other documentation related with FRENIC5000VG7S. Read them in conjunction with this manual if necessary.

Name	Manual No.	Description
Catalog	MEH405	General description, specifications, and external drawings of the product
Instruction manual	INR-HF51306	- Inspections and installation of the product - Periodic maintenance and inspection - Method of using KEYPAD panel - Troubleshooting

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- (2) The information contained herein such as specifications is subject to change without prior notice for improvement of the products.
- (3) This manual is intended to provide accurate information on Fuji inverters. If you find any errors or omissions, please feel free to send you comments to our sale office described on the back cover of this manual.

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Manuals are revised whenever necessary. Read the manuals of the latest edition.



# Introduction

## Safety Instructions

Read this manual carefully before installing, connecting (wiring), operating, servicing, or inspecting the inverter.

Familiarize yourself with all safety features before using the inverter.

In this manual, safety messages are classified as follows:

 <b>WARNING</b>	Improper operation may result in serious personal injury or death.
 <b>CAUTION</b>	Improper operation may result in slight to medium personal injury or property damage.

Situations more serious than those covered by CAUTION will depend on prevailing circumstances.

Always follow instructions.

## Instructions on use

### **WARNING**

- This inverter is designed to drive a 3-phase induction motor and is not suitable for a single-phase motor or others, **as fire may result.**
- This inverter may not be used (as is) as a component of a life-support system or other medical device directly affecting the personal welfare of the user.
- This inverter is manufactured under strict quality control standards. However, safety equipment must be installed if the failure of this device may result in personal injury and/or property damage.

**There is a risk of accident.**

## Instructions on installation

### **CAUTION**

- Mount this inverter on an incombustible material such as metal.

**There is a risk of fire.**

- Do not place combustible or flammable material near this inverter, **as fire may result.**
- The inverter housed in IP00 (18.5kW or over) should be installed in a place where no one can touch it easily.

**Electric shock or injury may result.**

### **CAUTION**

- Do not hold or carry this inverter by the surface cover. Inverter may be dropped **causing injury.**
- Ensure that the inverter and heat sink surfaces are kept free from foreign matter (lint, paper dust, small chips of wood or metal chips), **as fire or accident may result.**
- Do not install or operate a damaged inverter or an inverter with missing parts, **as injury may result.**
- When changing installation bracket position, use the attached screws, **as injury may result.**

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## Instructions on wiring

### **WARNING**

- Connect the inverter to power via a line-protection molded-case circuit breaker or earth-leakage circuit breaker, **as fire may result.**
- Use the cables of the specified size, **as fire may result.**
- Always connect a ground wire, **as electric shock or fire may result.**
- A licensed specialist must perform the wiring works, **as electric shock may result.**
- Turn off the power before starting the wiring work, **as electric shock may result.**
- Wire the inverter after installation is complete, **as electric shock or injury may occur.**
- Do not supply power to any inverter of which parts are broken, omitted, or damaged in transportation, **as electrical shock or fire may result.**

### **CAUTION**

- Confirm that the phases and rated voltage of this product match those of the AC power supply, **as injury may result.**
- Do not connect the AC power supply to the output terminals (U, V, and W), **as injury may result.**
- Do not connect a braking resistor directly to the DC terminals (P(+) and N(-)), **as fire may result.**
- When using DC power input, ensure that the fan power switching connector (CNRXTX) is correctly engaged in the inverter **as a trouble may occur.**
- When using DC power input of 18.5kW or larger inverter, be sure to connect AC power to terminals R0 and T0 for a power supply of fan **as a trouble may occur.**
- Ensure that the noise generated by the inverter, motor, or wiring does not adversely affect peripheral sensors and equipment, **as accident may result.**

# Introduction

## Instructions on operation

### **WARNING**

- Be sure to install the surface cover before turning on the power (closed). Do not remove the cover while power to the inverter is turned on.

#### **Electric shock may occur.**

- Do not operate switches with wet hands, **as electric shock may result.**
- When the retry function is selected, the inverter may restart automatically after tripping. (Design the machine to ensure personal safety in the event of restart)

#### **Accident may result.**

- When the torque limiting function is selected, operating conditions may differ from preset conditions (acceleration/deceleration time or speed). In this case, personal safety must be assured.

#### **Accident may result.**

- As the STOP key is effective only when a function setting has been established, install an emergency switch independently, and when an operation via the external signal terminal is selected, the STOP key on the keypad panel will be disabled.

#### **Accident may result.**

- As operations start suddenly if alarm is reset with a running signal input, confirm that no running signal is input before resetting alarm.

#### **Accident may result.**

- When an alarm is activated, the motor coasts. If the motor needs to be stopped in such a case, install a brake to the machine with the motor.

#### **Accident may result.**

- If AUTO RESTART is selected in the restart mode after momentary power failure (function code F14), the inverter restarts automatically starting the motor rotation when the power is recovered.

#### **Accident may result.**

- When the tuning (function code H01) is started, the motor, machine or equipment starts and stops repeatedly. Ensure safety before performing tuning.

#### **Accident may result.**

- If the user set the function codes wrongly or without completely understanding this user's manual, the motor may rotate with a torque or at a speed not permitted for the machine.

#### **Accident or injury may result.**

- Do not touch inverter terminals when energized even if inverter has stopped.

#### **Electric shock may result.**

### **CAUTION**

- Do not start or stop the inverter using the main circuit power.

#### **Failure may result.**

- Do not touch the heat sink or braking resistor because they become very hot.

#### **Burns may result.**

- As the inverter can set high speed operation easily, carefully check the performance of motor or machine before changing speed settings.

#### **Injury may result.**

- Do not use the inverter braking function for mechanical holding.

#### **Injury may result.**

- During pre-excitation, the speed adjuster does not function and the motor may be rotated by load disturbance. When using pre-excitation, therefore, also use the mechanical brake.

#### **Injury may result.**

- If improper data is set at the function code related with speed adjuster as in the case of setting high gain abruptly, the motor may hunt.

#### **Injury may result.**

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## Instructions on maintenance, inspection, and replacement

 **WARNING**

- Wait a minimum of five minutes (15kW or less) or ten minutes (18.5kW or more) after power has been turned off (open) before starting inspection. (Also confirm that the charge lamp is off and that DC voltage between terminals P(+) and N(-) does not exceed 25V.)

**Electric shock may result.**

- Only authorized personnel should perform maintenance, inspection, and replacement operations. (Take off metal jewelry, such as watches and rings. Use insulated tools.)

**Electric shock or injury may result.**

## Instructions on disposal

 **CAUTION**

- Treat as industrial waste when disposing it.

**Injury may result.**

## Other instructions

 **WARNING**

- Never modify the product.

**Electric shock or injury may result.**

### **General Instructions**

Although figures in this manual may show the inverter with covers and safety screens removed for explanation purposes, do not operate the device until all such covers and screens have been replaced.

# Introduction

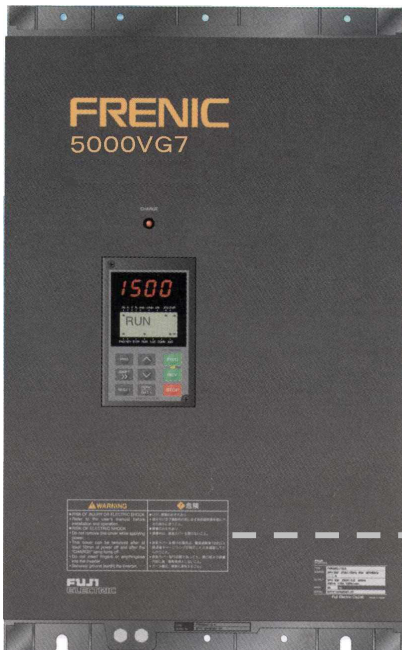
## Warning label positions




Inverter with a small capacity (15kW or lower)



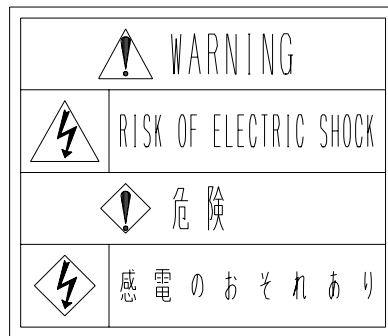
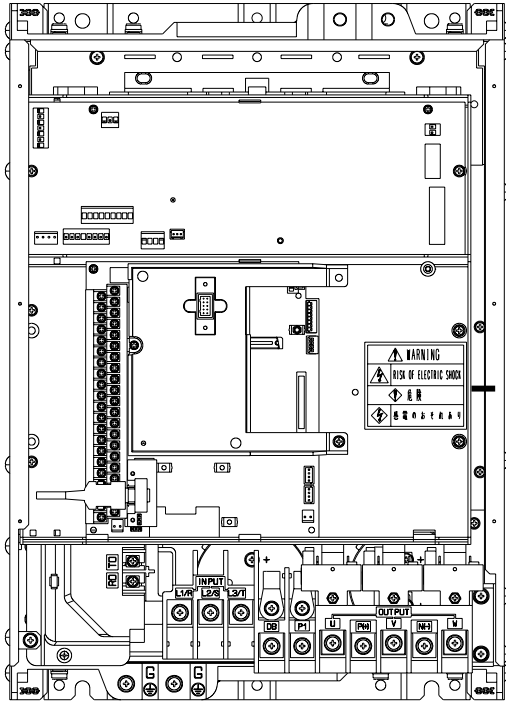
 <b>WARNING</b>	
<ul style="list-style-type: none"> <li>■ RISK OF INJURY OR ELECTRIC SHOCK               <ul style="list-style-type: none"> <li>• Refer to the instruction manual before installation and operation.</li> </ul> </li> <li>■ RISK OF ELECTRIC SHOCK               <ul style="list-style-type: none"> <li>• Do not remove this cover while applying power and at least 5min. after disconnecting power.</li> <li>• More than one live circuit.</li> <li>• Securely ground (earth) the inverter.</li> </ul> </li> </ul>	
 <b>危険</b>	
<ul style="list-style-type: none"> <li>■ けが、感電のおそれあり               <ul style="list-style-type: none"> <li>• 据え付け及び運転の前に必ず取扱説明書を読んで、その指示に従うこと。</li> </ul> </li> <li>■ 感電のおそれあり               <ul style="list-style-type: none"> <li>• 通電中及び電源遮断後5分以内は、表面カバーを開けないこと。</li> <li>• 表面カバーを開ける場合は、制御回路補助電源（R0、T0端子）も遮断していることを確認してから行うこと。</li> <li>• アース線は、確実に接地すること。</li> </ul> </li> </ul>	

Inverter with a middle capacity (18.5kW or higher)



 <b>WARNING</b>	 <b>危険</b>
<ul style="list-style-type: none"> <li>■ RISK OF INJURY OR ELECTRIC SHOCK               <ul style="list-style-type: none"> <li>• Refer to the instruction manual before installation and operation.</li> </ul> </li> <li>■ RISK OF ELECTRIC SHOCK               <ul style="list-style-type: none"> <li>• Do not remove this cover while applying power.</li> <li>• This cover can be removed after at least 10min of power off and after the "CHARGE" lamp turns off.</li> <li>• More than one live circuit.</li> </ul> </li> </ul> <p>• Do not insert fingers or anything else into the inverter.</p> <p>• Securely ground (earth) the inverter.</p>	<ul style="list-style-type: none"> <li>■ けが、感電のおそれあり               <ul style="list-style-type: none"> <li>• 据え付け及び運転の前に必ず取扱説明書を読んで、その指示に従うこと。</li> </ul> </li> <li>■ 感電のおそれあり               <ul style="list-style-type: none"> <li>• 通電中は、表面カバーを開けないこと。</li> <li>• 表面カバーを開ける場合は、電源遮断後10分以上経過後チャージランプが消灯したのを確認してから行うこと。</li> <li>• 表面カバーを開ける場合は、制御回路補助電源（R0、T0端子）も遮断していることを確認してから行うこと。</li> <li>• 表面カバー取付状態であっても、開口部より装置内部に指・異物等挿入しないこと。</li> <li>• アース線は、確実に接地すること。</li> </ul> </li> </ul>
	

Inside the inverter





# Introduction

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## Compliance with UL/cUL standard

### (1) General

The UL standard stands for Underwriters Laboratories Inc. and it is an American safety standard intended to avoid fire and other accidents, thereby protecting users, service personnel and other general people.

The cUL standard is established so that UL complies with the CSA standard. The cUL-certified product is equivalent to a CSA-certified product.

### (2) Caution

To use our product as a UL/cUL-certified product, satisfy the following requirements.

### **CAUTION for UL/cUL requirements**

 <b>CAUTION</b>
<ul style="list-style-type: none"><li>• Hazard of electrical shock. Disconnect incoming power before working on this control.</li><li>• Dangerous voltage exists until charge lights is off.</li><li>• More than one live circuit.</li><li>• Use 60/75°C or 90°C copper wire only.</li><li>• A Class 2 circuit wired with class1 wire.</li><li>• Field wiring connection 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.</li><li>• Connect the power supply to main power supply terminals via the molded-case circuit breaker (MCCB) or the earth leakage circuit breaker (ELCB) to apply the UL Listing Mark. (See Instruction Manual basic connection diagram Fig. 2-3-1).</li><li>• In case of using auxiliary control-power input (R0,T0), connect it referring to Instruction Manual Basic connection diagram Fig. 2-3-1.</li><li>• Solid state motor overload protection is provided in each model. See Users Manual : MEH407 for details.</li></ul>



Tightening torque and wire size

1. 60°C/75°C copper wire

CT/HT use

Voltage	Inverter type FRN□ VG7S-2/4	Required torque [lb-inch](N·m)				Wire size [AWG] (mm <sup>2</sup> )					
		Main terminal	Ground	Auxiliary control power	Control	L1/R,L2/S, L3/T	U,V,W	P1,P(+)	P(+),DB, N(-)	Auxiliary control power	Control
3-phase 200V	0.75	31.0 (3.5)	31.0 (3.5)	10.6 (1.2)	6.2 (0.7)	14 (2.1)	14 (2.1)	14 (2.1)	14 (2.1)	16 (1.3)	24 (0.2)
	1.5					12 (3.3)	10 (5.3)	10 (5.3)			
	2.2					8 (8.4)	8 (8.4)	8 (8.4)			
	3.7					6 (13.3)	6 (13.3)	6 (13.3)			
	5.5					8X2 (8.4X2)	6 (13.3)	6 (13.3)			
	7.5					6X2 (13.3X2)	4 (21.2)	4 (21.2)			
	11	51.3 (5.8)	51.3 (5.8)			4X2 (21.2X2)	3 (26.7)	3 (26.7)	12 (3.3)		
	15					3X2 (26.7X2)	6X2 (13.3X2)	4X2 (21.2X2)	10 (5.3)		
	18.5					2X2 (33.6X2)	4X2 (21.2X2)	4X2 (21.2X2)	8 (8.4)		
	22					1X2 (42.4X2)	1/0 (53.5)	3X2 (26.7X2)	6 (13.3)		
	30					2X2 (33.6X2)	1/0 (53.5)	3X2 (26.7X2)	8 (8.4)		
	37					1X2 (42.4X2)	3/0 (85)	4/0 (107.2)	6 (13.3)		
	45	239 (27)	119 (13.5)			2/0X2 (67.4X2)	4/0 (107.2)	1X2 (42.4X2)	4 (21.2)		
	55					3/0X2 (85X2)	1/0X2 (53.5X2)	2/0X2 (67.4X2)	2 (33.6)		
75	2/0X2 (67.4X2)			3/0X2 (85X2)	4/0X2 (107.2X2)	1 (42.4)					
90	600 (304)			4/0X2 (107.2X2)	250X2 (127X2)	1 (42.4)					
3-phase 400V	3.7	31.0 (3.5)	31.0 (3.5)	10.6 (1.2)	6.2 (0.7)	12 (3.3)	14 (2.1)	14 (2.1)	14 (2.1)	16 (1.3)	24 (0.2)
	5.5					10 (5.3)	12 (3.3)	12 (3.3)			
	7.5					8 (8.4)	10 (5.3)	10 (5.3)			
	11					6 (13.3)	8 (8.4)	6 (13.3)			
	15	51.3 (5.8)	51.3 (5.8)			4 (21.2)	8 (8.4)	6 (13.3)			
	18.5					3 (26.7)	6 (13.3)	6 (13.3)			
	22					6X2 (13.3X2)	4 (21.2)	4 (21.2)			
	30					2 (33.6)	3 (26.7)	3 (26.7)			
	37	119 (13.5)	119 (13.5)			1 (42.4)	2 (33.6)	2 (33.6)			
	45					3X2 (26.7X2)	1/0 (53.5)	3X2 (26.7X2)	10 (5.3)		
	55					2X2 (33.6X2)	1/0 (53.5)	3X2 (26.7X2)	8 (8.4)		
	75					2/0 (67.4)	3/0 (85)	4/0 (107.2)	6 (13.3)		
	90	239 (27)	239 (27)			3/0 (85)	4/0 (107.2)	1X2 (42.4X2)			
	110					1X2 (42.4X2)	1/0X2 (53.5X2)	1/0X2 (53.5X2)	4 (21.2)		
	132					350 (177)	400 (203)	3/0X2 (85X2)	3 (26.7)		
	160					3/0X2 (85X2)	3/0X2 (85X2)	4/0X2 (107.2X2)	2 (33.6)		
	200	425 (48)	239 (27)			4/0X2 (107.2X2)	250X2 (127X2)	300X2 (152X2)			
	220					250X2 (127X2)	300X2 (152X2)	350X2 (177X2)	1/0 (53.5)		
	280					400X2 (203X2)	400X2 (203X2)	250X3 (127X3)	2/0 (67.4)		
	315					250X3 (127X3)	250X3 (127X3)	300X3 (152X3)	3/0 (85)		
355	600X2 (304X2)			600X2 (304X2)	400X3 (203X3)	250 (127)					
400	350X3 (177X3)			350X3 (177X3)	500X3 (253X3)						

# Introduction

## VT use

Voltage	Inverter type FRN□ VG7S-2/4	Required torque [lb-inch](N·m)				Wire size [AWG] (mm <sup>2</sup> )					
		Main terminal	Ground	Auxiliary control power	Control	L1/R,L2/S, L3/T	U,V,W	P1,P(+)	P(+),DB, N(-)	Auxiliary control power	Control
3-phase 200V	0.75	31.0 (3.5)	31.0 (3.5)	10.6 (1.2)	6.2 (0.7)	14 (2.1)	14 (2.1)	14 (2.1)	14 (2.1)	16 (1.3)	24 (0.2)
	1.5					12 (3.3)	10 (5.3)	10 (5.3)			
	2.2					8 (8.4)	8 (8.4)	6 (13.3)			
	3.7					6 (13.3)	8 (8.4)	6 (13.3)			
	5.5					8X2 (8.4X2)	6 (13.3)	6 (13.3)			
	7.5					6X2 (13.3X2)	8X2 (8.4X2)	10X2 (5.3X2)			
	11	4X2 (21.2X2)	3 (26.7)			3 (26.7)	12 (3.3)				
	15	51.3 (5.8)	51.3 (5.8)			6X2 (13.3X2)	6X2 (13.3X2)	6X2 (13.3X2)	10 (5.3)		
	18.5					3X2 (26.7X2)	4X2 (21.2X2)	4X2 (21.2X2)	8 (8.4)		
	22					3X2 (26.7X2)	3X2 (26.7X2)	3X2 (26.7X2)	6 (13.3)		
	30	119 (13.5)	119 (13.5)			1X2 (42.4X2)	2X2 (33.6X2)	2X2 (33.6X2)	4 (21.2)		
	37	239 (27)				2/0X2 (67.4X2)	4/0 (107.2)	1X2 (42.4X2)	2 (33.6)		
	45					3/0X2 (85X2)	1/0X2 (53.5X2)	2/0X2 (67.4X2)	10 (5.3)		
	55					2/0X2 (67.4X2)	3/0X2 (85X2)	4/0X2 (107.2X2)	4 (21.2)		
75	425 (48)	239 (27)		4/0 (107.2X2)	4/0X2 (107.2X2)	250X2 (127X2)	1 (42.4)				
90	250X2 (127X2)	300X2 (152X2)		350X2 (177X2)							
3-phase 400V	3.7	31.0 (3.5)	31.0 (3.5)	10.6 (1.2)	6.2 (0.7)	10 (5.3)	12 (3.3)	14 (2.1)	14 (2.1)	16 (1.3)	24 (0.2)
	5.5					8 (8.4)	10 (5.3)	10 (5.3)			
	7.5					6 (13.3)	8 (8.4)	6 (13.3)			
	11	51.3 (5.8)	51.3 (5.8)			4 (21.2)	8 (8.4)	6 (13.3)	6 (13.3)		
	15					3 (26.7)	6 (13.3)	6 (13.3)	12 (3.3)		
	18.5					6X2 (13.3X2)	4 (21.2)	4 (21.2)	10 (5.3)		
	22	119 (13.5)	119 (13.5)			1 (42.4)	2 (33.6)	2 (33.6)	5 (3.3)		
	30					3X2(26.7X2)	(33.6)	1 (42.4)	8 (8.4)		
	37					2X2 (33.6X2)	(53.5)	3X2 (26.7X2)	6 (13.3)		
	45					3X2 (26.7X2)	(33.6X2)	2X2 (33.6X2)	4 (21.2)		
	55					3/0 (85)	4/0 (107.2)	1X2 (42.4X2)	3 (26.7)		
	75					1X2 (42.4X2)	1/0X2 (53.5X2)	1/0X2 (53.5X2)	10 (5.3)		
	90	239 (27)	239 (27)			1/0X2 (53.5X2)	2/0X2 (67.4X2)	3/0X2 (85X2)	4 (21.2)		
	110					3/0X2 (85X2)	3/0X2 (85X2)	4/0X2 (107.2X2)	3 (26.7)		
	132					4/0X2 (107.2X2)	250X2 (127X2)	300X2 (152X2)	2 (33.6)		
	160	425 (48)	239 (27)			250X2 (127X2)	300X2 (152X2)	350X2 (177X2)	1/0 (53.5)		
	200					350X2 (177X2)	400X2 (203X2)	500X2 (253X2)	2/0 (67.4)		
	220					4/0X3 (107.2X3)	250X3 (127X3)	300X3 (152X3)	3/0 (85)		
280	300X3 (152X3)			300X3 (152X3)	400X3 (203X3)	250 (127)					
315	350X3 (177X3)			350X3 (177X3)	500X3 (253X3)						
355	500X3 (253X3)			600X3 (304X3)	600X3 (304X3)						

\* "Suitable for use on a circuit capable of delivering not more than 42,000 rms symmetrical amperes, 230V maximum" rated for 200V class input.

\* "Suitable for use on a circuit capable of delivering not more than 42,000 rms symmetrical amperes, 480V maximum" rated for 400V class input.

For the incoming power of the inverter, connect the power supply satisfying the requirements specified in the table below (short-circuit rating).

Inverter type	Max. input voltage	Input source current
FRN0.75VG7S-2 to FRN90VG7S-2	230V AC	Less than 42,000A
FRN3.7VG7S-4 to FRN400VG7S-4	480V AC	

2. 90°C copper wire

CT/HT use

Voltage	Inverter type FRN□ VG7S-2/4	Required torque [lb-inch](N·m)				Wire size [AWG] (mm <sup>2</sup> )					
		Main terminal	Ground	Auxiliary control power	Control	L1/R,L2/S, L3/T	U,V,W	P1,P(+)	P(+),DB, N(-)	Auxiliary control power	Control
3-phase 200V	0.75	31.0 (3.5)	31.0 (3.5)	10.6 (1.2)	6.2 (0.7)	14 (2.1)	14 (2.1)	14 (2.1)	14 (2.1)	16 (1.3)	24 (0.2)
	1.5										
	2.2										
	3.7										
	5.5										
	7.5										
	11										
	15										
	18.5										
	22										
	30										
	37										
	45										
	55										
75											
90											
3-phase 400V	3.7	31.0 (3.5)	31.0 (3.5)	10.6 (1.2)	6.2 (0.7)	14 (2.1)	14 (2.1)	14 (2.1)	14 (2.1)	16 (1.3)	24 (0.2)
	5.5										
	7.5										
	11										
	15										
	18.5										
	22										
	30										
	37										
	45										
	55										
	75										
	90										
	110										
	132										
	160										
	200										
	220										
	280										
	315										
	355										
	400										

# Introduction

VT use												
Voltage	Inverter type FRN□ VG7S-2/4	Required torque [lb-inch](N·m)				Wire size [AWG] (mm <sup>2</sup> )						
		Main terminal	Ground	Auxiliary control power	Control	L1/R,L2/S, L3/T	U,V,W	P1,P(+)	P(+),DB, N(-)	Auxiliary control power	Control	
3-phase 200V	0.75	31.0 (3.5)	31.0 (3.5)	10.6 (1.2)	6.2 (0.7)	14 (2.1)	14 (2.1)	14 (2.1)	14 (2.1)	16 (1.3)	24 (0.2)	
	1.5					10 (5.3)						
	2.2					8 (8.4)						
	3.7					6 (13.3)						
	5.5					8X2 (8.4X2)						
	7.5	6X2 (13.3X2)	6 (13.3)									
	11	51.3 (5.8)	51.3 (5.8)			4X2 (21.2X2)	6 (13.3)	6 (13.3)				
	15					6X2 (13.3X2)	4 (21.2)	3 (26.7)				
	18.5					4X2 (21.2X2)	6X2 (13.3X2)	4X2 (21.2X2)				10 (5.3)
	22					3X2 (26.7X2)	4x2 (21.2x2)	3X2 (26.7X2)				8 (8.4)
	30					2X2 (33.6X2)	1/0X2 (53.5X2)	3/0 (107.2)				6 (13.3)
	37	239 (27)	119 (13.5)			2/0X2 (67.4X2)	1x2 (42.4x2)	1/0X2 (53.5X2)				
	45					1/0X2 (53.5X2)	2/0X2 (67.4X2)	3/0X2 (85X2)				4 (21.2)
	55					3/0X2 (85X2)	3/0X2 (85X2)	4/0X2 (107.2)				2 (33.6)
75	425 (48)	239 (27)	4/0X2 (107.2X2)	4/0X2 (107.2X2)	300X2 (152X2)							
90												
3-phase 400V	3.7	31.0 (3.5)	31.0 (3.5)	10.6 (1.2)	6.2 (0.7)	12 (3.3)	14 (2.1)	14 (2.1)	14 (2.1)	16 (1.3)	24 (0.2)	
	5.5					10 (5.3)						
	7.5					8 (8.4)						
	11	51.3 (5.8)	51.3 (5.8)			6 (13.3)	10 (5.3)	8 (8.4)				
	15					4 (21.2)						
	18.5					3 (26.7)	6 (13.3)	6 (13.3)				
	22					2 (33.6)	4 (21.2)	3 (26.7)				
	30					1/0 (53.5)	2 (33.6)	2 (33.6)				12 (3.3)
	37	119 (13.5)	119 (13.5)			4X2 (21.2X2)	1 (42.4)	1/0 (53.5)				
	45					1/0 (53.5)	4X2 (21.2X2)	3X2 (26.7X2)				8 (8.4)
	55					3/0 (85)	3/0 (85)	4/0 (107.2)				6 (13.3)
	75	239 (27)	239 (27)			4/0 (107.2)	1X2 (42.4X2)	1X2 (42.4X2)				
	90					1X2 (42.4X2)	1/0X2 (53.5X2)	2/0X2 (67.4X2)				4 (21.2)
	110	425 (48)	239 (27)			400 (203)	400 (203)	3/0X2 (85X2)				
	132					3/0X2 (85X2)	4/0X2 (107.2X2)	250X2 (127X2)				1 (42.4)
	160					4/0X2 (107.2X2)	300X2 (152X2)	1/0 (53.5)				
	200					300X2 (152X2)	350X2 (177X2)	400X2 (203X2)				2/0 (67.4)
	220					350X2 (177X2)	400X2 (203X2)	250X3 (127X3)				4/0 (107.2)
	280					4/0X3 (107.2X3)	250X3 (127X3)	300X3 (152X3)				
	315					600X2 (304X2)	600X2 (304X2)	400X3 (203X3)				
355	400			400	400X3 (203X3)	500X3 (253X3)	600X3 (304X3)					
400												

\* "Suitable for use on a circuit capable of delivering not more than 42,000 rms symmetrical amperes, 230V maximum" rated for 200V class input.  
 \* "Suitable for use on a circuit capable of delivering not more than 42,000 rms symmetrical amperes, 480V maximum" rated for 400V class input.

For the incoming power of the inverter, connect the power supply satisfying the requirements specified in the table below (short-circuit rating).

Inverter type	Max. Input voltage	Input source current
FRN0.75VG7S-2 to FRN90VG7S-2	230V AC	Less than 42,000A
FRN3.7VG7S-4 to FRN400VG7S-4	480V AC	

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## Compliance with European standards

The CE marking attached on our product indicates compliance with Electromagnetic Compatibility Directives 89/336/EEC and Low Voltage Directives 73/23/EEC announced by Council of the European Union.

**Complying standard** - EN61800-3: 1997  
- EN50178: 1997

The FRENIC 5000 VG7S Series 400V class models are complying with the above standards. The 200V class models are out of compliance. Among 400V class, CT/HT use 18.5kW and VT use 22kW are out of compliance. If you need a compliant product, use one capacity larger model (CT/HT use 22kW or VT use 30kW).

### 1) Compliance with Low Voltage Directives

#### (1) General

The inverter is applicable to the European Low Voltage Directives. Our product is certified by a European auditor to be compliant with the standard and therefore we declares compatibility with the Low Voltage Directives.

#### (2) Caution

To use our product as one certified to the European low voltage directive, note the following cautions.

 <b>CAUTION</b>
<ul style="list-style-type: none"><li>• The contact capacity specification of batch alarm output (30A, B, C) and relay signal output (Y5A and Y5C) is 48VDC 0.5A.</li><li>• Ground the inverter securely.</li><li>• To connect to the main circuit terminal or inverter grounding terminal, connect a ring terminal to the cable.</li><li>• Connect an inverter grounding terminal exclusively. (Do not connect two or more cables.)</li><li>• To use an earth leakage breaker (RCD), only type B can be used for protection on the power supply side. Or use a transformer to isolate the power supply and inverter with double shields or to take a reinforced isolation measures.</li><li>• Use a molded case circuit breaker (MCCB) and magnetic contactor (MC) complying with EN or IEC standard.</li><li>• In a power supply system (I-T NET) that is not grounded at the neutral point, the control terminal is basically isolated from the main circuit. If there is direct personal contact, install an external isolating circuit to isolate with double shields.</li><li>• Operate the inverter under the overvoltage category III, pollution degree 2 or better conditions specified in IEC664. To assure pollution degree 2 or better, install the inverter in a control panel (IP54 or above) having a structure where water, oil, carbon, dust particles or the like does not enter.</li><li>• Use the cable diameter and cable type specified in EN60204 Annex C for the input/output wiring of the inverter.</li><li>• To install an external heat sink to the inverter that extends out of the control panel, provide the heat sink with a protective cover so that the capacitors and braking resistors installed on the heat sink are out of personal reach.</li><li>• To install an optional AC reactor, DC reactor or external braking resistor, follow the description below to avoid electric shock caused at terminals or live parts.<ol style="list-style-type: none"><li>1) If terminals or live parts are likely to be in personal reach, install them inside an IP4X enclosure or partition.</li><li>2) If terminals or live parts are likely to be out of personal reach, install them inside an IP2X enclosure or partition.</li></ol></li></ul>

# Introduction



Table 1-2 Applicable devices and cable size (400V class) of main circuit for assuring compliance with Low Voltage Directives

Voltage	Applied motor kW	Inverter type FRN□	Fuse/MCCB Rated current		Tightening torque [N·m]				Recommended cable size [mm <sup>2</sup> ]									
			With DCR	Without DCR	L1/R, L2/S, L3/T U, V, W	P1, P(+), DB, N(-) P1, P(+), DB, N(-)	G	R0, T0	Control section	L1/R, L2/SL3/T (G)		U, V, W	R0, T0	P1, P(+)	P(+), DB, N(-)	Control section		
										With DCR	Without DCR							
400V class	3.7	3.7VG7S-4(CT/HT)	10	15	3.5			1.2	0.7	2.5	2.5	2.5		2.5				
	5.5	3.7VG7S-4(VT)	15	20						(2.5)	4							
	5.5	5.5VG7S-4(CT/HT)	20	30						6	4							
	7.5	5.5VG7S-4(VT)															(4)	6
	7.5	7.5VG7S-4(CT/HT)																
	11	7.5VG7S-4(VT)	30	40						5.8								1.2
	11	11VG7S-4(CT/HT)	40	50	(4)	10												
	15	11VG7S-4(VT)					6	16										
	15	15VG7S-4(CT/HT)	(6)	(16)														
	18.5	15VG7S-4(VT)	40	60	13.5			1.2	0.7	10	25	2.5 to 6		2.5				
	22	22VG7S-4(CT/HT)	75	100						(16)	16X2							
	30	22VG7S-4(VT)														25	50	
	30	30VG7S-4(CT/HT)	100	125						(16)	25							
	37	30VG7S-4(VT)														35	50	
	37	37VG7S-4(CT/HT)	100	150						(25)	25X2							
	45	37VG7S-4(VT)			50	35X2												
	45	45VG7S-4(CT/HT)	125	175			(25)	35X2										
	55	45VG7S-4(VT)			25X2	25X2												
	55	55VG7S-4(CT/HT)	175	-			25X2	-										
	75	55VG7S-4(VT)			70(35)	95												
	75	75VG7S-4(CT)	95	-														
	90	75VG7S-4(VT)			200	-	(50)	35X2										
	90	90VG7S-4(CT)	225	-					50X2	50X2								
	110	90VG7S-4(VT)			27		50X2	70X2										
	110	110VG7S-4(CT)	300	-					70X2	95X2								
	132	110VG7S-4(VT)			350	-	185	240										
	132	132VG7S-4(CT)	160	132VG7S-4(VT)					240	95X2								
	160	132VG7S-4(VT)			400	-	(120)	120X2										
	160	160VG7S-4(CT)	200	200VG7S-4(CT)					120X2	150X2								
	200	160VG7S-4(VT)			200	200VG7S-4(VT)	-	120X2										
	200	200VG7S-4(CT)	500	-					-	150X2								
	220	200VG7S-4(VT)			220	220VG7S-4(CT)	120X2	185X2										
	220	220VG7S-4(CT)	600	-					185X2	240X2								
	280	220VG7S-4(VT)			280	280VG7S-4(CT)	-	240X2										
	280	280VG7S-4(CT)	700	-					240X2	185X3								
315	280VG7S-4(VT)	315			315VG7S-4(CT)	240X2	-											
315	315VG7S-4(CT)		800	-				(240)	150X3									
355	315VG7S-4(VT)	355			355VG7S-4(CT)	240X2	-											
355	355VG7S-4(CT)		1,000	-				(240)	300X2									
400	355VG7S-4(VT)	400			400VG7S-4(CT)	185X3	-											
400	400VG7S-4(CT)		1,200	-				(300)	185X3									
500	400VG7S-4(VT)	240X3			-	-	300X3											

Notes: The cable to be used is isolated PVC 600V cable with allowable temperature 70°C.  
Selection is made at ambient temperatures within 50°C.

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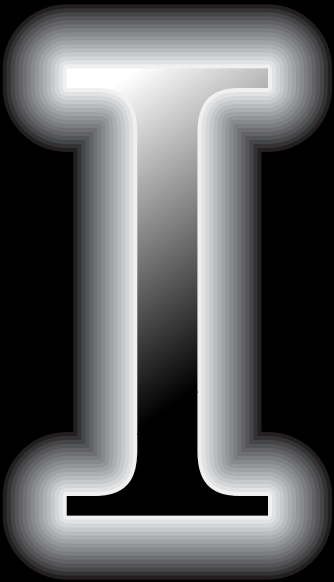
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# THE INVERTER



## I . Vector Control Inverter System FRENIC5000VG7S

- 1.1 Outline
- 1.2 Features
- 1.3 Control Systems

# 1. Vector Control Inverter System FRENIC5000VG7S

## 1.1 Outline

### 1.1.1 The Industry's Best Control Capability

- The multi-drive functions have vector control, sensorless vector control, V/f control and vector control for synchronous motors.
- Vector control with dedicated motors has attained the industry's best control capabilities such as; speed control accuracy of  $\pm 0.005\%$ , speed response of 100Hz, current response of 800Hz and torque control accuracy (linearity) of  $\pm 3\%$ .

### 1.1.2 System Integration

- UPAC, the optional card incorporating user-programmable functions, enables user-original system configuration and construction. Dedicated package software products are also available.
- The RS-485 communication function is provided as standard and T-Link and SX bus communication functions are available as options.
- Inverter support loader for Windows is supplied to facilitate function code setting.

### 1.1.3 A Wealth of Integrated Functions

- The tuning function has been enhanced to optimally control different motors.
- Load vibration suppressing observer and load adaptive control functions are built in.
- Position control functions, such as zero speed locking control, have been upgraded.
- Position synchronization control using pulse train input is built in.
- Orientation control is available as an option.

### 1.1.4 A Wide Range of Capacities and Applications

- A single specification with a capacity range from 0.75kW to 400kW makes system construction simple.
- Optimal control is achieved with the CT use (constant torque) for 150% overload capability, the VT use (variable torque) for 110% overload capability and the HT use for 200%/170% overload torque.

### 1.1.5 Global Products

- A standard product that conforms to UL/cUL and CE marking, allowing unification of devices and machines made at home and abroad.
- The KEYPAD panel is set for 8 languages as standard to make exporting simple.
- Various options to connect to all types of the field bus are available

## 1.2 Features

High-performance vector control inverter capable of controlling motor speed and torque at will.

### 1.2.1 The Industry's Best Control Capability

- Speed control accuracy of  $\pm 0.005\%$  (tested with a dedicated motor with PG under vector control: one half compared to our conventional model).
- Speed response of 100Hz (tested with a dedicated motor with PG under vector control: two times compared to our conventional model).
- Current response of 800Hz (tested with a dedicated motor with PG under vector control: four times compared to our conventional model).
- Torque control accuracy (linearity) of  $\pm 3\%$ .

#### Wow characteristics

Wow at low speed has been improved down to 60% or less (1Hz) by enhancing the speed response frequency by 2 times (compared with VG5), digital speed control accuracy by one tenth, and current control response by four times (compared with VG5).

Conventional model (FRENIC5000VG5)

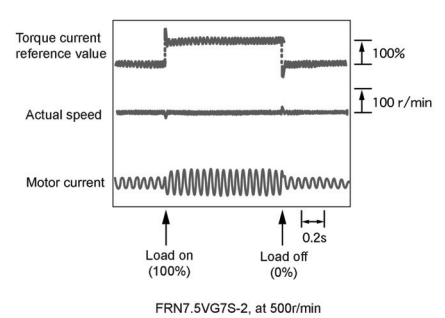


FRENIC5000VG7S

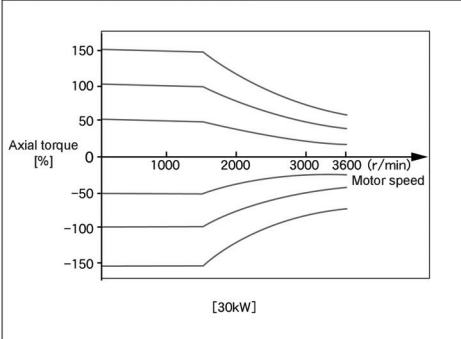


[37kW]

#### Follow-up characteristics under impact load

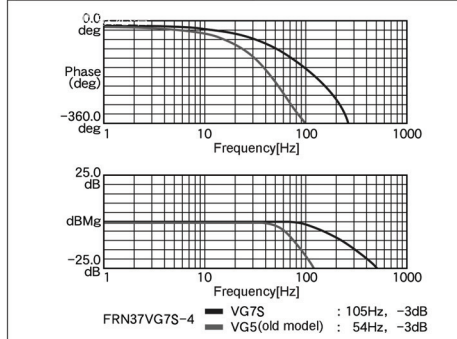


#### Speed-torque characteristics



[30kW]

#### Speed response characteristics



### 1.2.2 Use with Different Control Types (Multi-drive Function)

- You can select from four types of control for different motors; vector control, senserless vector control, V/f control for induction motors, and vector control for synchronous motors (optional card required).

### 1.2.3 A Wide Range of Capacity/flexible Applications

- Simple system construction based on a single specification with a capacity range from 0.75kW to 800kW.
- A standard product that meets three specifications.

Specification type	Overload	Main application	Carrier frequency
CT	150%	Constant torque applications	High frequency
VT(*)	110%	Variable torque applications	Low frequency
HT	200% / 170%	Vertical transfer applications	High frequency

(\*) One class smaller model applicable.

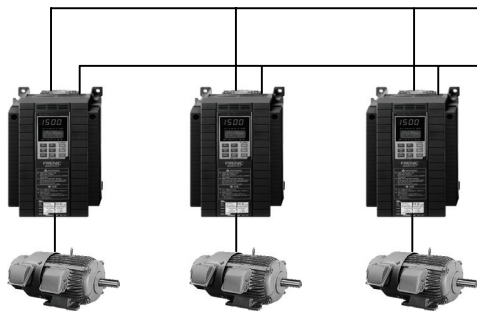
# 1. Vector Control Inverter System FRENIC5000VG7S

## 1.2.4 Built-in User-programmable Functions (Option as UPAC)

- Users can personalize inverter control and terminal functions in order to build an original system using the programmable functions of UPAC (User Programmable Application Card).
- Dedicated package software products for tension control, dancer control and position control are provided .

### UPAC System

Link for inverters (optical communication)  
Min.2ms cycle with optical transmission



Personal computer



Inverter support loader  
UPAC support loader  
(Equivalent to D300win)  
RS-485/RS-232C converter

RS-485(38.4kbps)

UPAC is installed only on a master VG7S inverter.  
An inverter link option is installed on each inverter.

FRENIC5000VG7S dedicated  
motors or general-purpose motors

## 1.2.5 Enhanced Network Readiness

- The RS-485 communication function is provided as standard, and the T-Link and SX bus (available soon) functions are provided as options.
- Different field bus types (Profibus-DP, etc) can also be used (available soon).

### T-Link System

MICREX-F or MICREX-SX with T-Link module



Personal computer



T-Link(500kbps)

RS-485(38.4kbps)

RS-485/RS-232C converter



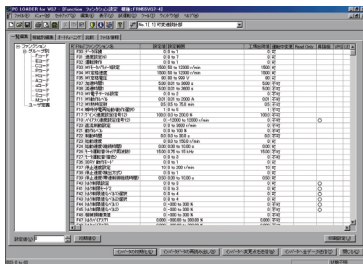
VG7S with T-Link option

FRENIC5000VG7S dedicated  
motors or general-purpose  
motors

Install a dedicated SX bus option to connect with the SX bus. Install dedicated bus options to connect with different types of field buses (Profibus-DP, etc).

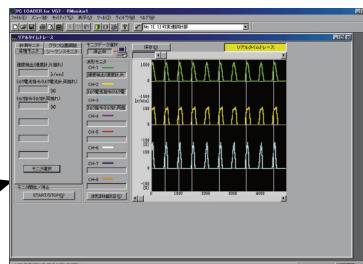
## 1.2.6 Inverter Support Loader Provided

- An inverter support loader for Windows is available as an option to facilitate function code setting.



You can set an operational environment easily with the inverter support loader software by connecting to your personal computer over built-in RS-485 interface (max. 38,400bps).

The loader runs on Windows95/98 and NT. Real-time trace and historical trace are incorporated along with an operation monitor and function settings.



## 1.2.7 Enhanced Built-in Functions

- Improved tuning function  
Motor parameters can be tuned while the motor is stopped.
- Built-in observer function for load vibration suppressing
- Equipped with load adaptive control function  
Steeples variable double-speed control is possible at low speed.
- Increased position control
  - Zero-speed locking control is possible.
  - Position synchronizing control with pulse train input is possible as an option.
  - Orientation control is possible as an option.
- Vector control is applicable to two types of motors. Also, V/f control is applicable to the third motor.
- Built-in braking unit  
Built-in braking unit for 55kW or smaller models (200V series) and for 110kW or smaller models (400V series) allows for downsizing machines and devices.
- 23 I/O terminal points

	Input	Output
Analog	3 points	3 points
Digital	11 points	6 points

- Built-in PG feedback card
  - Both 12V and 15V voltage inputs are accepted.
  - The card can handle line drivers as an option.

## 1.2.8 Upgraded Maintenance/protective Functions

- I/O terminal checking function
- Main circuit capacitor life judgment
- Inverter load factor measure
- Records and displays accumulated operation time
- Displays operating conditions, such as output voltage, heat sink temperature and calculated torque value
- Detailed data is recorded on the inverter trip
- Setting the thermal time constant of the electronic thermal overload relay makes different motors applicable.
- Standard protective function against input phase loss. Protects the inverter from damage caused by power line disconnection
- Motor protection with PTC thermistor
- Equipped with terminals for connecting DC REACTOR that can suppress harmonics



# 1. Vector Control Inverter System FRENIC5000VG7S

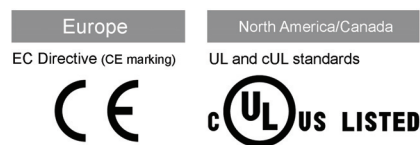
## 1.2.9 Interactive KEYPAD Panel for Simple Operation

- Standard copy function  
Easily copies function code data to other inverters.
- Remote operation capability  
The KEYPAD panel is detachable for remote operation using an optional cable.
- 8 standard language operation (English, German, French, Italian, Spanish, Chinese, Korean and Japanese)
- Jogging operation from the KEYPAD panel or with input from an external signal
- Switching between KEYPAD operations (LOCAL) and external signal input operations (REMOTE) using the KEYPAD panel



## 1.2.10 Conformity to World Standards

- Standard conformity to EC Directive (CE marking), UL and cUL standards enables unification of specifications at home and abroad
- Conforms to the European EMC Directive with optional EMC filters



Note: The models of FRENIC 5000 VG7S Series complying with European standard are 400V class only. The 200V class is out of compliance. In 400V class, CT specification 18.5kW and 250kW, VT specification 22kW and 300kW and HT specification 18.5kW are out of compliance. If a compliant product is necessary, use one capacity larger model (CT specification: 22kW or 280kW. VT specification: 30kW or 315kW. HT specification: 22kW).

## 1.3 Control Systems

### 1.3.1 Features and Applications of Different Control Systems

The AC motor control inverters are most widely used for controlling the rotational speed of the load. This subsection describes the basic configuration and features of different speed control systems and tips for using them for various applications.

The speed control systems are roughly divided into open loop and closed loop types (see Figure 1-3-1).

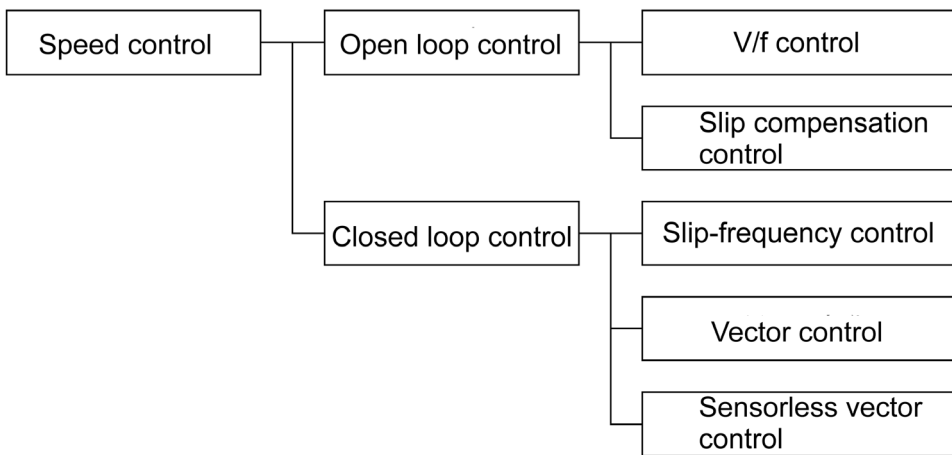


Figure 1-3-1 Speed Control Systems

#### 1.3.1.1 Open Loop Speed Control System

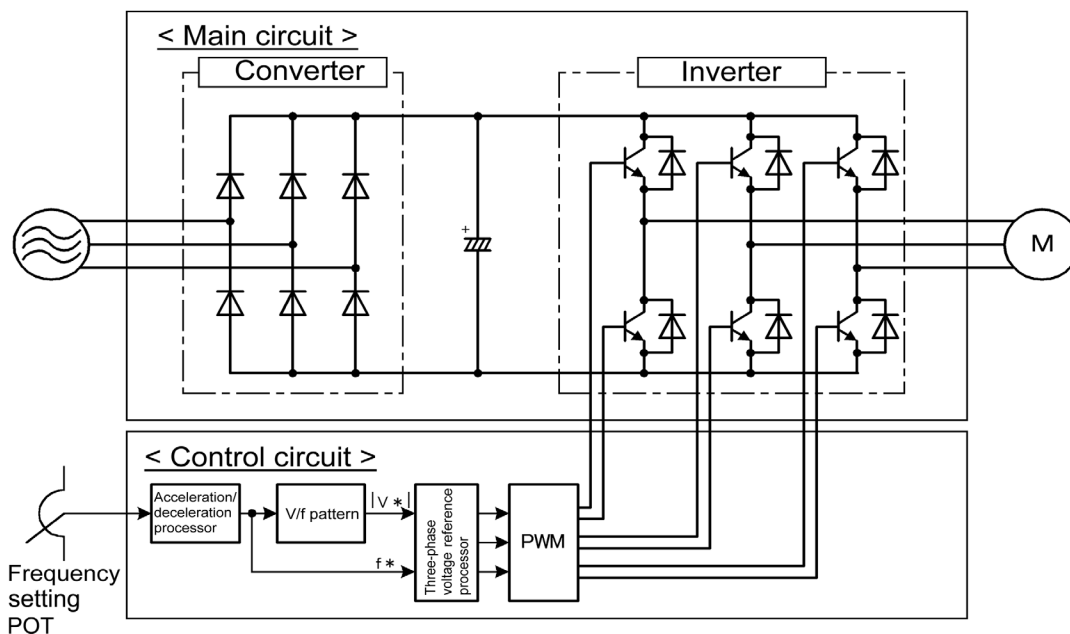


Figure 1-3-2 Basic Configuration of Open Loop Speed Control System

# 1. Vector Control Inverter System FRENIC5000VG7S

As recognized from the basic configuration of the open loop control system in Figure 1-3-2, the speed information is not fed back to the system and the rotational speed of the load is controlled according to the frequency applied by the inverter. As shown in Figure 1-3-3, the induction motor speed is almost constant against the torque variation at each of frequency levels  $f_1$  to  $f_6$ . This means that, with constant voltage and frequency applied to the motor, the motor speed remains almost unchanged if the load torque changes. For example, the slip is less than 10% at the rated torque. In other words, to control the motor speed by changing the inverter output frequency, the ratio control of motor terminal voltage to applied frequency, V/f control is used.

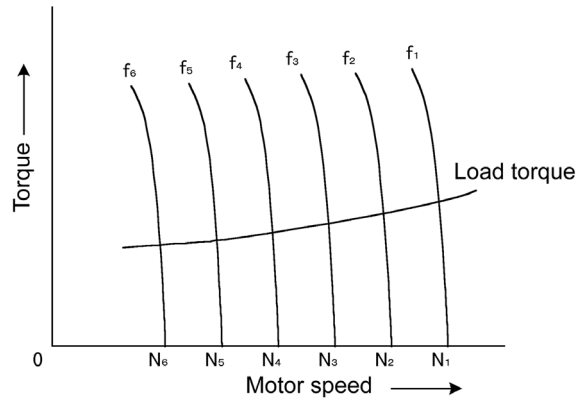


Figure 1-3-3 Motor Speed vs Torque

The open loop control system does not need any speed sensor and is primarily used for general-purpose inverters. This system is suitably used for changing the speeds of existing motors and for variable torque loads not requiring so quick a response such as fans and pumps.

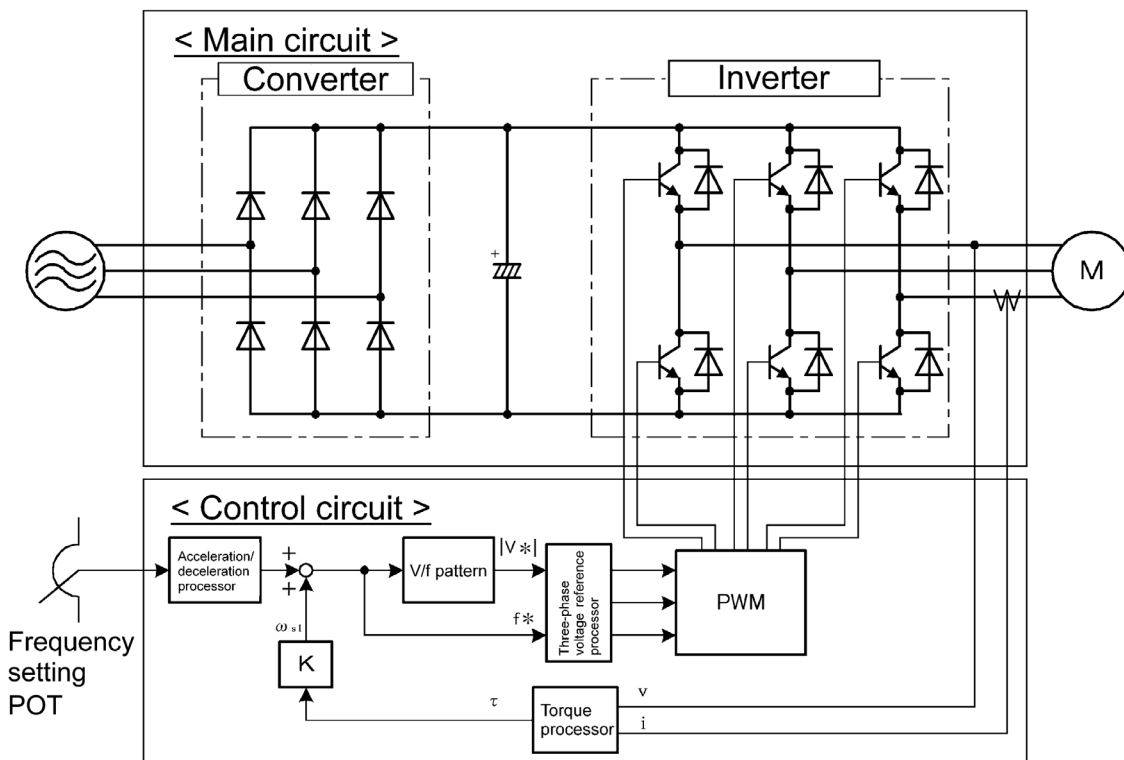


Figure 1-3-4 Slip Compensation Speed Control System

The motor speed accuracy guaranteed by the open loop speed control system depends on the load torque variation, output frequency accuracy, supply voltage variation, etc. The 'slip compensation speed control' is provided to maintain the motor speed against the torque variation by adjusting the inverter output frequency according to the output torque calculated from the motor terminal voltage and primary current as shown in Figure 1-3-4.

### 1.3.1.2 Closed Loop Speed Control Systems

The closed loop speed control system compensates for speed variation according to the speed information fed back to the system.

This system ensures a very precise speed control based on the actual rotational speed of the load under control and applies to paper machines and machine tools.

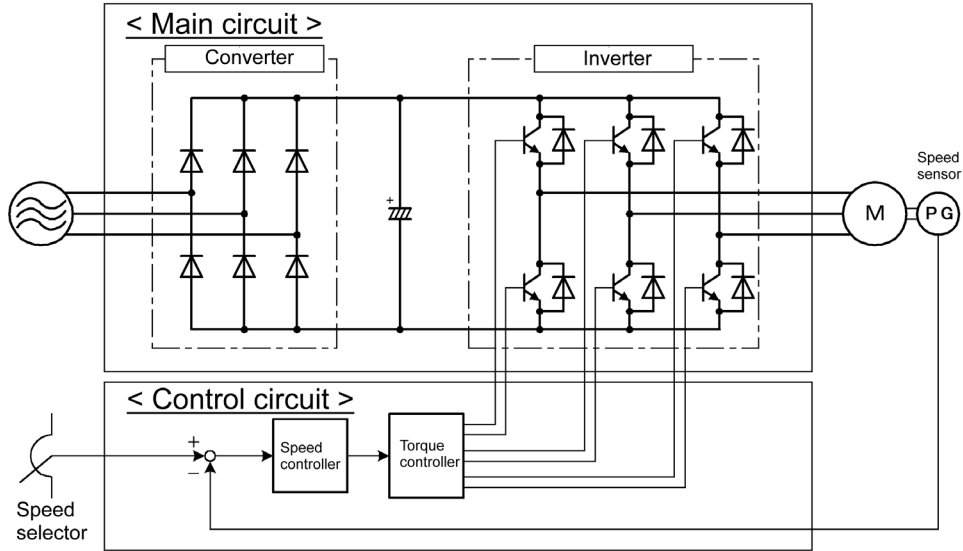


Figure 1-3-5 Basic Configuration of Closed Loop Speed Control System

The basic configuration of the closed loop speed control system is shown in Figure 1-3-5. The speed information is fed back from a speed sensor such as pulse encoder (PG) and compared with the speed command to control the inverter output frequency so that the speed command will agree to the speed sensor reading.

The slip-frequency, vector, or sensorless vector control system is used for speed control. A brief description of each control system is given below.

The FRENIC 5000VG7S series high-performance vector control inverters use a closed loop vector control system for speed control.

(1) Slip-frequency Control System

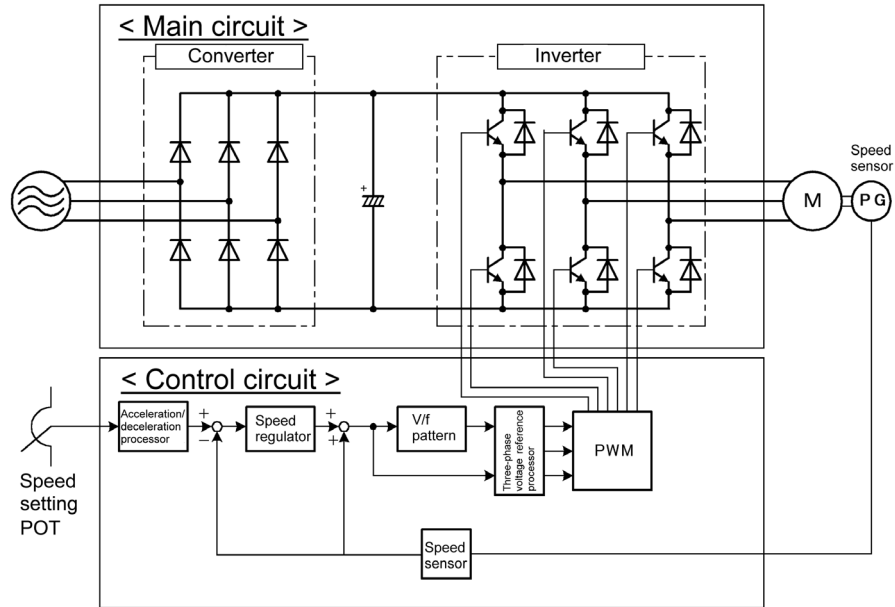


Figure 1-3-6 Configuration of Slip-frequency Control System

# 1. Vector Control Inverter System FRENIC5000VG7S

The configuration of the slip-frequency control system is shown in Figure 1-3-6. The speed regulator outputs a slip-frequency corresponding to the load and compensates for speed variation by adding to the actual speed. This control system is relatively simple and, therefore, used for the speed control system of general-purpose inverters. As it is based on the V/f control, however, it is not suitable for applications requiring a quick response.

## (2) Vector Control system

The vector control system ensures a quick response from an AC motor. This system controls the primary current of the AC motor as divided into magnetic flux and torque components to provide a control performance equivalent to that as would be obtained with DC motors.

Compared with the V/f control system, the vector control system has the following features and is suitable for applications requiring a quick response and high precision.

- 1) An excellent acceleration/deceleration performance
- 2) A wider speed control range
- 3) The torque can be controlled.
- 4) A quick control response

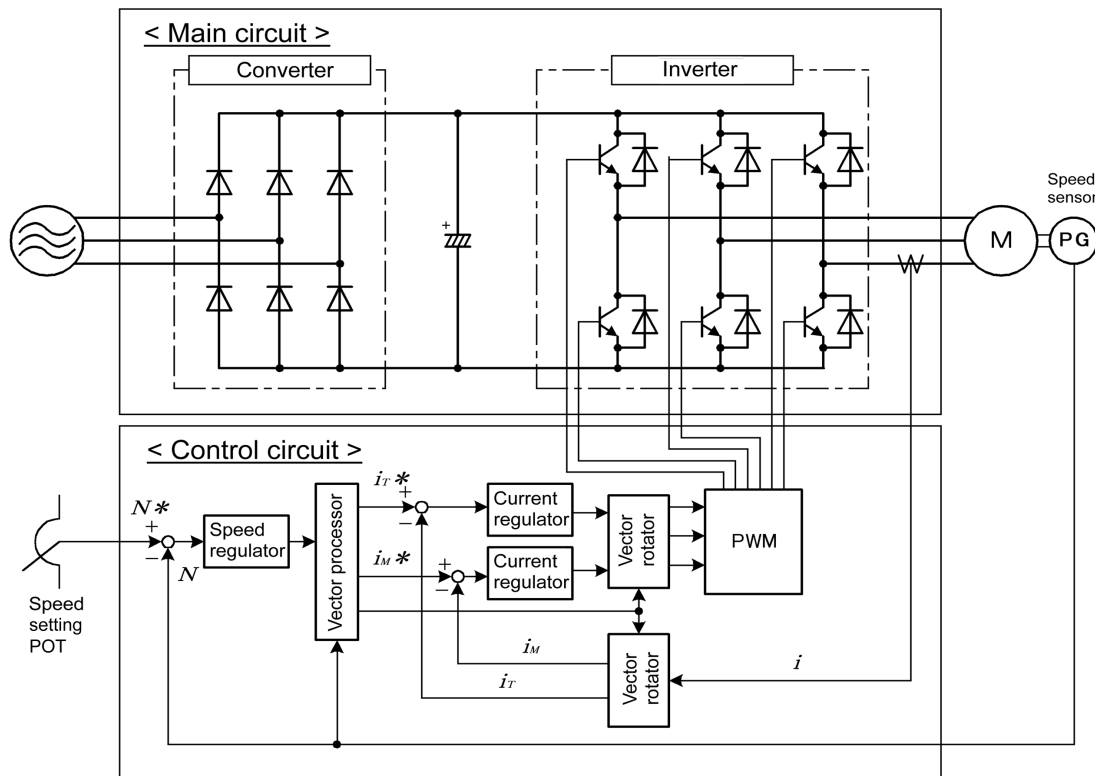


Figure 1-3-7 Example of Configuration of Vector Control System

An example of configuration of the vector control system is given in Figure 1-3-7. The motor parameters are used by the vector processor and, therefore, the performance greatly depends on the parameter detection accuracy. The parameter variation due to the changing ambient conditions also affects the performance in a significant manner. Because of its complexity, this system is mostly used as a combination of dedicated inverter and dedicated motor.

(3) Sensorless Vector Control System

The vector control system ensures a quick response and high accuracy but requires a speed sensor, which may cause a problem when installed or wired. On the other hand, the sensorless vector control system does not require any sensor although it is slightly inferior in performance. This system estimates the motor speed from the motor terminal voltage and primary current and controls the speed using the estimated speed as speed feedback signal.

An example of configuration of the sensorless system is given in Figure 1-3-8.

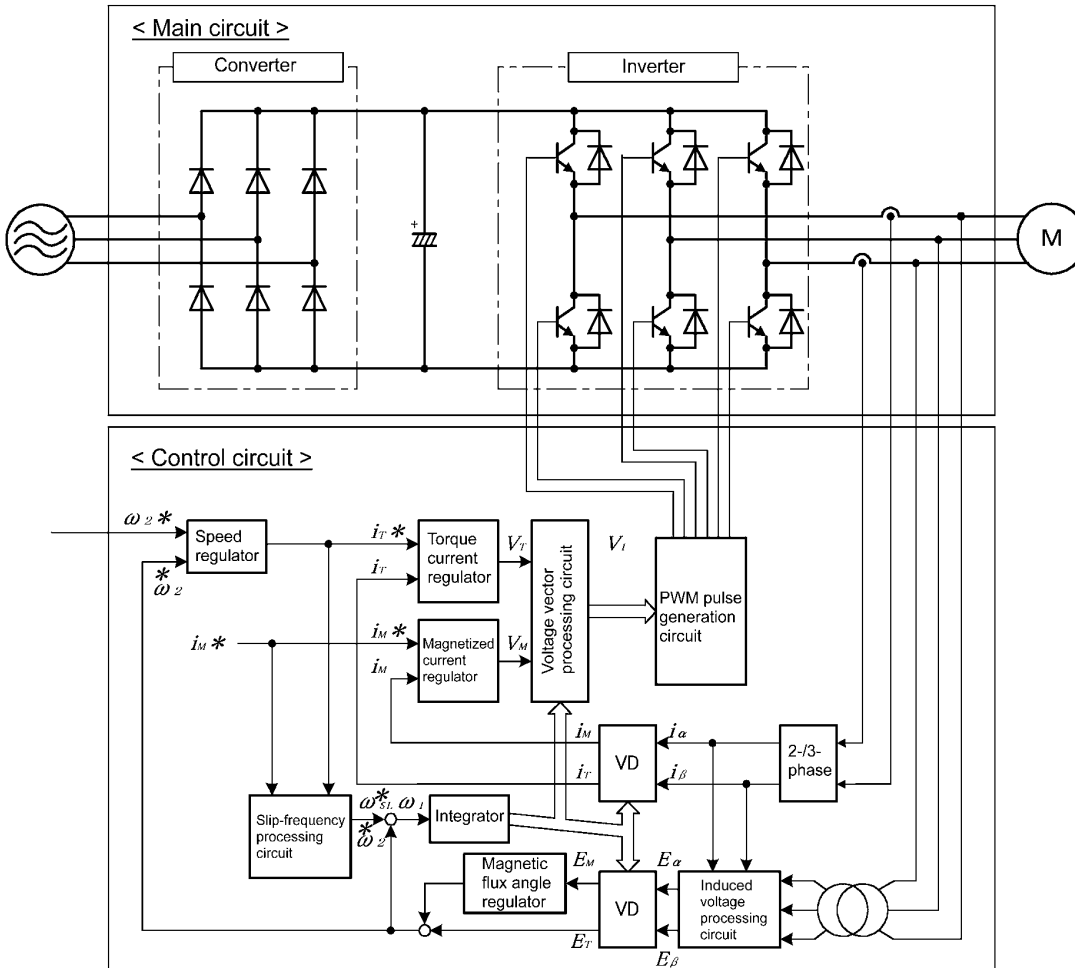


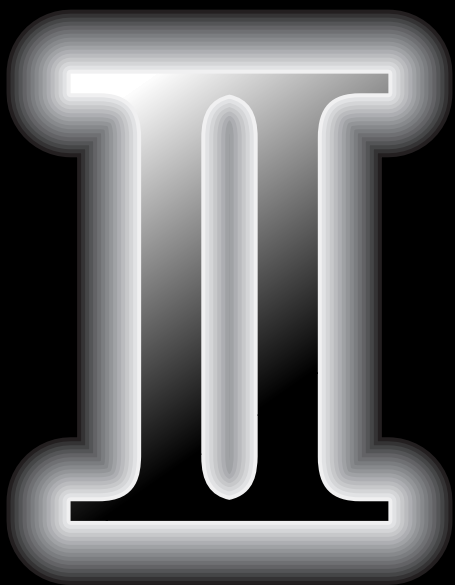
Figure 1-3-8 Example of Construction of Sensorless Vector Control System

The FRENIC 5000VS7S series can also be combined with a general-purpose motor but with a lower control performance than combined with a dedicated motor.

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- MEMO -

# THE INVERTER



## II . Specifications

- 2.1 Standard Specifications
- 2.2 Common Specifications
- 2.3 Basic Wiring Diagram and Terminal Functions



## 2. Specifications

### 2.1 Standard Specifications

#### 2.1.1 CT Use (For Constant Torque, Overload Capability: 150%– 1min.)

##### ● Three-phase 200V series

Type	FRN□VGS-2	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	
Nominal applied motor [kW]		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	
Rated capacity [kVA] (*1)		1.9	3.0	4.1	6.8	10	14	18	24	28	34	44	55	68	81	107	131	
Rated current	(Continuous)	5	8	11	18	27	37	49	63	74	90	116	145	180	215	283	346	
	(1min.)	7.5	12	16.5	27	40.5	55.5	73.5	94.5	111	135	174	217.5	270	333	441	519	
Input ratings	Phase, Voltage, Frequency	3-phase 200 to 230V, 50Hz/60Hz									3-phase 200 to 220V/50Hz, 200 to 230V/60Hz (*2)							
	Voltage/frequency variation	Voltage: +10 to -15%, Frequency: +5 to -5%, Voltage unbalance: 2% or less (*3)																
	Momentary voltage dip capability (*4)	When voltage drops from the rated voltage, the inverter will continue operation if the voltage is more than 165V. If the voltage is less than 165V, the inverter can be operated for 15ms.																
	Rated current [A] (with DCR) (*7)	3.1	5.7	8.3	14.0	19.7	26.9	39.0	54.0	66.2	78.8	109	135	163	199	272	327	
	(without DCR)	6.4	11.1	16.1	25.5	40.8	52.6	76.9	98.5	117	136	168	204	243	291	-	-	
Required power supply capacity [kVA] (*5)		1.1	2.0	2.9	4.9	6.9	9.4	14	19	23	28	38	47	57	69	95	114	
Braking method /braking torque		Braking resistor discharge control: 150% braking torque, Separately installed braking resistor (option), Separately installed braking unit(option for 75KW or more)																
Carrier frequency [kHz] (*6)		0.75 to 15															0.75 to 10	
Mass [kg]		8	8	8	8	8	12.5	12.5	25	25	30	37	46	48	70	115		
Enclosure		IP20									IP00(IP20:option)							

\*1) Inverter output capacity [kVA] at 220V.

\*2) Order individually for 220 to 230V/50Hz.

\*3) Use a DC REACTOR if the voltage unbalance exceeds 2% (this is the same as for FUJI's conventional models).

$$\text{Voltage unbalance [\%]} = (\text{Max. voltage [V]} - \text{Min. voltage [V]}) / \text{Three-phase average voltage [V]} \times 67$$

\*4) Tested at the standard load condition (85% load of nominal applied motor) prescribed by JEMA.

\*5) When power-factor correcting DC REACTOR is used. (Optional for 55kW or less model).

\*6) The inverter may automatically reduce carrier frequency in accordance with ambient temperature or output current in order to protect itself.

\*7) This value is obtained by using a FUJI original calculation method.

\*8) Use the function code F80 to switch between CT, VT and HT uses.

##### ● Three-phase 400V series

Type	FRN □VGS-4	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	250	280	315	355	400	500	630	710B	800B	
Nominal applied motor [kW]		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	250	280	315	355	400	500	630	710	800	
Rated capacity [kVA] (*1)		6.8	10	14	18	24	29	34	45	57	69	85	114	134	160	192	231	287	316	356	396	445	495	563	731	891	1044	1127	
Rated current	(Continuous)	9	13.5	18.5	24.5	32	39	45	60	75	91	112	150	176	210	253	304	377	415	468	520	585	650	740	960	1170	1370	1480	
	(1min.)	13.5	20	27.5	36.5	48	58.5	67.5	90	113	137	168	225	264	315	380	456	566	623	702	780	878	975	1110	1440	1755	2055	2220	
Input ratings	Phase, Voltage, Frequency	3-phase 380 to 480V, 50Hz/60Hz														3-phase 380 to 440V/50Hz, 380 to 480V/60Hz (*8)										DC513 to 758V			
	Voltage/frequency variation	Voltage: +10 to 15%, Frequency: +5 to 5%, Voltage unbalance: 2% or less (*2)																											
	Momentary voltage dip capability (*3)	When voltage drops from the rated voltage, the inverter will continue operation if the voltage is more than 310V. If the voltage is less than 310V, the inverter can be operated for 15ms.																											
	Rated current [A] (with DCR) (*6)	7.1	10	13.5	19.8	26.8	33.2	39.3	54	67	81	100	134	160	196	232	282	352	385	438	491	552	624	704	880	1104	-	-	
	(without DCR)	14.9	21.5	27.9	39.1	50.3	59.9	69.3	86	104	124	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Required power supply capacity [kVA] (*4)		5.0	7.0	9.4	14	19	24	28	38	47	57	70	93	111	136	161	196	244	267	304	341	383	432	488	610	765	-	-	
Braking method/braking torque		Braking resistor discharge control: 150% braking torque, Separately installed braking resistor (option), Separately installed braking unit (option for 132kW or more)																											
Carrier frequency [kHz] (*5)		0.75 to 15														0.75 to 10													
Mass [kg]		8	8	8	12.5	12.5	25	25	30	35	40	41	50	72	72	100	100	140	140	150	250	250	360	360	525	525	225 X 3		
Enclosure		IP20														IP00 (IP20: option)													

\*1) Inverter output capacity [kVA] at 440V.

\*2) Use a DC REACTOR if the voltage unbalance exceeds 2% (this is the same as for FUJI's conventional models).

$$\text{Voltage unbalance [\%]} = (\text{Max. voltage [V]} - \text{Min. voltage [V]}) / \text{Three-phase average voltage [V]} \times 67$$

\*3) Tested at the standard load condition (85% load of nominal applied motor) prescribed by JEMA.

\*4) When power-factor correcting DC REACTOR is used. (Optional for 55kW or less model)

\*5) The inverter may automatically reduce carrier frequency in accordance with ambient temperature or output current in order to protect itself.

\*6) This value is obtained by using a FUJI original calculation method.

\*7) Use the function code F80 to switch between CT, VT and HT uses.

\*8) When the input voltage is 380 to 398V/50Hz or 380 to 430V/60Hz, a connector inside the inverter must be switched.

Note) The output may become reduced in case of 380V. For details, refer to Section 11-5 List of Special Combinations.

\*9) The 18.5kW and 250kW models are not compliant with EU Directives. For compliance with EU Directives, choose models with one size higher capacities (22kW and 280kW models respectively).

## 2.1.2 VT Use (For Variable Torque, Overload Capability: 110%– 1min.)

### ● Three-phase 200V series

Type	FRN□VGS-2															
	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Nominal applied motor [kW]	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110
Rated capacity [kVA] (*1)	3.0	4.1	6.8	10	14	18	24	28	34	44	55	68	81	107	131	158
Rated current (Continuous)	8	11	18	27	37	49	63	74	90	116	145	180	215	283	346	415
(1min.)	8.8	12.1	19.8	29.7	40.7	53.9	69.3	81.4	99	128	160	198	237	311	381	457
Phase, Voltage, Frequency	3-phase 200 to 230V, 50Hz/60Hz									3-phase 200 to 220V/50Hz, 200 to 230V/60Hz (*2)						
Input ratings	Voltage/frequency variation: Voltage: +10 to –15%, Frequency: +5 to –5%, Voltage unbalance: 2% or less (*3)															
Momentary voltage dip capability (*4)	When voltage drops from the rated voltage, the inverter will continue operation if the voltage is more than 165V. If the voltage is less than 165V, the inverter can be operated for 15ms.															
Rated current [A] (with DCR) (*7)	5.7	8.3	14.0	19.7	26.9	39.0	54.0	66.2	78.8	109	135	163	199	272	327	400
(without DCR)	11.1	16.1	25.5	40.8	52.6	76.9	98.5	117	136	168	204	243	291	–	–	–
Required power supply capacity [kVA] (*5)	2.0	2.9	4.9	6.9	9.4	14	19	23	28	38	47	57	69	95	114	139
Braking method/braking torque	Braking resistor discharge control: 110% braking torque, Separately installed braking resistor (option), Separately installed braking unit (option for 75kW or more)															
Carrier frequency [kHz] (*6)	0.75 to 10														0.75 to 6	
Mass [kg]	8	8	8	8	8	8	12.5	12.5	25	25	30	37	46	48	70	115
Enclosure	IP20									IP00 (IP20: option)						

\*1) Inverter output capacity [kVA] at 220V.

\*2) Order individually for 220 to 230V/50Hz.

\*3) Use a DC REACTOR if the voltage unbalance exceeds 2% (this is the same as for FUJI's conventional models).

Voltage unbalance [%] = (Max. voltage [V] – Min. voltage [V])/Three-phase average voltage [V] × 67

\*4) Tested at the standard load condition (85% load of nominal applied motor) prescribed by JEMA.

\*5) When power-factor correcting DC REACTOR is used. (Optional for 55kW or less model)

\*6) The inverter may automatically reduce carrier frequency in accordance with ambient temperature or output current in order to protect itself.

\*7) This value is obtained by using a FUJI original calculation method.

\*8) Use the function code F80 to switch between CT, VT and HT uses.

### ● Three-phase 400V series

Type	FRN □VGS-4																											
	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	250	280	315	355	400	500	630			
Nominal applied motor [kW]	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	280	300	315	355	400	500	630	710			
Rated capacity [kVA] (*1)	10	14	18	24	29	34	45	57	69	85	114	134	160	192	231	287	316	396	425	445	495	563	731	891	1044			
Rated current (Continuous)	13.5	18.5	24.5	32.0	39.0	45.0	60.0	75.0	91.0	112	150	176	210	253	304	377	415	520	558	585	650	740	960	1170	1370			
(1min.)	14.9	20.4	27	35.2	42.9	49.5	66	82.5	100	123	165	194	231	278	334	415	457	583	614	655	737	847	1056	1287	1507			
Phase, Voltage, Frequency	3-phase 380 to 480V, 50Hz/60Hz														3-phase 380 to 440V/50Hz, 380 to 480V/60Hz (*8)													
Input ratings	Voltage/frequency variation: Voltage: +10 to 15%, Frequency: +5 to 5%, Voltage unbalance: 2% or less (*2)																											
Momentary voltage dip capability (*3)	When voltage drops from the rated voltage, the inverter will continue operation if the voltage is more than 310V. If the voltage is less than 310V, the inverter can be operated for 15ms.																											
Rated current [A] (with DCR) (*6)	10	13.5	19.8	26.8	33.2	39.3	54	67	81	100	134	160	196	232	282	352	385	491	526	552	624	704	880	1104	1248			
(without DCR)	21.5	27.9	39.1	50.3	59.9	69.3	86	104	124	150																		
Required power supply capacity [kVA] (*4)	7.0	9.4	14	19	24	28	38	47	57	70	93	111	136	161	196	244	267	341	365	383	432	488	610	765	865			
Braking method/braking torque	Braking resistor discharge control: 110% braking torque, Separately installed braking resistor (option), Separately installed braking unit (option for 132kW or more)																											
Carrier frequency [kHz] (*5)	0.75 to 10												0.75 to 6															
Mass [kg]	8	8	8	12.5	12.5	25	25	30	35	40	41	50	72	72	100	100	140	140	150	250	250	360	360	525	525			
Enclosure	IP20														IP00 (IP20: option)													

\*1) Inverter output capacity [kVA] at 440V

\*2) Use a DC REACTOR if the voltage unbalance exceeds 2% (this is the same as for FUJI's conventional models).

Voltage unbalance [%] = (Max. voltage [V] – Min. voltage [V])/Three-phase average voltage [V] × 67

\*3) Tested at the standard load condition (85% load of nominal applied motor) prescribed by JEMA.

\*4) When power-factor correcting DC REACTOR is used. (Optional for 55kW or less model)

\*5) The inverter may automatically reduce carrier frequency in accordance with ambient temperature or output current in order to protect itself.

\*6) This value is obtained by using a FUJI original calculation method.

\*7) Use the function code F80 to switch between CT, VT and HT uses.

\*8) When the input voltage is 380 to 398V/50Hz or 380 to 430V/60Hz, a connector inside the inverter must be switched.

\*9) The 22kW and 300kW models are not compliant with EU Directives. For compliance with EU Directives, choose models with one size higher capacities (30kW and 315kW models respectively).

## 2. Specifications

### 2.1.3 HT Use (For Vertical Transfer Application, Overload Torque: 200%/170%– 10s)

#### ● Three-phase 200V series

Type FRN□VG7S-2		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55		
Nominal applied motor [kW]		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55		
Rated capacity [kVA] (*1)		6.8	10	14	18	24	28	34	44	55	68	81		
Rated current (*2)		(Continuous)		18	27	37	49	63	74	90	116	145	180	215
		(1min.)		27	40.5	55.5	73.5	94.5	111	135	174	217.5	270	333
		(10s)		32.4	45.7	63.3	85.8	111	142	170	194	246	290	360
Input ratings	Phase, Voltage, Frequency	3-phase 200 to 230V, 50Hz/60Hz						3-phase 200 to 220V/50Hz, 200 to 230V/60Hz (*3)						
	Voltage/frequency variation	Voltage: +10 to -15%, Frequency: +5 to -5%, Voltage unbalance: 2% or less (*4)												
	Momentary voltage dip capability (*5)	When voltage drops from the rated voltage, the inverter will continue operation if the voltage is more than 165V. If the voltage is less than 165V, the inverter can be operated for 15ms.												
	Rated current [A]	(with DCR)		14.0	19.7	26.9	39.0	54.0	66.2	78.8	109	135	163	199
	(*8)	(without DCR)		25.5	40.8	52.6	76.9	98.5	117	136	168	204	243	291
Required power supply capacity [kVA] (*6)		4.9	6.9	9.4	14	19	23	28	38	47	57	69		
Carrier frequency [kHz] (*7)		0.75 to 15												
Mass [kg]		8	8	8	12.5	12.5	25	25	30	37	46	48		
Enclosure		IP20						IP00 (IP20: option)						
Torque	Continuous [%] (*9)	100%												
	1min. rating [%] (*9)	150%												
	10s rating [%] (*9)	200% (at 80% or less of rated speed)/170% (at rated speed)									170%			
	Braking method/braking torque		Braking resistor discharge control: 150% braking torque, Separately installed braking resistor (option)											

\*1) Inverter output capacity [kVA] at 220V.

\*2) Select the inverter capacity such that the square average current in cycle operation is 80% or less of the rated current of an inverter.

\*3) Order individually for 220 to 230V/50Hz.

\*4) Use a DC REACTOR if the voltage unbalance exceeds 2% (this is the same as for FUJI's conventional models).  
Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V]) / Three-phase average voltage [V] × 67

\*5) Tested at the standard load condition (85% load of nominal applied motor) prescribed by JEMA.

\*6) When power-factor correcting DC REACTOR (option) is used.

\*7) The inverter may automatically reduce carrier frequency in accordance with ambient temperature or output current in order to protect itself.

\*8) This value is obtained by using a FUJI original calculation method.

\*9) These torque characteristics are obtained when combined with a dedicated motor.

\*10) Use the function code F80 to switch between CT, VT and HT uses.

#### ● Three-phase 400V series

Type FRN□VG7S-4		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55		
Nominal applied motor [kW]		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55		
Rated capacity [kVA] (*1)		6.8	10	14	18	24	29	34	44	57	69	85		
Rated current (*2)		(Continuous)		9.0	13.5	18.5	24.5	32.0	39.0	45.0	58.0	75.0	91.0	112
		(1min.)		13.5	20.0	27.5	36.5	48.0	58.5	67.5	90.0	113	137	168
		(10s)		16	22.7	31.6	42.9	59.1	73.5	85.1	96.0	120	150	182
Input ratings	Phase, Voltage, Frequency	3-phase 380 to 480V, 50Hz/60Hz						3-phase 380 to 440V/50Hz, 380 to 480V/60Hz (*9)						
	Voltage/frequency variation	Voltage: +10 to -15%, Frequency: +5 to -5%, Voltage unbalance: 2% or less (*3)												
	Momentary voltage dip capability (*4)	When voltage drops from the rated voltage, the inverter will continue operation if the voltage is more than 310V. If the voltage is less than 310V, the inverter can be operated for 15ms.												
	Rated current [A]	(with DCR)		7.1	10	13.5	19.8	26.8	33.2	39.3	54	67	81	100
	(*7)	(without DCR)		14.9	21.5	27.9	39.1	50.3	59.9	69.3	86	104	124	150
Required power supply capacity [kVA] (*5)		5.0	7.0	9.4	14	19	24	28	38	47	57	70		
Carrier frequency [kHz] (*6)		0.75 to 15												
Mass [kg]		8	8	8	12.5	12.5	25	25	30	35	40	41		
Enclosure		IP20						IP00 (IP20: option)						
Torque	Continuous [%] (*8)	100%												
	1min. rating [%] (*8)	150%												
	10s rating [%] (*8)	200% (at 80% or less of rated speed)/170% (at rated speed)									170%			
	Braking method/braking torque		Braking resistor discharge control: 150% braking torque, Separately installed braking resistor (option)											

\*1) Inverter output capacity [kVA] at 440V.

\*2) Select the inverter capacity such that the square average current in cycle operation is 80% or less of the rated current of an inverter.

\*3) Use a DC REACTOR if the voltage unbalance exceeds 2% (this is the same as for FUJI's conventional models).

Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V]) / Three-phase average voltage [V] × 67

\*4) Tested at the standard load condition (85% load of nominal applied motor) prescribed by JEMA.

\*5) When power-factor correcting DC REACTOR (option) is used.

\*6) The inverter may automatically reduce carrier frequency in accordance with ambient temperature or output current in order to protect itself.

\*7) This value is obtained by using a FUJI original calculation method.

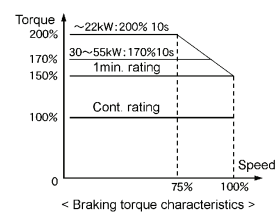
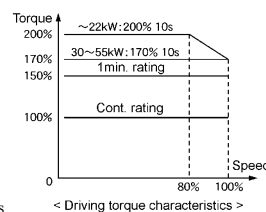
\*8) These torque characteristics are obtained when combined with a dedicated motor.

\*9) When the input voltage is 380 to 398V/50Hz or 380 to 430V/60Hz, a connector inside the inverter must be switched.

\*10) Use the function code F80 to switch between CT, VT and HT uses.

\*11) The 18.5kW and 250kW models are not compliant with EU Directives. For compliance with EU Directives, choose models with one size higher capacities (22kW and 280kW models respectively).

Torque characteristics of HT use (for vertical transfer application, overload torque: 200%/170%) (Common to 3-phase 200V/400V)



## 2.2 Common Specifications

### 2.2.1 CT Use, VT Use and HT Use

Item	Explanation
Main circuit type	Voltage type IGBT sinusoidal PWM inverter
Motor control method	Vector control Sensorless vector control V/f control Vector control (synchronous motors) Simulated operation mode
Speed control	Maximum speed
	Control range
	Control response
	Control accuracy
	Setting resolution
	Operation method
Control	Speed setting
	Running status signal
	Acceleration/Deceleration time
	Gain for speed setting
	Jump speed
	Rotating motor pick up (Flying start)
	Auto-restart after momentary power failure
	Slip compensation
	Droop control
	Torque limiting
	PID control
	Fan stop operation
	Torque bias
	Speed limiting
	Motor selection
	Multiple winding motor drive
	UP/DOWN control
	Stopping function
	PG pulse output
Observer	
Position control	
Synchronized operation	

## 2. Specifications

Item	Explanation
Indication	Running/Stopping <ul style="list-style-type: none"> <li>• Detected speed value</li> <li>• Torque command value</li> <li>• Output voltage</li> <li>• Load shaft speed</li> <li>• Ai adjusted value (12)</li> <li>• Ai adjusted value (Ai4)</li> <li>• Optional monitor 4</li> <li>• Motor temperature</li> <li>• Speed command value</li> <li>• Torque calculation value</li> <li>• DC link circuit voltage</li> <li>• PID command value</li> <li>• Ai adjusted value (Ai1)</li> <li>• Optional monitor 1</li> <li>• Optional monitor 5</li> <li>• Heat sink temperature</li> <li>• Output frequency</li> <li>• Motor output</li> <li>• Magnetic-flux command value</li> <li>• PID feedback value</li> <li>• Ai adjusted value (Ai2)</li> <li>• Optional monitor 2</li> <li>• Optional monitor 6</li> <li>• Load factor</li> <li>• Torque current command value</li> <li>• Output current</li> <li>• Magnetic-flux calculation value</li> <li>• PID output value</li> <li>• Ai adjusted value (Ai3)</li> <li>• Optional monitor 3</li> <li>• Presence of digital input/output signal</li> <li>• Operation time, etc.</li> </ul>
	Programming <p>Displays function codes, names, and data. Multi-language display: English, French, Spanish, German, Italian, Chinese and Japanese.</p>
	Trip mode <p>Displays the following trip codes;</p> <ul style="list-style-type: none"> <li>• <b>d b H</b> Overheat at the DB circuit</li> <li>• <b>P g</b> PG error</li> <li>• <b>d 0</b> Excessive position deviation</li> <li>• <b>E r 6</b> Operation procedure error</li> <li>• <b>E r 9</b> Speed disagreement</li> <li>• <b>I P E</b> IPM fault</li> <li>• <b>E r b</b> Inter-inverter communication error</li> <li>• <b>O H 2</b> External alarm input</li> <li>• <b>O L 1</b> Motor 1 overload</li> <li>• <b>O L U</b> Inverter unit overload</li> <li>• <b>O L 3</b> Motor 3 overload</li> <li>• <b>d C F</b> DC fuse blown</li> <li>• <b>E r 1</b> Memory error</li> <li>• <b>E r 4</b> Network error</li> <li>• <b>E r 3</b> CPU error</li> <li>• <b>E r A</b> UPAC error</li> <li>• <b>L i n</b> Input phase loss</li> <li>• <b>O C</b> Overcurrent</li> <li>• <b>n r b</b> NTC thermistor disconnection</li> <li>• <b>O L 2</b> Motor 2 overload</li> <li>• <b>O 5</b> Overspeed</li> <li>• <b>P b F</b> Charging circuit error</li> <li>• <b>E F</b> Ground fault</li> <li>• <b>E r 2</b> KEYPAD panel communication error</li> <li>• <b>E r 5 2</b> RS485 error</li> <li>• <b>E r 8</b> A/D converter error</li> <li>• <b>E r 7</b> Output wiring error</li> <li>• <b>L U</b> Undervoltage</li> <li>• <b>O H 1</b> Overheating at heat sink</li> <li>• <b>O H 4</b> Motor overheat</li> <li>• <b>O H 3</b> Inverter internal overheat</li> <li>• <b>O U</b> Overvoltage</li> </ul>
	Running/Trip mode <p>Stores and displays data for the last ten trips. Stores and displays the detailed cause of the last trip.</p>
Charge lamp <p>ON when there is residual voltage in the main circuit capacitors.</p>	
Protection	Overload <p>Protects the inverter by electronic thermal overload relay and the detection of inverter temperature.</p>
	Overvoltage <p>Detects DC link circuit overvoltage and stops the inverter.</p>
	Incoming surge <p>Protects the inverter from surge voltage between the main circuit power lines and the ground.</p>
	Undervoltage <p>Detects DC link circuit undervoltage and stops the inverter.</p>
	Overheat <p>Stops the inverter by detecting the inverter internal temperature.</p>
	Short-circuit <p>Protects the inverter from overcurrent due to a short-circuit in the output circuit.</p>
	Ground fault <p>Protects the inverter from overcurrent due to a ground fault in the output circuit.</p>
	Motor protection <p>Protects the motor with NTC thermistor and PTC thermistor. Protects the motor with electronic thermal overload relay. Overload early warning: Overload early warning can be issued at a predetermined level before stopping the inverter. (The electronic thermal overload relay and the overload early warning can be set for motor 1 to 3 individually)</p>
	DB resistor overheating <ul style="list-style-type: none"> <li>• Protects through internal functions of the inverter.</li> <li>• For the optional DB resistor, an external alarm signal issued from the built-in temperature sensor stops the inverter.</li> </ul>
	Input phase loss <p>Protects the inverter from damage due to input phase loss</p>
	Output phase loss <p>Detects impedance unbalance in the output circuit and issues an alarm (under tuning operation).</p>
Retry <p>Sets the retry numbers and retry waiting time for stoppage due to an alarm (only for OV, OC, LU, OH1, OH3, OLU, OL, dBH).</p>	
Conditions	Installation location <p>Indoor use only. Free from corrosive and flammable gases, dusts, and direct sunlight.</p>
	Ambient temperature <p>−10 to 50°C</p>
	Ambient humidity <p>5 to 95%RH (no condensing)</p>
	Altitude <p>3000m or less, with some power derating from 1,001 to 3,000m.</p>
	Vibration <p>Amplitude: 3mm at 2 to 9Hz, 9.8m/s<sup>2</sup> at 9 to 20Hz. 2m/s<sup>2</sup> at 20 to 55Hz, 1m/s<sup>2</sup> at 55 to 200Hz</p>
	Storage temperature <p>−25 to 55°C</p>
Storage humidity <p>5 to 95%RH</p>	
Maintenance	Main circuit capacitor life <p>Life judgment function installed</p>
	Common functions <ul style="list-style-type: none"> <li>• Displays and records accumulated time for capacitor life and cooling fan operation time in the control power.</li> <li>• Displays and records inverter operation time.</li> <li>• Displays and records the maximum output current and the maximum internal temperature for the past one year.</li> </ul>
RS485	Provided as standard

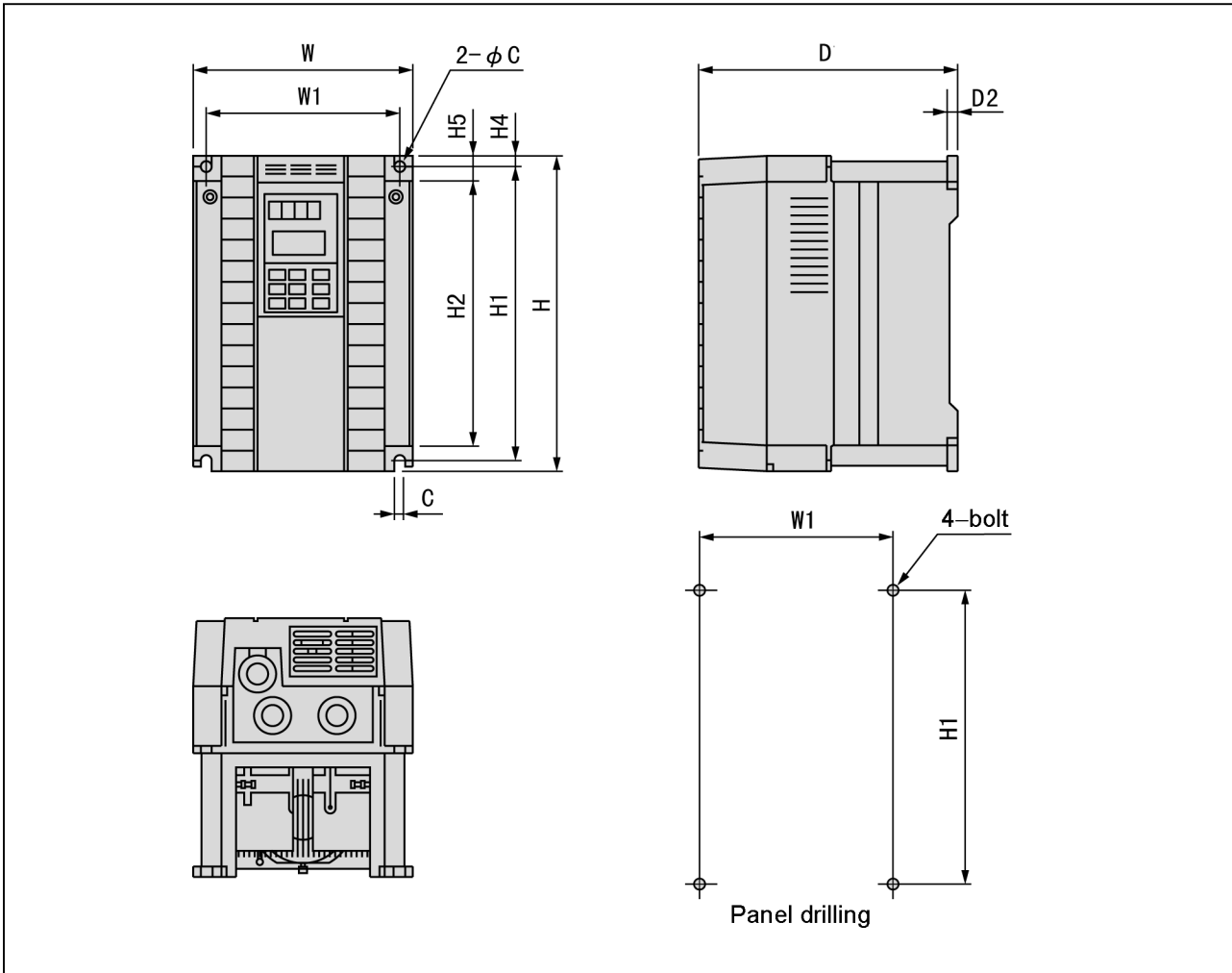
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## 2. Specifications

### 2.2.2 External Dimensions

#### ● Internal mounting type



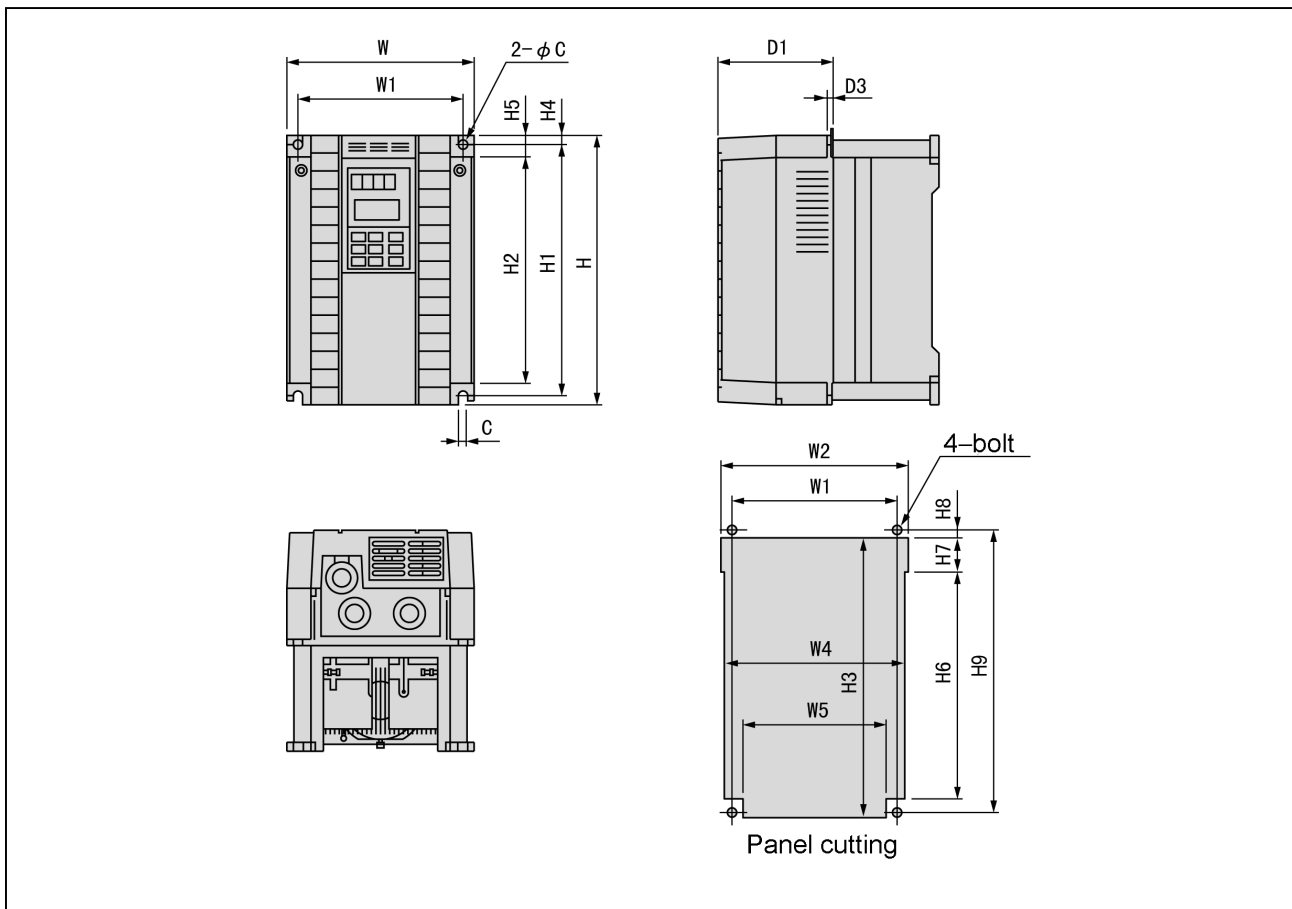
#### ● 200V series

Inverter type	Dimensions [mm]																		Mtg. bolt	Approx. mass [kg]
	W	W1	W2	W3	W4	W5	H	H1	H2	H3	H4	H5	H6	H7	H8	D	D2	C		
FRN0.75VG7S-2	205	181	-	-	-	-	300	278	255	-	11	21	-	-	-	245	10	10	M8	7
FRN1.5VG7S-2																				8
FRN2.2VG7S-2																				8
FRN3.7VG7S-2																				8
FRN5.5VG7S-2																				8
FRN7.5VG7S-2	250	226	-	-	-	380	358	335	-	-	-	-	-	-	-	245	10	10	M8	12.5
FRN11VG7S-2																				12.5
FRN15VG7S-2																				12.5

#### ● 400V series

Inverter type	Dimensions [mm]																		Mtg. bolt	Approx. mass [kg]
	W	W1	W2	W3	W4	W5	H	H1	H2	H3	H4	H5	H6	H7	H8	D	D2	C		
FRN3.7VG7S-4	205	181	-	-	-	-	300	278	255	-	11	21	-	-	-	245	10	10	M8	8
FRN5.5VG7S-4																				8
FRN7.5VG7S-4																				8
FRN11VG7S-4	250	226	-	-	-	380	358	335	-	-	-	-	-	-	-	245	10	10	M8	12.5
FRN15VG7S-4																				12.5

● External cooling type



● 200V series

Inverter type	Dimensions [mm]																			Mtg. bolt	Approx. mass [kg]
	W	W1	W2	W3	W4	W5	H	H1	H2	H3	H4	H5	H6	H7	H8	H9	D1	D3	C		
FRN0.75VG7S-2	205	181	207	-	197	159	300	278	255	314	11	21	253.5	39	8	315	125	7	10	M8	7
FRN1.5VG7S-2																					8
FRN2.2VG7S-2																					8
FRN3.7VG7S-2																					8
FRN5.5VG7S-2																					8
FRN7.5VG7S-2	250	226	252	-	242	202	380	358	335	394	11	21	333.5	39	8	395	125	7	10	M8	12.5
FRN11VG7S-2																					12.5
FRN15VG7S-2																					12.5

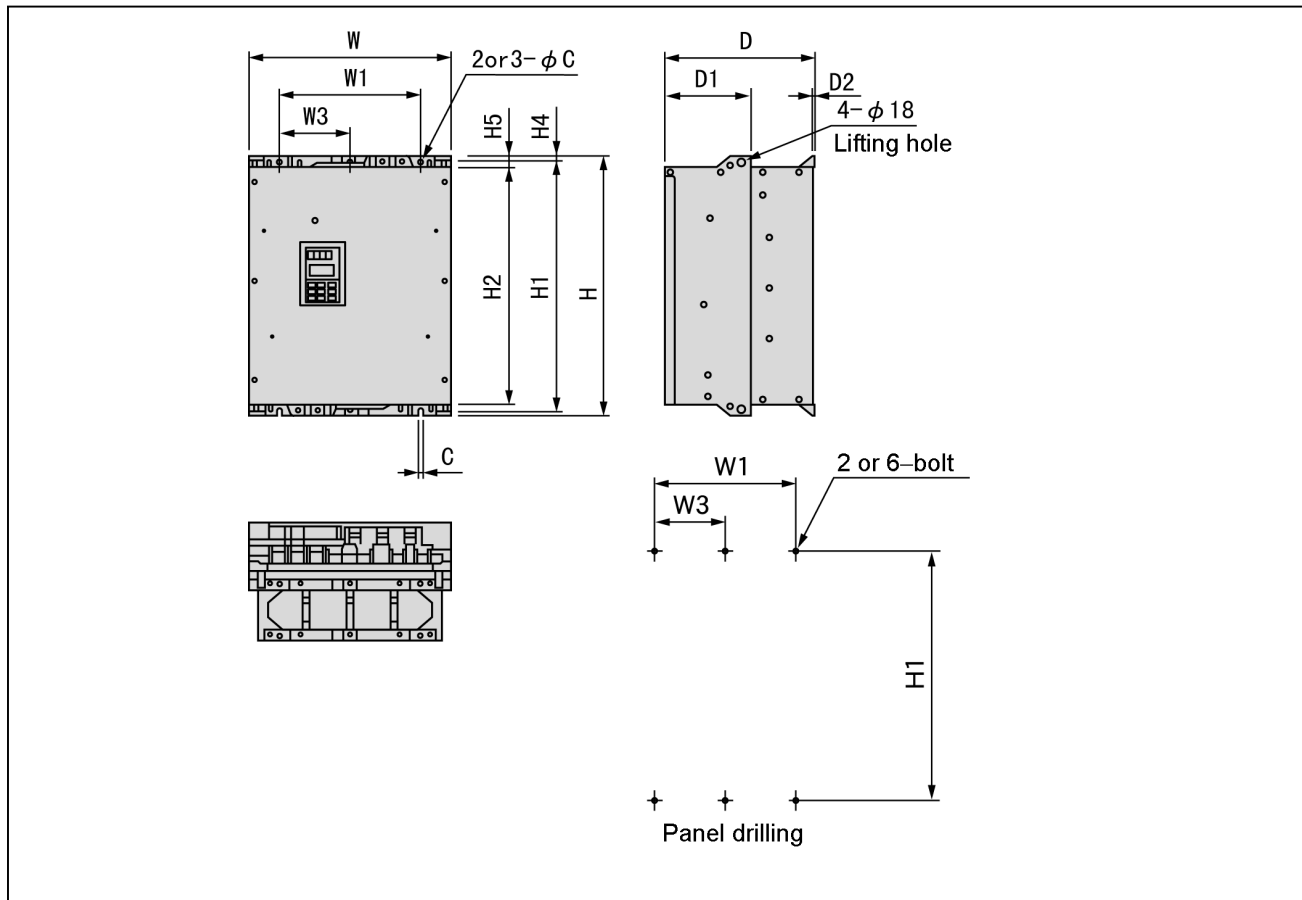
● 400V series

Inverter type	Dimensions [mm]																			Mtg. bolt	Approx. mass [kg]
	W	W1	W2	W3	W4	W5	H	H1	H2	H3	H4	H5	H6	H7	H8	H9	D1	D3	C		
FRN3.7VG7S-4	205	181	207	-	197	159	300	278	255	314	11	21	253.5	39	8	315	125	7	10	M8	8
FRN5.5VG7S-4																					8
FRN7.5VG7S-4																					8
FRN11VG7S-4	250	226	252	-	242	202	380	358	335	394	11	21	333.5	39	8	395	125	7	10	M8	12.5
FRN15VG7S-4																					12.5



## 2. Specifications

### ● Internal mounting type



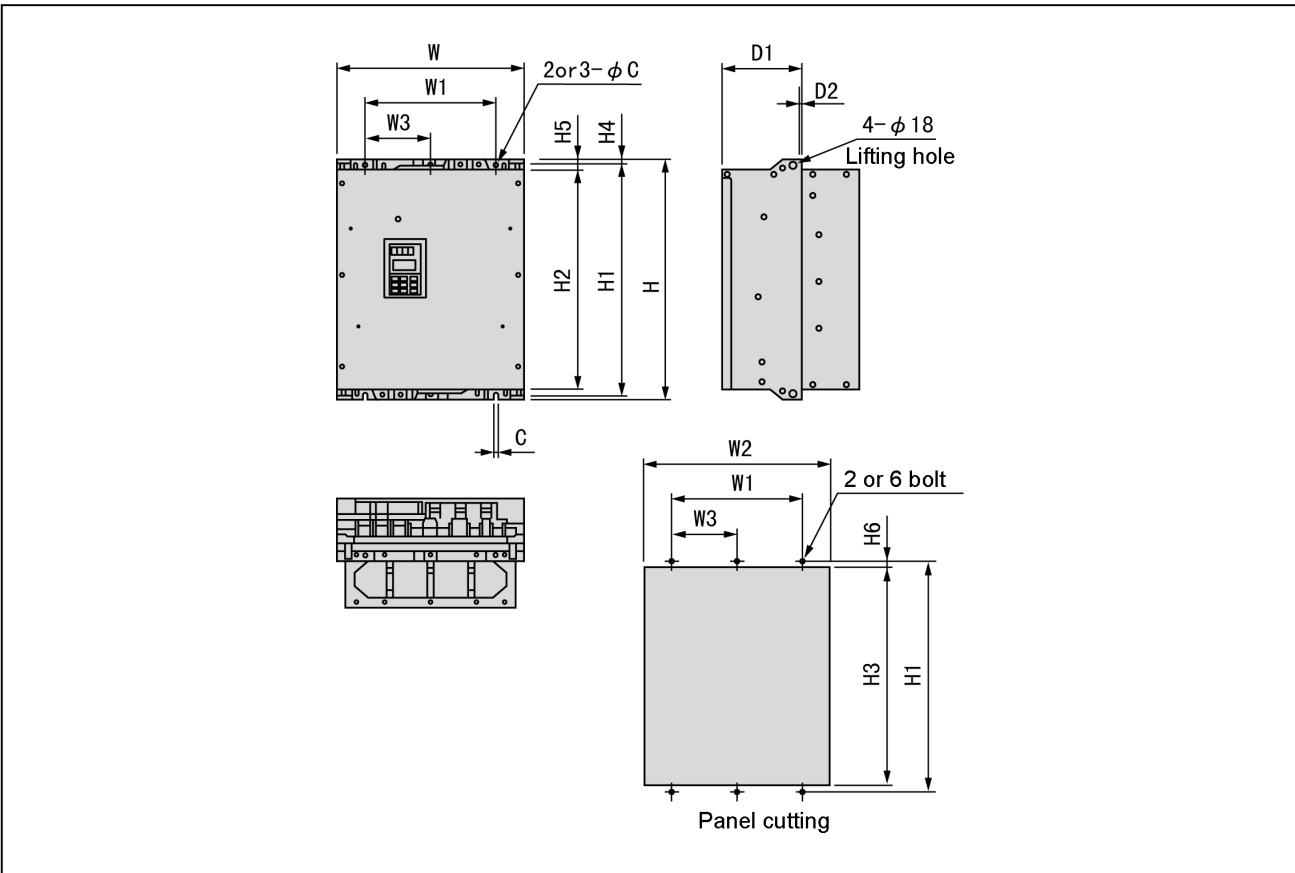
### ● 200V series

Inverter type	Dimensions [mm]												Mtg. bolt	Approx. mass [kg]
	W	W1	W3	H	H1	H2	H4	H5	D	D1	D2	C		
FRN18.5VG7S-2	340	240	-	480	460	430	12	25	255	145	4	10	M8	25
FRN22VG7S-2				550	530	500								30
FRN30VG7S-2				615	595	565								37
FRN45VG7S-2	375	275	-	740	720	690	15.5	32.5	270	145	4	15	M12	46
FRN55VG7S-2				750	720	685								48
FRN75VG7S-2	530	430	265	880	850	815	15.5	32.5	285	145	4	15	M12	70
FRN90VG7S-2	680	580		880	850	815			360	220				115

### ● 400V series

Inverter type	Dimensions [mm]												Mtg. bolt	Approx. mass [kg]
	W	W1	W3	H	H1	H2	H4	H5	D	D1	D2	C		
FRN18.5VG7S-4	340	240	-	480	460	430	12	25	255	145	4	10	M8	25
FRN22VG7S-4				550	530	500								30
FRN30VG7S-4				675	655	625								35
FRN37VG7S-4	375	275	-	740	720	690	15.5	32.5	270	145	4	15	M12	40
FRN45VG7S-4				740	710	675								41
FRN55VG7S-4	530	430	290	1000	970	935	15.5	32.5	315	175	4	15	M12	50
FRN75VG7S-4				1000	970	935								72
FRN90VG7S-4				1000	970	935								100
FRN110VG7S-4	680	580	290	1000	970	935	15.5	32.5	360	220	4	15	M12	140
FRN132VG7S-4				1000	970	935								140
FRN160VG7S-4	680	580	290	1000	970	935	15.5	32.5	360	220	4	15	M12	140
FRN200VG7S-4				1000	970	935								140
FRN220VG7S-4	680	580	290	1000	970	935	15.5	32.5	360	220	4	15	M12	140

● External cooling type



● 200V series

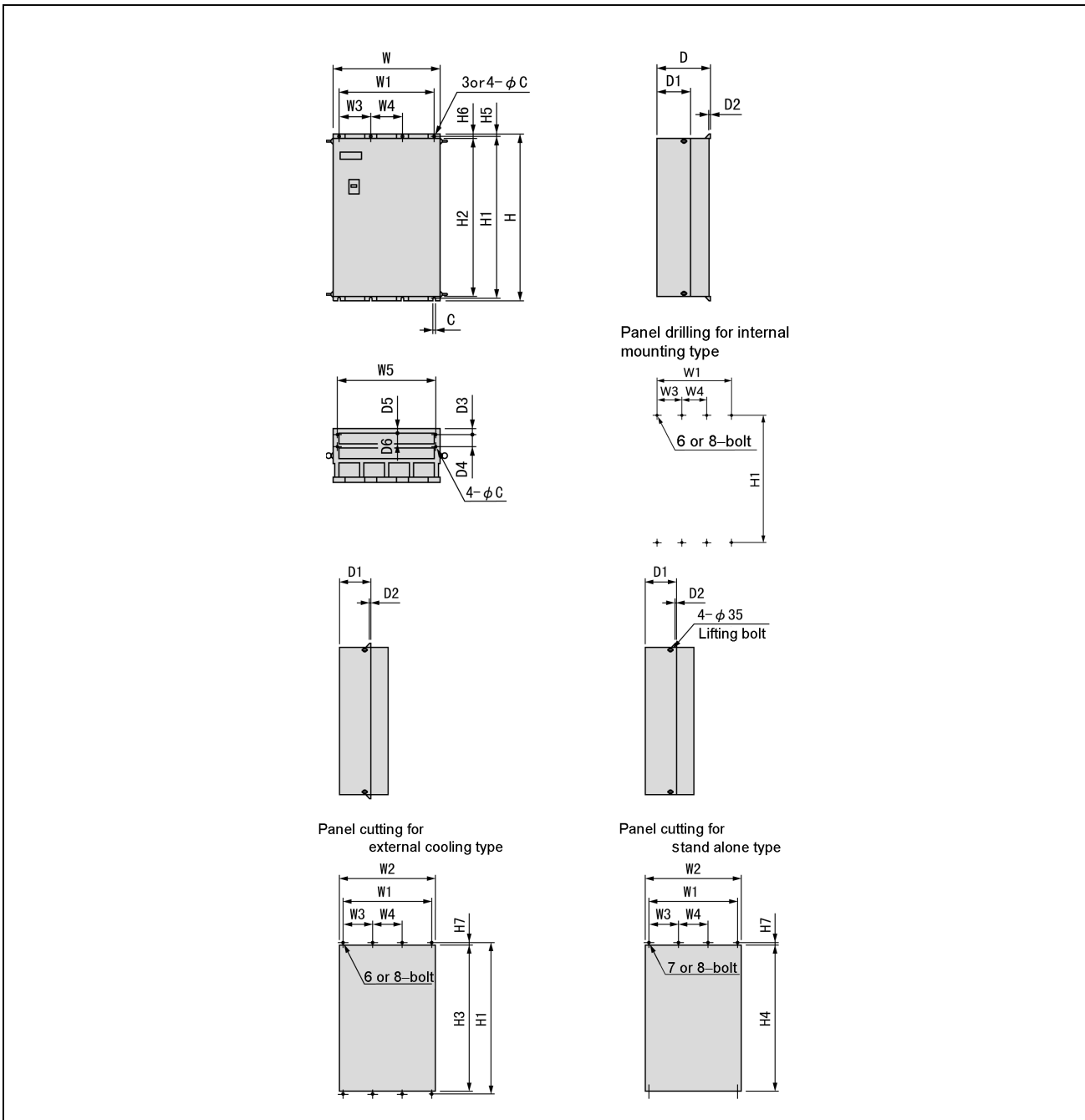
Inverter type	Dimensions [mm]														Mtg. bolt	Approx. mass [kg]
	W	W1	W2	W3	H	H1	H2	H3	H4	H5	H6	D1	D2	C		
FRN18.5VG7S-2	340	240	326	-	480	460	430	442	12	25	9	145	4	10	M8	25
FRN22VG7S-2					550	530	500	512								30
FRN30VG7S-2					615	595	565	577								37
FRN37VG7S-2	375	275	361	-	740	720	690	702	15.5	32.5	12.5	145	4	15	M12	46
FRN45VG7S-2					750	720	685	695								70
FRN55VG7S-2	530	430	510	-	880	850	815	825	15.5	32.5	12.5	145	4	15	M12	70
FRN75VG7S-2					220	115										
FRN90VG7S-2	680	580	660	265	880	850	815	825	15.5	32.5	12.5	220	4	15	M12	115

● 400V series

Inverter type	Dimensions [mm]														Mtg. bolt	Approx. mass [kg]
	W	W1	W2	W3	H	H1	H2	H3	H4	H5	H6	D1	D2	C		
FRN18.5VG7S-4	340	240	326	-	480	460	430	442	12	25	9	145	4	10	M8	25
FRN22VG7S-4					550	530	500	512								30
FRN30VG7S-4					615	595	565	577								35
FRN37VG7S-4	375	275	361	-	675	655	625	637	15.5	32.5	12.5	145	4	15	M12	40
FRN45VG7S-4					740	720	690	702								41
FRN55VG7S-4	530	430	510	-	740	710	675	685	15.5	32.5	12.5	175	4	15	M12	50
FRN75VG7S-4					720	690	702	72								
FRN90VG7S-4	530	430	510	-	1000	970	935	945	15.5	32.5	12.5	220	4	15	M12	72
FRN110VG7S-4					1000	970	935	945				100				
FRN132VG7S-4	680	580	660	290	1000	970	935	945	15.5	32.5	12.5	220	4	15	M12	100
FRN160VG7S-4					1000	970	935	945				140				
FRN200VG7S-4	680	580	660	290	1000	970	935	945	15.5	32.5	12.5	220	4	15	M12	100
FRN220VG7S-4					1000	970	935	945				140				

## 2. Specifications

- Type common to internal mounting, external cooling, and stand alone



- 400V series

Inverter type	Dimensions [mm]																				Mtg. bolt	Approx. mass [kg]		
	W	W1	W2	W3	W4	W5	H	H1	H2	H3	H4	H5	H6	H7	D	D1	D2	D3	D4	D5			D6	C
FRN280VG7S-4	680	580	660	290	-	610	1400	1370	1330	1340	1335	15.5	3.5	14.5	450	285	6.4	50	100	35	115	15	M12	250
FRN315VG7S-4	880	780	860	260	260	810																		360
FRN355VG7S-4																								
FRN400VG7S-4																								

## 2.2.3 Dedicated Motor Specifications

### ● Three-phase 200V series standard specifications

Item	Specifications																
Dedicated motor rated output [kW]	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	
Applicable motor type (MVK A-C)	6096	6097	6107	6115	6133	6135	6165	6167	6184	6185	6206	6207	9221 (6208)	9250	9252	9280	
Moment of inertia of rotor [kg·m <sup>2</sup> ]	0.009	0.009	0.009	0.016	0.030	0.037	0.085	0.11	0.21	0.23	0.34	0.41	0.84(0.47)	0.80	0.95	1.37	
Base speed/Max. speed [r/min]	1500/3600						1500/3000			1500/2400			1500/2000				
Vibration	V10 or less												V15 or less				
Cooling fan	Voltage [V]	200 to 210V/50Hz, 200 to 230V/60Hz															
	Number of phases/poles	1-phase/4P						3-phase/4P									
	Input power [W]	40/50						90/120			150/210			360/570 to 650			
	Current [A]	0.29/0.27 to 0.31						0.49/0.44 to 0.48			0.75/0.77 to 0.8			2.0/2.0 to 2.0			
Approx. mass [kg]	28		32	46	63	73	111	133	190	197	254	280	350(296)	490	545	710	

### ● Three-phase 400V series standard specifications

Item	Specifications																			
Dedicated motor rated output [kW]	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220		
Applicable motor type (MVK A-C)	6115	6133	6135	6165	6167	6184	6185	6206	6207	9221(6208)	9250	9252	9280	9282	9310	9312	9316	9318		
Moment of inertia of rotor [kg·m <sup>2</sup> ]	0.016	0.030	0.037	0.085	0.11	0.21	0.23	0.34	0.41	0.48(0.47)	0.80	0.95	1.37	1.60	2.68	3.22	3.9	4.26		
Base speed/Max. speed [r/min]	1500/3600						1500/3000			1500/2400			1500/2000							
Vibration	V10 or less										V15 or less									
Cooling fan	Voltage [V]	200 to 210V/50Hz, 200 to 230V/60Hz			400 to 420V/50Hz, 400 to 440V/60Hz															
	Number of phases/poles	1-phase/4P			3-phase/4P															
	Input power [W]	40/50			90/120			150/210			150/200 to 210 (150/210)			360/570 to 580			4405/4330			
	Current [A]	0.29/0.27 to 0.31			0.27/0.24 to 0.25			0.38/0.39 to 0.4			0.38/0.4 to 0.4 (0.38/0.39 to 0.4)			1.0/1.0 to 1.0			7.5/6.8			
Approx. mass [kg]	46	63	73	111	133	190	197	254	280	350(296)	490	545	710	765	1250	1450	1550	1640		

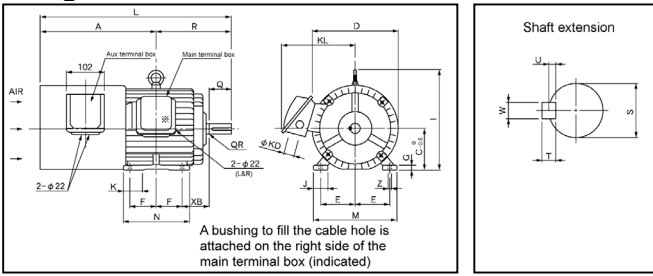
### ● Common specifications

Item	Specifications
Insulation class/Number of poles	Class F/4P
Terminal design	Main terminal box (lug type): 3 or 6 main circuit terminals, 3 NTC thermistor terminals (1 is reserved) Auxiliary terminal box (terminal block): Pulse generator (PGP, PGM, PA, PB, SS), cooling fan (FU, FV or FU, FV, FW)
Mounting method	Foot mounted with bracket (IMB3), Note: Contact FUJI for other methods.
Degree of protection, Cooling method	JP44, Totally enclosed forced-ventilation system with cooling fan motor. A cooling fan blows air over the motor toward the drive-end.
Installation location	Indoor, 1000m or less in altitude.
Ambient temperature, humidity	-10 to +40°C, 90%RH or less (no condensation)
Finishing color	Munsell N5
Standard conformity	JEM1446
Standard accessories	Pulse generator (1024P/R, +15V, complementary output), NTC thermistors (2), cooling fan.

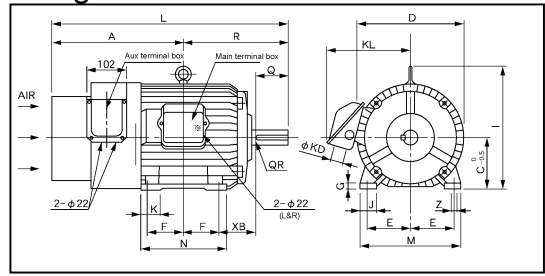
Note : Contact a FUJI representative for dedicated motors other than those with 4-pole and a base speed of 1500 [r/min].

# 2. Specifications

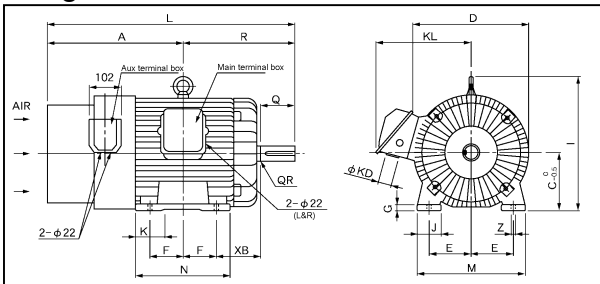
● Fig. A



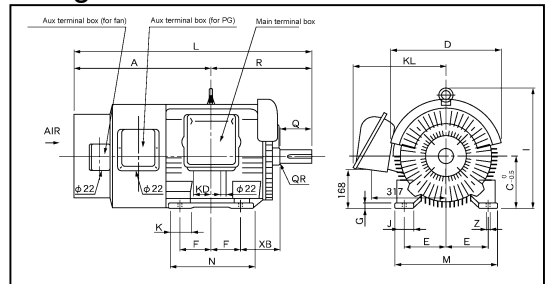
● Fig. B



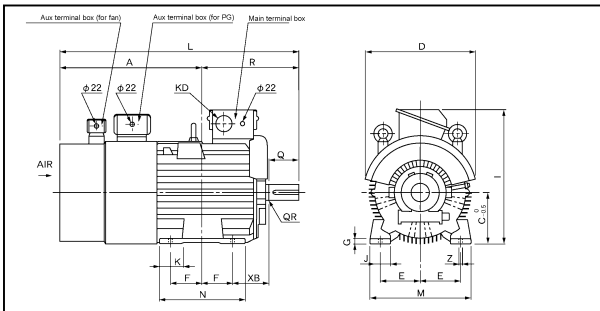
● Fig. C



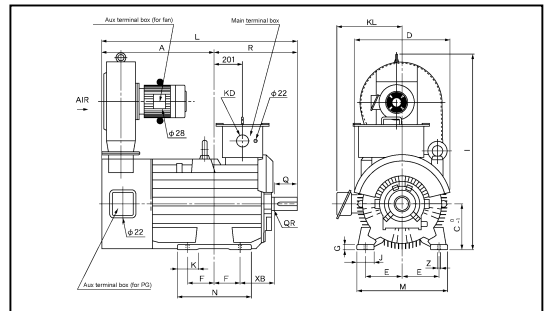
● Fig. D



● Fig. E



● Fig. F



● Common dimensions to 200V and 400V series

Motor rated output [kW]	Motor type	Fig.	Dimensions [mm]																	Shaft extension [mm]						Approx. mass [kg]		
			A	C	D	E	F	G	I	J	K	KD	KL	L	M	N	R	XB	Z	Q	QR	S	T	U	W			
0.75	FMVK6096A · C	A	277.5	90	203	70	62.5	10	229	35.5	35.5	27	190	446	170	150	168.5	58	10	50	0.5	24j6	7	4	8	28		
1.5	MVK6097A · C		292	100		80	70	12.5	238	40	40			485	195	170	193	63	12	60		28j6				28		
2.2	MVK6107A · C		299	112	236	95		14	270		50			205	499	224	175	200	70								32	
3.7	MVK6115A · C	B	309	132	273	108		17	311	45		34	223	548	250	180	239	89		80		38j6	8	5	10	63		
5.5	MVK6133A · C		328			89								586		212	258										73	
7.5	MVK6135A · C	A	400	160	321	127	105	18	376	50	63	48	272	723	300	250	323	108	14.5	110	1	42j6				12	111	
11	MVK6165A · C		422			127								767		300	345											133
15	MVK6167A · C		425	180	376	139.5	120.5	20	428	75	75		305	776.5	350	292	351.5	121	14.5	110	1.5	48j6	9	5.5	14		190	
18.5	MVK6184A · C	C	490	200	411	159	152.5	25	466	80	85	80	364	915.5	390	360	425.5	133	18.5	140	2	60m6	11	7	18		254	
22	MVK6185A · C																											280
30	MVK6206A · C																											
37	MVK6207A · C	D	593	225	475	178	143		515		95		387	1025	436	366	432	149			1							350
45	(MVK6208A · C) MVK9221A · C		593.5	250	535	203	155.5	30	653	100	120			1157	506	411	463.5	168	24		2	75m6	12	7.5	20		490	
55	MVK9250A · C	E	712.5				174.5						1195		449	482.5												545
75	MVK9252A · C		766	280	605	228.5	184	35	807					1310	557	468	544	190		170		85m6	14	9	22		710	
90	MVK9280A · C		790.5			209.5								1360		519	569.5											765
110	MVK9282A · C	F	798	315	675	254	203	42	1367	120	145	90		1387	628	526	589	216	28			95m6				25	1250	
132	MVK9310A · C		822.5			228.5								1437		577	614.5											1450
160	MVK9312A · C		922.5										460	1537														1550
200	MVK9316A · C		947			254								1587		628	640											1640

## 2.2.4 Protective Functions

Function	Description	LED monitor	Related function code
DB resistor overheating	When the built-in braking resistor overheats, the inverter stops discharging and running. Function codes E35 to 37 corresponding to the resistor (built-in/external) must be set.	d b H	E35-37
DC fuse blown	When a fuse at the main DC circuit blows due to a short-circuit in the IGBT circuit, the inverter stops operation.	d C F	
Ground fault	Activated by a ground fault in the inverter output circuit. Connect a separate earth-leakage protective relay or an earth-leakage circuit breaker for accident prevention such as human damage and fire.	E F	
Excessive position deviation	Activated when the position deviation between the command and the detected values exceeds the function code o18 "Excessive deviation value" in synchronized operation. The option code "o" becomes valid and is displayed on the KEYPAD panel after installing options.	d 0	o18
Memory error	Activated when a fault such as "write error" occurs in the memory.	E r 1	
KEYPAD panel communication error	Activated if a communication error is detected between the inverter control circuit and the KEYPAD panel when the start/stop command from the KEYPAD is valid (function code F02=0). Note: KEYPAD panel communication error does not indicate the alarm display and issue the alarm relay output when the inverter is operated by external signal input or the link function. The inverter continues operating.	E r 2	F02
CPU error	Activated when a CPU error occurs due to noise.	E r 3	
Network error	Activated if a communication error occurs due to noise when the inverter is operated through T-Link, SX bus or field bus.	E r 4	o30,31
RS485 communication error	Activated if: The function code H32 is set to 0 to 2, or a disconnection continues for more than the specified period of 0.1 to 60.0 with the function code H38.	E r 5	H32,H33 H38
Operation procedure error	Activated if multiple network options (T-Link, SX bus, and field bus) are installed. Though you can install multiple SI, DI and PG options, this error is issued if the two SW settings are identical.	E r 6	
Output wiring error	Activated when the measured data are out of the motor characteristic data range during executing tuning or the wires are not connected in the inverter output circuit.	E r 7	H01,H71
A/D converter error	Activated when an error occurs in the A/D converter circuit.	E r 8	
Speed disagreement	Activated when the deviation between the speed command (speed setting) and the motor speed (detected speed, predicted speed) becomes excessive.	E r 9	
UPAC error	Activated on a hardware fault in the UPAC option or a communication error between the inverter control circuit and the UPAC option.	E r R	
Inter-inverter communication error	The error occurs upon a transmission fault during inverter-to-inverter communication using high-speed serial cards (options).	E r b	
IPM fault	The fault occurs if the self-shutdown function is activated due to an excessive current or heat.	I P E	
Input phase loss	The inverter is protected from being damaged due to input phase loss.	L i n	
Undervoltage	Activated if the DC link circuit voltage decreases to the undervoltage level due to a reduction in the supply voltage. The alarm output is not issued when the DC link circuit voltage decreases and the "function code F14" is set to "3 to 5". · Undervoltage detection level: 200V series: 186V dc, 400V series: 371V dc. Activated when the power supply *phase is unbalanced.	L U	F14
NTC thermistor disconnection	Activated if the thermistor circuit is disconnected when the application of NTC thermistors to corresponding motors (M1, 2, 3) is specified with the function codes P30, A31 and A47.	n r b	P30,A31,A47
Overcurrent	Activated if the momentary value of the inverter output current exceeds the overcurrent detection level due to a short-circuit or ground fault.	O C	
Overheating at heat sink	Activated if the temperature of the heat sink to cool the rectifier diodes and the IGBTs increases due to cooling fan stoppage.	O H 1	
External alarm	The inverter stops on receiving the external alarm signal (THR). It is activated by a terminal signal when the control circuit terminals (THR assignment) are connected to alarm terminals of external devices such as a braking unit or a braking resistor.	O H 2	E01-E14
Inverter internal overheat	Activated if the ambient temperature of the control PC board increases due to poor ventilation of the inverter.	O H 3	
Motor overheat	Activated if the detected temperature of the built-in NTC thermistor for motor temperature detection exceeds the data of the "function code E30 Motor overheat protection".	O H 4	E30,E31
Motor 1 overload	Activated when the motor 1 current (inverter output current) exceeds the operation level set by "function code F11".	O L 1	F11
Motor 2 overload	Activated when the motor 2 current (inverter output current) exceeds the operation level set by "function code A33".	O L 2	A33
Motor 3 overload	Activated when the motor 3 current (inverter output current) exceeds the operation level set by "function code A49".	O L 3	A49
Inverter unit overload	Activated if the output current exceeds the overload characteristic of the inverse time characteristic.	O L U	
Overspeed	Activated if the motor speed (detected speed value/predicted speed value) exceeds 120% of the specified value by the function code "maximum speed".	O S	F03,A06,A40
Overvoltage	Activated if the DC link circuit voltage exceeds the overvoltage level due to an increase of supply voltage or regenerative braking current from the motor. However, the inverter cannot be protected from excessive voltage (high voltage, for example) supplied by mistake. · Overvoltage detection level 200V series: 400V dc, 400V series: 800V dc	O U	
PG error	Activated when the pulse generator terminal PA/PB circuits are disconnected. It is not activated when the sensorless control or the V/f control is selected.	P 9	
Charging circuit error	Activated if the bypass circuit of the DC link circuit is not formed (the magnetic contactor for the charging circuit bypass is not closed) two minutes after power is supplied.	P b F	

Note 1: All protective functions are reset automatically if the control power voltage decreases to where maintaining the operation of the inverter control circuit is impossible.

Note 2: Fault history data is stored for the last ten trips.

Note 3: Stoppage due to a protective function can be reset by the RST key of the KEYPAD or turning OFF and then ON between the X terminal (RST assigning) and the CM. This action is invalid if the cause of an alarm is not found and resolved.

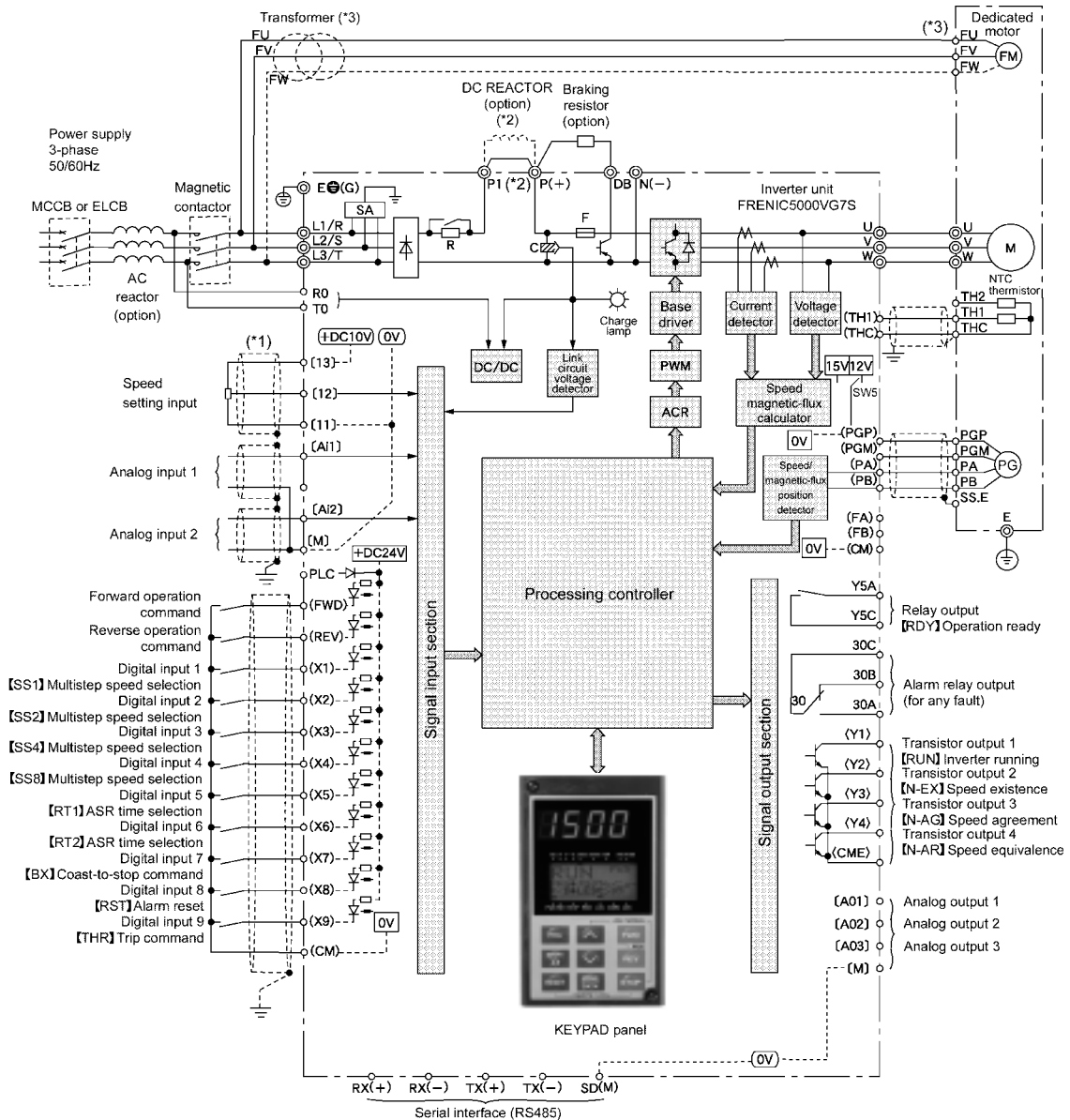
Note 4: In addition to these protective functions, there can be further protective from surge voltage by connecting surge suppressors to the main circuit power terminals (L1/R, L2/S, L3/T) and the auxiliary control power terminals T0 (R0).

Note 5: The inverter is not reset until the causes of all alarms are removed.

## 2. Specifications

### 2.3 Basic Wiring Diagram and Terminal Functions

#### 2.3.1 Basic Wiring Diagram



- (\*1) Use twisted cables or shielded cables for the wire indicated with  $\frac{1}{2}$ . The shielded wires should be basically grounded. However, when the wires are influenced by induction noise from external devices, they may be connected to (OV) ([M], [I1], [THC]), or (OV) ([CM]) to reduce such influence.
- (\*2) When connecting a DC REACTOR, remove the jumper wire between the P1 and P (+) terminals. The DC REACTOR comes with 7.5kW or larger inverters as a standard accessory (supplied separately from the unit). Be sure to connect the REACTOR to the inverter.
- (\*3) The power supply for cooling fan for motors of 7.5kW or less is single-phase. Connect to the FU and the FV terminals. The cooling fan for models of 7.5kW or less for the 400V series is 200V/50Hz or 200 to 230V/60Hz. The cooling fan for models of 11kW or more for the 400V series is 400 to 420V/50Hz or 400 to 440/60Hz. Obtain a transformer when using the fan for the power supply voltage that is not mentioned above.
- (\*4) The 24V power system and the 15V power system are insulated inside the inverter unit.

## 2.3.2 Terminal Functions

	Symbol	Terminal name	Function
Main circuit	L1/R, L2/S,L3/T	Power input	Connects a 3-phase power supply.
	U, V, W	Inverter output	Connects a 3-phase motor.
	P (+), P1	For DC REACTOR	Connects a DC REACTOR. A DC REACTOR is optional for 55kW or less and standard for 75kW or more.
	P(+), N(-)	For BRAKING UNIT	Connects a braking resistor via the braking unit. Used for a DC bus connection system.
	P(+), DB	For EXTERNAL BRAKING RESISTOR	Connects an external braking resistor (optional).
	⊕	Grounding	Ground terminal for inverter chassis (housing).
Speed setting	R0, T0	Auxiliary control power supply	Connects the same AC power supply as that of the main circuit to back up the control circuit power supply.
	13	Potentiometer power supply	Used for power supply for a speed setting POT (variable resistor: 1 to 5kΩ). 10V DC 10mA Max.
	12	Voltage input for speed setting	Used for analog command voltage input. Reversible operation can be selected by a ± signal: 0 to ±10V DC/0 to ± Max. speed.
Analog input	11	Analog input common	Common terminal to input signals.
	Ai1	Analog input 1	Select and set the following based on the analog input voltage. 0: Input signal off [OFF] 1: Auxiliary speed setting 1 [AUX-N1] 2: Auxiliary speed setting 2 [AUX-N2] 3: Torque limiter (level 1) [TL-REF1] 4: Torque limiter (level 2) [TL-REF2] 5: Torque bias command [TB-REF] 6: Torque command [T-REF] 7: Torque current command [IT-REF] 8: Creep speed 1 in UP/DOWN setting [CRP-N1] 9: Creep speed 2 in UP/DOWN setting [CRP-N2] 10: Magnetic-flux reference [MF-REF] 11: Detected speed [LINE-N] 12: Motor temperature [M-TMP] 13: Speed override [N-OR] 14: Universal Ai [U-AI] 15: PID feedback value [PID-FB] 16: PID command value [PID-REF] 17: PID correction value [PID-G] 18: Option Ai [O-AI]
	Ai2	Analog input 2	
Digital input	M	Analog input common	Common terminal to input signals.
	FWD	Forward operation command	FWD - CM: ON... The motor runs in the forward direction. FWD - CM: OFF...The motor decelerates and stops.
	REV	Reverse operation command	REV - CM: ON... The motor runs in the reverse direction. REV - CM: OFF...The motor decelerates and stops.
	X1	Digital input 1	0, 1, 2, 3: Multistep speed selection (step 1 to 15) [0: SS1, 1: SS2, 2: SS4, 3: SS8]
	X2	Digital input 2	4, 5: ASR, ACC/DEC time selection (4 steps) [4: RT1, 5: RT2]
	X3	Digital input 3	6: 3-wire operation stop command [HLD] 7: Coast-to-stop command [BX] 8: Alarm reset [RST]
	X4	Digital input 4	9: Trip command (External fault) [THR]
	X5	Digital input 5	10: Jogging operation [JOG] 11: Speed setting N2/Speed setting N1 [N2/N1]
	X6	Digital input 6	12: Motor M2 selection [M-CH2] 13: Motor M3 selection [M-CH3] 14: DC brake command [DCBRK]
	X7	Digital input 7	15: ACC/DEC cleared to zero [CLR] 16: Creep speed switching in UP/DOWN setting [CRP-N2/N1]
	X8	Digital input 8	17: UP command in UP/DOWN setting [UP] 18: DOWN command in UP/DOWN setting [DOWN]
	X9	Digital input 9	19: Write enable for KYEPAD (data can be changed) [WE-KP] 20: PID control cancel [KP/PID] 21: Inverse mode change over [IVS] 22: Interlock signal for 52-2 [IL] 23: Write enable through link [WE-LK] 24: Operation selection through link [LE] 25: Universal DI [U-DI] 26: Pick up start mode [STM] 27: Synchronization command [SYC] 28: Zero speed locking command [LOCK] 29: Pre-exciting command [EXITE] 30: Speed command cancel [N-LIM] 31: H41 (torque command) cancel [H41-CCL] 32: H42 (torque current command) cancel [H42-CCL] 33: H43 (magnetic-flux command) cancel [H43-CCL] 34: F40 (torque limiter mode 1) cancel [F40-CCL] 35: Torque limiter (level1, level2 selection) [TL2/TL1] 36: Bypass [BPS] 37, 38: Torque bias command 1/2 [37:TB1, 38:TB2] 39: Droop selection [DROOP] 40: Ai1 zero hold [ZH-AI1] 41: Ai2 zero hold [ZH-AI2] 42: Ai3 zero hold [ZH-AI3] 43: Ai4 zero hold [ZH-AI4] 44: Ai1 polarity change [REV-AI1] 45: Ai2 polarity change [REV-AI2] 46: Ai3 polarity change [REV-AI3] 47: Ai4 polarity change [REV-AI4] 48: PID output inverse changeover [PID-INV] 49: PG alarm cancel [PG-CCL] 50: Undervoltage cancel [LU-CCL] 51: Ai torque bias hold [H-TB] 52: STOP1 (The motor stops with standard deceleration time) [STOP1] 53: STOP2 (The motor decelerates and stops with deceleration time 4) [STOP2] 54: STOP3 (The motor stops with torque limiter) [STOP3] 55: DIA card enable [DIA] 56: DIB card enable [DIB] 57: Multi-winding motor control cancel [MT-CCL] 58, 59, 60, 61, 62, 63: Option Di 1/2/3/4/5/6 [O-DI1 to 6]
	PLC	PLC signal power supply	Connects to the PLC output signal power supply.
	CM	Digital input common	Common terminal to digital input signals.



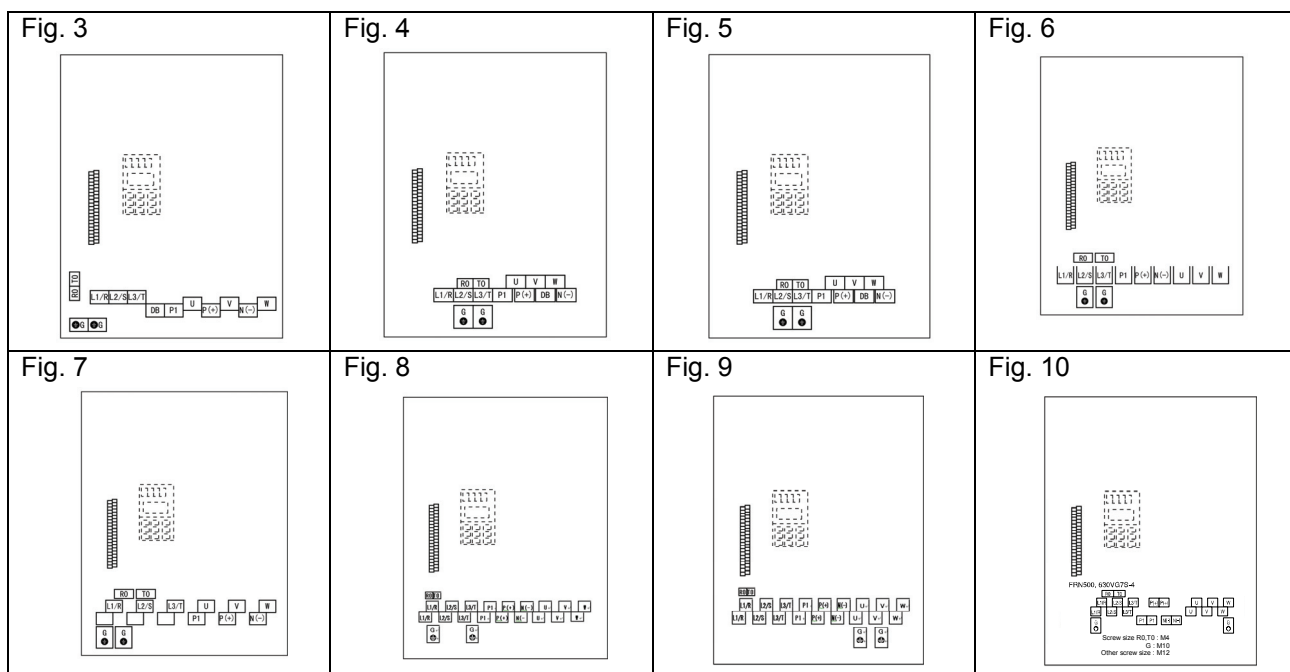
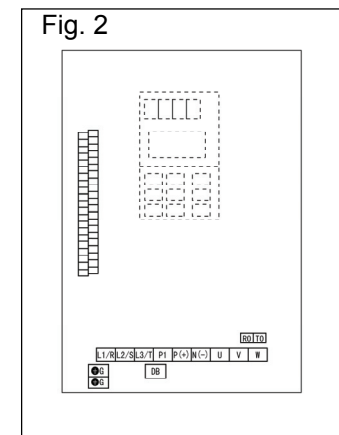
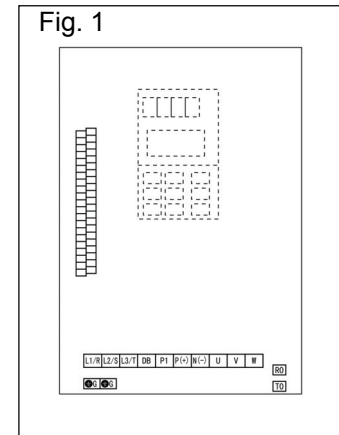
## 2. Specifications

	Symbol	Terminal name	Function
Analog output	AO1	Analog output 1	<ul style="list-style-type: none"> <li>Provides the monitor signal of 0 to <math>\pm 10V</math> DC for signals from the following:</li> </ul> 0: Detected speed (Speedometer, one-way deflection) [N-FB1+] 1: Detected speed (Speedometer, two-way deflection) [N-FB1±] 2: Speed setting 2 (Before acceleration/deceleration calculation) [N-REF2] 3: Speed setting 4 (ASR input) [N-REF4] 4: Detected speed [N-FB2±] 5: Detected line speed [LINE-N±] 6: Torque current command (Torque ammeter, two-way deflection) [IT-REF±] 7: Torque current command (Torque ammeter, one-way deflection) [IT-REF+] 8: Torque command (Torque meter, two-way deflection) [T-REF±] 9: Torque command (Torque meter, one-way deflection) [T-REF+] 10: Motor current rms value [I-AC] 11: Motor voltage rms value [V-AC] 12: Input power [PWR] 13: DC link circuit voltage [V-DC] 14: +10V output test [P10] 15: -10V output test [M10] 30: Universal AO [U-AO] 31: Optional AO [O-AO]
	AO2	Analog output 2	
	AO3	Analog output 3	
	M	Analog output common	
Transistor output	Y1	Transistor output 1	<ul style="list-style-type: none"> <li>Outputs the selected signals from the following items:</li> </ul> 0: Inverter running [RUN] 1: Speed existence [N-EX] 2: Speed agreement [N-AG] 3: Speed equivalence [N-AR] 4, 5, 6: Detected speed 1/ 2/ 3 [4: N-DT1, 5: N-DT2, 6: N-DT3] 7: Stopping on undervoltage [LU] 8: Detected torque polarity (braking/driving) [B/D] 9: Torque limiting [TL] 10, 11: Detected torque [10: T-DT1, 11: T-DT2] 12: KEYPAD operation mode [KP] 13: Inverter stopping [STOP] 14: Operation ready output [RDY] 15: Magnetic-flux detection signal [MF-DT] 16: Motor M2 selection status [SW-M2] 17: Motor M3 selection status [SW-M3] 18: Brake release signal [BRK] 19: Alarm indication1 [AL1] 20: Alarm indication 2 [AL2] 21: Alarm indication 3 [AL4] 22: Alarm indication 4 [AL8] 23: Fan operation signal [FAN] 24: Auto-resetting [TRY] 25: Universal DO [U-DO] 26: Heat sink overheat early warning [INV-OH] 27: Synchronization completion signal [SY-C] 28: Lifetime alarm [LIFE] 29: Under accelerating [U-ACC] 30: Under decelerating [U-DEC] 31: Inverter overload early warning [INV-OL] 32: Motor temperature early warning [M-OH] 33: Motor overload early warning [M-OL] 34: DB overload early warning [DB-OL] 35: Link transmission error [LK-ERR] 36: Load adaptive control under limiting [ANL] 37: Load adaptive control under calculation [ANC] 38: Analog torque bias hold [TBH] 39, 40, 41, 42, 43, 44, 45, 46, 47: Optional Do 1/2/3/4/5/6/7/8/9 [O-DO1 to 9]
	Y2	Transistor output 2	
	Y3	Transistor output 3	
	Y4	Transistor output 4	
	CME	Transistor output common	
Relay output	Y5A,Y5C	Relay output	Functions can be selected for signals like Y1 to Y4.
	30A,30B,30C	Alarm relay output (for any fault)	Outputs a non-voltage contact signal (1SPDT) when a protective function is activated to stop inverter. Can select alarm for exciting or non exciting conditions.
Commu- nication	RX(+),RX(-) TX(+),TX(-)	RS-485 communication input/output	Input/output terminals for RS-485 communication. Can connect up to 31 inverters through a multidrop (daisy chain) connection.
	SD(M)	Communication shield cable connection	Connects to the shield cable.
Speed detection	PA,PB	Pulse generator 2-phase signal input	Terminals for connecting 2-phase signal of pulse generator.
	PGP,PGM	Pulse generator power supply	+15V DC pulse generator power supply (or can be switched to +12V).
	FA,FB	Pulse generator output	Outputs pulse generator signal by dividing by n. The "n" can be changed by function setting.
	CM	Pulse generator output common	Common terminals to FA and FB.
Temperature detection	TH1,THC	NTC Thermistor PTC Thermistor	Motor temperature can be detected with the NTC and the PTC thermistors. The motor overheat protective level can be specified by the PTC thermistor function.

## 2.3.3 Terminal Arrangement

### 2.3.3.1 Terminal Arrangement

Nominal applied motor [kW]	Three-phase 200V series		Three-phase 400V series	
	Inverter type	Fig.	Inverter type	Fig.
0.75	FRN0.75VG7S-2	1	-	-
1.5	FRN1.5VG7S-2		-	-
2.2	FRN2.2VG7S-2		-	-
3.7	FRN3.7VG7S-2		-	-
5.5	FRN5.5VG7S-2		FRN3.7VG7S-4	1
7.5	FRN7.5VG7S-2		FRN5.5VG7S-4	
			FRN7.5VG7S-4	
11	FRN11VG7S-2	2	FRN11VG7S-4	2
15	FRN15VG7S-2	3	FRN15VG7S-4	3
18.5	FRN18.5VG7S-2		FRN18.5VG7S-4	
22	FRN22VG7S-2	4	FRN22VG7S-4	4
30	FRN30VG7S-2		FRN30VG7S-4	
37	FRN37VG7S-2		FRN37VG7S-4	
45	FRN45VG7S-2	5	FRN45VG7S-4	5
55	FRN55VG7S-2		FRN55VG7S-4	
75	FRN75VG7S-2	6	FRN75VG7S-4	5
90	FRN90VG7S-2	7	FRN90VG7S-4	
110	-	-	FRN110VG7S-4	7
132			FRN132VG7S-4	
160			FRN160VG7S-4	
200			FRN200VG7S-4	
220			FRN220VG7S-4	
250			FRN250VG7S-4	
280			FRN280VG7S-4	
315	FRN315VG7S-4	9		
355	FRN355VG7S-4			
400	FRN400VG7S-4	10		
500	FRN500VG7S-4			
630	FRN630VG7S-4			



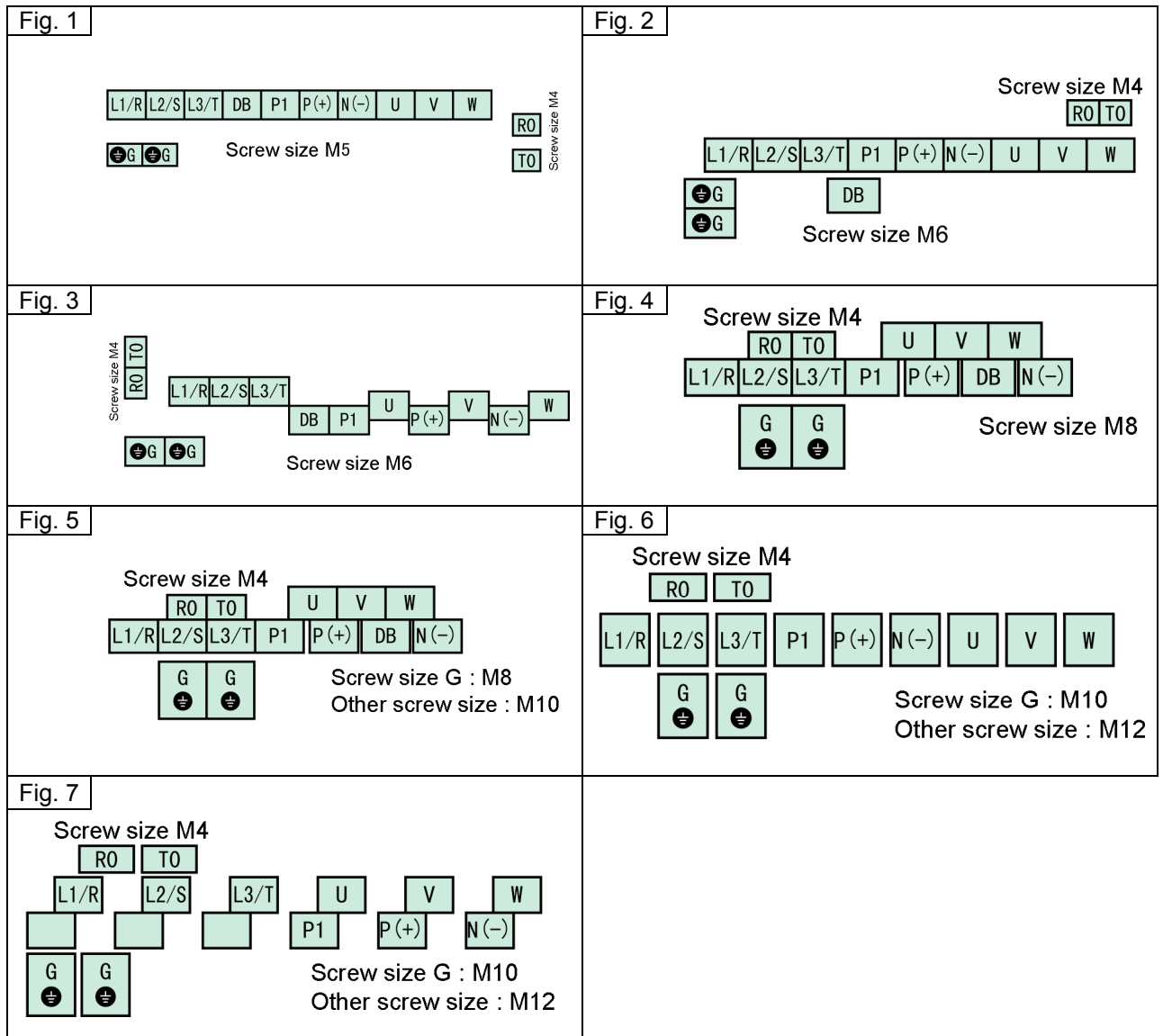
See the next page for details of terminal arrangement.

## 2. Specifications

### 2.3.3.2 Terminal Arrangement Chart

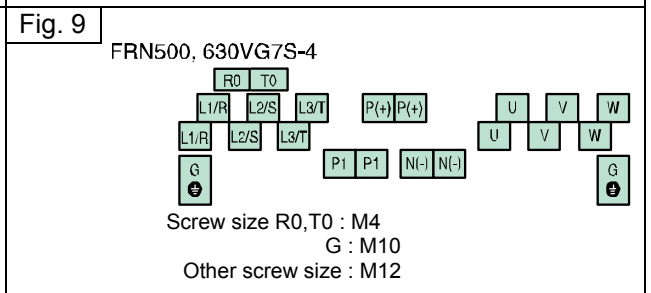
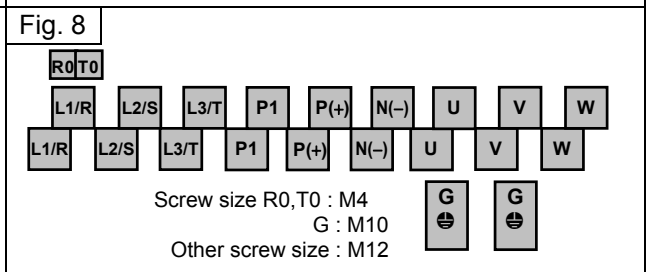
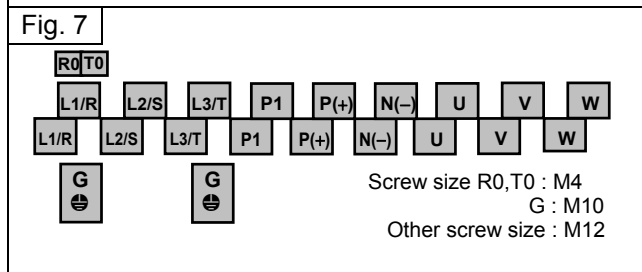
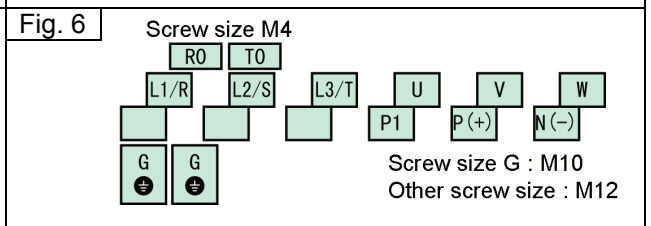
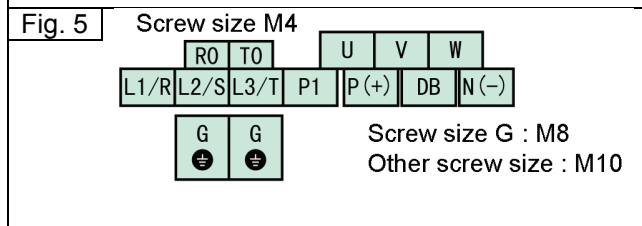
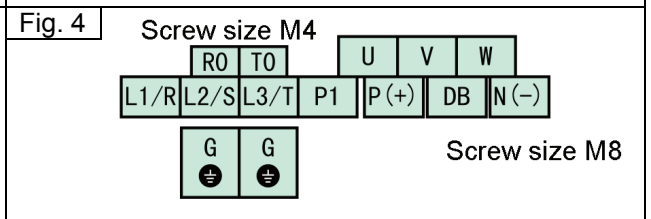
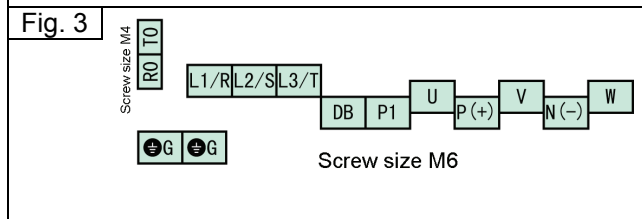
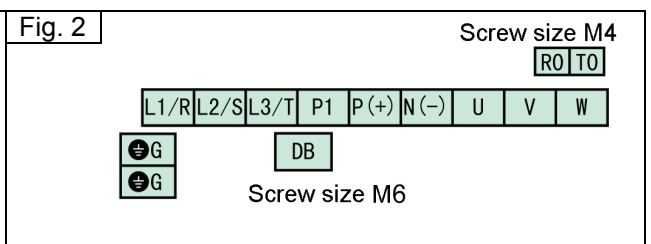
● Main circuit terminals  
Three-phase 200V series

Nominal applied motor [kW]	Inverter type	Fig.	Nominal applied motor [kW]	Inverter type	Fig.
0.75	FRN0.75VG7S-2	1	18.5	FRN18.5VG7S-2	3
1.5	FRN1.5VG7S-2		22	FRN22VG7S-2	
2.2	FRN2.2VG7S-2		30	FRN30VG7S-2	4
3.7	FRN3.7VG7S-2		37	FRN37VG7S-2	
5.5	FRN5.5VG7S-2		45	FRN45VG7S-2	5
7.5	FRN7.5VG7S-2		55	FRN55VG7S-2	
11	FRN11VG7S-2	2	75	FRN75VG7S-2	6
15	FRN15VG7S-2		90	FRN90VG7S-2	7



### Three-phase 400V series

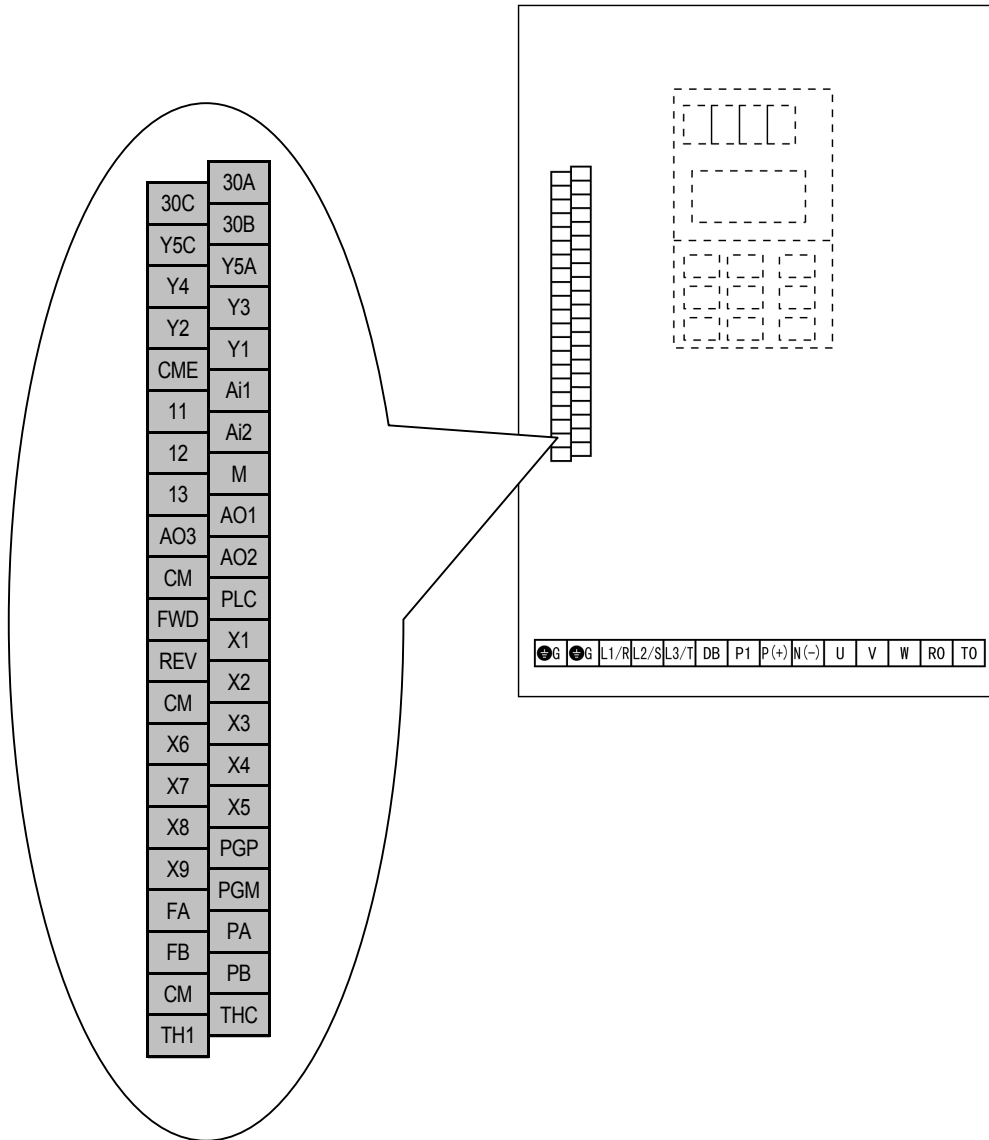
Nominal applied motor [kW]	Inverter type	Fig.	Nominal applied motor [kW]	Inverter type	Fig.
3.7	FRN3.7VG7S-4	1	132	FRN132VG7S-4	6
5.5	FRN5.5VG7S-4		160	FRN160VG7S-4	
7.5	FRN7.5VG7S-4		200	FRN200VG7S-4	
11	FRN11VG7S-4	2	220	FRN220VG7S-4	
15	FRN15VG7S-4		250	FRN250VG7S-4	
18.5	FRN18.5VG7S-4	3	280	FRN280VG7S-4	
22	FRN22VG7S-4		315	FRN315VG7S-4	
30	FRN30VG7S-4	4	355	FRN355VG7S-4	8
37	FRN37VG7S-4		400	FRN400VG7S-4	
45	FRN45VG7S-4		500	FRN500VG7S-4	9
55	FRN55VG7S-4		630	FRN630VG7S-4	
75	FRN75VG7S-4	5			
90	FRN90VG7S-4				
110	FRN110VG7S-4				



## 2. Specifications

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- Control circuit terminals



### 2.3.3.3 Terminal Size

#### ● Main circuit terminals

Power supply voltage	Nominal applied motor [kW]	Inverter type	Size		
			L1/R,L2/S,L3/T,DB,P1, P(+),N(-),U,V,W	G	R0,T0
Three-phase 200V series	0.75	FRN0.75VG7S-2	M5	M5	M4
	1.5	FRN1.5VG7S-2			
	2.2	FRN2.2VG7S-2			
	3.7	FRN3.7VG7S-2	M6	M6	M4
	5.5	FRN5.5VG7S-2			
	7.5	FRN7.5VG7S-2			
	11	FRN11VG7S-2	M6	M6	M4
	15	FRN15VG7S-2			
	18.5	FRN18.5VG7S-2	M6	M6	M4
	22	FRN22VG7S-2			
	30	FRN30VG7S-2	M8	M8	M4
	37	FRN37VG7S-2	M10	M8	M4
	45	FRN45VG7S-2			
	55	FRN55VG7S-2			
75	FRN75VG7S-2	M12	M10	M4	
90	FRN90VG7S-2	M12	M10	M4	
Three-phase 400V series	3.7	FRN3.7VG7S-4	M5	M5	M4
	5.5	FRN5.5VG7S-4			
	7.5	FRN7.5VG7S-4			
	11	FRN11VG7S-4	M6	M6	M4
	15	FRN15VG7S-4			
	18.5	FRN18.5VG7S-4			
	22	FRN22VG7S-4	M6	M6	M4
	30	FRN30VG7S-4			
	37	FRN37VG7S-4			
	45	FRN45VG7S-4	M8	M8	M4
	55	FRN55VG7S-4			
	75	FRN75VG7S-4			
	90	FRN90VG7S-4	M10	M8	M4
	110	FRN110VG7S-4			
	132	FRN132VG7S-4			
	160	FRN160VG7S-4	M12	M10	M4
	200	FRN200VG7S-4			
	220	FRN220VG7S-4			
	250	FRN250VG7S-4			
	280	FRN280VG7S-4			
315	FRN315VG7S-4				
355	FRN355VG7S-4				
400	FRN400VG7S-4				
500	FRN500VG7S-4				
630	FRN630VG7S-4				

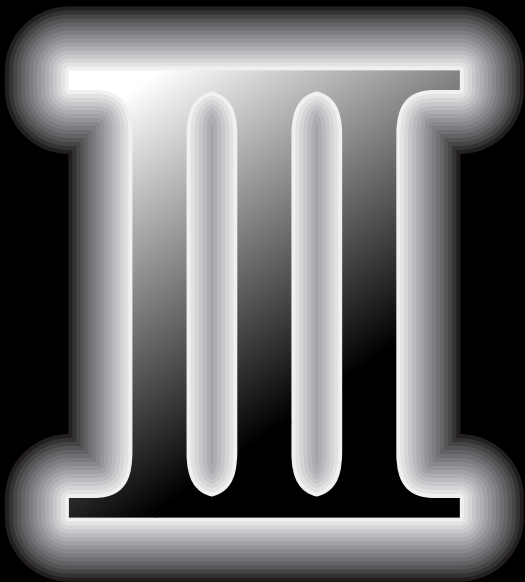
#### ● Control circuit terminals

M3 : Common to all types.

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- MEMO -

# THE INVERTER



## III. Preparatory Operations and Test Run

- 3.1 Before Use
- 3.2 Installation and Connection
- 3.3 Electric Connections
- 3.4 Test Run



# 3. Preparatory Operations and Test Run

## 3.1 Before Use

### 3.1.1 Inspection After Receipt

Unpackage the product and perform the following checks.

If the product is found to have a fault, please contact the dealer from which you purchased the product or the nearest sales office of Fuji Electric.

- (1) Read the nameplate to check that the product is the same thing as ordered.

TYPE: Inverter type  
**FRN 30 VG7S - 4**  
 Voltage class: 2 for 200V or 4 for 400V  
 Series name: VG7S  
 Applicable motor capacity: 30 for 30 kW  
 Model :FRENIC5000

TYPE	FRN30VG7S-4
SER.No.	43HH12345R001H
US LISTED IND. CONT. CO. E140476 8844	
SOURCE	Constant Torque   Variable Torque   High Torque
	3PH 380-440V/50Hz 86A   380-480V/60Hz 104A   86A
OUTPUT	3PH 380-460V
	45kVA 60A   57kVA 75A   44kVA 58A
MASS	30 kg
Fuji Electric FA Made in Japan	
TYPE	FRN30VG7S-4
SER.No.	43HH12345R001H

Figure 3-1-1 Nameplate

SOURCE : Power ratings  
 OUTPUT : Rated output  
 MASS : Mass  
 SER.No. : Serial No.

**0 1 HY12345R001 - 1H**  
 Product No.  
 Serial lot No.  
 Month of manufacture: 1 to 9 for January to September, X for October, Y for November, or Z for December  
 Year of manufacture: Last digit of A.D. (0 for 2000)

- (2) Check for broken or missing parts and damage caused to the cover/body during transportation.
- (3) In addition to the inverter body and instruction manual, a rubber bushing is included in the package (for 15kW or lower inverters).

### ! WARNING

• Do not energize a product with broken or missing parts or damaged during transportation.  
**Doing so may lead to electric shock or fire.**

### 3.1.2 External View of the Product

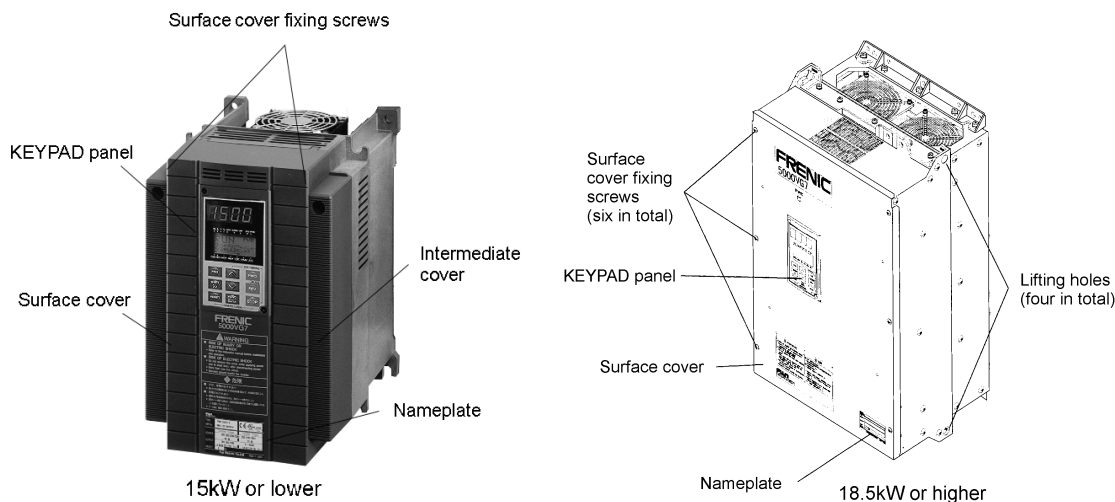


Figure 3-1-2 External View of the Product

### 3.1.3 Handling of the Product

(1) Removal of Surface Cover

Loosen the surface cover fixing screws. Remove the cover by pulling the top of the cover as shown in Figure 3-1-3.

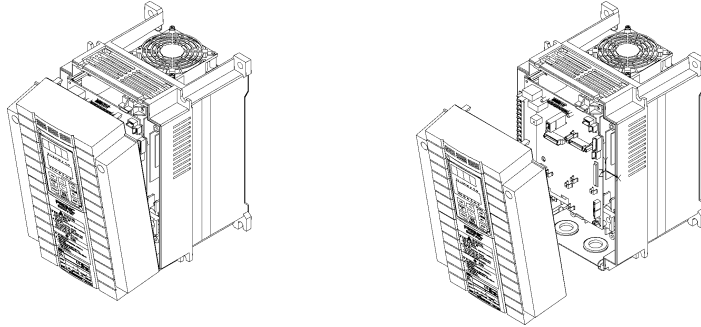


Figure 3-1-3 Removal of Surface Cover (15 kW or lower)

Remove the six surface cover fixing screws. Remove the surface cover.

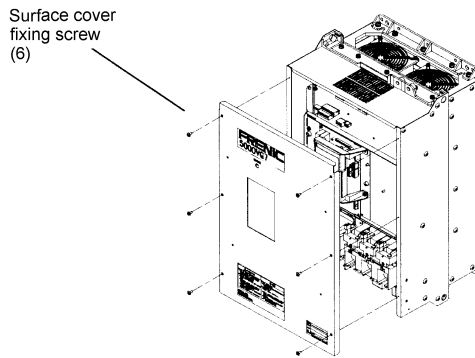


Figure 3-1-4 Removal of Surface Cover (18.5 kW or higher)

(2) Removal of KEYPAD Panel

After removing the face cover in step (1), loosen the KEYPAD panel fixing screws. Remove the KEYPAD panel as shown in Figure 1-3-3.

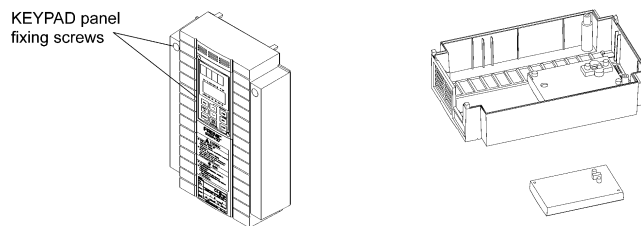


Figure 3-1-5 Removal of KEYPAD Panel (15 kW or lower)

Loosen the KEYPAD panel fixing screws. Carefully remove the KEYPAD panel with your fingers inserted to the cutouts at the side of the KEYPAD panel. Careless handling may break connectors.

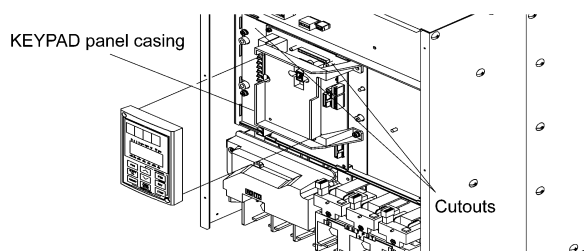


Figure 3-1-6 Removal of KEYPAD Panel (18.5 kW or higher)

# 3. Preparatory Operations and Test Run

## 3.1.4 Transportation

Always hold the body during transportation.  
Do not hold the cover or any other part. Doing so may break or fall the product.  
When using a hoist or crane to transport a product with lifting holes, hang hooks and ropes to the holes.

## 3.1.5 Storage

### Temporary Storage

Store the product under the conditions specified on Table 3-1-1.

Table 3-1-1 Storage Conditions

Item	Requirement	
Ambient temperature	-10 to +50 °C	No condensation or freezing should occur due to sudden temperature changes.
Storage temperature <small>See Note 1</small>	-25 to +65 °C	
Relative humidity	5% to 95% <small>See Note 2</small>	
Atmosphere	The product should not be exposed to dust, direct sunlight, corrosive or combustible gas, oil mist, vapor, waterdrops, vibration, or air containing much salt.	

Note 1: The storage temperature applies to the temporary storage during transportation, for example.

Note 2: Do not store the product in a place where the temperature significantly changes as this may cause condensation or freezing even if the humidity requirement is satisfied.

- (1) Do not place the product directly on the floor.
- (2) Pack the product with a plastic sheet or such if stored under undesirable conditions.
- (3) Seal in a desiccative such as silica gel when packing the product if it may be affected by moisture.

### Extended Storage

The requirements to be satisfied when storing the product for an extended period after purchased greatly depend on the environment. General requirements are listed below.

- (1) Satisfy the requirements for temporary storage.  
If the storage period exceeds three months, the ambient temperature should be kept below 30 °C to protect the dead electrolytic capacitor from deterioration.
- (2) Carefully pack the product to prevent the intrusion of moisture, etc. Seal in a desiccant to keep the relative humidity inside the pack below 70%, as a guide.
- (3) The product will be often exposed to moisture or dust if left mounted on an unit or console, especially in a building under construction. In such a case, remove the product and relocate in a well-conditioned place.  
The electrolytic capacitor will be deteriorated if left dead for an extended period. Do not leave it dead for a period exceeding a year.

## 3.2 Installation and Connection

### 3.2.1 Operating Conditions

Install the product under the conditions specified in Table 3-2-1.

Table 3-2-1 Operating Conditions

Item	Requirement
Place	Indoor
Ambient temperature	-10 to +50 °C
Relative humidity	5% to 95% (no condensation allowed)
Atmosphere	The product should not be exposed to dust, direct sunlight, corrosive gas, oil mist, vapor, waterdrops, or air containing much salt. No condensation should occur due to sudden temperature changes.
Altitude	1,000m or less (if more than 1,000m, see Table 2-1-2)
Vibration	<ul style="list-style-type: none"> <li>• 200V 55kW or lower, 400V 75kW or lower</li> <li>2 to 9Hz : 3mm amplitude</li> <li>9 to 20Hz : 9.8m/s<sup>2</sup></li> <li>20 to 55Hz : 2m/s<sup>2</sup></li> <li>55 to 200Hz : 1m/s<sup>2</sup></li> <li>• 200V 75kW or higher, 400V 90kW or higher</li> <li>9 to 55Hz : 2m/s<sup>2</sup></li> <li>55 to 200Hz : 1m/s<sup>2</sup></li> </ul>

Table 3-2-2 Output Reduction Rates at Higher Altitudes

Altitude	Output Current Reduction Rate
1,000m or less	1.00
1,000-1,500m	0.97
1,500-2,000m	0.95
2,000-2,500m	0.91
2,500-3,000m	0.88

# 3. Preparatory Operations and Test Run

## 3.2.2 Installation Procedure

- (1) Install the product onto a rigid structure in the vertical direction with the letters, FRENIC5000 VG7S, seen from the front and fix with specified bolts. Do not install upside down or in the horizontal direction.

<b>CAUTION</b>
<b>Failure to do so may lead to injury.</b>

- (2) The inverter generates heat during operation. Reserve a space as shown in Figure 3-2-1 to ensure a sufficient flow of cooling air. The heat is radiated from the top. Do not install the inverter under any unit susceptible to heat.

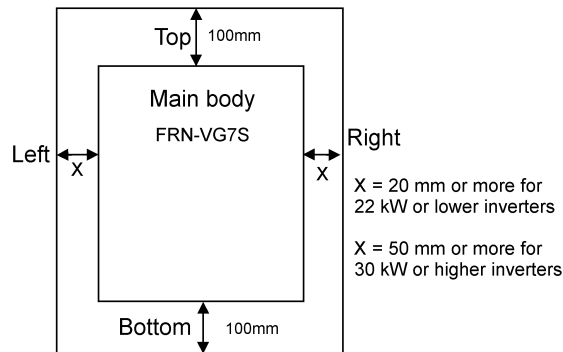


Figure 3-2-1

- (3) The cooling fins (heat sink) are heated to almost 90 °C during operation of the inverter. The inverter mounting surface should be made of a material capable of withstanding this temperature rise.

<b>CAUTION</b>
<b>The fins may burn your skin.</b>

<b>WARNING</b>
<ul style="list-style-type: none"> <li>• Install the inverter onto an incombustible material such as metal.</li> </ul> <b>Failure to do so may lead to fire.</b>

- (4) When storing the inverter in a control panel, for example, sufficiently ventilate the inverter so that its ambient temperature will not exceed the specified limit. Do not store the inverter in a small closed box that does not radiate heat well.
- (5) When storing two or more inverters in a unit or control panel, they are desirably arranged side by side to minimize the thermal effect on each other. If they are inevitably arranged with one above another, separating plate should be provided to prevent the heat transfer from the bottom side inverter to the above.

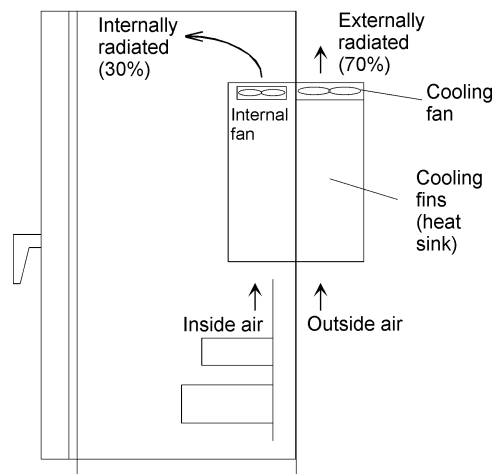



Figure 3-2-2 External Cooling System

- (6) The inverter is prepared to be mounted in a control panel when delivered. It may be externally cooled using the optional adapter if 15kW or lower or with the mounting legs relocated if 18.5kW or higher. With the inverter externally cooled, the heat generated inside the unit or control panel is dissipated because the cooling fins, which radiate 70% of the generated heat, are excluded from the unit or control panel.  
Do not exclude the cooling fins where they may be clogged with lint or damp dust.


 <b>CAUTION</b>
<ul style="list-style-type: none"> <li>Do not admit lint, paper, wooden chips, dust, metallic pieces, and any other foreign matters into the inverter or allow them to stick to the cooling fins.</li> </ul> <p><b>Doing so may lead to fire or accident.</b></p>

To externally cool a  $\geq 18.5\text{kW}$  and  $\leq 630\text{kW}$  inverter, relocate the upper and lower mounting legs as shown in Figure 3-2-3. Remove the mounting leg fixing screws, relocate the legs, and fix with casing fixing screws. (The casing fixing screws cannot be directly used for some models. See the following table.)

The mounting leg fixing screws become unnecessary after the legs are relocated.

Number and Size of Fixing Screws

Voltage class	Inverter model	Mounting leg fixing screws	Casing fixing screws
200V	FRN18.5VG7S-2~FRN55VG7S-2	5(M6 × 20)	5(M5 × 16)
	FRN75VG7S-2	7(M6 × 20)	5(M5 × 16)
	FRN90VG7S-2	6(M6 × 20)	6(M5 × 16)
400V	FRN18.5VG7S-4~FRN75VG7S-4	5(M6 × 20)	5(M5 × 16)
	FRN90VG7S-4~FRN110VG7S-4	7(M6 × 20)	5(M5 × 16) Note 1
	FRN132VG7S-4~FRN160VG7S-4	7(M6 × 20)	7(M5 × 16)
	FRN200VG7S-4~FRN250VG7S-4	6(M6 × 20)	6(M5 × 16) Note 1
	FRN280VG7S-4~FRN315VG7S-4 Note 3	6(M8 × 20)	– Note 2
FRN355VG7S-4~FRN630VG7S-4 Note 3	8(M8 × 20)		

 <b>CAUTION</b>
<ul style="list-style-type: none"> <li>Do not use any screws other than specified.</li> </ul> <p><b>Doing so may lead to fire or accident.</b></p>

Note 1: Fix the legs with M5 × 20 screws.

Note 2: Fix the legs with leg fixing screws.

Note 3: The lower leg becomes unnecessary when the inverter is installed on its bottom.

### 3. Preparatory Operations and Test Run

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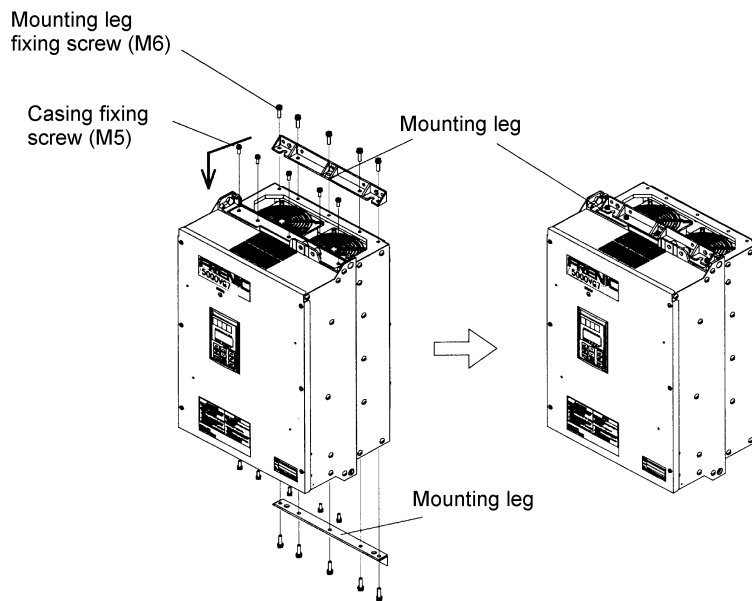


Figure 3-2-3

**! CAUTION**

- Use the screws provided with the inverter when relocating the mounting legs.  
**Failure to do so may lead to injury.**

---

## 3.3 Electric Connections

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Removing the surface cover exposes the terminal blocks. Correctly wire them after reading the following instructions.

### 3.3.1 Basic Connections

- (1) Connect power supply leads to the main circuit power terminals, L1/R, L2/S, and L3/T. Connecting any power supply lead to another terminal may fail the inverter. Check that the supply voltage does not exceed the permissible limit indicated on the nameplate, etc.
- (2) The grounding terminal must be grounded to prevent disasters such as electric shock and fire and reduce the noise.
- (3) Use a reliable crimp terminal to connect each lead.
- (4) After making connections (wiring), check that:
  - 1) leads are correctly connected,
  - 2) all necessary connections are made, and
  - 3) no terminal or wire is short-circuited or grounded.
- (5) When any connection is changed after the inverter is energized:

It takes a long time for the smoothing capacitor in the DC link circuit of the main circuit to be discharged after the power supply is shut off. After the CHARGE lamp goes off, check with a multimeter or such that the DC voltage has been reduced to a safe level (25V DC or less). Short-circuiting a circuit in which a voltage (potential) still remains may generate sparks. Wait until the voltage goes away.

 <b>WARNING</b>
<ul style="list-style-type: none"><li>• Always connect the grounding lead.</li></ul> <p><b>Failure to do so may lead to electric shock or fire.</b></p> <ul style="list-style-type: none"><li>• The wiring work should be performed by qualified persons.</li><li>• Before working, check that the power supply is shut off (open).</li></ul> <p><b>Failure to do so may lead to electric shock.</b></p> <ul style="list-style-type: none"><li>• Do not use any lead size other than specified.</li></ul> <p><b>Doing so may lead to fire.</b></p>











The basic connection diagram is given in Subsection 2.3.1.



## 3. Preparatory Operations and Test Run

### 3.3.2 Wiring of Main Circuit and Grounding Terminals

Table 3-3-1 Functions of Main Circuit and Grounding Terminals

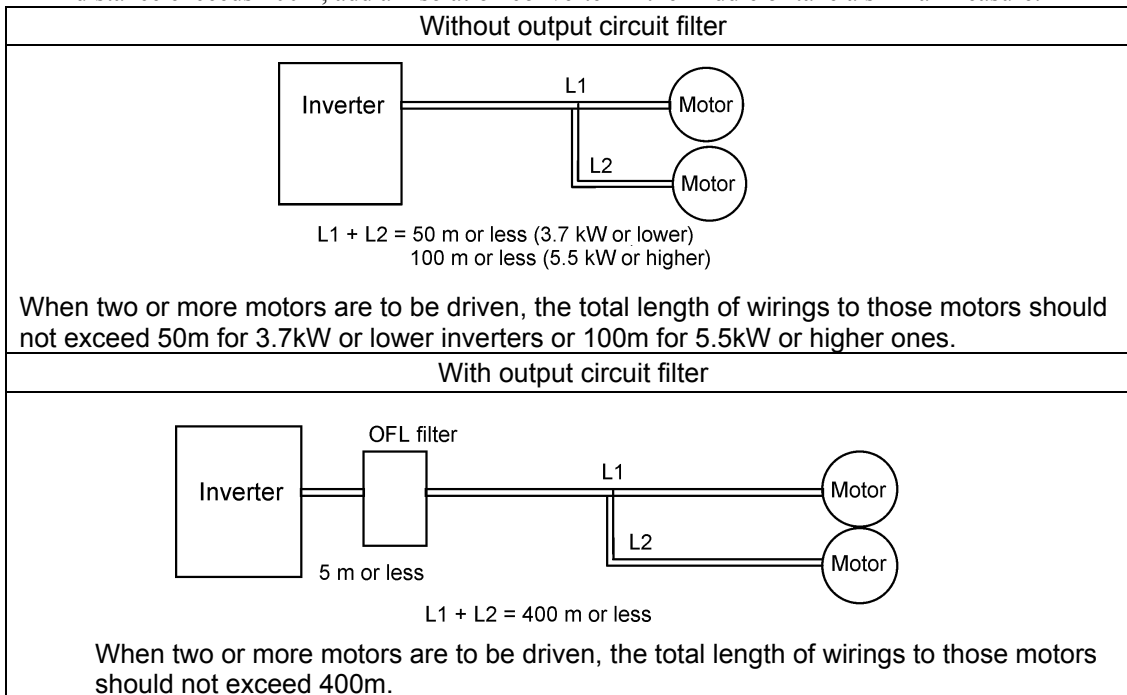
Terminal symbol	Terminal name	Description
L1/R,L2/S,L3/T	Main circuit power input terminals	Connected with three-phase power source.
U,V,W	Inverter output terminals	Connected with three-phase motor.
R0,T0	Auxiliary control power input terminals	Connected with the same AC power source as used for main circuit, as back-up power source for control circuit.
P1,P(+)	DC REACTOR connecting terminals	Connected with (optional) input power-factor correcting DC REACTOR.
P(+),DB	Braking resistor connecting terminals	Connected with (optional) braking resistor.
P(+),N(-)	DC link circuit terminals	Supplies DC link circuit voltage. Connected with (optional) external braking unit or (optional) PWM converter.
 G	Inverter grounding terminals	Grounds inverter chassis (casing). Connected with earth.

(1) Main circuit power input terminals (L1/R, L2/S, and L3/T)

- 1) The main circuit power input terminals, L1/R, L2/S, and L3/T should be connected with the power source via earth-leakage circuit breaker for line protection. Any phase may be connected to any lead. If the zero-phase current is detectable by the upstream system, however, ordinary circuit breakers may be used.
- 2) Connect a magnetic contactor so that the inverter can be disconnected from the power source to minimize the influence of any failure when the inverter protective function is activated.
- 3) Do not start or stop the inverter by turning the main power switch on or off. Use the control circuit terminals, FWD and REV, or the FWD, REV, and STOP keys on the KEYPAD panel to start or stop the inverter. When the inverter is inevitably started or stopped using the main power switch, do not turn it on or off more than once per hour.
- 4) Do not connect any terminal to a single-phase power source.

(2) Inverter output terminals (U, V, and W)

- 1) Connect three-phase motor leads to the inverter output terminals, U, V, and W with care not to connect a wrong phase.
- 2) Do not connect a phase advancing capacitor or surge absorber (suppressor) to the inverter output terminals.
- 3) If the wiring between the inverter and the motor is too long, a high-frequency current will run through the wiring due to floating capacity to trip the inverter because of overcurrent, increase the leakage current, and/or deteriorate the current indication accuracy. Therefore, the motor wiring length should not exceed 50m for 3.7kW or lower inverters or 100m for others, as a guide. Connect the optional output circuit filter (OFL filter) if the wiring is too long.
- 4) In case of the motor equipped with an encoder, the wiring distance between the inverter and motor must not exceed 100m. This is due to the limitation set by the specification of the encoder. If the distance exceeds 100m, add an isolation converter in the middle or take a similar measure.



Note: When a thermal relay is used between the inverter and the motor, especially for 400V series, the thermal relay may malfunction even with a wiring length less than 50m. In this case, connect an OFL filter or reduce the inverter operation noise (carrier frequency) using function code F26 (motor sound (carrier frequency)).

• **Driving a 400V motor with an inverter**

If a motor is driven with a PWM inverter, the surge voltage generated by switching inverter elements is overlapped as applied to the motor terminals. Especially for 400V motors, the motor insulation may be deteriorated by the surge voltage if the motor wiring is too long. Therefore, any of the following measures should be taken when a 400V motor is to be driven with an inverter.

- 1) Use a motor with reinforced insulation (all the Fuji Electric's general-purpose motors have reinforced insulation).
- 2) Connect the optional output circuit filter (OFL filter) to the inverter output terminals.
- 3) Shorten the wiring between the inverter and the motor as short as possible (to 10 to 20m or less).

### 3. Preparatory Operations and Test Run

(3) Auxiliary control power input terminals (R0 and T0)

If the magnetic contactor in the power supply circuit to the inverter is turned off (open) when the protection circuit is activated, the inverter control power supply is shut off. As a result, alarm outputs (30A, B, and C) are no longer retained and indications on the KEYPAD panel go away. To prevent this, the same AC voltage as used for the main circuit is applied to the auxiliary control power input terminals, R0 and T0.

Although the inverter functions with no voltage applied to these terminals, it is strongly recommended to connect the voltage to R0 and T0 to ensure safe operation.

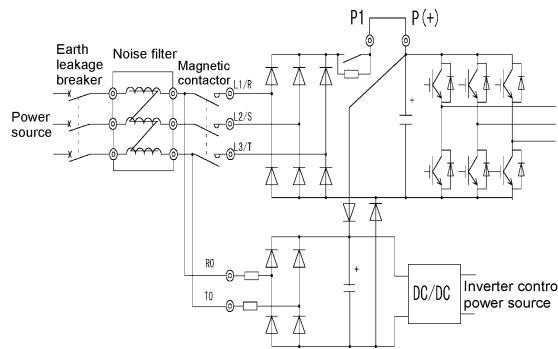


Figure 3-3-1 Wiring of Auxiliary Control Power Input Terminals

- 1) When a radio noise filter is used, the power to be connected to the auxiliary control power input terminals, R0 and T0, should be taken from a point downstream the filter. If it is taken from a point upstream the filter, the noise reduction effect is impaired.

(4) DC REACTOR connecting terminals (P1 and P(+))

- 1) These terminals are provided to connect the optional input power-factor correcting DC REACTOR. A jumper is connected between the terminals before delivery from the factory. **Remove the jumper before connecting the DC REACTOR.**

- 2) Do not remove the jumper when the DC reactor is not used.

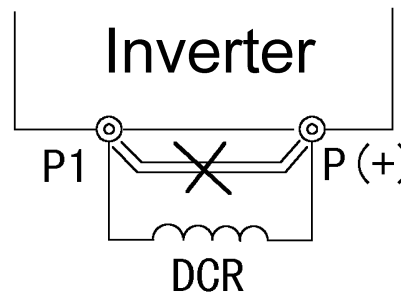


Figure 3-3-2

**Note:** The DC REACTORS are (externally) provided as standard equipment for 75 kW or higher inverters. Always use the DC REACTOR for those inverters.

3) Connect an optional DC reactor to the inverter for 55kW or smaller rated motor outputs.

- The inverter capacity ratio to the power transformer is in the relationship shown in Fig. 3-3-3 (a).
- A thyristor is in the same power supply or a power factor-adjusting capacitor is turned on or off in the same power supply as shown in Fig. 3-3-3 (b).
- There is 2% or a higher imbalance in the source voltage.

$$\text{Imbalance ratio of source voltage [\%]} = \frac{(\text{max. voltage [V]} - \text{min. voltage [V]})}{(\text{average voltage of three phases [V]})} \times 67$$

- To improve power-factor in the input side. The power-factor can be improved to about 0.94.

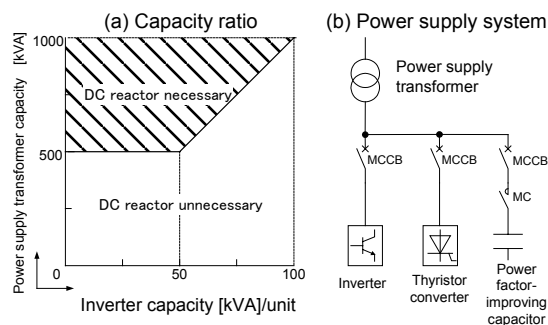


Fig. 3-3-3 Application of DC reactor

(5) Braking resistor connecting terminals (P(+) and DB)

The optional braking resistor may be externally mounted. It is required when the inverter is operated frequently or under heavy inertia.

- 1) Connect the braking resistor terminals, P(+) and DB, to the inverter terminals, P(+) and DB.
- 2) Lay out so that the wiring length will not exceed 10m. The two leads should be twisted or in close contact (parallel).

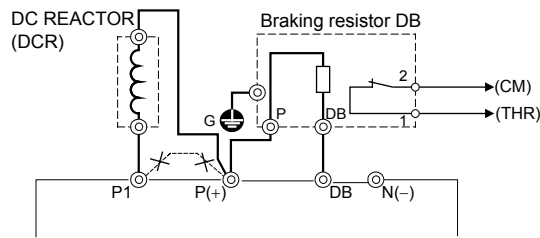


Figure 3-3-4 Connection Diagram  
(For 200V, 55kW or Lower and 400V, 110kW or Lower Inverters)

**! CAUTION**

- Do not directly connect the braking resistor to the DC terminals, P(+) and N(-).  
**Doing so may lead to fire.**

(6) DC link circuit terminals (P(+) and N(-))

The 200V series, 75kW or higher and 400V series, 132kW or higher inverters contain no braking resistor drive circuit. When the braking resistor is required, a braking unit should be used.

- 1) Connect the braking unit terminals, P(+) and N(-), to the inverter terminals, P(+) and N(-).

Lay out so that the wiring length will not exceed 5m. The two leads should be twisted or in close contact (parallel).

- 2) Connect the braking resistor terminals, P(+) and DB, to the braking unit terminals, P(+) and DB. Lay out so that the wiring length will not exceed 10m. The two leads should be twisted or in close contact (parallel).

When the inverter terminals, P(+) and N(-), are not used, they should be left open. Never short these terminals or directly connect the braking resistor. Doing so may break the inverter.

- 3) Auxiliary contacts 1 and 2 of the braking unit have polarity.
- 4) When connecting a PWM converter, see the instruction manual for the converter.

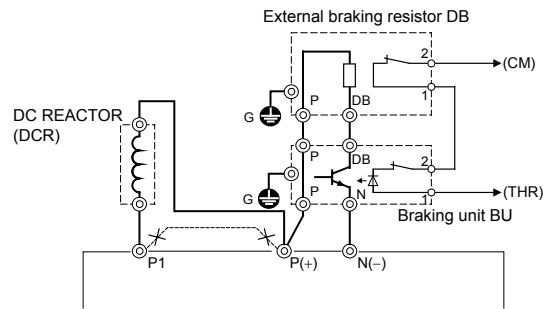


Figure 3-3-5 An Example of Connection Diagram\*  
(200V, 75kW or Higher and 400V, 132kW or Higher Inverters)

\* Two or more braking units or braking resistors are necessary for some models. For details of connection, refer to the operation manual of the braking unit.

### 3. Preparatory Operations and Test Run

(7) Inverter grounding terminals (⚡ G)

The inverter grounding terminals, ⚡ G, must be grounded to ensure your safety and for noise measures. The Technical Standards for Electric Equipment requires metallic frames of electric equipment be grounded to prevent disasters such as electric shock and fire. Connect the terminals as described below.

- 1) Connect to type D grounded poles for 200V series or type C grounded poles for 400V series according to the Technical Standards for Electric Equipment.
- 2) Connect the earth terminal to the dedicated grounding pole of the inverter system using a thick, short lead.

Table 3-3-2


Voltage class	Grounding work class	Grounding resistance
200V	Type D	100 Ω or less
400V	Type C	10 Ω or less

(8) Auxiliary power switching connector (CN UX) (18.5kW or higher)

For 18.5kW or higher inverters, if the supply voltage to the main circuit is within the range shown in Table 3-3-3, reconnect the auxiliary power switching connector, CN UX, to U2. For other inverters, leave the connector connected to U1. For details, see Figure 3-3-8.

Table 3-3-3 Voltage Ranges Requiring Reconnection of Auxiliary Power Switching Connector

Frequency [Hz]	Supply voltage range [ V ]
50	380 to 398
60	380 to 430

 <b>CAUTION</b>
<ul style="list-style-type: none"> <li>Check that the number of phases and rated voltage of the product agree with those of the AC power source.</li> <li>Do not connect any AC power source to the output terminals, U, V, and W.</li> </ul> <p><b>Doing so may lead to injury.</b></p>


(9) Fan power switching connector (CN RXTX) (18.5kW or higher)

The VG7S accepts DC power inputs through a common DC terminal without using any optional equipment when combined with a PWM converter as shown in Figure 3-3-7. However, 18.5kW or higher inverters contain AC power operated parts such as AC cooling fan. When such DC power inputs are used, reconnect the fan power switching connector, CN RXTX, inside the inverter to R0-T0 as shown in Figure 3-3-6 and apply an AC power to the terminals, R0 and T0.

For details, see Figure 3-3-8.

**Note:** The fan power switching connector, CN RXTX, is normally connected to L1/R-L3/T. Do not reconnect the connector when no DC power inputs are used.

Always connect the same AC voltage as used for the main circuit to the auxiliary control power input terminals, R0 and T0. Failure to do so deactivates the fan, which may overheat (OH1) and then fail the inverter.

 <b>CAUTION</b>
<ul style="list-style-type: none"> <li>Do not connect the fan power switching connector, CN RXTX, inside the inverter to a wrong terminal.</li> </ul> <p><b>Doing so may fail the inverter.</b></p> <ul style="list-style-type: none"> <li>When DC power inputs are used, apply an AC power to R0 and T0 to drive the fan.</li> </ul> <p><b>Failure to do so may fail the inverter.</b></p>

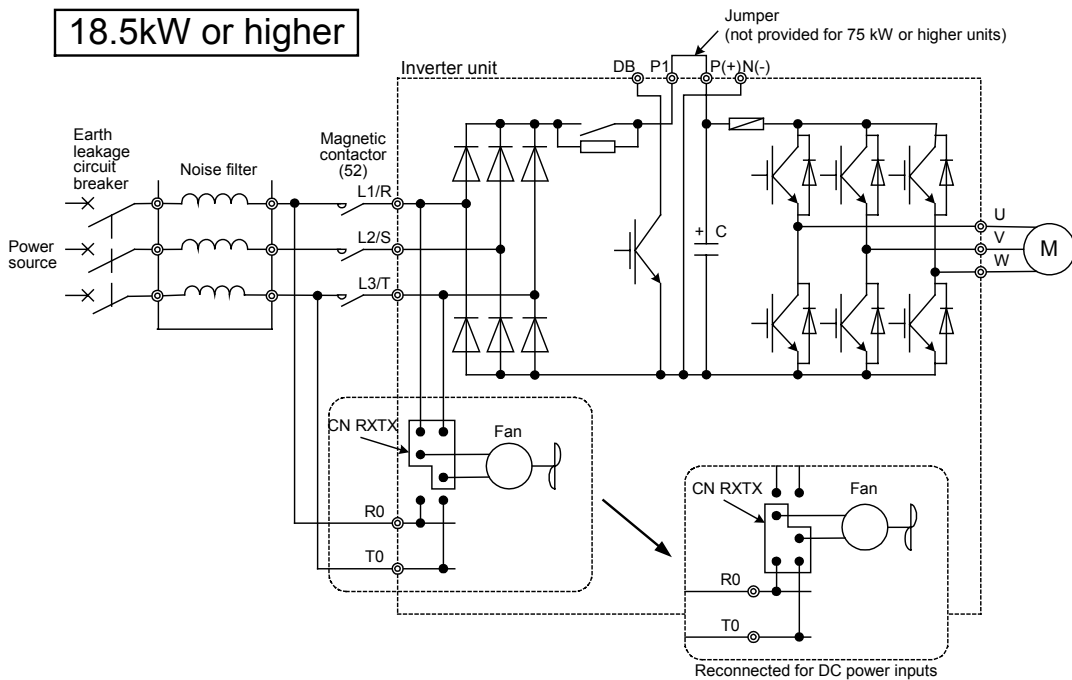


Figure 3-3-6 Switching of Fan Power Supply

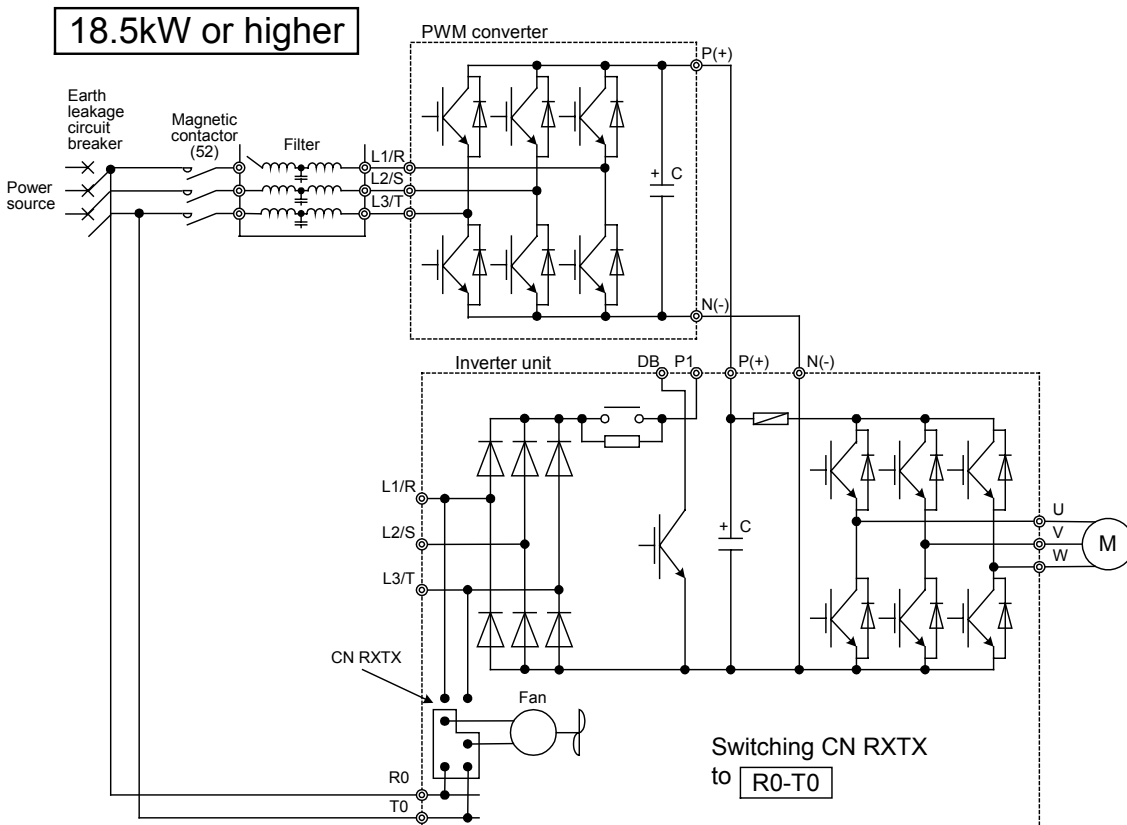


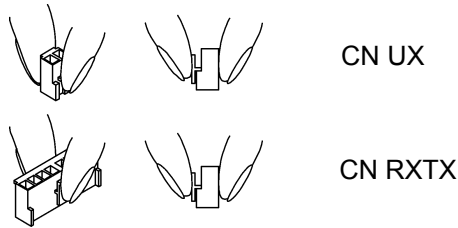
Figure 3-3-7 A Wiring Example of Inverter Combined with PWM Converter

**Note 1:** When a 15 kW or lower inverter is combined with a PWM converter, do not directly connect any power source to the input terminals R0 and T0 for auxiliary control power. To connect, use an isolation transformer to isolate from the main power supply of the PWM converter or use a normally closed contact of the magnetic contactor (52) as a relaying terminal. Examples of wiring of the PWM converter are given in the instruction manual for PWM converter.

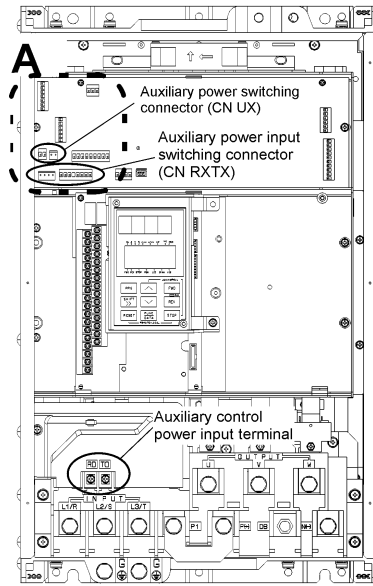
**Note 2:** 200 V, 75 kW or higher and 400 V, 132 kW or higher inverters contain no braking transistor.

# 3. Preparatory Operations and Test Run

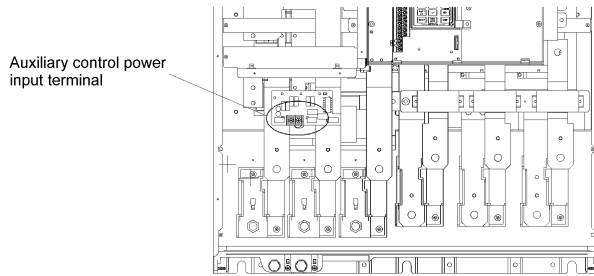
The switching connectors are mounted in the power PC board at the top of the control circuit PC board.



Note: When removing either connector, hold the top of the jaw between fingers to release the latch and remove by pulling upward.  
When mounting, fully insert the connector and apply the latch until it clicks.

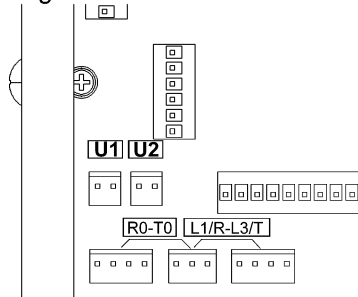


FRN18.5VG7S-2 to FRN55VG7S-2  
FRN18.5VG7S-4 to FRN110VG7S-4



FRN75VG7S-2 to FRN90VG7S-2  
FRN132VG7S-4 to FRN220VG7S-4

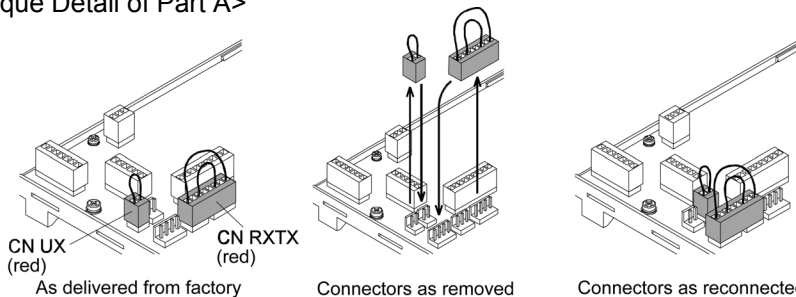
< Enlarged View of Part A >



CN UX is connected to U1

and CN RXTX to L1/R-L3/T before factory shipment.

<Oblique Detail of Part A>



CN UX : U1

CN RXTX : L1/R-L3/T

The Figure applies when the inverter is used with DC power inputs at a supply voltage of 380-398 V, 50 Hz or 380-430 V, 60 Hz.

Figure 3-3-8 Power Switching Connectors (18.5 kW or Higher Inverters Only)

### 3.3.3 Wiring of Control Terminals


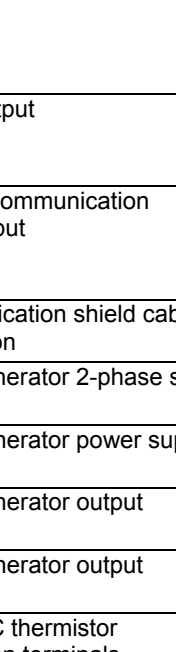
Functions of the control circuit terminals are described in Table 3-3-4. Each control terminal should be wired in different ways, depending on its setting.  
Terminal arrangement is given in Section 2.3.3.

Table 3-3-4

Category	Terminal symbol	Terminal name	Function																								
Analog input	13	Potentiometer power supply	Supplies power (+10Vdc) to speed setting POT (1-5 k $\Omega$ ).																								
	12	Voltage input	Controls the speed according to the external analog input voltage command. <ul style="list-style-type: none"> <li>• 0 to +10V DC/0 to 100%</li> <li>• Reversed operation with <math>\pm</math> signals: 0 to <math>\pm</math>10V DC/0 to <math>\pm</math>100%</li> </ul>																								
	11	Analog input common	A common terminal for analog input signals																								
	Ai1	Analog input 1	Inputs analog DC voltages between 0 to $\pm$ 10V DC. For assignment of signals, see 2.3.2 'Functions of Terminals'.																								
	Ai2	Analog input 2																									
M	Analog input common	* Input resistance: 10 k $\Omega$																									
Digital input	FWD	Forward operation command	FWD-CM: ON... The motor runs in the forward direction. FWD-CM: OFF... The motor decelerates and stops.																								
	REV	Reverse operation command	REV-CM: ON... The motor runs in the reverse direction. REV-CM: OFF... The motor decelerates and stops.																								
	X1	Digital input terminal 1	Functions such as external coast-to-stop command, external alarm, alarm reset, and multi-speed control can be turned on or off with terminals X1 to X9. For details, see 2.3.2 'Functions of Terminals'. <Digital Input Circuit Specifications>																								
	X2	Digital input terminal 2																									
	X3	Digital input terminal 3																									
	X4	Digital input terminal 4																									
	X5	Digital input terminal 5																									
	X6	Digital input terminal 6																									
	X7	Digital input terminal 7																									
	X8	Digital input terminal 8																									
	X9	Digital input terminal 9																									
			<table border="1"> <thead> <tr> <th colspan="2">Item</th> <th>min.</th> <th>typ.</th> <th>max.</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Operating voltage</td> <td>ON level</td> <td>0V</td> <td>-</td> <td>2V</td> </tr> <tr> <td>OFF level</td> <td>22V</td> <td>24V</td> <td>27V</td> </tr> <tr> <td colspan="2">On-time operating current</td> <td>-</td> <td>3.2mA</td> <td>4.5mA</td> </tr> <tr> <td colspan="2">Off-time permissible leak current</td> <td>-</td> <td>-</td> <td>0.5mA</td> </tr> </tbody> </table>	Item		min.	typ.	max.	Operating voltage	ON level	0V	-	2V	OFF level	22V	24V	27V	On-time operating current		-	3.2mA	4.5mA	Off-time permissible leak current		-	-	0.5mA
	Item		min.	typ.	max.																						
Operating voltage	ON level	0V	-	2V																							
	OFF level	22V	24V	27V																							
On-time operating current		-	3.2mA	4.5mA																							
Off-time permissible leak current		-	-	0.5mA																							
	PLC	PLC signal power supply	Connected with output signal power source of PLC (Rated voltage: 24 (22-27) V DC ).																								
	CM	Digital input common	A common terminal for digital input signals																								
Analog output	AO1	Analog output terminal 1	Outputs monitor signals at analog DC voltages between 0 and $\pm$ 10 V DC. For details of signals, see 2.3.2 'Functions of Terminals'. * Connectable impedance: 3 k $\Omega$ min.																								
	AO2	Analog output terminal 2																									
	AO3	Analog output terminal 3																									
	M	Analog output common																									



### 3. Preparatory Operations and Test Run

Transistor output	Y1	Transistor output 1	<p>Outputs signals such as Running, Speed equivalence, Overload early warning, ... and  as transistor outputs from inverter to specified ports. For details, see 2.3.2 'Functions of Terminals'. &lt; Transistor Output Circuit Specifications &gt;</p> <table border="1"> <thead> <tr> <th>Item</th> <th>min.</th> <th>typ.</th> <th>max.</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Operating voltage</td> <td>ON level</td> <td>-</td> <td>1V</td> <td>2V</td> </tr> <tr> <td>OFF level</td> <td>-</td> <td>24V</td> <td>27V</td> </tr> <tr> <td>On-time max. load current</td> <td>-</td> <td>-</td> <td>50mA</td> </tr> <tr> <td>Off-time permissible leak current</td> <td>-</td> <td>-</td> <td>0.1mA</td> </tr> </tbody> </table> 	Item	min.	typ.	max.	Operating voltage	ON level	-	1V	2V	OFF level	-	24V	27V	On-time max. load current	-	-	50mA	Off-time permissible leak current	-	-	0.1mA
	Item	min.		typ.	max.																			
	Operating voltage	ON level		-	1V	2V																		
		OFF level		-	24V	27V																		
	On-time max. load current	-		-	50mA																			
Off-time permissible leak current	-	-	0.1mA																					
Y2	Transistor output 2																							
Y3	Transistor output 3																							
Y4	Transistor output 4																							
CME	Transistor output common	A common terminal for transistor output terminals. Insulated from terminals CM and 11.																						
Relay output terminals	30A,30B, 30C	Alarm relay output (for any fault)	<p>Outputs alarm signal as relay contact output (1SPDT) when inverter stops due to alarm. Contact capacity: 250V AC, 0.3 A, <math>\cos \phi = 0.3</math> (or 48 V DC, 0.5 A when conformed with Low Voltage Directive) You may choose to close contacts under unusual or normal conditions.</p>																					
	Y5A,Y5C	Relay output	You may select a signal as you may with Y1 to Y4 terminals. Contact capacity is the same as with alarm relay output terminals.																					
Communication	RX(+), RX(-) TX(+),TX(-)	RS-485 communication input/output	Input/output terminals for RS-485 communication Up to 31 inverters may be connected through multi-drop connections. Terminating resistor (100 $\Omega$ ) can be connected via switch (SW3).																					
	SD(M)	Communication shield cable connection	Connected with shielded wires.																					
Speed detection	PA,PB	Pulse generator 2-phase signal input	Connected with 2-phase signals from pulse generator																					
	PGP,PGM	Pulse generator power supply	Supplies power (+15 V DC (switchable to +12 V DC)) to PG.																					
	FA,FB	Pulse generator output	Output pulse generator signal with frequency divided to 1/n. (n is programmable with function code E29.)																					
	CM	Pulse generator output common	A common terminal for FA and FB.																					
Temperature	TH1,THC	NTC/PTC thermistor connection terminals	Monitors motor temperature with NTC and PTC thermistors. For PTC thermistor, motor overheat protection level can be set with function code E32.																					

(1) Input terminals (13, 12, and 11)

1) Shielded wires as short as possible (20 m or less) should be used for cables because these terminals handle weak analog signals that are very susceptible to external noise. The shields should be grounded to the earth, as a rule. If the signals are greatly affected by external induction noise, however, connecting the shields to terminal 11 may be advantageous.

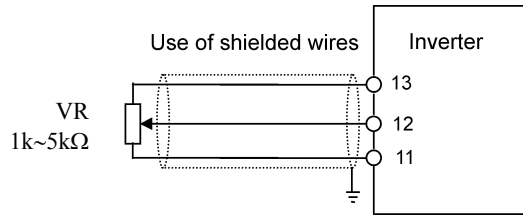


Figure 3-3-9

2) When relay contacts are required in this circuit, use twin contacts handling weak signals. Do not use contacts at terminal 11.

3) If any of these terminal is connected with an external analog signal output unit, it may malfunction due to the noise generated by the inverter, depending on the analog signal output circuit. In this case, connect a ferrite core or capacitor to the external analog signal output unit.

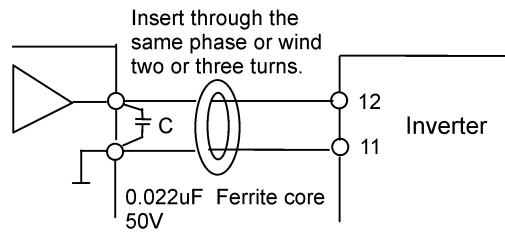


Figure 3-3-10  
Protection against Noise (Example)

(2) Digital input terminals (FWD, REV, X1-X9, PLC, and CM)

1) The digital input terminals such as FWD, REV, and X1-X9 are generally turned on/off between the CM terminal. If turned on/off using an external power source and open collector outputs from the programmable logic controller, the terminals may malfunction due to current leak from the external power source. In this case, connect the external power source using the PLC terminal as shown in Figure 3-3-11.

2) When inputs are made through relay contacts, use a highly reliable relay contacts (Fuji Electric's HH54PW control relays, for example).

(3) Transistor output terminals (Y1-Y4 and CME)

1) A circuit configuration as shown in the 'Transistor Output Terminals' column of Table 3-3-4 is used. Take care not to connect external power leads with reversed polarity.

2) When control relays are used, connect a surge suppression diode to each end of the exciting coil.

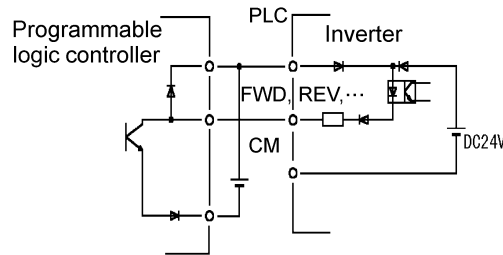


Figure 3-3-11  
Protection against Current Leak from External Power Source

### 3. Preparatory Operations and Test Run

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(4) Pulse generator terminals (PGP, PGM, PA, and PB)

Connect each inverter terminal with a motor PG terminal with the same terminal code. Switch the PG power between +15 V and +12 V using SW5. The location of SW5 is shown on the next page.

(5) PG output terminals (FA, FB, and CM)

Open collector output signal. Connect these terminals as follows if used.

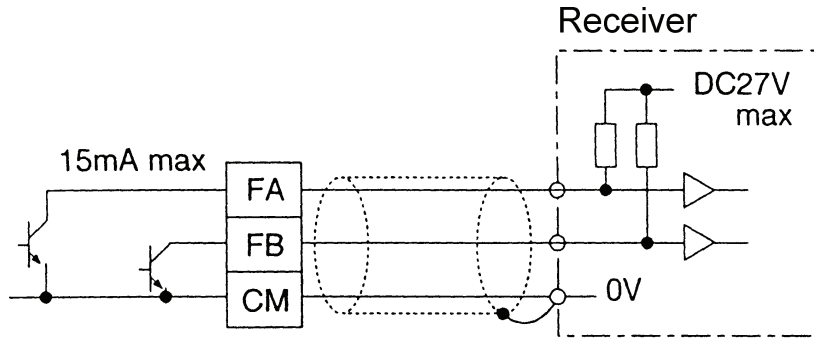


Figure 3-3-12 Wiring of PG Output Terminals

(6) Temperature detection terminals (THC and TH1)

Connect each thermistor connecting terminal with a motor terminal with the same code. The motor has a spare thermistor terminal (TH2). If terminal TH1 becomes unusable due to a cut wire or for another reason, connect motor terminal TH2 to inverter terminal TH1.

(7) RS-485 connector

A connector is located as shown in the Figure. For the connector shape, see the description of standard RS-485. The terminating resistor should be switched with SW3. The location of SW3 is shown on the next page.

- SW3 : 1-2 short-circuit, using terminating resistor
- SW3 : 2-3 short-circuit, without terminating resistor

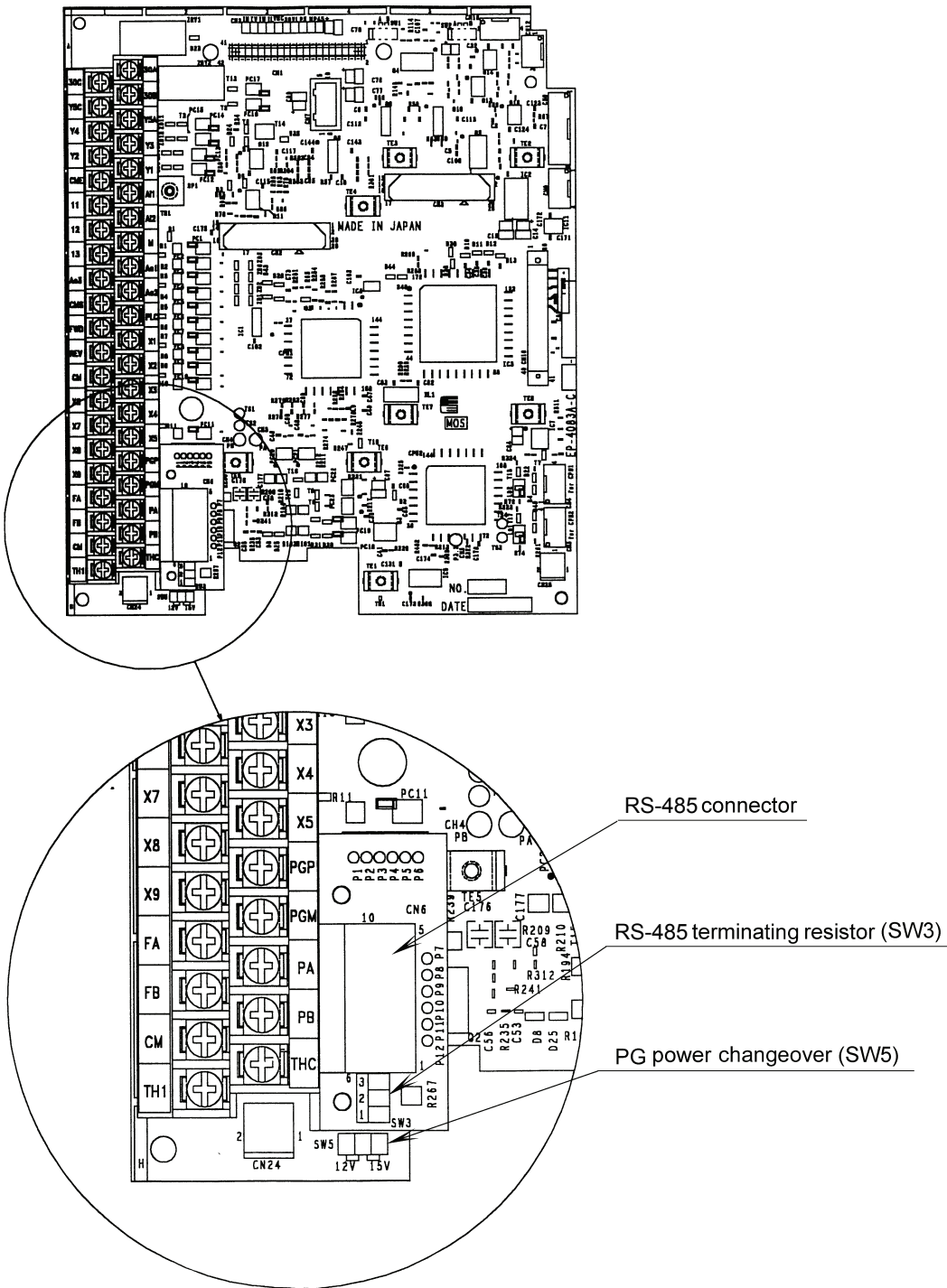


Figure 3-3-13  
Layout of switch and connector

### 3. Preparatory Operations and Test Run

(8) Miscellaneous

- 1) The control terminal leads should be kept as apart from the main circuit leads as possible to prevent malfunction due to noise.
- 2) The control leads inside the inverter should be secured to prevent direct contact with the live part of the main circuit (the main circuit terminal blocks, for example).

<b>! WARNING</b>
<ul style="list-style-type: none"><li>• The shield of each control cable does not serve as a reinforced insulator. If the shield is broken for some reason, a high voltage in the main circuit may invade the control signal circuit. The Low Voltage Directive in Europe also prohibits the users to wire the inverter with a main circuit lead in contact with a control lead.</li></ul> <b>Doing so may lead to electric shock.</b>

<b>! CAUTION</b>
<ul style="list-style-type: none"><li>• Noise may be generated from the inverter, motor, and leads.</li><li>• Protect sensors and devices around the inverter from malfunction.</li></ul> <b>Failure to do so may lead to accident.</b>

(9) Wiring of Control Circuits

- 1) FRN18.5VG7S-2 to FRN55VG7S-2  
FRN18.5VG7S-4 to FRN110VG7S-4
  - (a) Pull the wiring out along the left side panel of the inverter as shown in Figure 3-3-14.
  - (b) Tie leads with bands (Insulock, for example) and secure to the hole (tie mounting hole A) on the left side wall of the main circuit terminal block on the way outward. The bands should be 3.5 mm or less in width and 1.5 mm or less in thickness as they are to be passed through the holes (4 mm dia.).
  - (c) If an optional printed circuit board is mounted, secure signal leads to the tie mounting hole B.

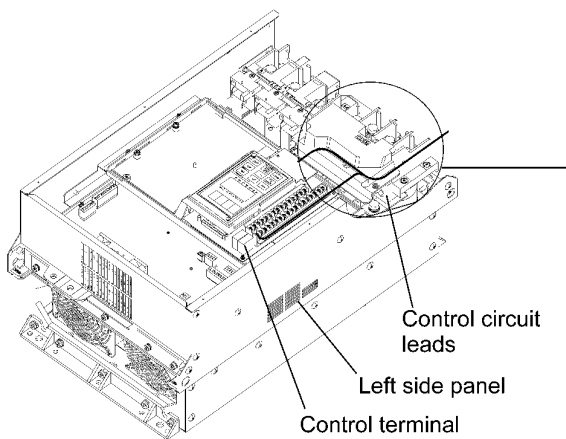


Figure 3-3-14  
Routing Inverter (18.5 kW or Higher) Control Circuit Leads

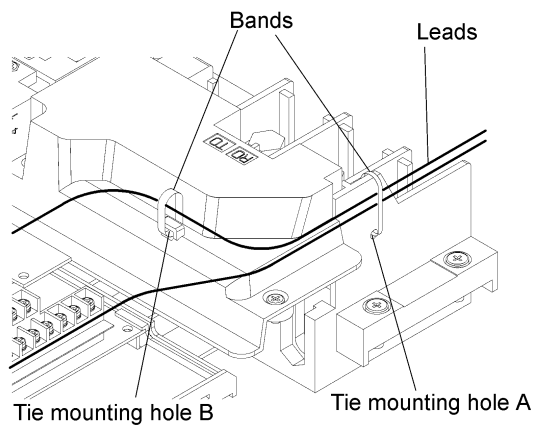


Figure 3-3-15  
Securing Inverter (18.5 kW or Higher) Control Circuit Leads

2) FRN132VG7S-4 to FRN160VG7S-4

- (a) Pull the wiring out along the left side panel as shown in Figure 3-3-16.
- (b) Tie leads with bands (Insulock, for example) and secure with cable tie holders on the beams on the way outward. The bands should be 3.8 mm or less in width and 1.5 mm or less in thickness as they are to be passed through square holes (3.8 × 1.5).

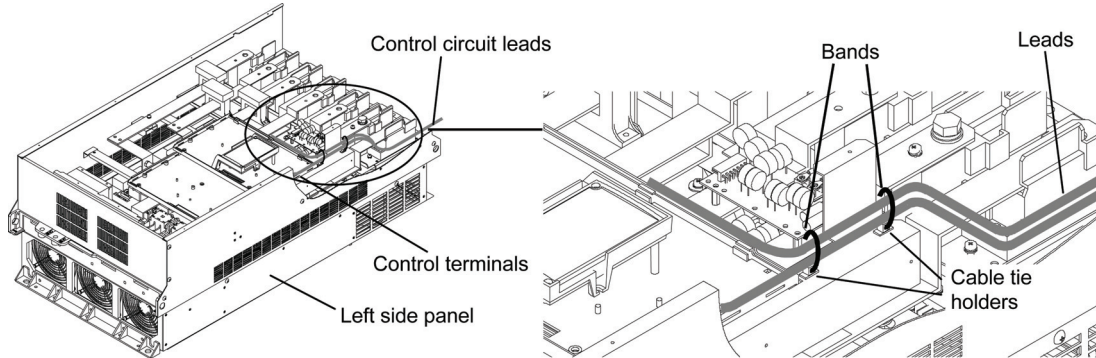


Figure 3-3-16  
Routing Inverter Control Circuit Leads

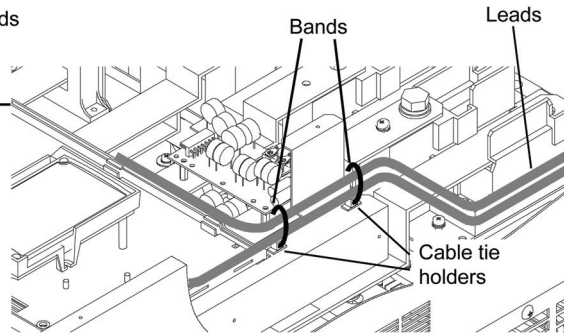


Figure 3-3-17  
Securing Inverter Control Circuit Leads

3) FRN75VG7S-2 to FRN90VG7S-2  
FRN200VG7S-4 to FRN220VG7S-4

- (a) Pull the wiring out along the left side panel as shown in Figure 3-3-18.
- (b) Tie leads with bands (Insulock, for example) and secure with cable tie holders on the beams on the way outward. The bands should be 3.8 mm or less in width and 1.5 mm or less in thickness as they are to be passed through holes (3.8 × 1.5).

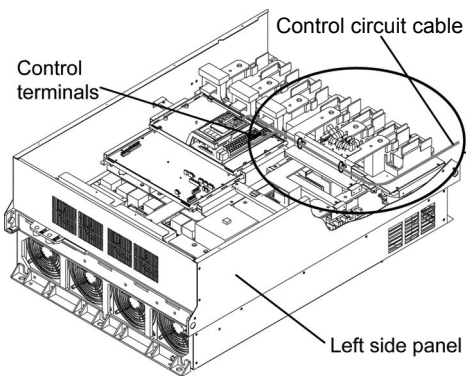


Figure 3-3-18  
Routing Inverter Control Circuit Leads

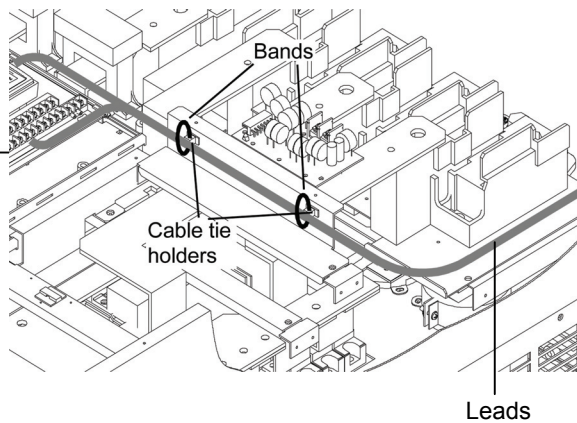


Figure 3-3-19  
Securing Inverter Control Circuit Leads

4) FRN280VG7S-4 to FRN400VG7S-4

- (a) Similarly to Fig. 3-3-18, pull along the left side plate of the inverter.
- (b) Use an isolated clip located at the upper part of main circuit terminal block L1/R to fix the wiring.

# 3. Preparatory Operations and Test Run

## 3.4 Test Run

### 3.4.1 Preliminary Check and Preparation

Perform the following checks before starting operation.

- (1) Check that the inverter is correctly wired.  
Most importantly, the inverter output terminals, U, V, and W should not be connected to a power source and the earth terminal should be correctly grounded.
- (2) No terminal or exposed live part should be short-circuited or grounded.
- (3) Check for loose terminals, connectors, and screws.
- (4) Check that the motor is disconnected from mechanical devices.
- (5) Turn all switches off so that the inverter will not start or malfunction when powered on.
- (6) After power-up of the inverter, check that:
  - 1) the KEYPAD panel gives indications as shown in Figure 3-4-2 (no alarm message), and
  - 2) the inverter contained fan is rotating.

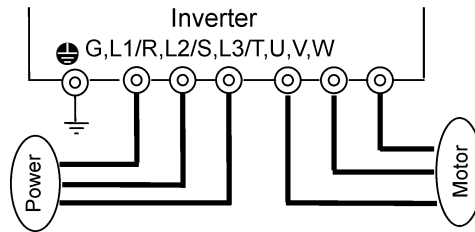


Figure 3-4-1  
Inverter Connection Diagram



Figure 3-4-2  
KEYPAD Panel Display with the Power ON

#### **! WARNING**

- Never turn the power switch on (closed) before mounting the face cover. Do not remove the cover while the inverter is energized.
- Do not handle the inverter with wet hand.

**Doing so may lead to electric shock.**





## 3.4.2 Operating Methods

There are many operating methods. Read this manual and select the one most suitable to the intended use and operating conditions. General operating methods are described in Table 3-4-1.

## 3.4.3 Test Run








After checking that no abnormal condition exists in 3.4.1, perform a test run.

Before delivery, the inverter is programmed to be operated from the KEYPAD panel (with function code F01 set to 0 and F02 to 0).

- (1) Turn the power on. Check that the speed indicated by blinking LEDs is 0 r/min.
- (2) Set the speed to a lower level around 100 r/min using the  key.
- (3) Press the  key to run the motor in the forward direction or the  key to run in the reverse direction. Press the  key to stop the motor.
- (4) Check that:
  - 1) the motor runs in the selected direction (see Figure 3-4-3),
  - 2) it revolves without any problem (motor roars and excessive vibration), and
  - 3) it smoothly accelerates or decelerates.

If no abnormal condition is observed, raise the operating speed and check again.

Table 3-4-1 General Operating Methods

Operating method	Speed controls	Operation commands
From KEYPAD panel	KEYPAD panel keys  	 ,  
Through external signal input	 	Contact inputs (switches) Terminals: FWD - CM REV - CM
	Variable resistor (POT) or analog voltages	

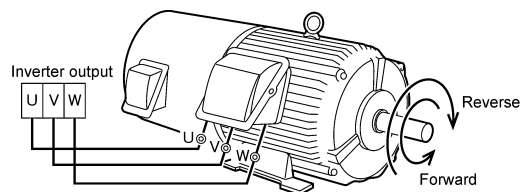


Figure 3-4-3 Motor Rotating Directions



### 3. Preparatory Operations and Test Run

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If the inverter is found to normally function in the test run, start regular operation.

 **CAUTION**

- If any abnormal condition is observed with the inverter or motor, immediately stop and locate the cause (see 'Troubleshooting').
- Even after the inverter stops outputting, touching any of the inverter output terminals, U, V, and W may lead to electric shock if a voltage is continuously applied to the main circuit power terminals, L1/R, L2/S, and L3/T, and auxiliary control power terminals, R0 and T0. The smoothing capacitor remains live after the power switch is turned off and requires some time until completely discharged. When touching an electric circuit after the shut-down, check that the charge lamp is off or check with a multimeter that the voltage has been reduced to a safe level (24V or less).

 **WARNING**

- Setting a function code in a wrong manner or without fully understanding this manual may cause the motor to revolve at an unacceptable torque or speed, possibly resulting in accident or injury.  
**Accident on injury may result.**

# THE INVERTER

# IV

## IV. Control and Operation

- 4.1 Read this Section First
- 4.2 Control Block Diagrams
- 4.3 Function Code Description  
(Arranged by Code)
- 4.4 Function Description  
(Arranged by Function)

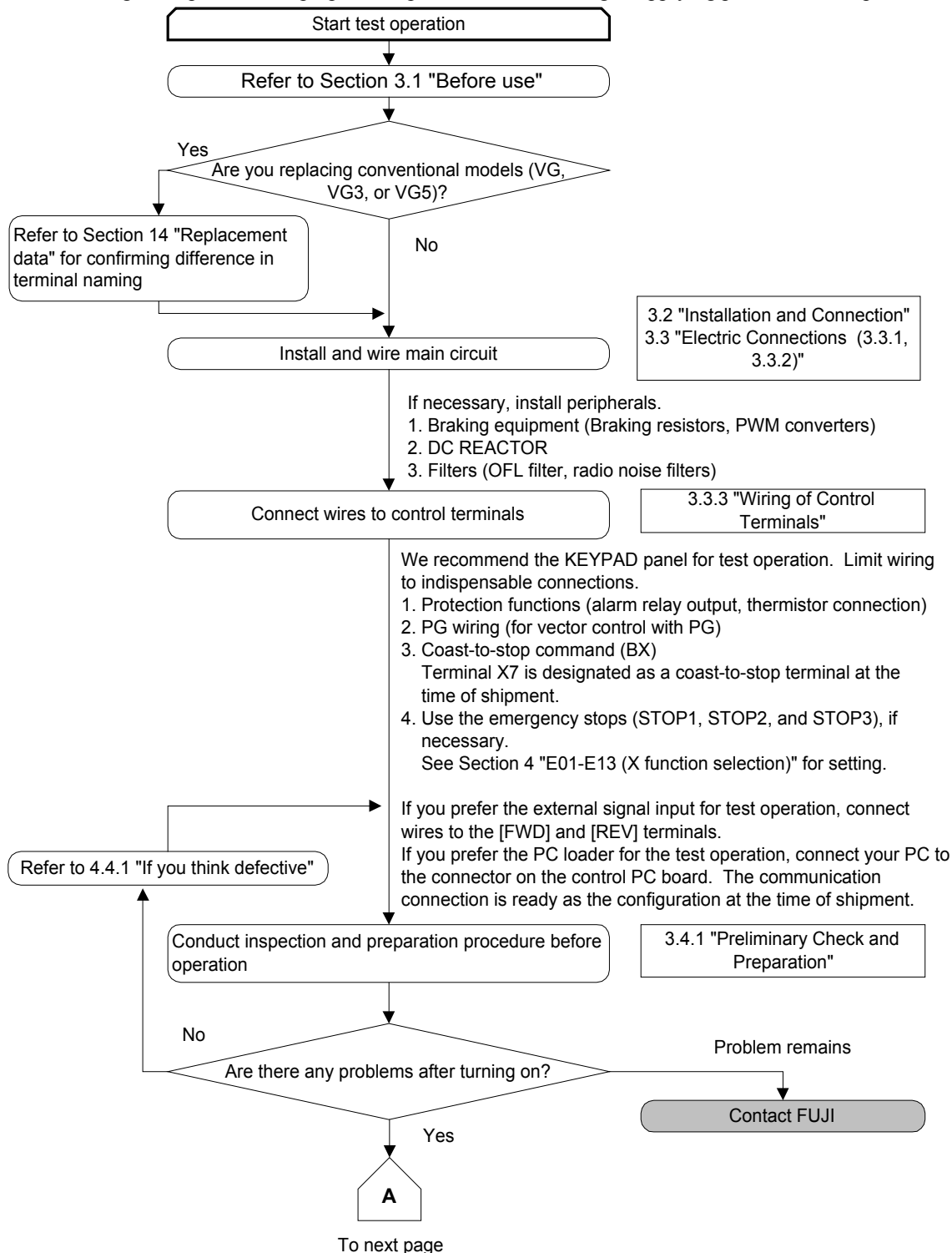
# 4. Control and Operation

## 4.1 Read this Section First

This section describes how to start the VG7 after your purchase. The description here assumes that you have already finished the selection of capacities of your inverter, its braking resistor, and peripheral equipment by consulting Chapter 2 "Specifications", Chapter 9 "Selecting Peripheral equipment", Chapter 10 "Selecting Inverter Capacity", Chapter 11 "About Motors", Chapter 14 "Replacement Data", and Chapter 15 "Appendix" before your purchase.

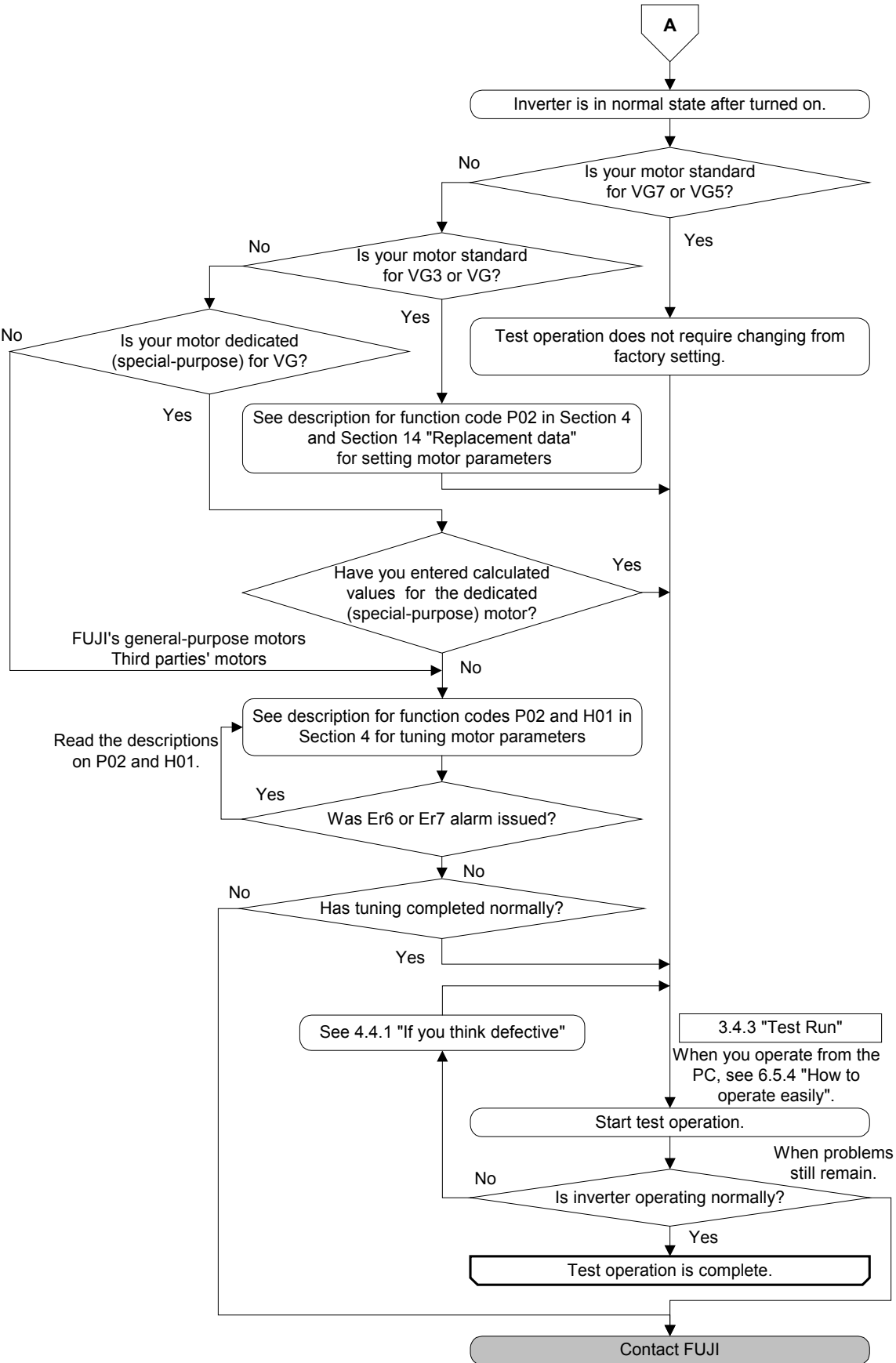
### 4.1.1 Turning ON the Power

The following chart presents the preparation procedure from wiring to applying power for test operation.



## 4.1.2 Starting Test Operation

Start test operation after the inverter is turned on normally.



# 4. Control and Operation

## 4.1.3 Introduction to Setting in Detail

FRENIC5000VG7 inverters contain various functions to meet all customer needs. You can extend these functions by employing their options. This section gives you a brief description on these functions.

Changes made to previous models	
You can assign any functions to any control terminals. The standard nine terminals are [X1] to [X9]	The dedicated terminals, [RST]: Alarm reset and [THR]: Trip command terminals are discontinued. They are included for general assignment. [X8] terminal= [RST], [X9] terminal= [THR] are factory assignment.
Trip command [THR] is set to "NO: Normally Open"	External alarm input is set to "NO" at shipment. Refer to "External alarm" in "E01 to E13" in 4.3 "Function code description" for instruction on switching to "NC terminal"
Service power supplies ( $\pm 15$ V, 24 V) are discontinued.	Obtain commercial power supplies for your needs.
The KEYPAD panel is firmly installed.	Since the KEYPAD panel is firmly inserted into the face cover, remove the KEYPAD panel after you open the cover.
Overview of the integrated functions	
PWM converter connection is provided as standard.	See Section 3.3.2 "Wiring of Main Circuit and Grounding Terminals".
Triple standards (CT, VT, and HT) are selectable.	See "F80" in Section 4.3 "Function Code Description".
Various control types (such as vector control) are available.	See "P01" and "A01" in Section 4.3 "Function code description".
"NO" or "NC" is selectable for control terminals, [X1] to [X9], [Y1] to [Y5A], and alarm output [30X].	See "F36", "E14", and "E28" in Section 4.3 "Function Code Description".
Electronic thermal relay protection is available for motors.	See "F10" to "F12" in Section 4.3 "Function Code Description".
Servo-lock is available.	See zero speed locking control (LOCK) in "E01" to "E13" in Section 4.3 "Function Code Description".
You can store motor parameters for three motors.	See "F79", P codes, and A codes in Section 4.3 "Function Code Description".
Four patterns are available for acceleration/ deceleration and ASR setting.	See "E01" to "E13" and "RT1" and "RT2" for ASR, ACC/DEC time selection in Section 4.3 "Function Code Description".
r/min and % are available for 15-step speed selection.	See "C21" in Section 4.3 "Function Code Description".
Speed control is available during torque (current) control command operation.	See "F76" to "F78" in Section 4.3 "Function Code Description".
You can restrict the speed control reference according to load.	See "H60" to "H66" in Section 4.3 "Function Code Description".
Dedicated S-curve acceleration and deceleration setting is available for vertical transfer applications.	See L codes in Section 4.3 "Function Code Description".
Eight languages are available in the KEYPAD indication.	See "F58" in Section 4.3 "Function Code Description".
PID function is integrated.	See 4.2 "Control block diagrams" and "H20" to "H27" in Section 4.3 "Function Code Description".
PG pulse can be divided for output.	See "E29" in Section 4.3 "Function Code Description".
UP/DOWN function is available.	See UP/DOWN functions in "E01" to "E13" in Section 4.3 "Function Code Description".
Motor parameter tuning is available during motor stopping state.	See "H01" in Section 4.3 "Function Code Description".
Speed observer (vibration, disturbance) is available.	See "H46" in Section 4.3 "Function Code Description".
Line speed control is available.	See "H53" in Section 4.3 "Function Code Description".

---

### Introduction to optional functions

You can control and monitor the inverter using your PC.

See section 6.5 "How to use PC Loader".

Various PLC's are available for connection.

See T-Link, SX, and field bus in Section 7 "Optional control devices".

Users can modify control programs freely.

See UPAC in Section 7 "Optional control devices".

Synchronized operation and pulse train operation are available.

See synchronization command in "E01" to "E13" in 4.3 "Function code description".

You can drive multiwinding motors.

See multi-winding motor control canceling [MT-CCL] in "E01" to "E13" in 4.3 "Function code description".

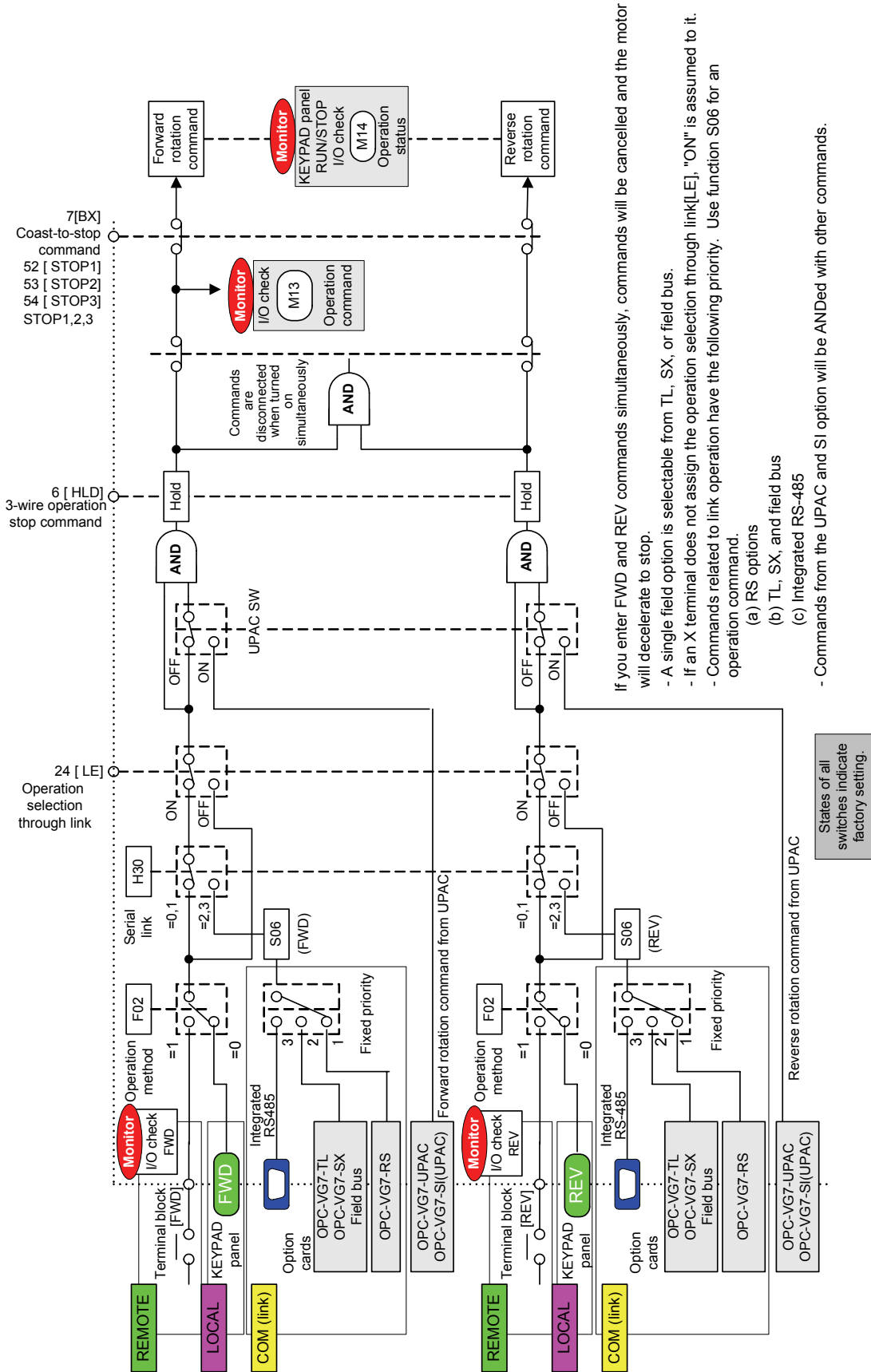
16-bit digital input is available.

See DI in Section 7 "Optional control devices".

# 4. Control and Operation

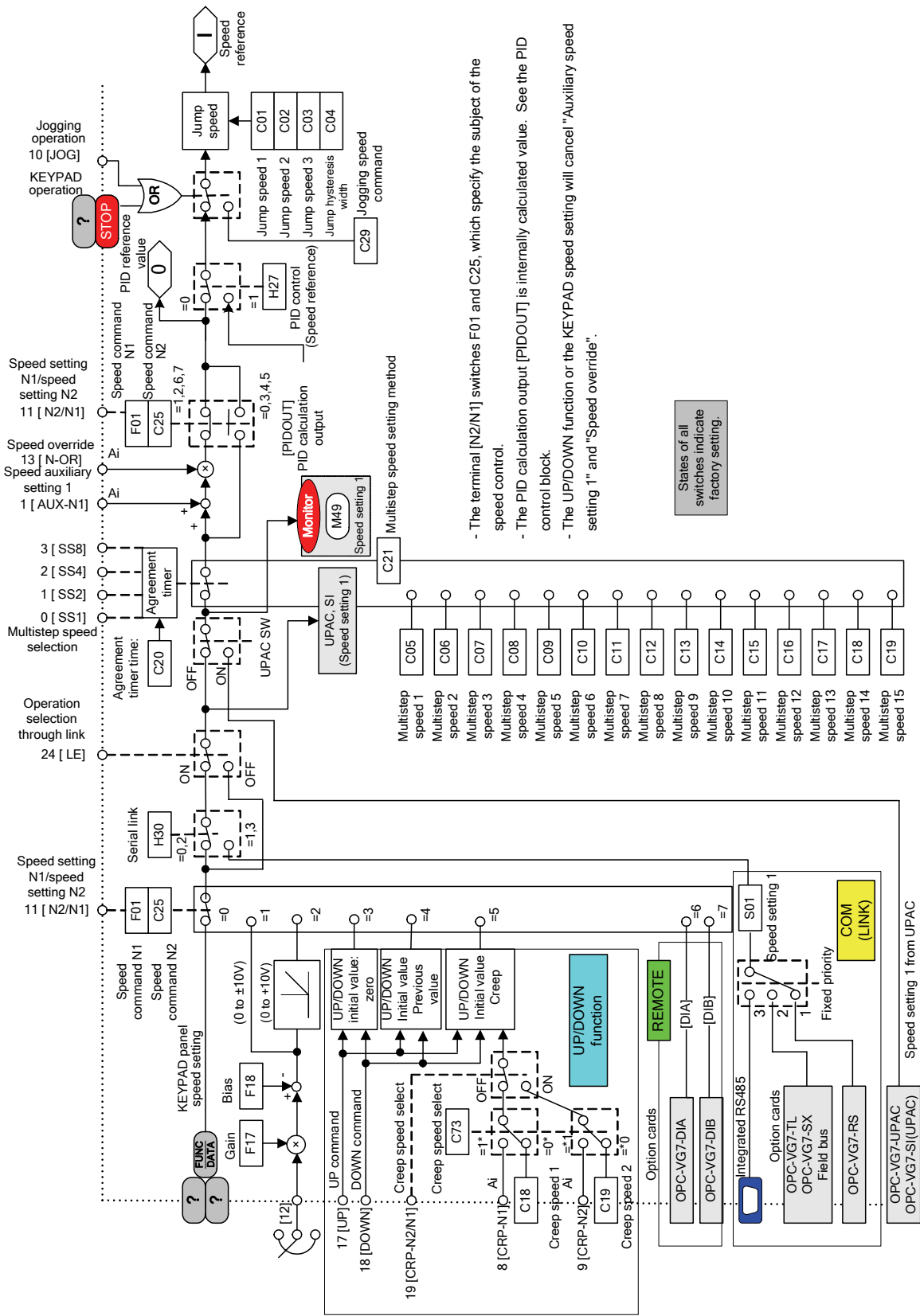
## 4.2 Control Block Diagrams

### 4.2.1 Operation Command



- If you enter FWD and REV commands simultaneously, commands will be cancelled and the motor will decelerate to stop.
- A single field option is selectable from TL, SX, or field bus.
- If an X terminal does not assign the operation selection through link[LE], "ON" is assumed to it.
- Commands related to link operation have the following priority. Use function S06 for an operation command.
  - (a) RS options
  - (b) TL, SX, and field bus
  - (c) Integrated RS-485
- Commands from the UPAC and SI option will be ANDed with other commands.

# 4.2.2 Speed Command Selection Section



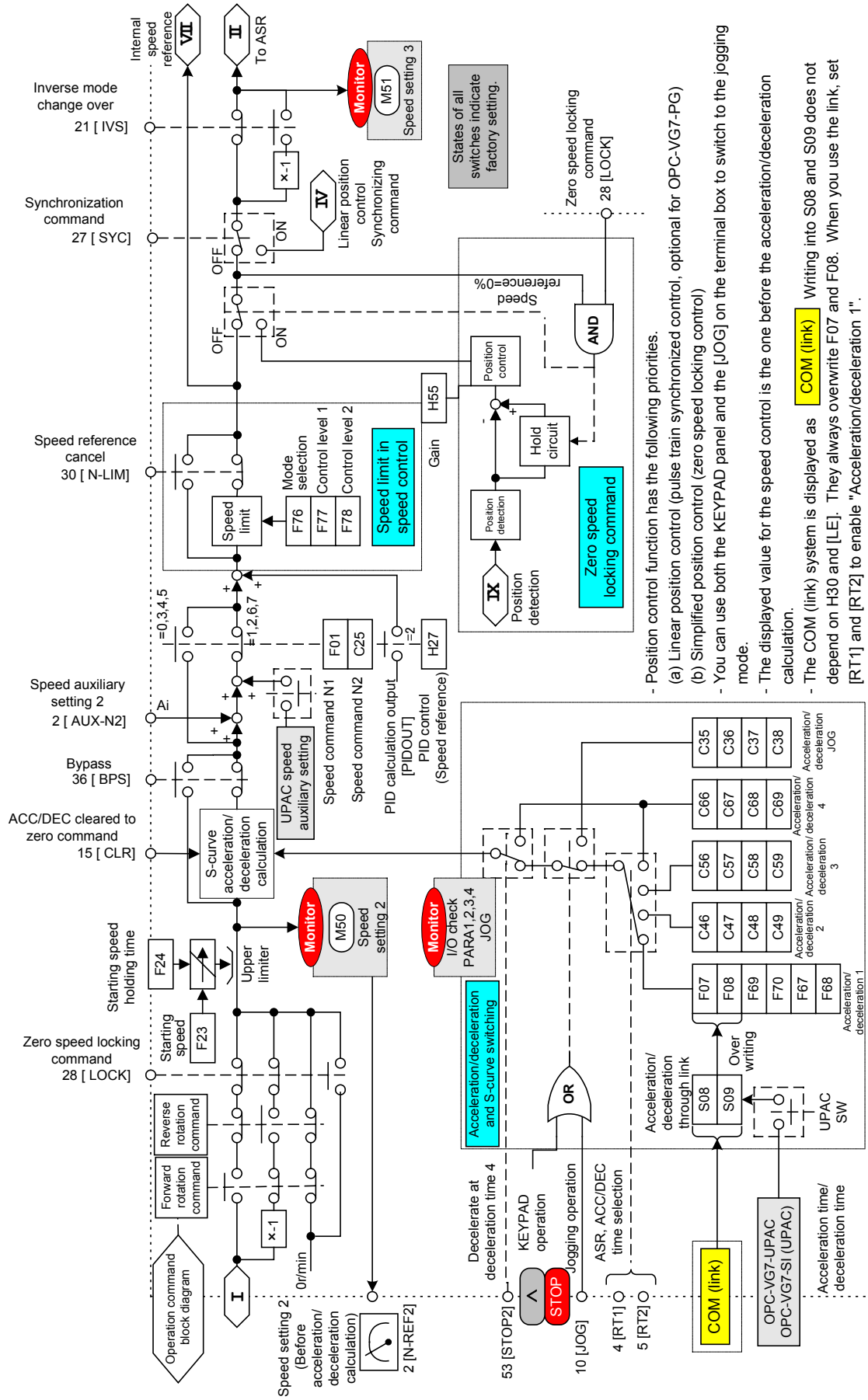
- The terminal [N2/N1] switches F01 and C25, which specify the subject of the speed control.
- The PID calculation output [PIDOUT] is internally calculated value. See the PID control block.
- The UP/DOWN function or the KEYPAD speed setting will cancel "Auxiliary speed setting 1" and "Speed override".

States of all switches indicate factory setting.



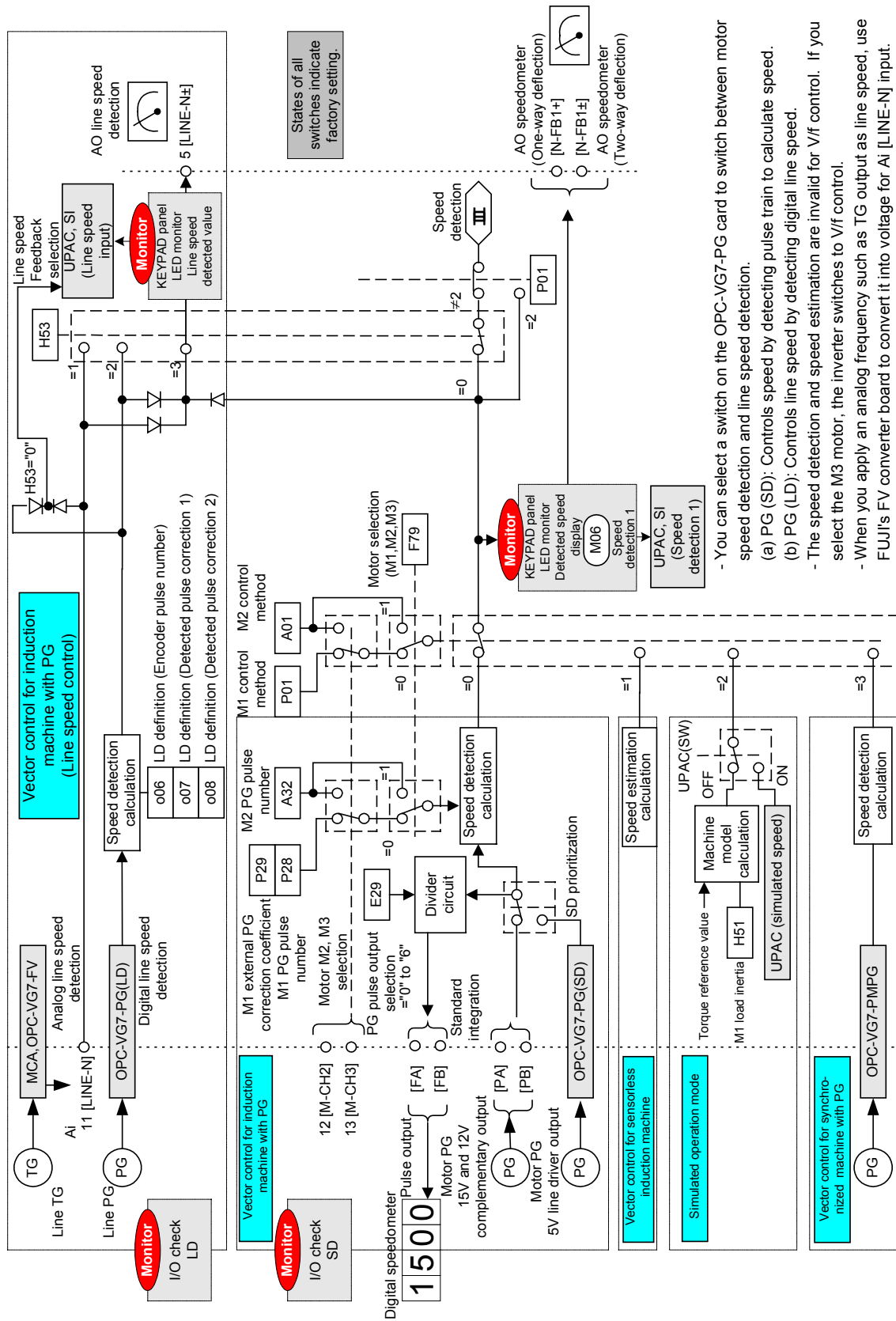
# 4. Control and Operation

## 4.2.3 Acceleration/deceleration Calculation, Speed Limiting, and Position Control Input Section



- Position control function has the following priorities.
  - (a) Linear position control (pulse train synchronized control, optional for OPC-VG7-PG)
  - (b) Simplified position control (zero speed locking control)
- You can use both the KEYPAD panel and the [JOG] on the terminal box to switch to the jogging mode.
- The displayed value for the speed control is the one before the acceleration/deceleration calculation.
- The COM (link) system is displayed as **COM (link)**. Writing into S08 and S09 does not depend on H30 and [LE]. They always overwrite F07 and F08. When you use the link, set [RT1] and [RT2] to enable "Acceleration/deceleration 1".

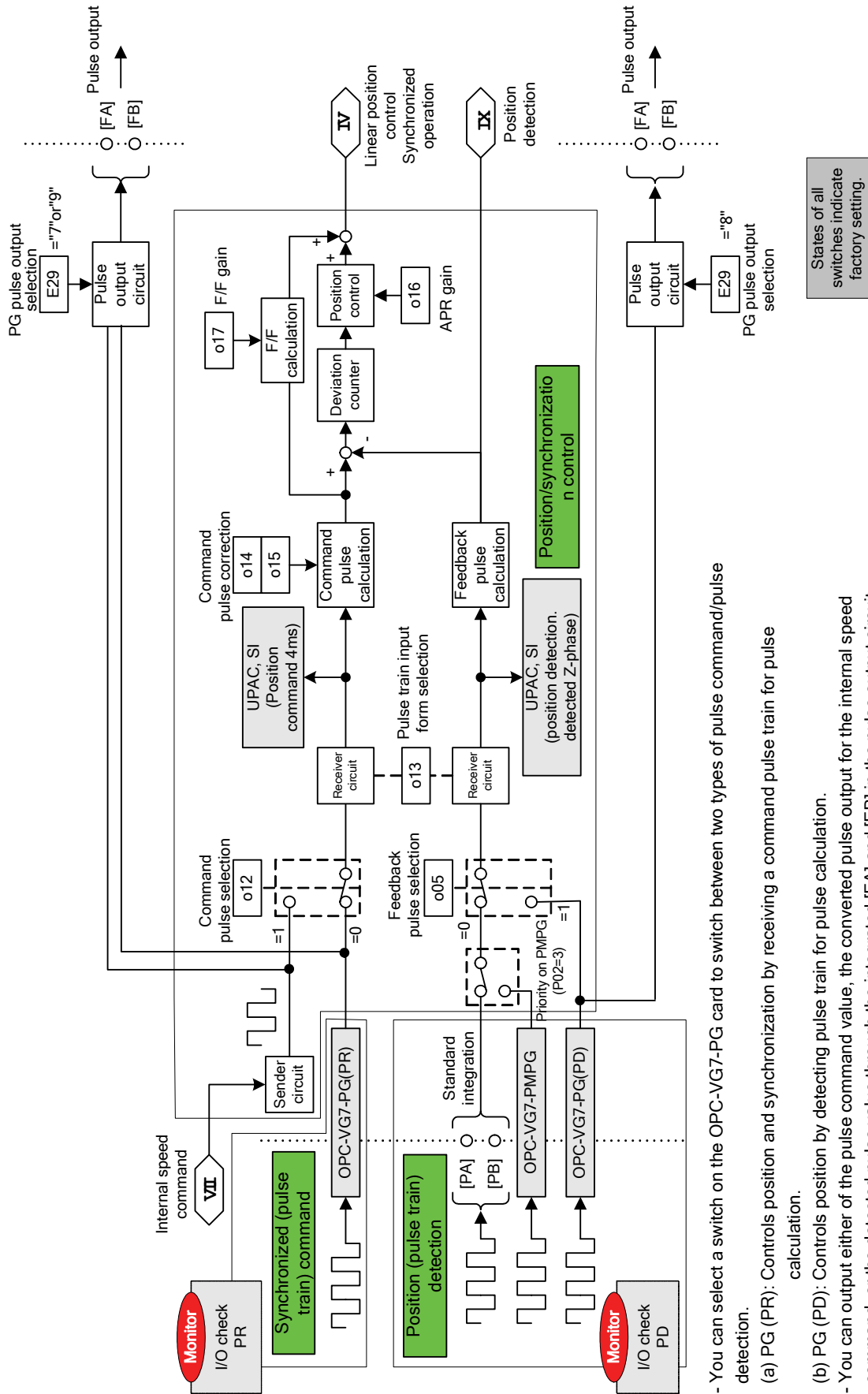
## 4.2.4 Motor Speed/line Speed Detection



- You can select a switch on the OPC-VG7-PG card to switch between motor speed detection and line speed detection.
- (a) PG (SD): Controls speed by detecting pulse train to calculate speed.
- (b) PG (LD): Controls line speed by detecting digital line speed.
- The speed detection and speed estimation are invalid for V/f control. If you select the M3 motor, the inverter switches to V/f control.
- When you apply an analog frequency such as TG output as line speed, use FUJI's FV converter board to convert it into voltage for Ai [LINE-N] input.
- The pulse output (divider circuit) is equal magnification output.

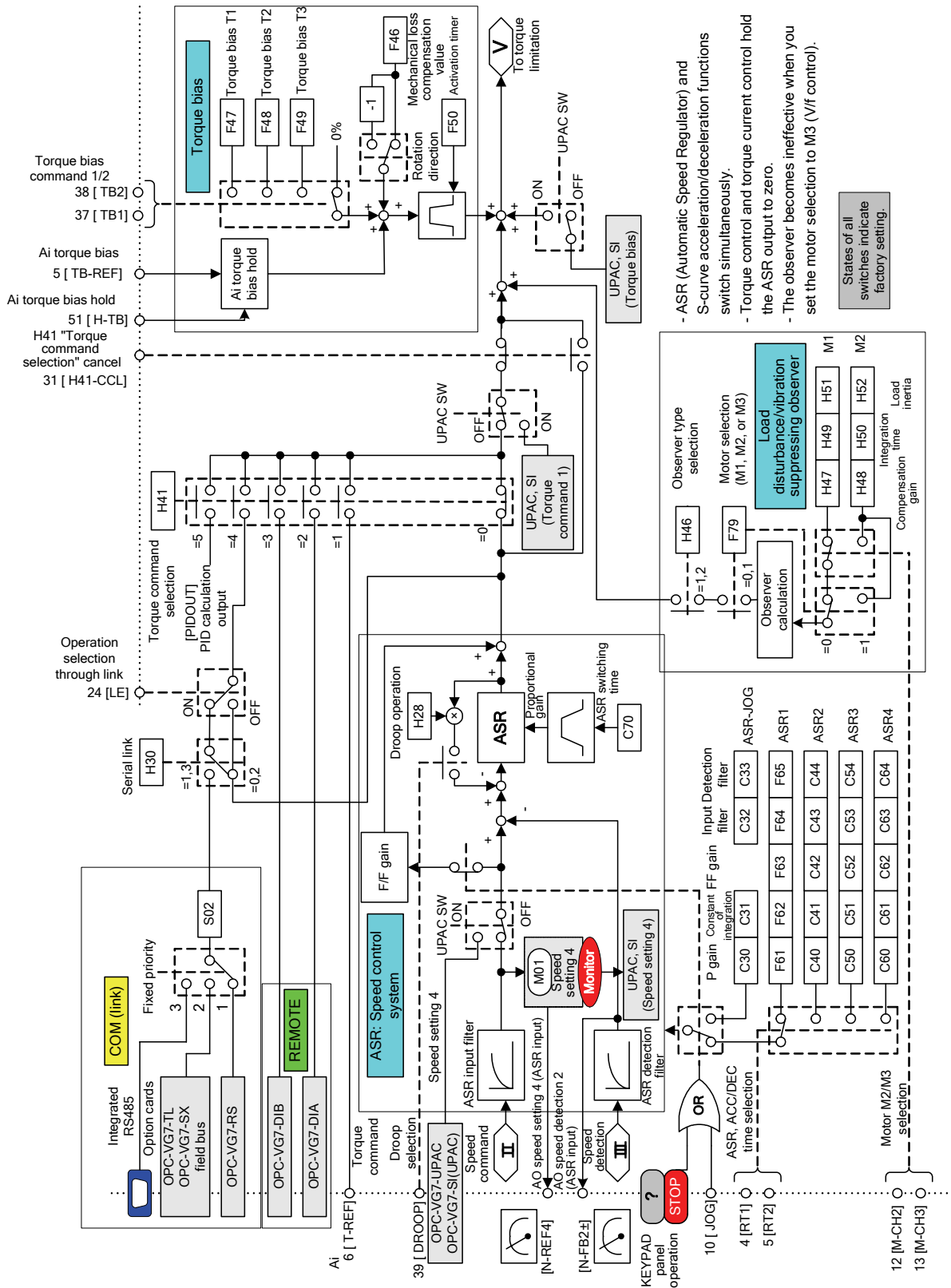
# 4. Control and Operation

## 4.2.5 Pulse Train Command Input Section and Position Detection Section



- You can select a switch on the OPC-VG7-PG card to switch between two types of pulse command/pulse detection.
- (a) PG (PR): Controls position and synchronization by receiving a command pulse train for pulse calculation.
- (b) PG (PD): Controls position by detecting pulse train for pulse calculation.
- You can output either of the pulse command value, the converted pulse output for the internal speed command, or the detected pulse value through the integrated [FA] and [FB] in the pulse output circuit.

## 4.2.6 Speed Control and Torque Command Section

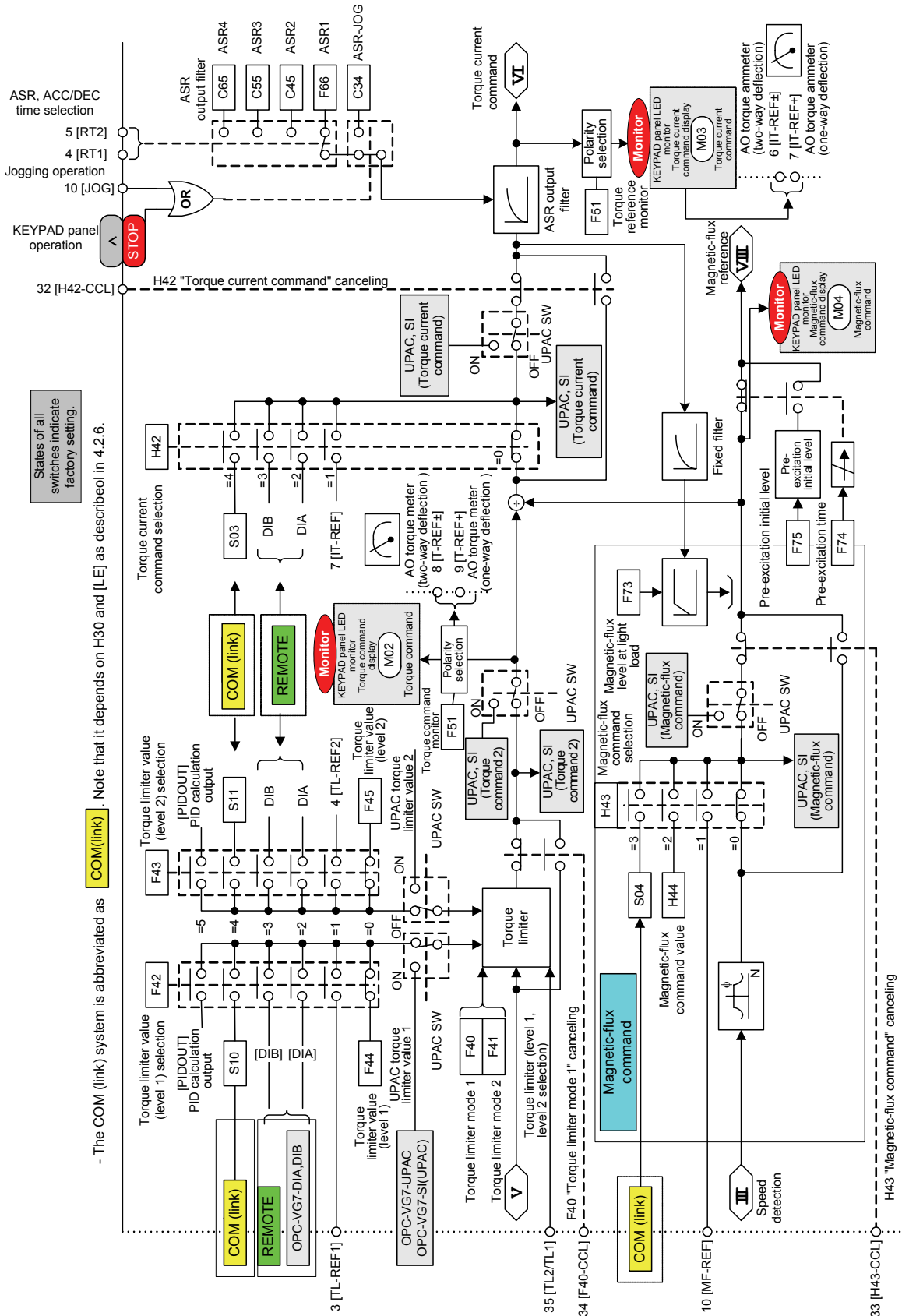


- ASR (Automatic Speed Regulator) and S-curve acceleration/deceleration functions switch simultaneously.
- Torque control and torque current hold the ASR output to zero.
- The observer becomes ineffective when you set the motor selection to M3 (V/f control).

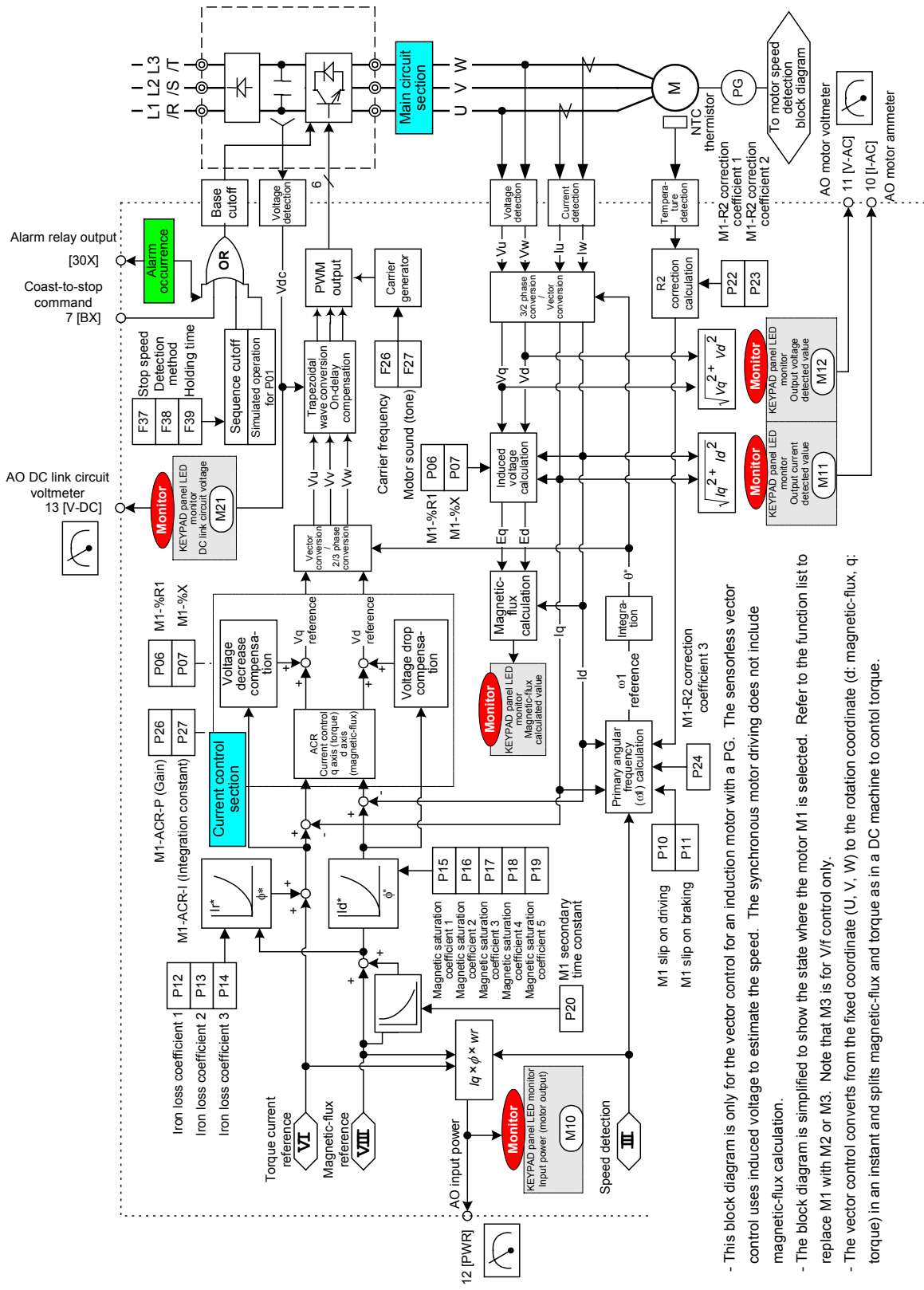
States of all switches indicate factory setting.

# 4. Control and Operation

## 4.2.7 Torque Limit, Torque Current Command, and Magnetic-flux Command Section



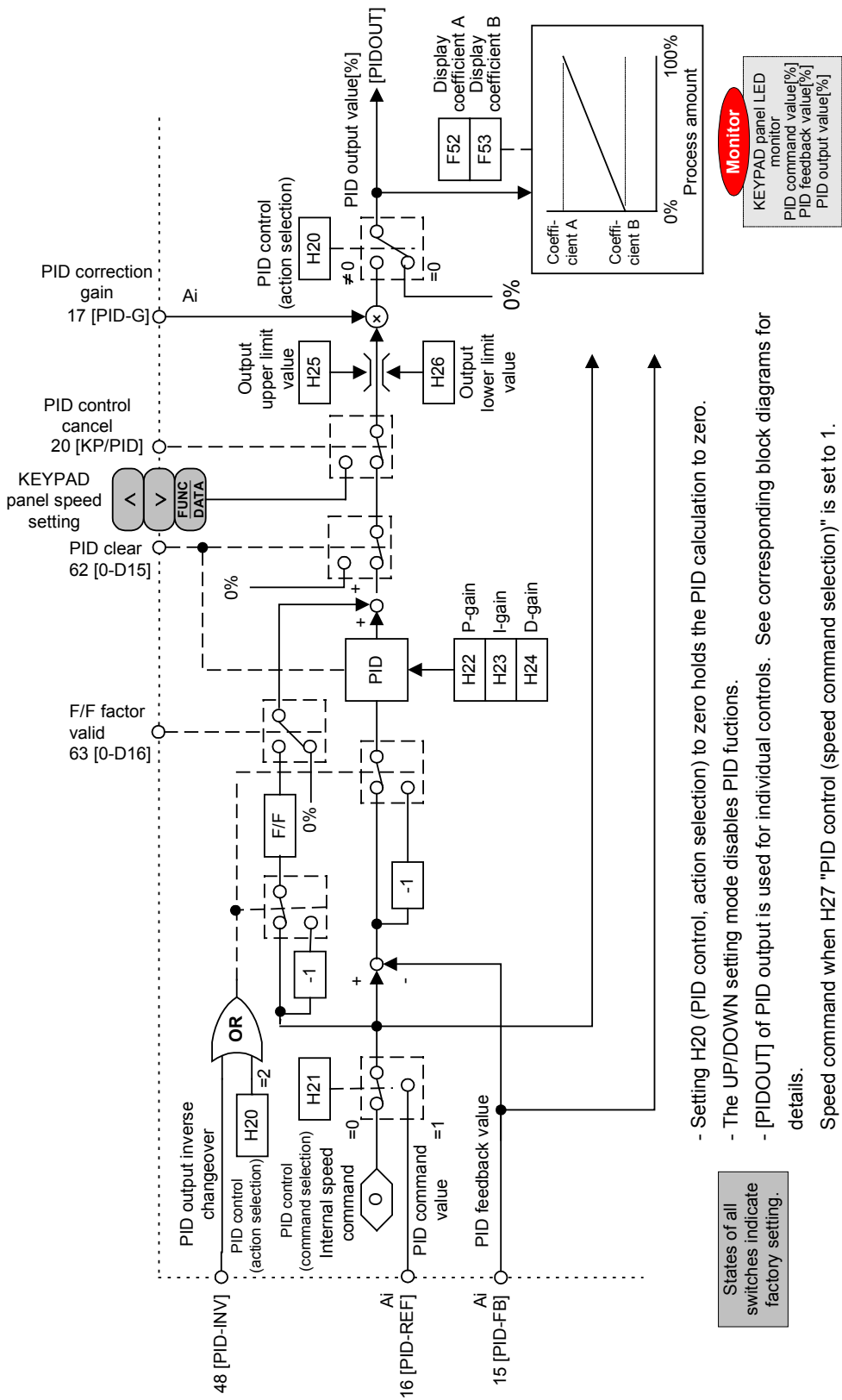
# 4.2.8 Current Control and Vector Control Section



- This block diagram is only for the vector control for an induction motor with a PG. The sensorless vector control uses induced voltage to estimate the speed. The synchronous motor driving does not include magnetic-flux calculation.
- The block diagram is simplified to show the state where the motor M1 is selected. Refer to the function list to replace M1 with M2 or M3. Note that M3 is for V/f control only.
- The vector control converts from the fixed coordinate (U, V, W) to the rotation coordinate (d: magnetic-flux, q: torque) in an instant and splits magnetic-flux and torque as in a DC machine to control torque.

# 4. Control and Operation

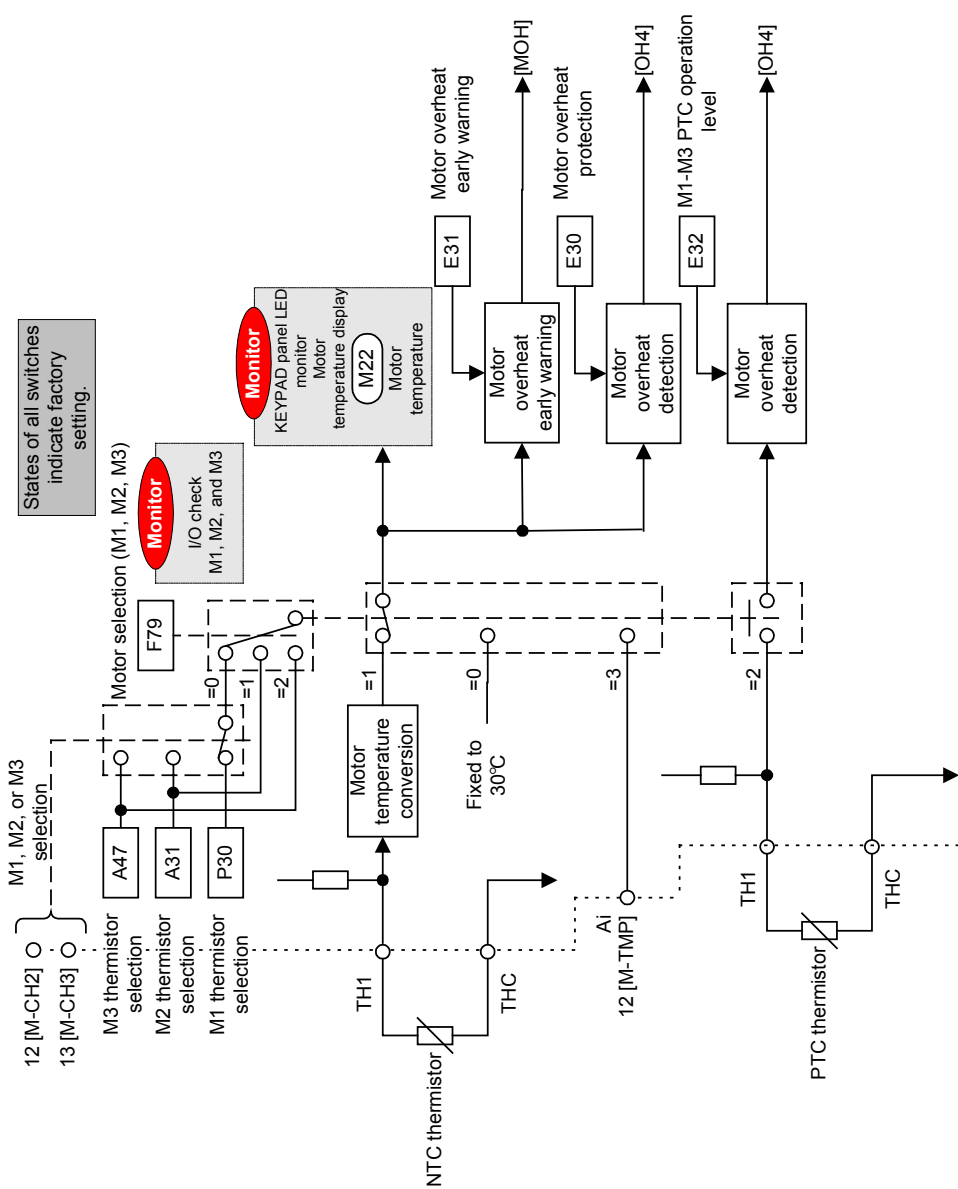
## 4.2.9 PID Calculation Section



- Setting H20 (PID control, action selection) to zero holds the PID calculation to zero.
- The UP/DOWN setting mode disables PID functions.
- [PIDOUT] of PID output is used for individual controls. See corresponding block diagrams for details.
- Speed command when H27 "PID control (speed command selection)" is set to 1.
- Auxiliary speed command when H27 "PID control (speed command selection)" is set to 2.
- Torque command when H41 "Torque command selection" is set to 5.
- Torque limiting when F42 or F43 "Torque limiter value (level 1) or (level 2) selection" is set to 5.

States of all switches indicate factory setting.

## 4.2.10 Motor Temperature Detection Section



- For thermistor, you can select NTC, PTC thermistor or analog input.

NTC (Negative Temperature Characteristic) thermistor: a thermistor having a negative relation between temperature and its resistance.

PTC (Positive Temperature Characteristic) thermistor: a thermistor having a positive relation between temperature and its resistance.

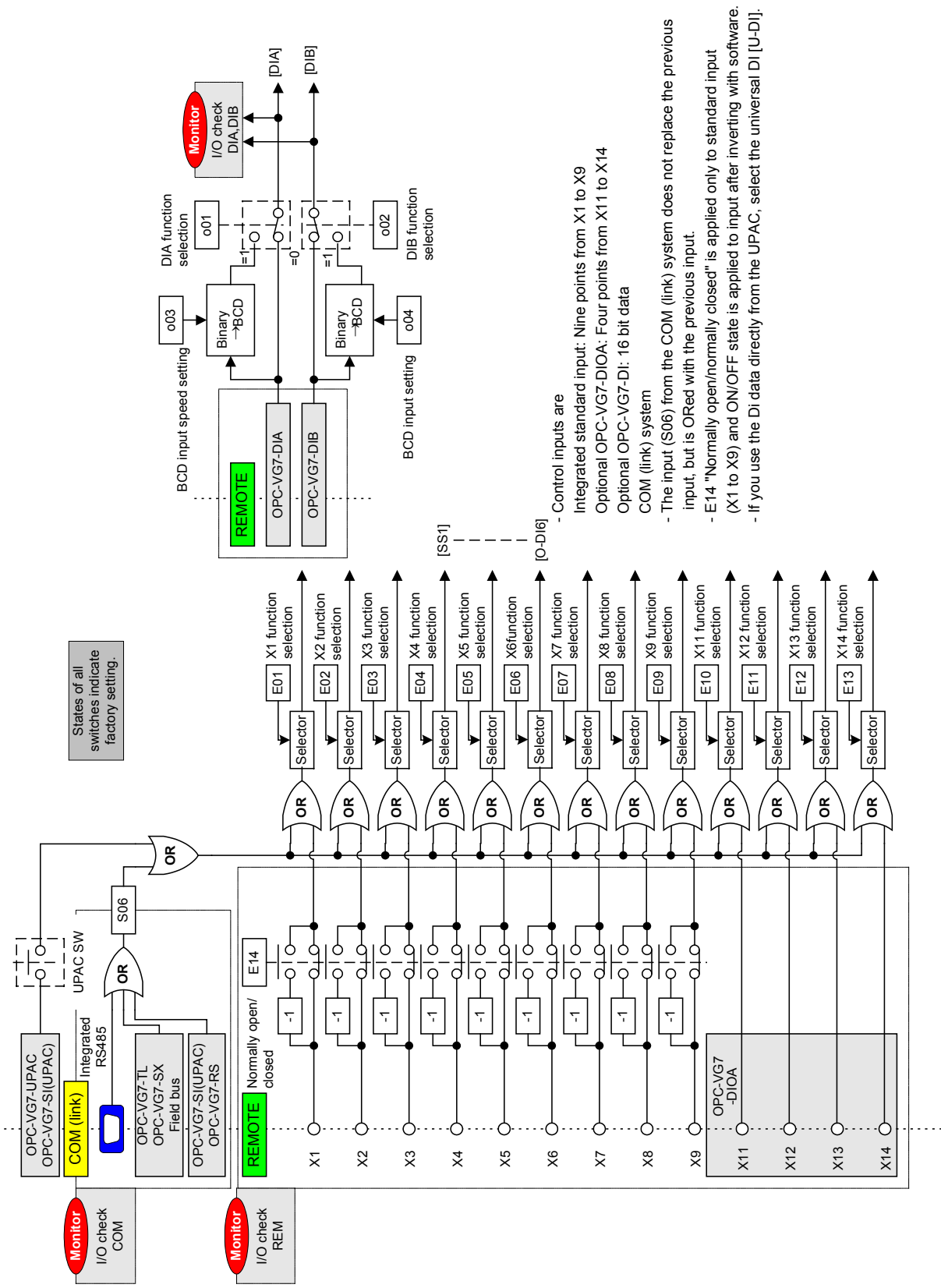
- The motor temperature monitor displays only when an NTC thermistor is connected. Otherwise it displays "---".

- Though thermistor is used for motor overheat protection, you can use an NTC thermistor for the secondary resistor compensation (R2 compensation) in primary angular frequency calculation to realize accurate torque control without being influenced by the motor temperature as described Section 4.2.8 "Current control and vector control section".



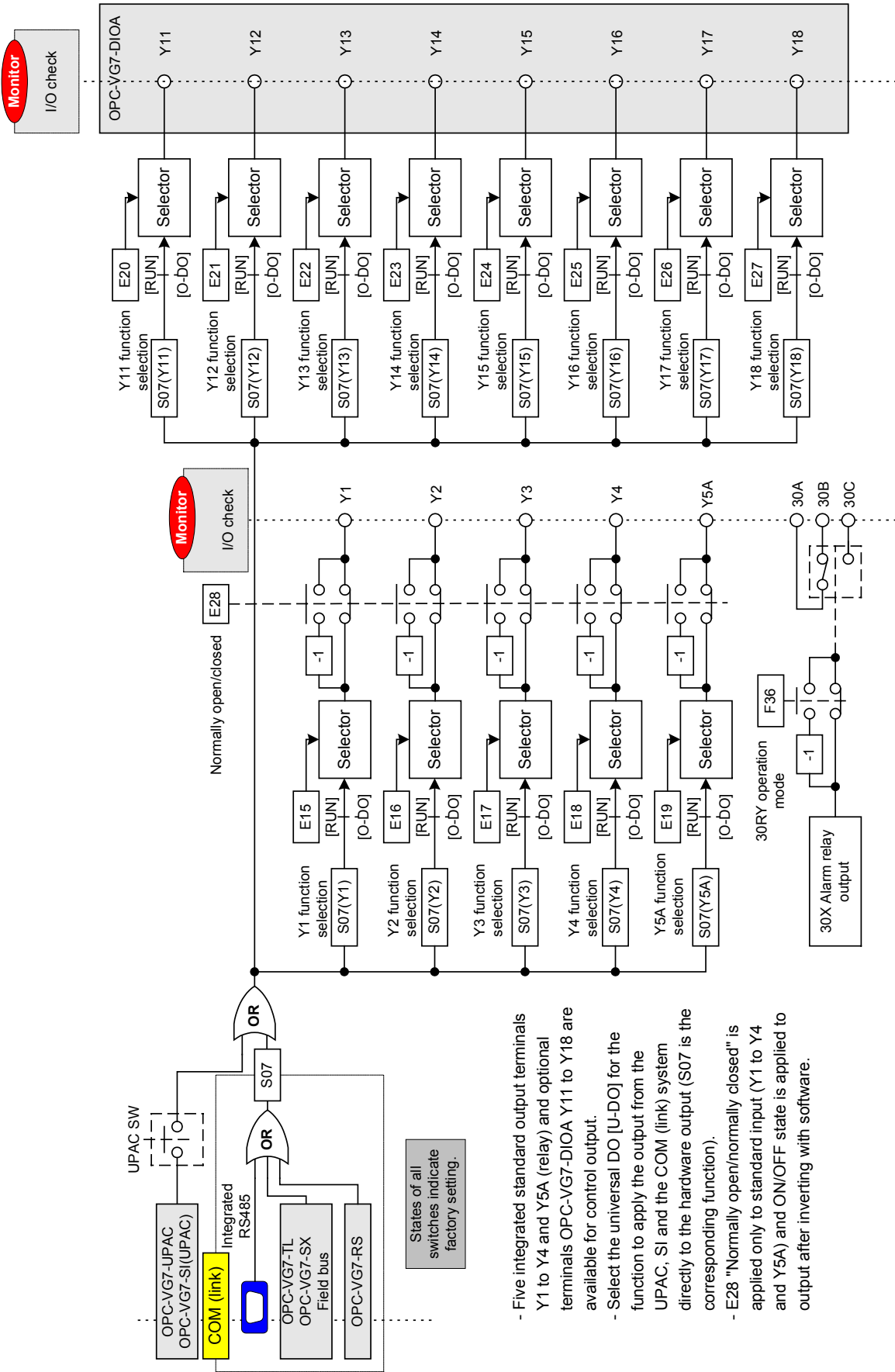
# 4. Control and Operation

## 4.2.11 Function Selection Digital Input



- Control inputs are
- Integrated standard input: Nine points from X1 to X9
- Optional OPC-VG7-DIOA: Four points from X11 to X14
- Optional OPC-VG7-DI: 16 bit data
- COM (link) system
- The input (S06) from the COM (link) system does not replace the previous input, but is ORed with the previous input.
- E14 "Normally open/normally closed" is applied only to standard input (X1 to X9) and ON/OFF state is applied to input after inverting with software.
- If you use the DI data directly from the UPAC, select the universal DI [U-DI].

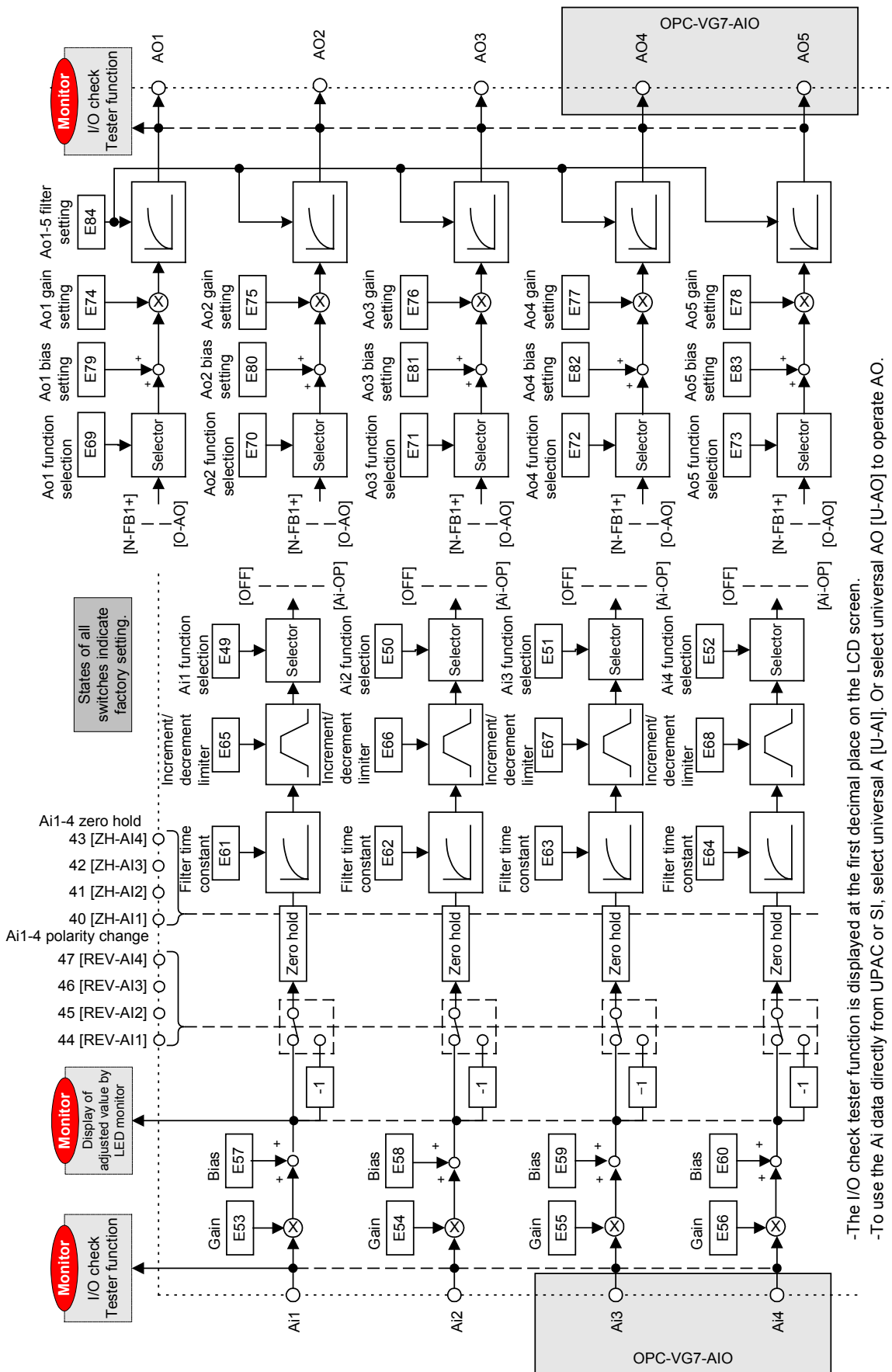
## 4.2.12 Function Selection Digital Output/Fault Output



- Five integrated standard output terminals Y1 to Y4 and Y5A (relay) and optional terminals OPC-VG7-DIOA Y11 to Y18 are available for control output.
- Select the universal DO [U-DO] for the function to apply the output from the UPAC, SI and the COM (link) system directly to the hardware output (S07 is the corresponding function).
- E28 "Normally open/normally closed" is applied only to standard input (Y1 to Y4 and Y5A) and ON/OFF state is applied to output after inverting with software.

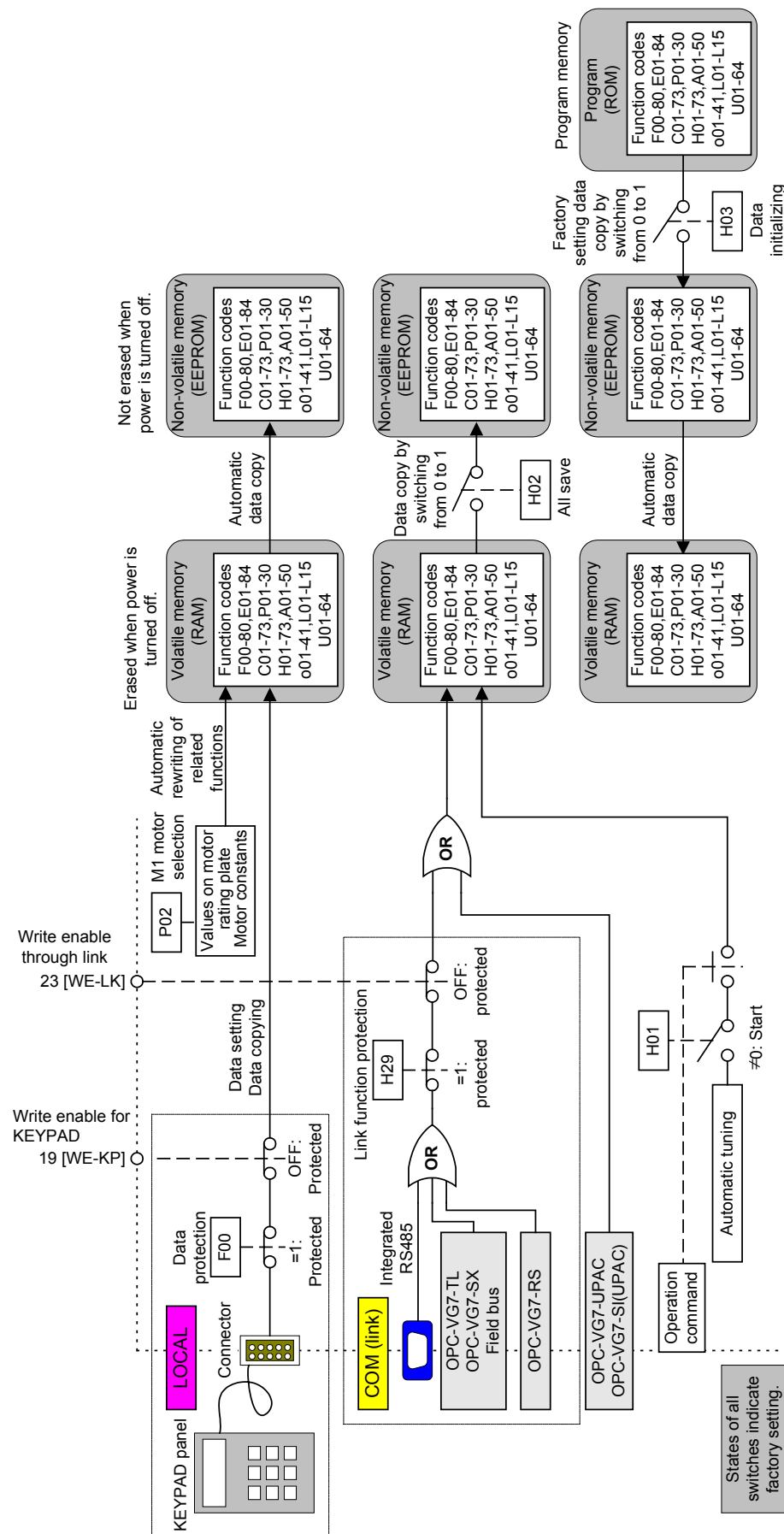
# 4. Control and Operation

## 4.2.13 Function Selection Analog Input/Output



-The I/O check tester function is displayed at the first decimal place on the LCD screen.  
 -To use the Ai data directly from UPAC or SI, select universal A [U-AI]. Or select universal AO [U-AO] to operate AO.  
 -To read Ai data from the COM system (T-Link, SX, Field Bus, RS485), select universal AI [U-AI] and access UNO-61 (Ai1), 62 (Ai2), 63 (Ai3) and 64 (Ai4). However, this function is invalid if a UPAC option is installed.

## 4.2.14 Enabling to Write to/recording Function Codes



- Later writing has always priority. Data written last is maintained and previous data is deleted on writing.
- The all save and initialization procedures take about 2s. You cannot change data in this period.
- When you have not assigned the [WE-KP] or the [WE-LK] to X functions, they are assumed as "ON".
- You cannot enable or disable to write data from the UPAC.
- Data from the COM (link) or the UPAC are written to the RAM and are deleted when you turn off the power. If you want to keep them, execute the all save procedure.
- The H30 and [LE] define the access from the COM (link) to the function S area separately. See the block diagrams for operation commands and speed reference.
- You cannot use the COM (link) to change the function code P02.

## 4. Control and Operation

### 4.3 Function Code Description (Arranged by Code)

#### 4.3.1 F Code (Fundamental Functions)

**F00**

**Data protection**

- ◆ Protection for setting values is available to disable changes through the KEYPAD panel. The KEYPAD panel displays "DATA PRTC" during the data protection.
- ◆ This protection is effective for writing through the KEYPAD, and is not applied to the writing through the link (such as RS485 and field bus). You can use H29 "Protection from write through link" to define the write protection through the link.

**F 0 0 D A T A P R T C**

Set value: 0: You can change data. <0:CHGOK>  
1: Data are protected. <1:PROTECT>

[Setting procedure]

0→1: Press **STOP** and **▲** keys simultaneously to change the value from 0 to 1, then press **FUNC DATA** key to confirm the change.

1→0: Press **STOP** and **▼** keys simultaneously to change the value from 1 to 0, then press **FUNC DATA** key to confirm the change.

**F01**

**Speed setting N1**

- ◆ Defines the speed command setting.
- ◆ You can use the digital input signal [N2/N1] to switch the destination of F01 and C25. See the function description of E01 to E13 for switching detail.

**F 0 1 S P D C M D 1**

Set value: 0: Set by the KEYPAD panel ( **▲** and **▼** keys) <0: KEYPAD>

1: Set by the voltage input (Terminal [12]: 0 to ±10 V) <1:12INPUT>

2: Set by the voltage input (Terminal [12]: 0 to +10 V) <2:12(ABS)>

3: Set by the UP/DOWN (Initial value=0) <3:U/D(0)>

4: Set by the UP/DOWN (Initial value=previous value) <4:U/D(BEF)>

5: Set by UP/DOWN (Initial value=CRP1, CRP2)

(Set by the [UP] and [DOWN] terminals. Related functions: E01 to E13 "X function selection") <5:U/D(CRP)>

6: DIA card input <6: DIA CARD>

7: DIB card input <7: DIB CARD>

- ◆ Use the "Operation monitor" of the KEYPAD panel to confirm the speed command.

The right figure shows "Operation monitor" screen when you set the speed command to 1200r/min and the operation command to ON.

**1200**

N\*=1200.0r/m

N =1200.0r/m

f\* = 0.0Hz

TRQ= 0%

**F02****Operation method**

- ◆ Sets operation method.

**F 0 2 O P R M E T H O D**

Set value: 0: Key operation (KEYPAD panel: **FWD**, **REV**, and **STOP** keys)  
(LOCAL mode) <0:KEYPAD>

1: External input (terminal [FWD] and [REV]) (REMOTE mode) <1:FWD, REV>

You can also use **RST** + **STOP** keys on the KEYPAD panel to switch between REMOTE and LOCAL (This KEYPAD panel operation rewrites the set value for F02).

When the function code H30 "Serial link" is set to 2 or 3, operation through the link will be effective regardless of F02 setting.

- ◆ Operation command through the key operation on the KEYPAD panel turns on the green RUN LED. When you have selected an operation through the external inputs (FWD and REV), display the I/O check **REM** on the KEYPAD panel to make sure that corresponding inputs for FWD and REV are indicated with .

The right figure shows the I/O screen when the FWD signal is turned on externally.

Note that the I/O screen for the **COMM** shows commands through the link and does not reflect the terminal block commands.

**1500**

<b>REM</b>	<input type="checkbox"/> X2	<input type="checkbox"/> X6
<input checked="" type="checkbox"/> FWD	<input type="checkbox"/> X3	<input type="checkbox"/> X7
<input type="checkbox"/> REV	<input type="checkbox"/> X4	<input type="checkbox"/> X8
<input type="checkbox"/> X1	<input type="checkbox"/> X5	<input type="checkbox"/> X9

**F03****M1 max. speed**

- ◆ Sets the maximum speed for the motor 1. If you set the value greater than the rating of a driven device, you may damage the motor or the machine. Be sure to set according to a machine to drive.
- ◆ Use so that the ratio of the rated speed to the maximum speed is within 1:6.

**F 0 3 M 1 - N m a x**

Setting range: 50 to 24,000 [r/min]

**CAUTION**

Change the valid ASR P gains (F61, C40, C50 and C60) in proportion to the change in the F03 value. For example, if F03 is "1500" and F61 is 10.0 and if F03 is changed to "150," hunting of the motor will be caused. Because this change means a 10-fold ASR gain (1500/150), be sure to change F61 from "10.0" to "1.0."

**F04****M1 rated speed**

- ◆ Sets the rated speed in the constant torque range of the motor M1. Set according to the rating (displayed on a rating plate) of a motor to be used. When the standard motor of VG5 or VG7 is used at P02, the data is automatically set and you cannot change. When P02 is set to "P-OTR", you cannot change the value.
- ◆ Use so that the ratio of the rated speed to the maximum speed is within 1:6.

**F 0 4 M 1 - N r**

Setting range: 50 to 24,000 [r/min]

**F05****M1 rated voltage**

- ◆ Sets the rated voltage supplied to the motor 1. Set according to the rating (displayed on a rating plate) of a motor to be used. When you use a standard motor for the VG5 or the VG7, the data is set automatically and you cannot change it. When P02 is set to "P-OTR", you cannot change the value.

**F 0 5 M 1 - V r**

Setting range: 80 to 999 [V]

# 4. Control and Operation

**F07** Acceleration time 1

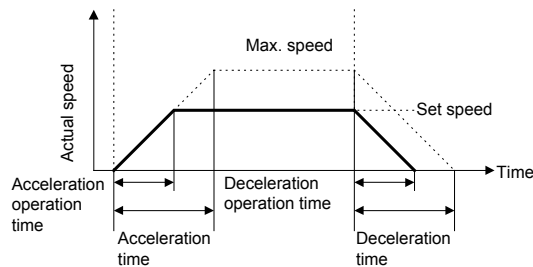
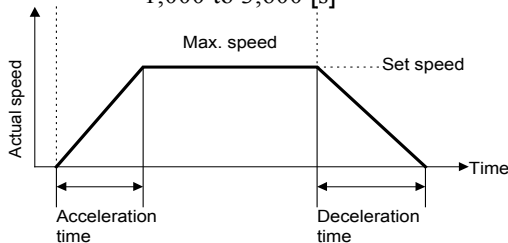
**F08** Deceleration time 1

- ◆ Set the acceleration time from zero to the maximum speed and the deceleration time from the maximum speed to zero. The acceleration time and deceleration time are set based on the maximum speed.
- ◆ The following equation denotes the relationship between the set speed and the acceleration/ deceleration times. The acceleration/deceleration times become longer when you specify the S-curve acceleration and deceleration. See F67 function description for more details.

F	0	7	A	C	C	T	I	M	E	1
F	0	8	D	E	C	T	I	M	E	1

$$\text{Time required for acceleration/deceleration} = \text{Set value (F07, F08)} \times \frac{\text{Set speed}}{\text{Maximum speed}}$$

Setting range: 0.01 to 99.99 [s]  
 100.0 to 999.9 [s]  
 1,000 to 3,600 [s]



- ◆ Specified values through the link (RS485, T-Link, SX, and field bus) are copied to F07 and F08 to use.

**F10** M1 electronic thermal overload relay (Select)

**F11** M1 electronic thermal overload relay (Level)

**F12** M1 electronic thermal overload relay (Thermal time constant)

- ◆ The electronic thermal overload relay manages the motor rotation, the output current and the operation time and protects the motor from overload. This function protects the motor M1. When you use a dedicated motor for the VG5 or the VG7, disable this function (setting is not required).

F	1	0	M	1	-	E	O	L	-	S	E	L
---	---	---	---	---	---	---	---	---	---	---	---	---

- Operation selection

When you use a dedicated motor for the VG5 or the VG7, the motor overheat protection by an NTC thermistor becomes in operation and you do not have to use an electronic thermal overload relay. Disable this function.

When a motor overheat protection by an NTC thermistor is not available, enable the electronic thermal overload relay and select a motor (self-cooling fan or separate cooling fan).

The protection function (motor overload: oL1) is activated when 150% of the current specified by F11 flows for the time specified by F12.

Set value: 0: Inactive (For a dedicated motor for the VG5 or the VG7. Protected by an NTC thermistor)

1: Active (Self-cooling fan, general-purpose motor)

2: Active (Separate cooling fan, FUJI's inverter motor)

## F 1 1 M 1 - E O L - L V L

### - Operation level

Set the activation level in current value for the electronic thermal overload relay.

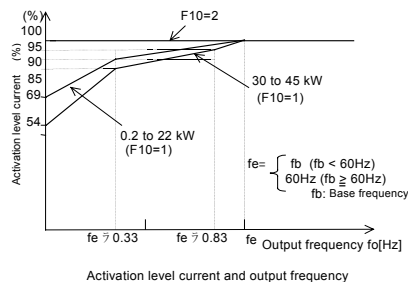
Enter a value in the range from 1.0 to 1.1 times rated current of the motor specified at P04.

In the factory setting, the rated current of the standard motor for our general-purpose inverter FRENIC 5000G 11S is set. To connect another motor, change the setting.

Setting range: 0.01 to 99.99 [A]

100.0 to 999.9 [A]

1,000 to 2,000 [A]



## F 1 2 M 1 - E O L - T C

### - Thermal time constant

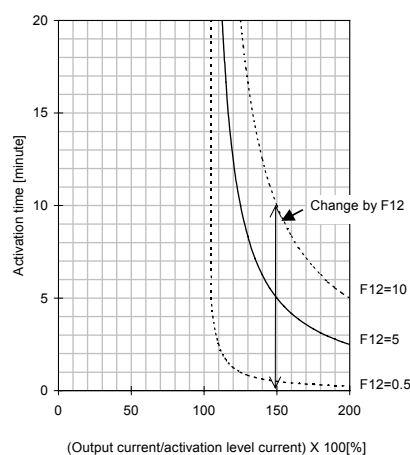
Set the time for 150% or more of the current at operation level (specified by F11) flows continuously before the electronic thermal overload relay is activated.

Setting range: 0.5 to 75.0 [min]

(Example) If you set F12=5 [min],

As indicated in the right graph, if 150% current flows for five minutes, the protection function of the motor 1 overload (alarm: oL1) is activated. If the current is 120%, then the protection function will be activated in 13 minutes. Since the current flowing through a motor is not usually constant, the average current in a certain period activates the timer for the electronic thermal overload relay.

Example of current-activation time characteristics



**Note:** Very frequent operation will fluctuate the load current and the current will reach the short-time rating (100% or more) frequently.

In this case, refer to Section 10.1.3.4 "Actual equivalent loading estimation" to calculate the equivalent effective current and to limit this value under the rated current of a motor (for separate cooling fan).



# 4. Control and Operation

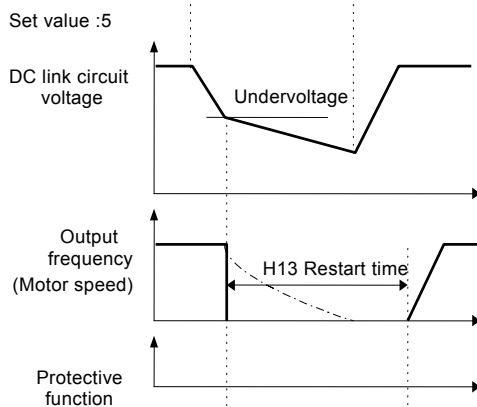
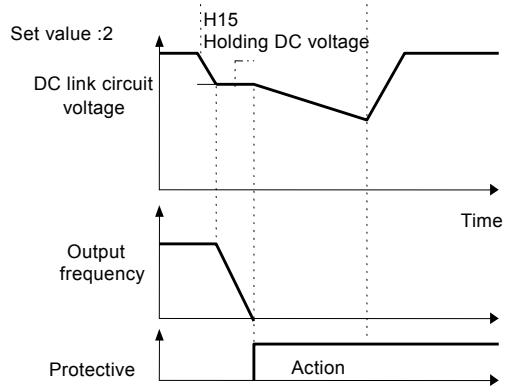
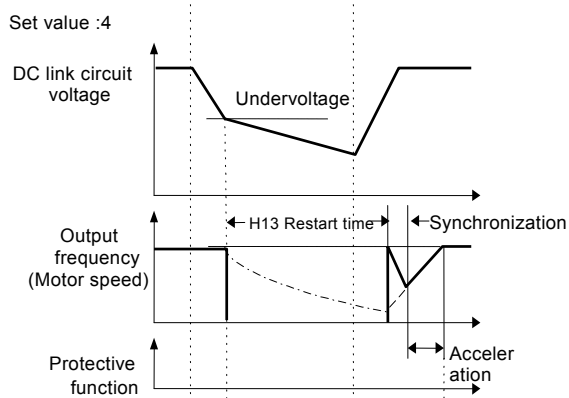
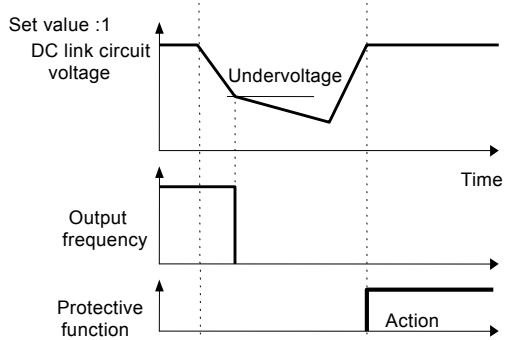
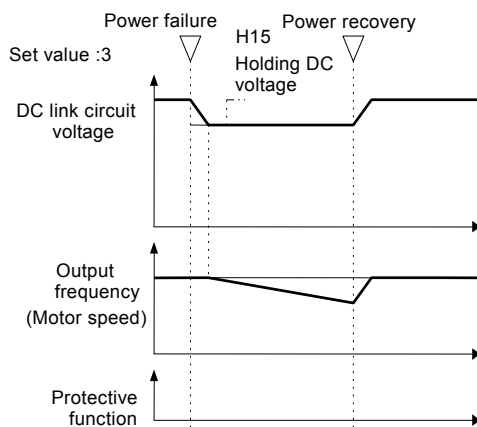
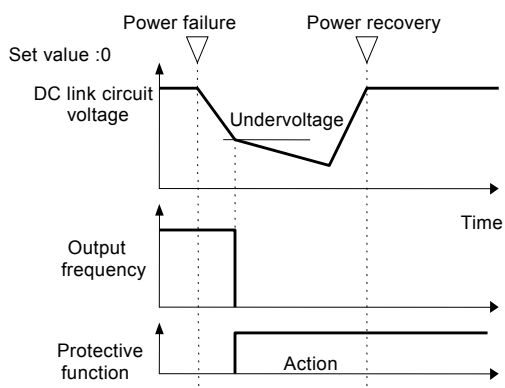
**F14**

**Restart mode after momentary power failure (Select)**

- ◆ This function selects an action after a momentary power failure. You can select a function for detecting power failure and activating protective operation (alarm output, alarm display, inverter output cutoff) for undervoltage or an automatic restart function without stopping a coasting motor after the supply voltage recovery.
- ◆ See the following table for more information on this function.  
The function codes H14 to H17 "Auto-restart" are provided for a restart after a momentary power failure. You should be familiar with these functions too.
- ◆ To restart after momentary power failure under V/f control, specify "1 (active)" at H58 (overcurrent suppressing function).

**F 1 4 R E S T A R T**

Set value	Function name	Operation on power failure	Operation on power recovery	
0	Inactive (immediate inverter trip)	If undervoltage is detected, the protective function is activated and output is turned off.	The inverter does not restart.	Enter commands for resetting the protective function and starting operation.
1	Inactive (inverter trip on recovery)	If undervoltage is detected, the protective function is not activated and output will be turned off.	The protective function is activated, but the operation does not restart,	
2	Inactive (inverter trip after deceleration to a stop on power failure)	When the holding DC level (H15) "Restart after momentary power failure" is reached, the inverter decelerates a motor to stop. The DC voltage of the main circuit sharpens the deceleration slope so that the undervoltage protective function is not activated. The inverter collects the inertia energy of the load and controls the motor until it stops, then the undervoltage protective function is activated. If the amount of inertia energy from the load is small, and the undervoltage level is achieved during deceleration, the undervoltage protective function is then activated.	The protective function is activated, but the operation does not restart,	
3	Active (continuous operation)	When the holding DC level is reached, energy is collected from the inertia amount of the load to extend the operation continuation time. If undervoltage is detected, the protective function is not activated, but the output is turned off.	Operation restarts automatically. For a power recovery during a continued operation, the inverter accelerates to the original speed. If the inverter detected an undervoltage, operation automatically restarts at the speed when the undervoltage is detected.	
4	Active (restart at the speed on power failure)	If undervoltage is detected, the protective function is not activated and the output is turned off.	Operating restarts automatically at the speed on a power failure.	
5	Active (restart at the starting speed)	If undervoltage is detected, the protective function is not activated and the output is turned off.	Automatic restart from 0r/min	



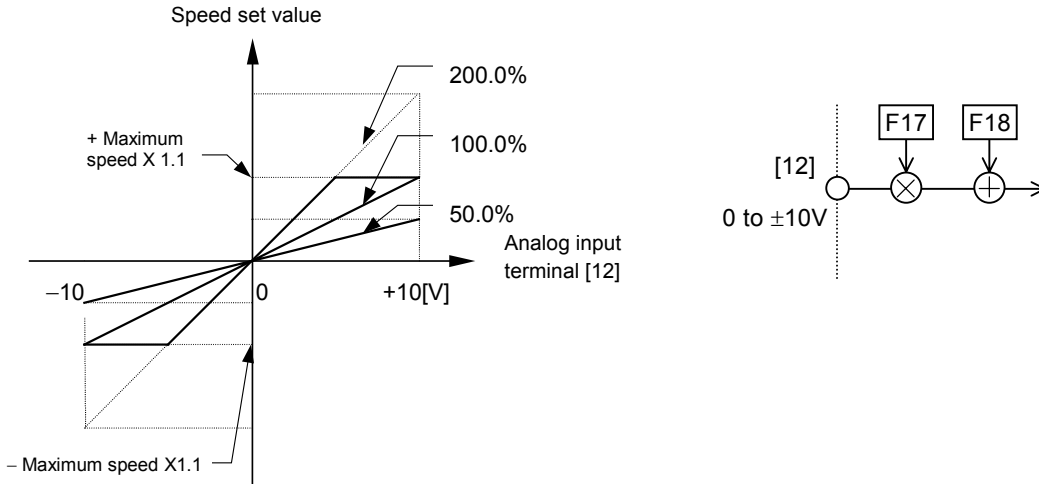
# 4. Control and Operation

## F17 Gain (for speed setting signal 12)

◆ Sets the proportion to the speed setting value (analog input) from the control terminal [12]. Setting is limited to 110% (1.1 times) of  $\pm$ max. speeds.

**F 1 7 G A I N ( 1 2 )**

Setting range: 0.0 to 200.0 [%]

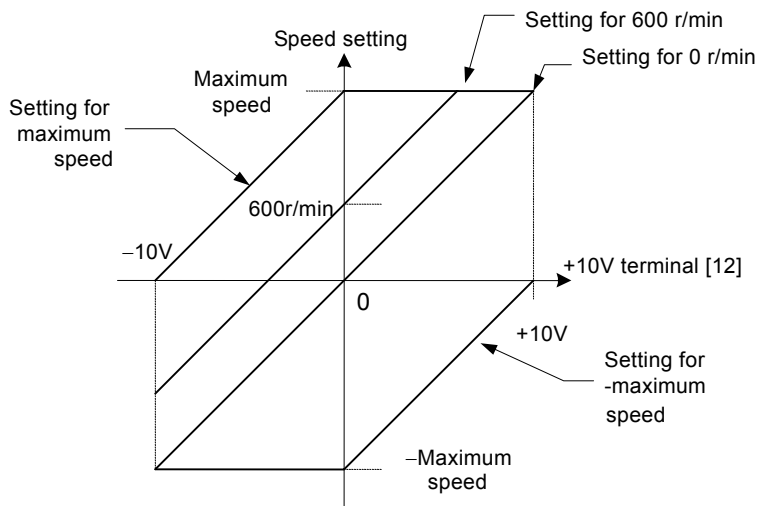


## F18 Bias (for speed setting signal 12)

◆ You can add a bias speed to the speed setting value (analog input) from the control terminal [12]. Setting is limited to  $\pm$ max. speeds.

**F 1 8 B I A S ( 1 2 )**

Setting range: -24,000 to 24,000 [r/min]



<b>F20</b>	<b>DC brake (Starting speed)</b>
<b>F21</b>	<b>DC brake (Braking level)</b>
<b>F22</b>	<b>DC brake (Braking time)</b>

◆ If you apply a DC voltage to an operating motor (set the output frequency to zero), the motor generates a braking torque to decelerate to stop. This is referred as DC brake and these functions specify the setting. If a motor does not stop within a DC braking time, the motor will coast. You can assign a digital signal input [DCBRK] to start the DC brake.

**F 2 0 D C B R K N**

- Starting speed

Set the starting speed of the DC brake during decelerating.

Setting range: 0 to 3,600 [r/min]

**F 2 1 D C B R K L V L**

- Braking level

Sets the output current level of the DC braking.

You can specify as a percentage of the inverter rated output (100%) with a minimum unit of 1%.

Setting range: 0 to 100 [%]

**F 2 2 D C B R K t**

- Braking time

Sets the operation time for the DC braking

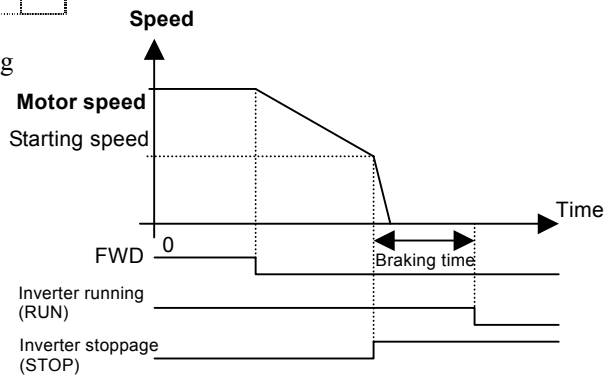
Setting range: 0.0: Inactive

0.1 to 30.0 [s]

◆ DC brake operation

The DC brake is applied for a specified time after the speed reaches the starting speed level on deceleration of a motor. The inverter running (RUN) signal maintains ON during the DC braking and the inverter stoppage (STOP) signal turns on when the DC brake is activated.

◆ Specify the slip frequency conversion speed level at F20. If a very large value is specified, the control becomes unstable, possibly causing overvoltage protection being activated.



**CAUTION**

- The brake function of the inverter does not provide a mechanical hold.

**You may be injured.**

<b>F23</b>	<b>Starting speed</b>
<b>F24</b>	<b>Starting speed (Holding time)</b>

◆ You can set a starting speed to assure a starting torque.

Vector control operation:

This function acts to release a mechanical brake. If you enter the operation command after setting the starting speed to 0r/min, the brake will be released after the magnetic-flux and the torque reach a certain level. See E15 to E27 "Y function selection" for brake release signal.

# 4. Control and Operation

V/f control operation:

You can accelerate a motor after operating the motor at a starting speed for a certain period to establish the magnetic-flux on start.

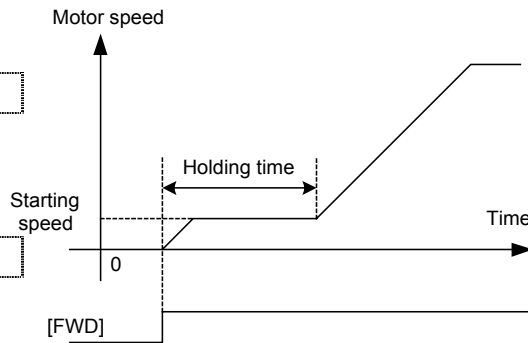
**F 2 3 S T A R T N**

- Starting speed  
Sets the rotation at start.  
Setting range: 0.0 to 150.0 [r/min]

**F 2 4 H L D S T A R T t**

- Holding time  
Sets the period for maintaining the starting time.  
Setting range: 0.0 to 10.0 [s]

Note: The holding time is not activated when you switch between forward and reverse rotation. The acceleration time does not include the holding time.



## F26 Motor sound (Carrier freq.)

- ◆ Adjusts the carrier frequency. You can adjust the carrier frequency to reduce the motor sound and the inverter noise, to avoid resonance with the mechanical systems, and to reduce the leakage current from the output circuit wiring.

**F 2 6 M T R S O U N D**

Setting range: 0.75 to 15 [kHz]

Carrier frequency	0.75 to 15kHz
Motor sound	High to low
Output current waveform	Bad to good
Leakage current	Low to high
Generated noise	Low to high

Note 1: Reducing the setting adversely affects the output current waveform (i.e., high harmonics), increases the motor loss, and raises the motor temperature. For example, setting 0.75 kHz reduces the motor torque by about 15%. Increasing the setting increases inverter loss and raises the inverter temperature.

Note 2: The recommended carrier frequency is 2 to 15kHz for vector control. If you select the range from 0.75 to 1kHz, you cannot control current properly. Insufficient current control will activate the protective function for overcurrent (OC).

Note 3: Set the carrier frequency between 2 and 15kHz under sensorless vector control.

## F27 Motor sound (Sound tone)

- ◆ You can adjust the motor sound tone when the carrier frequency is lower than 7kHz. Use this function, if needed.

**F 2 7 S O U N D T O N E**

Set values: 0: Level 0  
1: Level 1  
2: Level 2  
3: Level 3

This function changes (modulates) the carrier frequency in the range of set frequency  $\pm\alpha$ [%] periodically. This does not cause adverse effects such as losses (motor or inverter).

**F36****30RY operation mode**

- ◆ Selects whether to activate (excite) the alarm output relay (30RY) in a normal state or in an abnormal state.

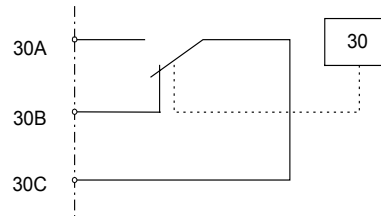
**F 3 6 R Y M O D E**

Setting value: 0: Normal state: 30A-30C: OFF,  
30B-30C: ON

Abnormal state: 30A-30C: ON,  
30B-30C: OFF

1: Normal state: 30A-30C: ON,  
30B-30C: OFF

Abnormal state: 30A-30C: OFF,  
30B-30C: ON



When the setting value is 1, the contacts between 30A and 30C are connected after the inverter control voltage is established (about one second after turning on). Since the relay is excited in a normal state, the relay can detect a disconnection in the alarm output line.

**F37****Stop speed****F38****Stop speed (Detection method)****F39****Stop speed (Zero speed holding time)****F 3 7 S T O P N**

- Stop speed

Sets the stop speed.

Setting range: 0.0 to 150.0 [r/min]

**F 3 8 D E T S I G N A L**

- Detection method

Sets the stop speed detection method whether to the speed command value (Speed setting 4 (ASR input)) or the detected speed value (Detected speed 1)

Setting value: 0: Speed command value

1: Detected speed value

However, if the control method is in the V/f control mode or sensorless control mode, the speed command only is valid irrespective of the setting.

**F 3 9 H L D S T O P t**

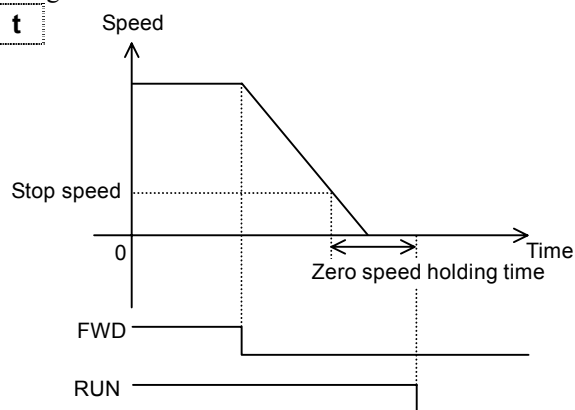
- Zero speed holding time

Setting range: 0.00 to 10.00 [s]

The Inverter running (RUN) signal will turn off at the end of the Zero speed holding time for continuing operation after the motor speed reaches the stop speed level.

- ◆ You can use this function to adjust the timing to apply a mechanical brake.

However, if the control method is in the V/f control mode or sensorless control mode, this function is invalid. Even in the vector control mode, this function is invalid under torque control (H41 ≠ 0) or torque current control (H42 ≠ 0).



# 4. Control and Operation

**F40** Torque limiter mode 1

**F41** Torque limiter mode 2

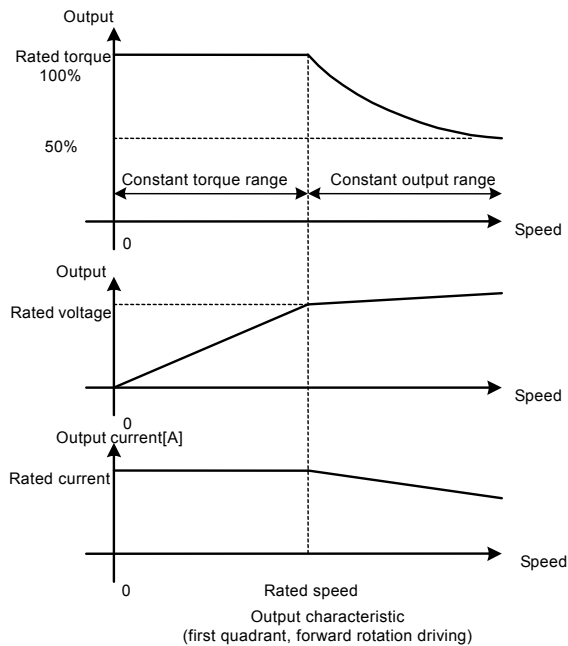
- ◆ Torque limiter mode 1: Selects whether to enable or disable limiters (torque, power, or torque current). Turning on with applying "F40 cancel" [F40-CCL] has the same effect as setting "0" which disabling limiters.

**F 4 0 T L I M M O D E 1**

- Set value: 0: Limiters disabled  
 1: Torque limiter enabled  
 2: Power limiter enabled  
 3: Torque current limiter enabled

### Background information

The right graph shows a continuous permissible torque (not short-time rating) for forward rotation driving in the speed control range (0-rated speed-200%). The control generally reduces magnetic-flux above the rated speed to extend the speed control range. The reduced output current in the right graph shows that the control reduces the current corresponding to the amount of the reduced magnetic-flux. This reduces the increase of the induced motor voltage to restrain the increase of the voltage output proportional to the speed. Under the rated speed, the rated torque is effective. Since the torque is proportional to the product of the exciting current and the torque current, the current is limited in practice. Over the rated speed, since the inverter capacity (output: power) restricts the torque, the output torque decreases in inversely proportional to the speed. The torque limiter condition switches at the rated speed.



- ◆ You can use the "Operation monitor" of the "I/O check" of the KEYPAD panel to review the state of the torque limiter, the power limiter and torque current limiter status

■ TL in the right figure shows the torque limiter is active. When the torque limiter is not applied, the display turns to □TL. You can also read the function code M14 "Operation status" through the link to confirm the state.

**1500**

■ FWD	□ BRK	□ IOL
□ REV	■ INUV	□ ACC
□ EXT	■ TL	□ DEC
□ INT	□ VL	□ ALM

- ◆ Torque limiter mode 2: Selects a type of torque limiter.

**F 4 1 T L I M M O D E 2**

- Set value1: 0: Level 1 for four quadrants simultaneously  
 1: Driving (Level 1), braking (Level 2)  
 2: Upper limit (Level 1), lower limit (Level 2)  
 3: Switching between the Level 1 and the Level 2 for all four quadrants.

The next section describes the actual limitations determined by the values set at F40 and F41. For level 1 and level 2 of each limitation, see the explanation of the function codes F42 and F43.

## Description and application of the limiter mode 1

Limiter type	Limiter description	Application
Torque limiter disabled (set value: 0) [F40-CCL]= ON	<p>Limits the torque by the maximum output current (One-minute, ten-second ratings) in the entire speed limiting range.</p> $\tau(\text{Torque}\%) = \frac{\sqrt{I_{m\alpha}^2 - I_m^2 - \left(I_T \times \frac{\text{Iron loss coefficient}}{100}\right)^2}}{I_T} \times 100[\%]$ <p>Maximum driving torque for 30kW, 200V, CT use, and VG7 dedicated motor is 153.1%</p> <p><math>I_{m\alpha}</math>(Short-time rated current)=174(A)  <math>I_m</math>(Exciting current:P08)=53.42(A)  <math>I_t</math>(Torque current:P09)=108.18(A)  Iron loss coefficient:P12=2.50%</p> $\tau(\text{Torque}\%) = \frac{\sqrt{174^2 - 53.42^2 - \left(\frac{108.18 \times 2.50}{100}\right)^2}}{108.18} \times 100[\%]$ $\approx 153[\%]$	<p>Use for the shortest acceleration/deceleration with the inverter.</p> <p>Note:  Check the operation sequence to avoid activating the protective function due to the inverter over load or the motor overload.  For braking, check if disabled limiters do not cause any problems when you select braking resistor capacity for the operation sequence if you use power regenerative devices (RHR or RHC series) or connect braking resistors.</p>
Torque limiter enabled (set value: 1)	<p>Limits the output of the speed control unit (ASR).  Restrain the torque[N·m] in terms of the percentage of the rated torque of a motor assumed as 100%.  The maximum output current of the inverter (one-minute, ten-second rating) may limit the torque in the constant output range depending on the set value for the limiter.</p>	<p>Use for constant torque control involving speed control and torque limiting such as winding or tension control.</p>
Power limiter enabled (set value: 2)	<p>Limits the torque by the power in the entire speed control range. Restrain the output capacity (power: kW) in terms of the percentage of the rated capacity of an inverter assumed as 100%.  The maximum output current of the inverter (one-minute, ten-second rating) may limit the torque in the constant torque range depending on the set value for the limiter.</p>	<p>Use for limiting braking torque such as stopping by braking capacity (power).  Use for braking that uses the capacity of a braking resistor.  Also use for stopping that uses only the inverter loss[kW] when you do not use an external braking resistor (DB).</p>
Torque current limiter enabled (set value: 3)	<p>Limits the torque in the constant torque range and limits the power in the constant output range.  Restricts the torque current command in terms of the percentage of the rated torque current assumed as 100%. Since this control limits the torque current to a constant level, the control reduces the magnetic-flux in the constant output range, resulting in reducing torque accordingly.</p>	<p>Enables a limiter restricting below the short-time rated torque.  Use when you limit the output torque for the motor temporarily.</p>

See the following pages for detailed application examples.

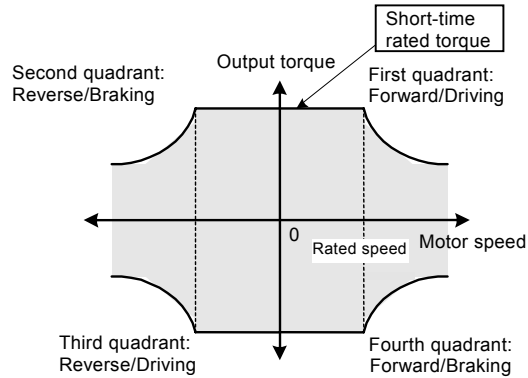


# 4. Control and Operation

## (1) Torque limiter disabled

Code	Set value	Description
F40	0	Limiter disabled
F41	0, 1, 2, 3	Not effective

- Limits the torque by the maximum output current (one-minute, ten-second ratings) in the entire speed limiting range. Use for the shortest acceleration/deceleration with the inverter.
- For driving, check the operation sequence to avoid activating the protective function due to the inverter overload or the motor overload.
- For braking, check if disabled limiters do not cause any problems when you select braking resistor capacity for the operation sequence if you use power regenerative devices (RHR or RHC series) or connect braking resistors.

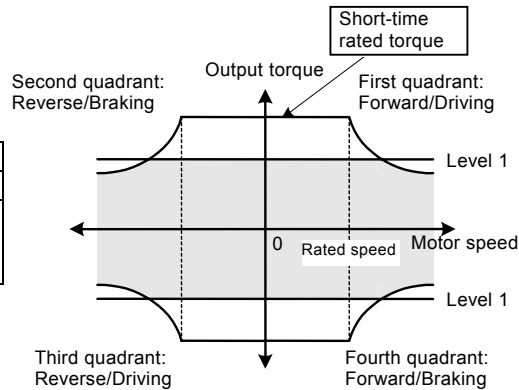


## (2) Torque limiter enabled

### (2)-1. Level 1 for all four quadrants

Code	Set value	Description
F40	1	Torque limiter enabled
F41	0	Level 1 for all four quadrants simultaneously

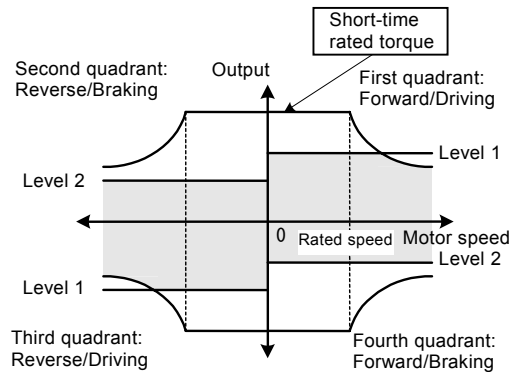
- The short-time rated torque limits the torque where the Level 1 exceeds the short-time rated torque as in the right figure.
- Though you can specify the Level 1 both in plus and minus values, you do not have to use a minus value, since it is interpreted as a plus value.



(2)-2. Driving (Level 1), braking (Level 2)

Code	Set value	Description
F40	1	Torque limiter enabled
F41	1	Driving (Level 1), Braking (Level 2)

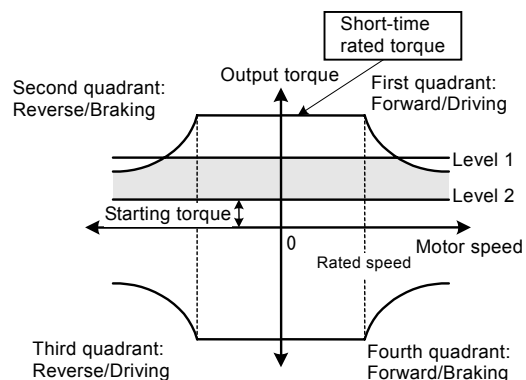
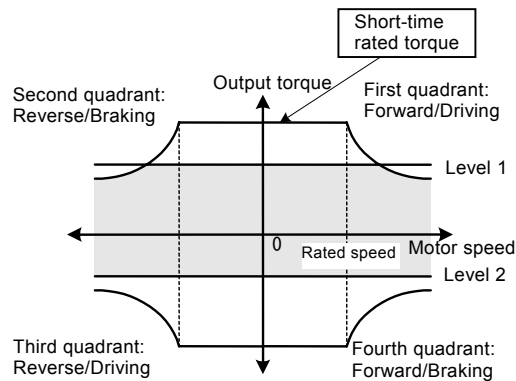
- The short-time rated torque limits the torque where the Level 1 or the Level 2 exceeds the short-time rated torque as in the right figure.
- Though you can specify the Level 1 and the Level 2 both in plus and minus values, you do not have to use a minus value, since it is interpreted as a plus value.
- You can use this specification to set the Level 1 as the short-time rated torque for driving and to set the Level 2 as the braking torque limiter due to the brake capacity for braking.
- You cannot use the digital input [TL2/TL1] to switch between the Level 1 and the Level 2.



(2)-3. Upper limit (Level 1), lower limit (Level 2)

Code	Set value	Description
F40	1	Torque limiter enabled
F41	2	Upper limit (Level 1), Lower limit (Level 2)

- Plus and minus values specify the Level 1 and the Level 2. Make sure the setting polarity is correct. Usually the **Level 1 is set to plus and the Level 2 is set to minus**.
- The short-time rated torque limits the torque where the Level 1 or the Level 2 exceeds the short-time rated torque as in the right figure.
- You cannot use the digital input [TL2/TL1] to switch between the Level 1 and the Level 2.
- When you assign plus values both to the Level 1 and the Level 2, the entire valid torque range stays in plus (Level 1 > Level 2).
- When you assign minus values both to the Level 1 and the Level 2, the entire valid torque range stays in minus ( $|\text{Level 1}| < |\text{Level 2}|$ , e.g. Level 1=-10 and Level 2=-100).
- Use for applications such as winding control where starting torque is required (right figure).
- In this setting, a torque more than the starting torque is generated. The motor **may accelerate up to the hazard protective level (overspeed: OS, 120% of the maximum speed)** when the load is light. To avoid this situation, use the **Speed limiter** (function code: F76) as well.



**CAUTION**

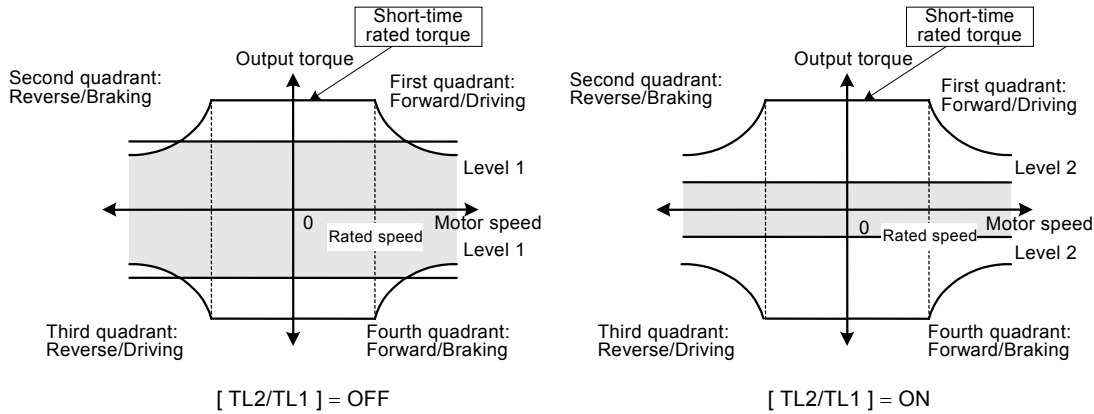
- If you set the Level 2 larger than Level 1, the output torque will be fixed to the Level 1. Unless you want this operation, never use this setting. A motor may become out of control and dangerous. **Accidents or physical injuries may occur.**

# 4. Control and Operation

## (2)-4. Switching between Level 1 and Level 2 for all four quadrants simultaneously

Code	Set value	Description
F40	1	Torque limiter enabled
F41	3	Switching between Level 1 and Level 2 for all four quadrants simultaneously

- When you turn on with assigning the torque limiter (Level 1, Level 2 selection) [TL2/TL1] signal to a digital input signal, you can switch between the Level 1 and the Level 2.



- The short-time rated torque limits the torque where the Level 1 or the Level 2 exceeds the short-time rated torque.
- Though you can specify the Level 1 and the Level 2 both in plus and minus values, you do not have to use a minus value, since it is interpreted as a plus value.

## (3) Power limiter enabled

### (3)-1. Level 1 for all four quadrants

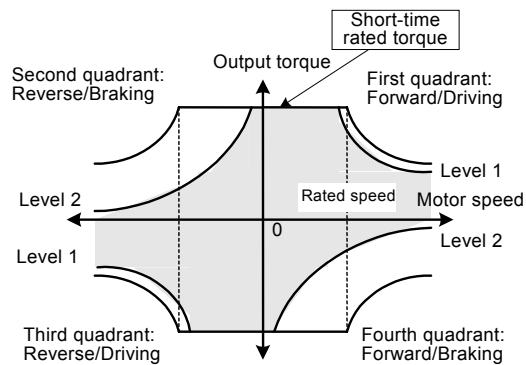
Code	Set value	Description
F40	2	Power limiter enabled
F41	0	Level 1 for all four quadrants simultaneously

- Though this setting is possible, there is no such an application.

### (3)-2. Driving (Level 1), braking (Level 2)

Code	Set value	Description
F40	2	Power limiter enabled
F41	1	Driving (Level 1), Braking (Level 2)

- The short-time rated torque limits the torque where the Level 1 or the Level 2 exceeds the short-time rated torque as in the right figure.
- Though you can specify the Level 1 and the Level 2 both in plus and minus values, you do not have to use a minus value, since it is interpreted as a plus value.
- If you set the Level 1 as the short-time rated torque for driving and set a capacity corresponding to the inverter loss for braking, you can use the inverter loss to enable the shortest stop without an external braking resistor.
- Use this setting for an application such as applying brake with the capacity of a braking resistor.



(3)-3.Upper limit (Level 1), lower limit (Level 2)

Code	Set value	Description
F40	2	Power limiter enabled
F41	2	Upper limit (Level 1), Lower limit (Level 2)

- Though this setting is possible, there is no such an application.

(3)-4.Switching between Level 1 and Level 2 for all four quadrants simultaneously

Code	Set value	Description
F40	2	Power limiter enabled
F41	3	Switching between Level 1 and Level 2 for all four quadrants simultaneously

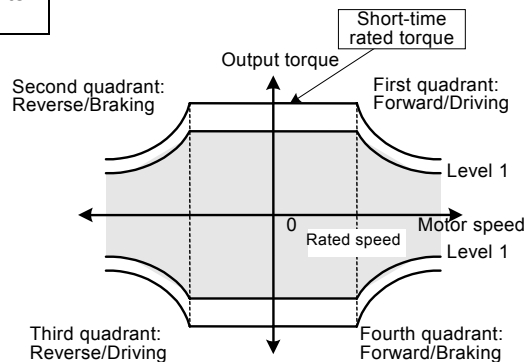
- Though this setting is possible, there is no such an application.

(4) Torque current limiter enabled

(4)-1.Level 1 for all four quadrants

Code	Set value	Description
F40	3	Torque current limiter enabled
F41	0	Level 1 for all four quadrants simultaneously

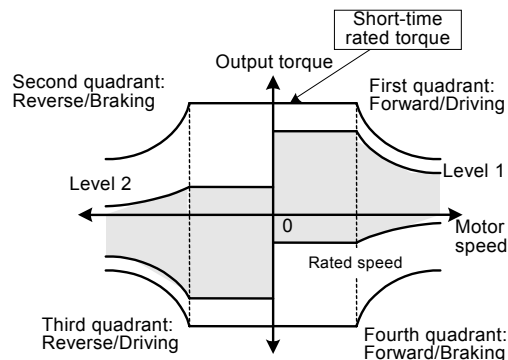
- Unless you set the Level 1 over the short-time rated torque, the short-time rated torque does not limit the torque.
- When protective actions (inverter overload or motor overload) occur frequently, you can lower the setting level to avoid this phenomenon.
- Though you can specify the Level 1 both in plus and minus values, you do not have to use a minus value, since it is interpreted as a plus value.



(4)-2.Driving (Level 1), braking (Level 2)

Code	Set value	Description
F40	3	Torque current limiter enabled
F41	1	Driving (Level 1), Braking (Level 2)

- Unless you set the Level 1 and Level 2 over the short-time rated torque, the short-time rated torque does not limit the torque.
- Though you can specify the Level 1 and the Level 2 both in plus and minus values, you do not have to use a minus value, since it is interpreted as a plus value.
- You can use this specification to set the Level 1 as the short-time rated torque for driving and to set the Level 2 as the braking torque limiter due to the brake capacity for braking.
- You cannot use the digital input [TL2/TL1] to switch between the Level 1 and the Level 2.



# 4. Control and Operation

(4)-3.Upper limit (Level 1), lower limit (Level 2)

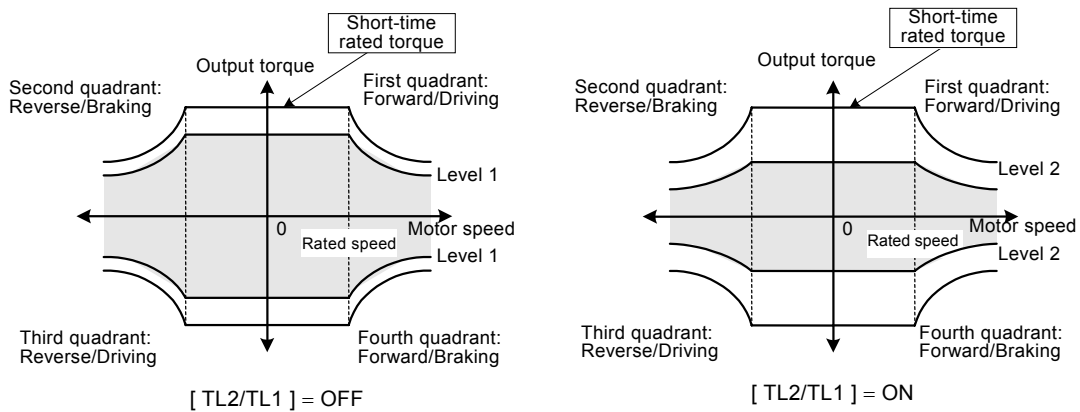
Code	Set value	Description
F40	3	Torque current limiter enabled
F41	2	Upper limit (Level 1), Lower limit (Level 2)

- Though this setting is possible, there is no such an application.

(4)-4.Switching between Level 1 and Level 2 for all four quadrants simultaneously

Code	Set value	Description
F40	3	Torque current limiter enabled
F41	3	Switching between Level 1 and Level 2 for all four quadrants simultaneously

- When you turn on with assigning the torque limiter (Level 1, Level 2 selection) [TL2/TL1] to a digital input signal, you can switch between the Level 1 and the Level 2.



- Unless you set the Level 1 and Level 2 over the short-time rated torque, the short-time rated torque does not limit the torque.
- When protective actions (inverter overload or motor overload) occur frequently, you can lower the setting level to avoid this phenomenon. Though you can specify the Level 1 and Level 2 with both in plus and minus values, you do not have to use a minus value, since it is interpreted as a plus value.

**F42 Torque limiter value selection (Level 1)****F43 Torque limiter value selection (Level 2)**

- ◆ Selects a mean that sets the torque limiter. These means are the function code, the analog input, the digital input card (DIA, DIB), the link (RS485, T-Link, SX, field bus) and the PID output (PIDOUT)
- ◆ When this function is activated (the torque limiter takes effect), the acceleration and the deceleration become longer than the set values.

F	4	2	T	-	L	I	M	-	L	V	L	1
F	4	3	T	-	L	I	M	-	L	V	L	2

**- Level 1**

Selects a mean that sets the Level 1

Set value: 0: Function code F44

1: Ai [TL-REF1]

2: DIA card

3: DIB card

4: Link enabled

5: PID output

**- Level 2**

Selects a mean that sets the Level 2

Set value: 0: Function code F45

1: Ai [TL-REF2]

2: DIA card

3: DIB card

4: Link enabled

5: PID output

**<Setting example>****(1) Preparation**

- Set 1, 2, or 3 to the function code F40 to enable the limiter.
- Use the function code F41 to set how to use the limiter Level 1 and Level 2.
- Use the function code F42 and F43 to assign inputs to the Level 1 and Level 2. If you want to set only the Level 1, use F42 only. Go to one of the steps from the following (2) to (6) according to the setting thus far.

**(2) When you use the function code**

- Set 0 to both of the function code F42 and F43.
- Set a data for the Level 1 to F44 and that for the Level 2 to F45.

**(3) When you use the analog input**

- Set 1 to both of the function code F42 and F43.
- Use E49 to E52 to select which analog input terminals among Ai1 to 4 (Ai3 and Ai4 are optional AIO) are used. Here we assume that Ai1 and Ai2 are assigned to the Level 1 and the Level 2 respectively.
- Connect the wires to the Ai1 and Ai2. An input of 10V corresponds to 150% (torque, power and torque current).
- See the "I/O check" screen of the KEYPAD panel to check if the inverter correctly recognizes the input while you are varying the voltage input from 0 to  $\pm 10V$ .
- See the description of the function codes E53 to E68 for voltage input setting (gain, bias, filter, and increment/decrement limiter).

**(4) When you use the DIA or the DIB card**

- Set the hardware switch on the digital input card either to DIA or DIB.
- Set the function code F42 and F43 to 2 or 3 to use the DIA or the DIB respectively.
- You can assign the DIA (F42=2) to the Level 1 and the DIB (F43=3) to the Level 2 when you use two digital input cards and set one to DIA and the other to DIB.
- Connect the wires for the DIA and DIB cards. See the DI option section or the instruction manual supplied with the product for more details.
- See the "I/O check" screen of the KEYPAD panel to check if the inverter correctly recognizes the digital input.

# 4. Control and Operation

## (5) When you use the link

- Set the function codes F42 and F42 to 4.
- Determine which link to be used. Refer the individual sections of the function description to study the detail of the links (RS485, T-Link, SX, field bus).
- Set 1 or 3 to the function code H30 to enable the command data through the link. Note that setting 3 disables the operation through the terminal block and the KEYPAD panel.
- Write data from a master device (such as PC or PLC) to S10 (Limiter level 1) and S11 (Limiter level 2). The writing is complete when the normal response is sent back. You cannot confirm the writing on the inverter side. Since writing to S area (command data) is performed on the RAM (volatile memory) and written data disappear when your turn the inverter off, you should write necessary data every time when you turns on the inverter.

## (6) When you use the PID output

- Set 5 to the function code F42. Also set 5 to F43 to assign the PID output. Usually set the PID output to the upper limit and use the function code to set the lower limit.
- See the PID control block diagram (4.2.9) or the PID description section to wire the system.
- You can display the PID output on the LED monitor of the KEYPAD panel.

**F44** Torque limiter value (Level 1)

**F45** Torque limiter value (Level 2)

◆ Sets the torque limiter values (Level 1 and Level 2)

F	4	4	T	-	L	I	M	-	S	E	T	1
F	4	5	T	-	L	I	M	-	S	E	T	2

Setting range: -300 to 300 [%]

**F46** Mechanical loss compensation value

◆ Use to compensate the amount of the mechanical loss of a load.

F	4	6	T	-	M	E	C	-	L	O	S
---	---	---	---	---	---	---	---	---	---	---	---

Setting range: -300.00 to 300.00 [%]

**F47** Torque bias 1

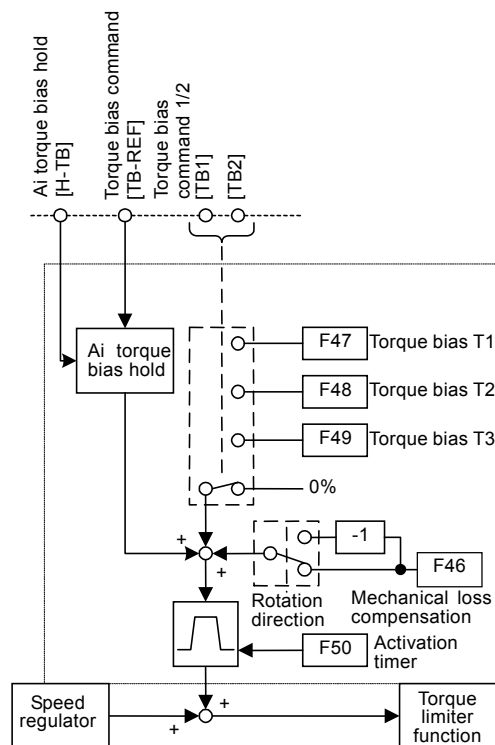
**F48** Torque bias 2

**F49** Torque bias 3

◆ You can add these setting values to the torque command values. The addition is conducted on a stage before the torque limiter. You can use the function selection Di, the torque bias command 1 [TB1] and the torque bias command 2 [TB2] to switch among three torque biases (T1, T2, T3).

F	4	7	T	-	B	I	A	S	1
F	4	8	T	-	B	I	A	S	2
F	4	9	T	-	B	I	A	S	3

Setting range: -300.00 to 300.00 [%]



**F50****Torque bias activation time**

- ◆ Sets the time to increase the torque by 300%.
- ◆ If there is a shock at the start of operation with a torque bias added, adjust this timer.

**F 5 0 T - B I A S - T I M**

Setting range: 0.00 to 1.00 [s]

**F51****Torque command monitor  
(Polarity selection)**

- ◆ Sets the polarity for data display related to torque. (AO monitor, KEYPAD panel LED monitor, KEYPAD panel LCD monitor)

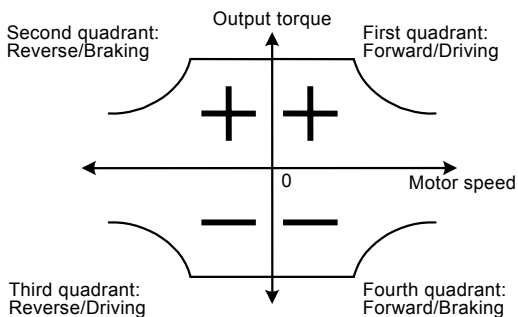
**F 5 1 T - R E F - M N T R**

Set value: 0: Torque polarity

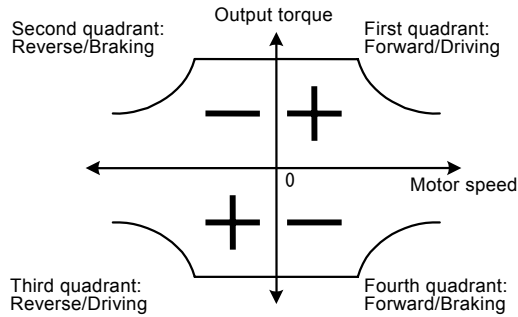
1: + for driving, – for braking

- ◆ The following table shows data related with torque. These values are displayed or transmitted with sign. Judge the meaning of signs from the F51 set value.

Display and output	Setting	Related data
KEYPAD panel LED monitor	3	Torque current command value
	4	Torque command value
	5	Calculated torque value
KEYPAD panel LCD monitor	Operation status monitor	Torque command value
	Alarm information	Torque command value on alarm
Analog output (AO1, 2, 3)	6	Torque current command value (torque ammeter, two-way deflection)
	8	Torque command value (torque meter, two-way deflection)
Function code M (monitor codes)	M02	Torque command value
	M03	Torque current command value
	M07	Calculated torque value
	M08	Calculated torque current value
	M28	Torque command value on alarm
	M29	Torque current command value on alarm
	M33	Calculated torque value on alarm
	M34	Calculated torque current value on alarm



F51=0: Torque polarity



F51=1: + for driving, – for braking



## 4. Control and Operation

**F52** **Display coefficient A**

**F53** **Display coefficient B**

- ◆ Use these coefficients as conversion coefficient to determine the display values (process amount) of the load speed/line speed, the reference/feedback value of the PID regulator on the KEYPAD panel LED.

Setting range: Display coefficient A: -999.00 to +999.00

Display coefficient B: -999.00 to +999.00

- ◆ Load speed, line speed

Use the Display coefficient A of F52

Displayed value = Motor speed × (0.01 to 200.00)

The effective display range is 0.01 to 200.00 while the setting range is ±999.00. The minimum value 0.01 or the maximum value 200.00 replaces a value out of the display range.

For example, you should specify as F52=0.02 when the motor speed is 1500[r/min] and the line speed is 30[m/min].

- ◆ Reference and feedback values for the PID regulator

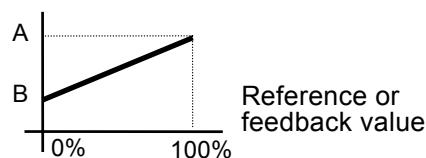
Use F52 Display coefficient A to set the maximum value for display data and use F53 Display coefficient B to set the minimum value for display data.

Displayed value = (Reference or feedback value)

× (Display coefficient A - B) + B

F	5	2	C	O	E	F	A				
F	5	3	C	O	E	F	B				

Displayed value



**F54** **Display filter**

- ◆ You do not have to display an instant value for some continuously changing data on the LED monitor of the KEYPAD panel. You can apply a filter for those data to prevent the flicker due to the change of the value.

- ◆ Specify the time constant of the primary filter.

F	5	4	D	I	S	P	L	A	Y	F	L
---	---	---	---	---	---	---	---	---	---	---	---

Setting range: 0.0 to 5.0 [s]

**F55****LED monitor (Display selection)**

- ◆ The LED monitor of the KEYPAD panel displays different data at operation, stopping, speed setting and PID setting.

**F 5 5** L E D M N T R

Set value	Function	Unit	Description
0	Detected speed value 1	[r/min]	Change display with F56 when motor is stopping
1	Speed command value 4	[r/min]	Speed command 4 of ASR input
2	Output frequency	[Hz]	Slip included
3	Torque current command value	[%]	
4	Torque command value	[%]	
5	Torque calculation value	[%]	
6	Input power	[kW, HP]	Use F60 to change unit
7	Output current	[A]	
8	Output voltage	[V]	
9	DC link circuit voltage	[V]	
10	Magnetic-flux command value	[%]	
11	Magnetic-flux calculation value	[%]	
12	Motor temperature	[°C]	Displays --- when NTC thermistor is not installed
13	Load shaft speed	[r/min]	Use F56 to change display when motor is stopping
14	Line speed	[m/min]	
15	Ai adjusted value (I2)	[%]	
16	Ai adjusted value (Ai1)	[%]	
17	Ai adjusted value (Ai2)	[%]	
18	Ai adjusted value (Ai3)	[%]	Displayed when an option is used
19	Ai adjusted value (Ai4)	[%]	Displayed when an option is used
20	PID command value	[%]	Displayed in the PID mode
21	PID feedback value	[%]	
22	PID output value	[%]	
23	Option monitor 1	[HEX]	Displayed with option
24	Option monitor 2	[HEX]	
25	Option monitor 3	[DEC]	Displayed with option. Positive data.
26	Option monitor 4	[DEC]	
27	Option monitor 5	[DEC]	Displayed with option. Positive and negative data.
28	Option monitor 6	[DEC]	

- Set values 20 to 22 are displayed when you set H20 "PID control setting" (action selection) to 1 (forward operation) or 2 (reverse operation).
- Set value 18, 19, 23 to 28 are displayed when you install specific control options. See the option section for more details.

**F56****LED monitor (Display at stopping state)**

- ◆ You can switch the detected data display for F55 to the command value display when a motor stops (no output from the inverter, STOP state).

**F 5 6** L E D M N T R 2

Set value: 0: Command value display

1: Actual value display (detected value)

- ◆ Corresponding data are F55=0 (Detected speed value), 13 (Load shaft speed), and 14 (Line speed).

# 4. Control and Operation

## F57 LCD monitor (Display selection)

◆ Selects the contents of the KEYPAD panel LCD monitor in the operation mode.

**F 5 7 L C D M N T R**

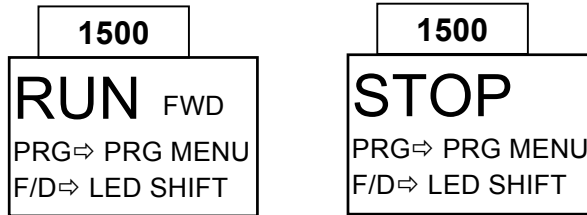
Set value: 0: Operation state, rotation direction, operation guide

1: Bar graphs for motor speed, output current, torque command values.

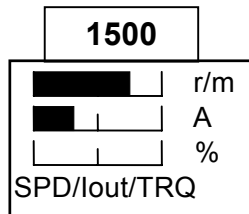
Set value: 0

In operation

In stopping



Set value: 1



Full scale values for bar graphs

Display item	Full scale value
Motor speed	Maximum speed (Code F03, A06, and A40)
Output current	Inverter rating × 200%
Torque command value	Rated torque × 200%

Note: The scale is not adjustable.

## F58 LCD monitor (Language selection)

◆ Selects a language displayed on the KEYPAD LCD monitor.

**F 5 8 L A N G U A G E**

Set value	Displayed language	Set value	Displayed language
0	Japanese	4	Spanish
1	English	5	Italian
2	German	6	Chinese
3	French	7	Korean

Note 1: The language used in this manual is English.

Note 2: The L code is displayed in the Japanese, English or Chinese language mode, the P, A and O codes are displayed in the Japanese or English language mode only, and the U code is displayed in the English language mode only.

Note 3: The Korean language is displayed for 0040 or later keypad panel version and 0060 or later main body version.

## F59 LCD monitor (Contrast adjusting)

◆ Adjusts the contrast of the KEYPAD LCD monitor. Increase the set value to adjust the contrast to high and to decrease the set value to adjust the contrast to low.

**F 5 9 C O N T R A S T**

Set value	0, 1, 2, ... 8, 9, 10
Display	Low High

**F60****Output unit (HP/kW) selection**

- ◆ Switches the display unit of the inverter output (input power) and the selection list (kW-HP) of P02 "Motor selection (M1, 2, 3)".

F	6	0	k	W	/	H	P				
---	---	---	---	---	---	---	---	--	--	--	--

Set value: 0: Display in kW  
1: Display in HP

**F61****ASR1-P (Gain)****F62****ASR1-I (Constant of integration)**

- ◆ Sets the P and I constants of the ASR1.

F	6	1	A	S	R	1	-	P			
F	6	2	A	S	R	1	-	I			

Setting range: F61: 0.1 to 200.0 [times]  
F62: 0.010 to 1.000 [s]

**- P gain**

Adjust according to the mechanical inertia (inertia and mechanical constant) connected to the motor shaft. The factory set value of 10.0 corresponds to the inertia of a single VG standard motor. The following table provides a guideline for setting. If you drive a machine whose inertia is larger than that of the VG standard motor when converted into a motor shaft inertia, set a value larger than 10.0. See Chapter 2 "Specifications" for the inertia data of the standard motors.

Inertia	Single VG standard motor to Medium to Large
P gain	10.0 to Medium to Large

P gain=1.0 is defined such that the torque command is 100% (corresponding to the maximum speed setting) when the speed deviation (speed command–observed speed) is 100%.

**⚠ CAUTION**

- If you set a too large value to gain compared with the inertia, though you can get faster control response, the motor may present an overshoot or a hunting. Also the motor or the machine may generate oscillation due to mechanical resonance or over-amplified noise.
- If you set a too small value to gain compared with the inertia, the control response slows down and it may take time to settle down the speed fluctuation at low speed.

**- Constant of integration**

Sets the constant of integration of the Automatic Speed Regulator (ASR). You can specify a value in the range from 0.010 to 0.999s to set the speed deviation (speed command–observed speed) at steady state to zero. Setting 1.000s disables the integration (P control only). The integration means to sum the deviation at a specified interval. A smaller interval means a smaller summation interval that presents faster response. On the other hand, larger interval extends summation interval to reduce the effect on the ASR. Set a small value to reach the speed reference faster while allowing overshoots.

**⚠ CAUTION**

- Integrating action is a delay element. The constant of integration corresponds to the gain of a delay element. If you increase the response of the integration action, the delay element becomes larger to destabilize the control system including motors and machines. The instability presents overshoots and oscillations. Thus, one measure to restrain the mechanical resonance such as abnormal mechanical noises from motors and gears is to increase the constant of integration.
- However, if you do not want a slower response, the machine side may need measures such as reviewing machines presenting mechanical resonance. You can also use F66 "ASR output filter".

# 4. Control and Operation

**F63**

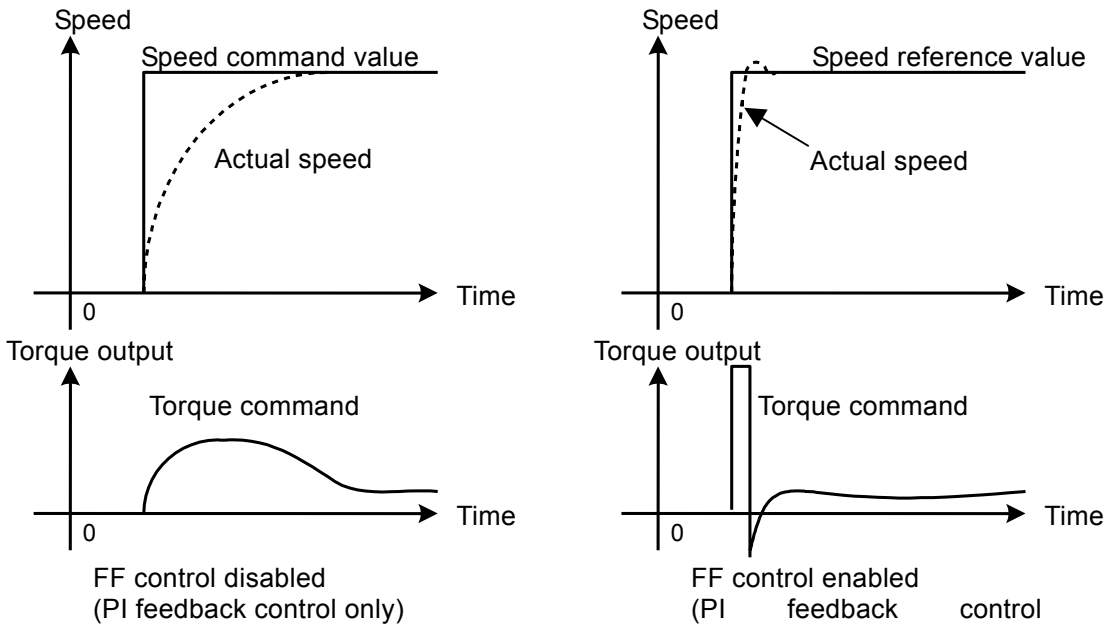
**ASR1-FF (Gain)**

- ◆ Conducts a feedforward control by adding torque determined by the change in the speed command to the torque command directly.
- ◆ The PI control by the ASR is a feedback control adjusting the speed against the command according to its control result (Actual speed). This control can adjust deviations due to what are not measurable such as unexpected disturbances and uncertain characteristics of control subjects. However, known changes in command value are followed after they appear in the deviation (Speed command - Actual speed). Since you can obtain a control value (torque command) for a known factor, you can expect a faster control by adding it to the torque command directly. This function is provided for this purpose.

**F 6 3 A S R 1 - F F**

Setting range: 0.000 to 9.999 [s]

- ◆ It is effective when the inertia is known. The differences in follow-up speed against the command value between the feedforward and non-feedforward controls are conspicuous as shown in the figures below. Note that it is necessary to balance the PI constants of the feedback control and this setting to obtain the maximum effect.



Though increasing the P gain of the ASR realizes the effect described above, increased gain also increases response resulting in negative effects (such as mechanical resonance or vibration).

**F64**

**ASR1 input filter**

- ◆ Sets the time constant for the first-order lag filter applied to a speed reference. Usually you should not change this value.
- ◆ Use this filter when you cannot stabilize the analog speed setting voltage at control terminal [12] after you failed to eliminate the causes. If noise is the case, first try measures in hardware such as separating control wiring, grounding, or connecting a capacitor to the terminal [12] and [11] in parallel before you use F64 as a software measure.

**F 6 4 A S R 1 - I N**

Setting range: 0.000 to 5.000 [s]

**F65****ASR1 detection filter**

- ◆ Sets the time constant for the first-order lag filter applied to the detected speed. Usually you should not change this value. You do not have to change when you use a pulse generator (PG) for the speed detection. Use an oscilloscope to check the waveform if the output of the PG is unstable.
- ◆ Use this filter when you use the line speed detection [LINE-N] signal for speed detection and the ripple presents on the signal. Note that a large setting will reduce the response of the speed control loop. A too large setting may destabilize the control.

F	6	5	A	S	R	1	-	D	E	T		
---	---	---	---	---	---	---	---	---	---	---	--	--

Setting range: 0.000 to 0.100 [s]

**F66****ASR1 output filter**

- ◆ Sets the time constant for the first-order lag filter applied to the torque command. Use this filter for a mechanical resonance after you failed to adjust the ASR gain or the constant of integration to eliminate it.

F	6	6	A	S	R	1	-	O	U	T		
---	---	---	---	---	---	---	---	---	---	---	--	--

Setting range: 0.000 to 0.100 [s]

- ◆ Check the cause and the oscillation frequency of a mechanical resonance such as a vibration by gear backlash or a rope vibration in a vertical transfer. You should take measures in the inverter side after you failed to investigate and fix machine devices to eliminate the resonance.

## (1) Measures to eliminate mechanical resonance

## 1) Reduce response speed

- Reduce the ASR P gain to reduce the amplitude of the resonance.
- Increase the ASR I constant to shift the resonance point to lower frequency to restrain the high frequency resonance.

## 2) Use ASR output filter

- Though you can reduce the resonance amplitude, excessive filter elements may cause instability.

## 3) Use oscillation suppressing observer

- See H46 "Observer type selection" for more details.

**F67****S-curve acceleration start side 1****F68****S-curve acceleration end side 1****F69****S-curve deceleration start side 1****F70****S-curve deceleration end side 1**

- ◆ Arranges the speed reference value to form a curve at the start and the end of acceleration and deceleration. You can realize smooth acceleration and deceleration actions without shocks.

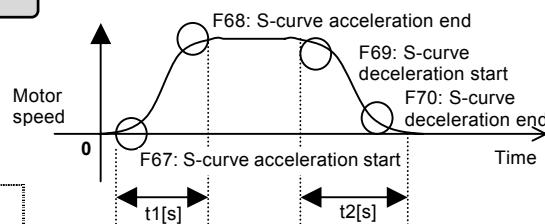
F	6	7	S	-	A	C	C	-	S	T	1	
F	6	8	S	-	A	C	C	-	A	R	1	
F	6	9	S	-	D	E	C	-	S	T	1	
F	7	0	S	-	D	E	C	-	A	R	1	

Setting range: 0 to 50 [%]

- ◆ Setting the S-curve will extend F07 "Acceleration time 1" and F08 "Deceleration time 1" as described below.

$$t1(s) = \text{Acceleration time [s]} \times \left( 1 + \frac{\text{S-curve acceleration start side [%]}}{100 [\%]} + \frac{\text{S-curve acceleration end side [%]}}{100 [\%]} \right) [s]$$

$$t2(s) = \text{Deceleration time [s]} \times \left( 1 + \frac{\text{S-curve deceleration start side [%]}}{100 [\%]} + \frac{\text{S-curve deceleration end side [%]}}{100 [\%]} \right) [s]$$



# 4. Control and Operation

## F73 Magnetic-flux level at light load

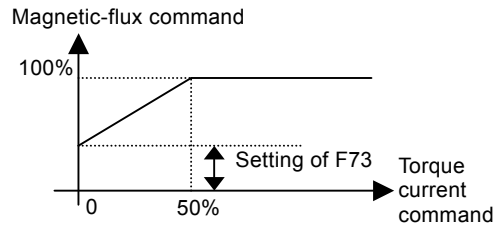
- You can specify a small value to reduce the electromagnetic noise of a motor at light load. The magnetic-flux command decreases according to the torque current command to reduce the electromagnetic noise.

**F 7 3 M I N - F L U X**

Setting range: 10 to 100 [%]

Note: The function is valid only under PG vector control, sensorless vector control.

- You can view the level [%] of the magnetic-flux command on the "Operation monitor" of the KEYPAD panel. See "FLX\*" (magnetic-flux command) on the operation monitor screen "Operation monitor". The value is usually 100% and decreased in the low output range. This function reduces the magnetic-flux according to the setting as shown in the graph. The graph shows that the magnetic-flux decreases to 60%.
- In case of sensorless vector control, the 100% setting is recommended.
- The internal process sets a lower limit at 25% under sensorless vector control.



**1500**  
 TMP = 30°C  
 Iout = 14.3A  
 Vout = 188V  
 FLX\* = 60%

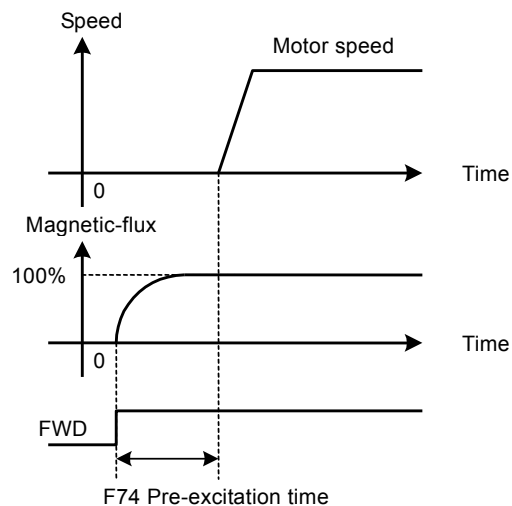
## F74 Pre-excitation time

- When you set ON to the operation command (FWD, REV), the inverter conducts pre-exciting automatically for the time specified by this function code. This function applies only the exciting current to a motor to increase the response of the motor start.

**F 7 4 P R E E X t**

Setting range: 0.0 to 10.0 [s]

- Set the pre-excitation time to start a motor after the magnetic-flux is established 100% as shown in the graph.
- Note: The motor may turn during pre-excitation. To use pre-excitation, use a mechanical brake at the same time.



**1500**  
FWD BRK IL  
REV NUV ACC  
EXT TL DEC  
INT VL ALM

- You can use the "Operation status" of the "I/O check" screen of the KEYPAD panel to confirm whether a motor is in normal operation or in pre-exciting. EXT indicates pre-exciting and EXT indicates normal operation. You can also read out the function code M14 "Operation status" through the link to confirm the status.

**F75****Pre-excitation initial level**

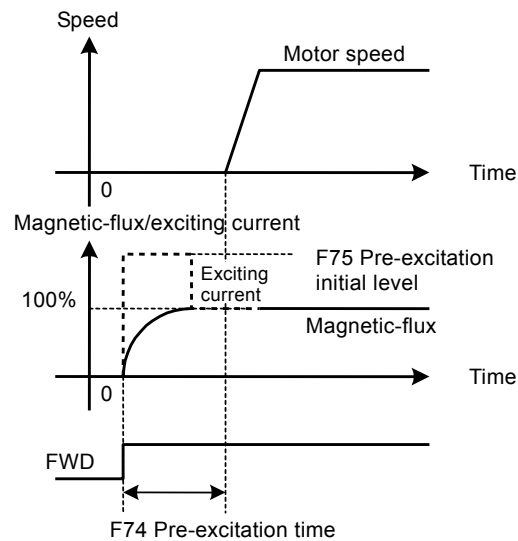
◆ Sets the initial level of the pre-excitation.

**F 7 5 F L U X F O R C E**

Set value: 100 to 400 [%]

◆ When you want to reduce the pre-excitation time (function code F74) to establish the magnetic-flux quickly, set the exciting current high.

◆ The transient response to the exciting current command until the magnetic-flux is established 100% depends on the secondary time constant of a motor (exciting inductance/resistor). This function applies more than 100% of the exciting current to establish the magnetic-flux faster. The initial level ends when the magnetic-flux is established 100%, and the exciting current returns 100%.

**F76****Speed limiter (method selection)****F77****Speed limiter level 1****F78****Speed limiter level 2**

◆ The speed control and the torque control (torque control, torque current control) differs in the usage of these function codes.

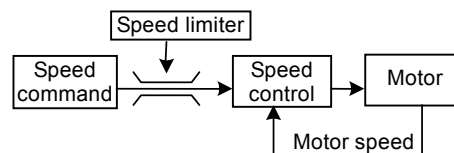
**Usage for speed control**

Since the inverter usually (factory setting) controls speed (internal ASR enabled, motor controlled by speed command), and the speed limiter is applied to the speed command (See "(1) Speed control")

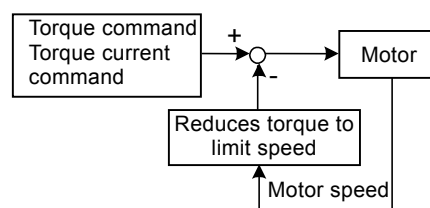
You can use the function code H41 "Torque command selection" and H42 "Torque current command selection" to select a specification other than the "internal ASR enabled" to operate the inverter to control the torque. This is the case, the speed control is applied to the motor speed (speed detection/speed estimation). Since the inverter does not control the speed, the control adds negative torque bias to the torque command when the motor accelerates beyond the limiter value. You can use the [I2] input as a bias for the speed limiter instead of the speed command (see "(2) Torque control").

◆ You can set ON to the digital input signal [N-LIM] to disable (cancel) the speed limiter function.

(1) For speed control



(2) For torque control





# 4. Control and Operation

## 1) Speed control

You can set the speed limit to the speed command value.

**F 7 6 N - L I M - M O D E**

- Method selection

Set value: 0: Forward (Level 1) and reverse (Level 2) are limited individually.

1: Level 1 limits forward and reverse.

2: Upper limit by the Level 1 and the lower limit by the Level 2.

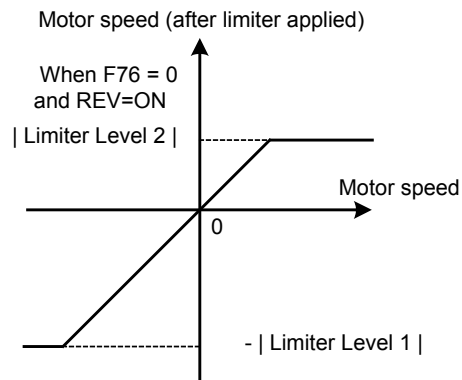
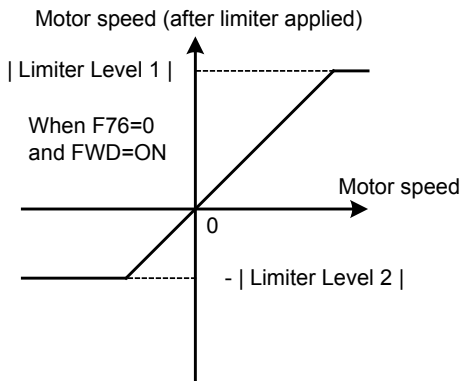
3: Disabled (If set, replaced by 0).

**F 7 7 N - L I M - L V L 1**  
**F 7 8 N - L I M - L V L 2**

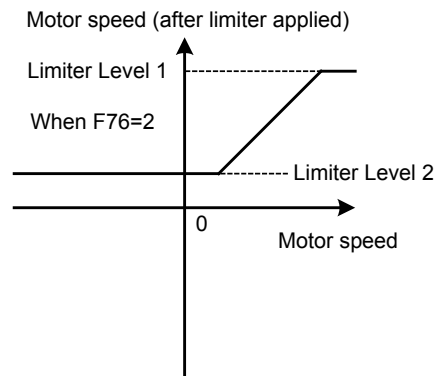
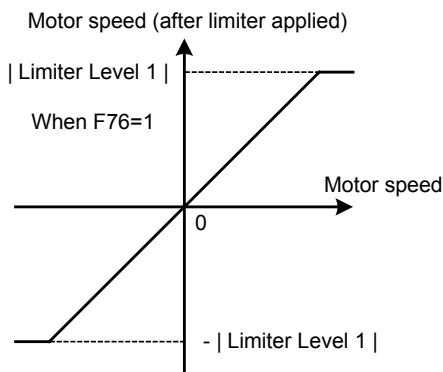
- Level 1, 2

Setting range: -110.0 to 110.0 [%]

- If F76 is set at “0,” the upper and lower limit levels during FWD operation and the upper and lower limit levels alter between levels 1 and 2.



- The pattern with “1” or “2” set at F76 is shown in the figure below.



### **CAUTION**

- Specify such that the imiter Level 1 > the limiter Level 2 for F76=2 (Upper limit by the Level 1 and the lower limit by the Level 2). If you specify as the limiter Level 1 < the limiter Level 2, the speed reference is fixed to the limiter Level 2. In this state, turning off the operation does reduce the speed reference and the operation continues.

**You may be injured.**

<Example of a setting inhibiting reverse rotation>

When you want to inhibit reverse rotation (forward rotation directed by reverse rotation command) while forward rotation command is directed, specify as F76=0, the limiter level 1=100.0% and the limiter level 2=0,0%.

2) Torque control (torque command, torque current command)

**F 7 6 N - L I M - M O D E**

- Method selection

Set value: 0: Forward and reverse are limited individually. FWD and REV switch the levels.

1: Level 1 limits forward and reverse.

2: Invalid (Even if specified, the setting is assumed to be "0.")

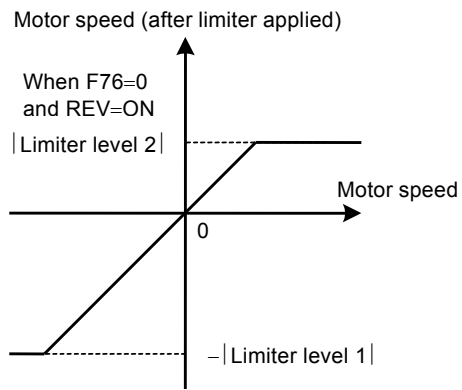
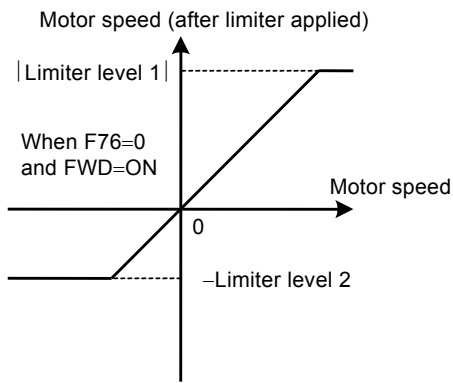
3: Individual limiters for forward and reverse rotation. [12] input is added as a variable part of limiters.

**F 7 7 N - L I M - L V L 1**  
**F 7 8 N - L I M - L V L 2**

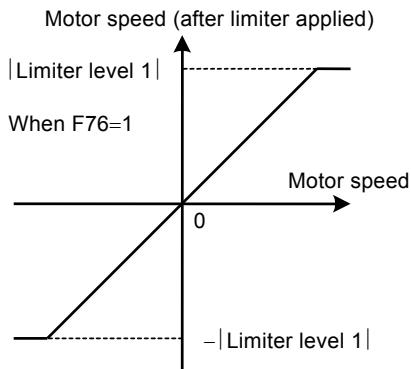
- Level 1, 2

Setting range: -110.0 to 110.0 [%]

- When F76=0 is specified, the upper and lower limit levels for forward operation and those for reverse operation switch between the Level 1 and the Level 2.

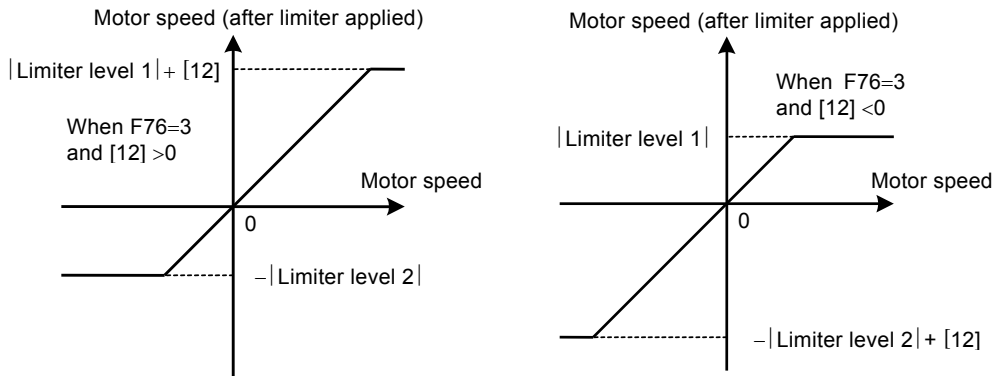


- The pattern with "1" set at F76 is shown in the figure below.



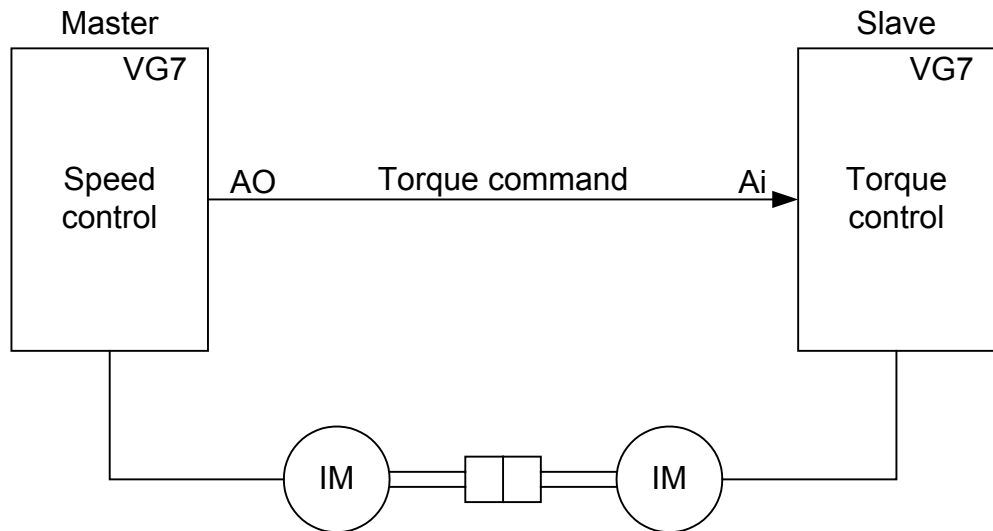
# 4. Control and Operation

- When F76=3 is specified, [12] input acts as a bias as in the following graphs.



Input voltage for [12] is  $\pm 10\text{V}$  at maximum motor speed ( $\pm 100\%$ ).

- ◆ Use C60 (ASR4-P) to adjust the speed stability under speed limit.
- ◆ The torque limit in accordance with the line speed (input at [12]) can be added if F76 is "3."
- ◆ To perform mechanically coupled operation with torque command handover (see the figure below), enter a slightly larger value (+5%) than that specified on the master as a speed limit level for the inverter (slave) driven under torque control.



- ◆ Select a motor to be used from M1, M2, and M3. You should combine this function code and the terminal input to select.

**F 7 9 M 1 - 3 S E L E C T**

Set value: 0: M1 selection. Terminal input has higher priority.

M1 selection, ([MCH2], [MCH3])=(OFF, OFF), or MCH2 and MCH3 have no assigned states.

M2 selection, ([MCH2], [MCH3])=(ON, OFF) (ON, ON)

M3 selection, ([MCH2], [MCH3])=(OFF, ON)

1: M2 selection.

2: M3 selection.

- ◆ Merits and restrictions for selecting M1, M2, or M3

	M1 selection (first motor)	M2 selection (second motor)	M3 selection (second motor)
Control type	Set by code P01 PG vector control Sensorless vector control Synchronous motor control Simulated operation	Set by code A01 PG vector control Sensorless vector control	V/f control only
Restrictions specific to control type	None	None	V/f control restricts many functions. See Chapter 13 function code list for more details.
Motor parameters	Code F03 to F05, F10 to F12, P. When a VG7 dedicated motor is selected (P02), data are set to F04, F05, and P03 to P27 automatically.	Code A02 to A34 Manual setting	Code A35 to A50 Manual setting
Protective functions specific to motor parameters	Code P01 specifies a dedicated motor, P-OTHER specifies write protection.	None	None

- ◆ You can use the "Effective sets of motors/parameters" on the "I/O check" screen of the KEYPAD panel to check the currently selected motor set (M1, M2, M3).

If the motor set 2 is selected, ■M2 is indicated.

**1500**

PARA 1  M1  
 PARA 2  M2  
 PARA 3  M3  
 PARA 4  JOG

- ◆ Answer back signals are put on the DO output [SW-M2] and [SW-M3] to indicate whether the motor switch among motor set (M1, M2, M3) is completed in the inverter.  
See E15 to E27 for more information. We recommend to prepare a sequence to check the DO for the answer back when you use the terminal input signals [MCH2] and [MCH3] to switch motors.
- ◆ It is recommended to activate overcurrent suppression function (H58 = 1) when M3 is selected (V/f control).

# 4. Control and Operation

## F80 Current rating switching

◆ Switches the triple ratings (CT, VT, and HT) of the inverter.

**F 8 0 I r S E L E C T**

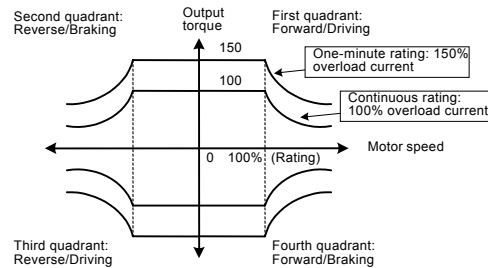
- Set value: 0: CT (Constant Torque, overload current 150%)
  - 1: VT (Variable Torque, overload current 110%)
  - 2: HT (High Torque, overload torque 200%/170%)

◆ Overload current means to apply overload limiter by torque current (corresponding armature current of a DC motor), and the torque decreases in proportion to the decrease of the magnetic-flux above the rated speed (100%).

- Torque characteristics for CT use

### Application

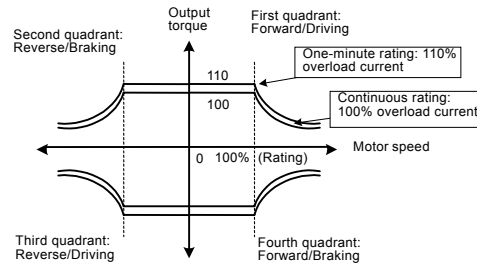
Use for general constant torque applications including speed control with torque limit for winding machines, wire drawing machines, and test machines and control by direct torque command.



- Torque characteristics for VT use

### Application

Use for applications that do not require overload capability for a short period such as extruding machines and centrifugal separators. Also suitable for applications where the operation cycle is short and torque is limited to 100% or less since the root-mean-square current exceeds the rated current of an inverter (Large press machines).



You can choose an inverter by one class smaller grade compared with CT and HT uses.

Suitable for general variable torque lead application.

Note that the maximum carrier frequency is smaller than the CT and HT uses. See Section 2.1 "Standard Specifications" for more details.

- HT use

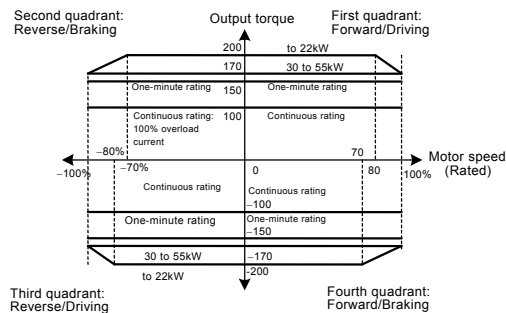
### Application

Use for vertical transfer applications (elevators, multi-storied parking facilities) that require about 200%/170% of torque for a short period (ten seconds or less).

### Restrictions

10s rating is 200% up to 80% of the rated speed and is reduced to 170% over 80% of the rated speed for 22kW or less.

10s rating is 170% for 30 to 50kW (200/400V).



Motor operation exceeding the rated speed.

The motor torque reduces in inverse proportion to the motor speed as in the case of CT or VT use. Though HT use is suitably applied to the motor operation in the constant torque range, it is also applicable in the operation in the constant output range.

## 4.3.2 E Codes (Extension Terminal Functions)

**E01-E13**

**X function selection**

- ◆ You can assign arbitrary functions to individual digital input terminals [X1-X14] ([X11-X14] are effective only when optional OPC-VG7-DIOA is installed).
- ◆ Use after you review the 4.2 "Control Block Diagrams" to check the selection of control terminals.
- ◆ The valid and invalid functions vary according to the control method (vector control, sensorless vector control, V/f control and synchronous motor drive). For details, refer to the function code list in Section 13.

**E 0 1 X 1 F U N C**

to

**E 1 3 X 1 4 F U N C**

Setting range: 0 to 63

Set value	Function	Symbol	Set value	Function	Symbol
0, 1, 2, 3	Multistep speed selection	[SS1, 2, 4,8]	31	H41 [torque command] cancel	[H41-CCL]
4, 5	ASR, ACC/DEC time selection (4 steps)	[RT1, RT2]	32	H42 [torque current command] cancel	[H42-CCL]
6	3-wire operation stop command	[HLD]	33	H43 [magnetic-flux command selection] cancel	[H43-CCL]
7	Coast-to-stop command	[BX]	34	F40 [torque limiter mode 1] cancel	[F40-CCL]
8	Alarm reset	[RST]	35	Torque limiter (level1, level2 selection)	[TL2/TL1]
9	Trip command	[THR]	36	Bypass	[BPS]
10	Jogging operation	[JOG]	37, 38	Torque bias command 1/2	[TB1, TB2]
11	Speed setting N2/speed setting N1	[N2/N1]	39	Droop selection	[DROOP]
12	Motor M2 selection	[M-CH2]	40	Ai1 zero hold	[ZH-AI1]
13	Motor M3 selection	[M-CH3]	41	Ai2 zero hold	[ZH-AI2]
14	DC brake command	[DCBRK]	42	Ai3 zero hold (AIO optional function)	[ZH-AI3]
15	ACC/DEC cleared to zero	[CLR]	43	Ai4 zero hold (AIO optional function)	[ZH-AI4]
16	Creep speed switching in UP/DOWN setting	[CRP-N2/N1]	44	Ai1 polarity change	[REV-AI1]
17	UP command in UP/DOWN setting	[UP]	45	Ai2 polarity change	[REV-AI2]
18	DOWN command in UP/DOWN setting	[DOWN]	46	Ai3 polarity change (AIO optional function)	[REV-AI3]
19	Write enable for KEYPAD (data can be altered)	[WE-KP]	47	Ai4 polarity change (AIO optional function)	[REV-AI4]
20	PID control cancel	[N/PID]	48	PID output inverse changeover	[PID-INV]
21	Inverse mode changeover	[IVS]	49	PG alarm cancel	[PG-CCL]
22	Interlock signal for 52-2	[IL]	50	Undervoltage cancel	[LU-CCL]
23	Write enable through link	[WE-LK]	51	Ai torque bias hold	[H-TB]
24	Operation selection through link	[LE]	52	STOP1 (The motor stops with normal deceleration time)	[STOP1]
25	Universal DI	[U-DI]	53	STOP2 (The motor decelerates and stops with deceleration time 4)	[STOP2]
26	Pick up start mode	[STM]	54	STOP3 (The motor stops with torque limiter)	[STOP3]
27	Synchronization command (PG (PR) optional function)	[SYC]	55	DIA data latch (DIA optional function)	[DIA]
28	Zero speed locking command	[LOCK]	56	DIB data latch (DIB optional function)	[DIB]
29	Pre-exciting command	[EXITE]	57	Multiwinding motor control cancel (SI (MWS) optional function)	[MT-CCL]
30	Speed command limiter cancel	[N-LIM]	58-63	Option Di 1/2/3/4/5/6	[O-DI1 to 6]

# 4. Control and Operation

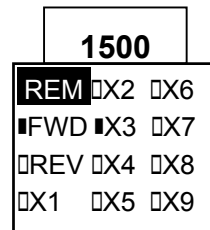
## <Using terminal input>

There are 64 types of terminal input functions available. You cannot use all of them simultaneously. You can use total of thirteen terminals, which are nine terminals from X1 to X9 as standard and four terminals from X11 to X14 using option of DIOA. You can also access these thirteen terminals through the link function (RS485, T-Link, SX, and field bus).

Note that the alarm reset [RST] and trip command [THR] are included into general X function assignment, though they used to have dedicated terminals.

### Setting procedure

- Select a function you want to use. We select the "Coast-to-stop" command as an example.
- Assign the "Coast-to-stop" command to one of the available terminals (X1 to X9, X11 to X14). If you want to assign it to X3, write a data, "7:BX", to the function code E03 "X3 function selection".
- When you turn on the X3 terminal externally (turn on [BX] ), the coast-to-stop function is activated. When you turn it off, the function is disabled.
- See the "I/O check" screen of the KEYPAD panel to confirm the ON/OFF status of the X3. If you switch the X3 from OFF to ON, X3 changes to X3 on the screen.
- When you access through the link function, you should see another I/O screen **COM**.



## <You can specify as "NO terminal" or "NC terminal">

You can use the function code E14 to specify the state of individual terminals (standard 9 terminals only) as normally open ("NO terminal") or normally closed ("NC terminal"). See the function description of E14 or the description of the trip command [THR] for more information.

## 0, 1, 2, 3. Multistep speed selection [SS1, 2, 4, 8]

You can use external digital input signals to switch predetermined speeds specified by function codes from C05 to C19 "Multistep speed". Assign data 00 to 03 to digital terminals to select a speed by combining those terminal inputs.

Input signal combination to select specified data				Speed to be selected	
3 [SS8]	2 [SS4]	1 [SS2]	0 [SS1]		
OFF	OFF	OFF	ON	C05 Multistep speed 1	Related function codes C05 to C19  Setting range 0 to 24000r/min or 0.00 to 100.00% or 0.0 to 999.9 m/m
OFF	OFF	ON	OFF	C06 Multistep speed 2	
OFF	OFF	ON	ON	C07 Multistep speed 3	
OFF	ON	OFF	OFF	C08 Multistep speed 4	
OFF	ON	OFF	ON	C09 Multistep speed 5	
OFF	ON	ON	OFF	C10 Multistep speed 6	
OFF	ON	ON	ON	C11 Multistep speed 7	
ON	OFF	OFF	OFF	C12 Multistep speed 8	
ON	OFF	OFF	ON	C13 Multistep speed 9	
ON	OFF	ON	OFF	C14 Multistep speed 10	
ON	OFF	ON	ON	C15 Multistep speed 11	
ON	ON	OFF	OFF	C16 Multistep speed 12	
ON	ON	OFF	ON	C17 Multistep speed 13	
ON	ON	ON	OFF	C18 Multistep speed 14/Creep speed 1	
ON	ON	ON	ON	C19 Multistep speed 15/Creep speed 2	

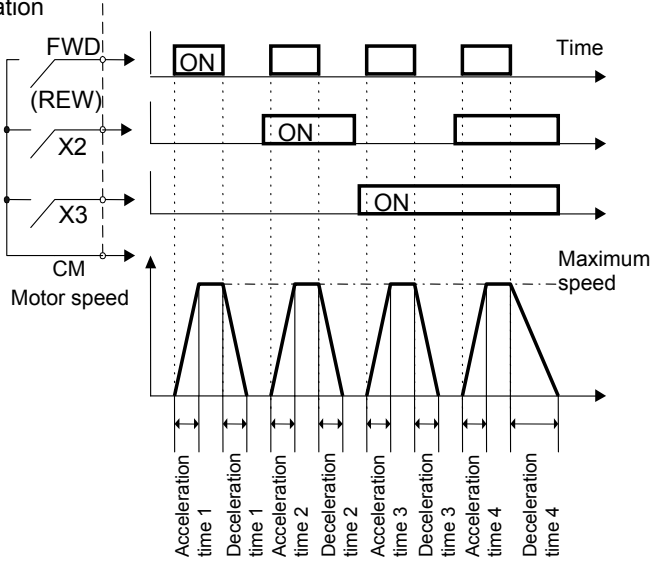
4, 5. ASR, acceleration/deceleration time selection [RT1, RT2]

You can switch predetermined acceleration/deceleration times, ASR constants and S-curve accelerations/decelerations specified by function codes through external digital input signals. Assign data 04 to 05 to digital terminals to select acceleration/deceleration times, ASR constants and S-curve accelerations/decelerations.

Input signal combination to select specified data		Acceleration/deceleration times to be selected	
05 [RT2]	04 [RT1]		
OFF	OFF	F07 Acceleration time 1 F08 Deceleration time 1 F61 to F66 ASR1 constants F67 S-curve (Acc start side) F68 S-curve (Acc end side) F69 S-curve (Dec start side) F70 S-curve (Dec end side)	Related function codes F07, F08, F61 to F70 C40 to C69
OFF	ON	C40 to C45 ASR 2 constants C46 Acceleration time 2 C47 Deceleration time 2 C48 S-curve 2 (Start side) C49 S-curve 2 (End side)	
ON	OFF	C50 to C55 ASR 3 constants C56 Acceleration time 3 C57 Deceleration time 3 C58 S-curve 3 (Start side) C59 S-curve 3 (End side)	
ON	ON	C60 to C65 ASR 4 constants C66 Acceleration time 4 C67 Deceleration time 4 C68 S-curve 4 (Start side) C69 S-curve 4 (End side)	

◆ Example: Four and five are assigned to the terminals [X2] and [X3].

Operation



\* If you switch the acceleration/deceleration times, the ASR constants and S-curve actions are switched simultaneously. You can see which set is currently selected from (1, 2, 3, 4) on the "I/O check" screen of the KEYPAD panel. When the data set 3 is selected, "■ PARA 3" is indicated on the display.

**1500**

□ PARA 1 □ M1

□ PARA 2 ■ M2

■ PARA 3 □ M3

□ PARA 4 □ JOG

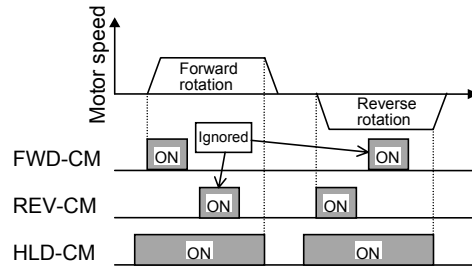


# 4. Control and Operation

## 6. 3-wire operation stop command [HLD]

Use for 3-wire operation. When [HLD]-[CM] is ON, the FWD or the REV signal is self-held, and is canceled when [HLD]-[CM] is OFF.

When you want use this [HLD] function, you should assign a data 06 to a desired digital input terminal.

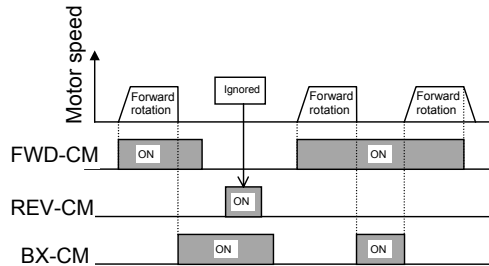


## 7. Coast-to-stop command [BX]

The inverter output is turned off and the motor enters into the coast-to-stop state, when [BX]-[CM] is ON.

The signal does not cause an alarm output. Also, this signal is not self-held.

When you want use this [BX] function, you should assign data a 07 to a desired digital input terminal.



## 8. Alarm reset [RST]

Switching the [RST]-[CM] from OFF to ON cancels the alarm relay output and the alarm display and restart operation while the protective function is active.

When you want use this [RST] function, you should assign a data 08 to a desired digital input terminal.

## 9. Trip command [THR]

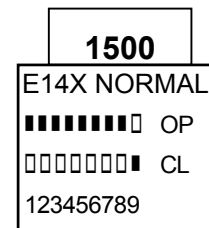
The factory setting for the trip command is an "NO terminal" (normally open).

When you use the trip command as an "NC terminal" (normally closed), follow the procedure described below.

When [THR]-[CM] is ON, the operation is assumed as normal. When [THR]-[CM] is turned OFF, the inverter output is turned off (motor is in the coast-to-stop state) and the alarm "OH2" is issued. You can use the trip command for the overheat protection of an external resistor.

### <Application and notes>

- The [THR] function is assigned to the X9 terminal in the factory setting (function code E09=9, THR). Use the X9 as an external alarm as it is.
- Use the function code E14 "X function normally open/normally closed" to set the X9 terminal to an "NC terminal". To set as an "NC terminal", move the 9th ■ (X9 terminal) from the OP side to the CL side and use the FUNC/DATA key to write.
- When you turn on the inverter while X9 [THR]-[CM] is open, the "OH2" alarm is issued. This is a normal state.
- Connect X9 [THR] and [CM] to the overheat detection contact of the braking resistor or the like.
- If you do not connect a braking resistor, short-circuit the [THR]-[CM] or move the 9th ■ (X9 terminal) from the CL side to the OP side again and use the FUNC/DATA key to write.



## 10. Jogging operation [JOG]

Use this function for an inching action such as work adjustment. You can operate at the jogging speed specified by the function C29 "Jogging speed" by turning on the signal between [JOG] and [CM] while the operation command (FWD-CM or REV-CM) is ON. You can also use the KEYPAD panel to switch to the jogging mode.

When you want to use this [JOG] function, you should assign a data 10 to a desired digital input terminal.

The function codes related to the jogging operation are C29 to C38. A dedicated speed control setting (such as gain) is available.

The indicator stays at the JOG position on the LCD monitor of the KEYPAD panel during the jogging operation.

## 11. Speed setting N2/speed setting N1 [N2/N1]

Use an external digital input signal to switch the speed setting method predetermined with function F01 "speed setting N1" and C25 "speed setting N2."

If you do not specify, F01 is selected.

Input signal to select specified data	Speed setting method to be selected
11	
OFF	F01 Speed setting N1
ON	C25 Speed setting N2

## 12, 13. Motor selection 1,2 [MCH2, CH3]

You can use the external digital input signals to switch the predetermined motor parameters.

You can use the terminal to switch only when F79 "Motor selection (M1, 2, 3)" is set to 0.

If F79=1, the selection is fixed to the M2. If F79=2, the selection is fixed to the M3.

The switching result becomes effective when the operation command to the inverter is ON and the motor is in the stop state.

Input signal combination to select specified data		Motor to be selected	Related codes
13 [MCH3]	12 [MCH2]		
OFF	OFF	First motor	F03 to 05, F10 to 12, P01 to P30
OFF	ON	Second motor	A01 to A34
ON	OFF	Third motor (dedicated for V/f control)	A35 to A50
ON	ON	First motor	F03 to 05, F10 to 12, P01 to P30

Note: Both [MCH2] and [MCH3] are ON, the first motor is selected.

See also the description of the function code F79.

Note: When inverter is stopped, if motor switch 1/2 is changed during rotation of the connected motor (during naturally coasting or coasting with a load), the analog speed detection output, digital speed detection signal or the like may cause unpredictable operation.

## 4. Control and Operation

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### 14. DC brake command [DCBRK]

When the external digital input signal is ON and the operation command is turned OFF (when you press the STOP key during the KEYPAD panel operation, or the both [FWD] and [REV] terminals are OFF during the external signal operation), the DC braking starts after the motor speed decreases to the predetermined rotation specified by the function code F20 "DC brake (Starting speed)", and the braking continues while the input signal is ON.

The longer period between F22 "DC brake (Braking time)" or the ON duration of the input signal [DCBRK] is selected.

Note that turning on the operation command will resume the operation.

See also the description of the function codes F20 to 22.

Input signal to select specified data	Action to be selected
14	
OFF	DC braking active
ON	DC braking inactive

### 15. ACC/DEC cleared to zero [CLR]

The external digital input signal clears the calculated speed of the acceleration/deceleration calculation unit.

During the UP/DOWN operation in particular, this input signal clears the acceleration/deceleration and operates the inverter at 0r/min, the previous speed, or the creep speed specified by the C18 and 19 "Multistep speed".

### 16. Creep speed switching in UP/DOWN setting [CRP-N2/N1]

The external digital input signal switches the creep speed at the UP/DOWN selector unit.

Input signal to select specified data	Specified speed to be selected
16	
OFF	C18 N – 15 / CREP 1
ON	C19 N – 16 / CREP 2

### 17. UP command in UP/DOWN setting [UP]

The external digital input signal increase the speed during the signal is ON. The maximum speed restricts the speed. The acceleration follows the specified acceleration time and S-curve acceleration.

### 18. DOWN command in UP/DOWN setting [DOWN]

The external digital input signal decrease the speed during the signal is ON.

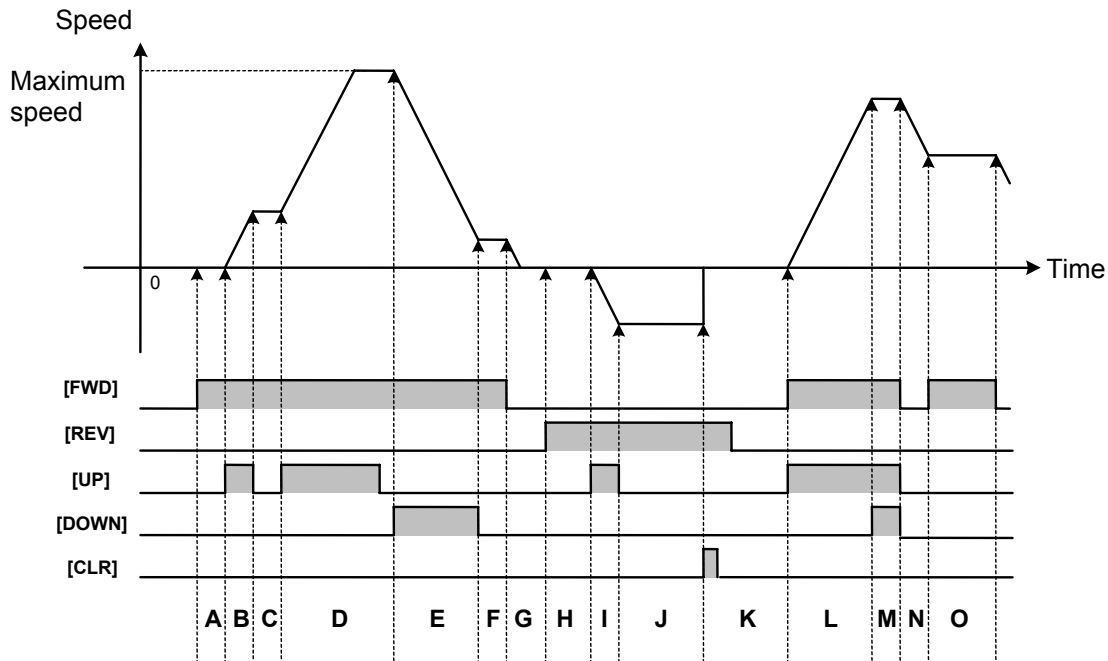
The deceleration follows the specified deceleration time and S-curve deceleration.

The current speed is maintained when the [UP] and the [DOWN] are pressed at the same time (no acceleration/deceleration).

There are three types of the UP/DOWN operations depending on the initial values. You can use the speed setting function (function code F01 or C25) to select them.

(1) UP/DOWN (initial value: 0r/min)

The following graph shows an operation with this function (The S-curve specification is not active in this example).



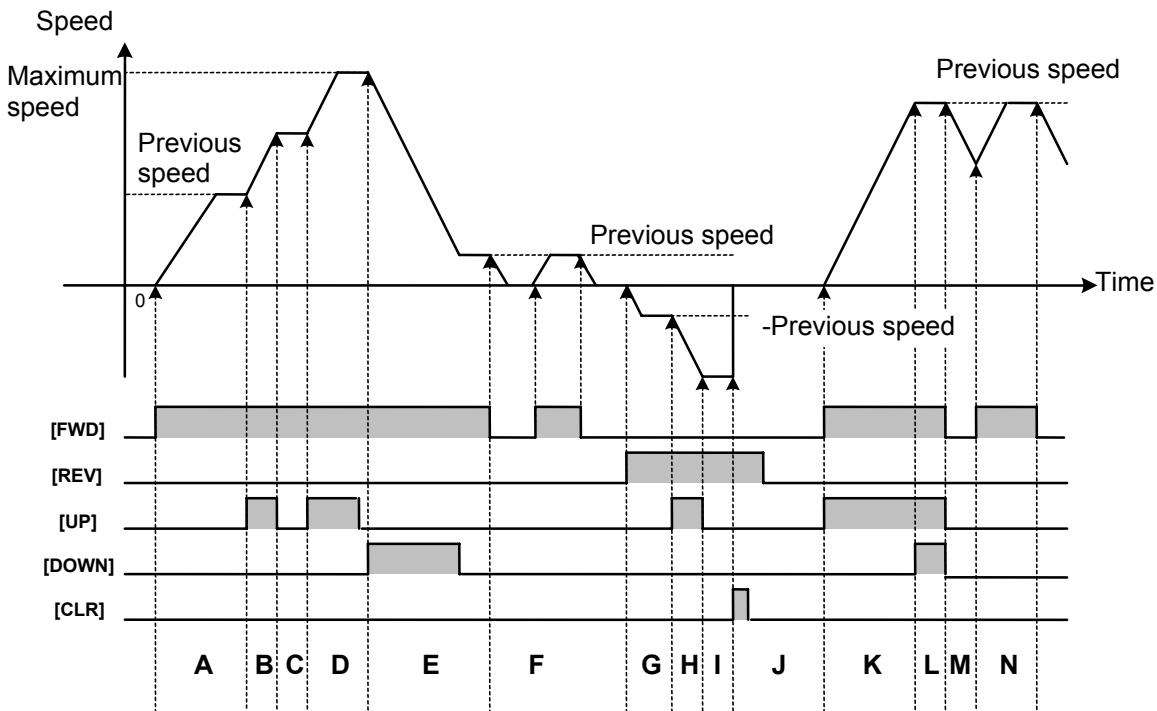
- A** : Operates at 0r/min speed command
- B** : Accelerates in forward direction
- C** : Fixed to the speed command value when **[UP]** is set to OFF
- D** : Restricted by the maximum speed after acceleration in forward direction
- E** : Decelerates in forward direction
- F** : Fixed to the speed command value when **[DOWN]** is set to OFF
- G** : Decelerates to stop
- H** : Operates at 0r/min speed command value
- I** : Accelerates in reverse direction
- J** : Fixed to the speed command value when **[UP]** is set to OFF
- K** : Resets to 0r/min when **[CLR]** is set to ON
- L** : Accelerates in forward direction
- M** : Simultaneous **[UP]** and **[DOWN]** are treated as OFF. Fixed to the speed command value when both **[UP]** and **[DOWN]** are turned ON
- N** : Decelerates to stop
- O** : Continues operation at the speed just after **[FWD]** is set to ON.

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### (2) UP/DOWN (initial value: previous value)

The following graph shows an operation with this function (The S-curve specification is not active in this example).

- The previous value is defined as the speed command value adopted when the previous operation command (FWD, REV) is turned OFF. The previous value is stored in the non-volatile memory (memory that retains data even when the power has been switched OFF), and becomes effective when the power is supplied again.

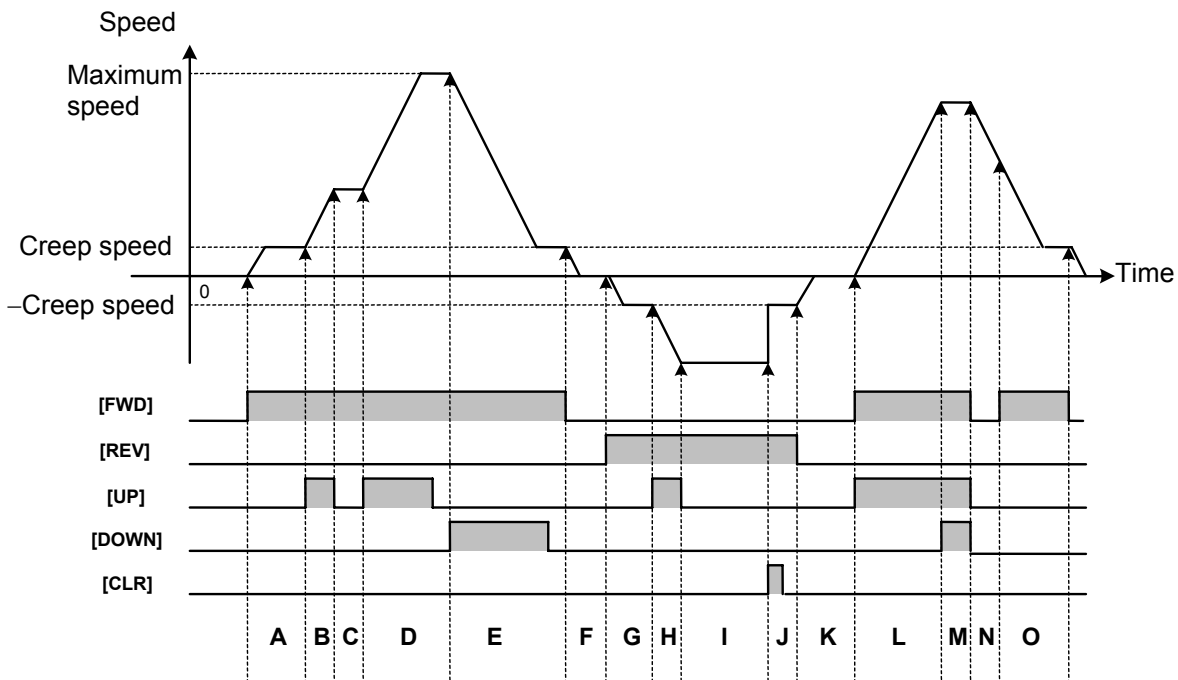


- A** : Accelerates in forward direction up to "+previous speed command value (speed command value just before the operation command is set to OFF)"
- B** : Accelerates in forward direction
- C** : Fixed to the speed command value when [UP] is set to OFF
- D** : Restricted by the maximum speed after acceleration in forward direction
- E** : Decelerates to stop. Fixed to the speed command value when [DOWN] is set to OFF
- F** : Stores the speed as a previous value when the [FWD] is set to OFF. Accelerates in forward direction to the previous value when the [FWD] is set to ON. Decelerates to stop when the [FWD] is set to OFF.
- G** : Accelerates in reverse direction up to "-previous speed command value"
- H** : Accelerates in reverse direction
- I** : Fixed to the speed command value when [UP] is turned OFF
- J** : Resets to 0r/min when [CLR] is turned ON
- K** : Accelerates in forward direction
- L** : Simultaneous [UP] and [DOWN] are treated as OFF. Fixed to the speed command value when both [UP] and [DOWN] are turned ON
- M** : Decelerates to stop. Stores the speed as a previous value when the [FWD] is set to OFF.
- N** : Accelerates in forward direction up to "+previous speed command value".

(3) UP/DOWN (initial value: creep speed 1, 2)

The following graph shows an operation with this function (The S-curve specification is not active in this example).

- You can use the terminal inputs [CRP-N2/N1] to select the creep speed 1 or the creep speed 2.
- You should specify the function code C73 "Creep speed switching (on UP/DOWN control)" to choose the function codes C18 and C19 or the analog input signals ([CRP-N1] and [CRP-N2]). See the description of the C73 for more details.
- Because priority is given on the clearing process even if [FWD] or [REV] is turned off while [CLR] is turned on, the motor speed remains the creeping speed.
- The creeping speed continues even if the creeping speed is decreased after it is reached.
- A: Converted into an absolute value and processed into the input creep speed.



- A** : Accelerates in forward direction up to "+creep speed"
- B** : Acceleration in forward direction
- C** : Fixed to the speed command value when [UP] is turned OFF
- D** : Restricted by the maximum speed after acceleration in forward direction
- E** : Decelerates in forward direction down to "+creep speed"
- F** : Deceleration to stop
- G** : Accelerates in reverse direction to "-creep speed"
- H** : Acceleration in reverse direction
- I** : Fixed to the speed command value when [UP] is turned OFF
- J** : Resets to creep speed when [CLR] is set to ON
- K** : Deceleration to stop
- L** : Acceleration in forward direction
- M** : Simultaneous [UP] and [DOWN] are treated as OFF. Fixed to the speed command value when both [UP] and [DOWN] are turned ON
- N** : Deceleration to stop
- O** : If [FWD] is turned off temporarily and restored again during deceleration, the speed at the timing of activation of FWD is held if the speed is equal to or larger than the creeping speed. If the speed has dropped below the creeping speed, the speed increases to the creeping speed upon activation of FWD.

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### 19. Write enable for KEYPAD [WE-KP]

This function enables changes to the function codes through the KEYPAD panel only when the digital input signal [WE-KP] is applied to prevent unauthorized changes. You can make changes when 19 is not assigned to a terminal. This function enables/disables changes through the KEYPAD panel. Use "Write enable through link" to enable/disable changes through the link.

Input signal to select specified data	Function to be selected
19	
OFF	Changes to data disabled
ON	Changes to data enabled

Note: You cannot change the function codes if you set this data to a terminal by mistake. If this is a case, set ON to the terminal, and then set a correct data.

### 20. PID control cancel [N/PID]

The external digital input signal disables the PID control.

Input signal to select specified data	Function to be selected
20	
OFF	PID control enabled
ON	PID control disabled

### 21. Normal/inverse action switch [IVS]

The external digital input signal switches the direction of the motor rotation.

Input signal to select specified data	Rotation direction to be selected		Normal/inverse
	FWD command	REV command	
21			
OFF	Forward rotation	Reverse rotation	Normal operation
ON	Reverse rotation	Forward rotation	Inverse operation

Note: Forward rotation is defined as CCW (counter clockwise facing to motor shaft) for regular motors in Japan. Forward rotation is defined as CW for some motors from abroad

### 22. Interlock signal [IL]

When a magnetic contactor is provided to the output of the inverter, this magnetic contactor (52-2) opens to slow down the voltage drop in the DC circuit at a momentary power failure. As a result, the inverter may not detect the power failure to recover from the momentary power failure smoothly. In such a case, use an external device to give a digital signal for informing the inverter of the momentary power failure.

The motor will restart smoothly after the power failure.

Valid if the setting of F14 (restart after momentary power failure (action selection)) is "3," "4" or "5."

Input signal to select specified data	Function to be selected
22	
OFF	Momentary power failure detection through digital input disabled
ON	Momentary power failure detection through digital input enabled

### 23. Write enable through link [WE-LK]

This function enables changes to the function codes through RS485, T-Link, SX, or field bus only when the digital input signal is applied to prevent unauthorized changes. You can make changes when 23 is not assigned to a terminal. Use aforementioned "Write enable for KEYPAD" to enable/disable changes through the KEYPAD.

Input signal to select specified data	Function to be selected	Applicable communication system
23		
OFF	Changes to data disabled	Integrated RS 485
ON	Changes to data enabled	T-Link, SX Field bus

Note: This function does not restrict the writing to the function code S (such as operation command, speed command) areas dedicated to the communication system. The next function "Operation selection through link" enables/disables writing to the S area.

### 24. Operation selection through link [LE]

The external digital input enables/disables the speed command and the operation command through the link (communication system). Assign a data 24 to a desired digital input terminal and the input signal applied to it switches between the enabled state and the disabled state.

When the operation selection is enabled or this function is not assigned, you can specify the sources of commands.

Input signal to select specified data	Function to be selected
24	
OFF	Link commands disabled (link disabled regardless of setting by H30)
ON	Link commands enabled (setting by H30 enabled)

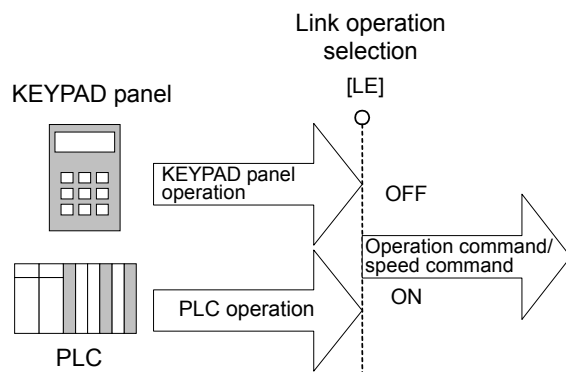
When the link is enabled, the following priority applies if speed commands and operation commands come from multiple communication systems.

Priority	Operation command (FWD, REV), speed command	Description of source of commands
1	Field options	One option selected from T-Link, SX, and field bus can be installed at a time.
2	Integrated RS485	Disabled when the option above is installed.

#### <Application example 1>

When you specify the operation command and the speed command from the KEYPAD panel and use the terminal function [LE] to switch to the operation command and the speed command from the PLC, the KEYPAD panel will be enabled if the terminal [LE] is OFF, and the PLC will be enabled if the terminal [LE] is ON.

The description "Not assigned (\*)" in the following table on the next page indicates that a function 24 [LE] is not assigned to an X function terminal. If this is a case, the setting by the function code H30 becomes effective. The PLC operation requires option cards (If you use RS485, an integrated function is available). See the descriptions of the option or RS485 for more details.



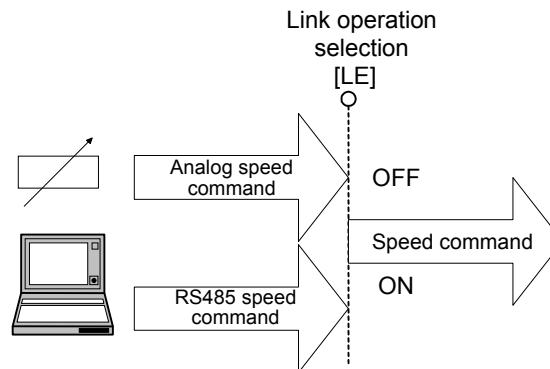


## 4. Control and Operation

	Set value	Description	Terminal [LE]		
			OFF	ON	Not assigned (*)
Function code specification	F01="0"	Operation command from KEYPAD panel	Enabled	Disabled	
	F02="0"	Speed command from KEYPAD panel			
	H30="3"	Initial setting enabling both speed command and operation command through link (PLC)	Disabled	Enabled	

### <Application example 2>

When you select the operation command from the external signal ([FWD], [REV]) and the speed command from the analog terminal [12] input ( $0\pm 10V$ ) or the RS485 communication (from master device such as a personal computer) using [LE] function, the analog terminal [12] will be enabled if the terminal [LE] is OFF, and the RS485 will be enabled if the terminal [LE] is ON. If you use RS485, an integrated function is available. See the descriptions of RS485 for more details.



	Set value	Description	Terminal [LE]		
			OFF	ON	Not assigned (*)
Function code specification	F01="1"	Operation command from [FWD] and [REV]	Enabled (External signal is always selected)		
	F02="1"	Speed command from analog input at terminal [12]	Enabled	Disabled	
	H30="1"	Initial setting enabling only speed command from link (RS485)	Disabled	Enabled	

### 25. Universal DI [U-DI]

You can assign a data 25 to a digital terminal to designate it as a universal DI terminal. This function is provided to check the existence of an input signal through communication and does not affect the inverter operation.

There are following applications for this signal.

- 1) Check the ON/OFF state of the input signal through RS485, T-Link, SX, or field bus.
- 2) Use for an input to software created with the UPAC option without affecting the inverter operation.

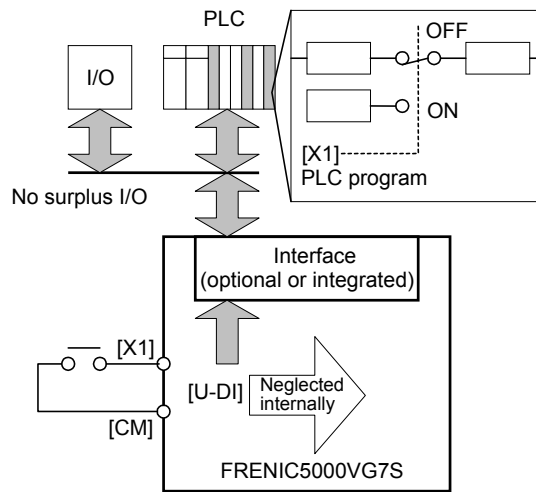
<Application example>

You do not have enough numbers of I/O and want to use inverter control terminals to switch the control of a PLC program.

If you choose [X1] as a control terminal:

- 1) Set the function code E01 "X1 function selection" to 25. This specification makes this input neglected by the inverter.
- 2) Use the PLC to read out (polling) the function code M13 "Operation method (final command)" through communication.
- 3) Since the data type of M13 is 32 (type), refer to the bit assignment under that data type to check the corresponding bit of X1 input.

Note that you can read out input information of an input terminal using the code M13 without assigning the [U-DI] to the terminal. The significance of the assignment is to avoid activating an assigned function to the terminal unless you do not assign the [U-DI].



26. Pick up start mode [STM]

The external digital input signal enables/disables the function H09 "Start mode (Rotating motor pick up)"

Assign a data 26 to a desired digital input terminal and the input signal applied to it switches between the enabled state and the disabled state.

Input signal to select specified data	Function to be selected
26	Function to be selected
OFF	
ON	

# 4. Control and Operation

## 27. Synchronized operation command [SYC]

This function switches between the speed command converted from a pulse train received as a position command via the position control and other speed command. You can use this function for a synchronized operation. You need an optional PG (PR).

Assign a data 27 to a desired digital input terminal and the state of the input signal applied to it selects the function.

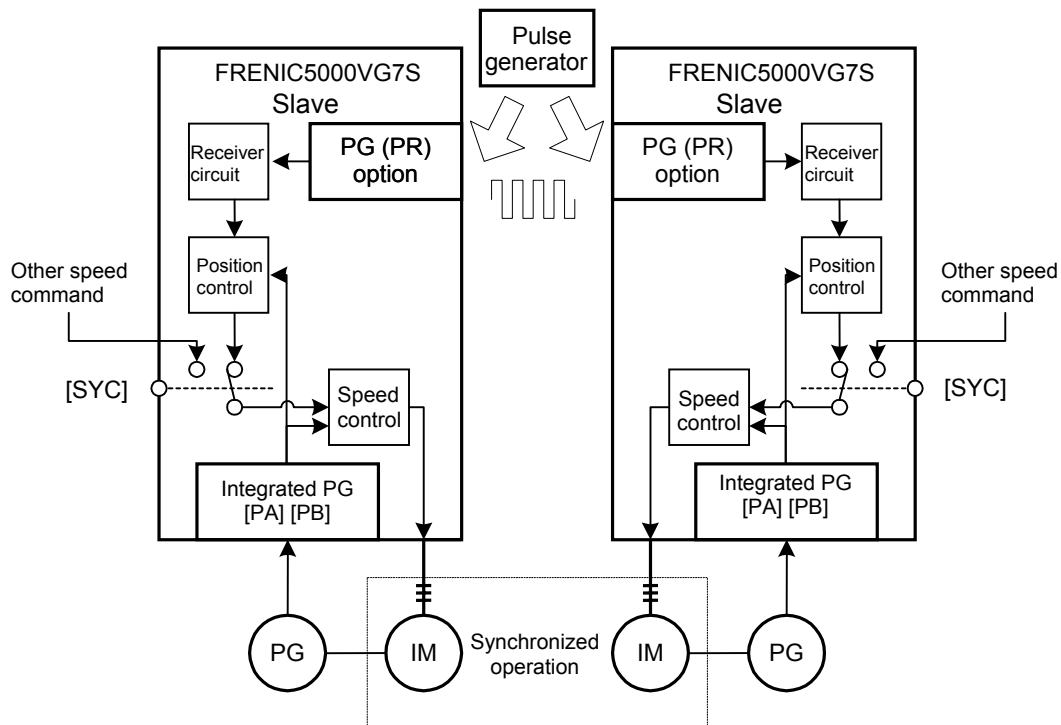
Input signal to select specified data	Function to be selected
27	
OFF	Synchronized speed disabled (Other speed command enabled)
ON	Synchronized speed enabled

Also see E29 "PG pulse output selection", o12 to 19 "PG (PR) options", and the description on the PG (PR) options.

Note that the Zero speed locking command [LOCK] is disabled during the pulse train position control with [SYC].

### <Application example 1> Synchronized operation by receiving pulse

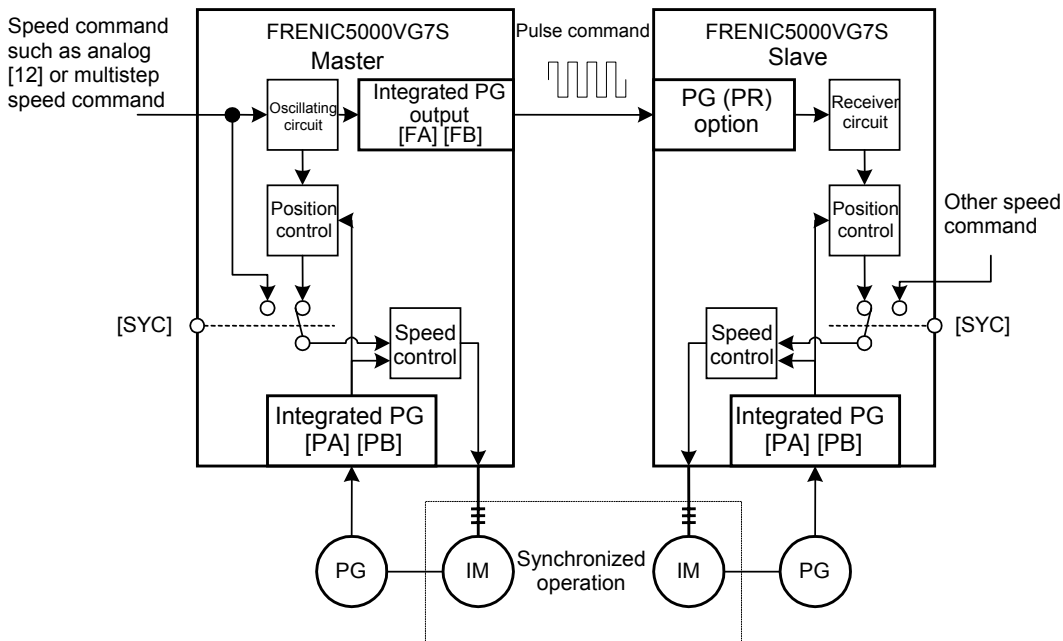
Apply a pulse train signal from the external pulse generator to the PG (PR) options of multiple inverters to be synchronized. The position command received by the option is converted into a synchronized speed command and the [SYC] enables the speed command.



<Application example 2> Synchronized operation by pulse generation

Pulse signal converted (oscillated) from an internal speed command (such as [12] input or multistep speed command) is also converted into a speed command through the position control and the [SYC] enables the resulting speed command. You can put the converted pulse signal to the output and apply it to the other inverters to synchronize the inverter with other inverters.

The motor speed of the master and the PG pulse number determines the pulse frequency. When you use a PG with 1024P/R at 1500r/min, the frequency is  $1500 \times 1024 / 60 = 25.6\text{kHz}$ . The pulse compensation is available on the slave side. See the function codes o14 and o15 or the PG (PR) option for more details.



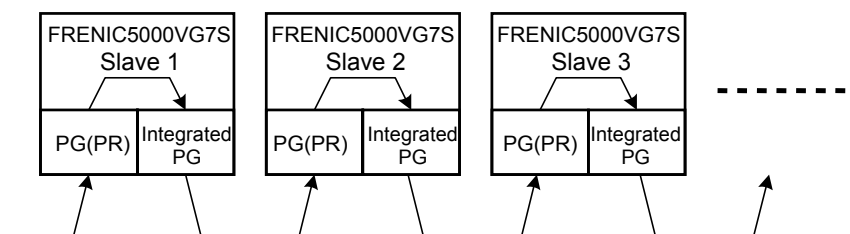
The complete synchronization ( $\pm 2$  pulses or less) is possible both in the application example 1 and 2 during both transient and steady states.

About differences in methods

Method	Merits	Demerits
<Application example 1> Synchronized operation by receiving pulse	No position deviation	One PG (PR) option necessary Pulse generator necessary
<Application example 2> Synchronized operation by pulse generation	No position deviation One PG (PR) option can be omitted No pulse generator	None
Master-slave operation (Master directly applies its PG signal to slaves)	None	Position deviation

<Application example> Synchronized operation for three or more inverters

Set E29 "PG pulse output selection" to 9 to directly supply the position command applied to the PG (PR) option to the [FA] and the [FB] of the integrated PG.



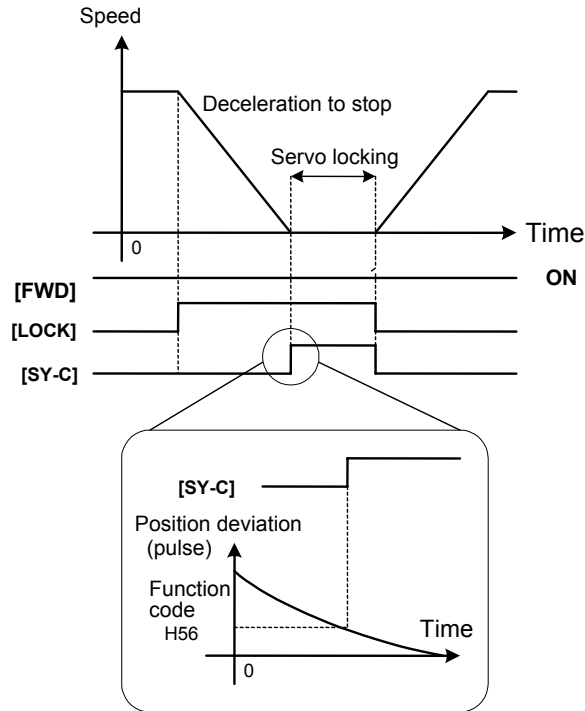
# 4. Control and Operation

## 28. Zero speed locking command [LOCK]

The external digital input signal conducts servo lock. Assign data 28 [LOCK] to a terminal and set the input signal ON.

Input signal to select specified data	Function to be selected
28	
OFF	Normal state
ON	Zero speed locking state

- 1) The inverter decelerates to stop (following an effective deceleration time setting) from the speed just after the [LOCK] is set to ON.
- 2) Position control (servo locking state) is applied with respect to the motor position (angle) when the speed command of the acceleration/deceleration calculation unit reaches to zero.  
The acceleration/deceleration calculation unit declines a step speed command directed by the user in a specified acceleration/deceleration time.
- 3) You can supply a resistive torque up to the short-time rating. The function code H55 "Zero speed control (Gain)" and the speed control system (ASR gain) control the magnitude of the torque in relation to the position deviation (position error).
- 4) Balance the speed control (ASR) gain (function codes F and C) and the position control gain (H55) to adjust the gain. The system may become unstable to present low frequency hunting when you increase the setting of the H55 while leaving ASR gain small.
- 5) A signal indicating completed servo locking appears on the DO as "Synchronization completion signal" when the position deviation converges into the setting range of the H56 "Zero speed control (completion range)".  
When PG (PR) option is used for synchronization control by pulse train, the zero speed locking command becomes invalid.
- 6) Because only one rotation is detected if the motor turns due to an external force after it is locked at zero speed, the DO output (synchronous control complete [SY-C]) may be turned on each time the predetermined position passes.



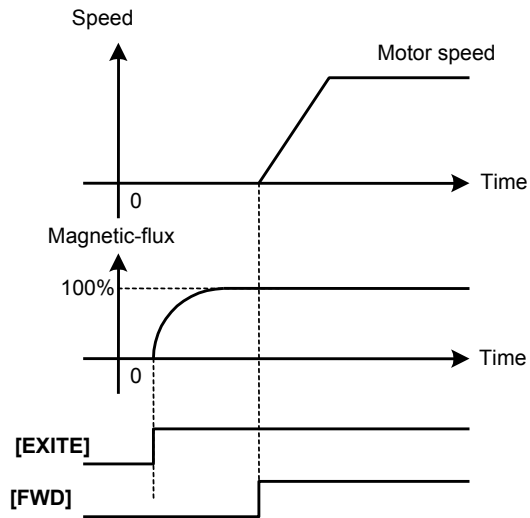
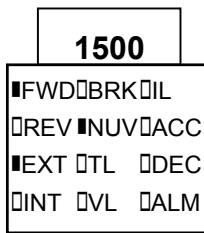
### 29. Pre-exciting command [EXITE]

The external digital input signal switches the inverter in pre-exciting state. Assign a data 29 to a desired digital input terminal and the state of the input signal applied to it selects the function. When the operation command (FWD, REV) is set to ON, the state changes from pre-exciting to normal.

Input signal to select specified data	Function to be selected
29	
OFF	Normal state
ON	Pre-exciting state

You can also use the function codes F74 and F75 to start the pre-exciting. See also the description of these functions.

You can use the "Operation status" of the "I/O check" screen of the KEYPAD panel to see whether the inverter is in the pre-exciting state or in the normal state. The EXT indicates the pre-exciting state and the EXT indicates the normal operation. You can also read out the function code M14 "Operation status" through the link.



### 30. Speed command limiter cancel [N-LIM]

The external digital input signal disables the speed command limiter. Assign a data 30 to a desired digital input terminal and the state of the input signal applied to it selects the function. See the description of the function code F76 for more information on the speed command limiter function.

Input signal to select specified data	Function to be selected
30	
OFF	Speed limiter enabled
ON	Speed limiter disabled

### 31. H41 (torque command) cancel [H41-CCL]

The external digital input signal cancels the setting specified by the H41 "Torque command selection" (0: internal ASR enabled). Assign a data 31 to a desired digital input terminal and the state of the input signal applied to it selects the function.

Input signal to select specified data	Function to be selected
31	
OFF	H41 setting enabled
ON	H41 setting disabled (internal ASR enabled)

#### Application

Use for applications that switch between speed control (internal ASR) and torque command control.

## 4. Control and Operation

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### 32. H42 (torque current command) cancel [H42-CCL]

The external digital input signal cancels the setting specified by the H42 "Torque current command" (0: internal ASR enabled). Assign a data 32 to a desired digital input terminal and the state of the input signal applied to it selects the function.

Input signal to select specified data	Function to be selected
32	
OFF	H42 setting enabled
ON	H42 setting disabled (internal ASR enabled)

#### Application

Use for applications that switch between speed control (internal ASR) and torque current command control.

### 33. H43 (magnetic-flux command selection) cancel [H43-CCL]

The external digital input signal cancels the setting specified by the H43 "Magnetic-flux command selection" (0: internal calculation enabled). Assign a data 33 to a desired digital input terminal and the state of the input signal applied to it selects the function.

Input signal to select specified data	Function to be selected
33	
OFF	H43 setting enabled
ON	H43 setting disabled (internal calculation enabled)

### 34. F40 (torque limiter mode 1) cancel [F40-CCL]

The external digital input signal cancels the setting specified by F40 "Torque limiter mode 1" (0: limiter disabled). Assign a data 34 to a desired digital input terminal and the state of the input signal applied to it switches between the enabled state and the disabled state.

Input signal to select specified data	Function to be selected
34	
OFF	F40 setting enabled
ON	F40 setting disabled (limiter disabled)

### 35. Torque limiter (level 1, level 2 selection) [TL2/TL1]

The external digital input signal switches the torque limiter value (level 1 or 2). Assign a data 35 to a desired digital input terminal and the state of the input signal applied to it switches between the level 1 and the level 2. This function is effective only when F41 "Torque limiter mode 2"=3.

Input signal to select specified data	Function to be selected
35	
OFF	F42: Torque limiter value (level 1) selection
ON	F43: Torque limiter value (level 2) selection

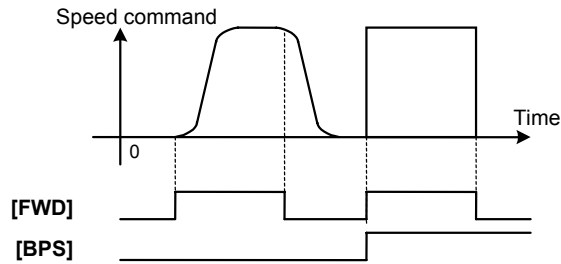
### 36. Bypass [BPS]

The external digital input signal bypasses the acceleration/deceleration calculation unit to disable the acceleration/deceleration time and the S-curve specifications. Assign a data 36 to a desired digital input terminal and the state of the input signal applied to it switches between the enabled state and the disabled state.

(The resultant setting is the same as the acceleration/deceleration time: 0.00s and the S-curve acceleration/deceleration: 0%)

Input signal to select specified data	Function to be selected
36	
OFF	Acceleration/deceleration calculation unit enabled
ON	Acceleration/deceleration calculation unit disabled

The speed command from the acceleration/deceleration calculation unit follows the acceleration/deceleration and S-curve settings as shown in the figure. Setting the [BPS] to ON cancels these functions to control the motor speed following a step-form speed command. Use the dedicated jogging operation function codes (C30 to C38), not the [BPS], for jogging operation.



#### Restrictions

- When you use the [BPS], control functions such as the UP/DOWN control and the active drive (when V/f control is selected) are also disabled.
- The [BPS] does not affect the auxiliary speed setting 2 and the PID calculation output (speed command). For details, refer to the control block diagrams.

#### ⚠ CAUTION

- Setting the [BPS] ON accelerates/decelerates the motor rapidly and the motor may accelerate at its maximum permissible torque and decelerate down to the zero speed. Use the [BPS] after you confirm that these are permissible actions of the mechanical system and the braking devices you use.

**You may be injured.**

### 37, 38. Torque bias command 1/2 [TB1, TB2]

The external input digital signals can be used to switch among three types of torque biases predetermined by F47 to 49 "Torque bias T1, T2, and T3".

See the function code F47 to 49 for more details.

Input signal combination to select specified data		Torque bias to be selected
38 [TB2]	37 [TB1]	
OFF	OFF	Torque bias disabled
OFF	ON	F47 torque bias T1 enabled
ON	OFF	F48 torque bias T2 enabled
ON	ON	F49 torque bias T3 enabled

### 39. Droop selection [DROOP]

The external digital input signal switches between the droop control enabled state and the droop control disabled state. Assign a data 39 to a desired digital input terminal and the state of the input signal applied to it selects the function. See the function code H28 "Droop control" for more details.

Input signal to select specified data	Function to be selected
39	
OFF	Droop control disabled
ON	Droop control enabled



# 4. Control and Operation

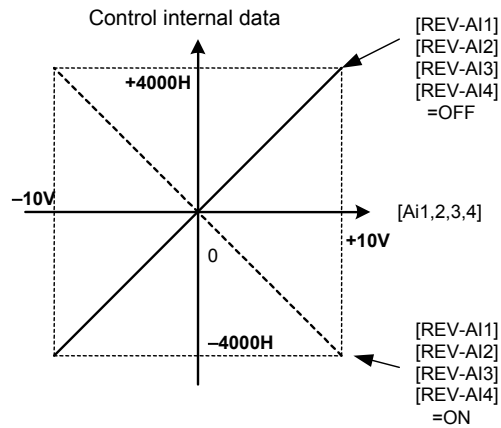
- 40. Ai1 zero hold [ZH-AI1]
- 41. Ai2 zero hold [ZH-AI2]
- 42. Ai3 zero hold [ZH-AI3]
- 43. Ai4 zero hold [ZH-AI4]

The external digital input signals fix the individual analog signals Ai1 to 4 to "0: input voltage invalid". Assign a data to a desired digital input terminal and the state of the input signal applied to it selects the function.

You need optional OPC-VG7-AIO for Ai3 and Ai4.

Input signal to select specified data	Function to be selected
40 to 43	
OFF	Ai input enabled
ON	Ai input held to zero

- 44. Ai1 polarity change [REV-AI1]
- 45. Ai2 polarity change [REV-AI2]
- 46. Ai3 polarity change [REV-AI3]
- 47. Ai4 polarity change [REV-AI4]



The external digital input signals invert the polarity of the input data from Ai1 to 4. Assign a data to a desired digital input terminal and the state of the input signal applied to it selects the function.

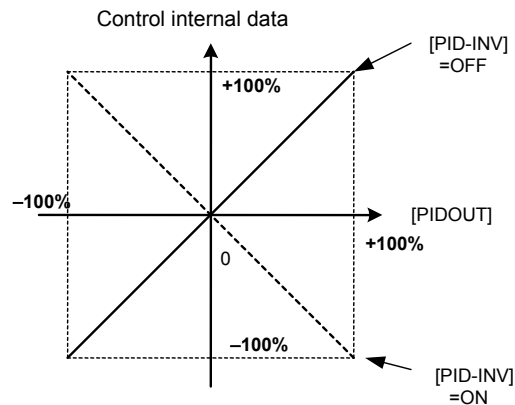
You need optional OPC-VG7-AIO for Ai3 and Ai4.

Input signal to select specified data	Function to be selected
44 to 47	
OFF	Normal operation
ON	Inverted polarity

## 48. PID output inverse changeover [PID-INV]

The external digital input signal switches the PID output [PIDOUT] between the normal operation and the inverse operation. Assign a data 48 to a desired digital input terminal and the state of the input signal applied to it selects the function.

Input signal to select specified data	Function to be selected
48	
OFF	Normal PID output operation
ON	Inverse PID output operation



#### 49. PG alarm cancel [PG-CCL]

The external digital input signal cancels the PG alarm. This function is available when you select "vector control" for the function code P01 or A01.

The inverter does not issue the alarm even when the PG wiring is disconnected during the input signal is ON. Assign a data 49 to a desired digital input terminal and the existence of the input signal cancels the PG alarm.

Input signal to select specified data	Function to be selected
49	
OFF	
ON	PG alarm canceled

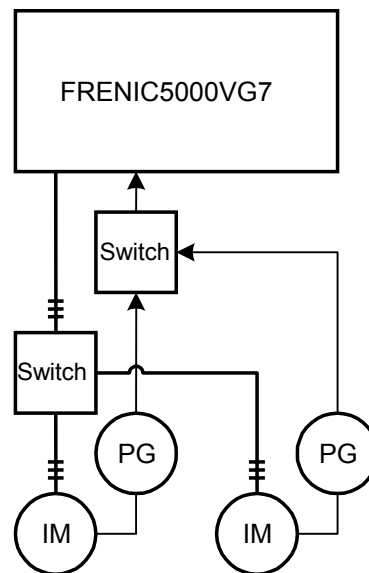
#### Actions on detecting PG disconnection

Alarm operation	[PG-CCL] = OFF	[PG-CCL] = ON
		Normal operation
KEYPAD panel	Alarm mode	Operation mode
Alarm history	Recorded	Not recorded
Alarm DO output	PG disconnection output	No output
30X relay output	Alarm output	No output
Inverter output	Shut down	Normal operation

#### Application

Since this is a special function, limit your application to the following cases. When you use the function code E14 "X function normally open/normally closed", you can set to "normally closed (ON)" without actually short-circuiting terminals.

- 1) Use to apply the power to a system and test the system without connecting the PG signal.
- 2) When you use two motors by switching them with one unit, a momentary disconnection will present and the PG alarm is issued if the PGs are switched externally. Cancel the PG alarm at the sequence timing when the PGs are switched. Note that when you use FUJI's option (OPC-VG7-CPG) for PG switching, you do not need this canceling function.
- 3) Monitoring the current on the signal line detects the PG disconnection. The false detection may occur when the PG wiring has high impedance causing low current. Usually 0.6mA or less is considered as a disconnection. If this is the case, you can operate with canceling the PG alarm as an emergency mean.



## 4. Control and Operation

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### Operation with PG disconnected

A motor rotates at a slip frequency regardless of the speed command when the PG is disconnected (either PGP, PGM, PA, or PB is disconnected) and the PG alarm is canceled ([PG-CCL] = ON). Since the calculation of the speed control system (ASR) will saturate and increase the torque command and the torque current command to the maximum, either the inverter overload (OLU) or the motor overloads (OL1, 2, 3) when you use an electronic thermal overload relay will enter the alarm mode (Note that if you invert the A phase and the B phase of the PG signal, it will present the same phenomenon).  
If you are sure that the PG wiring is disconnected, do not operate with canceling the PG alarm.

### <Control mechanism>

The vector control of the VG7 is a slip frequency type vector control. The inverter obtains the motor speed ( $\omega_r$ ) from the PG signal and the slip frequency ( $\omega_s$ ) from the current detection to determine the output frequency to the motor ( $\omega_l = \omega_r + \omega_s$ ). In case of a PG disconnection, the motor speed is 0 ( $\omega_r = 0$ ) and the output frequency to the motor becomes the slip frequency  $\omega_s$ .

In the speed control system (ASR), since the motor speed ( $\omega_r$ ) does not follow the speed command ( $\omega_r^*$ ), the speed control system (ASR) conducts an integral operation (I constant of ASR) to increase the speed deviation ( $\omega_r^* - \omega_r$ ) and the saturation is reached in a short period. The output of the ASR is the torque command and this torque command is fixed to the maximum value resulting in the overload protection.

### 50. Undervoltage cancel [LU-CCL]

The external digital input signal cancels the undervoltage alarm. When the input signal is ON, the alarm is canceled.

Assign a data 50 to a desired digital input terminal and the existence of the input signal cancels the undervoltage alarm.

Input signal to select specified data	Function to be selected
50	Function to be selected
OFF	
ON	

#### Actions on detecting undervoltage inside the inverter

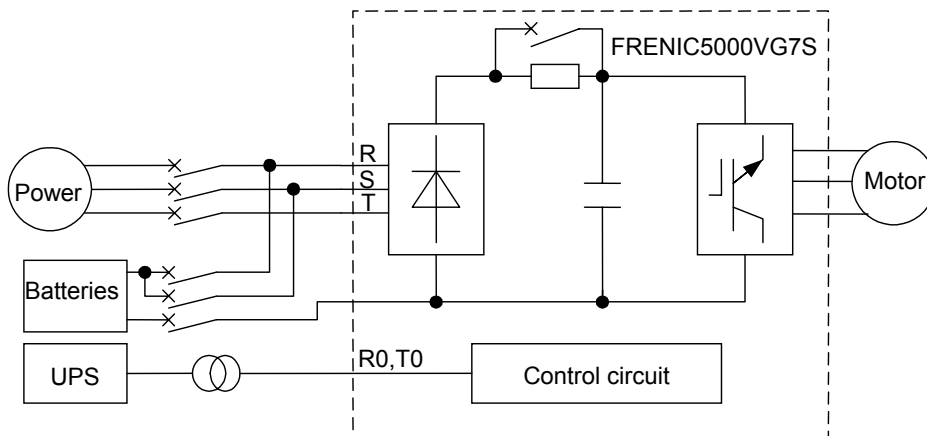
Alarm operation	[LU-CCL] = OFF	[LU-CCL] = ON
		Normal operation
KEYPAD panel	Alarm mode	Operation mode
Alarm history	Recorded	Not recorded
Alarm DO output	Output	No output
DO output for Stopping on undervoltage [LU]	Output	No output
30X relay output	Output	No output
Inverter output	Shut down	Normal operation

#### Application

Since this is a special function, limit your application to the following cases.

- 1) When you supply control power via [R0] and [T0] separately, if you turn off the main circuit power supply, the inverter enters the alarm mode due to the detected undervoltage. Use this function to avoid the alarm.
- 2) Use to operate lifting unit or the like at a power failure. The inverter with 15kW or smaller capacities can be operated at voltages smaller than the undervoltage level (200V class: 186V. 400V class: 371V). Use in a system shown in the figure below where an uninterruptible power supply (UPS), battery, stand-by generator and so on are included.

Note: To operate a 18.5kW or larger capacity inverter at voltages smaller than the undervoltage level, the inverter must be modified. If you need a modification, contact us for individual purposes. The modified inverter has suffix -LV in the model of the inverter.



- 3) Upon cancellation of undervoltage, operation at the keypad panel (F02 (operation) = 0, keypad panel operation valid) is disabled. Issue operation commands (FWD, REV) at the terminal block or link. As well, parameter changes at the keypad panel are rejected during cancellation of the undervoltage.

# 4. Control and Operation

## 51. Ai torque bias hold [H-TB]

The external digital input signal directs to preserve the torque bias data supplied via an analog input. Assign a data 51 to a desired digital input terminal and the existence of the input signal preserves the analog data.

Input signal to select specified data	Function to be selected
51	
OFF	Torque bias hold disabled
ON	Torque bias hold enabled

## 52. STOP1 [STOP1]

The external digital input signal directs to decelerate to stop with the currently specified/effective deceleration time and S-curve decelerations on start/end sides.

Assign a data 52 to a desired digital input terminal and the existence of the input signal activates the operation.

Input signal to select specified data	Function to be selected
52	
OFF	Normal operation
ON	Deceleration to stop (effective deceleration time)

## 53. STOP2 [STOP2]

The external digital input signal directs to decelerate to stop with the C67 "Deceleration time 4" and C68 and C69 "S-curve start/end side 4".

Assign a data 53 to a desired digital input terminal and the existence of the input signal activates the operation.

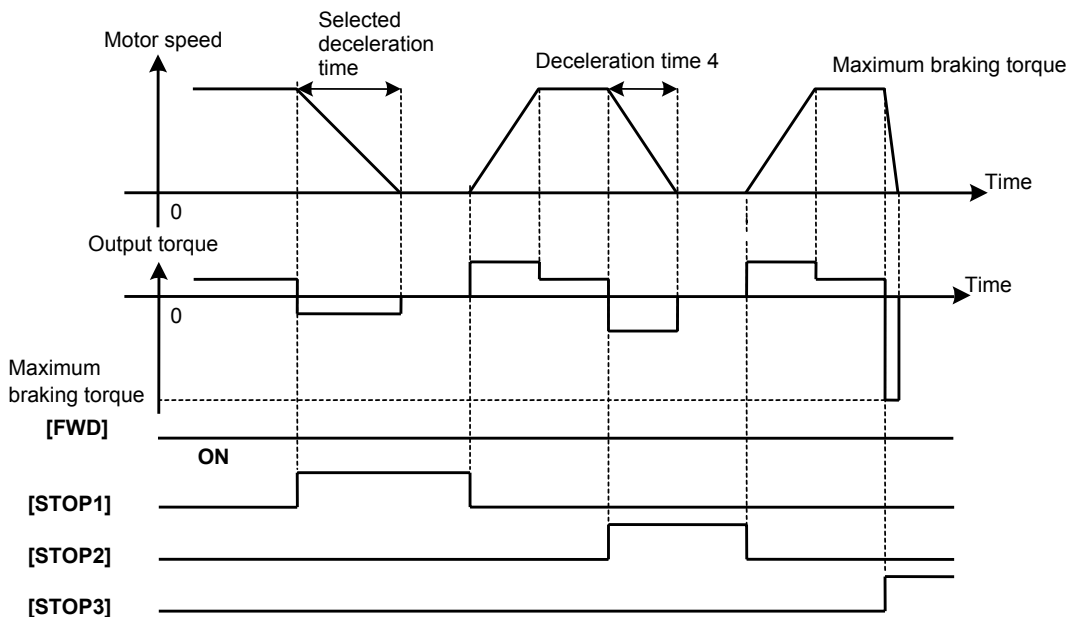
Input signal to select specified data	Function to be selected
53	
OFF	Normal operation
ON	Deceleration to stop (Deceleration time 4)

## 54. STOP3 [STOP3]

The external digital input signal directs to decelerate to stop with the maximum braking torque regardless of the specified deceleration time.

Assign a data 54 to a desired digital input terminal and the existence of the input signal activates the operation.

Input signal to select specified data	Function to be selected
54	
OFF	Normal operation
ON	Deceleration to stop (Maximum braking torque)



55. DIA data latch [DIA]

56. DIB data latch [DIB]

The external digital input signal enables to read in a data through the DI option (OPC-VG7-DIA, DIB). The data is read when the input signal [DIA] or [DIB] is ON and the data is held when the input signal [DIA] or [DIB] is OFF. See the DI option section for more details.

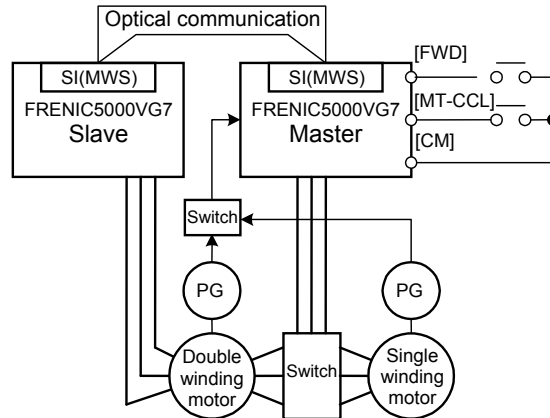
Input signal to select specified data	Function to be selected
55	Function to be selected
OFF	Hold DIA data
ON	Read DIA data

Input signal to select specified data	Function to be selected
56	Function to be selected
OFF	Hold DIB data
ON	Read DIB data

57. Multiwinding motor control cancel [MT-CCL]

The external digital input signal cancels the multiwinding drive with SI (MWS) option (OPC-VG7-SI(MWS)) and switches to the standard single winding motor drive. The function code to switch to the multiwinding drive is o33 "Multiwinding system".

The right figure shows easy connection for changing drives between 2-winding motor and single-winding motor. In this circuit, the slave unit does not need operation command or feedback of PG, NTC signals. With change of motors, PG and NTC signals must be changed as well as the 2nd power circuit. To change PG and NTC signals, use the DI option (OPC-VG7-CPG). For details of the multiwinding system, refer to the description of Options.



Input signal to select specified data	Function to be selected when o33 "Multiwinding system"=1
57	Function to be selected
OFF	Multiwinding motor drive
ON	Single winding motor drive (Multiwinding cancelled)

58 to 61. Option Di1 to 4 [O-DI1 to 4]

Di terminal for manufacturer. Do not assign.

62. Option Di5 [O-DI5]

When the built-in PID function is used, the PID output can be held at zero.

Input signal to select specified data	Function to be selected
62	Function to be selected
OFF	No zero hold of PID output
ON	Zero hold of PID output

63. Option Di6 [O-DI6]

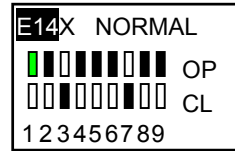
When the built-in PID function is used, the feed forward term can be made valid.

Input signal to select specified data	Function to be selected
63	Function to be selected
OFF	Feed forward term invalid
ON	Feed forward term valid

# 4. Control and Operation

**E14** **X function normally open/normally closed**

- ◆ Sets [X1] to [X9] to be open or closed by software when their terminals do not have connections.  
Use for "NC terminal" connection for functions such as THR (Trip command).  
Setting range: 0000 to 01FF  
0: Normally open  
1: Normally closed



- ◆ Example of setting change through RS485 or other links  
To configure X2 and X5 as normally closed contacts and configure other X functions as normally open contacts.  
(1) Perform bit assignment according to type [35] (refer to Section 13.4.2 Data Type). To configure X2 and X5 as normally closed contacts, enter "0000 0000 0001 0010 (binary)."  
(2) Next, convert the bit-assigned binary data into a hexadecimal.  
0000 0000 0001 0010 (binary) = 0012 (hexadecimal)  
Enter this hexadecimal data.

**E 1 4 X N O R M A L**

**E15-E27** **Y function selection**

- ◆ Part of control signals and monitor signals can be selected and output to the terminals [Y1] to [Y18] and [Y5A].  
The transistor signals are output to the terminals [Y1] to [Y18] and the relay contact signal to [Y5A].  
Use of terminal functions from [Y11] to [Y18] requires the optional OPC-VG7-DIOA.
- ◆ The valid and invalid functions vary according to the control method (vector control, sensorless vector control, V/f control and synchronous motor drive). For details, refer to the function code list in Section 13.

<b>E 1 5</b>	<b>Y 1</b>	<b>F U N C</b>		
<b>E 1 6</b>	<b>Y 2</b>	<b>F U N C</b>		
<b>E 1 7</b>	<b>Y 3</b>	<b>F U N C</b>		
<b>E 1 8</b>	<b>Y 4</b>	<b>F U N C</b>		
<b>E 1 9</b>	<b>Y 5</b>	<b>F U N C</b>		
<b>E 2 0</b>	<b>Y 1 1</b>	<b>F U N C</b>		
<b>E 2 1</b>	<b>Y 1 2</b>	<b>F U N C</b>		
<b>E 2 2</b>	<b>Y 1 3</b>	<b>F U N C</b>		
<b>E 2 3</b>	<b>Y 1 4</b>	<b>F U N C</b>		
<b>E 2 4</b>	<b>Y 1 5</b>	<b>F U N C</b>		
<b>E 2 5</b>	<b>Y 1 6</b>	<b>F U N C</b>		
<b>E 2 6</b>	<b>Y 1 7</b>	<b>F U N C</b>		
<b>E 2 7</b>	<b>Y 1 8</b>	<b>F U N C</b>		

Setting range: 0 to 47

Set value	Function	Symbol	Set value	Function	Symbol
0	Inverter running	[RUN]	21	Alarm indication 4	[AL4]
1	Speed existence	[N-EX]	22	Alarm indication 8	[AL8]
2	Speed agreement	[N-AG]	23	Fan operation signal	[FAN]
3	Speed equivalent	[N-AR]	24	Auto-resetting	[TRY]
4	Detected speed 1	[N-DT1]	25	Universal DO	[U-DO]
5	Detected speed 2	[N-DT2]	26	Heat sink overheat early warning	[INV-OH]
6	Detected speed 3	[N-DT3]	27	Synchronization completion signal	[SY-C]
7	Stopping on undervoltage	[LU]	28	Lifetime alarm	[LIFE]
8	Detected torque polarity (braking/driving)	[B/D]	29	Under accelerating	[U-ACC]
9	Torque limiting	[TL]	30	Under decelerating	[U-DEC]
10	Detected torque 1	[T-DT1]	31	Inverter overload early warning	[INV-OL]
11	Detected torque 2	[T-DT2]	32	Motor temperature early warning	[M-OH]
12	KEYPAD operation mode	[KP]	33	Motor overload early warning	[M-OL]
13	Inverter stopping	[STOP]	34	DB overload early warning	[DB-OL]
14	Operation ready output	[RDY]	35	Link transmission error	[LK-ERR]
15	Magnetic-flux detection signal	[MF-DT]	36	Load adaptive control under limiting	[ANL]
16	Motor M2 selection status	[SW-M2]	37	Load adaptive control under calculation	[ANC]
17	Motor M3 selection status	[SW-M3]	38	Analog torque bias hold	[TBH]
18	Brake release signal	[BRK]	39-47	Optional Do 1 to 9	[O-DO1 to 9]
19	Alarm indication 1	[AL1]			
20	Alarm indication 2	[AL2]			

#### <Using terminal output>

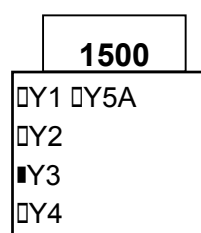
There are 48 types of terminal output functions available. You cannot use all of these functions at the same time. You can use total of thirteen terminals, which are five terminals from Y1 to Y4 and Y5A as standard and eight terminals from Y11 to Y18 using option of DIOA. Similarly to the link function (RS485, T-Link, SX, Field Bus), you can refer to the output of 13 points through communications.

You can use the function code M52, 53 and 54 (control output 1, 2, and 3) to read all information (48 bits in total) that are available for the DO outputs through the link (RS485, T-Link, SX, and field bus) and UPAC.

For details, refer to M52-M54 data types 125, 126 and 127 in the function code list.

#### Setting procedure

- Select a function you want to use. We select the "Operation ready output" command as an example.
- Assign the "Operation ready output" command to one of the available terminals (Y1 to Y4, Y5A, Y11 to Y18). If you want to assign it to Y3, write a data, "14:RDY", to the function code E17 "Y3 function selection".
- Y3 terminal is set to ON after you turn on and the operation becomes ready.
- See the "I/O check" screen of the KEYPAD panel to confirm the ON/OFF status of the Y3. If you switch the Y3 from OFF to ON,  Y3 changes to  Y3 on the screen shown on the right.



#### <You can specify as "NO terminal" or "NC terminal">

You can use the function code E28 to specify the state of individual terminals (standard 5 terminals only) as normally open ("NO terminal") or normally closed ("NC terminal"). See the function description of E28 for more information.

#### 0. Inverter running [RUN]

"Running" is defined as a state when the inverter supplies output. This signal is ON when the inverter is running and OFF when the inverter is stopping.

The inverter does not stop when it is decelerating after you turn OFF the FWD or the REV signal. The inverter shuts down the output and stops when the speed becomes less than the speed specified by F37 "Stop speed" and the zero speed continues for the time specified by F39 "Zero speed holding time".

The status is running during DC braking, pre-exciting, and servo locking (synchronized control completed).



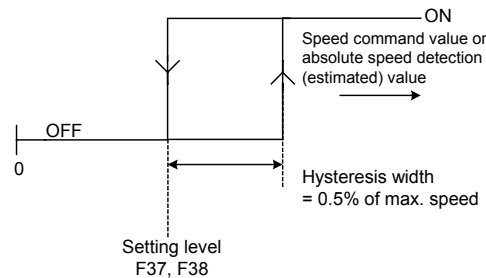
## 4. Control and Operation

### 1. Speed existence [N-EX]

Turns ON when the absolute value of the speed command or the actual speed is more than the value specified by the function code F37 "Stop speed", and OFF when the value is less than the "Stop speed".

You can use the function code F38 "Stop speed (Detection method)" to select either the speed command or the actual speed.

[N-EX]



### 2. Speed agreement [N-AG]

Turns ON when the actual speed value falls in the detection range specified by the speed command value (Speed setting 4: ASR input).

See the function description of E44 "Speed agreement (Detection range) (Off delay timer)" and E45 "Enable/disable alarm for speed disagreement".

### 3. Speed equivalent [N-AR]

Turns ON when the actual speed value reaches the speed command value (Speed command 1: acceleration/deceleration calculation unit input). See the function description of E42.

### 4-6. Detected speed 1, 2, 3 [N-DT1, 2, 3]

Turns ON when the observed speed reaches the Speed detection level 1 (E39), level 2 (E40), or level 3 (E41). See the function description of E39, 40, and 41.

### 7. Stopping on undervoltage [LU]

Turns ON when the undervoltage protective function is active, or the DC link circuit voltage of the main circuit decreases down below the undervoltage detection level. This function is not active when the "undervoltage alarm cancel" signal is ON.

This signal turns OFF when the voltage recovers to exceed the undervoltage detection level.

Undervoltage detection level 200V series: 186V, 400V series: 371V

### 8. Detected torque polarity (braking/driving) [B/D]

Provides a signal indicating whether the torque is for driving or for braking by detecting the polarity of the calculated torque inside the inverter.

Turns OFF for the driving torque and turns ON for the braking torque.

### 9. Torque limiting [TL]

Turns on when the torque command is limited by the torque limiter 1 or 2.

### 10, 11. Detected torque 1, 2 [T-DT1, 2]

Turns on when the torque command increases over the Torque detection level 1 or 2 (E46 or E47).

### 12. KEYPAD operation mode [KP]

Turns ON when the operation command keys (FWD, REV, STOP keys) directing running/stopping are effective (F02 "Operation method"=0).

### 13. Inverter stopping [STOP]

Supplies an inverted signal of the [RUN] signal indicating zero speed.

Provides the ON signal during DC braking, pre-exciting, and servo locking (synchronized control completed).

### 14. Operation ready output [RDY]

Turns ON when the inverter is ready for the operation, for example, the power supply to the main and the control circuits are established or the inverter protective function is not active. Under a normal condition, the inverter becomes ready in about one second after you turn on. During operation with the UPAC option (o38 ≠ 0), [RDY] is turned on upon UPAC operation in addition to the above-mentioned condition. (It takes about 2 or 3s.)

This signal is turned off if the coast-to-stop command is turned on.

15. Magnetic-flux detection signal [MF-DT]

Turns ON when the magnetic-flux command values increases over the Magnetic-flux detection level (E48-5%).

16, 17. Motor M2, M3 selection status [SW-M2, M3]

Provides the motor switching signal to the magnetic contactor for a motor according to the selected motor M1, M2, or M3 selected by the function code F79 or X control terminal.

Combination of the output signals		Motor to be selected
[SW-M3]	[SW- M2]	
OFF	OFF	Motor 1
OFF	ON	Motor 2
ON	OFF	Motor 3
ON	ON	Motor 1

18. Brake release signal [BRK]

◆Provides the mechanical brake apply/release signal.

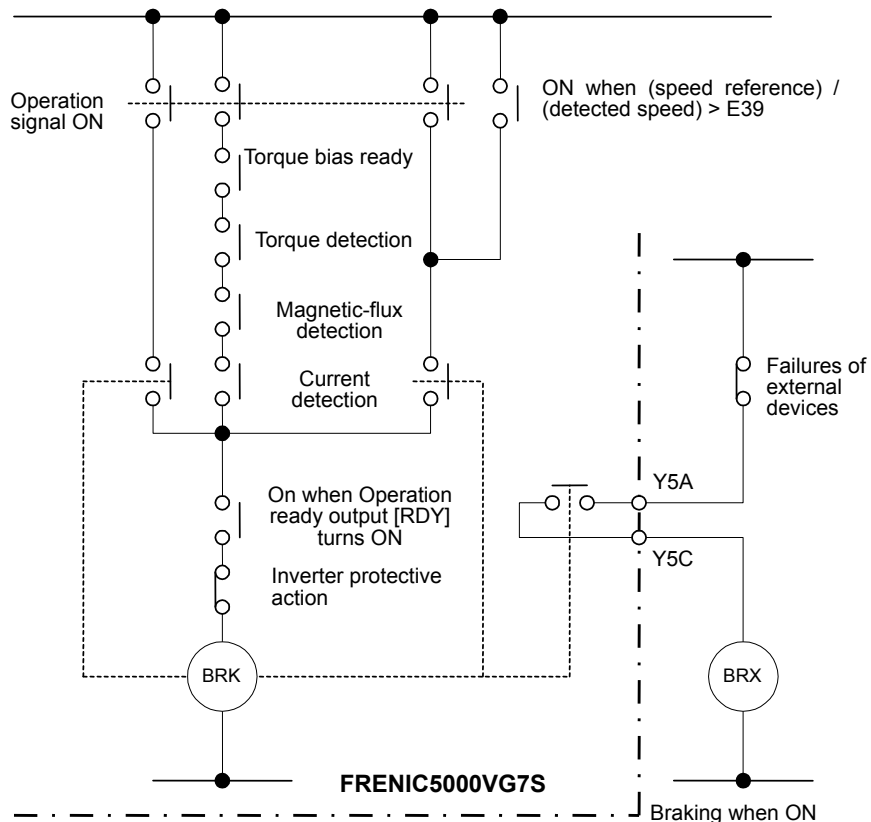
There are the Torque bias, the Torque detection level 1, and the Magnetic-flux detection level as parameters (user defined) for releasing (opening) brake.

There is the speed detection level 1 as parameter for applying brake.

Usually you should assign the brake releasing signal to the relay output (Y5A and Y5C) of the VG7S standard DO. This signal is connected to the external mechanical brake (BRX relay). The action of the mechanical brake is "NC contact".

Y5A-Y5C: Brake is released on ON (closed)

Y5A-Y5C: Brake is applied on OFF (open)



Servo locking function (braking not by a mechanical brake but by the inverter output torque) is also available. See the zero speed locking command in E01 to E13 "X function selection" for more details. We recommend to use the servo lock function not independently but together with a mechanical brake.

# 4. Control and Operation

## <Setting>

### Brake release sequence

The following procedure turns ON the Brake release signal [BRK] and releases the mechanical brake.

- 1) Operation ready output [RDY] turns ON to release the mechanical brake after the power supply to the main is turned on, the control circuit voltage is established, and the initialization is completed.
- 2) The inverter protective function (alarm) is not active.
- 3) The operation command (FWD or REV) is ON.
- 4) Current detection: The presence of overcurrent level/64 is considered as "detected".
- 5) Magnetic-flux detection: Specified by the function code E48 "Magnetic-flux detection level"
- 6) Torque detection: Specified by the function code E46 "Torque detection level 1". There are two torque detection levels, Torque detection level 1 (E46) and Torque detection level 2 (E47). Use E46 for the Forward command (FWD) and E47 for the Reverse command (REV).
- 7) Torque bias ready: You can use the activation timer (function code F50) to set the rise time for the bias when you add a torque bias (function code F46 to F49). This time duration is defined as "torque bias ready".

### Brake applying sequence

The following procedure turns OFF the Brake release signal [BRK] and applies the mechanical brake.

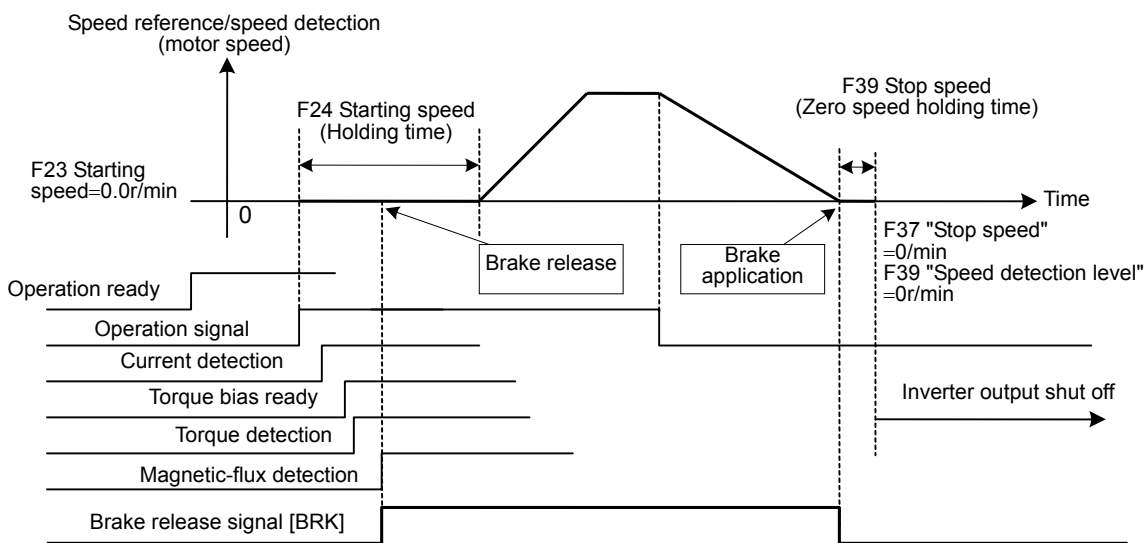
- 1) The operation command (FWD or REV) is OFF.
- 2)  $(\text{Speed reference value}/\text{Detected speed value}) < \text{Speed detection level 1}$   
 Select the speed reference for sensorless control.  
 Use the third digit (0: Speed detection, 1: Speed reference) of the function code E38 "Speed detection method" to select the detection method (reference, detection) and use the function code E39 "Speed detection level 1" to set the Detection level 1.

### Starting speed/Stop speed

You should also set the Starting speed (function code F23 and F24) and the Stop speed (function code F37 to F39) for the brake sequence.

Starting speed: Set to the zero speed control (F23=0.0r/min) to release the brake in less than zero speed holding time (F24).

Stop speed: When you set to the zero speed control (F37=0.0r/min), the Brake release signal is set to OFF when a motor (machine) stops completely.



#### 19-22. Alarm indication [AL1, 2, 4, 8]

Provides the operation status of the inverter protection function.

Alarm description (Inverter protective function)	Output terminal			
	[AL1]	[AL2]	[AL4]	[AL8]
No alarm	OFF	OFF	OFF	OFF
Overcurrent (EF, OC)	ON	OFF	OFF	OFF
Overvoltage (OU)	OFF	ON	OFF	OFF
Undervoltage (LU)	ON	ON	OFF	OFF
Main circuit error (dcF, PbF)	OFF	OFF	ON	OFF
CPU system error (Er1, Er3, Er8, ErA)	ON	OFF	ON	OFF
Overheat (dBH, OH1, OH3, OH4)	OFF	ON	ON	OFF
Overload (OL1, OL2, OL3, OLU)	ON	ON	ON	OFF
Speed error (dO, Er9, OS)	OFF	OFF	OFF	ON
Input phase loss (Lin)	ON	OFF	OFF	ON
Inverter output circuit error (Er7)	OFF	ON	OFF	ON
Communication error (Er2, Er4, Er5, Erb)	ON	ON	OFF	ON
Signal disconnection (nrb, PG)	OFF	OFF	ON	ON
Operation procedure error (Er6)	ON	OFF	ON	ON
External fault (OH2)	OFF	ON	ON	ON
Others (IPE, Ar1 to ArF)	ON	ON	ON	ON

#### 23. Fan operation signal [FAN]

This signal is associated with H06 "Fan stop operation" and is present when the cooling fan is operating.

#### 24. Auto-resetting [TRY]

This signal is issued when the protective function is conducting the retry operation if you set one or more to H04 "Auto reset (Times)".

# 4. Control and Operation

## 25. Universal DO [U-DO]

You assign a data 25 to a digital output terminal to use it as a universal DO terminal. You can turn on/off through RS485, field bus, and UPAC. This function simply set ON and OFF to the transistor and relay outputs without affecting the inverter functions.

The applications of this signal are:

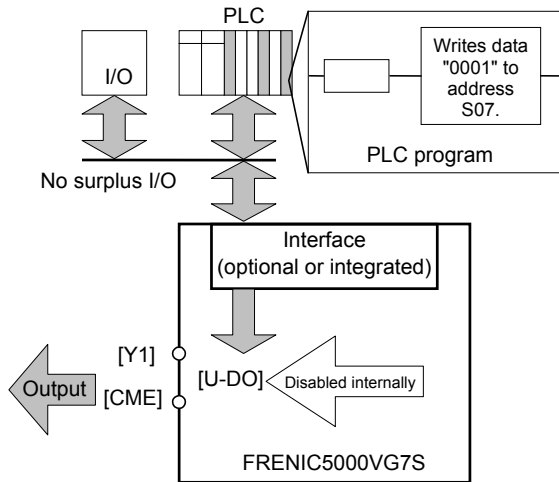
- 1) To set ON/OFF to the control terminal directly through RS485 or field bus.
- 2) To put the output which are assigned by the software created by the UPAC option on a DO of the control terminals.

### <Application>

You do not have enough numbers of I/O and want to use an inverter control terminal for a control output of a PLC program.

If you use the control terminal [Y1]:

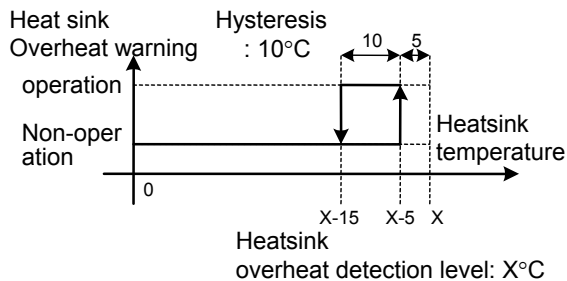
- 1) Set 25 [U-DO] to the function code E15 "Y1 function selection". Now the inverter does not use the Y1 terminal internally and you can use the terminal for the output of the communication.
- 2) Use the PLC to write "1" to the corresponding bit (data type: 33) of the function code S07 "Universal DO". You will write "0001 [h]" for [Y1].



## 26. Heat sink overheat early warning [INV-OH]

The heat sink overheat early warning will be issued when the temperature of the heat sink reaches the temperature five degrees less than the detection level of "Heat sink overheat alarm" (OH1). This is an early warning for the "Heat sink overheat alarm" which is present when the ambient temperature of the heatsink that cools the rectifier diode and the IGBT (PWM switching device) due to the failure of the cooling fan.

The heat sink overheat level ( $X^{\circ}\text{C}$ ) is set within the range of about 80 to 110 $^{\circ}\text{C}$  based on the inverter capacity and short-time rating (CT, VT, and HT), and user cannot change it.



---

### 27. Synchronization completion signal [SY-C]

Turns ON when the synchronization completes within the pulse width specified by the function o19 "Deviation zero range" during the synchronizing operation with an option OPC-VG7-PG (PR). See the option section for more details.

It also turns ON when the lock completes within the pulse width specified by the function H56 "Zero speed control (completion range)". See the function description of the zero speed locking command (function code E01 to E13).

### 28. Lifetime alarm [LIFE]

Turns ON when the accumulated operation time of main circuit smoothing capacitor, the electrolytic capacitor on the control print circuit board, or the cooling fan.

The lifetime is determined by the following criteria and the lifetime is considered to be expired if either of them is reached. You can see them in the maintenance information of the KEYPAD panel.

Part	Life time determination level
Main circuit capacitor	85.0% or less of the initial value. Life time expires when CAP=85.0%.
Electrolytic capacitor on control print circuit board	Accumulated time: 61,000 hours
Cooling fan	25,000 hours Estimated life time in 45°C of inverter ambient temperature

This function indicates merely an approximate life span. Daily inspection and periodic inspection are necessary to avoid failures and keep operating at high reliability over a long period of time. (Refer to Chapter 8 in Instruction manual INR-HF51306x.)

Correct measurement of the capacity of the electrolytic capacitor in the main circuit is not obtained under the following conditions.

- (1) An option card is used in the inverter. (\*1)
- (2) A braking unit or a DC bus of another inverter is connected at main circuit terminals P(+) and N(-).
- (3) The digital input (FWD, REV, X1-X9) at the control terminal is turned on.
- (4) RS485 communication is used.
- (5) The R0, T0 auxiliary power supply is used.

(\*1) If this function is used under this condition, the initial value of the capacitor capacitance must be entered again. For the entry method, contact Fuji separately.

### 29. Under accelerating [U-ACC]

### 30. Under decelerating [U-DEC]

Turns ON during acceleration or deceleration.

Acceleration or deceleration is determined by comparing the input to the acceleration/deceleration calculation unit (Speed reference 1) and the detected speed value. The Under-acceleration/deceleration signal turns OFF when the speed reaches to a level specified by the function code E42 "Speed equivalent (Detection range)".

### 31. Inverter overload early warning [INV-OL]

Provides the overload early warning signal at a level specified by the Inverter overload early warning (E33). See the E33 "Inverter overload early warning" for more details.

### 32. Motor temperature early warning [M-OH]

Provides the overheat early warning signal at a level specified by the Motor overheat early warning (E31). See the E31 "Motor overheat early warning" for more details.

### 33. Motor overload early warning [M-OL]

Provides the overload early warning signal at a level specified by the Inverter overload early warning (E34). See the E34 "Inverter overload early warning" for more details.

## 4. Control and Operation

### 34. DB overload early warning [DB-OL]

Provides the overload early warning signal at a level specified by the DB overload early warning (E36). See the E36 "DB overload early warning" for more details.

### 35. Link transmission error [LK-ERR]

Turns ON when a communication error occurs in the transmission through the link (RS485, T-Link, SX, field bus). Turns OFF when the communication returns to normal.

### 36. Load adaptive control under limiting [ANL]

### 37. Load adaptive control under calculation [ANC]

Refer to the description given for function codes H60 to 66 "Automatic Load Compensation Function."

### 38. Analog torque bias hold [TBH]

Turns on when the analog bias hold command is present.

### 39-47. Option Do1 to 9 [O: DO1 to 9]

Do terminal for manufacturer. Do not assign.

## E28 Y function normally open/normally closed

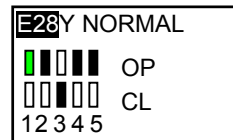
- ◆ Sets Y1 to Y5 to be open or closed by software.

**E 2 8 Y N O R M A L**

Setting range: 0000 to 01FF

0: Normally open

1: Normally closed



- ◆ Example of setting change through RS485 or other links

To configure Y2 and Y5 as normally closed contacts and configure other Y functions as normally open contacts

1) Perform bit assignment according to type [36] (refer to Section 13.4.2 Data Type).

To configure Y2 and Y5 as normally closed contacts, enter "0000 0000 0001 0010 (binary)."

2) Next, convert the bit-assigned binary data into a hexadecimal.

0000 0000 0001 0010 (binary) = 0012 (hexadecimal)

Enter this hexadecimal data.

## E29 PG pulse output selection

- ◆ Use this function to provide different applications with the PG pulse signal.

**E 2 9 P G - P L S - O U T**

1) You can divide the pulse signal to supply.

Set value: 0: 1/1, 1: 1/2, 2: 1/4, 3: 1/8, 4: 1/16, 5: 1/32, 6: 1/64

The input signal to the integrated PG is divided for output as presented above. You can use the divided signal for digital speedometer.

2) You can convert the internal speed command (digital and analog) into pulse to supply. See the <Application example 2> of Synchronization command [SYC] of the function codes E01 to E13 for more details.

Set value: 7: Pulse generation mode (A, B: Signals with 90° phase difference)

3) You can put the optional PG input on the pulse output.

Set value: 8: OPC-VG7-PG (PD), pulse train detection input is directly supplied to the pulse output.

9: OPC-VG7-PG (PR), pulse train command input is directly supplied to the pulse output.

See the <Application example 3> of Synchronization command [SYC] of the function codes E01 to E13 for more details.

---

**E30**

**Motor overheat protection  
(Temperature)**

- ◆ Sets the temperature at which the motor overheat alarm is issued. Specify the protection level according to the isolation class of the motor.

**E 3 0 M - P R T C - T**

Note: This function is available for the motor temperature input from the NTC thermistor or the Ai.  
Setting range: 100 to 200 [°C]

**E31**

**Motor overheat early warning  
(Temperature)**

- ◆ Sets the temperature at which the motor overheat early warning is issued before the overheat protection becomes active. The early warning signal is put on the DO to which [M-OH] is assigned.

**E 3 1 M - W A R N - T**

Note: This function is invalid if the PTC thermistor is used.  
Setting range: 50 to 200 [°C]

**E32**

**M1-M3 PTC operation level**

- ◆ Activated when the input voltage from a PTC becomes higher than the specified voltage (activation level) if you select to use a thermistor.

**E 3 2 M - P T C - L V L**

Setting range: 0.00 to 5.00 [V]

The warning temperature depends on a PTC thermistor and the resistor of the PTC thermistor changes drastically at the warning temperature. The activation (voltage) level is specified by this change of the resistor.

**E33**

**Inverter overload early warning**

- ◆ Sets the level at which the overload early warning is issued before the Inverter overload protection becomes active. When you set 100%, the early warning is simultaneously issued with the overload protection. The early warning signal is put on the DO to which [INV-OL] is assigned.

**E 3 3 I N V - O L W A R N**

Setting range: 25 to 100 [%]

**E34**

**Motor overload early warning**

- ◆ Sets the level at which the overload early warning is issued before the Motor overload protection becomes active. When you set 100%, the early warning is simultaneously issued with the overload protection. The early warning signal is put on the DO to which [M-OL] is assigned.
- ◆ This function is valid only if the first motor is selected. The motor overload early warning function does not operate if the second or third motor is selected.

**E 3 4 M - O L - W A R N**

Setting range: 25 to 100 [%]

**E35**

**DB overload protection**

- ◆ Sets in %ED with respect to the inverter capacity. When you use a braking resistor with 10%ED, set as 10%. When the set value is zero, the overload protection (dBH) becomes disabled.

**E 3 5 D B - O L - P R T C**

Setting range: 0 to 100 [%]



# 4. Control and Operation

## E36 DB overload early warning

◆ Sets the level at which the overload early warning is issued before the DB overload protection becomes active. When you set 100%, the early warning is simultaneously issued with the overload protection. The early warning signal is put on the DO to which [DB-OL] is assigned.

**E 3 6 D B - O L - W A R N**  
 Setting range: 0 to 100 [%]

## E37 DB thermal time constant

◆ Sets the thermal time constant of a DB resistor to be used.

**E 3 7 D B - T H - T C**  
 Setting range: 0 to 1,000 [s]

## E38 Speed detection method

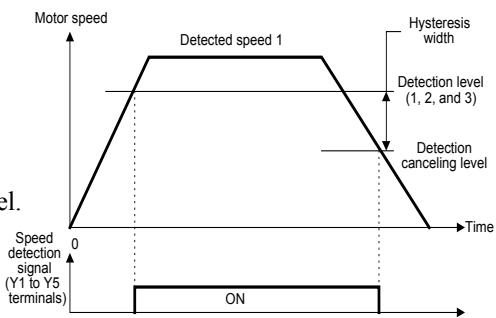
## E39 Speed detection level 1

## E40 Speed detection level 2

## E41 Speed detection level 3

◆ Provide signals when the Detected speed 1 [N-FB1±] /Speed reference 4 [N-REF4] exceeds the detection level (1, 2, and 3). The detected signals are present on the DO's to which [N-DT1], [N-DT2], and [N-DT3] are assigned. You can set the detection method (detection, speed reference) individually.

**E 3 8 N D T M E T H O D**  
**E 3 9 N D T 1 - L V L**  
**E 4 0 N D T 2 - L V L**  
**E 4 1 N D T 3 - L V L**



### - Detection level

You can specify three types of speed detection level.

(Level 1)

Setting range: 0 to 24,000 [r/min]

Note: The absolute value of the speed is used.

(Level 2 and 3)

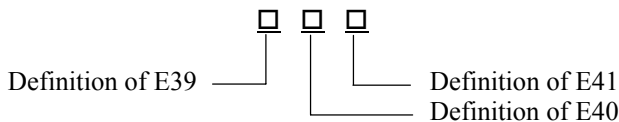
Setting range: -24,000 to 24,000 [r/min]

Note: When the speed reference value exceeds the maximum speed, the reference value is interpreted as the maximum speed. The hysteresis width is 1% of the maximum speed.

### - Detection method

The detection method of the speed detection function can be individually specified.

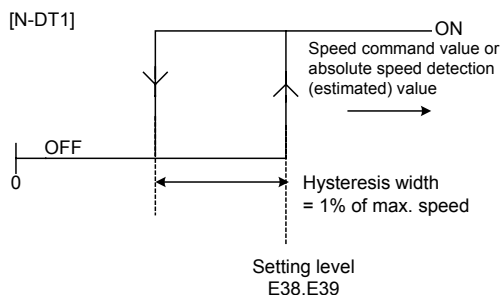
Setting range: 000 to 111 (0: speed detection (estimated). 1: speed reference)



Speed detection is judged at speed detection 1

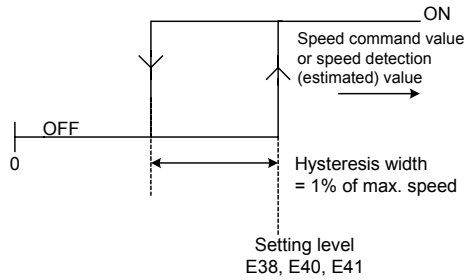
[N-FB1±].

Speed setting is judged at speed reference 4 (ASR input) [N-REF4].

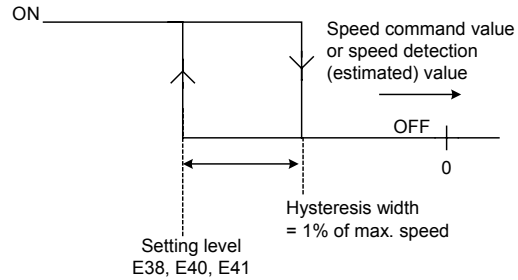


[N-DT2] [N-DT3]

If the setting level is positive

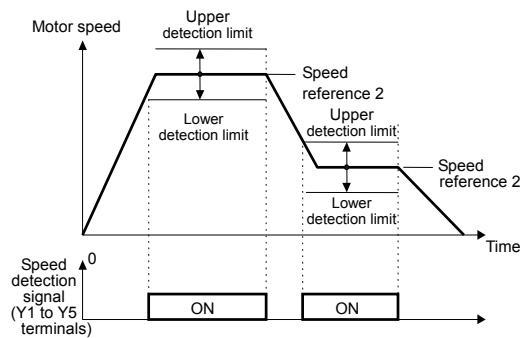


If the setting level is negative

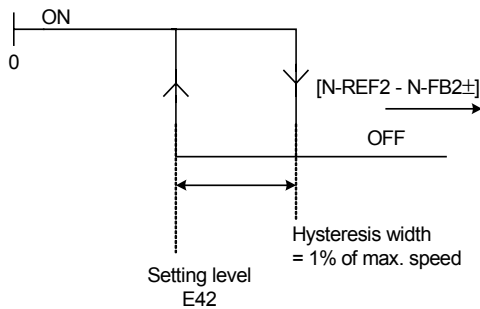


**E42 Speed equivalence (Detection range)**

◆ Specifies the level (detection range) to determine whether the Detected speed 2 (ASR input) [N-FB2±] reaches the Speed reference 2 (before the acceleration/deceleration calculation) [N-REF2]. The inverter provides the detection signal when the detected speed is between the Speed reference 2 plus the hysteresis and the Speed reference 2 minus the hysteresis. The 100% means the maximum speed. The detection signal appears on the DO to which the [N-AR] is assigned.



[N-AR]



**E 4 2 N A R - H Y S T R**

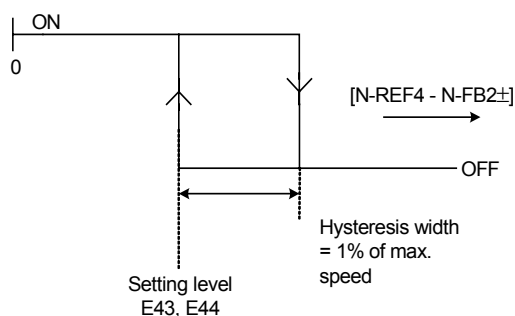
Setting range: 1.0 to 20.0 [%]

**E43 Speed agreement (Detection range)**

**E44 Speed agreement (Off delay timer)**

◆ Set the agreement levels (agreement ranges) of the Speed reference 4 (ASR input) [N-REF4] and the Detected speed 2 [N-FB2±]. The inverter provides the detection signal when the Detected speed 2 is between the Speed reference 4 plus the Detection range and the Speed reference 4 minus the Detection range.

[N-AG]



## 4. Control and Operation

- ◆ The 100% means the maximum speed. The detection signal appears on the DO to which the [N-AR] is assigned. You can also set the off delay timer for the detection signal. If the Detected speed 2 goes out and returns to the detection range in a period specified by the off delay time, the detection signal will not be set to OFF.

E	4	3	N	A	G	H	Y	S	T	R	
E	4	4	N	A	G	D	E	L	A	Y	

Setting range: E43 = 1.0 to 20.0 [%]

E44 = 0.000 to 1.000 [s]

**E45**

### Use or do not use speed disagreement alarm Phase loss detection level setting

- ◆ Specifies whether the Speed disagreement alarm (Er9) is issued or not when the deviation between the Speed reference 4 (ASR input) and the Detected speed 2 remains for a certain period.
- ◆ The detection level of the phase loss detection alarm (Lin) can be changed. Refer to page 4-177, too.

E	4	5	N	-	U	E	-	A	L	M	
---	---	---	---	---	---	---	---	---	---	---	--

Setting:

Speed disagreement alarm 0: Not used. 1: Used.

Phase loss detection alarm 0: Standard level  
1: With DCR

2: For manufacturer (Do not change.)

**E46**

### Torque detection level 1

**E47**

### Torque detection level 2

- ◆ Provides a detection signal when the torque command exceeds a specified value. You can specify two levels of detection level, level 1 and level 2. 100% means a torque command of the continuous rating. The detection signals appear on the DO's to which the [T-DT1] and [T-DT2] are assigned.

E	4	6	T	D	T	1	-	L	V	L	
E	4	7	T	D	T	2	-	L	V	L	

Setting range: 0 to 300.0 [%]

Note: The calculated torque value is used for determination in V/f control.

**E48**

### Magnetic-flux detection level

- ◆ Provides a detection signal when the calculated magnetic-flux value exceeds a specified value. The detection signal appears on the DO to which the [M-DT] is assigned.

E	4	8	M	F	D	T	-	L	V	L	
---	---	---	---	---	---	---	---	---	---	---	--

Setting range: 10 to 100 [%]

**E49-E52**

### Ai function selection

- ◆ You can select functions for the analog input Ai1 to Ai4 from the following.
- ◆ Valid and invalid functions vary according to the control method (vector control, sensorless vector control, V/f control and synchronous motor drive). For details, refer to the function code list in Chapter 13.

E	4	9	A	i	1	F	U	N	C	
E	5	0	A	i	2	F	U	N	C	
E	5	1	A	i	3	F	U	N	C	
E	5	2	A	i	4	F	U	N	C	

Set value: 0 to 18

Set value	Function	Symbol	Scale
0	Input signal off	[OFF]	–
1	Auxiliary speed setting 1	[AUX-N1]	$\pm 10V/\pm N_{max}$
2	Auxiliary speed setting 2	[AUX-N2]	$\pm 10V/\pm N_{max}$
3	Torque limiter (level 1)	[TL-REF1]	$\pm 10V/\pm 150\%$
4	Torque limiter (level 2)	[TL-REF2]	$\pm 10V/\pm 150\%$
5	Torque bias command	[TB-REF]	$\pm 10V/\pm 150\%$
6	Torque command	[T-REF]	$\pm 10V/\pm 150\%$
7	Torque current command	[IT-REF]	$\pm 10V/\pm 150\%$
8	Creep speed 1 in UP/DOWN setting	[CRP-N1]	$\pm 10V/\pm N_{max}$
9	Creep speed 2 in UP/DOWN setting	[CRP-N2]	$\pm 10V/\pm N_{max}$
10	Magnetic-flux command	[MF-REF]	$+10V/+100\%$
11	Detected line speed	[LINE-N]	$\pm 10V/\pm N_{max}$
12	Motor temperature	[M-TMP]	$+10V/200\text{ }^{\circ}\text{C}$
13	Speed override	[N-OR]	$\pm 10V/\pm 50\%$
14	Universal Ai	[U-AI]	$\pm 10V/\pm 4,000\text{ [h]}$
15	PID feedback value	[PID-FB]	$\pm 10V/\pm 20,000\text{ [d]}$
16	PID command value	[PID-REF]	$\pm 10V/\pm 20,000\text{ [d]}$
17	PID correction gain	[PID-G]	$\pm 10V/\pm 4,000\text{ [h]}$
18	Option Ai	[O-AI]	$\pm 10V/\pm 7,FFF\text{ [h]}$

#### <Using analog input>

There are 19 types of analog input functions from 0 to 18 available. You cannot use all of these functions at the same time. You can use total of four terminals, which are two terminals, [Ai1] and [Ai2], as standard and two terminals, [Ai3] and [Ai4], using optional AIO. The maximum number you can use is four unless you switch externally.

When you assign the same function to [Ai1] and [Ai2], the input to [Ai2] will become effective. When you install the AIO option and assign the same function to [Ai1], [Ai2], [Ai3], and [Ai4], the input to [Ai4] will become effective. Note that you should assign [U-AI] to all the analog input terminals at the same time.

#### Setting procedure

- Select a function you want to use. We select the "Torque bias" as an example.
- Assign the "Torque bias" function to one of the available terminals ([Ai1] to [Ai4]). If you want to assign it to [Ai2], write a data, "5:TB-REF", to the function code E50 "Ai2 function selection".
- Apply a voltage of  $\pm 10V/\pm 150\%$  to the analog terminal [Ai2] considering the scale conversion of the torque bias in mind.  
If you need the torque bias of 15%, you should apply +1.0V.
- See the "I/O check" screen of the KEYPAD panel to confirm that +1.0V is applied to [Ai2]. The right figure shows the screen you must view.
- You can specify the bias, the gain, the filter and the increment/decrement limiter applied to the analog input.

<b>1500</b>
12 = 0.0 V
Ai1 = 0.2 V
Ai2 = 1.0 V

Function	Application
Bias	Sets the bias.
Gain	Use to enlarge a small voltage range or to reduce a large voltage range. Use a minus value to invert the polarity.
Filter	Use to eliminate high frequency ripple and noise on the input voltage. Since you apply a low-pass filter, excessive setting may slow down the response.
Increment/decrement limiter	Slants a step input voltage. The specified values work as rising and falling times.

See the description of the individual function codes for more details.

- You can use the DI terminal input to hold the analog input to zero or to invert the polarity of the analog input. See Ai zero hold and Ai polarity change of E01 to E13 "X function selection" for more details.

See also the control block diagram to work with this function effectively.

## 4. Control and Operation

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### 0. Input signal off [OFF]

Select when you want assign no function to an analog input terminal.

Use when you do not use the analog input terminals.

### 1, 2. Auxiliary speed setting 1, 2 [AUX-N1, 2]

Assign a data 1 [AUX-N1] and a data 2 [AUX-N2], to desired analog input terminals to designate them as Auxiliary speed setting 1 and Auxiliary speed setting 2 terminals. See the table below and the control diagram for the points where the control inputs are applied. This function adds a speed ( $\pm 10V$  corresponds  $\pm$ maximum speed) to main speed command values ( [12] input and the multistep speed command). Two points are available to add a speed.

Auxiliary speed setting	Point of application	Restrictions
1 [AUX-N1]	After multistep speed command	Disabled when you use "0: KEYPAD panel" and "3, 4, 5: UP/DOWN functions" of the function codes F01 and C25.
2 [AUX-N2]	After acceleration/deceleration calculation (acceleration/deceleration calculation applied to input is disabled)	

If auxiliary speed setting 2 is larger than the stopping speed level (F37), the motor keeps rotating at auxiliary speed setting 2 even after the operation command (FWD, REV) is turned off. In this case, use the Ai zero hold function with X function selection to zero-hold the Ai input simultaneously when the operation command is turned off.

### 3, 4. Torque limiter (level 1, 2) [TL-REF1, 2]

Assign a data 3 [TL-REF1] and a data 2 [TL-REF2] to desired analog input terminals to designate them as Torque limiter (level 1) and Torque limiter (level 2) terminals. See the function codes F40 to 43 for torque limiter.

### 5. Torque bias command [TB-REF]

Assign a data 5 [TB-REF] to a desired analog input terminal to designate it as Torque bias command terminal. See the function code F47 to 49 for more details.

### 6. Torque command [T-REF]

Assign a data 6 [T-REF] to a desired analog input terminal to designate it as Torque command terminal. See the control block diagram and the function code H41 "Torque command selection" for more details.

### 7. Torque current command [IT-REF]

Assign a data 7 [IT-REF] to a desired analog input terminal to designate it as Torque current command terminal. See the control block diagram and the function code H42 "Torque current command selection" for more details.

### 8, 9. Creep speed 1 and 2 in UP/DOWN setting [CRP-N1, 2]

Assign a data 8 [CRP-N1] and a data 9 [CRP-N2] to desired analog input terminals to designate them as Creep speed 1 and Creep speed 2 terminals. See the UP/DOWN functions of the function codes E01 to 13 for more details.

The Ai input is processed as an absolute value.

### 10. Magnetic-flux command [MF-REF]

Assign a data 10 [MF-REF] to a desired analog input terminal to designate it as Magnetic-flux command terminal. See the control block diagram and the function code H43 "Magnetic-flux command value" for more details.

### 11. Detected line speed [LINE-N]

Assign a data 11 [LINE-N] to a desired analog input terminal to designate it as Detected line speed terminal. See the control block diagram and the function code H53 "Line speed feedback selection" for more details.

### 12. Motor temperature [M-TMP]

Assign a data 12 [M-TMP] to a desired analog input terminal to designate it as Motor temperature terminal. When you use a VG dedicated motor (VG3, VG5, VG7), you can use the NTC thermistor supplied with a motor to detect the motor temperature and to protect the motor from overheat. When you use a motor with a PTC thermistor, you can use it for overheat protection. You can also use an electronic thermal relay for protection against motor overload.

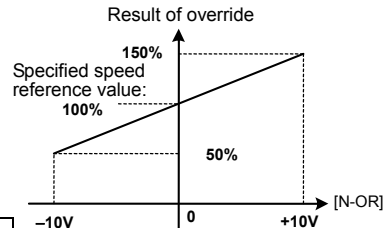
You can use this function to build your own motor overheat protection system detecting the motor temperature directly without using method mentioned above.

You can use the function code E30 "Motor overheat protection" and E31 "Motor overheat early warning" to specify the detection levels.

### 13. Speed override [N-OR]

Assign a data 13 [N-OR] to a desired analog input terminal to designate it as Speed override terminal.

You can supply +10V to override the speed with 150% of the speed reference and supply -10V to override with 50% of the speed reference. See the control diagram for a point of the control input.



Speed override	Point of application	Restrictions
13 [N-OR]	Just after Auxiliary speed setting 1	Disabled when you use "0: KEYPAD panel" and "3, 4, 5: UP/DOWN functions" of the function codes F01 and C25. Used for acceleration/deceleration calculation. Restricted by the maximum speed.

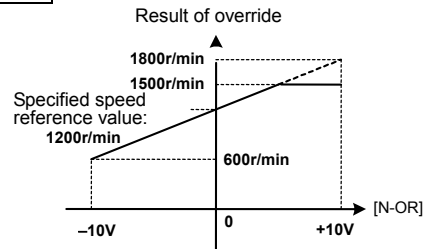
#### <Application example>

You can specify the coarse/fine adjustment of the speed.

Specified maximum speed value: 1,500r/min

Specified speed reference value: 1,200r/min (100%)

Input voltage applied to the terminal [N-OR]: ±10V



#### Coarse adjustment

As shown in the right graph, the overridden value is 600r/min for -10V input and is restricted by the maximum speed for +10V input.

Applying voltage enables coarse speed adjustment around the speed reference (1,200r/min).

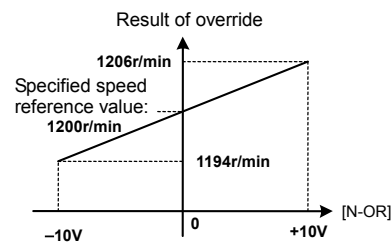
#### Fine adjustment

Set the gain of used [Ai] to 0,01 (function code E53 to 56).

As shown in the right graph, the overridden value is 1194r/min for -10V input and is 1206r/min for +10V input. Applying voltage enables fine speed adjustment around the speed reference (1,200r/min).

Either the reference value of the maximum speed or the precision of the analog input determines the resolution.

In this example, the resolution is determined by the former one: 0.08r/min.



The larger value between the following values determines the resolution.

Reference value of the maximum speed: 1,500r/min ÷ internal data

20,000 = 0.075r/min ≈ 0.08r/min

Precision of the analog input: Unipolar scale (6r/min) is divided into 15 bit. Thus, 6r/min ÷ 32767 (15bit) × 100 (scaling) = 0.018r/min

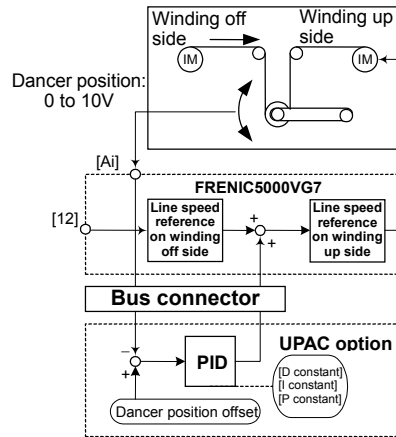
# 4. Control and Operation

## 14. Universal Ai [U-AI]

Assign a data 14 [U-AI] to a desired analog input terminal to designate it as Universal Ai terminal. You can use this function to check the existence of the input signal through communication and this function does not affect the inverter operation.

You can use this signal to the following applications.

- 1) You can read out input signal as an analog data through RS485 or optional field bus.
- 2) You can use Ai for an input to a software you create with the UPAC option or the PLC without affecting the inverter operation.



### <Application example>

The right figure shows a diagram of a winding control utilizing dancer control.

The UPAC option uses PID control for dancer position control. The line speed command generated by adding the PID output to the line speed command for the winding off side from [12] is supplied to the winding up side.

You can use an [Ai] terminal to read the dancer position detected by a potentiometer.

If you assign Universal Ai [U-AI] to the AI input, the output of the potentiometer is directly available to the UPAC. See the description of the UPAC for more details on the UPAC.

You can also use [U-AI] to control in the same manner if you replace the UPAC option and the bus connector with the PLC and the communication line.

## 15. PID feedback value [PID-FB]

## 16. PID command value [PID-REF]

## 17. PID correction value [PID-G]

Assign a data 15 [PID-FB], a data 16 [PID-REF] and a data 17 [PID-G] to desired analog input terminals to designate them as PID feedback value, PID command value, and PID correction value terminals, respectively.

These terminals can be used as input terminals for feedback signals, command signals and correction signals in the process under PID control.

See the function codes H19 to H26 for more details on the PID functions.

## 18. Option Ai [O-AI]

Reserved for options and special applications

### E53-E56

### Ai gain setting

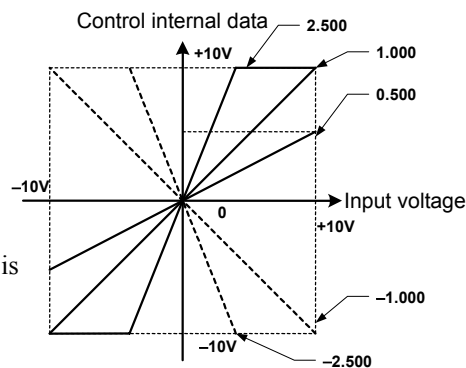
◆ You can specify a times applied to the analog input (Ai1 to 4 terminals)

E	5	3	G	A	I	N	A	i	1		
E	5	4	G	A	I	N	A	i	2		
E	5	5	G	A	I	N	A	i	3		
E	5	6	G	A	I	N	A	i	4		

Setting range: -10.000 to 10.000 [times]

Note: [Ai3, 4] are available only when you install OPC-VG7-AIO.

◆ The data changed with the ^ or v key at the keypad panel is valid. To save to the backup memory, press the FUNC/DATA key.



**E57-E60****Ai bias setting**

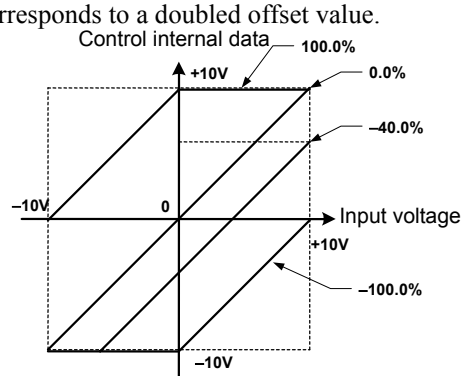
- ◆ Sets a bias to the analog input [Ai1-4]. A value of 100% corresponds to a doubled offset value.

E	5	7	B	I	A	S	A	i	1	
E	5	8	B	I	A	S	A	i	2	
E	5	9	B	I	A	S	A	i	3	
E	6	0	B	I	A	S	A	i	4	

Setting range: -100.0 to 100.0 [%]

Note: [Ai3, 4] are available only when you install OPC-VG7-AIO.

- ◆ The data changed with the  $\wedge$  or  $\vee$  key at the keypad panel is valid. To save to the backup memory, press the FUNC/DATA key.

**E61-E64****Ai filter setting**

- ◆ You can specify whether to apply a filter to the analog input [Ai1 to 4] terminals, and you can also specify a time constant of the filter individually. The filter used here is a low-pass filter. The time constant means the time until the filter output data reaches 63% of the input data. Since a large filter time constant decreases the response, consider the response of a mechanical system to determine the time constant. If the input voltage fluctuates due to noise, first try hardware measures, and then use this filter after you failed.

Use the function code (E65 to E68) to increase or decrease a command value gradually.

E	6	1	F	I	L	T	E	R	A	i	1
E	6	2	F	I	L	T	E	R	A	i	2
E	6	3	F	I	L	T	E	R	A	i	3
E	6	4	F	I	L	T	E	R	A	i	4

Setting range: 0.000 to 0.500 [s]

Note: [Ai3, 4] are available only when you install OPC-VG7-AIO.

**E65-E68****Increment/decrement limiter (Ai)**

- ◆ Specifies a time to increase a data inside the inverter from 0V to 10V when you change the input from 0 to 10V applied to the analog input [Ai1 to 4] terminals.

<Application example>

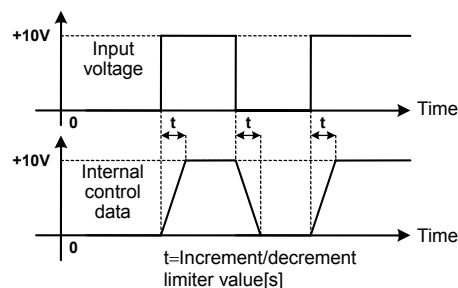
When you use the analog torque command or the analog torque bias, you may not use a command that changes stepwise. A step-wise torque command may tear a paper in a paper rolling machine or present an elastic vibration (damping) when a subject matter has a large elastic modulus.

To avoid this phenomenon, though you should change the command with an external volume, you can use this Increment/decrement limiter to specify the automatic increase and decrease of an analog command value.

E	6	5	A	/	D	-	L	-	A	i	1
E	6	6	A	/	D	-	L	-	A	i	2
E	6	7	A	/	D	-	L	-	A	i	3
E	6	8	A	/	D	-	L	-	A	i	4

Setting range: 0.00 to 60.00 [s]

Note: [Ai3, 4] are available only when you install OPC-VG7-AIO.



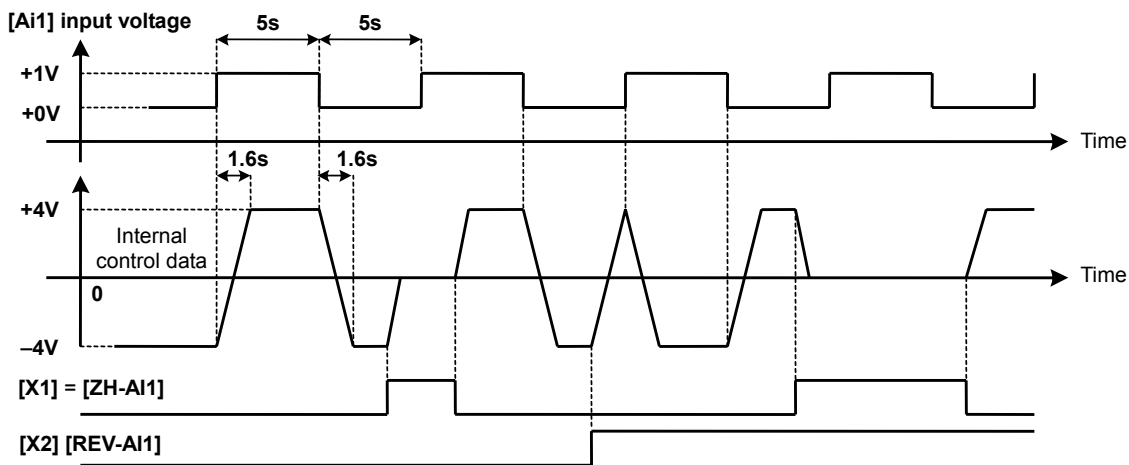


## 4. Control and Operation

### Appendix

This section shows an example specifying the bias, the gain, and the increment/decrement limiter of [Ai1] and assigning "Ai1 zero hold" to [X1] function and "Ai1 polarity change" to [X2] function. See also the control block diagram for better understanding. The filter function is not included in this example, since you can use this function to eliminate noise, but should not use actively.

Function code	Set value
E01: X1 function selection	40: Ai1 zero hold [ZH-AI1]
E02: X2 function selection	44: Ai1 polarity change [REV-AI1]
E53: Ai1 gain setting	8.000 [magnification]
E57: Ai1 bias setting	-50.0 [%]
E65: Increment/decrement limiter (Ai1)	2.00s



- The increment/decrement limiter set the time for the change of an internal control data by 8V ( $-4V \leftrightarrow +4V$ ) to  $2.0s \times 8/10 = 1.6s$ . Note that the increment/decrement limiter is applied not to the change of the input voltage from 0 to 1V, but to the change of the internal data scaled by the gain.
- The change of the internal control data to 0V follows the increment/decrement limiter when the zero hold signal [ZH-AI1] is applied.
- The change of the polarity of the internal control data follows the increment/decrement limiter when the polarity change signal [REV-AI1] is applied.

## E69-E73

## AO function selection

- ◆ You can select signals applied to the analog output and signals for adjusting AO.
- ◆ The valid and invalid functions vary according to the control method (vector control, sensorless vector control, V/f control and synchronous motor drive). For details, refer to the function code list in Chapter 13.

E	6	9	A	O	1	F	U	N	C		
E	7	0	A	O	2	F	U	N	C		
E	7	1	A	O	3	F	U	N	C		
E	7	2	A	O	4	F	U	N	C		
E	7	3	A	O	5	F	U	N	C		

Setting range: 0 to 15, 30, 31

16 to 29 are reserved. Do not use them.

Set value	Function	Symbol	Scale
0	Detected speed 1 (Speedometer, one-way deflection)	[N-FB1+]	+Nmax/10V
1	Detected Speed 1 (Speedometer, two-way deflection)	[N-FB1±]	±Nmax/±10V
2	Speed setting 2 (Before acceleration/deceleration calculation)	[N-REF2]	±Nmax/±10V
3	Speed setting 4 (ASR input)	[N-REF4]	±Nmax/±10V
4	Detected speed 2 (ASR input)	[N-FB2±]	±Nmax/±10V
5	Detected line speed	[LINE-N±]	±Nmax/±10V
6	Torque current command (Torque ammeter, two-way deflection)	[IT-REF±]	±150%/±10V
7	Torque current command (Torque ammeter, one-way deflection)	[IT-REF+]	+150%/10V
8	Torque command (Torque meter, two-way deflection)	[T-REF±]	±150%/±10V
9	Torque command (Torque meter, one-way deflection)	[T-REF+]	+150%/10V
10	Motor current rms value	[I-AC]	200%/10V
11	Motor voltage rms value	[V-AC]	200%/10V
12	Input power	[PWR]	200%/10V
13	DC link circuit voltage	[V-DC]	800V/10V
14	+10V output test	[P10]	Output equivalent to +10V
15	-10V output test	[N10]	Output equivalent to -10V
30	Universal AO	[U-AO]	±4000H/±10V
31	Option AO	[O-AO]	±4000H/±10V

Note: [AO4, 5] are available only when you install OPC-VG7-AIO.

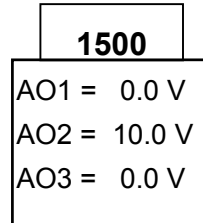
#### <Using analog output>

There are 16 types of analog output functions from 0 to 15 available. You cannot use all of these functions at the same time. You can use total of five terminals, which are three terminals, [AO1], [AO2] and [AO3], as standard and two terminals, [AO4] and [AO5] using optional AIO.

# 4. Control and Operation

## Setting procedure

- Check a device such as a meter including wires. Set data to 14 to check 10V output.
- Select a function you want to use. We select the "Detected Speed 1 (Speedometer, two-way deflection)" as an example.
- Assign the "Detected Speed 1 (Speedometer, two-way deflection)" function to one of the available terminals ([AO1] to [AO5]). If you want to assign it to [AO2], write a data, "1:N-FB1±", to the function code E70 "AO2 function selection".
- See the "I/O check" screen of the KEYPAD panel to confirm that [AO2] supplies +10.0V during operating a motor. The right figure shows the screen you must view.
- Connect a speedometer to the analog terminal [AO2].



- You can specify the bias, the gain, and the filter applied to the analog output.

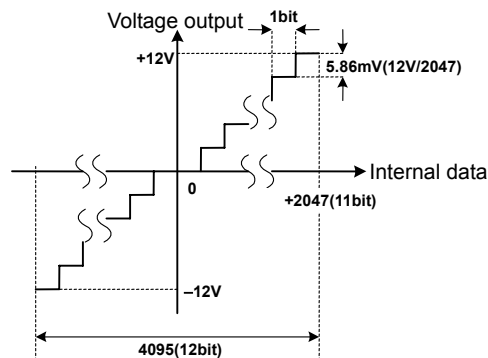
Function	Application
Bias	Sets the bias.
Gain	Use to enlarge a small voltage range or to reduce a large voltage range. Use a minus value to invert the polarity.
Filter	You do not need to change the factory set data 0.010s (10ms). This filter does work for the noise affecting a device (such as a meter) and wires between the device and [AO] terminal. Take necessary measures against noise outside of the inverter.

See the description of the individual function codes for more details.  
See also the control block diagram to work with this function effectively.

## Output resolution

The AO converts a 12-bit digital data into an analog data for output. 11 bits (2047) are assigned to +12V, thus the output resolution is 5.86mV. Note that a binary data corresponding to 10V is 1705 (2047×10/12).

When you use about +10V to supply a speed reference corresponding to the maximum speed of 1500r/min, the resolution is 1500/1700=0.88r/min.



## Output cycle

Output is supplied with a sampling cycle of 500µs.

### 0. Detected speed 1 (Speedometer, one-way deflection) [N-FB1+]

### 1. Detected speed 1 (Speedometer, two-way deflection) [N-FB1±]

Assign a data 0 [N-FB1+] and 1 [N-FB1±] to desired analog output terminals to designate them as speedometer functions.

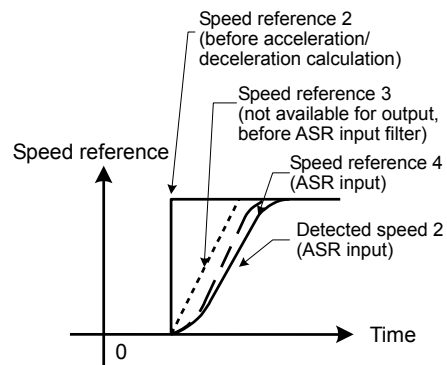
Use [N-FB1+] for a unipolar meter and use [N-FB1±] for a bipolar meter. This function detects encoded motor speed and supplies a data after the speed detection calculation or the speed estimation calculation.

### 2. Speed setting 2 (Before acceleration/deceleration calculation) [N-REF2]

### 3. Speed setting 4 (ASR input) [N-REF4]

#### 4. Detected speed 2 (ASR input) [N-FB2±]

Assign a data 2 [N-REF2], 3 [N-REF4] and 4 [N-FB1+] to desired analog output terminals to output the speed reference and detected speed of each of them. You can use these functions to measure and observe the follow-up and the deviation of the Detected speed 2 (ASR input) against individual speed references externally. Note that the Speed agreement (the comparison between [N-REF2] and [N-FB2±]) and the Speed equivalent ([N-REF4] and [N-FB2±]) of the inverter DO output use these data for output.



The speed reference 3 in the right graph is not available for an AO output.

#### 5. Detected line speed [LINE-N±]

Assign a data 5 [LINE-N±] to a desired analog output terminal to designate it as line speed detection. The highest data among the analog line speed [LINE-N], the digital line speed, detected speed by PG (LD) and a data from integrated speed detection/estimation is provided to output.

#### 6. Torque current command (Torque ammeter, two-way deflection) [IT-REF±]

#### 7. Torque current command (Torque ammeter, one-way deflection) [IT-REF+]

Assign a data 6 [IT-REF±] and 7 [IT-REF+] to desired analog output terminals to designate them as torque ammeters.

Use [IT-REF+] for a unipolar meter and use [IT-REF±] for a bipolar meter. You can use the function code F51 "Torque command monitor (Polarity selection)" to select the output polarity.

#### 8. Torque command (Torque meter, two-way deflection) [T-REF±]

#### 9. Torque command (Torque meter, one-way deflection) [T-REF+]

Assign a data 8 [T-REF±] and 9 [T-REF+] to desired analog output terminals to designate them as torque meters.

Use [T-REF+] for a unipolar meter and use [T-REF±] for a bipolar meter. You can use the function code F51 "Torque command monitor (Polarity selection)" to select the output polarity.

#### Torque meter and torque ammeter

A torque meter and a torque ammeter behave differently in constant output range over the rated speed (100%).

You can use the torque ammeter as a load meter (equivalent to load current).

You can use the torque meter as an output equivalent to actual torque reflecting torque decrement.

Though both of them provide the command values, you can use them as real torque and torque current since the VG7 controls the current.

#### 10. Motor current rms value [I-AC]

#### 11. Motor voltage rms value [V-AC]

Provide effective values of the output current and voltage supplied to the motor.

"100%" indicates the rated current and voltage of the motor.

#### 12. Input power [PWR]

#### 13. DC link circuit voltage [V-DC]

See the control block diagram (4.2.8).

# 4. Control and Operation

**E74-E78**

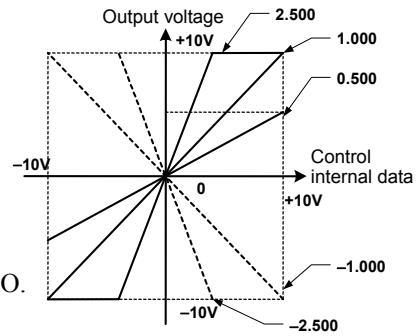
**AO gain setting**

◆ Sets the gain of the analog output AO1 to AO5.

E	7	4	G	A	I	N	A	O	1	
E	7	5	G	A	I	N	A	O	2	
E	7	6	G	A	I	N	A	O	3	
E	7	7	G	A	I	N	A	O	4	
E	7	8	G	A	I	N	A	O	5	

Setting range: -100.00 to 100.00 [times]

Note: [AO4, 5] are available only when you install OPC-VG7-AIO.



**E79-E83**

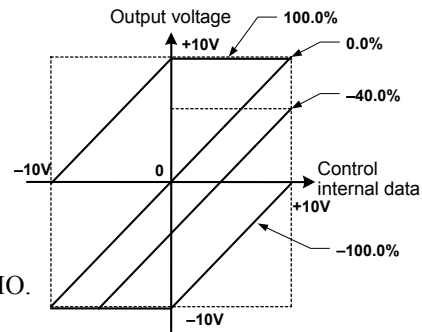
**AO bias setting**

◆ Sets the bias of the analog output AO1 to AO5.

E	7	9	B	I	A	S	A	O	1	
E	8	0	B	I	A	S	A	O	2	
E	8	1	B	I	A	S	A	O	3	
E	8	2	B	I	A	S	A	O	4	
E	8	3	B	I	A	S	A	O	5	

Setting range: -100.00 to 100.00 [%]

Note: [AO4, 5] are available only when you install OPC-VG7-AIO.



**E84**

**AO1-5 filter setting**

◆ Sets the time constant of the output filters for the analog output AO1 to AO5 simultaneously.

E	8	4	F	I	L	T	A	O	1	-	5
---	---	---	---	---	---	---	---	---	---	---	---

Setting range: 0.000 to 0.500 [s]

Note: [AO4, 5] are available only when you install OPC-VG7-AIO.

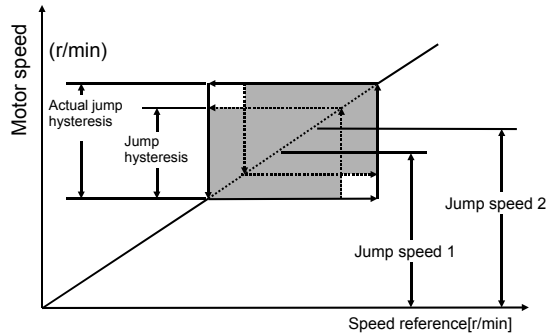
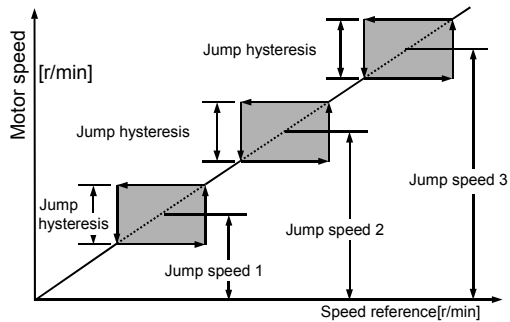
### 4.3.3 C Codes (Control Functions of Frequency)

<b>C01</b>	<b>Jump speed 1</b>
<b>C02</b>	<b>Jump speed 2</b>
<b>C03</b>	<b>Jump speed 3</b>
<b>C04</b>	<b>Jump hysteresis</b>

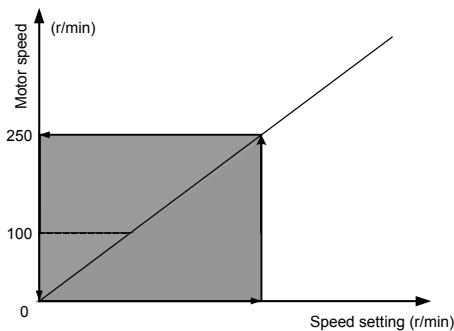
- ◆ Jumps the speed reference to avoid mechanical resonance points of a load. You can set three jump points.
- ◆ When you set the Jump speed 1 to 3 to 0r/min, this function is disabled. The speed reference does not jump during acceleration/deceleration.
- ◆ When specified ranges of jump speed overlap one another, the sum of them is considered as a jump range.

<b>C</b>	<b>0</b>	<b>1</b>	<b>J</b>	<b>U</b>	<b>M</b>	<b>P</b>	<b>N</b>	<b>1</b>		
<b>C</b>	<b>0</b>	<b>2</b>	<b>J</b>	<b>U</b>	<b>M</b>	<b>P</b>	<b>N</b>	<b>2</b>		
<b>C</b>	<b>0</b>	<b>3</b>	<b>J</b>	<b>U</b>	<b>M</b>	<b>P</b>	<b>N</b>	<b>3</b>		
<b>C</b>	<b>0</b>	<b>4</b>	<b>J</b>	<b>U</b>	<b>M</b>	<b>P</b>	<b>H</b>	<b>Y</b>	<b>S</b>	<b>T</b>

Setting range: C01 to C03 = 0 to 24,000 [r/min]  
 C04 = 0 to 1,000 [r/min]



- ◆ If the jump width is larger than twice the jump speed setting, the downward jump is limited at 0r/min. (Example) Jump speed = 100 r/m, Jump width = 300 r/m



#### **C05-C17 Multistep speed 1-13**

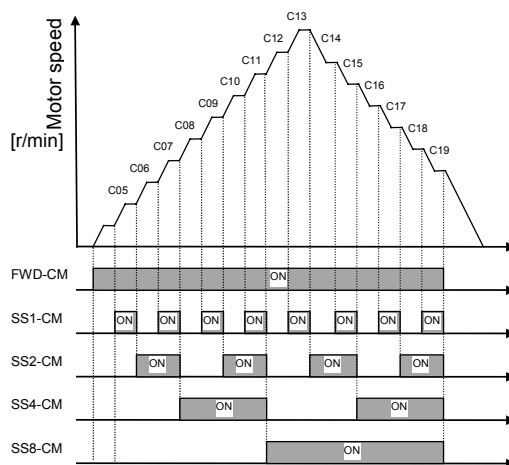
- ◆ You can set ON or OFF to the terminal function [SS1], [SS2], [SS4], and [SS8] to switch among Multistep speed 1 to 15 (refer to E01 to E13 "X function selection" for setting the terminal function).
- ◆ When a terminal among [SS1], [SS2], [SS4], and [SS8] is not defined, the terminal considered to be OFF. You can select 1r/min or 0.01% for a unit of a setting range according to the setting of C21 "Multistep setting definition". When you choose 0.01% for a unit, 100% is the maximum speed defined by the function code (F03, A06, or A40).

<b>C</b>	<b>0</b>	<b>5</b>	<b>M</b>	<b>U</b>	<b>L</b>	<b>T</b>	<b>I</b>	<b>N</b>	<b>-</b>	<b>1</b>
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------

to

<b>C</b>	<b>1</b>	<b>7</b>	<b>M</b>	<b>U</b>	<b>L</b>	<b>T</b>	<b>I</b>	<b>N</b>	<b>-</b>	<b>1</b>	<b>3</b>
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------

Setting range: 0 to 24,000 [r/min], 0.00 to 100.00 [%] or 0.0 to 999.9 [m/min]



# 4. Control and Operation

## C18 Multistep speed 14/Creep speed 1

## C19 Multistep speed 15/Creep speed 2

◆ C18 and C19 also work as a creep speed function when you use the UP/DOWN function. See E01 to E09 "X function selection" for more details.

C	1	8	N	-	1	4	/	C	R	E	P	1
C	1	9	N	-	1	5	/	C	R	E	P	2

Setting range: 0 to 24,000 [r/min], 0.00 to 100.00 [%] or 0.0 to 999.9 [m/min]

## C20 Multistep speed reference agreement timer

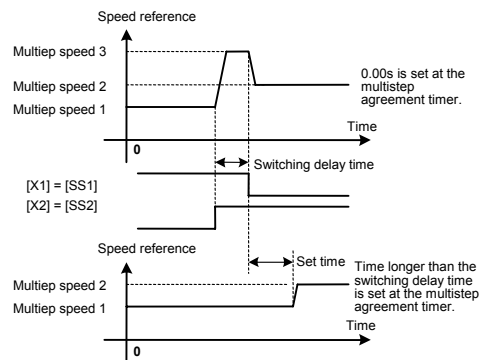
◆ When the terminal function [SS1], [SS2], [SS4], and [SS8] do not change simultaneously, a speed reference out of the specification may be specified. When you use the Multistep speed reference agreement timer, the speed reference changes after [SS1], [SS2], [SS4], and [SS8] maintain the same state for a time specified by the Multistep speed reference agreement timer.

Use this timer to use two or more terminals simultaneously among [SS1], [SS2], [SS4], and [SS8] to switch the speed. If you switch only one terminal, leave the setting to 0.000s.

### <Application example>

This section shows an example to use terminals [SS1] and [SS2] to switch the multistep speed. When you want to change from the Multistep speed 1 to the Multistep speed 2, you should switch two terminals simultaneously.

- When you set the timer to 0.00s, the difference in switching timing of [SS1] and [SS2] activates the Multistep speed 3 for the delayed period and presents a operation pattern out of the specification as shown in the upper right graph.
  - When you set the time of this function code to a period longer than the switching time, the switching to Multistep speed 2 occurs just when a specified time passes after [SS1] is set to OFF.
- You can avoid the Multistep speed 3 to be selected.



### <Point>

The cycle sampling the terminal signals is about 500μs (0.5ms) in the VG7. You do not have to set this function if your switching period is shorter than the sampling cycle.

C	2	0	M	L	T	N	T	I	M	E
---	---	---	---	---	---	---	---	---	---	---

Setting range: 0.000 to 0.100 [s]

## C21 Multistep setting definition

◆ Sets the unit to specify the multistep speed.

C	2	1	M	L	T	U	N	I	T
---	---	---	---	---	---	---	---	---	---

Setting: 0: Specify the multi-step speed in r/min.

1: Specify in increments of 0.01%.

2: Specify in m/min. (L03 lifter rated speed must be specified.)

◆ If the C21 setting is changed, enter C05 through C19 again.

## C25 Speed setting N2

◆ Sets a method to specify the speed command. When the X terminal function [N2/N1] is set to ON, the speed specified this function will be effective. See the description of F01 "Speed setting N1" for setting method you can select.

C	2	5	S	P	D	C	M	D	2
---	---	---	---	---	---	---	---	---	---

**C29****Jogging speed****C 2 9 J O G N**

Setting range: 0 to 24,000 [r/min]

- ◆ Sets a speed for inching a motor in addition to the normal operation. You can use this function for positioning a work, for example.
- ◆ You can choose the following two ways for the jogging operation.
  - Turn on the X control terminal [JOG] to change to the jogging mode and set the operation command [FWD] or [REV] to ON.
  - Set the **▲** and **STOP** keys on the KEYPAD panel to ON simultaneously to switch to the jogging mode and set the operation command [FWD] or [REV] to ON.

**C30-C69****ASR, S-curve acceleration/  
deceleration 2, 3, and 4,  
and JOG function groups**

The function code group C30 to C38 becomes effective in the JOG mode.

The terminal input signal [RT1] and [RT2] set the function code group C40 to C69 to either enabled or disabled

The speed limit function response gain in the torque control mode is adjusted with C60 (ASR4-P). See E01 to E13 "X function selection" and the control block diagram for the details of switching.

Acceleration/deceleration time: See the description of the function code F07 and F08.

S-curve setting : See the description of the function codes F67 to F70. Note that you can set only the two points, the start and end sides, for the S-curve acceleration/deceleration 2,3, and 4 and the JOG.

ASR setting : See the description of the function codes F61 to F65. Note that you cannot set the F/F gain to the ASR-JOG.

You can view the setting on the "I/O check" screen of the KEYPAD panel.

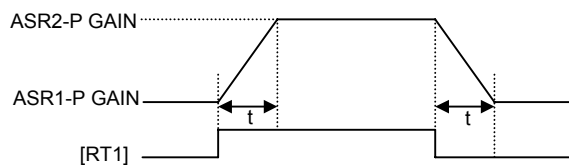
The right figure shows that the ASR2 and the S-curve deceleration (PARA 2) are selected.

**1500**
 PARA 1  M1  
 PARA 2  M2  
 PARA 3  M3  
 PARA 4  JOG
**C70****ASR switching time**

- ◆ This function specifies the duration of the switching, when you use the X control terminals [RT1] and [RT2] to switch the ASRs. This function change the P (gain) gradually in a specified time to reduce the mechanical shocks during the switching.
- ◆ Specify the time necessary to change the ASR gain 100 times.
- ◆ The right figure shows an example to set the [RT1] to OFF, ON, then to ON to switch the gain between the ASR1 and ASR2.

**C 7 0 A S R C H t**

Setting range: 0.00 to 2.55 [s]



$$t = \frac{|(\text{ASR2 P GAIN}) - (\text{ASR1 P GAIN})|}{100} \times \text{C70 (s)}$$

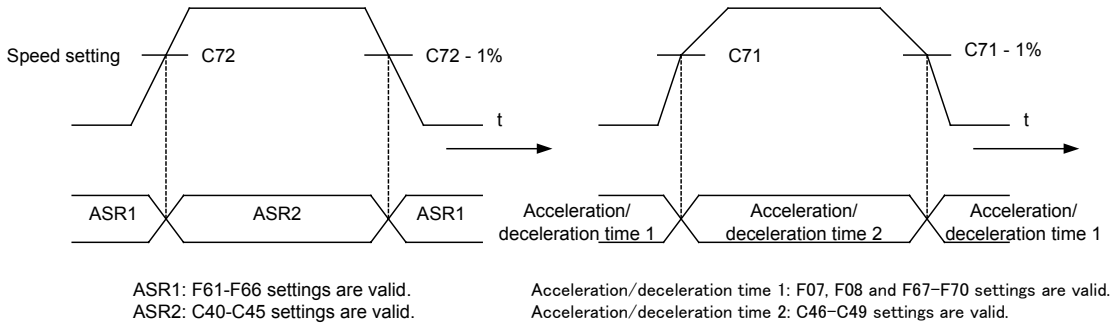
**C71****Acceleration/  
deceleration time switching speed****C72****ASR switching time****C 7 1 A C C / D E C C H**  
**C 7 2 A S R C H S P D**

Setting range: 0.00 to 100.00 [s]



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- ◆ If both X control terminals [RT1] and [RT2] are off, use the speed setting of this parameter to automatically switch the setting of acceleration/deceleration time ASR.  
(Deactivation of both [RT1] and [RT2] includes the case where [RT1] and [RT2] are not assigned to X control terminals.)
- ◆ When the speed setting (ASR input) exceeds the level specified at C71 and C72, changeover to acceleration/deceleration time 2 (ASR2) occurs. The hysteresis width is 1% of the maximum speed.



- ◆ If the setting is "0.00%," changeover does not occur.
- ◆ If the L04 (fixed S-curve pattern) is set at "1" or "2," the C71 and C72 settings are invalid.
- ◆ "100.00%" indicates the maximum speed set at function codes F03, A06 and A40.

**C73**

### Creep speed switching (on UP/DOWN control)

- ◆ Specifies whether to use a function or an analog input to set the creep speeds used in the UP/DOWN setting mode.

**C 7 3 C R P S W I T C H**

Setting range: 00 to 11

Description:

First digit: Creep speed 1 (0: function code C18, 1: analog input [CRP-N1] )

Second digit: Creep speed 2 (0: function code C19, 1: analog input [CRP-N2] )

See the description of the UP/DOWN in the E01 to E13 "X function selection".

## 4.3.4 P Codes (Motor Parameters)

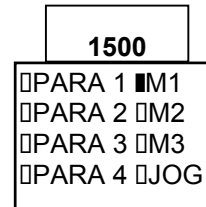
The P codes are motor parameters that become available when you select the M1 (first motor). See the A codes (second and third motors) when you use the M2 or M3.

You can use the function code F79 and the terminal input signal [M-CH2] and [M-CH3] to select the M1, the M2, or the M3.

See the individual descriptions and make sure that the M1 is selected. You can use the "I/O check" screen of the KEYPAD panel as shown in the right figure.

■ indicates a selection. Check if ■M1 is indicated.

F03 to 05 and F10 to 12 are available in addition to the P codes when you select the M1.



### P01 M1 control method

- You can select a control method to drive the motor 1 from vector control for an induction motor with PG, vector control without PG (sensorless control), and vector control for a synchronous motor with PG. See also the description of the function code P02 for the setting.

P 0 1 M 1 - C T L - M T D

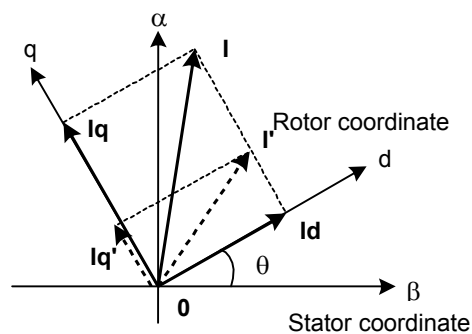
Set value: 0: Vector control

- 1: Sensorless vector control
- 2: Simulated operation mode
- 3: Vector control (synchronous motors)

- About vector control

The right figure shows a rotating coordinate (d-q axes) of a rotor on a coordinate ( $\alpha$ - $\beta$  axes) generated by two-phase conversion from a stator coordinate (U, V, W).  $\theta$  shows the rotation position and indicates the position of the magnetic-flux (d axis=direction of magnetic flux) observed on the fixed coordinate ( $\alpha$ - $\beta$  axes).

The alternating current (I) flowing through the stator generates a rotating magnetic field. The rotor coordinate (d-q axes) rotates at the frequency of this alternating current. If you observe the current (I) from the rotor coordinate (d-q axes), the current (I) seems stationary. Thus, the alternating current (I) can be considered direct current value on the rotor coordinate (d-q axes). You can decompose the current into the d axis element and the q axis element ( $I \rightarrow I_q + I_d$ ). The d axis current ( $I_d$ ) is defined as magnetic-flux current (exciting current) denoting a current required to generate a magnetic-flux. The q axis current ( $I_q$ ) is defined as torque current (load current).



When a load changes to require  $I_q'$  (indicated by a dotted arrow in the figure) as the torque current, you should control the current by directing  $I'$  (indicated by a dotted arrow in the figure) as a current command while maintaining the magnetic-flux current ( $I_d$ ). The control that maintains the magnetic-flux ( $I_d = \text{constant}$ ) and changes the torque current ( $I_q$ ) according to the load is referred as **vector control**. Since this control is similar to the control for the direct current motor where the magnetic-flux is maintained constant by the magnet and the rotor current is controlled according to the load, you can use the same control for an alternating current motor as for a direct current motor.

# 4. Control and Operation

◆ About sensorless control

This control utilizes vector control (similar to DC motor control) for a motor without a pulse generator. This control enables torque control, which is not available in V/f control. Use this control when you use existing general-purpose motors or motors to which you cannot install a PG.

Note that the control capability (such as speed control range, speed control response, and speed control accuracy) differs from that of control utilizing PG described in Chapter 2 "Specifications" when you select the control. If you need this capability, select vector control with PG for a motor with a PG.

Tune the motor parameter to control properly. Use the function code H01 to conduct tuning (set value 3 and 4).

<Control mechanism>

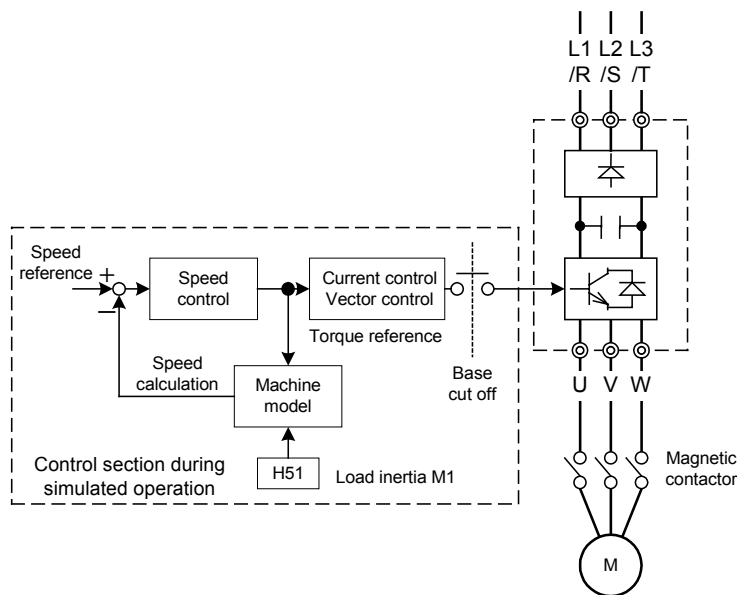
Sensorless control calculates the motor speed and the magnetic pole position. This control detects the output voltage and the output current and uses the motor parameters (R1, Lσ) identified through tuning to calculate the induced voltage. The magnetic flux position is determined since the Ed element obtained by decomposing this induced voltage into the d axis direction is 0. Since the Eq element on the q axis direction corresponds to the induced motor voltage and is proportional to the motor speed, you can obtain the motor speed. This control has the following restrictions compared with vector control with PG.

- Speed control range is limited at low speed due to the inferior accuracy of the induced motor voltage compared with that at high speed.
- Speed control response is low due to the slow convergence of the internal calculation.
- Speed control accuracy is inferior due to the accuracy of the speed calculation based on the induced voltage.

◆ About simulated operation

You can select the setting "2" "Simulated operation mode" to operate the inverter internally without connecting a motor in a state similar to the real operation. Use the simulated operation to check your system such as I/O or to test after installation.

When you give a torque command to a machine model (load inertia: H51), the machine model accelerates to a certain speed. Since speed control is a type of feedback control, the machine model rotates to follow the speed reference in the end. You can use the LED and the LCD monitor on the KEYPAD panel and the monitor code (M code) to monitor this operation. Note that since the inverter does not detect the current and the voltage, the "Detected output current" and the "Detected output voltage" display "0". The individual function codes and the protective function are available as long as they are not restricted. Since the simulated operation cuts off the bases (cuts of the inverter output), the secondary side (U, V, W) does not present voltage. However, disconnect the secondary side or use a magnetic contactor to cut off the secondary side for your safety.



**P02**

**M1 motor selection**

- ◆ You need different procedure to use a standard motor for VG7S and VG5 (setting: 0.75-2 to 220-4) (Note 1) or another motor (setting: OTHER)
- ◆ When you use a standard motor for VG7S or VG5, select a combination of "capacity (kW)-voltage (2 or 4)" from the setting list ranging "0.75-2" to "220-4", and optimal values for the standard motor are written into F04, F05, and P03 to P27 automatically. You do not need to change F04, F05, and P03 to P27 and they are write-protected.
- ◆ Select "OTHER" when you use a motor (FUJI's motor, standard motor for VG3 or VG, or others) other than standard motors for VG7S and VG5.
- ◆ Specifies the function codes in the table below following the items from top to bottom according to the motor to be used. They are valid only for vector control and sensorless control of an induction motor. When you use a synchronous motor, contact FUJI.

**P 0 2 M 1 - S E L E C T**

Function code for motor 1	FUJI motors			Other motors
	Standard motors for VG7S or VG5	Standard motors for VG3 and VG	FUJI motors	
P01 M1 control method	0: Vector control		Select depending on with or without PG With PG : 0, vector control Without PG: 1, sensorless control	
P02 M1 motor selection	Select form "0.75-2" to "220-4"	Select "OTHER"		
F04 M1 rated speed	P02 automatically sets: - Motor ratings nameplate values, and - Optimal motor constants.  These data remain after you turn off.  You cannot change the data set automatically (write-protected).  Do not use H01 "Tuning operation selection".	Set the data described in the Chapter 14 "Replacement data" manually.  Do not use H01 "Tuning operation selection".	Set the ratings nameplate data provided on the motor manually.  Use H01 "Tuning operation selection" to tune motor parameters. See the function description of H01 for more details.  Preserve the initial value. Not available for tuning.	
F05 M1 rated voltage				
P03 M1 rated capacity				
P04 M1 rated current				
P05 M1 pole number				
P06 M1-%R1				
P07 M1-%X				
P08 M1 exciting current				
P09 M1 torque current				
P10,11 M1 slip on driving, braking				
P12-14 M1 iron loss coefficient 1-3				
P15-19 M1 magnetic saturation coefficient 1-5				
P20 M1 secondary time constant				
P21 M1 induced voltage coefficient				
P22-24 M1-R2 correction coefficient 1-3				
P25 M1 exciting current correction coefficient				
P26, 27 M1-ACR-P, I (Gain, Constant of integration)			Preserve the initial value.	
P28 M1-PG pulse number	Select PG pulse number. Not effective during sensorless control.			
P30 M1 thermistor selection	1: NTC thermistor		See F10 for details on motor protection.	
F10 M1 electronic thermal overload relay (Select)	0: Disabled (VG standard motor)			
H01 Tuning operation selection	Motor parameters tuning not required. Procedure above sets optimal data automatically. Select "2" for tuning operation when output impedance is not negligible due to long (100m or more) wires between inverter and motor or OFL filter connected.		Motor parameters turning required. Tune while wires are installed. See function description of function code H01.	
H02 All save function	Execute "all save" operation after using H01 to tune. This operation writes tuned data to non-volatile memory. Not necessary when you did not tune parameters.			
P02 M1 motor selection	-	Setting to "36:P-OTR" protects function code F04, F05, and P03 to P27 from writing. Set last if necessary.		

Note 1: VG7S standard motors are the same as the VG5 standard motors in shape and electrical constants (motor parameters).

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**P03**

**M1 rated capacity**

- ◆ Sets the rated capacity value of the motor 1. Enter the value described on the ratings nameplate. Set a capacity corresponding to a single winding for a multiwinding motor.

**P 0 3 M 1 - C A P**

Setting range F60=0: 0.00 to 500.00 [kW]

F60=1: 0.00 to 600.00 [HP]

**P04**

**M1 rated current**

- ◆ Sets the rated current value of the motor 1. Enter the value described on the ratings nameplate.

**P 0 4 M 1 - I r**

Setting range: 0.01 to 99.99 [A]

100.0 to 999.9 [A]

1,000 to 2,000 [A]

**P05**

**M1 pole number**

- ◆ Sets the number of poles of the motor 1. Enter the value described on the ratings nameplate.

**P 0 5 M 1 - P O L E S**

Setting range: 2 to 30 [pole]

**P06**

**M1-%R1**

**P 0 6 M 1 - % R 1**

Setting range: 0.00 to 30.00 [%]

$$\%R1 = \left( \frac{(R1[\Omega] + \text{Cable resistance}[\Omega]) \times P04 : \text{Motor rated current}[A]}{F05 : \text{Motor rated voltage}[V] / \sqrt{3}} \right) \times 100[\%]$$

Use a value corresponding to the Y connection for one phase to specify R1 [Ω].

Use a value corresponding to one winding of multiwinding motor.

**P07**

**M1-%X**

**P 0 7 M 1 - % X**

Setting range: 0.00 to 50.00 [%]

$$\%X = \left( \frac{(L\sigma[H] + \text{Cable } L[H]) \times P04 : \text{Motor rated current}[A]}{F05 : \text{Motor rated voltage}[V] / \sqrt{3}} \times 2\pi \left( \frac{P05 : \text{Pole numbers} \times P04 : \text{Rated speed}[r/min]}{120} \right) \right) \times 100[\%]$$

Use a value corresponding to the Y connection to specify Lσ[H].

Use a value corresponding to one winding of multiwinding motor.

**P08**

**M1 exciting current**

- ◆ Sets the effective current value of the motor 1 during no-load operation.

**P 0 8 M 1 - I M**

Setting range: 0.01 to 99.99 [A]

100.0 to 999.9 [A]

1,000 to 2,000 [A]

**P09 M1 torque current**

◆ Sets the current contributing torque.

P	0	9	M	1	-	I	T			
---	---	---	---	---	---	---	---	--	--	--

Setting range: 0.01 to 99.99 [A]  
 100.0 to 999.9 [A]  
 1,000 to 2,000 [A]

$$P09 : \text{Torque current} = \sqrt{(P04 : \text{Rated current})^2 - (P08 : \text{Exciting current})^2} [A]$$

**P10 M1 slip on driving**

**P11 M1 slip on braking**

◆ Sets the slips of the motor at rated speed and under rated load.

P	1	0	M	1	-	S	L	I	P	d
P	1	1	M	1	-	S	L	I	P	b

Setting range: 0.001 to 10.000 [Hz]

$$\text{Slip frequency [Hz]} \times \frac{P05 : \text{Pole numbers} \times (\text{Synchronized speed})[\text{r/min}] - F04 : \text{Rated speed}[\text{r/min}]}{120}$$

**P12 M1 iron loss coefficient 1**

**P13 M1 iron loss coefficient 2**

**P14 M1 iron loss coefficient 3**

◆ Sets coefficients to compensate an amount corresponding the iron loss (hysteresis loss, eddy current loss) of the motor. If you do not need the iron loss compensation, you may set 0.

P	1	2	M	1	-	L	O	S	S	1
P	1	3	M	1	-	L	O	S	S	2
P	1	4	M	1	-	L	O	S	S	3

Setting range: 0.00 to 10.00 [%]

**P15 Magnetic saturation coefficient 1**

**P16 Magnetic saturation coefficient 2**

**P17 Magnetic saturation coefficient 3**

**P18 Magnetic saturation coefficient 4**

**P19 Magnetic saturation coefficient 5**

◆ The relation between the exciting current (current generating magnetic-flux in a motor) and the magnetic-flux is non-linear. These functions set the coefficients to compensate this relation.

P	1	5	M	1	-	S	A	T	1
P	1	6	M	1	-	S	A	T	2
P	1	7	M	1	-	S	A	T	3
P	1	8	M	1	-	S	A	T	4
P	1	9	M	1	-	S	A	T	5

Setting range: 0.0 to 100.0 [%]

# 4. Control and Operation

**P20**      **M1 secondary time constant**

◆ The response of the magnetic-flux to the exciting current is a first-order lag. This time constant is defined as secondary time constant and you should set a value determined by the motor parameters as in the following equation. You can compensate the lag to lead.

**P 2 0 M 1 - N D - T C**

Setting range: 0.001 to 9.999 [s]

Set value: Secondary time constant [s]=Lm [H] / R2 [Ω]

Lm: Exciting inductance, R2: Resistance of secondary winding

**P21**      **M1 induced voltage coefficient**

◆ The rotating magnetic field generated by the stator (primary winding) sections the rotor vertically to induce voltage on the secondary side in an induction machine. You can add voltage larger than this induced voltage to accelerate a motor. This function sets a coefficient to compensate this induced voltage.

**P 2 1 M 1 - E M F - C O F**

Setting range: 0 to 999 [V]

Set value: Effective induced voltage substituted by the voltage between the windings at the rated speed.

**P22**      **M1-R2 correction coefficient 1**

**P23**      **M1-R2 correction coefficient 2**

**P24**      **M1-R2 correction coefficient 3**

◆ The resistance of the rotor (secondary resistor) is used to calculate the slip frequency in vector control of slip frequency type. The change in secondary resistance due to the temperature increase caused by the frequent operation or load may degrade the torque control accuracy. The inverter detects the temperature with an NTC thermistor and uses R2 correction coefficient 1, 2, and 3 to estimate the rotor temperature to prevent the decrease of the torque control accuracy. Do not change these settings.

**P 2 2 M 1 - R 2 C O R R 1**

**P 2 3 M 1 - R 2 C O R R 2**

**P 2 4 M 1 - R 2 C O R R 3**

P22, P23 setting range: 0.500 to 5.000

P24 setting range: 0.010 to 5.000 (P24)

**P25**      **M1 exciting current correction coefficient**

◆ Corrects the exciting inductance. Do not change these settings.

**P 2 5 M 1 - I M C O R R**

**P26** **M1-ACR-P (Gain)**

**P27** **M1-ACR-I (Integration time)**

- ◆ Vector control feeds back the motor output current to control a motor to follow the current command. These functions specify the gain and the integration time for the current control (ACR). Usually you do not have to change from the factory setting.
- ◆ When a winding has a large inductance, you should set a large P gain to compensate it in general. When a winding has a small inductance, you should set a small P gain to prevent OC (overcurrent) due to the overshoot of the current.
- ◆ You should specify the integration time to reduce the steady-state deviation between the current command and the actual current to zero. Do not specify too small value otherwise a current hunting occurs.

P	2	6	M	1	-	A	C	R	-	P		
P	2	7	M	1	-	A	C	R	-	I		

P26 setting range: 0.1 to 20.0

P27 setting range: 0.5 to 100.0 [ms]

**P28** **M1-PG pulse number**

- ◆ Set according to the pulse number of the PG for detecting the speed of the motor 1. If you set a wrong value, the inverter cannot determine the speed and the magnetic pole to conduct speed and vector controls accurately.
- ◆ Specify the PG pulse count setting so that the following condition is satisfied.

PG pulse count (P28) > 9390 / Nmax (F03)

P	2	8	M	1	-	P	G	-	P	L	U	S
---	---	---	---	---	---	---	---	---	---	---	---	---

Setting range: 100 to 60,000

**P29** **M1 external PG correction coefficient**

- ◆ You need a correction coefficient to convert the output of a PG built in a machine system into the motor speed to control the speed. Set the coefficient here. Speed control by PG requires parameter setting at both P28 and P29.

P	2	9	P	G	-	C	O	M	P		
---	---	---	---	---	---	---	---	---	---	--	--

Setting range: 0000 to 4FFF

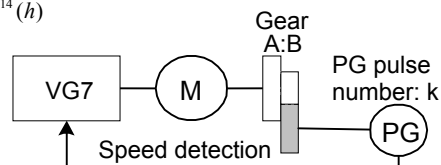
- ◆ When you do not use an external PG, do not change from 4000h. The value of 4000h corresponds to a gear ratio of 1:1, i.e., a PG directly coupled to a motor. When you use a PG directly coupled to a motor, if you set a value other than 4000h, you cannot conduct speed and vector controls accurately.

**Setting procedure**

Suppose the gear ratio is A:B, specify the function code P28 and P29 as indicated below.

$$\text{Function code P28 (M1 - PG pulse number)} = \text{Integer part of } \left| k(\text{PG pulse number}) \times \frac{B}{A} \right|$$

$$\text{Function code P29 (M1 external PG correction coefficient)} = \left[ \frac{P28}{k \times \frac{B}{A}} \right] \times 2^{14} (h)$$



**<Setting example>**

If PG pulse number=1,024 and the gear ratio A:B=7:1, then:

$$\text{Function code P28 (M1 - PG pulse number)} = \text{Integer part of } \left| 1024(\text{PG pulse number}) \times \frac{1}{7} \right| = 146$$

$$\text{Function code P29 (M1 external PG correction coefficient)} = \left[ \frac{P28}{k \times \frac{B}{A}} \right] \times 2^{14} (h) = \left[ \frac{146}{1024 \times \frac{1}{7}} \right] \times 2^{14} (h) = 16352 (d) = 3FE0 (h)$$



## 4. Control and Operation

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**P30**

**M1 thermistor selection**

- ◆ Specifies an analog input (0 to 10V) from a thermistor or a temperature sensor for motor protection. Select NTC thermistor for VG standard motors (VG7S, VG5, and VG3). Select PTC thermistor when a PTC thermistor is installed on a motor for overheat protection.

**P 3 0 M 1 - T H R**

Setting range: 0: No thermistor

- 1: NTC thermistor (for VG standard motors)
- 2: PTC thermistor
- 3: Ai [M-TMP]

Use E30 "Motor overheat protection (Temperature)" to E32 "M1-M3 PTC operation level" to specify the protection level of the motor.

## 4.3.5 H Codes (High Performance Functions)

**H01**

### Tuning operation selection

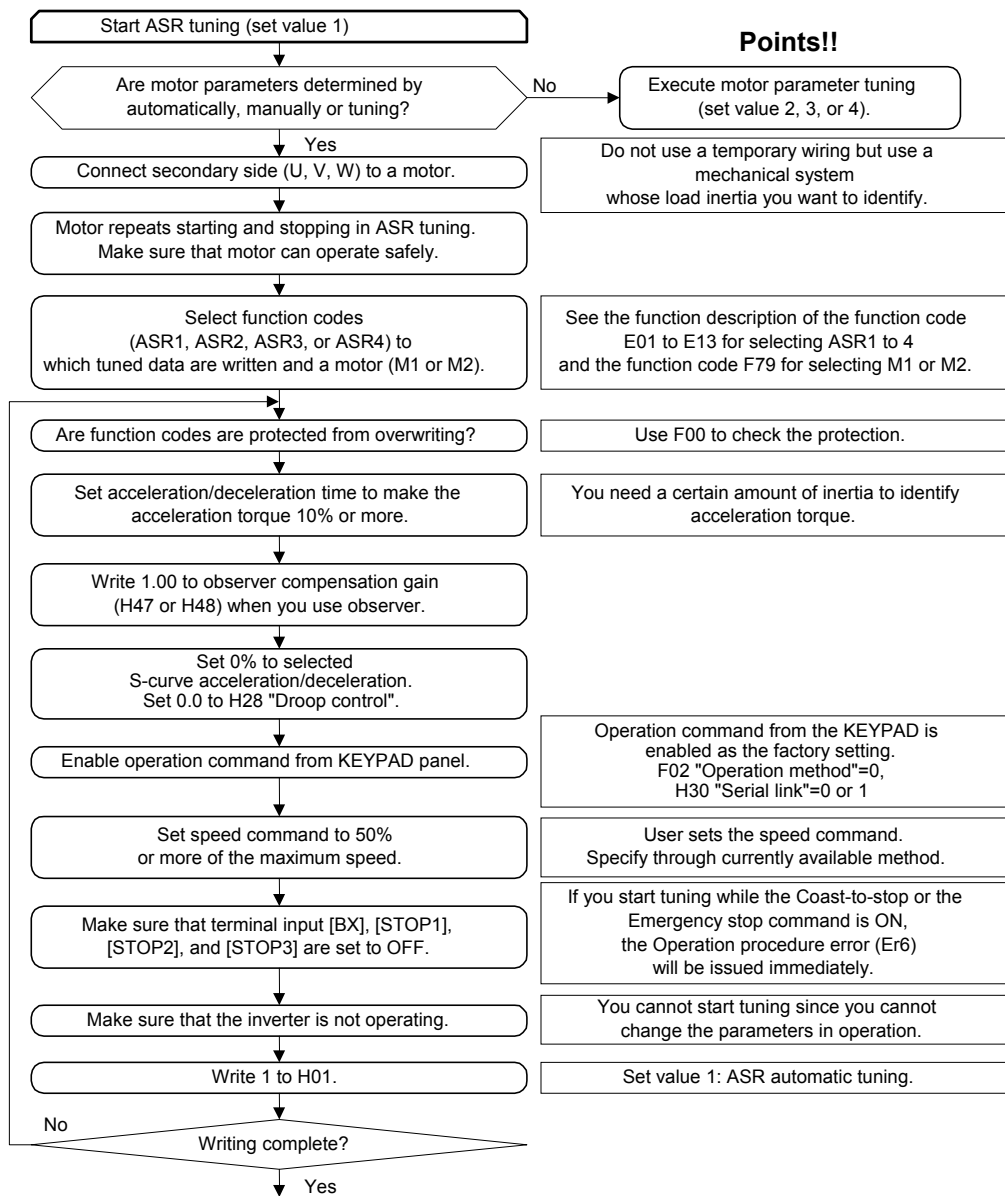
- ◆ There is no need to tune the motor parameter if the inverter is combined with the standard motor.
- ◆ Refer to the table below and flowcharts on the following pages to tune correctly.
- ◆ The tuned data are written to the volatile memory (RAM) and are erased when you turn off the power. Make sure to use H02 "All save" to write data into the non-volatile memory after tuning.
- ◆ Execute the ASR automatic tuning specified by the setting "1" after motor parameters are determined (determined by automatically, manually, or tuning).
- ◆ Tuning is impossible in the simulation mode (P01 = 2).
- ◆ The motor parameter tuning function may not be used in the multi-winding motor driving system.
- ◆ If the motor is turned while one of the [BX], [STOP1], [STOP2] and [STOP3] digital inputs is turned on, Er6 (operation procedure error) is caused.
- ◆ Contact FUJI to tune a synchronous motor.

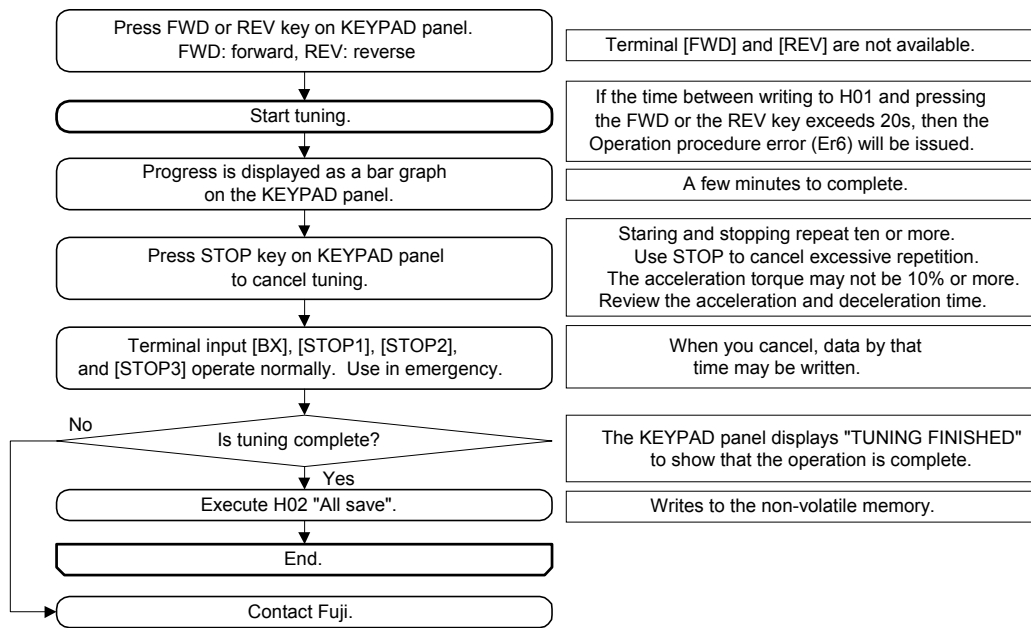
**H 0 1 T U N I N G M O D E**

Setting	Tuning description	Data to be tuned	Process description	Application
1	ASR (Speed control system) tuning (* Execute after motor parameters are fixed) Not available for V/f control	Following functions to be selected ASR-P (Gain) ASR-I (Constant of integration) H47, 48: Compensation gain H49, 50: Integration time H51, 52: Load inertia	Measures motor shaft conversion load inertia of a mechanical device (mechanical time constant), calculates optimal gain and constant of integration, and sets them to corresponding function codes	Execute for a motor integrated into a mechanical system to be tuned for speed control. Execute especially to obtain the motor shaft conversion mechanical inertia to use observer function of H46 "Observer type selection"
2	R1, $L\sigma$	When M1 is selected: P06, P07 When M2 is selected: A08, A09 When M3 is selected: A42, A43	Measures primary resistance (%R1) when the motor is at stopping and leakage reactance ( $L\sigma$ ) when the motor is at rated speed and sets motor parameters (M1, M2, and M3) automatically	Use when you use a VG standard motor (VG, VG3, VG5, and VG7) and output impedance is not negligible due to long (100m or more) wires between inverter and motor or OFL filter connected.
3	Motor stopping action	When M1 is selected: P06 to P25 (P12, P13, and P14 excluded) When M2 is selected: A08 to A27 (A14, A15, and A16 excluded)	Measures %R1 and %X when the motor is at stopping as in set value "2". Then, measures and tune exciting current, slip of rated load, magnetic saturation coefficient, induced voltage, secondary time constant, R2 correction coefficient, and exciting current correction coefficient when the motor is at stopping and writes them into corresponding motor parameters (M1, M2, and M3) automatically.	Execute in advance to drive a non-standard motor or a special-purpose motor whose motor parameters are not available. Use when a motor you want to drive is integrated into a mechanical system and you cannot disconnect it. Note that the tuning accuracy is a bit inferior to those obtained by the tuning in operation for the set value "4".
4	Motor rotation action		Measures %R1 and %X when the motor is at stopping as in set value "2". Then, measures and tune exciting current, slip of rated load, magnetic saturation coefficient, induced voltage, secondary time constant, R2 correction coefficient, and exciting current correction coefficient when the motor is running and writes them into corresponding motor parameters (M1, M2, and M3) automatically.	Execute in advance to drive a non-standard motor or a special-purpose motor whose motor parameters are not available. Since you tune parameters while motor is running, make sure that you can drive a motor safely when the motor is disconnected from a mechanical system before you start. The motor operates following the specified acceleration/deceleration times.

# 4. Control and Operation

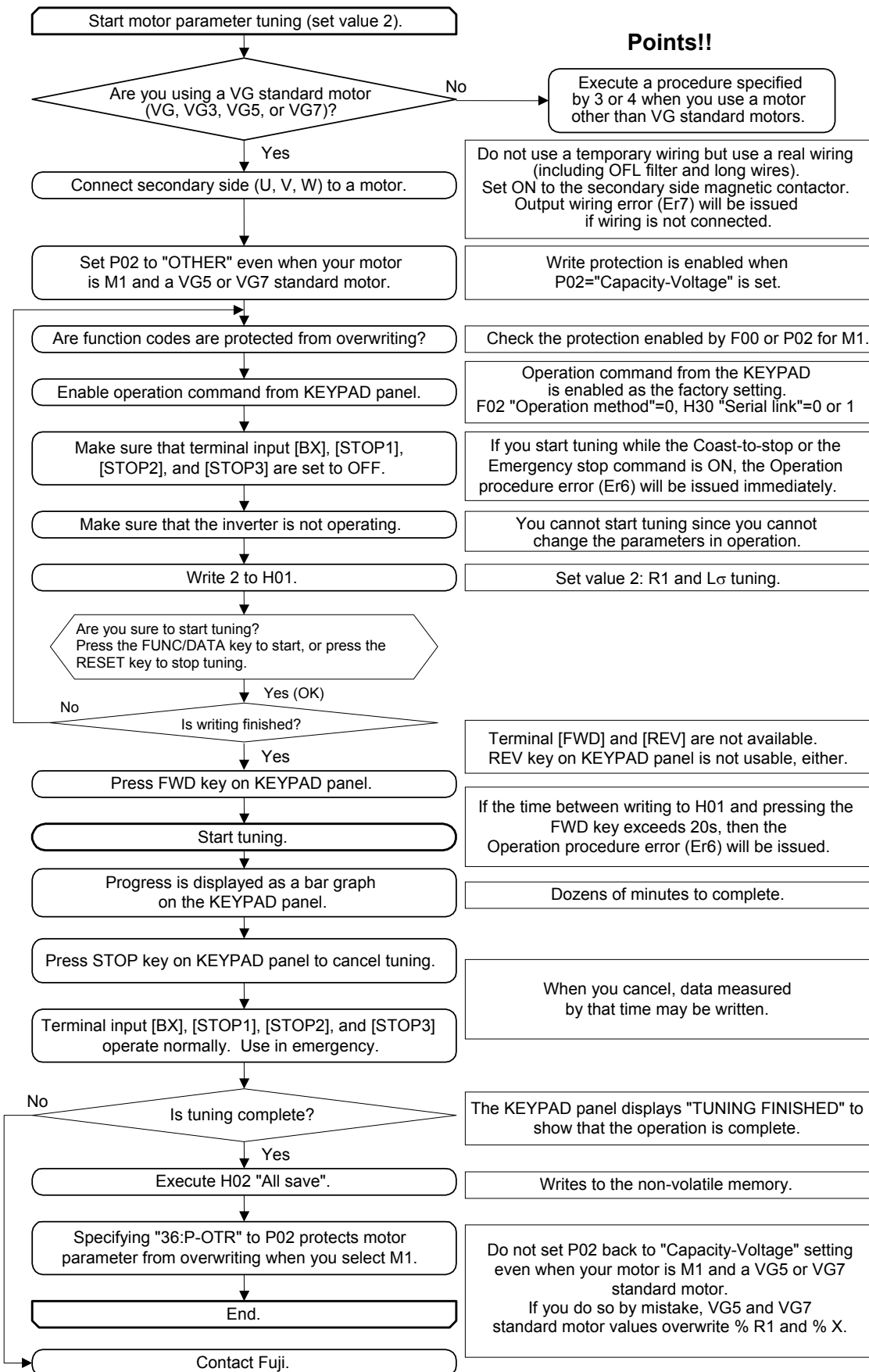
## ASR tuning procedure (For set value 1)



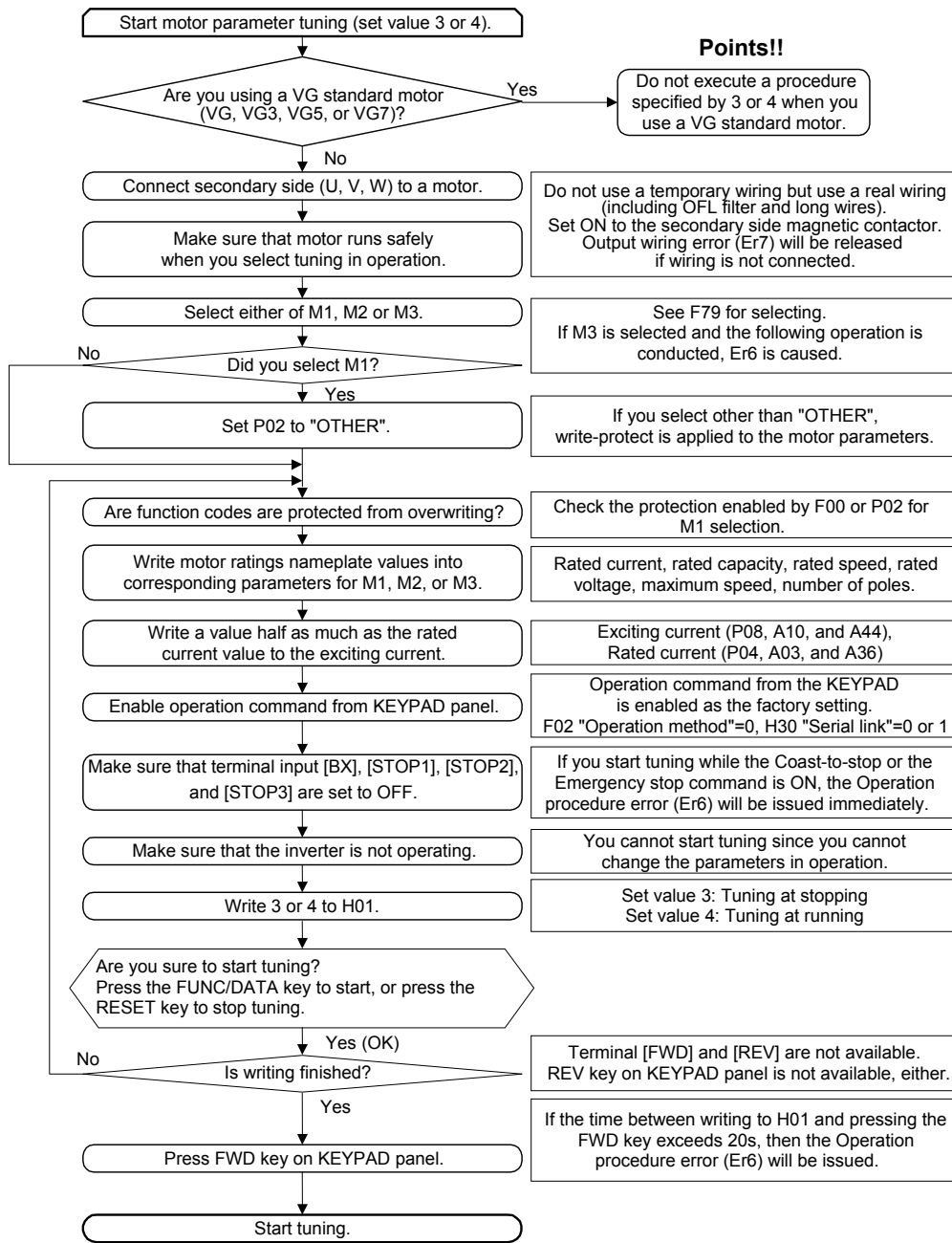


# 4. Control and Operation

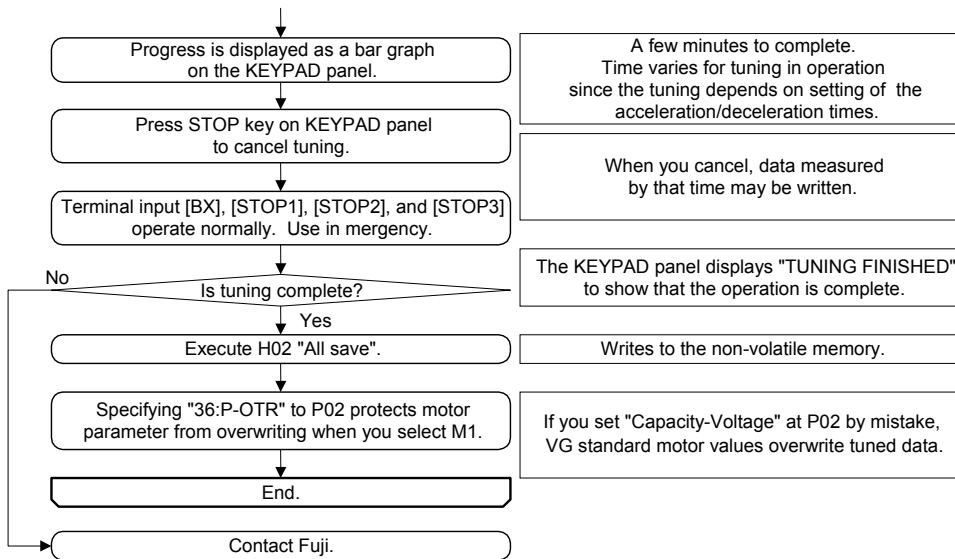
Motor parameters tuning procedure (For set value 2)



Motor parameters tuning procedure (For set value 3, or 4)



## 4. Control and Operation



### **WARNING**

- When you set 1 or 4 to the tuning, a motor will run. Make sure that the motor runs safely. **You may be injured.**

**H02****All save function**

- ◆ When you execute H01 "Tuning operation" to rewrite the internal data or you rewrite data through the link (RS485 or field bus), the data are written to the volatile memory (RAM) temporarily and the data are erased when you turn off the power. Execute this function when you want to save these data (to write to the non-volatile memory).
- ◆ Set the value 1 and press **STOP** and **^** keys at the same time to execute.
- ◆ When you use the All save, you may delete previous data.

H	0	2	A	L	L	S	A	V	E		
---	---	---	---	---	---	---	---	---	---	--	--

**H03****Data initializing**

- ◆ Set the value 1 and press **STOP** and **^** keys at the same time to initialize set values to the factory setting. When the initialization is complete, the set values return to zero automatically. Not all functions execute initialization. See the function code list for more details.

H	0	3	D	A	T	A	I	N	I	T	
---	---	---	---	---	---	---	---	---	---	---	--

**H04****Auto-reset (Number)****H05****Auto-reset (Reset interval)**

- ◆ The Auto-reset function cancels the inverter protective function to restart the inverter automatically without alarm and output shut-off after the inverter protective function is activated. These functions set the number of canceling the protective function and the wait time between the activation and the cancellation of the protective function.

H	0	4	A	U	T	O	-	R	E	S	E	T
H	0	5	R	E	S	E	T	I	N	T		

Setting range (number): 0: Auto-reset disabled

1 to 10 [times]

(Wait time) 0.01 to 20.00 [s]

Set H04 "Auto-reset (Number)" to 0 when you do not use the auto-reset function.

- ◆ Inverter protective functions you can reset to restart.

OC: Overcurrent	dBH: Braking resistor overheat
OV: Overvoltage	OL1, 2, 3: Motor 1,2, and 3 overload
OH1: Overheating at heat sink	OLU: Inverter overload
OH3: Inverter internal overheat	

- ◆ When you set 1 to 10 to H04 "Auto-reset (Number)", the auto-reset is activated and inverter start command is automatically directed after a time specified by H05 "Auto-reset (Reset interval)" has passed. If the cause of the alarm does not exist any more, the inverter starts without entering the alarm mode. Otherwise, the protective function is activated again to wait for the time specified by H05 "Auto-reset (Reset interval)". If the cause of the alarm still exists after the inverter restarts specified times by H04 "Auto-reset (Number)", then the inverter enters the alarm mode. You can use the terminal [Y1] to [Y5] and [Y11] to [Y18] to monitor the retry operation. Note that if you want to use [Y11] to [Y18], you need the option OPC-VG7-DIOA. You can also use the link to poll M15 to read out the terminal information.

**! WARNING**

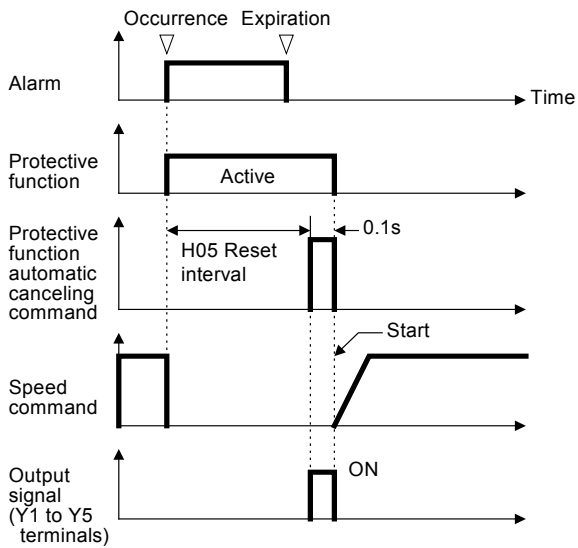
- When you select the restart function, the inverter may restart automatically depending on the cause a trip after the inverter stops due to the trip. You must design your machine such that the machine restarts without causing any danger to persons.

**Otherwise the restart may cause accidents.**

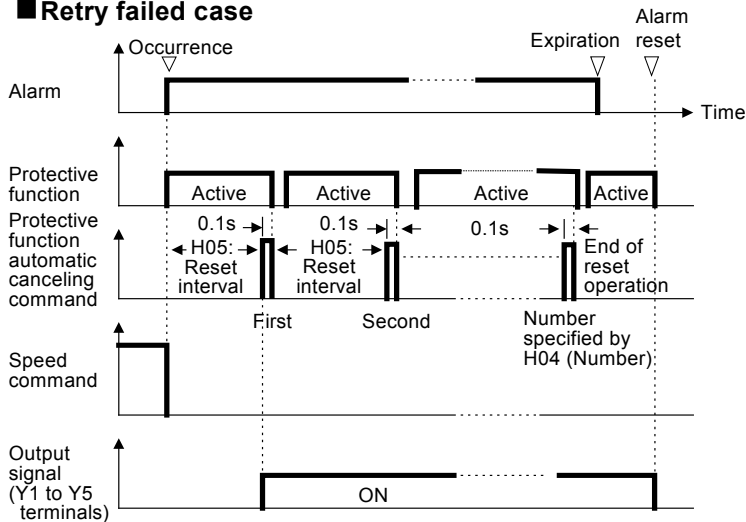


# 4. Control and Operation

## ■ Retry successful case



## ■ Retry failed case



**H06**

### Fan stop operation

- ◆ You can select whether to enable automatic ON/OFF operation of the cooling fan by detecting the temperature of the heat sink inside the inverter when the power is supplied to the inverter.  
Set value: 0: Fan ON/OFF operation disabled  
1: Fan ON/OFF operation enabled
- ◆ You can use the terminal [Y1] to [Y5] and [Y11] to [Y18] to monitor the cooling fan operation. Note that if you want to use [Y11] to [Y18], you need the option OPC-VG7-DIOA.

**H 0 6 F A N S T O P**

**H08****Rev. phase sequence lock**

- ◆ You can inhibit the reverse rotation of a mechanical device that should not do so. This function is not available when you use V/f control.

**H 0 8 P R T D - I N V T**

Set value: 0: Disabled  
1: Enabled

- ◆ Use the function code F76 to F78 "Speed limiter" to inhibit the reverse operation directed by negative [12] input or [REV] input. This function uses torque control to inhibit the reverse operation due to an undershoot in stopping operation.

**H09****Start mode (Rotating motor pick up)**

- ◆ Restarts a motor smoothly when the motor starts after a momentary power failure or an external force is coasting the motor.  
Detects the speed of a motor and supplies the same speed as that of the motor to start. Thus, the motor starts smoothly without presenting any shocks.

**H 0 9 S T A R T C H A R**

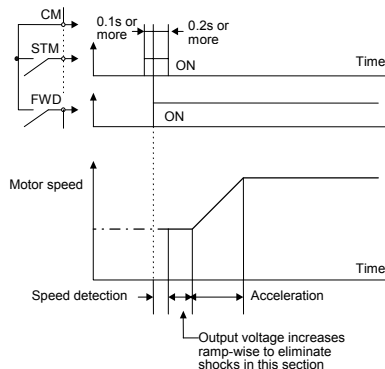
- ◆ Setting range: 0, 1, and 2

Set value	Normal start	Start after momentary power failure
0	Disabled	Disabled
1	Disabled	Enabled
2	Enabled	Enabled

- ◆ Description of the set values

- 1: Enabled when F14 "Restart mode after momentary power failure (Select)" is set to 3, 4, or 5. Also starts the motor at the coasting speed.
- 2: Starts the motor at the detected coasting speed after any start situation including the ON operation command regardless of the occurrence of a momentary power failure.

- ◆ Assign a setting value 26 (Pick up start mode) to either of the terminal from [X1] to [X9] to switch this function externally to apply the function to a normal ON operation command.

**H10****Energy-saving operation**

- ◆ To reduce the output voltage automatically during constant speed operation with light load to operate at a state where the product of voltage and current (power) is the smallest. This function is not available for V/f control.

**H 1 0 A U T O - E N G Y**

Set value: 0: Disabled  
1: Enabled

**H11****Automatic operation OFF function**

- ◆ Turns off the operation automatically when the motor speed decreases down under the F37 "Stop speed" while the FWD or REV command is present, or coasts the motor instead of decelerating the motor to stop when the input is set to OFF.

**H 1 1 A U T O O F F**

- Set value: 0: The motor decelerates to stop when the FWD-CM and the REV-CM are OFF (normal).  
1: The motor operation is set to OFF when the speed is F37 under the "Stop speed" while the FWD-CM and the REV-CM are ON.  
2: The motor coasts to stop when the FWD-CM and the REV-CM are OFF.

## 4. Control and Operation

### H13 Auto-restart (Restart time)

- ◆ Waits for a time specified this function after power recovery and restarts.

**H 1 3 R E S T A R T**

Setting range: 0.1 to 5.0 [s]

### H14 Auto-restart (Speed fall rate)

- ◆ Sets the speed fall rate, i.e. the speed of matching operation, to match the inverter output speed to the motor speed after a momentary power failure and power recovery. Used only for V/f control.

**H 1 4 F A L L R A T E**

Setting range: 1 to 3,600 [r/min/s]

### H15 Auto-restart (Holding DC voltage)

- ◆ If you select setting 2 (deceleration to a stop on power failure) or 3 (continuous operation) in Restart mode after momentary power failure (F14: Action selection), this function affects them. At both settings, control operation starts when the main circuit DC voltage drops below this setting level.

**H 1 5 H O L D V**

Setting range: 200V: 200 to 300 [V]  
400V: 400 to 600 [V]

### H16 Auto-restart (Operation command self-hold setting)

- ◆ Holds the operation command when the control power supply is maintained in the inverter or until the main circuit DC power supply voltage decreases about to zero (recognized as "momentary power failure") when you specifies 1.
- ◆ Holds the operation command for a time specified by the H17 "Auto-restart (Operation command self-hold time)" when you specifies 0.

**H 1 6 S L F H L D - S E L**

### H17 Auto-restart (Operation command self-hold time)

- ◆ When the power to the main power supply and the external control circuit (relay sequence) discontinues on power failure, the operation command given to the inverter becomes OFF in general. This function sets the time to hold the operation command. When the period of a power failure exceeds the self-hold time, the inverter recognizes the power failure here cancels the "restart after momentary power failure" mode and restarts normally on power recovery (you can consider this setting as permissible momentary power failure time).

**H 1 7 S E L F H O L D**

Setting range: 0.0 to 30.0 [s]

### H19 Active drive

- ◆ In the vector control mode, the output torque is automatically limited to avoid a trip caused by an overload or the like.
- ◆ If 60s or a longer acceleration time is selected under V/f control, the acceleration time is automatically lengthened three-folded to avoid alarms.

**H 1 9 A C T - D R I V E**

Set value: 0: Disabled  
1: Enabled

- ◆ Before a trip is caused due to an inverter overload (OLU), heat sink overheat (OH1) or inverter inside overheat (OH3), the torque command value is limited or the acceleration time is extended to avoid alarms.

**H20****PID control**

- ◆ PID control uses a sensor attached to a subject of control to detect the controlled value (feedback value) and compares it with the reference value (such as speed reference). When there is a deviation between them, the control behaves to decrease the deviation to zero. This is a control to match the feedback value with the reference value.

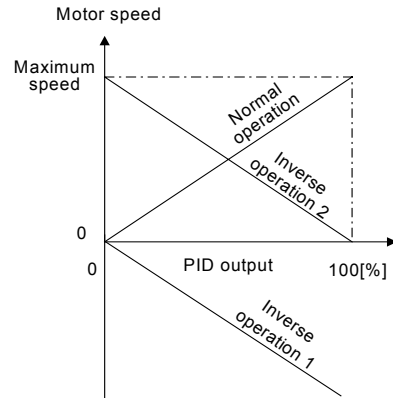
This control is applied to process control such as dancer control, tension control and extruders.

- ◆ You can select normal or inverse operation for the output of the PID regulator and set increase or decrease to the rotation of a motor receiving the output of the PID regulator.

H	2	0	P	I	D	C	O	M	N	D
---	---	---	---	---	---	---	---	---	---	---

Set value: 0: Disabled

- 1: Enabled (normal operation)
- 2: Enabled (inverse operation 1)
- 3: Enabled (inverse operation 2)

**H21****Command selection**

- ◆ Select the source of the reference value applied to the PID regulator.

Set value: 0: KEYPAD panel or [12] terminal input

- 1: Analog input Ai [PID-REF]

- ◆ You can assign [PID-FB] to an analog input Ai to specify the feed back value applied to the PID regulator. You cannot specify a feed back value other than this voltage input.

- ◆ You can view the process values of the reference value and the feedback value according to set values of the F52 "Display coefficient A" and F53 "Display coefficient B". See the function description of F52 and F53 for more details.

H	2	1	P	I	D	R	E	F	E	R
---	---	---	---	---	---	---	---	---	---	---

**H22****PID control setting (P-gain)****H23****PID control setting (I-gain)****H24****PID control setting (D-gain)**

Set the individual constants of PID control.

H	2	2	P	-	G	A	I	N		
H	2	3	I	-	G	A	I	N		
H	2	4	D	-	G	A	I	N		

H22 setting range: 0.000 to 10.000 [times]

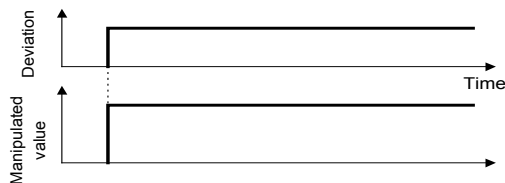
H23 setting range: 0.00 to 100.00 [s]

H24 setting range: 0.000 to 10.000 [s]

- ◆ You do not use P: Gain, I: Integral time, or D: Differential time individually, but use them by combining them as P control, PI control, PD control, and PID control in general.

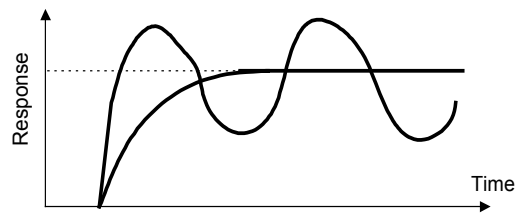
- ◆ P control action

This action is referred to as P control action when a manipulated value (Speed command, Auxiliary speed command, and Torque limiter) and deviation has a linear relation. Thus P control action provides a manipulated value proportional to the deviation. Note that you cannot use only P control action to decrease the deviation to zero.



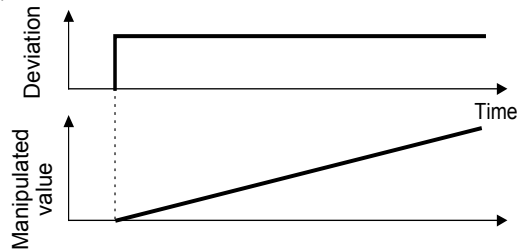
## 4. Control and Operation

P: gain is a parameter to define a degree of the response to a deviation. When you set a large gain, you will have a quick response. Too large gain presents an oscillation. Too small gain slows down the response.



### ◆ I control action

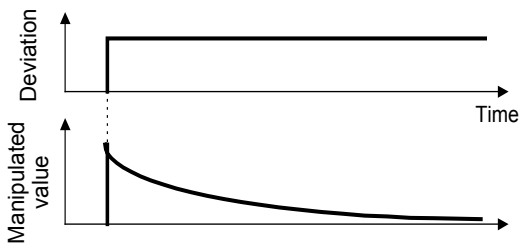
This action is referred to as I control action when a manipulated value (Speed command, Auxiliary speed command, and Torque limiter) changes at a speed in proportion to deviation. Thus, I control action provides an integrated deviation as a manipulated value. I control action behaves to conform the controlled value (feedback value) to the reference value (such as speed command). However I control cannot respond to a deviation changing quickly.



You can use I: integral time as a parameter to determine the effect of I control action. If you set a large integral time, you will have a slow response. A large integral time also decreases the repulsive force. A small integral time quickens response. However, too small integral time will cause an oscillation.

### ◆ D control action

This action is referred to as D control action when a manipulated value (Speed command, Auxiliary speed command, and Torque limiter) is proportional to differential of deviation. Thus D control action provides a differential of deviation as a manipulated value to respond a quick change.



You can use D: differential time as a parameter to determine the effect of D control action. A large differential time attenuates an oscillation caused by P control action quickly when a deviation occurs. Too large differential time may induce even a larger oscillation. A small differential time decreases attenuation action applied to a deviation.

### ◆ PI control action

When you use only P control action, the deviation still remains. PI control, P control action combined with I control action, is used in general to eliminate this residual deviation. PI control always behaves to eliminate a deviation due to a change of reference value or a continual disturbance. However if you increase I control action, the control cannot respond a fast deviation.

You can use only P control action for a load including an integral element.

### ◆ PD control action

PD control action generates a larger manipulated value than that of D control action to restrain the increase of the deviation. When the deviation decreases, P control action is restrained.

If a subject of control contains an integral element, sole P control action will present an oscillating response due to the integral element. If this is a case, you can use PD control to attenuate the oscillation caused by sole P control action. You apply this control to a process that does not have self-damping action.

### ◆ PID control action

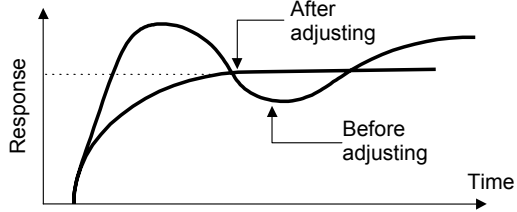
PID control action combines I control action, which acts to reduce deviation and D control action, which acts to restrain oscillation with P control action. You can obtain a stable response with no deviation.

This control is effective when applied to a load which respond slowly.

◆ Adjusting PID setting

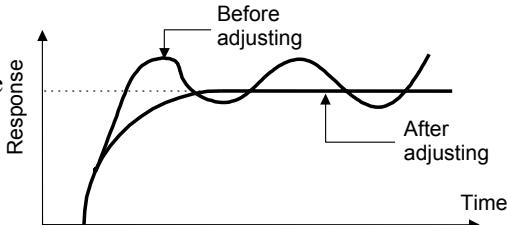
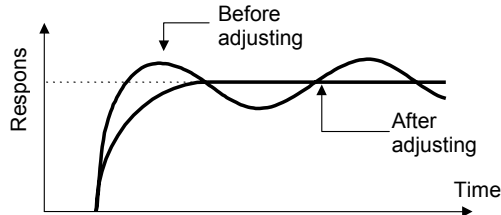
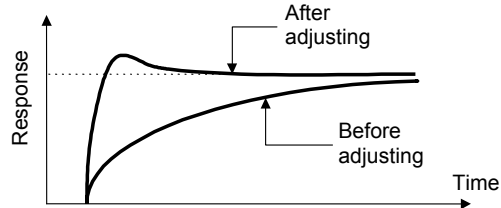
We recommend you to use an oscilloscope to view a response waveform and adjust PID setting. Adjust following the procedure described below.

- Increase H22 "PID control setting (P control action)" (P gain) as long as it does not present an oscillation.
- Decrease H23 "PID control setting (I control action)" (I integral time) as long as it does not present an oscillation.
- Increase H24 "PID control setting (D control action)" (D differential time) as long as it does not present an oscillation.



Follow the procedure below to adjust the response waveform.

- To restrict overshoot  
Increase H23 "PID control setting (I control action)" (I integral time). Decrease H24 "PID control setting (D control action)" (D differential time).
- To stabilize fast (accepting some overshoots.)  
Decrease H23 "PID control setting (I control action)" (I integral time). Increase H24 "PID control setting (D control action)" (D differential time).
- To restrain an oscillation whose cycle is longer than H23 "PID control setting (I control action)" (I integral time).  
Increase H23 "PID control setting (I control action)" (I integral time).
- To restrain an oscillation whose cycle is about the same as the H24 PID control setting (D control action)" (D differential time)  
Decrease H24 "PID control setting (D control action)" (D differential time).  
Decrease H22 "PID control setting (P control action)" (P gain) if you set 0.0 and the oscillation still exists.



**H25** PID control setting (Output upper limit value)

**H26** PID control setting (Output lower limit value)

◆ Set the upper and lower limiters applied to PID control.

H	2	5	P	I	D	U	P	P	E	R
H	2	6	P	I	D	L	O	W	E	R

Setting range: -300 to 300 [%]

**H27** PID control setting (Speed command selection)

◆ Selects a destination of PID output to be used as a speed command.

H	2	7	P	I	D	S	P	R	E	F
---	---	---	---	---	---	---	---	---	---	---

- Setting: 0: Disabled  
 1: PID  
 2: Auxiliary speed

# 4. Control and Operation

## ◆ Application example

Usage	Destination of connection	Parameter setting
Process control	Speed command	H27=1
Dancer control	Auxiliary speed command	H27=2
Torque control (tension control)	Torque command	H27=0 & H41=5
	Torque control value	H27=0 & (F42 or F43=5)

### H28

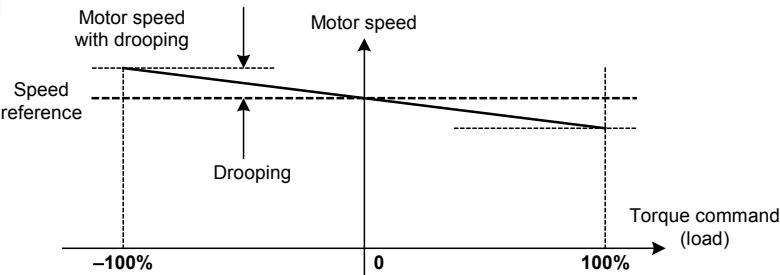
### Droop operation

- ◆ When you use multiple motors to drive a single machine, a motor whose speed is higher has to drive a larger load. Droop operation balances load by adding a drooping characteristic to speed. This function is not available for V/f control.

**H 2 8 D R O O P**

Setting range: 0.0 to 25.0 [%]

- ◆ Set a drooping amount at 100% of torque command. A value set to 100% corresponds to the maximum speed. When the maximum speed is 1,500r/min and the drooping is set to 10%, then the drooping speed is -150.0r/min at 100% of torque command (load).



- ◆ The droop function becomes valid after the [DROOP] contact input and ON “DROOP ON” are turned on.
- ◆ If the droop gain is too large, the motor speed may increase too much under a control load, causing an excessive speed alarm (OS). If this happens, decrease the gain.

### H29

### Link function protection

- ◆ Protects code data from false writing through different types of communication systems (such as integrated RS485 and field bus).

Set value: 0: Write enabled

1: Write protected

- ◆ You should use H30 "Serial link" to define the write operation to the S area (function codes including operation commands and speed commands) separately.
- ◆ When you assign [WE-LINK] to a digital input, you can protect from writing by short-circuiting between [WE-LINK] and [COM].

**H 2 9 L I N K P R O C T**

### H30

### Serial link

- ◆ Uses different types of communication systems (such as integrated RS485 and field bus) to enable/disable command data (such as speed command, position command, torque command) and operation commands (FWD and REV), control inputs (X1-X9, X11-X14). Monitoring (access to M area) is always available. The command data correspond to S01 to S05 and S08 to S12. The operation commands correspond to the lowest two bits of S06.
- ◆ When you assign [LE] to a digital input, you can connect between [LE] and [CM] to enable the setting by H30 and open to disable operations specified through the link (set to H30=0 regardless of the setting by H30).

**H 3 0 L I N K F U N C**

Set value:

	Monitoring	Command data	Operation commands Control inputs (X1-X9, X11-X14)
0:	Enabled	Disabled	Disabled
1:	Enabled	Enabled	Disabled
2:	Enabled	Disabled	Enabled
3:	Enabled	Enabled	Enabled

**1500**

<b>COMM</b>	<input type="checkbox"/> X2	<input type="checkbox"/> X6
<input type="checkbox"/> FWD	<input type="checkbox"/> X3	<input type="checkbox"/> X7
<input type="checkbox"/> REV	<input type="checkbox"/> X4	<input type="checkbox"/> X8
<input type="checkbox"/> X1	<input type="checkbox"/> X5	<input type="checkbox"/> X9

You can use the KEYPAD panel to check the operation commands from the link, and I/O check of control input.

- ◆ Sets different types of specifications for RS485 communication. Specify according to your host device. See "Standard RS485 interface" for the communication protocol.

**H31 Station address**

Sets the station address of RS485

Setting range: 0 to 255 (Broad cast: (0: RTU), (99: FUJI)/ address: 1 to 255)

**H32 Action on error occurrence**

Setting range: 0 to 3

Setting: 0: Immediate trip upon communication error

- 1: Trip upon communication error after continuation of operation for the time set at H33 "timer interval"
- 2: Trip upon communication error if the error persists after the time set at H33 "timer action time" has elapsed
- 3: Operation continues even if a communication error occurs.  
(The transmitted operation command is automatically restored after the cause of the failure is removed.)

**H33 Timer operation time**

Specify a procedure when an error occurs and an error handling time.

Timer operation time: 0.01 to 20.00 [s]

**H34 Transmission rate**

Specifies transmission rate.

Set value: 0: 38,400 [bps]

1: 19,200 [bps]

2: 9,600 [bps]

3: 4,800 [bps]

4: 2,400 [bps]

**H35 Data length**

Specifies data length.

Set value: 0: 8 [bit]

1: 7 [bit]

(The SX protocol and Modbus RTU protocol are fixed at 8 bits irrespective of the H35 setting.)

**H36 Parity bit**

Specifies parity bit.

Set value: 0: None

1: Even parity

2: Odd parity

(The SX protocol is fixed at the even parity irrespective of the H36 setting.)

**H37 Stop bit**

Specifies stop bit.

Set value: 0: 2 [bit]

1: 1 [bit]

(With the Modbus RTU protocol, the stop bit is automatically selected according to the parity bit selected at H36 irrespective of the H37 setting. See page 6-2.)

**H38 Continued communication disconnected time**

Specifies a time to wait to provide a trip signal (Er5) after detecting discontinued access due to disconnection during operation through RS485 in a system where the station is always accessed in a certain period.

Setting range: 0: Detection disabled

0.1 to 60.0 [s]

**H39 Interval time**

Specifies a time between the completion of receiving a request from a host device (personal computer or PLC) and the start of responding to the request.

Setting range: 0.00 to 1.00 [s]



# 4. Control and Operation

## H40 Protocol selection

Specifies a communication protocol.

- Set value: 0: FUJI general-purpose inverter protocol  
 1: SX bus protocol (loader protocol)  
 2: Modbus RTU protocol

Set 1 to connect to VG7S support loader.

Set 0 to control FUJI general-purpose inverters and VG7S inverters connected through the common RS485 communication.

Note: Modbus RTU is a communication protocol defined by Modicon company.

## H41

### Torque reference selection

- ◆ Selects an element with which you provide the torque command. See the control block diagram for more details.

**H 4 1 T - R E F S E L**

- Setting value: 0: Internal ASR data  
 1: Ai input [T-REF]  
 2: DIA card  
 3: DIB card  
 4: Link (S02)  
 5: PID output

- ◆ Use also the speed limiter setting (F76 to F78) when you use the torque command.

#### WARNING

- Make sure to use the speed limiter in cooperation with the torque command or the torque current command. You can avoid the motor overrun.

**Accidents or physical injuries may occur.**

## H42

### Torque current reference selection

- ◆ Selects an element with which you provide the torque current command. See the control block diagram for more details.

**H 4 2 I T R E F S E L**

- Setting value: 0: Internal ASR data  
 1: Ai input [IT-REF]  
 2: DIA card  
 3: DIB card  
 4: Link (S03)

- ◆ Use also the speed limiter setting (F76 to F78) when you use the torque current command.

#### WARNING

- Make sure to use the speed limiter in cooperation with the torque command or the torque current command. You can avoid the motor overrun.

**Accidents or physical injuries may occur.**

## H43

### Magnetic-flux command selection

- ◆ Selects an element with which you provide the magnetic-flux command.
- ◆ If the Ai input and link are selected, magnetic flux command inputs within 10% are fixed at 10%.

**H 4 3 M R E F S E L**

- Setting value: 0: Internal calculated value  
 1: Ai input [MF-REF]  
 2: Function code H44  
 3: Link (S04)

## H44

### Magnetic-flux command value

- ◆ Specifies magnetic-flux command value. This function becomes available when you set 2 to H43.

**H 4 4 M R E F**

- Setting range: 10 to 100 [%]

**H46****Observer type selection**

- ◆ Specifies an inertia of a mechanical system or uses the ASR tuning to measure the inertia, operates an internal machine model in the inverter, estimates a load torque that becomes a disturbance element or a oscillation element, adds a value to the torque command to counteract the load torque to increase the speed response against a load disturbance and to damp an oscillation generated by the mechanical resonance quickly. This function selects load disturbance observer or oscillation suppressing observer.

H	4	6	O	B	S	M	O	D	E		
---	---	---	---	---	---	---	---	---	---	--	--

Set value: 0: Disabled

1: Load disturbance observer

2: Oscillation suppressing observer

Note: When a load inertia specified by H51 or H52 has a large error, you cannot obtain an expected performance. Specify an accurate value.

**H47,48****Observer setting  
(M1, M2 compensation gain)****H49,50****Observer setting  
(M1, M2 integral time)****H51,52****Observer setting  
(M1,M2 load inertia)**

- ◆ Specifies the compensation gain, the integral time, and the load inertia for the observer function.

H	4	7	O	B	S	-	P	1				
H	4	8	O	B	S	-	P	2				
H	4	9	O	B	S	-	I	1				
H	5	0	O	B	S	-	I	2				
H	5	1	M	1	-	I	N	E	R	T	I	A
H	5	2	M	2	-	I	N	E	R	T	I	A

H47, H48 setting range: 0.00 to 1.00 [times]

H49, H50 setting range: 0.005 to 1.000 [s]

H51, H52 setting range: 0.001 to 50.000 [kg·m<sup>2</sup>]

- ◆ Specify a load inertia of motor shaft conversion in kg·m<sup>2</sup>. You can also use ASR tuning by H01 "Tuning operation selection" to measure the inertia.

**H53****Line speed feedback selection**

- ◆ You can select an element for the speed feedback.

H	5	3	N	-	F	B	S	E	L		
---	---	---	---	---	---	---	---	---	---	--	--

Set value: 0: Line speed disabled (integrated PG enabled)

However, with UPAC, Ai input or PG(LD) high select

\* Applicable ROM No.: H1/2 003F or later

1: Analog line speed detection [LINE-N]

2: Digital line speed detection (optional OPC-VG7-PG (LD))

3: High selector (select the higher speed between the motor speed or line speed)

- ◆ About High selector

When you conduct a line speed control, and a line PG fails and presents a speed feedback of 0r/min, the inverter provides a command corresponding the maximum torque (torque limiter value if you use it) to accelerate the motor to the maximum speed to follow up the speed command. To change the feedback input from the line PG to a motor PG to prevent overrun when the line PG is disconnected is referred as "High selector". Make sure to use this High selector when you do not have a protective mean to detect the PG disconnection for line speed control.

Note: When you use a motor PG and the optional OPC-VG7-PG (LD), a protective function of "PG disconnection alarm" becomes available.

- ◆ If P01 (M1 control method) is set at "2" (simulation mode), the line speed feedback automatically becomes invalid.

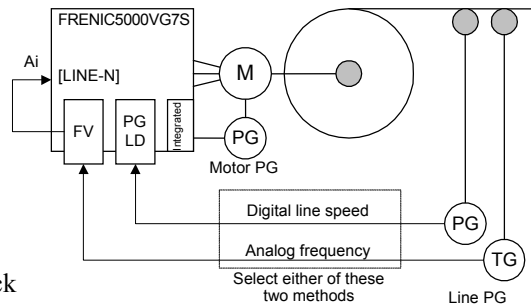
# 4. Control and Operation

<Application example of line speed control>

The right figure illustrates an example of line speed control with PG.

When the line PG output is analog frequency, then use the FUJI FV card (MCA, OPC-VG7-FV) to convert the analog frequency into voltage to supply the voltage output to Ai [LINE-N]. Also specifies H53 as High selector.

When the line PG output is digital pulse, then use FUJI PG card (OPC-VG7-PG(LD)). See also the description of o06, o07, and o08 and the control block diagram.



## H55 Zero speed control (Gain)

## H56 Zero speed control (Completion range)

- ◆ Specifies the gain of the servo locking command and the range of completion to provide the servo locking completion signal. See the section of [LOCK] of the function code E01 to E13 "X function selection".

H	5	5	Z	E	R	O	-	G	A	I	N
H	5	6	Z	E	R	O	-	H	I	S	S

H55 setting range: 0 to 100 [times]

H56 setting range: 0 to 100 [pulse]

## H57 Overvoltage suppressing function

- ◆ When the DC link circuit voltage exceeds the overvoltage protection level during braking operation, the overvoltage (OV) trip occurs. This function limits the braking torque to zero before the overvoltage trip during the braking operation. The link circuit voltage decreases after 0 limiting, and the brake torque recovers automatically. This operation repeats to restrain the overvoltage trip.
- ◆ You can use only inverter loss energy to apply brake without braking devices (braking resistor and PWM converter). When you want to use this function, see also "Power limiter" of the function code F40 to F45 "Torque limiter".

H	5	7	O	U	P	R	E	V	E	N	T
---	---	---	---	---	---	---	---	---	---	---	---

Set value: 0: Disabled  
1: Enabled

Note: The torque generated by the motor may decrease under a suppressed voltage state. Do not use this function for vertical transportation applications.

In case of V/f control, too short a deceleration setting may disable overvoltage suppression. If overvoltage suppression is disabled, extend the deceleration time.

## H58 Overcurrent suppressing function

- ◆ The overcurrent trip occurs when the motor current changes suddenly to become more than the protection level. The overcurrent suppressing function restrains the inverter from supplying a current more than the protection level when the load changes.

H	5	8	O	C	P	R	E	V	E	N	T
---	---	---	---	---	---	---	---	---	---	---	---

Set value: 0: Disabled  
1: Enabled

Note: The torque generated by the motor may decrease under a suppressed voltage state. Do not use this function for vertical transportation applications.

**H60-H66****Load adaptive control function**

- ◆ Use this function to lift faster in case of small loads when compared with the speed at the rated load, thereby improving the efficiency of operation of the equipment.
- ◆ Internal calculation of the inverter estimates the load during acceleration up to the rated (base) motor speed to calculate the maximum operable speed and perform speed limit control. Operation at the same speed in the up- and down-winding cycles with the same load is a major feature. As well, the maximum speed calculation correction function is added so that the up-/down-winding operation at the rated load is always at the rated (base) motor speed. The function can be used for lifting equipment equipped with a counterweight.

**Note:** The load adaptive control is valid with the M1 motor only. Specify the same torque limit value for driving and braking.

Use acceleration/deceleration time 1 during operation under load adaptive control. Do not change the acceleration/deceleration time setting during load adaptive control operation.

**H51 Observer setting (load inertia of M1) 0.001 to 50.000 [kgm<sup>2</sup>]**

Specify the inertia without a load converted to the M1 motor shaft.

**Note:** In a multi-winding system, specify the quotient of the total inertia divided by the number of windings. For example, for a motor with two windings, specify a half the total inertia.

**H60 Load adaptive control definition 1**

Select the control method.

Setting: 0: The load adaptive control is made invalid.

- 1: Speed limit at almost same speed in up- and down-winding cycles
- 2: Regular speed limit
- 3: Limit invalid during driving operation and speed limit during braking operation

**H61 Load adaptive control definition 2**

Define the relationship between the direction of rotation of motor and lifting direction.

Setting: 0: Winding up during forward rotation of motor

- 1: Winding down during forward rotation of motor

**H62 Up-winding speed 0.0 to 999.9 [m/min]**

Specify the lifting speed at the rated (base) motor speed. Note that this is not the maximum speed.

**H63 Weight of counterweight 0 to 600.00 [t]**

Specify for lifting equipment equipped with a counterweight. Specify the weight of the counterweight.

**H64 Safety factor 0.50 to 1.20****H65 Machine efficiency 0.500 to 1.000**

Specify the total efficiency of the equipment.

**H66 Rated load 0 to 600.00 [t]**

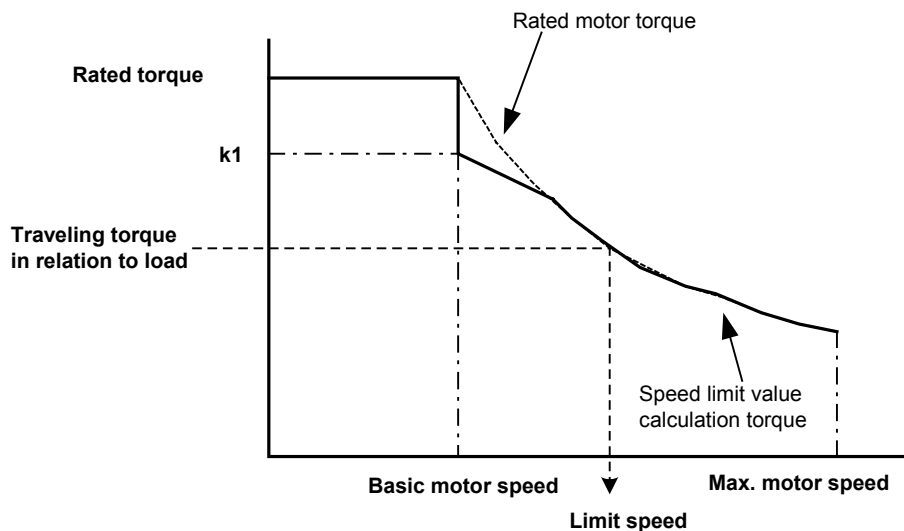
The parameter is necessary for the correction of the maximum speed calculation so that operation at the rated (base) motor speed is assured during up-/down-winding cycles at the rated load.

**Note:** Include the mass of the spreader and head block, too, in the setting. For a multi-winding system, specify the quotient of the total mass divided by the number of windings. For example, for a motor with two windings, specify a half the total mass.

- ◆ Specify H51 (observer setting (M1 load inertia)), H61 (load adaptive control definition 2), H62 (up-winding speed), H63 (weight of counterweight), and H65 (machine efficiency) according to the specification of the machine. The speed limit is set in a constant-output pattern according to the rated motor output. The rated motor output serving as a basis for the calculation of the speed limit can be adjusted with H65 (safety factor).
- ◆ To operate at almost the same speed in the up-winding and down-winding cycles of the same load, specify setting "1" as H60 (load adaptive control definition 1).
- ◆ To operate at the rated (basic) motor speed in the up-winding and down-winding cycles of the rated load, specify H66 (rated load). If the estimated inverter load exceeds the rated load, limit the motor speed using the rated speed (basic speed).

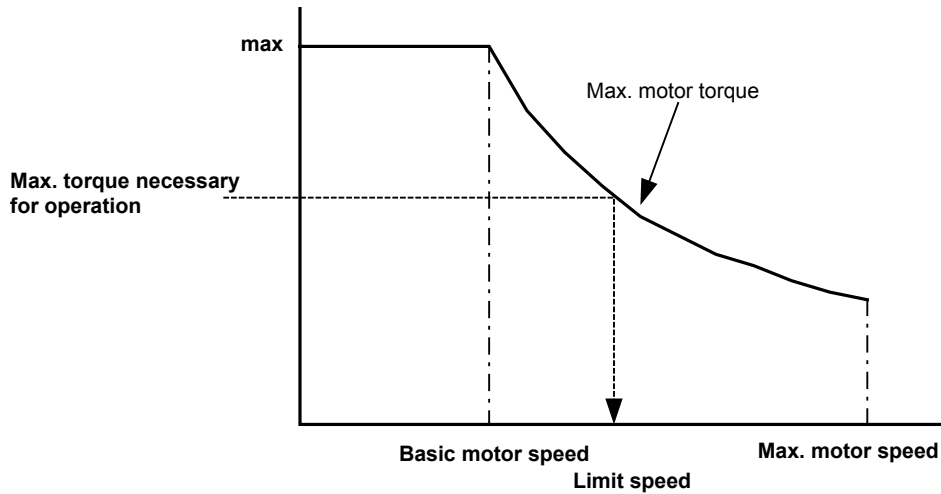
## 4. Control and Operation

- ◆ To determine the maximum speed under consideration for the machine efficiency, specify setting "2" as H60 (load adaptive control definition 1). The down-winding speed (during braking operation) becomes higher by the machine efficiency when compared with the up-winding speed (driving operation).
- ◆ To invalidate load adaptive control during driving operation and validate the control only during braking operation, specify setting "3" as H60 (load adaptive control definition 1). The control becomes invalid in the up-winding cycle (during driving operation) and the control becomes valid in the down-winding cycle.
- ◆ To invalidate load adaptive control control, specify setting "0" as H60 (load adaptive control definition 1). Or turn on the speed command value limit cancellation [N-LIM] of function selection D1 (X terminal function). Only the speed limit caused by load adaptive control becomes invalid. Because the estimated load is calculated and the speed limit is calculated, the speed limit value calculation result obtained with the option monitor 6 mentioned later is effective, too.
- ◆ Use option monitor 6 to check the limit value calculation result. (Valid if H60 (load adaptive control definition 1) is set at "1," "2" or "3.")
- ◆ Use function selection DO (Y terminal function) to check the activation state of load adaptive control. Under load adaptive control limitation [ANL]: The function turns on when the speed setting is limited by the speed limit value calculated in the load adaptive control mode. Once turned on, the function does not turn off until the inverter is stopped. During load adaptive control calculation [ANC]: The signal is on during calculation of the load and speed limit in the load adaptive control mode. Upon completion of calculation, the signal is turned off and the result of calculation of limit value of option monitor 6 is updated to the latest data. The signal is turned off when the inverter is stopped.
- ◆ Speed limit pattern diagram
  - If setting of H60 load adaptive control definition 1 = 1



k1 indicates the motor torque determined from H66 (rated load) and H62 (rated lifting speed). The motor speed is limited by the base speed with the loads exceeding the rated load. The rated motor torque can be operated, using H64 (safety factor).

- If setting of H60 load adaptive control definition 1 = 2 or 3



The limit speed is obtained from the relationship between the maximum motor torque and maximum torque necessary for acceleration/deceleration. The maximum motor torque can be operated, using H64 (safety factor).

**H68** **Trip data delete**

- ◆ Deletes the alarm history and the alarm information maintained in the inverter completely. The corresponding functions are the KEYPAD panel alarm information, the alarm history and the source of alarms.
- ◆ Specify 1 and press the **STOP** and the **^** keys simultaneously to execute the function. The data returns to 0 automatically.

**H 6 8 T R I P D A T A**

**H70** **Reserved 1**

- ◆ Selects function codes to be displayed on the KEYPAD panel.  
Set value: 0: Standard  
1: Elevators  
2-9999: Reserved
- ◆ When you select 1: Elevators, you will view the functions required for vertical transfer.

**H 7 0 M A K E R 1**

**H71** **Reserved 2**

**H72** **Reserved 3**

**H73** **Reserved 4**

- ◆ These functions are reserved for makers to adjust the inverter.

**H 7 1 M A K E R 2**

**H 7 2 M A K E R 3**

**H 7 3 M A K E R 4**

**⚠ CAUTION**

• Do not change.  
**Accident and/or injury may result.**

# 4. Control and Operation

## 4.3.6 A Codes (Alternative Motor Parameters)

The A codes are motor parameters that become available when you select the motor M2 or M3 (second or third motor). See the P codes when you use the M1.

### A01 - A34 Codes for the second motor

1500

- PARA 1  M1
- PARA 2  M2
- PARA 3  M3
- PARA 4  JOG

You can use the function code F79 and the terminal input signal [M-CH2] and [M-CH3] to select the M2.

See the individual descriptions and make sure that the M2 is selected. You can use the "I/O check" screen of the KEYPAD panel as shown in the right figure.

■ indicates "selected". Check if ■ M2 is indicated.

◆ The function description is omitted since the A codes are the same as the P codes in terms of function.

◆ Specifies the function codes in the table below following the items from top to bottom according to the motor to be used.

Function code for motor 2	FUJI motors		Other motors	
	Standard motors for VG7S, VG5, VG3 and VG	FUJI motors		
A01 M2 control method	0: Vector control	Select depending on with or without PG. With encoder: 0, vector control Without encoder: 1, sensorless control		
A02 M2 rated capacity	Set the data described in the Chapter 14 "Replacement data" manually.  Do not use H01 "Tuning operation selection".	Set the ratings nameplate data provided on the motor manually.		
A03 M2 rated current				
A04 M2 rated voltage				
A05 M2 rated speed				
A06 M2 maximum speed				
A07 M2 pole number				
A08 M2-%R1				
A09 M2-%X				
A10 M2 exciting current				
A11 M2 torque current				
A12,13 M2 slip on driving, braking				
A14-16 M2 iron loss coefficient 1-3				Preserve the initial value. Not available for tuning.
A17-21 M2 magnetic saturation coefficient 1-5				
A22 M2 secondary time constant				
A23 M2 induced voltage coefficient				
A24-26 M2-R2 correction coefficient 1-3				
A27 M2 exciting current correction coefficient	Preserve the initial value.			
A28, 29 M2-ACR-P, I (Gain, Constant of integration)				
A30 M2-PG pulse number	Select pulse number of PG to be used. Not effective during sensorless control.			
A31 M2 thermistor selection	1: NTC thermistor	See F10 for details on motor protection.		
A32 M2 electronic thermal overload relay (Select)	0: Disabled (VG standard motor)			
H01 Tuning operation selection	Motor parameter tuning not required. Procedure above sets optimal data automatically. Select 2 for tuning operation when output impedance is not negligible due to long (100m or more) wires between inverter and motor or OFL filter connected.	Motor parameter tuning required. Tune while wires are installed. See function description of function code H01.		
H02 All save function	Execute "all save" operation after using H01 to tune. This operation writes tuned data to non-volatile memory. Not necessary when you did not tune parameters.			

Note 1: VG7S standard motors are the same as the VG5 standard motors in shape and electrical constants (motor parameters).

**A35-A50**

**Codes for the third motor  
(for V/f control)**

- ◆ Motor parameters dedicated for the V/f control.
- ◆ These parameters become available when you use the function F79 "Motor selection" and X functions to select the motor 3.
- ◆ Specifies the function codes in the table below following the items from top to bottom according to the motor to be used.

Function code for motor 3	FUJI motors	
	Standard motors for VG7S, VG5, VG3 and VG	FUJI motors
A35 M3 rated capacity	Set the data described in the Chapter 14 "Replacement data" manually.  Do not use H01 "Tuning operation selection".	Set the ratings nameplate data provided on the motor manually.
A36 M3 rated current		
A37 M3 rated voltage		
A38 M3 maximum output voltage		
A39 M3 rated speed		
A40 M3 maximum speed		
A41 M3 pole number		
A42 M3-%R1		
A43 M3-%X		
A44 M3 exciting current		
A45 M3 slip compensation value	Use H01 "Tuning operation selection" to tune motor parameters. See the function description of H01 for more details.	
A47 M3 thermistor selection		1: NTC thermistor
A48 M3 electronic thermal overload relay (Select)		0: Disabled (VG standard motor)
H01 Tuning operation selection	Motor parameter tuning not required. Procedure above sets optimal data automatically. Select 2 for tuning operation when output impedance is not negligible due to long (100m or more) wires between inverter and motor or OFL filter connected.	Motor parameter tuning required. Tune while wires are installed. See function description of function code H01.
H02 All save function	Execute "all save" operation after using H01 to tune. This operation writes tuned data to non-volatile memory. Not necessary when you did not tune parameters.	

Note 1: VG7S standard motors are the same as the VG5 standard motors in shape and electrical constants (motor parameters).

- A37** M3 rated voltage
- A38** M3 maximum output voltage
- A39** M3 rated speed
- A40** M3 maximum speed

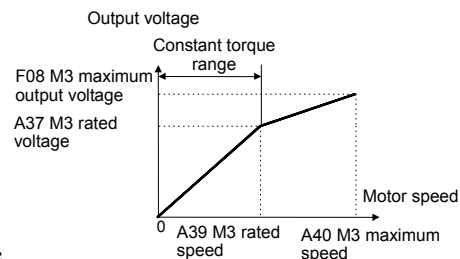
- ◆ Specifies the maximum speed of the motor 3 that the inverter provides. The maximum output frequency for V/f control is 400Hz. Set the maximum speed determined by the pole number of the motor.

A	3	7	M	3	-	V	r				
A	3	8	M	3	-	V	m	a	x		
A	3	9	M	3	-	N	r				
A	4	0	M	3	-	N	m	a	x		

A37, A38 setting range: 80 to 999 [V]

A39, A40 setting range: 50 to 24,000 [r/min]

You may damage a motor or machines when you set a value higher than the rating of the driven devices. Set according to the devices.





# 4. Control and Operation

**A45**

**M3 slip compensation value**

◆ A change in the load torque will change the motor slip, resulting in the motor speed change. The slip compensation control adds a frequency proportional to the motor torque to the inverter output frequency and reduces the fluctuation of the motor speed due to torque change.

**A 4 5 M 3 - S L I P d**

Setting range: -20.000 to 5.000 [Hz]

◆ You can use the following equation to obtain the slip compensation value.

$$\text{Slip compensation value} = \text{Base frequency} \times \frac{\text{Slip[r/min]}}{\text{Synchronous speed[r/min]}} \text{ [Hz]} \quad \text{Slip} = \frac{\text{Synchronous speed} - \text{Rated speed}}{\text{Rated speed}}$$

**A46**

**M3 torque boost**

◆ This function is dedicated to V/f control of the motor 3. The following selections are available.

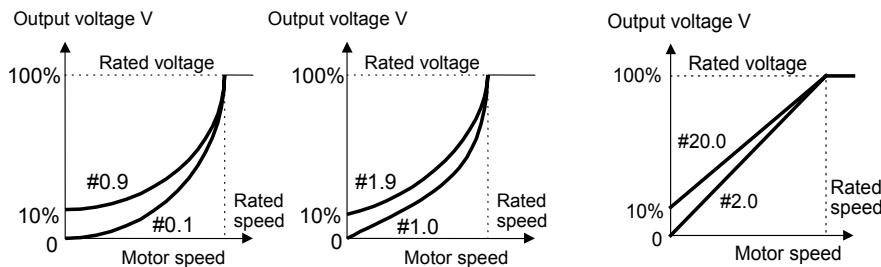
**A 4 6 M 3 - B O O S T**

- Selection of load characteristic from automatic torque boost, variable torque load, proportional torque load, and constant torque load.
- Compensating insufficient magnetic-flex of a motor due to the voltage decrease in low frequency range and boosting torque at low speed operation (boosting V/f characteristic).

Setting range	Description
0.0	Automatic torque boost characteristic to adjust torque boost value automatically for constant torque load changing linearly
0.1 to 0.9	Variable torque characteristic for fan/pump load
1.0 to 1.9	Linear torque characteristic for a load that has a middle characteristic between variable torque and constant torque characteristics
2.0 to 20.0	Constant torque characteristic changing linearly

◆ Torque characteristic

<Variable torque characteristic>   <Proportional torque characteristic>   <Constant torque characteristic>



Note: Increasing torque boost value will present over-excited state at low speed in all characteristics. Continued operation may cause motor overhear. Review the characteristic of a motor to be driven.

## 4.3.7 O Codes (Optional Functions)

### OPC-VG7-DIA, DIB

Use this option to specify the digital speed command, torque limiter value, torque command, and torque current command. When you install two option cards, you use hardware switches to distinguish them as DIA and DIB. See the control option section for more details.

**o01**      **DIA function selection**

**o02**      **DIB function selection**

◆ Select the data format for the digital speed command, torque limiter value, torque command, and torque current command.

o	0	1	D	I	A	F	U	N	C		
o	0	2	D	I	B	F	U	N	C		

- 1) See the function description of the function code F01 "Speed setting N1" to use for the speed command.
- 2) See the function description of the function code F42 "Torque limiter value selection" to use for the torque limiter value.
- 3) See the function description of the function code H41 "Torque command selection" to use for the torque command.
- 4) See the function description of the function code H42 "Torque current command selection" to use for the torque current command.

Set value: 0: Binary  
1: BCD

**o03**      **DIA BCD input setting**

**o04**      **DIB BCD input setting**

◆ Specify BCD data for setting the maximum speed of DIA and DIB inputs. Use when you want to enter "machine operation speed" directly to specify input data.

o	0	3	B	C	D	C	M	D	A	
o	0	4	B	C	D	C	M	D	B	

Setting range: 99 to 7,999

### OPC-VG7-PG

Use this option for the following applications.

- 1) Place the switch in the PD position to use position control (orientation) through pulse calculation.
- 2) Set the switch to LD to detect the line speed.
- 3) Place the switch in the PR position to use the pulse train synchronous operation.
- 4) Place the switch in the SD position to use for speed detection.

**CAUTION**

The model of the PG interface option varies according to the difference in the electric specification.  
 OPC-VG7-PG : 5V line driver  
 OPC-VG7-PGo : Open collector, voltage output

**o05**      **Feedback pulse selection**

◆ Switches the source of the position detection signal between the integrated PG and the optional PG. Use for synchronized operation and the position control for orientation control.

o	0	5	P	L	S	F	E	D	S	L
---	---	---	---	---	---	---	---	---	---	---

Set value: 0: Integrated PG (15, 12V complementary output)  
1: PG (PD) option (5V line driver output)

◆ For systems where function code P01 "M1 control method" is set at "3" (vector control of synchronous motor) and option OPC-VG7-PMPG is installed, specify "0" in o05 to validate signals to the PMPG.

## 4. Control and Operation

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**o06** Digital line speed detection definition  
(PG pulse number)

**o07** Digital line speed detection definition  
(Detected pulse correction 1)

**o08** Digital line speed detection definition  
(Detected pulse correction 2)

◆ Specify to use the PG (LD) option for line speed control. A PG disconnection activates a protective function (PG alarm).

◆ The pulse correction is for speed detection.  $Speed = (\text{Correction 1} / \text{Correction 2}) \times \text{Input pulse}$

o	0	6	L	S	-	P	G	D	E	F
o	0	7	L	S	-	P	G	C	P	1
o	0	8	L	S	-	P	G	C	P	2

o06 setting range: 100 to 60,000 [P/R]

o07, o08 setting range: 0 to 9,999

**o12** Command pulse selection

◆ Select a pulse output source from the PG (PR) option and internal speed data.

o	1	2	P	L	S	R	E	F	S	L
---	---	---	---	---	---	---	---	---	---	---

Set value: 0: PG (PR) option

1: Internal speed command

◆ See the 4.2.5 Block diagram for more details.

**o13** Pulse train input form selection

◆ Select the input form of the signal supplied to the PG (PR) option.

o	1	3	P	L	S	S	T	A	T	E
---	---	---	---	---	---	---	---	---	---	---

Set value: 0: 90° phase difference between phase A and phase B.

1: Phase A: Command pulse, Phase B: Command code (sign)

2: Phase A: Forward pulse, Phase B: Reverse pulse

**o14** Command pulse correction 1

**o15** Command pulse correction 2

◆ Set when you install the PG (PR) option card to conduct synchronized operation. You can change the position command data entered into the pulse train card to change the speed ratio between the master motor and the slave motor.

o	1	4	P	L	S	C	O	R	R	1
o	1	5	P	L	S	C	O	R	R	2

Setting range: 1 to 9,999

◆  $\text{Internal data} = \text{Input pulse} \times (\text{Pulse correction 1} / \text{Pulse correction 2})$

**o16** APR gain

◆ You can specify a data to improve the position control response in pulse train operation. You can also reduce the steady-state deviation in the steady-state operation. Since too large setting may present a motor hunting, increase gradually from a small value to adjust.

o	1	6	A	P	R	-	P	-	G	A	I	N
---	---	---	---	---	---	---	---	---	---	---	---	---

Setting range: 0.1 to 999.9 [times]

o17

**F/F gain**

- ◆ The setting can reduce the steady-state deviation. The setting of 1.0 provides the smallest deviation. You do not have to change from 0.0 in general.

o 1 7 F / F G A I N

Setting range: 0.0 to 1.5 [times]

o18

**Deviation excess range**

- ◆ The difference (deviation) between the internal position command and actual motor revolutions exceeds 10 folds of this setting, an "excessive deviation alarm" is caused, letting the motor coast to stop.

o 1 8 D E V O V E R W

Setting range: 0 to 65,535 [pulse]

o19

**Deviation zero range**

- ◆ When the current position of the motor comes into this range of a reference position, the inverter provides the "zero deviation" signal. You can use the zero deviation signal to detect that the motor locates almost at the target position. The inverter provides the zero deviation signal on the DO to which you can assign a function.

o 1 9 D E V Z E R O W

Setting range: 0 to 1,000 [pulse]

**OPC-VG7-PMPG**

You can use this option to detect the magnetic pole position and the speed and to drive a synchronous motor. Specify function code P01 "M1 control method" at "3."

o09

**ABS signal input definition**

- ◆ Defines the input signal when you install a PG card to drive a synchronous motor.

o 0 9 A B S D E F I N T

Setting: 0: 1 bit (terminal: F0). Z-phase interface

1: 3 bits (terminals: F0, F1 and F2). U-/V-/W-phase interface, Fuji's ES and servomotor interface

2: 4 bits (terminals: F0, F1, F2 and F3). Gray code interface

3 to 16: Not used

o10

**Magnetic pole position offset**

- ◆ Specifies an offset value relative to the magnetic pole position detected by the PG.

o 1 0 S M - O F F S E T

Set value: 0000 to FFFF (h)

o11

**Salient pole ratio (%Xq/%Xd)**

- ◆ Set the difference in reactance due to the difference in magnetic resistance on the q axis and the d axis in terms of the ratio of the q axis value/d axis value.

o 1 1 S A L I E N T R T

Setting range: 1.000 to 3.000

**CAUTION**

The model of the PMPG interface option varies according to the electric specification.

OPC-VG7-PMPG : 5V line driver

OPC-VG7-PMPGo : Open collector

## 4. Control and Operation

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### OPC-VG7-TL

You can use this option to conduct operate, to refer to and change the function codes, and monitor operation from the MICREX-F and SX (T-Link module) series PLC. You cannot install other field bus options (SX, field bus) at the same time. See the section of the control options for more details.

#### **o30**      **Action on communication error**

◆ Specifies an action on error in the T-Link communication.

**o 3 0 M O D E O N E R**

Set value: 0: Immediate trip on a communication error

- 1: Stop after a time specified by o31 "Action time on communication error" initiated by a communication error, then trip
- 2: Stop after a continued communication error for a time specified by o31 "Action time on communication error", then trip.
- 3: Continued operation even on a communication error  
(Removal of the error cause will recover the operation through communication automatically.)

#### **o31**      **Action time on communication error**

◆ Specifies a time for a continued T-Link communication error.

**o 3 1 T I M E R T L**

Setting range: 0.01 to 20.00 [s]

#### **o32**      **Communication format**

◆ Specifies the number of data transmitted over the T-Link.

**o 3 2 4 W / 8 W S E L**

Setting range: 0: 4 words+4 words

1: 8 words+8 words

### OPC-VG7-SI

You can use this option in the following two ways according to the setting of the hardware switch.

- 1) SI (MWS): Use as multiwinding system
- 2) SI (UPAC): Use as inter-inverter link option of the UPAC

Simultaneous use of the 1) and 2) functions with two options is impossible.

#### **o33**      **Multiwinding system**

◆ Specifies whether to use the SI option as a multiwinding system. When you set this parameter to disabled, then you can use this option for single motor operation. See also the canceling multiwinding motor control of E01 to E13 "X function selection".

**o 3 3 M W S A C T V E**

Set value: 0: Disabled (single motor operation)

1: Multiwinding system

#### **o34**      **Multiwinding system slave station number**

◆ Specifies the number of slave stations for the multiwinding system.

**o 3 4 M W S S L A V E S**

Setting range: 1 to 5

### OPC-VG7-SI

Use this option to configure an inverter-to-inverter link with UPAC being the master. For details, refer to the separate UPAC manual.

#### **o35**      **Link address**

◆ Define the link station address for using the S1 option in the UPAC link.

**o 3 5 S I P A R A 1**

Setting range: 0:            master address

1 to 11:            Slave address

100:                Master address (broadcasting)

101 to 255:        Slave address (broadcasting)

**o36**      **Number of slave stations in link system**

◆ Specify the number of slave stations communicating via the SI option among two or more inverters with the one equipped with UPAC serving as a master.

**o 3 6 S I P A R A 2**

Setting range: 1 to 155

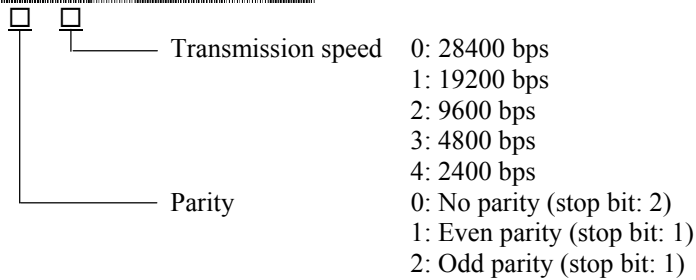
**OPC-VG7-RS**

**o37**      **Communication definition setting**

◆ Specify the communication definition of the RS485 communication expansion option.

**o 3 7 S I P A R A 3**

Setting:



**OPC-VG7-UPAC**

You can use this option to create a program and to operate the VG7S with the program. For details, refer to the separate UPAC manual.

**o38**      **UPAC start/stop**

◆ Specifies to start/stop the UPAC option.

**o 3 8 U P A C A C T**

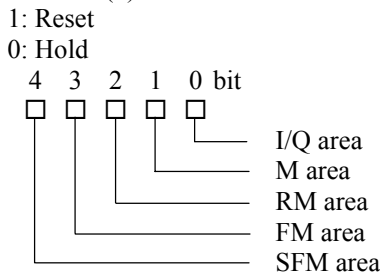
Set value: 0: Stop UPAC  
 1: Start UPAC  
 2: Start UPAC (with initialization)

**o39**      **UPAC memory mode**

◆ Define whether the corresponding memory area is reset or held during stoppage or when the launched UPAC is stopped.

**o 3 9 U P A C M E M O R**

Setting range: 00 to 1F (h)



◆ Priority is given to resetting over holding of the IQ area if there is difference between system definition (D300win) and o39 setting.

<Example>

System definition	o39	Action
Hold	0	Hold
Hold	1	Reset
Reset	0	Reset
Reset	1	Reset

## 4. Control and Operation

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o40

UPAC Address

- ◆ Set the address of the UPAC when you access the UPAC from a personal computer through RS485 communication.

o	4	0	U	P	A	C	A	D	R	E	S
---	---	---	---	---	---	---	---	---	---	---	---

Setting range: 100 to 255

### 4.3.8 L Codes

L01

Password data 1

L02

Password data 2

#### CAUTION

- Handle the password with care. If you set the password by mistake, you cannot refer to or change the function code. The person who is responsible for specifying the password must manage the password carefully.

- ◆ You can specify an 8-digit password by combining L01 and L02. You can use the password to restrict the change and the reference to the function codes. When you specify a non-zero value to either L01 or L02, the restriction by password will become effective.

L	0	1	P	A	S	S	W	O	R	D	1
L	0	2	P	A	S	S	W	O	R	D	2

Setting range: 0 to 9,999

(1) Setting password

When you set non-zero data to L01 or L02 and open the program menu, you will not view "1. Set data" and "2. Check data", but "3. Operation monitor". and the rest. See the figure right below.

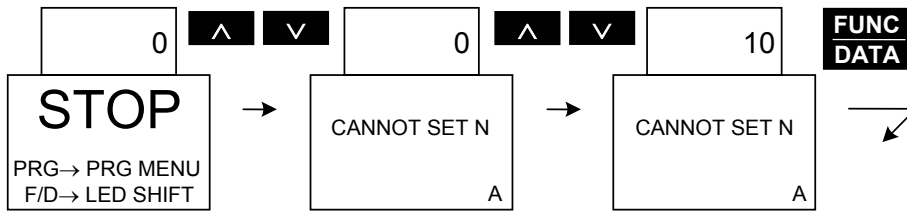
Usual program menu screen  
(password is not specified or is disabled)

- 1. Set data
- 2. Check data
- 3. Operation monitor
- 4. I/O check
- 5. Maintenance info
- 6. Measure load factor
- 7. Alarm info
- 8. Cause

Program menu screen  
when password is enabled

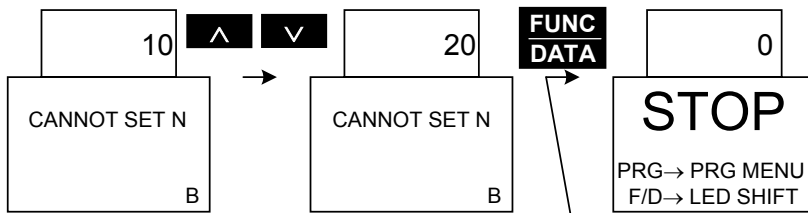
- 3. Operation monitor
- 4. I/O check
- 5. Maintenance info
- 6. Measure load factor
- 7. Alarm info
- 8. Cause

(2) To disable password (ex. password: L01=10, L02=20)



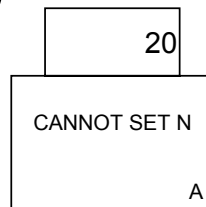
Press ^ or v key once on the operation mode screen, "A" is displayed at the lower right corner on the LCD monitor.

Set the LED monitor to the password data set to L01 and press FUNC/DATA.



When "B" is displayed at the lower right corner on the LCD monitor, set the LED monitor to the password data set to L02 and press FUNC/DATA.

The display will return to the operation monitor screen, if the data entered at "A" conforms to the password data set by L01 and the data entered at "B" conforms to the password data set by L02. You will view the following screen if the data do not conform to the data.



You will see this screen if the data entered at "A" and/or "B" are wrong.

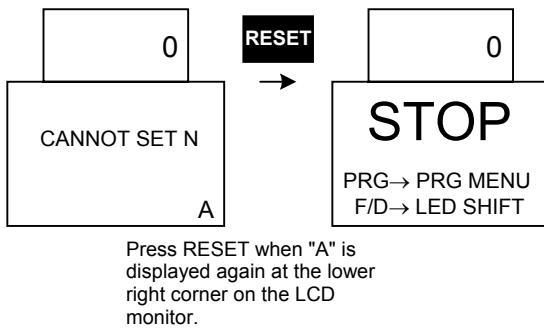
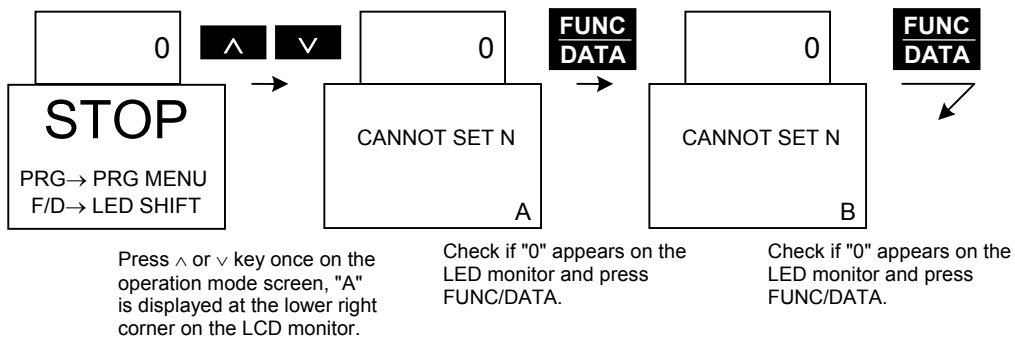
Note: Canceling password described above will become ineffective after you turn off the inverter.



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(3) To enable password again after disabled



**L03****Elevator rated speed**

- ◆ This function code is necessary to calculate the estimated travel distance on deceleration.

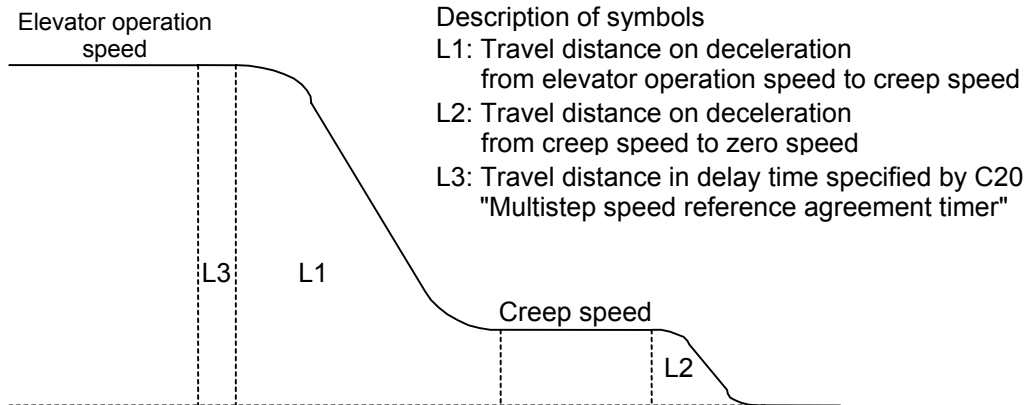
**L 0 3 L I F T - M A X**

Setting range: 0.0 to 999.9 [m/min]

#### About the estimated travel distance on deceleration

- ◆ You can display an estimated travel distance from the deceleration start point to the stopping point to check the consistency of the decelerating pattern.
- ◆ The estimated travel distance on deceleration is an addition of travel distance on deceleration from the elevator operation speed to the creep speed and that from the creep speed to the zero speed and does not include the travel distance by the constant operation at the creep speed (L1+L2+L3 in the graph below).

#### [Operation pattern]



#### Description of symbols

- L1: Travel distance on deceleration from elevator operation speed to creep speed
- L2: Travel distance on deceleration from creep speed to zero speed
- L3: Travel distance in delay time specified by C20 "Multistep speed reference agreement timer"

- ◆ The estimated travel distance on deceleration appears on the "Option monitor 3, 4" on the LED monitor of the KEYPAD panel.
- ◆ This function is effective when L04=1 or 2.
  - Option monitor 3: Travel distance from the operation speed 1 after deceleration operation.
  - Option monitor 4: Travel distance from the operation speed 2 after deceleration operation.
- ◆ Function data codes used for the estimated travel distance on deceleration.

Description	L04=1		L04=2	
	Code	Name	Code	Name
Elevator rated speed	L03	Elevator rated speed	←	←
Operation speed 1	C09	Multistep speed 5	←	←
Operation speed 2	C11	Multistep speed 7	C10	Multistep speed 6
Creep speed	C07	Multistep speed 3	←	←
Deceleration time from operation speed 1	F08	Deceleration time 1	←	←
Deceleration time from operation speed 2	C47	Deceleration time 2	←	←
Deceleration time from creep speed	C36	Deceleration time JOG	←	←
S-curve setting on decelerating from operation speed 1	L10	S-curve 6	←	←
S-curve setting on decelerating from operation speed 2	L12	S-curve 8	←	←
S-curve setting on reaching creep speed	L07	S-curve 3	←	←
S-curve setting on decelerating from creep speed	L08	S-curve 4	←	←
S-curve setting on reaching zero speed	L06	S-curve 2	←	←
Delay time by the speed reference agreement timer	C20	Multistep speed reference agreement timer	←	←

# 4. Control and Operation

## L04 Preset S-curve

◆ Specifies the application of S-curve setting and the multistep speed.

**L 0 4 S - C U R V E**

Setting range: 0 to 2

Setting: 0: **VG7S standard multistep speed and S-curve mode**

15 steps of multistep speed (C05 to C19)

S-curve applied to four sections (F67 to F70)

Setting: 1: **Elevator application compatible with VG3N and VG5N**

7 steps of multistep speed (C05 to C11)

S-curve applied to eight sections (L05 to L12)

Setting: 2: **VG7 original elevator application mode**

7 steps of multistep speed (C05 to C11)

S-curve applied to ten sections (L05 to L14)

## L05 - L14 S-curve set 1 to 10

**L 0 5 S - C R V S E T 1**

to

**L 1 4 S - C R V S E 1 0**

Setting range: 0 to 50 [%]

(1) Introduction to an operation example in each mode

1) VG7S standard multistep speed and S-curve mode

Since this operation mode uses the standard multistep speed and the S-curve, see the description of the individual function codes.

2) Elevator application compatible with VG3N and VG5N

Set ON/OFF to the terminal functions [SS1], [SS2], and [SS4] to switch the multistep speed as described in the following table.

Terminal function			Multistep speed setting		
SS4	SS2	SS1	Code	Name	Description
OFF	OFF	OFF	-	-	External speed setting
OFF	OFF	ON	C05	Multistep speed 1	Zero speed
OFF	ON	OFF	C06	Multistep speed 2	Inching speed
OFF	ON	ON	C07	Multistep speed 3	Creep speed
ON	OFF	OFF	C08	Multistep speed 4	Maintenance operation speed
ON	OFF	ON	C09	Multistep speed 5	Operation speed 1
ON	ON	OFF	C10	Multistep speed 6	Zero speed
ON	ON	ON	C11	Multistep speed 7	Operation speed 2

The following table shows how the acceleration/deceleration times are assigned to the multistep speed.

Speed			Acceleration		Deceleration	
Code	Name	Description	Code	Description	Code	Description
C06	Multistep speed 2	Inching speed	F07	Acceleration time 1	F08	Deceleration time 1
C07	Multistep speed 3	Creep speed	C35	Acceleration time JOG	C36	Deceleration time JOG
C08	Multistep speed 4	Maintenance operation speed	F07	Acceleration time 1	F08	Deceleration time 1
C09	Multistep speed 5	Operation speed 1	F07	Acceleration time 1	F08	Deceleration time 1
C11	Multistep speed 7	Operation speed 2	C46	Acceleration time 2	C47	Deceleration time 2

---

The following table shows how S-curve setting is applied to the multistep speed.

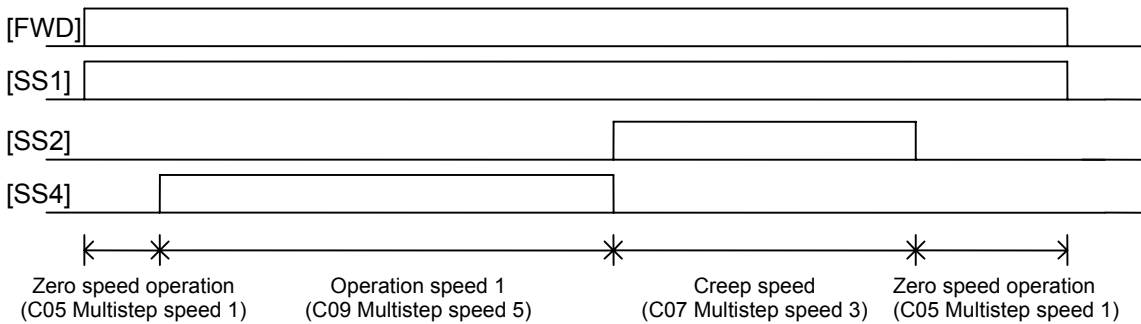
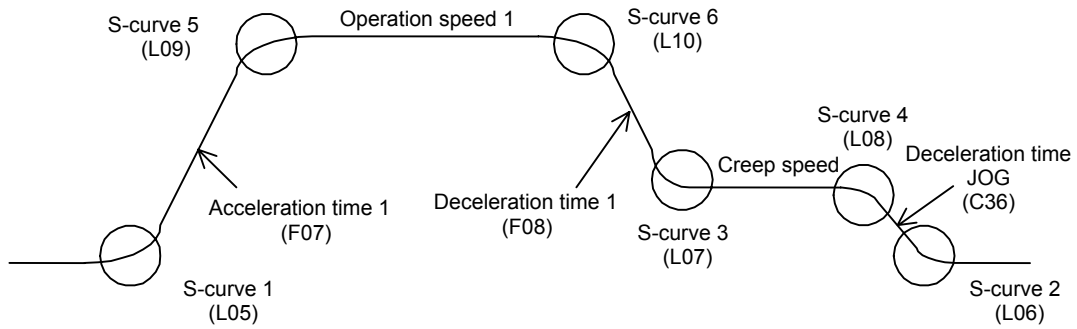
S curve setting		Application
Code	Name	
L05	S-curve 1	Acceleration start side from Zero speed
L06	S-curve 2	Deceleration end side to Zero speed
L07	S-curve 3	Acceleration end side to Creep speed
L08	S-curve 4	Deceleration start side from Creep speed
L09	S-curve 5	Acceleration end side to Operation speed 1, Maintenance operation speed, or Inching speed
L10	S-curve 6	Deceleration start side from Operation speed 1, Maintenance operation speed, or Inching speed
L11	S-curve 7	Acceleration end side to Operation speed 2
L12	S-curve 8	Deceleration start side from Operation speed 2

#### About emergency stop

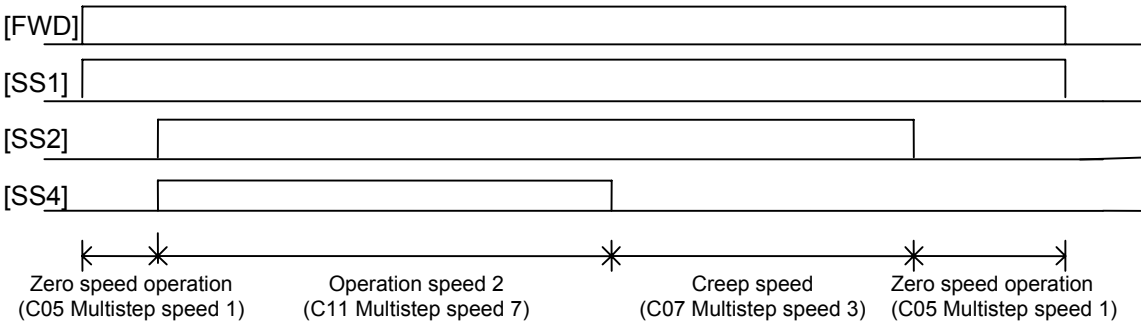
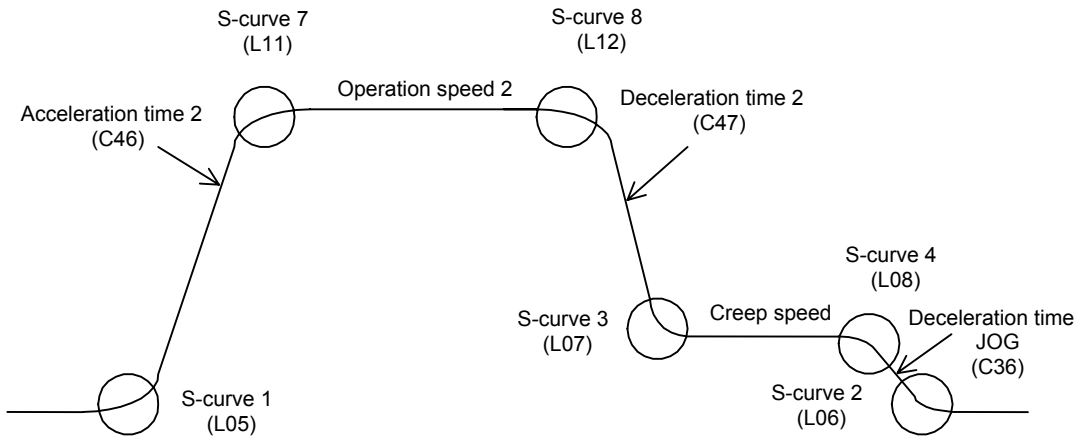
When the operation command (FWD, REV) is set to OFF, the inverter decelerates linearly neglecting the S-curve setting. The deceleration time follows the C67 "Deceleration time 4".

# 4. Control and Operation

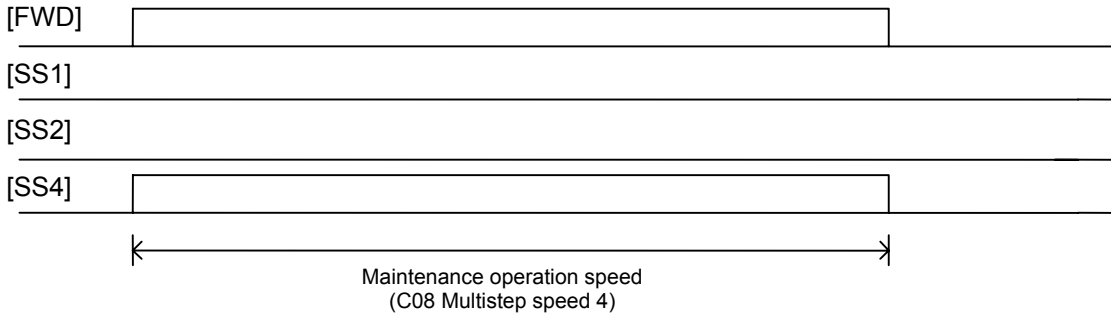
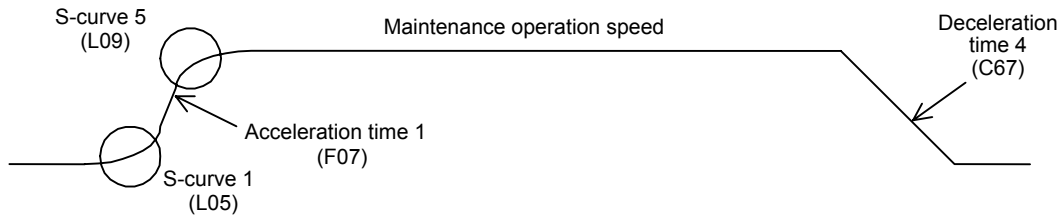
(a) Operation speed 1



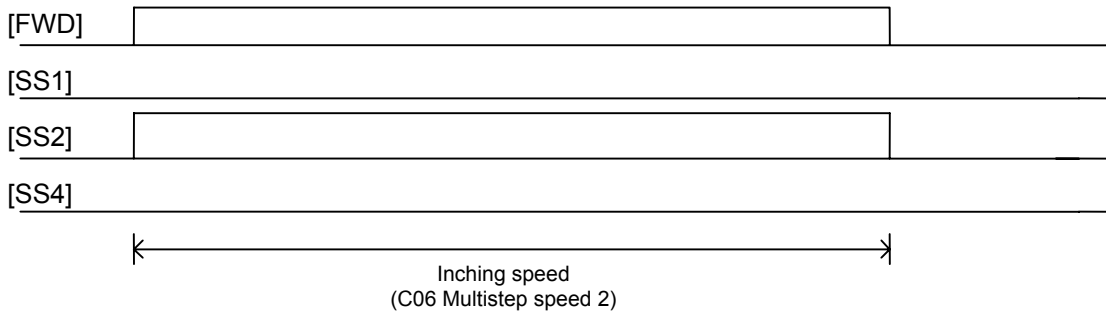
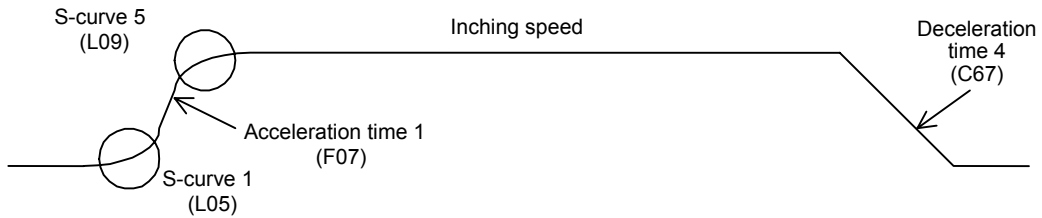
(b) Operation speed 2



(c) Maintenance operation speed



(d) Inching speed



## 4. Control and Operation

### 3) VG7 original elevator application mode

Set ON/OFF to the terminal functions [SS1], [SS2], and [SS4] to switch the multistep speed as described in the following table.

Terminal function			Multistep speed setting		
SS4	SS2	SS1	Code	Name	Description
OFF	OFF	OFF	-	-	Zero speed
OFF	OFF	ON	C05	Multistep speed 1	Emergency elevator speed
OFF	ON	OFF	C06	Multistep speed 2	Inching speed
OFF	ON	ON	C07	Multistep speed 3	Creep speed
ON	OFF	OFF	C08	Multistep speed 4	Maintenance operation speed
ON	OFF	ON	C09	Multistep speed 5	Operation speed 1
ON	ON	OFF	C10	Multistep speed 6	Operation speed 2
ON	ON	ON	C11	Multistep speed 7	Operation speed 3

The following table shows how the acceleration/deceleration times are assigned to the multistep speed.

Speed			Acceleration		Deceleration	
Code	Name	Description	Code	Description	Code	Description
C05	Multistep speed 1	Emergency elevator speed	C56	Acceleration time 3	C57	Deceleration time 3
C06	Multistep speed 2	Inching speed	F07	Acceleration time 1	F08	Deceleration time 1
C07	Multistep speed 3	Creep speed	C35	Acceleration time JOG	C36	Deceleration time JOG
C08	Multistep speed 4	Maintenance operation speed	F07	Acceleration time 1	F08	Deceleration time 1
C09	Multistep speed 5	Operation speed 1	F07	Acceleration time 1	F08	Deceleration time 1
C10	Multistep speed 6	Operation speed 2	C46	Acceleration time 2	C47	Deceleration time 2
C11	Multistep speed 7	Operation speed 3	C56	Acceleration time 3	C57	Deceleration time 3

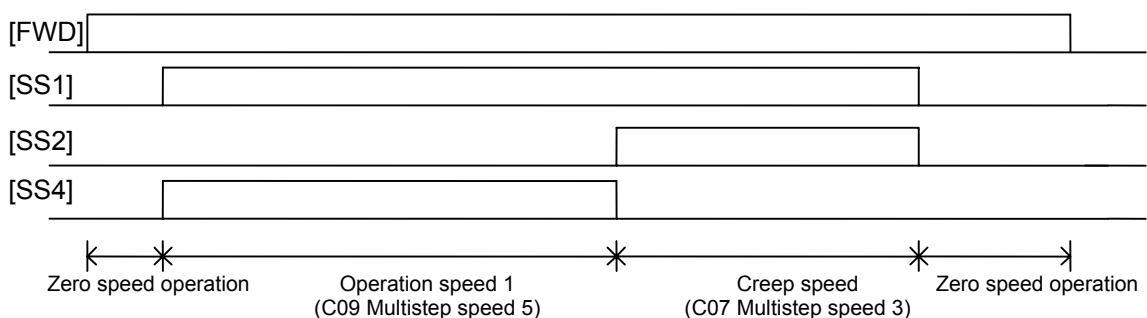
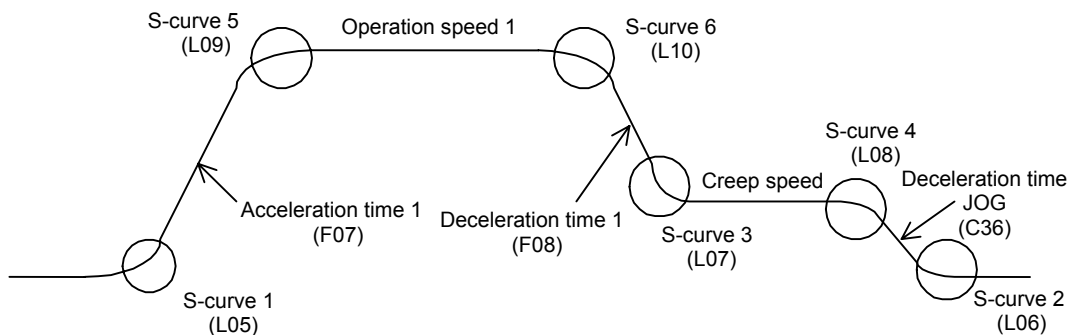
The following table shows how S-curve setting is applied to the multistep speed.

S curve setting		Application
Code	Name	
L05	S-curve 1	Acceleration start side from Zero speed
L06	S-curve 2	Deceleration end side to Zero speed
L07	S-curve 3	Acceleration end side to Creep speed
L08	S-curve 4	Deceleration start side from Creep speed
L09	S-curve 5	Acceleration end side to Operation speed 1, Maintenance operation speed, or Inching speed
L10	S-curve 6	Deceleration start side from Operation speed 1, Maintenance operation speed, or Inching speed
L11	S-curve 7	Acceleration end side to Operation speed 2
L12	S-curve 8	Deceleration start side from Operation speed 2
L13	S-curve 9	Acceleration end side to Operation speed 3 or Emergency elevator speed
L14	S-curve 10	Deceleration start side from Operation speed 3 or Emergency elevator speed

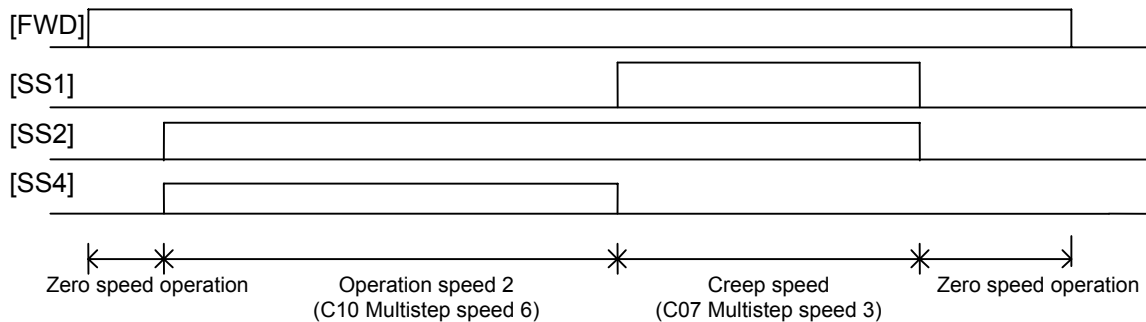
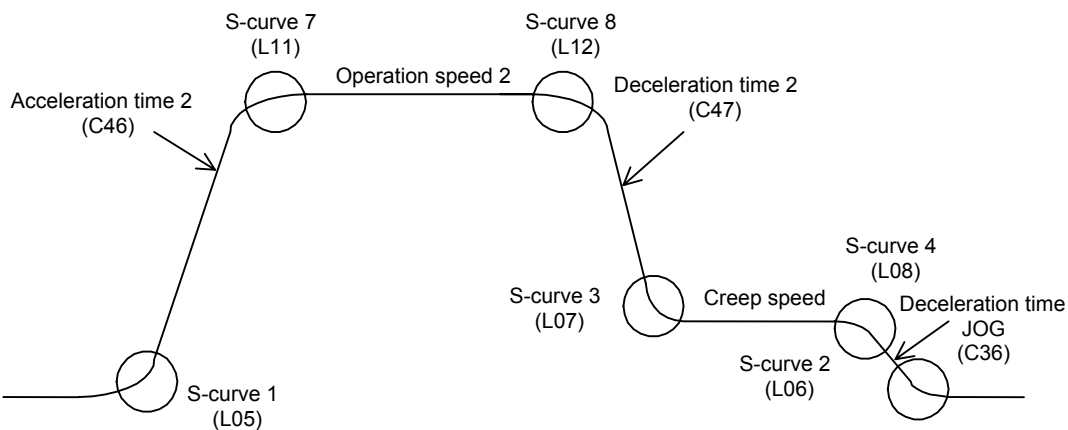
### About emergency stop

When the operation command (FWD, REV) is set to OFF, the inverter decelerates linearly neglecting the S-curve setting. The deceleration time follows the C67 "Deceleration time 4".

(a) Operation speed 1



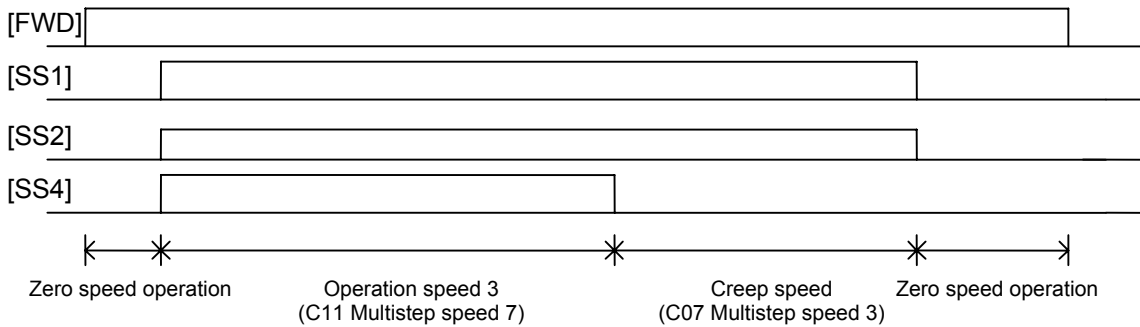
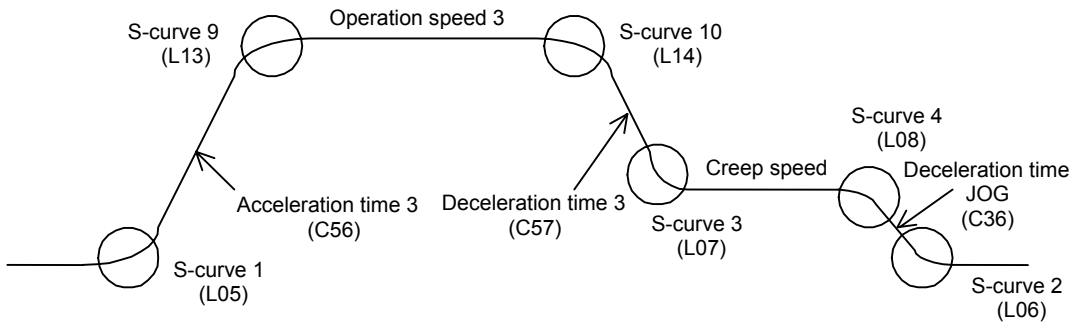
(b) Operation speed 2



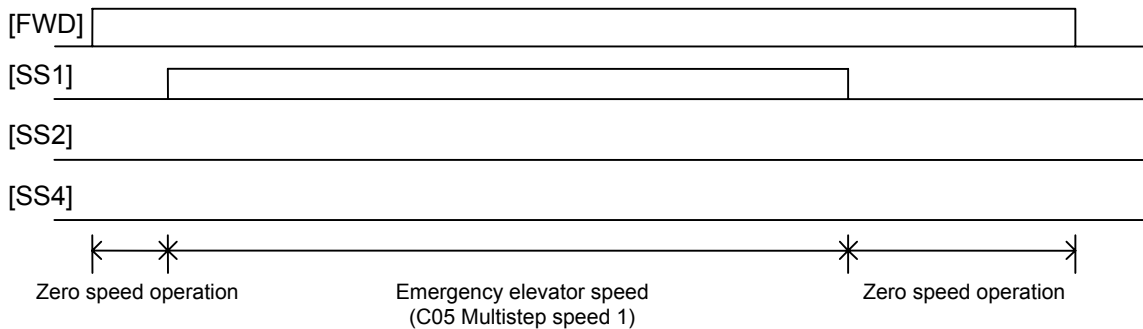
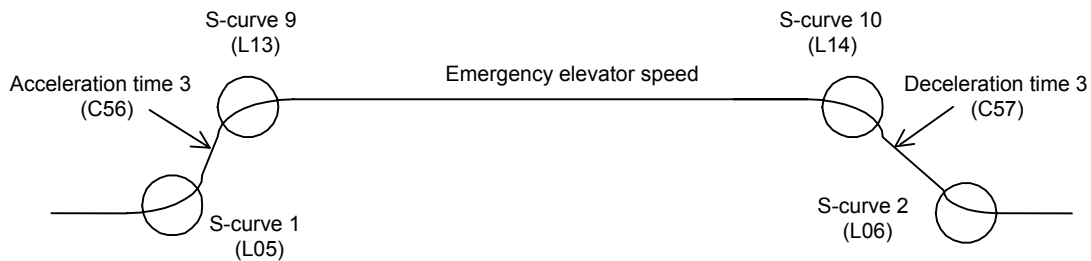


# 4. Control and Operation

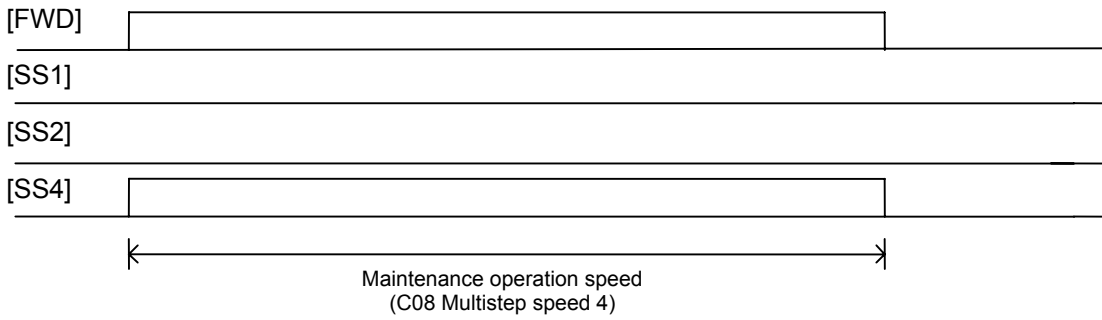
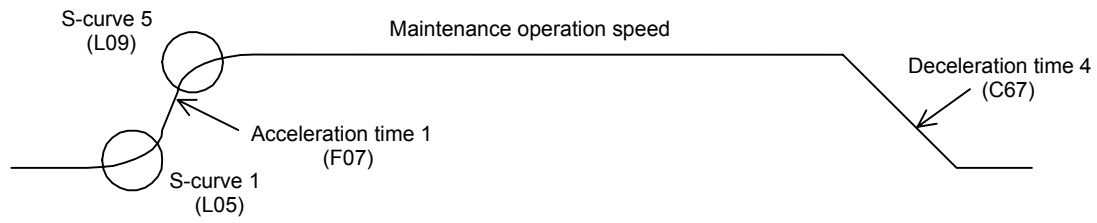
## (c) Operation speed 3



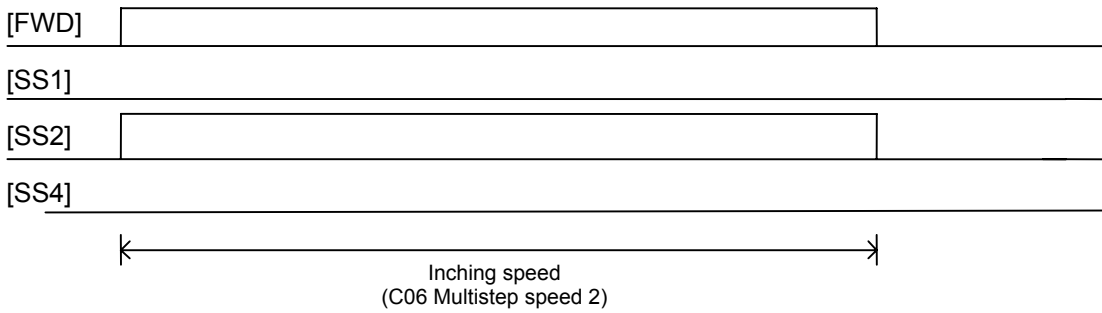
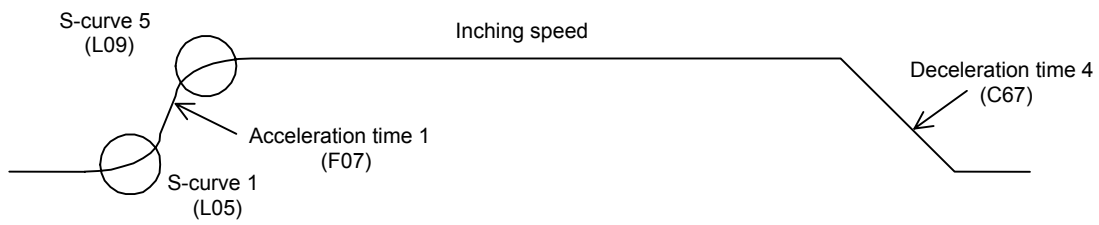
## (d) Emergency elevator speed



(e) Maintenance operation speed

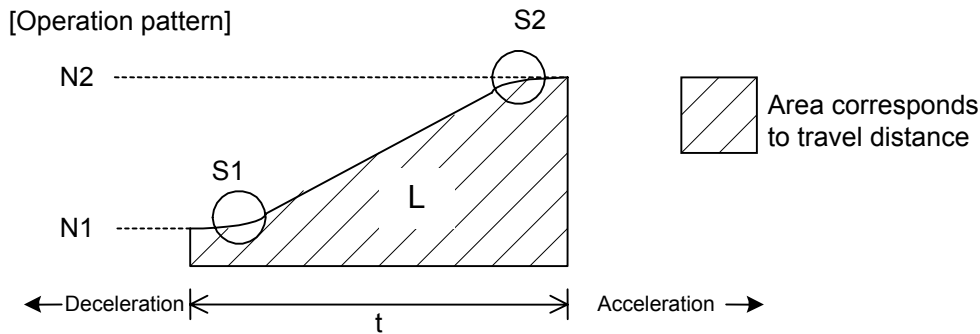


(f) Inching speed



# 4. Control and Operation

(1) How to calculate acceleration/deceleration times and travel distance



[Description of symbols]

$N_{max}$  [r/min]: Maximum motor speed

$N1$  [r/min] : Speed reference before acceleration (after deceleration)

$N2$  [r/min] : Speed reference after acceleration (before deceleration)

$S1$  [%]: S-curve portion at the beginning of acceleration (at the end of deceleration)

$S2$  [%]: S-curve portion at the end of acceleration (at the beginning of deceleration)

$T$  [s] : Acceleration (deceleration) reference time (time from zero to  $N_{max}$  ( $N_{max}$  to 0))

$V_{max}$  [m/min]: Elevation speed at the maximum motor speed (Maximum elevation speed)

$t$  [s] : Acceleration (deceleration) time

$L$  [m] : Travel distance

1) When the S curve portion fits in a specified speed range .....  $\frac{N2 - N1}{N_{max}} \geq \frac{S1 + S2}{100}$

Acceleration (deceleration) time

$$t = \left( \frac{N2 - N1}{N_{max}} + \frac{S1 + S2}{100} \right) \times T \text{ ..... [Equation 1]}$$

Travel distance

$$L = \frac{T \times V_{max}}{120} \times \left[ \frac{S1^2 - S2^2}{30000} + \frac{S2}{50} \times \frac{N2 - N1}{N_{max}} + \left( \frac{N2 - N1}{N_{max}} \right)^2 \right] + \frac{t \times V_{max}}{60} \times \frac{N1}{N_{max}} \text{ ..... [Equation 2]}$$

2) When the S curve portion exceeds a specified speed range .....  $\frac{N2 - N1}{N_{max}} < \frac{S1 + S2}{100}$

Acceleration (deceleration) time

$$t = \frac{S1 + S2}{50} \sqrt{\frac{N2 - N1}{N_{max}} \times \frac{100}{S1 + S2}} \times T \text{ ..... [Equation 3]}$$

Travel distance

$$L = \left( \sqrt{\frac{N2 - N1}{N_{max}} \times \frac{100}{S1 + S2}} \right)^3 \times \frac{T \times V_{max}}{90} \times \frac{S1^2 + 2 \times S2^2 + 3 \times S1 \times S2}{10000} \times \frac{t \times V_{max}}{60} \times \frac{N1}{N_{max}} \text{ ..... [Equation 4]}$$

L15

For adjustment by manufacturer

◆ This is a function code for adjustment by the manufacturer.

L 1 5 C R P L A C T

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## 4.4 Function Description (Arranged by Function)

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### 4.4.1 If You Think Defective

#### WARNING

- After the inverter protective function was activated and you removed the cause, if you reset the alarm while the operation command has been set to ON, the inverter restarts. Reset the alarm after you confirm the operation command has been set to OFF.

**You may be injured.**

### If you think defective

An inverter may not operate as instructed while you think you specified the operation command and the speed command properly or you may not reset the alarm to restart operation. Also an alarm may occur frequently to obstruct the operation of a facility.

If this is the case, use the KEYPAD panel to identify the cause of the malfunction or the alarm. If you still cannot identify the cause or you suspect an inverter fault or damaged parts, contact the shop you purchased the inverter or the FUJI's sales representative.

#### 4.4.1.1 What You Should Check First

This section describes how to use the KEYPAD panel to investigate causes though the protective function is not activated, but an inverter does not operate as instructed. Then the flowcharts illustrate the procedures.

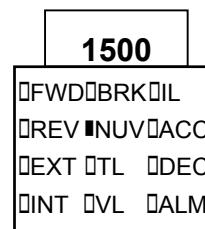
##### (1) Is the inverter ready for operation?

It takes about one second before an inverter becomes ready for operation after you turn on the main circuit. You can view the "CHARGE" lamp on the front of an inverter with 18.5 kW or more capacity to confirm this state. Also you should use the "I/O check" screen of the KEYPAD panel to check if "■NUV" is displayed as shown in the right figure. This status indicates that the inverter is ready for operation.

If "□NUV" is displayed, the power may not be supplied to the inverter.

Check the input power line to the main circuit.

When you do not use a DCR, you should connect a jumper wire between P1 and P(+ ) terminals. Check if the jumper wire is not disconnected.



##### (2) Have you instructed an operation command?

Following the procedure described above to confirm that the inverter is ready.

When you direct the operation command (FWD), "RUN" must be displayed as in the right figure.

If the display remains "STOP", the inverter has not received your operation command.

At this time, a green indicator lights up at RUN on the keypad panel.

You can see the indicator on the LCD monitor to check the available source of the operation command (LOC: KEYPAD panel, REM: External signal, and COMM: link).

You should change the function code F02 "Operation method" and H30 "Serial link" to change the source of the operation command.

If you have installed an option, you cannot use RS485 to enter the operation command (the option has higher priority). When you have several options, the priority is fixed. See the description of applicable options.



## 4. Control and Operation

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When you use the UPAC, you should enter the operation command as well. See the description of the UPAC for more details.

### (3) Have you entered the speed command?

Confirm the speed command (N\*) on the "Operation monitor" when you have directed the speed command by the KEYPAD panel, external analog input, or through the link (T-Link or RS485) or the UPAC. If the "N\*" is blank, the inverter has not received the speed command.

<b>1500</b>
N* = <u>xxxxxx</u> r/m
N = <u>xxxxxx</u> r/m
f* = <u>xxx</u> Hz
TRQ = <u>xxx</u> %

When you use the analog input [12] to provide the speed command, you can check the voltage on the "I/O check" screen of the KEYPAD panel.

Since the displayed voltage is the one the inverter recognizes, you can check the [12] input on this screen.

When you use the [12] and the value fluctuates, you can check if the analog command itself fluctuates.

In the same manner, check the auxiliary speed command supplied to the analog input Ai1 and Ai2.

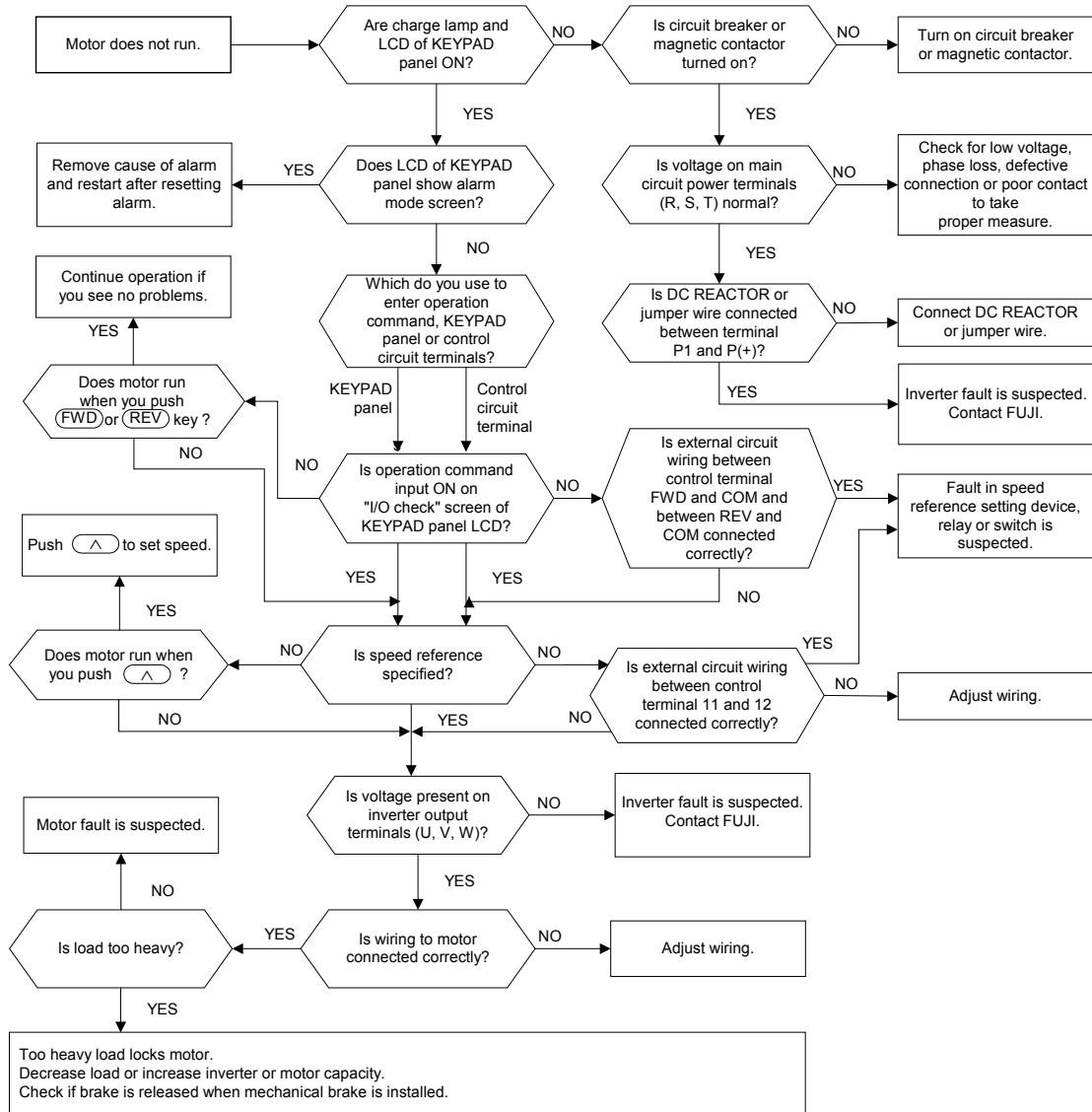
<b>1500</b>
12 = ± <u>xx.x</u> V
Ai 1 = ± <u>xx.x</u> V
Ai 2 = ± <u>xx.x</u> V

## 4.4.1.2 Diagnosing Unstable Operation

This section shows individual flowcharts for vector control, sensorless vector control and V/f control.

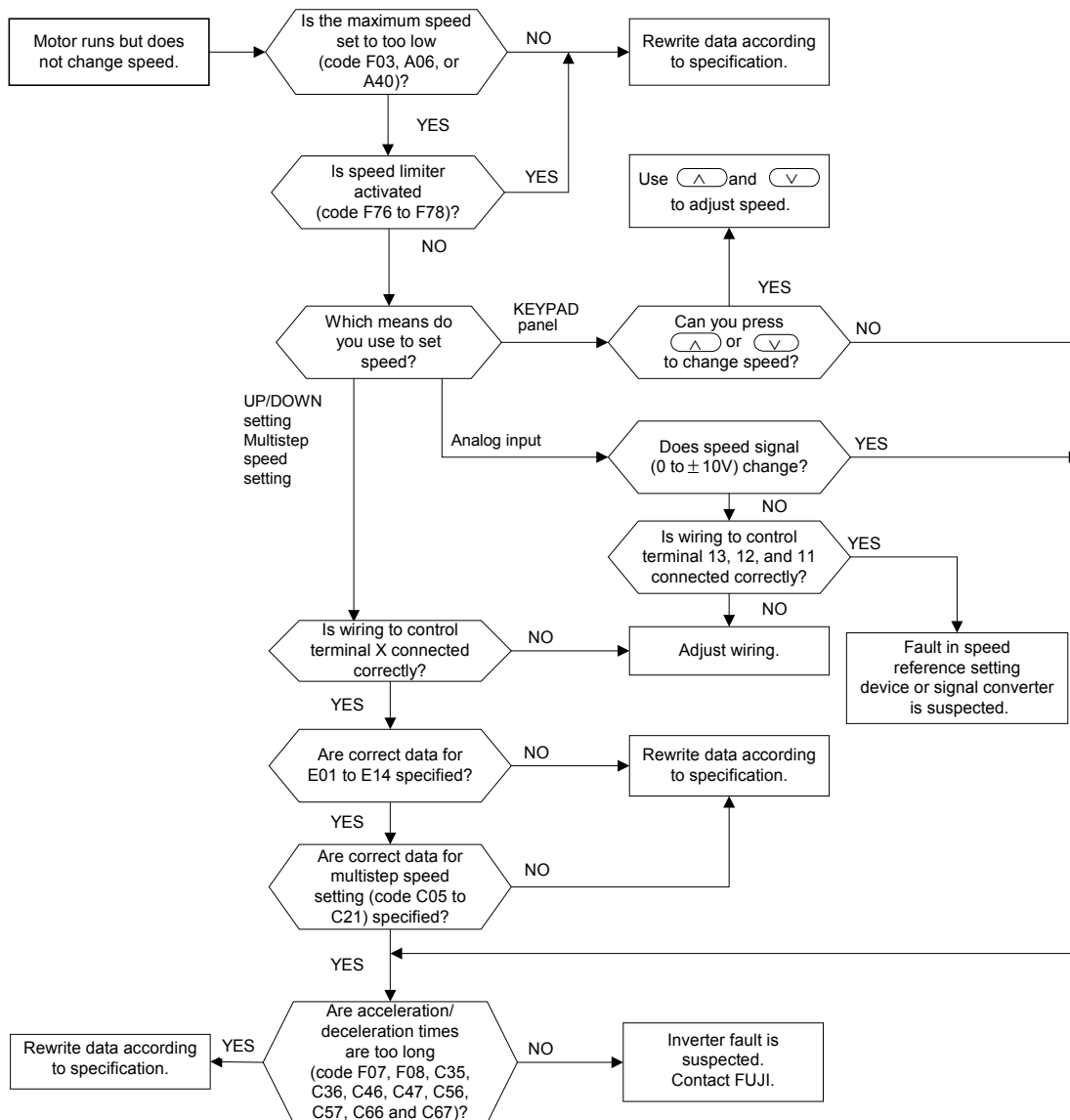
### (1) Vector control and sensorless vector control

#### 1) Motor does not run.

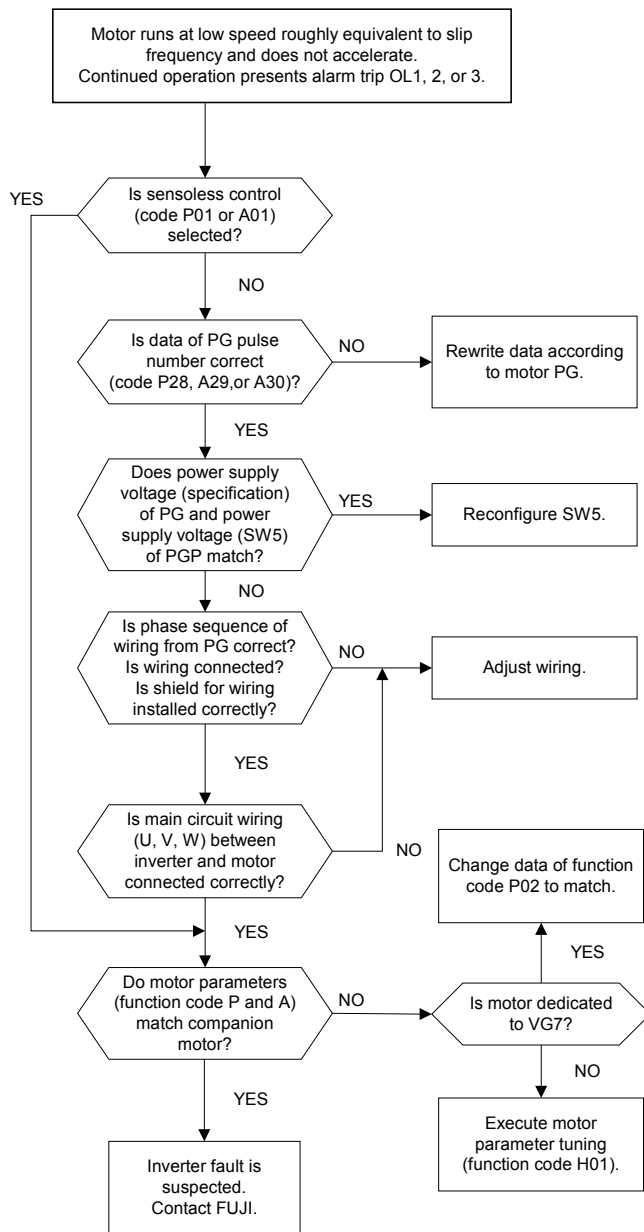


# 4. Control and Operation

## 2) Motor runs but does not change speed



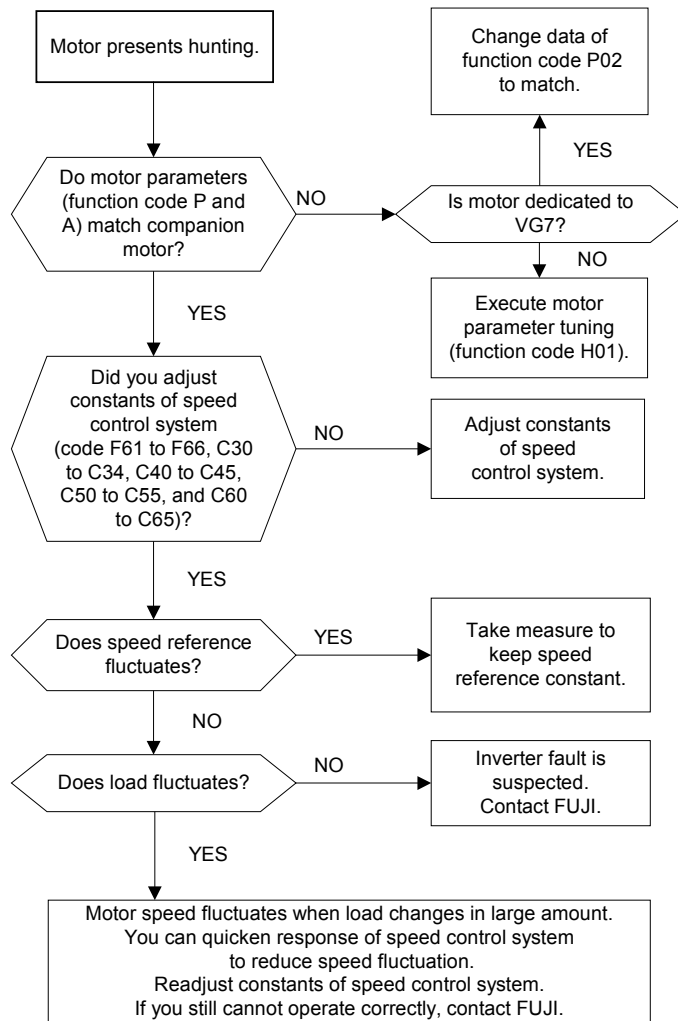
### 3) Motor runs only at low speed



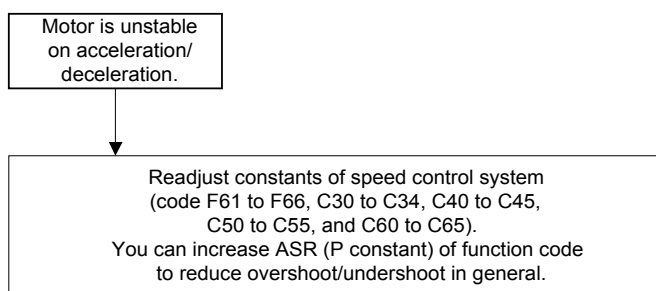


# 4. Control and Operation

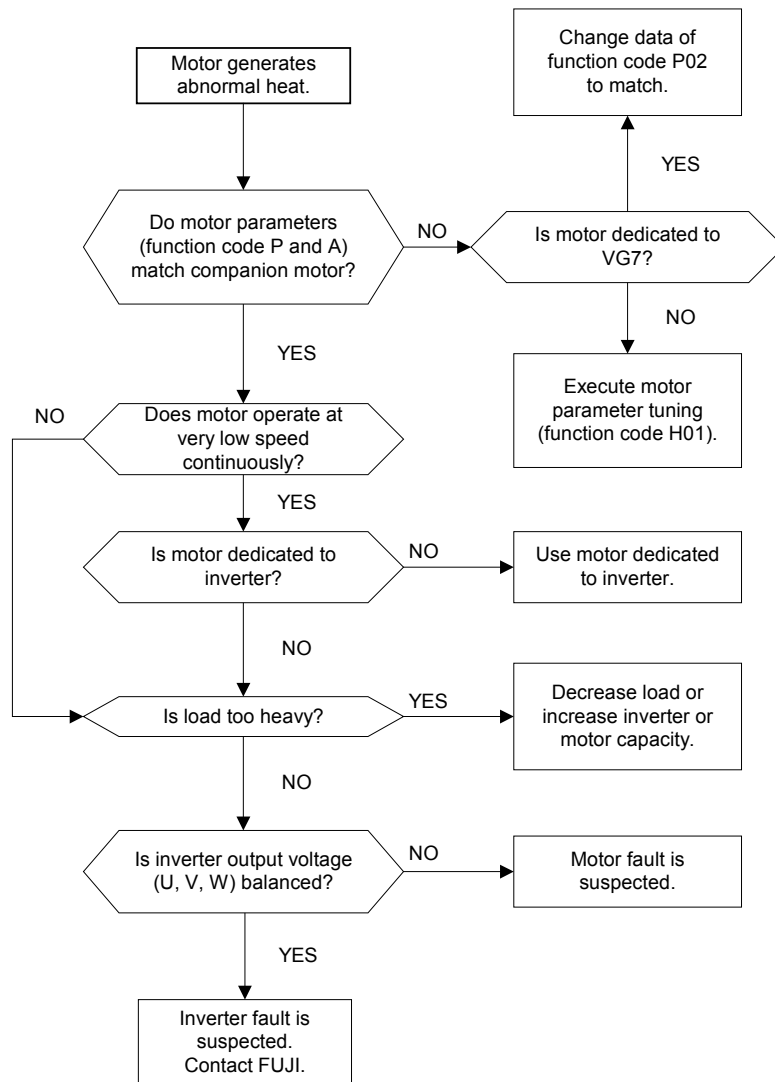
## 4) Motor presents hunting



## 5) Motor is unstable on acceleration/deceleration



## 6) Motor generates abnormal heat



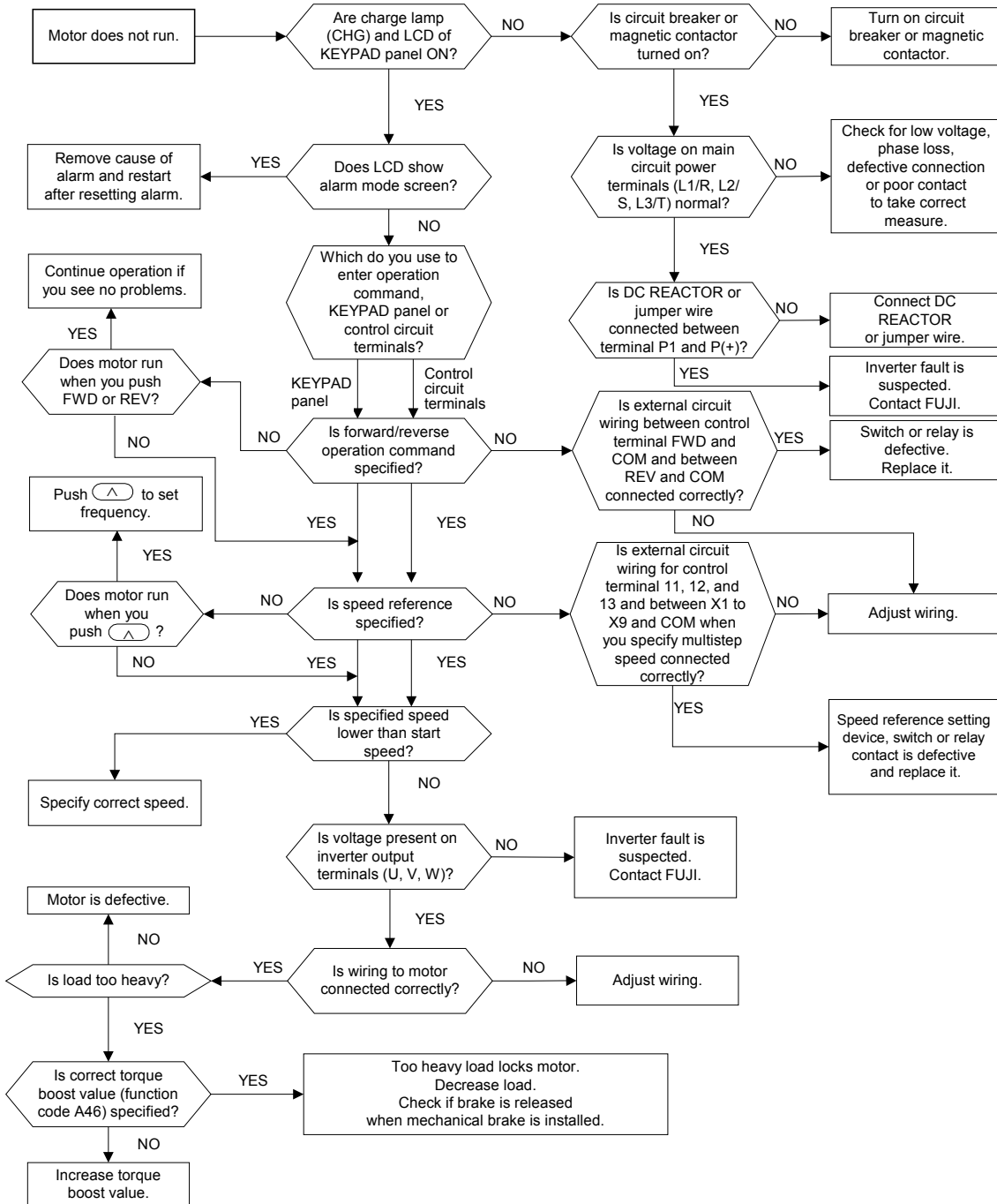
## 7) Motor runs inversely against rotational command

Phase sequence of main circuit wiring (U, V, W) between inverter and motor does not match in sensorless control.

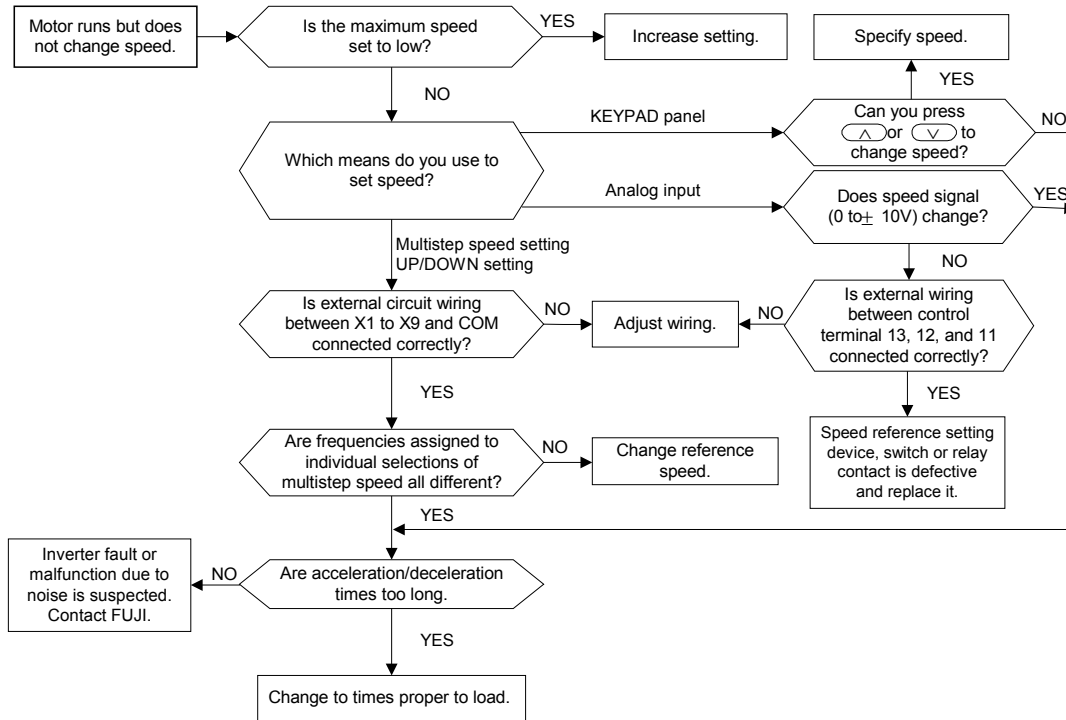
Or, function data for speed command are incorrect.

# 4. Control and Operation

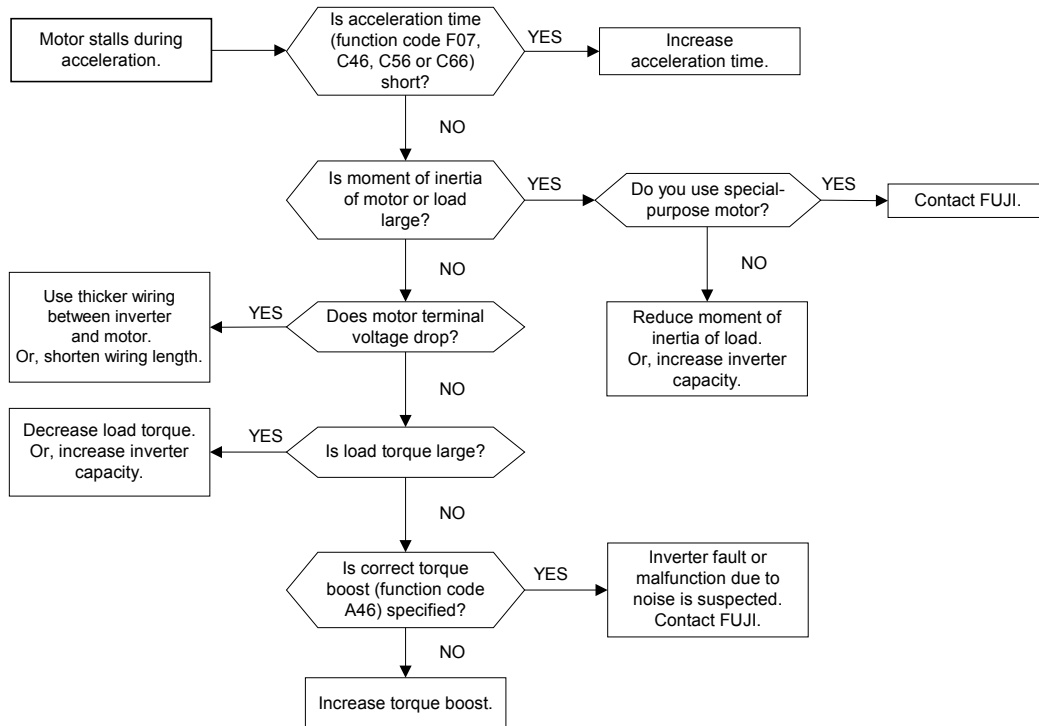
(2) V/f control  
 1) Motor does not run.



## 2) Motor runs but does not change speed



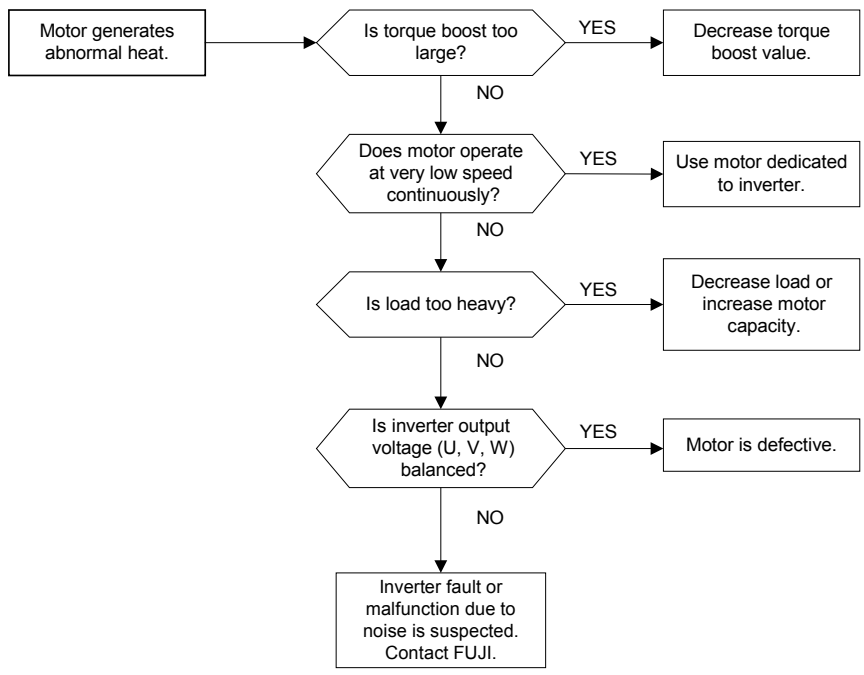
## 3) Motor stalls during acceleration



# 4. Control and Operation

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## 4) Motor generates abnormal heat



### 4.4.1.3 List of Inverter Protective Functions

**⚠ WARNING**

- The motor coasts when an alarm is issued. Install a brake on the driven machine side if you need to stop the motor.

**An accident may occur.**

- When you reset the inverter while applying the operation command, the motor restarts suddenly. Make sure the operation command is turned off before you restart.

Function	Description	Display	Related function code
DB resistor overheating	When the built-in braking resistor overheats, the inverter stops discharging and running. You must set the function codes E35 to 37 corresponding to the resistor (built-in/external).	d b H	E35 - 37
DC fuse blown	When a fuse at the main DC circuit blows due to a short-circuit in the IGBT circuit, the inverter stops operation. This function prevents secondary disaster. A damage to the inverter is suspected and contact FUJI immediately.	d C F	
Ground fault	Activated by a ground fault in the inverter output circuit. If a large current flows due to ground fault, the overcurrent protective function may operate to protect the inverter. Connect a separate earth-leakage protection relay or an earth-leakage circuit breaker for accident prevention such as human damage and fire.	E F	
Excessive position deviation	The function is activated during synchronous operation if the difference between the command and detection value (position deviation) exceeds 10 folds of function code o18 "deviation limit width. " The option code "o" becomes valid and is displayed on the KEYPAD panel after installing options.	d 0	o18
Memory error	Activated when a fault such as "write error" occurs in the memory.	E r 1	
KEYPAD panel communication error	Activated if a communication error is detected between the inverter control circuit and the KEYPAD panel when the start/stop command from the KEYPAD is valid (function code F02=0). Note: KEYPAD panel communication errors do not indicate the alarm display and issue the alarm relay output when the inverter is operated by external signal input or the link function. The inverter continues operating.	E r 2	F02
CPU error	Activated when a CPU error occurs due to noise.	E r 3	
Network error	Activated if a communication error occurs due to noise when the inverter is operated through T- Link, SX bus or field bus.	E r 4	o30,31
RS485 communication error	Activated if: - RS485 communication error occurs while the function code H32 is set to 0 to 2. - A disconnection continues for more than the specified period of 0.1 to 60.0 with the function code H38.	E r 5	H32,H33 H38
Operation procedure error	Activated if multiple network options (T- Link, SX bus, and field bus) are installed. Though you can install multiple DIO, DI and PG options, this error is issued if the two SW settings are identical. The function is activated if H01/H71 auto tuning is started while one of the [BX], [STOP1], [STOP2] and [STOP3] digital inputs is turned on. The function is activated if the FWD key on the keypad panel is not turned on for 20 seconds after H01/H71 auto tuning action is selected.	E r 6	
Output wiring error	Activated when the measured data are out of the motor characteristic data range during executing tuning or the wires are not connected in the inverter output circuit.	E r 7	H01,H71
A/D converter error	Activated when an error occurs in the A/D converter circuit.	E r 8	
Speed disagreement	Activated when the deviation between the speed command (speed setting) and the motor speed (detected speed, predicted speed) becomes excessive.	E r 9	
UPAC error	The function is activated if there is a hardware failure in the UPAC option or a communication fault with the main body control section or if the backup battery is flat.	E r R	

## 4. Control and Operation

Function	Description	Display	Related function code
Inter-inverter communication error	The function is activated if a transmission fault is caused in the inverter-to-inverter communication using the high-speed serial card (option).	E r b	
IPM fault	The function is activated if the IPM self-shutdown function is activated due to an excessive current or heat.	I P E	
Input phase loss	The inverter is protected from being damaged due to input phase loss.	L i n	
Undervoltage	Activated if the DC link circuit voltage decreases to the undervoltage level due to a reduction in the supply voltage. The alarm output is not issued when the DC link circuit voltage decreases and the function code F14 is set to "3 to 5". ■ Undervoltage detection level: 200V series: 186Vdc, 400V series: 371Vdc.	U U	F14
NTC thermistor disconnection	Activated if the thermistor circuit is disconnected when the application of NTC thermistors to corresponding motors (M1, 2, 3) is specified with the function codes P30, A31 and A47.	n r b	P30,A31,A47
Overcurrent	Activated if the momentary value of the inverter output current exceeds the overcurrent detection level due to a short-circuit or ground fault.	O C	
Overheating at heat sink	Activated if the temperature of the heat sink to cool the rectifier diodes and the IGBTs increases due to cooling fan stoppage.	O H 1	
External alarm	The inverter stops on receiving the external alarm signal (THR). It is activated by a terminal signal when the control circuit terminals (THR assignment) are connected to alarm terminals of external devices such as a braking unit or a braking resistor.	O H 2	E01 - E04
Inverter internal overheat	Activated if the ambient temperature of the control PC board increases due to poor ventilation of the inverter.	O H 3	
Motor overheat	Activated if the temperature detected by the NTC thermistor built in the VG7 dedicated motor exceeds the data of the function code E30 "Motor overheat protection".	O H 4	E30,E31
Motor 1 overload	Activated when the motor 1 current (inverter output current) exceeds the operation level set by function code F11.	O L 1	F11
Motor 2 overload	Activated when the motor 2 current (inverter output current) exceeds the operation level set by function code A33.	O L 2	A33
Motor 3 overload	Activated when the motor 3 current (inverter output current) exceeds the operation level set by function code A49.	O L 3	A49
Inverter unit overload	Activated if the output current exceeds the overload characteristic of the inverse time characteristic.	O L U	
Overspeed	Activated if the motor speed (detected speed value/predicted speed value) exceeds 120% of the specified value by the function code "maximum speed".	O S	F03,A06,A40
Overvoltage	Activated if the DC link circuit voltage exceeds the overvoltage level due to an increase of supply voltage or regenerative braking current from the motor. However, the inverter cannot be protected from excessive voltage (high voltage, for example) supplied by mistake. ■ Overvoltage detection level 200V series: 400Vdc, 400V series: 800Vdc	O U	
PG error	Activated when the pulse generator terminal PA/PB circuits are disconnected. It is not activated when the sensorless control or the V/f control is selected.	P G	
Charging circuit error	Activated if the bypass circuit of the DC link circuit is not formed (the magnetic contactor for the charging circuit bypass is not closed) two minutes after power is supplied.	P b F	

Note 1: All protective functions are reset automatically if the control power voltage decreases to where maintaining the operation of the inverter control circuit is impossible.

Note 2: Fault history data is stored for the last ten trips.

Note 3: Stoppage due to a protective function can be reset by the RST key of the KEYPAD or turning OFF and then ON between the X terminal (RST assigning) and the CM. Note that this action is invalid if the cause of an alarm is not found and resolved.

Note 4: In addition to these protective functions, there can be further protective from surge voltage by connecting surge suppressors to the main circuit power terminals (L1/R, L2/S, L3/T) and the auxiliary control power terminals (R0, T0).

## 4.4.1.4 Diagnosing Activated Protective Function

VG7 inverter includes various protective functions to prevent damages to connected machines, accidents, fires or physical injuries of customers.

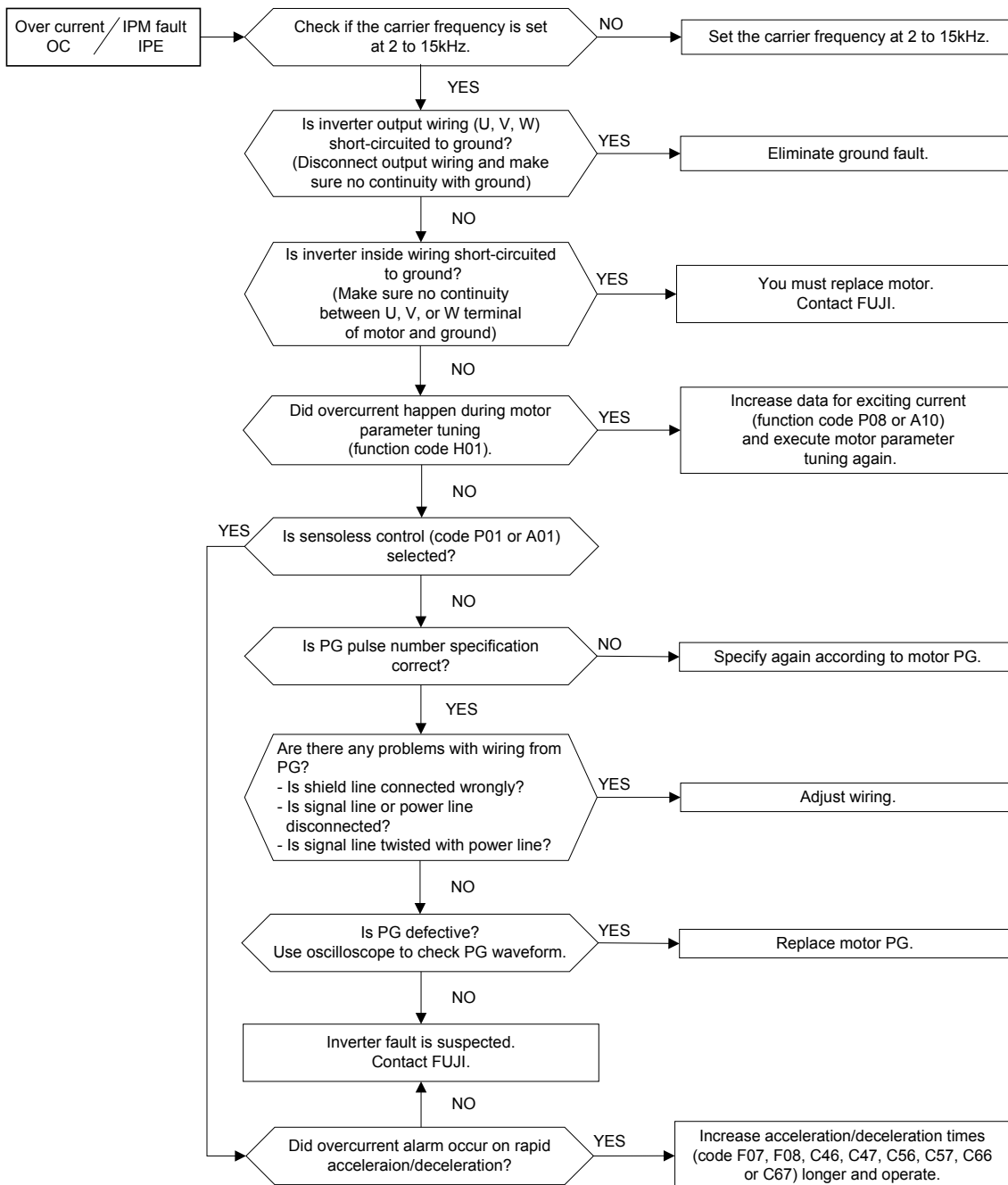
When the protective function is activated, the inverter immediately trips (discontinues output) and enters into the alarm mode. The alarm mode displays the description of the alarm on the LCD screen of the KEYPAD panel, flashes alarm code (such as OC or OH1) on the LED display and informs the customer of the alarm mode. The trip (discontinued output) shifts the rotating motor into coasting state.

The alarm mode continues until you enter the reset command. Make sure to direct the reset command after you isolate the source of the alarm or replace parts.

When you have eliminated the source of the alarm, the inverter returns to the operation mode on the reset command and is ready to restart.

### (1) Overcurrent

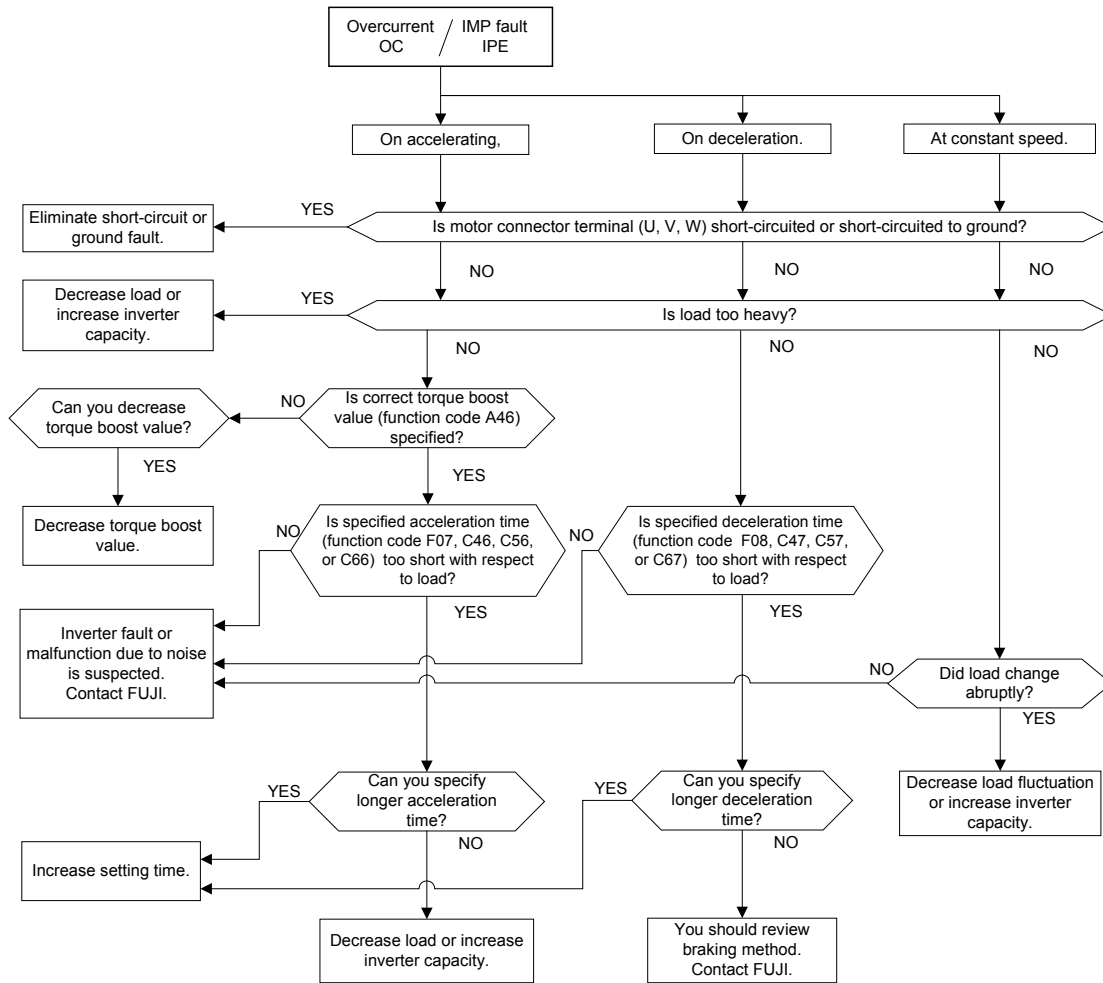
#### 1) Vector control and sensorless vector control





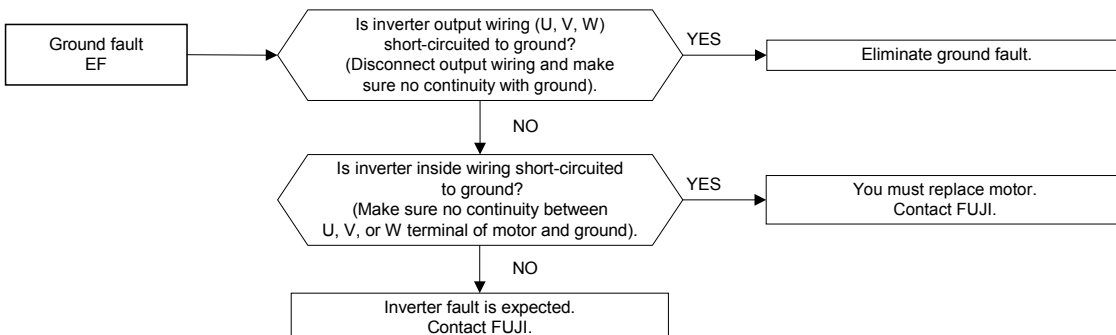
# 4. Control and Operation

## 2) V/f control



## (2) Ground fault

<b>WARNING</b>
<ul style="list-style-type: none"> <li>• Eliminate the cause before turn on the power.</li> </ul> <p><b>There is a risk of fire.</b></p>

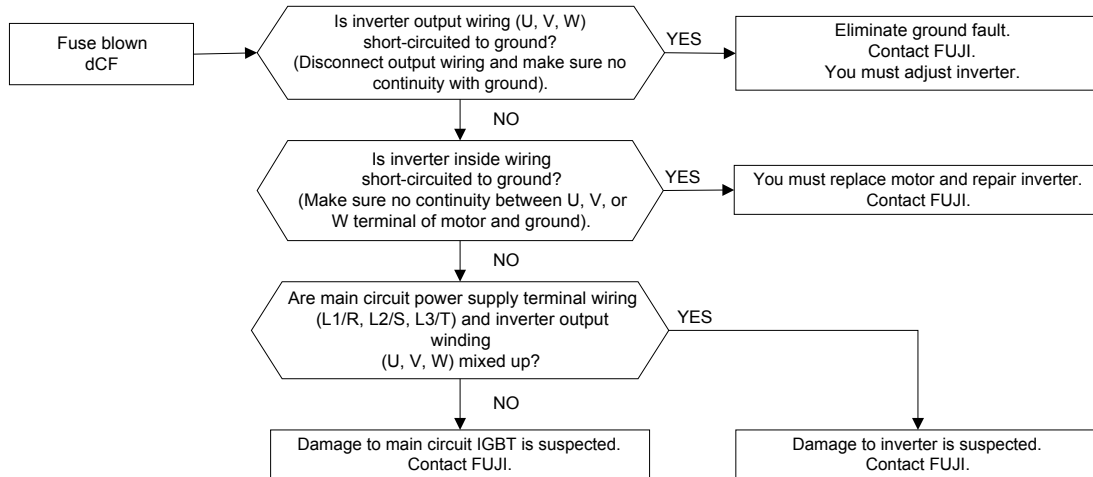


Note: The ground fault protective function is installed on models of 18.5kW or more.

(3) Fuse blown

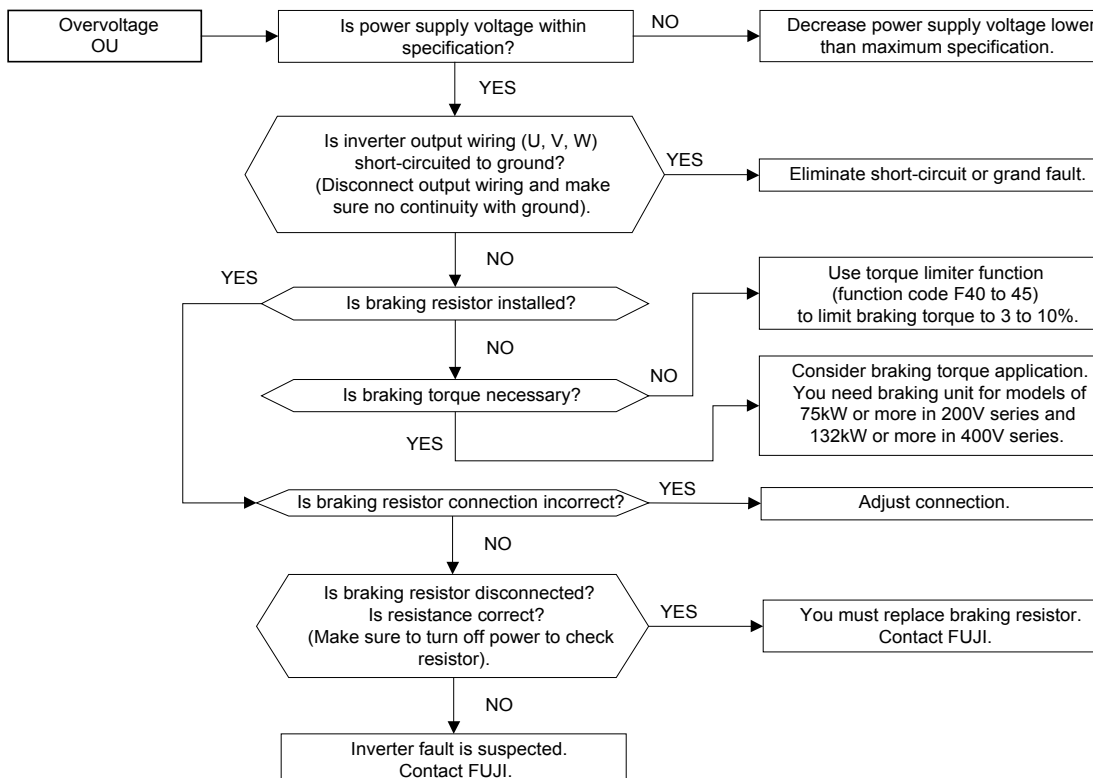
<b>⚠ WARNING</b>
<ul style="list-style-type: none"> <li>• Replace inverter before turn on the power.</li> </ul> <p><b>There is a risk of fire.</b></p>

The fuse is provided to prevent a secondary disaster such as a fire. You cannot operate inverter with the fuse blown. When this alarm is issued, turn off the power immediately, identify the cause following the description below, and replace the inverter. When this alarm is issued, do not turn on the power and contact us.



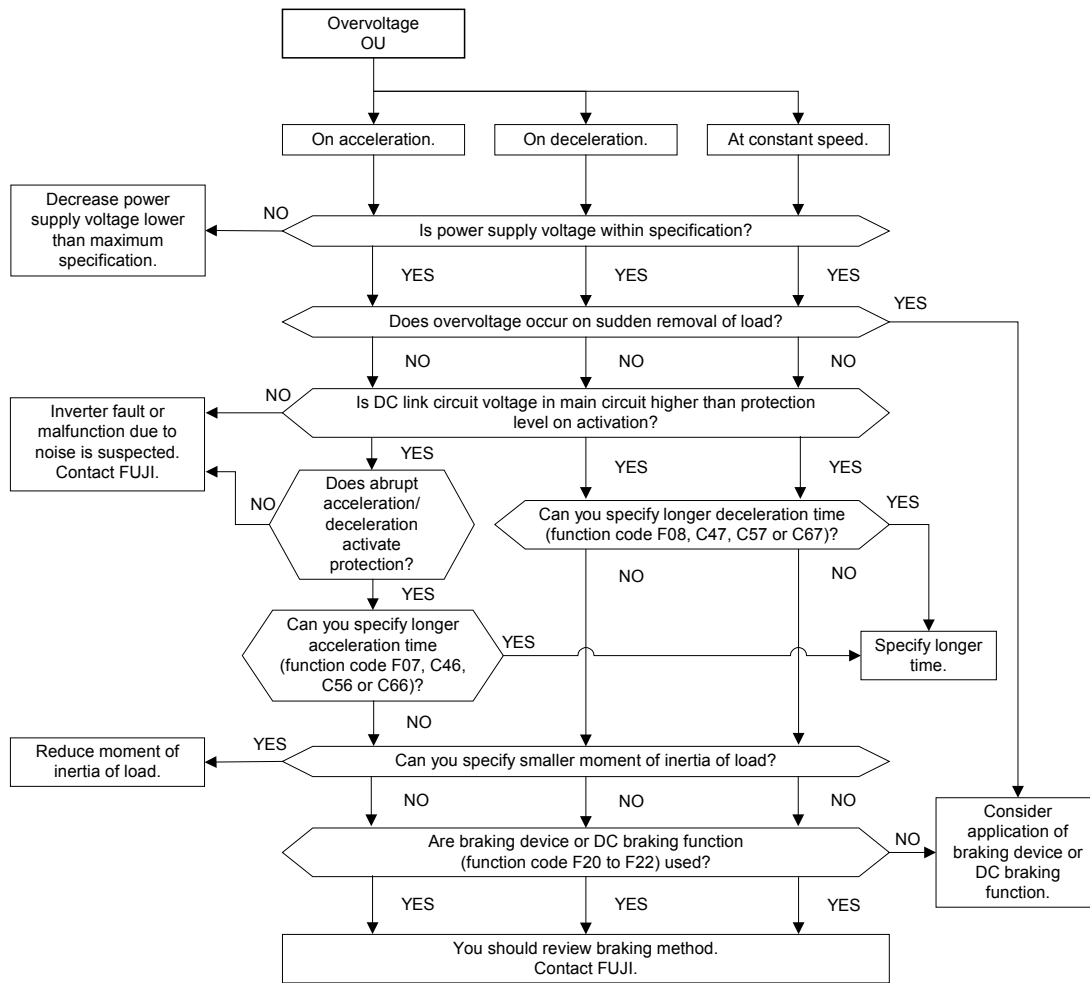
(4) Overvoltage

1) Vector control and sensorless vector control

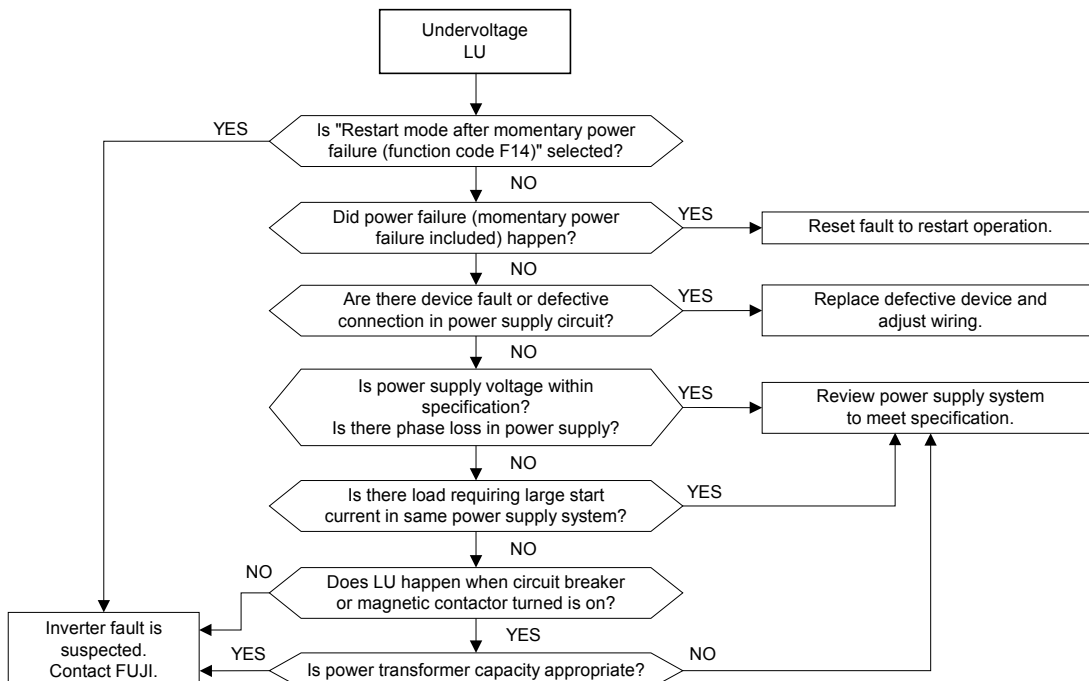


# 4. Control and Operation

## 2) V/f control

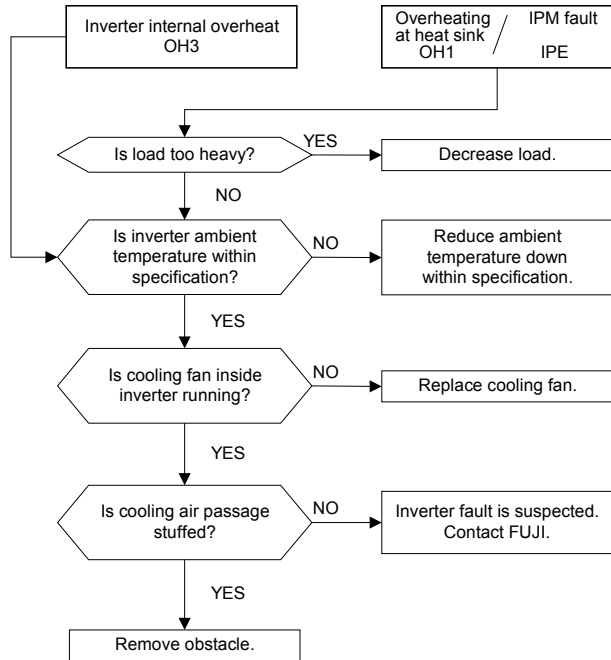


## (5) Undervoltage

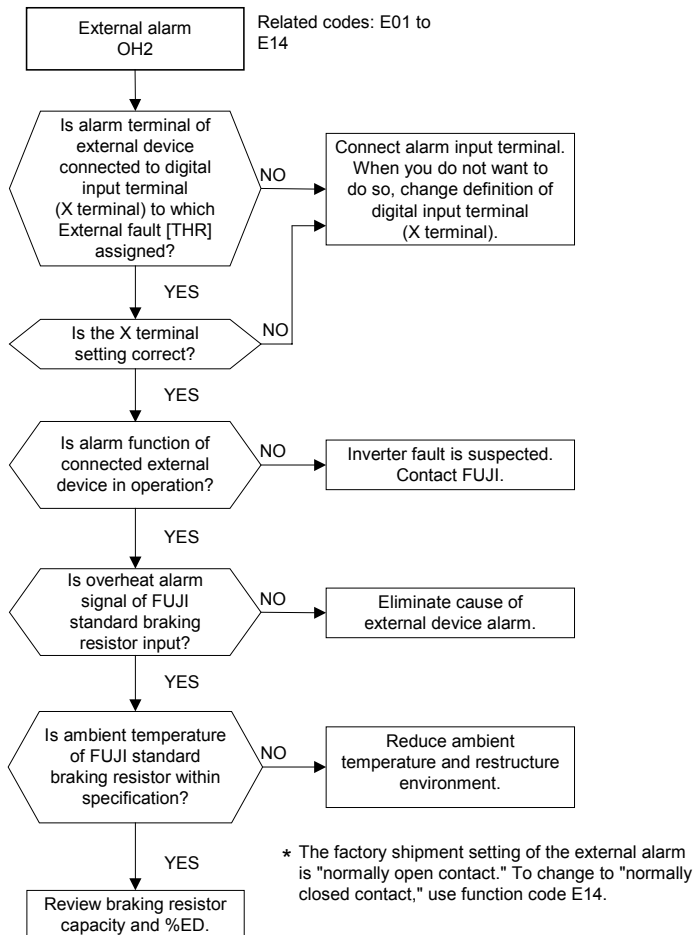


(6) Inverter internal overheat and overheating at heat sink

<b>CAUTION</b>
<ul style="list-style-type: none"> <li>• Heatsink becomes very hot and do not touch it.</li> </ul> <p><b>You may get burnt.</b></p>



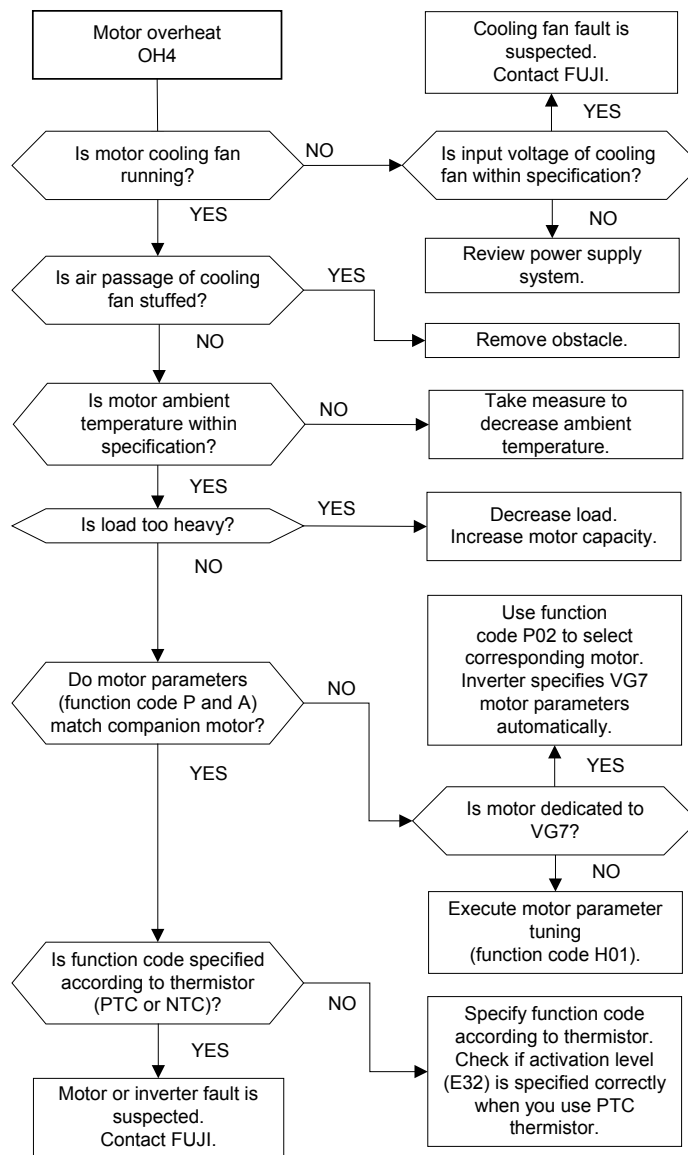
(7) External alarm



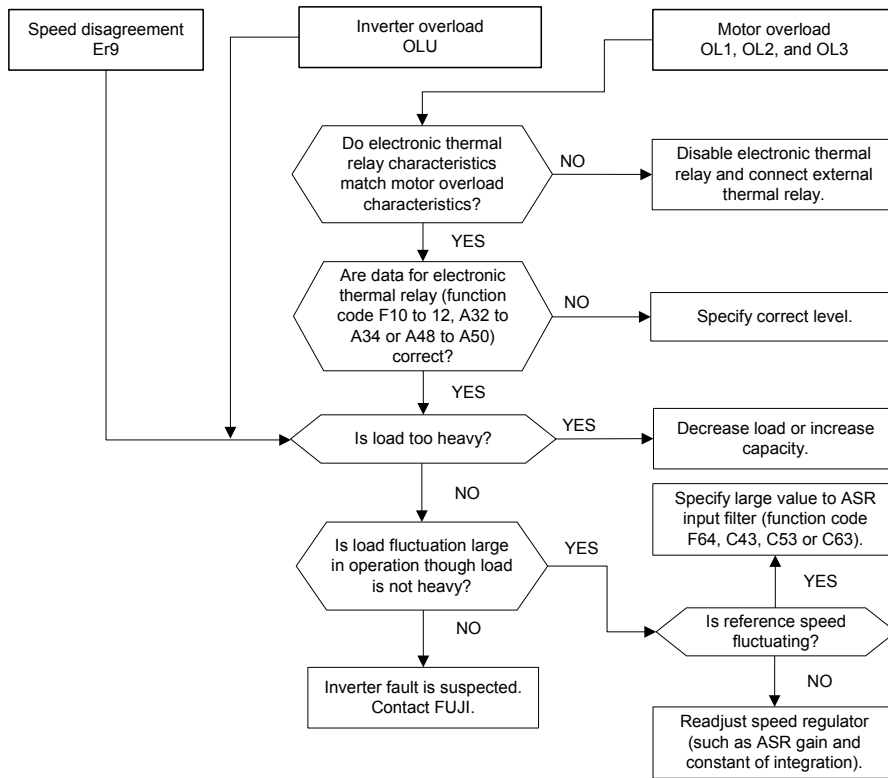
# 4. Control and Operation

## (8) Motor overheat

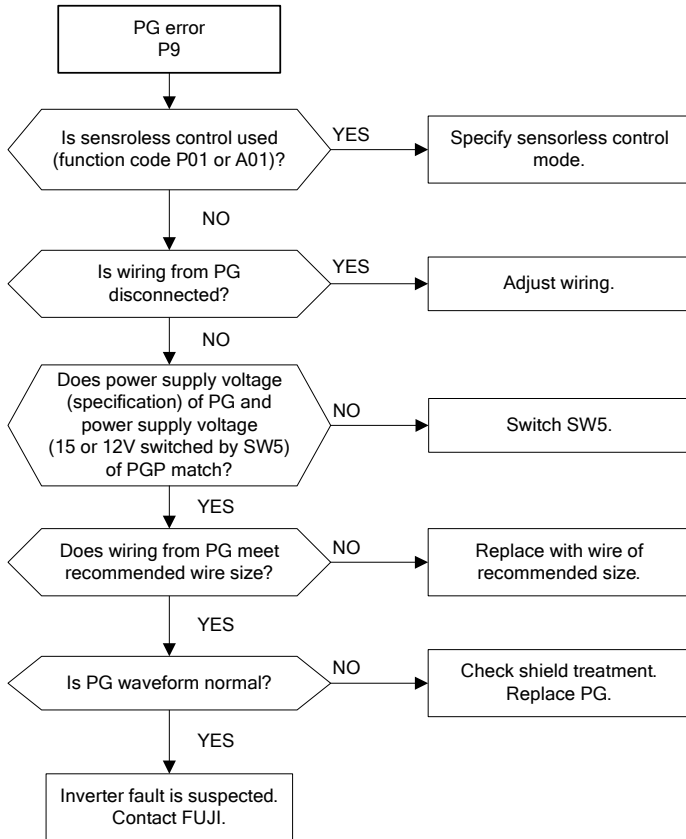
Related codes:  
E30, E31, E32, and P30



(9) Inverter overload and motor overload

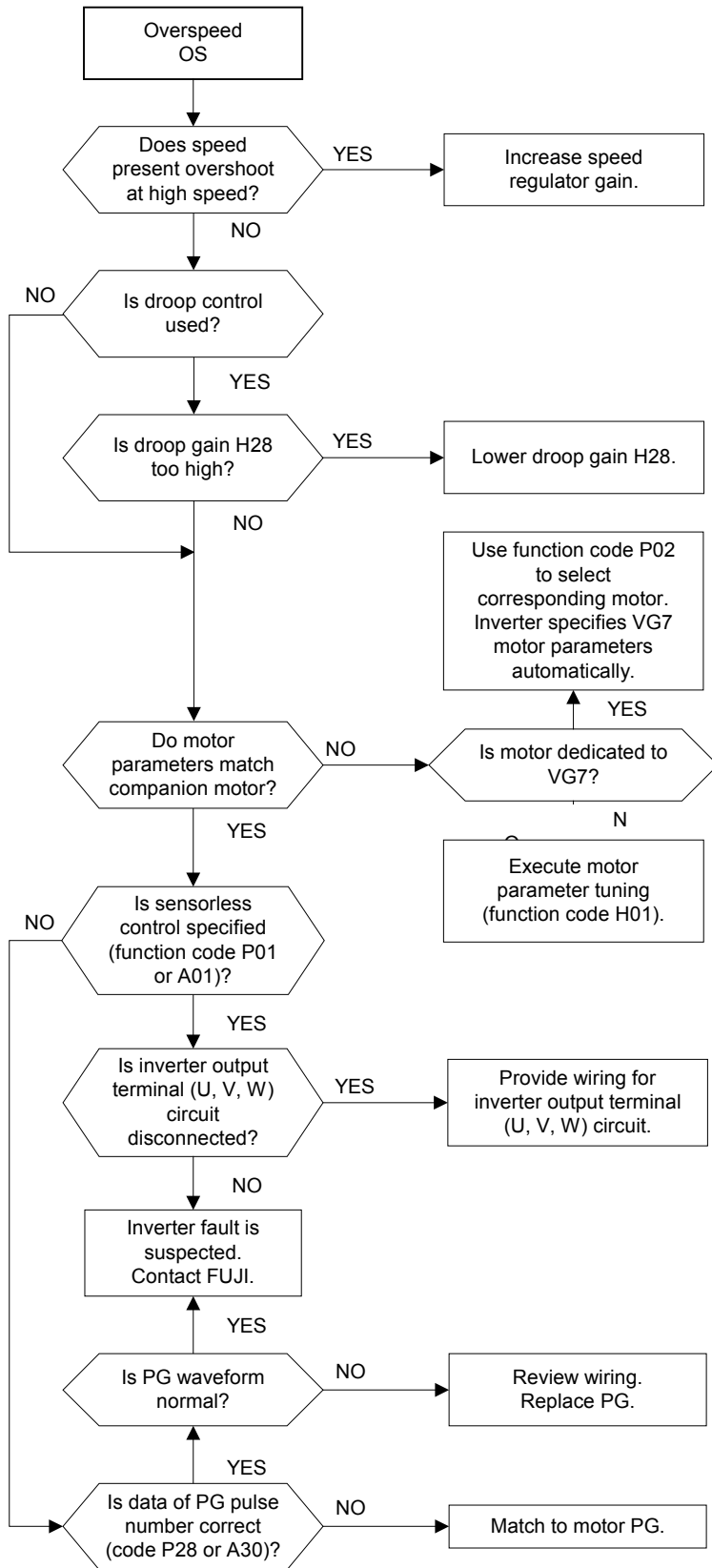


(10) PG error

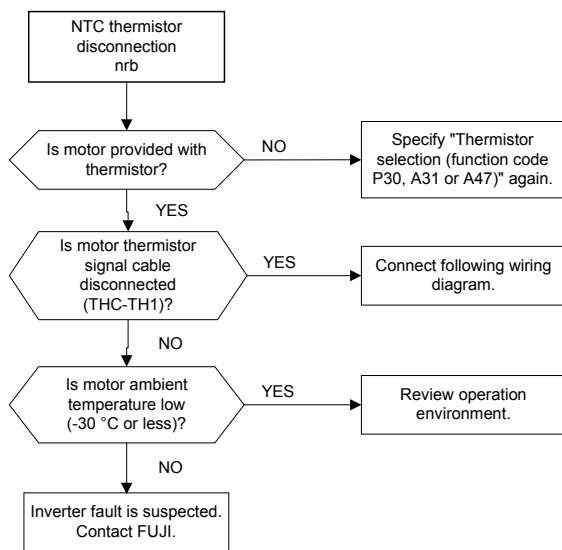


# 4. Control and Operation

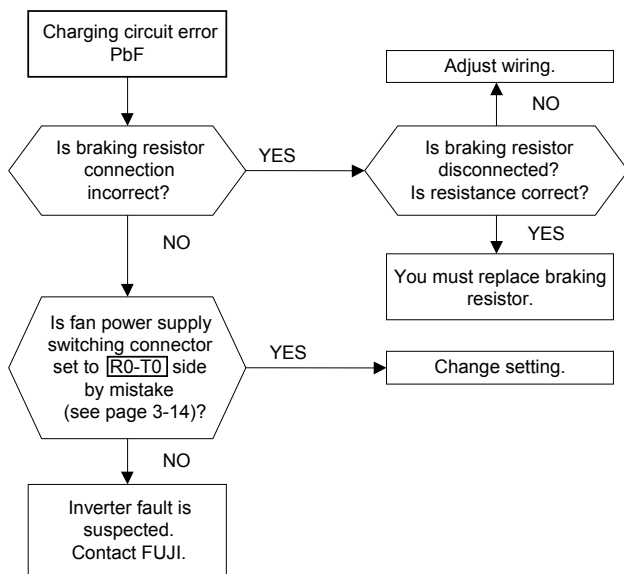
## (11) Overspeed



(12) NTC thermistor disconnection



(13) Charging circuit error





## 4. Control and Operation

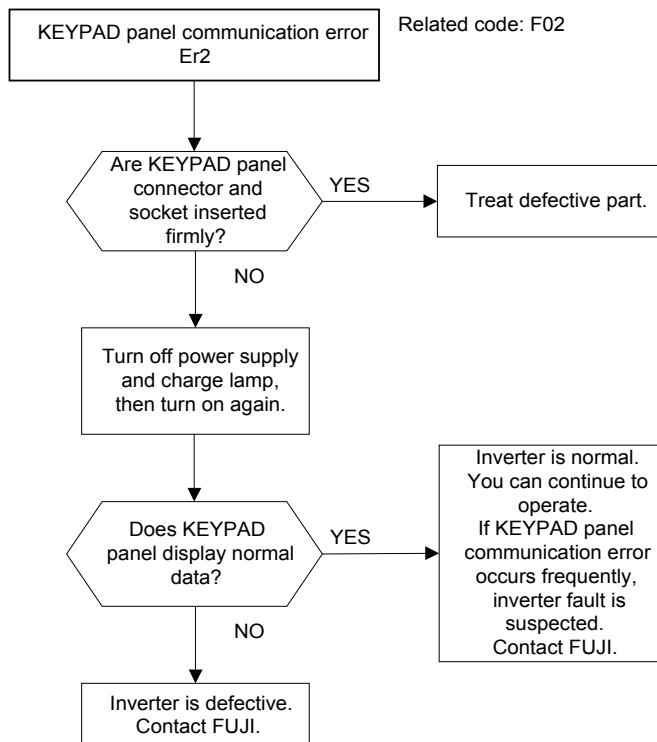
---

### (14) Memory error (Er1)

Review the function data before you turn off the power when the memory error occurs. When the data are correct, the error is limited to data in the back up memory. Only if you can use "All save" to save data without reoccurrence of Memory error, you can operate the inverter. Check the printed circuit board visually for dusts.

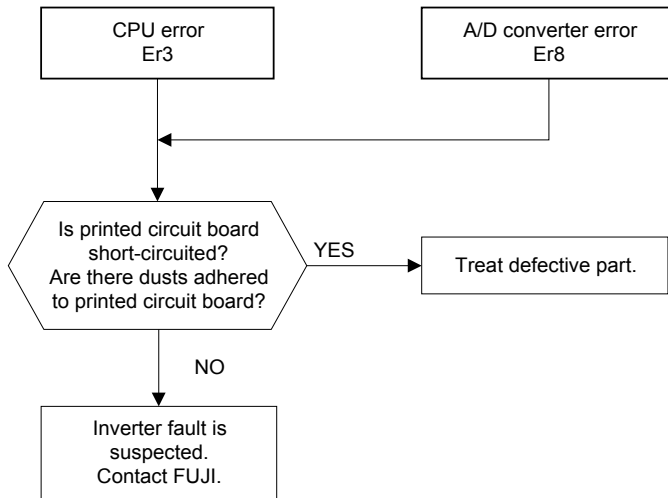
When the function data are abnormal, or memory error occurs frequently while function data are normal, an inverter fault is suspected. Contact FUJI.

### (15) KEYPAD panel communication error

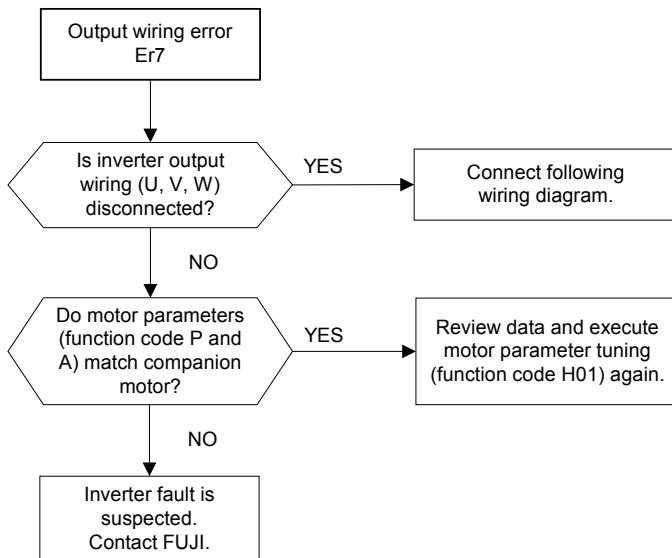


---

(16) CPU error and A/D converter error

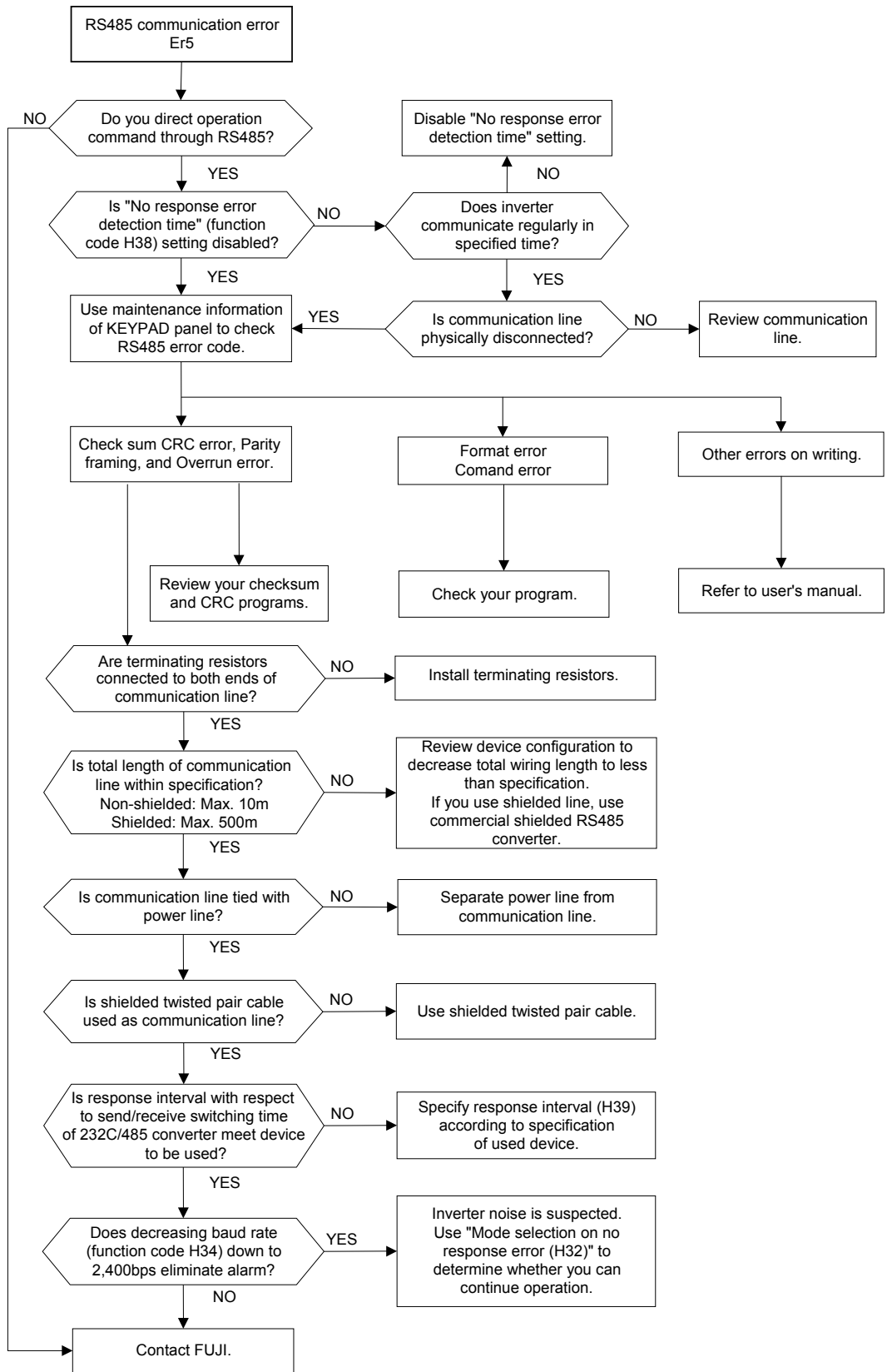


(17) Output wiring error



# 4. Control and Operation

## (18) RS485 communication error



(19) Input phase loss

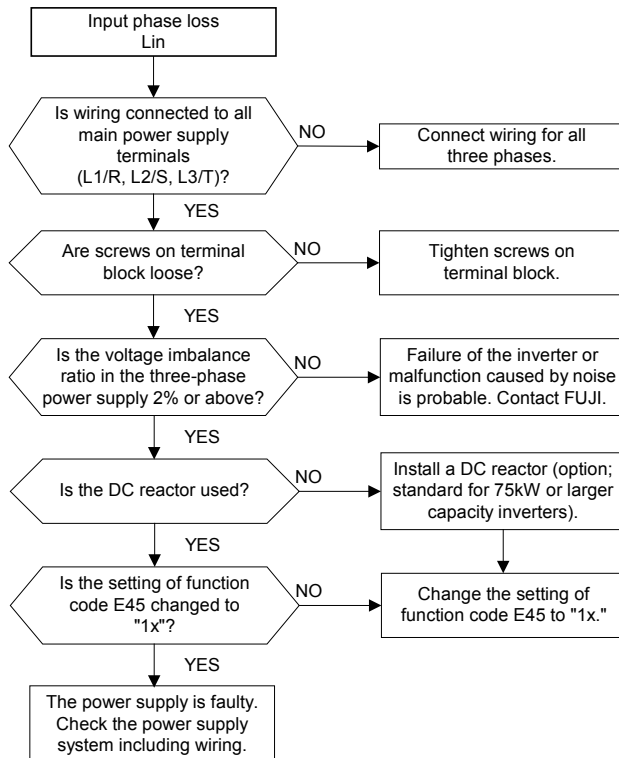
**CAUTION**

- Turn on the power after you eliminate faults.

**There is a risk of fire.**

- Change the setting of function code E45 to "1x" to change the input phase-loss detection sensitivity. Use a DC reactor (option; standard for 75kW or larger capacities) and change the parameter.

**If the parameter is changed erroneously, the inverter may be broken.**



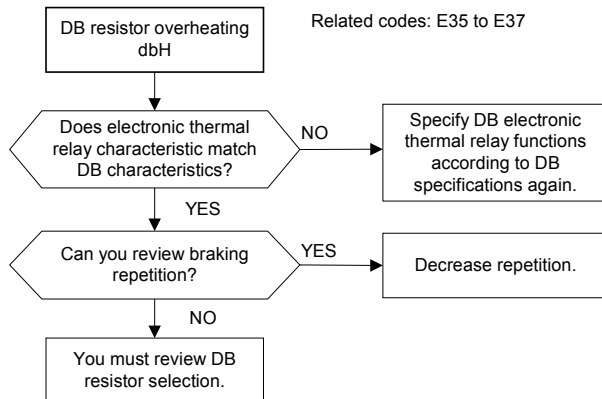
Note: Power supply voltage imbalance ratio [%]

$$= \frac{(\text{max. voltage [V]} - \text{min. voltage [V]})}{(\text{average voltage of 3-phases [V]})} \times 67$$

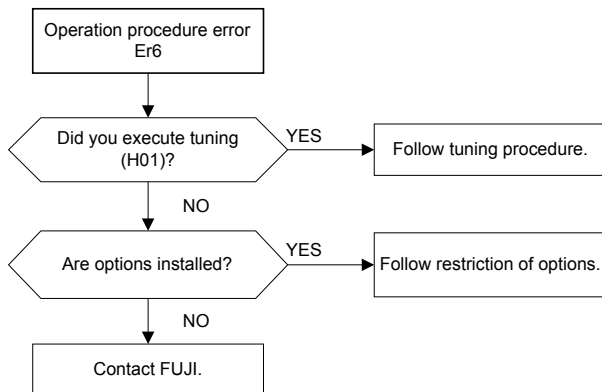
# 4. Control and Operation

---

## (20) DB resistor overheating



## (21) Operation procedure error



## (22) Others

The following alarms are related to options. See User's Manual for details.

Er4 : Network error. When T-Link, SX bus or field bus option is installed.

ErA : UPAC error. When UPAC option is installed.

Erb : Inter-inverter communication error. When RS or SI option is installed.

# THE INVERTER



## V. KEYPAD Panel

- 5.1 Appearance of KEYPAD Panel
- 5.2 Alarm Mode
- 5.3 KEYPAD Operation System  
(Hierarchical Structure of LCD Screens)
- 5.4 KEYPAD Operating Procedures

# 5. KEYPAD Panel

## ⚠ WARNING

- If the user set the function codes wrongly or without completely understanding this user's manual, the motor may rotate with a torque or at a speed not permitted for the machine.

### Accident or injury may result.

- The STOP key is effective only when its function has been set. Install an emergency stop switch separately.

### Accident may result.

## 5.1 Appearance of KEYPAD Panel

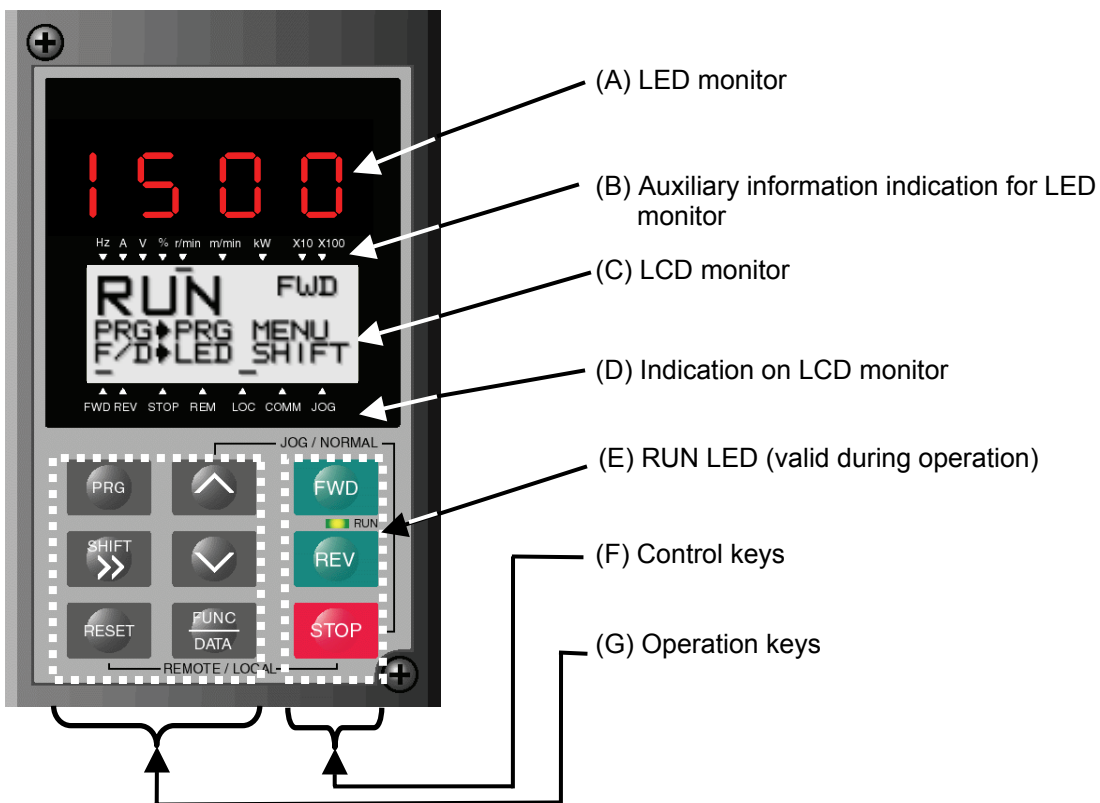


Figure 5-1-1 Appearance of KEYPAD Panel

(A) LED monitor:

Four-digit 7-segment display

Used to display various items of monitored data such as setting frequency, output frequency and alarm code.

(B) Auxiliary information indication for LED monitor:

Selected units or multiple of the monitored data (on the LED monitor) are displayed on the top line of the LCD monitor. The ■ symbol indicates selected units or multiple number. The symbol ▲ indicates there is an upper screen not currently displayed. (The ×100 indicator is not used.)

(C) LCD monitor:

Used to display such various items of information as operation status and function data. An operation guide message, which can be scrolled, is displayed at the bottom of the LCD monitor.

(D) Indication on LCD monitor:

Displays one of the following operation status with ■.

FWD: Forward operation REV: Reverse operation STOP: Stop

Displays the selected operation method:

REM: External signal LOC: KEYPAD panel COMM: Communication terminal JOG: Jogging mode

The symbol ▼ indicates there is a lower screen not currently displayed.

(E) RUN LED (valid during operation):

Indicates that an operation command is being input by pressing the **FWD** or **REV** key.

(F) Control keys:

Used for inverter run and stop

**FWD** : Forward operation command **REV** : Reverse operation command **STOP** : Stop command

(G) Operation keys:

Used for screen switching, data change, frequency setting, etc.

The Table 5-1-1 shows the main function of the operation keys.

Table 5-1-1 Functions of Operation Keys

Operation key	Main function
<b>PRG</b>	Used to switch the current screen to the menu screen or switch to the initial screen in the operation/alarm mode.
<b>FUNC DATA</b>	Used to switch the LED monitor or to determine the entered frequency, function code, or data.
<b>▲</b> , <b>▼</b>	Used to change data, move the cursor up or down, or scroll the screen.
<b>SHIFT</b> <b>&gt;&gt;</b>	Used to move the cursor horizontally at data change. When this key is pressed with the up or down key, the cursor moves to the next function block.
<b>RESET</b>	Used to cancel current input data and switch the displayed screen. If an alarm occurs, this key is used to reset the trip status (valid only when the alarm mode initial screen is displayed).
<b>STOP</b> + <b>▲</b>	Used to switch normal operation mode to jogging operation mode or vice versa. The selected mode is displayed on the LCD monitor.
<b>STOP</b> + <b>RESET</b>	Switches operation method (from KEYPAD panel operation to external signal operation or vice versa). When these keys are pressed, function F01 data is also switched from 0 to 1 or from 1 to 0. The selected mode is displayed on the LCD indicator. (REM, LOC)



# 5. KEYPAD Panel

## 5.2 Alarm Mode

Alarm detection order

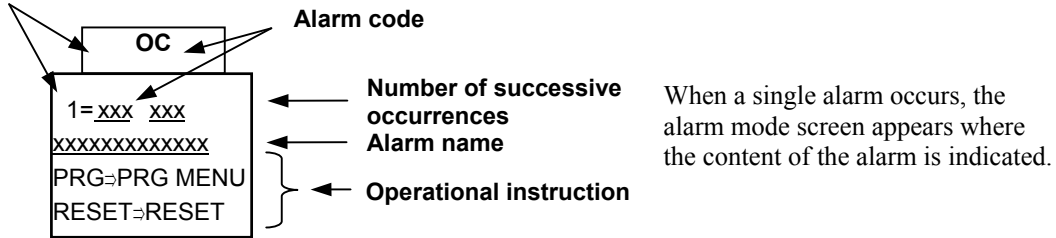


Figure 5-2-1 Alarm Mode Screen

When multiple alarms occur at the same time, the contents of the alarms can be checked using the **▲** and **▼** keys.

Table 5-2-1 Alarm Detection Order

Operating keys	LED display	LCD display	Content
<div style="display: flex; align-items: center; gap: 10px;"> <div style="text-align: center;"> <b>▲</b> ↑         </div> <div style="text-align: center;"> <b>▼</b> ↓         </div> </div>	5.	5	Alarm No. 5
	4.	4	Alarm No. 4
	3.	3	Alarm No. 3
	2.	2	Alarm No. 2
	1.	1	Alarm No. 1 (multiple alarms)
	Blank	0	Latest alarm (single alarm/already has been reset)
	Blank	-1	1st latest alarm
	Blank	-2	2nd latest alarm
	Blank	-3	3rd latest alarm
	Blank	-4	4th latest alarm
Blank	-5	5th latest alarm	
Blank	-6	6th latest alarm	
Blank	-7	7th latest alarm	
Blank	-8	8th latest alarm	
Blank	-9	9th latest alarm	
Blank	-10	10th latest alarm	

- The information given by the LCD and LED when multiple alarms are issued at the same time is different from that given when a single alarm is issued.
  - When multiple alarms are issued, the information about alarm No.1 is given.
  - When a single alarm is issued, the information about the latest alarm is given.
- When multiple alarms are issued, only alarm No.1 is recorded in the alarm history. No.2 and subsequent ones are not recorded.
- When a single alarm is issued, the latest alarm is recorded in the alarm history.

## 5.3 KEYPAD Operation System (Hierarchical Structure of LCD Screens)

### 5.3.1 During Normal Operation

The basic KEYPAD operation system (hierarchical structure of screens) is illustrated below.

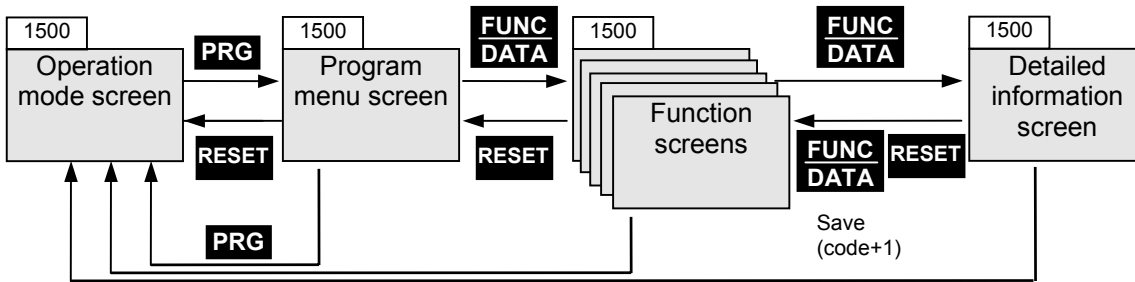


Figure 5-3-1 KEYPAD Operation in Operation Mode

### 5.3.2 When an Alarm Occurs

When an alarm occurs, the KEYPAD screen system is switched from the normal operation mode to the alarm mode. The alarm mode screen appears where the alarm information is indicated. The program menu, function, and detailed information screens are similar to those of normal operation. The program menu screen can be switched to the alarm mode screen using **PRG** only.

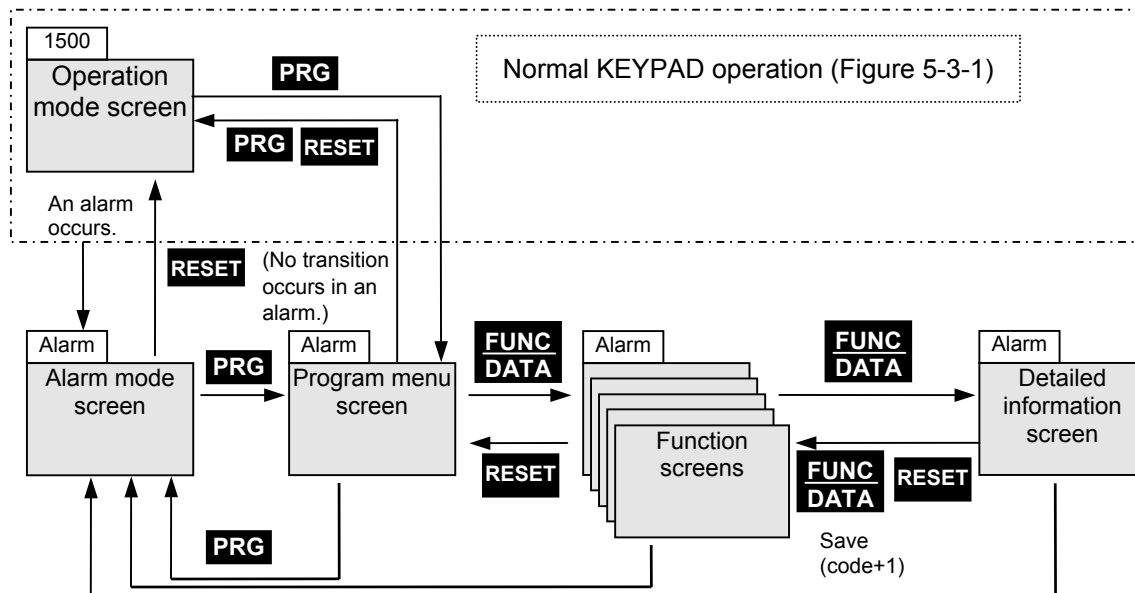


Figure 5-3-2 KEYPAD Operation in Alarm Mode

## 5. KEYPAD Panel

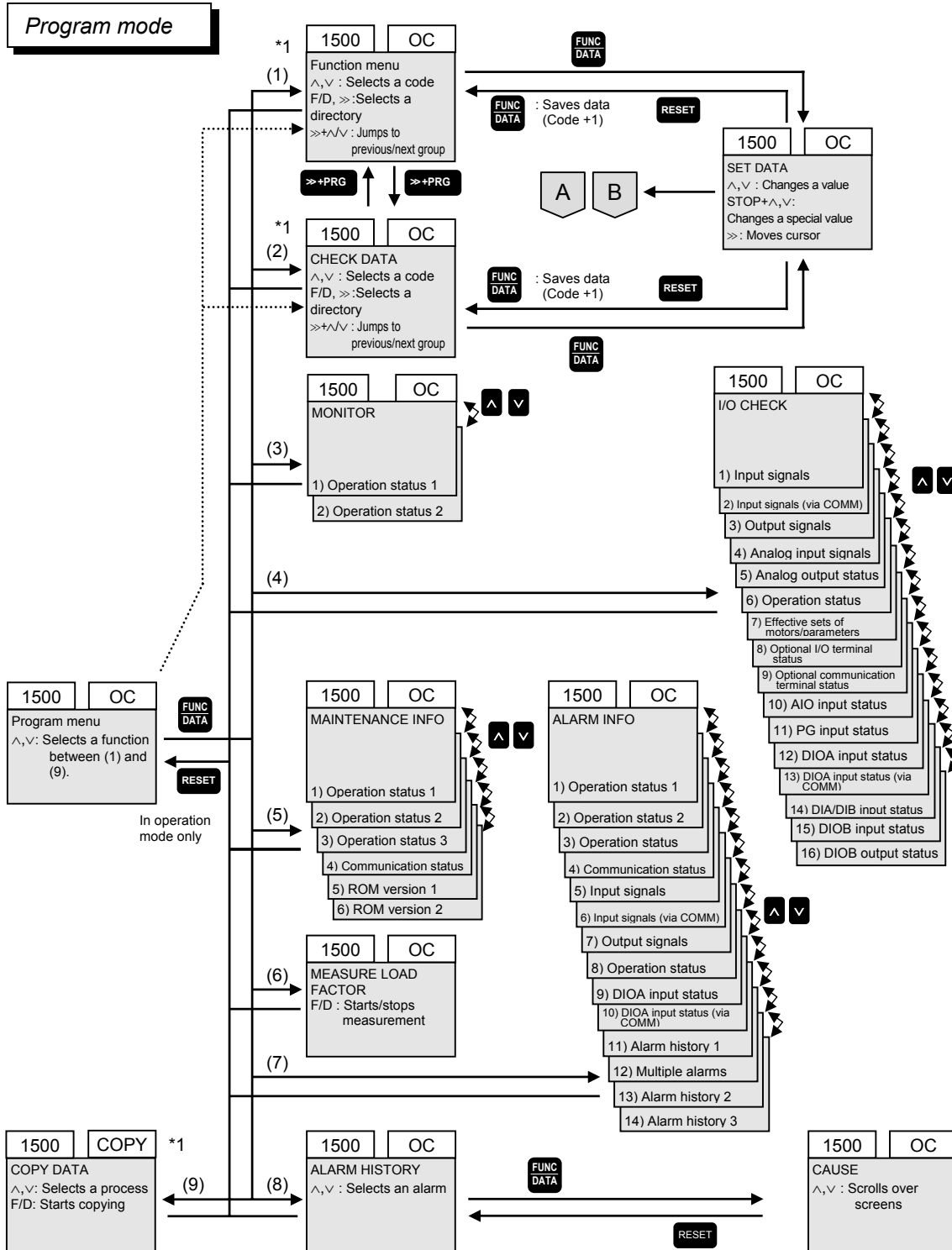
Table 5-3-1 Outline of Indications on Different Screens

No.	Screen name	Description																														
1	Operation mode	You can change motor speed or switch LED monitor when this screen is shown on KEYPAD during normal operation.																														
2	Program menu (Program mode)	<p>Function menu is shown on this screen for your selection. Select a desired function from menu and press <b>FUNC DATA</b> to call screen for selected function. Menu contains the following options as KEYPAD functions.</p> <table border="1"> <thead> <tr> <th>No.</th> <th>Menu item</th> <th>Outline</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Function menu</td> <td>If this is selected, a name list of function codes appears. Select a desired code to call data setting screen for that code where its setting can be checked or changed.</td> </tr> <tr> <td>2</td> <td>CHECK DATA</td> <td>If this is selected, a data list of function codes appears. Select a desired code to check its setting. Similar to the SET DATA above, data setting screen can be selected where its setting can be changed.</td> </tr> <tr> <td>3</td> <td>MONITOR</td> <td>This screen is used as operation status monitor to check various data.</td> </tr> <tr> <td>4</td> <td>I/O CHECK</td> <td>This screen is used to check status of inverter and optional analog input/output and digital input/output signals.</td> </tr> <tr> <td>5</td> <td>MAINTENANCE INFO</td> <td>This screen is used to check maintenance information including inverter status, life expectancy, communication errors, and ROM version.</td> </tr> <tr> <td>6</td> <td>MEASURE LOAD FACTOR</td> <td>Maximum and average currents and average braking power can be measured to determine load factor.</td> </tr> <tr> <td>7</td> <td>ALARM INFO</td> <td>This screen is used to check operation status and I/O status at the time of the latest alarm.</td> </tr> <tr> <td>8</td> <td>ALARM HISTORY</td> <td>This screen is used to check the latest alarm, multiple alarms that occurred at the same time, and alarm history. Select an alarm and press <b>FUNC DATA</b> to check cause of that alarm and troubleshooting information.</td> </tr> <tr> <td>9</td> <td>COPY DATA</td> <td>Function code settings for an inverter can be stored and copied to another inverter.</td> </tr> </tbody> </table>	No.	Menu item	Outline	1	Function menu	If this is selected, a name list of function codes appears. Select a desired code to call data setting screen for that code where its setting can be checked or changed.	2	CHECK DATA	If this is selected, a data list of function codes appears. Select a desired code to check its setting. Similar to the SET DATA above, data setting screen can be selected where its setting can be changed.	3	MONITOR	This screen is used as operation status monitor to check various data.	4	I/O CHECK	This screen is used to check status of inverter and optional analog input/output and digital input/output signals.	5	MAINTENANCE INFO	This screen is used to check maintenance information including inverter status, life expectancy, communication errors, and ROM version.	6	MEASURE LOAD FACTOR	Maximum and average currents and average braking power can be measured to determine load factor.	7	ALARM INFO	This screen is used to check operation status and I/O status at the time of the latest alarm.	8	ALARM HISTORY	This screen is used to check the latest alarm, multiple alarms that occurred at the same time, and alarm history. Select an alarm and press <b>FUNC DATA</b> to check cause of that alarm and troubleshooting information.	9	COPY DATA	Function code settings for an inverter can be stored and copied to another inverter.
No.	Menu item	Outline																														
1	Function menu	If this is selected, a name list of function codes appears. Select a desired code to call data setting screen for that code where its setting can be checked or changed.																														
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8	ALARM HISTORY	This screen is used to check the latest alarm, multiple alarms that occurred at the same time, and alarm history. Select an alarm and press <b>FUNC DATA</b> to check cause of that alarm and troubleshooting information.																														
9	COPY DATA	Function code settings for an inverter can be stored and copied to another inverter.																														
3	Function screens	When a function is selected from program menu, the corresponding function screen appears for execution of that function.																														
4	Detailed information screen	Functions that cannot be executed by function screens (change of function code settings and indication of causes of alarms) are displayed by detailed information screen.																														

## 5.4 KEYPAD Operating Procedures

### 5.4.1 Transition of Screens

The KEYPAD operation (hierarchical structure of screens) in the program mode is illustrated below.

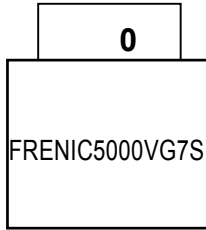


\*1: The functions whose use has been limited by password (function codes L01 and L02) cannot be selected until the password is entered. Unless limited, they can be selected at any time.

# 5. KEYPAD Panel

## 5.4.2 Operation Mode

### Initial screen

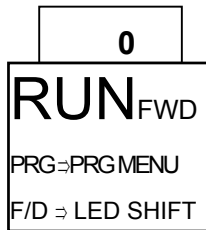
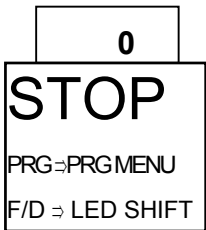


The screen shown on the left appears for five seconds after power-on. Then, the screen is replaced by the operation mode screen.

### Operation mode screens

W/o operation command

W/operation command

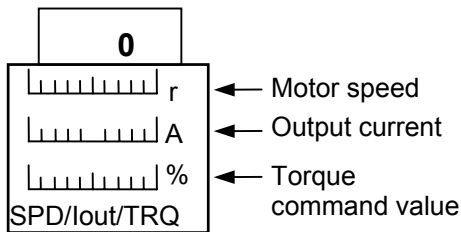


The operation mode screen takes the descriptive form where the inverter operation status and operational instruction are indicated or the graphical form where the operation status is expressed by bar graphs.

The form can be switched with function code F57 (LCD monitor). (The descriptive form is initially selected.)

To switch to the bar graph screen:

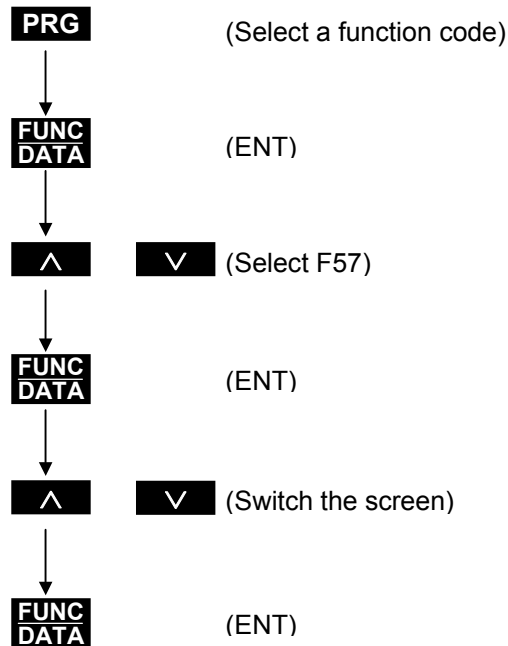
### Bar graph screen



Motor speed:  
The full scale represents the maximum speed.

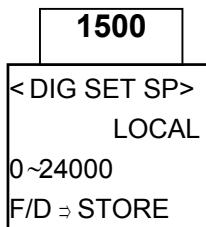
Output current:  
The full scale represents 200% of the rated inverter output.

Torque command value:  
The full scale represents 200% of the rated motor torque.



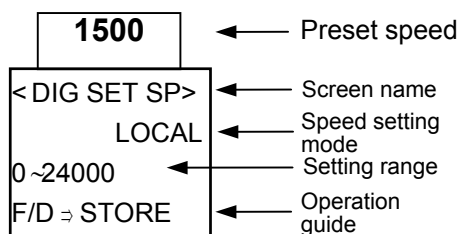
## 5.4.3 Digital Speed Setting Procedure

### Digital speed setting screen

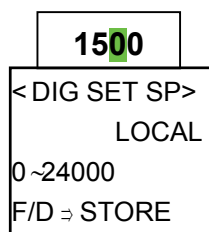


Press the **▲** or **▼** key with the operation mode screen to call the digital speed setting screen. (If you do nothing for five minutes, the screen will return to the operation mode.)

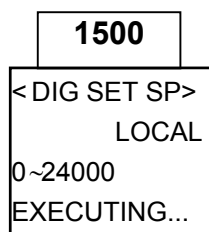
### Digital speed setting procedure



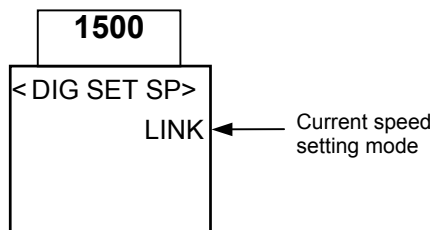
Press the **▲** or **▼** key again with the digital speed setting screen to change the digital speed. Keep pressing the **▲** or **▼** key to change the speed in tens, hundreds, or thousands.



Press the **SHIFT >>** key to shift the place where the value is to be changed. (LEDs at the selected place will blink.)



Press the **FUNC DATA** key to store the currently entered speed.



If the KEYPAD setting mode has not been selected (Remote or PID screen), the current speed setting mode is indicated on the LCD. If REMOTE is indicated, you can check but cannot change the speed using the **▲** and **▼** keys.

KEYPAD Panel

# 5. KEYPAD Panel

## 5.4.4 Switching the LED Monitor Indication

Press the **FUNC DATA** key with the operation mode screen to switch the LED monitor indication. The information given by the monitor changes each time the **FUNC DATA** key is pressed and the current mode is indicated on the LCD.

Table 5-4-1 Monitor Indication

	LED monitor		Digital setting mode		Unit	Resolution
	Running	Stopping	Digital speed setting	PID command		
0	Detected speed 1 *0)	Setting speed 4 *0)	Speed command from KEYPAD	PID command from KEYPAD	r / min	0-9999: 1-10,000 resolution 10,000-24,000: 10
1	Speed setting 4 *0)				r / min	0-9999: 1-10,000 resolution 10,000-24,000: 10
2	Reference output frequency				Hz	0.1 to 400.0: 0.1 resolution
3	Reference torque current				%	1 %
4	Reference torque				%	1 %
5	Calculated torque				%	1 %
6	Input power				F 60= 0;kW F 60= 1;HP	0.01 to 99.99 : 0.01 100.0 to 999.9 : 0.1 1000 to : 1
7	Detected output current				A	0.01 to 99.99 : 0.01 100.0 to 999.9 : 0.1 1000 to : 1
8	Detected output voltage				V	1 V
9	Detected DC link circuit voltage				V	1 V
10	Reference magnetic-flux value				%	1 %
11	Calculated flux value				%	1 %
12	Motor temperature *1)		-	1		
13	Load shaft detected speed	Load shaft reference speed	Load speed from KEYPAD	r / min	1	
14	Detected line speed	Reference line speed	Speed command from KEYPAD	m / min	1	
15	Adjusted value of Ai (12)			%	0.1 %	
16	Adjusted value of Ai (Ai1)			%	0.1 %	
17	Adjusted value of Ai (Ai2)			%	0.1 %	
18	Adjusted value of Ai (Ai3) *2)			%	0.1 %	
19	Adjusted value of Ai (Ai4) *2)			%	0.1 %	
20	PID command value *3)			-	0.00 to ± 9.99 : 0.01	
21	PID feedback value *3)				10.0 to ± 99.9 : 0.1	
22	PID output value *3)				100 to ± 999 : 1	
23	Optional monitor 1 (HEX) *4)			HEX	1	
24	Optional monitor 2 (HEX) *4)			HEX	1	
25	Optional monitor 3 (DEC) *4)		DEC	1, × 10		
26	Optional monitor 4 (DEC) *4)		DEC	1, × 10		
27	Optional monitor 5 (DEC) *4)		DEC	1, × 10		
28	Optional monitor 6 (DEC) *4)		DEC	1, × 10		

\*0): Indicated as an absolute value. \*1): If the system is programmed not to indicate the motor speed, "--" appears. \*2): Not indicated when optional AIO unit is not connected.

\*3): Not indicated when the PID is inactive. \*4): Indicated or not indicated, depending on the application.

\*5): The upper limit of the displayed value is "60,000"

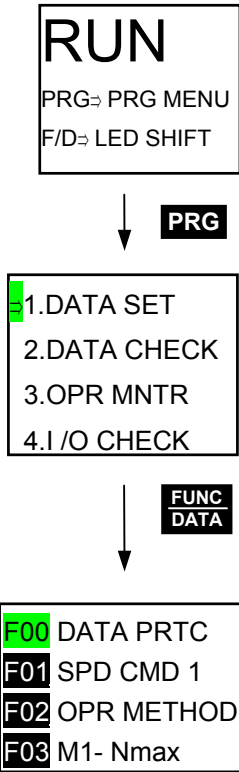
## 5.4.5 Menu Screen

- 1.DATA SET
- 2.DATA CHECK
- 3.OPR MNTR
- 4.I/O CHECK

Press the **PRG** key with the operation mode screen to call the menu screen.

Move the arrow at the left of the screen to a desired menu using the **^** or **v** key. Press the **FUNC DATA** key to call the screen for the selected menu.

## 5.4.6 Function Code Setting Procedure



Press the **PRG** key with the operation mode screen to call the menu screen. Move the arrow to “1. SET DATA” using the **^** or **v** key. Press the **FUNC DATA** key to call the function code setting screen.

Select a desired function code on the function code setting screen using the **^** or **v** key.

KEYPAD Panel



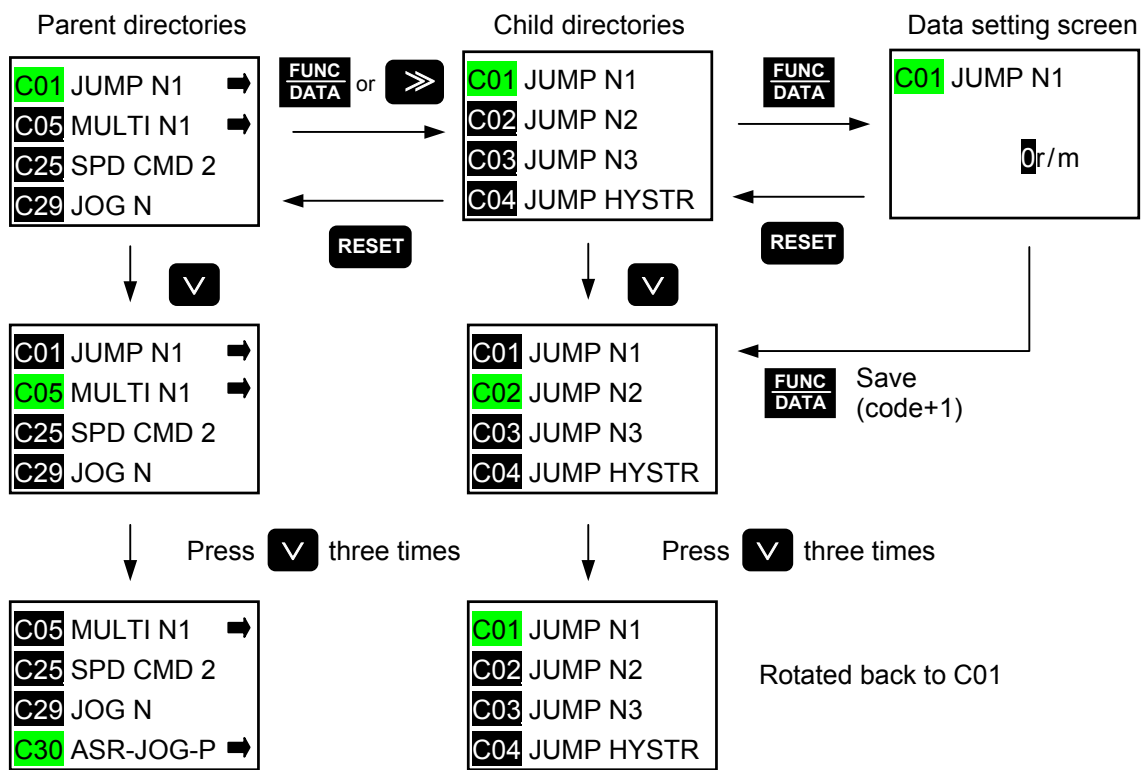
# 5. KEYPAD Panel

## (1) KEYPAD Directory Structure

The directory structure described herein is the same as used for personal computers where a group of function codes are contained in each directory.

For example, function codes C01 to C04 are all related with the mechanical resonance point of the load and considered as the same. Therefore, C02 to C04 are not indicated in the parent directory list. In this case, → appears to the right of C01 to indicate that it has child directories. To open the directory for a function code identified with →, move the cursor to that code using the ▲ or ▼ key and press the FUNC DATA or >> key.

### An Example of Selecting a Function Code with Child Directories



- → appears to the right of each function code with child directories.
- Press the >> key once (do not keep pressing longer than a second) to call the child directory list for the selected function code.

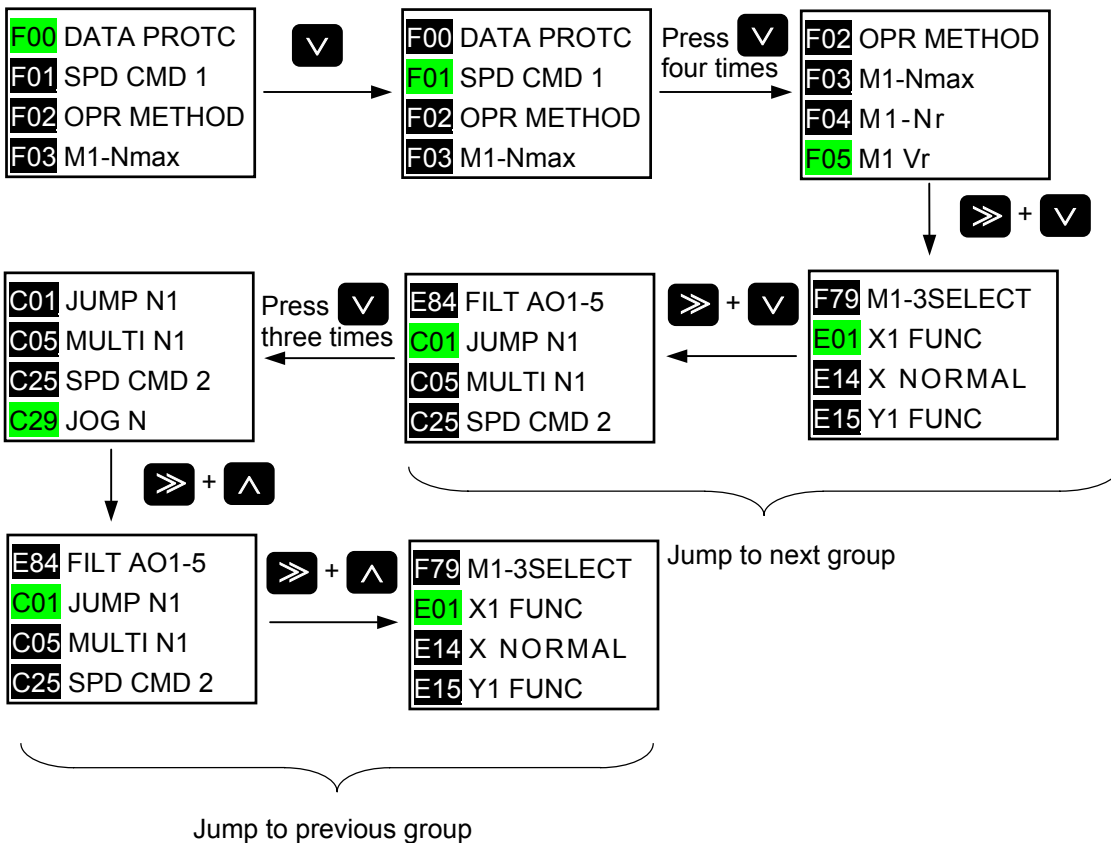
Each function code consists of an alphabet and number. The alphabet represents the function group.

Table 5-4-2 Function Code Groups

Function codes	Functions	Remark
F00 to F80	Fundamental functions	
E01 to E84	Extension terminal functions	
C01 to C73	Control functions of frequency	
P01 to P30	Motor 1 parameters	
H03 to H73	High performance functions	
A01 to A50	Alternative motor parameters	
o01 to o40	Optional functions	
L01 to L15	Lifter functions	
U01 to U64	User functions	

## (2) Jumping by Group

When selecting a function code not shown on the screen, press the **>>** and **^** or **>>** and **v** keys to jump to the previous or next group.

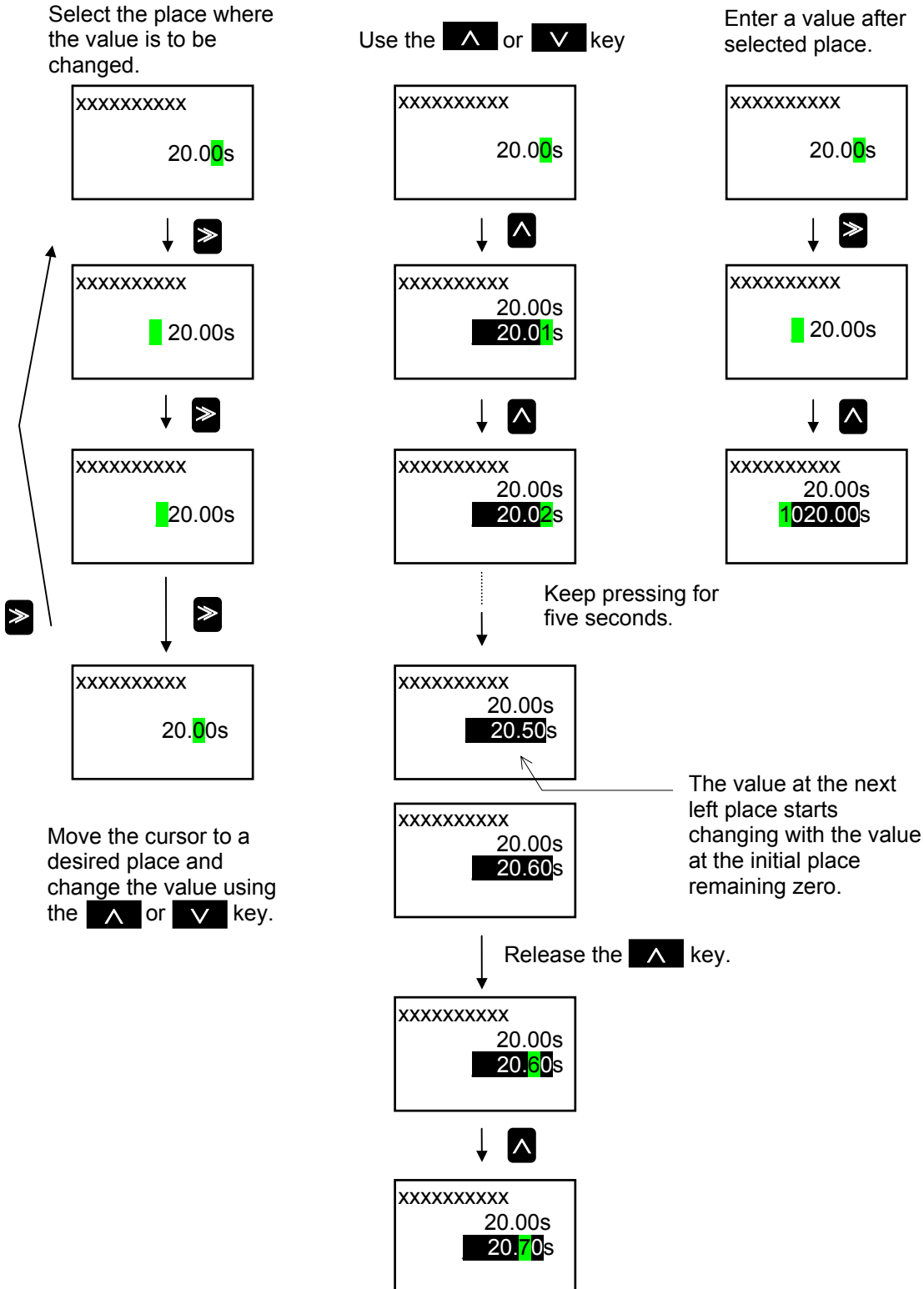


# 5. KEYPAD Panel

## (3) Setting Procedures

### Ordinary setting procedures

To change a setting, keep pressing the **▲** or **▼** key or select a place using the cursor and directly enter a new value.



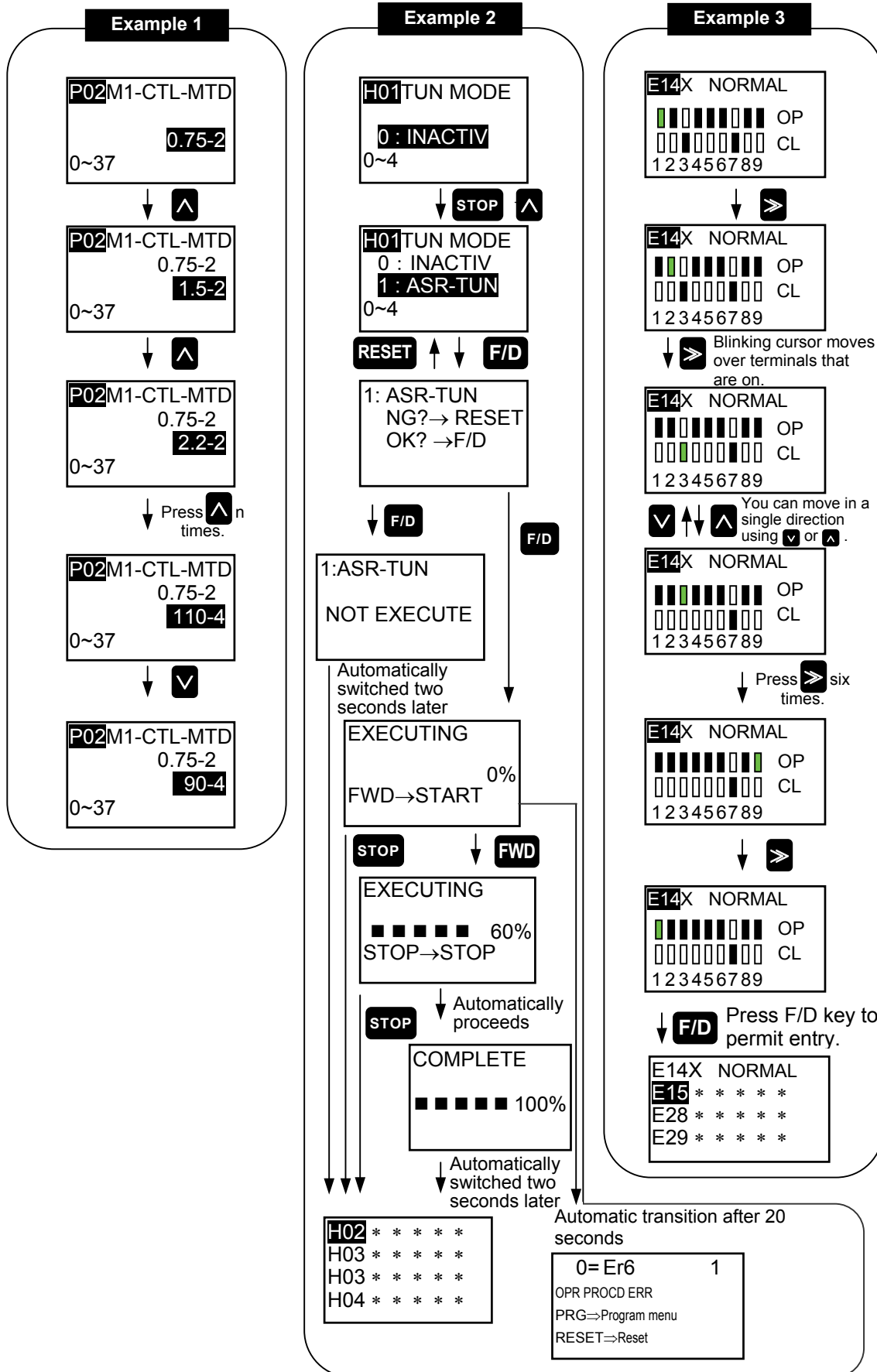
Select a function code. Press **FUNC DATA** to call the data setting screen.  
 Press **▲** or **▼** with the data setting screen to increase or decrease the value in the minimum unit on the LCD.  
 Keep pressing **▲** or **▼** to increase or decrease the setting in tens, hundreds, or thousands for rapid changing. It is also possible to select a place using **➡** and directly **enter** a value. Once any setting is changed, the previous value is also indicated for your reference. Press **FUNC DATA** to store the new value.  
 Press **RESET** to return to the function menu screen without storing the value.  
 Any function code setting is not reflected on the inverter operation until stored by pressing **FUNC DATA**. Some settings cannot be changed when protected or during operation or for another reason. The conditions required for changing them should be satisfied. The reason why the settings cannot be changed is indicated below.

Table 5-4-3 Reasons for Disabling the Change

Indication	Reason	Remedy
NO SIGNAL (WE)	The edit enable command function via general-purpose input terminal has been selected.	Turn on the terminal for function codes set to 19 (edit enable command selected) between E01 and E13.
DATA PRCTD	Data is protected by function code F00.	Set function code F00 to 0.
INV RUNNING	An attempt was made to change a function code with the inverter running though the change has been disabled during inverter operation.	Stop the inverter.
FWD/REV ON	An attempt was made to change a function code with the FWD/REV command on though the change has been disabled with the FWD/REV command on.	Turn the FWD/REV command off.

# 5. KEYPAD Panel

Examples of special setting procedures



- 
- Example 1 shows an example of list selection.  
For conventional models, only function codes are listed and the settings should have been changed or stored by referring to the manual. With the list selection capability, codes are listed on the LCD with their contents so that you can change or store the settings while checking the contents. The list selection screens for different function codes are shown in the subsequent pages.
  - Example 2 shows an example of transition of screens during tuning process.
  - Example 3 shows an example of setting control I/O terminals.
  - Some function codes in addition to the above should be programmed in the same manner. Change the settings in reference to the above examples.

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## (4) List selection screens for function codes

List selection screens (common to all languages)

### 1) Data protection (function code F00)

Code	List
0	0 : CHG OK
1	1 : PROTECT

### 2) Speed setting N1 and N2 (function code F01, C25)

Code	List
0	0 : KEYPAD
1	1 : 12 INPUT
2	2 : 12 - ABS
3	3 : U / D - 0
4	4 : U / D - BEF
5	5 : U / D - CRP
6	6 : DIA CRD
7	7 : DIB CRD

### 3) Operation method (function code F02)

Code	List
0	0 : KEYPAD
1	1 : FWD, REV

### 4) Electronic thermal (action selection) (function codes F10, A32, A48)

Code	List
0	0 : INACTIV
1	1 : ACT - GEN
2	2 : ACT - INV

### 5) 30RY operation mode (function code F36)

Code	List
0	0 : EXT - TRP
1	1 : EXT - NOR

### 6) Stopping speed (function code F38)

Code	List
0	0 : ACTUAL
1	1 : REFREC

### 7) Torque limiter mode 1 (function code F40)

Code	List
0	0 : INVALID
1	1 : TORQUE
2	2 : POWER
3	3 : TRQ CUR

### 8) Torque limiter mode 2 (function code F41)

Code	List
0	0 : 4Q LVL1
1	1 : DR / GEN
2	2 : UP / LOW
3	3 : 4Q SEL

### 9) Torque limit selection (level 1) (function code F42)

Code	List
0	0 : F 4 4 DAT
1	1 : AI ( TL 1 )
2	2 : DIA CRD
3	3 : DIB CRD
4	4 : COMM
5	5 : PID OUT

### 10) Torque limit selection (level 2) (function code F43)

Code	List
0	0 : F 4 5 DAT
1	1 : AI ( TL 2 )
2	2 : DIA CRD
3	3 : DIB CRD
4	4 : COMM
5	5 : PID OUT

### 11) Torque command monitor (function code F51)

Code	List
0	0 : TRQ POR
1	1 : DRV / GEN

12) LED monitor selection  
(function code F55)

Code	List	Code	List
0	00 : SPEED	15	15 : 12 ADJ
1	01 : SPD RF	16	16 : A i 1ADJ
2	02 : FREQ	17	17 : A i 2ADJ
3	03 : TRQ CR	18	18 : A i 3ADJ
4	04 : TRQ RF	19	19 : A i 4ADJ
5	05 : TRQ CL	20	20 : PID RF
6	06 : M PWR	21	21 : PID FB
7	07 : EFT CR	22	22 : PID OU
8	08 : EFT VL	23	23 : OPMON 1
9	09 : DC LNK	24	24 : OPMON 2
10	10 : M FLXR	25	25 : OPMON 3
11	11 : M FLXC	26	26 : OPMON 4
12	12 : M TMP	27	27 : OPMON 5
13	13 : LD SPD	28	28 : OPMON 6
14	14 : LIN SP		

13) LED monitor stop display  
(function code F56)

Code	List
0	0 : REFER
1	1 : DETECT

14) LCD monitor display selection  
(function code F57)

Code	List
0	0 : GUIDANC
1	1 : GRAPH D

15) LCD monitor language selection  
(function code F58)

Code	List
0	0 : JAPANESE
1	1 : ENGLISH
2	2 : GERMANY
3	3 : FRENCH
4	4 : SPANISH
5	5 : ITALIAN
6	6 : CHINESE
7	7 : KOREAN

16) Output unit selection  
(function code F60)

Code	List
0	0 : kW DISP
1	1 : HP DISP

17) Speed limit method selection  
(function code F76)

Code	List
0	0 : +L1 -L2
1	1 : LVL1
2	2 : U - 1 D - 2
3	3 : 12 INPUT

18) Motor selection  
(function code F79)

Code	List
0	0 : M1 CONT
1	1 : M2 SEL
2	2 : M3 SEL

19) Current rating switch  
(function code F80)

Code	List
0	0 : CT
1	1 : VT
2	2 : HT

20) X function selection (function codes E01 to E13)

Code	List	Code	List	Code	List	Code	List
0	00 : SS1	16	16 : CPN2 / 1	32	32 : H42CCL	48	48 : PIDINV
1	01 : SS2	17	17 : UP	33	33 : H43CCL	49	49 : PG - CCL
2	02 : SS4	18	18 : DOWN	34	34 : F40CCL	50	50 : LU - CCL
3	03 : SS8	19	19 : WE - KP	35	35 : TL2 / 1	51	51 : H - TB
4	04 : RT1	20	20 : KP / PID	36	36 : BPS	52	52 : STOP1
5	05 : RT2	21	21 : IVS	37	37 : TB1	53	53 : STOP2
6	06 : HLD	22	22 : IL	38	38 : TB2	54	54 : STOP3
7	07 : BX	23	23 : WE - LK	39	39 : DROOP	55	55 : DIA
8	08 : RST	24	24 : LE	40	40 : ZH - A11	56	56 : DIB
9	09 : THR	25	25 : U - DI	41	41 : ZH - A12	57	57 : MT - CCL
10	10 : JOG	26	26 : STM	42	42 : ZH - A13	58	58 : O - DI1
11	11 : N2 / N1	27	27 : SYC	43	43 : ZH - A14	59	59 : O - DI2
12	12 : M - CH2	28	28 : LOCK	44	44 : REVA11	60	60 : O - DI3
13	13 : M - CH3	29	29 : EXITE	45	45 : REVA12	61	61 : O - DI4
14	14 : DCBRK	30	30 : N - LIM	46	46 : REVA13	62	62 : O - DI5
15	15 : CLR	31	31 : H41CCL	47	47 : REVA14	63	63 : O - DI6



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21) Y function selection (function codes E15 to E27)

Code	List	Code	List	Code	List
0	00:RUN	16	16:SW-M2	32	32:M-OH
1	01:N-EX	17	17:SW-M3	33	33:M-OL
2	02:N-AG	18	18:BRK	34	34:DB-OL
3	03:N-AR	19	19:AL1	35	35:LK-ERR
4	04:N-DT1	20	20:AL2	36	36:ANL
5	05:N-DT2	21	21:AL4	37	37:ANC
6	06:N-DT3	22	22:AL8	38	38:TBH
7	07:LU	23	23:FAN	39	39:O-DO1
8	08:B/D	24	24:TRY	40	40:O-DO2
9	09:TL	25	25:U-DO	41	41:O-DO3
10	10:T-DT1	26	26:INV-OH	42	42:O-DO4
11	11:T-DT2	27	27:SY-C	43	43:O-DO5
12	12:KP	28	28:LIFE	44	44:O-DO6
13	13:STOP	29	29:U-ACC	45	45:O-DO7
14	14:RDY	30	30:U-DEC	46	46:O-DO8
15	15:MF-DT	31	31:INV-OL	47	47:O-DO9

22) PG pulse output selection (function code E29)

Code	List
0	0:1/1
1	1:1/2
2	2:1/4
3	3:1/8
4	4:1/16
5	5:1/32
6	6:1/64
7	7:SPDREF
8	8:PG(PD)
9	9:PG(PR)

23) Ai function selection (function codes E49 to E52)

Code	List	Code	List
0	00:OFF	12	12:M-TMP
1	01:AUX-N1	13	13:N-OR
2	02:AUX-N2	14	14:U-AI
3	03:TLREF1	15	15:PID-FB
4	04:TLREF2	16	16:PID-RF
5	05:TB-REF	17	17:PID-G
6	06:T-REF	18	18:O-AI
7	07:IT-REF		
8	08:CRP-N1		
9	09:CRP-N2		
10	10:MF-REF		
11	11:LINE-N		

24) AO function selection (function codes E69 to E73)

Code	List	Code	List
0	00:N-FB1+	16	16:TMP-M
1	01:N-FB1±	17	17:TMP-I
2	02:N-REF2	18	18:IM-REF
3	03:N-REF4	19	19:IM
4	04:N-FB2±	20	20:MF-REF
5	05:LIN-N±	21	21:MF
6	06:ITREF±	22	22:T
7	07:ITREF+	23	23:IT
8	08:T-REF±	24	24:I-U
9	09:T-REF+	25	25:I-W
10	10:I-AC	26	26:V-U
11	11:V-AC	27	27:V-W
12	12:PWR	28	28:TBL
13	13:V-DC	29	29:TBG
14	14:P10	30	30:U-AO
15	15:N10	31	31:O-AO

25) Multi-step speed setting definition (function code C21)

Code	List
0	0:r/min
1	1:%
2	2:m/min

26) Control method selection (function codes P01, A01)

Code	List
0	0:PG VECT
1	1:SNRLES
2	2:EMULAT
3	3:SM VECT

27-1) Motor selection (function code P02) When F60 = 0 (kW)

Code	List	Code	List
0	0 0 : 0 . 7 5 - 2	19	1 9 : 7 . 5 - 4
1	0 1 : 1 . 5 - 2	20	2 0 : 1 1 - 4
2	0 2 : 2 . 2 - 2	21	2 1 : 1 5 - 4
3	0 3 : 3 . 7 - 2	22	2 2 : 1 8 . 5 - 4
4	0 4 : 5 . 5 - 2	23	2 3 : 2 2 - 4
5	0 5 : 7 . 5 - 2	24	2 4 : 3 0 - 4
6	0 6 : 1 1 - 2	25	2 5 : 3 7 - 4
7	0 7 : 1 5 - 2	26	2 6 : 4 5 - 4 Y
8	0 8 : 1 8 . 5 - 2	27	2 7 : 4 5 - 4 S
9	0 9 : 2 2 - 2	28	2 8 : 5 5 - 4
10	1 0 : 3 0 - 2	29	2 9 : 7 5 - 4
11	1 1 : 3 7 - 2	30	3 0 : 9 0 - 4
12	1 2 : 4 5 - 2 Y	31	3 1 : 1 1 0 - 4
13	1 3 : 4 5 - 2 S	32	3 2 : 1 3 2 - 4
14	1 4 : 5 5 - 2	33	3 3 : 1 6 0 - 4
15	1 5 : 7 5 - 2	34	3 4 : 2 0 0 - 4
16	1 6 : 9 0 - 2	35	3 5 : 2 2 0 - 4
17	1 7 : 3 . 7 - 4	36	3 6 : P - OTR
18	1 8 : 5 . 5 - 4	37	3 7 : OTHER

27-2) Motor selection (function code P02) When F60=1(HP)

Code	List	Code	List
0	0 0 : 1 - 2	19	1 9 : 1 0 - 4
1	0 1 : 2 - 2	20	2 0 : 1 5 - 4
2	0 2 : 3 - 2	21	2 1 : 2 0 - 4
3	0 3 : 5 - 2	22	2 2 : 2 5 - 4
4	0 4 : 7 . 5 - 2	23	2 3 : 3 0 - 4
5	0 5 : 1 0 - 2	24	2 4 : 4 0 - 4
6	0 6 : 1 5 - 2	25	2 5 : 5 0 - 4
7	0 7 : 2 0 - 2	26	2 6 : 6 0 - 4 Y
8	0 8 : 2 5 - 2	27	2 7 : 6 0 - 4 S
9	0 9 : 3 0 - 2	28	2 8 : 7 5 - 4
10	1 0 : 4 0 - 2	29	2 9 : 1 0 0 - 4
11	1 1 : 5 0 - 2	30	3 0 : 1 2 5 - 4
12	1 2 : 6 0 - 2 Y	31	3 1 : 1 5 0 - 4
13	1 3 : 6 0 - 2 S	32	3 2 : 1 7 5 - 4
14	1 4 : 7 5 - 2	33	3 3 : 2 0 0 - 4
15	1 5 : 1 0 0 - 2	34	3 4 : 2 5 0 - 4
16	1 6 : 1 2 5 - 2	35	3 5 : 3 0 0 - 4
17	1 7 : 5 - 4	36	3 6 : P - OTR
18	1 8 : 7 . 5 - 4	37	3 7 : OTHER

28) Thermistor selection (function codes P30, A31, A47)

Code	List
0	0 : UNUSED
1	1 : NTC
2	2 : PTC
3	3 : M - TMP

29) Tuning action selection (function code H01)

Code	List
0	0 : INACTIV
1	1 : ASR - TUN
2	2 : R 1 , L
3	3 : AUT - STP
4	4 : AUT - ROT

30) Cooling fan ON/OFF control (function code H06)

Code	List
0	0 : INACTIV
1	1 : ACTIVE

31) Reverse rotation prevention (function code H08)

Code	List
0	0 : INACTIV
1	1 : ACTIVE

32) Automatic energy-saving operation (function code H10)

Code	List
0	0 : INACTIV
1	1 : ACTIVE

33) Operation command self-retention time (function code H16)

Code	List
0	0 : H 1 7
1	1 : MAX TIME

34) Active drive (function code H19)

Code	List
0	0 : INACTIV
1	1 : ACTIVE

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35) PID control (action selection)  
(function code H20)

Code	List
0	0 : I N A C T I V
1	1 : A C T I V E
2	2 : A C T I N V 1
3	3 : A C T I N V 2

36) PID control (command selection)  
(function code H21)

Code	List
0	0 : K P A D , 1 2
1	1 : P I D - R E F

37) Speed command selection  
(function codes H27)

Code	List
0	0 : I N A C T I V
1	1 : N - R E F
2	2 : N - A U X

38) Link function protection  
(function code H29)

Code	List
0	0 : C H G O K
1	1 : P R O T E C T

39) Link operation  
(function code H30)

Code	List
0	0 : M O N I T O R
1	1 : R E F E R
2	2 : C O M M A N D
3	3 : R E F , C O M

40) Action at RS485 error  
(function code H32)

Code	List
0	0 : E M G S T P
1	1 : S T P L I M
2	2 : S T P E R R
3	3 : D R V C N T

41) RS485 transmission speed  
(function code H34)

Code	List
0	0 : 3 8 4 0 0
1	1 : 1 9 2 0 0
2	2 : 9 6 0 0
3	3 : 4 8 0 0
4	4 : 2 4 0 0

42) RS485 data length selection  
(function code H35)

Code	List
0	0 : 8 B I T S
1	1 : 7 B I T S

43) RS485 parity bit selection  
(function code H36)

Code	List
0	0 : N O N
1	1 : E V E N
2	2 : O D D

44) RS485 stop bit selection  
(function code H37)

Code	List
0	0 : 2 B I T S
1	1 : 1 B I T

45) RS485 protocol selection  
(function code H40)

Code	List
0	0 : F U J I
1	1 : S X ( L D R )
2	2 : R T U

46) Torque command selection  
(function code H41)

Code	List
0	0 : A S R
1	1 : A I - T R E F
2	2 : D I A C R D
3	3 : D I B C R D
4	4 : C O M M
5	5 : P I D O U T

47) Torque current command selection  
(function code H42)

Code	List
0	0 : A S R
1	1 : A I - I T R F
2	2 : D I A C R D
3	3 : D I B C R D
4	4 : C O M M

48) Magnetic flux command selection  
(function code H43)

Code	List
0	0 : I N - C A L C
1	1 : A I - M F R F
2	2 : H 4 4 D A T
3	3 : C O M M

49) Observer method selection  
(function code H46)

Code	List
0	0 : I N A C T I V
1	1 : D I S T U R B
2	2 : V I B R A T

50) Line speed feedback selection  
(function code H53)

Code	List
0	0 : I N A C T I V
1	1 : A I - L I N E
2	2 : D I - P G L D
3	3 : H I S E L

51) Overvoltage suppression function  
(function code H57)

Code	List
0	0 : I N A C T I V
1	1 : A C T I V E

52) Overcurrent suppression function  
(function code H58)

Code	List
0	0 : I N A C T I V
1	1 : A C T I V E

53) Load adaptive control function  
definition 1 (function code H60)

Code	List
0	0 : I N A C T I V
1	1 : M E T H O D 1
2	2 : M E T H O D 2
3	3 : M E T H O D 3

54) Load adaptive control function definition 2  
(function code H61)

Code	List
0	0 : F W D - U P
1	1 : F W D - D W N

55) For manufacturer  
(function code H71)

Code	List
0	0 : I N A C T I V
1	1 : A C R - T U N
2	2 : V G A I N - T
3	3 : V O F F S T
4	4 : I - U M B L C
5	5 : P O L E - T U
6	6 : I G A I N

56) DIA, DIB (function selection)  
(function code o01, o02)

Code	List
0	0 : B I N A R Y
1	1 : B C D

57) Feedback pulse selection  
(function code o05)

Code	List
0	0 : B U I L T I N
1	1 : P G ( P D )

58) Command pulse selection  
(function code o12)

Code	List
0	0 : P G ( P R )
1	1 : N - R E F

59) Pulse string input style selection  
(function code o13)

Code	List
0	0 : 9 0 P H A S E
1	1 : R E F , + -
2	2 : F W D R E V

60) Action at transmission error  
(function code o30)

Code	List
0	0 : E M G S T P
1	1 : S T P L I M
2	2 : S T P E R R
3	3 : D R V C N T

61) Transmission format  
(function code o32)

Code	List
0	0 : 4 W + 4 W
1	1 : 8 W + 8 W

62) Multi-winding system  
(function code o33)

Code	List
0	0 : I N A C T I V
1	1 : A C T I V E

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63) UPAC function  
(function code o38)

Code	List
0	0 : I N A C T I V
1	1 : A C T I V E
2	2 : A C T - I N I

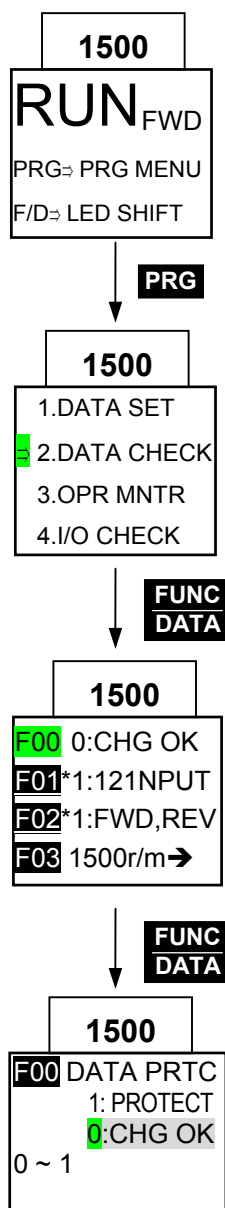
64) Fixed S-curve pattern  
(function code L04)

Code	List
0	0 : I N A C T I V
1	1 : M E T H O D 1
2	2 : M E T H O D 2

65) Creepless floor arrival function used/not used  
(function code L15)

Code	List
0	0 : I N A C T I V
1	1 : M E T H O D 1

## 5.4.7 Checking the Function Code Settings



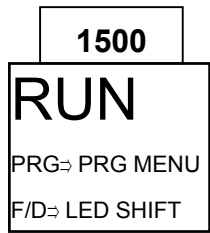
Press the **PRG** key with the operation mode screen to call the menu screen. Move the arrow at the left of the screen to “2. CHECK DATA” using the **▲** or **▼** key. Press the **FUNC DATA** key to call a list of function codes and their settings to the LCD.

Select the function code which is to be checked using the **▲** or **▼** key with the same procedure as described in 5.4.6 “Function Code Setting Procedure”.

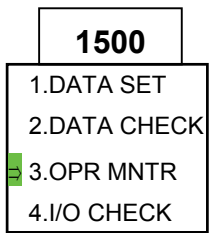
Select a function code and change its setting. Press the **FUNC DATA** key to store the new value as you do on the function code setting screen.

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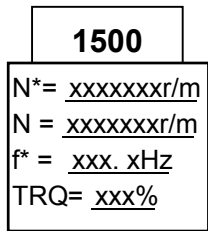
## 5.4.8 Operation Status Monitor



PRG



FUNC  
DATA



LED monitor (The latest alarm code blinks quickly when an alarm is issued.)

Speed command value (Speed setting 4 is indicated.)

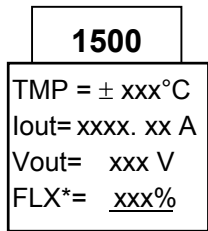
Speed detection value

Reference output frequency

Reference torque (The first decimal place is rounded.)

The second decimal place is rounded to the first decimal place. If the absolute value is 10,000 or larger, the first decimal place is rounded.

∇



Motor temperature (“---” appears with NTC thermistor not connected)

Detected output current

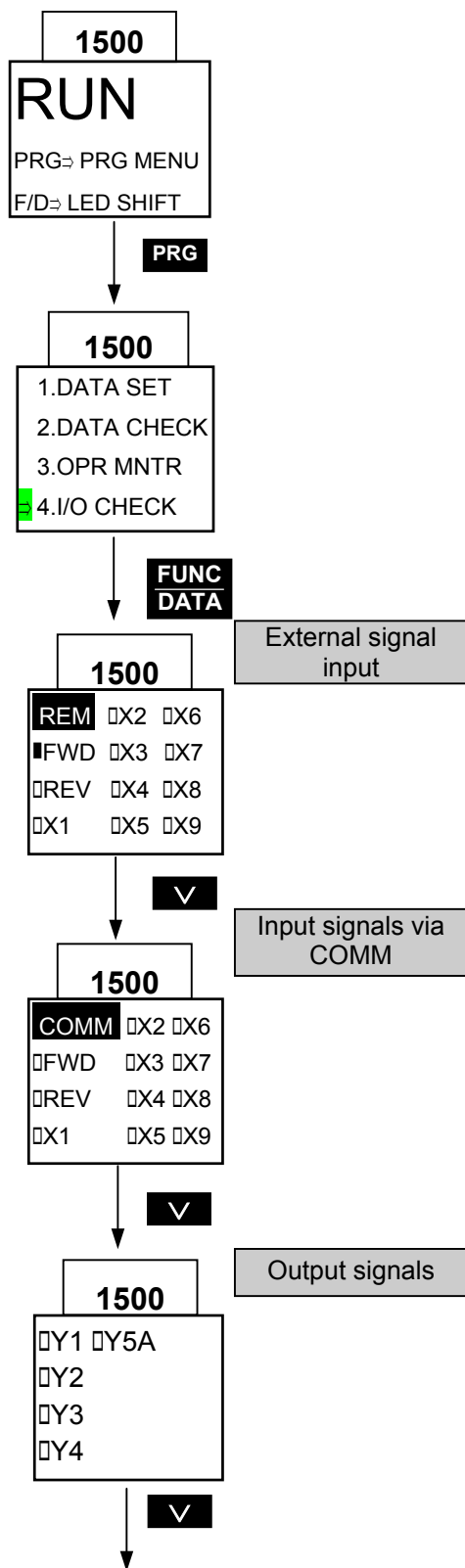
Detected output voltage

Reference flux value

Press the **PRG** key with the operation mode screen to call the menu screen. Move the arrow at the left of the screen to “3. MONITOR” using the **∧** or **∇** key. Press the **FUNC DATA** key to check the current inverter operation status on the LCD.

There are two operation status monitor screens. Press the **∧** or **∇** key to call the other screen.

## 5.4.9 I/O Check



Press the **PRG** key with the operation mode screen to call the menu screen. Move the arrow at the left of the screen to "4. I/O CHECK" using the **^** or **v** key. Press the **FUNC DATA** to check the status of inverter and optional analog input/output and digital input/output units on the LCD.

There are sixteen I/O check screens. Press the **^** or **v** key to call the previous or next screen. The I/O status of each optional unit is only indicated when the optional unit is mounted.

This screen is used to check input signals to the terminal block (REM).

□ : Signal off , ■ : Signal on

This screen is used to check input signals via the link (COMM).

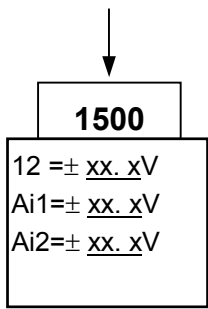
□ : Signal off , ■ : Signal on

This screen is used to check the on/off status of the functions assigned to Y1 to Y5A.

□ : Signal off , ■ : Signal on



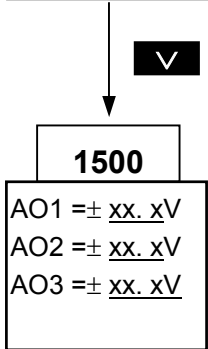
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Analog input signals (AI)

This screen is used to check analog input voltages to the terminal block (−10.0 to +10.0 V).

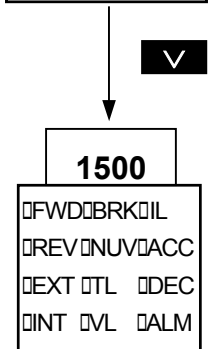
- [1] Analog input signal (12)
- [2] Analog input signal (Ai1)
- [3] Analog input signal (Ai2)
- [4] Not used



Analog output status (AO)

This screen is used to check the status of the functions assigned to analog output terminals (−10.0 to +10.0 V).

- [1] Analog output signal (AO1)
- [2] Analog output signal (AO2)
- [3] Analog output signal (AO3)
- [4] Not used

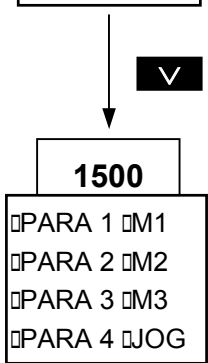


Operation status

This screen is used to check the inverter operation status.

□ : Signal off , ■ : Signal on

- |                        |  |
|------------------------|--|
| FWD: Forward operation | REV: Reverse operation   |
| EXT: Pre-exciting      | INT: Inverter shut off   |
| BRK: Braking           | NUV: DC link circuit voltage established (ready for operation) |
| TL: Torque limiting    | VL: Voltage limiting   |
| IL: Current limiting   | ACC: Accelerating  |
| DEC: Decelerating      | ALM: Alarm output (for any fault)                              |

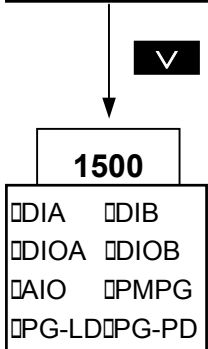


Effective sets of motors/parameters

Indicates currently effective sets.

□ : Signal off , ■ : Signal on

- PARA 1 (F07, F08, and F61 to F70) JOG (C30 to C38)
- PARA 2 (C40 to C49)
- PARA 3 (C50 to C59)
- PARA 4 (C60 to C69)
- M1 (F03 to F05, F10 to F12, and P codes)
- M2 (A01 to A34)
- M3 (A35 to A50)

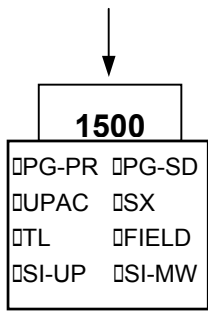


Status of optional I/O units

Indicates the status of optional I/O units.

□ : Signal off , ■ : Signal on

- DIA, DIB (OPC-VG7-DIA, DIB)
- DIOA, DIOB (OPC-VG7-DIOA, DIOB)
- AIO (OPC-VG7-AIO)
- PMPG (OPC-VG7-PMPG)
- PG-LD, PD (OPC-VG7-PG)



Status of optional I/O communication units

Indicates the status of optional I/O communication units.

: Signal off ,  : Signal on

PG-PR, SD (OPC-VG7-PG)

UPAC (OPC-VG7-UPAC)

SX (OPC-VG7-SX)

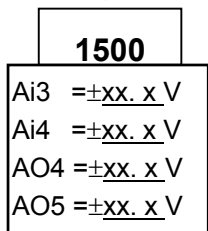
TL (OPC-VG7-TL)

FIELD (optional field bus)

SI-UP, MW (OPC-VG7-SI)



\* The following information is indicated when the optional AIO unit is mounted.



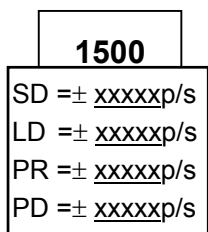
I/O status of optional AIO unit

[1] I/O status 1 of AIO (Ai3) ... “---” appears with AIO not connected.

[2] I/O status 1 of AIO (Ai4) ... “---” appears with AIO not connected.

[3] I/O status 2 of AIO (AO4) ... “---” appears with AIO not connected.

[4] I/O status 2 of AIO (AO5) ... “---” appears with AIO not connected.



Input status of inverter/optional PG (SD, LD, PR, and PD)

[1] Input status of inverter/PG (SD) signal; Open collector: Phase A/B x4 frequency, SD: line driver phase A/B

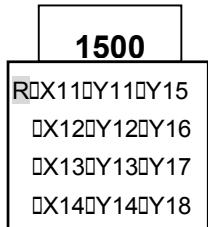
[2] Input status of PG (LD) signal ... “---” appears with PG (LD) not connected.

[3] Input status of PG (PR) signal ... “---” appears with PG (PR) not connected.

[4] Input status of PG (PD) signal ... “---” appears with PG (PD) not connected.



\* The following information is indicated when the optional DIOA unit is mounted.

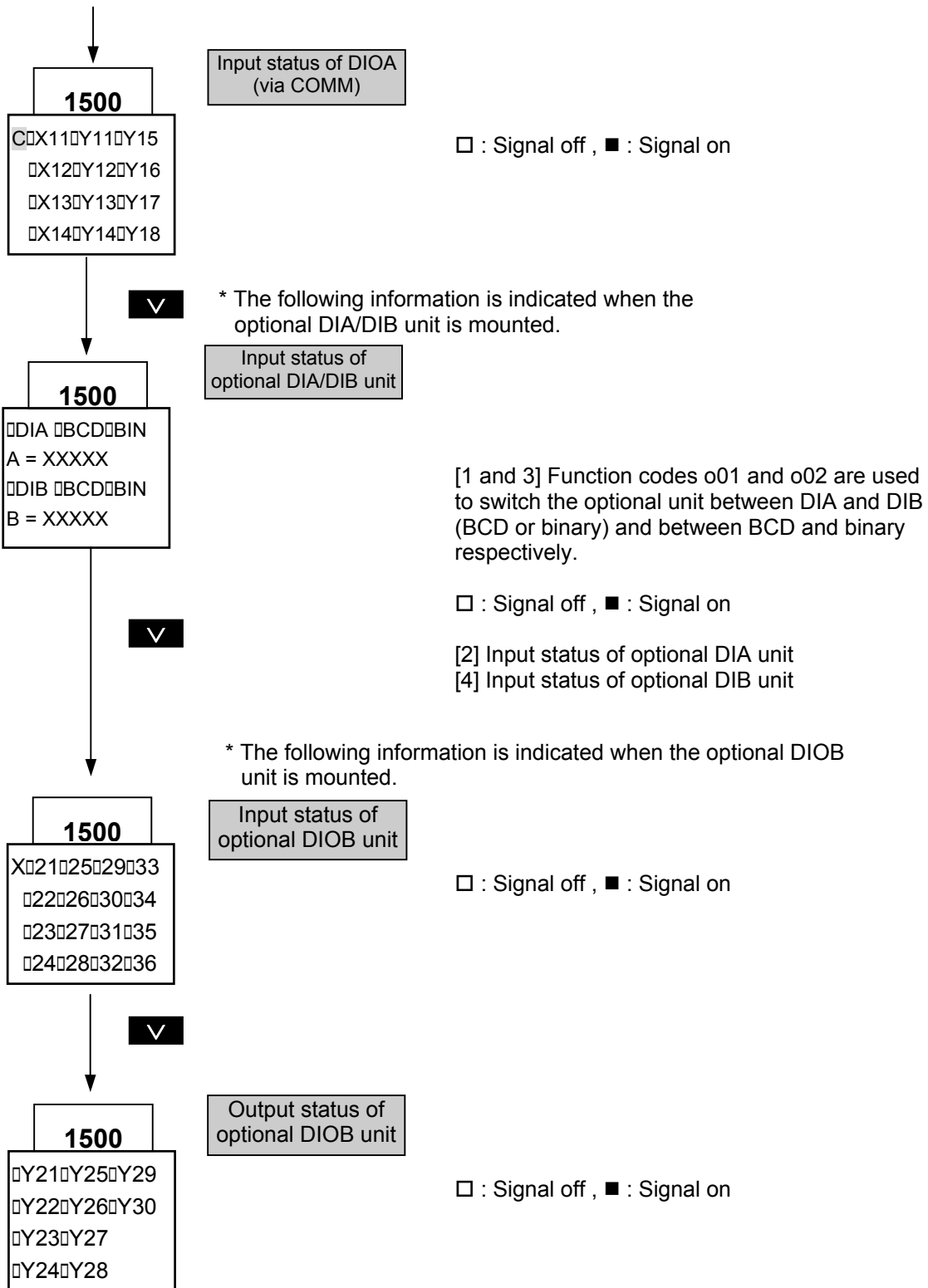


Input status of optional DIOA unit

: Signal off ,  : Signal on



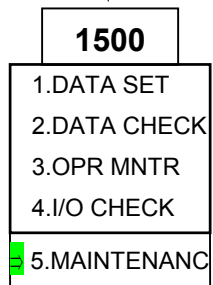
# 5. KEYPAD Panel



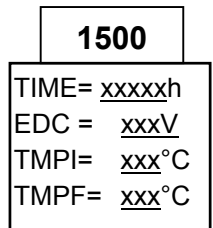
## 5.4.10 Maintenance Information



Press the **PRG** key with the operation mode screen to call the menu screen. Move the arrow at the left of the screen to "5. MAINTENANCE INFO" using the **^** or **v** key. Press the **FUNC DATA** key to call the information necessary for maintenance and inspection on the LCD.

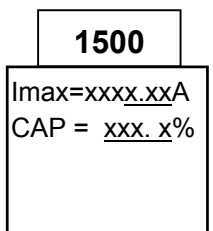


There are five maintenance information screen. Press the **^** or **v** key to call the previous or next screen.



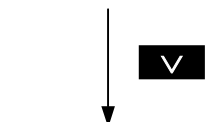
Operation status  
1

- [1] Cumulative operation hours
- [2] Detected DC link circuit voltage
- [3] Maximum inverter inside air temperature (within an hour)
- [4] Maximum heat sink temperature (within an hour)

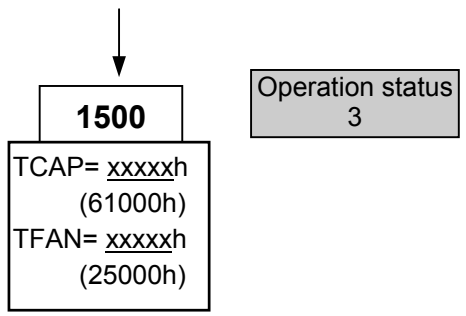


Operation status  
2

- [1] Maximum effective current (within an hour)
- [2] Main capacitor capacity

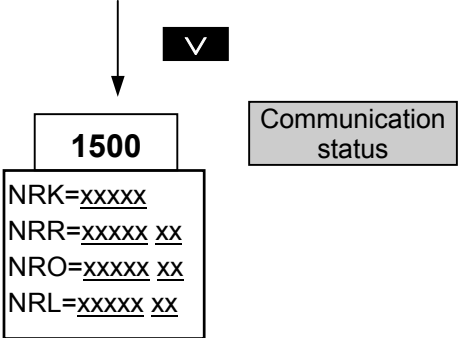


# 5. KEYPAD Panel



Operation status  
3

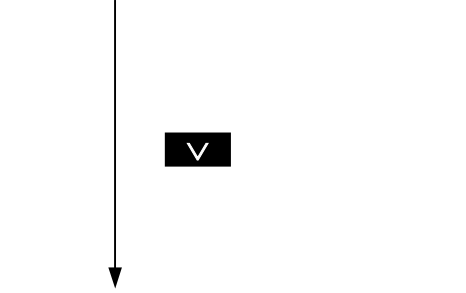
- [1] Cumulative operation hours of capacitor on PC board
- [2] Estimated remaining life of capacitor on PC board (fixed)
- [3] Cooling fan operation hours
- [4] Estimated remaining life of cooling fan (fixed)



Communication status

This screen indicates the number of communication errors that have occurred with each unit and the code representing the cause of the latest error. For details of codes, see the description of each optional unit or RS485.

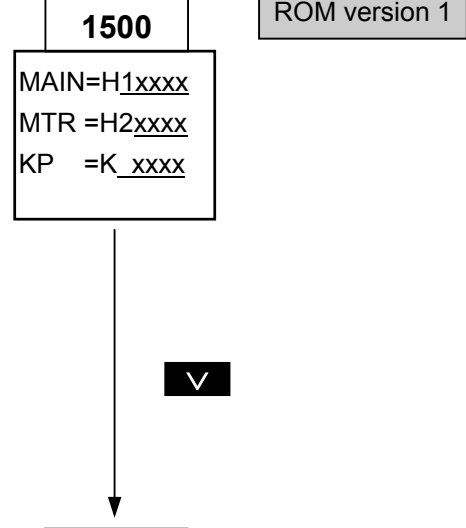
- [1] Number of communication retries for KEYPAD
  - [2] Number of communication retries and latest error code for RS-485
  - [3] Number of communication retries and latest error code for T-Link/SX
  - [4] Number of communication retries and latest error code for optional SI/RS unit
- Numbers of communication errors detected by the inverter. “--” appears when no error has occurred.



ROM version 1

The screen indicates the ROM number of the inverter control CPU. Fuji Electric may ask the ROM version in case of a malfunction.

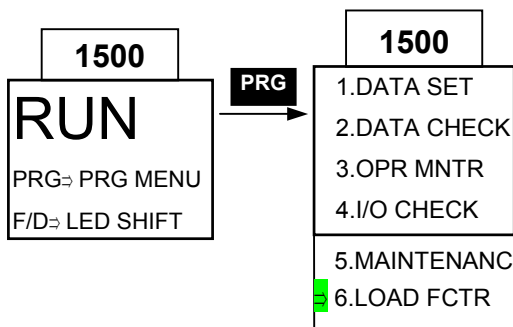
- [1] ROM version of main control CPU (MAIN)
- [2] ROM version of motor control CPU (MTR)
- [3] ROM version of KEYPAD
- [4] Not used



ROM version 2

- [1] ROM version: 8-bit BUS option CPU (OP1)  
... “----” if the option is not installed.
- [2] ROM version: 8-bit BUS option CPU (OP2)  
... “----” if the option is not installed.
- [3] ROM version: UPAC firmware (UPAC)  
... “----” if the option is not installed.

## 5.4.11 Measurement of Load Factor



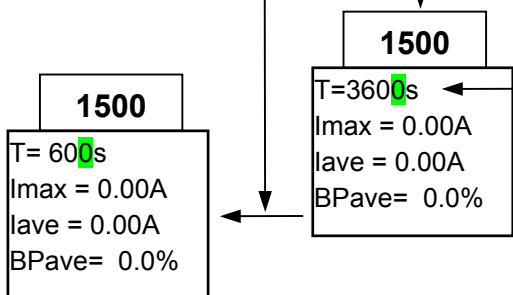
Press the **PRG** key with the operation mode screen shown on the KEYPAD to call the menu screen. Move the arrow at the left of the screen to "6. MEASURE LOAD FACTOR" using the **▲** or **▼** key. Press the **FUNC DATA** key to call the load factor measurement screen on the LCD.

The load factor measurement screen indicates the measured maximum current, average current, and average braking power within a preset period.

Change the measurement period using **▲**, **▼**, and **➡**.

Set measurement period

(Measure maximum and average currents and average braking power within 600 seconds.)

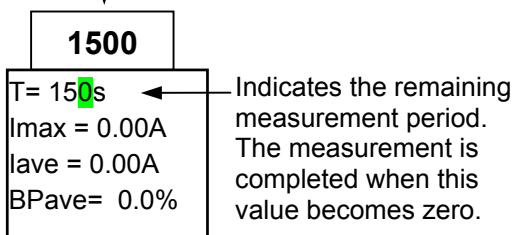


Measurement period

The cursor resides at the last digit of the measurement period. You can change the value at the place where the cursor resides. Press the **➡** key to move the cursor.

Start measurement

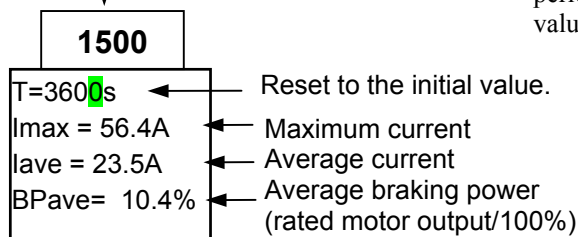
FUNC DATA



Indicates the remaining measurement period. The measurement is completed when this value becomes zero.

Press the **FUNC DATA** key to start the measurement of the load factor. The indicated measurement period is gradually decremented after this key is pressed. The measurement is completed when this value becomes zero.

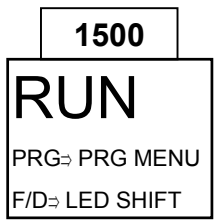
After the measurement is completed, the measurement period is reset to the initial value and the measured values are indicated.



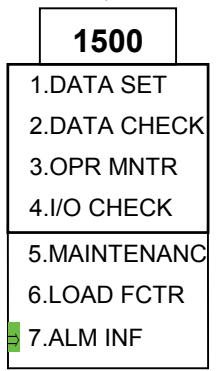
Reset to the initial value.  
 Maximum current  
 Average current  
 Average braking power (rated motor output/100%)

# 5. KEYPAD Panel

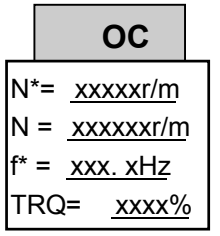
## 5.4.12 Alarm Information



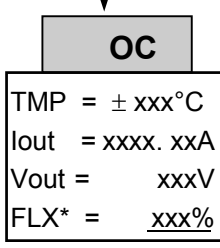
**PRG**



**FUNC DATA**



**∇**



**∇**

Press the **PRG** key with the operation mode screen shown on the KEYPAD to call the menu screen. Move the arrow at the left of the screen to "7. ALARM INFO" using the **∧** or **∇** key. Press the **FUNC DATA** key to indicate the various operation status upon the occurrence of the last alarm on the LCD.

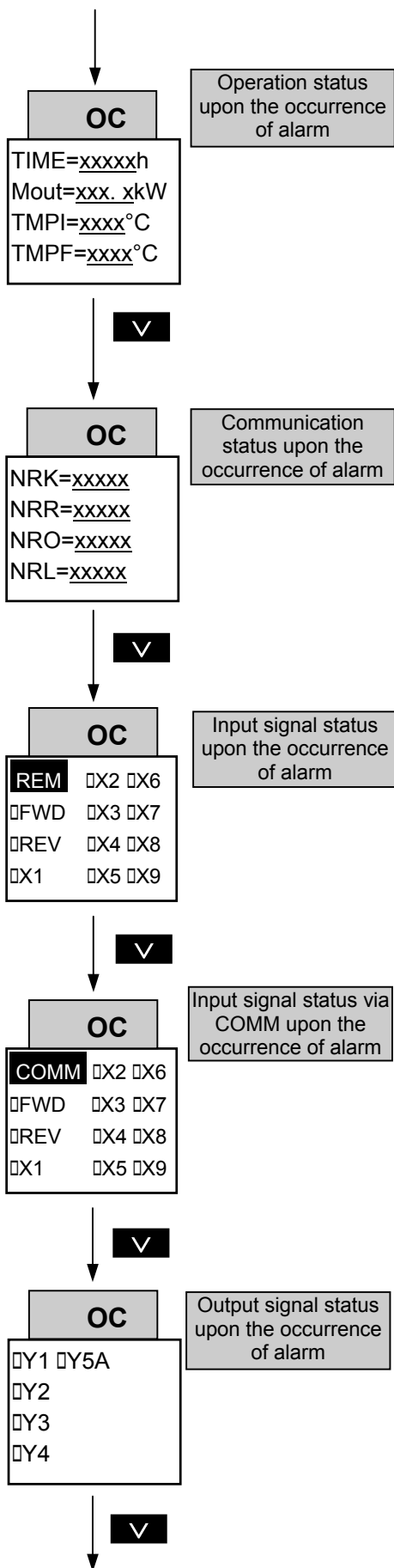
There are eleven alarm information screens. Press the **∧** or **∇** key to call the previous or next screen.

Operation status 1 upon the occurrence of alarm

- [1] Speed setting 4 upon the occurrence of alarm
  - [2] Detected speed 1 upon the occurrence of alarm
  - [3] Reference output frequency upon the occurrence of alarm
  - [4] Reference torque upon the occurrence of alarm
- The value is rounded to the first decimal place. If the absolute value of the detected speed is 10,000 or larger, the value is rounded to an integer.

Operation status 2 upon the occurrence of alarm

- [1] Motor temperature upon the occurrence of alarm ("---" appears with NTC not connected)
- [2] Detected output current upon the occurrence of alarm
- [3] Detected output voltage upon the occurrence of alarm
- [4] Reference magnetic-flux value upon the occurrence of alarm



- [1] Cumulative operation hours upon the occurrence of alarm
  - [2] Reference motor output (in kW or HP) upon the occurrence of alarm..... kW or HP can be selected with code F60.
  - [3] Inverter inside air temperature upon the occurrence of alarm
  - [4] Heat sink temperature upon the occurrence of alarm
- Temperatures measured when the alarm was detected

- [1] Number of communication retries for KEYPAD upon the occurrence of alarm
  - [2] Number of communication retries for RS-485 upon the occurrence of alarm
  - [3] Number of communication retries for T-Link/SX upon the occurrence of alarm
  - [4] Number of communication retries for optional SI/RS unit upon the occurrence of alarm
- Numbers of communication errors detected by the inverter

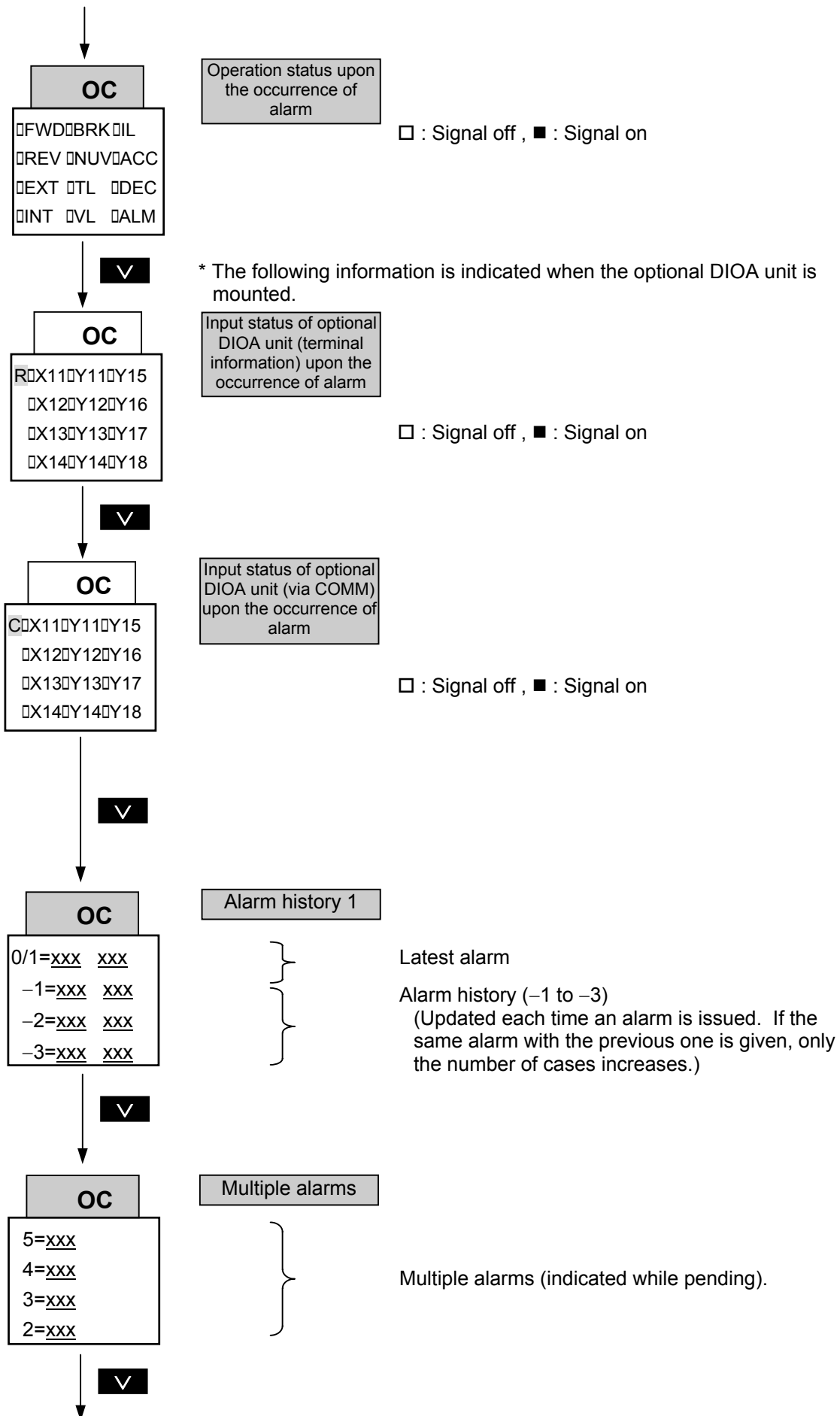
□ : Signal off , ■ : Signal on

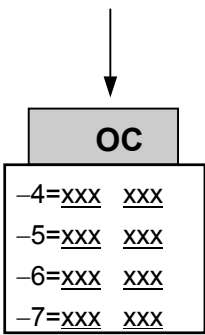
□ : Signal off , ■ : Signal on

□ : Signal off , ■ : Signal on



# 5. KEYPAD Panel





Alarm history 2

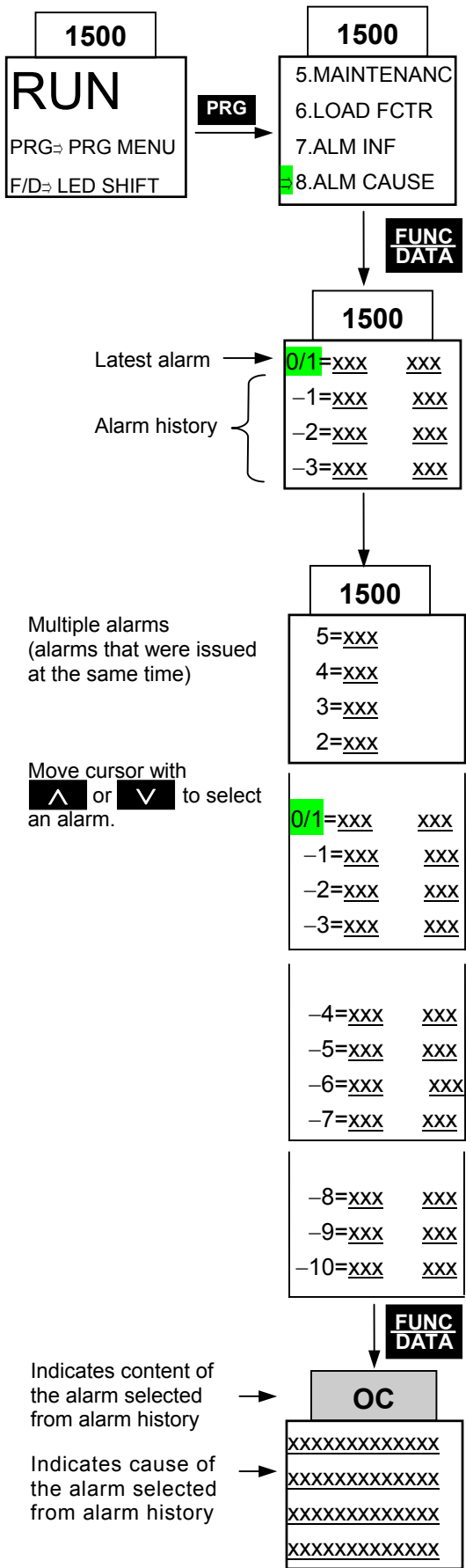
Alarm history (-4 to -7)  
 (Updated each time an alarm is issued. If the same alarm with the previous one is given, only the number of cases increases.)

Alarm history 3

Alarm history (-8 to -10)  
 (Updated each time an alarm is issued. If the same alarm with the previous one is given, only the number of cases increases.)

# 5. KEYPAD Panel

## 5.4.13 Alarm History and Causes

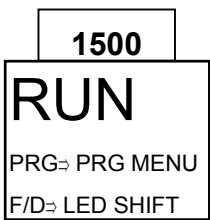


Press the **PRG** key with the operation mode screen shown on the KEYPAD to call the menu screen. Move the arrow at the left of the screen to "8. ALARM CAUSES" using the **^** or **v** key. Press the **FUNC DATA** key to call the alarm history on the LCD.

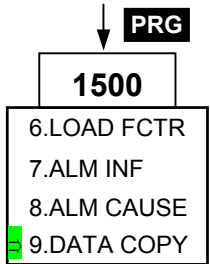
Press the **^** or **v** key to select an alarm the information of which is to be checked. Press the **FUNC DATA** key to call the troubleshooting information for the selected alarm.

If all the information for the selected alarm is not shown on the screen at a time, scroll over the descriptive information using the **^** and **v** keys.

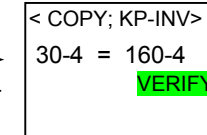
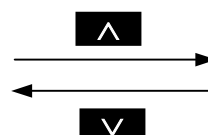
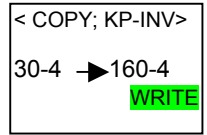
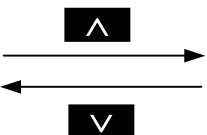
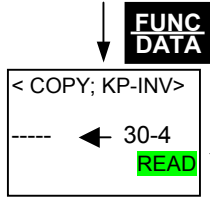
## 5.4.14 Copying Data



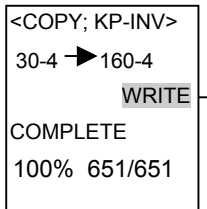
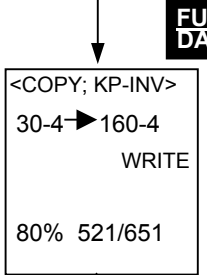
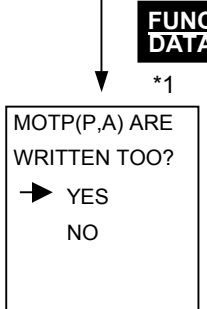
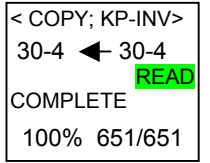
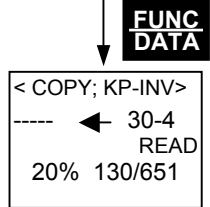
Press the **PRG** key with the operation mode screen shown on the KEYPAD to call the menu screen. Move the arrow at the left of the screen to '9. COPY DATA' using the **^** or **v** key. Press the **FUNC DATA** key to call the copy mode screen on the LCD.



You can select the read, write, or verify mode on the copy mode screen using the **^** or **v** key.



Only read mode can be selected with EEPROM data ineffective.



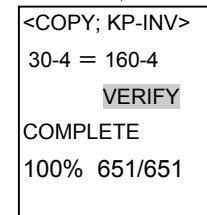
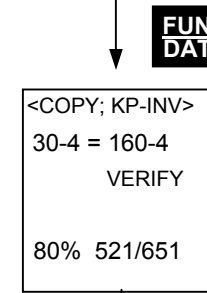
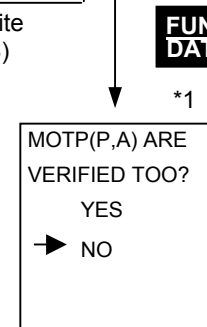
**FUNC DATA**

**FUNC DATA**

**FUNC DATA**

From write mode (B)

To verify mode (B)



**FUNC DATA**

**FUNC DATA**

## 5. KEYPAD Panel

---

Copy data with the following procedure.

- 1) Download the function code settings to the KEYPAD panel.
- 2) Remove the KEYPAD panel from the inverter.
- 3) Mount the KEYPAD panel to another inverter.
- 4) Upload the function code settings to the inverter.

The verify mode is used to check the consistency between the data stored in the KEYPAD panel and those in the inverter.

- \* If “YES” is selected, the following function codes are written (or verified), too.  
F03 to F05, F10 to F12, all P codes and all Acodes

---

## Data copy errors

### (1) Writing disabled during operation

If an attempt is made to upload data to a running inverter or start the inverter during an uploading process, an error message appears as shown on the right.

Stop the inverter, press **RESET**, and try to upload again.

During operation

```
< COPY; KP-INV>
30-2 → 160-4
WRITE
INV RUNNING
```

Press RESET or PRG to quit.

### (2) Memory error

If an attempt is made to upload without downloading data to the KEYPAD memory (with the memory empty) or upload data to an inverter with a different capacity, model, or voltage class from the inverter from which the data was downloaded, an error message appears as shown on the right.

EEPROM check sum error

```
< COPY; KP-INV>
55-4 → 160-4
WRITE
MEMORY ERROR
```

Press RESET or PRG to quit.

### (3) Verification error

If the data stored in the KEYPAD memory is found by the data check (verification) to be inconsistent from that stored in the inverter, the relevant function code and error code appear. The data check is interrupted.

Press **FUNC DATA** to resume the data check and check for other inconsistencies or **RESET** to exit the verify mode and proceed to another process.

Error found in write/verify mode

```
< COPY; KP-INV>
55-4 → 160-4
WRITE
ERR:F25
```

Press F/D to continue or RESET or PRG to quit

### (4) Data protection

If data protection is set, using F00, or if the P02 setting is other than “37: OTHER,” the screen shown on the right is displayed. To write, follow the procedure below.

- Change F00 to accept data changes.
- Change P02 to “37: OTHER.”

Data protection with F00

```
< COPY; KP-INV>
30-2 → 160-4
WRITE
DATA PRTC
```

RESET, PRG: interrupted

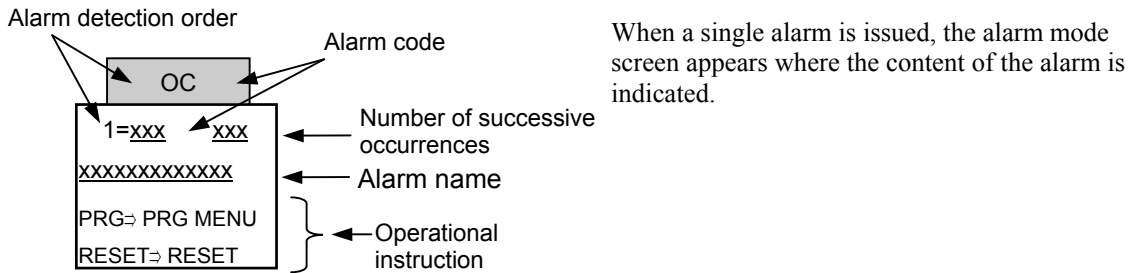
Data protection

```
< COPY; KP-INV>
30-2 → 160-4
WRITE
DATA PRTC: F04
```

F/D: continued. RESET, PRG: interrupted

# 5. KEYPAD Panel

## 5.4.15 Alarm Mode



When multiple alarms are issued at the same time, the contents of the alarms can be checked using the **▲** and **▼** keys.

Table 5-4-4 Alarm Detection Order

Operating keys	LED display	LCD display	Content
<div style="display: flex; justify-content: space-around;"> <span>▲</span> <span>▼</span> </div> <div style="margin-top: 10px;"> <span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; margin-right: 5px;"></span> ↑           <span style="display: inline-block; width: 10px; height: 10px; border: 1px solid black; margin-left: 10px; margin-right: 5px;"></span> ↓         </div>	5.	5	Alarm No. 5
	4.	4	Alarm No. 4
	3.	3	Alarm No. 3
	2.	2	Alarm No. 2
	1.	1	Alarm No. 1 (multiple alarms)
	Blank	0	Latest alarm (single alarm/already reset)
	Blank	-1	1st latest alarm
	Blank	-2	2nd latest alarm
	Blank	-3	3rd latest alarm
	Blank	-4	4th latest alarm
Blank	-5	5th latest alarm	
Blank	-6	6th latest alarm	
Blank	-7	7th latest alarm	
Blank	-8	8th latest alarm	
Blank	-9	9th latest alarm	
Blank	-10	10th latest alarm	

- The information given by the LCD and LED when multiple alarms are issued at the same time is different from that given when a single alarm is issued.
  - When multiple alarms are issued, the information about alarm No. 1 is given.
  - When a single alarm is issued, the information about the latest alarm is given.
- When multiple alarms are issued, only alarm No. 1 is recorded in the alarm history. No. 2 and subsequent ones are not recorded.
- When a single alarm is issued, the latest alarm is recorded in the alarm history.

**THE INVERTER**

**VI**

## **VI. Standard Interface RS-485**

- 6.1 Overview**
- 6.2 Common Specifications**
- 6.3 FUJI General Purpose Communication**
- 6.4 Modbus RTU**
- 6.5 How to Use PC Loader  
(Loader command protocol)**



# 6. Standard Interface RS485

---

## 6.1 Overview

---

The FRENIC5000VG7S has an integrated RS485 communication system. You can use this communication system to connect the inverter unit serially with a host device (master) such as a personal computer or a PLC and to enable the host device to operate, to stop, or to monitor the inverter or to change the function codes of the inverter.

The following three types of communication protocols are available. Select a protocol according to your application or for your convenience.

You can use the function code H40 "Protocol selection" to select a protocol.

### FGI (FUJI General Purpose Inverter Protocol)

FGI is a protocol supported by the FUJI G, P, and E series inverters. This protocol is convenient for multidrop connection with these inverters and the VG7S's as slaves.

### SX Protocol

This is a protocol to use the FRENIC5000VG7S support loader, a personal computer software operating on the Microsoft Windows. This protocol uses a number of special commands to make best use of the functions and the performance of the support loader. This protocol is not open to users and you should use them only when you use the support loader.

### Modbus RTU

Modicon has specified this protocol to link their PLC's together or their PLC and other slave devices (such as inverters) over network.

Though the standard Modbus Protocol supports RTU transmission mode and ASCII transmission mode, the VG7S supports only the RTU that has higher transmission density.

Though the standard integrated RS485 communication hardware has a full duplex connector connection, the communication protocol is half duplex procedure that repeats request and response. Since the internal hardware of the inverter supports half duplex, a half duplex connection outside of the inverter is available. Note that when you use the UPAC option, since the internal connection between the UPAC and the VG7S is multidrop and the UPAC only supports full duplex communication, the external half duplex communication is not available. As well, in case of connection to two or more inverters using the inverter support loader (SX protocol), half-duplex connection with external devices is impossible.

In general, the driver/receiver circuits of RS485 are balance circuits. The "balance" means a positive signal and a negative signal (combination of TX+ and TX- or RX+ and RX-) have equal status. These circuits will have a strong anti-noise characteristic when you combine the circuits with balance cables (twisted pair cables with shield).

Inverters are source of noise. Master instrumentation devices (personal computers and PLC's) and isolated converters (RS485/RS485, RS232C/RS485) may malfunction. If this is the case, you need the measures against abnormal communication described in this section.

You can select an action if the communication line is disconnected or an error occurs when you direct an operation command via the RS485 communication. When a communication error occurs during operation, the Er5 alarm (RS485 alarm) will be released after an action you select. After the alarm, the inverter will shut off its output and coast to stop.

The RS485 communication utilizing the option OPC-VG7-RS (simplified inter-inverter link) is dedicated for an inter-inverter link with the UPAC as a master or for the POD connection. No part of the description in this section is applicable to that case. See the sections for the control options.

## 6.2 Common Specifications

### 6.2.1 Specifications

Item		Specification				
Communications	Slave side specifications					
	Communication protocol	SX protocol	Modbus RTU	FUJI general purpose inverter protocol		
	Compliant with	Special commands dedicated to support loader (not open to user)	Modicon Modbus RTU	FUJI general purpose inverter protocol		
	Applicable to	FRENIC5000VG7S	FUJI general purpose inverter (E9, 11 series UN) FRENIC5000VG7S	FUJI general purpose inverter (11 series) FRENIC5000VG7S		
	Protocol selection	Function code H40="1"	Function code H40="2"	Function code H40="0"		
	Message type	Command message	RTU (Remote Terminal Unit) mode ASCII mode is not supported Query, Broadcast message	Polling/selecting Broadcast		
	Electric specification	EIA RS485				
	Communication rate	2,400, 4,800, 9,600, 19,200, 38,400bps		2,400, 4,800, 9,600, 19,200bps		
	Synchronization type	Asynchronous (UART)				
	Transmission type	Half duplex				
	Communication form	Direct connection to inverter, 1:N (1≤N≤31)				
	Character type	HEX		ASCII 7 bits		
	Data length	8 bits fixed <sup>*3)</sup>	8 bits fixed <sup>*2)</sup>			
	Stop bit	1 bit fixed <sup>*3)</sup>	2 bits <sup>*2)</sup>	1 bit <sup>*2)</sup>	H35 data length setting Seven bits or eight bits	
	Parity	Even parity fixed <sup>*3)</sup>	No parity	Even parity	Odd parity	H36 parity setting No, even, or odd parity
	Error check type	Checksum (one byte BCC)	CRC-16 Generation polynomial: $X^{16}+X^{15}+X^2+1$		Checksum (2-byte BCC)	
	Station number selection	1 to 255: Station number	0: Broadcast 1 to 247: Station number	99: Broadcast <sup>*1)</sup> 1 to 31: Station number		
	Frame length	Variable length	Variable length		Standard transmission: 16-byte fixed length High-speed transmission: 8-, 12-byte fixed length	
	Maximum transmission data (per one message)	Write: 16 words Read: 99 words	Write: 16 words Read: 99 words		1 word	
	Disconnection detection time	H38 (Time out) sets disconnection detection time. This function is effective only during RS485 operation.				
Wiring length	Non-isolated: 10m max Isolated: 500m max <ul style="list-style-type: none"> <li>Use a commercial 485/485 isolator (repeater) or a 485/232C isolated converter for isolation.</li> <li>An inverter may be a source of noise. Use a converter superior in anti-noise capability.</li> </ul> Recommended converter: System Sacom KS-485PTI					

\*1) The broadcast is available only for S01 to S12. You cannot broadcast other function codes.

\*2) In case of the RTU protocol, the stop bit is automatically selected according to the parity selection setting (H36 parity setting), and therefore there is no need to specify H37 stop bit. As well because the data length is fixed at 8 bits, there is no need to specify H35 data length.

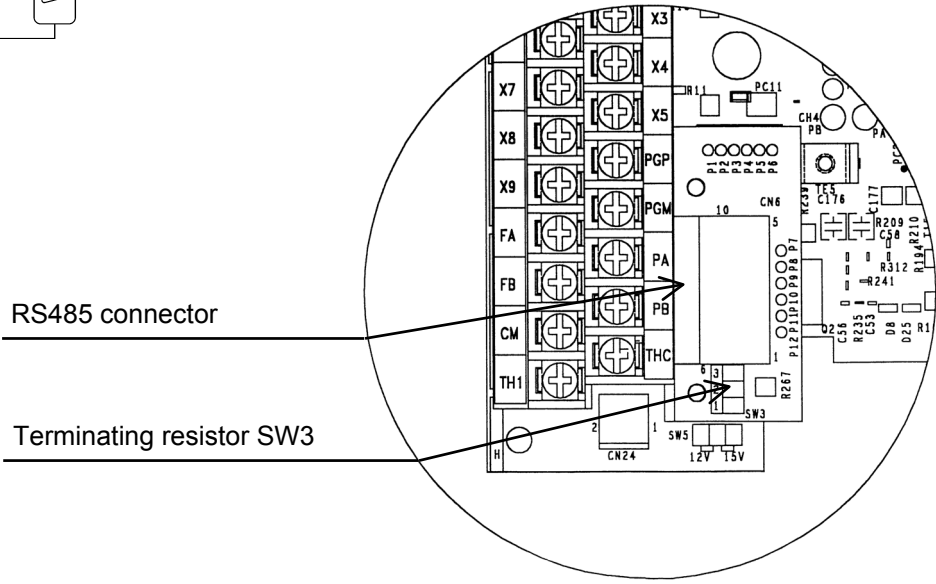
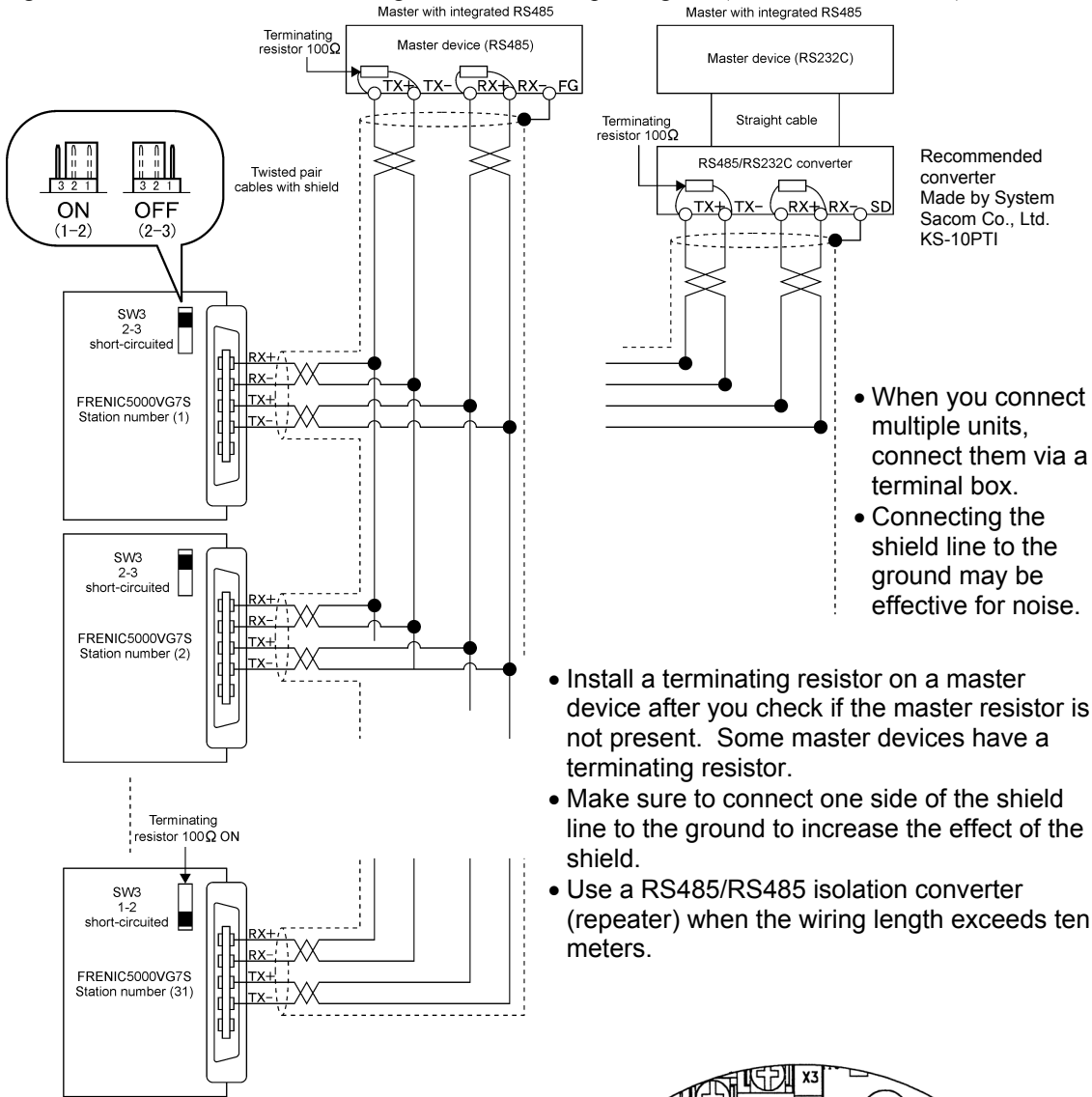
\*3) In case of the SX protocol, the data length, stop bit and parity are fixed, and therefore there is no need to change the H35 to H37 settings.

# 6. Standard Interface RS485

## 6.2.2 Basic Wiring Diagram

### (1) Full duplex wiring diagram

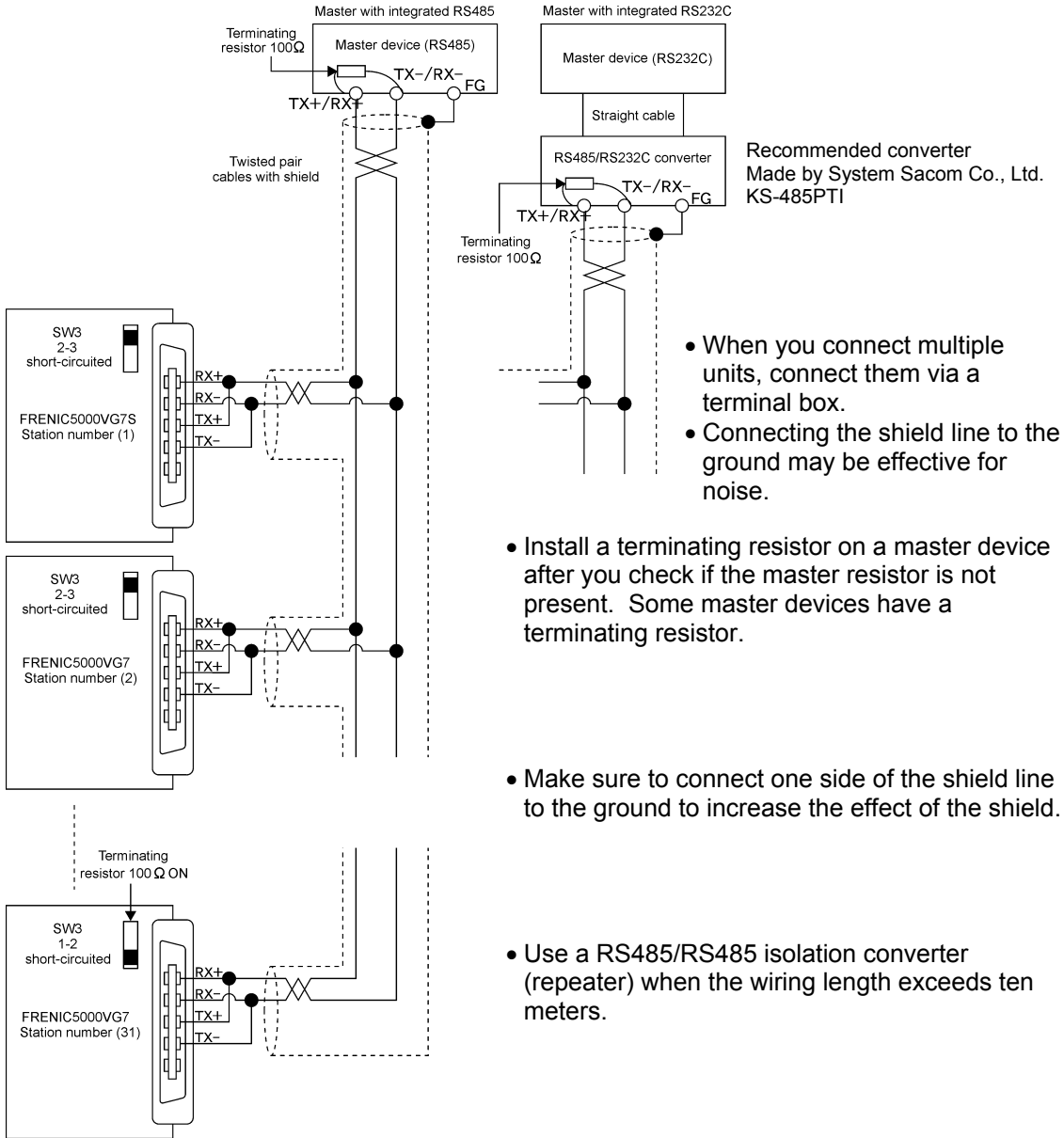
This wiring diagram describes a case when you select a separate transmission signal and a reception signal. The VG7S connector has assignments for full duplex signals (TX+, TX-, RX+, RX-).



Locations on the control print circuit board

## (2) Half duplex wiring diagram

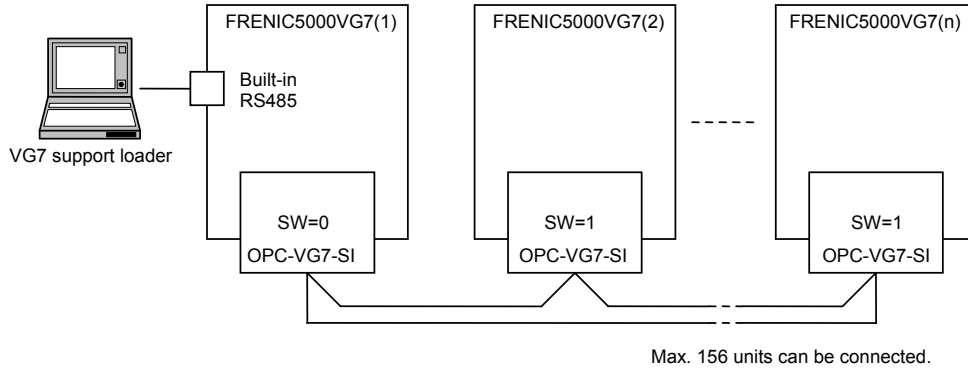
This wiring diagram describes a case when you use common lines serving both for a transmission signal and a reception signal. Since the VG7S connector has assignments for full duplex signals (TX+, TX-, RX+, RX-), you should short-circuit lines from the VG7S connector as described in the diagram.



## 6. Standard Interface RS485

### (3) Example of connection using optical communication

This is a connection example using the OPC-VG7-SI option. Using this option, an optical link can be established, instead of RS485 multi-drop.



- At inverter 1, data monitoring and change, trace, turning and other operations can be made.
- At inverter 2 and the following inverters, the function data (F, E, C, P, H, A, o, L and U) of the inverter connected via the optical option (OPC-VG7-SI) can be monitored or changed. However, trace, turning and other operations are impossible.
- Merits
  - The change from the built-in RS485 connector into a terminal block becomes unnecessary.
  - The path between inverters is noise free.
  - The maximum number of units connected in the physical RS485 multi-drop link is 31, while that connected with the optical option is 156.

### 6.2.3 Connection Instructions

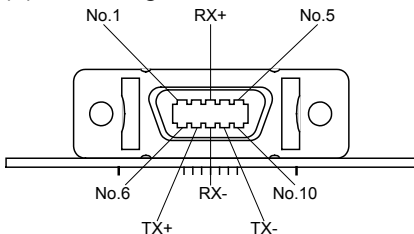
#### ⚠ WARNING

- Make sure to turn off (open) the power before performing connection work.  
**You may get electric shock.**

Connectors are used for RS485 connection.

- When you connect a master device to a VG7S one-to-one, we recommend a RS485/RS232C converter with a cable (2m) (Type: NP4H-CNV).
- For one-to-N connection, make sure to combine a connection plug (See (2) below) with a twisted pair cable with shield.

#### (1) Pin assignment for PCB mount receptacle



Pin assignment for RS485 receptacle (Connector) mounted on the PCB.

Pin number	Name	Description	Pin number	Name	Description
1	Do not use		7	TX+	Transmission (+)
2			8	RX-	Reception (-)
3	RX+	Reception (+)	9	TX-	Transmission (-)
4	Do not use				
5					
6					

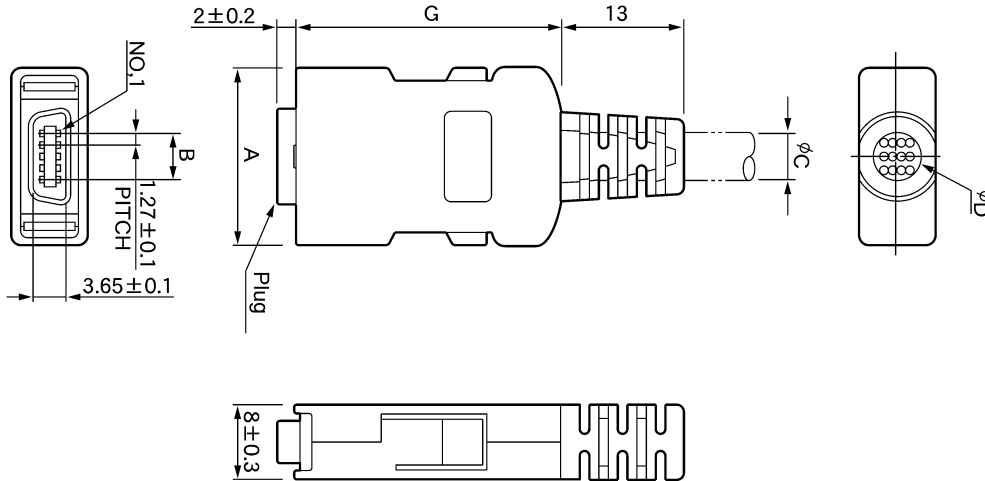
(2) Recommended plug manufacturer

Recommended plug manufacturer for the RS485 receptacle on the print circuit board.

Manufacturer: Japan Aviation Electronics Ind.

Product Name: Pressure contact type plug (with food), 10-core, TX20A-10PH1-D2P1-D1

- The other party: TX20A-10R-D2LTI-AILH



Dimensions

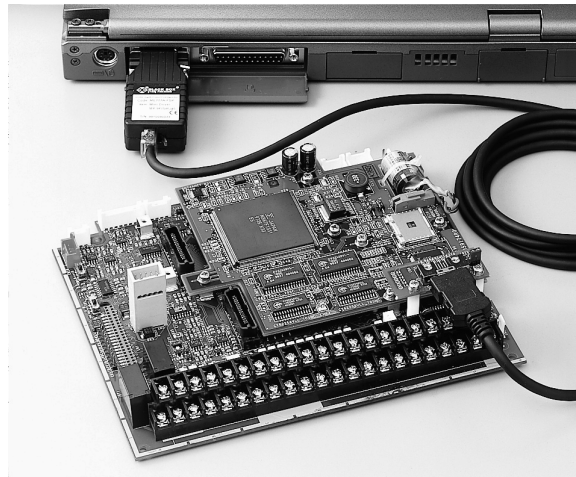
Core number	Product name	A ±0.3	B ±0.15	ØC	ØD ±0.4	G ±0.3
10	TX20A-10PH1-D2P1-D1	19.08	5.08	5	5.3	28

(3) Cable with RS485 converter

If a master device is a communication apparatus for RS232C, you need a RS485/RS232C converter. You can find wiring diagrams with a converter inserted in 6.2.2 "Basic Wiring Diagram".

1) Wiring structure

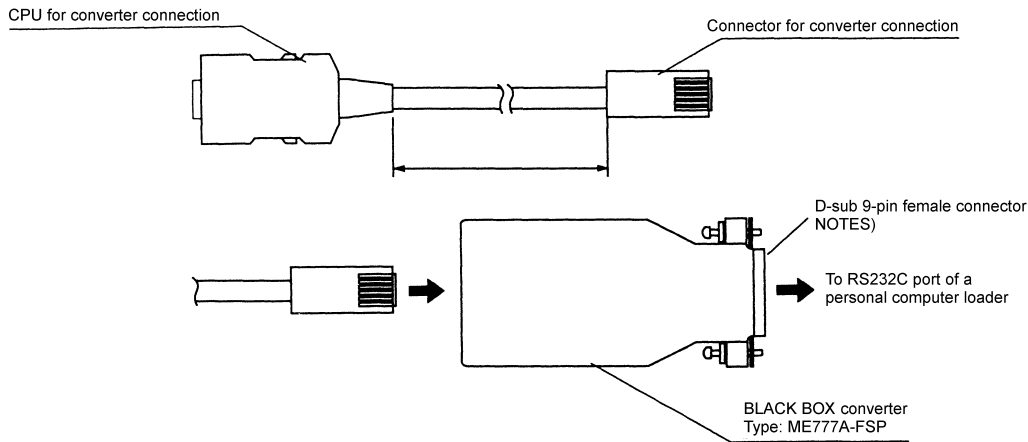
For one-to-one connection, use FUJI general purpose cable (cable with RS485/RS232C converter: NP4H-CNV) to connect to the RS485 connector on the PCB as in the right figure. (Not isolated)



## 6. Standard Interface RS485

MICREX-SX series SPH D300win connection cable (with a converter)

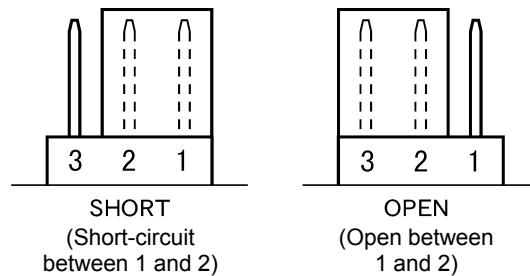
Type: NP4H-CNV



- Note:**
- Connect a commercial converter cable if the RS232C port of your personal computer is not a D-sub 9-pin male connector. Also use a commercial converter cable when the mounting screws interfere with the hooks of the RS232C port.
  - BLACK BOX-made converter (type: ME777A-FSP) is obsolete.
  - As the BLACK BOX-made connector and Fuji's connector have different pin assignment, they cannot be connected.

### (4) Termination resistor

Install 100Ω of termination resistors on the both ends of the system. These termination resistors eliminate the reflection of signals. The VG7S has a termination resistor as standard. Set the short bar to the SW3. Make sure to install on two positions, a master device and a terminal slave device (inverter). Avoid installing at all positions, otherwise the signal capacity will be insufficient.



### (5) Isolation

The control print circuit board is not isolated. We recommend an RS485/RS485 isolated converter or an RS232C/RS485 converter with isolation capability to protect the control PCB from noise and to eliminate common mode noise.

## 6.2.4 Link Function

You can use the function code H30 and the X function "24: Operation selection through link [LE]" together to switch the sources (REM/LOC or COM) of command data (S area). See also "4.2 Control Block Diagrams" for better understanding.

You can combine the function code H29 and the X function "23: Write enable through link [WE-LK]" to control write to the function codes (F, E, C, P, H, A, o, L, U) through the link. See also "4.2 Control Block Diagrams" for better understanding.

## 6.2.4.1 Enabling Link Operation

### 1) Switching to link

You can assign "24: Operation selection through link [LE]" to an X function input terminal to change the mode as follows.

Signal of "Operation selection through link"	Input to terminal	State
Assigned	-	"Operation through link disabled" mode
Not assigned	ON	"Operation through link enabled" mode
	OFF	

Though you can write command data and operation commands through the link in the "Operation through link disabled" mode, the data are not reflected. You can set data in the "Operation through link disabled" mode and switch to the "Operation through link enabled" mode to reflect the data.

### 2) Writing through link

In the "Operation through link enabled" mode, you can use the function code H30 (Serial link) to switch the source of the operation command and command data between the link (COM) and the remote/local.

The remote and local means REM (terminal box) and LOC (KEYPAD panel) respectively.

H30 setting	Operation through link enabled		Operation through link disabled
	Command data (S01 to S05, S08 to S12)	Operation command (FWD, REV)	
0	Link disabled (REM/LOC)	Link disabled (REM/LOC)	Link disabled (REM/LOC)
1	Link enabled (COM)	Link disabled (REM/LOC)	
2	Link disabled (REM/LOC)	Link enabled (COM)	
3	Link enabled (COM)	Link enabled (COM)	

This function enables you to construct a flexible system where you can apply an operation command from the terminal box and apply a speed command from RS485.

## 6.2.4.2 Enabling Writing through Link

### 1) Switching to writing through link

You can assign "23: Write enable through link [WE-LK]" to an X function input terminal to write in the function codes (F, E, C, P, H, A, o, L, and U).

Signal of "Write enable through link"	Input to terminal	State
Assigned	-	"Write through link enabled" mode (Writing enabled to F to U)
Not assigned	ON	"Write through link disabled" mode (Writing disabled to F to U)
	OFF	

### 2) Writing through link

In "Write through link" enabled mode, you can use the function code H29 (Link function protection) to control writing to the function codes (F, E, C, P, H, A, o, L, and U).

H29 setting	"Write through link enabled" mode	"Write through link disabled" mode
0	Codes (F, E, C, P, H, A, o, L, U) write-protected	Codes (F, E, C, P, H, A, o, L, U) write-protected
1	Codes (F, E, C, P, H, A, o, L, U) write-enabled	

## 6.2.4.3 Prioritized Options for S Area

When you have installed a field option (**T-LINK, field bus, SX, SI (UPAC), or RS485 option**), writing (operation commands and command data) to the S area via RS485 communication is disabled and the option has priority. You can always read and write data for the function codes (F, E, C, P, H, A, o, L, U) through RS485.



## 6. Standard Interface RS485

### 6.2.5 Referencing to and Changing Data

When you have not installed a field option, you can always write to the S area (operation commands and command data). Use "485 number" in the Chapter 13 "Function Code List" to read or write data for the other function codes (F, E, C, P, H, A, o, L, U, M) through RS485.

Note the setting range and the restriction on changes during operation, when you read or write these data.

#### 6.2.5.1 Restrictions on Writing to Function Codes

There are following restrictions on writing (selecting) to the function codes (F, E, C, P, H, A, o, L, U).

##### 1) Writing to volatile memory

The destination of the writing through RS485 is the volatile memory (RAM: Random Access Memory, stored data are disappeared when you turn off the power) to enable high-speed writing. When you want maintain the data after you turn off the power, use the function code H02 "All save" to store the data into the non-volatile memory. It takes about two seconds to use H02 to write into the non-volatile memory. Note that you cannot write new data while you are saving data.

##### 2) "Writing through RS485 disabled" mode

You will receive negative acknowledgement after you write to the following function codes.

Code	Name	Reason
P02	M1 motor selection	Changing P02 updates other codes automatically. Though this update will be written into the non-volatile memory, the change of P02 is written only into the volatile memory (disappears when you turn off the power) and the consistency among the codes is not maintained after power cycle. However, writing is enable if the VG7 support loader software (SX protocol) is used.
H31	Station address	Changing will disconnect the communication.
H34 to H37	(UART setting)	These function codes specify RS485 communication hardware setting.
H40	Protocol selection	Changing will disconnect the communication.

##### 3) "Consecutive writing disabled" mode

You can use the Modbus RTU to write 16 words consecutively. Do not include the following function codes into a group of consecutive words, otherwise you will receive a negative acknowledgement. You can include the following function codes in a single writing in the FUJI general purpose communication or Modbus RTU.

Code	Name	Reason
H01	Tuning operation selection	Internal data are updated simultaneously with the execution of these functions and the consecutive data will overwrite the updated data.
H02	All save	
H03	Data initialization	
H67	Alarm data delete	

##### 4) Data protection

- The function code F00 "Data protection" does not restrict the writing through RS485. F00 protects only the writing from the KEYPAD panel.
- The function code H29 "Link function protection" and the X function [WE-LK] restrict the writing through RS485 (see 6.2.4.2). **Note that you can write to H29**, even in the "Operation through link disabled" mode.

#### 6.2.5.2 Negative Acknowledgement and Error Response

If there is an error in transmission data or you write when the inverter is not ready, you will get a negative acknowledgement or an error response and the writing is not processed. You can use the function code M26 or the "I/O Check" screen of the KEYPAD panel to check the description of the error. See the Type [34] "Communication error code" in the "Function Code List" for more information.

The Modbus RTU protocol uses a special code (Subcode) for the error response. See the section for the Modbus RTU.

### 6.2.5.3 No Response

You will receive no response when the inverter hardware detects a parity framing error or the software detects a checksum error or a CRC error after the communication data are physically destructed. You can also use the function code M26 or the "I/O Check" screen of the KEYPAD panel to check the description of the no response.

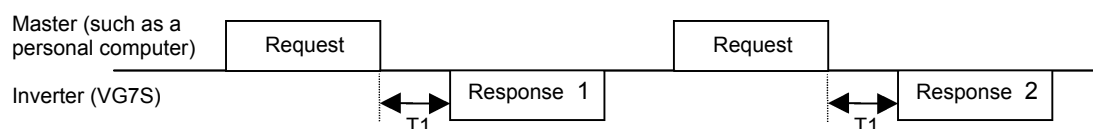
When the interval between characters from the host exceeds 20ms due to hardware abnormality, the inverter does not respond and resets the communication up to then.

### 6.2.6 RS485 Function Codes

Function code		Data setting	Note
H31	RS485 setting (Station address)	0 to 255 1 to 255: Address	Specifies a station number when connected to an inverter. No response to broadcast 0 : Broadcasting with RTU 99: Broadcasting with Fuji's general-purpose communication
H32	RS485 setting (Action on error)	0: Forced to stop 1: Stops in specified period after error 2: Stops if transmission error continues for specified period 3: Continues operation	Processes for RAS
H33	RS485 setting (Timer operation time)	0.01 to 20.00s	
H34	RS485 setting (Transmission rate)	0: 38,400bps 1: 19,200bps 2: 9,600bps 3: 4,800bps 4: 2,400bps	Initializes communication
H35	RS485 setting (Data length)	0: 8 bit 1: 7 bit	
H36	RS485 setting (Parity bit)	0: No 2: Even parity 3: Odd parity	
H37	RS485 setting (Stop bit)	0: 2 bits 1: 1 bit	
H38	RS485 continued communication disconnected time	0.1 to 60.0s 0.0; Invalid	
H39	Response interval time	0.00 to 1.00s	
H40	RS485 protocol selection	0: FUJI general purpose communication protocol 1: SX protocol (Loader protocol) 2: Modbus RTU	Switches protocol

#### 6.2.6.1 Response Interval Time (H32)

This function code sets a time in which the inverter responds after a request from an upper level device such as a personal computer. This function allows a personal computer slow in response to set a response interval and to match the timing of an inverter.



$T1 = \text{Response interval} + T_d$  (Response delay: 0 to 30ms)

Use the function code H39 to set in the range from 0.00 to 1.00s

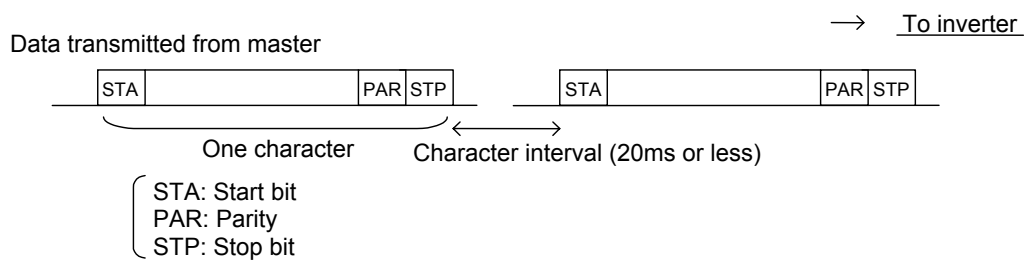
## 6. Standard Interface RS485

### 6.2.6.2 Continued Communication Disconnected Time (H38)

During link operation (S06 operation command FWD, REV) through RS485, if a communication disconnection from a master (PLC, PC) exceeds this specified period, a RS485 communication error (Er5) will occur. Disable this function (set to 0) when the communication is at a random cycle. When your communication is at a constant cycle, set the H38 to a period longer than that cycle and use the function of detecting disconnection.

### 6.2.6.3 Character Time Out Processing

A timer measuring a fixed period monitors the reception cycle. If the character interval of transmitted data from the master exceeds the period specified by the timer, a disconnection is assumed. The timer expires in 20ms determined by the character interval of 5ms to 4.6ms (12 to 11 bit/2400) at the lowest baud rate of 2,400bps. The inverter resets the communication if the character interval exceeds this period.



### 6.2.6.4 Time Out Processing on Master Side

The master (PLC, PC) assumes a time out when a communication from the inverter discontinues for a certain period. The time out period is common to all FUJI inverters (G, C, E, VG) and is specified as 500ms. Set a longer period than this period as a time out period of the master. An inverter responds in a period combining an internal processing period (about 1ms) and a period set by an interval timer (H39 setting). Though you may set a time a little longer than the period set by an interval timer, set 500ms or longer to a master device assuming a connection to other models (G, E, series).

## 6.2.7 Host Side Procedure

Refer to flowcharts of individual communication procedures for frame communication procedure. Make sure to transmit the next frame after confirming a response both in reading and writing. When the master does not receive a response from an inverter in a certain period, assume a time out and execute a retry (if you start a retry before the time out, you cannot receive a request frame).

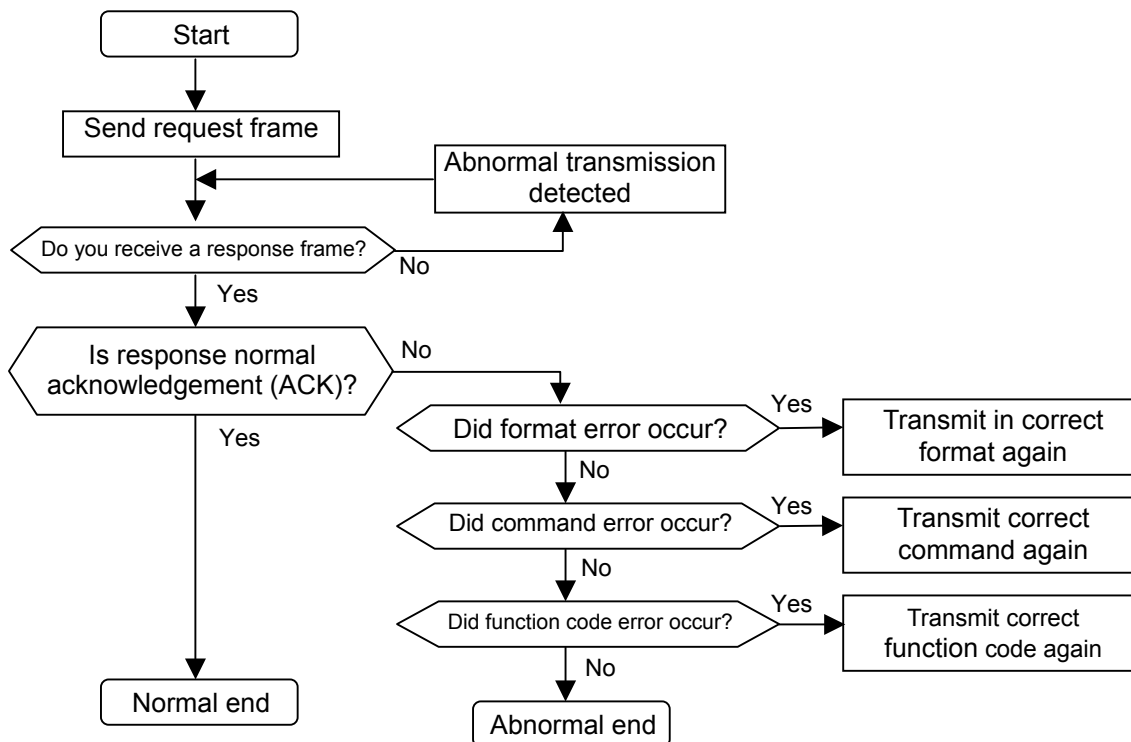
### 1) Retry Processing

The retry processing sends a data as sent before the no response error in a standard frame or polls to read out the error description (M26) to check if a normal acknowledgement is received (you need to check if a time out occurs again).

If you receive a normal acknowledgement, a transient communication error occurred due to noise or others and you can continue normal communication (there may be abnormality and you need an investigation if you have this phenomenon frequently).

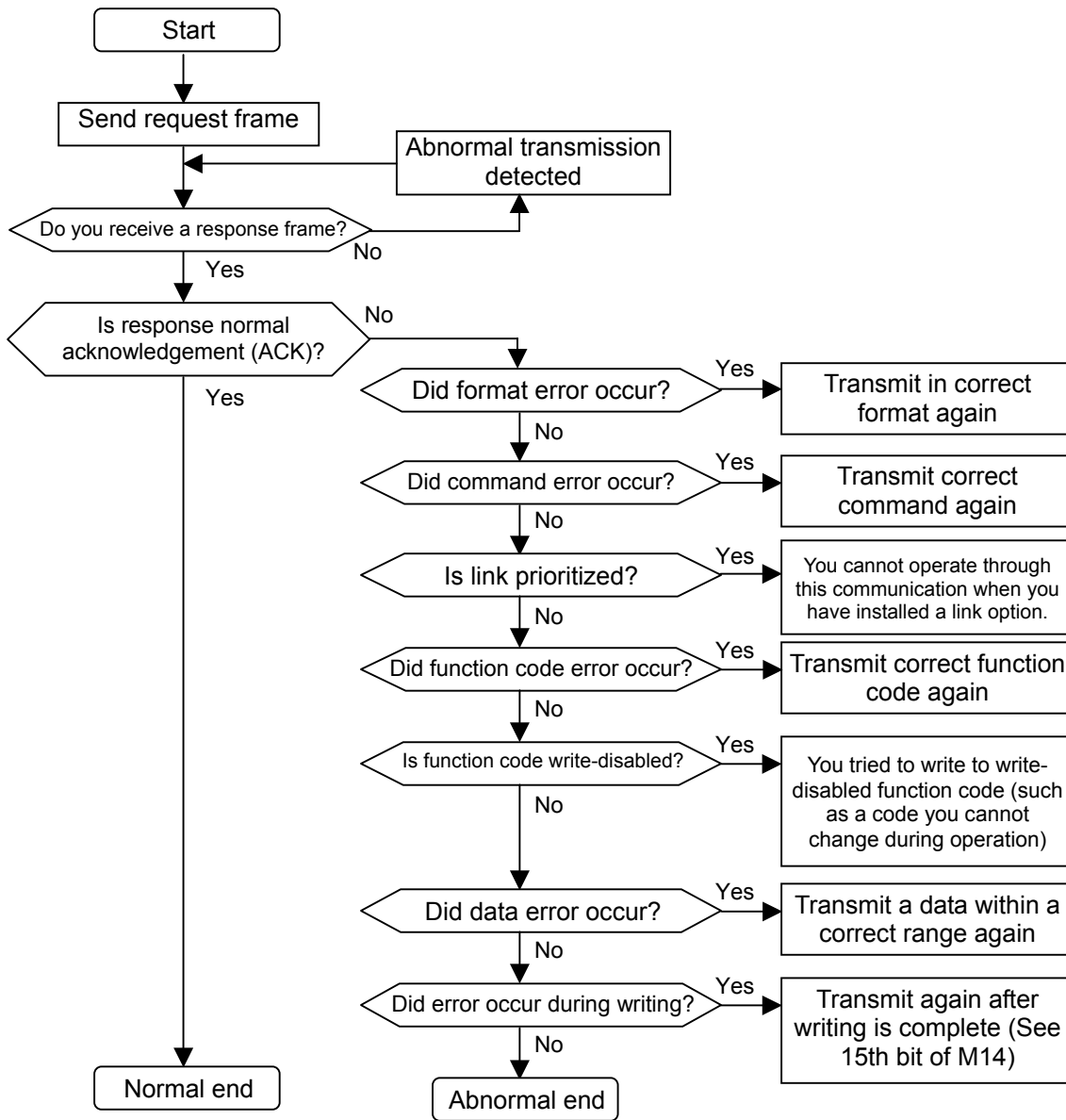
If you have no response again, repeat retry. If the number of retry exceeds a specified value (usually three times), you can suspect a hardware problem or a software problem of a upper level device. If this is the case, you have to terminate the communication as an abnormal end and start investigation.

### 6.2.7.1 Reading Procedure



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## 6.2.7.2 Writing Procedure



## 6.2.8 RAS Processing

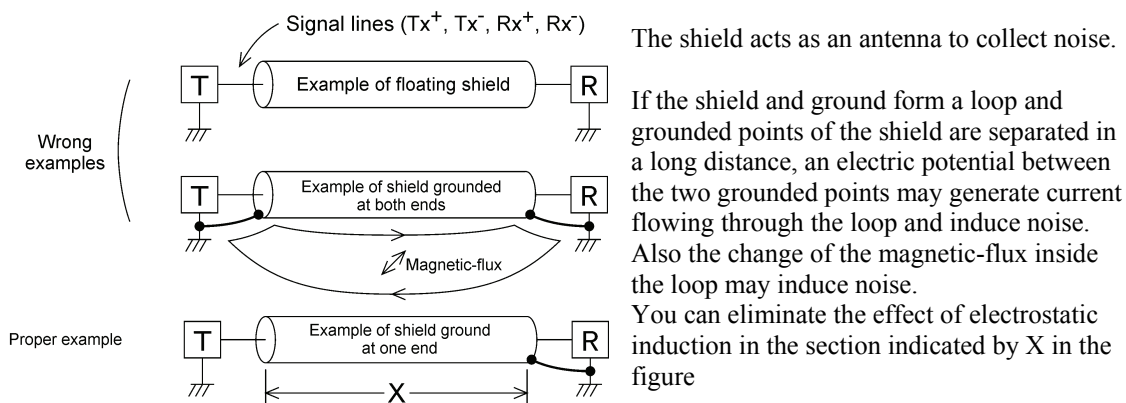
### 6.2.8.1 Measures against Abnormal Communication

In some environments, the noise generated by the inverter may interfere normal communication or cause malfunctions of instrumentation devices and converters of a master. This section describes the measures against these situations.

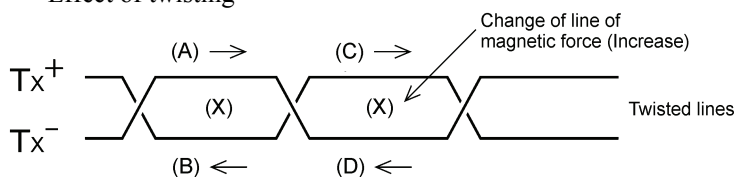
#### (1) Measures at receiving end of noise

- Isolated converter: Eliminates common mode noise exceeding the specified operation voltage range of a receiver generated in a case such as long distance wiring. Since a converter may malfunction due to noise, use a converter withstanding noise.
- Twisted pair cable with shield: The shield is effective against electrostatic induction noise. Make sure to connect only one side of the shield to the ground. The twisted lines are effective against electromagnetic induction noise. Use a cable with a twist pitch as short as possible. Consider individual shields for transmission and reception for long wiring where cross talk is a problem.

#### Effect of shield



#### Effect of twisting



When there is constant magnetic flux penetrating this page from front face to back face and the magnetic flux changes (increases), electromotive forces in the direction indicated by arrows are generated. The magnitude of electromotive forces from (A) to (D) are the same and the directions are indicated in the figure.

(B) and (C) on the Tx+ line are in the opposite direction each other and counteract each other. Also (A) and (D) counteract each other. Thus, the electromagnetic induction never induce normal mode noise. Note that the noise cannot be eliminated completely due to reasons such as uneven twist pitch. If Tx+ and Tx- are in parallel, normal mode noise will be induced.

- Termination resistor: Install resistors equivalent to the cable impedance (100Ω at the both ends to restrain ringing.
- Separate wiring installation: Install RS-485 communication lines separately from the power lines (input: R, S, T and output: U, V, W) and do not tie them together. Separate installation will restrain induction noise.
- Grounding: Do not share the same grounding between the instrumentation devices and the inverter. The grounding line may propagate noise. Use thick lines for grounding.

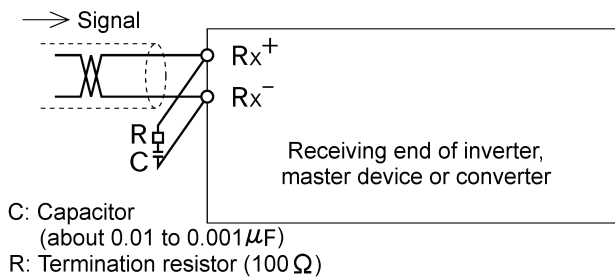
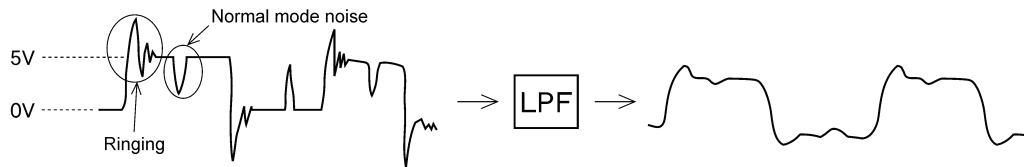
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**Isolating power supply:** The power lines of the instrumentation devices may propagate noise. We recommend an insulated inverter power supply and application of an isolated transformer (TRAFY) for power supply or a noise cut transformer.

**Filter:** Install capacitors in parallel at input/output terminals to form a LPF (Low Pass Filter) eliminating ringing or high frequency noise.

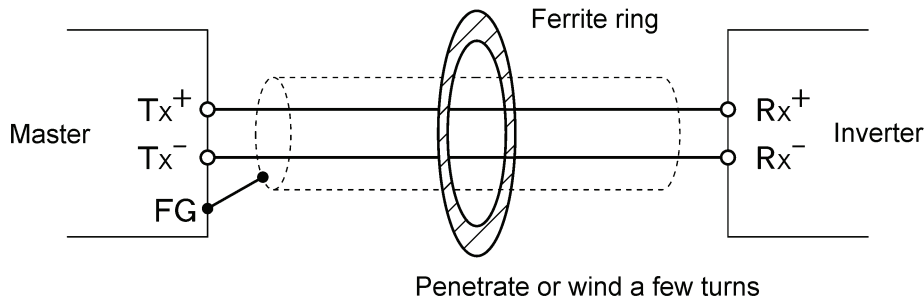
### Effect of Filtering

A low pass filter separates ringing due to a reflected signal and normal mode noise from a signal. Since the ringing is generally in higher frequency, the low pass filter can separate the signal.



**Adding inductance:** Insert a choke coil serial to the signal lines or pass the signal lines through a ferrite ring to introduce an inductance into the circuit to create a high impedance against high frequency noise.

### Adding inductive element



<b>! CAUTION</b>	
When you apply a filter or add an inductive element, the signal waveform may be deformed at high-speed transmission. If this is the case, use the function code H34 to reduce the communication rate.	
<p>Normal signal</p>	<p>Deformed waveform</p>

---

## (2) Measures at source of noise

- Carrier frequency: You can use the function code F26 "Motor sound (Carrier frequency)" to decrease the carrier frequency to reduce noise. Note that reduced carrier frequency increase noise.
- Installation: You can install power lines through a metal pipe or use a metal control panel to contain noise (radiation/induction).
- Isolating power source: Install an isolated power supply transformer for the inverter power source to eliminate propagating noise (conduction).

## (3) Measures reducing noise level

Consider using ferrite rings (9.6.5) or EMC filters (9.6.2). First implement (1) and (2) and then implement (3) if the noise level does not go down below the permissible level of your facility.

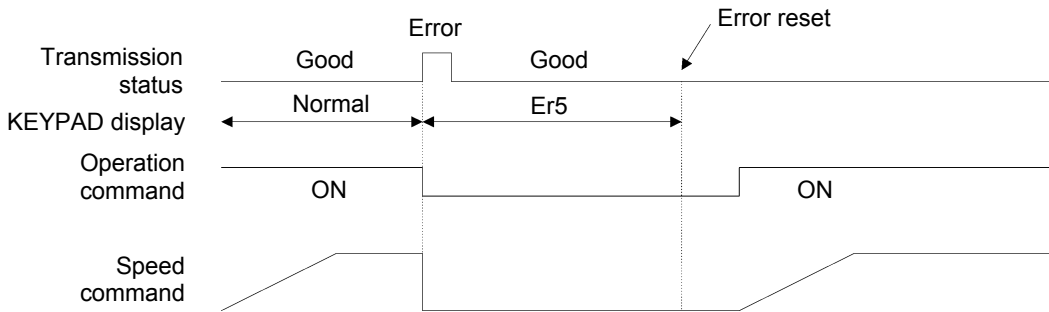


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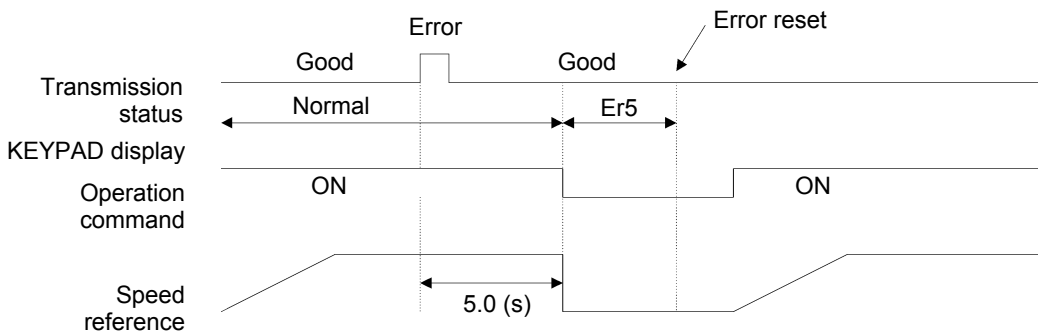
## 6.2.8.2 Actions on Communication Error

When you are providing operation commands and command data, you can use a function handling communication error to continue inverter operation without shutting down the inverter. The following section describes examples corresponding to individual settings of the error handling function (the KEYPAD panel displays "Er5") when you direct operation commands from a master.

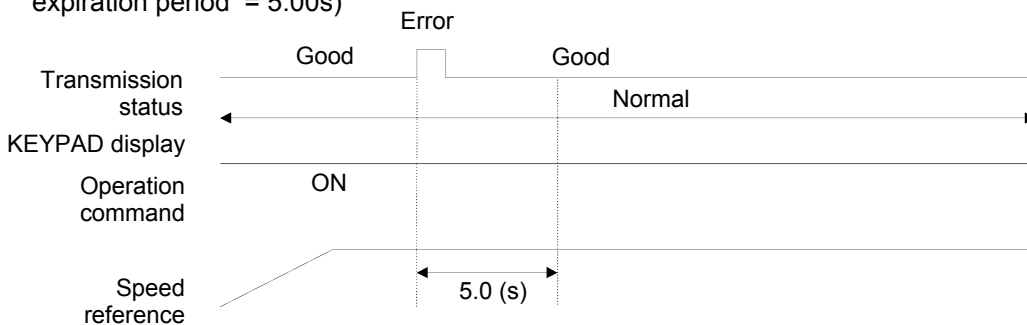
(1) H32 = 0, forced to stop mode (coasts to stop after error)



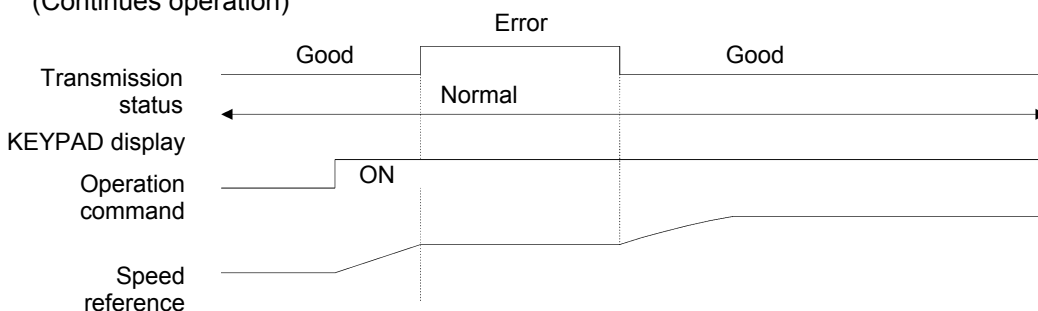
(2) H32 = 1, mode to coast to stop in a specified period by a function code after transmission error (Stops after a period specified by timer, H33: timer expiration period = 5.00s)



(3) H32 = 2, mode to continue operation if a transmission error is restored in a specified period by timer as in (b) (Stops after continued error for a period specified by timer, H33: timer expiration period = 5.00s)



(4) H32 = 3, mode to continue operation during transmission error (Continues operation)

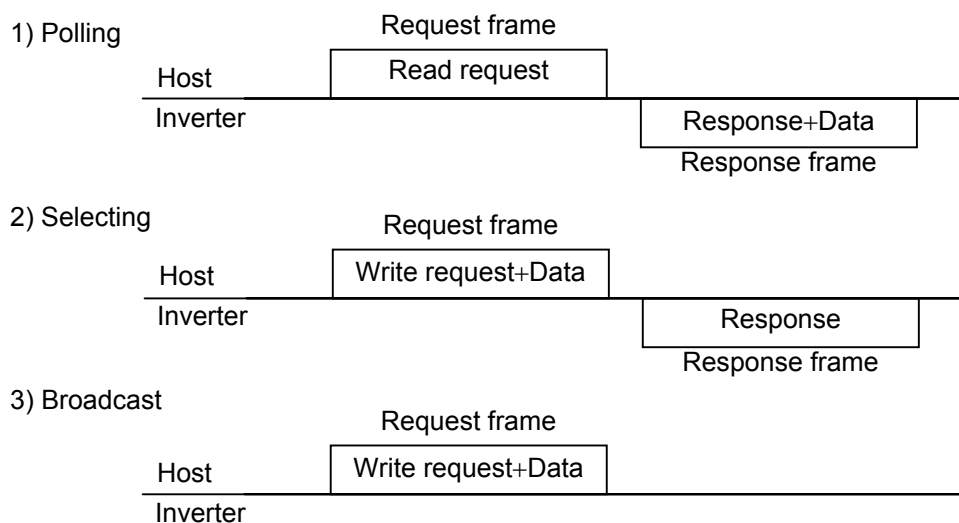


## 6.3 FUJI General Purpose Communication

### 6.3.1 Message Format

Messages are handled in polling/selecting manner. An inverter is always waiting for selecting (write request) or polling (read request) from a host (personal computer or PLC).

When an inverter is ready and receives a request addressed to its station number from a host, if the inverter receives the frame successfully, the inverter returns a positive acknowledgement, and if the inverter fails to receive the frame, the inverter returns a negative acknowledgement. Note that an inverter returns no response to a broadcast (selecting all stations at once).



Notes on broadcast (selecting all stations at once)

All inverters process a frame with a station number (station address) of 99 as a broadcast. You can use a broadcast to provide an operation command or a command data to all inverters at once (available for S01 to S06 in standard frame and for W, E, a to f, and m in option frame).

### 6.3.2 Transmission Frame

There are standard frame, which you can use for all communication functions and option frame, which is fast but limited to transmitting command data to and monitoring an inverter in the transmission frame.

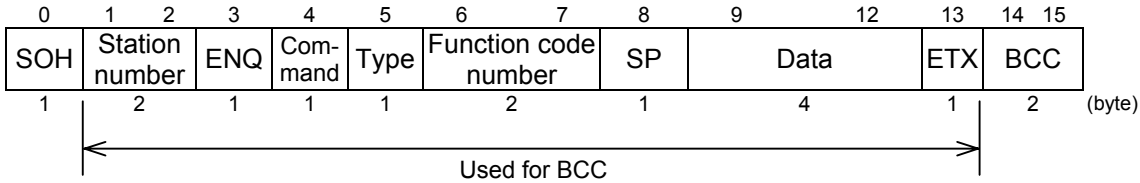
All characters (including BCC) constituting both the standard frame and the option frame are ASCII codes. The lengths of the standard frames and the option frames are listed in the following table.

Frame type			Frame length
Standard frame	Selecting	Request	16 byte
		Response	16 byte
	Polling	Request	16 byte
		Response	16 byte
Option frame	Selecting	Request	12 byte
		Response	8 byte
	Polling	Request	8 byte
		Response	12 byte

# 6. Standard Interface RS485

## 6.3.2.1 Standard Frame

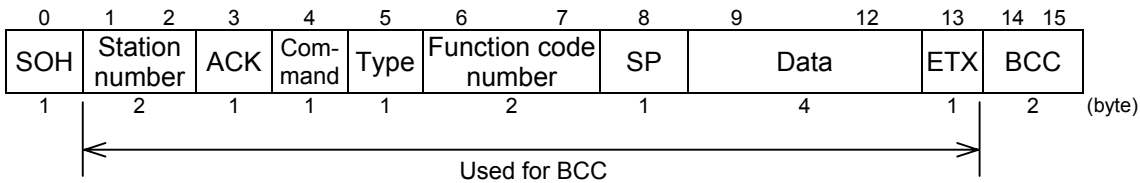
Request Frame (Host ⇒ Inverter)



Byte	Field	Value		Description
		ASCII	Hexadecimal	
0	SOH	SOH	01 <sub>H</sub>	Start of message
1	Station number	'0' to '3', '9'	30 <sub>H</sub> to 33 <sub>H</sub> , 39 <sub>H</sub>	Inverter station address (decimal, tens digit)
2		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Inverter station address (decimal, ones digit)
3	ENQ	ENQ	05 <sub>H</sub>	Transmission request
4	Command	'R' 'W' 'A' 'E'	52 <sub>H</sub> 57 <sub>H</sub> 41 <sub>H</sub> 45 <sub>H</sub>	Request command Polling (read) Selecting (write) Fast response selecting (write) *1 Alarm reset
5	Type	'F' 'E' 'C' 'P' 'H' 'A' 'L' 'U' 'o' 'S' 'M'	46 <sub>H</sub> 45 <sub>H</sub> 43 <sub>H</sub> 50 <sub>H</sub> 48 <sub>H</sub> 41 <sub>H</sub> 4C <sub>H</sub> 55 <sub>H</sub> 6F <sub>H</sub> 53 <sub>H</sub> 4D <sub>H</sub>	Function code type Fundamental functions Extension terminal functions Control functions Motor parameters High performance functions Alternative motor parameters Lift functions User functions Optional functions Serial communication functions Monitoring functions
6	Function code number	'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Function code number (Decimal, tens digit)
7		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Function code number (Decimal, ones digit)
8	SP	' '	20 <sub>H</sub>	Not used (fixed to space)
9	Data	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	First data character (hexadecimal: thousands digit)
10		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Second data character (hexadecimal: hundreds digit)
11		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Third data character (hexadecimal: tens digit)
12		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Fourth data character (hexadecimal: ones digit)
13	ETX	ETX	03 <sub>H</sub>	End of message
14	BCC	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 1 (hexadecimal, tens digit)
15		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 2 (hexadecimal, ones digit)

\*1) The VG7S returns response fast to any writings. The standard selecting (W) and the fast response selecting (A) behave in the same manner for the VG7S.

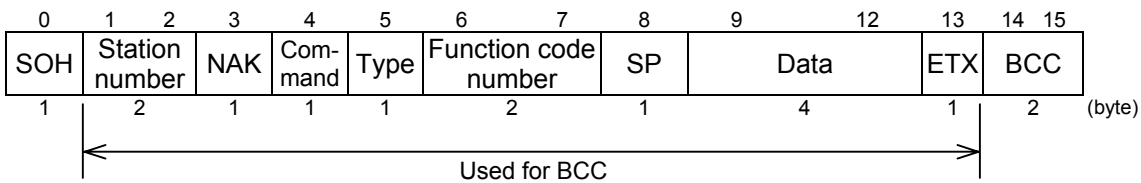
ACK Response Frame (Inverter ⇒ Host)



Byte	Field	Value		Description
		ASCII	Hexadecimal	
0	SOH	SOH	01 <sub>H</sub>	Start of message
1	Station number	'0' to '3', '9'	30 <sub>H</sub> to 33 <sub>H</sub> , 39 <sub>H</sub>	Inverter station address (decimal, tens digit)
2		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Inverter station address (decimal, ones digit)
3	ACK	ACK	06 <sub>H</sub>	Transmission response Positive acknowledgement: No reception error and no logical error in request
4	Command	'R' 'W' 'A' 'E'	52 <sub>H</sub> 57 <sub>H</sub> 41 <sub>H</sub> 45 <sub>H</sub>	Answer back to request command Polling (read) Selecting (write) Fast response selecting (write) Alarm reset
5	Type	'F' 'E' 'C' 'P' 'H' 'A' 'L' 'U' 'o' 'S' 'M'	46 <sub>H</sub> 45 <sub>H</sub> 43 <sub>H</sub> 50 <sub>H</sub> 48 <sub>H</sub> 41 <sub>H</sub> 4C <sub>H</sub> 55 <sub>H</sub> 6F <sub>H</sub> 53 <sub>H</sub> 4D <sub>H</sub>	Function code type Fundamental functions Extension terminal functions Control functions Motor parameters High performance functions Alternative motor parameters Lift functions User functions Optional functions Serial communication functions Monitoring functions
6	Function code number	'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Function code number (Decimal, tens digit)
7		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Function code number (Decimal, ones digit)
8	Special			Not used
9	Data	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	First data character (hexadecimal: thousands digit)
10		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Second data character (hexadecimal: hundreds digit)
11		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Third data character (hexadecimal: tens digit)
12		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Fourth data character (hexadecimal: ones digit)
13	ETX	ETX	03 <sub>H</sub>	End of message
14	BCC	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 1 (hexadecimal, tens digit)
15		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 2 (hexadecimal, ones digit)

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NAK Response Frame (Inverter ⇒ Host)

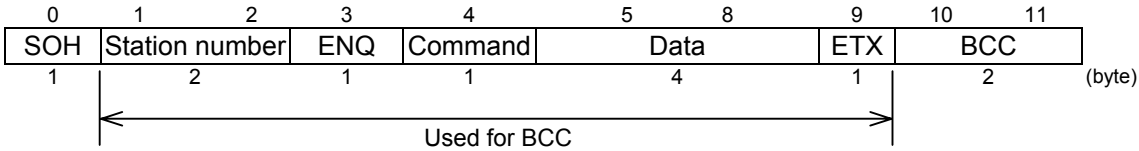


Byte	Field	Value		Description
		ASCII	Hexadecimal	
0	SOH	SOH	01 <sub>H</sub>	Start of message
1	Station number	'0' to '3', '9'	30 <sub>H</sub> to 33 <sub>H</sub> , 39 <sub>H</sub>	Inverter station address (decimal, tens digit)
2		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Inverter station address (decimal, ones digit)
3	NAK	NAK	15 <sub>H</sub>	Transmission response Negative acknowledgement: Logical error in request
4	Command *1)	'R' 'W' 'A' 'E'	52 <sub>H</sub> 57 <sub>H</sub> 41 <sub>H</sub> 45 <sub>H</sub>	Answer back to request command Polling (read) Selecting (write) Fast response selecting (write) Alarm reset
5	Type *1)	'F' 'E' 'C' 'P' 'H' 'A' 'L' 'U' 'o' 'S' 'M'	46 <sub>H</sub> 45 <sub>H</sub> 43 <sub>H</sub> 50 <sub>H</sub> 48 <sub>H</sub> 41 <sub>H</sub> 4C <sub>H</sub> 55 <sub>H</sub> 6F <sub>H</sub> 53 <sub>H</sub> 4D <sub>H</sub>	Function code type Fundamental functions Extension terminal functions Control functions Motor parameters High performance functions Alternative motor parameters Lift functions User functions Optional functions Serial communication functions Monitoring functions
6	Function code number *1)	'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Function code number (Decimal, tens digit)
7		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Function code number (Decimal, ones digit)
8	SP	' '	20 <sub>H</sub>	Not used (fixed to space)
9	Data	' '	20 <sub>H</sub>	Not used (fixed to space)
10		' '	20 <sub>H</sub>	Not used (fixed to space)
11		'4', '5'	34 <sub>H</sub> , 35 <sub>H</sub>	Communication error code 1 (hexadecimal, tens digit)
12		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Communication error code 2 (hexadecimal, ones digit)
13	ETX	ETX	03 <sub>H</sub>	End of message
14	BCC	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 1 (hexadecimal, tens digit)
15		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 2 (hexadecimal, ones digit)

\*1) A space (' '=20<sub>H</sub>) is set when a transmission format error or a transmission command error.

## 6.3.2.2 Option Frame

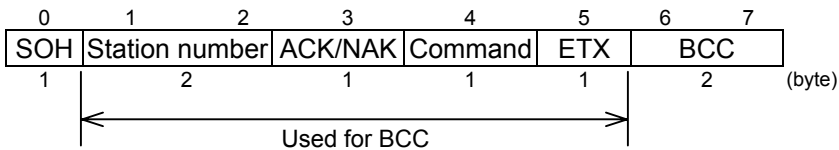
Selecting Request Frame (Host ⇒ Inverter)



Byte	Field	Value		Description
		ASCII	Hexadecimal	
0	SOH	SOH	01 <sub>H</sub>	Start of message
1	Station number	'0' to '3', '9'	30 <sub>H</sub> to 33 <sub>H</sub> , 39 <sub>H</sub>	Inverter station address (decimal, tens digit)
2		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Inverter station address (decimal, ones digit)
3	ENQ	ENQ	05 <sub>H</sub>	Transmission request
4	Command	'a'	61 <sub>H</sub>	Request command Speed reference 1 (S01)
		'b'	62 <sub>H</sub>	Torque command (S02)
		'c'	63 <sub>H</sub>	Torque current command (S03)
		'd'	64 <sub>H</sub>	Magnetic-flux command (S04)
		'e'	65 <sub>H</sub>	Orientation position command (S05)
		'f'	66 <sub>H</sub>	Operation method 1 (S06)
		'm'	6D <sub>H</sub>	Reset command: Set "0" to all
5	Data	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	First data character (hexadecimal: thousands digit)
6		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Second data character (hexadecimal: hundreds digit)
7		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Third data character (hexadecimal: tens digit)
8		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Fourth data character (hexadecimal: ones digit)
9	ETX	ETX	03 <sub>H</sub>	End of message
10	BCC	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 1 (hexadecimal, tens digit)
11		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 2 (hexadecimal, ones digit)

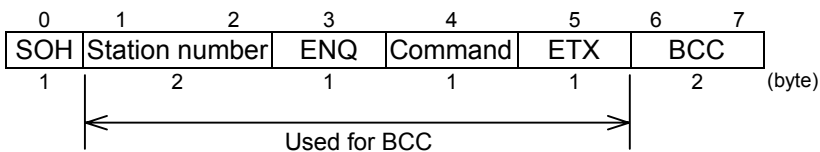
## 6. Standard Interface RS-485

Selecting Response Frame (Inverter ⇒ Host)



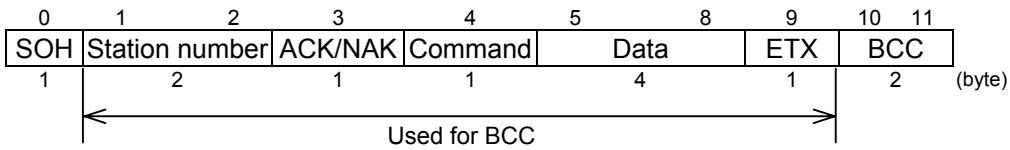
Byte	Field	Value		Description
		ASCII	Hexa-decimal	
0	SOH	SOH	01 <sub>H</sub>	Start of message
1	Station number	'0' to '3', '9'	30 <sub>H</sub> to 33 <sub>H</sub> , 39 <sub>H</sub>	Inverter station address (decimal, tens digit)
2		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Inverter station address (decimal, ones digit)
3	ACK/NAK	ACK NAK	06 <sub>H</sub> 15 <sub>H</sub>	Transmission response Positive acknowledgement: No reception error and no logical error in request Negative acknowledgement: Logical error in request
4	Command	'a' 'b' 'c' 'd' 'e' 'f' 'm'	61 <sub>H</sub> 62 <sub>H</sub> 63 <sub>H</sub> 64 <sub>H</sub> 65 <sub>H</sub> 66 <sub>H</sub> 6D <sub>H</sub>	Request command Speed reference 1 (S01) Torque command (S02) Torque current command (S03) Magnetic-flux command (S04) Orientation position command (S05) Operation method 1 (S06) Reset command: Set "0" to all
5	ETX	ETX	03 <sub>H</sub>	End of message
6	BCC	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 1 (hexadecimal, tens digit)
7		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 2 (hexadecimal, ones digit)

Polling Request Frame (Host ⇒ Inverter)



Byte	Field	Value		Description
		ASCII	Hexa-decimal	
0	SOH	SOH	01 <sub>H</sub>	Start of message
1	Station number	'0' to '3', '9'	30 <sub>H</sub> to 33 <sub>H</sub> , 39 <sub>H</sub>	Inverter station address (decimal, tens digit)
2		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Inverter station address (decimal, ones digit)
3	ENQ	ENQ	05 <sub>H</sub>	Transmission request
4	Command	'g' 'h' 'i' 'j' 'k'	67 <sub>H</sub> 68 <sub>H</sub> 69 <sub>H</sub> 6A <sub>H</sub> 6B <sub>H</sub>	Request command Detected speed value (M06) Calculated torque value (M07) Calculated torque current value (M08) Output frequency (M09) Operation status (M14)
5	ETX	ETX	03 <sub>H</sub>	End of message
6	BCC	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 1 (hexadecimal, tens digit)
7		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 2 (hexadecimal, ones digit)

Polling Response Frame (Inverter ⇒ Host)



Byte	Field	Value		Description
		ASCII	Hexadecimal	
0	SOH	SOH	01 <sub>H</sub>	Start of message
1	Station number	'0' to '3', '9'	30 <sub>H</sub> to 33 <sub>H</sub> , 39 <sub>H</sub>	Inverter station address (decimal, tens digit)
2		'0' to '9'	30 <sub>H</sub> to 39 <sub>H</sub>	Inverter station address (decimal, ones digit)
3	ACK/NAK	ACK NAK	06 <sub>H</sub> 15 <sub>H</sub>	Transmission response Positive acknowledgement: No reception error and no logical error in request Negative acknowledgement: Logical error in request
4	Command	'g' 'h' 'i' 'j' 'k'	67 <sub>H</sub> 68 <sub>H</sub> 69 <sub>H</sub> 6A <sub>H</sub> 6B <sub>H</sub>	Request command Detected speed value (M06) Calculated torque value (M07) Calculated torque current value (M08) Output frequency (M09) Operation status (M14)
5	Data	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	First data character (hexadecimal: thousands digit)
6		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Second data character (hexadecimal: hundreds digit)
7		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Third data character (hexadecimal: tens digit)
8		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Fourth data character (hexadecimal: ones digit)
9	ETX	ETX	03 <sub>H</sub>	End of message
10	BCC	'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 1 (hexadecimal, tens digit)
11		'0' to '9', 'A' to 'F'	30 <sub>H</sub> to 39 <sub>H</sub> , 41 <sub>H</sub> to 46 <sub>H</sub>	Checksum 2 (hexadecimal, ones digit)



## 6. Standard Interface RS-485

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### 6.3.2.3 Negative Acknowledgment Frame

When a response frame length depends on the command type, the response follows the length specified by that command type if the command type character is recognized successfully.

Number	Frame/command type	Source of error	Negative acknowledgment frame	Error code (M26)
1	Standard frame Option frame	ENQ is not detected at prescribed position	Standard frame (16-byte length)	Format error [74]
2	Other than prescribed command	Command other than prescribed commands (R, W, A, E, a to k, m) is detected	Standard frame (16-byte length)	Format error [75]
3	Selecting command (a to f, m)	ETX is not detected at prescribed position	Option frame (8-byte length)	Format error [74]
4	Polling command (g to k)	ETX is not detected at prescribed position	Option frame (12-byte length)	Format error [74]

**Note:** When a negative acknowledgment is returned in a standard frame as in Number 1 or Number 2 in case of format error or command error, the contents of the Command field, the Type field, and the Function code number field are undetermined.

## 6.3.3 Description of Fields

### 6.3.3.1 Data Field

	8	9	10	11	12
Standard frame	Special additional data	First data character	Second data character	Third data character	Fourth data character
Option frame	5	6	7	8	
	First data character	Second data character	Third data character	Fourth data character	

All data except for special ones are 16 bits in length. These data are hexadecimal (0000<sub>H</sub> to FFFF<sub>H</sub>) and each digit is expressed by an ASCII code in the data field of a communication frame. A negative integer data (signed data) are expressed as a 2's complement.

**Note 1:** Use upper case for A to F of hexadecimal number.

**Note 2:** Set zero ('0') to the entire data field of a polling request frame and send it.

**Note 3:** The data field of the ACK response frame is undetermined

Example) When you want to use the function code S01 "Speed reference 1" to specify 500r/min (where the maximum speed is 1500r/min):

- 1) Calculate a value to set according to the data format of S01 ( $\pm 20,000/\text{maximum speed}$ )

$$\begin{aligned} \text{Data} &= 500\text{r/min} \times \pm 20,000/1,500\text{r/min} \text{ (+ for forward rotation and - for reverse rotation)} \\ &= \pm 6,666.6 \\ &\approx \pm 6,667 \end{aligned}$$

- 2) Convert the data into a hexadecimal number (2's complement for a negative data)

$$\begin{aligned} \text{Data} &= 6,667 \text{ (Forward rotation)} \\ &= 1A0B_{\text{H}} \\ \text{Data} &= -6,667 \text{ (Reverse rotation)} \\ &= 0 - 6,667 = 65,536 - 6,667 = 58,869 \\ &= E5F5_{\text{H}} \end{aligned}$$

- 3) Set the data

Field position	Setting (Forward rotation)	Setting (Reverse rotation)
First data character	ASCII '1'	ASCII 'E'
Second data character	ASCII 'A'	ASCII '5'
Third data character	ASCII '0'	ASCII 'F'
Fourth data character	ASCII 'B'	ASCII '5'

### 6.3.3.2 Checksum Field

This data is used to check an error of a communication frame in data transmission. The checksum is the lowest byte of a byte-wise addition of all fields except for the SOH and the checksum fields represented in ASCII code.

Example) When result of addition is 0123<sub>H</sub>:

Field position	Setting
Checksum 1	ASCII '2'
Checksum 2	ASCII '3'

## 6. Standard Interface RS-485

### 6.3.4 Communication Examples

The following section describes typical communication examples (All station numbers are assumed as 12)

#### 6.3.4.1 Standard Frame

- (1) Selecting (write) for S01 "Speed reference 1", 300r/min (command) × 20,000/1,500  
(maximum speed) = **4,000d** = 0FA0<sub>H</sub>

Request frame (Host ⇒ Inverter)

SOH	1	2	ENQ	W	S	0	1	SP	0	F	A	0	ETX	7	D
-----	---	---	-----	---	---	---	---	----	---	---	---	---	-----	---	---

ACK response frame (Inverter ⇒ Host)

SOH	1	2	ACK	W	S	0	1	SP	0	F	A	0	ETX	7	E
-----	---	---	-----	---	---	---	---	----	---	---	---	---	-----	---	---

NAK response frame (Inverter ⇒ Host) ..... Error due to link priority

SOH	1	2	NAK	W	S	0	1	SP	0	0	4	C	ETX	7	D
-----	---	---	-----	---	---	---	---	----	---	---	---	---	-----	---	---

- (2) Polling (read) for M09 "Output frequency"

Request frame (Host ⇒ Inverter)

SOH	1	2	ENQ	R	M	0	9	SP	0	0	0	0	ETX	5	3
-----	---	---	-----	---	---	---	---	----	---	---	---	---	-----	---	---

ACK response frame (Inverter ⇒ Host) ..... 30.00Hz (0BB8<sub>H</sub> ⇒ 3,000d ⇒ 30,00)

SOH	1	2	ACK	R	M	0	9	SP	0	B	B	8	ETX	8	0
-----	---	---	-----	---	---	---	---	----	---	---	---	---	-----	---	---

#### 6.3.4.2 Option Frame

- (1) Selecting for operation command (write)

Request frame (Host ⇒ Inverter) ..... FWD command

SOH	1	2	ENQ	f	0	0	0	1	ETX	9	2
-----	---	---	-----	---	---	---	---	---	-----	---	---

ACK response frame (Inverter ⇒ Host)

SOH	1	2	ACK	f	ETX	D	2
-----	---	---	-----	---	-----	---	---

NAK response frame (Inverter ⇒ Host) ..... Refer to M26 "Communication error code"  
for source of error

SOH	1	2	NAK	f	ETX	E	1
-----	---	---	-----	---	-----	---	---

- (2) Polling for torque command (read)

Request frame (Host ⇒ Inverter)

SOH	1	2	ENQ	h	ETX	D	3
-----	---	---	-----	---	-----	---	---

ACK response frame (Inverter ⇒ Host) ..... 85.0% (2134<sub>H</sub> ⇒ 8,500d ⇒ 85.00)

SOH	1	2	ACK	h	2	1	3	4	ETX	9	E
-----	---	---	-----	---	---	---	---	---	-----	---	---

- (3) Selecting for operation command as broadcast (write)

Request frame (Host ⇒ Inverter) ..... REV command

SOH	9	9	ENQ	f	0	0	0	2	ETX	A	2
-----	---	---	-----	---	---	---	---	---	-----	---	---

No response is returned to a broadcast.

● ASCII Code Table

	00 <sub>H</sub>	10 <sub>H</sub>	20 <sub>H</sub>	30 <sub>H</sub>	40 <sub>H</sub>	50 <sub>H</sub>	60 <sub>H</sub>	70 <sub>H</sub>
0 <sub>H</sub>	NUL	DLE	SP	0	@	P	`	p
1 <sub>H</sub>	SOH	DC1	!	1	A	Q	a	q
2 <sub>H</sub>	STX	DC2	"	2	B	R	b	r
3 <sub>H</sub>	ETX	DC3	#	3	C	S	c	s
4 <sub>H</sub>	EOT	DC4	\$	4	D	T	d	t
5 <sub>H</sub>	ENQ	NAK	%	5	E	U	e	u
6 <sub>H</sub>	ACK	SYN	&	6	F	V	f	v
7 <sub>H</sub>	BEL	ETB	'	7	G	W	g	w
8 <sub>H</sub>	BS	CAN	(	8	H	X	h	x
9 <sub>H</sub>	HT	EM	)	9	I	Y	i	y
A <sub>H</sub>	LF	SUB	*	:	J	Z	j	z
B <sub>H</sub>	VT	ESC	+	;	K	[	k	{
C <sub>H</sub>	FF	FS	,	<	L	\	l	
D <sub>H</sub>	CR	GS	-	=	M	]	m	}
E <sub>H</sub>	SO	RS	.	>	N	^	n	~
F <sub>H</sub>	SI	US	/	?	O	_	o	DEL

This communication uses the codes indicated by the shading .

# 6. Standard Interface RS-485

## 6.3.5 Programming Example

This program is written in Microsoft QuickBASIC (MS-DOS QBasic) and it runs on the Fuji's general-purpose inverter protocol.

```
100 ' FGI-Bus Sample Program (MS-DOS QBasic)
110 '
120 OPEN "COM1:38400,E,8,1" FOR RANDOM AS #1 ' ComPort: BaudRate, Parity, DataBits, StopBits
130 soh$ = CHR$(1) ' FunctionCode H34, H36, H35, H37
140 etx$ = CHR$(3)
150 eng$ = CHR$(5)
160 ack$ = CHR$(6)
170 nak$ = CHR$(8H15)
180 esc$ = CHR$(8H1B)
190 CLS
200 '
1000 PRINT "Select Operation 1:Read,2:Write"
1010 key$ = INKEY$
1020 IF key$ = "1" THEN 2000
1030 IF key$ = "2" THEN 3000
1040 GOTO 1010
1050 '
2000 ' ==== Read (F03) ==== ' Reference User's Manual 6-19
2010 cmd$ = soh$ ' SOH
2020 cmd$ = cmd$ + "01" ' Address (01 - 31) FunctionCode: H31
2030 cmd$ = cmd$ + eng$ ' ENQ
2040 cmd$ = cmd$ + "R" ' Command (R, W, A, E)
2050 cmd$ = cmd$ + "F03" ' Code (F00... )
2060 cmd$ = cmd$ + " 0000" ' Data (0000 - FFFF)
2070 cmd$ = cmd$ + etx$ ' ETX
2080 GOTO 4000
2090 '
3000 ' ==== Write (F03:1500r/m) ==== ' Reference User's Manual 6-19
3010 cmd$ = soh$ ' SOH
3020 cmd$ = cmd$ + "01" ' Address (01 - 31) FunctionCode: H31
3030 cmd$ = cmd$ + eng$ ' ENQ
3040 cmd$ = cmd$ + "W" ' Command (R, W, A, E)
3050 cmd$ = cmd$ + "F03" ' Code (F00... )
3060 cmd$ = cmd$ + " 05DC" ' Data (0000 - FFFF)
3070 cmd$ = cmd$ + etx$ ' ETX
3080 '
4000 ' ==== Send ====
4010 buf$ = cmd$
4020 GOSUB calcbcc
4030 cmd$ = cmd$ + bcc$ ' Add BCC
4040 '
4050 PRINT #1, cmd$ ' Send
4060 '
5000 ' ==== Receive ====
5010 recv$ = INPUT$(1, #1) ' Receive
5020 IF recv$ = soh$ THEN answer$ = ""
5030 answer$ = answer$ + recv$
5040 IF recv$ <> etx$ THEN 5010
5050 answer$ = answer$ + INPUT$(2, #1)
5060 PRINT "Received Data: "; answer$
5070 '
5080 PRINT "Hit any key (ESC -> End)"
5090 key$ = INKEY$
5100 IF key$ = "" THEN 5090
5110 IF key$ <> esc$ THEN 1000
5120 CLOSE #1
5130 END
5140 '
6000 calcbcc:
6010 b = 0
6020 c = 2
6030 char$ = MID$(buf$, c, 1)
6040 b = b + ASC(char$) ' Add
6050 c = c + 1
6060 IF char$ <> etx$ THEN 6030
6070 b = b AND &HFF
6080 bin = INT(b / 16)
6090 GOSUB bintoasc ' BCC1 (8bit High) Character
6100 bcc$ = ascii$
6110 bin = b MOD 16
6120 GOSUB bintoasc ' BCC2 (8bit Low) Character
6130 bcc$ = bcc$ + ascii$ ' BCC1+2 (Character)
6140 RETURN
6150 '
7000 bintoasc: ' Digit "0 - 15" to Character "0 - F"
7010 IF bin < 10 THEN ascii$ = CHR$(ASC("0") + bin) ELSE ascii$ = CHR$(ASC("A") + bin - 10)
7020 RETURN
```

---

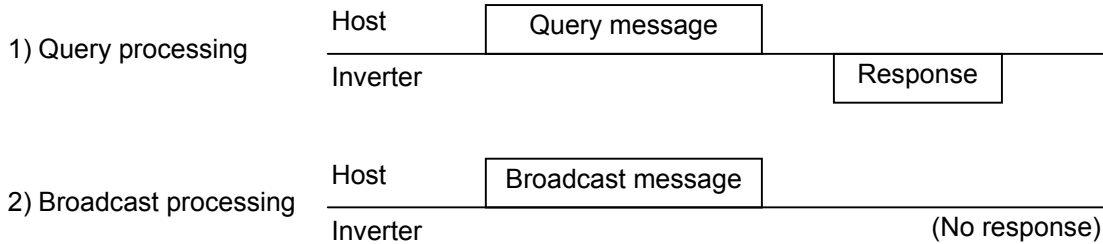
## 6.4 Modbus RTU

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This protocol is created outside of Japan.

### 6.4.1 Message Format

The standard formats for RTU message transmission are described below.



When an inverter is ready and receives a message addressed to itself, if the inverter determines that it received the message successfully, the inverter processes the request and returns a normal response. If the inverter determines that it did not receive the message successfully, the inverter returns an error response. The inverter does not return a response to a broadcast.

#### (1) Query

A host transmits a message to a single inverter.

#### (2) Normal response

After receiving a query, the inverter processes the request and returns a normal response.

#### (3) Error response

After receiving a query, the inverter cannot process the request and returns an error response. The error response includes a reason why the inverter cannot process the message. The inverter does not return an error response to a CRC error or a physical transmission error.

#### (4) Broadcast

A master uses address 0 to transmit a message to all slaves. All slaves receiving the broadcast message execute a requested function. The timeout of the master terminates this process.

### 6.4.2 Transmission Frame

The following section describes the transmission frame. The details depend on the FC (Function Code) and see 6.4.2.1 "Reading FC Data", 6.4.2.2 "Writing Data for Single FC" and 6.4.2.3 "Writing Data for Consecutive FC's".

1byte	1byte	max 203byte	2bytes
Station Address	FC (Function Code)	Information	Error Check

#### (1) Station address (station number)

The Station Address in one byte in length and you can select from 0 to 247. The Station Address 0 selects all slave stations and means a broadcast message.

## 6. Standard Interface RS-485

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### (2) FC (function code)

The FC is one byte in length and you can use a value ranging from 0 to 255 to define a function code. The FC's indicated by shading are available. Do not use the FC's that are not available, otherwise you will receive an error response.

FC	Description
0 to 2	Not used
3	Read data for FC, maximum 99
4 to 5	Not used
6	Write data for single FC
7	Not used
8	Maintenance code
9 to 15	Not used
16	Write data for consecutive FC's, maximum 16 data
17 to 127	Not used
128 to 255	Reserved for Exception Response

### (3) Information

The Information field contains all information (such as FC, Byte Count, Data Number, and Data). See **6.4.2.1 "Reading FC Data"**, **6.4.2.2 "Writing Data for Single FC"** and **6.4.2.3 "Writing Data for Consecutive FC's"** for more information on the Information field.

### (4) Error check

The Error Check field is two bytes in length and used for a CRC-16 type error check. The frame length is necessary to obtain a CRC-16 code from the FC and the byte count data since the Information field length is variable.

## 6.4.2.1 Reading FC Data

### (1) Query

1byte	1byte	2bytes	2bytes	2bytes
Station Number	03	Function Code	Number of Data to be Read (Maximum 99)	Error Check

### (2) Normal response

1byte	1byte	1byte	2 to 198bytes	2bytes
Station Number	03	Byte Count	Read Data (Maximum 198)	Error Check

Hi,Lo,Hi,Lo,Hi,Lo,...

### (3) How to set query

- You cannot use the Broadcast for a Query. The Station Number 0 is not available.
- FC=03
- The FC is two bytes in length and consists of an identification code and a number (Example F40=F+40). The Hi byte corresponds to an identification code ranging F to L and the Lo byte corresponds to a number. The setting range for the Hi is 0 to 9 or 11 (F to L or U) and for the Lo is 0 to 99. For example, you should set "0014h" for F20,

Set data	Identification code	Name	Set data	Identification code	Name
0	F	Fundamental functions	6	o	Optional functions
1	E	Extension terminal functions	7	S	Serial communication functions
2	C	Control functions	8	M	Monitoring functions
3	P	Motor parameters	9	L	Lift functions
4	H	High performance functions	11	U	User functions
5	A	Alternative motor parameters			

- A read out data is two bytes in length. The setting range is 1 to 99 (in word). Set the Number of Data to be Read so as not to exceed the upper offset limit, 99, otherwise you will receive an error response.

### (4) Interpreting normal response

- The range of the Byte Count is 2 to 198. The Byte Count is twice as large as the Number of Data to be Read (1 to 99) of a Query.
- The Read Data are arranged in the order of the Hi byte and the Lo byte of individual word data and the word data are arranged from the data of the specified function code in a query and its address, then the next data and its address, and so on. If you try to read a nonexistent function code (such as F09), you will receive "0000".



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### 6.4.2.2 Writing Data for Single FC

(1) Query

1byte	1byte	2bytes	2bytes	2bytes
Station Number	06	Function Code	Data to be Written	Error Check
			Hi    Lo	

(2) Normal response

1byte	1byte	2bytes	2bytes	2bytes
Station Number	06	Byte Count	Data to be Written	Error Check
			Hi    Lo	

(3) How to set query

- You can set 0 to the station number for Broadcast. Then all inverters execute the request directed by the broadcast and return no response.
- FC=06
- The Function Code is two bytes in length and consists of an identification code and a number. See the table in 6.4.2.1 for more information on the identification code.
- The Data to be Written field is fixed two bytes in length.

(4) Interpreting normal response

- A normal response has the same frame as the query.

### 6.4.2.3 Writing Data for Consecutive FC's

(1) Query

1byte	1byte	2bytes	2bytes	1byte	2 to 32 bytes	2bytes
Station Number	16	Function Code	Number of Data to be Written	Byte Count	Data to be Written	Error Check
					Hi,Lo,Hi,Lo,...	

(2) Normal response

1byte	1byte	2byte	2byte	2byte
Station Number	16	Byte Count	Data to be Written	Error Check

(3) How to set query

- You can set 0 to the station number for Broadcast. Then all inverters execute the request directed by the Broadcast and return no response.
- FC=16
- The Function Code is two bytes in length and consists of an identification code and a number. See the table in 6.4.2.1 for more information on the identification code.
- The Number of Data to be Written field is two bytes in length. The setting range is from 1 to 16. You will receive an error response to a number of 17 or more.
- The Byte Count is one byte in length. The setting range is from 2 to 32. The Byte Count must be set twice as large as the Number of Data to be Written.
- Set the lowest data (data for the function code specified in the Function Code) to the first two bytes and set higher data (the second data, the third data and so on) in the increasing order.

(4) Interpreting normal response

- A response returns the same values as those in its query in the Function Code and the Number of Data to be Written fields.

---

## 6.4.2.4 Maintenance Code

You can use this function code to check the connection of the communication line (hardware).

(1) Query

1byte	1byte	2bytes	2bytes	2bytes
Station Number	08	Diagnosis Code 00 00	Data	Error Check

(2) Normal response

1byte	1byte	2bytes	2bytes	2bytes
Station Number	08	Diagnosis Code 00 00	Data	Error Check

(3) How to set Query

- You cannot use the Broadcast for a Query.
- FC=08
- The Diagnosis Code is two bytes in length and you should always specify 0x0000, otherwise you will receive an error response.
- The Data is two bytes in length and you can specify freely.

(4) Interpreting normal response

- A normal response is the same as its query.

## 6. Standard Interface RS-485

### 6.4.2.5 Error Response

An invalid query will not be executed and be responded with an Error Response.

(1) Error response

1byte	1byte	1byte	2bytes
Station Number	Exception Func	Sub Code	Error Check

(2) Interpreting error response

- The error response is the same as a query requesting a Station Number.
- The Exception Func is the sum of the FC in the query and 128.  
For example, when FC=3, then Exception Func=3+128=131 (83<sub>H</sub>).
- The Subcode indicates the reason of invalidity as in the following table.

Sub-code	Item		Description	M26 code	Keypad panel
1	Invalid FC		FC other than 3, 6, 8, and 16 is received.	75	01
2	Invalid address	Invalid function code	An excessive or unknown function code (for example, "F81") is received.	78	02
		Invalid data number	Writing 16 words or more is attempted.		
		Abnormal diagnosis code (maintenance code)	Data other than "0" is set to Diagnosis Code.		
3	Invalid data	Data range error	Data to be written is out of valid range.	80	03
7	NAK	Link priority	Writing operation command or command data is attempted while a field option (such as T-link or SX) is installed.	76	07
		Write disabled	1. Write disabled during operation 2. Write disabled (read only or M area) 3. Operation through link disabled 4. Write through RS-485 disabled (H31, H34 to H37, H40, P02) 5. F04, F05, P03 to P27 (when M1 motor parameters are protected)	79	

---

## 6.4.3 Error Check

### 6.4.3.1 CRC-16

This data is used to check for an error in a communication frame.

The CRC is one of the most effective error check systems. The sender side calculates and adds a CRC data at the end of a frame. The receiver side calculates a CRC data on a received data and compares these two CRC data.

#### (1) Brief description of steps to calculate CRC data

- A data expressed as a polynomial (1100 0000 0010 0001 is expressed as  $X^{15}+X^{14}+X^5+1$ ) is divided by a generation polynomial (17 bits,  $X^{16}+X^{15}+X^2+1$ ). The CRC data is obtained as a remainder (16 bits) of this division.
- Neglect the quotient, add the remainder at the end of a data, and send a message.
- A receiver side divides this message (with CRC data) by the generation polynomial and assumes that a transmission is executed without error if the remainder is 0.

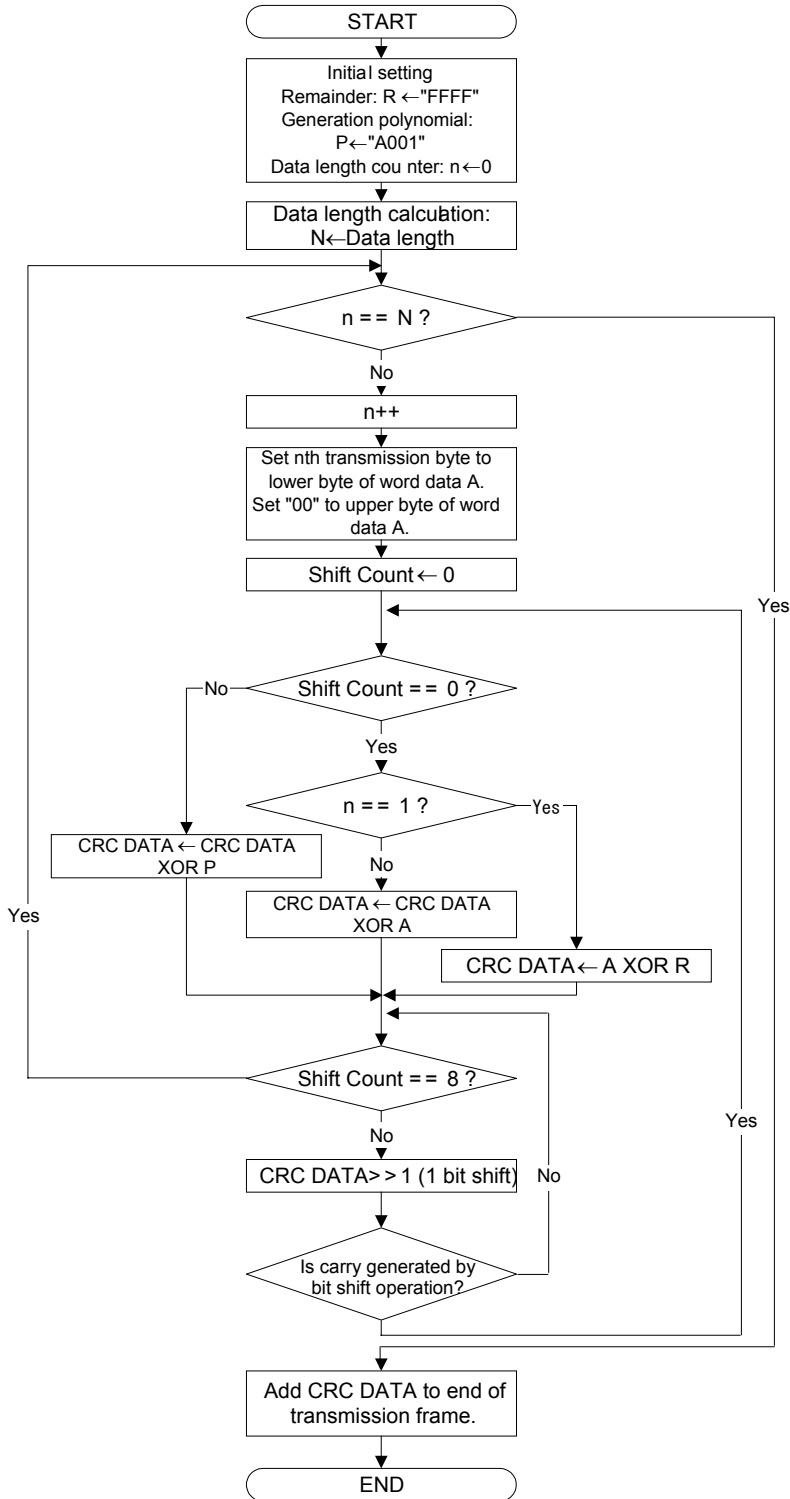
#### (2) About CRC-16

The generation polynomial is expressed with powers of X such as  $X^3+X^2+X$  instead of binary code 1110. Though you can choose an arbitrary generation polynomial, there are some defined/proposed standard polynomials to optimize error detection. The RTU protocol uses a generation polynomial of  $X^{16}+X^{15}+X^2+1$  corresponding to 1 1000 0000 0000 0101 expressed in binary. In this case, a generated CRC is known as CRC-16.

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## 6.4.3.2 CRC Algorithm

The following flowchart describes the calculation algorithm of CRC-16. See also a calculation example in 6.4.3.3.



- The CRC DATA occupies one word memory and is updated through calculation to be finally added to a transmission frame as a check code.
- The reception process is the same as that in the figure above. Note that the CRC data calculated on the transmission side and that on the reception side should be compared.

### 6.4.3.3 Example of CRC-16 Calculation

The following example is a data sent as a Query for a function code. The Station Number is 1, FC=03, the Function Code is P49 (code for P is 03 and 49 is 31hex), the Number of Data to be Read is 20, G.P. is a generation polynomial (1010 0000 0000 0001).

Station Number	FC	Function Code		Number of Data to be Read	
01	03	03	31	00	14

N	PROCESS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Flag
1	Initial data R="FFFF"	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2	1 <sup>st</sup> data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
3	CRC = No.1 Xor No.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
4	Shift >> 2 (until flag=1)	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	CRC = No.4 Xor G.P.	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	
6	Shift >> 2	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1
7	CRC = No.6 Xor G.P.	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	
8	Shift >> 2	0	0	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1
9	CRC = No.8 Xor G.P.	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	
10	Shift >> 2 (completion of 8 shifts)	0	0	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1
11	CRC = No.10 Xor G.P.	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	
12	2 <sup>nd</sup> data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
13	CRC = No.11 Xor No.12	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	
14	Shift >> 1	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
15	CRC = No.14 Xor G.P.	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	1	
16	Shift >> 1	0	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	1
17	CRC = No.16 Xor G.P.	1	1	0	1	0	0	0	0	0	0	1	1	1	1	1	0	
18	Shift >> 2	0	0	1	1	0	1	0	0	0	0	0	0	1	1	1	1	1
19	CRC = No.18 Xor G.P.	1	0	0	1	0	1	0	0	0	0	0	0	1	1	0		
20	Shift >> 2	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1
21	CRC = No.20 Xor G.P.	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
22	Shift >> 2 (completion of 8 shifts)	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0
23	3 <sup>rd</sup> data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1		
24	CRC = No.22 Xor No.23	0	0	1	0	0	0	1	0	1	0	0	0	0	0	1	1	
25	Shift >> 1	0	0	0	1	0	0	0	1	0	1	0	0	0	0	1	1	1
26	CRC = No.25 Xor G.P.	1	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0	
27	Shift >> 6	0	0	0	0	0	0	1	0	1	1	0	0	0	0	1	0	1
28	CRC = No.27 Xor G.P.	1	0	1	0	0	0	1	0	1	1	0	0	0	0	1	1	
29	Shift >> 1	0	1	0	1	0	0	0	1	0	1	1	0	0	0	0	1	1
30	CRC = No.29 Xor G.P.	1	1	1	1	0	0	1	0	1	1	0	0	0	0	0	0	
31	4 <sup>th</sup> data byte	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1		
32	CRC = No.30 Xor No.31	1	1	1	1	0	0	1	0	1	0	1	0	0	0	1		
33	Shift >> 1	0	1	1	1	1	0	0	1	0	1	0	1	0	0	0	1	1
34	CRC = No.33 Xor G.P.	1	1	0	1	1	0	0	1	0	1	0	1	0	1	0	1	
35	Shift >> 1	0	1	1	0	1	1	0	0	1	0	1	0	1	0	0	1	1
36	CRC = No.35 Xor G.P.	1	1	0	0	1	1	0	0	1	0	1	0	1	0	1		
37	Shift >> 1	0	1	1	0	0	1	1	0	0	1	0	1	0	1	0	1	1
38	CRC = No.37 Xor G.P.	1	1	0	0	0	1	1	0	0	1	0	1	0	1	1		
39	Shift >> 1	0	1	1	0	0	0	1	1	0	0	1	0	1	0	1	1	1
40	CRC = No.37 Xor G.P.	1	1	0	0	0	0	1	1	0	0	1	0	1	0	1	0	0
41	Shift >> 3	0	0	0	1	1	0	0	0	1	1	0	0	0	1	0	1	1
42	CRC = No.41 Xor G.P.	1	0	1	1	1	0	0	0	1	1	0	0	0	1	1		
43	Shift >> 1	0	1	0	1	1	1	0	0	0	1	1	0	0	0	1	1	1
44	CRC = No.43 Xor G.P.	1	1	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0
45	5 <sup>th</sup> data byte	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	CRC = No.44 Xor No.45	1	1	1	1	1	1	0	0	0	1	1	0	0	0	0		
47	Shift >> 5	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	1	1
48	CRC = No.47 Xor G.P.	1	0	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0
49	Shift >> 3	0	0	0	1	0	1	0	0	1	1	1	1	1	1	0	0	0

## 6. Standard Interface RS-485

N	PROCESS	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Flag
50	6 <sup>th</sup> data byte	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	
51	CRC = No.49 Xor No.50	0	0	0	1	0	1	0	0	1	1	1	0	1	0	0	0	
52	Shift >> 4	0	0	0	0	0	0	0	1	0	1	0	0	1	1	1	0	1
53	CRC = No.52 Xor G.P	1	0	1	0	0	0	0	1	0	1	0	0	1	1	1	1	
54	Shift >> 1	0	1	0	1	0	0	0	0	1	0	1	0	0	1	1	1	1
55	CRC = No.54 Xor G.P	1	1	1	1	0	0	0	0	1	0	1	0	0	1	1	0	
56	Shift >> 2	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	1	1
57	CRC = No.56 Xor G.P	1	0	0	1	1	1	0	0	0	0	1	0	1	0	0	0	
58	Shift >> 1	0	1	0	0	1	1	1	0	0	0	0	1	0	1	0	0	0
	CRC data to be transmitted	4				E				1				4				

The following table shows the data to be transmitted after the calculation above.

Station Number	FC	Function Code		Number of Data to be Read		CRC Check	
01	03	03	31	00	14	14	4E

### 6.4.3.4 Calculating Frame Length

You should obtain the variable message length to calculate a CRC-16 data. You can use the following table to determine the length of all message types.

FC	Name	Query Broadcast message length except for CRC code	Response message length except for CRC code
3	Reading FC Data	6 bytes	(3+3 <sup>rd</sup> data length) bytes
6	Writing Data for Single FC	6 bytes	6 bytes
8	Maintenance Code	6 bytes	6 bytes
16	Writing Data for Consecutive FC's	(7+7 <sup>th</sup> data length) bytes	6 bytes
128 to 255	Exception Function	Not used	3 bytes

\*7<sup>th</sup> or 3<sup>rd</sup> bit shows the number of counted bytes of the information.

---

## 6.4.4 Communication Examples

The following section describes typical communication examples (all station numbers are assumed to be 5).

### 6.4.4.1 Reading

(1) Read M06 "Detected speed value".

1) Query (Host ⇒ Inverter)

05	03	08	06	00	01	67	EF
----	----	----	----	----	----	----	----

2) Normal response (Inverter ⇒ Host)

05	03	02	27	10	53	B8
----	----	----	----	----	----	----

Detected speed value;  $2710_H \Rightarrow 10,000_d$

$$10,000 \times \frac{\text{Maximum speed}}{20,000} = 750 \text{ [r/min]}$$

(Maximum speed: 1,500r/min)

(2) Write 400r/min to S01 "Speed reference 1" (Maximum speed: 1,500r/min).

$$400 \text{ [r/min]} \times \frac{20,000}{1,500} = 5333_d = 14D5_H$$

1) Query (Host ⇒ Inverter)

05	06	07	01	14	D5	16	65
----	----	----	----	----	----	----	----

2) Normal response (Inverter ⇒ Host)

05	06	07	01	14	D5	16	65
----	----	----	----	----	----	----	----



## 6. Standard Interface RS-485

### 6.5 How to Use PC Loader (Loader command protocol)

#### 6.5.1 Advantages of PC Loader

##### Real-time trace

**Real-time trace shows the current condition of the inverter more realistically in a graph by the high-speed sampling (10ms).**

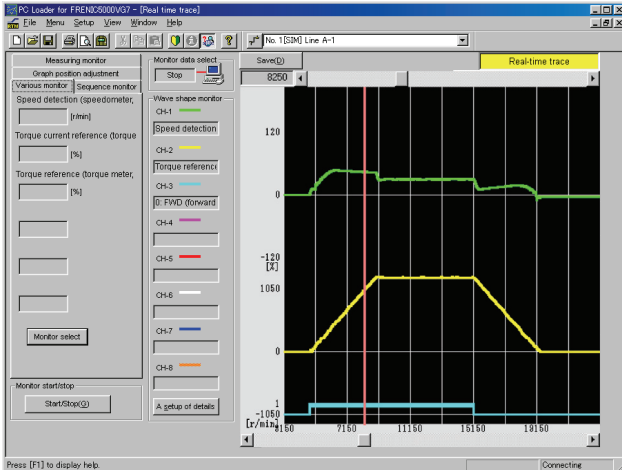


Figure 1 Real-time Trace

Real-time trace realizes the continuous waveform measurement of up to 30,000 points at the minimum intervals of 10ms (continues 5 minutes in case of 10ms sampling). This high-speed sampling discloses the detailed transition of the inverter at an unprecedented speed. Historical trace enables the continuous sampling of 100 points at the minimum intervals of 1ms.

All the required information such as speed detection, speed setting, line speed, torque current command, motor voltage, motor current can be indicated in a graph with eight points at a time (in case all the data are digital signals). Additionally, the condition of that moment is indicated with digital values in the left columns of the screen. Therefore, you can understand the condition of the inverter at a glance. Furthermore, the time scale and Y scale of the graph can be set freely.

## Auto tuning

**Inverter will correct the motor in any environment condition. You can start the operation of the inverter immediately in everywhere.**

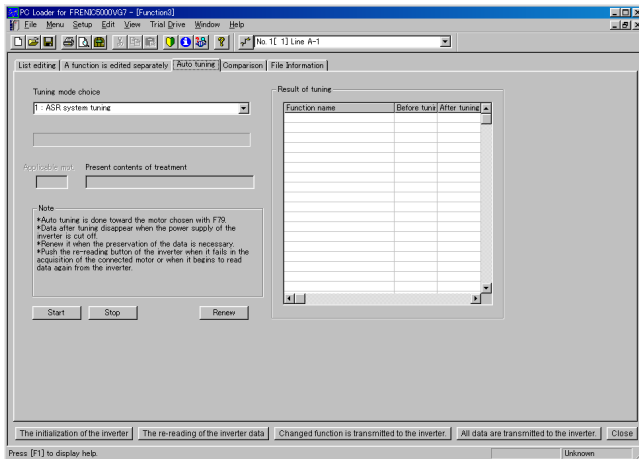


Figure 2 Auto Tuning

The settings of inverter in the motor was formerly very difficult for the people who were not accustomed to do it, because various kinds of the complicated configuration are required to operate the inverter correctly.

In this VG7S, the inverter will do the required settings automatically by itself. Complicated configuration or calculation is no more required.

You can perform the auto tuning through KEYPAD or, if using PC Loader, you can easily check the condition of the tuning or compare the data before and after tuning.

Auto tuning function also reduces the time for the settings. This is really the function for the customers.

## 6. Standard Interface RS-485

### 6.5.2 Specifications

Item	Specifications	Remarks
System requirements		
PC	PC/AT compatible machine	Excluding Macintosh
OS	Microsoft Windows™ 98	Excluding Microsoft Windows 3.XX.
Display	SVGA(800×600) or more is recommended	Trace screen corresponds to XGA.
Software		
Language	Japanese, English	Selectable at the time of installation.
Software to be installed		
Distribution medium	CD-ROM	
Uninstallation	Possible	
Custom set-up	Total installation type	Customization is impossible.
Communication setup		
Interface	RS-485	
Transmission speed	2400, 4800, 9600, 19200, 38400bps	Changeable at communication setup.
Synchronization method	Start-stop synchronization (UART)	
Transmission Method	Full-duplex (physical level) Half-duplex (protocol)	The connection method is full-duplex but the data exchange method repeats request and response alternately
Communication style	Direct connection to inverter 1:n(1≤n≤31)	Changeable at connection setup.
SX bus connection	Impossible	
Network connection	Impossible	
Data length	8bit	Cannot be changed at communication setup. Set the VG7S function code to be fixed.
Stop bit	1bit	
Parity	Even parity	
Flow control	Supports the selection of RTS or DTR control.	Changeable at communication setup.
Error check method	Checksum method (1byte BCC)	
Protocol	Following the SX bus protocol	Not opened.
Time-out detection interval	Time-out × number of retries	Changeable at communication setup.
No. of retries	Retry function executed in the case of data error or physical error.	Changeable at communication setup.

Note: The inverter support loader software for Fuji's general-purpose inverters (11 Series) does not run via the same RS-485 line.

Loader standard specifications		
Function code setting specifications		
Edit by list	Refers/Changes the function code F, E, C, P, H, A, o, L, and U.	
Edit by function	Individual setting for digital input · output, analog input/output is available.	
Automatic tuning	The condition of the tuning and its result can be compared.	
Comparison	Can compare the inverter data and the data in edit, files and the data in edit. The result can be printed out.	
File information	Inverter system, function codes, the date information when the file is read and comments can be input.	
Print-Save	Function codes can be printed and saved. CSV format is also available, therefore the file can be read by other applications.	
Monitor function		
Multiple monitor	Monitors VG7S connected to RS-485 by the periodical scanning, up to max. 31 machines	
I/O monitor	Monitors digital input/output.	
System monitor	Monitors ROM, option, inside control information, maintenance information.	
Error monitor	Indicates currently occurring alarm and alarm history.	
Real-time trace · Historical trace specifications		
	Real-time trace	Historical trace
Sampling interval	10,20,50,100,200ms	1,2,5,10,20,50,100,200ms
No. of samplings	Max. 30,000 points (In case of over 30,000, the data will disappear in order from the old one).	100 points (the number of samplings can be set before and after the trigger).
Filter function	Can set manual or auto filter individually.	
No. of data	Max. 4 for analog, max. 8 for digital. (The number of data is limited when the analog and digital data are used in combination.)	
Analog data	Speed detection 1 (Speedometer, one-way deflection), Speed detection 1 (Speedometer, two-way deflection), Speed setting 2 (Before calculation for acceleration/deceleration), Speed setting 4 (ASR input), Speed detection 2 (ASR input), Line speed detection, Torque current command (Torque ammeter, two-way deflection), Torque current command (Torque ammeter, one-way deflection), Torque command (Torque meter, two-way deflection), Torque command (Torque meter, one-way deflection), Motor current, Motor voltage, Power consumption, DC link circuit voltage, +10V output test, -10V output test, Motor temperature, Heat sink temperature, excitation current command, excitation current detection, Magnetic-flux command, Magnetic-flux calculation, Torque calculation, Torque current detection, U,W phase motor current, U,W phase motor voltage, Torque bias balance adjustment, Torque bias gain adjustment, Universal AO, Option AO	

## 6. Standard Interface RS-485

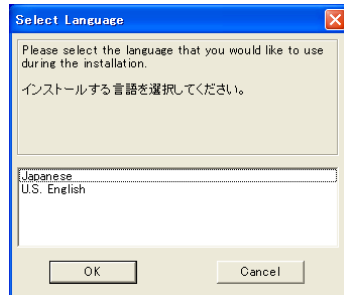
Digital input data	Multistep speed selection, 1,2,4,8,ASR, Acceleration/deceleration selection 1,2, Self-hold selection, Coast-to-stop command, Alarm reset, External alarm, Jogging operation, Speed setting, N2/Speed setting N1, Motor M2 selection, Motor M3 selection, DC control braking command, ACC/DEC zero clear command, UP/DOWN setting, Creep speed switching, UP command, DOWN command, KEYPAD write enable command, PID control cancel, Forward operation/Reverse operation switch over, Interlock (52-2), Write enable through link command, Operation selection through link, Universal DI, Control method selection at the time of motor start, Synchronization command, Zero speed locking command, Pre-exciting command, Speed command limit cancel, H41 [torque command] cancel, H42 [torque current command] cancel, H43 [magnetic-flux command] cancel 34, F40 [torque limiter mode 1] cancel, Torque limiter (level 1, level 2 selection), Bypass, Torque bias command 1,2, Droop selection, Ai1,2,3,4, Zero hold, Ai1,2,3,4 Polarity change, PID output inverse changeover, PG alarm cancel, Undervoltage cancel, Ai torque bias hold, STOP1,2,3, DIA data latch, DIB data latch, Multi-winding function cancel, Option Di 1,2,3,4,5,6
Digital output data	Inverter running, Speed detected, Speed agreement, Reaching the preset speed, Speed detection 1,2,3, Stopping on undervoltage, Torque polarity detection (braking/driving), Torque limiting, Torque detection1,2, KEYPAD operation mode, Inverter stopping, Operation ready output, Magnetic-flux detection signal, Motor M2 selection status, Motor M3 selection status, Brake release signal, Alarm indication1,2,3,4, Cooling fan operating, Retry operation mode, Universal DO, Heat sink overheat early warning, Synchronization completion, Lifetime alarm, Under accelerating, Under decelerating, Inverter overload early warning, Motor temperature early warning, Motor overload early warning, DB overload early warning, Transmission error, Load adaptive control under limiting, Load adaptive control under calculation, Analog torque bias hold, Option DO 1,2,3,4,5,6,7,8,9
Print · Save	Trace data can be printed and saved. CSV format is also available, therefore the file can be read by other applications.
Trial operation	
Operation	FWD, REV, STOP command can be used.
Speed setting	Digital speed setting command can be used.
Control input	X1 to X9 can be input.
Monitor	Speed command, actual speed, torque and operational status can be monitored.

## 6.5.3 How to Install

### (1) Preparation

Place the CD-ROM while facing the blank side down.  
Follow the manual attached to the CD-ROM to launch Setup.exe.

### (2) Language selection



Select the installation language. Select Japanese for a Japanese language-based operating system, or select U.S. English for other operating systems.

Figure 3 Language selection

### (3) Welcome message

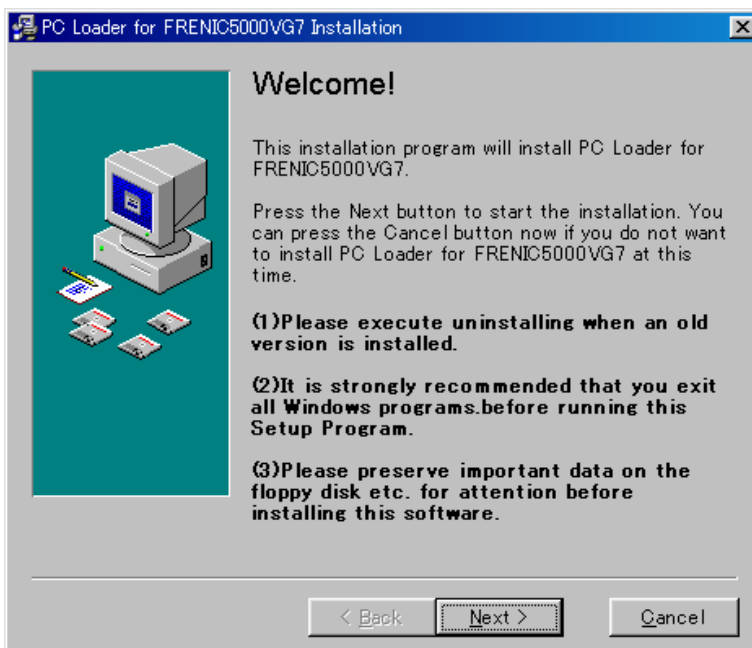


Figure 4 Welcome Message

Before running this installation program, be sure to exit all application programs. (because installation of PC loader requires to restart the computer, which will delete the application data). A welcome message (Figure 4) automatically appears. Read the message carefully and click “Next (N)”.

**Note:** This subsection describes the installation method assuming that the PC loader is installed on MS-Windows98. The installation method may differ according to the OS version. If installing on the other OS, replace the description with the operations that corresponds to the OS to be used.

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### (4) End user software license agreement

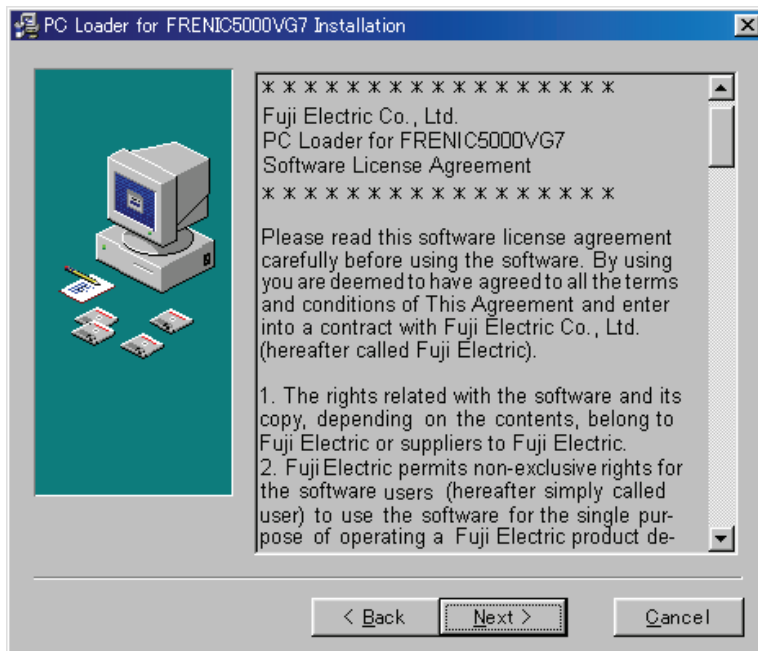


Figure 5 End User Software License Agreement

The end user software license agreement (Figure 5) will appear.

Read this agreement carefully, and if you agree with this, click “Next (N)”.

If not, click “Cancel”.

### (5) Input of the user information

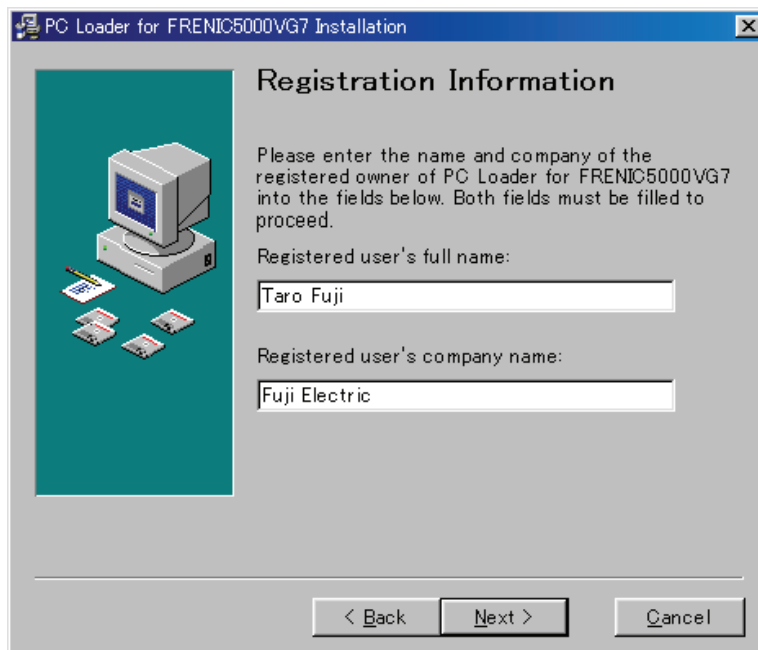


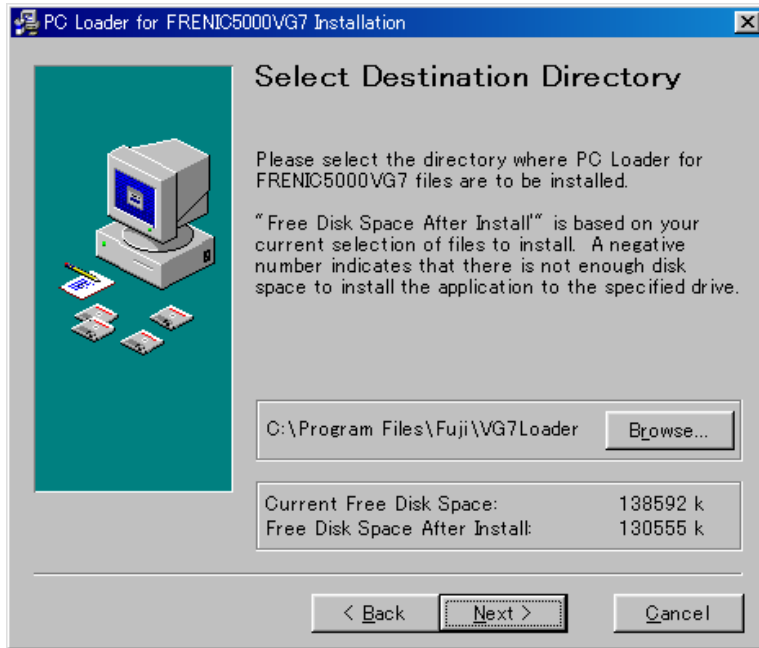
Figure 6 User Information

Always input the user name and the company name. Without these data, you cannot proceed to the next step.

After inputting the user name and the company name, click “Next (N)”.

Note: Enter each of the registration user name and company name within 24 single-byte characters (or within 12 double-byte characters).

(6) Locating the directory to be installed

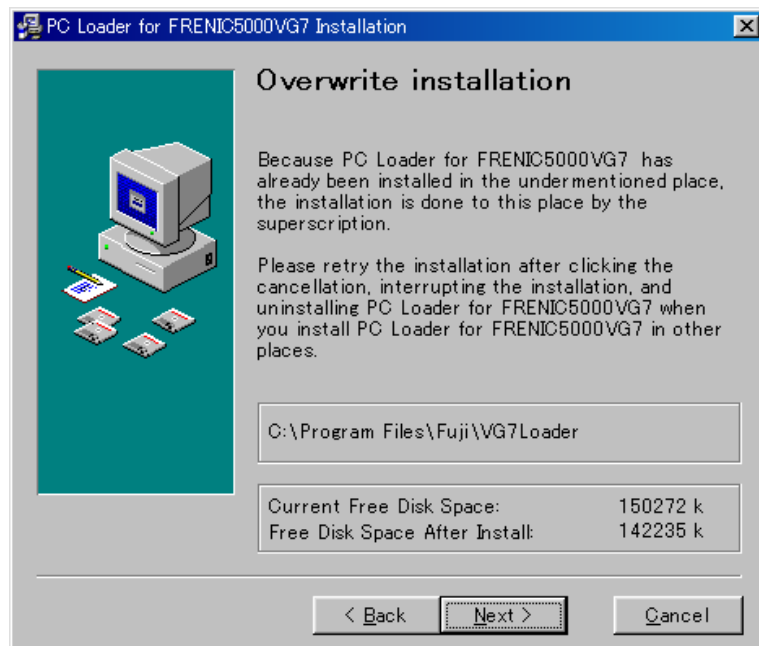


The default directory where the software is installed is C:\ProgramFiles\Fuji\FRENIC. If there is no problem, install in this directory.

When you change the directory, click "Browse...". At the same time, confirm the free area. After confirming the disk space and changing the directory, click "Next (N)".

Figure 7 Locating the Directory to be Installed

If the old version of the program is installed, the following screen will appear.



In this case, only the "Rewrite install" is available. If you want to change the directory for installation, click "Cancel" to stop installation. Uninstall the old version, and retry installation.

When installing the software by overwriting, click "Next (N)".

Figure 8 Rewrite Install



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### (7) Selecting the component to be installed

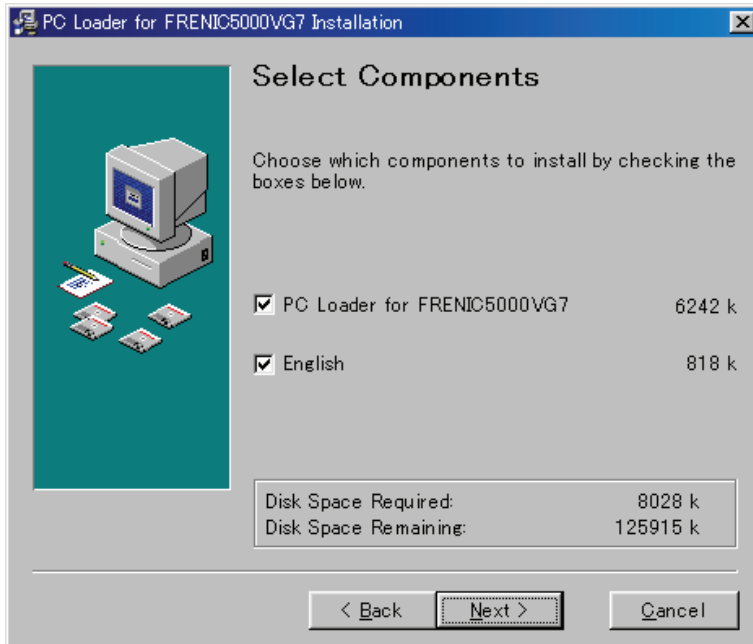


Figure 9 Selecting the Component

### (8) Selecting the program manager group

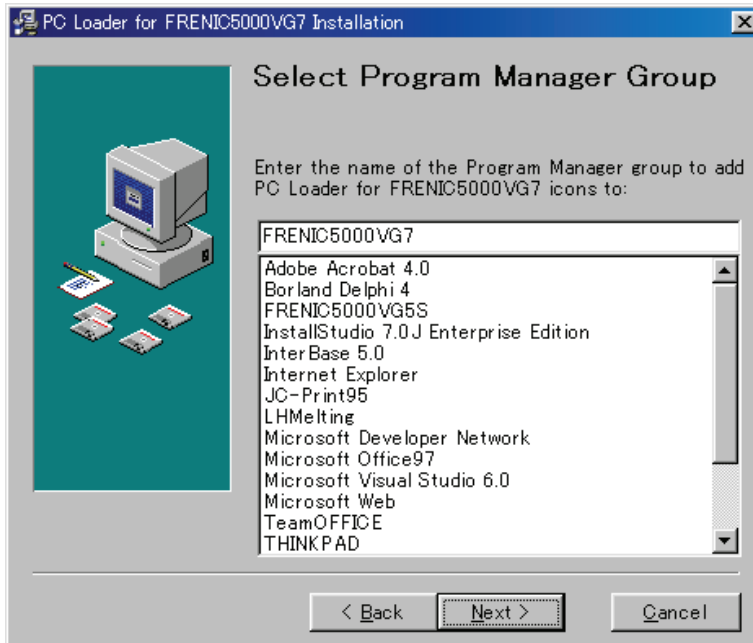


Figure 10 Selecting the Program Manager Group

You can select the component to be installed. The following components are available:

- (1) PC Loader for FRENIC5000VG7
- (2) Japanese

Currently, both of these components should be installed. When these components are installed separately, the program cannot run.

Check two columns and click "Next (N)".

By default, "Program manager group" is installed in "FRENIC5000VG7". If there is no problem, proceed without adding any change. Click "Next (N)" to go to the next step.

(9) Selecting the starting method

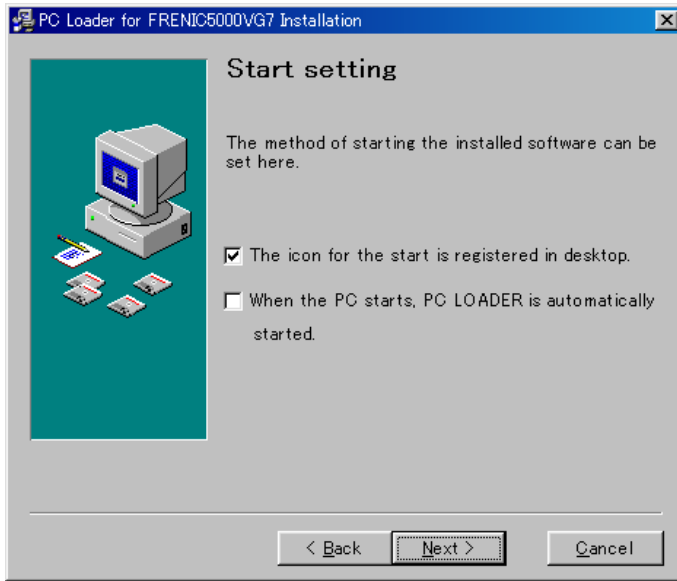


Figure 11 Selecting the Starting Method

- (1) If you want to create the startup icon on the desk top, check “Register the startup icon on the desk top”.
  - (2) If you want to start the PC LOADER automatically when starting the Windows, check “Start the PC LOADER automatically at the time of the computer start”.
- After the checking, click “Next (N)”.

(10) Starting the copy to the computer

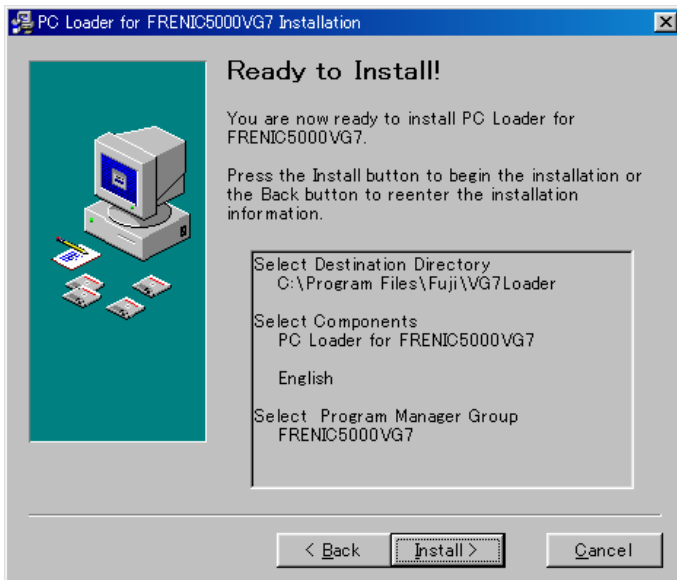


Figure 12 Starting the Copy

Click “Start (S)”, and the copy of the program from CD-ROM to the computer will start. If you want to change the indicated settings, click “Back (B)” and set them again.

When “Start (S)” is clicked, the “Installing” screen will appear as shown in Figure 13.

(11) Entering password

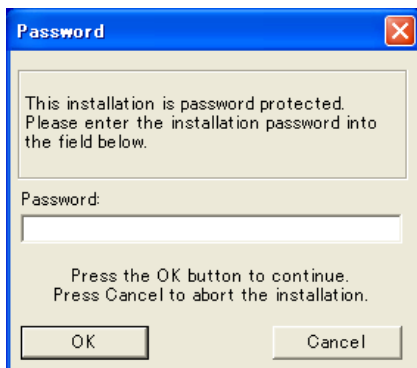


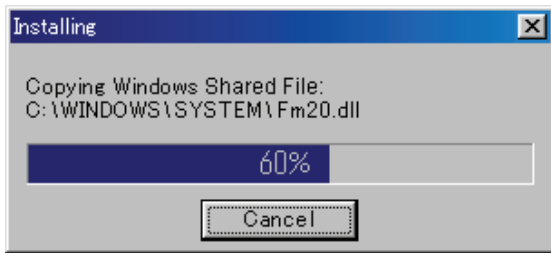
Figure 13 Password

Enter the password. The password is specified on the CD-ROM case as a “Serial No.” Click on “OK.” The “Installing” screen shown in Fig. 14 is displayed.

## 6. Standard Interface RS-485

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(12) Indication of “Now copying”



When the “Start (S)” is clicked on the screen in Figure 13, the left dialog box appears, indicating that the PC LOADER is being installed. When the bar in the middle of the screen reaches 100%, the installation is completed.

Figure 14 Dialog Box Showing Progress of Installation

(13) Indication after the completion of the copy

On completion of program copy, the configuration of the PC will start. Wait until the message of “Rewriting the system configuration file. Wait a second” disappears.

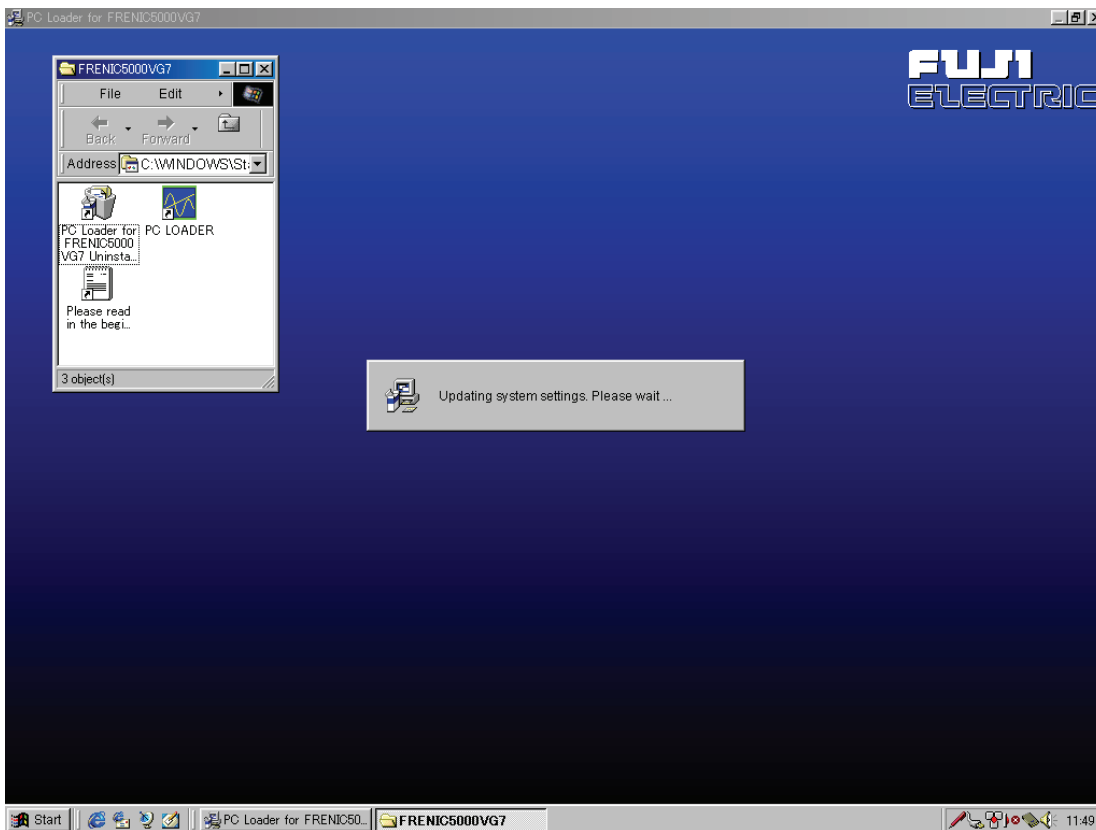
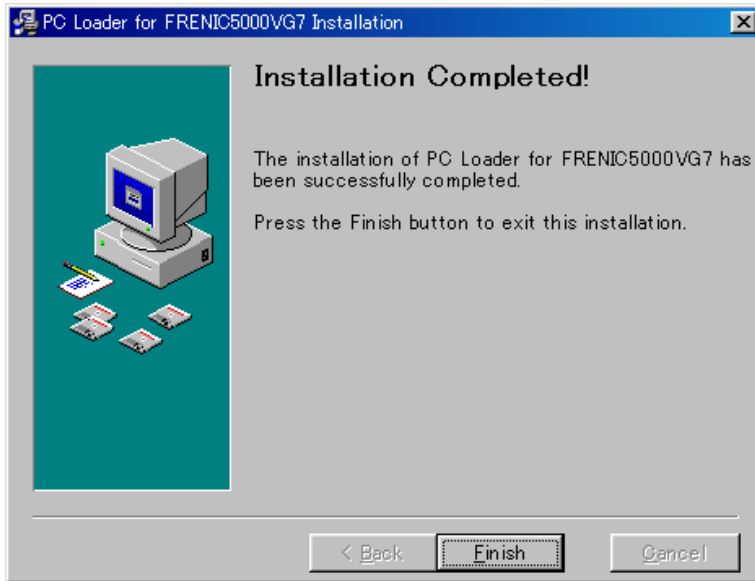


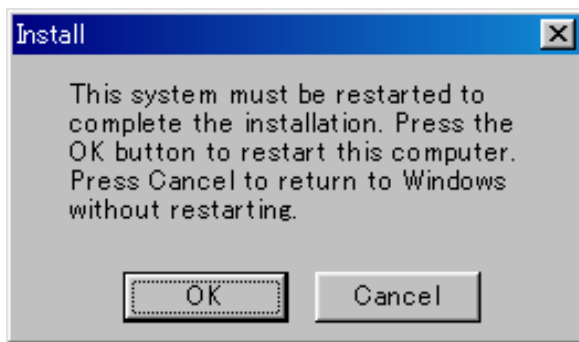
Figure 15 System Configuration is Being Set

(14) Installation completed



When the installation is completed, the left screen will appear. Click "Finish (F)" to complete installation.

Figure 16 Installation Completed



When clicking the "Finish(F)", the left screen will appear. The computer should be restarted to start the installed application. If other applications are not closed, click "Cancel" and exit all the applications. After that, restart the computer.

Figure 17 Finish

Note: If this screen does not appear, there is no need to reboot.

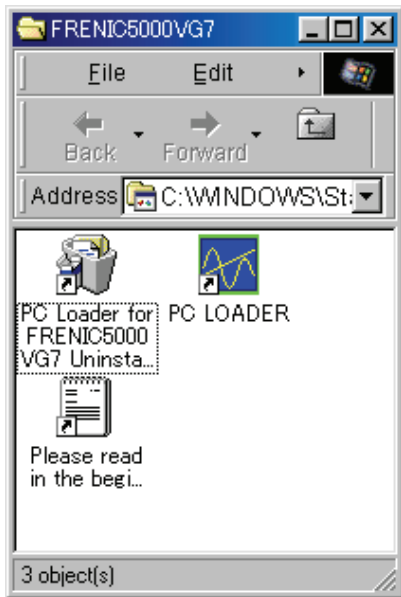
# 6. Standard Interface RS-485

## 6.5.4. Simple Operation Method

### 6.5.4.1 Start of PC Loader

The way of starting PC loader differs according to the selected starting method.

- (1) If “Start the PC LOADER automatically at the time of the computer start” is selected, PC Loader will start automatically when the computer is started.
- (2) If “Register the startup icon on the desk top” is selected, click this startup icon to start.
- (3) Click PC LOADER in FRENIC5000VG7S folder.



Note: When the folder name is changed, the dialog box in the left figure shows the new folder name.

Figure 18 FRENIC5000VG7S Folder

- (4) Select PC Loader in the start menu as shown in Figure 19.

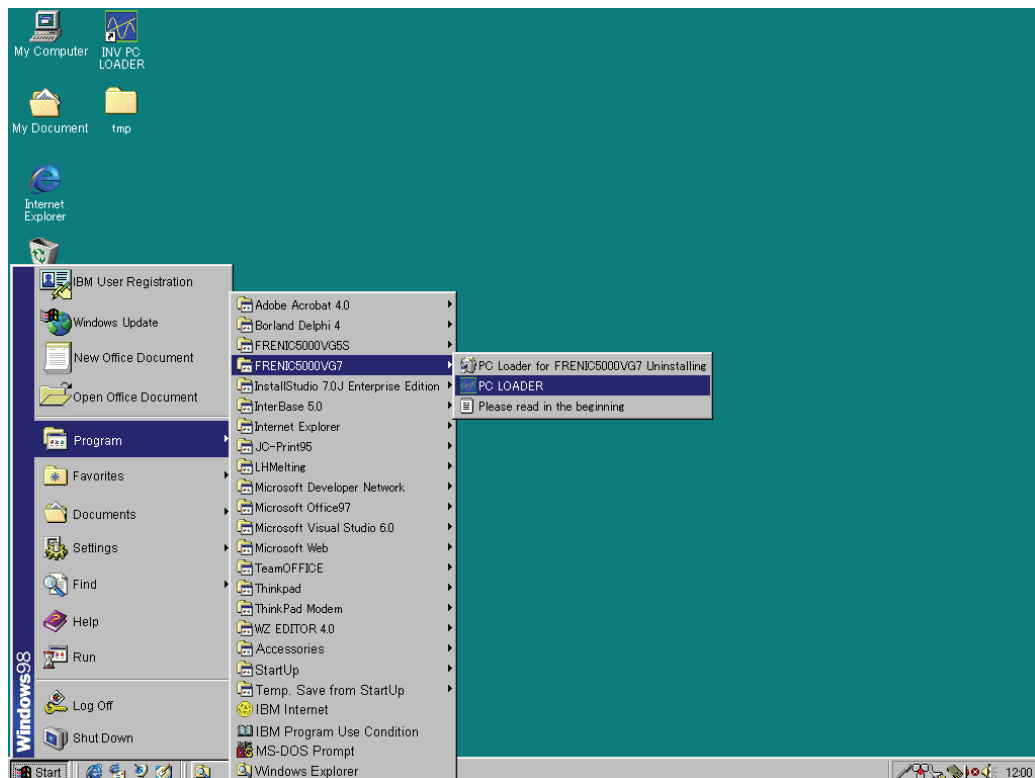


Figure 19 Start from the Start Menu

## 6.5.4.2 Communication Setup

Set the data for communication between the computer and the inverters.

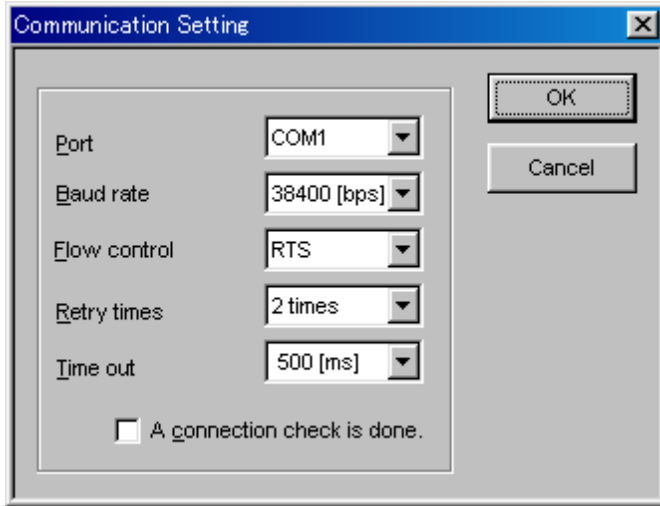


Figure 20 Communication Setup

- (1) Selection of port  
Select the connection port of the computer (four ports from COM1 to COM4 are available).
- (2) Baud rate setting  
Set the communication speed.
- (3) Flow control  
Select the flow control.

### (4) Number of retries

Set the number of retries to be done automatically when the communication error occurs. You can select the number of times from zero to ten.

### (5) Setting time-out error time

Set the time before timeout error occurs when no reply is returned from the inverter.

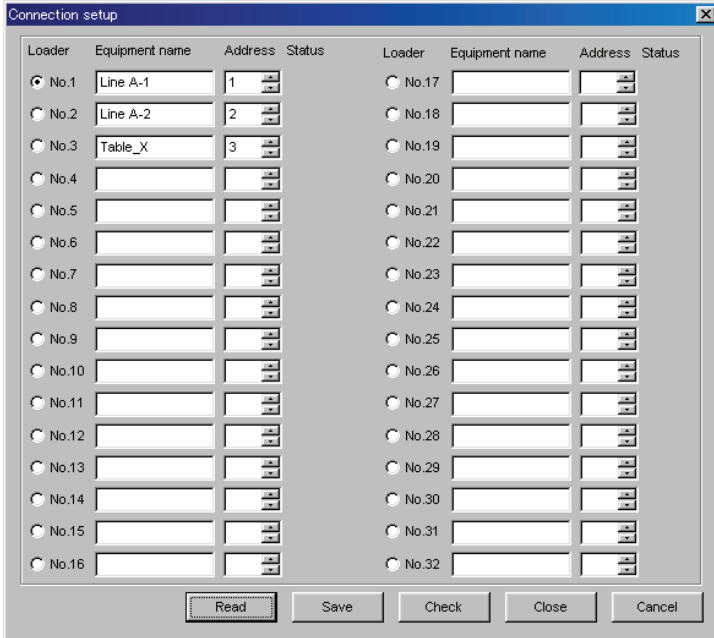
### (6) To do the connection check or not

Select whether the communication line should be connected or not. If this box is checked, the communication will be made at any time, and the processing of the computer will delay by the time taken for communication. Always check here during the real-time processing.

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## 6.5.4.3 Connection Setup

Next, select the inverters to which PC is connected for communication.



- (1) **Loader connection**  
Select the inverters to be connected with the computer.
- (2) **Inverter equipment name**  
Enter the of the inverter name currently used. (You can input freely)
- (3) **Channel number**  
Set the inverter number.
- (4) **Communication status**  
When “Confirm Communication” is clicked, the ON/OFF status appears in this column.  
(Refer to Figure 22.)

Figure 21 Connection Setup

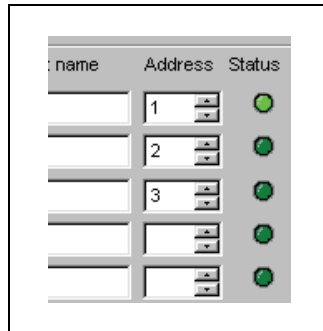
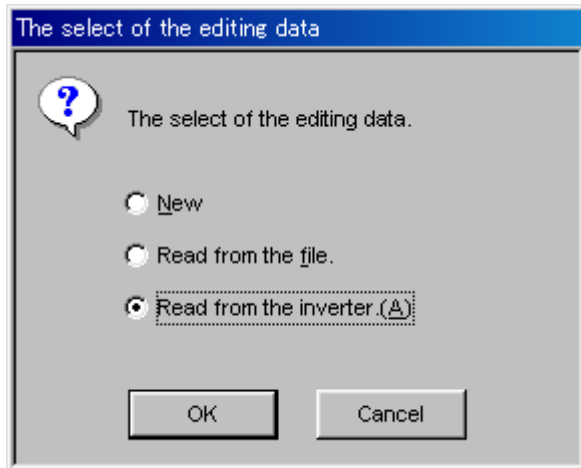


Figure 22 Communication Status

## 6.5.4.4 Function Code Setup

Edit, compare and initialize the function codes.

### (1) Selecting the data to be edited



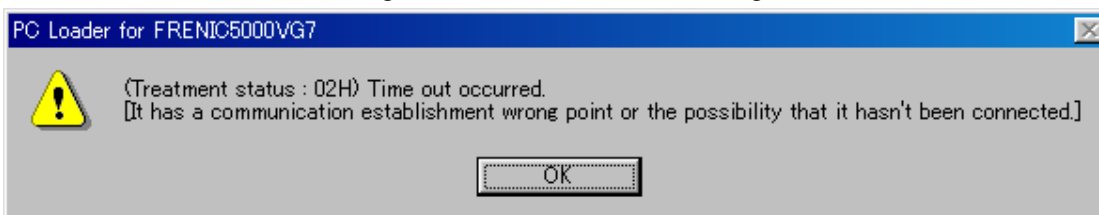
“Selecting the data to be edited” window will appear when the function code setup mode starts. Select the data to be edited and Click OK, then the new edit screen will start.

Figure 23 Selecting the Data to be Edited

- **New File (N)**  
Select this button mainly when the computer is not connected to the inverter.  
Edit the function codes based on the function codes prepared in the inverter support software.
- **Read the file in the computer (F)**  
Select this button when editing the function code setup file which has been already saved.
- **Load from the inverter (A)**  
Select this button when editing the function codes of the currently connected inverter.

### ! CAUTION

If “Load from the inverter” is selected although the computer is not connected to the inverter, “time-out” error will occur and the dialog box below shows an error message.



In this case, click “OK” and reconnect.



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(2) Edit by list  
Edits the function codes in the list.

The screenshot shows the 'Loader for RENIC5P00VG7' software interface. The main window displays a list of function codes (FNo) and their parameters. Callouts (A) through (H) point to menu items: (A) File, (B) Save, (C) Print, (D) Print preview, (E) Quick menu, (F) Function code information, (G) Connection, and (H) Version information. Callouts (I) through (K) point to status bars at the bottom: (I) User definition, (J) Selected function code setup value, (K) Initialization of the inverter, (L) Reload from inverter, (M) Initial, (N) Transmits the changed points to the inverter, (O) Parameter colors, (P) Transmits all data to the inverter, (Q) Print setting, and (R) Close.

FNo	Function name	Establishme...	Establishment range	Factory shi...	The change d...	Read Only
F00	Data protection	0	0 to 1	0	Disable	
F01	Speed setting N1	0	0 to 7	0	Disable	
F02	Operation method	0	0 to 1	0	Disable	
F03	M1 max. speed	1500	50 to 24000 r/m	1500	Disable	
F04	M1 rated speed	1500	50 to 24000 r/m	1500	Disable	
* F05	M1 rated voltage	188	80 to 999 V	80	Disable	
* F07	Acceleration time 1	8.00	0.01 to 3600 s	5.00	Enable	
* F08	Deceleration time 1	6.00	0.01 to 3600 s	5.00	Enable	
F10	M1 electronic thermal overload	0	0 to 2	0	Enable	
* F11	M1 electronic thermal overload	21.00	0.01 to 2000 A	0.01	Enable	
* F12	M1 electronic thermal overload	5.0	0.5 to 75.0 min	0.5	Enable	
F14	Restart mode after momentar...	0	0 to 5	0	Enable	
F17	Gain (for speed setting signal)	100.0	0.0 to 2000 %	100.0	Enable	
F18	Bias (for speed setting signal)	0	-24000 to 24000 r/m	0	Enable	
F20	DC brake (Starting speed)	0	0 to 3600 r/m	0	Enable	
F21	DC brake (Braking level)	0	0 to 100 %	0	Enable	
F22	DC brake (Braking time)	0.0	0.0 to 30.0 s	0.0	Enable	
F23	Starting speed	0.0	0.0 to 150.0 r/m	0.0	Disable	
* F24	Starting speed (Holding time)	1.00	0.00 to 10.00 s	0.00	Disable	
F26	Motor sound (Carrier freq.)	7	0.75 to 15 kHz	7	Disable	
F27	Motor sound (Sound tone)	0	0 to 3	0	Disable	
F36	30RY operation mode	0	0 to 1	0	Disable	
F37	Stop speed	10.0	0.0 to 150.0 r/m	10.0	Disable	
F38	Stop speed (Detection method)	0	0 to 1	0	Disable	
F39	Stop speed (Zero speed holding)	0.50	0.00 to 10.00 s	0.50	Disable	
F40	Torque limiter mode 1	0	0 to 3	0	Disable	
F41	Torque limiter mode 2	0	0 to 3	0	Disable	
F42	Torque limiter value (level 1)	0	0 to 5	0	Disable	
F43	Torque limiter value (level 2)	0	0 to 5	0	Disable	
F44	Torque limiter value (level 1)	150	-300 to 300 %	150	Enable	
F45	Torque limiter value (level 2)	10	-300 to 300 %	10	Enable	
F46	Mechanical loss compensation v...	0.00	-300.00 to 300.00 %	0.00	Enable	
F47	Torque bias T1	0.00	-300.00 to 300.00 %	0.00	Enable	
F48	Torque bias T2	0.00	-300.00 to 300.00 %	0.00	Enable	
F49	Torque bias T3	0.00	-300.00 to 300.00 %	0.00	Enable	
F50	Torque bias activation timer	0.00	0.00 to 1.00 s	0.00	Enable	
F51	Torque reference monitor (Pola...	0	0 to 1	0	Enable	
FR2	IFD monitor (Displacement coeffic...	1.00	-999.00 to 999.00	1.00	Enable	

Figure 24 Setting Function Code List

(A) File

Used to open, save, and print the existing function code file.

(B) Save

Used to save the function codes being edited.

**If you choose the CSV format ( \* . CSV) at the time of saving, the file can be opened by Microsoft Excel etc.**

(C) Print

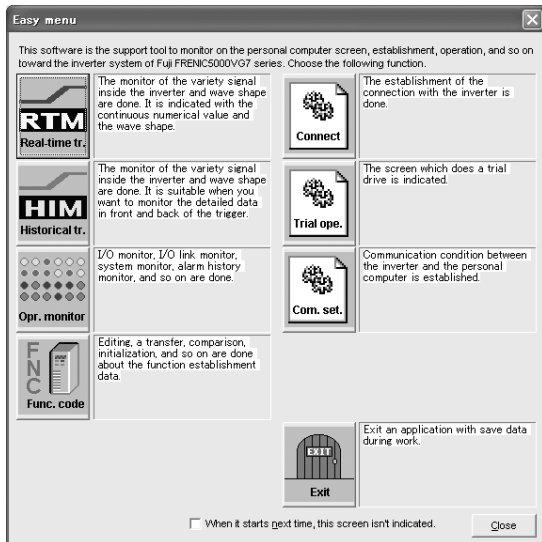
Used to print the parameters being edited.

Prints in the form of a list.

(D) Print preview

Previews the printed image.

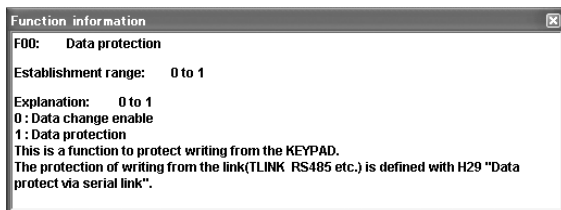
(E) Quick menu



This screen allows you to jump from the menu screen to each setting screen. This screen covers all the fundamental data setting screens.

Figure 25 Quick Menu

(F) Function code information



The left window shows the information on the selected function code.

Figure 26 Function Code Information Window

(G) Connection

Used to set the data communication as the persistent connection or not.

(H) Version information

Shows the version of this software.

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(I) User definition

Right click the mouse on an arbitrary function code in the list and select “user definition 1 to 3” to assign the function code to user definition 1 to 3. Register frequently used function

(J) Selected function code setup value

Indicates the code number and the setup value of the currently selected function code.

You can edit the currently selected function code by either the numerical keys or the spin buttons on the right side of this data input column.

(K) Initialization of the inverter

Changes the function code setup value of the connected inverter to the factory setup value.

(L) Reload from inverter

Loads the function code setup values from the currently connected inverter and inserts it into the file being edited.

**Save the file before executing this function to prevent the file being edited from getting lost.**

Use this function to reconfirm the function codes transmitted to the inverter.

(M) Initial value

Sets the currently selected function code setup value as an initial value.

(N) Transmits the changed points to the inverter

Writes only the changed function codes to the connected inverter.

\* Function code with blue setting (Refer to (O).)

(O) Parameter colors

Black: Function codes which are not yet changed.

Blue: 1) Function codes which are already changed.

The color will become black after the change is written in the inverter correctly.

“\*” before the function code shows that the current setup value differs from the factory setup value. However, for those function codes where the factory shipment setting varies according to the motor capacity and PC board, the minimum value is displayed as a factory shipment value.

(Refer to Section 13.2 Function Code List.)

(P) Transmits all data to the inverter

Writes all of the function code setup value being edited in the connected inverter.

(Q) Print setting

Sets the print condition.

(R) Close

Quits the function code setup.



After changing the setup value, if the data is not saved, the screen as shown in the left figure will appear.

If you want to save the data, click “cancel” and save the data according to “(B) Save”.

Figure 27 Notice that the Data are not Saved

### (3) Edit by function

Edits the function codes by classifying the codes by function.

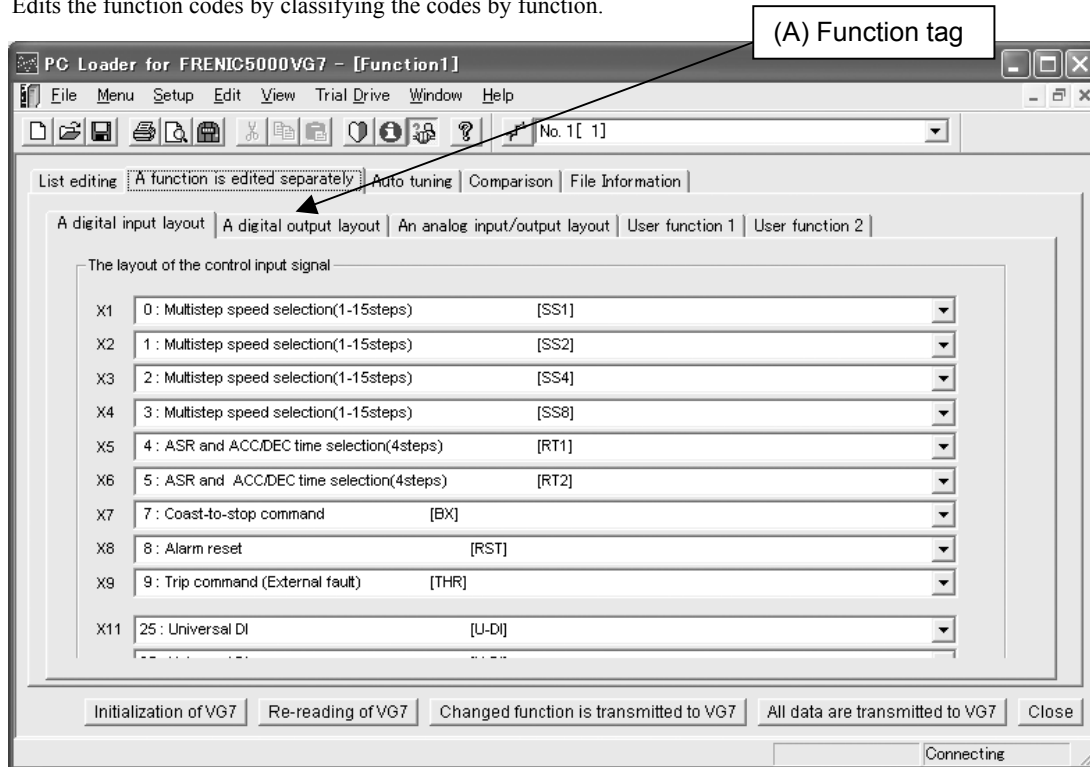


Figure 28 Edit by Function

#### (A) Function tag

Tags classified by the function.

#### 1) Digital, analog input/output allocation

Selects the tag of the function to be edited.

Refer to (2) Edit by list for the procedure of initialization of the inverter etc.

## 6. Standard Interface RS-485

### (B) User function

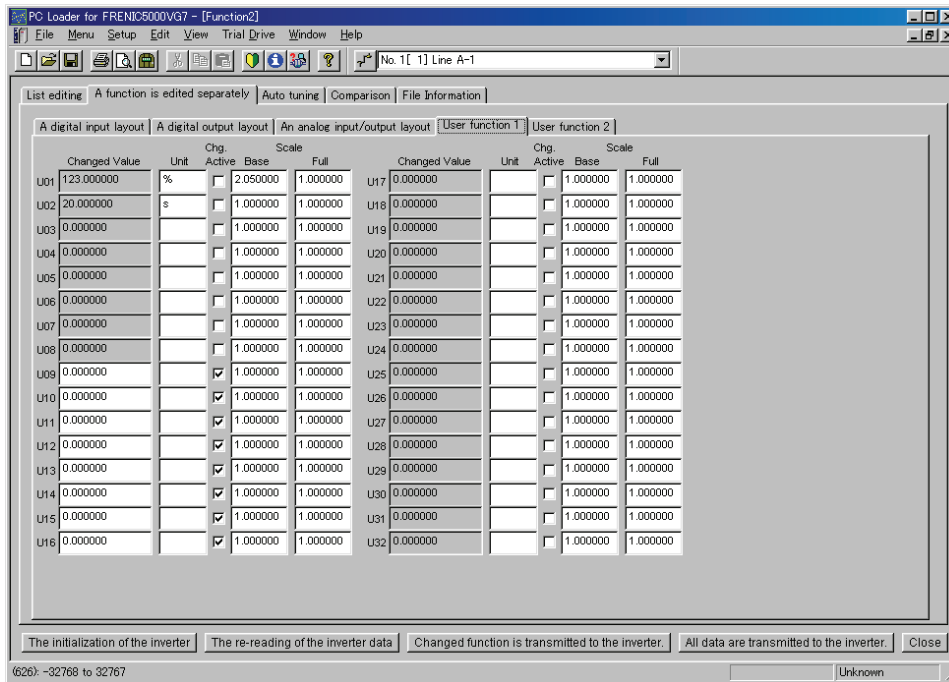


Figure 29 Edit by Function

The above table is used to convert the hexadecimal data used by the computer to the decimal data that you can easily understand. You can complete this table by entering required calculation values.

- In case of loading the data from the inverter (reload of the inverter data)  
Regardless of the check in the converted value reference box, indicates the result of calculation of “communication data” × ”base scale” / ”full scale” = ”converted value” in the text box of the converted value.
- In case the converted value reference box is not checked.  
The text box of the converted value is set as “**read only**” (edit is impossible). The color of the text box will also change.  
The indicated converted value will be changed according to the change of base scale and full scale. (Recalculated when the focus moves. The communication data will not be changed).
- In case the converted value reference box is checked.  
The converted value can be edited in the text box. In this case, the communication data will also be changed (recalculated when the focus moves).  
The communication data will be changed according to the change of base scale and full scale. (Recalculated when the focus moves. The data of the converted value will not be changed).
- When the U code is edited in the “edit by list” screen, the converted value will be recalculated regardless of the check in the converted value reference box.

(4) Auto tuning

Executes the auto tuning for each constant of the inverter.

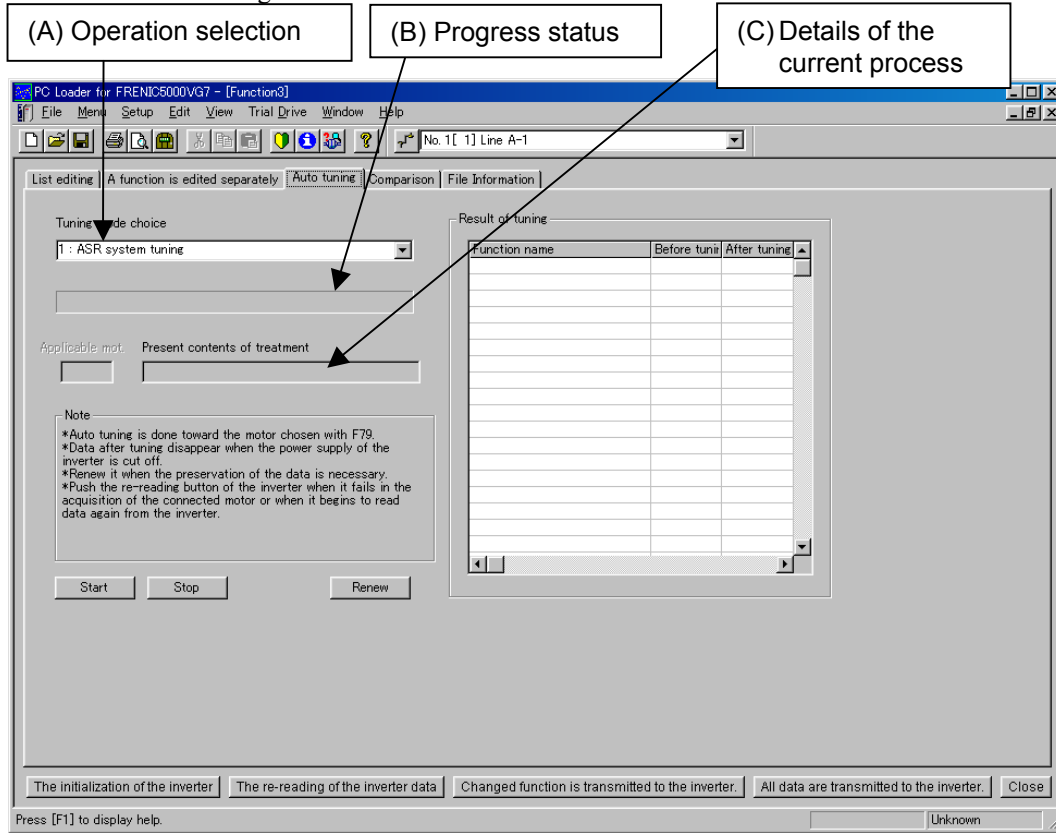
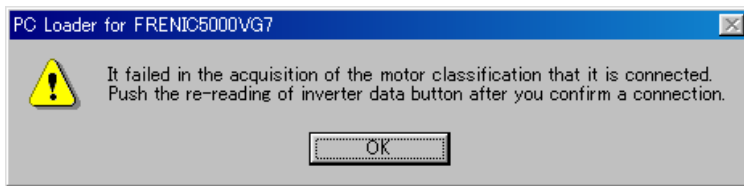


Figure 30 Auto Tuning

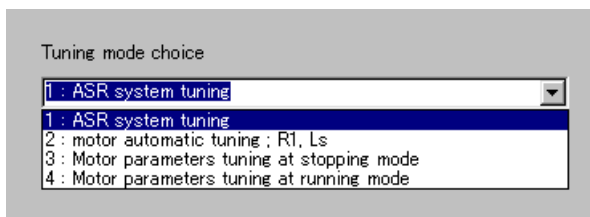
If the PC fails to acquire the motor type (not connected), the in the following message window will appear.



In this case, auto tuning cannot be executed until the inverter data successfully reloaded.

Figure 31 Acquisition Failed

(A) Selecting operation



Select the auto tuning operation from the pull-down menu as shown in the left figure.

Figure 32 Selection of the Operation

(B) Progress status

Indicates the progress status of the auto tuning by a bar (indicated in percent).

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### (C) Details of the current process

Indicates the details of the actual process during auto tuning.

Note: Auto tuning can be executed only if P02 is “37 (OTHER).” For details of auto tuning, refer to “H01 Tuning Operation Selection” in Section 4.3.5 “H Code.”

### (5) Comparison

Compares the following combinations.

- 1) Function codes being edited and data of the connected inverter.
  - 2) Function codes being edited and the saved function code setup file.
- 1) Compares the function code being edited with the setup value of the function code of the connected inverter.

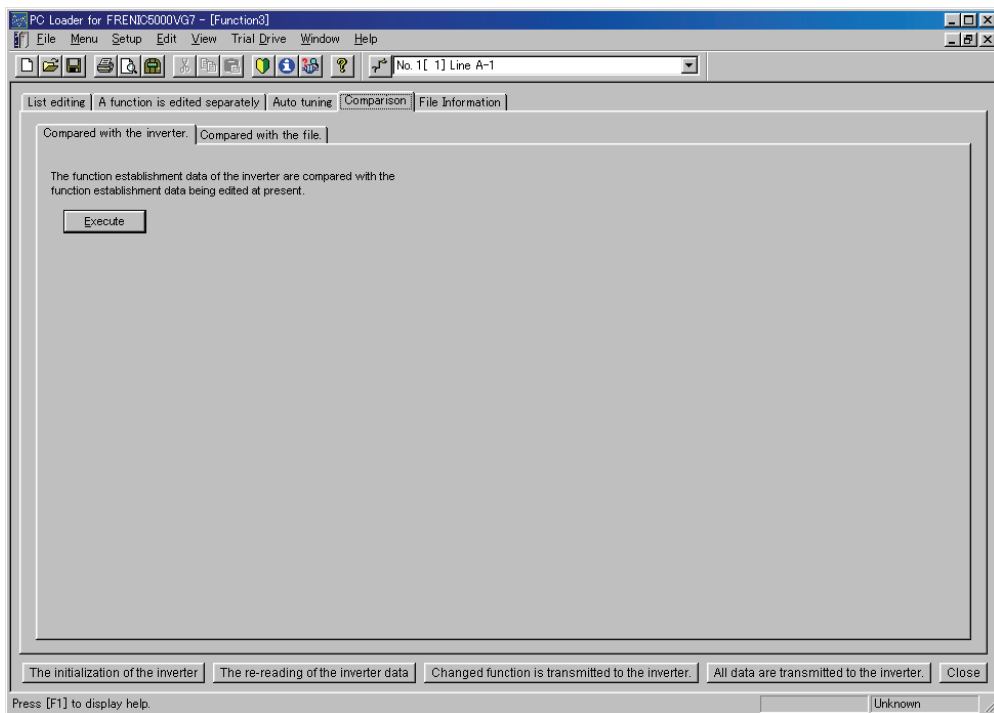
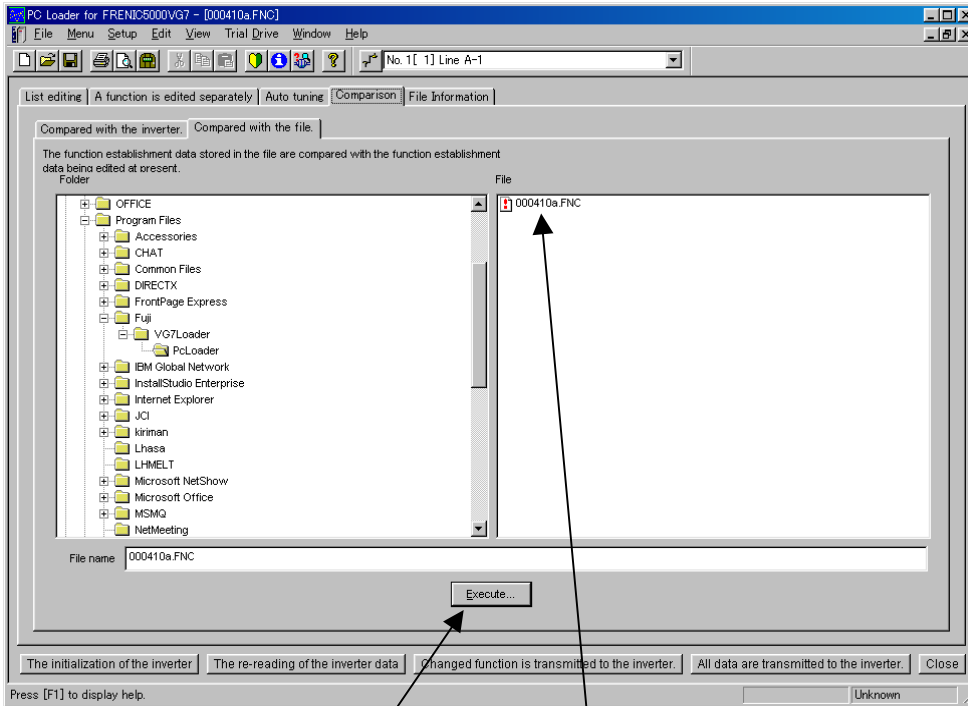


Figure 33 Comparison-inverter

2) Compares the function code being edited and the saved function code file.

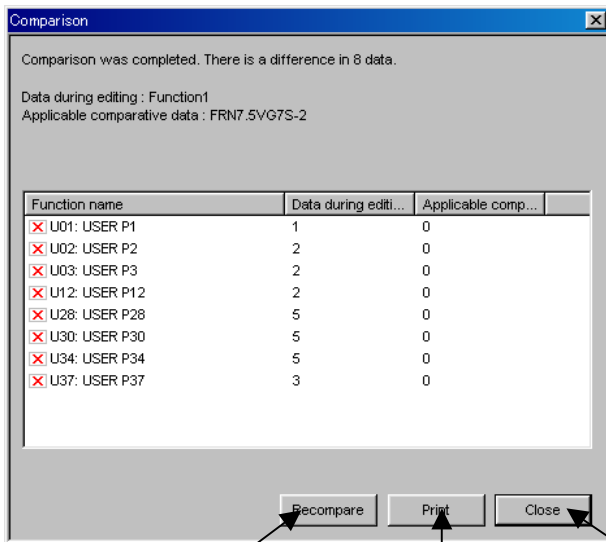


After the selection, click "Enter" and the comparison will start.

Selects the function code setup file to be compared.

Figure 34 Comparison-file

■ The result of the comparison



The left window appears, showing comparison results. The items indicated here are only those of which data are different from each other.

Compares again

Print the result

Close the result

Figure 35 The Result of the Comparison



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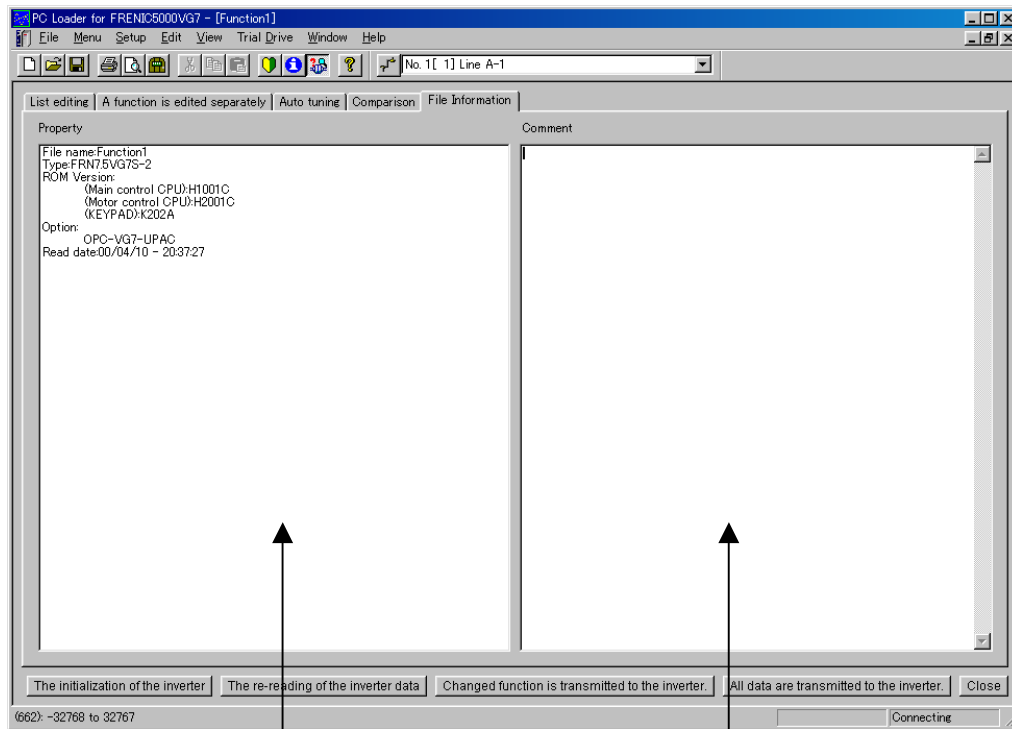
- Print of the result of the comparison

Print out the comparison result.

<u>Comparison result</u>		2000/ 4/10 20:23:16	
Source:Function1			
Destination:FRN7.5VG7S-2			
Number of differences:8			
FNo.	Function code Name	Sorce	Destination
U01	USER P1	1	0
U02	USER P2	2	0
U03	USER P3	2	0
U12	USER P12	2	0
U28	USER P28	5	0
U30	USER P30	5	0
U34	USER P34	5	0
U37	USER P37	3	0

Figure 36 Output Indication

## (6) File information



Indicates the property of the function codes being edited.

- File name at the time of save.
- System condition of the loaded inverter.
- Date of load from the inverter.

You can add comments freely to the file being edited.

This comment will be saved automatically at the time of file save.  
Up to 500 characters can be accepted.

Figure 37 File Information

## 6. Standard Interface RS-485

### 6.5.4.5 Operation Monitor

#### (1) Multiple monitor

Indicates the operational status of the inverter whose terminal number is set by the connection setup.

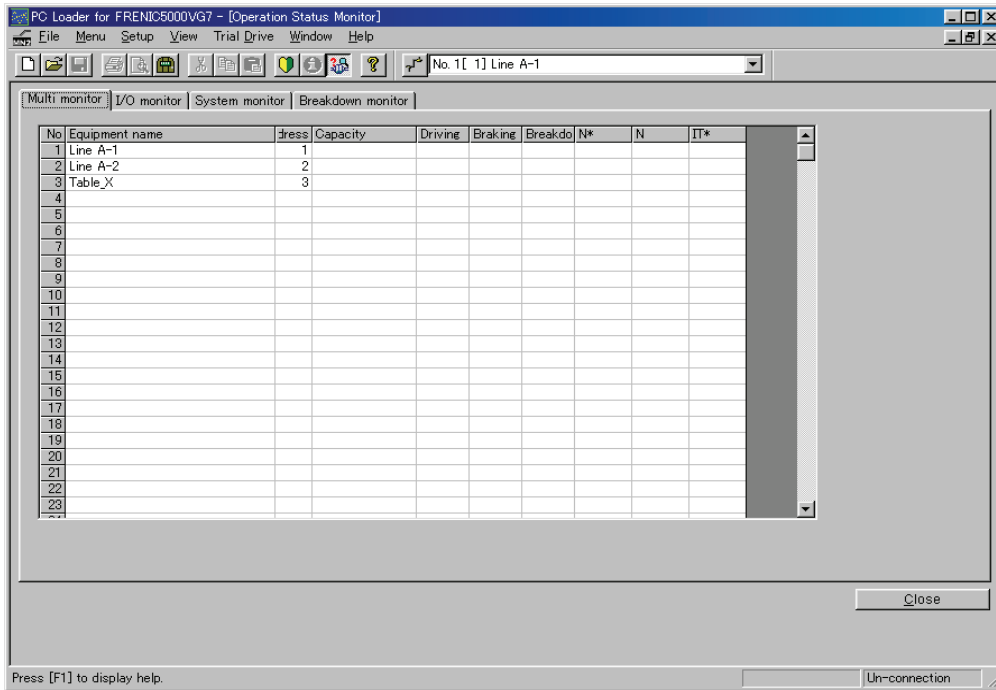


Figure 38 Multiple Monitor

- 1) Name of the equipment : Indicates the name which was input in the connection setup.
- 2) Terminal number : Terminal number of the inverter
- 3) Capacity : The type (capacity) of the inverter
- 4) In operation : 1=In operation 0=Not in operation
- 5) In braking : 1=Braking 0=Not braking
- 6) At fault : 1=Alarming 0=not yet alarming
- 7) Close : Closes the operation monitor.

**Note:** If the PC fails to acquire the inverter operational status, the data columns are left blank as shown at No. 2 and No. 3 in the above screen.

(2) I/O monitor

Indicates the ON/OFF of the input/output control signal of the connected inverter.

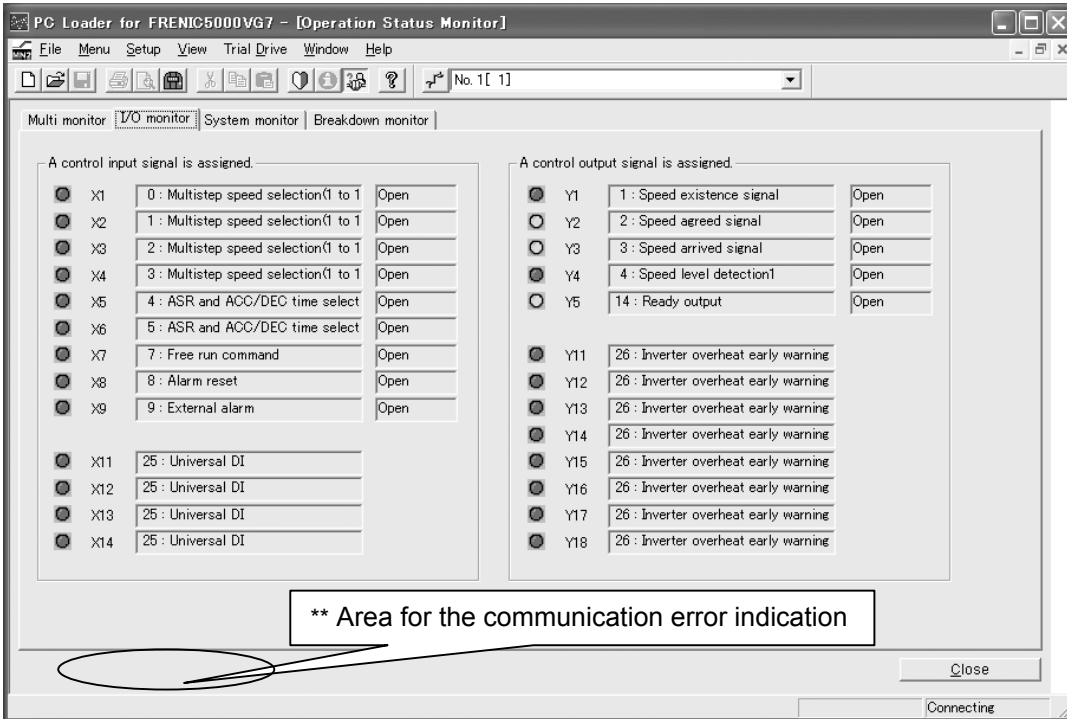


Figure 39 I/O Monitor

1) Status of the input/output control signal

- ON
- OFF

2) Close :Closes the operation monitor.

3) Communication error indication: The message in the following figure will appear if the acquisition of data from the inverter fails.

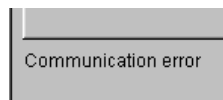


Figure 40 Communication Error Indication

System monitor and fault monitor will be indicated in the same way.

## 6. Standard Interface RS-485

### (3) System monitor

Indicates the system condition of the connected inverter and motor.

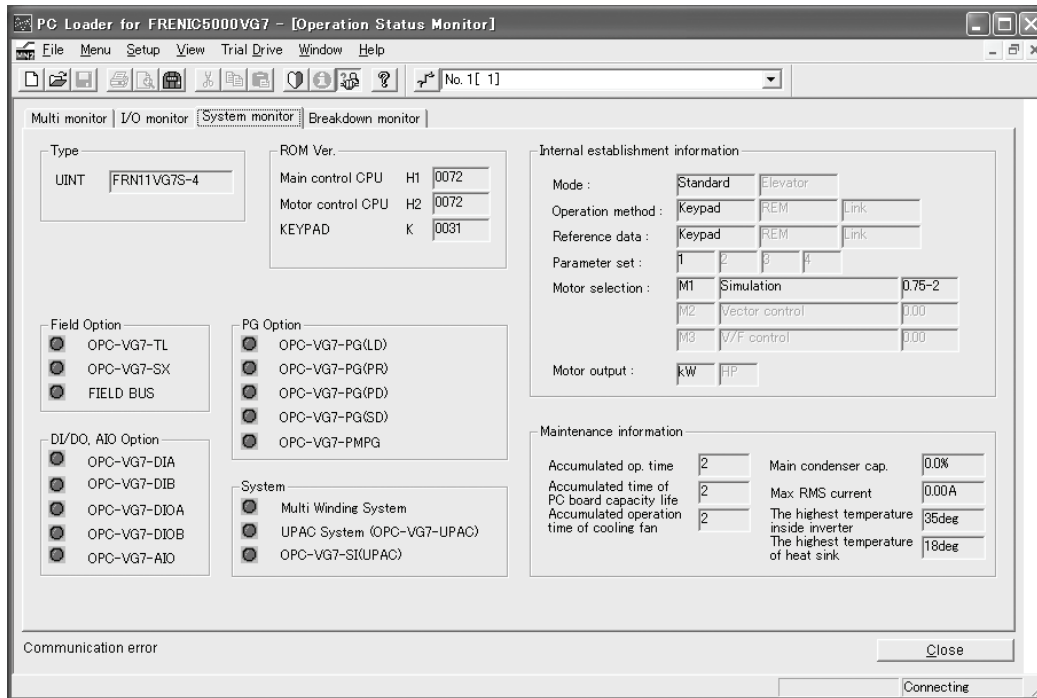


Figure 41 System Monitor

#### 1) Condition of each option

- (Green light on) :Loaded
- (Green light off) :Not loaded

#### 2) ROM Ver.

Indicates the ROM Ver. (version information of ROM) of two CPUs in the inverter (main control and motor control) and a CPU in KEYPAD panel. In case of the trouble of the inverter, we may sometimes require this ROM Ver. number.

#### 3) Type

Indicates the unit information of the inverter (capacity, voltage).

#### 4) Information of the internal configuration

- Mode : Standard/Lift (function code H70).
- Operation command : Effective input device among KEYPAD (LOC), terminal block (REM), and LINK (Link, COMM).
- Command data : Effective input device among KEYPAD (LOC), terminal block (REMM), and LINK (Link, COMM).
- Parameter set : Acceleration and deceleration time, switching-over status of ASR setup.
- Motor selection : Selection of M1, M2, M3, control status, motor capacity

#### 5) Maintenance information

Indicates the data for judging the inverter's life and load information.

#### 6) Close : Closes the operation monitor screen.

#### (4) Fault monitor

Indicates the alarms occurring in the connected inverter.

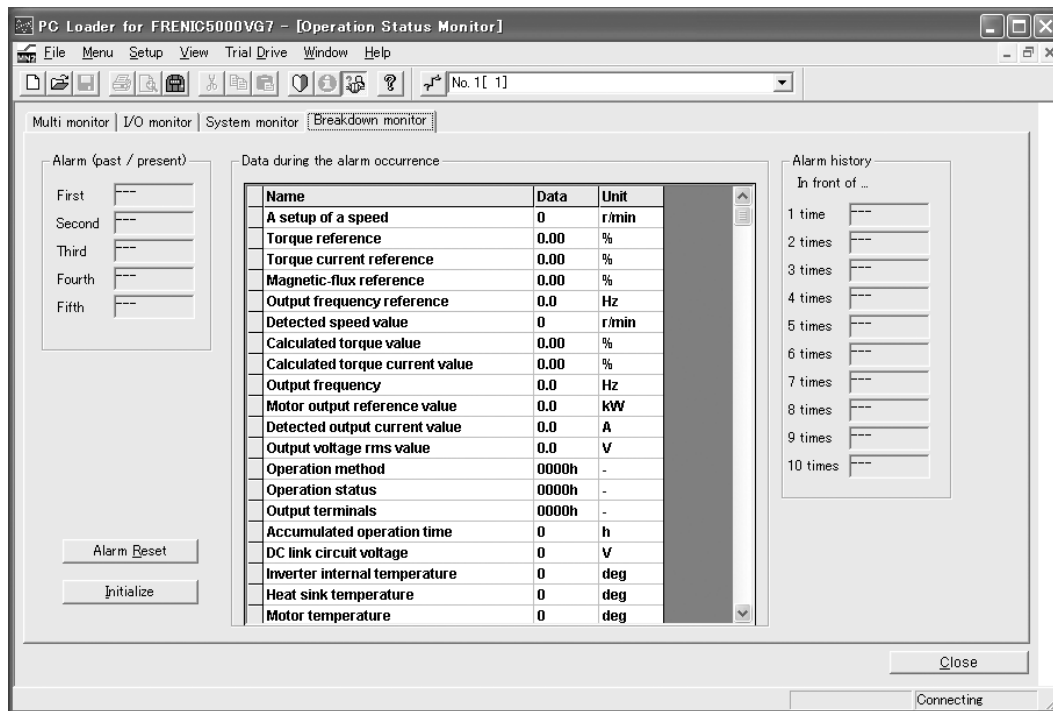


Figure 42 Fault Monitor

- 1) Alarm reset : Resets the alarm being activated.
- 2) Initialization of the alarm : Initializes the alarm history.
- 3) Close : Closes the operation monitor screen.

#### List of alarm display

Display	Description	Display	Description	Display	Description
- - -	No alarm	Er7	Output wiring error	OH4	Motor overheat
IPE	IPM error	Er8	A/D converter error	OL1	Motor overload (M1)
dbH	DB resistor overheat	Er9	Speed disagreement	OL2	Motor overload (M2)
dCF	Fuse Fusion	ErA	UPAC error	OL3	Motor overload (M3)
dO	Excessive position deviation	Erb	Inverter-to-inverter link error	OLU	Inverter overload
EF	Ground fault	Lin	Input phase loss, Condenser error	OS	Overspeed
Er1	Memory error	LU	Undervoltage	OU	Overvoltage
Er2	KEYPAD Panel communication error	nrb	NTC thermistor Disconnection	PbF	Charging circuit error
Er3	CPU error	OC	Overcurrent	PG	PG error
Er4	Network error	OH1	Cooling fin overheat		
Er5	RS-485 Communication error	OH2	External alarm		
Er6	Operation procedure error	OH3	Pt board surrounding temperature overheat		

# 6. Standard Interface RS-485

## 6.5.4.6 Historical Real-time Trace

### (1) Historical trace

Historical trace indicates the waveform before and after the trigger at the minimum sampling interval of 1ms.  
 (Quantity of the waveform data: 100 points/ch)  
 The trigger must be always set because the data does not appear without the trigger.

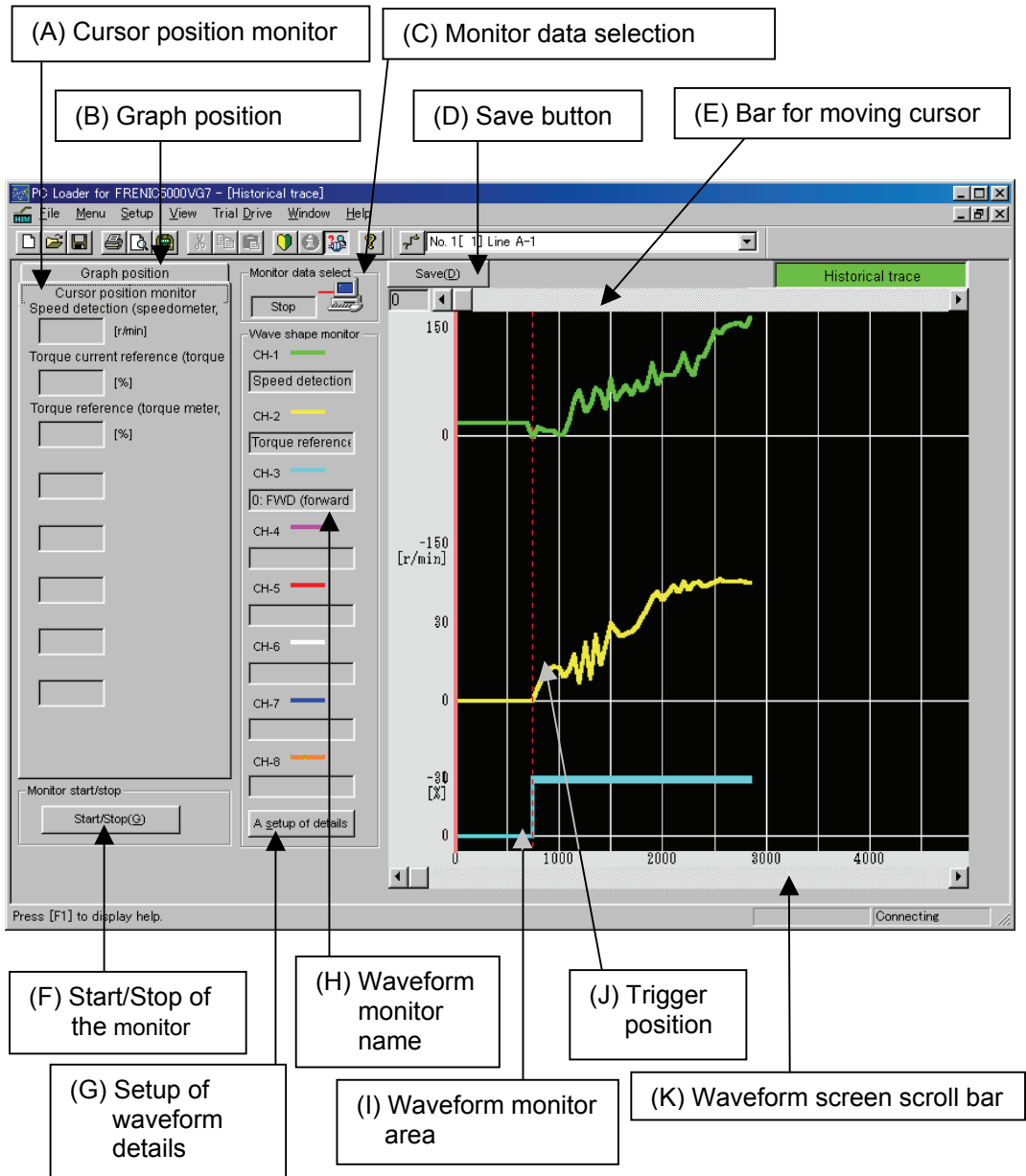


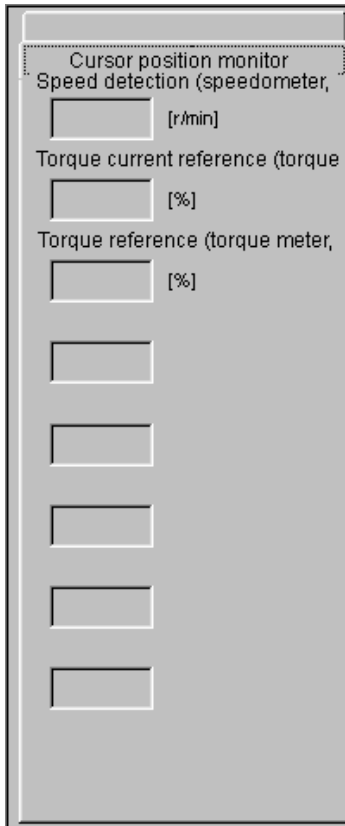
Figure 43 Historical Trace

Note 1: When the historical trace and real-time trace are on the screen, the terminal number cannot be changed.

Note 2: When changing the size of the historical trace screen, the size of the waveform monitor area is also changed.

---

(A) Cursor position monitor



The intersection data of the cursor position in the waveform monitor area and waveform are expressed numerically. Cursor position can be moved by (5) Bar for moving cursor.

Figure 44 Cursor Position Monitor



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## (B) Graph position adjustment

Set the position where the waveform is indicated in the waveform monitor, amplitude, and time scale of one screen.

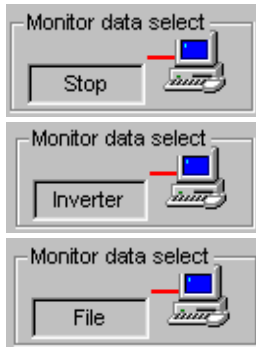
The image shows a control panel titled "Graph position" with several adjustable parameters and callout boxes:

- Ch:** A dropdown menu currently set to "CH-1". Callout: "Selects the channel where the position is adjusted or the amplitude is changed."
- Indicate position:** A vertical slider with up and down arrows. Callout: "Adjusts the position of the selected waveform."
- Am.:** A vertical slider with up and down arrows, currently set to "4". Callout: "Changes the amplitude of the selected waveform."
- Expansion / reduction:** Two buttons labeled "+" and "-". Callout: "Enlarges/Reduces the selected waveform."
- Graph position reset:** A button. Callout: "Initializes the position and the amplitude of the selected waveform."
- The range that it is indicated in one scene:** A dropdown menu currently set to "200ms" followed by "/Scene". Callout: "Selects the range to be indicated (time scale of one screen) in one screen. \* When setting this value as sampling time×100, all historical trace waveform can be shown in one screen and easier to view."

Figure 45 Graph Position Adjustment

(C) Monitor data selection

This window shows the status of the currently displayed waveform.



The indicated waveform is after or before the trace.

The indicated waveform is in trace.

The indicated waveform shows the data of the saved file.

Figure 46 Monitor Data Selection

(D) Save

Saves the traced waveform in the file.

(E) Bar for moving cursor

Moves the position of the cursor of the traced waveform.

The intersection value of the cursor position and the waveform is expressed numerically in (1) Cursor position monitor.

(F) Start/Stop of the monitor

Starts/Stops the historical trace.

(G) Setup of waveform details

1) Setup of the channel composition.

Sets the composition of the waveform to be traced.

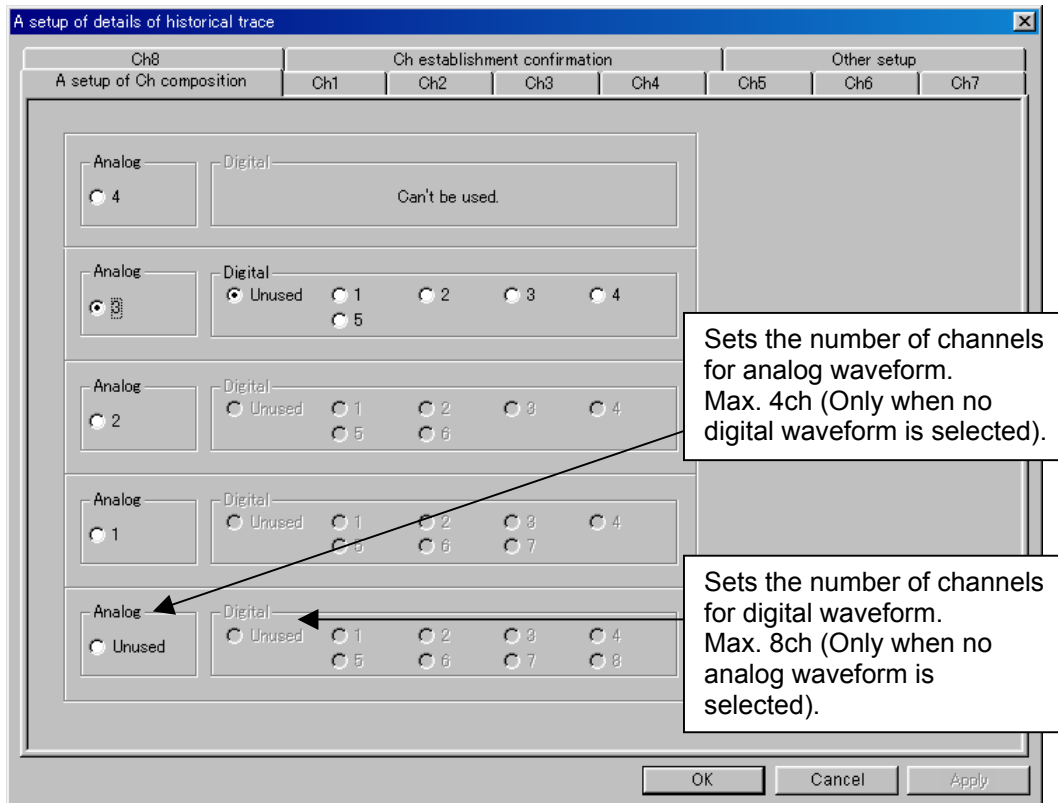


Figure 47 Historical trace - Setup of Waveform Details

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### 2) Setup of analog channel

Selects the analog signal to be traced, and sets the filter and trigger.

This channel indicates that the waveform is analog.

Selects if the filter is set for analog waveform.

Selects if this channel is set as the trigger.

Selects signal to be indicated in the analog waveform.

\*\*Selects the time constant of the manual filter when the manual filter is selected.

Sets the trigger level if the channel is set as the trigger.

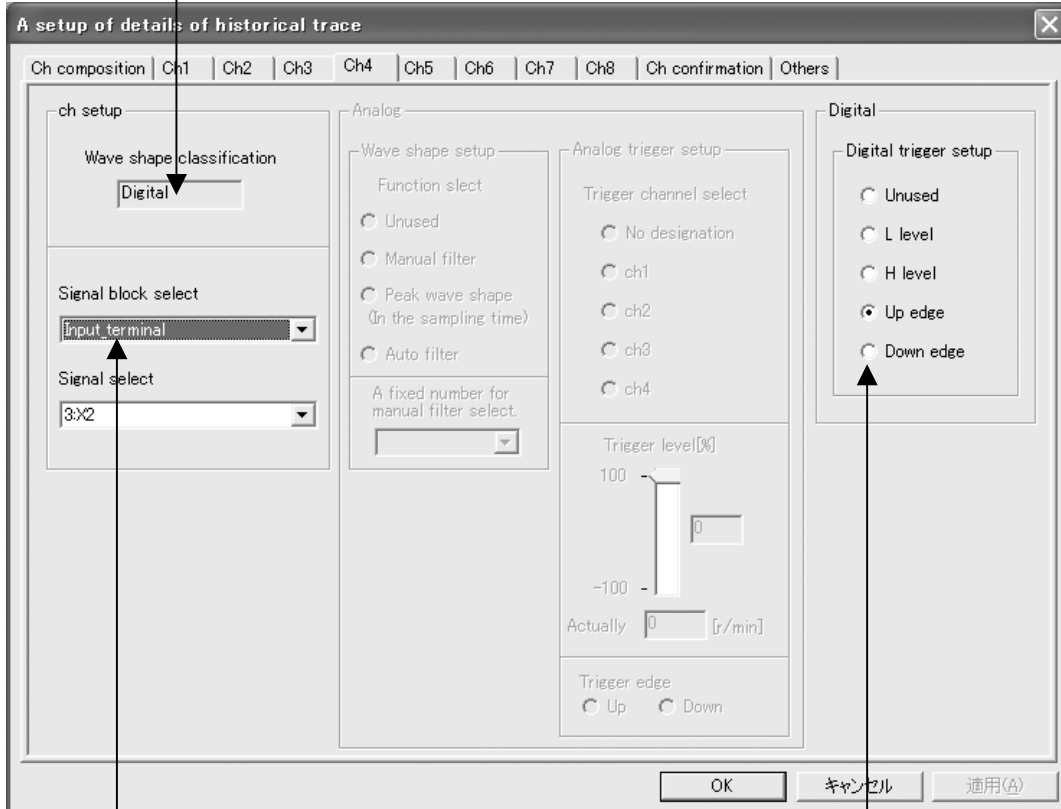
Sets the trigger edge if the channel is set as the trigger.

Figure 48 Historical Trace - Analog

3) Setup of digital channel

Selects the digital signal to be traced, and sets the trigger.

This channel indicates that the waveform is digital.



Selects signal to be indicated in the digital waveform.

Selects if this channel is set as the trigger. Also sets the requirements of the trigger if this channel is set as the trigger.

Figure 49 Historical Trace - Digital

Note: If two or more triggers are specified for the digital signal trigger setting, the trigger is issued when the conditions of all digital signals are established (AND).

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### 4) Review of the channel settings

The settings of each channel to be traced can be reviewed.

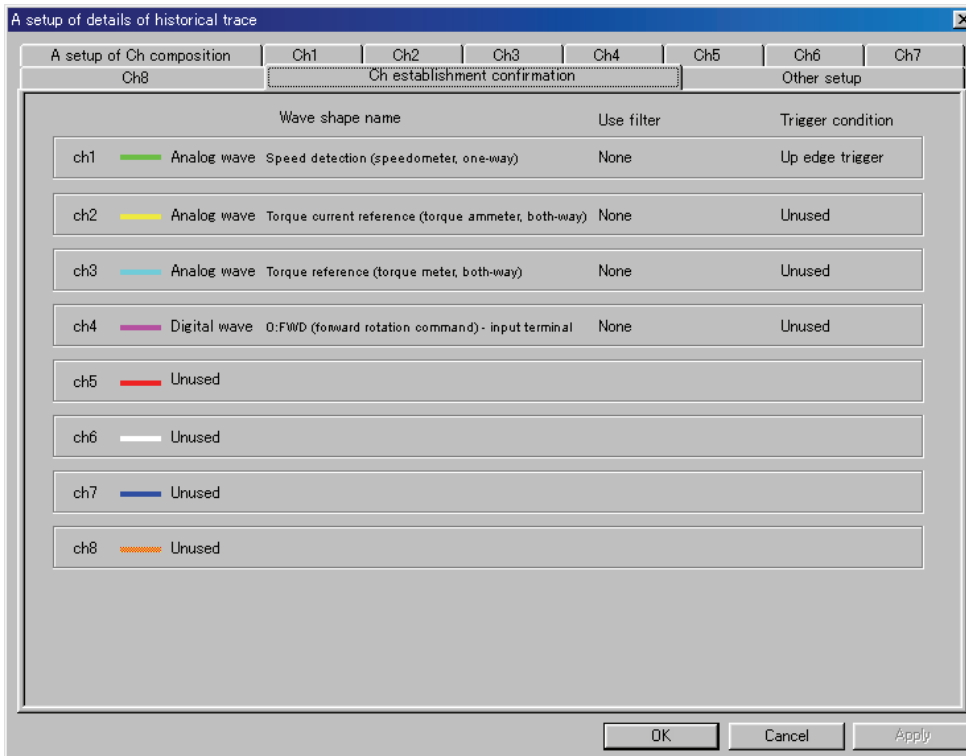


Figure 50 Historical Trace - Review of Channel Setting

### 5) Other settings

Sets the sampling intervals of the trace and the number of traces from the trigger position.

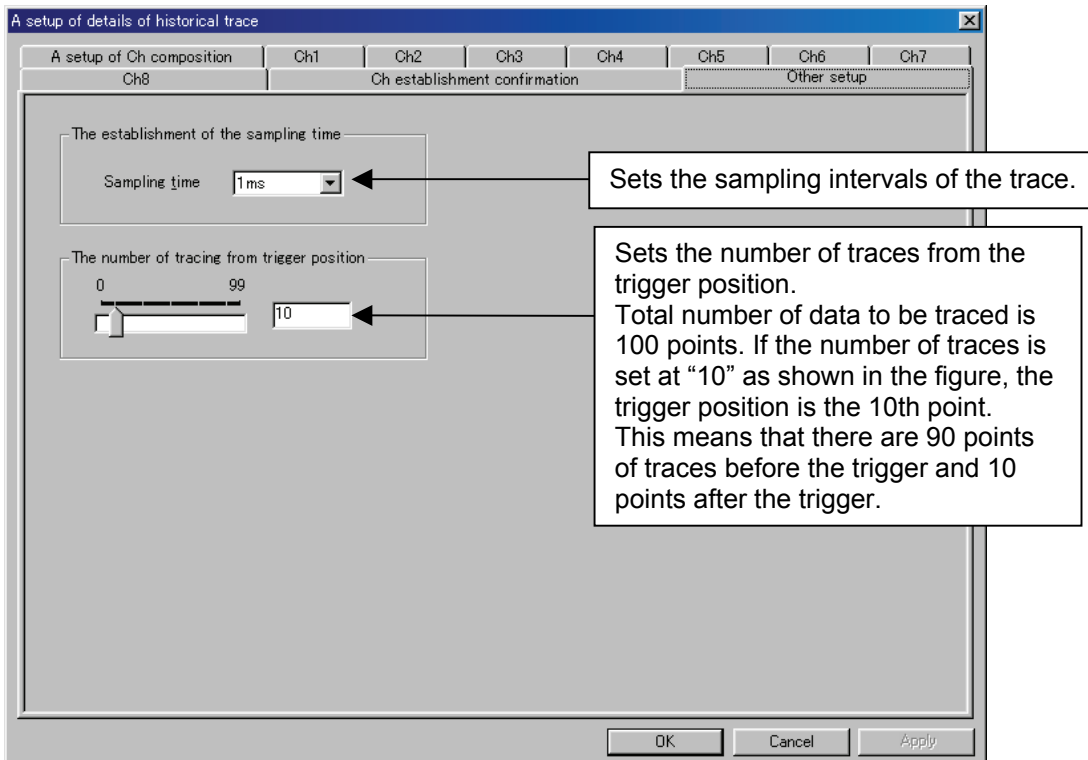


Figure 51 Historical Trace - Other Settings

(H) Waveform monitor name

Indicates the name of the traced waveform of each channel.

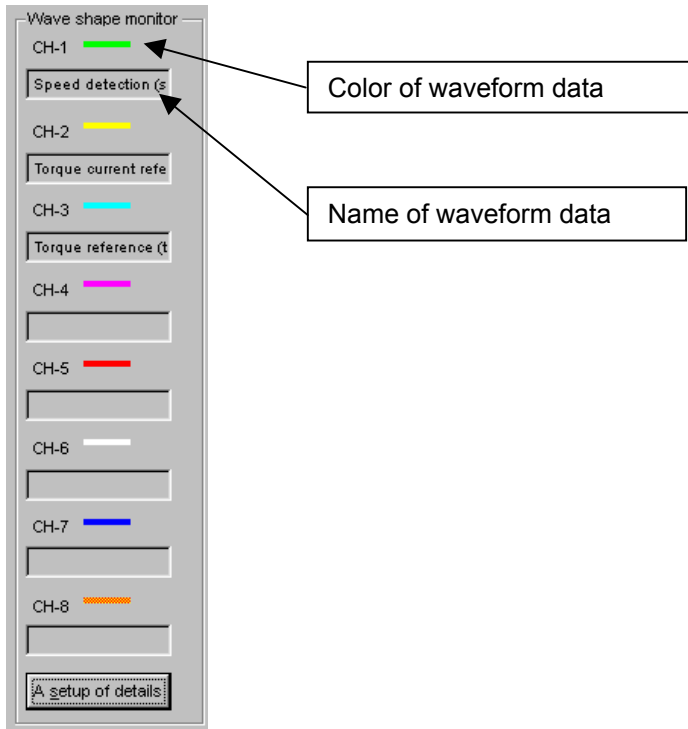
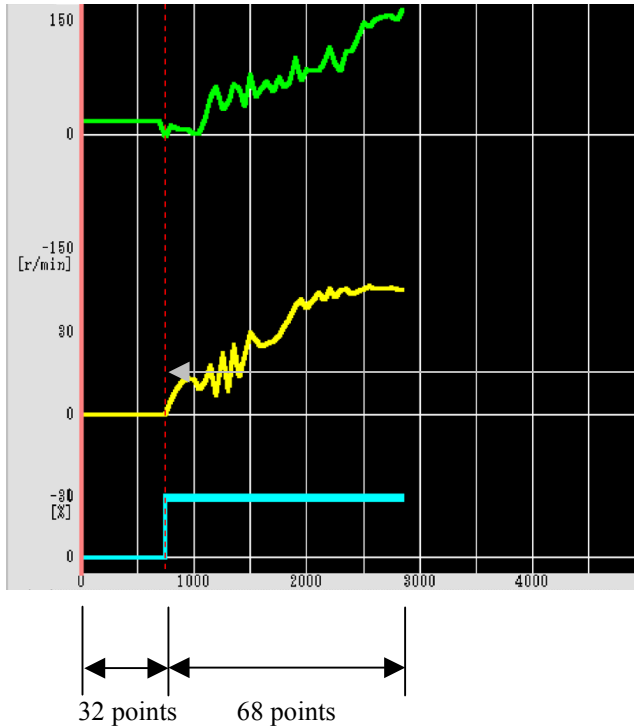


Figure 52 Historical Trace - Waveform Monitor

(I) Waveform monitor area

Shows the traced waveform.

(J) Position of trigger



The total waveform data consists of 100 points. Decide the points from which the data should be acquired. A dotted line indicates the trigger position. The number of traces from the trigger position in the left figure is set as "68".

Trigger position

Figure 53 Historical Trace - Position of Trigger

## 6. Standard Interface RS-485

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(K) Waveform screen scroll bar

Scrolls the waveform screen.

You can check before and after the currently indicated screen by scrolling.

(L) Print

Printing is executed when selecting "Print" from the menu.

"Print Preview" in the menu shows the image of print

## (2) Real-time trace

Real-time trace realizes the continuous waveform measurement at the minimum sampling intervals of 10ms. (Total quantity of waveform data: approx. 30000 points/1ch)

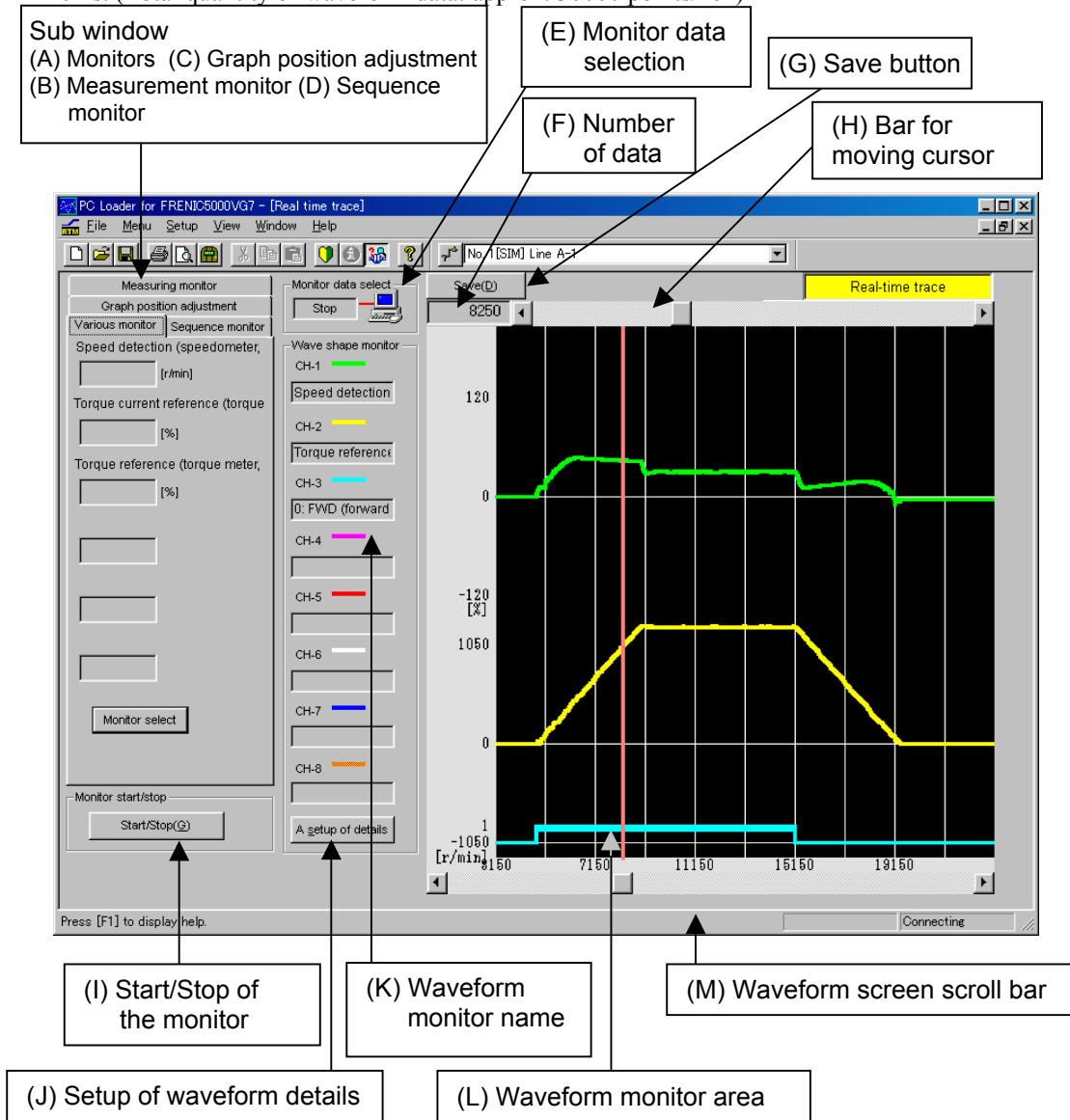


Figure 54 Real-time Trace

**Note 1:** The real-time trace screen and the trial operation screen cannot be opened at the same time. Choose either one.

**Note 2:** When the historical trace and real-time trace are on the screen, the terminal number cannot be changed.

**Note 3:** When the size of the real-time trace screen is changed, the size of waveform monitor area is also changed.

### 1) Tracing time

The real-time trace data totals approx. 30,000 points. If the sampling interval is set to 10ms, the tracing is possible for five minutes ( $30,000 \times 10\text{ms} = 300\text{s} = 5 \text{ min.}$ ). If the tracing time exceeds five minutes, the older data will disappear in due order. This means the data taken for the latest five minutes is always kept.



## 6. Standard Interface RS-485

### (A) Monitors

The data selected in the “Monitor selection” are expressed numerically, separately from the traced waveform data.

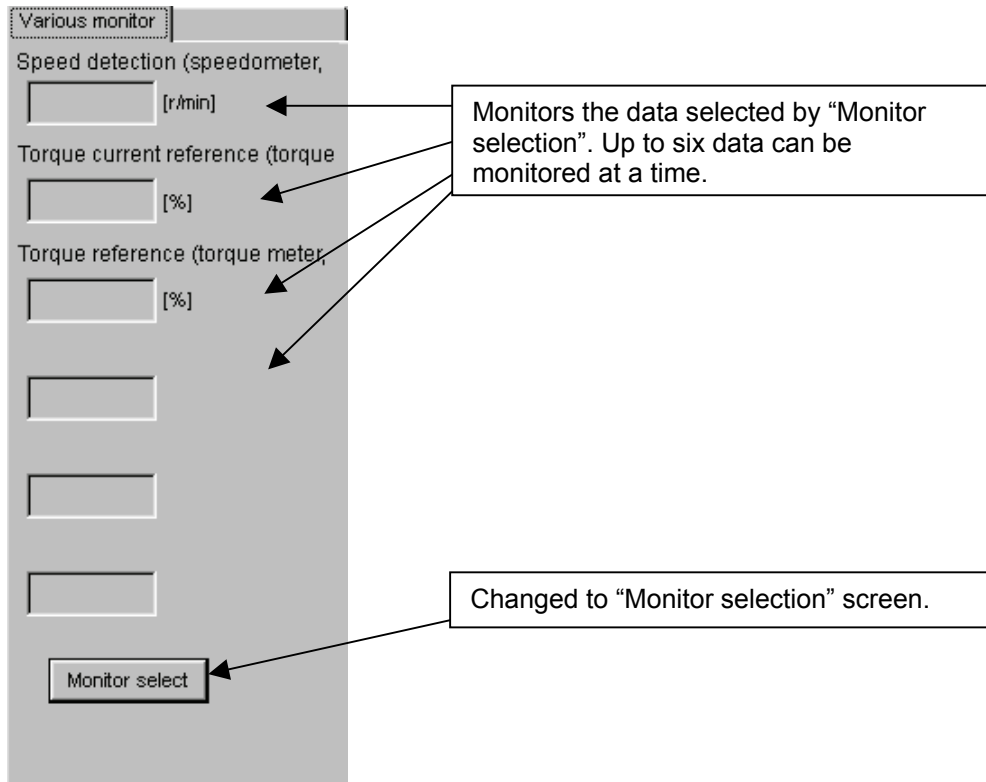


Figure 55 Real-time Trace - Monitors

1) In the “Monitor selection” screen, the data to be indicated in “Monitors” can be selected.

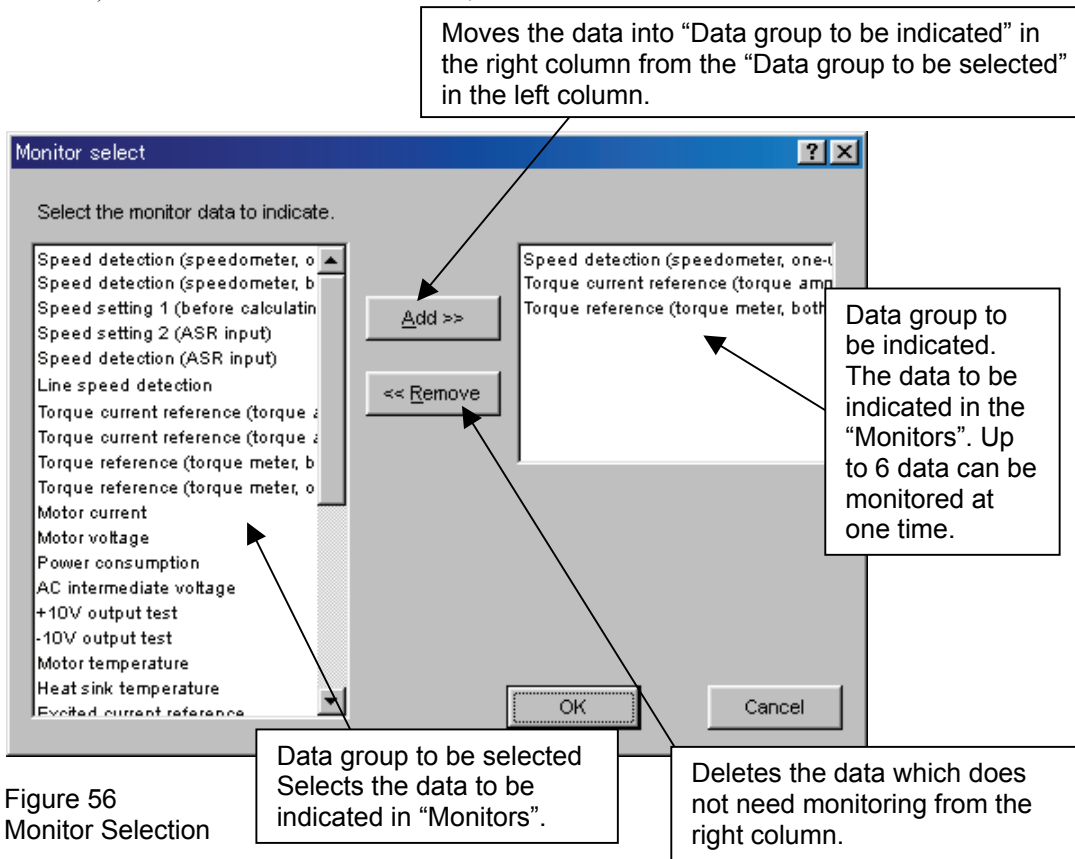
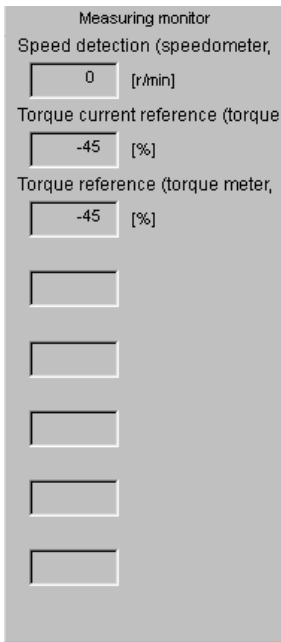


Figure 56 Monitor Selection

(B) Measurement monitor



The intersection value of the cursor position in the waveform monitor area and the waveform are expressed numerically. Cursor position can be changed by (H) Bar for moving cursor.

Figure 57 Measurement Monitor

(C) Graph position adjustment

Set the position where the waveform is indicated in the waveform monitor, amplitude, and time scale of one screen.

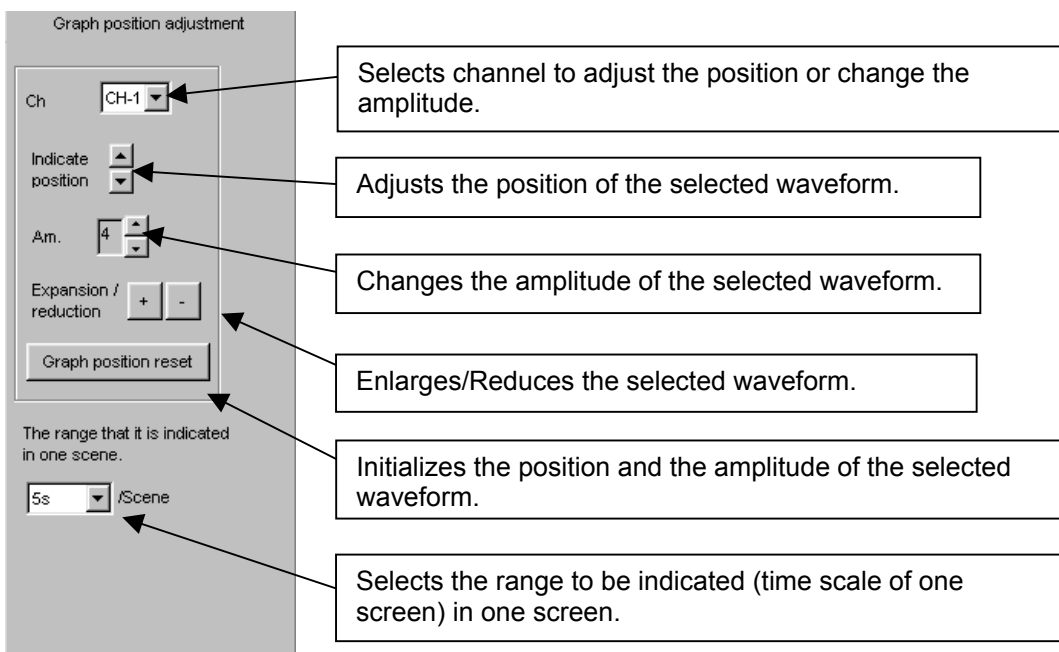


Figure 58 Graph Position Adjustment

## 6. Standard Interface RS-485

### (D) Sequence monitor

Indicates the sequence mode of the connected amplifier.

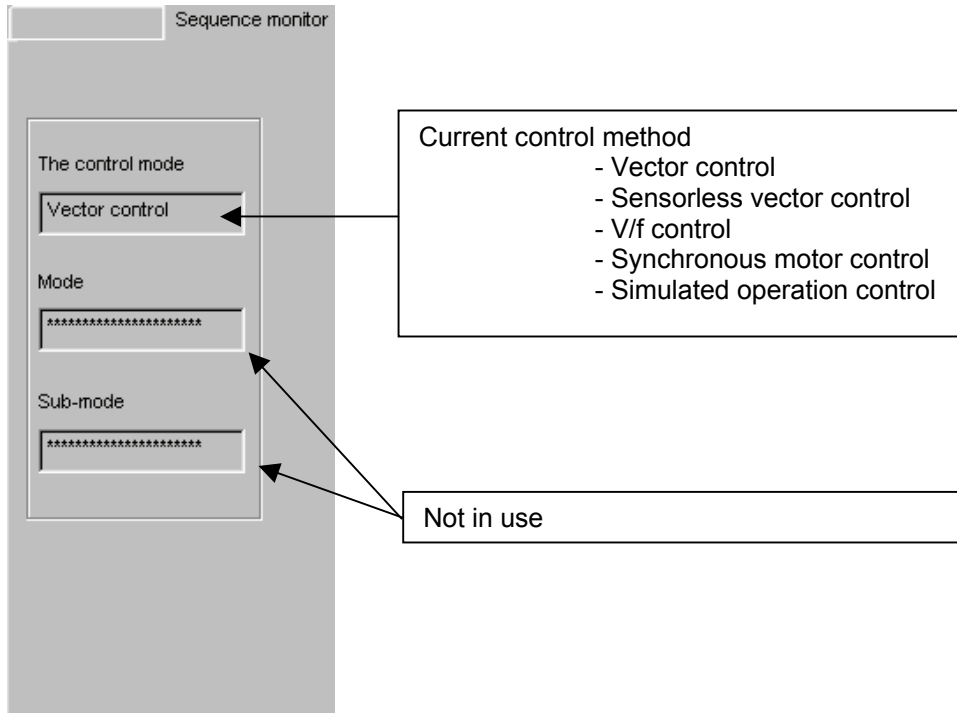


Figure 59 Sequence Monitor

### (E) Monitor data selection

This window shows the status of currently indicated waveform.

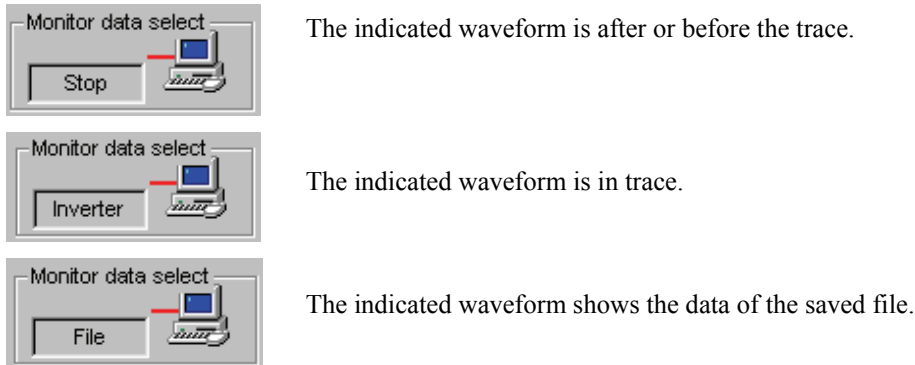


Figure 60 Monitor Data Selection

### (F) Number of data

Indicates the number of traced data per channel.

### (G) Save button

Saves the traced waveform in the file.

### (H) Bar for moving cursor

Moves the position of the cursor of the traced waveform.

The intersection value of the cursor position and the waveform is indicated numerically in (a) Cursor position monitor.

(I) Start/Stop of the monitor

Starts/Stops the real-time trace.

(J) Setup of waveform details

Sets the details of the waveform to be traced.

Refer to “1) Historical trace (g) Setup of waveform details” for the details.

Note: Continuous data may not be obtained if the sampling time is too short. As well, continuous data may not be obtained if the response interval time (H39) is too long. If this is the case, adjust the settings of the sampling time and H39.

(K) Waveform monitor name

Indicates the name of the traced waveform of each channel.

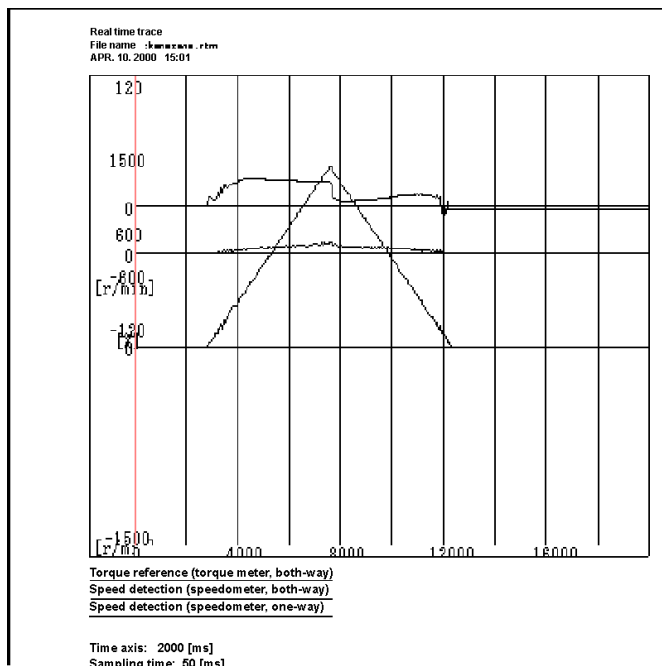
(L) Waveform monitor area

Shows the traced waveform.

(M) Waveform screen scroll bar

Scrolls the waveform screen.

(N) Print



Printing is executed when selecting "Print" from the menu. "Print Preview" in the menu show the image of print.

Figure 61 Print

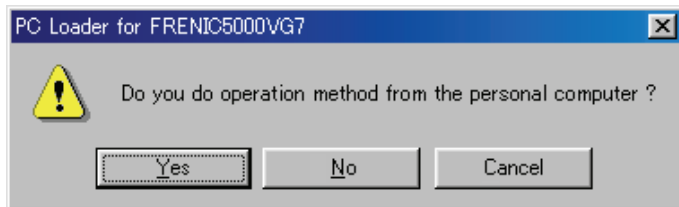
# 6. Standard Interface RS-485

## 6.5.4.7 Operation Procedure

When the “Trial operation ” in the menu bar is clicked, operation procedure for the connected inverter will be executed.

**Note: A motor actually rotates.**

When the test operation is selected, the following message window will appear.



If “Yes” is selected, the operation procedure of the trial operation will become effective. “2” is written in H30 (link function).

If “No” is selected, the operation procedure of the trial operation will not be available. “0” is written in H30 (link function).

Figure 62 Message Window for Selecting Operation Mode

**Note 1:** The real-time trace screen and the trial operation screen cannot be opened at the same time. Choose either one.

**Note 2:** When the tool bar for the trial operation is already shown, the message window for selecting the operation mode will not appear. In this case, the operation procedure will become effective.

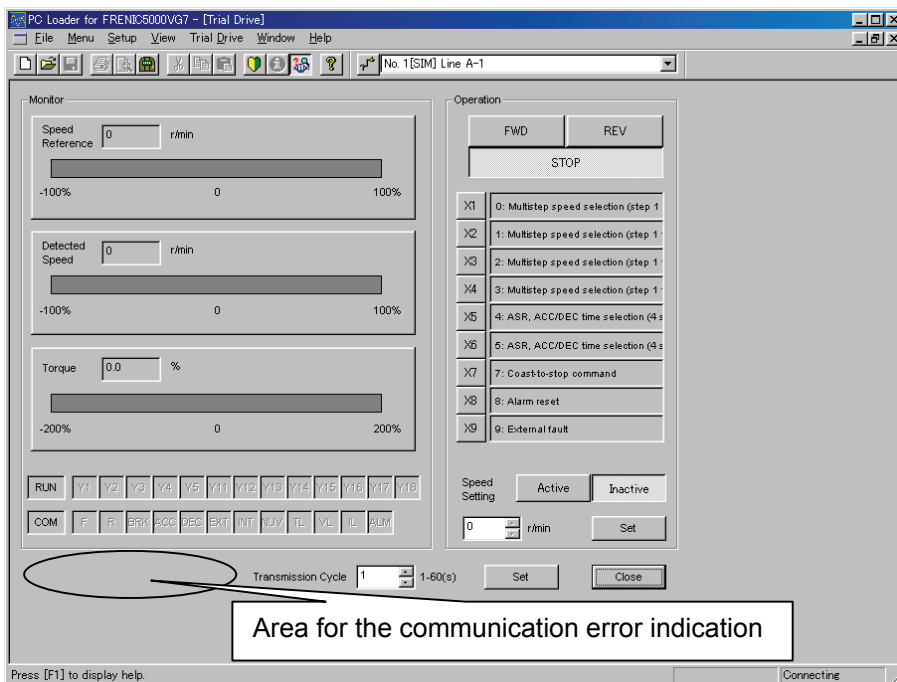


Figure 63 Trial Operation Screen

- 1) Speed command : Set the data in the range from–max. speed to+max. speed in r/min.  
Click the “Reload” button to make the newly set value effective.
- 2) Transmission cycle : Set the data in the range from 1 to 60s.  
Data is acquired and commands are transmitted to the inverter at the intervals set at the transmission cycle.  
Click the “Reload” button to make the newly set value effective.
- 3) Close : Closes the trial operation.  
“0” is automatically written in H30 (link function).

---

4) Communication error indication: If the PC failed to acquire the inverter data, the following message will appear.

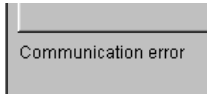


Figure 64 Communication Error Message

5) COM (Operation status) : If the inverter is under the following status, the corresponding symbol is displayed in black with the irrelevant symbols displayed in gray.

F	: Motor is rotating in forward direction.
R	: Motor is rotating in reverse direction.
BRK	: Brake is being applied.
ACC	: Motor speed is accelerated.
DEC	: Motor speed is decelerated.
EXT	: DC injection braking or pre-exciting
INT	: Inverter is shut-off.
NUV	: DC link voltage has been established.
TL	: Torque is being limited.
VL	: Voltage is being limited.
IL	: Current is being limited.
ALM	: Alarm output

## 6. Standard Interface RS-485

### 6.5.5 Troubleshooting

Troubleshooting the RS-485 (support loader)

Symptom	Cause and remedy	Remarks
Failure to connect	Check if the communications port (serial port) of the PC is valid. If not, validate the port.	Refer to the Windows manual.
	Check if the communications port specified for Windows matches the port specified for loader communications. Check the setting of the communications port of the loader.	
	Check if the inverter is configured correctly. Check the H31 to H40 settings.	
	There is possibility of noise. Refer to Section 6.2.8.1 "Remedy against communications."	
	Are two or more inverters connected? If two or more inverters are connected, the half duplex communication link is not established. Change to full duplex.	
Failure to write in a batch	Check if the P02 setting is "37: OTHER." Writing may be impossible with other settings.	
Historical trace failure	Check if the trigger setting is correct. If the trigger setting is incorrect, the historical trace does not function. Specify the trigger.	
	Check if the trigger setting includes a deadlock. Adjust the trigger level and so on so that the trigger functions.	
Real-time trace failure	Check if another screen is open simultaneously. The real-time trace sends very large data during communication. If another screen is open, there may be interrupts in communication, possibly causing lack in data. Close all screens except for the real-time trace screen.	
	Check if connection check (*) is valid. If the connection check is valid, communication is always made with the inverter. To avoid data loss, invalidate connection check.	*Refer to "2) List Editing" in Section 6.5.4.4 "Function Code Setting."
Auto tuning failure	Check if preparation for auto tuning is completed. Refer to the description of H01 in Section 4.3.5 "H Code."	
Test operation failure	Check if link system options such as OPC-VG7-TL, OPC-VG7-SX, OPC-VG7-RS and Field Bus are installed in the inverter. If a link system option is installed in the inverter, operation commands via RS-485 are invalid.	Refer to Section 4.2.1 "Operation Command."
	Check if the speed command is valid. If the speed command is invalid, the motor does not rotate. Open the loader test operation screen to validate, or follow the F01 and H30 settings to validate the speed command.	

**THE INVERTER**

**VI**

## **VII. Control Options**

- 7.1 Common Specification**
- 7.2 F/V Converter**
- 7.3 Synchronous Interface**
- 7.4 Expansion DI Card**
- 7.5 Expansion D10 Card**
- 7.6 Expansion AIO Card**
- 7.7 Expansion PG Interface Card**
- 7.8 PG for Synchronous Motor Driving**
- 7.9 Multi-winding Motor Drive High Speed Serial Card**
- 7.10 PG Signal Switching Option**
- 7.11 T-link Interface Card**
- 7.12 Expansion RS-485 Card**



# 7. Control Options

## 7.1 Common Specification

### 7.1.1 List for Options

Table 7-1

Classification	Name	Type	Specification	See Section	
Analog card	Synchronous interface	OPC-VG7-SN	Synchronous interface circuit for dancer control	7.3	
	F/V converter	OPC-VG7-FV	F/V converter	7.2	
	Expansion AIO card	OPC-VG7-AIO	Expansion card of two Ai + two Ao	7.6	
Digital card (compatible with 8bit bus)	Expansion Di card	OPC-VG7-DI	16bit Di binary or BCD 4 digits + sign: Used for speed, torque and torque current command settings. Two cards can be simultaneously mounted. (identified by DIA and DIB setting)	7.4	
	Expansion Dio card	OPC-VG7-DIO	DIOA setting: Used for function selection Di x 4bit + function selection D0 x 8bit expansion DIOB setting: Used for I/O expansion Di of UPAC x 16bit + D0 x 10bit	7.5	
	Expansion PG interface card	OPC-VG7-PG	Compatible with +5V line driver output	Used for motor speed, line speed, position command and position detection for interface of voltage output encoder (A, B and Z signals).	7.7
		OPC-VG7-PGo	Compatible with open collector output		
	T-link interface card	OPC-VG7-TL	T-link interface card	7.11	
	CC-Link interface card	OPC-VG7-CCL	CC-Link interface card	Separate document	
	High speed serial card	OPC-VG7-SI (Note)	SI (UPAC): For UPAC communication system	SI (UPAC) Separate document	
			SI (MWS): For multi-winding motor drive system	7.9	
	Expansion RS485 card	OPC-VG7-RS	Expansion RS485 interface card	7.12	
	PG card for synchronous motor operation	OPC-VG7-PMPG	Compatible with +5V line driver output	A and B at + magnetic pole position (max. 4bit)	7.8
		OPC-VG7-PMPGo	Compatible with open collector output		
Digital card (compatible with 16bit bus)	User Programmable Application Card	OPC-VG7-UPAC	Technology card	Separate document	
	SX bus interface card	OPC-VG7-SX	SX bus interface card	Separate document	
Field bus interface unit	PROFIBUS-DP	OPC-VG7-PDP	PROFIBUS option unit	Separate document	
	DeviceNet	OPC-VG7-DEV	DeviceNet option unit		
Separate mount type (Separate power source of ±15V is required.)	Synchronous interface	MCA-VG7-SN	Synchronous interface circuit for dancer control	7.2	
	F/V converter	MCA-VG7-FV	F/V converter	7.3	
	Dancer controller	MCA II -PU	Dancer controller	Separate document	
	PG signal switching option	MCA-VG7-CPG	PG and NTC signal switch (2 signal switch)	7.10	
Loader	Inverter support loader	WPS-VG7-PCL	CD-ROM for Windows	5	
Package software	Software for tension control	WPS-VG7-TEN	Attached to inverter support loader CD-ROM for Windows	Separate document	
	Software for dancer control	WPS-VG7-DAN			
	Software for position control	WPS-VG7-POS			
System software	UPAC upgrade	—			

Note: The SI card ROM version between SI (UPAC) and SI (MWS) is different.

Acceptability of card combination

Table 7-2

Classification	Maximum No. of cards to be mounted
Analog card	One analog + one digital cards, or else two digital cards
Digital card (Compatible with 8-bit bus)	
Digital card (Compatible with 16-bit bus)	1
Field bus interface unit	1

Restrictions when OPC control option is mounted.

As shown in Table 7-3, simultaneous mounting is restricted.

**OK**: OK for simultaneous mounting, **NG**: Not acceptable for simultaneous mounting

Table 7-3

	SN	FV	AIO	DI	DIO	PG/PGo	TL/CC L	SI (UPAC)	SI (MWS)	RS	PMPG/PMPGo	UPAC	SX	OPEN
SN	NG													
FV	NG	NG												
AIO	NG	NG	NG											
DI	OK	OK	OK	OK										
DIO	OK	OK	OK	OK	OK									
PG/PGo	OK	OK	OK	OK	OK	OK								
TL/CCL	OK	OK	OK	OK	OK	OK	NG							
SI(UPAC)	OK	OK	OK	OK	OK	OK	OK	NG						
SI(MWS)	OK	OK	OK	OK	OK	OK	OK	NG	NG					
RS	OK	OK	OK	OK	OK	OK	OK	OK	NG	NG				
PMPG/PMPGo	OK	OK	OK	OK	OK	OK	OK	OK	NG	OK	NG			
UPAC	OK	OK	OK	OK	OK	OK	OK	OK	NG	OK	OK	NG		
SX	OK	OK	OK	OK	OK	OK	OK	NG	OK	NG	OK	NG	NG	
OPEN	Under-development	Under-development	Under-development	Under-development	Under-development	Under-development	NG	Under-development	Under-development	Under-development	Under-development	Under-development	NG	NG

## 7.1.2 Inspection in Receiving

### 7.1.2.1 Check of Option

The hardware option has a built-in type (8bit and 16bit options) and a separate mount option. The software option is provided in CD-ROM.

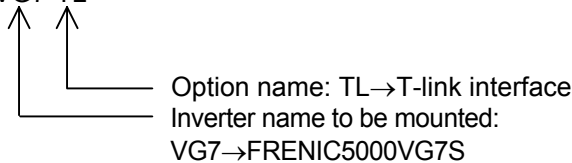
### 7.1.2.2 Inspection

<b>⚠ CAUTION</b>
<ul style="list-style-type: none"> <li>Do not use a product with damage or missing part.</li> </ul> <p><b>It may result in injury or damage.</b></p>

When you receive the product, check the following items.

(1) Check if the product is complete to the order. Check the model number printed in this option.

Example of model number: OPC-VG7-TL



- (2) Check if there is any damage during transportation.
- (3) Check if all of necessary accessories are complete to the product.

## 7. Control Options

Table 7-4 Accessories

Option type	Screw and spacer	Power harness	Optical cable	Plug and housing
OPC-VG7-FV, SN, AIO	Screw (M3): 3 Spacer: 3	For ±15V (Connection to CN12)	Plastic optical cable 5m: 1 cable/card	Sumitomo 3M Ltd. Plug: 10120-3000VE Housing: 10320-52F0-008
OPC-VG7-DI		For 24V (Connection to CN24, 25)		
OPC-VG7-PMPG, PMPGo				
OPC-VG7-DIO				
OPC-VG7-PG, PGo		For 24V (Connection to CN24, 25)		
OPC-VG7-SI(UPAC/MWS)				
OPC-VG7-RS, TL, CCL	Screw (M3): 1 Spacer: 5			
OPC-VG7-UPAC, SX				
MCA-VG7-FV, SN, CPG				
WPS-VG7-PCL (DAN, TEN, POS)				

### 7.1.2.3 Operation Environment

Use the option under the same operation environment as that in VG7S.

Table 7-5 Operation Environment

Item	Specification
Location	Indoor
Ambient temperature	-10 to +50°C
Relative humidity	5 to 95%RH (no condensation)
Atmosphere	Free from dust, direct sunlight, corrosive gas, oil mist, vapor or water drip. Much salt shall not be contained. There shall be no condensation or freezing due to quick change of temperature.
Altitude	1000 m or less
Vibration	5.9m/s <sup>2</sup> [0.6G] or less

**Note:** When this environment condition is not satisfied, the product performance may deteriorate or life may be low, or failure may occur.

### 7.1.2.4 Check of Unit ROM Version

#### CAUTION


- Some options are not compatible with VG7S that has old ROM version. The options do not operate with the old version. Be sure to check the ROM version with the maintenance information on the keypad panel. If you are not sure about the version, please contact us.

Check the unit ROM version before mounting the options.

When options are already mounted, check the VG7 unit ROM version as they are.

Check the ROM version of the VG7 unit (not optical part option or keypad panel).

To check the version, see the right of "MAIN" and "MTR" of the maintenance information on the keypad panel.

The screen on the right side can be found at the 5th row of the maintenance information. Press the  key on the keypad panel to the 5th row.

**1500**

MAIN= H1xxxx  
MTR = H2xxxx  
KP = K xxxx

Table 7-6

Option type	ROM version		Products after Jan. 2001 (later than H10044 and H20044)
	MAIN	MTR	
OPC-VG7-FV	Not restricted.		Not restricted.
OPC-VG7-SN	Not restricted.		
OPC-VG7-AIO	H1003F or later	H2003F or later	
OPC-VG7-DI	Not restricted.		
OPC-VG7-DIO	H1003E or later	H2003E or later	
OPC-VG7-PG,PGo	H1003F or later	H2003F or later	
OPC-VG7-TL	Not restricted.		
OPC-VG7-SI(UPAC)	H10060 or later	H20060 or later	Check the items on the left.
OPC-VG7-SI(MWS)	H12013	H22013	H10060 and H20060 or later are acceptable.
OPC-VG7-RS	H10060 or later	H20060 or later	Check the items on the left.
OPC-VG7-PMPG,PMPGo	H10040 or later	H20040 or later	Not restricted.
OPC-VG7-UPAC	H10039 or later	H20039 or later	
OPC-VG7-SX	H1E010 or later	H2E010 or later	
OPC-VG7-PDP			Check the items on the left.
OPC-VG7-DEV	H11060 or later	H21060 or later	
MCA-VG7-□□□□,MCAII-	Not restricted.		Not restricted.
WPS-VG7-PCL	Not restricted.		
WPS-VG7-DAN	H10039 or later	H20039 or later	
WPS-VG7-TEN	H10039 or later	H20039 or later	
WPS-VG7-POS	H1003D or later	H2003D or later	
OPC-VG7-CCL	H1CC10 or later	H2CC10 or later	Check the items on the left.

## 7.1.3 Storage

### 7.1.3.1 Temporary Storage

Store the option in the environment as shown in Table 7-7.

Table 7-7 Storage Environment

Item	Specification	
Ambient temperature	-10 to +50°C	Place where there is no condensation or freezing due to abrupt change of temperature.
Storage temperature *1)	-25 to +65°C	
Relative humidity	5 to 95%RH *2)	
Atmosphere	Free from dust, direct sunlight, corrosive gas, flammable gas, oil mist, vapor, water drip or vibration. Little salt inclusion.	

Note \*1) Storage temperature refers to short period such as transportation.

\*2) If humidity satisfies the specification value, condensation or freezing occurs where temperature change is abrupt. Do not install the option at a place like this.

- (1) Do not install the option directly on the floor. Place it on a table or shelf.
- (2) When the option is stored under poorly conditioned atmosphere, pack the option with a plastic sheet or package polyethylene film.
- (3) If the option may be affected by humidity, put a desiccant (e.g. silica gel) inside the option before packing in (2).

## 7. Control Options

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### 7.1.3.2 Long Term Storage

If the option is not used for a long time after purchasing, the storage method may greatly vary depending on the storage environment. If a careful storage is required, contact the dealer where the product was purchased or the nearest sales office with specific environment specifications.

In general, the following storage is performed:

- (1) Satisfy the requirements of temporary storage.
- (2) Carefully pack the option to prevent entry of moisture. Put a desiccant (e.g. silica gel) inside the package. The amount of the desiccant shall be in accordance with JIS Z 0301 (Method of moisture-proof packaging). Maintain the relative humidity inside the package to 70% or less as a guideline.

When this option is mounted in VG7S and the option is installed and left on a system or control panel, the option may be exposed to a place with humidity or dust, especially under construction. In this case, remove the VG7S inverter and take it to a place with good environment. Observe the instruction manual.

### 7.1.4 Mounting Method of Built-in Option (OPC-VG7-□□)

 **CAUTION**

- When the product is installed or removed, inappropriate work may damage the product.
- Turn OFF the inverter power and make sure the charge lamp is OFF before installation/removal of the option. Even if all main power, control power and auxiliary power circuits of the inverter are OFF (open), the power is applied to control terminals 30A, 30B, 30C, Y5A and Y5C of the inverter when the external control circuit has a separate power source.
- Be sure to turn OFF (open) the external power source to prevent electric shock.

## 7.1.4.1 Removing Front cover

Remove the front cover of the inverter as shown below. Note that the removal method varies depending on the inverter type (capacity).

Applicable inverter type (capacity)  
FRN15VG7S-2/4 (15kW) or smaller

As shown in Fig. 7-1, loosen 2 front cover screws at (a) and remove it by holding the upper part of the front cover.

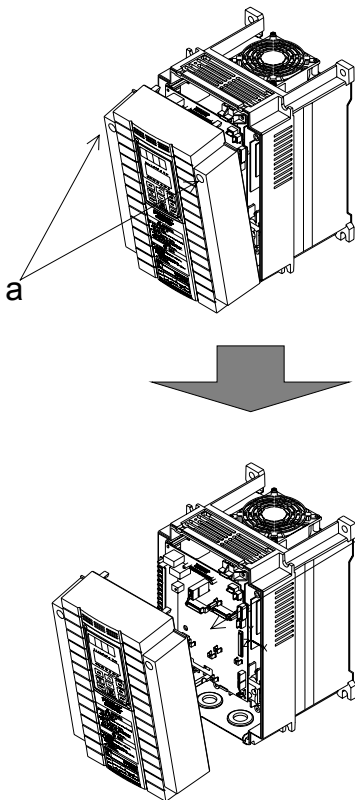


Fig. 7-1 Removing Method of Front Cover  
(FRN15VG7S-2/4 (15kW) or smaller)

Applicable inverter type (capacity)  
FRN18.5VG7S-2/4 (18.5kW) or larger

- (1) As shown in Fig. 7-2, loosen the front cover screws (the quantity varies depending on the capacity) at (b) and remove the front cover.
- (2) Loosen 2 screws at (c) and remove the keypad panel.
- (3) Loosen 2 screws at (d) and remove the keypad panel case.

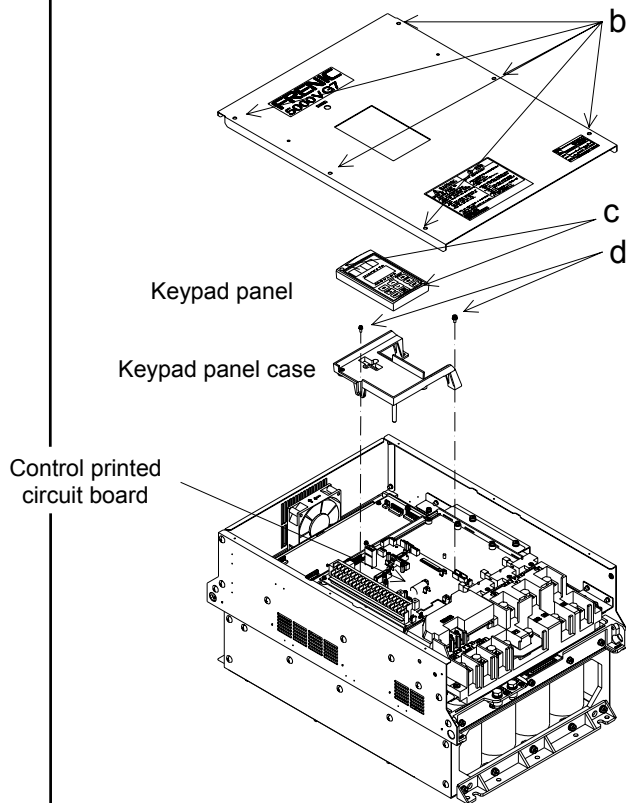


Fig. 7-2 Removing Method of Front Cover  
(FRN18.5VG7S-2/4 (18.5kW) or larger)

# 7. Control Options

## 7.1.4.2 Mounting Method of Communication Option

The following option (hereafter called communication option) has the restrictions for mounting as shown below:

**APPLICABLE  
OPTION**  
**OPC-VG7-TL**  
**OPC-VG7-RS**  
**OPC-VG7-SI**  
**OPC-VG7-CCL**

- ◆ Refer to (1) Mounting method 1-1 below. Mount the communication option card at either of the two mount positions (CN2 on the left and CN3 on the right) on the control printed circuit board. When it is used together with the analog card (OPC-VG7-FV, SN, AIO), be sure to mount the option card at CN2 and the analog card at CN3.
- ◆ When the communication option card is used together with OPC-VG7-UPAC/SX, refer to (2) Mounting method 1-2. Mount the communication option card on either of the two mount positions (CN2 on the left and CN3 on the right) on the control printed circuit board. TL and SX options cannot be simultaneously used.

### 1) Mounting method 1-1 (when not used together with OPC-VG7-UPAC/SX)

#### (Mounting at CN2 on the left)

- (1) Mount 3 spacers (g) accompanying this option at the option's mounting fitting (a,b,c) of the control printed circuit board.
- (2) Mount the option so that the option connector (CN1) (at the back of option) may be inserted into the connector (CN2) of the control printed circuit board.
- (3) Tighten 3 accompanying screws (h) in the mount holes of the option and fix the option.
- (4) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.



Fig. 7-3 Mounting Method of Communication Option (mounting at CN2)

#### (Mounting at CN3 on the right)

- (1) Mount 3 spacers (g) accompanying this option at the option's mounting fitting (d, e, f) of the control printed circuit board.
- (2) Mount the option so that the option connector (CN1) (at the back of option) may be inserted into the connector (CN3) of the control printed circuit board.
- (3) Tighten 3 accompanying screws (h) in the mount holes of the option and fix the option.
- (4) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.

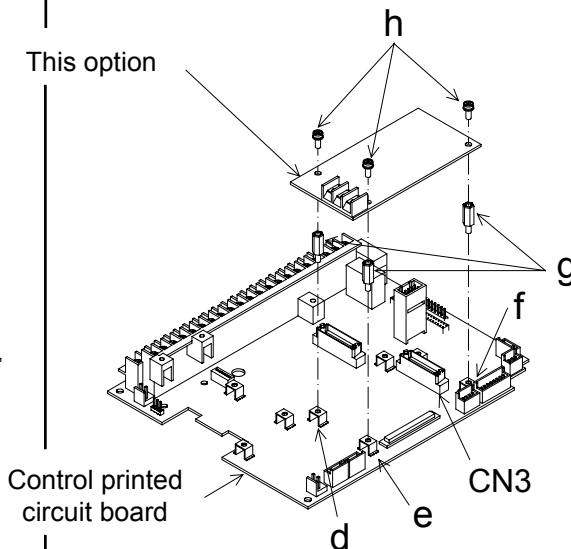
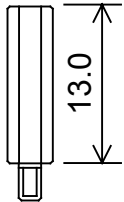


Fig. 7-4 Mounting Method of Communication Option (mounting at CN3)

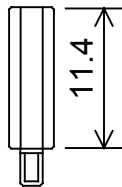
2) Mounting method 1-2 (when used together with OPC-VG7-UPAC/SX)

**CAUTION**

The spacer accompanying the communication option is slightly different in size from the spacer accompanying OPC-VG7-UPAC/SX. Use the spacer correctly according to the procedures below. Incorrect use may result in damage of the product.



Spacer accompanying communication option



Spacer accompanying OPC-VG7-UPAC/SX

Unit: mm

**(Mounting at CN2 on the left)**

- (1) Insert OPC-VG7-UPAC/SX into the connector (CN10) of the control printed circuit board.
- (2) Mount and fix 6 spacers (h) accompanying OPC-VG7-UPAC/SX in the mount holes (a, b, c, d, e, f) of the OPC-VG7-UPAC/SX option.
- (3) Mount the option so that the option connector (CN1) (at the back of option) may be inserted into the connector (CN2) of the control printed circuit board.
- (4) Tighten 3 accompanying screws (j) in the mount holes of the option and fix the product.
- (5) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.

**(Mounting at CN3 on the right)**

- (1) Insert OPC-VG7-UPAC/SX into the connector (CN10) of the control printed circuit board.
- (2) Mount 6 spacers (h) accompanying OPC-VG7-UPAC/SX in the mount holes (a, b, c, d, e, f) of the OPC-VG7-UPAC/SX option and mount a spacer (i) accompanying the communication option at the option mounting fitting (g) of the control printed circuit board.
- (3) Mount the option so that the option connector (CN1) may be inserted into the connector (CN3) of the control printed circuit board.
- (4) Tighten 3 accompanying screws (j) in the mount holes of the option and fix the product.
- (5) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.

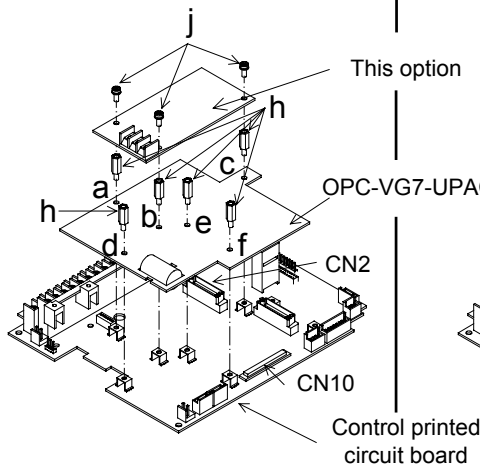


Fig. 7-5 Mounting Method of Communication Option (mounting at CN2)

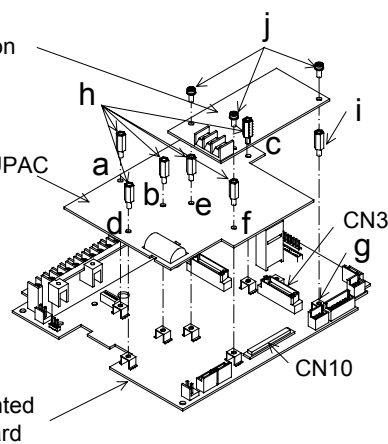


Fig. 7-6 Mounting Method of Communication Option (mounting at CN3)



# 7. Control Options

## 7.1.4.3 Mounting Method of Analog Option

The following option (hereafter called analog option) has the restrictions for mounting as shown below:

**APPLICABLE  
OPTION  
OPC-VG7-FV  
OPC-VG7-SN  
OPC-VG7-AIO**

Analog option (OPC-VG7-FV, SN, AIO)

◆ Refer to (1) Mounting method 2-1 below. Be sure to mount the analog option at the right side (CN3) of the two mount positions on the control printed circuit board. When it is used together with the digital option card (including communication), mount the digital option card at the left (CN2).

◆ When the analog option card is used together with OPC-VG7-UPAC/SX, refer to (2) Mounting method 2-2. Mount the analog option at the right (CN3) of the two mount positions on the control printed circuit board.

- 1) Mounting method 2-1 (when not used together with OPC-VG7-UPAC/SX)
  - (1) Mount 3 spacers (g) accompanying the option at the option mounting fitting (d, e, f) of the control printed circuit board.
  - (2) Mount the option so that the option connector (CN1) (at the back) may be inserted into the connector (CN3) of the control printed circuit board.
  - (3) Tighten 3 accompanying screws (h) in the mount holes of the option and fix the option.
  - (4) Connect the accompanying power harness to CN2 of this option and CN12 on the control printed circuit board.
  - (5) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.

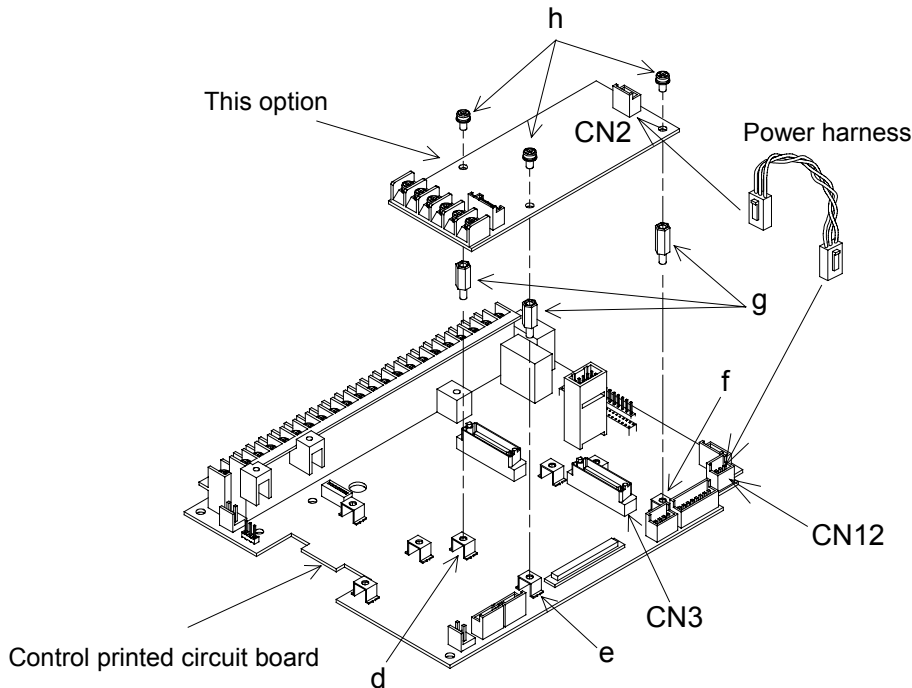
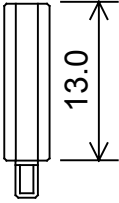
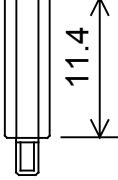


Fig. 7-7 Mounting Method of Analog Option

2) Mounting method 2-2 (when used together with OPC-VG7-UPAC/SX)

<b>CAUTION</b>		
<p>The spacer accompanying the analog option is slightly different in size from the spacer accompanying OPC-VG7-UPAC/SX. Use the spacer correctly according to the procedures below. Incorrect use may result in damage of the product.</p>		
		
Spacer accompanying analog option	Spacer accompanying OPC-VG7-UPAC	Unit: mm

- (1) Insert OPC-VG7-UPAC/SX into the connector (CN10) of the control printed circuit board.
- (2) Mount 5 spacers (h) and a screw (i) accompanying OPC-VG7-UPAC/SX in the mount holes (a, b, c, d, e, f) of the OPC-VG7-UPAC/SX, and mount a spacer (j) accompanying this option at the option fitting (g) of the control printed circuit board.
- (3) Mount the option so that the option connector (CN1) may be inserted into the connector (CN3) of the control printed circuit board.
- (4) Tighten 3 accompanying screws (k) in the mount holes of the option and fix this option.
- (5) Connect the accompanying power harness to CN2 of this option and CN12 on the control printed circuit board.
- (6) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.

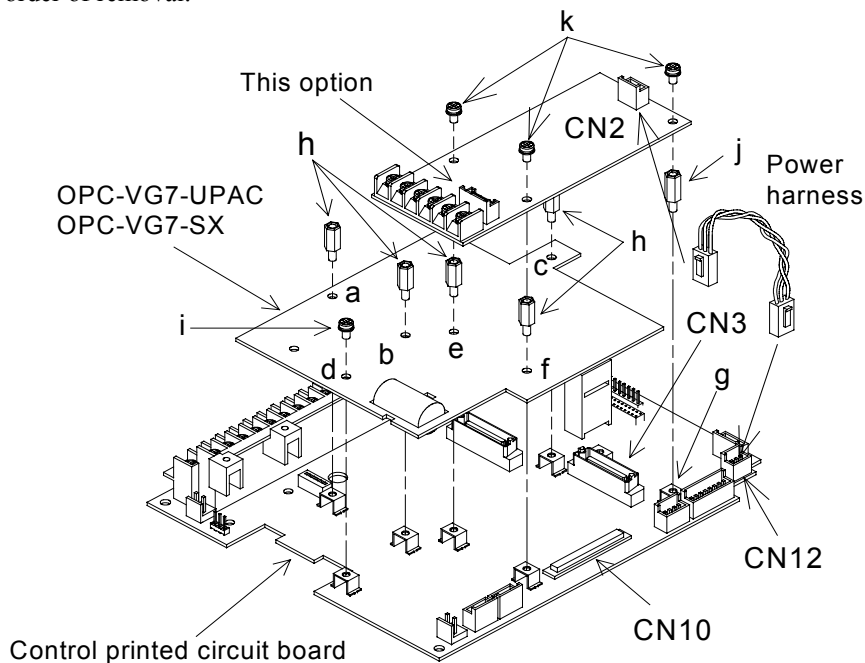


Fig. 7-8 Mounting Method of Analog Option

# 7. Control Options

## 7.1.4.4 Mounting Method of Digital Option

The following option (hereafter called digital option) has the restrictions for mounting as shown below:

**APPLICABLE  
OPTIONS**  
**OPC-VG7-DI**  
**OPC-VG7-DIO**  
**OPC-VG7-PG**  
**OPC-VG7-PGo**  
**OPC-VG7-PMPG**  
**OPC-VG7-PMPGo**

- ◆ Refer to (1) Mounting method 3-1 below. Mount the digital option at either of the two mount positions (CN2 on the left and CN3 on the right) on the control printed circuit board. When it is used together with the analog option (OPC-VG7-FV, SN, AIO), be sure to mount the digital card at CN2 and the analog option at CN3.
- ◆ When the digital option is used together with OPC-VG7-UPAC/SX, refer to (2) Mounting method 3-2. Mount the digital option on either of the two mount positions (CN2 on the left and CN3 on the right) on the control printed circuit board.

### 1) Mounting method 3-1 (when not used together with OPC-VG7-UPAC/SX)

#### (Mounting at CN2 on the left)

- (1) Mount 3 spacers (g) accompanying this option at the option's mounting fitting (a, b, c) of the control printed circuit board.
- (2) Mount the option so that the option connector (CN1) (at the back of option) may be inserted into the connector (CN2) of the control printed circuit board.
- (3) Connect the power harness from the option to CN24 on the control printed circuit board.
- (4) Tighten 3 accompanying screws (h) in the mount holes of the option and fix the option.
- (5) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.

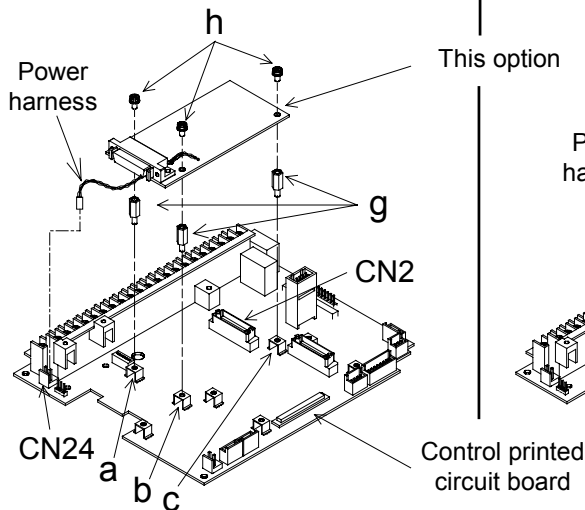


Fig. 7-9 Mounting Method of Digital Option (mounting at CN2)

#### (Mounting at CN3 on the right)

- (1) Mount 3 spacers (g) accompanying this option at the option's mounting fitting (d, e, f) of the control printed circuit board.
- (2) Mount the option so that the option connector (CN1) (at the back of option) may be inserted into the connector (CN3) of the control printed circuit board.
- (3) Connect the power harness from the option to CN25 on the control printed circuit board.
- (4) Tighten 3 accompanying screws (h) in the mount holes of the option and fix the option.
- (5) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.

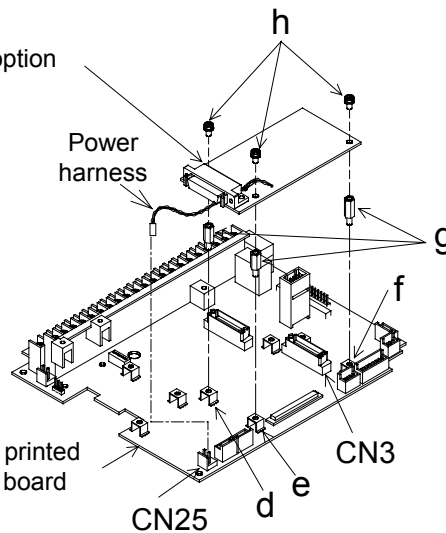
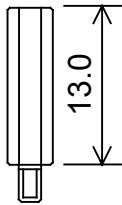


Fig. 7-10 Mounting Method of Digital Option (mounting at CN3)

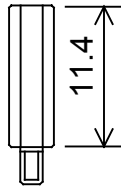
2) Mounting method 3-2 (when option is used together with OPC-VG7-UPAC or OPC-VG7-SX)

**CAUTION**

The spacer accompanying the digital option is slightly different in size from the spacer accompanying OPC-VG7-UPAC or OPC-VG7-SX. Use the spacer correctly according to the procedures below. Incorrect use may result in damage of the product.



Spacer accompanying digital option



Spacer accompanying OPC-VG7-UPAC or OPC-VG7-SX

Unit: mm

**(Mounting at CN2 on the left)**

- (1) Insert OPC-VG7-UPAC/SX into the connector (CN10) of the control printed circuit board.
- (2) Mount and fix 5 spacers (h) and a screw (i) accompanying OPC-VG7-UPAC/SX in the mount holes (a, b, c, d, e, f) of the OPC-VG7-UPAC/SX as shown in Fig. 7-11.
- (3) Mount the option so that the option connector (CN1) (at the back of option) may be inserted into the connector (CN2) of the control printed circuit board.
- (4) Connect the power harness from the option to CN24 on the control printed circuit board.
- (5) Tighten 3 accompanying screws (k) in the mount holes of the option and fix the product.
- (6) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.

**(Mounting at CN3 on the right)**

- (1) Insert OPC-VG7-UPAC/SX into the connector (CN10) of the control printed circuit board.
- (2) Mount 5 spacers (h) and a screw (i) accompanying OPC-VG7-UPAC/SX in the mount holes (a, b, c, d, e, f) of the OPC-VG7-UPAC/SX, and mount a spacer (j) accompanying the option at the option's mounting fitting (g) of the control printed circuit board as shown in Fig. 7-12.
- (3) Mount the option so that the option connector (CN1) may be inserted into the connector (CN3) of the control printed circuit board.
- (4) Connect the power harness from the option to CN25 on the control printed circuit board.
- (5) Tighten 3 accompanying screws (k) in the mount holes of the option and fix the product.
- (6) Refer to "Removing Method of Front Cover" in Figs. 7-1 and 7-2. Mount the front cover in the reverse order of removal.

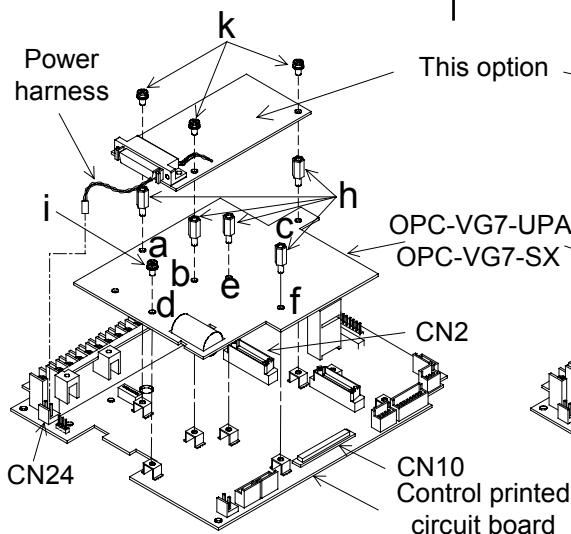


Fig. 7-11 Mounting Method of Digital Option (mounting at CN2)

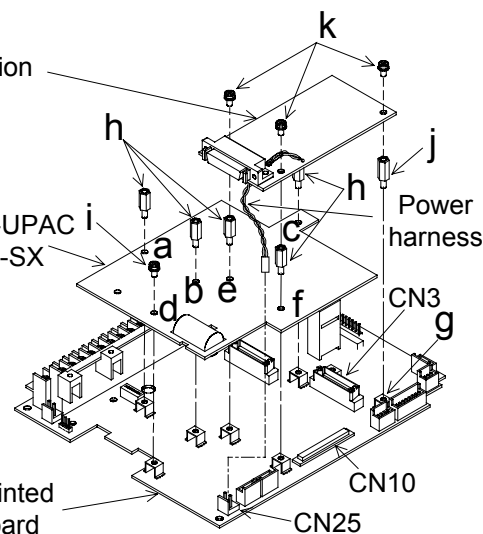


Fig. 7-12 Mounting Method of Digital Option (mounting at CN3)

# 7. Control Options

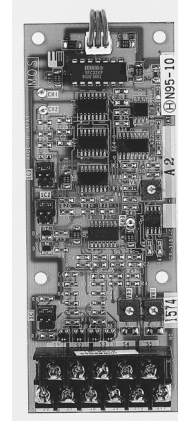
## 7.2 F/V Converter

### 7.2.1 Outline of Product

OPC-VG7-FV is a model of FRENIC5000VG7S analog interface option OPC series. One analog interface option OPC series can be built into one VG7S inverter unit.

OPC-VG7-FV is a signal converter that converts frequency signal into voltage signal. It is used when a signal like line speed is detected with a pulse encoder and converted into analog signal.

MCA-VG7-FV is a separate option unit with the built-in OPC-VG7-FV function. MCA-VG7-FV may be used with combination of other models (FVR/FRENIC series inverter).



#### **⚠ WARNING**

- Since switches and variable resistors inside the option are adjusted before shipment, never touch the switches and variable resistors not allowed for adjustment by operator.

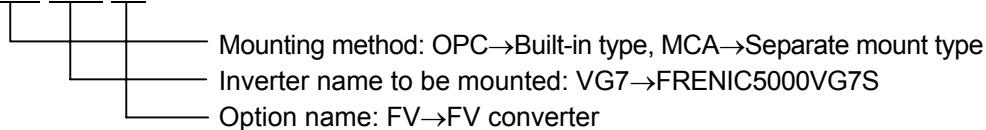
#### **⚠ CAUTION**

- Mount the MCA (separate mount type) vertically near the inverter with connection terminal facing downward. Perform wiring so that signal may not catch noise.
- The MCA type (separate mount type) needs a separate power source ( $\pm 15V$ ). Since the power is not supplied from VG7S, prepare a stabilized power source ( $\pm 15V$  DC).

### 7.2.2 Model and Specification

#### 7.2.2.1 Model

Model: OPC-VG7-FV



#### OPC type accessories

Spacer	3
Screw (M3)	3
Power harness (for $\pm 15V$ power)	1

## 7.2.2.2 Specification

### CAUTION

- The MCA type (separate mount type) needs a separate power source ( $\pm 15V$ ). Since the power is not supplied from VG7S, prepare a stabilized power source ( $\pm 15V$  DC).

#### 1) Hardware specification

Table 7-8 General Specification

Item	Specification	
	OPC-VG7-FV	MCA-VG7-FV
Voltage and required power	P: +15.0VDC $\pm 2.0V$ Approx. 65mA (Supplied from control printed circuit board CN12)	Supplied from mother board printed circuit board
	N: -15.0VDC $\pm 2.0V$ Approx. 35mA (Supplied from control printed circuit board CN12)	Power ( $\pm 15V$ ) is supplied to the mother board from outside
Frequency input	5kHz to 40kHz with internal switch	

Table 7-9 I/O Terminal Specification

Terminal	Application	I/O range	Remark		
S1 S7 S6(M)	Phase-A pulse (Refer to the basic connection for connection to each terminal.)	Max. 5V to 15V square wave	Voltage pulse (complementary) input	SC1:1-2 3-4 Switching	Input impedance 10k $\Omega$
		Max. 5V square wave Positive/negative phase input	Line driver input	SC1:5-6 Short-circuit	
S3 S9 S8(M)	Phase-B pulse (Refer to the basic connection for connection to each terminal.)	Max. 5V to 15V square wave	Voltage pulse (complementary) input	SC1:1-2 3-4 Switching	Input impedance 10k $\Omega$
		Max. 5V square wave Positive/negative phase input	Line driver input	SC1:5-6 Short-circuit	
S5	F/V output	0 to +10V, Max. 3.4mA $R_L \geq 3.0k\Omega$	+ output irrespective of PG phase, single-polarity		
S4	F/V output	0 to +10V, Max. 3.4mA $R_L \geq 3.0k\Omega$	Bipolarity, - output with delayed phase-A (switched with SC3) Polarity change is available. Refer to "7.2.5 Adjusting method" for details.		
S10(M) S11(M)	Standard potential	0V	It is common with the M terminal of the inverter.		
S2	Unused				

Table 7-10 Mother Board Printed Circuit Board Input Terminal List in MCA-VG7-FV

Terminal	Application	Level/type	Specification	Remark
S1 S2 S3	Unused			
P15	Power voltage	P	+15V DC $\pm 2.0V$ Approx. 65mA	Prepare a separate stabilized power source ( $\pm 15V$ ).
M		M	0V DC	
N15		N	-15V DC $\pm 2.0V$ Approx. 35mA	

# 7. Control Options

## 7.2.3 Outside Dimensions

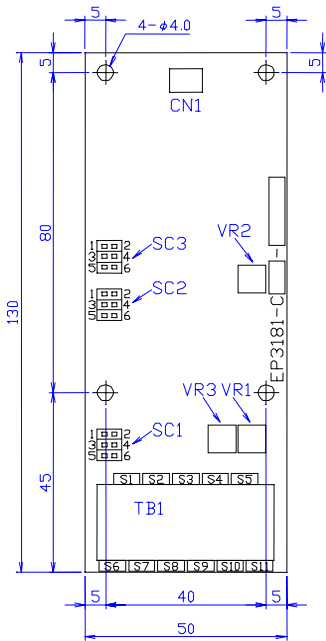


Fig. 7-13 OPC-VG7-FV Outline Drawing

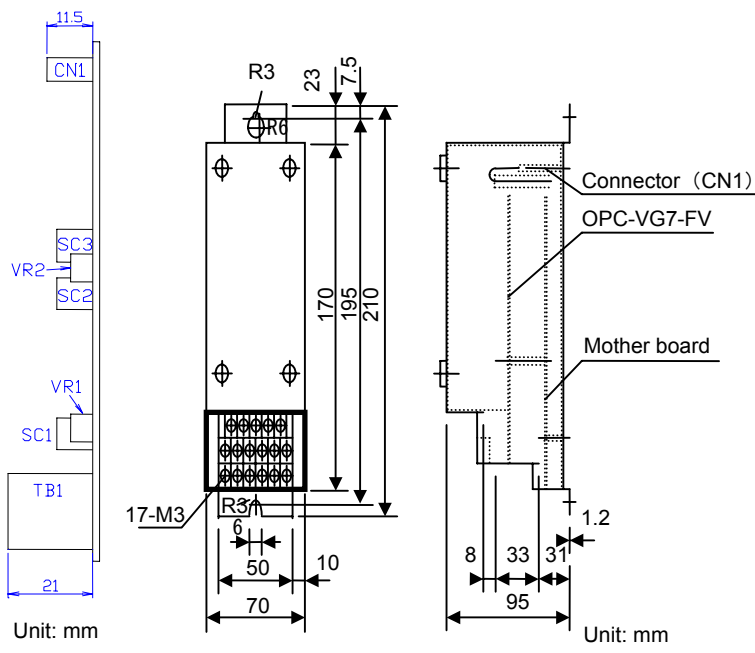


Fig. 7-14 MCA-VG7-FV Outline Drawing

Arrangement of terminal block

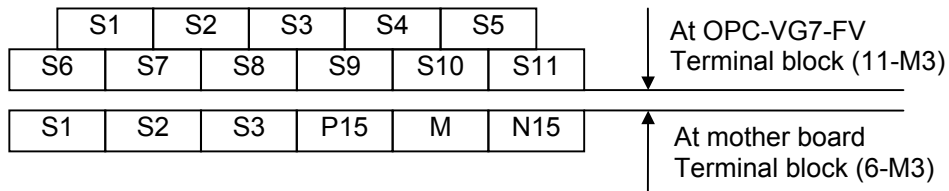


Fig. 7-15 MCA-VG7-FV Terminal Block Arrangement

## 7.2.4 Internal Block Diagram

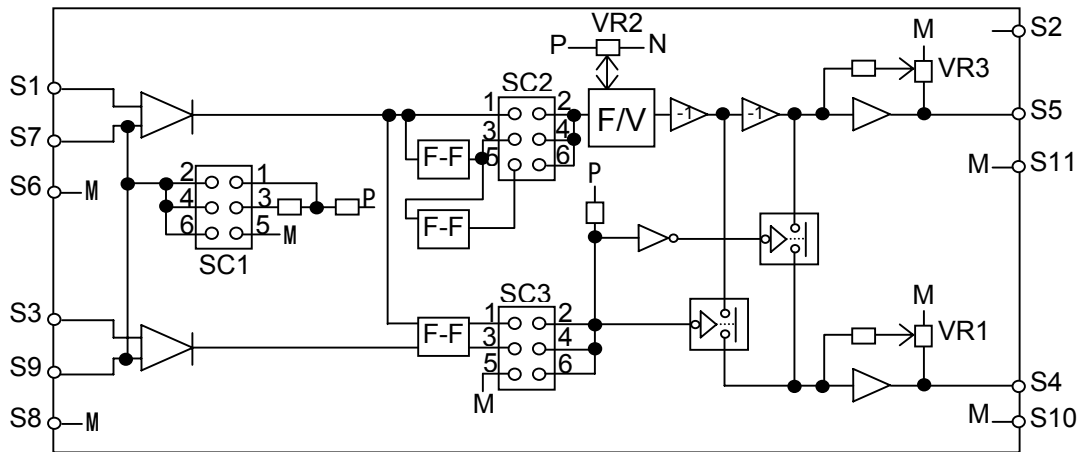


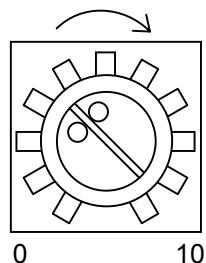
Fig. 7-16 Internal Block Diagram

## 7.2.5 Adjusting Method

### ⚠ WARNING

- Since switches and variable resistors inside the option are adjusted before shipment, never touch the switches and variable resistors not allowed for adjustment by operator.

- (1) Adjust SC1 to SC3 according to the input type and objective.
- (2) Set VR1 and VR3 to 0 notch.
- (3) At the minimum input frequency, adjust VR2 so that voltage output S4 and S5 may be the minimum.
- (4) At the maximum input frequency, adjust VR1 and VR3 so that voltage output S4 and S5 may be the maximum.
- (5) Repeat (3) and (4) until the value may be appropriate.  
(For S4 at short-circuit of SC3:1-2, the negative and positive output is opposite with the phase of phases A and B.)



Each VR value becomes large when the knob is turned to the right.  
Fig. 7-17

Table 7-11

Adjusting area	Name	Adjustment
SC1	Input frequency switching Common pulse for phases A and B	1-2 side: (Threshold level 5.1V) $V_L=0$ to 1V, $V_H=8$ to 15V
		3-4 side: (Threshold level 2.5V) $V_L=0$ to 1V, $V_H=3.5$ to 5V
		5-6 side: (A, $\bar{A}$ , etc. for differential input)
SC2	Input frequency division switching	1-2 side: Input maximum frequency 5 to 10kHz
		3-4 side: Input maximum frequency 10 to 20kHz
		5-6 side: Input maximum frequency 20 to 40kHz
SC3	F/V output polarity switching	1-2 side: Bipolarity (Phase A is lag phase and S4 is - polarity.) * Note 1
		3-4 side: Single polarity Output polarity is fixed. (S4 is + polarity.)
		5-6 side: Single polarity Output polarity is fixed. (S4 is - polarity.)
VR1	Gain adjustment	Gain is adjusted for voltage output S4.
VR2	Bias adjustment	F/V bias is adjusted.
VR3	Gain adjustment	Gain for voltage output S5 is adjusted.

\* Note 1 Refer to Table 7-12.

Table 7-12

	Input square waveform (voltage pulse input)	S4 output
Phase A lag		- polarity
Phase A lead		+polarity

- Adjustment at shipment from factory

SC1 to SC3: Adjusted to 1-2 side.

VR1 to VR3: When the voltage pulse input is 0 to 15V at 0 to 10kHz, the voltage output (S5) is adjusted to 0 to +10V and the voltage output (S4) is adjusted to 0 to  $\pm 10V$  with bipolarity (- polarity with lag phase A after phase B).



# 7. Control Options

## 7.2.6 Basic Connection Diagram

Refer to 7.1.4 "Mounting Method of Built-in Option (OPC-VG7-)" before proceeding to wiring and connection.

**⚠ WARNING**

- Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.
- Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.

**⚠ CAUTION**

- Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.
- Inappropriate work during installation or removal of the product will cause breakage of the product.
- Mount the MCA (separate mount type) vertically near the inverter with connection terminal facing downward. Perform wiring so that signal may not catch noise.

1) For voltage output PG

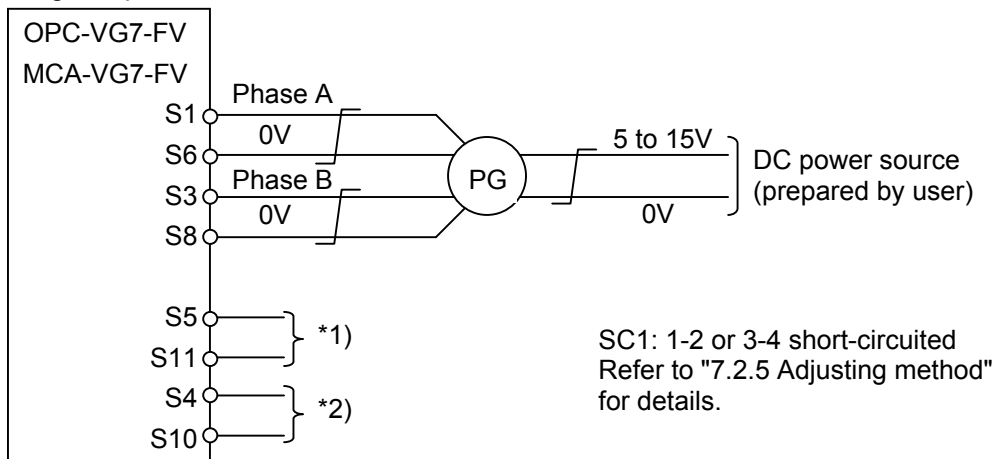


Fig. 7-18

2) For line driver PG

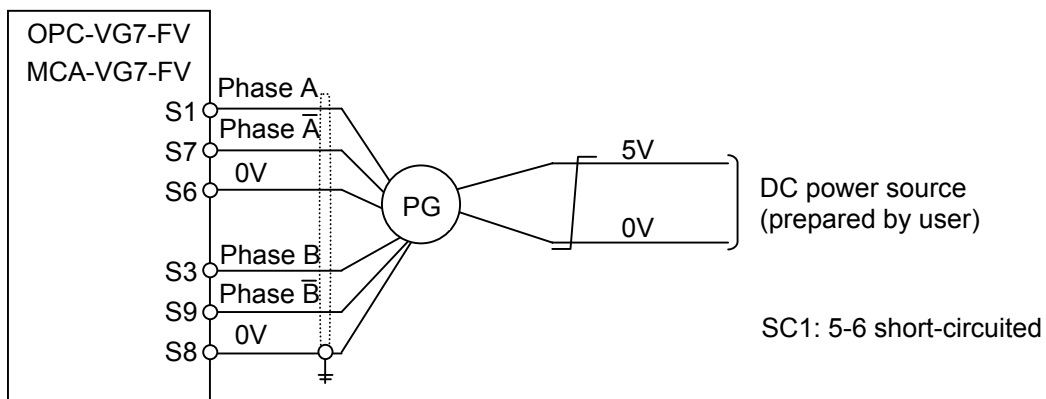


Fig. 7-19

Note: In principle, the shielded wire should be grounded. If the received external induction noise is large, connection to 0V may reduce interference of noise.

When the output of this printed circuit board (OPC-VG7-FV, MCA-VG7-FV) is used for control of the line speed and the motor speed (priority on higher speed) through FRENIC5000VG7S, connect voltage output terminal S4 to Ai1 (or Ai2) of the inverter, S10 to M (0V) of the inverter, and make the parameter setting \*3).

\*1) \*2) Output terminal specification

When the terminal is used other than above, refer to "Hardware specification I/O terminal specification".

\*3) Example of parameter setting

(Example of entering the line speed (F/V output) to Ai1 under control of the line speed and the motor speed (priority on higher speed))

Refer to H53 in "Chapter 4 Control and Operation" and set parameters with the following procedures:

(1) Set "11" to E49 "Ai1 function".

(2) Set "3" to H53 "Speed feedback mode".

(3) If gain adjustment of the line speed is required, use E53 "Ai1 Gain".

3) Supplementary explanation of PG output type

3)-1 Voltage output:

A circuit to give output at transistor collector with emitter grounded.

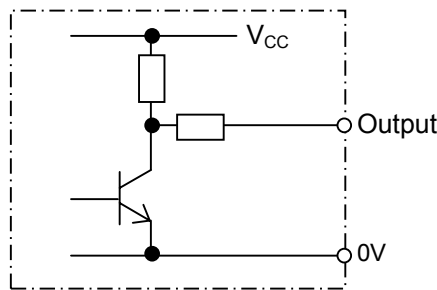


Fig. 7-20 Voltage Output

3)-2 Line driver:

A signal output is given in positive and negative phases. It applies to high speed transmission.

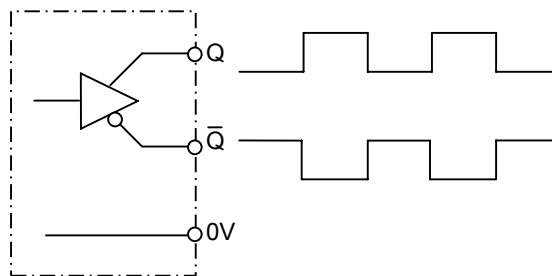


Fig. 7-21 Line Driver Output

3)-3 Complementary:

A constant voltage output circuit with emitter follower. It applies to high speed response and long distance transmission.

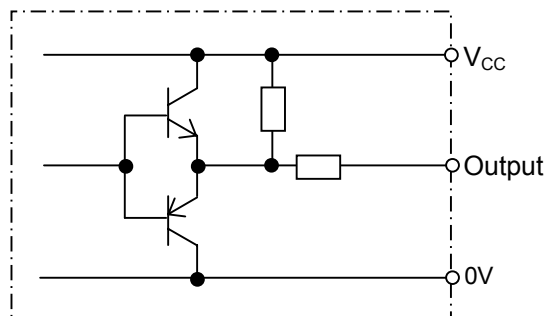


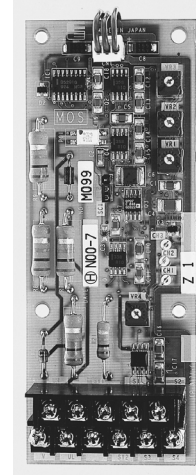
Fig. 7-22 Complementary Output

# 7. Control Options

## 7.3 Synchronous Interface

### 7.3.1 Outline of Product

OPC-VG7-SN is a model of FRENIC5000VG7 interface option OPC series. OPC series is the printed circuit board type control option built into the inverter unit. One interface option OPC series can be built into one inverter unit. OPC-VG7-SN is used for position control with the synchronous transmitter. The synchronous transmitter signal is converted into 0 to  $\pm 10V$ . MCA-VG7-SN is a separate option unit with the built-in OPC-VG7-SN function. MCA-VG7-SN may be used with combination of other models (FVR/FRENIC series inverter).



#### **WARNING**

- Since switches and variable resistors inside the option are adjusted before shipment, never touch the switches and variable resistors not allowed for adjustment by operator.

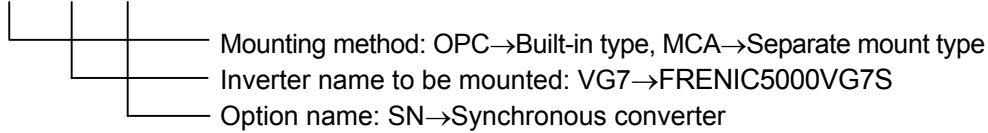
#### **CAUTION**

- Mount the MCA (separate mount type) vertically near the inverter with connection terminal facing downward. Perform wiring so that signal may not catch noise.
- The MCA type (separate mount type) needs a separate power source ( $\pm 15V$ ). Since the power is not supplied from V7GS, prepare a stabilized power source ( $\pm 15V$  DC).

## 7.3.2 Model and Specification

### 7.3.2.1 Model

Model: OPC-VG7-SN



#### OPC type accessories

Spacer	3
Screw (M3)	3
Power harness (for ±15V power)	1

### 7.3.2.2 Specification

#### ⚠ CAUTION

- The MCA type (separate mount type) needs a separate power source (±15V). Since the power is not supplied from VG7S, prepare a stabilized power source (±15V DC).

Table 7-13 Hardware Specification

Item	Specification	
	OPC-VG7-SN	MCA-VG7-SN
Voltage and required power	P: +15.0VDC ±2.0V Approx. 65mA (Supplied from control printed circuit board CN12)	Supplied from mother board printed circuit board
	N: -15.0VDC ±2.0V Approx. 35mA (Supplied from control printed circuit board CN12)	Power (±15V) is supplied to the mother board from outside

Table 7-14 I/O Terminal Specification

Terminal	Application	I/O range	Remark
UH-V	Synchronous power source	180 to 235V AC, 50/60Hz	Input capacity: Approx. 4VA
UL-V		90 to 121V AC, 50/60Hz	Input capacity: Approx. 2VA
SY1 to SY2	Synchronous output signal	31 to 78V AC, 50/60Hz	Approx. 0.3VA/78V (110V AC max.)
S1	Potential auxiliary input (position voltage signal input)	-10V to 0 to 10V	Input impedance: Approx. 13kΩ (10V max)
S3	Potentiometer output	-10V to 0 to 10V	Load impedance: 2.5kΩ or more
S4	Position output	-10V to 0 to 10V	
S2	Reference potential	M (0V)	

Table 7-15 Mother Board Printed Circuit Board Input Terminal List in MCA-VG7-SN

Terminal	Application	Level/type	Specification	Remark
S1 S2 S3	Unused			
P15	Power voltage	P	+15V DC±2.0V Approx. 65mA	Prepare a separate stabilized power source (±15V).
M		M	0V DC	
N15		N	-15V DC±2.0V Approx. 35mA	

# 7. Control Options

## 7.3.3 Outside Dimensions

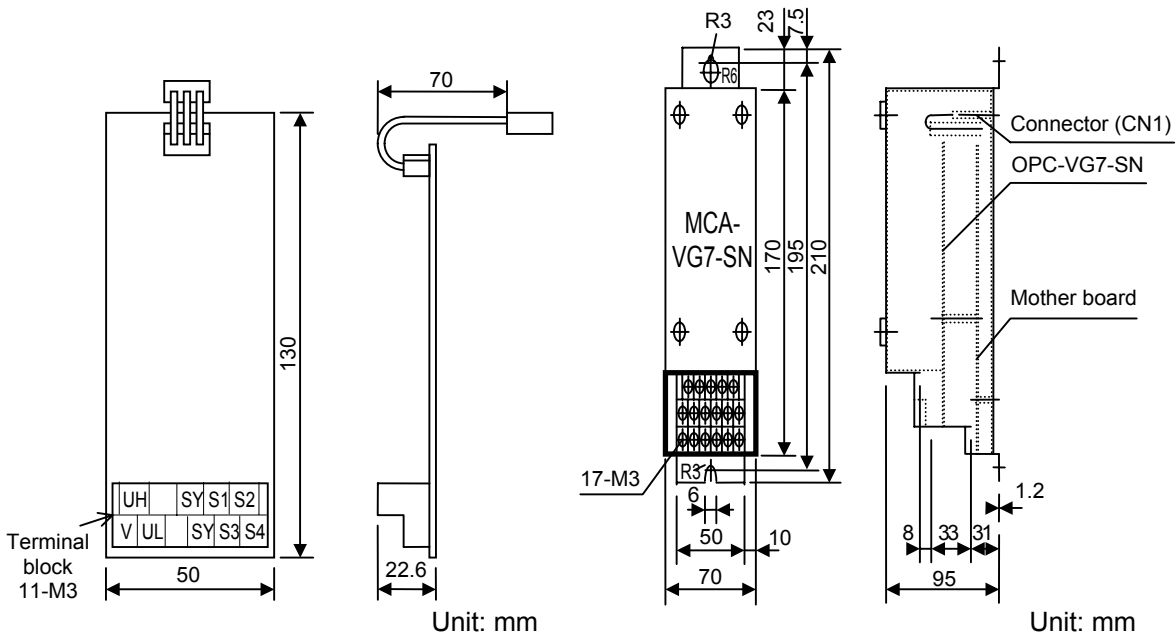


Fig. 7-23 OPC-VG7-SN Outline Drawing

Fig. 7-24 MCA-VG7-SN Outline Drawing

Arrangement of terminal block

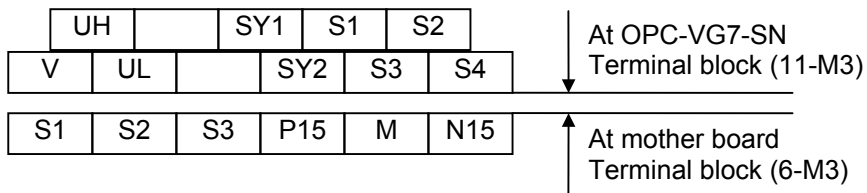


Fig. 7-25 MCA-VG7-SN Terminal Block Arrangement

## 7.3.4 Internal Block Diagram

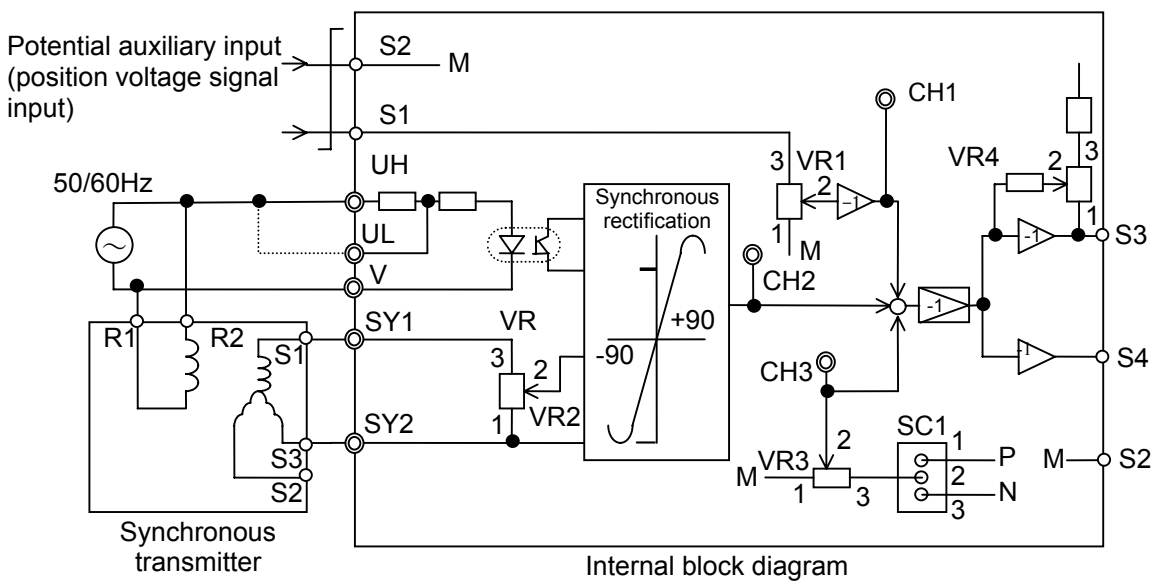


Fig. 7-26 Internal Block Diagram

## 7.3.5 Adjusting Method

### ⚠ WARNING

- Since switches and variable resistors inside the option are adjusted before shipment, never touch the switches and variable resistors not allowed for adjustment by operator.

### 7.3.5.1 Explanation of Adjusting Point

Table 7-16

Adjusting point	Name	Adjustment
SC1	Switching bias negative/positive	1-2 short-circuit: Bias voltage (+) 2-3 short-circuit: Bias voltage (-)
VR1	Potential auxiliary input signal adjustment	Potential auxiliary input signal is adjusted to 0V to voltage input (S1).
VR2	Synchronous transmitter output adjustment	Synchronous transmitter output is adjusted with voltage divider.
VR3	Bias adjustment	Bias voltage (with SC1) is adjusted (0V to $\pm 10.7V$ ).
VR4	Position meter output adjustment	Position meter output is adjusted to -10 to 0 to +10V. (Gain: 0.7 to 1.77)

Position of adjusting points

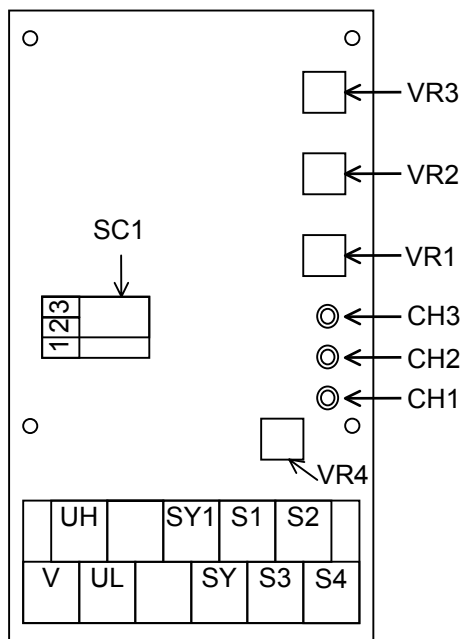


Fig. 7-27 Adjusting Points

- Adjustment at shipment from our factory

SC1: Adjusted to 1-2 short-circuit.

VR1: When the potential auxiliary input signal (S1) is +10V, the voltage at CH1 is adjusted to -10V (Amplifier gain is 1.).

VR2: Assuming that the synchronous transmitter output is 78V AC at the operation angle of  $\pm 60^\circ$ , the voltage output (S4) is adjusted to  $\pm 10V$  DC when the input is 78V AC.

VR3: Adjusted to 0 notch at shipment from our factory. (Voltage at CH3 is 0V.)

VR4: Adjustment is made so that the voltage output (S5) may be equal to the voltage output (S4). (Gain of the output stage amplifier is set to 1.)

# 7. Control Options

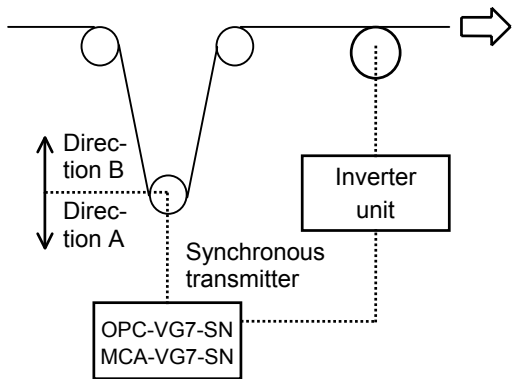
## 7.3.5.2 Mounting and Adjustment

Refer to 7.1.4 "Mounting Method of Built-in Option (OPC-VG7-)" before proceeding to wiring and connection.

⚠ WARNING
<ul style="list-style-type: none"> <li>• Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.</li> <li>• Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.</li> </ul>

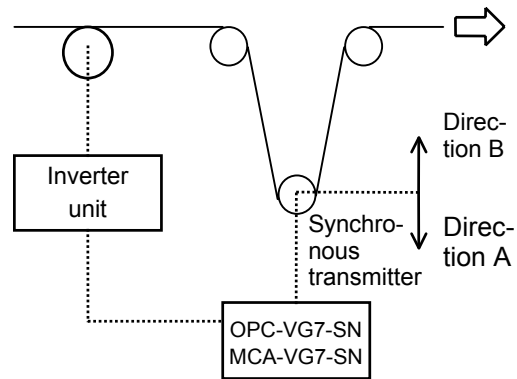
⚠ CAUTION
<ul style="list-style-type: none"> <li>• Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.</li> <li>• Inappropriate work during installation or removal of the product will cause breakage of the product.</li> <li>• Mount the MCA (separate mount type) vertically near the inverter with connection terminal facing downward. Perform wiring so that signal may not catch noise.</li> </ul>

- Mount the option so that the control position may be in the speed increasing position and that the output of the synchronous transmitter may be large. (When the polarity of output voltage S4 is + (+10V), the speed increases for the maximum compensation.)  
To change polarity, change the connection of SV1 and SV2.
- When the synchronous transmitter is mounted on the machine, adjust the angle so that the synchronous transmitter output may be 0V at the center of the maximum movable range of the synchronous transmitter movable shaft.  
Adjust VR2 so that the voltage output (S4) may be 10V DC in the maximum speed increasing direction. Make sure that the voltage output (S4) is -10V DC ( $\pm 0.5V$ ) in the maximum speed decreasing direction.
- The speed increasing direction varies depending on the mount position (for the inverter) of the synchronous transmitter. Refer to the figures below. (Fig. 7-28 applies to winding control and Fig. 7-29 applies to rewinding control.)



Direction A is the speed increasing position.

Fig. 7-28



Direction B is the speed increasing position.

Fig. 7-29

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## 7.4 Expansion DI Card

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### 7.4.1 Outline of Product

When this option OPC-VG7-DI is used, speed, torque command, torque current command and torque limit can be entered with 16bit digital input.

When DIA and DIB are selected with the switch on the option, two cards can be simultaneously mounted. With this function, the speed and the torque limit can be controlled at the same time with 16bit digital input.

1) Photocoupler insulation

The input interface section is insulated with photocoupler. Signal line of dozens of meters can be installed.

2) SINK/SOURCE

At the input interface, the current SINK output (hereinafter called SINK) and the current SOURCE output (hereinafter called SOURCE) can be switched.

In general, the interface often used in Japan and USA is SINK. This is the specification indicating 0V when the signal is active. The interface often used in Europe is SOURCE. This is the specification indicating +V when the signal is active.

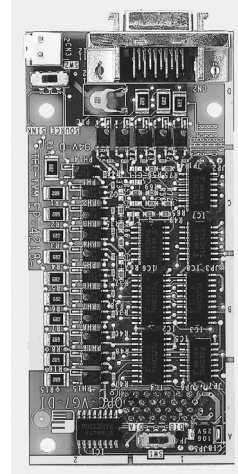
3) I/O check function

When either "DIA" or "DIB" is selected, each status of the input signal can be checked on the keypad panel and through communication (RS485, T-link, field bus, UPAC, etc.).

4) Optional function code

Selection of binary input "0000 0000 0000 0000" and BCD input of "7999" are available.

When the A/D converter is externally used, the data hold function with contact input is available to prevent variation of digital data low bits.



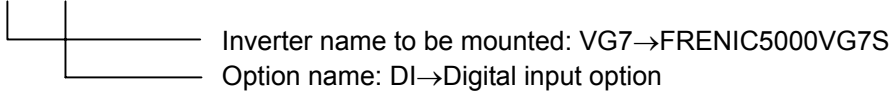


# 7. Control Options

## 7.4.2 Model and Specification

### 7.4.2.1 Model

Model: OPC-VG7-DI



#### Accessories

- Plug Model: 10120-3000VE 20-pin (Sumitomo 3M Ltd.)
- Housing (cover): Model: 10320-52F0-008 20-pin (Sumitomo 3M Ltd.)
- Spacer 3
- Screw (M3) 3
- Power harness (for 24V power) 1

[Restrictions for mounting]

(1) Combination allowed for mounting

- Two DI options can be simultaneously mounted when DIA and DIB are set.

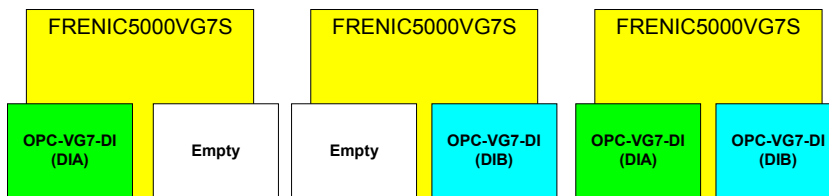


Fig. 7-30

(2) Combination not allowed for mounting (operation procedure error)

Two DIA options cannot be simultaneously mounted and two DIB options cannot be simultaneously mounted. This type of mounting results in operation procedure error "Er6".

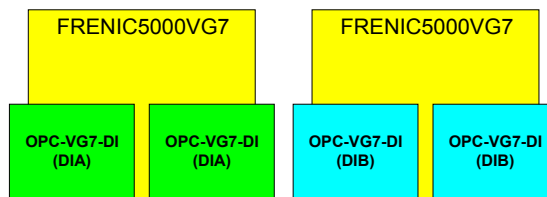


Fig. 7-31

## 7.4.2.2 Specification

### ⚠ CAUTION

- If the switch setting of the option (SW1, SW2) is incorrect, the system does not operate correctly. Read the following carefully for correct settings.

Table 7-17 Hardware Specification

Item	Specification	
Name	Digital input option	
Model	OPC-VG7-DI * DIA and DIB are switched with SW1.	
Input	No. of contacts	16 points (4 bits × 4 digits)
	Grounding	CM: Common grounding for all 4 points
	Circuit	Isolated circuit by photocoupler Current SINK output (SINK)/current SOURCE output (SOURCE) is switched with SW2. Distributed current per circuit: Approx. 3mA
Power supply	24V The power is supplied from the unit printed circuit board. Connect the wire harness CN24 or CN25 of the unit.	

### 1) Printed circuit board switch

Fig. 7-32 shows the approximate position of the switch when viewed from front of the printed circuit board.

- SINK or SOURCE of control input is selected with switch SW2 on the option printed circuit board.
- DIA or DIB is selected with switch SW1 on the option printed circuit board.

Table 7-18

Switch	Default
SW2	<b>SINK</b>
SW1	<b>DIA</b>

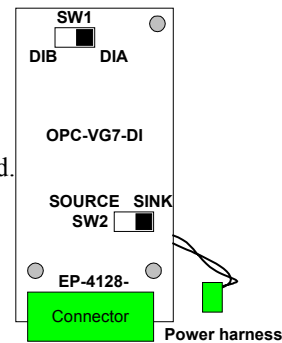


Fig. 7-32

### 2) Input circuit

When SW2 is set to SINK or SOURCE, each circuit configuration is as follows:

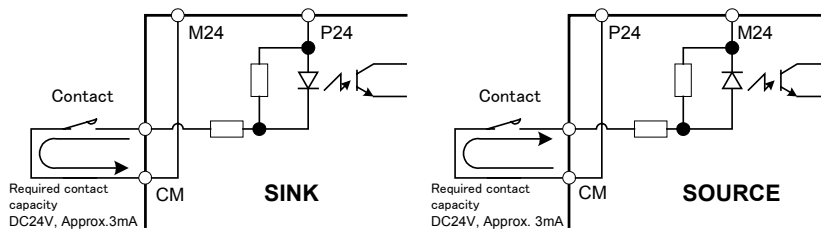


Fig. 7-33

24V power is supplied from the option. (P24: 24V, M24: Ground)

Table 7-19 Software Specification

Item	Specification	
Unit ROM version	The ROM version of the VG7S is not restricted.	
Input data reading frequency	Data is read at the frequency of 1 ms and it is defined when those data matched twice.	
Data latch function	Input data hold with contact [DIA] and [DIB]	
Application	Speed:	When function codes F01 and C25 are set to "6" DIA and "7" DIB, it is effective for input.
	Torque command:	When function code H41 is set to "2" DIA or "3" DIB, it is effective for input.
	Torque current command:	When function code H42 is set to "2" DIA or "3" DIB, it is effective for input.
	Torque limit command:	When function code F42 is set to "2" DIA or "3" DIB, torque limit level 1 is effective for input.
	Torque limit command:	When function code F43 is set to "2" DIA or "3" DIB, torque limit level 2 is effective for input.

# 7. Control Options

## 7.4.3 Outline Drawing

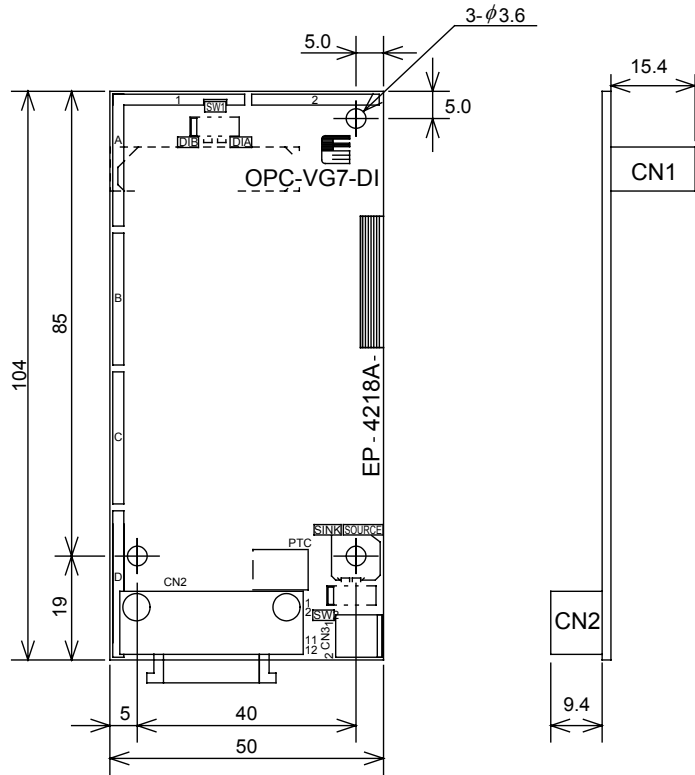
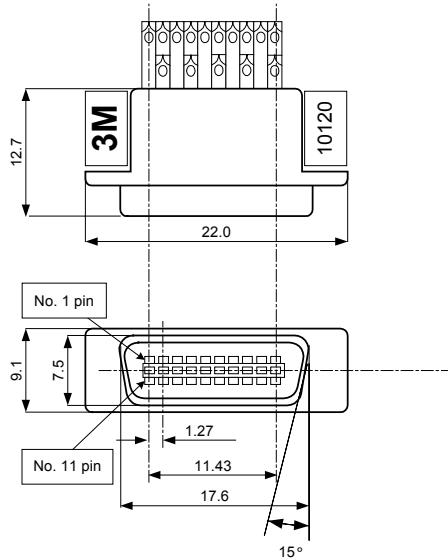


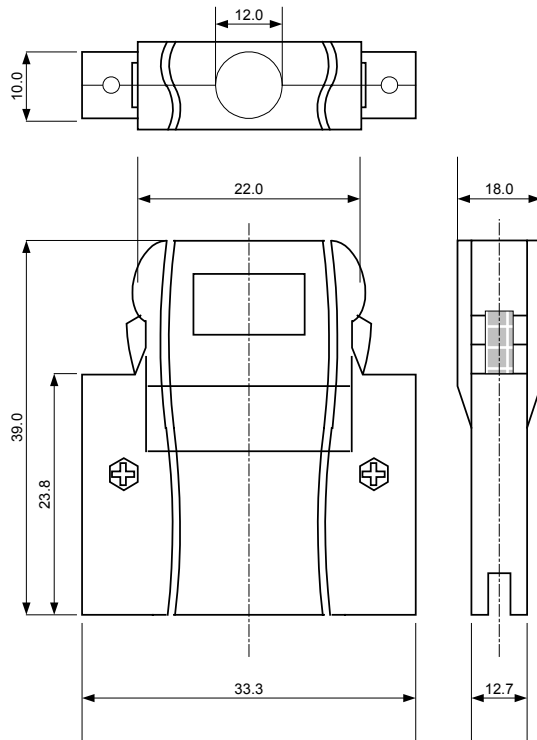
Fig. 7-34

### Accessories



Model: 10120-3000VE  
Specification: Sumitomo 3M Ltd., 20 pins

Fig. 7-35 Plug



Model: 10320-52F0-008  
Specification: Sumitomo 3M Ltd., 20 pins

Fig. 7-36 Housing

\* Plug and housing are supplied with the product.

## 7.4.4 Basic Connection Diagram

Refer to 7.1.4 "Mounting Method of Built-in Option (OPC-VG7-)" before proceeding to wiring and connection.

### ⚠ WARNING

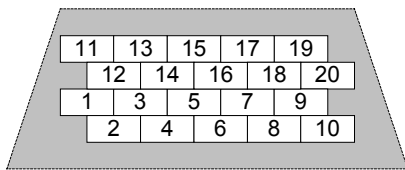
- Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.
- Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.

### ⚠ CAUTION

- Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.
- Inappropriate work during installation or removal of the product will cause breakage of the product.

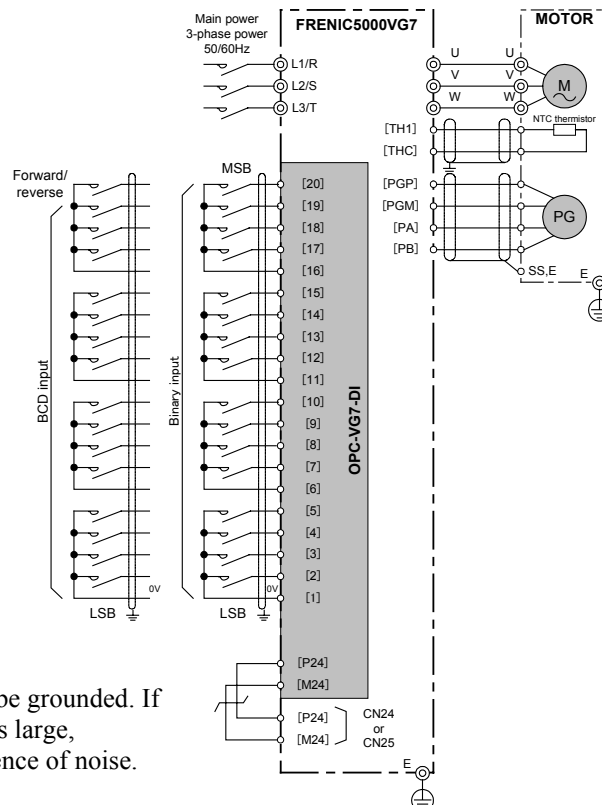
Table 7-20 Explanation of terminal functions

Pin No.	Name	Function		Pin No.	Name	Function	
		BINARY	BCD			BINARY	BCD
[1]	CM			[11]	CM		
[2]	DI0	$2^0 = 1$	$1 \times 10^0 = 1$	[12]	DI8	$2^8 = 256$	$1 \times 10^2 = 100$
[3]	DI1	$2^1 = 2$	$2 \times 10^0 = 2$	[13]	DI9	$2^9 = 512$	$2 \times 10^2 = 200$
[4]	DI2	$2^2 = 4$	$4 \times 10^0 = 4$	[14]	DI10	$2^{10} = 1024$	$4 \times 10^2 = 400$
[5]	DI3	$2^3 = 8$	$8 \times 10^0 = 8$	[15]	DI11	$2^{11} = 2048$	$8 \times 10^2 = 800$
[6]	CM			[16]	CM		
[7]	DI4	$2^4 = 16$	$1 \times 10^1 = 10$	[17]	DI12	$2^{12} = 4096$	$1 \times 10^3 = 1000$
[8]	DI5	$2^5 = 32$	$2 \times 10^1 = 20$	[18]	DI13	$2^{13} = 8192$	$2 \times 10^3 = 2000$
[9]	DI6	$2^6 = 64$	$4 \times 10^1 = 40$	[19]	DI14	$2^{14} = 16384$	$4 \times 10^3 = 4000$
[10]	DI7	$2^7 = 128$	$8 \times 10^1 = 80$	[20]	DI15	$2^{15} = 32768$	Sign (Negative at ON)



<Viewed from soldering terminal of plug>

Fig. 7-37




Note: In principle, the shielded wire should be grounded. If the received external induction noise is large, connection to 0V may reduce interference of noise.

Fig. 7-38

# 7. Control Options

## 7.4.5 Function Code

 <b>WARNING</b>
<ul style="list-style-type: none"> <li>• Incorrect data input of the function code may result in a dangerous situation. After data is set and written, check the data again.</li> </ul> <p><b>Otherwise, an accident may occur.</b></p>

DI option allows operation of function codes o01 to o04. These function codes are not displayed on the keypad panel in normal operation (without mounting of the option).

Table 7-21

No.	Parameter name		Setting range	Settings
	Name	Keypad panel display		
o01	Function selection of DIA	DIA function	0,1	0: Binary 1: BCD
o02	Function selection of DIB	DIB function	0,1	0: Binary 1: BCD
o03	DIA BCD input setting	BCD setting A	99 to 7999	
o04	DIB BCD input setting	BCD setting B	99 to 7999	

### 7.4.5.1 Data Latch Function

DIA input data is always taken into the inverter at 1 ms for operation.

To hold the DI input data or to suppress low bit variation for input of an external A/D converter, the data latch function is available.

[Setting method]

Allocate "55" DIA data latch or "56" DIB data latch to any contact of function code X1 to X14.

Then, the applicable contact is:

ON: Data is always taken.

OFF: DI input hold (Data is not taken. Data immediately before OFF is held.)

### 7.4.5.2 Selection of Binary/BCD Input

1) Input example when o01 and o02 are set to binary

-32768 to 32767 are effective.

Table 7-22

(MSB)														(LSB)		Exchange data	
20	19	18	17	15	14	13	12	10	9	8	7	5	4	3	2		
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2
0	1	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	20000
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	32767
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-32768
1	1	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	-20000
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	-2
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-1

- 2) Input example when o01 and o02 are set to BCD  
 -7999 to 7999 are effective.

Table 7-23

(MSB)														(LSB)	Exchange data	
20	19	18	17	15	14	13	12	10	9	8	7	5	4	3	2	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2
0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	4620
0	1	1	1	1	0	0	1	1	0	0	1	1	0	0	1	7999
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-1
1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	-2
1	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	-462
1	1	1	1	1	0	0	1	1	0	0	1	1	0	0	1	-7999

Sign	Place of 1000	Place of 100	Place of 10	Place of 1
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### 7.4.5.3 Input of control

- 1) Speed setting

When DI input is used for speed setting, set the effective function code of F01 or C25 to the switch status (DIA, DIB). For example, when F01 is effective and DIA, set F01 = "6".

F01 and C25 are switched with control input [N2/N1].

Table 7-24

Binary input setting	The maximum speed (F03) is set to 1500r/min.
Speed of 600r/min is set.	$600 \times \frac{20000}{1500} = 8000(d)$ $= 1F40(h)$ $= \text{Enter } 0001\_1111\_0100\_0000(B) \text{ in the DI card.}$
Speed of -1000r/min is set.	$-1000 \times \frac{20000}{1500} = -13333(d)$ $= CBEB(h)$ $= \text{Enter } 1100\_1011\_1100\_1011(B) \text{ in the DI card.}$

BCD input is used for conversion of the motor speed to the machine speed.

For example, when the motor rotating at 1500r/min is connected to the machine shaft through the gear of 5:1, the machine shaft rotates at 300.0r/min.

In this case, the BCD setting (o03, o04) of the function code is given as "3000". When DI input is 3000, the machine spindle can be rotated at 300.0r/min (1500r/min for the motor).

Table 7-25

BCD input setting	The maximum speed (F03) is set to 1500r/min and the BCD input setting (o03, o04) is set to 3000. (When the motor is 1500r/min, the machine shaft is 300.0r/min.)
Machine shaft is set to the speed of 75.0r/min. (Motor is 375r/min.)	$75.0=0750(BCD)$ $= \text{Enter } 0000\_0111\_0101\_0000 (B) \text{ in the DI card.}$
Machine shaft is set to the speed of -300.0r/min. (Motor is -1500r/min.)	$-300.0=(-)3000(BCD)$ $= \text{Enter } 1011\_0000\_0000\_0000 (B) \text{ in the DI card.}$

# 7. Control Options

## 2) Torque, torque current and torque limit input

When the DI input is given by torque quantity (torque command, torque current command, torque limit), it is necessary to define DIA and DIB with function codes H41, H42, F42 and F43. Refer to the applicable section in Chapter 4 for details.

Table 7-26

Binary input setting	To indicate the torque quantity scale, 100% is converted to 10000.
70% torque quantity is given.	$70 \times \frac{10000}{100} = 7000(d)$ $= 1B58(h)$ <p>= Enter 0001_1011_0101_1000 (B) in the DI card.</p>
-25% torque quantity is given.	$-25 \times \frac{10000}{100} = -2500(d)$ $= FC63C(h)$ <p>= Enter 1111_0110_0011_1100 (B) in the DI card.</p>

### 7.4.6 Check Function

#### 7.4.6.1 Option Mounting Check

DIA or DIB setting with DI option can be checked on the keypad panel. Go to the program menu screen from the operation mode screen and select "4. I/O check".

The I/O check monitor has 16 screens in total. Change the screen with **▲** or **▼** key and check the applicable screen of the DI option.

Refer to the section of the keypad panel operation method for details.

When DIA is set, → is displayed on the LCD screen as shown in the right.

**1500**

DIA    DIB  
DIOA   DIOB  
AIO    PMPG  
PG-LD PG-PD

#### 7.4.6.2 I/O Check

Digital input status of the DI option can be checked on the keypad panel of the inverter. Go to the program menu screen from the operation mode screen and select "4. I/O check". The I/O check monitor has 16 screens in total. Change the screen with **▲** or **▼** key and check the applicable screen of the DI option. Input data is displayed at XXXXX on the right side.

For example, A = "4000" means that "4000" is given for BCD input.

**1500**

DIA   BCD BIN  
 A = XXXXX  
DIB   BCD BIN  
 B = XXXXX

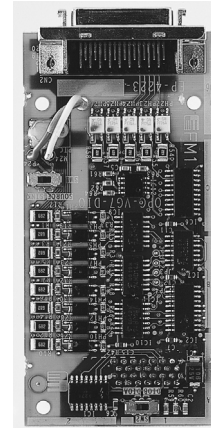
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## 7.5 Expansion DIO Card

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### 7.5.1 Outline of Product

When this option OPC-VG7-DIO is used, maximum DI/DO=16/10 points I/O can be added per card. When OPC-VG7-UPAC, being a different option is used, this option I/O can be operated from the program created by a user.



#### 1) Major application

DIOA and DIOB are switched with switch SW2 on the option.

##### "When DIOA is selected"

When DIOA is selected, DI/DO=4/8 can be used. At this time, **the control function of VG7S is available**. For example, coasting command, multi-step speed switching, servo lock function, etc. can be used as the input control function, and functions such as speed match or under operation can be used as the output control function.

##### "When DIOB is selected"

When "DIOB" is selected, DI/DO=16/10 points can be used. This I/O can be operated through the UPAC option. These I/Os can be operated on the program created by a user using the UPAC option. When the SI (optical option) card is mounted in addition to UPAC, I/O of DIOB card mounted on other inverters can be operated.

#### 2) Photocoupler

The input/output interface is insulated with photo coupler.

#### 3) SINK/SOURCE

At the input interface, the current SINK output (hereinafter called SINK) and the current source output (hereinafter called SOURCE) can be switched.

At the output interface, interactive power connection is available.

In general, the interface often used in Japan and USA is SINK. This is the specification indicating 0V when the signal is active. The interface often used in Europe is SOURCE. This is the specification indicating +V when the signal is active.

#### 4) I/O check function

When either "DIOA" or "DIOB" is selected, ON/OFF status of the input/output signal can be checked on the keypad panel and through communication (RS485, T-link, field bus, UPAC, etc.).

#### 5) Option function code

When "DIOA" is selected, the function code operation to allocate the VG7 input/output control function is available. To be specific, when the option is mounted and DIOA is selected, the applicable function codes (E10 to E13, E20 to E27) are displayed on the keypad panel. DI/DO=4/8 are allocated using these functions.

#### 6) UPAC function


When "DIOB" is selected, the option I/O can be selected from the UPAC option program. When "DIOA" is selected, the same operation is available. When two DIO cards are mounted, one is set as DIOA and the other is set as DIOB. Maximum DI/DO=20/18 can be operated with two DIO options. Including the number of built-in I/Os, DI/DO=31/23 can be operated at the maximum in one VG7. When two options are mounted, both options cannot be set to DIOA or DIOB. If this setting is performed, it is warned with operation procedure error "Er6".



# 7. Control Options

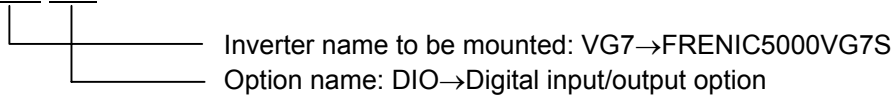
## 7.5.2 Model and Specification

### 7.5.2.1 Model

 <b>CAUTION</b>
<ul style="list-style-type: none"> <li>When the DIO option is set to DIOB (Di/Do = 16/10), the UPAC option is separately required. When the setting is DIOA, the standard I/O function of VG7S is available.</li> </ul>

In the DIO option of FRENIC5000VG7S, DIOA or DIOB can be selected with the hardware switch (SW1) on the option according to the application.

Model: OPC-VG7-DIO



#### Accessories

- Plug Model: 10136-3000VE 36-pin (by Sumitomo 3M Ltd.)
- Housing (cover): Model: 10336-52F0-008 36-pin (by Sumitomo 3M Ltd.)
- Spacer 3
- Screw (M3) 3

#### [Restrictions for mounting]

- (1) Combination allowed for mounting
- Two DIO options can be simultaneously mounted when DIOA and DIOB are set.
  - When DIOB is set, it must be used with the UPAC option.

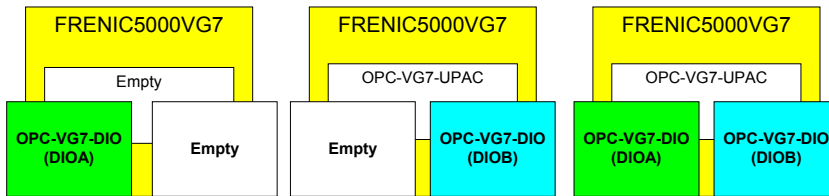


Fig. 7-39

- (2) Combination not allowed for mounting (operation procedure error)
- Two DIOA options cannot be simultaneously mounted and two DIOB options cannot be simultaneously mounted. This type of mounting results in operation procedure error "Er6".

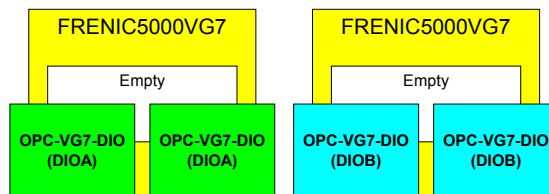


Fig. 7-40

## 7.5.2.2 Specification

### ⚠ CAUTION

- DIO options are not compatible with VG7S that has old ROM version. The system does not operate with the old version. Be sure to check the ROM version with the maintenance information on the keypad panel. If you are not sure about the version, please contact us.
- If the switch on the option (SW1, SW2) is incorrect, the system does not operate correctly. Read the following carefully for correct settings.

Table 7-27 Hardware Specification

Item	Specification	
	DIOA	DIOB (only for UPAC)
Name	Digital input/output option	
Model	OPC-VG7-DIO *DIOA and DIOB are switched with SW2.	
Input	No. of contacts	4 points (X11-X14) / 16 points (X21-X36)
	Grounding	CM: Common grounding for all 4 points
	Circuit	Isolated circuit with photocoupler Current SINK output (SINK)/current SOURCE output (SOURCE) is switched with SW1. Distributed current per circuit: Approx. 3mA
Output	No. of contacts	8 points (Y11-Y18) / 10 points (Y21-Y30)
	Grounding	CME: Common grounding for all 2 points
	Circuit	Circuit: Isolated circuit with photo relay (50mA DC max., 28V max.) Interactive connection is available. (SINK, SOURCE)
Power supply	24V The power is supplied from the unit printed circuit board. Connect the wire harness CN24 or CN25 of the unit.	

### 1) Printed circuit board switch

Fig. 7-41 shows the approximate position of the switch when viewed from front of the printed circuit board.

- SINK or SOURCE of control input is selected with switch SW1 on the option printed circuit board. The switching on the control output is not available.
- DIOA or DIOB is selected with switch SW2 on the option printed circuit board.

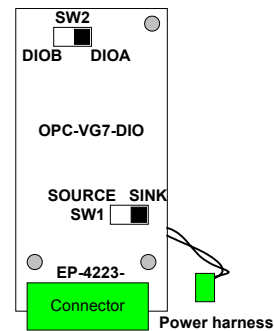


Table 7-28

Switch	Default
SW1	<b>SINK</b>
SW2	<b>DIOA</b>

Fig. 7-41

### 2) Input circuit

When SW1 is set to SINK and SOURCE, each circuit configuration is as follows:  
24V power is supplied from the option. (P24: 24V, M24: Ground)

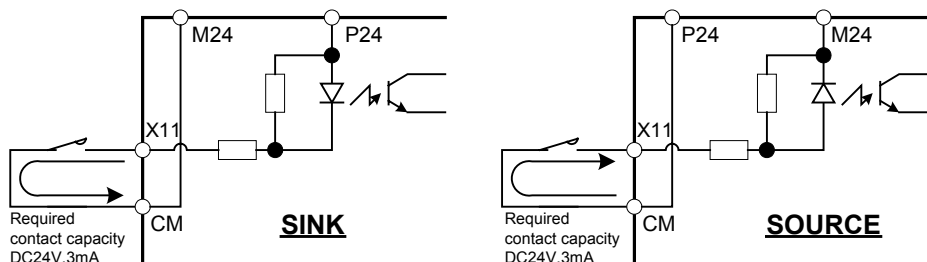


Fig. 7-42

# 7. Control Options

## 3) Output circuit

Interactive power connection is available. Since common CME is common for all contacts (Y11 to Y30), multiple interactive connection is not allowed.

For connection of the control relay, connect the surge absorbing diode directly to both ends of the excitation coil as shown in Fig. 7-43.

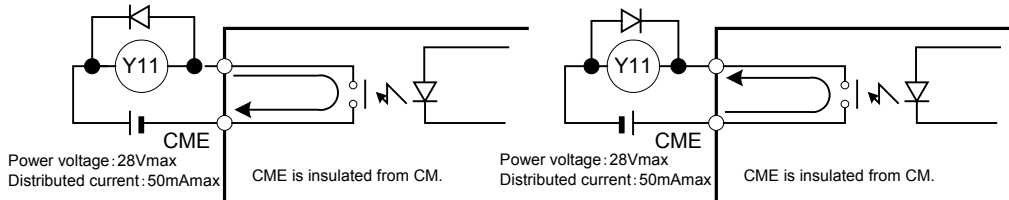


Fig. 7-43

Table 7-29 Software Specification

Item		Specification
Unit ROM version		H1003E or later, H2003E or later Use the ROM version above. (The ROM version can be checked with the I/O check on the keypad panel.)
Input data	Read frequency	Data is read at the frequency of 0.5 or 0.8ms. It is defined when data match twice. 0.5 or 0.8ms is determined according to the carrier frequency.
	Function allocation	Available when DIOA is used. Refer to Table 7-32.
Output data	Renewal frequency	Data is renewed at the frequency of 0.5ms minimum. In output functions, data may be renewed at the frequency longer than 0.5ms.
	Function allocation	Available when DIOA is used. Refer to Table 7-33.

### Check of version

Check the ROM version of the VG7 unit (neither optical option nor keypad panel). To check the version, See the data to the right of "MAIN" and "MTR" of the maintenance information on the keypad panel.

The screen on the right side can be found at the 5th row of the maintenance information. Move the **V** key on the keypad panel to the 5th row.

<b>1500</b>
MAIN=H1xxxx
MTR =H2xxxx
KP =K xxxx

## 7.5.3 Outside Dimensions

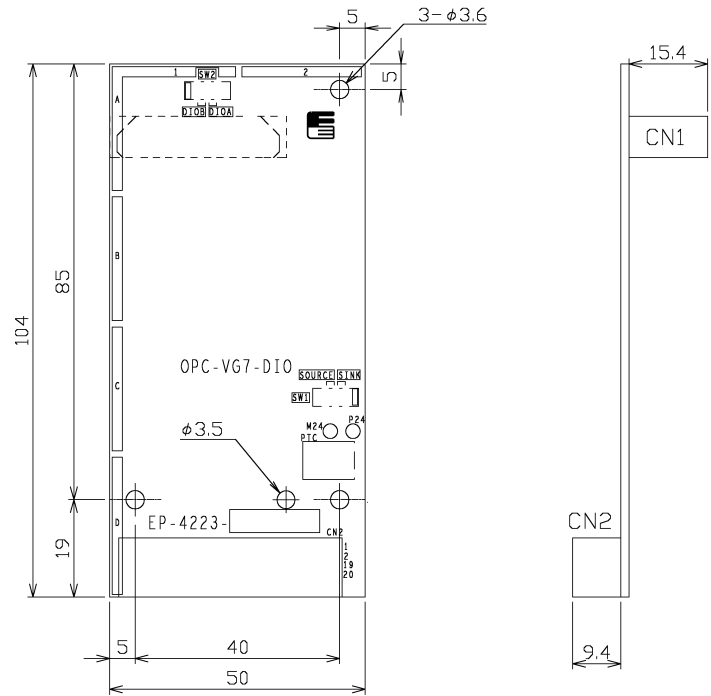
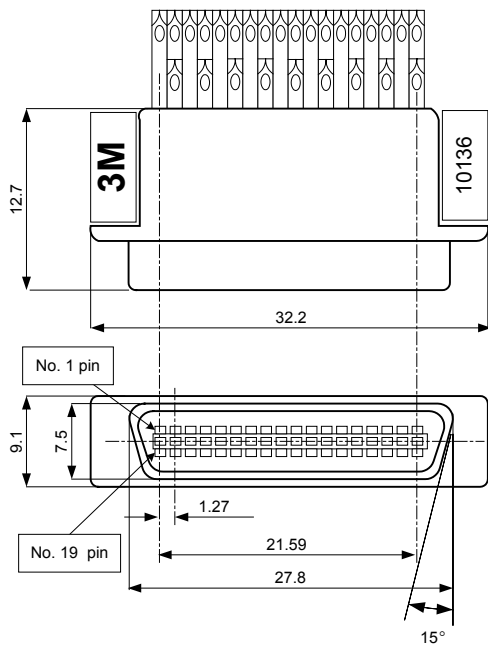


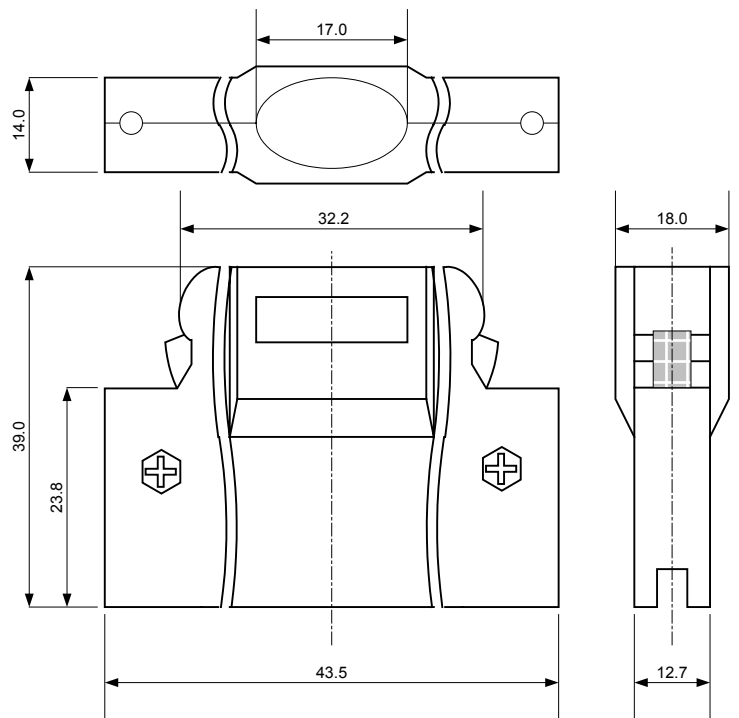
Fig. 7-44

### Accessories



Model: 10136-3000VE 36-pin  
Manufacturer: Sumitomo 3M Ltd.

Fig. 7-45 Plug



Model: 10336-52F0-008 36-pin  
Manufacturer: Sumitomo 3M Ltd.

Fig. 7-46 Housing

\* Plug and housing are supplied with the product.

# 7. Control Options

## 7.5.4 Basic Connection Diagram

Refer to 7.1.4 "Mounting Method of Built-in Option (OPC-VG7-)" before proceeding to wiring and connection.

**⚠ WARNING**

- Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.
- Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.

**⚠ CAUTION**

- Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.
- Inappropriate work during installation or removal of the product will cause breakage of the product.

### 7.5.4.1 Basic Connection Diagram (DIOA)

Table 7-30 shows the pin arrangement of the plug.

Table 7-30

Pin No.	Name	Function	Pin No.	Name	Function
[1]	CM	Common (M24)	[13]	Y11	Control output Y11
[2]	X11	Control input X11	[14]	Y12	Control output Y12
[3]	X12	Control input X12	[15]	Y13	Control output Y13
[4]	X13	Control input X13	[16]	Y14	Control output Y14
[5]	X14	Control input X14	[17]	Y15	Control output Y15
[6]	CM	Common (M24)	[18]	CME	Output common
[7] - [12]	-	Not connected	[19]-[30]	-	Not connected
			[31]	Y16	Control output Y16
			[32]	Y17	Control output Y17
			[33]	Y18	Control output Y18
			[34],[35]	-	Not connected
			[36]	CME	Output common

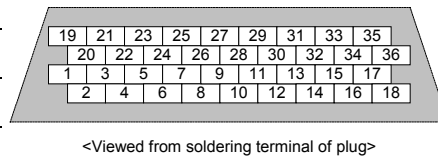


Fig. 7-47

Note: In principle, the shielded wire should be grounded. If the received external induction noise is large, connection to 0V may reduce interference of noise.

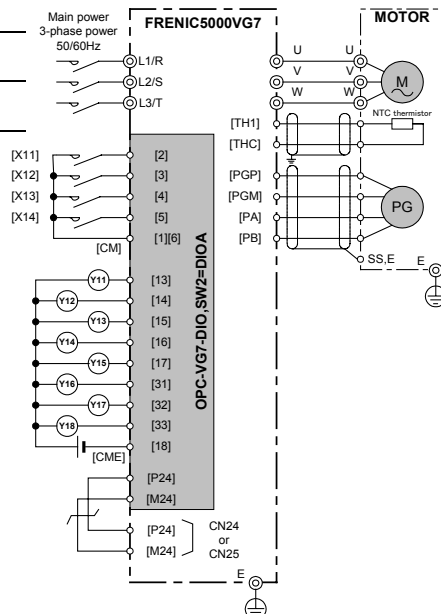


Fig. 7-48

## 7.5.4.2 Basic Connection Diagram (DIOB)

I/O of the DIO card can be operated only from the OPC-VG7-UPAC option.  
Table 7-31 shows the pin arrangement of the plug.

Table 7-31

Pin No.	Name	Function	Pin No.	Name	Function
[1]	CM	Common (M24)	[13]	Y21	Control output Y21
[2]	X21	Control input X21	[14]	Y22	Control output Y22
[3]	X22	Control input X22	[15]	Y23	Control output Y23
[4]	X23	Control input X23	[16]	Y24	Control output Y24
[5]	X24	Control input X24	[17]	Y25	Control output Y25
[6]	CM	Common (M24)	[18]	CME	Output common
[7]	X25	Control input X25	[31]	Y26	Control output Y26
[8]	X26	Control input X26	[32]	Y27	Control output Y27
[9]	X27	Control input X27	[33]	Y28	Control output Y28
[10]	X28	Control input X28	[34]	Y29	Control output Y29
[11]		Not connected	[35]	Y30	Control output Y30
[12]		Not connected	[36]	CME	Output common
[19]	CM	Common (M24)			
[20]	X29	Control input X29			
[21]	X30	Control input X30			
[22]	X31	Control input X31			
[23]	X32	Control input X32			
[24]	CM	Common (M24)			
[25]	X33	Control input X33			
[26]	X34	Control input X34			
[27]	X35	Control input X35			
[28]	X36	Control input X36			
[29]	-	Not connected			
[30]		Not connected			

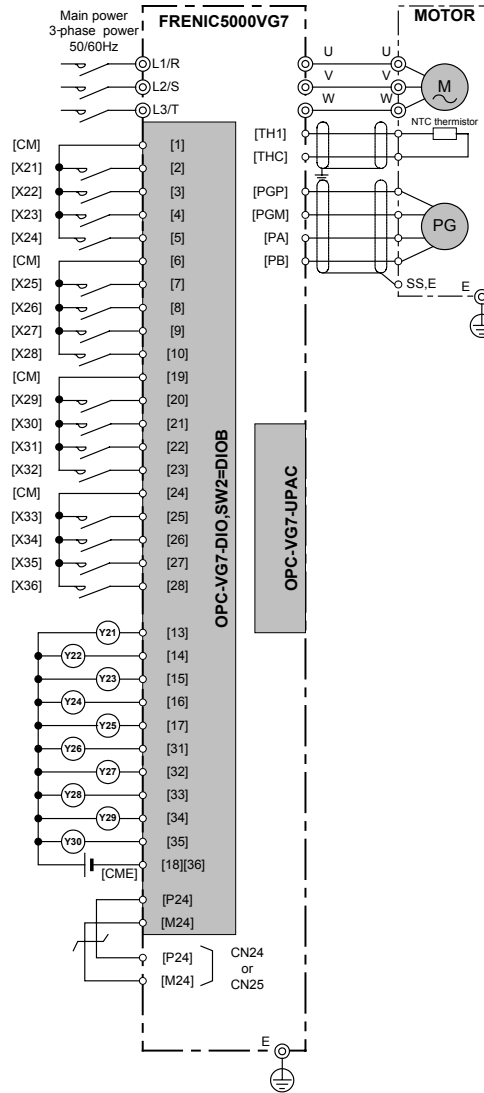
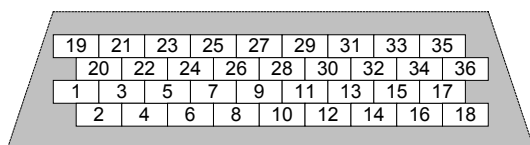


Fig. 7-50



<Viewed from soldering terminal of plug>

Fig. 7-49

Note: In principle, the shielded wire should be grounded. If the received external induction noise is large, connection to 0V may reduce interference of noise.

# 7. Control Options

## 7.5.5 Function Code

<b>WARNING</b>
<ul style="list-style-type: none"> <li>• Incorrect data input of the function code may result in a dangerous situation. After data is set and written, check the data again.</li> </ul>
<b>Accident may result.</b>

### 7.5.5.1 When DIOA Is Selected

#### 1) Input

The following functions can be assigned to digital input 4 points (X11 to X14).  
Settings are made with function code E10 to E13.

Table 7-32

Setting value	Function	Symbol	Setting value	Function	Symbol
0,1,2,3	Multistep speed selection (1 to 15 steps)	[SS1,2,3,4]	31	H41 [torque command] cancel	[H41-CCL]
4,5	ASR, ACC/DEC time selection (4 steps)	[RT1, RT2]	32	H42 [torque current command] cancel	[H42-CCL]
6	3-wire operation stop command	[HLD]	33	H43 [magnetic-flux command] cancel	[H43-CCL]
7	Coast-to-stop command	[BX]	34	F40 [torque limit mode 1] cancel	[F40-CCL]
8	Alarm reset	[RST]	35	Torque limiter (level 1, level 2 selection)	[TL2/TL1]
9	External alarm (Trip command)	[THR]	36	Bypass	[BPS]
10	Jogging operation	[JOG]	37,38	Torque bias reference 1/2	[TB1, TB2]
11	Speed setting N2/speed setting N1	[N2/N1]	39	Droop selection	[DROOP]
12	Motor M2 selection	[M-CH2]	40	Ai1 zero hold	[ZH-AI1]
13	Motor M3 selection	[M-CH3]	41	Ai2 zero hold	[ZH-AI2]
14	DC brake command	[DCBRK]	42	Ai3 zero hold (AIO optional function)	[ZH-AI3]
15	ACC/DEC cleared to zero	[CLR]	43	Ai4 zero hold (AIO optional function)	[ZH-AI4]
16	Creep speed switching in UP/DOWN setting	[CRP-N2/N1]	44	Ai1 polarity change	[REV-AI1]
17	UP command in UP/DOWN setting	[UP]	45	Ai2 polarity change	[REV-AI2]
18	DOWN command in UP/DOWN setting	[DOWN]	46	Ai3 polarity change (AIO optional function)	[REV-AI3]
19	Write enable for KEYPAD command (data can be altered)	[WE-KP]	47	Ai4 polarity change (AIO optional function)	[REV-AI4]
20	PID control cancel	[KP/PID]	48	PID output inverse changeover	[PID-INV]
21	Normal operation / inverse operation switching	[IVS]	49	PG alarm cancel	[PG-CCL]
22	Interlock signal for 52-2	[IL]	50	Undervoltage cancel	[LU-CCL]
23	Write enable through link	[WE-LK]	51	Ai torque bias hold	[H-TB]
24	Operation selection through link	[LE]	52	STOP1 (The motor stops with normal deceleration time)	[STOP1]
25	Universal DI	[U-DI]	53	STOP2 (The motor decelerates and stops with deceleration time 4)	[STOP2]
26	Pick up start mode	[STM]	54	STOP3 (The motor stops with torque limiter)	[STOP3]
27	Synchronization command (PG (PR) optional function)	[SYC]	55	DIA data latch (DIA optional function)	[DIA]
28	Zero speed locking command	[LOCK]	56	DIB data latch (DIB optional function)	[DIB]
29	Pre-exciting command	[EXITE]	57	Multiwinding motor control cancel (SI (MWS) optional function)	[MT-CCL]
30	Speed reference value limit cancel	[N-LIM]	58-63	Option Di 1/2/3/4/5/6	[O-DI1 to 6]

#### 2) Output

The following functions can be assigned to digital input 8 points (Y11 to Y18).  
Settings are made with function code E20 to E27.

Table 7-33

Setting value	Function	Symbol	Setting value	Function	Symbol
0	Inverter running	[RUN]	20	Alarm indication 2	[AL2]
1	Speed existence	[N-EX]	21	Alarm indication 4	[AL4]
2	Speed agreement	[N-AG]	22	Alarm indication 8	[AL8]
3	Speed equivalent	[N-AR]	23	Fan operation signal	[FAN]
4	Detected speed 1	[N-DT1]	24	Auto-resetting	[TRY]
5	Detected speed 2	[N-DT2]	25	Universal DO	[U-DO]
6	Detected speed 3	[N-DT3]	26	Heat sink overheat early warning	[INV-OH]
7	Stoppint on undervoltage	[LU]	27	Synchronization completion signal	[SY-C]
8	Detected torque polarity (braking/driving)	[B/D]	28	Lifetime alarm	[LIFE]
9	Torque limited	[TL]	29	Under accelerating	[U-ACC]
10	Detected torque 1	[T-DT1]	30	Under decelerating	[U-DEC]
11	Detected torque 2	[T-DT2]	31	Inverter overload early warning	[INV-OL]
12	KEYPAD operation mode	[KP]	32	Motor temperature early warning	[M-OH]
13	Inverter stopping	[STOP]	33	Motor overload early warning	[M-OL]
14	Operation ready output	[RDY]	34	DB overload early warning	[DB-OL]
15	Magnetic-flux detection signal	[MF-DT]	35	Link transmission error	[LK-ERR]
16	Motor M2 selection status	[SW-M2]	36	Load adaptive control under limiting	[ANL]
17	Motor M3 selection status	[SW-M3]	37	Load adaptive control under calculation	[ANC]
18	Brake release signal	[BRK]	38	Analog torque bias hold	[TBH]
19	Alarm indication 1	[AL1]	39-47	Optional Do 1 to 9	[O-DO1 to 9]

\* Refer to Chapter 4 for setting value, function and symbol.

Function code

Function codes allocate the input/output functions.

Table 7-34

No.	Parameter name		Setting range	Settings
	Name	Keypad panel display		
E10	X11 function selection	X11 FUNC	0 to 63	Refer to Chapter 4.
E11	X12 function selection	X12 FUNC	0 to 63	
E12	X13 function selection	X13 FUNC	0 to 63	
E13	X14 function selection	X14 FUNC	0 to 63	
E20	Y11 function selection	Y11 FUNC	0 to 31	Refer to Chapter 4.
E21	Y12 function selection	Y12 FUNC	0 to 31	
E22	Y13 function selection	Y13 FUNC	0 to 31	
E23	Y14 function selection	Y14 FUNC	0 to 31	
E24	Y15 function selection	Y15 FUNC	0 to 31	
E25	Y16 function selection	Y16 FUNC	0 to 31	
E26	Y17 function selection	Y17 FUNC	0 to 31	
E27	Y18 function selection	Y18 FUNC	0 to 31	

### 7.5.5.2 When DIOB Is Selected

Operation is available only from the OPC-VG7-UPAC option. Refer to [the UPAC users manual](#) for details.

The DIOB function is allocated to the control variables (global variables allocated to control variables) that can be used when the six-VG7 system is selected.

In operation, select from the list of control variables or designate the table address (%IQ area) to register variables. Put a check in the use/non-use checkbox in the system definition.

When DIOB options from INV2 to 6 are operated, the OPC-VG7-SI (UPAC) option is required.

Table 7-35

Address	No	Area	Name	Data type	Code	Direction	
%IW1.13	14	INV1	DI of INV1 (DIOB option: 16bit)	Data type: 26	W	INV1,2,3,4,5,6→UPAC	DI of INV1-6 is operated by UPAC. It is used at INV1-6.
%IW2.13	14	INV2	DI of INV2 (DIOB option: 16bit)	Data type: 26	W		
%IW3.13	14	INV3	DI of INV3 (DIOB option: 16bit)	Data type: 26	W		
%IW4.13	14	INV4	DI of INV4 (DIOB option: 16bit)	Data type: 26	W		
%IW5.13	14	INV5	DI of INV5 (DIOB option: 16bit)	Data type: 26	W		
%IW6.13	14	INV6	DI of INV6 (DIOB option: 16bit)	Data type: 26	W		
%QW1.41	24	INV1	DI of INV1 (DIOB option: 10bit)	Data type: 27	W	UPAC→INV1,2,3,4,5,6	DO of INV1-6 is operated by UPAC. It is used at INV1-6.
%QW2.41	24	INV2	DI of INV2 (DIOB option: 10bit)	Data type: 27	W		
%QW3.41	24	INV3	DI of INV3 (DIOB option: 10bit)	Data type: 27	W		
%QW4.41	24	INV4	DI of INV4 (DIOB option: 10bit)	Data type: 27	W		
%QW5.41	24	INV5	DI of INV5 (DIOB option: 10bit)	Data type: 27	W		
%QW6.41	24	INV6	DI of INV6 (DIOB option: 10bit)	Data type: 27	W		



# 7. Control Options

## 7.5.6 Check Function

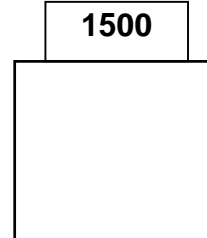
### 7.5.6.1 Option Mounting Check

DIOA or DIOB setting with DIO option can be checked on the keypad panel. Go to the program menu screen from the operation mode screen and select "4. I/O check".

The I/O check monitor has 16 screens in total. Change the screen with **▲** or **▼** key and check the applicable screen of the DIO option.

Refer to the section of the keypad panel operation method for details.

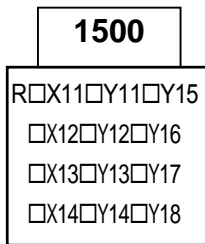
When DIOA is set, → is displayed on the LCD screen as shown on the right.



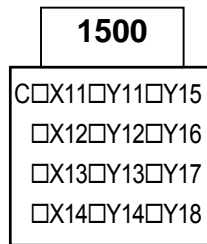
### 7.5.6.2 I/O Check

Digital input/output status of the DIO option can be checked on the keypad panel of the inverter. Go to the program menu screen from the operation mode screen and select "4. I/O check". The I/O check monitor has 16 screens in total. Change the screen with **▲** or **▼** key and check the applicable screen of the DIO option.

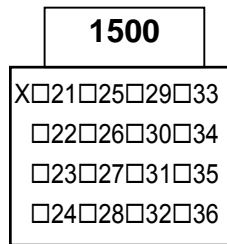
When the contact is ON, → is displayed.



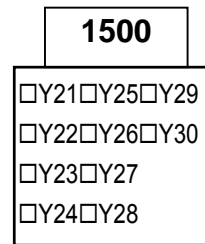
DIOA I/O status



DIOA I/O status (communication)



DIOB input status



DIOB output status

## 7.6 Expansion AIO Card

### 7.6.1 Outline of Product

The number of the analog inputs/outputs in the VG7 unit is 6 in total; [12] (only for speed command input), [Ai1], [Ai2], [AO1], [AO2] and [AO3].

When this option OPC-VG7-AIO is used, [Ai1]/[AO] = 2/2 can be added.

#### 1) Major application

The same control function as the analog input/output built into the VG7 unit is available. For example, speed auxiliary setting 1, torque bias, torque command, magnetic flux command, etc. can be used as the analog input function.

Speedometer, torque gauge, torque ammeter and line speed detection can be used as the analog output function.

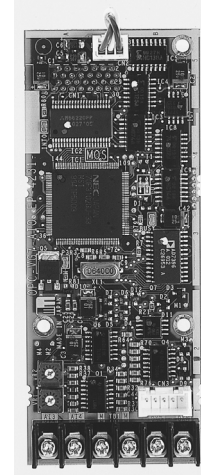
#### 2) Compensating insufficient analog I/O

In the system using UPAC or the control system using PID control built into the inverter, this card is used when the number of analog input/output is not sufficient.

For example, when WPS-VG7-TEN (tension control) is used, all three I/Os built into the VG7 unit are used for line speed, tension setting and tension detection.

When additional I/O is desired in this system, this expansion card is required.

However, the system that uses the synchronous interface option (OPC-VG7-SN) for dancer control does not allow use of this expansion card due to restriction of analog option mounting. When PID control built into the inverter is used, [Ai1] and [Ai2] are used for PID command (process setting) and PID feedback value (process). To add a PID correction gain to this system, this expansion card is required.



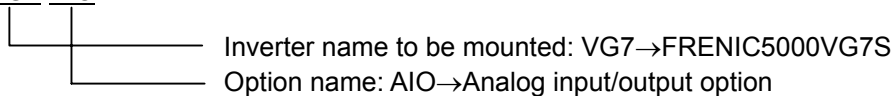
### 7.6.2 Model and Specification

#### 7.6.2.1 Model

#### ⚠ CAUTION

- Only one AIO option card can be mounted on the control printed circuit board. When other analog options (FV, SN) are mounted, AIO cannot be additionally mounted.

Model: OPC-VG7-AIO



#### Accessories

Spacer	3
Screw (M3)	3
Power harness (for ±15V power)	1

[Restrictions for mounting]

#### (1) Combination allowed for mounting

The AIO option can be mounted on the right side connector (CN3) when facing the control printed circuit board. Only one analog option can be mounted.

#### (2) Combination not allowed for mounting

When the analog option such as OPC-VG7-FV/SN is already mounted, the AIO option cannot be additionally mounted.

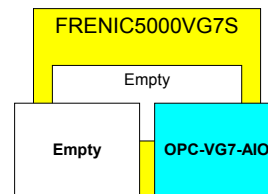


Fig. 7-51

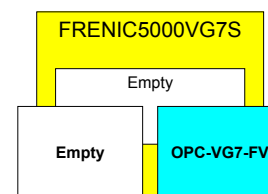


Fig. 7-52

# 7. Control Options

## 7.6.2.2 Specification

⚠ CAUTION	
<ul style="list-style-type: none"> <li>• Since variable resistors (VR1, VR2) inside the option are adjusted before shipment, never touch them not allowed for adjustment by operator.</li> <li>• AIO options are not compatible with VG7S that has old ROM version. The system does not operate with the old version. Be sure to check the ROM version with the maintenance information on the keypad panel. If you are not sure about the version, please contact us.</li> </ul>	

Table 7-36 Hardware Specification

Item		Specification
Name		Expansion AIO card
Model		OPC-VG7-AIO
Input	No. of terminals	2 points ([Ai3], [Ai4])
	Grounding	[M] (It is connected internally to terminal [M] of the control printed circuit board.)
	Circuit	Input voltage: 0 to ±10V DC, Resolution: 16-bit (with sign) Input impedance: 10kΩ
Output	No. of terminals	2 points ([AO4], [AO5])
	Grounding	[M] (It is connected internally to terminal [M] of the control printed circuit board.)
	Circuit	Output voltage: 0 to ±10V DC, Resolution: 12-bit (with sign) Output impedance: min. 3kΩ
Power supply		±15V The power is supplied from the control printed circuit board. Connect the wire harness with CN12.
VR1,VR2		These VRs are adjusted at the shipment. Never touch them.

Table 7-37 Software Specification

Item		Specification
Unit ROM version		MAIN = H1003F or later, MTR = H2003F or later Use with the ROM version above. (The ROM version can be checked with the maintenance screen on the keypad panel.)
Input data	Read cycle time	1ms
	Function allocation	Setting with function codes E51 and 52 is available.
	Input processing	Bias, gain, filter, increase/decrease limiter, zero hold and polarity change can be individually set.
Output data	Cycle time	1ms
	Function allocation	Setting with function codes E72 and 73 is available.
	Output processing	Bias and gain can be individually set. Filter is AO function. Overall setting is available.

### Check of version

Check the ROM version of the VG7 unit (neither optical option nor keypad panel).

To check the version, see the data to the right of "MAIN" and "MTR" of the maintenance information on the keypad panel.

The screen on the right side can be found at the 5th row of the maintenance information. Move the **V** key on the keypad panel to the 5th row.

**1500**

MAIN=H1xxxx

MTR =H2xxxx

KP =K xxxx

## 1) Input

The following functions can be arbitrary set to two analog inputs ([Ai3], [Ai4]).

Function codes E52 and 53 are used for setting. When the same function is set for both [Ai3] and [Ai4], [Ai3] has priority.

When the same function is set for [Ai1] and [Ai4], [Ai1] has priority.

Table 7-38 Input Function Allocation

Setting value	Function	Symbol	Scale
0	Input signal off	[OFF]	–
1	Auxiliary speed setting 1	[AUX-N1]	$\pm 10V/\pm N_{max}$
2	Auxiliary speed setting 2	[AUX-N2]	$\pm 10V/\pm N_{max}$
3	Torque limiter (level 1)	[TL-REF1]	$\pm 10V/\pm 150\%$
4	Torque limiter (level 2)	[TL-REF2]	$\pm 10V/\pm 150\%$
5	Torque bias command	[TB-REF]	$\pm 10V/\pm 150\%$
6	Torque command	[T-REF]	$\pm 10V/\pm 150\%$
7	Torque current command	[IT-REF]	$\pm 10V/\pm 150\%$
8	Creep speed 1 in UP/DOWN setting	[CRP-N1]	$\pm 10V/\pm N_{max}$
9	Creep speed 2 in UP/DOWN setting	[CRP-N2]	$\pm 10V/\pm N_{max}$
10	Magnetic-flux command	[MF-REF]	+10V/+100%
11	Detected line speed	[LINE-N]	$\pm 10V/\pm N_{max}$
12	Motor temperature	[M-TMP]	+10V/+200°C
13	Speed override	[N-OR]	$\pm 10V/\pm 50\%$
14	Universal Ai	[U-AI]	$\pm 10V/\pm 4000(h)$
15	PID feedback value	[PID-FB]	$\pm 10V/\pm 100\%$
16	PID command value	[PID-REF]	$\pm 10V/\pm 100\%$
17	PID correction gain	[PID-G]	$\pm 10V/\pm 100\%$
18	Option Ai	[O-AI]	$\pm 10V/\pm 7FFF(h)$

## 2) Output

The following functions can be arbitrary set to two analog outputs ([AO4], [AO5]).

Function codes E72 and 73 are used for setting.

Table 7-39 Output Function Allocation

Setting value	Function	Symbol	Scale
0	Detected speed 1 (speedometer, one-way deflection)	[N-FB1+]	+N <sub>max</sub> /10V
1	Detected speed 1 (speedometer, two-way deflection)	[N-FB1±]	$\pm N_{max}/\pm 10V$
2	Speed setting 2 (before acceleration/deceleration calculation)	[N-REF2]	$\pm N_{max}/\pm 10V$
3	Speed setting 4 (ASR input)	[N-REF4]	$\pm N_{max}/\pm 10V$
4	Speed detection 2 (ASR input)	[N-FB2±]	$\pm N_{max}/\pm 10V$
5	Detected line speed	[LINE-N±]	$\pm N_{max}/\pm 10V$
6	Torque current command (torque ammeter, two-way deflection)	[IT-REF±]	$\pm 150\%/\pm 10V$
7	Torque current command (torque ammeter, one-way deflection)	[IT-REF+]	+150%/+10V
8	Torque command (torque meter, two-way deflection)	[T-REF±]	$\pm 150\%/10V$
9	Torque command (torque meter, one-way deflection)	[T-REF+]	+150%/+10V
10	Motor current rms value	[I-AC]	200%/+10V
11	Motor voltage rms value	[V-AC]	200%/+10V
12	Input power	[PWR]	200%/+10V
13	DC link circuit voltage	[V-DC]	800V/+10V
14	+10V output test	[P10]	Output equivalent to +10V
15	-10V output test	[N10]	Output equivalent to -10V
30	Universal AO	[U-AO]	$\pm 4000(h)/\pm 10V$
31	Option AI	[O-AI]	$\pm 4000(h)/\pm 10V$

\* Nmax: Maximum motor speed currently selected (Setting value of F03, A06 or A40)

# 7. Control Options

## 7.6.3 Outside Dimensions

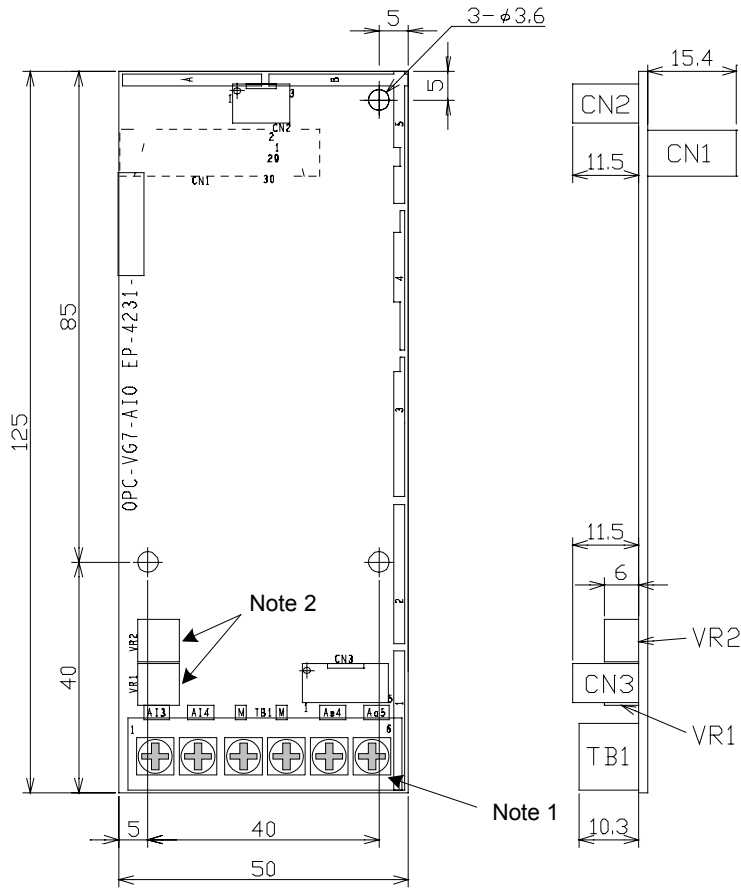


Fig. 7-53

Note 1: Terminal block screw size: M3

Note 2: Since VR1 and VR2 are adjusted at shipment from factory, do not change settings.

## 7.6.4 Basic Connection Diagram

Refer to 7.1.4 "Mounting Method of Built-in Option (OPC-VG7-)" before proceeding to wiring and connection.

<b>⚠ WARNING</b>
<ul style="list-style-type: none"> <li>• Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.</li> <li>• Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.</li> </ul>

<b>⚠ CAUTION</b>
<ul style="list-style-type: none"> <li>• Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.</li> <li>• Inappropriate work during installation or removal of the product will cause breakage of the product.</li> </ul>

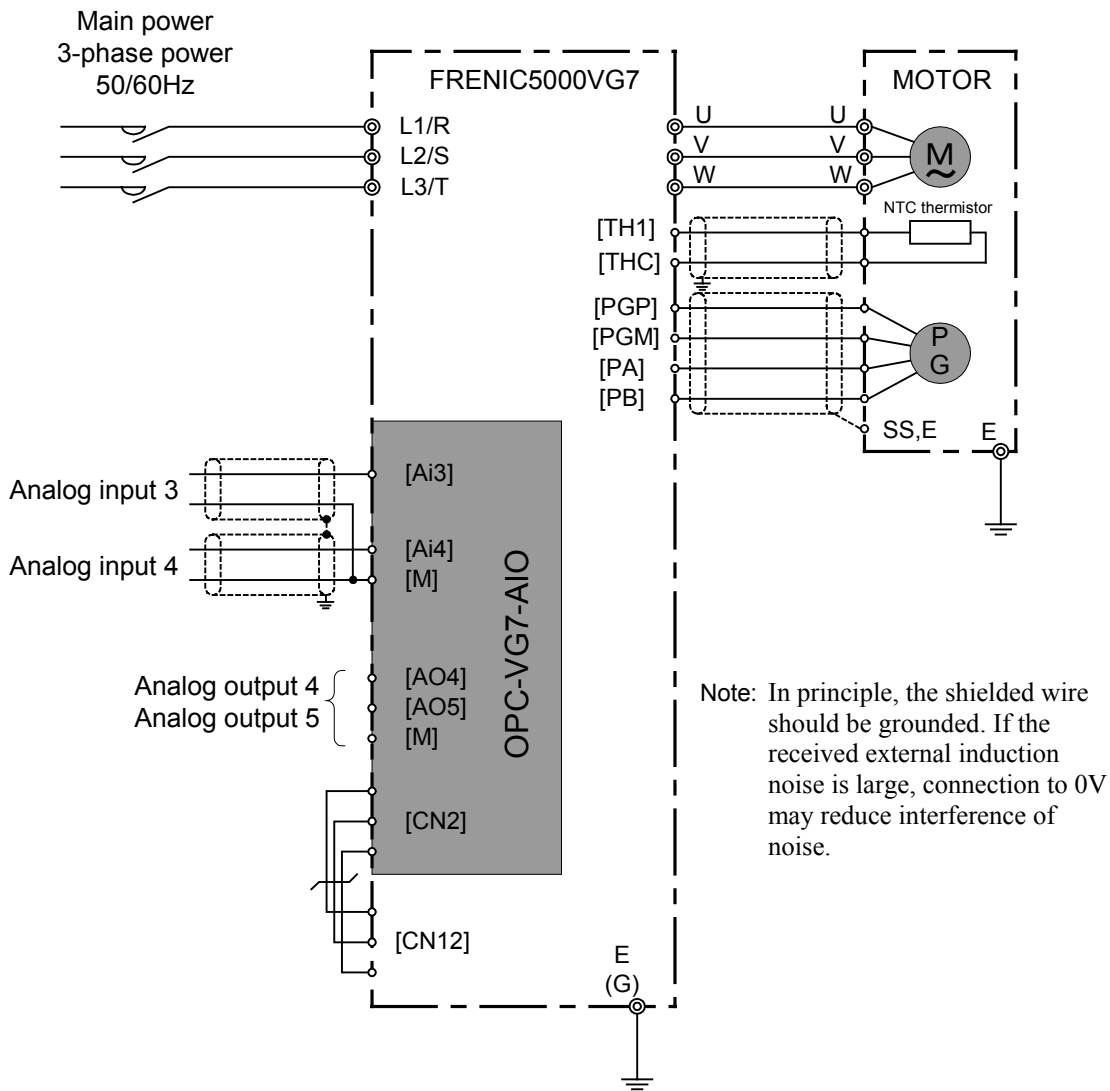


Fig. 7-54

## 7.6.5 Function Code

### ⚠ WARNING

- Incorrect data input of the function code may result in a dangerous situation. After data is set and written, check the data again.

**Accident may result.**

### ⚠ CAUTION

- Option function codes (E51, E52, E55, E56, E59, E60, E63, E64, E67, E68, E72, E73, E77, E78, E82 and E83) of AIO are not displayed on the keypad panel when the AIO option is not mounted. The codes are displayed once the option is mounted.

# 7. Control Options

When this option is mounted, operation of function codes E51, E52, E55, E56, E59, E60, E63, E64, E67, E68, E72, E73, E77, E78, E82 and E83 are available.

These function codes are displayed on the keypad panel when the AIO option is mounted. The codes are not displayed in normal operation (without AIO option).

Table 7-40

No.	Parameter name		Setting range	Settings
	Name	Keypad panel display		
E51	Ai3 function selection	Ai3 FUNC	0 - 18	Refer to Chapter 4.
E52	Ai4 function selection	Ai4 FUNC	0 - 18	
E55	Ai3 gain setting	GAIN Ai3	-10.00 - 10.00 (times)	
E56	Ai4 gain setting	GAIN Ai4	-10.00 - 10.00 (times)	
E59	Ai3 bias setting	BIAS Ai3	-100.0 - 100.0 (%)	
E60	Ai4 bias setting	BIAS Ai4	-100.0 - 100.0 (%)	
E63	Ai3 filter setting	FILTER Ai3	0.000 - 0.500 (s)	
E64	Ai4 filter setting	FILTER Ai4	0.000 - 0.500 (s)	
E67	Increase/decrease limiter (Ai3)	A/D-L-Ai3	0.00 - 60.00(s)	
E68	Increase/decrease limiter (Ai4)	A/D-L-Ai4	0.00 - 60.00(s)	
E72	AO4 function selection	AO4 FUNC	0 - 15,30,31	
E73	AO5 function selection	AO5 FUNC	0 - 15,30,31	
E77	AO4 gain setting	GAIN AO4	-100.0 - 100.0 (times)	
E78	AO5 gain setting	GAIN AO5	-100.0 - 100.0 (times)	
E82	AO4 bias setting	BIAS AO4	-100.0 - 100.0 (%)	
E83	AO5 bias setting	BIAS AO5	-100.0 - 100.0 (%)	
E84	AO1-5 filter setting	FILT AO1-5	0.000 - 0.500 (s)	

## 7.6.6 Check Function

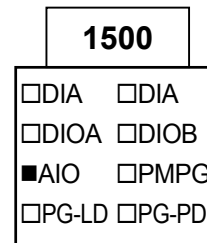
### (1) Option mounting check

Correct mounting of AIO option can be checked on the keypad panel. Go to the program menu screen from the operation mode screen and select "4. I/O check".

The I/O check monitor has 16 screens in total. Change the screen with **▲** or **▼** key and check the applicable screen of the AIO option.

Refer to the section of the keypad panel operation method for details.

When it is correctly mounted, → is displayed on the LCD screen as shown on the right.



### (2) I/O check

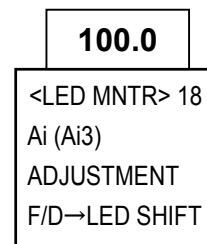
Input/output status of the AIO option can be checked on the keypad panel of the inverter.

Check with LED monitor

Press the "FUNC/DATA" key on the operation mode screen and select the applicable item.

The current analog input status is displayed in percentage on the 7 segment LED. When the analog input gain and bias gain are set, adjustment can be made based on the LED display.

(Analog output status is not displayed on the LED.)

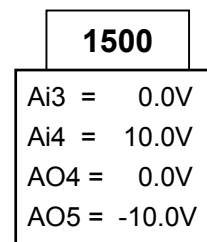


Check with LCD screen

Go to the program menu screen from the operation mode screen and select "4. I/O check".

The I/O check monitor has 16 screens in total. Change the screen with **▲** or **▼** key and check the applicable screen of the AIO option.

The screen displays input voltage of [Ai3] and [Ai4] and output voltage of [AO4] and [AO5].



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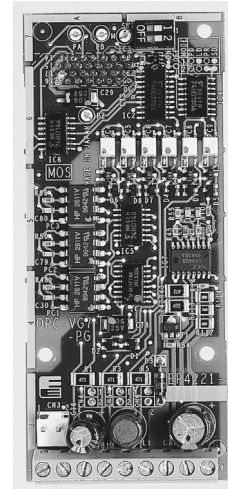
## 7.7 Expansion PG Interface Card

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### 7.7.1 Outline of Product

Use this PG interface expansion card to interface a line driver output type encoder or the like to perform speed control or to perform synchronous operation of two or more motors or rotary positioning (orientation).

The PG interface built in VG7S supports 15/12V complementary (totem pole, push-pull) output method. To perform speed control of the VG7S standard motor with a PG feedback, use this built-in PG interface function.



#### 1) Major applications

- Interface of PGs that are not covered with the built-in PG interface, 5V line driver output PG interface, etc.
- Detection of line speed with PG installed in the line
- Motor drive with pulse train commands or synchronous operation
- Orientation (rotary positioning) (The UPAC option is necessary.)

To meet each of these purposes, change switches SW1 and SW2 on the option from SD to LD to PR to PD in order from the top.

#### 2) Hardware

Because the interface section is isolated with photocouplers, the PG cable can be extended up to 50m if the line driver signal is used and the voltage drop of the cable is small.

#### 3) Wire disconnection detection function

When the card is used in the motor speed detection (SD) mode, the wire disconnection detection function can be used. Upon detection of disconnection, the inverter displays alarm “Pg” and the inverter output is shut off, causing the motor to coast to stop. However, this function is unavailable if the open collector and voltage output type (OPC-VG7-PGo) is used. As a PG wire disconnection detection cancellation function, the function provided for the main body of VG7 can be used as standard.

#### 4) Option function code

Use option codes (o05 to 08, o12 to 19) for pulse correction under position or line control.

#### 5) PG frequency division output

To select “SD” at the option PG to perform speed control similarly to the built-in PG, pulse signals can be divided and issued in open collector outputs from the built-in terminal block ([FA] and [FB]). With settings other than “SD,” the output pulses are not divided.

#### 6) Input type selection

To use speed detection (“SD” or “LD”) of the option, the input signal is fixed at two 90° phase different signal (phases A and B). In case of pulse train reception (“PR” or “PD”), one of three signal types can be selected with a function code (o13: pulse train input type selection).

#### 7) UPAC function

The cumulative input PG signal pulses can be read from the program of the UPAC option. With this function, applications such as winding diameter calculation and synchronous operation can be realized. For details, refer to UPAC User’s Manual.



# 7. Control Options

## 7.7.2 Model and Specification

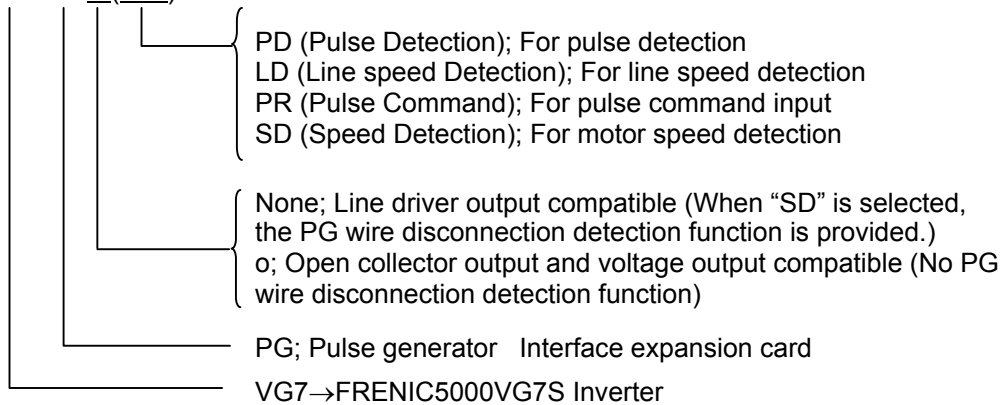
### 7.7.2.1 Model

⚠ CAUTION	
<ul style="list-style-type: none"> <li>The following two models are provided according to the difference in the output interface of external devices.</li> </ul>	
OPC-VG7-PG	: Line driver signal
OPC-VG7-PGo	: Open collector and voltage output
<u>Select a proper model matching your purpose when ordering.</u>	

The PG option of FRENIC5000VG7S reflects the difference in the output interface of the external device (line driver output or open collector output and voltage output). Because no switch for selecting the interface are fit, you must determine either option when purchasing (OPC-VG7-PG or OPC-VG7-PGo). The application can be changed, using the hardware switches (SW1 and 2) provided on the option.

Model

OPC-VG7-PG□(□□)



#### Accessories

- Spacer: 3 pieces
- Screw (M3): 3 pieces
- Power supply harness (for 24V power supply): 1 piece

#### SW1 and SW2 setting

To perform speed control of a motor equipped with a line driver output type encoder, for example, order OPC-VG7-PG and select “SD” at the switch for speed control. To perform synchronous operation while receiving pulse train, place the switch in the “PR” position.

Table 7-41 Switch Setting on Option

Function	SW1	SW2
PD	OFF	OFF
LD	ON	OFF
PR	OFF	ON
SD	ON	ON

(Default setting)

## 7.7.2.2 Specifications

### CAUTION

- If the setting of the switches (SW1 and SW2) on the option is wrong, the system does not function correctly. Read the following hardware specification and give the correct setting.
- For rotary positioning, select PG (PD) and install the UPAC option.
- The PG option is not compatible with earlier ROM versions of VG7S. Correct operation is not obtained with an earlier version. Be sure to refer to the maintenance data at the keypad panel for the ROM version. For any inquiries about the version, contact us.

Table 7-42 Hardware Specification

Item	Specification	
Model	OPC-VG7-PG	OPC-VG7-PGo
Signaling method	Line driver output method (AM26LS31PC or equivalent recommended)	Open collector output method Voltage output method
Mode change	Use SW1 and 2 on the option to switch in the following way. (SW1, SW2) = [(OFF, OFF) : (ON, OFF) : (OFF, ON) : (ON, ON)] = [PD : LD : PR :SD]	
Application	Motor speed detection (SD), line speed detection (LD), pulse detection (PD) and pulse command input (PR)	
Power supply for PG	<b>For 5V power supply</b> [PGP] terminal ; +5V ±5%, 250mA. [PGM] terminal; common With overcurrent protection function Internal isolation with photocoupler (Connected with [PGM] and [CM] on control PC board of main body. Isolated from [M].)	
Signal terminal	[PA], [*PA], [PB], [*PB], [PZ], [*PZ] Photocoupler isolated	[PA], [PB], [PZ] [*PA], [*PB] and [*PZ] are not used.) Photocoupler isolated
Connection (See the basic connection diagram.)	① Line driver output method Supply 5V power from [PGP] and [PGM]. Other 5V power supply may not be used. A twisted pair shielded cable must be used for wiring to configure a balanced circuit. ② Open collector output method Built-in 5V pull-up. Sink current ; 8mA max./circuit (Can be used if the counterpart of connection is [FA] and [FB] of VG7.) ③ Voltage output method L level voltage detection: 0 to 2V. H level voltage detection: 4 to 15V	
Input signal style	One of the following three types can be selected with function code o13 "pulse train input style selection." ① Phase A and B, 2 90° phase different signal ② Phase A: Command pulse. Phase B: Command sign ③ Phase A: Forward rotation pulse. Phase B: Reverse rotation pulse	
Pulse output	The frequency of input pulses at [FA], [FB] and [CM] built in the main body can be divided and the pulses are issued in open collector outputs. The maximum frequency of the output is <b>100kHz</b> . 15mA max., 1.5mA min., 27V max./circuit.	
Max. frequency	<b>500kHz</b> , duty: 50±10%.	<b>100kHz</b> , duty: 50±10%.
Allowable wiring length	About 50m The wiring length must be shorter if the voltage drop is large. For 50m or longer wiring length, use an isolation converter described in Section 7.7.4.2 "Wiring."	Within 10m To avoid effects of noise, the wiring length should be as short as possible.
Power supply	24V Supplied from the printed circuit board of the main body. Connect power supply harness to CN24 or CN25.	

# 7. Control Options

Input signal style (Inverse signals\* are omitted.)

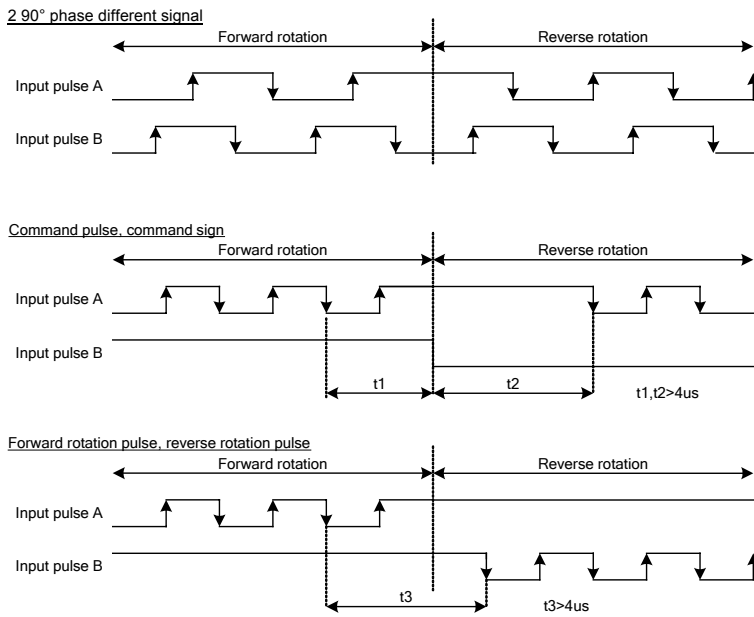


Fig. 7-55

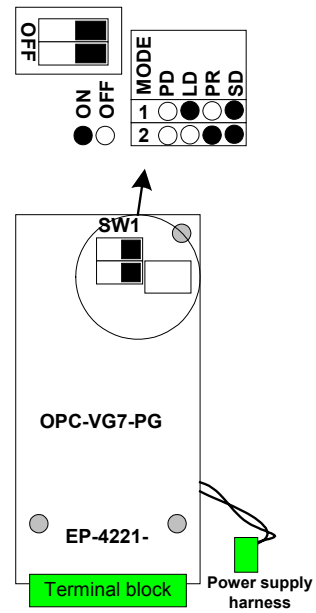


Fig. 7-56


## Software specification

### Version check

Check the ROM version of the main body of VG7 (not that of the optical option or keypad panel).

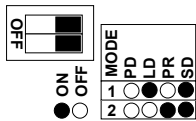
To check, refer to the maintenance data on the right side of “MAIN” and “MTR” at the keypad panel.

The screen shown on the right is found at page 5 of the maintenance information.

Use the  key on the keypad panel to go to page 5.

<b>1500</b>
MAIN=H1xxxx MTR =H2xxxx KP =K xxxx

### 1) Speed control specification



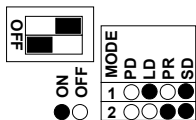
The speed control specification is the same as that using the built-in PG interface.

Fig. 7-57

Table 7-43

Item		Speed control specification
Card model (setting)		<b>OPC-VG7-PG□ (SD)</b>
ROM version of main body		H10030 or later, H20030 or later Use with the ROM version specified above. (Refer to the I/O check on the keypad panel for the ROM version.)
Motor control method		Induction motor vector control with PG
Speed control Vector control with PG	Control range	1:1000 (Min. speed: base speed; 1.5 to 1500r/min when converted to 4P; during operation at 1024P/R) 1:4 (constant torque area : constant output area)
	Speed control accuracy	Analog setting: $\pm 0.1\%$ of max. speed Digital setting: $\pm 0.005\%$ of max. speed
PG interface function		When the PG option is installed and “SD” is selected, the built-in PG becomes invalid and priority is given to the PG option.
Wire disconnection detection function		Provided
Frequency division output		Option input pulses are divided and output from the standard [FA] and [FB] terminals.

### 2) Line speed control specification



Use the line speed control specification to control the line speed of winding equipment or the like, instead of the motor speed, using the PG installed in the line.

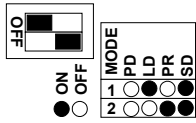
Fig. 7-58

Table 7-44

Item		Line speed control specification
Card model (setting)		<b>OPC-VG7-PG□ (LD)</b>
ROM version of main body		H1003F or later, H2003F or later Use with the ROM version specified above. (Refer to the I/O check on the keypad panel for the ROM version.)
Motor control method		Induction motor vector control (line speed control) The line speed control function is built in the standard model.
Line control Vector control with PG	Control range	1:1000 (Min. speed: base speed; 1.5 to 1500r/min when converted to 4P; during operation at 1024P/R) 1:4 (constant torque area : constant output area)
	Speed control accuracy	Analog setting: $\pm 0.1\%$ of max. speed Digital setting: $\pm 0.005\%$ of max. speed
PG interface function		When the PG option is installed and “LD” is selected Function code H53 = “2”: Line speed detection valid Function code H53 = “3”: High selector (line speed detection, motor speed detection with built-in PG)
Pulse correction		Possible with function codes o07 and 08
Wire disconnection detection function		None
Application function		① 15 multi-step speed settings can be given in m/min. (Function codes C05 to C21) ② Line speed detection at A0 output ( $\pm$ max. speed per $\pm 10V$ ) output possible
Frequency division output		The standard built-in PG interface input is frequency divided and output. (The line PG is not output.)

# 7. Control Options

## 3) Pulse train and synchronous drive specification



The action follows the pulse train inputs.  
The synchronous master/slave operation can be made.

Fig. 7-59

Table 7-45

Item		Pulse train and synchronous drive specification
Card model (setting)		OPC-VG7-PG□ (PR)
ROM version of main body		H1003F or later, H2003F or later Use with the above ROM version. (Refer to the I/O check on the keypad panel for the ROM version.)
Wire disconnection detection function		None
Synchronous operation	Function	The synchronous driving function is built in as standard. Position control can be made, if the UPAC option is used.
	No. of units connected for synchronous operation	① Cascade connection can be made. (See Fig. 7-60.) ② If the units are connected in parallel using the pulse generator or open collector output of the isolated pulse amplifier, the number of connected units depends on the 8mA sink current per circuit. For example, if the maximum output rating of the devices is 25mA, up to 3 units can be connected. (24mA = 3 x 8mA)
Speed control	Setting range	0 to ±24,000r/min However, the input pulse frequency is limited up to 500kHz (OPC-VG7-PG) or 100kHz (OPC-VG7-PGo).
	Speed control accuracy	±0.005% of max. speed (Accuracy in relation to stationary deviation caused by temperature fluctuation or load)
Position control	Position response	10Hz The response is adjusted with the APR and ASR gains.
	Synchronization accuracy (See the figure below.)	Within ±2 pulses (in stationary/transient mode; F/F gain: set at 1.0) If the F/F gain is not 1.0, stationary and transient deviation is caused.
	Lock accuracy	Within ±1 pulse The repulsion torque can be 150%.

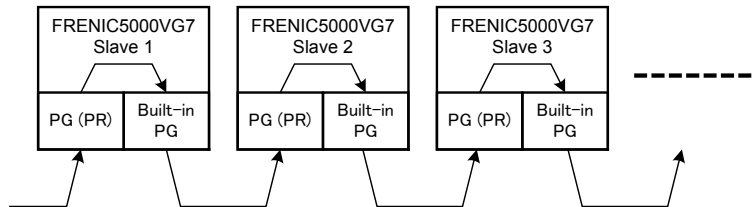
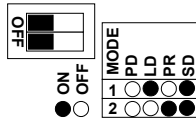


Fig. 7-60

4) Orientation specification



Rotary positioning can be controlled if UPAC is used.  
For details, refer to UPAC User's Manual.

Fig. 7-61

Table 7-46

Item	Orientation specification
Card model (setting)	Two cards must be used. <b>OPC-VG7-UPAC</b> <b>OPC-VG7-PG□ (PD)</b>
ROM version of main unit	H1003F or later, H2003F or later Use with the ROM version specified above. (Refer to the I/O check on the keypad panel for the ROM version.)
Orientation function	<b>Orientation package software</b> is used. (Not built as the standard)
Wire disconnection detection function	None
Stopping position	Stopping position setting = External stopping position setting + internal stopping position setting
External stopping position setting	Either of the following can be used to enter. ① <b>OPC-VG7-TL</b> (T-link card) + Fuji's MICREX PLC ② <b>OPC-VG7-DIOB</b> (16bit input, 10bit output card) ③ <b>Standard RS485</b>
Internal stopping position setting	4 points can be entered with the UN0 function code. To change, combine the general-purpose input terminals.
Repetitive positioning accuracy	<b>Within ±1 pulse</b> (Within ±0.088° with a 1024P/R pulse encoder) The accuracy depends on the encoder pulse count and is calculated with 360° / 4 / encoder pulse count. A Z-phase detection (initialization) is performed when the encoder is turned on.
Specification of pulse encoder	<u>Specification of pulse encoder</u> Refer to Fig. 7-62. The encoder pulse resolution can be selected among 128, 256, 512, 1024, 2048, 4096 and 8192 P/R.
Repulsion torque	Up to max. value of motor (under ASR PI control) * The transient displacement against a momentary load torque becomes large. The repulsion torque and response can be adjusted with the speed control gain and orientation gain.
Mechanical conditions	Speed gear steps: <b>4</b> . [RT1] and [RT2] are used.

Table7-47

Item	Description	
Software package function	Orientation package (WPS-VG7-POS)	
	Speed change gear steps	4 speeds (Select with contact inputs [RT1] and [RT2].)
	Action selection	Software stop function for stopping action Selection of stopping direction such as shortcut Selection of function such as boosting and stopping in a shortest distance and stopping without boosting
	Control input	Orientation command Position change command (Latch function after changing the stopping position) Slow-speed direction command (stopping direction change)
	Control output	Orientation in progress End of orientation Off-delay/on-delay of each output signal. Completion width setting
	Monitoring function	Position displacement amount (stopping position command - current position) display External stopping position command Position display based on Z-phase
	Keypad panel	U code: parameter setting, etc. Option monitor (position display, etc.)

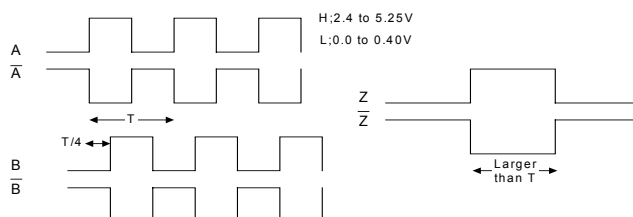


Fig. 7-62

# 7. Control Options

## 7.7.3 Outside Dimensions

### 7.7.3.1 Outside Dimensions

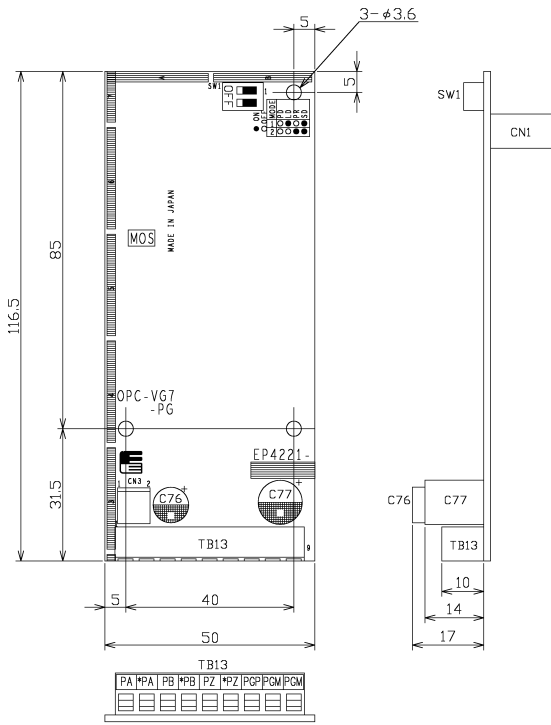


Fig. 7-63 OPC-VG7-PG Outline drawing

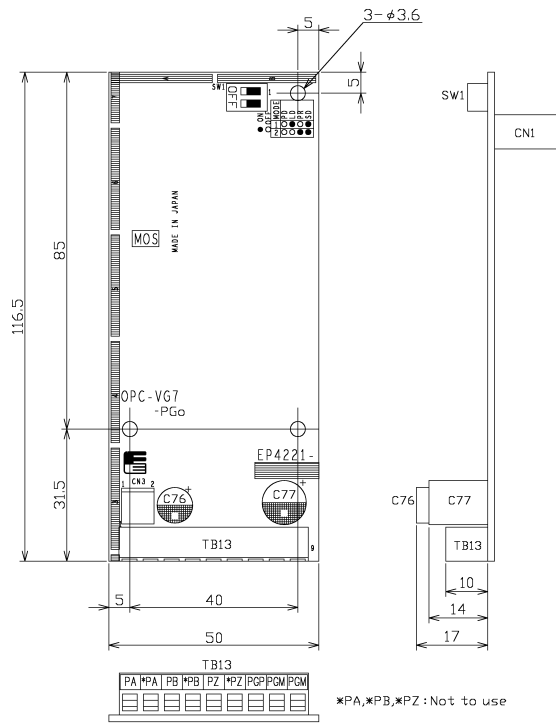


Fig. 7-64 OPC-VG7-PGo Outline drawing

\*PA,\*PB,\*PZ:Not to use

## 7.7.4 Basic Connection Diagram

Refer to Section 7.1.4 “Mounting Method Built-in Option (OPC-VG7-)” to perform wiring and connection work.

### WARNING

- Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.
- Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.

### CAUTION

- Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.
- Inappropriate work during installation or removal of the product will cause breakage of the product.
- If the setting of the switches (SW1 and SW2) on the option is wrong, the system does not function correctly. Read the following setting procedure and give the correct setting.

### 7.7.4.1 Connecting the Terminal

The applicable cable size of the option connection terminal is AWG:16-26. To use the connection end in the bare wire state, strip of 6 (mm). To use a crimp terminal, use a rod-shaped terminals equipped with vinyl sheath. Insert the cable on the upper side of the fitting of the terminal block and tighten the screw to fix.

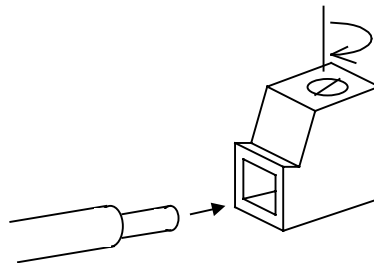
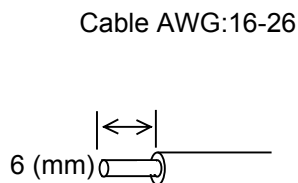


Fig. 7-65 Cable End on Option Connection Terminal Side

Fig. 7-66 Connection of Cable on Option Terminal Side

### 7.7.4.2 Wiring

#### Wiring of PG option, pulse generator, PG and so on

- Use shielded cables for the wiring of the option. The wiring length is limited according to the type of the interface (table below).
- Connect the sheathe of the shielded cable to the external device or the grounding terminal of the motor while leaving the inverter side open.
- To avoid malfunction by noise, route the cables of the option as far away from main circuit cables of the inverter and other motor power cables as possible (10cm or farther), and never route them in the same duct.



# 7. Control Options

Table 7-48

External interface	Approximate wiring length	Application
Line driver method	Within 50 (m)	Use to connect a line driver output type encoder. Wiring length 50m is a guideline with a thick signal cables of power supply line (PGP/PGM) to reduce the voltage drop.
Open collector output method	Within 10 (m)	This method can be used to connect open collector outputs [FA] and [FB] on the master side with [PA] and [PB] of PG(PR) on the slave side.
Voltage output method		Use to connect a voltage output type or external power-assisted device. Be careful of maximum voltage 15V and threshold value. (L level voltage detection: 0 to 2V. H level voltage detection: 3.5 to 15V)

## Recommended isolation converter (isolation amplifier)

- For the line driver method (combination of motor PG and VG7) with 50m or longer wiring, use an isolation converter. The models and manufacturer are:  
SHC-205P05D (made by Sumtak Corporation); 200V power supply input  
SHC-105P05D (made by Sumtak Corporation); 100V power supply input
- For open collector method, to connect two or more VG7 in parallel on the slave side, one unit is maximum. To connect two or more units, use an isolation amplifier. The models and manufacturer are:  
SHC-205C24C (made by Sumtak Corporation); 200V power supply input  
SHC-105C24C (made by Sumtak Corporation); 100V power supply input

### 7.7.4.3 Speed Control

With this connection example, motors equipped with line driver output type encoders or open collector, complementary encoders (such as Fuji's servomotors) can be driven.

Because the speed is detected and calculated according to pulses, select "SD" at the option. As well, because frequency division outputs can be issued using [FA] and [FB], this method can be used for a digital speedometer or the like.

To use a 12/15V complementary output type encoder, use [PGP] and [PGM] on the main body side. At this time, the common line is connected with the option.

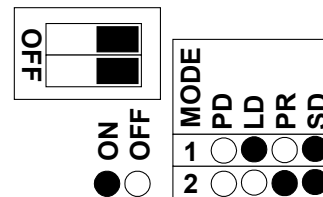


Fig. 7-67

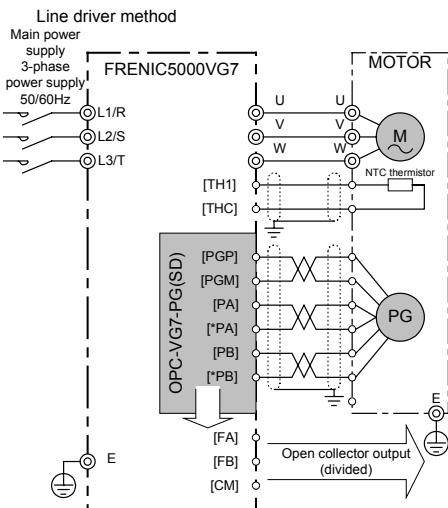


Fig. 7-68

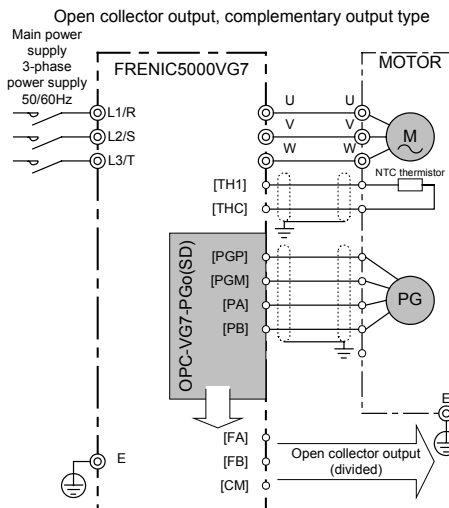


Fig. 7-69

Note: In principle, the shielded wire should be grounded. If the received external induction noise is large, connection to 0V may reduce interference of noise.

## 7.7.4.4 Line Speed Control

Use this connection method to control the speed with a line driver output type encoder installed in the winding line of the system. Because the speed feedback of the motor itself and the line speed feedback are simultaneously detected, you can avoid runaway caused by paper shortage of the line. To use for this purpose, select “LD” at the option.

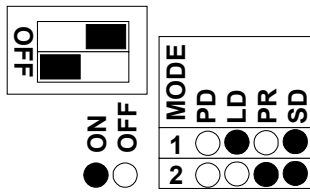


Fig. 7-70

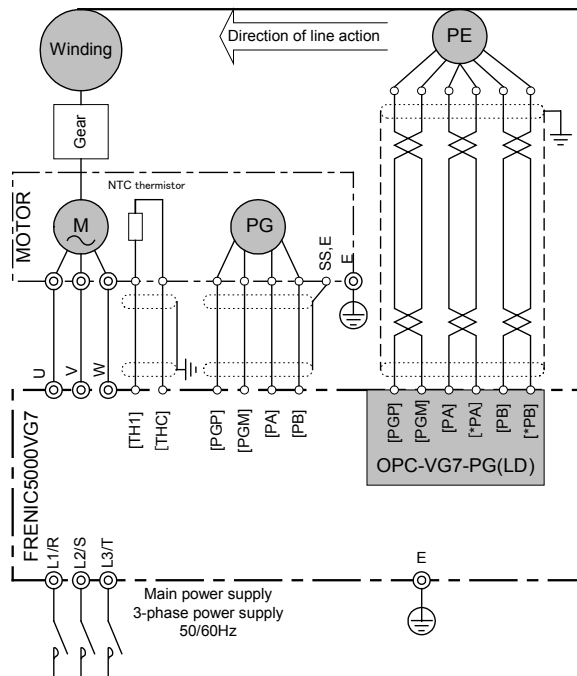


Fig. 7-71

Note: In principle, the shielded wire should be grounded. If the received external induction noise is large, connection to 0V may reduce interference of noise.

# 7. Control Options

## 7.7.4.5 Pulse Train Operation and Synchronous Drive

**CAUTION**

- To use open collector outputs [FA] and [FB] of VG7S to perform synchronous operation of the master and slave, route the open collector wiring separately from the motor power cable and the wiring length should be as short as possible. If the wiring length is long, it is recommended to use a converter for converting into line driver signals.

To use for this purpose, select "PR" at option switch SW1.

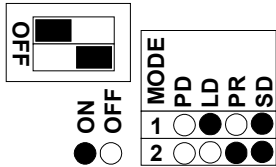


Fig. 7-72

### 1) Line driver output method

Operation is based on the external pulse generator or pulse commands issued from the PG.

Because VG7S receiving the pulses is capable of open collector output ([FA] and [FB]), it can hand over the pulse signal to the next VG7S. In this way, two or more VG7S can be synchronously driven.

### 2) Open collector output method

Use this method to drive two or more VG7S synchronously. Connect the open collector output of VG7S ([FA] and [FB]) of the master to the slave VG7S option. The slave operates upon pulse commands of the master.

Because VG7 receiving the pulses is capable of open collector output ([FA] and [FB]), it can hand over the pulse signal to the next VG7. In this way two or more VG7 can be driven synchronously. A zero-phase sequence reactor (ACL-40B) should be installed as shown in the figure on the right, to reserve a noise margin.

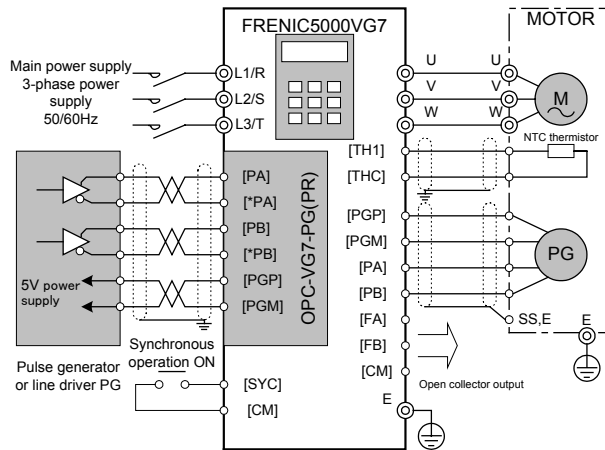


Fig. 7-73

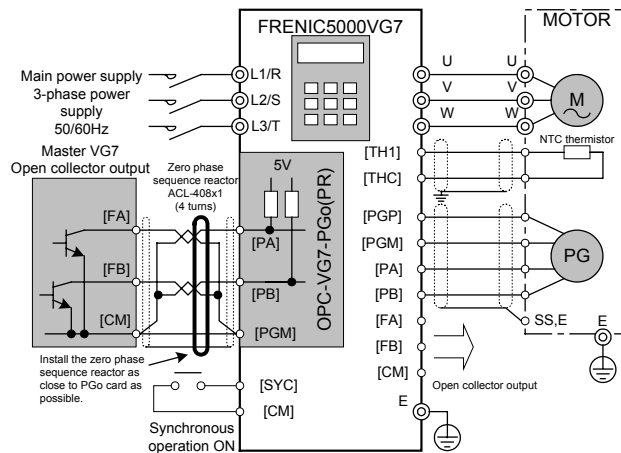


Fig. 7-74

### Note

OPC-VG7-PGo (open collector) does not match the environment where a part of cables must be routed along the motor power cables or if the wiring length is long because the noise margin in such environments is small.

In such a case, it is recommended to use OPC-VG7-PG (line driver) with the configuration shown in the figure on the right.

Recommended isolation converter  
SHC-205C05D (made by Sumtak Corporation)

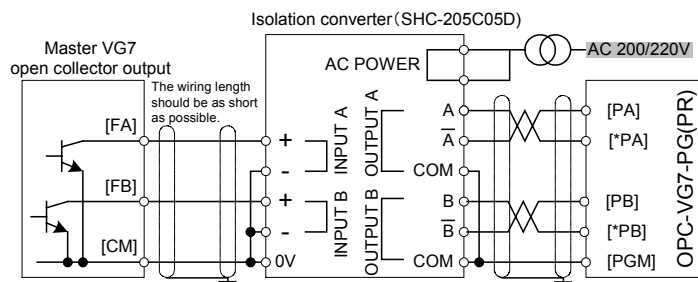


Fig. 7-75

Note: In principle, the shielded wire should be grounded. If the received external induction noise is large, connection to 0V may reduce interference of noise.

## 7.7.4.6 Orientation

This connection example shows the case of rotary positioning using an encoder installed on a mechanical shaft. Select “PD” at the option because detection of pulses including the Z-phase is necessary. The Z-phase is used to detect the absolute position of the machine. The stopping position and orientation command can be entered through T-Link, DI card, built-in RS485 or Field Bus.

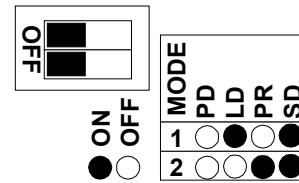


Fig. 7-76

(1) Connection example using T-Link

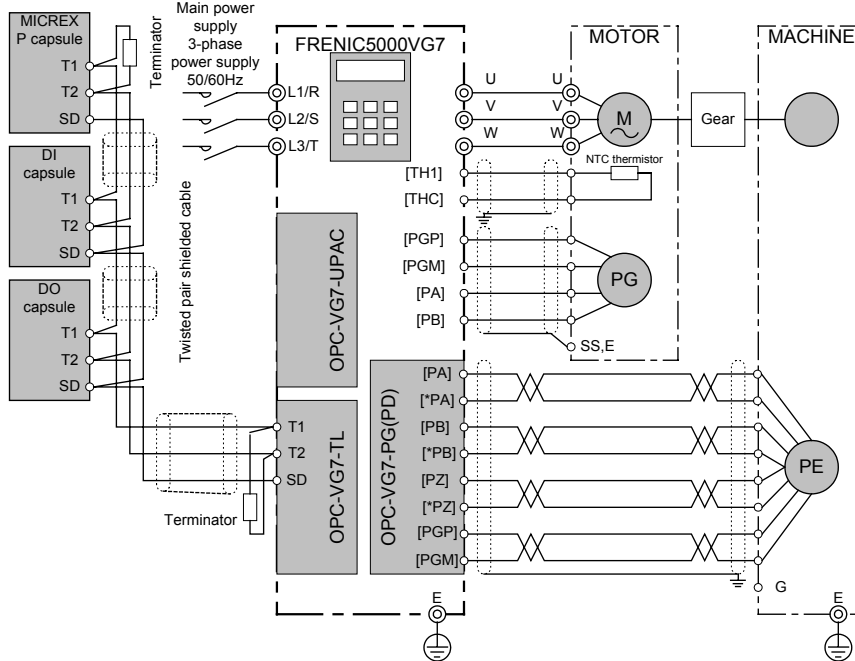


Fig. 7-77

(2) Connection example using DIO(B) card

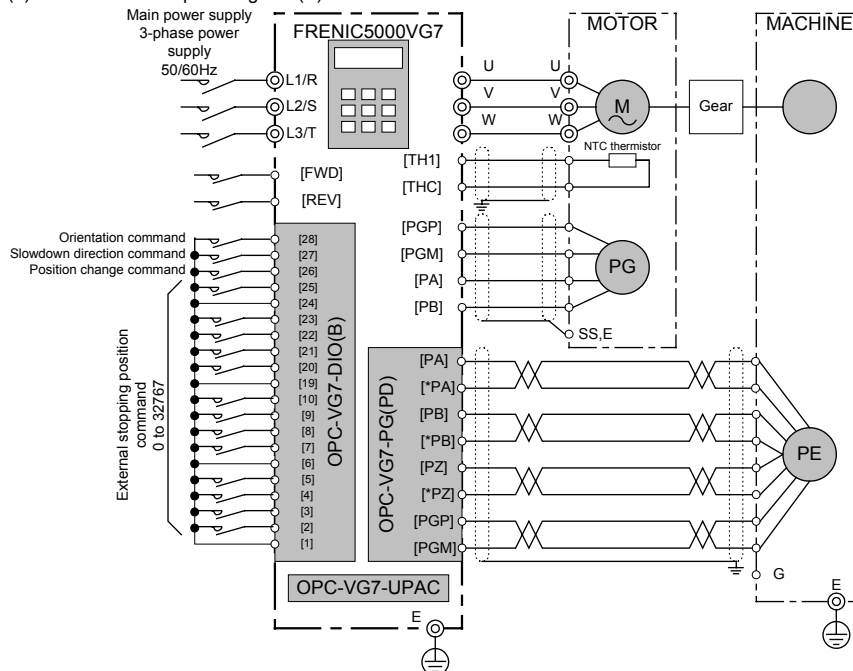


Fig. 7-78

Note: In principle, the shielded wire should be grounded. If the received external induction noise is large, connection to 0V may reduce interference of noise.

# 7. Control Options

## 7.7.5 Synchronous Operation

### 7.7.5.1 System Configuration for Synchronous Operation

The system for performing synchronous operation of motors with VG7S includes master/slave connection, cascade connection, and pulse train commands from an external generator such as PLC.

(1) Master/slave connection

<b>⚠ CAUTION</b>
<ul style="list-style-type: none"> <li>• For master/slave connection, the slave side can connect up to one VG7S in parallel (sink current: 8mA/circuit). To connect two or more units, adopt cascade connection.</li> <li>• To rotate the slave in reverse to the master, do not use the REV contact but use the [IVS] contact.</li> </ul>

Use this method to hand over the open collector pulse output of one VG7S (master) to the PG card input of another VG7S (slave) to be operated synchronously. The maximum number of connected units is one as shown below.

Table 7-49

Open collector output terminals [FA], [FB] and [CM] on master side	OPC-VG7-PGo on slave side [PA] [PB] [CM]
15mA max. per circuit	8mA max. per circuit

The synchronous operation speed of the slave of synchronous master/slave operation is the product of the speed of the master and the pulse correction coefficient (function codes o14 and 15). Use [IVS] (normal/inverse action) on the slave side to change the direction of rotation of the motor of the slave. At this time, do not use the [REV] contact.

Table 7-50

Direction of rotation of master	[IVS] on slave side	Direction of rotation of slave
Forward	OFF	Same direction as that of master
Forward	ON	Reverse direction to that of master
Reverse	OFF	Same direction as that of master
Reverse	ON	Reverse direction to that of master

(2) Cascade connection

<b>⚠ CAUTION</b>
<ul style="list-style-type: none"> <li>• In case of cascade connection, enter “9” in function code E29 “PG pulse output selection” of the slave (not master; slave 1, 2, ...) to eliminate the delay up to the last stage of the slave from the master.</li> </ul>

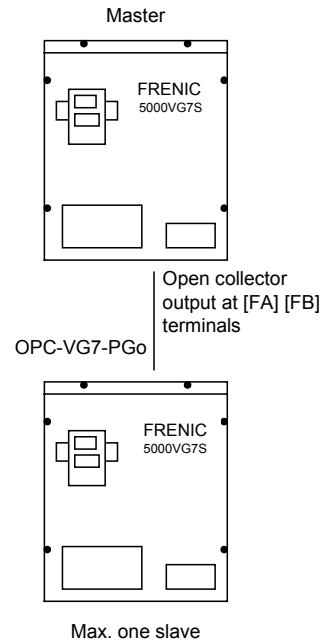


Fig. 7-79

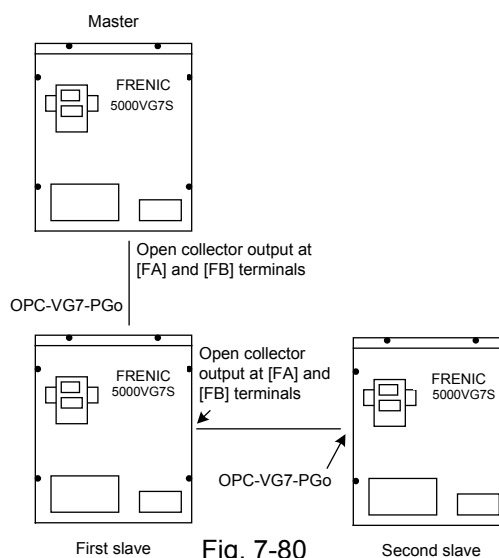
Use this connection method to connect two or more slaves in master/slave connection.

Connect the master with the first slave similarly to the description in (1), and enter function code E29 between the first and second slaves.

This is to hand over the pulse train command of the master to slave 2 without software processes at slave 1.

Table 7-51

Function code	Name	Setting
E29	PG pulse output selection	9: PG (PR) Issue the position command pulse input in an open collector output without change.



(3) Pulse generator

Fig. 7-80

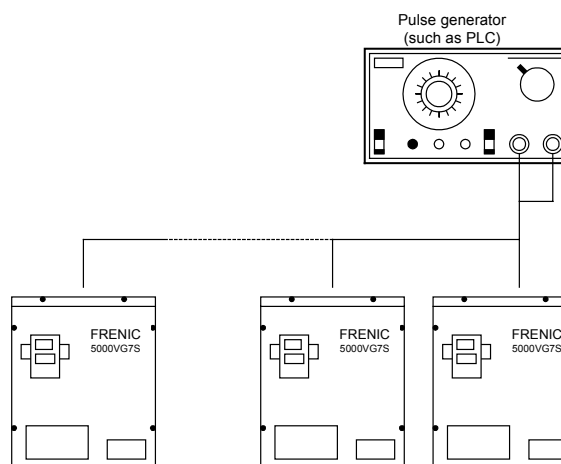
⚠ CAUTION	
<ul style="list-style-type: none"> <li>The number of slaves that can be connected depends on the current capacity of the pulse generator for pulse train operation using the pulse generator. (Sink current 8mA/circuit)</li> <li>To reverse the rotation of the slave in relation to that of the master, the [IVS] contact and pulse input style are important. Enter function code o13 “pulse train input style selection” according to the pulse style.</li> </ul>	

Use this method to drive VG7S with pulse commands using the master and a pulse generator such as PLC.

The maximum number of connected units depends on the current capacity of the pulse generator on the master side as shown below.

Table 7-52

Pulse generator on master side	OPC-VG7-PGo on slave side [PA] [PB] [CM]
Current capacity per circuit	8mA max. per circuit
16mA or above	2 units
24mA or above	3 units
XmA or more	Multiple of (X divided by 8)



The number of slaves depends on the driving current capacity of the PG.

The direction of rotation of the motor on the slave side depends on [IVS] and pulse input style.

Table 7-53

①	②	③	IVS	Direction of operation on slave side
Phase B high	Phase A input	Phase B 90-degree lead	OFF	Forward rotation
Phase B high	Phase A input	Phase B 90-degree lead	ON	Reverse rotation
Phase B low	Phase B input	Phase B 90-degree lag	OFF	Reverse rotation
Phase B low	Phase B input	Phase B 90-degree lag	ON	Forward rotation

Pulse input style

- ① Command pulse/command sign
- ② Forward/reverse rotation pulse
- ③ 2 90-degree phase different signals

Select the pulse input style using function code o13.

Fig. 7-81

# 7. Control Options

## 7.7.5.2 How to Perform Synchronous Operation

<b>⚠ WARNING</b>
<ul style="list-style-type: none"> <li>• Operate the [FWD] and [SYC] (contact input) terminals simultaneously to perform pulse train operation.</li> <li>• If [SYC] is turned on then [FWD] is turned on while a pulse train is entered continuously, cumulative deviation may be forced out to accelerate up to the maximum speed.</li> </ul> <p><b>Injury may result.</b></p>

<b>⚠ CAUTION</b>
<ul style="list-style-type: none"> <li>• If operation is made with wrong data allocation to a function selection input code, injuries or damage to the equipment may be caused. Check the allocation again before starting operation.</li> </ul> <p><b>Failure may result.</b></p>

Synchronous operation signal [SYC]  
 Assign "27" [SYC] to an arbitrary contact among X1 to X14 on the slave side and operate it together with the [FWD] signal to perform pulse train operation.

Table 7-54

Function code	Name of function	Pulse train function
E01 to E13	X1 to X14 function selection	To perform position control operation, assign the synchronous operation command ([SYC]; 27) to an arbitrary terminals among the contact input terminals specified on the left.

### (1) Synchronous master/slave operation

<b>⚠ CAUTION</b>
<ul style="list-style-type: none"> <li>• If the F/F gain is set at other than 1.0 during master/slave operation, steady-state deviation remains between the master and slave. Though the deviation can be reduced using the APR gain and F/F gain, adjustment with the F/F gain may cause an overshoot.</li> </ul>

To perform synchronous operation under master/slave connection, turn on and hold both the [FWD] terminal and the contact input signal [SYC] on the slave side. With this, the slave operates in synchronization with the master, and the slave is stopped in the servo lock state when the master side is stopped.

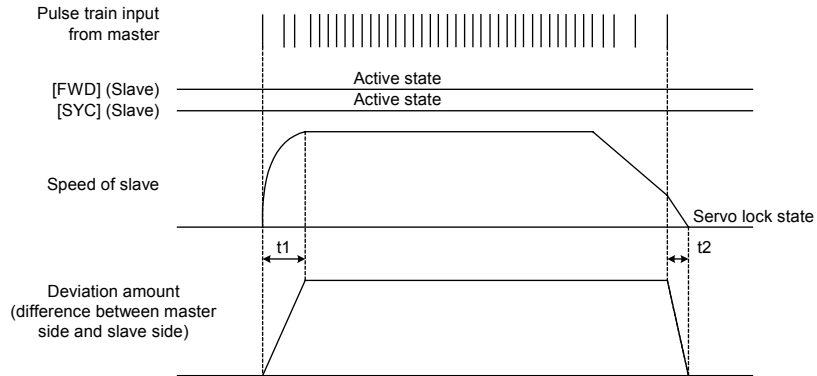


Fig. 7-82

- Change the rotational direction of the slave, using [IVS]. Do not use the [REV] terminal.

#### Acceleration/deceleration time on slave side

There is a slight delay in the acceleration (t1) and deceleration (t2) time of the motor on the slave side when compared with that of the master side. As shown in the figure above, pulse deviation (steady-state deviation) is held on the slave side in response to the master side while operation continues.

### Steady-state deviation

The motor on the slave side keeps operating while holding steady-state deviation in relation to the master side. The deviation is forced out when the motor is stopped, and the servo is locked after deviation is reduced to zero.

The steady-state deviation is during constant speed operation, the difference between the number of command pulses sent from the master, and the number of position detection pulses on the slave side.

The steady-state deviation can be adjusted with the APR gain and F/F gain. For details, refer to the section describing the option function code.

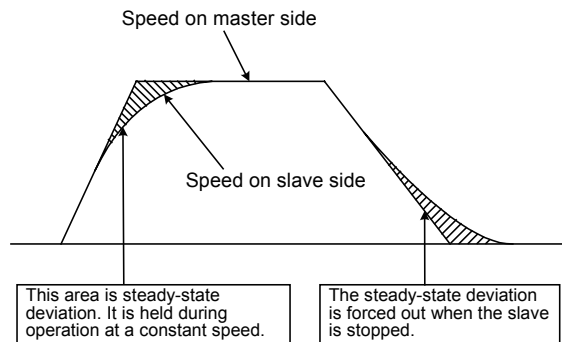


Fig. 7-83

### (2) Pulse train operation using a pulse generator

#### ⚠ CAUTION

- In case of pulse train operation, The acceleration and deceleration time settings in function codes are invalid. Control the frequency on the pulse generator side. If the motor is started while a high-frequency pulse train command is given, the motor may accelerate suddenly.

#### **Injury may result.**

Operate the [FWD] terminal and the contact input [SYC] simultaneously to start or stop. If only [FWD] is turned on, the action depends on other speed commands.

The acceleration time and deceleration time are not controlled on the VG7S side.

Perform frequency control on the pulse generator side.

$t_1$  (s) and  $t_2$  (s) shown in Fig. 7-84 are not controlled on the inverter side.

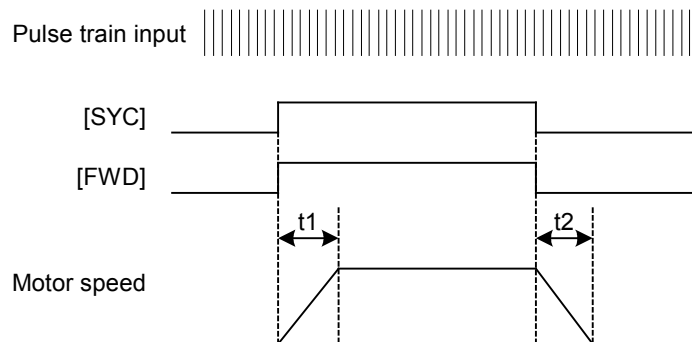


Fig. 7-84

### 7.7.5.3 Option Function Code

#### ⚠ WARNING

- Wrong function code data will cause dangerous states. Therefore check the data again after entering or writing it.

#### **Accident may result.**

#### ⚠ CAUTION

- If improper data such as a sudden high gain is written in the ASR family (gain and integration time) function code, hunting of the motor will be caused, giving damage to the motor and equipment as well as accompanying injuries.

#### **Injury may result.**

- If the data of function code 017 "F/F gain" has been changed, when abrupt speed changes occurs an overshoot may be caused. Enter "0.0" if the inverter is connected to the equipment, not resistant to an overshoot.

#### **Failure may result.**



# 7. Control Options

Table 7-55 shows function codes related to pulse train operation. Refer to the control block diagram in Chapter 4, too.

Table 7-55

No.	Name of parameter		Setting range	Description of setting
	Name	Message displayed on keypad panel		
o12	Command pulse selection	PLS REF SL	0,1	0: PG (PR) option 1: Internal speed command
o13	Pulse train input form selection	PLS STATE	0 to 2	0: 2 signals (phases A and B) with 90-degree phase difference 1: Command pulse with phase A and command sign with phase B 2: Forward rotation pulse with phase A and reverse rotation pulse with phase B
o14	Command pulse correction 1	PLS CORR 1	1 to 9999	The ratio of the command pulse count can be changed.
o15	Command pulse correction 2	PLS CORR 2	1 to 9999	
o16	APR gain	APR-P-GAIN	0.1 to 100.0	Position adjuster gain
o17	F/F gain	F/ F GAIN	0.0 to 1.5	Feed-forward gain
o18	Excessive deviation width	DEV OVER W	1 to 65535	10 times the pulse setting 10 to 655350 can be specified.
o19	Zero deviation width	DEV ZERO W	1 to 32767	Enter in the range between 1 and 32767 pulses.

### (1) Command pulse selection

To perform position control using the pulses entered to the PG (PR) option, enter “0.” Enter “0” on the slave side in regular cases.

On the other hand, enter “1” on the master side to generate internal speed commands, based on which the master itself operates with pulse train, and to deliver the same pulses to the slave.

[Operation with “1” entered at o12]

The internal speed command ([12] input, multi-step speed command, etc.) is converted into pulse signals and the pulse signals are converted into speed commands again under position control and they are made valid with [SYC]. To synchronize with another inverter, issue the converted pulse signals outside, which are received by a PGo (PR) option.

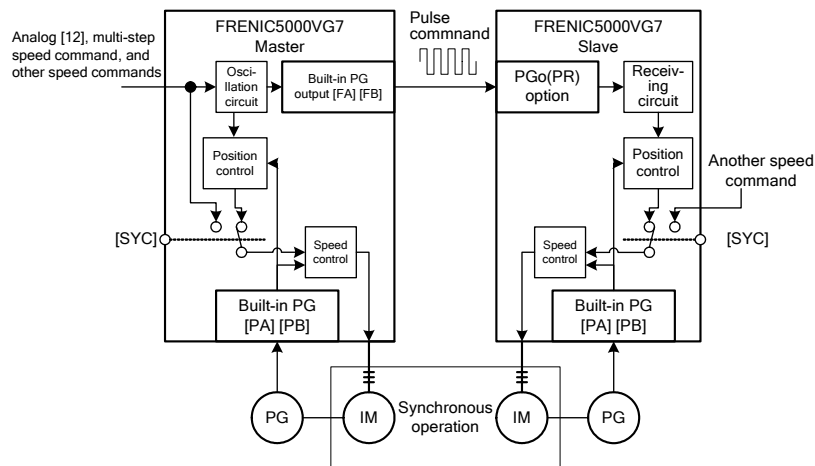


Fig. 7-85

### Note

During operation with “1” in o12, the pulse remainder is corrected during generation of the internal speed command in a pulse train. For example, pulse conversion of a 1500r/min command during operation with a 1024p/r encoder causes a pulse output at 25.6kHz and no problem is caused. However, at a speed command of 1000r/min, the result is 17.0666666...kHz and it is not divided clearly. In the procedure, the remainder is corrected at each process. This correction process causes a slight speed variation but it is smoothed with a speed command filter and no problem is caused. As well, because the synchronization accuracy is reserved in the remainder correction process, no pulse lack (position deviation) is caused.

(2) Pulse train input form selection

Select according to the form of the pulse supplied in phases A and B. Enter “0” for master/slave connection.

(3) Command pulse correction 1, 2

The position command data supplied to the pulse train card can be changed with command pulse correction 1 and 2. You can change the speed ratio between the motors on the master and slave sides during synchronous operation with this.

$$\text{Position command pulse} = (\text{externally entered command pulse}) \times \frac{(\text{command pulse correction 1})}{(\text{command pulse correction 2})} \times \frac{\alpha}{4}$$

where

$\alpha$ : Input form constant. When the input form is a command pulse/sign or forward/reverse rotation pulse,  $\alpha = 1$ .

When it is two 90-degree phase-different signal,  $\alpha = 4$ .

[Application example]

In case of synchronous master/slave connection operation with gears installed on the slave side, use command pulse correction to correct input pulses into a ratio of b to a. (where the gear ratio is a to b. b: command pulse correction 1, a: command pulse correction 2)

$$\text{Position command pulse} = (\text{external input command pulse}) \times \frac{b}{a} \times \frac{\alpha}{4}$$

When the gear ratio is 1 to 3, enter one of the following settings.

Table 7-56

Command pulse correction 1	900	300	...	30	3
Command pulse correction 2	300	100	...	10	1

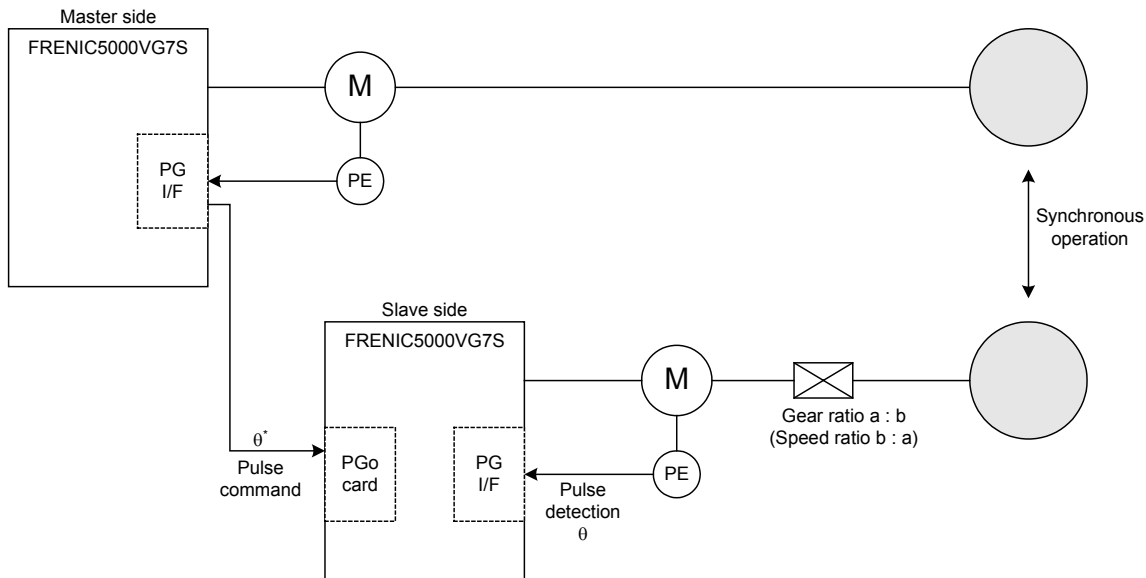


Fig. 7-86

# 7. Control Options

## (4) APR gain

Adjust the APR gain to improve the speed response during pulse train operation. In addition, the steady-state speed deviation during constant speed operation can be reduced. However, too large a gain causes hunting of the motor. Gradually increase the setting during adjustment.

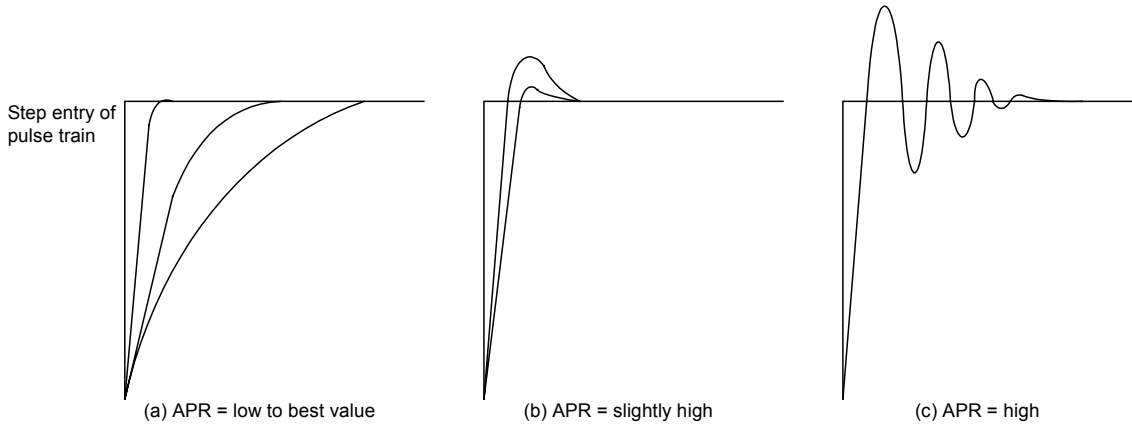


Fig. 7-78

To improve the speed response during pulse train operation, enter “0” (s) into an ASR input filter. If a large value is specified, the response depends on the filter.

## (5) F/F gain

The steady-state deviation can be made smaller according to the F/F gain value. With a “1.0” setting, the steady-state deviation becomes minimum. However enter “0.0” for a mechanical system where an overshoot must be avoided.

The figure below shows the speed response upon step entry of a position command pulse. (a) With an F/F gain of 0.0, no overshoot is caused if the APR gain is the best. However, steady-state deviation remains during operation.

(b) On the other hand, with an F/F gain of 1.0, steady-state deviation is almost zero while an overshoot is caused to force out the deviation having been accumulated until the target speed is achieved. At this time, acceleration may continue up to the maximum speed. To avoid an overshoot, leave the setting at “0.0.”

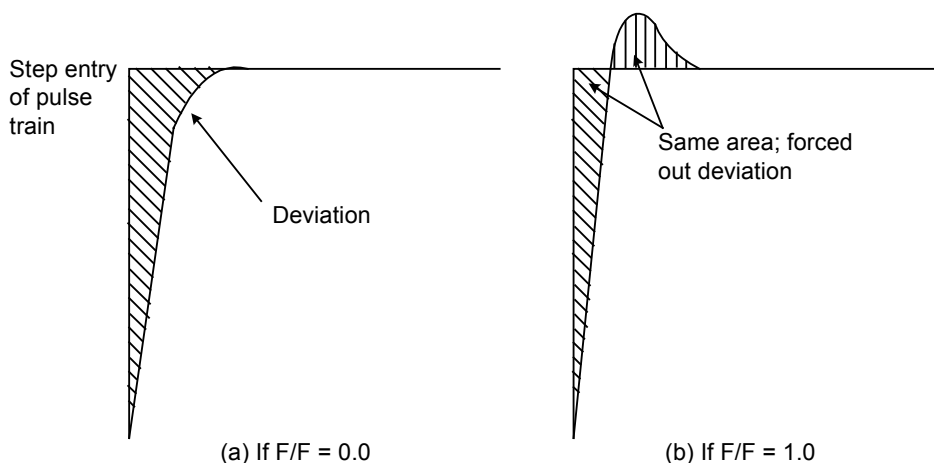


Fig. 7-88

The relationship between the F/F gain, APR gain and steady-state deviation is shown below.

$$| \text{Steady-state deviation} | = \frac{| 1 - G_{FF} |}{G_{APR}} \times \alpha \times (\text{input frequency})$$

where

$G_{FF}$ : F/F gain

$G_{APR}$ : APR gain

$\alpha$ : Input form constant ( $\alpha = 4$  in case of 90-degree phase difference,  $\alpha = 1$  in other cases)

## Synchronization accuracy and F/F gain

### 1) If F/F gain < 1.0

Steady-state and transient position deviation is kept during operation as shown on left side graphs of Fig. 7-89. Speed deviation remains in the transient part.

### 2) If F/F gain = 1.0

Steady-state and transient position deviation is within  $\pm 2$  pulses during operation as shown on right side graphs of Fig. 7-89. However, **if the overload limit is exceeded** (CT specification: 150%. HT specification: 200%/170%) or **if the variation in the command amount is too large to follow up with 10Hz position response**, follow-up to command pulses may be impossible.

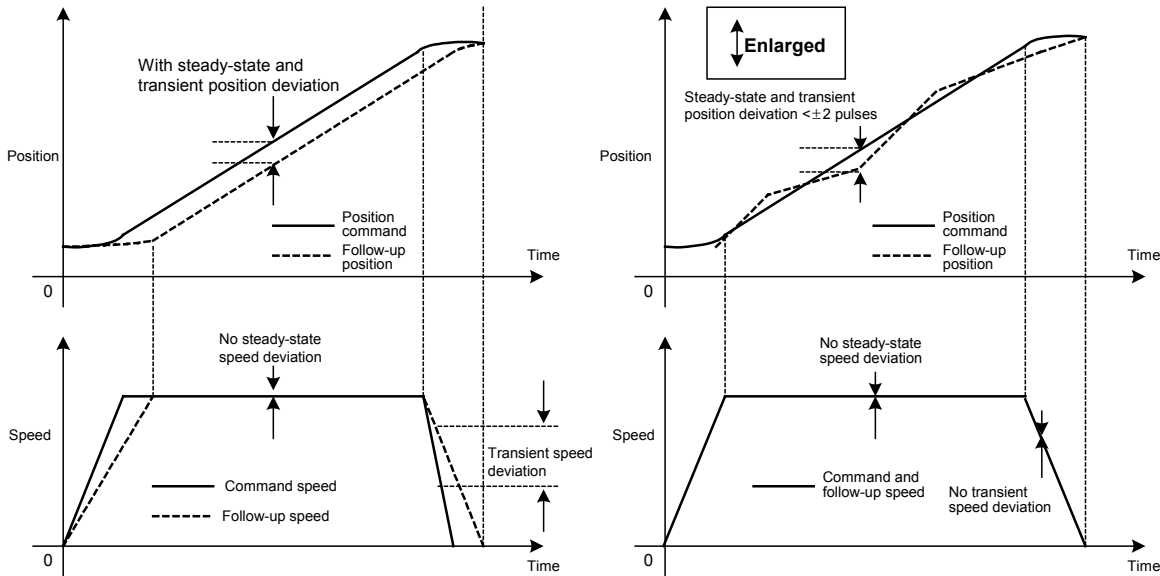


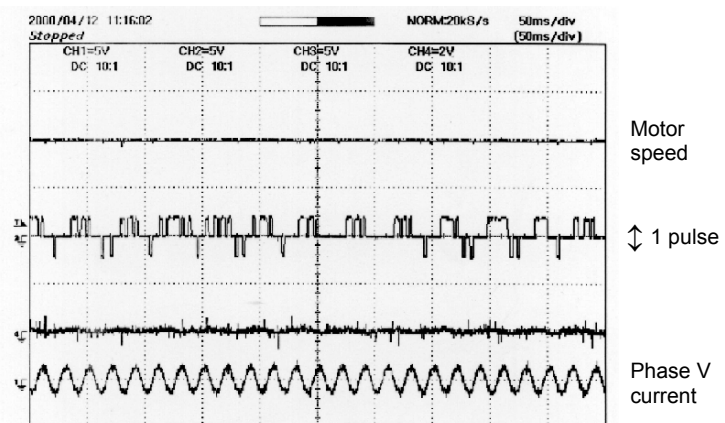
Fig. 7-89

## Experimental data

The figure on the right shows data of pulse deviation (command pulse train - motor pulse).

During steady-state operation, the pulse deviation is contained in  $\pm 1$  pulse, indicating that synchronization is successful.

FRENIC5000VG7 22kW-200V  
 +VG7 Standard motor  
 1500r / min (Command pulse train; 25.6kHz)  
 ASR gain = 10.0, ASR I constant = 0.200s  
 ASR input filter = 0.000s  
 APR gain=1.5, F/F gain=1.0



# 7. Control Options

## (6) Excessive deviation width

When the difference (deviation) between the internal command position and the actual motor rotation becomes larger than this setting, an “excessive deviation alarm” is issued, forcing the motor to coast to stop. At this time, the keypad panel LED shows “d0.” and the LCD shows alarm data related to the excessive deviation.

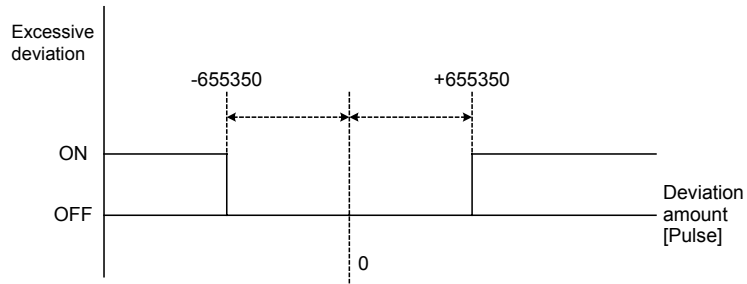


Fig. 7-91

To reset an excessive deviation alarm, turn off position control [SYC] and supply an [RST] signal (Fig. 7-92).

The excessive deviation alarm occurs when the motor does not follow the position command.

The initial value (factory shipment setting) is 655350 pulses. Change the setting to about twice the position deviation generated during regular operation. If the “APR gain” and “F/F gain” settings in function codes are wrong, the motor may hunt. The correct setting of the parameter is necessary to cause an excessive deviation alarm immediately to cause the motor to coast to stop.

Note that too small a setting will cause an alarm during acceleration or deceleration.

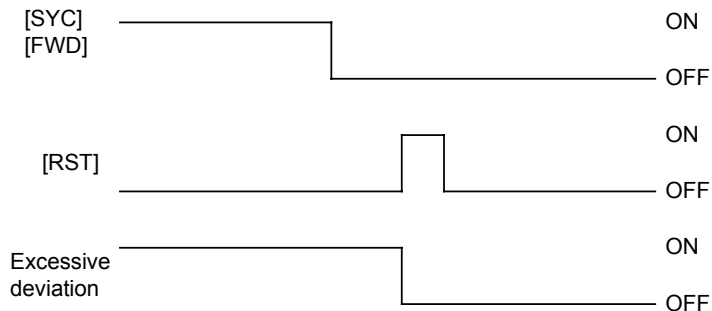


Fig. 7-92

## (7) Zero deviation width

If the current motor position is within this setting from the target position, a “synchronous control complete” signal is issued. Achievement of the motor to the target position is detected with this signal. The magnitude of the setting does not give effects on the positioning accuracy.

To issue a “synchronous control complete” signal, assign “27” [SY-C] to an arbitrary output between Y1 and Y5.

Fig. 7-93 shows the [SY-C] output when “20” is assigned as a zero deviation width.

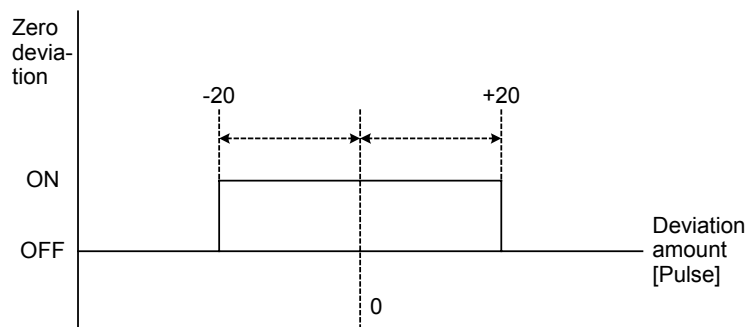


Fig. 7-93

## 7.7.6 Check Function

### 7.7.6.1 Option Installation Check

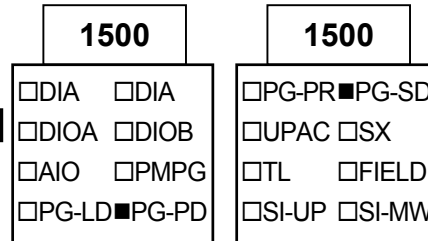
Installation of the PG option and selection between SD, LD, PR and PD can be monitored on the keypad panel.

From the operation mode screen, go to the program menu screen and select “4. I/O check.”

The I/O check monitor includes total 16 screens. Use the **▲** or **▼** key to scroll the screen to locate the corresponding screen related to DIO options.

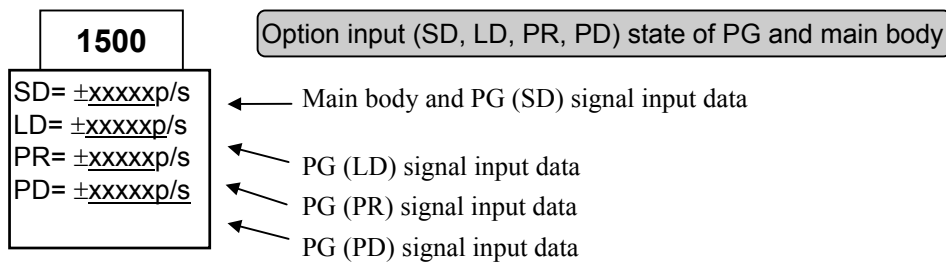
For details, refer to the keypad panel operation method.

If two PG cards are installed and they are in the PG (PD) and PG (SD) modes, solid squares (→) are marked on the LCD screen as shown in the example on the right.



### 7.7.6.2 I/O Check

The digital input state of the PG option can be checked on the keypad panel of the inverter. From the operation mode screen, go to the program menu screen and select “4. I/O check.” The I/O check monitor includes total 16 screens. Use the **▲** or **▼** key to scroll the screen and display the digital input state of the PG option. For details, refer to the keypad panel operation method.



## 7.7.7 Protective Function

When the protective function of the inverter is activated, the inverter shows an alarm immediately and the LED of the keypad panel shows the name of the alarm while the motor coasts to stop. If the protective function of the inverter is activated, remove the cause of the fault and restart. Do not issue an automatic alarm reset signal from an external sequence. Alarms related to this option are shown in Table 7-57. For other alarms, refer to “protective operation” for the main body of the inverter.

Table 7-57 Alarm and Protective Function List

Alarm sign	30X	Cause of alarm
<b>dO</b>	Active	An “excessive deviation alarm” is issued if there is a delay in the start of the motor due to a load in response to a pulse train command and the position deviation exceeds the preset value. Enter the threshold value at function code o18 “excessive deviation width.”
<b>Pg</b>	Active	A “disconnected wire” is issued due to wire disconnection in the PG signal when “SD” or “LD” is selected in the line driver mode.

# 7. Control Options

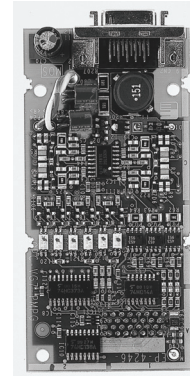
## 7.8 PG Card for Synchronous Motor Operation

### 7.8.1 Outline of Product

VG7S becomes capable of driving a synchronous motor when this option is used. The OPC-VG7-PG(SD) option can be used, too, to detect the magnetic pole position in the Z-phase only.

The synchronous motor is superior to the induction motor in view of the smaller size and energy consumption, and demands for the synchronous motor are increasing in recent years. If this option is combined with VG7S, not only Fuji's motors (ES and AC servomotors) but all synchronous motors can be driven if only encoder interface matches. However, motors exclusively for Fuji's FALDIC- $\alpha$  designed for a serial encoder cannot be combined.

Choose OPC-VG7-PMPG for line driver outputs, or OPC-VG7-PMPGo for open collector outputs.



#### 1) Max. rotation speed 24,000

Up to 400Hz can be output at a carrier frequency of 15kHz. That is, up to 24,000 revolutions can be driven when converted into the 2P motor. In the actual application, there is a limitation of 100kHz in the encoder's input frequency. For example, with a 256P/R encoder, up to 23,438r/min (= 100kHz / 256 x 60) can be driven.

#### 2) Magnetic pole position interface

Motors having encoder interfaces with the following specification can be driven.

- (1) Synchronous motor outputting the magnetic pole position in a 4-bit gray code
- (2) Synchronous motor outputting the magnetic pole position in a 3-bit code (U-/V-/W-phase)

#### 3) Wire disconnection detection function

The wire disconnection detection function can be used. Upon detection of a disconnection, the inverter displays alarm "Pg" and shuts off the inverter output, causing the motor to coast to stop. However, this function cannot be used for the open collector output type (OPC-VG7-PMPGo). To cancel PG wire disconnection detection, the function provided for the main body of VG7 as a standard feature can be used.

#### 4) ES and AC servomotor drive

Fuji's ES motors (GRK2□□□□) and AC servomotors (GRH□□□□) can be driven. Just enter some motor parameters for preparation.

To drive a GRK Series motor, choose the PMPGo card because the mounted encoder supports open collector outputs. In this case, do not fail to install a zero-phase sequence reactor to reduce noise.

#### 5) Driving small capacity motors

The line of VG7S inverters includes 200V series with capacities ranging from 0.75kW. However, 0.2 or 0.4kW synchronous motors can be driven, too. Just enter some motor parameters for preparation.

#### 6) IPM and SPM motor drive

The synchronous motor is divided into two types according to the assembling method of the magnet: IPM (Internal Permanent Magnet Synchronous Motor) and SPM (Surface Permanent Magnet Synchronous Motor). VG7 can drive both types. For the IPM motor, the salient pole ratio can be entered in a function code. With this, you can use the reluctance torque of the motor (torque using the difference in magnetic resistance), thus improving the efficiency.

## 7.8.2 Model and Specification

### 7.8.2.1 Model

#### CAUTION

- According to the difference in the output interface for external devices, the following two models are provided.

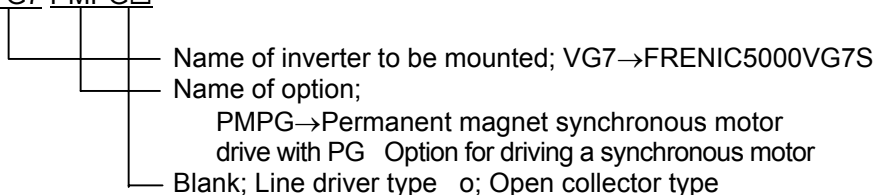
OPC-VG7-PMPG: Line driver signal

OPC-VG7-PMPGo: Open collector and voltage output

Designate the model matching your purpose when ordering.

The PMPG option of FRENIC5000VG7 reflects the difference in the output interface of the external device (line driver/open collector output). Because no switch for selecting the interface is installed, you must determine either option before purchasing (OPC-VG7-PMPG or OPC-VG7-PMPGo).

Model; OPC-VG7-PMPG□



#### Accessories

Plug model: 10120-3000VE 20-pin (Sumitomo 3M Limited)

Housing (cover) model: 10320-52F0-008 20-pin (Sumitomo 3M Limited)

Spacer: 3 pieces

Screw (M3): 3 pieces

### 7.8.2.2 Specifications

#### CAUTION

- The PMPG option does not compatible with earlier VG7S versions. Correct functions are not obtained with an earlier version. Be sure to refer to the maintenance data on the keypad panel for the ROM version. For any inquiries about the version, contact us.



# 7. Control Options

Table 7-58 Hardware Specification

Item	Specification	
Model	OPC-VG7-PMPG	OPC-VG7-PMPGo
Signaling method	Line driver output method compatible (AM26LS31PC or equivalent recommended)	Open collector output compatible
Power supply for PG	<b>For 5V power supply</b> [PGP] terminal: +5V+/-5%, 250mA. [PGM] terminal: with common and overcurrent protection function Internal isolation with photocoupler (Connected with [PGM] and [CM] on control PC board of main body. Isolated from [M]).	The PG power supply (+15/12V) of the main body can be supplied as a power supply of the motor encoder. Check the specification of the motor encoder before connecting.
Input signal terminal	Incremental signal for speed detection: [PA], [*PA], [PB], [*PB] Absolute signal for magnetic pole position detection: [F0], [*F0], [F1], [*F1], [F2], [*F2], [F3], [*F3] Isolated with photocoupler	Incremental signal for speed detection: [PA], [PB] Absolute signal for magnetic pole position detection: [F0], [F1], [F2], [F3] Isolated with photocoupler
Wire disconnection detection function	Provided	None
Connection	Supply 5V power through [PGP] and [PGM]. Twisted pair shielded cables must be used for wiring to configure a balanced circuit.	Built-in 5V pull-up. Sink current: about 11mA/circuit
Max. frequency	100kHz, duty: 50±10%.	
Allowable wiring length	About 50m The wiring length must be shorter if the voltage drop is large.	Within 10m To avoid effects of noise, the wiring length should be as short as possible. Connect a zero-phase sequence reactor without fail.
Power supply	24V Supplied from the printed circuit board of the main body. Connect power supply harness to CN24 or CN25.	

Table 7-59 Software Specification


Item	Specification	
ROM version of main body	H10040 or later, H20040 or later Use with the ROM version specified above. (Refer to the I/O check on the keypad panel for the ROM version.)	
Motor control method	Function code P01 "control method selection" = "3" PG-equipped synchronous motor vector control	
Speed control PG-equipped vector control	Control range	1:1000 (Min. speed: base speed; 1.5 to 1500r/min when converted to 4P; during operation at 1024P/R) 1:4 (constant torque area : constant output area)
	Speed control accuracy	Analog setting: ±0.1% of max. speed Digital setting: ±0.005% of max. speed
PG interface function	When the PMPG option is installed and function code P01 "control method selection" is "3," the built-in PG becomes invalid and priority is given to the PMPG option.	
Wire disconnection detection function	Provided	
Frequency division output	None	
Magnetic pole position detection function	Specify with function code o09 "ABS signal input definition." 3-bit detection: [F0], [F1] and [F2]; U-/V-/W-phase detection 4-bit detection: [F0], [F1], [F2] and [F3]: gray code detection	

### Version check

Check the ROM version of the main body of VG7 (not that of the optical option or keypad panel).

To check, refer to the maintenance data on the right side of "MAIN" and "MTR" at the keypad panel.

The screen shown on the right is found at page 5 of the maintenance data. Use the

 key on the keypad panel to go to page 5.

<b>1500</b>
MAIN=H1xxxx MTR =H2xxxx KP =K xxxx

### 7.8.2.3 Combination with Fuji's Motor

Table 7-60 Model GRK ES Motor

Model of motor	GRK2200M	GRK2400M	GRK2750M	GRK2151A	GRK2221A	GRK2301A	GRK2371A
Model of VG7	FRN0.75VG7S-2		FRN1.5VG7S-2	FRN2.2VG7S-2	FRN3.7VG7S-2		
Rated output (kW)	0.2	0.4	0.75	1.5	2.2	3.0	3.7
Rated torque (N·m)	0.955	1.91	3.58	7.16	10.5	14.3	17.7
Rated rotation speed (r/min)	2000						
Max. rotation speed (r/min)	2500						
Max. torque (N·m)	1.43	2.87	5.38	10.8	15.8	21.5	26.5
Rated current (A)	1.2	2.3	4.0	8.6	13.0	17.2	21.0
Max. current (A)	2.0	3.6	6.0	13.0	19.5	25.8	31.5

\* For capacities smaller than 0.2kW, contact us.

\* For the motor parameters to be entered to VG7, contact us.

\* The model GRK ES motor is of a pulse encoder 1000P/R and open collector output type. Choose **OPC-VG7-PMPGo**.

\* The encoder interface includes A/B/Z and 1 (U)/2 (V)/3 (W). Connect with U/V/W 3-bit magnetic pole position detection. Connection of the Z-phase is unnecessary.

Table 7-61 Model GRH Servomotor

Model of motor	GRH.30BG	GRH.50BG	GRH1.1BG	GRH1.5BG	GRH1.8BG	GRH2.7BG
Model of VG7	FRN0.75VG7S-2	FRN1.5VG7S-2	FRN2.2VG7S-2	FRN3.7VG7S-2		FRN5.5VG7S-2
Rated output (kW)	0.3	0.5	1.1	1.5	1.8	2.7
Rated torque (N·m)	0.955	1.59	3.50	4.77	6.88	10.3
Rated rotation speed (r/min)	3000				2500	
Max. rotation speed (r/min)	3000				2500	
Max. torque (N·m)	2.86	5.73	11.5	15.7	18.0	26.3
Rated current (A)	1.9	2.7	5.4	7.0	8.3	13
Max. current (A)	5.7	8.1	16.2	21.0	21.7	33.2

\* For the motor parameters to be entered to VG7, contact us.

\* The model GRH servomotor is of a pulse encoder 2000P/R and line driver output type. Choose **OPC-VG7-PMPG**.

\* The encoder interface includes A/B/Z and 1 (U)/2 (V)/3 (W). Connect with U/V/W 3-bit magnetic pole position detection. Connection of the Z-phase is unnecessary.

### 7.8.3 Outside and Dimensions

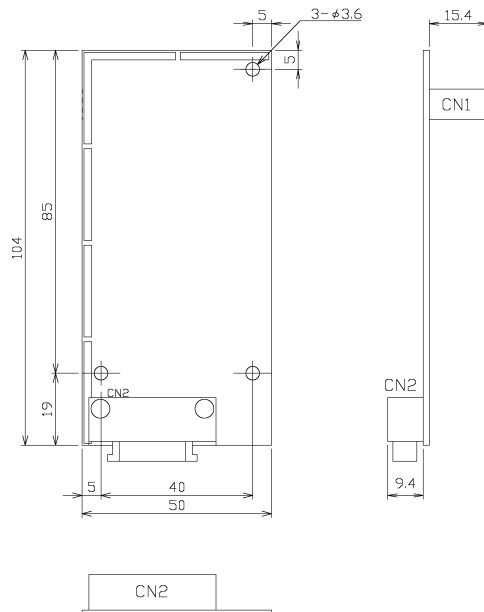
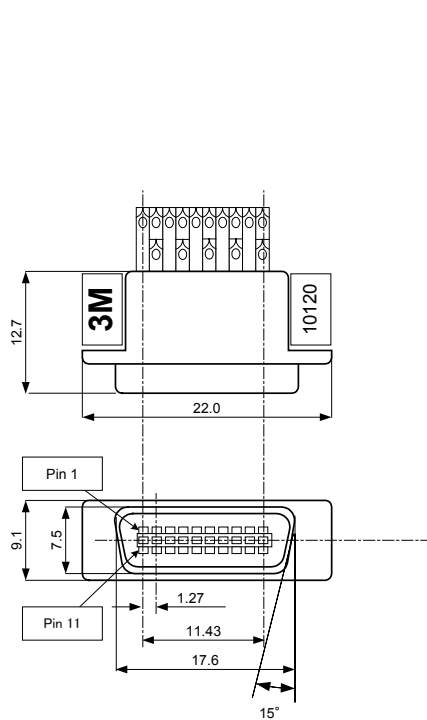


Fig. 7-94

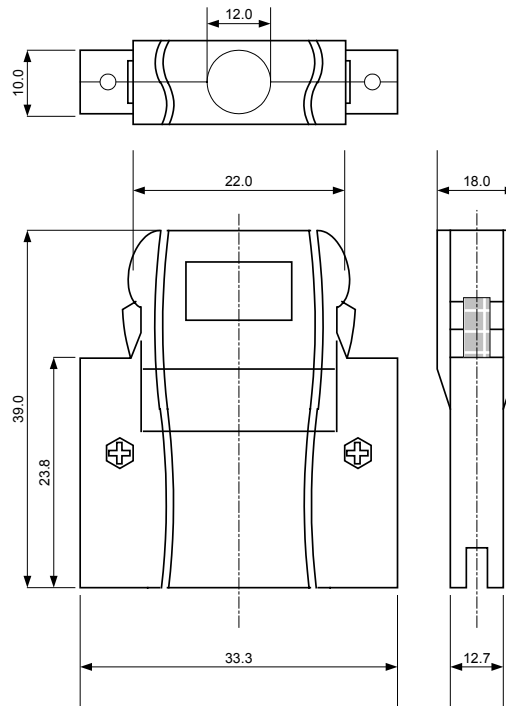
# 7. Control Options

## Accessories



Model: 10120-3000VE 20-pin  
 Manufacturer: Sumitomo 3M Limited

Fig. 7-95 Plug



Model: 10320-52F0-008 20-pin  
 Manufacturer: Sumitomo 3M Limited

Fig. 7-96 Housing

\* The plug and housing are supplied with the option.

## 7.8.4 Basic Connection Diagram

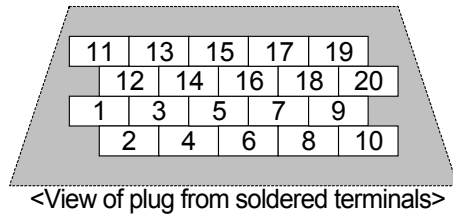
Refer to Section 7.1.4 “How to install built-in option (OPC-VG7-□□)” before starting wiring or connection work.

<p><b>⚠ WARNING</b></p> <ul style="list-style-type: none"> <li>• Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.</li> <li>• Even if the circuit breaker is turned off, smoothing capacitors remain live. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.</li> </ul>
---

<p><b>⚠ CAUTION</b></p> <ul style="list-style-type: none"> <li>• Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.</li> <li>• Inappropriate work during installation or removal of the product will cause breakage of the product.</li> </ul>
--

Table 7-62 Description of Terminal Function

Pin No.	Name	Function	Pin No.	Name	Function
1	-		11	-	
2	*PA	Phase A inversion	12	*F1	Magnetic pole position *F1
3	PA	Phase A	13	F1	Magnetic pole position F1
4	*PB	Phase B inversion	14	*F2	Magnetic pole position *F2
5	PB	Phase B	15	F2	Magnetic pole position F2
6	-		16	-	
7	*F0	Magnetic pole position *F0	17	*F3	Magnetic pole position *F3
8	F0	Magnetic pole position F0	18	F3	Magnetic pole position F3
9	PGP	5VPG power supply	19	PGM	0VPG Common
10	PGM	0VPG common	20	PGP	5VPG power supply



<View of plug from soldered terminals>

Fig. 7-97

### 7.8.4.1 Line Driver Method

For a line driver output type motor encoder, choose OPC-VG7-PMPG to connect.

In the following figure, detection of the magnetic pole position with a 4-bit gray code and detection with three phases (U, V and W) (GRH Series motor) are described.

In case of magnetic pole position detection of the z-phase only, option OPC-VG7-PM(SD) can be used, too.

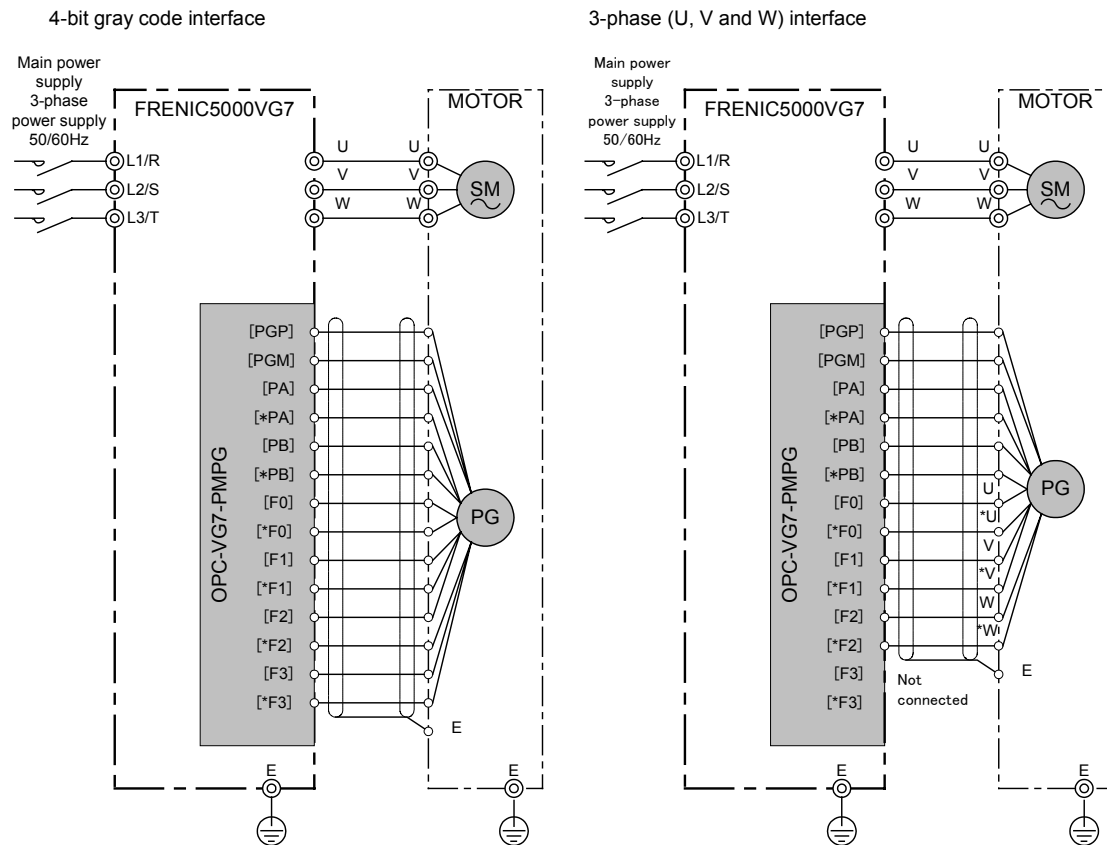


Fig. 7-98

# 7. Control Options

## 7.8.4.2 Open Collector Output Method

For an open collector output type motor encoder, choose OPC-VG7-PMPGo to connect. The following description indicates an example of detection of 3-phase U, V or W (model GRK ES motor).

In case of open collector connection, the noise immunity is low. Therefore the wiring length should be as short as possible and connect a zero-phase sequence reactor on the primary and secondary sides.

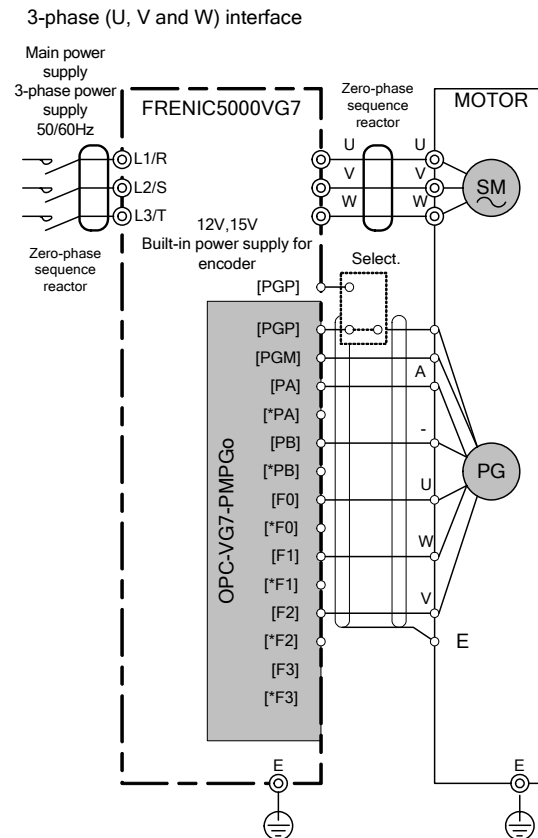


Fig. 7-99

### Notes

- (1) Choose and connect the power supply for the motor encoder carefully while referring to the specification of the motor.
- (2) The power supply of the option is 5V. You can supply 15 or 12V if the encoder power supply of the main body is used.

### 7.8.4.3 Connection Diagram with Fuji's Servomotor

To assure a sufficient noise margin against malfunctions caused by the encoder signal, change the destination of the shield of the PG cable from “E” on the motor side to “PGM” on the inverter side.  
To reduce radiation noise, connection of the shield to “E” on the motor side is effective.

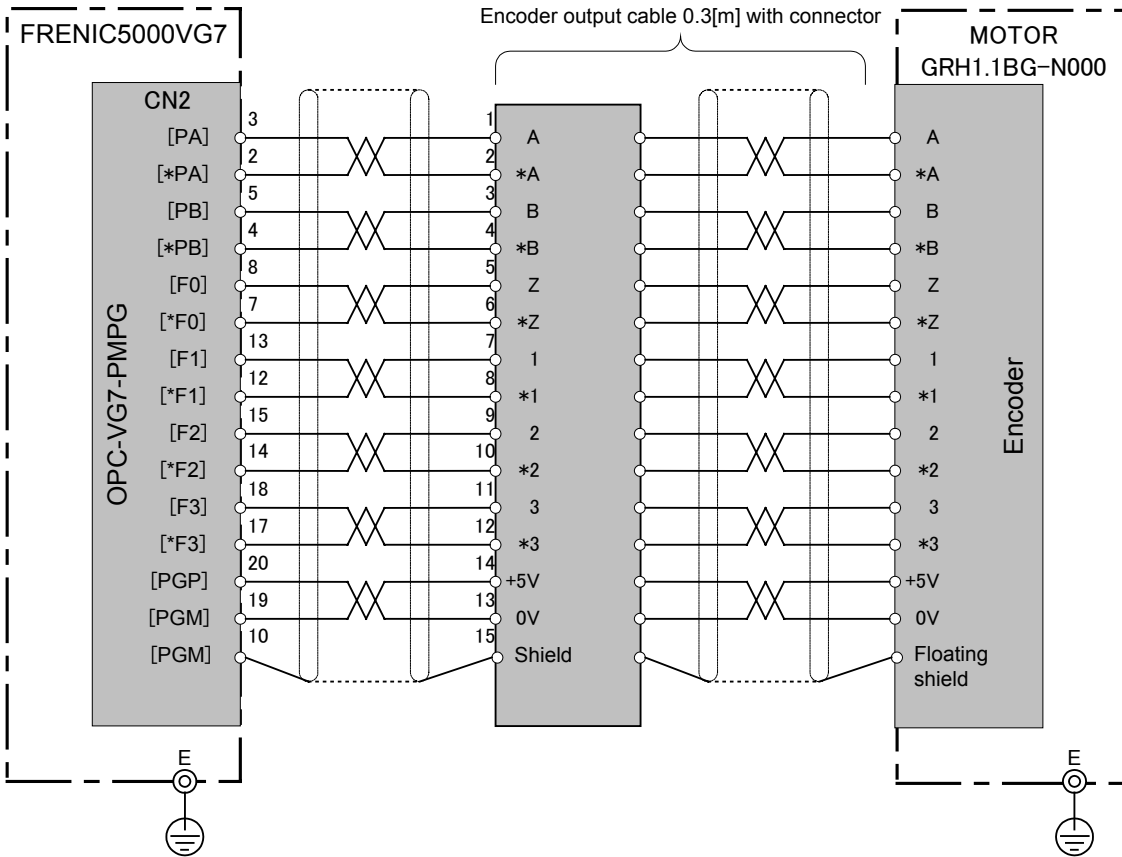


Fig. 7-100

**Note**

- The shield (pin 15) of the encoder is not connected with the ground (E) of the motor.

## 7. Control Options

### 7.8.5 Function Code

 **WARNING**

- Wrong function code data will cause dangerous states. Therefore check the data after entering or writing it.

**You may cause accidents.**

#### 7.8.5.1 Optional Function Code

After the PMPG or PMPGo option is installed, function codes o09 to o11 become operable. These function codes are not displayed on the keypad panel when the option is not installed.

Table 7-63

No.	Name of parameter		Setting range	Description of setting
	Name	Message displayed on keypad panel		
o09	ABS signal input definition	ABS DEFINT	0 to 16	Enter according to the specification of the motor and encoder. The action interface for detecting the magnetic pole position is defined. 0: 1-bit (terminal: F0) Z-phase interface 1: 3-bit (terminals: F0, F1 and F2) 3-phase (U, V and W phases) interface 2: 4-bit (terminals: F0, F1, F2 and F3) gray code interface 3 to 16: Reserved
o10	Magnetic pole position offset	SM-OFFSET	0000 to FFFF	Enter a value to correct deviation from the true value after magnetic pole positioning is performed. 0 to FFFF (0° to 360° CCW direction)
o11	Salient-pole ratio (%Xq/%Xd)	SALIENT RT	1.000 to 3.000	Enter to drive an IPM motor. Use the function to control the reluctance torque of the IPM motor. To drive an SPM motor, enter "1.000."

## 7.8.5.2 Motor Parameter

The motor parameter for driving the synchronous motor is fixed at M1. The effective parameter ranges from F03 to F05 and from P01 to P30.

Because the synchronous motor is driven, parameters related to magnetic flux control are invalid as shown below.

Enter the nameplate value and calculated value in the “used” field shown in Table 7-64.

Table 7-64

No.	Name	Valid/invalid at synchronous drive	No.	Name	Valid/invalid at synchronous drive	
F03	M1 max. speed	Used	P15	M1 magnetic saturation coefficient 1	Invalid	
F04	M1 rated speed		P16	M1 magnetic saturation coefficient 2		
F05	M1 rated voltage		P17	M1 magnetic saturation coefficient 3		
P01	M1 control method		3	M1 magnetic saturation coefficient 4		
P02	M1 motor selection		OTHER	M1 magnetic saturation coefficient 5		
P03	M1 rated capacity		Motor nameplate	P20	M1 secondary time constant	Used
P04	M1 rated current			P21	M1 induction voltage coefficient	
P05	No. of poles of M1			P22	M1-R2 correction coefficient 1	Invalid
P06	M1-R%			P23	M1-R2 correction coefficient 2	
P07	M1-X%		P24	M1-R2 correction coefficient 3		
P08	M1 exciting current		P25	M1 exciting current correction coefficient	Used	
P09	M1 torque current		P26	M1-ACR-P (gain)		
P10	M1 slip at driving	Invalid	P27	M1-ACR-I (integration constant)		
P11	M1 slip at braking		P28	M1-PG pulse count		Motor nameplate
P12	M1 iron loss coefficient 1		P29	M1 external PG correction coefficient		
P13	M1 iron loss coefficient 2		P30	M1 thermistor selection		
P14	M1 iron loss coefficient 3					

## 7.8.6 Check Function

Installation of the PMPG option can be checked on the keypad panel.

From the operation mode screen, go to the program menu screen and select “4. I/O check.”

The I/O check monitor includes total 16 screens. Use the **▲** or **▼** key to scroll the screen and check the screen corresponding to the PMPG option.

For details, refer to the section describing the keypad panel operation method.

If PMPG or PMPGo is installed, a solid square (→) is shown on the LCD screen as shown in the example on the right.

<b>1500</b>	
<input type="checkbox"/> DIA	<input type="checkbox"/> DIB
<input type="checkbox"/> DIOA	<input type="checkbox"/> DIOB
<input type="checkbox"/> AIO	<input checked="" type="checkbox"/> PMPG
<input type="checkbox"/> PG-LD	<input type="checkbox"/> PG-PD



# 7. Control Options

## 7.9 High Speed Serial Card for Multi-winding Motor Drive System

### 7.9.1 Outline of Product

1) Large capacity motor drive

The multi-winding system of VG7S is the product applicable to drive the induction motor (hereinafter called motor) with multi-winding coil (hereinafter called multi-winding) from 2 to 6 windings. This allows operation of one motor by sharing load into multiple converters.

The maximum capacity of the VG7S unit is 800kW. To drive the 1200kW motor, three 400kW inverters or two 630kW inverters are connected.

2) Sensorless vector control

Multi-winding motor can be sensorless vector controlled.

3) Current sharing

To drive one multi-winding motor with multiple inverters, it is necessary to mount the optical link option on each inverter. This optical link instantaneously conveys the current command to share current for each winding. Each inverter controls current (feedback control) for each winding. In this way, it is possible to share load for capacity of each inverter during operation.

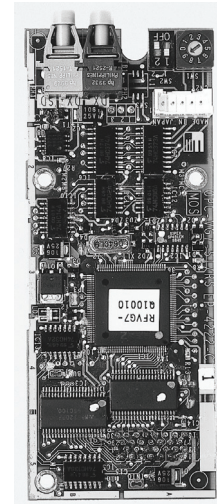
4) Minimized wiring

Multiple inverters are defined as that one is the master and others are slaves with the switch settings on the option. The master inverter gives operation command and speed command as in a standard product and performs feedback connection (not required for the sensorless type) of the motor encoder. In contrast, the function of the slave inverter is to share current. Connection for operation command or speed command is not required. Required wiring is main circuit, alarm output to external unit and optical link.

5) Switching multi-winding motor drive/single (standard) motor drive

When each inverter needs to drive an individual motor one to one (hereinafter called single motor drive) after operation of one multi-winding motor with multiple inverters, multi-winding motor drive and single motor drive can be switched with digital input signal. The constants (motor parameters) for three motors can be preset on each inverter. The motor constant (parameters) which is used in switching can be switched with digital input signal.

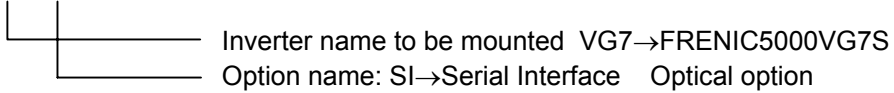
When PG signal or NTC signal is used, these signals should be switched externally. Note that OPC-VG7-CPG is the option specially designed to perform switching externally. Switch the secondary power line with an magnetic contactor.



## 7.9.2 Model and Specification

### 7.9.2.1 Model

Model: OPC-VG7-SI



#### Accessories

Spacer	3
Screw (M3)	3
Plastic optical fiber cable (with connectors)	1, 5m

[Restrictions for mounting]

Combination not allowed for mounting (operation procedure error)

Two SI (MWS) options cannot be simultaneously mounted. Options with SI (UPAC) settings cannot be simultaneously mounted, and options cannot be mounted together with UPAC. This type of mounting results in operation procedure error "Er6".

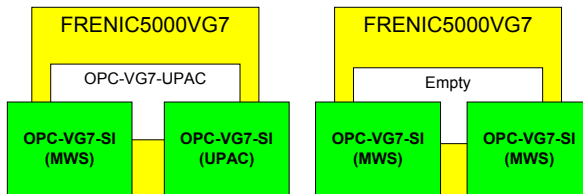


Fig. 7-101

# 7. Control Options

## 7.9.2.2 Specification


 <b>CAUTION</b>	
<ul style="list-style-type: none"> <li>• SI (MWS) options are not compatible with VG7S that has old ROM version. The system does not operate with the old VG7S version. Be sure to check the ROM version with the maintenance information on the keypad panel. If you are not sure about the version, please contact us.</li> <li>• If the switch on the option (SW1, SW2) is incorrect, the system does not operate correctly. Read the following carefully for correct settings.</li> </ul>	

Table 7-65 Hardware Specification

Item		Specification
Name		Optical option
Model		OPC-VG7-SI * Switching to the multi-winding system is performed with SW2.
Settings	Multi-winding settings	Multi-winding settings are SW2-1 = ON and SW2-2 = OFF.
	Station number settings	Hardware switch SW1 of option SW1 = 0: Master SW1 ≠ 0: Slave. Usually, slave 1 is set as "1" and slave 2 is set as "2".

Table 7-66 Communication Specification

Item		Specification
Data transfer method	Loop back method Non-synchronous serial communication with plastic optical fiber	
Transfer rate	4Mbps	
Error check method	Hardware: Parity, framing, overrun Software: BCC, timeout monitoring	
Transfer distance	When plastic optical fiber cable is used: Distance 20m (0 to 70°C) between inverters (Please contact us if wiring of 20m or more is required.)	

Table 7-67 Plastic Optical Fiber Cable Specification (Supplied accessories: Plastic Optical Fiber Cable by Mitsubishi Rayon)

Item	Minimum	Maximum	Unit	Remark
Storage temperature range	-40	+75	°C	
Tension		50	N	Within 30 minutes
Bending radius in short time	<b>10</b>	—	mm	Operation is disabled within one hour. Link error between inverters "Erb" occurs.
Bending radius in long time	<b>35</b>	—	mm	If bending of 35mm or less continues for a long time, link error between inverters "Erb" may occur. Be sure to maintain the bending curvature to 35mm or more.
Tensile strength (long time)	—	1	N	
Flexibility	—	1000	times	Bent by 90° on the 10mm mandrel (shaft, spindle).
Impact	—	0.5	kg	The impact test shall be in accordance with MIL-1678, Method2030 and Procefurel.
Minimum assurance distance	<b>20</b>		m	Minimum assurance value due to transfer loss (0 to 70°C)
Mass	4.6		g/m	

Table 7-68 Software Specification

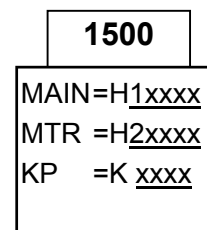
Item	Specification	
Unit ROM version Operation with SI (MWS)	- When SI (MWS) ROM: Q10013 is used. H12015 or older, H22015 or older, H110B0, H210B0, H10060 to 1 and H20060 to 1 can be used. - When SI (MWS) ROM: Q10016 or later is used. H10062 or later and H20062 or later can be used. Use the system with the ROM version above. (The ROM version can be checked with the I/O check on the keypad panel.)	
Applicable motor capacity	CT/VT specification (Up to 4,800kW: 6 winding)	
Motor control method	Induction machine vector control, induction machine sensorless vector control ((Note) V/f selection not allowed)	
Speed control	Maximum output frequency	120Hz
	Control range	1:1000 (Vector control), 1:100 (Sensorless control)
	Control response	20Hz or less (Vector control, sensorless control)
	Control accuracy	±0.005% of maximum speed (digital), ±0.1% (analog, 25±10°C)
	Specified resolution	0.005% of maximum speed
Control function	There are the following limitations. - There is a limitation in the monitor function of the slave unit. - In case of SX-compatible products, carrier frequencies 4, 7 and 15kHz are unavailable. These frequencies are recognized as 5 (4) or 10 (7 and 15) kHz respectively. There is no limitation in the carrier frequency of the standard product.	
Multi-winding/single motor switching	Single/multi-winding motor is switched with function code o33 "multi-winding system". 0: Single motor drive (factory shipment value) 1: Multi-winding drive When function code o33 "multi-winding" is set, single/multi-winding motor can be dynamically changed with the digital input signal [MT-CCL].	
Specifies number of slaves	The number of slaves for optical link is specified with function code o34 "Number of multi-winding system slaves". For example, when 4 units are connected, the number of slaves is "3".	
Protective function	Processing on protective function activated	All unit group alarm mode: Keypad panel alarm mode All unit alarm relay output: 30X output All unit group inverter output shutoff Note that when 30x is activated, make all units coast to stop with an external sequence.
	Communication alarm function Operation procedure alarm function	Link error between inverters "Erb" or operation procedure alarm "Er6" occurs under the conditions below: - When option hardware switch SW1 setting is duplicate: Erb - When Max (function code o34) ≠ Max (SW1 setting value): Erb - When SW1 setting value is 6 or more: Er6 - When two optical link options are mounted on one unit, both options are set as "MWS" (multi-winding): Er6
	Protective function cancel processing	When reset command is given to any unit connected with optical link option, all units are in group reset.

Note: When V/f is selected (M3 selection), "Er6" alarm occurs.

**Check of version**

Check the ROM version of the VG7 unit (neither optical option nor keypad panel). To check the version, see the right of "MAIN" and "MTR" of the maintenance information on the keypad panel.

The screen on the right side can be found at the 5th row of the maintenance information. Move the **V** key on the keypad panel to the 5th row.



**Multi-winding motor specification**

The motor is driven when the same-phase-current is supplied to the wire in the same-phase. This allows operation of the motor with the capacity, equivalent to the total capacity of inverters. For example, when a motor with 4 winding is driven with 4 (n=4) 200kW inverters, the maximum output is 800kW.

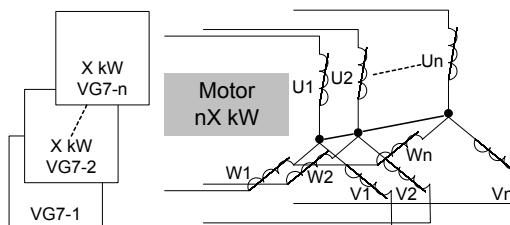


Fig. 7-102

Since the number of winding is a divisor of number of poles, the relation between the number of winding and the number of poles is as follows:

Table 7-69

Number of winding (n)	4P	6P	8P	12P
2	○	○	○	○
3	-	○	-	○
4	○	-	○	○
5	-	-	-	-
6	-	○	-	○

# 7. Control Options

## 7.9.3 Outside Dimensions

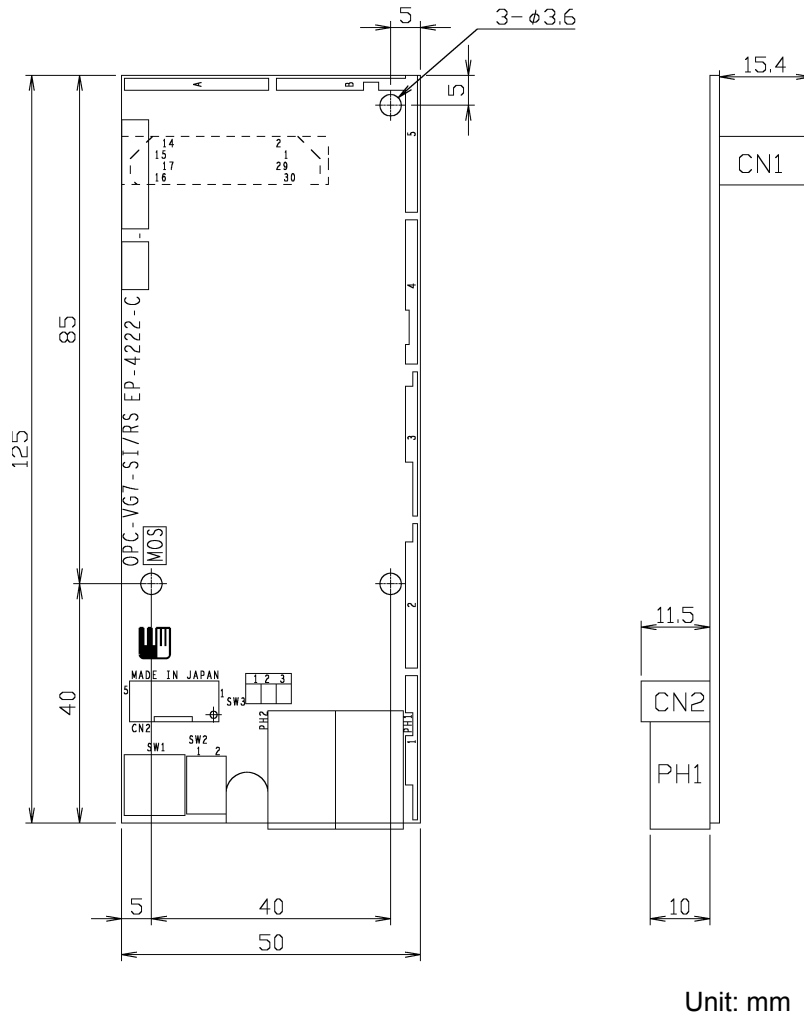


Fig. 7-103 Outside Dimensions of Option Printed Circuit Board

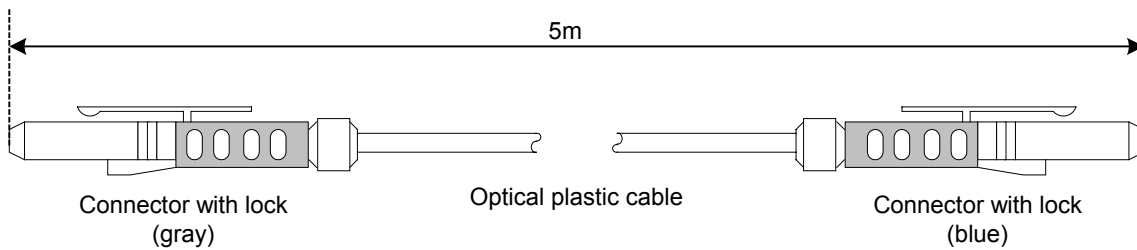


Fig. 7-104 Plastic Optical Fiber Cable (Supplied accessories)

## 7.9.4 Basic Connection Diagram

Refer to 7.1.4 "Mounting Method of Built-in Option (OPC-VG7-)" before wiring and connection.

<b>⚠ WARNING</b>
<ul style="list-style-type: none"> <li>• Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.</li> <li>• Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.</li> </ul>

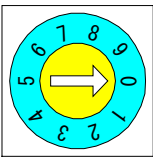
<b>⚠ WARNING</b>
<ul style="list-style-type: none"> <li>• Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.</li> <li>• Inappropriate work during installation or removal of the product will cause breakage of the product.</li> </ul>

### 7.9.4.1 Switch Setting

<b>⚠ CAUTION</b>
<ul style="list-style-type: none"> <li>• Incorrect switch (SW1, SW2) setting on the option does not result in normal operation of the multi-winding system. Read the settings below carefully and perform correct settings.</li> </ul>

Table 7-70 Switch on Optional Card (SW1)

Part No.	SW1 setting	Function	Remark
SW1 rotary switch	0	Master	Operation command, speed command and PG/NTC feedback connection including the main circuit wiring is required as in the standard product.
	1 to 5	Slave 1 to 5	Only current control is active. Therefore, the wiring is only for the main circuit and alarm output.
	6 to 9	Invalid	Do not make this setting. The setting on the left results in operation procedure alarm "Er6".



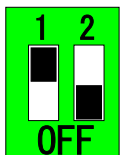
Duplication of the station number switch on the connected inverters is not allowed. To avoid mistake, put a serial number (master 0, slave 1, slave 2,..) for the station number in the connecting order of the cable.

SW1=0 unit is defined as master and SW1≠0 is defined as slave.

Fig. 7-105

Table 7-71 Switch (SW2) on Card

Part No.	SW2-1 setting	SW2-2 setting	Function	Remark
SW2 dip switch	OFF	OFF	–	Do not make this setting.
	ON	OFF	Multi-winding system (MWS)	Regardless of the master or slave, all mounted optical link options are set fixed. MWS: Acronym of Multi-winding system
	OFF	ON	–	Do not make this setting.
	ON	ON	–	Do not make this setting.



In actual setting, fix the switch as shown in Fig. 7-106. Usually, the unit has this setting at shipment from factory.

This setting allows the optical link option to be used as the multi-winding system (MWS).

Fig. 7-106

# 7. Control Options

## 7.9.4.2 Connection of Optical Fiber Cable

**⚠ CAUTION**

- If the plastic optical fiber is bent to the curvature of 35mm or less for a long time, link error between inverters "Erb" may occur and an alarm may be issued. At this time, the inverter output is shutoff and the motor coasts to stop. Be sure to maintain the bending curvature to 35mm or more for wiring.

Connect the OPC-VG7-SI card of each inverter with the optical fiber cable supplied with the option. Since the optical fiber cable plug is gray at one end and dark blue at the other end, connect the cable to the gray and dark blue connectors on each card. Perform connection so that a loop may be formed. For example, when three units (1, 2, 3) are used, perform a loop connection like 1 → 2 → 3 → 1 with three cables.

Table 7-72 Optical Connector on Option Card

Part No.	Name	Color	Description
T-1528	TX	Gray	Transmitter (transmission of optical communication)
R-2528	RX	Dark brown	Receiver (reception of optical communication)

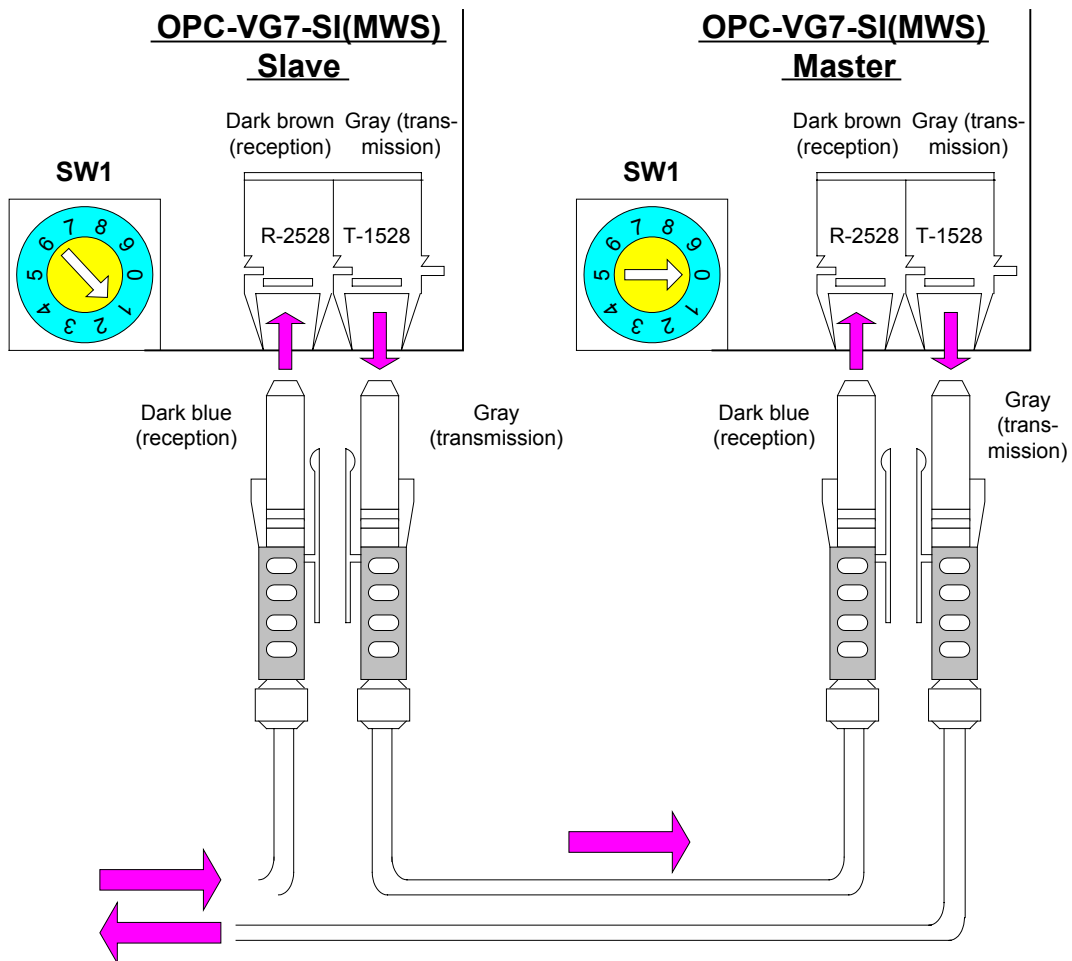


Fig. 7-107

### 7.9.4.3 Basic Connection Diagram

**WARNING**

- For safety, provide an external circuit that will make all units coast to stop if an alarm occurs (30X motion).

A connection example is as follows:

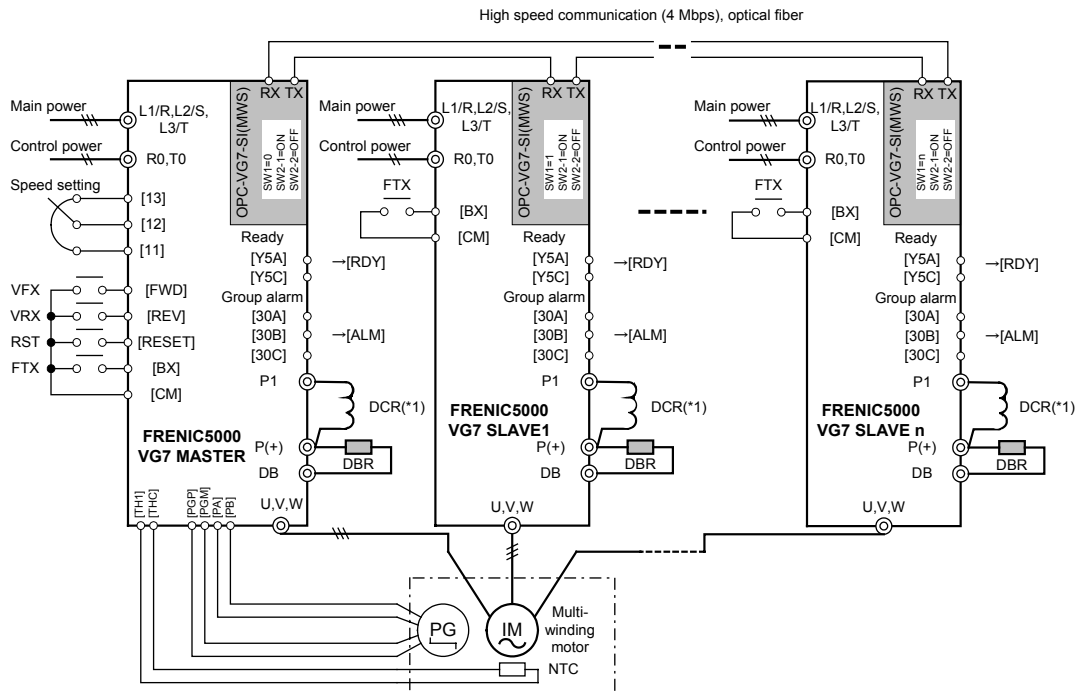


Fig. 7-108

**Special remark**

- (1) For safety, stop all units in coasting if an alarm occurs (30X activated). The coast-to-stop command is contact input [BX].
- (2) When all units are ready [RDY], set turn FWD and REV ON. This example shows that Ready is allocated to the relay output.
- (3) The reset command [RST] of the master unit can cancel alarms of all units.

**Note**

- (1) DCR is a separately installed option for 55kW or less and a standard built-in type for 75kW or more.
- (2) The braking resistance (DBR) is a separately installed option.

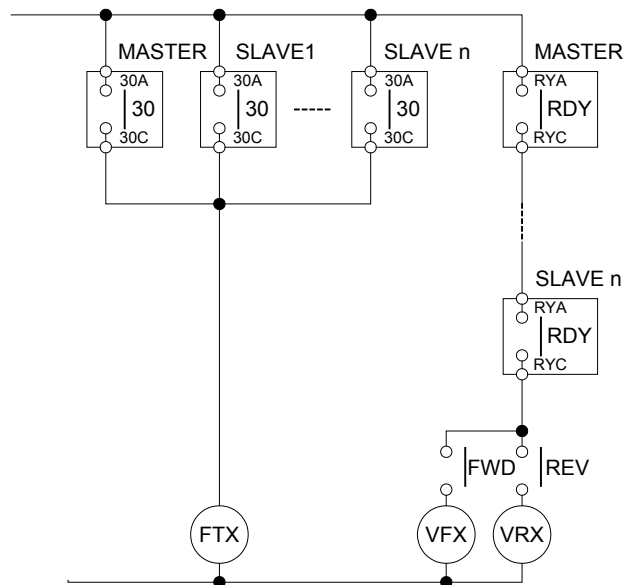


Fig. 7-109



# 7. Control Options

## 7.9.5 Function Code Setting

<b>⚠ WARNING</b>
<ul style="list-style-type: none"> <li>Incorrect data input of the function code may result in a dangerous situation. After data is set and written, check the data again.</li> </ul>
<b>Accident may result</b>

SI (MWS) option allows operation of function code o33 and o34. These function codes are not displayed on the keypad panel in normal operation (without mounting of the option).

Table 7-73

No.	Parameter name		Setting range	Settings
	Name	Keypad panel display		
o33	Multi-winding system	MWS ACTVE	0,1	0: Multi-winding system valid 1: Multi-winding system invalid
o34	No. of multi-winding system slave stations	MWS SLAVES	1 to 5	When the multi-winding system is valid, the number of slave units excluding the master is set.

### 7.9.5.1 Setting of Unit Numbers for Connection

The number of slave units connected with the optical fiber is set to the function code. It is not the setting of all units including the master unit.

Table 7-74 Number of Units for Connection and Function Code

Item	Function	o34 Setting value	Remark
Function code o34	No. of slave station in multi-winding system	1	Master 1 + Slave 1 = Setting for system of 2 units in total
		2	Master 1 + Slave 2 = Setting for system of 3 units in total
		3	Master 1 + Slave 3 = Setting for system of 4 units in total
		4	Master 1 + Slave 4 = Setting for system of 5 units in total
		5	Master 1 + Slave 5 = Setting for system of 6 units in total

**Setting example**

- (1) 2 unit system  
All units are set to o34=1 in common.
- (2) 4 unit system  
All units are set to o34=3 in common.

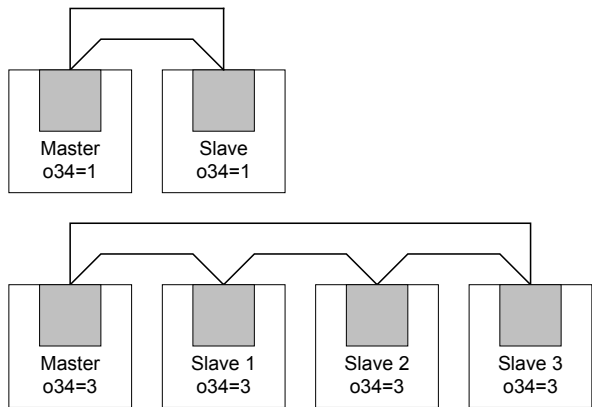


Fig. 7-110

Even if o34 setting is incorrect, an alarm may not occur and the system may not operate. Make sure that the settings are correct.

## 7.9.5.2 Multi-winding/Single Motor Switching

Operation of the multi-winding motor can be canceled with an external digital input signal [MT-CCL] and switched to normal single motor operation.

Fig. 7-111 shows a simple connection example for switching operation between 2 winding motor and single winding motor. In this case, operation command and feedback of PG/NTC signal are not required for the slave unit. When the motor is switched, it is necessary to switch PG signal, NTC signal, etc. in addition to the secondary power line. If switching is required at the slave, operation of [MT-CCL] is required.

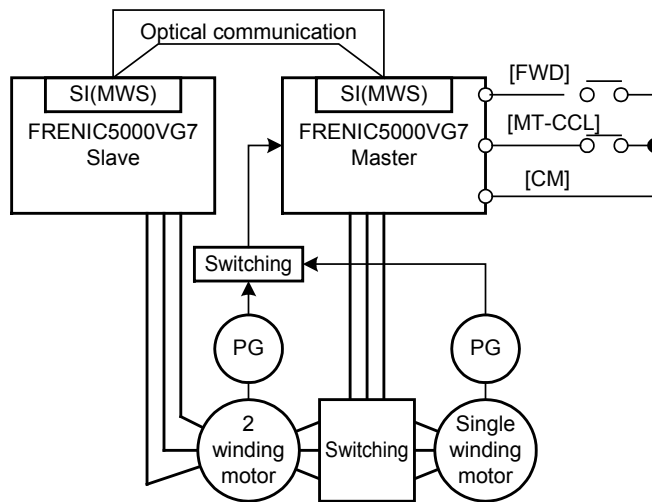


Fig. 7-111

Table 7-75 Multi-winding/single Winding Switching Specification

Item	Function	Settings	Remark
Function code o33	Multi-winding system	0: Single winding operation 1: Multi-winding operation	Be sure to set "1" for multi-winding operation.
Digital input signal	Multi-winding cancel	Setting value 57 [MT-CCL]	When the function code is o33=1 "Multi-winding valid"; Contact ON (closed): Single winding operation (multi-winding canceled) Contact OFF (open): Multi-winding operation

## 7.9.6 Preparatory Operation

### ⚠ CAUTION

- After mounting, wiring and switches are set, check the following items before supplying power to the inverter:

- (1) Is wiring correct?
- (2) Are wire chips or screws left?
- (3) Are screws or terminals loose?
- (4) Is loose wire of the crimp terminal in contact with other terminal?
- (5) Is setting of SW1 and 2 correct?

Perform preparatory operation after reading "Chapter 3 Preparatory Operations and Test Run".

### 7.9.6.1 Operation

- (1) Power-on

### ⚠ CAUTION

- If the system will start operation, not supplying power to even one unit in the multi-winding system, link error between inverters "Erb" occurs. When operation command (FWD, REV) is not given, the alarm will not be issued.

It is not necessary to supply the power simultaneously. The supply sequence is not specified. As operation command (FWD, REV) is not given, the alarm is not detected. Power can be supplied in the desired order.

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## (2) Setting before operation

<b>⚠ CAUTION</b>
<ul style="list-style-type: none"> <li>When the function code is set, it is necessary to set the master and the slave to the same. Without this setting, normal operation is not allowed.</li> </ul>

Before operation, set the following function codes to the same for the master and the slave. Although it is set like this at shipment from factory, confirm the setting again.

Table 7-76

Code to be same	Function	Remark
All F03 to F05, P and A codes	Motor parameter	Be sure to set the code same.
F36	30Ry mode	Setting is required for external fault sequence.
F80	Current rating switching	Be sure to set the code same.
H04, H05	Retry operation	If retry operation is not made valid, it is not necessary to make setting.
o33, o34	Special code for multi winding	Be sure to set the same code.

## (3) Operation method

<b>⚠ CAUTION</b>
<ul style="list-style-type: none"> <li>Give the operation and speed command only at the master.</li> <li>Connect the PG/NTC feedback signal only to the master. (PG connection is not required for operation without the sensor.) If signal is given only to the slave, normal operation is not allowed.</li> <li>Some function code setting and keypad panel display of the slave unit may be invalid.</li> </ul>

### (3)-1 Operation and command input

Operation and command input (speed, torque, torque limit, etc.) are performed only for the master unit. Multiple slave units with optical link should be considered as hardware that controls only current. The method of operation and command input are exactly same as the standard product.

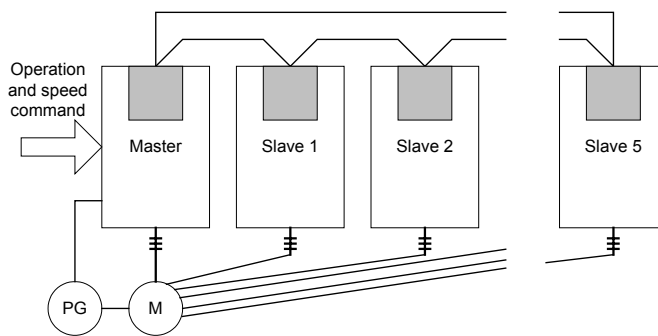


Fig. 7-112

(3)-2 I/O function

Master unit can be used like the standard product.

Slave unit has the following function restrictions.

Table 7-77

	Effective function for multi-winding slave (Items not described are invalid.)	Terminal symbol	Remark
DI	Coast-to-stop command	[BX]	All system units are set coasting.
	Alarm reset	[RST]	All system units are reset.
	External alarm	[THR]	
	Motor M2 selection	[M-CH2]	
	Motor M3 selection	[M-CH3]	When M3 is selected, Er6 alarm occurs.
	Write enable for keypad panel	[WE-KP]	
	Universal DI	[U-DI]	
	Undervoltage cancel	[LU-CCL]	
	Multi-winding function cancel	[MT-CCL]	
DO	Running	[RUN]	Function becomes active with the operation information from the master.
	Ready	[RDY]	
	Motor M2 selection status	[SW-2]	
	Alarm detail	[AL1 to 4]	Alarm information from the master is output with some additions.
	Cooling fan under operation	[FAN]	
	Heat sink overheat early warning	[INV-OH]	
	Life pre-alarm	[LIFE]	
	Inverter overload pre-alarm	[INV-OL]	
	DB overload pre-alarm	[DB-OL]	
	Link error	[LK-ERR]	
AI	All invalid		
AO	Speed detection 2 (ASR input)	[N-FB±]	Speed detection value from the master is output.
	Torque current command (torque ammeter, two-way deflection)	[IT-REF±]	Torque current command is output from the master.
	Torque current command (torque ammeter, one-way deflection)	[IT-REF+]	
	Motor current	[I-AC]	
	Motor voltage	[V-AC]	
	DC link circuit voltage	[VDC]	
	+10, -10V test	[P10,N10]	

Note: For AO, the function without description is indicated as 0.

(3)-3 Keypad panel function

Master's keypad panel can be used like the standard product.

Slave's can be used for only the following functions. The function without description is invalid (0).

Table 7-78 LED Monitor

Name	Remark
Output frequency command value	Primary angular frequency command value from master is displayed.
Torque current command value	Torque current command value from master is displayed.
Torque calculation value	Torque calculation value of single slave unit is displayed.
Output current detection value	Current detection for single slave unit is displayed.
Output voltage detection value	Voltage detection for single slave unit is displayed.
DC intermediate voltage detection value	Link circuit voltage detection for single slave unit is displayed.
Magnetic flux calculation value	Magnetic flux for single slave unit is displayed.

Table 7-79 Operation Status Monitor

Name	Remark
Output frequency command value	Primary angular frequency command value from master is displayed.
Output current detection value	Current detection for single slave unit is displayed.
Output voltage detection value	Voltage detection for single slave unit is displayed.

# 7. Control Options

Table 7-80 Alarm Information

Name	Remark
Output frequency command value on alarm	Primary angular frequency command value from master is displayed.
Output current detection value on alarm	Current detection for single slave unit is displayed.
Output voltage detection value on alarm	Voltage detection for single slave unit is displayed.
Total operation time on alarm	Single slave unit
Motor output command value on alarm	Value is output by multiplying the number of inverters.
Inverter inside air on alarm	Inside air temperature of single slave unit
Heat sink temperature on alarm	Heat sink temperature of single slave unit
Communication status on alarm (4 points)	

\* I/O check, maintenance information, load factor measurement, I/O status on alarm, alarm history and copy function are all valid.

(3)-4 Function code (F to U)

Master can be used like the standard product. Slave has restrictions for functions. Check restrictions of slave from the table below. In particular, code "1" that should have the same value as that of the master must have the same value for the master and the slave.

- 0: Setting is invalid.
- 1: Setting is valid. (Code requiring the same value as the master)
- 2: Setting is valid. (Code not requiring the same value as the master)
- 3: Setting is valid. (Code requiring setting specific to multi-winding)

Table 7-81 F00-F80 at Slave

Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division
F00	2	F10	0	F22	0	F39	0	F47	0	F55	2	F63	0	F73	0
F01	0	F11	0	F23	0	F40	0	F48	0	F56	2	F64	0	F74	0
F02	0	F12	0	F24	0	F41	0	F49	0	F57	2	F65	0	F75	0
F03	1	F14	0	F26	0	F42	0	F50	0	F58	2	F66	0	F76	0
F04	1	F17	0	F27	0	F43	0	F51	2	F59	2	F67	0	F77	0
F05	1	F18	0	F36	1	F44	0	F52	2	F60	2	F68	0	F78	0
F07	0	F20	0	F37	0	F45	0	F53	2	F61	0	F69	0	F79	2
F08	0	F21	0	F38	0	F46	0	F54	2	F62	0	F70	0	F80	1

Table 7-82 E00-E84 at Slave

Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division
E01	2	E12	2	E23	2	E34	0	E45	0	E55	0	E65	0	E75	2
E02	2	E13	2	E24	2	E35	2	E46	0	E56	0	E66	0	E76	2
E03	2	E14	2	E25	2	E36	2	E47	0	E57	0	E67	0	E77	2
E04	2	E15	2	E26	2	E37	2	E48	0	E58	0	E68	0	E78	2
E05	2	E16	2	E27	2	E38	0	E49	0	E59	0	E69	2	E79	2
E06	2	E17	2	E28	2	E39	0	E50	0	E60	0	E70	2	E80	2
E07	2	E18	2	E29	0	E40	0	E51	0	E61	0	E71	2	E81	2
E08	2	E19	2	E30	0	E41	0	E52	0	E62	0	E72	2	E82	2
E09	2	E20	2	E31	0	E42	0	E53	0	E63	0	E73	2	E83	2
E10	2	E21	2	E32	0	E43	0	E54	0	E64	0	E74	2	E84	2
E11	2	E22	2	E33	0	E44	0								

Note: For E01 to E13, E15 to E27 and E69 to E73, only functions described in Table 7-77 are valid.

\* C01 - C73 = All 0.

\* P01 – P27 = 1, P28 –P30 = 0

Table 7-83 H00-H73 at Slave

Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division
H01	0	H10	0	H21	0	H30	0	H38	2	H47	0	H56	0	H65	0
H02	2	H11	0	H22	0	H31	2	H39	2	H48	0	H57	0	H66	0
H03	2	H13	0	H23	0	H32	2	H40	2	H49	0	H58	0	H67	0
H04	1	H14	0	H24	0	H33	2	H41	0	H50	0	H60	0	H68	2
H05	1	H15	0	H25	0	H34	2	H42	0	H51	0	H61	0	H70	0
H06	2	H16	0	H26	0	H35	2	H43	0	H52	0	H62	0	H71	0
H08	0	H17	0	H27	0	H36	2	H44	0	H53	0	H63	0	H72	0
H09	0	H19	0	H28	0	H37	2	H46	0	H55	0	H64	0	H73	0
		H20	0	H29	2										

\* A01 – A29, A33, A34 =1, A30 –32, A35 – A50 = 0

Table 7-84 o00-o41 at Slave

Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division
o01	0	o04	0	o08	0	o12	0	o16	0	o30	2	o34	3	o38	2
o02	0	o05	0	o09	0	o13	0	o17	0	o31	2	o35	2	o39	2
o03	0	o06	0	o10	0	o14	0	o18	0	o32	2	o36	2	o40	2
		o07	0	o11	0	o15	0	o19	0	o33	3	o37	2	o41	2

\* L01 - L15 = All 0.

\* U01 - U64 = All 2.

(3)-5 Function code (S: Command data)

Master can be used like the standard product. Only S06 "Operation command 1" and S07 "Universal DO" functions are valid for the slave. However, it has the restrictions in 8.3.2 "I/O function".

(3)-6 Function code (M: Monitor)

Master can be used like the standard product.  
Slave has restrictions for functions. Check restrictions of slave from the table below. In particular, please understand that "0" display makes the data invalid.

Table 7-85 M00-M60 at Slave

Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division	Code	Division
M01	0	M09	1	M17	1	M25	1	M33	1	M40	1	M47	1	M54	1
M02	0	M10	2	M18	1	M26	1	M34	1	M41	1	M48	1	M55	1
M03	1	M11	1	M19	1	M27	1								

## 7. Control Options

### 7.9.7 Protective Function

#### WARNING

- If one of two or more inverter units that form the multi-winding system show an alarm status for some reason, sufficient torque may not be obtained in operation with the remaining units and the machine system may not be correctly operated. To prevent this, the multi-winding system will make all units connected with the optical link option into alarm status instantaneously (within a few ms). Assemble the sequence that stops all units using 30X (alarm relay output) on your side.
- When the error cause is removed after the inverter protective function is activated, resetting the alarm while the operation command is ON will start the inverter. Check if the operation command is OFF (open) before alarm resetting.

#### CAUTION

- If an optical cable is disconnected between units during operation of inverters, normal operation is disabled. Forced alarm (Link error between inverters: Erb) is given between inverters. At this time, the motor coasts to stop. This alarm is not activated during inverter stoppage.

#### 7.9.7.1 Link Error between Inverters (Erb)

If an optical cable is disconnected or removed from a connector during operation of inverters, alarm for all units occurs with link error between inverters: Erb, and the motor coasts to stop.

Even if a reset command (either of keypad panel, signal input or communication system) is entered when the alarm cause is not removed, the alarm status cannot be reset. Be sure to check the alarm cause before resetting.

##### Troubleshooting of "Erb"

When Erb alarm has occurred, possible causes are as follows. Check the items.

- (1) The optical cable is not connected. Insertion to the connector is incomplete.
- (2) The optical cable is bundled and bent with the curvature of 35mm or less.
- (3) Connection plug of the optical cable does not match to the connector color (gray, dark blue) of the printed circuit board.
- (4) Connection of the optical cable does not form a loop. Signal from the master must be looped back.
- (5) Setting of optical link option hardware station SW1 is larger than o34 "Number of slave units".
- (6) SW1 is set in duplicate.

When alarm "Erb" cannot be reset with the actions above done, the optical cable and the optical link option printed circuit board may be faulty. Contact your nearest sales office or service center.

#### 7.9.7.2 Operation Procedure Error (Er6)

If the hardware switch is incorrectly set, an alarm occurs. This is a preventive action to prevent unstable operation with incorrect settings.

- The optical link option hardware station SW1 is set to 6 or more.
- The setting of the optical link option hardware station SW1 is larger than o34 "Number of slave units".
- When two optical link options are used, the setting of the hardware switch SW2 is the same for both options.

##### (1) Batch alarm processing

When an alarm occurs on the master unit, the same alarm for all stations is displayed, 30X is active and inverters are shut off by means of optical transmission.

When an alarm occurs on the slave unit, the same alarm for all stations is displayed, 30X is active and inverters are shut off by means of optical transmission.

---

(2) Reset processing

With the reset command from the master, all stations are reset in a batch provided that the alarm cause is removed.

With the reset command from the slave, all stations are reset in a batch provided that the alarm cause is removed.

Table 7-86 Target for Resetting

	Master alarm status	Slave alarm status	Target for resetting
Reset command from master	Valid	Valid	All units
Reset command from slave	Valid	Valid	All units

(3) Invalid detection of disconnection

In the multi-winding slave unit, feedback of PG and NTC signal is not required. Therefore, detection of PG disconnection and NTC disconnection is invalid under the conditions of "multi-winding" and "slave".



# 7. Control Options

## 7.10 PG Signal Switching Option

### 7.10.1 Outline of Product

This switching option card can drive one of two motors with PG with one VG7S inverter by switching. The switching signal is the pulse encoder (PG: Pulse Generator) and the NTC thermistor signal. The switching function of the output wire (U, V, W) to the motor is not available. Perform switching with an external magnetic contactor (MC). Switching signal can be output from VG7S.

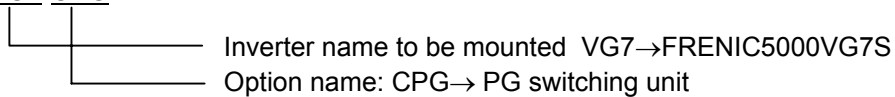
#### Major application

- Operation of multi-winding motor
- Multiple motors are operated with one inverter.

### 7.10.2 Model and Specification

#### 7.10.2.1 Model

Model: MCA-VG7-CPG



#### 7.10.2.2 Specification

Table 7-87 Hardware Specification

Item	Specification
Name	PG switching card
Switching signal	2 systems (NTC, PG signal), switching with SEL terminal
PG signal	15V complementary output
NTC signal	0-10V analog signal
Current consumption	24V, max. 80mA

### 7.10.3 Outline Drawing

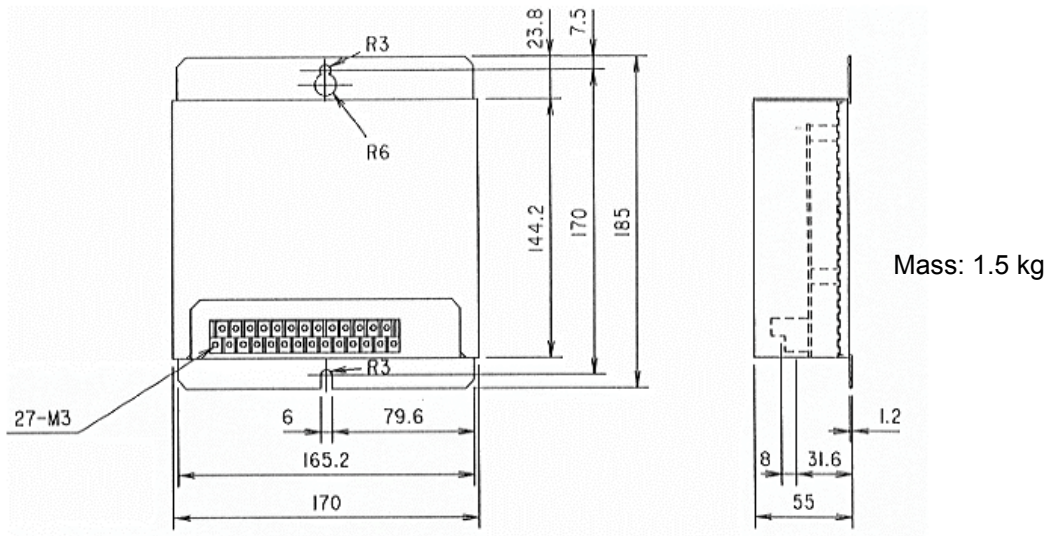


Fig. 7-114 Outside Dimensions of Product



Screw size M3

Fig. 7-115 Terminal Arrangement

### 7.10.4 Mounting Method

Fix securely the unit with upper and lower bolts (size M5) on the rigid structure so that label letters on the PG switching unit may be visible at the front.

**⚠ WARNING**

- Fix it on nonflammable object such as metals.

**Fire may result.**

**⚠ CAUTION**

- Do not allow foreign matter such as lint, paper, wood chip, dust, metal chip, etc. to enter the unit.

**Fire may result.**

# 7. Control Options

## 7.10.5 Basic Connection Diagram

Refer to 7.1.4 "Mounting Method of Built-in Option (OPC-VG7-)" before wiring and connection.

**⚠ WARNING**

- Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.
- Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.

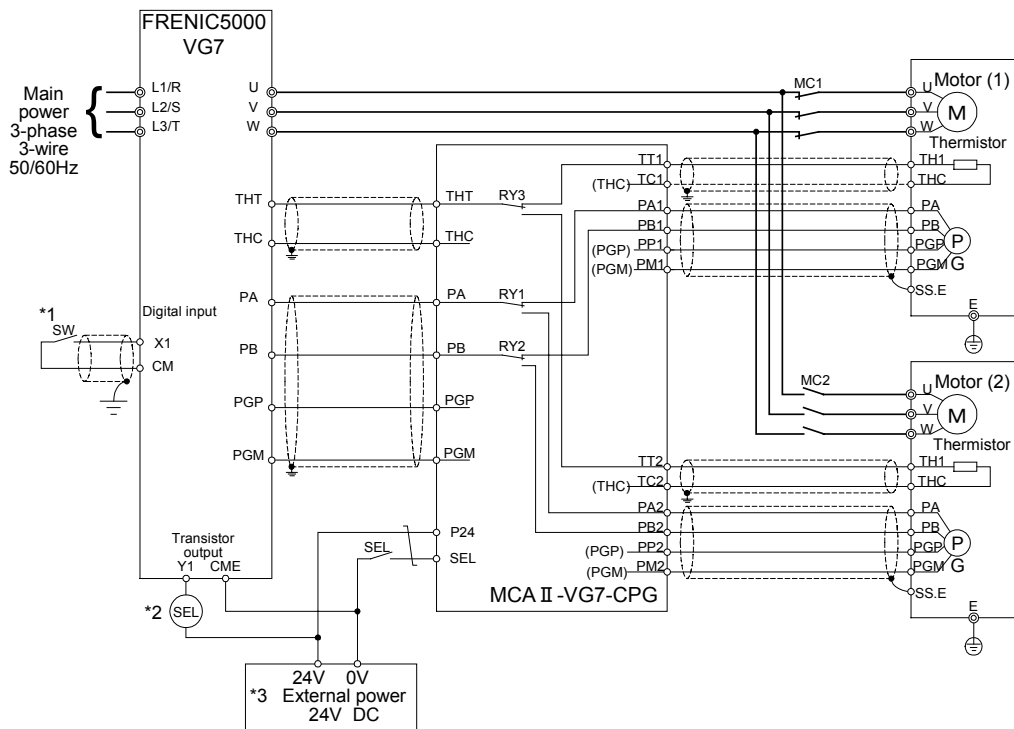
**⚠ CAUTION**

- Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.
- Inappropriate work during installation or removal of the product will cause breakage of the product.

Each terminal block is available at the lower part of this unit (Refer to Figs 7-114 and 7-115.). Pay attention to the following items for correct connection.  
 Perform connection as shown in Fig. 7-116. Prepare the circuit that switches main circuit (U, V, W) interlocked with the SEL contact. Use the crimp terminal which is highly reliable for connection between the terminal and the wire. After connection (wiring), check the following items:

- Is connection correct?
- Is there any missing connection?
- Is any terminal or wire short-circuited or grounding fault?

### 7.10.5.1 Basic Wiring Diagram



Note: In principle, the shielded wire should be grounded. If external induction noise is large, connection to 0V may reduce interference of noise.

Fig. 7-116 Connection Diagram of Inverter Unit

\*1: The connection example before-mentioned consists of the following allocation of digital input (X1) and transistor output (Y1).

Table 7-88

Function code	Function name	Setting value	Description	Operation or Action
E01	X1 function selection	12	Motor M2 selection	Select motor 2 with switch ON.
E15	Y1 function selection	16	Motor M2 selected status	Turn on SEL with switch ON.

\*2: Prepare the circuits separately so that the main circuit wirings may be switched with coil (SEL).

Table 7-89

SW	SEL	MC1	MC2	Selected motor
OFF	OFF	ON	OFF	1
ON	ON	OFF	ON	2

\*3: Required current for 24V external power: 70mA + Operational current for coil (SEL)

#### Applicable wire size

Use the wire of 0.5 to 1.25 (mm<sup>2</sup>).

For the main circuit wiring (U, V, W), observe the instruction manual and the User's Manual of this inverter.

## 7.10.6 Operation Method

When the SEL terminal on the terminal block and the external power supply 0V terminal are opened, connection to encoder (1) and NTC thermistor (1) is made.

When the SEL terminal on the terminal block and the external power supply 0V terminal are short-circuited, connection to encoder (2) and NTC thermistor (2) is made.

Table 7-90

SEL terminal	Encoder and NTC thermistor to be connection
OFF	Encoder (1), NTC thermistor (1)
ON	Encoder (2), NTC thermistor (2)

### CAUTION

- Switching function of the motor power line (U, V, W) is not available. Perform switching with MC externally.
- Never perform switching while the power is supplied to the motor.

#### **Motor may overrun or the inverter unit may fail.**

- The PG signal common terminal (PGM) and the thermistor common terminal (THC) of the switching unit are isolated. Do not short-circuit it with an external wire.
- Three or more motors cannot be switched using multiple number of this unit. (Since the PG power source is not switched, the PG current capacity of the inverter could be exceeded.)

#### **Inverter may be damaged.**

# 7. Control Options

## 7.11 T-link Interface Card

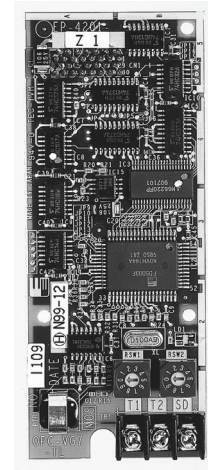
### 7.11.1 Outline of Product

This option is used when VG7S is controlled with Fuji programmable controller MICREX-F and MICREX-SX (T-link module).

#### Major applications

This option allows the following:

- Signal input such as run and stop: FWD, REV, X1 to X9, X11 to X14, RST
- Setting of speed command: 16 bit binary data
- Monitoring of operation status  
Forward rotation, reverse rotation, under DC braking or under preliminary excitation, inverter shutoff, under braking, DC link circuit voltage established, under torque limit, under voltage limit, under current limit, under acceleration, under deceleration, alarm output (for any fault), remote/local, write error from TL, under data write (processing),
- Monitoring of motor speed: 16 bit binary data
- Monitoring of operation status  
(Speed command, output frequency, torque calculation value, output current, output voltage, cumulative operation time, etc.)
- Change and confirmation of each function code  
Function code that can be changed from keypad panel during operation  
⇒ Can be changed during operation. (Confirmation is also available.)  
Function code that cannot be changed from keypad panel during operation  
⇒ Cannot be changed during operation. (Confirmation is available.)



Function code that is accessible from this option is restricted. Refer to Chapter 13 Function code list for details.

[Restrictions for mounting]

Combination not allowed for mounting (operation procedure error)

T-link option cannot be mounted together with SX option and OPEN NET. This type of mounting results in operation procedure error "Er6".

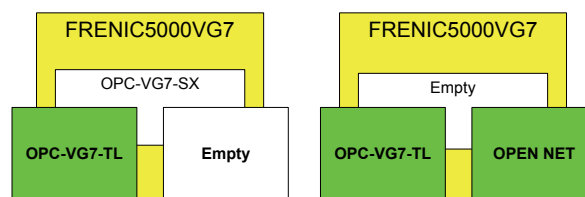
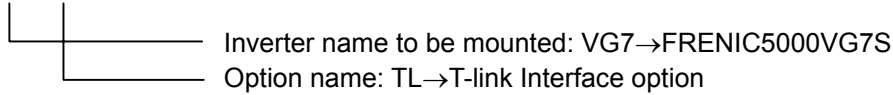


Fig. 7-117

## 7.11.2 Model and Specification

### 7.11.2.1 Model

Model: OPC-VG7-TL



#### Accessories

Spacer	3
Screw (M3)	3

### 7.11.2.2 Specification

#### ⚠ CAUTION

- Incorrect switch (RSW1, 2) setting on the option hinders normal operation of the system. Read the settings below carefully and perform correct settings.

Table 7-91 Hardware Specification

Item	Specification
Name	T-link interface option
Transmission specification	T-link slave, I/O transfer
Transmission rate	500kbps
No. of words reserved for transmission	Selection by function code o32 "Transfer format selection". 16 words (8W+8W) in total: 8W for MICREX → VG7S, 8W for VG7S → MICREX 8 words (4W+4W) in total: 4W for MICREX → VG7S, 4W for VG7S → MICREX
Terminal	TX+, TX-, SD
Rotary switch RSW1, 2	Address setting, 99W space 4W+4W: 12 units can be connected. 8W+8W: 6 units can be connected.

Rotary switch RSW1, 2

Station number (address) is set with rotary switches RSW1 and RSW2 on the option board.



**RSW1**



**RSW2**

RSW1: Upper level (×10)

RSW2: Lower level (×1)

Fig. 7-118

\* When multiple units are used, perform settings so that addresses may not be overlapped.

\* Values at shipment are RSW1 = 0 and RSW2 = 0 (station number = 00).

Table 7-92 Software Specification

Item	Specification	
Data renewal frequency	4ms renewal	
Operation	Operation command	Normal/reverse rotation command, alarm reset command, X1 to X14 command
	Speed command	16bit binary data, Setting resolution 0.005% (for the maximum speed)
	Operation status output	Under operation, under braking, under torque limit, alarm output (for any fault), etc. Motor speed, torque current command, etc.
Function code	255 functions allocated to the link number of the function code list can be referred to or changed.	
Function codes available	o30 - 32 (With this option, display on the keypad panel is allowed.)	
Protective function	Er4: T-link error Minor fault: Er4 alarm can be controlled with o30 and o31. Major fault: Instantaneous alarm	

\* Minor fault: Signal noise, etc. When noise is not frequent, Er4 alarm can be controlled with o30 and o31 to continue operation. Other fault are power shutoff, disconnection of communication line, etc. at MICREX.

\* Major fault: Fatal fault such as fault of hardware

# 7. Control Options

## 7.11.3 Outline Drawing

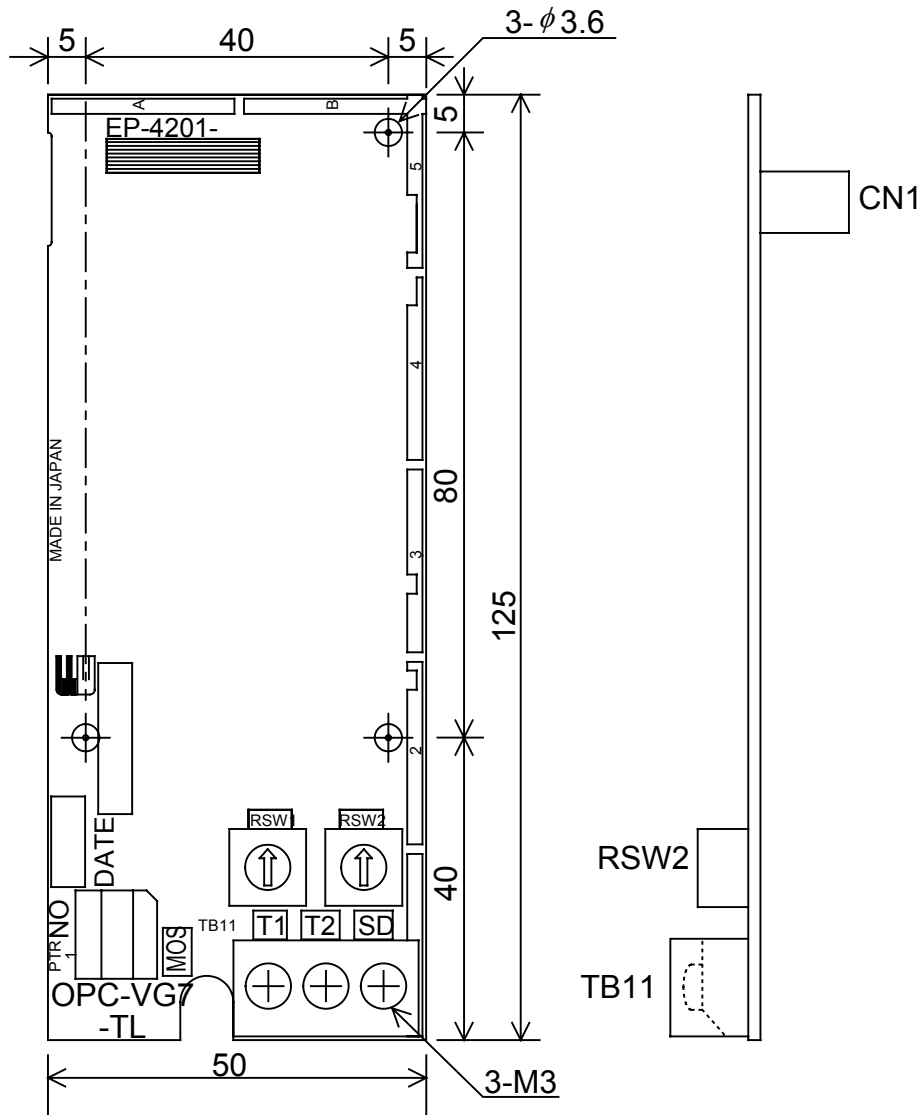
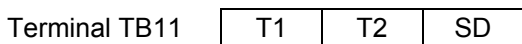


Fig. 7-119

### 7.11.3.1 Explanation of Terminal Function

(1) Terminal arrangement



(2) Terminal details

Table 7-93

Terminal symbol	Name	Explanation
T1 T2 SD (Shielded)	T-link cable connection terminal	For T-link cable connection

\* All terminals are open at shipment from factory.

---

## 7.11.4 Basic Connection Diagram

Refer to 7.1.4 "Mounting Method of Built-in Option (OPC-VG7-)" before wiring and connection.

### WARNING

- Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.
- Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.

### CAUTION

- Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.
- Inappropriate work during installation or removal of the product will cause breakage of the product.

### 7.11.4.1 Basic Connection Diagram

The basic connection diagram is shown below. Observe the following items for connection.

[Caution for connection]

- (1) Use the following specified T-link cables.
  - Twisted pair cable by Furukawa Electric Co., Ltd.  
CPEV-5B  $\phi 0.9 \times 1$  pair
  - Twisted pair cable by Furukawa Electric Co., Ltd.  
KPEV-SB  $0.5 \text{ mm}^2 \times 1$  pairRefer to the documents of MICREX for cable specifications above.
- (2) Connect terminating resistors of  $100 \Omega$  accompanying the P capsule at both ends of the T-link.
- (3) Connect the T-link cable in a single loop as shown in the basic connection diagram (Fig. 7-120).  
Branching of a cable does not allow normal transmission.
- (4) Keep the T-link cable for (30 cm or more) from the main circuit of the inverter or other power lines to prevent malfunction due to noise. Never put the T-link cable in the same duct with other power lines.



# 7. Control Options

Basic connection diagram

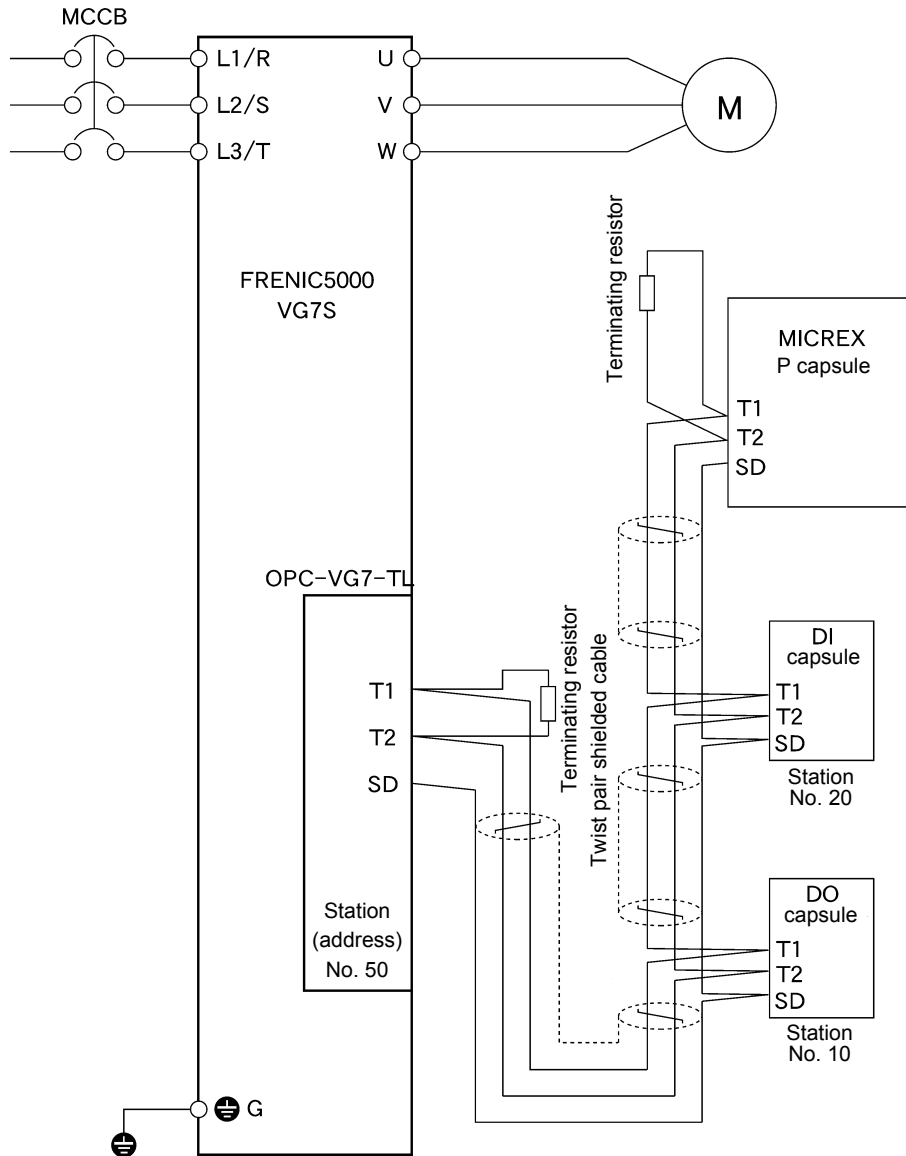


Fig. 7-120

## 7.11.5 Function Code

### WARNING

- Incorrect data input of the function code may result in a dangerous situation. After data is set and written, check the data again.

**Otherwise, an accident may occur.**

TL option allows operation of function codes o30 to o32. These function codes are not displayed on the keypad panel in normal operation (without mounting of the option).

Table 7-94

No.	Parameter name		Setting range	Settings
	Name	Keypad panel display		
o30	Action in transmission error	Link mode	0	Immediate forced stop on communication error (minor fault) (Er4 alarm: Coast-to-stop)
			1	After communication error (minor fault), operation continues for timer operation time. (Operation command from the immediately previous communication is held in communication error status.) Forced stop after timer time. (Er4 alarm: Coast-to-stop) When communication is recovered within timer time, command through communication is followed. Forced stop after timer time.
			2	After communication error (minor fault), operation continues for timer operation time. (Operation command from the immediately previous communication is held in communication error status.) When communication is not recovered from communication error after timer time, operation stops forcibly. When communication is recovered within timer time, normal operation is performed according to command through communication.
			3	Even if communication error (minor fault) occurs, alarm (Er4) is not activated. Operation command from the immediately previous communication is held in communication error status. When communication is recovered, normal operation is performed according to command through communication.
o31	Operation time on transmission error	Link timer	0.0 to 20.0	If communication error (minor fault) occurs, it is valid when the action in transmission error is o30 = 1 and 2.
o32	Transmission format selection	4W/8W switching	0,1	0: Format 1 (Standard format 4W + 4W) 1: Format 2 (VG7S format 8W + 8W)

## 7.11.6 Protective Action

### 7.11.6.1 Minor Fault and Major Fault

The T-link option has minor faults and major faults depending on the fault level. If a fault occurs, the inverter issues Er4 "T-link fault", and the motor coasts-to-stop.

Table 7-95

Item	Minor fault	Major fault
Cause	Noise application to communication line Duplicate address (incorrect setting of RSW1 and 2)	Disconnection of communication line Power shutoff of MICREX (PLC) (OFF)
Resetting method	Alarm cause is removed (automatic removal by recovery of communication) and reset command (reset from keypad panel, [RST] and communication) is given.	Remove the cause of hardware failure and reset the power.
Control of fault status	Alarm is active only when operation command is given from T-link. Alarm can be controlled with function code o31 and 32.	Instantaneous Er4 alarm

# 7. Control Options

## 7.11.6.2 Protective Action Function Code

When operation command is given from MICREX through T-link, the control method of Er4 alarm is explained when a minor fault occurs.

[Explanation of action]

When FWD and speed command are given from MICREX-F, an action example on communication error during operation is explained below:

\*: If communication is not recovered and new command or setting is not sent during this period, command (operation command or speed command or both) from communication on communication error is held.

(1) Where o30 = 0

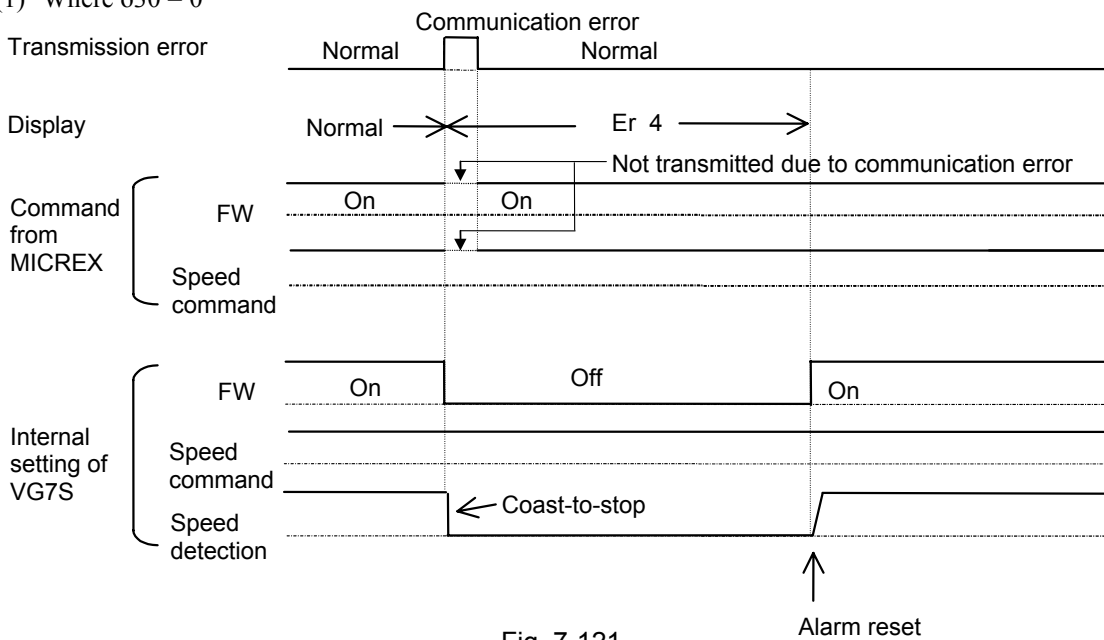


Fig. 7-121

(2) Where o30 = 1 and o31 = 5.0 (Mode of forced stop for 5 seconds at communication error)

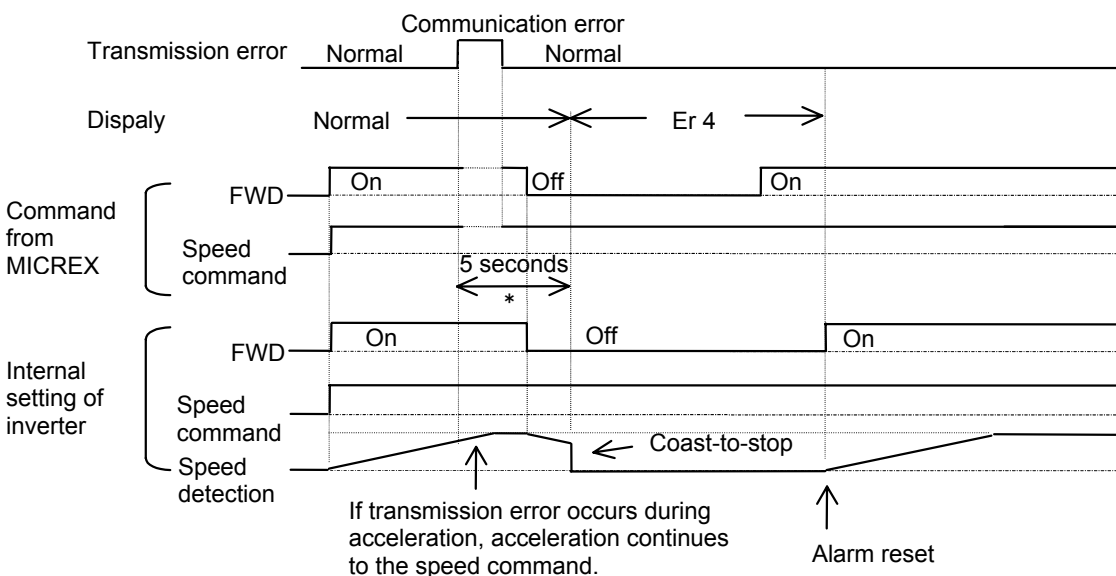


Fig. 7-122

- (3) Where o30 = 2 and o31 = 5.0 (Communication is not recovered even after 5 seconds from communication error and Er4 trip occurs.)

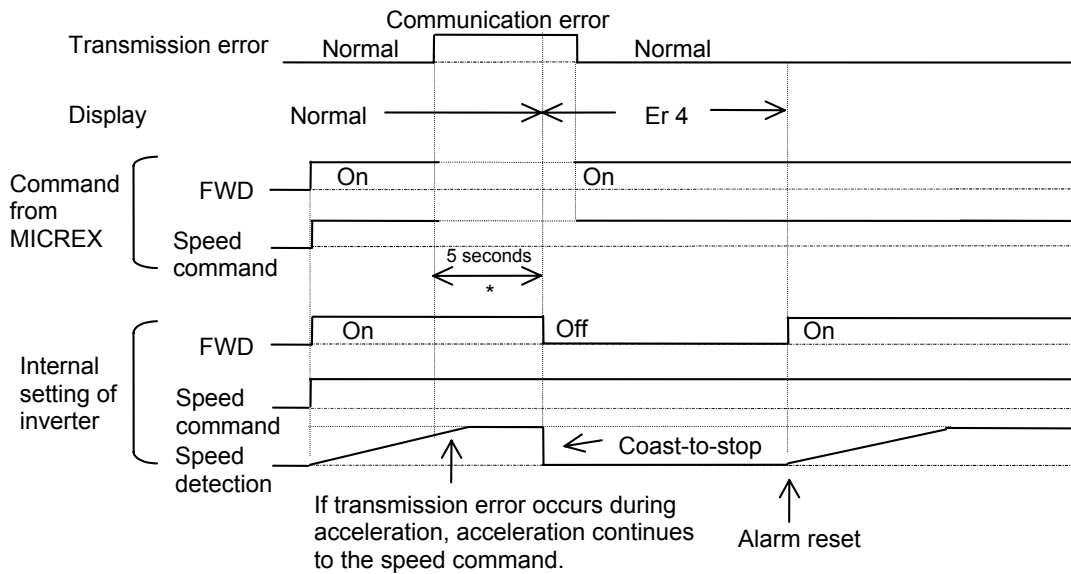


Fig. 7-123

- (4) Where o30 = 2 and o31 = 5.0 (Communication error occurred but communication recovered within 5 seconds)

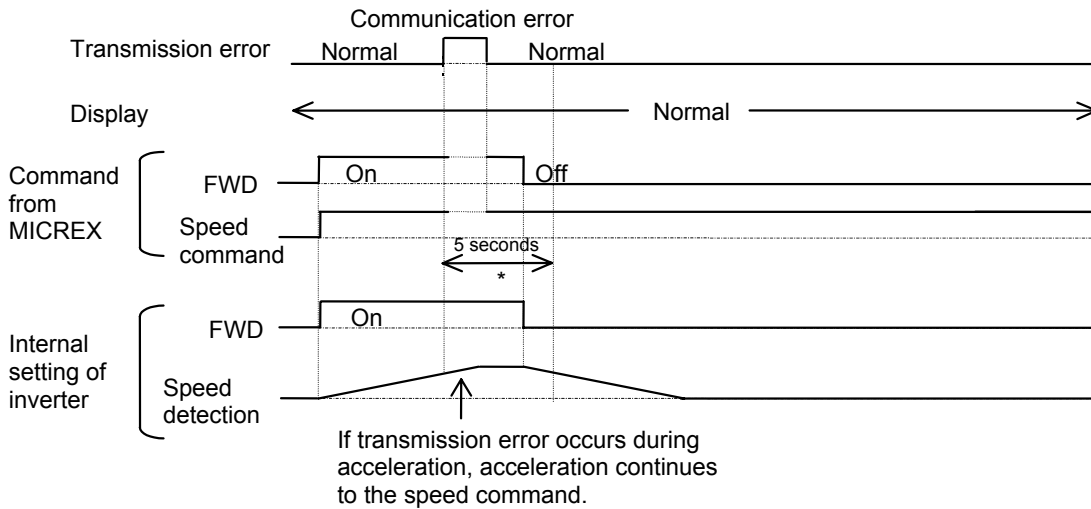


Fig. 7-124

- (5) Where o30 = 3

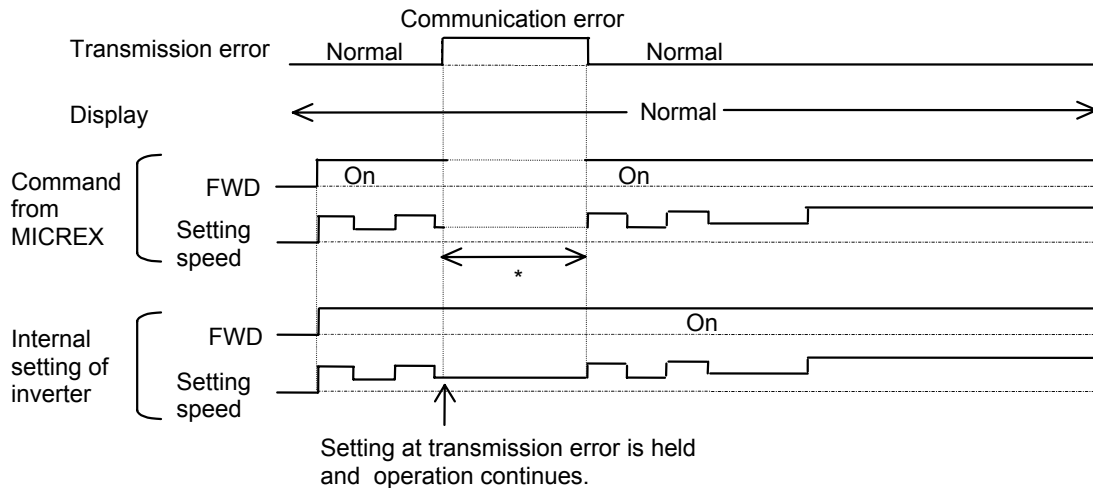


Fig. 7-125

# 7. Control Options

## 7.11.7 Data Allocation Address

### 7.11.7.1 Transmission Format

The following two transmission formats can be selected with function code o32 "Transmission format".

- 1) When o32 = 0 (Format 1, Standard format: No. of occupied words: 4W + 4W)
- 2) When o32 = 1 (Format 2, VG7 format: No. of occupied words: 8W + 8W)

### 7.11.7.2 Area for Use

As shown in the figure below, area of continuous 8 words or 16 words per inverter is used. Two digit address (WB00\*\* in the figure below) is set by the rotary switches RSW1 and RSW2 on the option card.

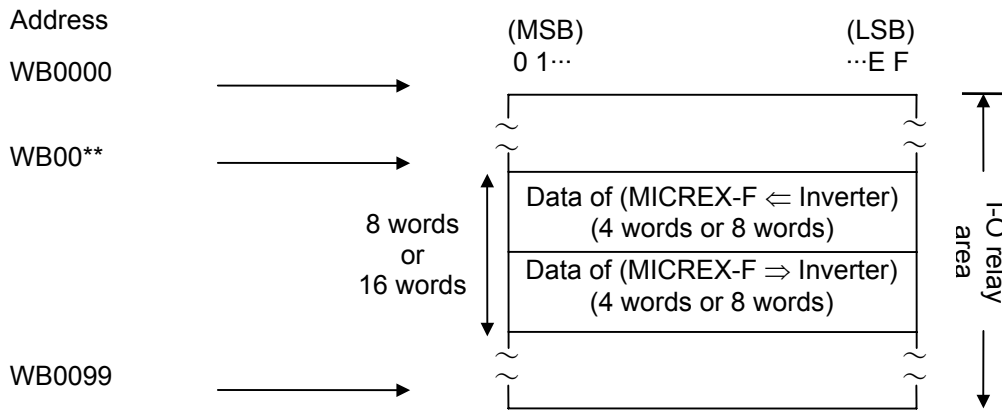


Fig. 7-126

### 7.11.7.3 Address Allocation

(1) Format 1 (standard format 4W+4W)

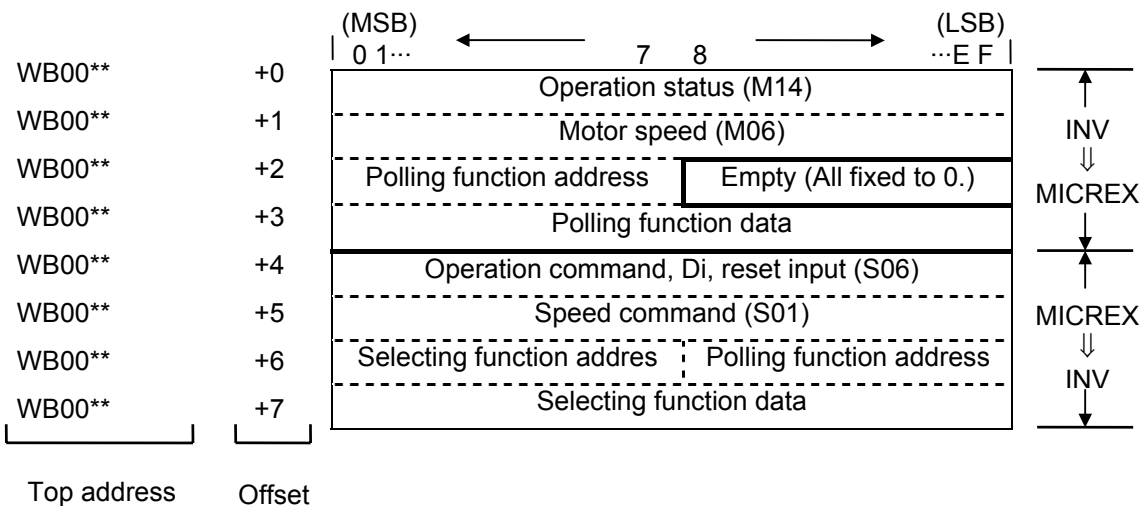


Fig. 7-127

(2) Format 2 (VG7 format 8W+8W)

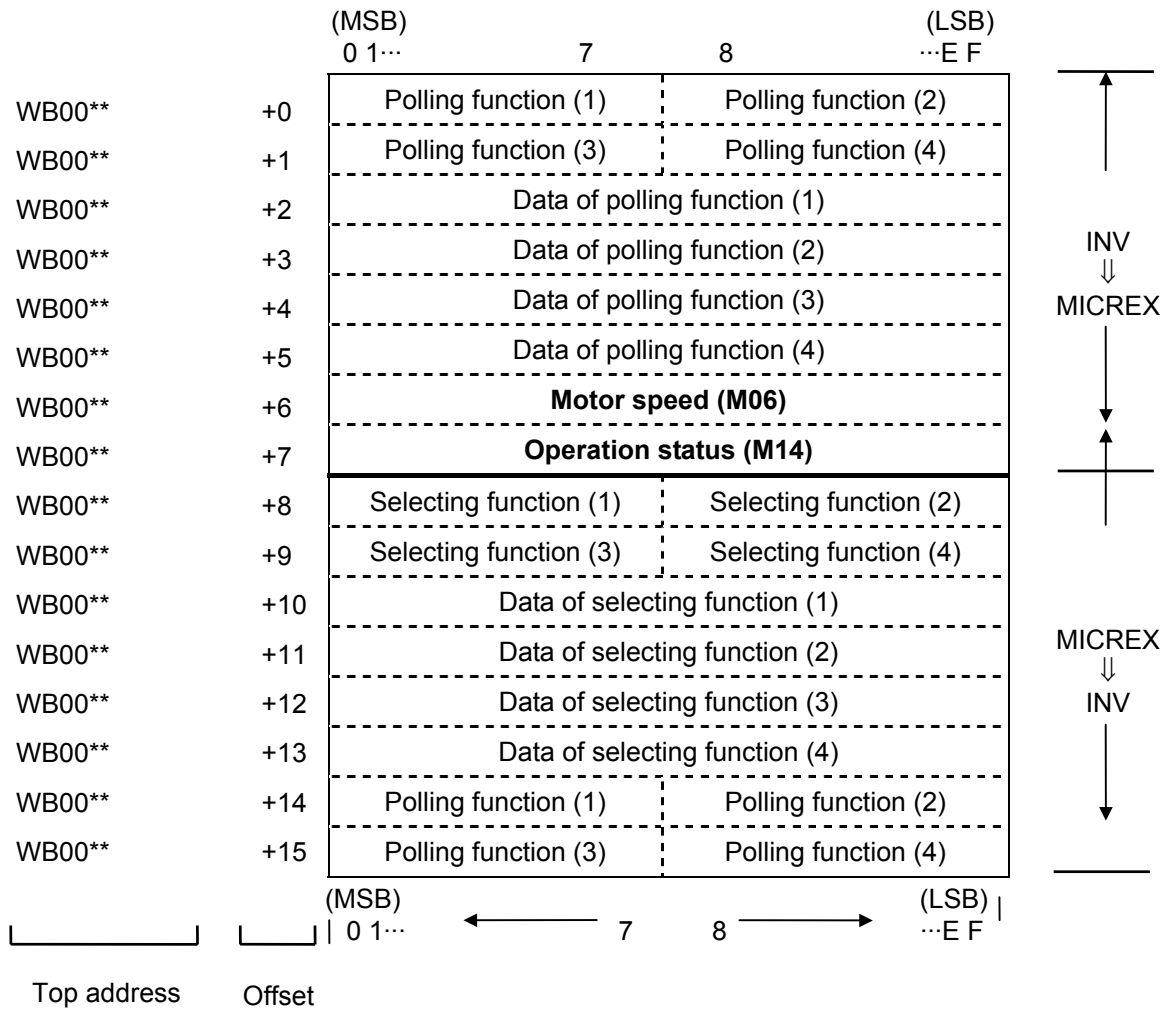


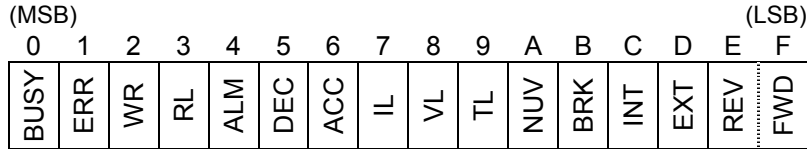
Fig. 7-128

# 7. Control Options

## 7.11.8 Transmission Format

### 7.11.8.1 Data Format (INV ⇒ MICREX)

(1) Operation status (1 when all are ON.)

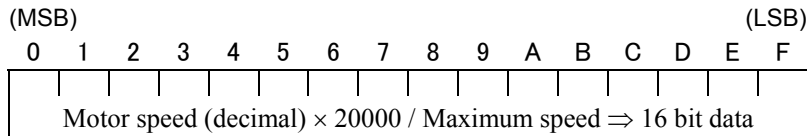


- ERR: is "0" when write/read is correctly performed. It is "1" if read/write error below occurs. It is automatically reset to "0" if the subsequent write/read is performed correctly. If this bit is "1", perform write/read until it becomes "0" again.

	Read/write error
1	Access to unused function
2	Writing to read-only function
3	Writing during operation to function that cannot be changed during operation
4	Writing to function that cannot be changed when FWD/REV is ON
5	Writing out-of-range data

- BUSY: becomes "1" during data write (processing). Therefore, when data is written continuously, make sure that this bit is "0" before writing the next data. Writing while this bit is "1" is ignored.

(2) Motor speed



The maximum speed is set with the function code. To set the speed in r/min unit, calculate back from the formula above. If the data is negative (complement of 2), the command is reverse rotation speed.

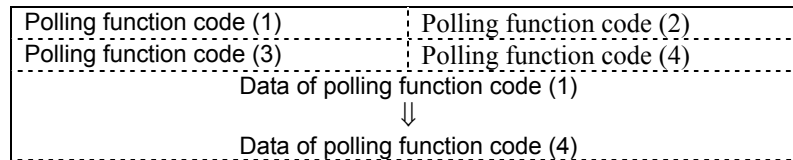
(3) Polling function code address and polling function code data

Format 1



The link No. corresponding to the function code for which polling request was sent from MICREX is stored to the "polling function code address" (8 bit). The data is stored to the "polling function code data". Refer to the "Function code list" for the link No.

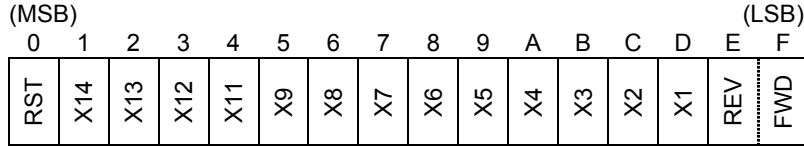
Format 2



The link No. corresponding to the function code for which polling request was sent from MICREX is stored to "polling function code (1) to (4)" (8 bit). The data is stored to "polling function code data (1) to (4)", respectively.

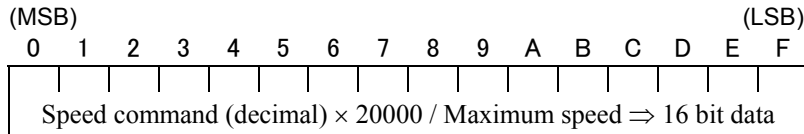
## 7.11.8.2 Data Format (MICREX ⇒ INV)

(1) Input of operation command, Di, and RESET (1 when all are ON.)



When the link command is allowed in 7.11.9.1 "Link command OK selection", FWD and REV are valid. X1 to X14 and RST are always valid.

(2) Speed command

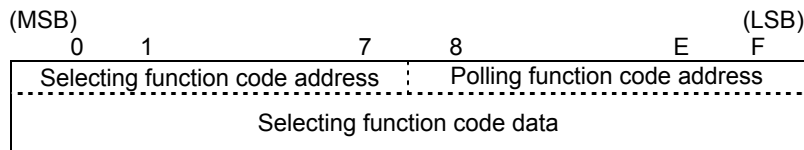


The above description is similar to that of the motor speed. The maximum speed is set with the function code. Set the value calculated from the formula above in 16 bit data. (Consider minus data in complement of 2.)

When the link command is allowed in 7.11.9.1 "Link command OK selection", command data (speed command, etc.) is also valid.

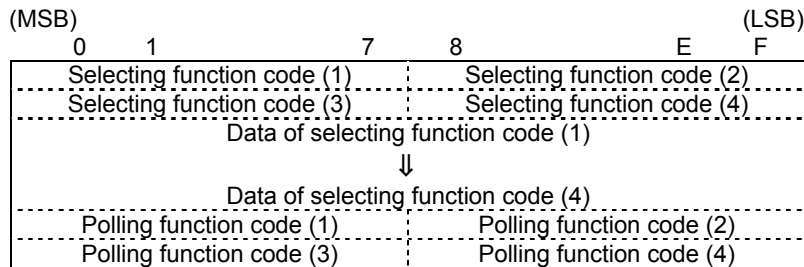
(3) Polling, selecting function code address and selecting function code data

Format 1



Write the function code data with "Selecting function code address" (8 bit) and "Selecting function code data" (16 bit) above. Specify the link No. corresponding to the function code No. for polling request with "Polling function code address" (8 bit).

Format 2



Write the link No. corresponding to the function code to "Selecting function codes (1) to (4)" (8 bit) for selection from MICREX, and then write the data to "Data of selecting function code (1) to (4)", respectively.

Note: Write the link No. and data simultaneously in selecting.

With "Polling function codes (1) to (4)" (8 bit), specify the link No. corresponding to the function code No. which requests polling.

When the link edit is allowed in 7.11.9.3 "Link edit OK selection", selecting is valid. Be aware of writing restrictions such as no change during operation.



# 7. Control Options

## 7.11.9 Link Function

The valid location (REM-LOC/COM) of command data (S area) is switched with function code H30 and X function "24: Link operation selection [LE]". Also refer to "4.2 Control block diagram".

The function code (F, E, C, P, H, A, o, L, U) from the link is controlled with function code H29 and X function "23: Link edit OK command [WE-LK]". Also refer to "4.2 Control block diagram".

### 7.11.9.1 Link Command Enable Selection

#### Link switching

The mode is switched as follows by allocating "24: Link operation selection [LE]" to the X function input terminal.

Table 7-96

Link operation selection signal allocation	Applicable input terminal	Status
Not allocated	-	Link command enable mode
Allocated	ON	
	OFF	Link command disable mode

Command data and operation control data in link command disable mode can be written from the link, but the data is not implemented. It is possible to preset the data in the link command disable mode and then switch to the link command enable mode to implement the data.

#### Link command

In the link command enable mode, command data and operation control command can be switched between the link (COM) and remote/local respectively with function code H30 (link function). REM (Remote: Terminal block (signal input)) and LOC (Local: Keypad panel) are shown below:

Table 7-97

H30 data	Link command enable mode		Link command disable mode
	Command data (S01 to S05, S08 to S12)	Operation control command (FWD, REV)	
0	Link disable (REM/LOC)	Link disable (REM/LOC)	Link disable (REM/LOC)
1	Link enable (COM)	Link disable (REM/LOC)	
2	Link disable (REM/LOC)	Link enable (COM)	
3	Link enable (COM)	Link enable (COM)	

This function allows flexible system structure by using terminal block for operation command and RS485 for speed command.

### 7.11.9.2 Operation Command and Command Data

The link function can be switched by setting function code H30 "Link operation" of VG7S or "24: Link operation switching" to either of functions X1 to X9. Refer to "Standard RS485" in Chapter 5 for details.

Input information such as FWD, REV, X1 to X9 from communication can be checked separately on the I/O check screen of the keypad panel.

<b>1500</b>	
COMM	<input type="checkbox"/> X2 <input type="checkbox"/> X6
<input type="checkbox"/> FWD	<input type="checkbox"/> X3 <input type="checkbox"/> X7
<input type="checkbox"/> REV	<input type="checkbox"/> X4 <input type="checkbox"/> X8
<input type="checkbox"/> X1	<input type="checkbox"/> X5 <input type="checkbox"/> X9

### 7.11.9.3 Link Edit Enable Selection

Link edit switching

Allocating "23: Link edit enable command [WE-LK]" to the X function input terminal allows write protection of the function code (F, E, C, P, H, A, o, L, U) as follows:

Table 7-98

Link edit enable command allocation	Applicable input terminal	Status
Not allocated	-	Link edit enable mode (Writing of F to U is allowed.)
Allocated	ON	
	OFF	Link edit disable mode (Writing of F to U is disabled.)

Link edit

With function code H29 (Link edit enable command), writing on function codes (F, E, C, P, H, A, o, L and U) can be controlled in the link edit enable mode.

Table 7-99

H29 data	Link edit enable mode	Link edit disable mode
0	Writing to codes (F, E, C, P, H, A, o, L and U) is abled.	Writing to codes (F, E, C, P, H, A, o, L and U) is protected.
1	Writing to codes (F, E, C, P, H, A, o, L and U) is protected.	

### 7.11.10 Example of Data Transmission

(1) Speed setting

Where speed command of forward rotation (FWD) at 785 r/min from MICREX is given:  
 (Conditions: Function code H30 [Link operation] = 3, Maximum speed: 1500 r/min, T-Link station address: 10, 8+8 word setting)  
 The command of forward rotation (FWD: ON) and the speed command are given to S06 and S01, respectively.

WB18	0	6	0	1	Function code	Selecting S06 and S01 (Link Nos. 06h and 01h)
19	0	0	0	0	Dummy data	of selecting
20	0	0	0	1	Function code	S06 FWD: ON
21	2	8	E	3	Function code	S01 Speed setting (785/1500×20000=10467=28E3 (h))
	↓				After acceleration is completed	
WB16	2	8	E	3		Monitoring of motor speed

(2) Torque command monitoring

Torque command value is monitored.  
 (Conditions: T-link station number: 24, 8+8 word setting)

WB38	1	0	0	0	Monitoring of torque command value	(Link No. 10h)
39	0	0	0	0		
	↓				After reading is completed	
WB24	1	0	0	0	Reading is completed when the link number for which polling is requested is sent back to this area.	
25	0	0	0	0	Monitor data of torque command value	
26	1	3	8	8	1388 (h) × 100 (%) / 10000 = 50 (%)	
27	0	0	0	0		
28	0	0	0	0		
29	0	0	0	0	According to the calculation above, the torque command value is "50% of drive".	

# 7. Control Options

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## (3) Function code data setting

The acceleration period is set to 30.5 seconds. (Function code S08)

(Conditions: T-link station address: 58, 4+4 word setting)

WB62	0	0	0	0	Selecting of function code S08 (Link No. 08h)
63	0	0	0	0	
64	0	8	0	8	131(h)=305,305×0.1s=30.5s
65	0	1	3	1	Polling of function code S08 to check if setting is completed.

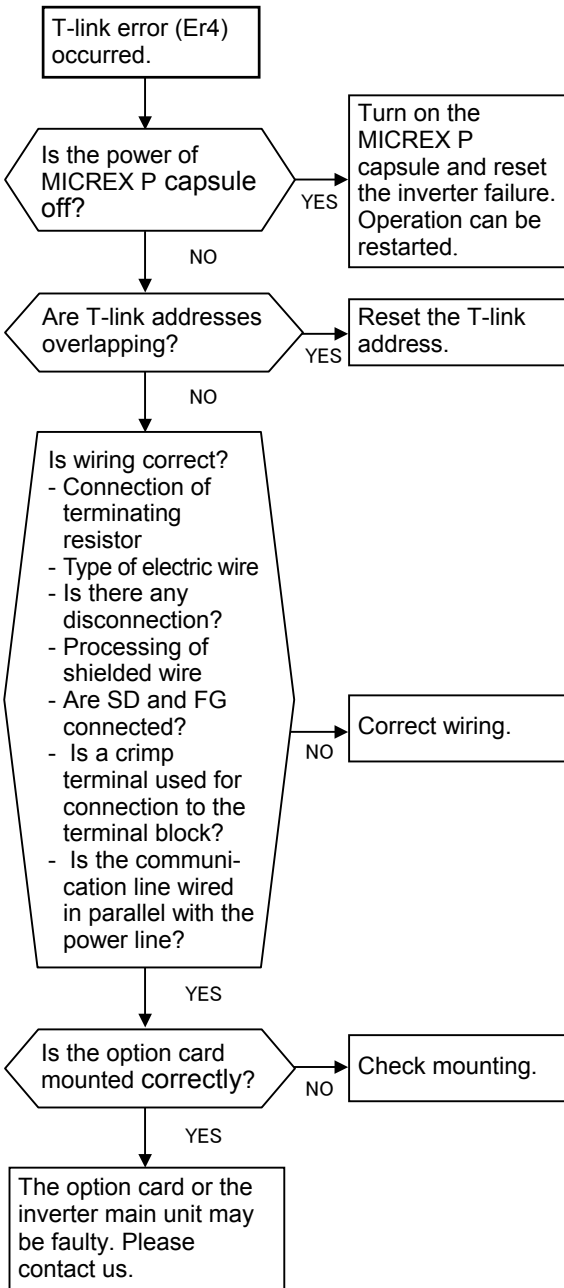
↓

WB58	*	*	*	*	Polling of function code S08
59	*	*	*	*	
60	0	8	0	0	131(h)=305,305×0.1s=30.5s
61	0	1	3	1	This value indicates that the data has been correctly set.

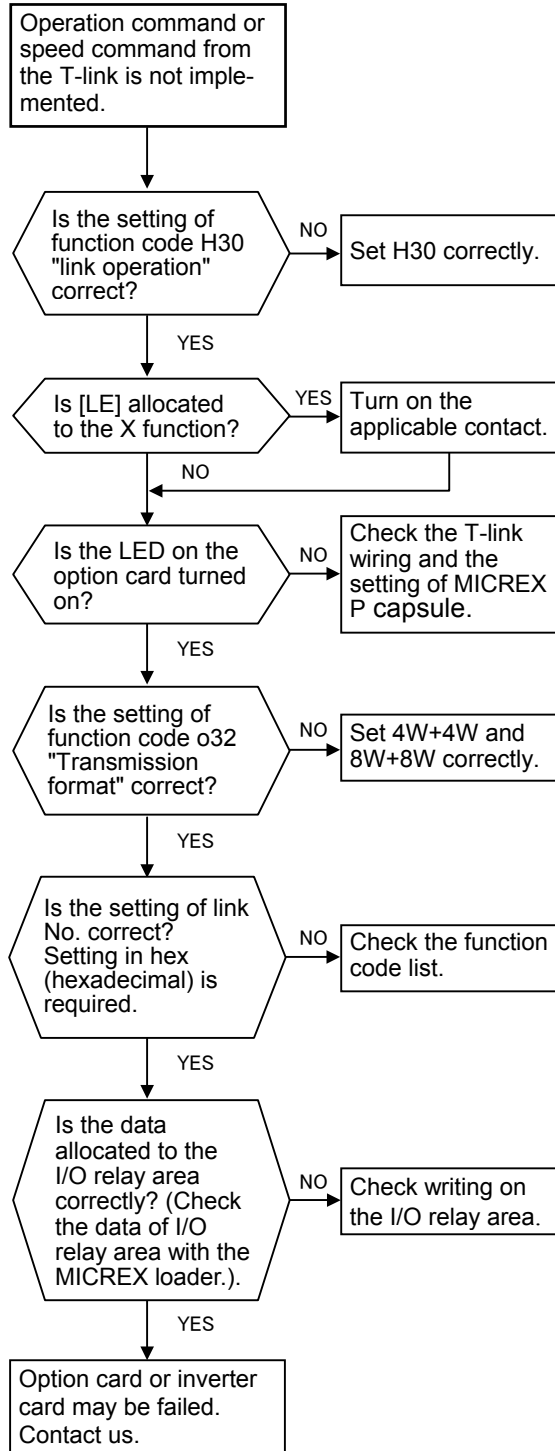
## 7.11.11 Troubleshooting

**(1) T-link error (Er4)**

If a T-link error occurred, refer to the RAS information of MICREX P capsule for troubleshooting. For details of the RAS information, refer to the instruction manual of MICREX.



**(2) Input of operation and speed commands**



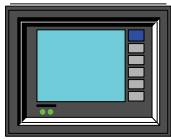
\*Details of Er4 may be checked with the maintenance information on the keypad panel.

Code	Description of T-link option error	Resetting method
1	CRC check mirror Flag error	Automatically reset with normal reception
2	Transmission cycle time over CRC error repetition (16 times or more)	Power reset or reset key
3	Overrun, under-run	Power reset or reset key

# 7. Control Options

## 7.12 Expansion RS-485 Card

### 7.12.1 Outline of Product



FRENIC5000VG7S inverter allows direct connection to Fuji programmable operation display (hereafter called POD) of UG20 series through RS-485 communication. Both RS-485 with built-in VG7S and expansion RS-485 card are available for RS-485 communication.

#### General description of connection

In general, indirect connection through PLC is used for operation of VG7S with POD, but a significant feature of the expansion RS-485 card is that it allows direct connection to VG7S without PLC. Select the appropriate connection type for your system.

Table 7-100

Method of connection	Type of connection		Remark
Indirect connection	Through PLC	POD-PLC-VG7	Conventional method that requires PLC separately. VG7S interface is as follows: For Fuji PLC: OPC-VG7-TL, OPC-VG7-SX For open net: Open net option For other manufacturers: RS-485
		Built-in RS-485	POD-VG7
Direct connection	RS option	POD-(RS option) VG7	Only for POD connection Only Modbus RTU is supported. Connection is available for PLC which allows connection to POD and Modbus RTU. * It does not allow connection to the VG7 loader (WPS-VG7-PCL).

This manual does not describe handling and operation method of POD and the programming. For details, refer to the following manuals:

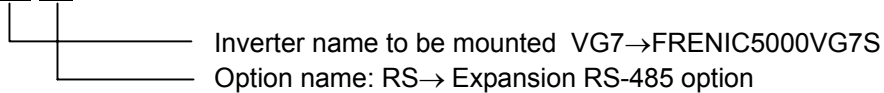
Table 7-101

Name	Manual No.	Description
UG210 series manual < Hardware >	FEH337	Hardware of UG210 series is described.
UG400 series manual < Hardware >	FEH338	Hardware of UG400 series is described.
UG□ 20 series manual < Tutorial >	FEH350	Typical functions and operation method of UG□ 20 series are described.
UG series manual < Reference >	FEH351	Functions of UG series
UG□ 20 series manual < Hardware >	FEH352	
UG□ 20 series manual < General-purpose serial communication >	FEH353	
UG series manual < Simulator >	FEH354	
UG□ 20 series manual < T-link communication >	FEH356	
UG□ 20 series manual < JPCN-1 >	FEH358	
UG□ 20 series manual < Memory card editor >	FEH359	
UG series manual < Macro >	FEH360	
UG series manual < Screen operation introductory >	FEH362	

## 7.12.2 Model and Specification

### 7.12.2.1 Model

Model: OPC-VG7-RS



#### Accessories

Spacer	3
Screw (M3)	3

### 7.12.2.2 Specification

#### CAUTION

- The RS option is not compatible with VG7S of the old ROM version. Communication is not available with the old version. Be sure to check the ROM version with the maintenance information on the keypad panel. If you are not sure about the version, please contact us.

Table 7-102 Hardware Specification

Item	Specification
Model	OPC-VG7-RS
I/O terminal	DX+, DX-, SD differential I/O 5V line driver signal
Electrical specification	RS-485
Transmission rate	2400, 4800, 9600, 19200, 38400bps
Synchronization method	Asynchronous (UART)
Transmission method	Half-duplex
Communication type	Multi-drop connection 1:N ( $1 \leq N \leq 31$ )
Terminating resistor	100 Ω built-in, resistance switching with jumper bar
Wiring length	No insulation: 10m max. Insulation: 500m max. * Use the commercially available 485/485 insulator (repeater) and 485/232C insulation converter for insulation. * An inverter may be the source of noise. Use the converter with excellent noise immunity. Recommended converter: KS-485PTI or KS-10PTI by System Sacom Corp.

#### Communication specification

Modbus RTU Protocol is the communication specification prepared for network communication between PLCs by Modicon or between PLC and other slave devices (e.g. inverter). The supported messages are query - response type and broadcast type. In VG7S, POD or PLC is the master to issue queries to VG7. VG7 returns responses only to the master according to queries. CRC (Cyclic Redundancy Check) is added to the last stage of the frame to ensure that data is correctly transmitted.

In the transmission mode (RTU and ASCII mode) supported by the standard Modbus Protocol, VG7 supports only the RTU mode with high transmission density.

# 7. Control Options

Table 7-103 Communication Specification

Item	Specification	
Communication (PC side)	Modbus RTU	
No. of address stations	0: Broadcast, 1 to 247: No. of slave stations	
Transmission mode	RTU mode	
Data length	8bit fixed	
Parity/stop bit	No parity	Stop bit: 2bits
	Even number parity	Stop bit: 1bit
	Odd number parity	
Flow control	Selection of RTS control is supported.	
Error check method	CRC-16 method (software), Generator polynomial: $X^{16}+X^{15}+X^2+1$	
Transmission protocol	Compatible with Modbus Protocol by Modicon	
Disconnection detection time	No response monitoring time (Timeout) x No. of retries * Timeout is determined by software.	
No. of retries	Both physical layer error (parity, framing and overrun) and software error (processing status, checksum) are determined by software.	
Master device	POD (UG20 series), PLC, PC (only PLC and PC supporting RTU)	

Table 7-104 Software specification

Item	Specification
ROM version of VG7	H10060 or more and H20060 or more Use the unit with the ROM version above. (The ROM version can be confirmed with I/O check on the keypad panel.)
Link operation	Specified by function code H30. Refer to control block diagram in Chapter 4.
Operation on communication error	Specified by function codes H32 and 33.

Check the ROM version of the VG7 unit (not optical part option or keypad panel).  
To check the version, see the right of "MAIN" and "MTR" of the maintenance information on the keypad panel.  
The screen on the right can be found at the 5th row of the maintenance information. Move the **V** key on the keypad panel to the 5th row.

**1500**

MAIN=H1xxxx

MTR =H2xxxx

KP =K xxxx

## 7.12.3 Outline Drawing

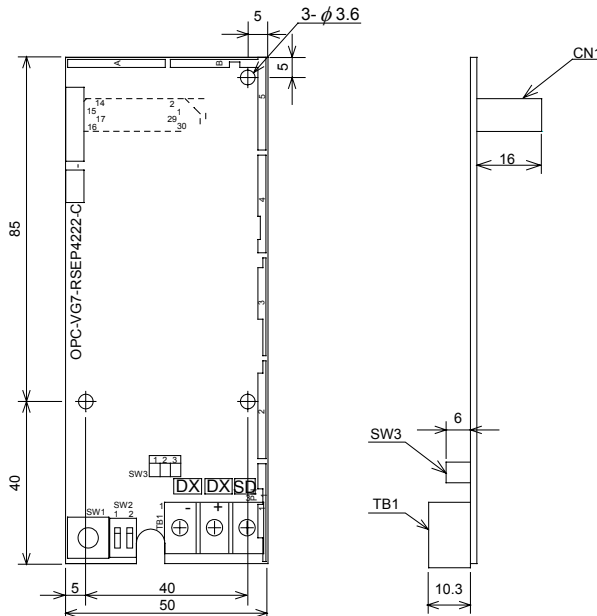


Fig.7-129

## 7.12.4 Basic Wiring Diagram

### 7.12.4.1 Setting

#### WARNING

- Inappropriate connection work causes electric shock, fire and other disaster. Have connection done by a professional electrician. To touch an electric circuit for connection after power-on, turn the circuit breaker off in the power supply to avoid electric shock.
- Even if the circuit breaker is turned off, smoothing capacitors remain alive. If you touch them, you will be hit by electric shock. Check that the CHARGE lamp of the inverter is unlit and the DC voltage inside the inverter has dropped to a safe voltage, using a multimeter or the like.

#### CAUTION

- Do not use the product from which some parts are missing or damaged. Otherwise injuries or losses may be caused.
- Inappropriate work during installation or removal of the product will cause breakage of the product.

#### CAUTION

- Incorrect setting of switch SW2 on the option does not result in normal operation of the RS option. Read the settings below carefully and perform correct settings.

Table 7-105 Switch on Card (SW1)

Part No.	SW1 setting	Function	Remark
SW1 rotary switch	0-9	Function invalid	Not used

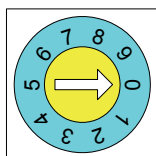


Fig. 7-130

The rotary switch of the figure on the left is not used for function of the RS option. Some products in the RS option do not have SW1.

Table 7-106 Switch on Card (SW2)

Part No.	SW21-setting	SW2-2 setting	Function	Remark
SW2 dip switch	OFF	OFF	-	Do not set the switch.
	ON	OFF	-	
	OFF	ON	RS option	
	ON	ON		Do not set the switch.

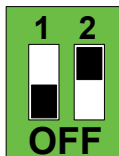


Fig. 7-131

Fix the setting as shown on the left. Normally, it is the default setting at shipment from factory. This setting allows functions of the RS option.

Table 7-107 Jumper Bar on Card (SW3)

Part No.	1-2	2-3	Terminating resistor	Remark
SW3 jumper bar	Open	Short-circuit	Invalid	Terminating resistor other than resistor at termination for connection to multiple VG7S units should be invalid.
	Short-circuit	Open	Valid	Terminating resistor at termination for connection to single or multiple VG7S units should be valid.



# 7. Control Options

## 7.12.4.2 Basic Connection Diagram

An example of multi-drop connection to 485 terminal block interface is shown.

UG20□ series

Table 7-108 PLC Connection Serial Interface (CN1) Specifications

Item	Specification
Mechanical specification	CN1: Dsub25 (Female: concave)
Electrical specification	<b>RS-485</b> , RS-232C
Transmission method	Asynchronous communication method, full duplex, <b>half duplex communication</b>
Data length	8bit fixed
Parity	Even, odd, none
Stop bit	1, 2bit
Transmission rate	<b>2,400/4,800/9,600/19,200/38,400</b>

### Terminal converter

UG20□ series

Terminal converter (UG00P-TC) specifications

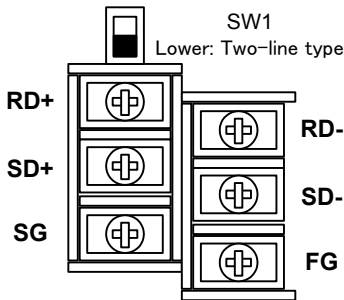


Fig. 7-132

This terminal is connected to CN1.

### When no terminal is used:

It is also possible to modify Dsub25 so that CN1 may be directly connected to the RS option without using a terminal. In this case, wiring shall be as follows:

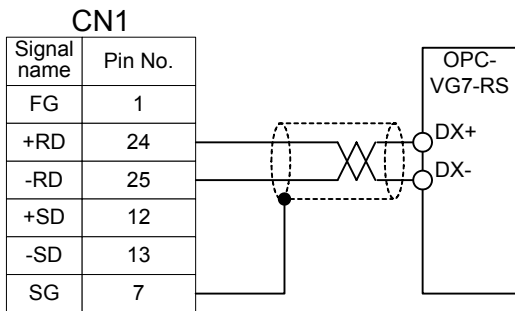
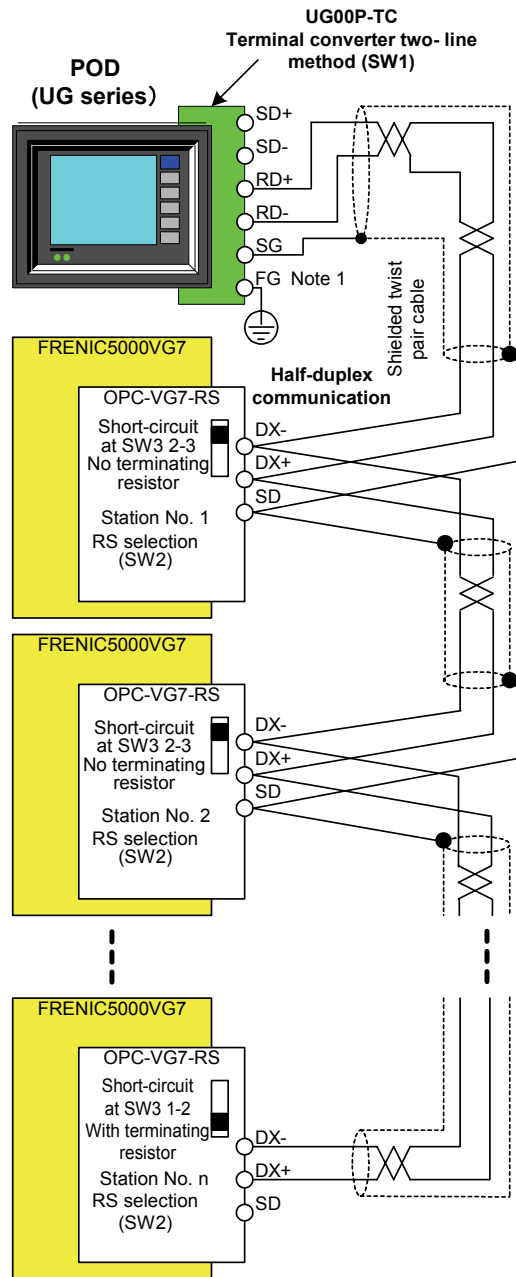


Fig. 7-133



Note 1: Noise immunity may be improved by connecting the shielded wire to the ground wire.

Note 2: If noise environment is poor and transmission errors occur frequently, insert the zero-phase reactor to the signal wire.

Recommended type: ACL-40B

\* For anti-noise measures, refer to "6.2.8.1 Measures for communication error" in the manual of standard RS-485.

Fig. 7-134

## 7.12.5 Function Code

 **WARNING**

- Incorrect data input of the function code may result in a dangerous situation. After data is set and written, check the data again.

**Accident may occur.**

The RS485 setting of the RS option is performed with function codes H29 to 33, H38 and o35 to 37. Function code o37 is not displayed on the keypad panel in normal operation (without RS option).

Table 7-109

No.	Parameter name		Setting range	Settings
	Name	Keypad panel display		
H29	Link function code protection	LINK PROCT	0,1	Shared with built-in RS-485.
H30	Link operation	LINK FUNC	0 to 3	Shared with built-in RS-485. Priority is given to RS when the RS option is mounted. For details, refer to 6.2.4.1 "Link command enable command".
H31	Station address	485ADDRESS	0 to 255	Setting of station address when the built-in RS485 and the RS option are used for connection to higher level systems (0 to 247 for RS option) 0: Broadcast 1 to 247: Station address 248 to 255: Setting inhibited
H32	Selection of action on error occurrence	MODE ON ER	0 to 3	0: Forced stop (Er5) 1: Stops (Er5) after continued operation for the timer time (H33) 2: Stops (Er5) when transfer error continues for the timer time (H33) 3: Continued operation For details, refer to 6.2.8.2 "Actions on communication error".
H33	Timer operation time	TIMER 485	0.01 to 20.00	Shared with built-in RS-485.
H38	Detection of communication disconnection	NO RES t	0.0 to 60.0	
H39	Response interval time	485 ANS	0.00 to 1.00	
o37	Link function	RS DEFINE	00 to 24	The communication default is set. Place of 1: Transmission rate 0 to 4 0: 38400bps 1: 19200bps 2: 9600bps 3: 4800bps 4: 2400bps Place of 10: Selection of parity and stop bits 0 to 2 0: No parity bit (Stop bit 2) 1: Even number parity (Stop bit 1) 2: Odd number parity (Stop bit 1)

For description of each function code, refer to Chapter 4.

# 7. Control Options

## 7.12.6 Example of POD Communication

An example of POD and VG7S setting is shown below.

Since "Modbus RTU" is used for the communication protocol, set VG7S and POD as follows:

(1) Setting of VG7S

Set the function code. Effective function codes vary depending on use of the built-in RS-485 or the RS option.

Table 7-110

Built-in RS485	This option			
H29		Link function	Function code protection	Enables/disables change of function code
H30			Link operation	Enables/disables command data and operation.
H31		RS485 setting	Station address	1 to 247
H34	o37		Transmission rate	2400, 4800, 9600, 19200, 38400bps
H35			Data length selection	Fixed to 8bit
H36			Parity bit selection	Non, even number, odd number
H37			Stop bit selection	2bit, 1bit
H40		Fixed		Protocol selection

(2) Setting of POD

POD is set with the POD editor.

Table 7-111

PLC selection	MODICON : Modbus RTU	
Communication parameter	Baud rate	Match the setting with VG7S " Function code H36 or o37" .
	Signal level	RS-422
	Read area	400001
	Write area	Specify the internal memory (\$ u).
	Parity	Match the setting with VG7 " Function code H36 or o37" .
	Data length	Match the setting with VG7 " Function code H35 or o37" .
	Stop bit	Match the setting with VG7 " Function code H37 or o37" .
	Character processing	LSB→MSB

(3) Access from POD to VG7S

To gain access from POD to VG7S, read/write the function code (F to U) of VG7S. Since "485 No." (Function code list) is allocated to accessible function code, specify this "485 No." as the PLC memory of POD.

$$\text{PLC memory address} = \text{"485 No"} + 1 + 400000d$$

Table 7-112

Example)	Function code	485No	PLC memory
	F00 Data protection	0000h	400001
	F79 Motor selection (M1, M2, M3)	004Fh	400080
	H30 Link operation	041Eh	401055
	S01 Frequency and speed command (Setting 1)	0701h	401794
	M25 Inverter ROM version	0819h	402074

[Precautions]

Although access from POD is available in the same manner as from PLC, the following items for POD are different from those for PLC. Be careful when changing a function code on POD.

- 1) If a function code is changed at POD, the code returns to the original value when the VG7 power is turned off. To memorize the change after turning off the power, use function code "H02: All save" to save the changed data.
- 2) There are function codes of which changes are inhibited. There are also "function codes of which changes are inhibited" depending on the operation status. If an attempt to change such function code is made, an error message is returned without change.
- 3) "Data range" is specified for all function codes. If an attempt to change to the value beyond the "data range" is made, an error message is returned without change.
- 4) "Data type" is specified for all function codes.

For most function codes, "data type" is specified by with/without sign, DEC or HEX, position of decimal point, etc. Therefore, it can be set with "value display" of POD. However, some function codes have complex "data type". In this case, processing with macro is required.

Example) Function code "S01: frequency and speed command (setting 1)"

Since the data type of this function code is "31", it is necessary to convert the data.

$$(\text{Data} \times \text{Nmax}) / 20000\text{d}$$

To convert the above data with macro, it is necessary to prepare the following macros:

Table 7-113

000	; ◆◆◆Calculation of motor frequency and speed command (setting 1)◆◆◆	
001	; Motor speed (S01: Speed command: Type 31)	
002	\$u00010=402050 (W)	"S01" is acquired.
003	;	
004	; Acquisition of motor selection condition (M53 Control input 2: Type 126).	
005	\$u00011=402102 (W)	"M53" is acquired.
006	;	
007	\$u00012=\$u00011 & 1 (W)	Motor 2 selection flag
008	\$u00013=\$u00011 & 2 (W)	Motor 3 selection flag
009	IF(\$u00012 == 1) LB11 (W)	Is the current motor Motor 2?
010	IF(\$u00013 == 2) LB12 (W)	Is the current motor Motor 3?
011	;	
012	; Acquisition of Nmax.	
013	LB10:	Motor 1
014	\$u00014=400004 (W)	"F03" is acquired.
015	JMP LB13	
016	LB11:	Motor 2
017	\$u00014=401287 (W)	"A06" is acquired.
018	JMP LB13	
019	LB12:	Motor 3
020	\$u00014=401321 (W)	"A40" is acquired.
021	;	
022	; Conversion of WORD (16bit) to DWORD (32bit)	
023	LB13:	
024	\$u00015=\$u00010 D<-W	
025	\$u00017=\$u00014 D<-W	
026	;	
027	; Data conversion: Type 31	
028	\$u00019=\$u00015 × \$u00017 (D)	Data x Nmax
029	\$u00021=\$u00019 + 10000 (D)	Rounding is considered for the next division.
030	\$u00023=\$u00021 / 20000 (D)	/ 20000d
031	;	
032	RET	

---

- MEMO -

# THE INVERTER



## VIII. Application Example

8.1 Application Example

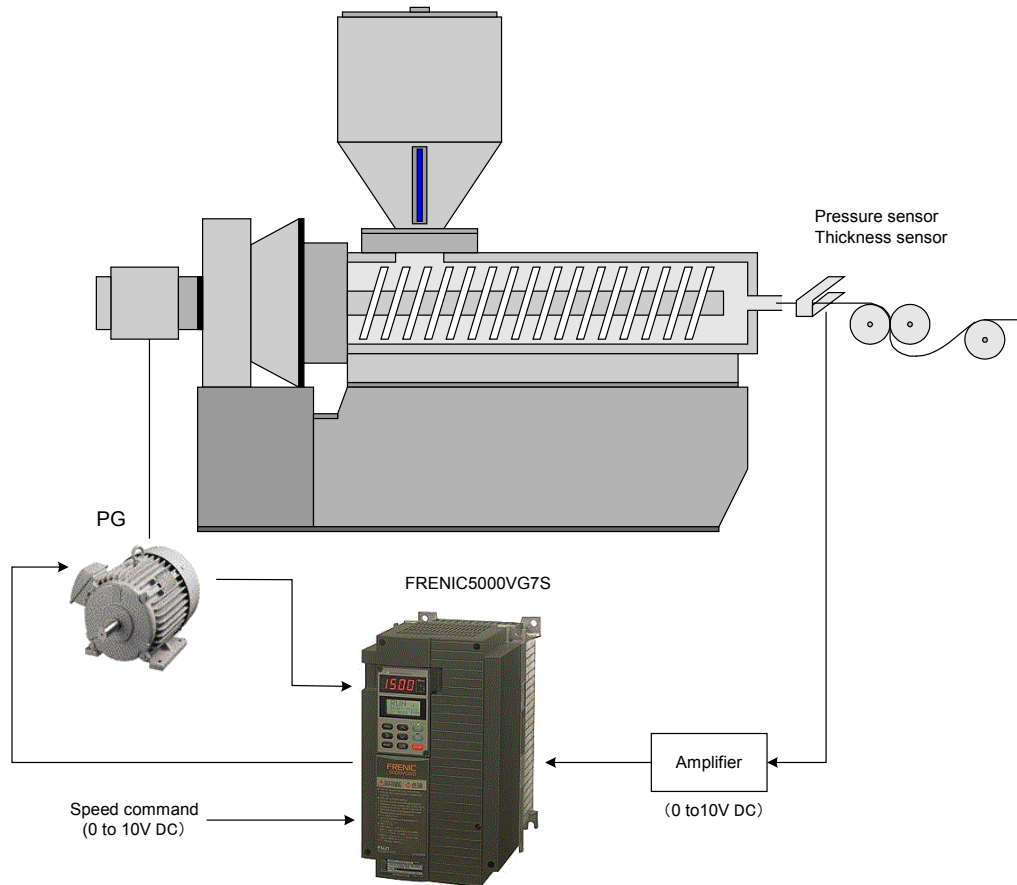
8.2 Application Example Using UPAC

# 8. Application Example

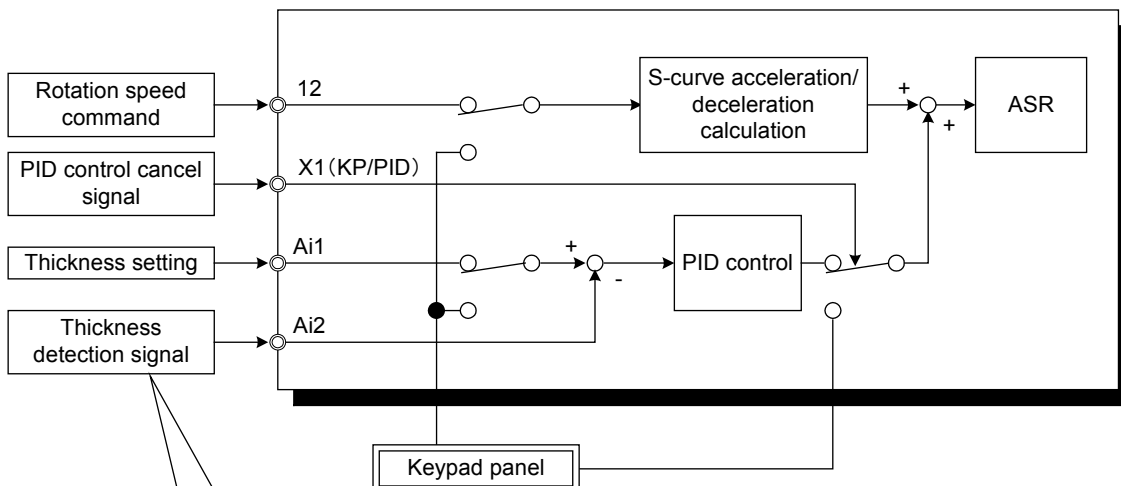
## 8.1 Application Example Using Standard Function

### 8.1.1 Extruder

#### (1) General configuration

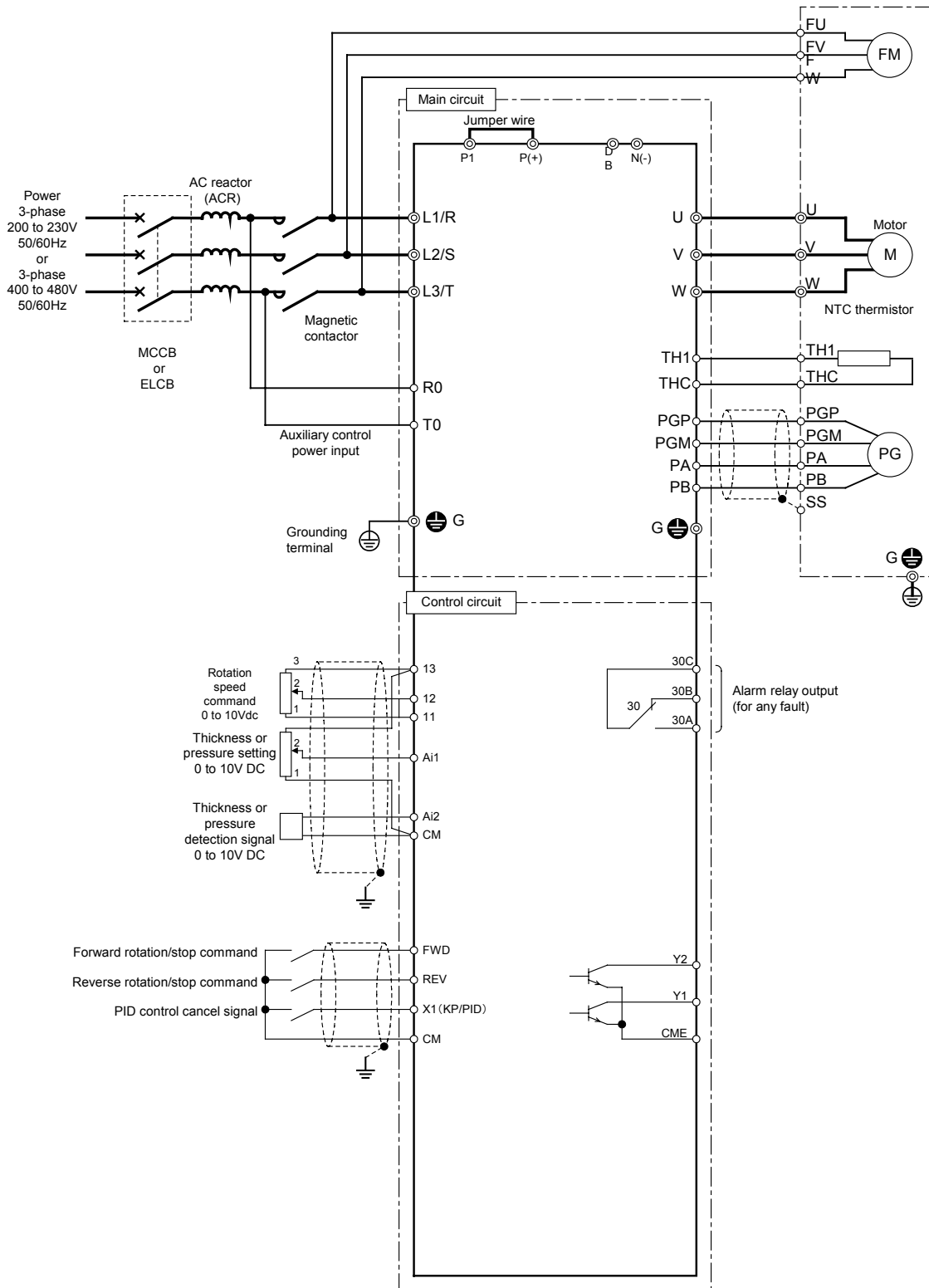


#### (2) Control configuration



*With the PID function in the inverter, speed correction is available using a feedback signal such as "Thickness" and "Pressure".*

(3) Connection diagram

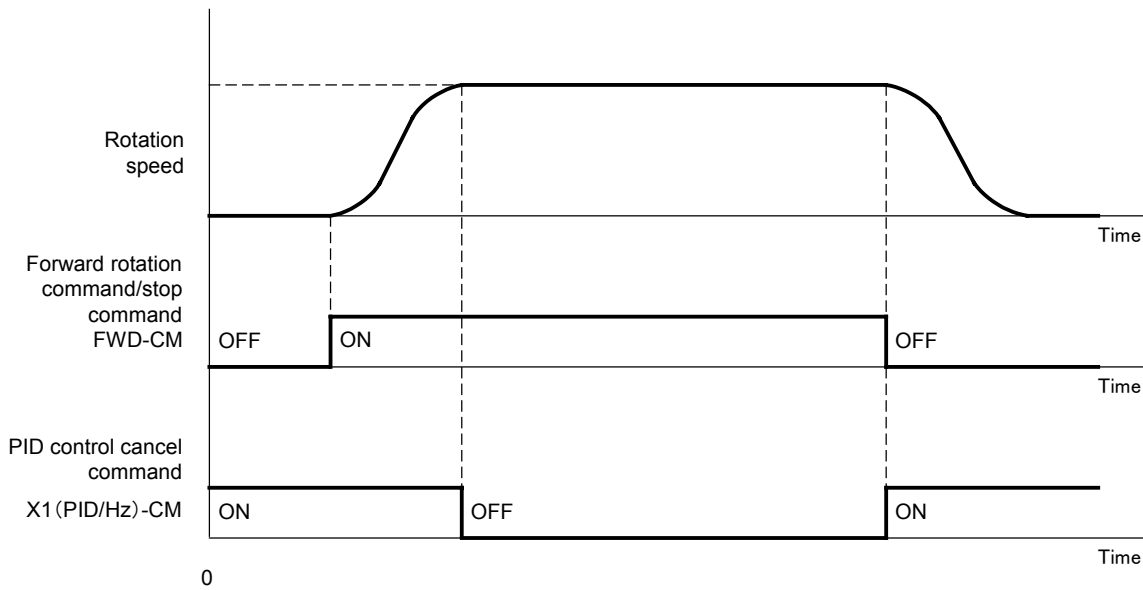




# 8. Application Example

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## (4) Time chart



## (5) Tips

Review and configure the system based on the following points:

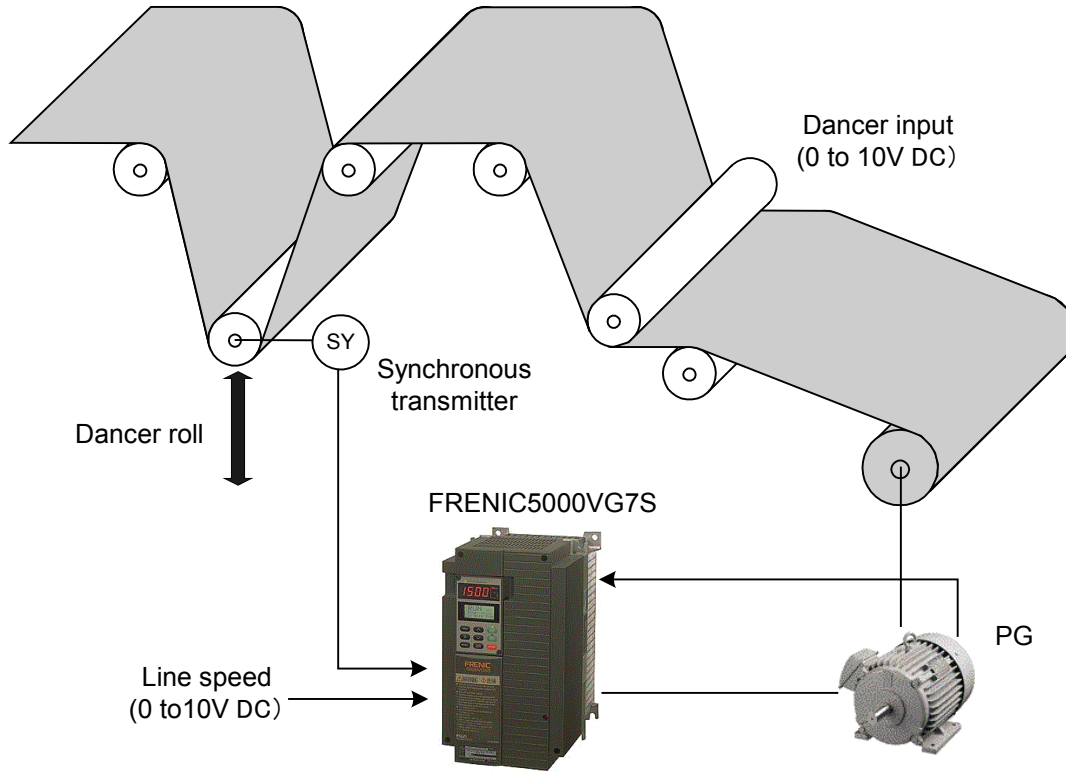
- Constant extrusion quantity is controlled by the PID control function built into the inverter.
- Good extrusion can be controlled with low torque ripple.

- MEMO -

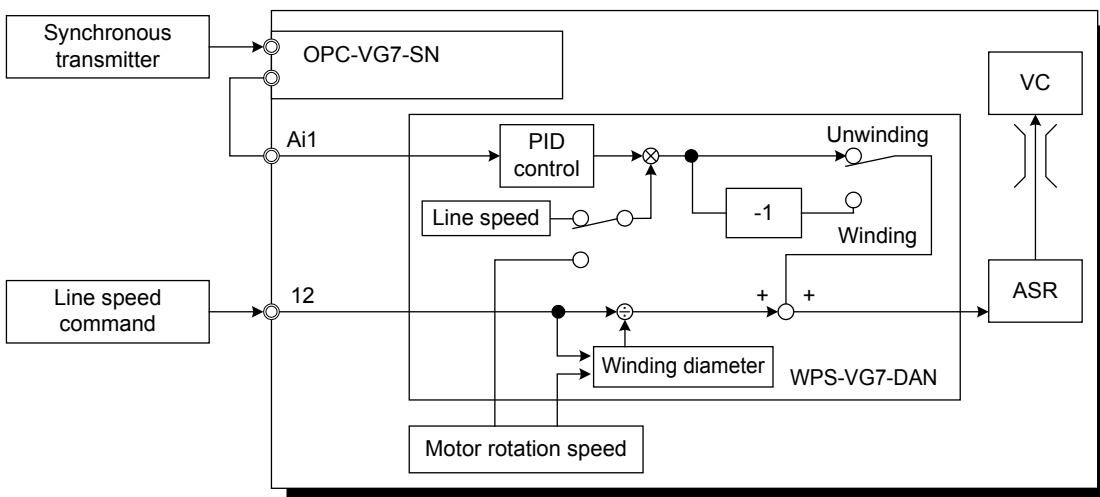
## 8.2 Application Example Using UPAC

### 8.2.1 Winder (Dancer Control)

#### (1) General configuration

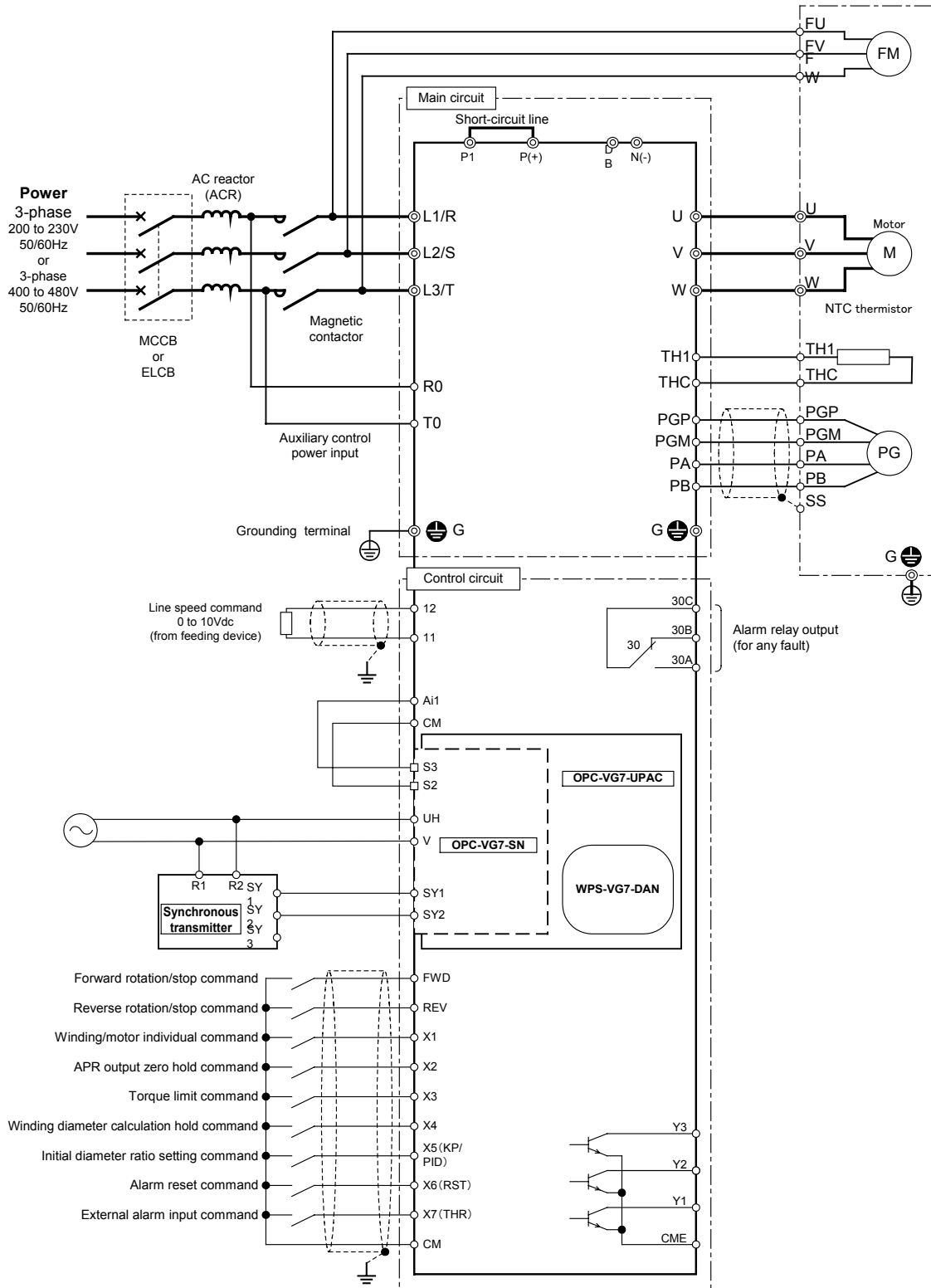


#### (2) Control configuration



# 8. Application Example

## (3) Connection diagram



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#### (4) Option

The following options are required:

- Option card: OPC-VG7-UPAC, OPC-VG7-SN
- Package software: WPS-VG7-DAN

#### (5) Tips

Review and configure the system based on the following points:

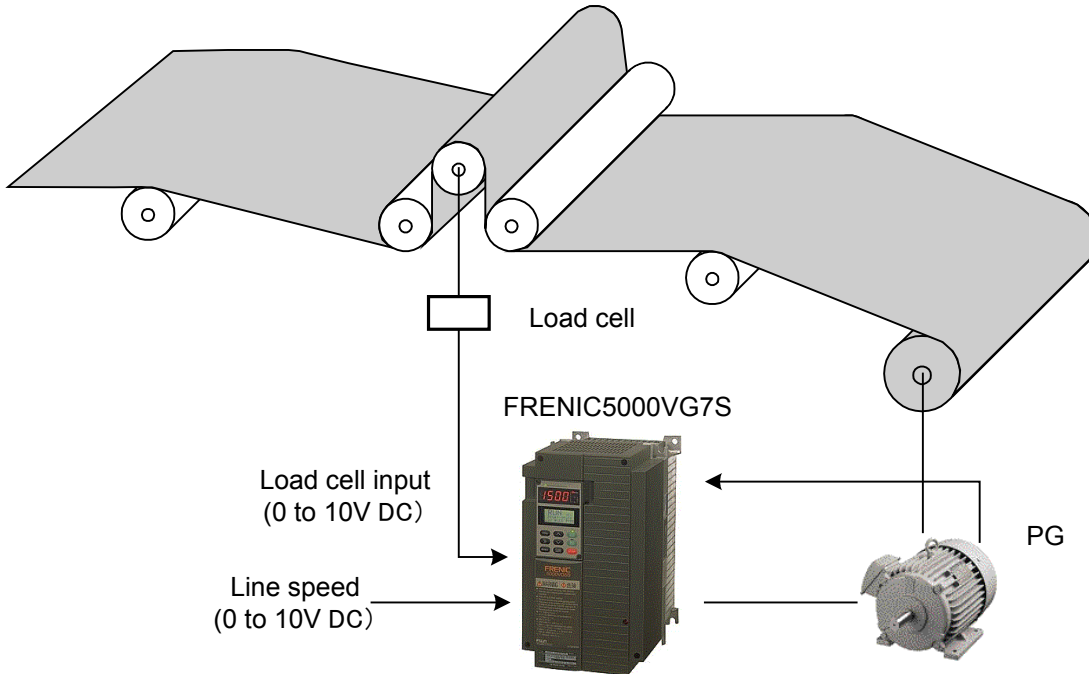
- Control of constant circumferential speed for winding drum: Correct the winding speed with the winding diameter.
- Control of taper in winding: Correct the winding speed with the specified taper.

- MEMO -

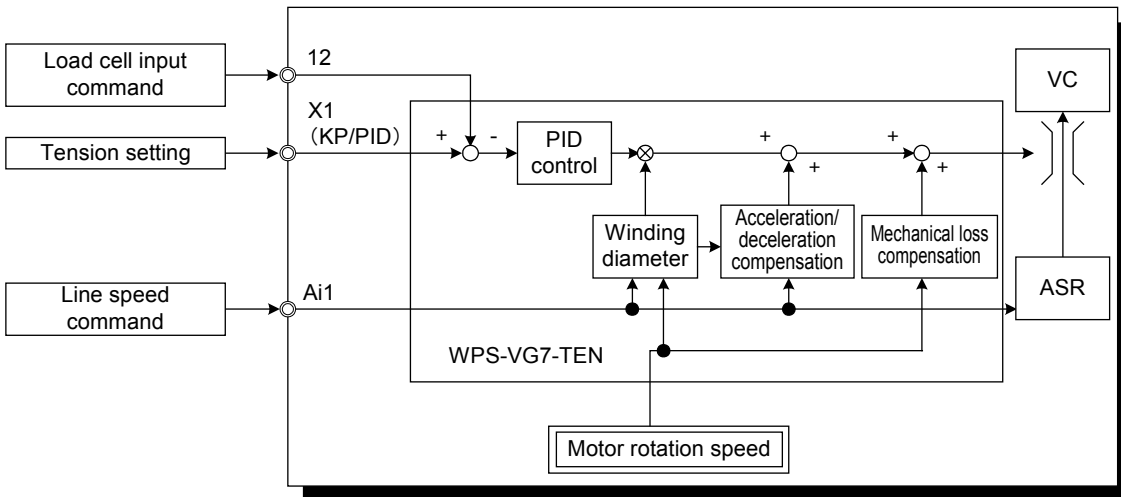
# 8. Application Example

## 8.2.2 Winder (Tension Control)

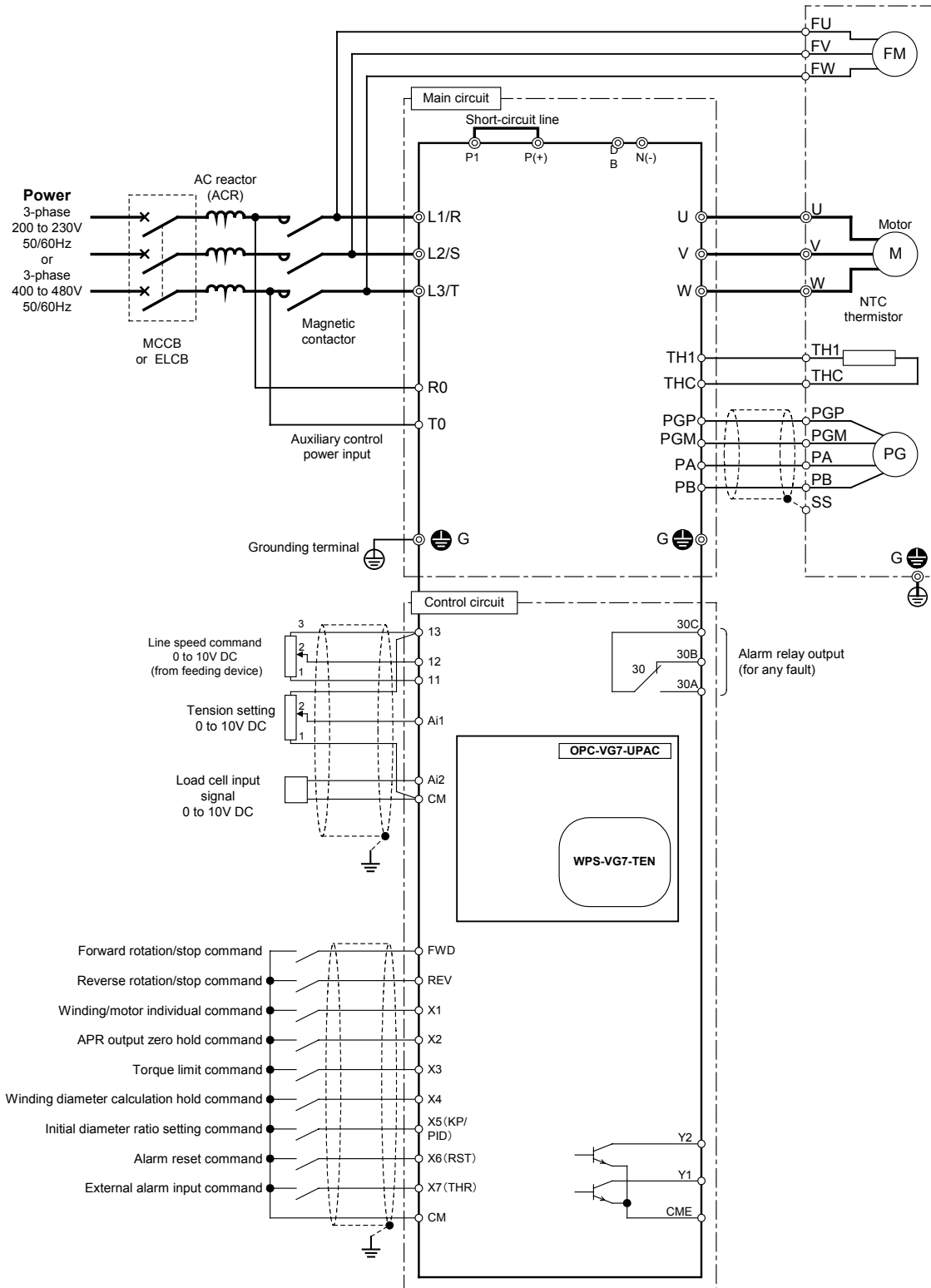
### (1) General configuration



### (2) Control configuration



(3) Connection diagram



## 8. Application Example

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### (4) Option

The following options are required:

- Option card: OPC-VG7-UPAC
- Package software: WPS-VG7-TEN

### (5) Tips

Review and configure the system based on the following points:

- Control of constant circumferential speed for winding drum: Correct the winding speed with the winding diameter.
- Control of taper in winding: Correct the winding with the specified taper.

- MEMO -



## **IX. Peripheral Equipment**

- 9.1 Inverter Input Current**
- 9.2 Circuit Breakers and Magnetic Contactors**
- 9.3 Wire Size**
- 9.4 Braking Unit and Braking Resistor**
- 9.5 Rated Sensitive Current of ELCB**
- 9.6 Options**
- 9.7 Compliance with Standards**



# 9. Peripheral Equipment

## 9.1 Inverter Input Current

- This section describes selecting peripheral devices and cables.

Table 9.1 Various Current Value Through Inverter

Power supply voltage	Nominal applied motor [kW]	50Hz, 200V (400V)					60Hz, 220V (440V)				
		Input effective value current [A]		DC link circuit current [A]	Braking resistor circuit current [A]		Input effective value current [A]		DC link circuit current [A]	Braking resistor circuit current [A]	
		With DCR	Without reactor		CT/HT	VT	With DCR	Without reactor		CT/HT	VT
Three-phase 200V	0.75	3.1	6.4	3.8	1.4	–	2.7	6.2	3.3	1.4	–
	1.5	5.7	11.1	7.0	1.9	1.4	5.1	10.6	6.2	1.9	1.4
	2.2	8.3	16.1	10	2.3	1.9	7.5	15.5	9.2	2.3	1.9
	3.7	14.0	25.5	17	3.4	2.3	12.5	24.2	15	3.4	2.3
	5.5	19.7	40.8	24	5.1	3.4	16.9	36.2	21	5.1	3.4
	7.5	26.9	52.6	33	6.8	5.1	24.0	46.6	29	6.8	5.1
	11	39.0	76.9	48	10.2	6.8	34.7	67.7	42	10.2	6.8
	15	54.0	98.5	66	13.7	10.2	48	87	59	13.7	10.2
	18.5	66.2	117	81	17.6	13.0	59	104	72	17.6	13.0
	22	78.8	136	96	20.3	16.4	70	123	86	20.3	16.4
	30	109	168	133	30.0	20.3	99	149	121	30.0	20.3
	37	135	204	165	35.1	28.5	122	181	149	35.1	28.5
	45	163	243	200	41.1	33.2	148	217	181	41.1	33.2
	55	199	291	244	50.8	38.9	182	262	223	50.8	38.9
75	272	–	333	68.5	50.8	247	–	303	68.5	50.8	
90	327		400	83.0	64.2	296		363	83.0	64.2	
110	400		490	–	78.6	364		446	–	78.6	
Three-phase 400V	3.7	7.1	14.9	8.7	1.7	–	6.3	14.2	7.7	1.7	–
	5.5	10.0	21.5	12	2.5	1.7	8.3	19.0	10	2.5	1.7
	7.5	13.5	27.9	17	3.4	2.5	12.1	24.6	15	3.4	2.5
	11	19.8	39.1	24	5.1	3.4	17.7	34.5	22	5.1	3.4
	15	26.8	50.3	32	6.8	5.1	24	44	29	6.8	5.1
	18.5	33.2	59.9	40	8.8	6.5	29	53	36	8.8	6.5
	22	39.3	69.3	48	10.2	8.2	35	62	43	10.2	8.2
	30	54	86	66	15.0	10.2	49	76	60	15.0	10.2
	37	67	104	82	17.6	14.3	61	92	75	17.6	14.3
	45	81	124	99	20.5	16.6	74	111	91	20.5	16.6
	55	100	150	122	25.2	19.4	91	134	111	25.2	19.4
	75	134	–	164	34.6	25.2	122	–	149	34.6	25.2
	90	160		196	41.6	32.5	146		179	41.6	32.5
	110	196		240	50.8	39.4	178		218	50.8	39.4
	132	232		284	61.7	47.6	211		258	61.7	47.6
	160	282		345	73.9	58.2	256		314	73.9	58.2
	200	352		431	92.6	70.7	320		392	92.6	70.7
	220	385		472	102	83.2	350		429	102	83.2
	250	438		536	120	–	398		488	120	–
	280	491		601	138	98.1	446		546	138	98.1
	300	526		644	–	113	478		586	–	113
315	552	676	147	125	502	615	147	125			
355	624	764	175	133	567	694	175	133			
400	704	862	186	159	640	784	186	159			
500	880	1078	240	178	800	980	240	178			
630	1104	1352	293	231	1004	1229	293	231			
710	1248	1528	–	266	1135	1390	–	266			

Note 1) The inverter efficiency is calculated using individual value by capacity. The input effective value current is obtained for following conditions:

[22kW or smaller]

Power source capacity : 500kVA Power source impedance : 2.5%

[30kW or larger]

Power source capacity and impedance are calculated using values corresponding to Fuji's recommended capacity.

Note 2) For different power voltages such as 230V or 380V, input current is in inverse proportion to the power voltage.

Note 3) The braking resistor circuit currents are obtained on condition that the standard braking resistor (10% ED) is used. Ask us for the data taken when the resistor of 20%ED, 40%ED, 100%ED, or continuous rating is used.

## 9.2 Circuit Breakers and Magnetic Contactors

Table 9.2 Circuit Breakers and Magnetic Contactors

Power supply voltage	Nominal applied motor [kW]	Inverter type		MCCB, ELCB Rated current [A]		MC1 (for input circuit)		MC2 (for output circuit)	
		CT use, HT use	VT use	With DCR	Without reactor	With DCR	Without reactor	All series	
Three-phase 200V	0.75	FRN0.75VG7S-2	–	5	10	SC-05	SC-05	SC-05	
	1.5	FRN1.5VG7S-2	FRN0.75VG7S-2	10	15				
	2.2	FRN2.2VG7S-2	FRN1.5VG7S-2		20		SC-5-1		
	3.7	FRN3.7VG7S-2	FRN2.2VG7S-2	30					
	5.5	FRN5.5VG7S-2	FRN3.7VG7S-2	30	50	SC-N1	SC-5-1		
	7.5	FRN7.5VG7S-2	FRN5.5VG7S-2	40	75	SC-5-1	SC-N2	SC-N1	
	11	FRN11VG7S-2	FRN7.5VG7S-2	50	100	SC-N1	SC-N2S	SC-N2S	
	15	FRN15VG7S-2	FRN11PS11-2	75	125	SC-N2	SC-N3		
	18.5	FRN18.5VG7S-2	FRN15VG7S-2	100	150	SC-N2S	SC-N4	SC-N3	
	22	FRN22VG7S-2	FRN18.5VG7S-2		175		SC-N5		
	30	FRN30VG7S-2	FRN22VG7S-2	150	200	SC-N4	SC-N7	SC-N4	
	37	FRN37VG7S-2	FRN30VG7S-2	175	250	SC-N5	SC-N8	SC-N5	
	45	FRN45VG7S-2	FRN37VG7S-2	200	300	SC-N7		SC-N7	
	55	FRN55VG7S-2	FRN45VG7S-2	250	350	SC-N8	SC-N11	SC-N8	
75	FRN75VG7S-2	FRN55VG7S-2	350	–	SC-N11	–	SC-N11		
90	FRN90VG7S-2	FRN75VG7S-2	400		SC-N12		SC-N12		
110	–	FRN90VG7S-2	500						
Three-phase 400V	3.7	FRN3.7VG7S-4	–	10	20	SC-05	SC-05	SC-05	
	5.5	FRN5.5VG7S-4	FRN3.7VG7S-4	15	30		SC-4-0	SC-05	
	7.5	FRN7.5VG7S-4	FRN5.5VG7S-4	20	40		SC-5-1		
	11	FRN11VG7S-4	FRN7.5VG7S-4	30	50		SC-N1	SC-4-0	
	15	FRN15VG7S-4	FRN11VG7S-4	40	60	SC-5-1	SC-5-1		
	18.5	FRN18.5VG7S-4	FRN15VG7S-4		75	SC-N1	SC-N2	SC-N1	
	22	FRN22VG7S-4	FRN18.5VG7S-4	50	100	SC-N1	SC-N2S	SC-N2	
	30	FRN30VG7S-4	FRN22VG7S-4	75	125	SC-N2	SC-N3		
	37	FRN37VG7S-4	FRN30VG7S-4	100		SC-N2S	SC-N4	SC-N2S	
	45	FRN45VG7S-4	FRN37VG7S-4		150	SC-N3	SC-N3		
	55	FRN55VG7S-4	FRN45VG7S-4	125	200	SC-N3	SC-N5	SC-N4	
	75	FRN75VG7S-4	FRN55VG7S-4	175	–	SC-N4	–	SC-N5	
	90	FRN90VG7S-4	FRN75VG7S-4	200		SC-N7		SC-N7	
	110	FRN110VG7S-4	FRN90VG7S-4	250		SC-N8		SC-N8	
	132	FRN132VG7S-4	FRN110VG7S-4	300				SC-N11	SC-N11
	160	FRN160VG7S-4	FRN132VG7S-4	350		SC-N12		SC-N12	
	200	FRN200VG7S-4	FRN160VG7S-4	500				SC-N14	SC-N14
	220	FRN220VG7S-4	FRN200VG7S-4	500		SC-N16			SC-N16
	280	FRN280VG7S-4	FRN220VG7S-4	600		*			*
	315	FRN315VG7S-4	FRN280VG7S-4	700		*			*
355	FRN355VG7S-4	FRN315VG7S-4	800			*			
400	FRN400VG7S-4	FRN355VG7S-4	1000		*				
500	–	FRN400VG7S-4	1200		*				
630	FRN630VG7S-4	FRN500VG7S-4	1400		*				
710	–	FRN630VG7S-4	1600		*				
710	FRN710BVG7S-4DC	–	–		*				
800	FRN800BVG7S-4DC	FRN710BVG7S-4DC	–		*				

Note 1) For the MCCB and ELCB types, the rated current values recommended for 50°C or lower panel inside temperature are shown. Select an actual type according to facility short-circuit interrupting capacity.

Note 2) The magnetic contactor is selected on assumption that **the contactor is connected with HIV cable (allowable temperature: 75°C)**. When connecting with other cables, reselect a magnetic contactor that matches the terminal size and the cable size.

\* Contact us for each case.

# 9. Peripheral Equipment

## 9.3 Wire Size

### 9.3.1 Recommended Wire Size

(a) Under the 50°C or lower panel inside temperature

Table 9.3.1(a) Wire Size (50°C)

Power supply voltage	Nominal applied motor [kW]	Inverter type		Wire Size [mm <sup>2</sup> ]															
				Input circuit [L1/R, L2/S, L3/T]						Output circuit [U, V, W]									
		CT use, HT use	VT use	With DCR			Without reactor			CT use, HT use			VT use						
				Allowable temp.			Allowable temp.			Allowable temp.			Allowable temp.						
				60°C	75°C	90°C	Current [A]	60°C	75°C	90°C	Current [A]	60°C	75°C	90°C	Current [A]	60°C	75°C	90°C	Current [A]
Three-phase 200V	0.75	FRN0.75VG7S-2	-	2.0	2.0	2.0	3.1	2.0	2.0	2.0	6.4	2.0	2.0	2.0	5.0	-			
	1.5	FRN1.5VG7S-2	FRN0.75VG7S-2				5.7				11.1				8.0	2.0	2.0	8.0	
	2.2	FRN2.2VG7S-2	FRN1.5VG7S-2				8.3				3.5				16.1	11	2.0	11	
	3.7	FRN3.7VG7S-2	FRN2.2VG7S-2				14				5.5				3.5	25.5	3.5	18	3.5
	5.5	FRN5.5VG7S-2	FRN3.7VG7S-2	3.5	3.5	3.5	19.7	14	5.5	3.5	40.8	5.5	3.5	27	5.5	3.5	27		
	7.5	FRN7.5VG7S-2	FRN5.5VG7S-2				26.9	8.0	5.5	52.6	14	5.5	3.5	37	5.5	3.5	37		
	11	FRN11VG7S-2	FRN7.5VG7S-2				39	14	76.9	8	5.5	49	14	8.0	5.5	49			
	15	FRN15VG7S-2	FRN11VG7S-2	22	8.0	5.5	54	22	14	98.5	22	14	8	63	22	14	8.0	63	
	18.5	FRN18.5VG7S-2	FRN15VG7S-2	-	14	8.0	66.2	38 <sup>1)</sup>	38 <sup>1)</sup>	22	117	-	14	74	22	14	74		
	22	FRN22VG7S-2	FRN18.5VG7S-2	14	78.8	136	22			14	90	90							
	30	-	FRN22VG7S-2	-	38 <sup>1)</sup>	22	109	-	38 <sup>1)</sup>	168	60	22	116	38 <sup>1)</sup>	22	116			
	37	-	FRN30VG7S-2	-	60	38	135	60	60	204	100	38	145	38	38	145			
		FRN37VG7S-2	-	100	38	163	243			60	180								
	45	FRN45VG7S-2	FRN37VG7S-2	-	60	199	100	100	291	-	100	60	215	100	60	215			
55	FRN55VG7S-2	FRN45VG7S-2	-	100	100	272	-	-	-	150	100	283	150	100	283				
75	-	FRN55VG7S-2	-	150	100	327	-	-	-	150	150	346	150	150	346				
90	FRN90VG7S-2	FRN75VG7S-2	-	200	150	400	-	-	-	-	-	-	200	150	415				
110	FRN110VG7S-2	FRN90VG7S-2	-	-	-	-	-	-	-	-	-	-	-	-	-				
Three-phase 400V	3.7	FRN3.7VG7S-4	-	2.0	2.0	2.0	7.1	2.0	14.9	2.0	2.0	2.0	9.0	-					
	5.5	FRN5.5VG7S-4	FRN3.7VG7S-4				10	5.5	21.5				13.5	2.0	13.5				
	7.5	FRN7.5VG7S-4	FRN5.5VG7S-4				13.5	3.5	27.9				18.5	3.5	2.0	18.5			
	11	FRN11VG7S-4	FRN7.5VG7S-4				19.8	5.5	3.5				39.1	5.5	3.5	24.5	5.5	3.5	24.5
	15	FRN15VG7S-4	FRN11VG7S-4	5.5	3.5	26.8	14	8.0	5.5	50.3	8.0	3.5	32	8.0	3.5	32			
	18.5	FRN18.5VG7S-4	FRN15VG7S-4	8.0	5.5	3.5	33.2	22	14	8.0	59.9	14	5.5	39	14	5.5	39		
	22	FRN22VG7S-4	FRN18.5VG7S-4	14	39.3	-	69.3	14	8.0	5.5	45	8.0	5.5	45	8.0	5.5	45		
	30	FRN30VG7S-4	FRN22VG7S-4	22	8.0	5.5	54	-	22	14	86	22	14	8.0	60	22	14	8.0	60
	37	FRN37VG7S-4	FRN30VG7S-4	14	8.0	67	60	38	22	104	38	22	14	75	38	22	14	75	
	45	FRN45VG7S-4	FRN37VG7S-4	38	22	14	81	-	38	22	124	38	22	14	91	38	22	14	91
	55	FRN55VG7S-4	FRN45VG7S-4	60	100	-	60	38	150	60	38	22	112	60	38	22	112		
	75	-	FRN55VG7S-4	-	38	38	134	-	-	100	60	38	150	100	60	38	150		
	90	FRN90VG7S-4	FRN75VG7S-4	100	60	160	-	-	-	-	176	-	-	60	38	176			
	110	FRN110VG7S-4	FRN90VG7S-4	-	60	196	-	-	-	100	60	210	-	100	60	210			
	132	FRN132VG7S-4	FRN110VG7S-4	100	100	232	-	-	-	150	100	253	-	100	100	253			
	160	FRN160VG7S-4	FRN132VG7S-4	150	100	282	-	-	-	200	150	304	-	150	100	304			
	200	FRN200VG7S-4	FRN160VG7S-4	200	150	352	-	-	-	250	200	377	-	200	150	377			
	220	FRN220VG7S-4	FRN200VG7S-4	250	150	385	-	-	-	325	250	415	-	250	150	415			
	250	FRN250VG7S-4	-	250	200	438	-	-	-	400	250	468	-	-	-	-			
	280	FRN280VG7S-4	FRN220VG7S-4	250	200	491	-	-	-	500	250	520	-	250	200	520			
300	-	FRN250VG7S-4	325	200	526	-	-	-	600	325	585	-	325	250	558				
315	FRN315VG7S-4	FRN280VG7S-4	2x150	250	552	-	-	-	700	2x150	250	585	2x150	250	585				
355	FRN355VG7S-4	FRN315VG7S-4	2x200	325	624	-	-	-	800	2x200	325	650	2x200	2x150	650				
400	FRN400VG7S-4	FRN355VG7S-4	325	325	704	-	-	-	900	325	740	-	2x250	325	740				
500	FRN500VG7S-4	FRN400VG7S-4	2x325	2x200	880	-	-	-	1000	2x325	2x250	960	-	2x325	2x250	960			
630	FRN630VG7S-4	FRN500VG7S-4	3x325	2x325	1104	-	-	-	1200	3x325	2x325	1170	-	3x325	2x325	1170			
710	-	FRN630VG7S-4	4x250	2x325	1248	-	-	-	1400	-	-	-	-	4x325	3x325	1370			
710	FRN710BVG7S-4DC	-	-	-	-	-	-	-	-	4x325	3x325	1370	-	-	-				
800	FRN800BVG7S-4DC	-	-	-	-	-	-	-	-	4x325	3x325	1480	-	-	-				

Note 1: Use crimp terminal 38-S6 made by J.S.T. Mfg. Co., Ltd.

Note 2: Use crimp terminal CB150-10 specified in JEM1399 Low Voltage Device Crimp Terminal.

Note 3: "60°C" in the allowable temperature field indicates "IV cable," while "75°C" indicates "600V HIV isolated cable" and "90°C" indicates "600V cross-linked polyethylene isolated cable."

Table 9.3.1(a) Wire Size (50°C) (cont'd)

Wire Size [mm <sup>2</sup> ]															Control circuit			Auxiliary control power supply [R0, T0]			Grounding [EG]					
DC link circuit [P1, P(+)]							Braking circuit [P(+), DB, N(-)]								Control circuit			Auxiliary control power supply [R0, T0]			Grounding [EG]					
CT use, HT use			VT use				CT use, HT use			VT use					Allowable temp. 1)			Allowable temp. 1)			Allowable temp. 1)					
Allowable temp.			Current [A]				Allowable temp.			Current [A]					60°C   75°C   90°C			60°C   75°C   90°C			60°C   75°C   90°C					
60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
2.0	2.0	2.0	3.8	-	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	
3.5	3.5	3.5	7.0	2.0	2.0	7.0	2.0	2.0	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.5	
5.5	5.5	5.5	10	3.5	3.5	10	3.5	3.5	2.3	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	5.5		
8.0	8.0	8.0	17	5.5	5.5	17	5.5	5.5	3.4	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	8.0		
14	14	14	24	8.0	8.0	24	8.0	8.0	5.1	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	14		
22	22	22	33	14	14	33	14	14	6.8	14	14	14	14	14	14	14	14	14	14	14	14	14	14	22		
-	-	-	48	22	22	48	22	22	8.0	22	22	22	22	22	22	22	22	22	22	22	22	22	22	38		
-	-	-	81	38 <sup>1)</sup>	38	81	38	38	10.2	38	38	38	38	38	38	38	38	38	38	38	38	38	38	60		
-	-	-	96	60	60	96	60	60	13.7	60	60	60	60	60	60	60	60	60	60	60	60	60	60	100		
-	-	-	133	100	100	133	100	100	17.6	100	100	100	100	100	100	100	100	100	100	100	100	100	100	150		
-	-	-	165	150	150	165	150	150	20.3	150	150	150	150	150	150	150	150	150	150	150	150	150	150	200		
-	-	-	200	200	200	200	200	200	28.5	200	200	200	200	200	200	200	200	200	200	200	200	200	200	250		
-	-	-	244	-	-	244	-	-	35.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	400		
-	-	-	333	-	-	333	-	-	41.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	490		
-	-	-	400	-	-	400	-	-	50.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	490	-	-	490	-	-	68.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	83.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	88.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	96.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	102.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	110.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	118.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	126.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	134.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	142.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	150.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	158.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	166.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	174.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	182.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	190.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	198.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	206.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	214.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	222.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	230.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	238.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	246.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	254.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	262.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	270.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	278.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	286.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	294.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	302.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	310.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	318.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	326.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	334.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	342.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	350.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	358.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	366.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	374.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	382.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	390.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	398.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	406.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	414.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	422.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	430.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	438.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	446.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	454.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	462.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	470.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	478.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	486.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	494.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	502.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	510.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	518.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	526.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	534.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	542.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	550.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	558.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	566.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-	-	-	-	-	574.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
-	-	-	-	-																						

# 9. Peripheral Equipment

(b) Under the 40°C or lower panel inside temperature

Table 9.3.1(b) Wire Size (40°C)

Power supply voltage	Nominal applied motor [kW]	Inverter type		Wire Size [mm <sup>2</sup> ]														
				Input circuit [L1/R, L2/S, L3/T]						Output circuit [U, V, W]								
		CT use, HT use	VT use	With DCR			Without reactor			CT use, HT use			VT use					
				Allowable temp.			Allowable temp.			Allowable temp.			Allowable temp.					
60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C				
Three-phase 200V	0.75	FRN0.75VG7S-2	-	-	-	-	-	-	-	-	-	-	-	-	-			
	1.5	FRN1.5VG7S-2	FRN0.75VG7S-2	2.0	2.0	2.0	3.1	2.0	2.0	2.0	6.4	2.0	2.0	2.0	5.0	-		
	2.2	FRN2.2VG7S-2	FRN1.5VG7S-2	-	-	-	5.7	-	-	-	11.1	-	-	-	8.0	8.0		
	3.7	FRN3.7VG7S-2	FRN2.2VG7S-2	-	-	-	8.3	-	-	-	16.1	-	-	-	11	2.0		
	5.5	FRN5.5VG7S-2	FRN3.7VG7S-2	-	-	-	14	3.5	-	-	25.5	-	-	-	18	2.0		
	7.5	FRN7.5VG7S-2	FRN5.5VG7S-2	3.5	-	-	19.7	8.0	5.5	3.5	40.8	3.5	-	-	27	3.5		
	11	FRN11VG7S-2	FRN7.5VG7S-2	5.5	5.5	3.5	26.9	14	8.0	5.5	52.6	5.5	3.5	3.5	37	5.5		
	15	FRN15VG7S-2	FRN11VG7S-2	8.0	5.5	5.5	39	22	14	8.0	76.9	8.0	5.5	5.5	49	8.0		
	18.5	FRN18.5VG7S-2	FRN15VG7S-2	14	8.0	8.0	54	-	-	-	98.5	14	8.0	8.0	63	14		
	22	FRN22VG7S-2	FRN18.5VG7S-2	22	14	8.0	66.2	-	-	-	117	22	14	8.0	74	14		
							78.8	-	-	-	136	22	14	14	90	22		
								38 <sup>1)</sup>	-	-	-	-	-	-	-	-	-	
									38 <sup>1)</sup>	-	168	-	22	-	116	-	22	
										60	38	-	22	38	22	22	116	
												60	38	22	145	60	38	145
												100	60	38	180	100	60	180
											100	60	38	215	100	60	215	
											150	100	100	283	150	100	283	
											200	150	100	346	200	150	346	
											-	-	-	250	150	150	415	
Three-phase 400V	3.7	FRN3.7VG7S-4	-	2.0	2.0	2.0	7.1	2.0	2.0	2.0	14.9	2.0	2.0	2.0	9.0	-		
	5.5	FRN5.5VG7S-4	FRN3.7VG7S-4	-	-	-	10	-	-	-	21.5	-	-	-	13.5	2.0		
	7.5	FRN7.5VG7S-4	FRN5.5VG7S-4	-	-	-	13.5	3.5	-	-	27.9	-	-	-	18.5	2.0		
	11	FRN11VG7S-4	FRN7.5VG7S-4	-	-	-	19.8	5.5	3.5	3.5	39.1	3.5	2.0	3.5	24.5	2.0		
	15	FRN15VG7S-4	FRN11VG7S-4	3.5	-	-	26.8	-	5.5	-	50.3	5.5	3.5	3.5	32	3.5		
	18.5	FRN18.5VG7S-4	FRN15VG7S-4	5.5	3.5	-	33.2	14	8.0	5.5	59.9	5.5	3.5	3.5	39	5.5		
	22	FRN22VG7S-4	FRN18.5VG7S-4	5.5	5.5	3.5	39.3	-	-	-	69.3	8.0	5.5	5.5	45	8.0		
	30	FRN30VG7S-4	FRN22VG7S-4	14	8.0	5.5	54	22	14	-	86	14	8.0	5.5	60	14		
	37	FRN37VG7S-4	FRN30VG7S-4	14	8.0	8.0	67	-	-	-	104	14	8.0	8.0	75	14		
	45	FRN45VG7S-4	FRN37VG7S-4	22	14	8.0	81	38	22	-	124	22	14	8.0	91	14		
	55	FRN55VG7S-4	FRN45VG7S-4	38	22	14	100	60	38	38	150	38	22	14	112	38		
	75	FRN75VG7S-4	FRN55VG7S-4	60	38	22	134	-	-	-	-	60	38	38	150	60		
	90	FRN90VG7S-4	FRN75VG7S-4	60	38	22	160	-	-	-	-	60	38	38	176	60		
	110	FRN110VG7S-4	FRN90VG7S-4	100	60	38	196	-	-	-	-	100	60	60	210	100		
	132	FRN132VG7S-4	FRN110VG7S-4	100	60	60	232	-	-	-	-	150	100	60	253	100		
	160	FRN160VG7S-4	FRN132VG7S-4	150	100	100	282	-	-	-	-	200	100	100	304	100		
	200	FRN200VG7S-4	FRN160VG7S-4	200	150	150	352	-	-	-	-	250	150	150	377	200		
	220	FRN220VG7S-4	FRN200VG7S-4	250	150	150	385	-	-	-	-	250	150	150	415	250		
	250	FRN250VG7S-4	-	-	200	150	438	-	-	-	-	-	200	150	468	-		
	280	FRN280VG7S-4	FRN220VG7S-4	-	200	150	491	-	-	-	-	-	250	200	520	325	250	
300	FRN300VG7S-4	FRN250VG7S-4	-	250	200	526	-	-	-	-	-	-	-	250	200	558		
315	FRN315VG7S-4	FRN280VG7S-4	-	250	200	552	-	-	-	-	-	-	-	250	200	565		
355	FRN355VG7S-4	FRN315VG7S-4	-	2x150	250	624	-	-	-	-	-	-	-	2x150	250	650		
400	FRN400VG7S-4	FRN355VG7S-4	-	2x150	250	704	-	-	-	-	-	-	-	2x200	325	740		
500	FRN500VG7S-4	FRN400VG7S-4	-	2x250	2x200	880	-	-	-	-	-	-	-	2x250	2x200	960		
630	FRN630VG7S-4	FRN500VG7S-4	-	2x325	2x250	1104	-	-	-	-	-	-	-	3x250	2x250	1170		
710	FRN710VG7S-4	FRN630VG7S-4	-	3x250	2x325	1248	-	-	-	-	-	-	-	3x325	2x325	1370		
710	FRN710BVG7S-4DC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
800	FRN800BVG7S-4DC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

Note 1: Use crimp terminal 38-S6 made by J.S.T. Mfg. Co., Ltd.

Note 2: “60°C” in the allowable temperature field indicates “IV cable,” while “75°C” indicates “600V HIV isolated cable” and “90°C” indicates “600V cross-linked polyethylene isolated cable.”

Table 9.3.1(b) Wire Size (40°C) (cont'd)

Wire Size [mm <sup>2</sup> ]																				Control circuit			Auxiliary control power supply [R0, T0]			Grounding [⊕G]							
DC link circuit current [P1, P(+)]										Braking circuit [P(+), DB, N(-)]										allowable temp. 1)			allowable temp. 1)			allowable temp. 1)							
CT use, HT use					VT use					CT use, HT use					VT use					allowable temp. 1)			allowable temp. 1)			allowable temp. 1)							
allowable temp. 1)			Current	allowable temp. 1)			Current	allowable temp. 1)			Current	allowable temp. 1)			Current	allowable temp. 1)			allowable temp. 1)	allowable temp. 1)		allowable temp. 1)											
60°C	75°C	90°C	[A]	60°C	75°C	90°C	[A]	60°C	75°C	90°C	[A]	60°C	75°C	90°C	[A]	60°C	75°C	90°C	[A]	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C					
2.0	2.0	2.0	3.8	-			-			-			1.4	-			2.0	2.0	2.0	1.4	1.25	1.25	1.25	2.0	2.0	2.0	2						
			7.0	-			-			1.9	-			1.4																			
			10	2.0	2.0	7.0	-			-			2.3	-						1.9													
			17	-			-			-			3.4	-						2.3													
			24	3.5	-			-			-			5.1	-					3.4													
			33	5.5	3.5	-			-			-			6.8	-				5.1													
			48	8.0	5.5	5.5	48	-			-			-						10.2							-			6.8			
			66	14	14	8.0	66	-			-			-						13.7							-			10.2			
			81	22	14	8.0	81	-			-			-						17.6							-			13.0			
			96	-	22	14	96	-			-			-						20.3							-			16.4			
60	38	22	38 <sup>1)</sup>	22	133	3.5	3.5	30.0	-			-			-			20.3	1.25	1.25	1.25	2.0	2.0	2.0	14								
			133	38	22	133	5.5	3.5	35.1	-			-			-									28.5								
			165	60	38	165	8.0	5.5	41.1	-			-			-									33.2								
			200	100	60	200	14	5.5	50.8	-			-			-									38.9								
			244	100	60	244	14	8.0	68.5	-			-			-									50.8								
			333	-	150	333	14	14	83.0	-			-			-									64.2								
			400	-	150	400	22	14	83.0	-			-			-									78.6								
			490	-	200	490	-	-	-	-			-			-									-								
			-	-	-	-	-	-	-	-	-			-			-								-								
			-	-	-	-	-	-	-	-	-			-			-								-								
2.0	2.0	2.0	8.7	-			-			-			1.7	-			2.0	2.0	2.0	1.7	1.25	1.25	1.25	2.0	2.0	2.0	2						
			12	2.0	2.0	12	-			-			-			1.7																	
			17	-			-			-			-			2.5				-							2.5						
			24	3.5	-			-			-			-						3.4							-			3.4			
			32	5.5	3.5	-			-			-			-					5.1							-			5.1			
			40	5.5	5.5	40	-			-			-			-				6.5							-			6.5			
			48	8.0	5.5	5.5	48	-			-			-						-							8.2	-			8.2		
			66	14	14	8.0	66	-			-			-						-							10.2	-			10.2		
			82	22	14	8.0	82	-			-			-						-							14.3	-			14.3		
			99	-	22	14	99	-			-			-						-							16.6	-			16.6		
60	38	38	164	60	38	38	164	5.5	3.5	3.5	34.6	-			-			-			19.4	1.25	1.25	1.25	2.0	2.0	2.0	14					
			196	100	60	38	196	8.0	5.5	41.6	-			-			-			25.2													
			240	100	60	240	14	5.5	50.8	-			-			-			32.5														
			284	-	100	284	14	8.0	61.7	-			-			-			39.4														
			345	200	150	345	22	14	73.9	-			-			-			47.6														
			431	-	200	431	38	22	92.6	-			-			-			58.2														
			472	325	150	472	38	22	102	-			-			-			70.7														
			536	-	-	536	-	-	120	-			-			-			83.2														
			601	-	-	601	-	-	120	-			-			-			-														
			601	-	-	601	-	-	120	-			-			-			-														
-	250	200	676	2x150	250	676	60	38	22	147	-			-			-			98.1	1.25	1.25	1.25	2.0	2.0	2.0	60						
			764	2x200	325	764	60	38	175	-			-			-			113														
			862	2x250	400	862	100	60	186	-			-			-			125														
			1078	2x325	2x250	1078	-	100	240	100	60	38	-			-			133														
			1352	3x325	2x325	1352	-	100	293	-	100	100	-			-			159														
			1528	4x325	3x325	1528	-	-	-	-	150	100	-			-			178														
			-	-	-	-	-	-	-	-	-	-	-			-			231														
			-	-	-	-	-	-	-	-	-	-	-			-			266														
			-	-	-	-	-	-	-	-	-	-	-			-			-														
			-	-	-	-	-	-	-	-	-	-	-			-			-														
Copper busbar 10 <sup>1</sup> x 100mm (Connected PWM converter)			-	-			-			-			-			-			-			-			-			-					

# 9. Peripheral Equipment

## 9.3.2 Recommended Wire Size Classified by Power Supply Conditions

- IV wire (Maximum allowable temperature : 60°C)

Table 9.3.2(1) Allowable Current of Insulation Wire

Wire size [mm <sup>2</sup> ]	Allowable current reference value (up to 30°C) I <sub>0</sub> [A]	Wiring outside duct					Wiring in the duct (Max. 3 wires in one duct)			
		35°C (I <sub>0</sub> ×0.91) [A]	40°C (I <sub>0</sub> ×0.82) [A]	45°C (I <sub>0</sub> ×0.71) [A]	50°C (I <sub>0</sub> ×0.58) [A]	55°C (I <sub>0</sub> ×0.41) [A]	35°C (I <sub>0</sub> ×0.63) [A]	40°C (I <sub>0</sub> ×0.57) [A]	45°C (I <sub>0</sub> ×0.49) [A]	50°C (I <sub>0</sub> ×0.40) [A]
2.0	27	24	22	19	15	11	17	15	13	10
3.5	37	33	30	26	21	15	23	21	18	14
5.5	49	44	40	34	28	20	30	27	24	19
8.0	61	55	50	43	35	25	38	34	29	24
14	88	80	72	62	51	36	55	50	43	35
22	115	104	94	81	66	47	72	65	56	46
38	162	147	132	115	93	66	102	92	79	64
60	217	197	177	154	125	88	136	123	106	86
100	298	271	244	211	172	122	187	169	146	119
150	395	359	323	280	229	161	248	225	193	158
200	469	426	384	332	272	192	295	267	229	187
250	556	505	455	394	322	227	350	316	272	222
325	650	591	533	461	377	266	409	370	318	260
400	745	677	610	528	432	305	469	424	365	298
500	842	766	690	597	488	345	530	479	412	336
2 x 100	497	452	407	352	288	203	313	283	243	198
2 x 150	658	598	539	467	381	269	414	375	322	263
2 x 200	782	711	641	555	453	320	492	445	383	312
2 x 250	927	843	760	658	537	380	584	528	454	370
2 x 325	1083	985	888	768	628	444	682	617	530	433
2 x 400	1242	1130	1018	881	720	509	782	707	608	496
2 x 500	1403	1276	1150	996	813	575	883	799	687	561

- HIV wire (Maximum allowable temperature : 75°C)

Table 9.3.2(2) Allowable Current of Insulation Wire

Wire size [mm <sup>2</sup> ]	Allowable current reference value (up to 30°C) I <sub>0</sub> ×1.22 [A]	Wiring outside duct					Wiring in the duct (Max. 3 wires in one duct)			
		35°C (I <sub>0</sub> ×1.15) [A]	40°C (I <sub>0</sub> ×1.08) [A]	45°C (I <sub>0</sub> ×1.00) [A]	50°C (I <sub>0</sub> ×0.91) [A]	55°C (I <sub>0</sub> ×0.82) [A]	35°C (I <sub>0</sub> ×0.80) [A]	40°C (I <sub>0</sub> ×0.75) [A]	45°C (I <sub>0</sub> ×0.70) [A]	50°C (I <sub>0</sub> ×0.63) [A]
2.0	32	31	29	27	24	22	21	20	18	17
3.5	45	42	39	37	33	30	29	27	25	23
5.5	59	56	52	49	44	40	39	36	34	30
8.0	74	70	65	61	55	50	48	45	42	38
14	107	101	95	88	80	72	70	66	61	55
22	140	132	124	115	104	94	92	86	80	72
38	197	186	174	162	147	132	129	121	113	102
60	264	249	234	217	197	177	173	162	151	136
100	363	342	321	298	271	244	238	223	208	187
150	481	454	426	395	359	323	316	296	276	248
200	572	539	506	469	426	384	375	351	328	295
250	678	639	600	556	505	455	444	417	389	350
325	793	747	702	650	591	533	520	487	455	409
400	908	856	804	745	677	610	596	558	521	469
500	1027	968	909	842	766	690	673	631	589	530
2 x 100	606	571	536	497	452	407	397	372	347	313
2 x 150	802	756	710	658	598	539	526	493	460	414
2 x 200	954	899	844	782	711	641	625	586	547	492
2 x 250	1130	1066	1001	927	843	760	741	695	648	584
2 x 325	1321	1245	1169	1083	985	888	866	812	758	682
2 x 400	1515	1428	1341	1242	1130	1018	993	931	869	782
2 x 500	1711	1613	1515	1403	1276	1150	1122	1052	982	883

● 600V cross-linking polyethylene insulation wire (Maximum allowable temperature : 90°C)

Table 9.3.2(3) Allowable Current of Insulation Wire

Wire size [mm <sup>2</sup> ]	Allowable current reference value (up to 30°C) I <sub>0</sub> 1.41 [A]	Wiring outside duct					Wiring in the duct (Max. 3 wires in one duct)			
		35°C (I <sub>0</sub> x1.35) [A]	40°C (I <sub>0</sub> x1.29) [A]	45°C (I <sub>0</sub> x1.22) [A]	50°C (I <sub>0</sub> x1.15) [A]	55°C (I <sub>0</sub> x1.08) [A]	35°C (I <sub>0</sub> x0.94) [A]	40°C (I <sub>0</sub> x0.90) [A]	45°C (I <sub>0</sub> x0.85) [A]	50°C (I <sub>0</sub> x0.80) [A]
2.0	38	36	34	32	31	29	25	24	22	21
3.5	52	49	47	45	42	39	34	33	31	29
5.5	69	66	63	59	56	52	46	44	41	39
8.0	86	82	78	74	70	65	57	54	51	48
14	124	118	113	107	101	95	82	79	74	70
22	162	155	148	140	132	124	108	103	97	92
38	228	218	208	197	186	174	152	145	137	129
60	305	292	279	264	249	234	203	195	184	173
100	420	402	384	363	342	321	280	268	253	238
150	556	533	509	481	454	426	371	355	335	316
200	661	633	605	572	539	506	440	422	398	375
250	783	750	717	678	639	600	522	500	472	444
325	916	877	838	793	747	702	611	585	552	520
400	1050	1005	961	908	856	804	700	670	633	596
500	1187	1136	1086	1027	968	909	791	757	715	673
2 x 100	700	670	641	606	571	536	467	447	422	397
2 x 150	927	888	848	802	756	710	618	592	559	526
2 x 200	1102	1055	1008	954	899	844	735	703	664	625
2 x 250	1307	1251	1195	1130	1066	1001	871	834	787	741
2 x 325	1527	1462	1397	1321	1245	1169	1018	974	920	866
2 x 400	1751	1676	1602	1515	1428	1341	1167	1117	1055	993
2 x 500	1978	1894	1809	1711	1613	1515	1318	1262	1192	1122



# 9. Peripheral Equipment

## 9.4 Braking Unit and Braking Resistor

### 9.4.1 10%ED

● CT use

Table 9.4.1(1) Braking Unit and Braking Resistor (Standard)

Power supply voltage	Nominal applied motor [kW]	Inverter type	Option					Maximum braking torque [%]		Cont. braking (150% torque conversion value)		Repetitive braking (100s or less cycle)				
			Braking unit		Braking resistor					Braking time [s]	Discharging capability [kWs]	Duty cycle [%ED]	Average loss [kW]			
			Type	Q'ty	Type	Q'ty	Ohmic value	50Hz	60Hz							
Three-phase 200V	0.75	FRN0.75VG7S-2	-	-	DB2.2V-21B	1	30	150	7.16	5.97	10	16.5	10	0.165		
	1.5	FRN1.5VG7S-2			DB2.2V-21B	1	30	150	14.3	11.9	10	16.5	10	0.165		
	2.2	FRN2.2VG7S-2			DB2.2V-21B	1	30	150	21.0	17.5	10	16.5	10	0.165		
	3.7	FRN3.7VG7S-2			DB3.7V-21B	1	24	150	35.3	29.4	10	27.8	10	0.278		
	5.5	FRN5.5VG7S-2			DB5.5V-21B	1	16	150	52.5	43.8	10	41.3	10	0.413		
	7.5	FRN7.5VG7S-2			DB7.5V-21B	1	12	150	71.6	59.7	10	56.3	10	0.563		
	11	FRN11VG7S-2			DB11V-21B	1	8.0	150	105	87.5	10	82.5	10	0.825		
	15	FRN15VG7S-2			DB15V-21B	1	6.0	150	143	119	10	113	10	1.13		
	18.5	FRN18.5VG7S-2			DB18.5V-21B	1	4.5	150	177	147	10	139	10	1.39		
	22	FRN22VG7S-2			DB22V-21B	1	4.0	150	210	175	10	165	10	1.65		
	30	FRN30VG7S-2			DB30V-21B	1	2.5	150	286	239	10	225	10	2.25		
	37	FRN37VG7S-2			DB37V-21B	1	2.25	150	353	294	10	278	10	2.78		
	45	FRN45VG7S-2			DB45V-21B	1	2.0	150	430	358	10	338	10	3.38		
	55	FRN55VG7S-2			DB55V-21C	1	1.6	150	525	438	10	413	10	4.13		
75	FRN75VG7S-2	BU55-2C	2	DB75V-21C	1	2.4/2	150	716	597	10	563	10	5.63			
90	FRN90VG7S-2	BU90-2C	2	DB90V-21C	1	2.0/2	150	859	716	10	675	10	6.75			
Three-phase 400V	3.7	FRN3.7VG7S-4	-	-	DB3.7V-41B	1	96	150	35.3	29.4	10	27.8	10	0.278		
	5.5	FRN5.5VG7S-4			DB5.5V-41B	1	64	150	52.5	43.8	10	41.3	10	0.413		
	7.5	FRN7.5VG7S-4			DB7.5V-41B	1	48	150	71.6	59.7	10	56.3	10	0.563		
	11	FRN11VG7S-4			DB11V-41B	1	32	150	105	87.5	10	82.5	10	0.825		
	15	FRN15VG7S-4			DB15V-41B	1	24	150	143	119	10	113	10	1.13		
	18.5	FRN18.5VG7S-4			DB18.5V-41B	1	18	150	177	147	10	139	10	1.39		
	22	FRN22VG7S-4			DB22V-41B	1	16	150	210	175	10	165	10	1.65		
	30	FRN30VG7S-4			DB30V-41B	1	10	150	286	239	10	225	10	2.25		
	37	FRN37VG7S-4			DB37V-41B	1	9.0	150	353	294	10	278	10	2.78		
	45	FRN45VG7S-4			DB45V-41B	1	8.0	150	430	358	10	338	10	3.38		
	55	FRN55VG7S-4			DB55V-41C	1	6.5	150	525	438	10	413	10	4.13		
	75	FRN75VG7S-4			DB75V-41C	1	4.7	150	716	597	10	563	10	5.63		
	90	FRN90VG7S-4			DB90V-41C	1	3.9	150	859	716	10	675	10	6.75		
	110	FRN110VG7S-4			DB110V-41C	1	3.2	150	1050	875	10	825	10	8.25		
	132	FRN132VG7S-4			BU220-4C	1	DB132V-41C	1	2.6	150	1261	1050	10	990	10	9.90
	160	FRN160VG7S-4			BU220-4C	1	DB160V-41C	1	2.2	150	1528	1273	10	1200	10	12.0
	200	FRN200VG7S-4			BU220-4C	2	DB200V-41C	1	3.5/2	150	1910	1592	10	1500	10	15.0
	220	FRN220VG7S-4			BU220-4C	2	DB220V-41C	1	3.2/2	150	2101	1751	10	1650	10	16.5
	250	FRN250VG7S-4			BU220-4C	2	DB132V-41C	2	2.6/2	150	2388	1990	10	1875	10	18.8
	280	FRN280VG7S-4			BU220-4C	2	DB160V-41C	2	2.2/2	150	2674	2228	10	2100	10	21.0
315	FRN315VG7S-4	BU220-4C	2	DB160V-41C	2	2.2/2	150	3008	2507	10	2363	10	23.6			
355	FRN355VG7S-4	BU220-4C	3	DB132V-41C	3	2.6/3	150	3390	2825	10	2663	10	26.6			
400	FRN400VG7S-4	BU220-4C	3	DB132V-41C	3	2.6/3	150	3820	3183	10	3000	10	30.0			
500	FRN500VG7S-4	BU220-4C	4	DB132V-41C	4	2.6/4	150	4775	3979	10	3750	10	37.5			
630	FRN630VG7S-4	BU220-4C	4	DB160V-41C	4	2.2/4	150	6016	5013	10	4725	10	47.3			

Note 1: Refer to Selection procedure and Notes on Selection.

Note 2: The braking resistor types DB160V-41C to DB220V-41C use two braking resistors when their quantity is described as "1".

(For example, if the quantity of DB160V-41C is "2", four braking resistors are used.)

## ● VT use

Table 9.4.1(2) Braking Unit and Braking Resistor (Standard)

Power supply voltage	Nominal applied motor [kW]	Inverter type	Option					Maximum braking torque [%]		Cont. braking (150% torque conversion value)		Repetitive braking (100s or less cycle)				
			Braking unit		Braking resistor			Torque [N·m]		Braking time [s]	Discharging capability [kWs]	Duty cycle [%ED]	Average loss [kW]			
			Type	Q'ty	Type	Q'ty	Ohmic value	50Hz	60Hz							
Three-phase 200V	1.5	FRN0.75VG7S-2	-	-	DB2.2V-21B	1	30	75	7.2	6.0	10	13.9	10	0.165		
	2.2	FRN1.5VG7S-2			DB2.2V-21B	1	30	102	14.3	11.9	10	18.9	10	0.165		
	3.7	FRN2.2VG7S-2			DB2.2V-21B	1	30	89	21.0	17.5	10	16.5	10	0.165		
	5.5	FRN3.7VG7S-2			DB3.7V-21B	1	24	101	35.4	29.5	10	27.8	10	0.278		
	7.5	FRN5.5VG7S-2			DB5.5V-21B	1	16	110	52.5	43.8	10	41.3	10	0.413		
	11	FRN7.5VG7S-2			DB7.5V-21B	1	12	102	71.4	59.5	10	56.1	10	0.563		
	15	FRN11VG7S-2			DB11V-21B	1	8.0	110	105	87.5	10	82.5	10	0.83		
	18.5	FRN15VG7S-2			DB15V-21B	1	6.0	110	130	108	10	102	10	1.13		
	22	FRN18.5VG7S-2			DB18.5V-21B	1	4.5	110	154	128	10	121	10	1.39		
	30	FRN22VG7S-2			DB22V-21B	1	4.0	110	210	175	10	165	10	1.65		
	37	FRN30VG7S-2			DB30V-21B	1	2.5	110	259	216	10	204	10	2.25		
	45	FRN37VG7S-2			DB37V-21B	1	2.25	110	315	263	10	248	10	2.78		
	55	FRN45VG7S-2			DB45V-21B	1	2.0	110	385	321	10	303	10	3.38		
	75	FRN55VG7S-2			DB55V-21C	1	1.6	110	525	438	10	413	10	4.13		
90	FRN75VG7S-2	BU55-2C	2	DB75V-21C	1	2.4/2	110	630	525	10	495	10	5.63			
110	FRN90VG7S-2	BU90-2C	2	DB90V-21C	1	2.0/2	110	770	642	10	605	10	6.75			
Three-phase 400V	5.5	FRN3.7VG7S-4	-	-	DB3.7V-41B	1	96	101	35.4	29.5	10	27.8	10	0.278		
	7.5	FRN5.5VG7S-4			DB5.5V-41B	1	64	110	52.5	43.8	10	41.3	10	0.413		
	11	FRN7.5VG7S-4			DB7.5V-41B	1	48	102	71.4	59.5	10	56.1	10	0.563		
	15	FRN11VG7S-4			DB11V-41B	1	32	110	105	87.5	10	82.5	10	0.825		
	18.5	FRN15VG7S-4			DB15V-41B	1	24	110	130	108	10	102	10	1.13		
	22	FRN18.5VG7S-4			DB18.5V-41B	1	18	110	154	128	10	121	10	1.39		
	30	FRN22VG7S-4			DB22V-41B	1	16	110	210	175	10	165	10	1.65		
	37	FRN30VG7S-4			DB30V-41B	1	10	110	259	216	10	204	10	2.25		
	45	FRN37VG7S-4			DB37V-41B	1	9.0	110	315	263	10	248	10	2.78		
	55	FRN45VG7S-4			DB45V-41B	1	8.0	110	385	321	10	303	10	3.38		
	75	FRN55VG7S-4			DB55V-41C	1	6.5	110	525	438	10	413	10	4.13		
	90	FRN75VG7S-4			DB75V-41C	1	4.7	110	630	525	10	495	10	5.63		
	110	FRN90VG7S-4			DB90V-41C	1	3.9	110	770	642	10	605	10	6.75		
	132	FRN110VG7S-4			DB110V-41C	1	3.2	110	924	770	10	726	10	8.25		
	160	FRN132VG7S-4			BU220-4C	1	DB132V-41C	1	2.6	110	1120	934	10	880	10	9.9
	200	FRN160VG7S-4			BU220-4C	1	DB160V-41C	1	2.2	110	1401	1167	10	1100	10	12.0
	220	FRN200VG7S-4			BU220-4C	2	DB200V-41C	1	3.5/2	110	1541	1284	10	1210	10	15.0
	280	FRN220VG7S-4			BU220-4C	2	DB220V-41C	1	3.2/2	110	1961	1634	10	1540	10	16.5
300	FRN250VG7S-4	BU220-4C	2	DB132V-41C	2	2.6/2	110	2101	1750	10	1650	10	18.8			
315	FRN280VG7S-4	BU220-4C	2	DB160V-41C	2	2.2/2	110	2206	1838	10	1733	10	21.0			
355	FRN315VG7S-4	BU220-4C	2	DB160V-41C	2	2.2/2	110	2486	2072	10	1953	10	23.6			
400	FRN355VG7S-4	BU220-4C	3	DB132V-41C	3	2.6/3	110	2801	2334	10	2200	10	26.6			
500	FRN400VG7S-4	BU220-4C	3	DB132V-41C	3	2.6/3	110	3501	2918	10	2750	10	30.0			
630	FRN500VG7S-4	BU220-4C	4	DB132V-41C	4	2.6/4	110	4412	3677	10	3465	10	37.5			
710	FRN630VG7S-4	BU220-4C	4	DB160V-41C	4	2.2/4	110	4972	4143	10	3905	10	47.3			

Note 1: Refer to Selection procedure and Notes on Selection.

Note 2: The braking resistor types DB160V-41C to DB220V-41C use two braking resistors when their quantity is described as "1".

(For example, if the quantity of DB160V-41C is "2", four braking resistors are used.)

# 9. Peripheral Equipment

● HT use

Table 9.4.1(3) Braking Unit and Braking Resistor (Standard)

Power supply voltage	Nominal applied motor [kW]	Inverter type	Option					Maximum braking torque [%]		Cont. braking (150% torque conversion value)		Repetitive braking (100s or less cycle)		
			Braking unit		Braking resistor									Torque [N · m]
			Type	Q'ty	Type	Q'ty	Ohmic value	50Hz	60Hz	Braking time [s]	Discharging capability [kWs]	Duty cycle [%ED]	Average loss [kW]	
Three-phase 200V	3.7	FRN3.7VG7S-2	-	-	DB3.7V-21B	1	24	150	35.3	29.4	10	27.8	10	0.278
	5.5	FRN5.5VG7S-2			DB5.5V-21B	1	16	150	52.5	43.8	10	41.3	10	0.413
	7.5	FRN7.5VG7S-2			DB7.5V-21B	1	12	150	71.6	59.7	10	56.3	10	0.563
	11	FRN11VG7S-2			DB11V-21B	1	8.0	150	105	87.5	10	82.5	10	0.825
	15	FRN15VG7S-2			DB15V-21B	1	6.0	150	143	119	10	113	10	1.13
	18.5	FRN18.5VG7S-2			DB18.5V-21B	1	4.5	150	177	147	10	139	10	1.39
	22	FRN22VG7S-2			DB22V-21B	1	4.0	150	210	175	10	165	10	1.65
	30	FRN30VG7S-2			DB30V-21B	1	2.5	150	286	239	10	225	10	2.25
	37	FRN37VG7S-2			DB37V-21B	1	2.25	150	353	294	10	278	10	2.78
	45	FRN45VG7S-2			DB45V-21B	1	2.0	150	430	358	10	338	10	3.38
55	FRN55VG7S-2	DB55V-21C	1	1.6	150	525	438	10	413	10	4.13			
Three-phase 400V	3.7	FRN3.7VG7S-4	-	-	DB3.7V-41B	1	96	150	35.3	29.4	10	27.8	10	0.278
	5.5	FRN5.5VG7S-4			DB5.5V-41B	1	64	150	52.5	43.8	10	41.3	10	0.413
	7.5	FRN7.5VG7S-4			DB7.5V-41B	1	48	150	71.6	59.7	10	56.3	10	0.563
	11	FRN11VG7S-4			DB11V-41B	1	32	150	105	87.5	10	82.5	10	0.825
	15	FRN15VG7S-4			DB15V-41B	1	24	150	143	119	10	113	10	1.13
	18.5	FRN18.5VG7S-4			DB18.5V-41B	1	18	150	177	147	10	139	10	1.39
	22	FRN22VG7S-4			DB22V-41B	1	16	150	210	175	10	165	10	1.65
	30	FRN30VG7S-4			DB30V-41B	1	10	150	286	239	10	225	10	2.25
	37	FRN37VG7S-4			DB37V-41B	1	9.0	150	353	294	10	278	10	2.78
	45	FRN45VG7S-4			DB45V-41B	1	8.0	150	430	358	10	338	10	3.38
55	FRN55VG7S-4	DB55V-41C	1	6.5	150	525	438	10	413	10	4.13			

Note 1: Refer to Selection procedure and Notes on Selection.

Note 2: When the motor speed is reduced to 75%, the maximum braking torque reaches the following rates.

- (1) Up to 22kW: 200%, 10s
- (2) 30 to 55kW: 170%, 10s

## 9.4.2 20%ED

### ● CT use

Table 9.4.2(1) Braking Unit and Braking Resistor (20%ED)

Power supply voltage	Nominal applied motor [kW]	Inverter type	Option					Maximum braking torque [%]		Cont. braking (150% torque conversion value)		Repetitive braking (100s or less cycle)		
			Braking unit		Braking resistor			Torque [N·m]		Braking time [s]	Discharging capability [kWs]	Duty cycle [%ED]	Average loss [kW]	
			Type	Q'ty	Type	Q'ty	Ohmic value	50Hz	60Hz					
Three-phase 200V	0.75	FRN0.75VG7S-2	-	-	DB2.2V-22B	1	30	150	7.16	5.97	20	33.0	20	0.330
	1.5	FRN1.5VG7S-2			DB2.2V-22B	1	30	150	14.3	11.9	20	33.0	20	0.330
	2.2	FRN2.2VG7S-2			DB2.2V-22B	1	30	150	21.0	17.5	20	33.0	20	0.330
	3.7	FRN3.7VG7S-2			DB3.7V-22B	1	24	150	35.3	29.4	20	55.5	20	0.555
	5.5	FRN5.5VG7S-2			DB5.5V-22B	1	16	150	52.5	43.8	20	82.5	20	0.825
	7.5	FRN7.5VG7S-2			DB7.5V-22B	1	12	150	71.6	59.7	20	113	20	1.13
	11	FRN11VG7S-2			DB11V-22B	1	8.0	150	105	87.5	20	165	20	1.65
	15	FRN15VG7S-2			DB15V-22B	1	6.0	150	143	119	20	225	20	2.25
	18.5	FRN18.5VG7S-2			DB18.5V-22B	1	4.5	150	177	147	20	278	20	2.78
	22	FRN22VG7S-2			DB22V-22B	1	4.0	150	210	175	20	330	20	3.30
	30	FRN30VG7S-2			DB30V-22C	1	3.0	150	286	239	20	450	20	4.50
	37	FRN37VG7S-2			DB37V-22C	1	2.4	150	353	294	20	555	20	5.55
	45	FRN45VG7S-2			DB45V-22C	1	2.0	150	430	358	20	675	20	6.75
	55	FRN55VG7S-2			DB55V-22C	1	1.6	150	525	438	20	825	20	8.25
	75	FRN75VG7S-2			BU55-2C	2	2.4/2	150	716	597	20	1125	20	11.3
90	FRN90VG7S-2	BU90-2C	2	2.0/2	150	859	716	20	1350	20	13.5			
Three-phase 400V	3.7	FRN3.7VG7S-4	-	-	DB3.7V-42B	1	96	150	35.3	29.4	20	55.5	20	0.555
	5.5	FRN5.5VG7S-4			DB5.5V-42B	1	64	150	52.5	43.8	20	82.5	20	0.825
	7.5	FRN7.5VG7S-4			DB7.5V-42B	1	48	150	71.6	59.7	20	113	20	1.13
	11	FRN11VG7S-4			DB11V-42B	1	32	150	105	87.5	20	165	20	1.65
	15	FRN15VG7S-4			DB15V-42B	1	24	150	143	119	20	225	20	2.25
	18.5	FRN18.5VG7S-4			DB18.5V-42B	1	18	150	177	147	20	278	20	2.78
	22	FRN22VG7S-4			DB22V-42B	1	16	150	210	175	20	330	20	3.30
	30	FRN30VG7S-4			DB30V-42C	1	12	150	286	239	20	450	20	4.50
	37	FRN37VG7S-4			DB37V-42C	1	9.0	150	353	294	20	555	20	5.55
	45	FRN45VG7S-4			DB45V-42C	1	8.0	150	430	358	20	675	20	6.75
	55	FRN55VG7S-4			DB55V-42C	1	6.5	150	525	438	20	825	20	8.25
	75	FRN75VG7S-4			DB75V-42C	1	4.7	150	716	597	20	1125	20	11.3
	90	FRN90VG7S-4			DB90V-42C	1	3.9	150	859	716	20	1350	20	13.5
	110	FRN110VG7S-4			DB110V-42C	1	3.2	150	1050	875	20	1650	20	16.5
	132	FRN132VG7S-4			BU220-4C	1	2.6	150	1261	1050	20	1980	20	19.8
	160	FRN160VG7S-4			BU220-4C	1	2.2	150	1528	1273	20	2400	20	24.0
	200	FRN200VG7S-4			BU220-4C	2	3.5/2	150	1910	1592	20	3000	20	30.0
	220	FRN220VG7S-4			BU220-4C	2	3.2/2	150	2101	1751	20	3300	20	33.0
	250	FRN250VG7S-4			BU220-4C	2	2.6/2	150	2388	1990	20	3750	20	37.5
	280	FRN280VG7S-4			BU220-4C	2	2.2/2	150	2674	2228	20	4200	20	42.0
315	FRN315VG7S-4	BU220-4C	2	2.2/2	150	3008	2507	20	4725	20	47.3			
355	FRN355VG7S-4	BU220-4C	3	2.6/3	150	3390	2825	20	5325	20	53.3			
400	FRN400VG7S-4	BU220-4C	3	2.6/3	150	3820	3183	20	6000	20	60.0			
500	FRN500VG7S-4	BU220-4C	4	2.6/4	150	4775	3979	20	7500	20	75.0			
630	FRN630VG7S-4	BU220-4C	4	2.2/4	150	6016	5013	20	9450	20	94.6			

Note 1: This option is manufactured on order.

Note 2: The braking unit requires a fan unit (BU-F).

Note 3: The braking resistor types DB200V-42C to DB220V-42C use two braking resistors when their quantity is described as "1".

(For example, if the quantity of DB200V-42C is "2", four braking resistors are used.)

# 9. Peripheral Equipment

● VT use

Table 9.4.2(2) Braking Unit and Braking Resistor (20%ED)

Power supply voltage	Nominal applied motor [kW]	Inverter type	Option					Maximum braking torque [%]		Cont. braking (150% torque conversion value)		Repetitive braking (100s or less cycle)				
			Braking unit		Braking resistor					Braking time [s]	Discharging capability [kWs]	Duty cycle [%ED]	Average loss [kW]			
			Type	Q'ty	Type	Q'ty	Ohmic value	Torque [N·m]								
									50Hz	60Hz						
Three-phase 200V	1.5	FRN0.75VG7S-2	-	-	DB2.2V-22B	1	30	75	7.2	6.0	20	27.8	20	0.330		
	2.2	FRN1.5VG7S-2			DB2.2V-22B	1	30	102	14.3	11.9	20	37.7	20	0.330		
	3.7	FRN2.2VG7S-2			DB2.2V-22B	1	30	89	21.0	17.5	20	32.9	20	0.330		
	5.5	FRN3.7VG7S-2			DB3.7V-22B	1	24	101	35.4	29.5	20	55.6	20	0.555		
	7.5	FRN5.5VG7S-2			DB5.5V-22B	1	16	110	52.5	43.8	20	82.5	20	0.825		
	11	FRN7.5VG7S-2			DB7.5V-22B	1	12	102	71.4	59.5	20	112	20	1.13		
	15	FRN11VG7S-2			DB11V-22B	1	8.0	110	105	87.5	20	165	20	1.65		
	18.5	FRN15VG7S-2			DB15V-22B	1	6.0	110	130	108	20	204	20	2.25		
	22	FRN18.5VG7S-2			DB18.5V-22B	1	4.5	110	154	128	20	242	20	2.78		
	30	FRN22VG7S-2			DB22V-22B	1	4.0	110	210	175	20	330	20	3.30		
	37	FRN30VG7S-2			DB30V-22C	1	3.0	110	259	216	20	407	20	4.50		
	45	FRN37VG7S-2			DB37V-22C	1	2.4	110	315	263	20	495	20	5.55		
	55	FRN45VG7S-2			DB45V-22C	1	2.0	110	385	321	20	605	20	6.75		
	75	FRN55VG7S-2			DB55V-22C	1	1.6	110	525	438	20	825	20	8.25		
90	FRN75VG7S-2	BU55-2C	2	DB37V-22C	2	2.4/2	110	630	525	20	990	20	11.3			
110	FRN90VG7S-2	BU90-2C	2	DB45V-22C	2	2.0/2	110	770	642	20	1210	20	13.5			
Three-phase 400V	5.5	FRN3.7VG7S-4	-	-	DB3.7V-42B	1	96	101	35.4	29.5	20	55.6	20	0.555		
	7.5	FRN5.5VG7S-4			DB5.5V-42B	1	64	110	52.5	43.8	20	82.5	20	0.825		
	11	FRN7.5VG7S-4			DB7.5V-42B	1	48	102	71.4	59.5	20	112	20	1.13		
	15	FRN11VG7S-4			DB11V-42B	1	32	110	105	87.5	20	165	20	1.65		
	18.5	FRN15VG7S-4			DB15V-42B	1	24	110	130	108	20	204	20	2.25		
	22	FRN18.5VG7S-4			DB18.5V-42B	1	18	110	154	128	20	242	20	2.78		
	30	FRN22VG7S-4			DB22V-42B	1	16	110	210	175	20	330	20	3.30		
	37	FRN30VG7S-4			DB30V-42C	1	12	110	259	216	20	407	20	4.50		
	45	FRN37VG7S-4			DB37V-42C	1	9.0	110	315	263	20	495	20	5.55		
	55	FRN45VG7S-4			DB45V-42C	1	8.0	110	385	321	20	605	20	6.75		
	75	FRN55VG7S-4			DB55V-42C	1	6.5	110	525	438	20	825	20	8.25		
	90	FRN75VG7S-4			DB75V-42C	1	4.7	110	630	525	20	990	20	11.3		
	110	FRN90VG7S-4			DB90V-42C	1	3.9	110	770	642	20	1210	20	13.5		
	132	FRN110VG7S-4			DB110V-42C	1	3.2	110	924	770	20	1452	20	16.5		
	160	FRN132VG7S-4			BU220-4C	1	DB132V-42C	1	2.6	110	1120	934	20	1760	20	19.8
	200	FRN160VG7S-4			BU220-4C	1	DB160V-42C	1	2.2	110	1401	1167	20	2200	20	24.0
	220	FRN200VG7S-4			BU220-4C	2	DB200V-42C	1	3.5/2	110	1541	1284	20	2420	20	30.0
	280	FRN220VG7S-4			BU220-4C	2	DB220V-42C	1	3.2/2	110	1961	1634	20	3080	20	33.0
300	FRN250VG7S-4	BU220-4C	2	DB132V-42C	2	2.6/2	110	2101	1750	20	3300	20	37.5			
315	FRN280VG7S-4	BU220-4C	2	DB160V-42C	2	2.2/2	110	2206	1838	20	3465	20	42.0			
355	FRN315VG7S-4	BU220-4C	2	DB160V-42C	2	2.2/2	110	2486	2072	20	3905	20	47.3			
400	FRN355VG7S-4	BU220-4C	3	DB132V-42C	3	2.6/3	110	2801	2334	20	4400	20	53.3			
500	FRN400VG7S-4	BU220-4C	3	DB132V-42C	3	2.6/3	110	3501	2918	20	5500	20	60.0			
630	FRN500VG7S-4	BU220-4C	4	DB132V-42C	4	2.6/4	110	4412	3677	20	6930	20	75.0			
710	FRN630VG7S-4	BU220-4C	4	DB160V-42C	4	2.2/4	110	4972	4143	20	7810	20	94.6			

Note 1: This option is manufactured on order.

Note 2: The braking unit requires a fan unit (BU-F).

Note 3: The braking resistor types DB200V-42C to DB220V-42C use two braking resistors when their quantity is described as "1".

(For example, if the quantity of DB200V-42C is "2", four braking resistors are used.)

● HT use

Table 9.4.2(3) Braking Unit and Braking Resistor (20%ED)

Power supply voltage	Nominal applied motor [kW]	Inverter type	Option					Maximum braking torque [%]		Cont. braking (150% torque conversion value)		Repetitive braking (100s or less cycle)		
			Braking unit		Braking resistor					Braking time [s]	Discharging capability [kWs]	Duty cycle [%ED]	Average loss [kW]	
			Type	Q'ty	Type	Q'ty	Ohmic value	Torque [N·m]						
								50Hz	60Hz					
Three-phase 200V	3.7	FRN3.7VG7S-2	-	-	DB3.7V-22B	1	24	150	35.3	29.4	20	55.5	20	0.555
	5.5	FRN5.5VG7S-2			DB5.5V-22B	1	16	150	52.5	43.8	20	82.5	20	0.825
	7.5	FRN7.5VG7S-2			DB7.5V-22B	1	12	150	71.6	59.7	20	113	20	1.13
	11	FRN11VG7S-2			DB11V-22B	1	8.0	150	105	87.5	20	165	20	1.65
	15	FRN15VG7S-2			DB15V-22B	1	6.0	150	143	119	20	225	20	2.25
	18.5	FRN18.5VG7S-2			DB18.5V-22B	1	4.5	150	177	147	20	278	20	2.78
	22	FRN22VG7S-2			DB22V-22B	1	4.0	150	210	175	20	330	20	3.30
	30	FRN30VG7S-2			DB30V-22C	1	3.0	150	286	239	20	450	20	4.50
	37	FRN37VG7S-2			DB37V-22C	1	2.4	150	353	294	20	555	20	5.55
	45	FRN45VG7S-2			DB45V-22C	1	2.0	150	430	358	20	675	20	6.75
55	FRN55VG7S-2	DB55V-22C	1	1.6	150	525	438	20	825	20	8.25			
Three-phase 400V	3.7	FRN3.7VG7S-4	-	-	DB3.7V-42B	1	96	150	35.3	29.4	20	55.5	20	0.555
	5.5	FRN5.5VG7S-4			DB5.5V-42B	1	64	150	52.5	43.8	20	82.5	20	0.825
	7.5	FRN7.5VG7S-4			DB7.5V-42B	1	48	150	71.6	59.7	20	113	20	1.13
	11	FRN11VG7S-4			DB11V-42B	1	32	150	105	87.5	20	165	20	1.65
	15	FRN15VG7S-4			DB15V-42B	1	24	150	143	119	20	225	20	2.25
	18.5	FRN18.5VG7S-4			DB18.5V-42B	1	18	150	177	147	20	278	20	2.78
	22	FRN22VG7S-4			DB22V-42B	1	16	150	210	175	20	330	20	3.30
	30	FRN30VG7S-4			DB30V-42C	1	12	150	286	239	20	450	20	4.50
	37	FRN37VG7S-4			DB37V-42C	1	9.0	150	353	294	20	555	20	5.55
	45	FRN45VG7S-4			DB45V-42C	1	8.0	150	430	358	20	675	20	6.75
55	FRN55VG7S-4	DB55V-42C	1	6.5	150	525	438	20	825	20	8.25			

Note 1: This option is manufactured on order.

Note 2: When the motor speed is reduced to 75%, the maximum braking torque reaches the following rates.

- (1) Up to 22kW: 200%, 10s
- (2) 30 to 55kW: 170%, 10s

# 9. Peripheral Equipment

## 9.4.3 Explanation of %ED

In developing FRENIC5000VG7S series, we changed the definition (calculation method) of %ED value, which is used to measure the braking resistor capacity.

Since the definition applied to VG7 differs from that applied to VG5 series (also all the VG series), be sure to read the following when selecting a braking resistor.

### ● FRENIC5000VG7S series

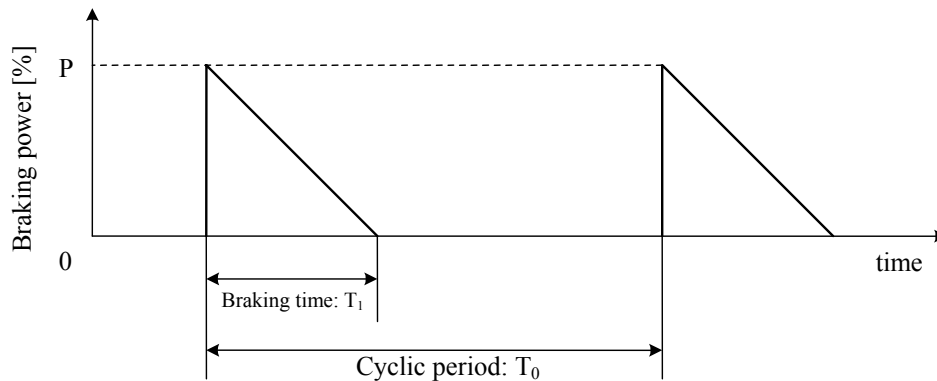


Figure 9.4.3 (a) Definition of %ED (Applied to FRENIC5000VG7S Series)

$$\text{Duty cycle \%ED} = \frac{T_1}{T_0} \times 100$$

### ● FRENIC5000VG5 series

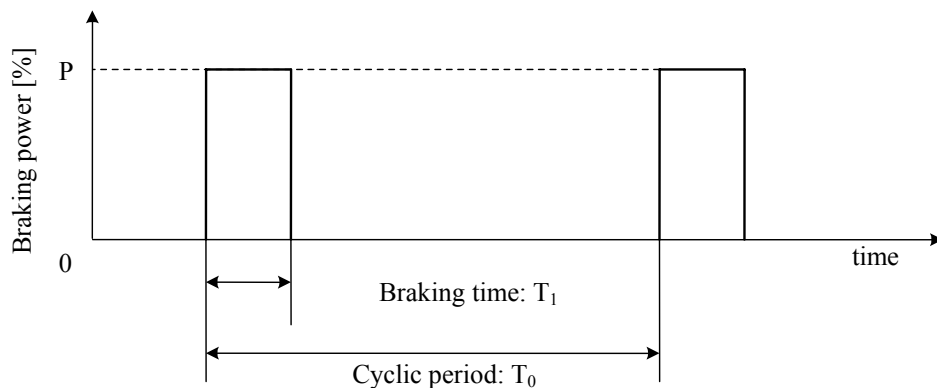


Figure 9.4.3 (b) Definition of %ED (Applied to FRENIC5000VG5 Series)

$$\text{Duty cycle \%ED} = \frac{T_1}{T_0} \times 100$$

As illustrated in the above graphs, the duty cycle of FRENIC5000VG7S series is calculated by regarding that the braking power reduces as the time elapses whereas the conventional calculation method is based on the concept that the braking force is constant during braking time. As a result, the duty cycle (%ED) of VG7 has doubled compared with that of VG5 series.

The right table shows the comparison in braking capacity.

Table 9.4.3 Braking Power Comparison Table

Series	FRENIC5000VG7S	FRENIC5000VG5
Braking power	Standard (10%ED)	5%ED
	20%ED	10%ED

We are ready to deliver FRENIC5000VG7S series with a braking capacity of 40%ED, 100%ED, or continuous rating on receiving order.

## 9.5 Rated Sensitive Current of ELCB

Table 9.5 Rated Sensitive Current of ELCB

Power supply voltage	Nominal applied motor [kW]	Inverter type		Rated current of nominal applied motor [A]	Wiring length and sensitive current					
		CT series, HT series	VT series		10m	30m	50m	100m	200m	300m
Three-phase 200V	0.75	FRN0.75VG7S-2	-	3.6						
	1.5	FRN1.5VG7S-2	FRN0.75VG7S-2	6.5						
	2.2	FRN2.2VG7S-2	FRN1.5VG7S-2	9.2						
	3.7	FRN3.7VG7S-2	FRN2.2VG7S-2	15		30mA				
	5.5	FRN5.5VG7S-2	FRN3.7VG7S-2	22						
	7.5	FRN7.5VG7S-2	FRN5.5VG7S-2	29						
	11	FRN11VG7S-2	FRN7.5VG7S-2	42				100mA		
	15	FRN15VG7S-2	FRN11VG7S-2	55						
	18.5	FRN18.5VG7S-2	FRN15VG7S-2	67					200mA	
	22	FRN22VG7S-2	FRN18.5VG7S-2	78						
	30	FRN30VG7S-2	FRN22VG7S-2	107						
	37	FRN37VG7S-2	FRN30VG7S-2	130						
	45	FRN45VG7S-2	FRN37VG7S-2	156						
	55	FRN55VG7S-2	FRN45VG7S-2	198						
	75	FRN75VG7S-2	FRN55VG7S-2	271						500mA
90	FRN90VG7S-2	FRN75VG7S-2	315							
110	-	FRN90VG7S-2	383							
Three-phase 400V	3.7	FRN3.7VG7S-4	-	7.5						
	5.5	FRN5.5VG7S-4	FRN3.7VG7S-4	11						
	7.5	FRN7.5VG7S-4	FRN5.5VG7S-4	14.5	30mA					
	11	FRN11VG7S-4	FRN7.5VG7S-4	21						
	15	FRN15VG7S-4	FRN11VG7S-4	27.5						
	18.5	FRN18.5VG7S-4	FRN15VG7S-4	34				100mA		
	22	FRN22VG7S-4	FRN18.5VG7S-4	39						
	30	FRN30VG7S-4	FRN22VG7S-4	54				200mA		
	37	FRN37VG7S-4	FRN30VG7S-4	65						
	45	FRN45VG7S-4	FRN37VG7S-4	78					500mA	
	55	FRN55VG7S-4	FRN45VG7S-4	99						
	75	FRN75VG7S-4	FRN55VG7S-4	135						
	90	FRN90VG7S-4	FRN75VG7S-4	160						
	110	FRN110VG7S-4	FRN90VG7S-4	192						
	132	FRN132VG7S-4	FRN110VG7S-4	226						1000mA
	160	FRN160VG7S-4	FRN132VG7S-4	265						(Special)
	200	FRN200VG7S-4	FRN160VG7S-4	336						
	220	FRN220VG7S-4	FRN200VG7S-4	396						
250	FRN250VG7S-4	-	-							
280	FRN280VG7S-4	FRN220VG7S-4	-							
300	-	FRN250VG7S-4	-							
315	FRN315VG7S-4	FRN280VG7S-4	-							
355	FRN355VG7S-4	FRN315VG7S-4	-				1000mA		3000mA	
400	FRN400VG7S-4	FRN355VG7S-4	-				(Special)		(Special)	
500	-	FRN400VG7S-4	-							
630	FRN630VG7S-4	FRN500VG7S-4	-							
710	-	FRN630VG7S-4	-							

Note: Rated current of nominal applied motor is based on the value of Fuji standard motor (4 pole, 200V, 50Hz).



# 9. Peripheral Equipment

## 9.6 Options

### 9.6.1 Output Circuit Noise Filter (OFL)

● 400V Series

Table 8.6.1 Output Circuit Noise Filter (OFL)

Nominal applied motor [kW]	Inverter type		Filter type	Rated current [A]	Overload capability	Inverter power input voltage	Carrier frequency allowable range [kHz]	Maximum output frequency [Hz]
	CT use, HT use	VT use						
3.7	FRN3.7VG7S-4	–	OFL-3.7-4A	9	“150%-1min” “200%-0.5s”	Three-phase 380 to 460[V] 50/60[Hz]	0.75 to 15	400
5.5	FRN5.5VG7S-4	FRN3.7VG7S-4	OFL-7.5-4A	18				
7.5	FRN7.5VG7S-4	FRN5.5VG7S-4	OFL-15-4A	30				
11	FRN11VG7S-4	FRN7.5VG7S-4		45				
15	FRN15VG7S-4	FRN11VG7S-4	OFL-22-4A	60				
18.5	FRN18.5VG7S-4	FRN15VG7S-4	OFL-30-4A	75				
22	FRN22VG7S-4	FRN18.5VG7S-4	OFL-37-4A	91	“150%-1min” “180%-0.5s”	0.75 to 10	400	
30	FRN30VG7S-4	FRN22VG7S-4	OFL-45-4A	112				
37	FRN37VG7S-4	FRN30VG7S-4	OFL-55-4A	150				
45	FRN45VG7S-4	FRN37VG7S-4	OFL-75-4A	176				
55	FRN55VG7S-4	FRN45VG7S-4	OFL-90-4A	210				
75	FRN75VG7S-4	FRN55VG7S-4	OFL-110-4A	253				
90	FRN90VG7S-4	FRN75VG7S-4	OFL-132-4A	304				
110	FRN110VG7S-4	FRN90VG7S-4	OFL-160-4A	377				
132	FRN132VG7S-4	FRN110VG7S-4	OFL-200-4A	415				
160	FRN160VG7S-4	FRN132VG7S-4	OFL-220-4A	520				
200	FRN200VG7S-4	FRN160VG7S-4	OFL-280-4A	585	“150%-1min” “180%-0.5s”	Three-phase 380 to 460[V] 50/60[Hz]	0.75 to 10	400
220	FRN220VG7S-4	FRN200VG7S-4	OFL-315-4A	650				
280	FRN280VG7S-4	FRN220VG7S-4	OFL-355-4A	740				
315	FRN315VG7S-4	FRN280VG7S-4	OFL-400-4A	960				
355	FRN355VG7S-4	FRN315VG7S-4	OFL-500-4A					
400	FRN400VG7S-4	FRN355VG7S-4						
500	–	FRN400VG7S-4						

## 9.6.2 DC Reactor (DCR)

- This Reactor is mainly used for normalizing the power supply or improving power-factor (reducing harmonics)

Table 9.6.2 DC Reactor (DCR)

Power supply voltage	Nominal applied motor [kW]	Inverter type		DC Reactor (DCR)				
		CT use, HT use	VT use	Type	Rated current [A]	Inductance [mH]	Coil resistance [mΩ]	Generated loss [W]
Three-phase 200V	0.75	FRN0.75VG7S-2	–	DCR2-0.75	5.0	7.0	123	2.8
	1.5	FRN1.5VG7S-2	FRN0.75VG7S-2	DCR2-1.5	8.0	4.0	57.5	4.6
	2.2	FRN2.2VG7S-2	FRN1.5VG7S-2	DCR2-2.2	11	3.0	43	6.7
	3.7	FRN3.7VG7S-2	FRN2.2VG7S-2	DCR2-3.7	18	1.7	21	8.8
	5.5	FRN5.5VG7S-2	FRN3.7VG7S-2	DCR2-5.5	25	1.2	16	14
	7.5	FRN7.5VG7S-2	FRN5.5VG7S-2	DCR2-7.5	34	0.8	9.7	16
	11	FRN11VG7S-2	FRN7.5VG7S-2	DCR2-11	50	0.6	7.0	27
	15	FRN15VG7S-2	FRN11VG7S-2	DCR2-15	67	0.4	4.3	27
	18.5	FRN18.5VG7S-2	FRN15VG7S-2	DCR2-18.5	81	0.35	3.1	29
	22	FRN22VG7S-2	FRN18.5VG7S-2	DCR2-22A	98	0.3	2.7	38
	30	FRN30VG7S-2	FRN22VG7S-2	DCR2-30B	136	0.23	1.10	37
	37	FRN37VG7S-2	FRN30VG7S-2	DCR2-37B	167	0.19	0.82	47
	45	FRN45VG7S-2	FRN37VG7S-2	DCR2-45B	203	0.16	0.62	52
	55	FRN55VG7S-2	FRN45VG7S-2	DCR2-55B	244	0.13	0.79	55
75	FRN75VG7S-2	FRN55VG7S-2	DCR2-75B	341	0.080	0.46	55	
90	FRN90VG7S-2	FRN75VG7S-2	DCR2-90B	410	0.067	0.28	57	
110	–	FRN90VG7S-2	DCR2-110B	526	0.055	0.22	67	
Three-phase 400V	3.7	FRN3.7VG7S-4	–	DCR4-3.7	9.0	7.0	74.5	8.1
	5.5	FRN5.5VG7S-4	FRN3.7VG7S-4	DCR4-5.5	13	4.0	43	10
	7.5	FRN7.5VG7S-4	FRN5.5VG7S-4	DCR4-7.5	18	3.5	35.5	15
	11	FRN11VG7S-4	FRN7.5VG7S-4	DCR4-11	25	2.2	23.2	21
	15	FRN15VG7S-4	FRN11VG7S-4	DCR4-15	34	1.8	18.1	28
	18.5	FRN18.5VG7S-4	FRN15VG7S-4	DCR4-18.5	41	1.4	12.1	29
	22	FRN22VG7S-4	FRN18.5VG7S-4	DCR4-22A	49	1.2	10.0	35
	30	FRN30VG7S-4	FRN22VG7S-4	DCR4-30B	71	0.86	4.00	35
	37	FRN37VG7S-4	FRN30VG7S-4	DCR4-37B	88	0.70	2.80	40
	45	FRN45VG7S-4	FRN37VG7S-4	DCR4-45B	107	0.58	1.90	44
	55	FRN55VG7S-4	FRN45VG7S-4	DCR4-55B	131	0.47	1.70	55
	75	FRN75VG7S-4	FRN55VG7S-4	DCR4-75B	178	0.335	1.40	58
	90	FRN90VG7S-4	FRN75VG7S-4	DCR4-90B	214	0.29	1.20	64
	110	FRN110VG7S-4	FRN90VG7S-4	DCR4-110B	261	0.24	0.91	73
	132	FRN132VG7S-4	FRN110VG7S-4	DCR4-132B	313	0.215	0.64	84
	160	FRN160VG7S-4	FRN132VG7S-4	DCR4-160B	380	0.177	0.52	90
	200	FRN200VG7S-4	FRN160VG7S-4	DCR4-200B	475	0.142	0.52	126
	220	FRN220VG7S-4	FRN200VG7S-4	DCR4-220B	524	0.126	0.41	131
	250	FRN250VG7S-4	–	DCR4-280B	649	0.1	0.32	150
	280	FRN280VG7S-4	FRN220VG7S-4	DCR4-280B	649	0.100	0.32	150
300	–	FRN250VG7S-4	DCR4-315B	739	0.089	0.33	190	
315	FRN315VG7S-4	FRN280VG7S-4	DCR4-315B	739	0.089	0.33	190	
355	FRN355VG7S-4	FRN315VG7S-4	DCR4-355B	833	0.079	0.28	205	
400	FRN400VG7S-4	FRN355VG7S-4	DCR4-400B	938	0.070	0.23	215	
500	–	FRN400VG7S-4	DCR4-500B	1173	0.057	0.20	292	
630	FRN630VG7S-4	FRN500VG7S-4	DCR4-630B	1477	0.044	0.18	500	
710	–	FRN630VG7S-4	DCR4-710B	1666	0.0395	0.14	540	

Note: The generated loss is an approximate value calculated by the following conditions:

- Power supply voltage is 200V or 400V, 50Hz. Voltage unbalance is 0(zero)%.
- Power transformer capacity is 500kVA, or 10 times of inverter rated capacity; which is larger one is adopted.
- The load motor is 4 pole standard motor with 100% load.
- No AC Reactor (ACR) is connected.

# 9. Peripheral Equipment

## 9.6.3 AC Reactor (ACR)

- This reactor is unnecessary unless an especially stable power supply as DC-bus connection operation (PN-connection operation) is required. Use a DC Reactor (DCR) for reducing harmonics.
- Use this reactor if the power supply voltage fluctuates excessively (for reason such as excessive voltage unbalance between phases).

Table 9.6.3 AC Reactor (ACR)

Power supply voltage	Nominal applied motor [kW]	Inverter type		AC Reactor (ACR)						
		CT use, HT use	VT use	Type	Rated current [A]	Reactance [mΩ/phase]		Coil resistance [mΩ]	Generated loss [W]	
						50[Hz]	60[Hz]			
Three-phase 200V	0.75	FRN0.75VG7S-2	–	ACR2-0.75A	5	493	592	–	12	
	1.5	FRN1.5VG7S-2	FRN0.75VG7S-2	ACR2-1.5A	8	295	354		14	
	2.2	FRN2.2VG7S-2	FRN1.5VG7S-2	ACR2-2.2A	11	213	256		16	
	3.7	FRN3.7VG7S-2	FRN2.2VG7S-2	ACR2-3.7A	17	218	153		23	
	5.5	FRN5.5VG7S-2	FRN3.7VG7S-2	ACR2-5.5A	25	87.7	105		27	
	7.5	FRN7.5VG7S-2	FRN5.5VG7S-2	ACR2-7.5A	33	65.0	78.0		30	
	11	FRN11VG7S-2	FRN7.5VG7S-2	ACR2-11A	46	45.5	54.7		37	
	15	FRN15VG7S-2	FRN11VG7S-2	ACR2-15A	59	34.8	41.8		43	
	18.5	FRN18.5VG7S-2	FRN15VG7S-2	ACR2-18.5A	74	28.6	34.3		51	
	22	FRN22VG7S-2	FRN18.5VG7S-2	ACR2-22A	87	24.0	28.8		57	
	30	FRN30VG7S-2	FRN22VG7S-2	ACR2-37	200	10.8	13.0	0.5	28.6	
	37	FRN37VG7S-2	FRN30VG7S-2						40.8	
		45	FRN45VG7S-2	FRN37VG7S-2	ACR2-55	270	7.50	9.00	0.375	47.1
		55	FRN55VG7S-2	FRN45VG7S-2						66.1
		75	FRN75VG7S-2	FRN55VG7S-2	ACR2-75	390	5.45	6.54	0.250	55.1
	90	FRN90VG7S-2	FRN75VG7S-2	ACR2-90	450	4.73	5.67	0.198	61.5	
	110	–	FRN90VG7S-2	ACR2-110	500	4.25	5.10	0.180	83.4	
Three-phase 400V	3.7	FRN3.7VG7S-4	–	ACR4-3.7A	9	512	615	–	17	
	5.5	FRN5.5VG7S-4	FRN3.7VG7S-4	ACR4-5.5A	13	349	418		22	
	7.5	FRN7.5VG7S-4	FRN5.5VG7S-4	ACR4-7.5A	18	256	307		27	
	11	FRN11VG7S-4	FRN7.5VG7S-4	ACR4-11A	24	183	219		40	
	15	FRN15VG7S-4	FRN11VG7S-4	ACR4-15A	30	139	167		46	
	18.5	FRN18.5VG7S-4	FRN15VG7S-4	ACR4-18.5A	39	114	137		57	
	22	FRN22VG7S-4	FRN18.5VG7S-4	ACR4-22A	45	95.8	115		62	
	30	FRN30VG7S-4	FRN22VG7S-4	ACR4-37	100	41.7	50	2.73	38.9	
	37	FRN37VG7S-4	FRN30VG7S-4						55.7	
		45	FRN45VG7S-4	FRN37VG7S-4	ACR4-55	135	30.8	37	1.61	50.2
		55	FRN55VG7S-4	FRN45VG7S-4						70.7
		75	FRN75VG7S-4	FRN55VG7S-4	ACR4-75 *1	160	25.8	31	1.16	65.3
		90	FRN90VG7S-4	FRN75VG7S-4	ACR4-110	250	16.7	20	0.523	42.2
		110	FRN110VG7S-4	FRN90VG7S-4						60.3
		132	FRN132VG7S-4	FRN110VG7S-4	ACR4-132 *1	270	20.8	25	0.741	119
		160	FRN160VG7S-4	FRN132VG7S-4	ACR4-220	561	10.0	12	0.236	56.4
		200	FRN200VG7S-4	FRN160VG7S-4						90.4
		220	FRN220VG7S-4	FRN200VG7S-4						107
		250	FRN250VG7S-4	–	ACR4-280	825	6.67	8	0.144	108
	280	FRN280VG7S-4	FRN220VG7S-4	ACR4-280	825	6.67	8	0.144	108	
	315	FRN315VG7S-4	FRN280VG7S-4							
	355	FRN355VG7S-4	FRN315VG7S-4							
	400	FRN400VG7S-4	FRN355VG7S-4							
	500	–	FRN400VG7S-4							

\*1) Fan cooling is required (3m/s or over).

\*2) The generated loss is an approximate value calculated by the following conditions:

- Power supply voltage is 200V or 400V, 50Hz. Voltage unbalance is 0 (zero)%.
- Power transformer capacity is 500kVA, or 10 times of inverter rated capacity; which is larger one is adopted.
- The load motor is 4 pole standard motor with 100% load.
- The inverters standard-equipped with DC power reactor (DCR) of 75kW or over are indicated as the value with DCR.

## 9.6.4 Ferrite Ring for Reducing Radio Noise (ACL)

- The applicable wire size depends on the inner diameter and installation condition of ferrite ring for reducing radio noise (ACL).

Table 9.6.4 Ferrite Ring for Reducing Radio Noise (ACL)

Type of Ferrite Ring for Reducing Radio Noise	Setting condition		Recommended wire size [mm <sup>2</sup> ]
	Q'ty [pcs]	No. of turns [time]	
ACL-40B	1	4	2.0
			3.5
			5.5
	2	2	8.0
			14

Type of Ferrite Ring for Reducing Radio Noise	Setting condition		Recommended wire size [mm <sup>2</sup> ]
	Q'ty [pcs]	No. of turns [time]	
ACL-74B	1	4	8.0
			14
	2	2	22
			38
			60
			5.5×2
			8.0×2
			14×2
			22×2
			4
	150		
	200		
	250		
	325		
	38×2		
60×2			
		100×2	
		150×2	

Note: Selected wire is supposed to be for three-phase.

# 9. Peripheral Equipment

## 9.6.5 Power Regenerative PWM Converter (RHC-A)

- For the actual connection method, refer to the instruction manual for the power regenerative PWM converter (RHC).

Table 9.6.5 Power Regenerative PWM Converter (RHC)

Power supply voltage	Nominal applied motor [kW]	Inverter type		PWM converter main unit type	Exclusive reactor type	Exclusive filter		
		CT use, HT use	VT use			Filter (Reactor type)	Filter (Capacitor type)	Filter (Resistor type)
Three-phase 200V	5.5	FRN5.5VG7S-2	FRN3.7VG7S-2	RHC7.5-2A	LR2-7.5	LFC2-7.5	CF2-7.5	RF2-7.5
	7.5	FRN7.5VG7S-2	FRN5.5VG7S-2					
	11	FRN11VG7S-2	FRN7.5VG7S-2	RHC15-2A	LR2-15	LFC2-15	CF2-15	RF2-15
	15	FRN15VG7S-2	FRN11VG7S-2					
	18.5	FRN18.5VG7S-2	FRN15VG7S-2	RHC22-2A	LR2-22	LFC2-22	CF2-22	RF2-22
	22	FRN22VG7S-2	FRN18.5VG7S-2					
	30	FRN30VG7S-2	FRN22VG7S-2	RHC37-2A	LR2-37L	LFC2-37	CF2-37	GRZG400-1Ω
	37	FRN37VG7S-2	FRN30VG7S-2					
	45	FRN45VG7S-2	FRN37VG7S-2	RHC55-2A	LR2-55L	LFC2-55	CF2-55	GRZG400-0.6Ω
	55	FRN55VG7S-2	FRN45VG7S-2					
	75	FRN75VG7S-2	FRN55VG7S-2	*	*	*	*	*
90	FRN90VG7S-2	FRN75VG7S-2						
110	-	FRN90VG7S-2						
Three-phase 400V	5.5	FRN5.5VG7S-4	FRN3.7VG7S-4	RHC7.5-4A	LR4-7.5	LFC4-7.5	CF4-7.5	RF4-7.5
	7.5	FRN7.5VG7S-4	FRN5.5VG7S-4					
	11	FRN11VG7S-4	FRN7.5VG7S-4	RHC15-4A	LR4-15	LFC4-15	CF4-15	RF4-15
	15	FRN15VG7S-4	FRN11VG7S-4					
	18.5	FRN18.5VG7S-4	FRN15VG7S-4	RHC22-4A	LR4-22	LFC4-22	CF4-22	RF4-22
	22	FRN22VG7S-4	FRN18.5VG7S-4					
	30	FRN30VG7S-4	FRN22VG7S-4	RHC37-4A	LR4-37L	LFC4-37	CF4-37	GRZG400-4Ω
	37	FRN37VG7S-4	FRN30VG7S-4					
	45	FRN45VG7S-4	FRN37VG7S-4	RHC55-4A	LR4-55L	LFC4-55	CF4-55	GRZG400-2.4Ω
	55	FRN55VG7S-4	FRN45VG7S-4					
	75	FRN75VG7S-4	FRN55VG7S-4	RHC75-4A	LR4-75L	LFC4-75	CF4-75	RF4-75
	90	FRN90VG7S-4	FRN75VG7S-4	RHC110-4A	LR4-110L	LFC4-110	CF4-110	RF4-110
	110	FRN110VG7S-4	FRN90VG7S-4					
	132	FRN132VG7S-4	FRN110VG7S-4	RHC160-4A	LR4-160L	LFC4-160	CF4-160	RF4-160
	160	FRN160VG7S-4	FRN132VG7S-4					
200	FRN200VG7S-4	FRN160VG7S-4	RHC220-4A	LR4-220L	LFC4-220	CF4-220	RF4-220	
220	FRN220VG7S-4	FRN200VG7S-4						
280	FRN280VG7S-4	FRN220VG7S-4	*	*	*	*	*	
315	FRN315VG7S-4	FRN280VG7S-4						
355	FRN355VG7S-4	FRN315VG7S-4						
400	FRN400VG7S-4	FRN355VG7S-4						

Ask us for the converter data marked with \*.

## 9.6.6 Power Supply Regeneration PWM Converter (RHC-C)

- Device configuration list  
CT use

Voltage	Applied motor [kW]	PWM converter model	Boosting reactor		Filtering reactor		Filtering capacitor		Filtering resistance		Charging resistance		Fuse		Charging circuit contactor		Power supply contactor		Filtering circuit contactor	
			(Lr)	Q'ty	(Lf)	Q'ty	(Cf)	Q'ty	(Rf)	Q'ty	(R0)	Q'ty	(F)	Q'ty	(73)	Q'ty	(52)	Q'ty	(6F)	Q'ty
200V Series	7.5	RHC7.5-2C	LR2-7.5C	1	LFC2-7.5C	1	CF2-7.5C	1	GRZG80 0.42Ω	3	80W7.5Ω (HF5C5504)	3	CR2LS-50/UL	2	SC-5-1	1				
	11	RHC11-2C	LR2-15C	1	LFC2-15C	1	CF2-15C	1	GRZG150 0.2Ω	3		3	CR2LS-75/UL	2	SC-N1	1				
	15	RHC15-2C										2	SC-N2	1						
	18.5	RHC18.5-2C	LR2-22C	1	LFC2-22C	1	CF2-22C	1	GRZG200 0.13Ω	3	GRZG120 2Ω	3	CR2LS-100/UL	2	SC-N3	1				
	22	RHC22-2C										2								
	30	RHC30-2C	LR2-37C	1	LFC2-37C	1	CF2-37C	1	GRZG400 0.1Ω	3		3	CR2L-150/UL	2	SC-N4	1				
	37	RHC37-2C										2	SC-N5	1						
	45	RHC45-2C										LR2-55C	1	LFC2-55C	1	CF2-55C	1	GRZG400 0.1Ω	3	
	55	RHC55-2C	2	SC-N8	1															
	75	RHC75-2C	LR2-75C	1	LFC2-75C	1	CF2-75C	1	GRZG400 0.1Ω	3				SC-N11	1					
90	RHC90-2C	LR2-110C	1	LFC2-110C	1	CF2-110C	1	GRZG400 0.12Ω (2 in parallel)	6	GRZG400 1Ω	3	A50P600-4	2							
400V Series	7.5	RHC7.5-4C	LR4-7.5C	1	LFC4-7.5C	1	CF4-7.5C	1	GRZG80 1.74Ω	3	TK50B 30ΩJ (HF5B0416)	3	CR6L-30/UL	2	SC-05	1				
	11	RHC11-4C	LR4-15C	1	LFC4-15C	1	CF4-15C	1	GRZG150 0.79Ω	3		3	CR6L-50/UL	2	SC-4-0	1				
	15	RHC15-4C										2	SC-5-1	1						
	18.5	RHC18.5-4C	LR4-22C	1	LFC4-22C	1	CF4-22C	1	GRZG200 0.53Ω	3	80W 7.5Ω (HF5C5504)	3	CR6L-75/UL	2	SC-N1	1				
	22	RHC22-4C										2								
	30	RHC30-4C	LR4-37C	1	LFC4-37C	1	CF4-37C	1	GRZG400 0.38Ω	3		3	CR6L-100/UL	2	SC-N2	1				
	37	RHC37-4C										2	SC-N2S	1						
	45	RHC45-4C										LR4-55C	1	LFC4-55C	1	CF4-55C	1	GRZG400 0.26Ω	3	
	55	RHC55-4C	2	SC-N4	1															
	75	RHC75-4C	LR4-75C	1	LFC4-75C	1	CF4-75C	1	GRZG400 0.38Ω	3				SC-N5	1					
	90	RHC90-4C	LR4-110C	1	LFC4-110C	1	CF4-110C	1	GRZG400 0.53Ω (2 in parallel)	6		6	CR6L-300/UL	2	SC-N7	1				
	110	RHC110-4C										2	SC-N8	1						
	132	RHC132-4C	LR4-160C	1	LFC4-160C	1	CF4-160C	1	RF4-160C	1	GRZG120 2Ω	3	A50P400-4	2						
	160	RHC160-4C										2	SC-N11	1						
	200	RHC200-4C										LR4-220C	1	LFC4-220C	1	CF4-220C	1	RF4-220C	1	GRZG400 1Ω
	220	RHC220-4C	2	A70QS800-4	2															
	280	RHC280-4C	LR4-280C	1	LFC4-280C	1	CF4-280C	1	RF4-280C	1	GRZG400 1Ω (2 in parallel)	6		SC-N3	1	SC-N14	1	SC-N4	1	
	315	RHC315-4C	LR4-315C	1	LFC4-315C	1	CF4-315C	1	RF4-315C	1		2	A70P1600-4TA	2						
355	RHC355-4C	LR4-355C	1	LFC4-355C	1	CF4-355C	1	RF4-355C	1											
400	RHC400-4C	LR4-400C	1	LFC4-400C	1	CF4-400C	1	RF4-400C	1						SC-N16	1				
500	RHC500-4C	LR4-500C	1	LFC4-500C	1	CF4-500C	1	RF4-500C	1	GRZG400 1Ω (2 in parallel)	6	A70P1600-4TA	2	SC-N3	1	SC-N11	3	SC-N4	1	
630	RHC630-4C	LR4-630C	1	LFC4-630C	1	CF4-630C	1	RF4-630C	1		6	A70P2000-4	2		SC-N12	3	SC-N7	1		
710	RHC710B-4C	LR4-710C	1	LFC4-710C	1	CF4-710C	1	RF4-710C	1		6	HF5G2655	2	SC-N4	1		SC-N8	1		
800	RHC800B-4C	LR4-800C	1	LFC4-800C	1	CF4-800C	1	RF4-800C	1		6		2		SC-N14	3				

# 9. Peripheral Equipment

VT use

Voltage	Applied motor [kW]	PWM converter model	Boosting reactor		Filtering reactor		Filtering capacitor		Filtering resistance		Charging resistance		Fuse		Charging circuit contactor		Power supply contactor		Filtering circuit contactor			
			(Lr)	Q'ty	(Lf)	Q'ty	(R0)	Q'ty	(F)	Q'ty	(R0)	Q'ty	(F)	Q'ty	(73)	Q'ty	(52)	Q'ty	(6F)	Q'ty		
200V Series	11	RHC7.5-2C	LR2-15C	1	LFC2-15C	1	CF2-15C	1	GRZG150 0.2Ω	3	80W7.5Ω (HF5C5504)	3	CR2LS-50/UL	2	SC-N1	1						
	15	RHC11-2C											CR2LS-75/UL	2	SC-N2	1						
	18.5	RHC15-2C	LR2-22C	1	LFC2-22C	1	CF2-22C	1	GRZG200 0.13Ω	3	GRZG120 2Ω	3	CR2LS-100/UL	2	SC-N3	1						
	22	RHC18.5-2C											CR2L-150/UL	2	SC-N4	1						
	30	RHC22-2C	LR2-37C	1	LFC2-37C	1	CF2-37C	1	GRZG400 0.1Ω	3	GRZG120 2Ω	3	CR2L-200/UL	2	SC-N5	1						
	37	RHC30-2C											CR2L-260/UL	2	SC-N7	1						
	45	RHC37-2C	LR2-55C	1	LFC2-55C	1	CF2-55C	1	GRZG400 0.1Ω	3	GRZG120 2Ω	3	SC-N8	1								
	55	RHC45-2C											CR2L-400/UL	2	SC-N11	1						
	75	RHC55-2C	LR2-75C	1	LFC2-75C	1	CF2-75C	1	GRZG400 0.1Ω	3	GRZG120 2Ω	3	CR2L-400/UL	2	SC-N11	1						
	90	RHC75-2C	LR2-110C	1	LFC2-110C	1	CF2-110C	1	GRZG400 0.12Ω (2 in parallel)	6	GRZG400 1Ω	3	A50P600-4	2	SC-N12	1						
110	RHC90-2C																					
400V Series	11	RHC7.5-4C	LR4-15C	1	LFC4-15C	1	CF4-15C	1	GRZG150 0.79Ω	3	TK50B 30ΩJ (HF5B0416)	3	CR6L-30/UL	2	SC-4-0	1						
	15	RHC11-4C											CR6L-50/UL	2	SC-5-1	1						
	18.5	RHC15-4C	LR4-22C	1	LFC4-22C	1	CF4-22C	1	GRZG200 0.53Ω	3	TK50B 30ΩJ (HF5B0416)	3	SC-N1	1								
	22	RHC18.5-4C											CR6L-75/UL	2	SC-N2	1						
	30	RHC22-4C	LR4-37C	1	LFC4-37C	1	CF4-37C	1	GRZG400 0.38Ω	3	TK50B 30ΩJ (HF5B0416)	3	CR6L-100/UL	2	SC-N2S	1						
	37	RHC30-4C											CR6L-150/UL	2	SC-N3	1						
	45	RHC37-4C	LR4-55C	1	LFC4-55C	1	CF4-55C	1	GRZG400 0.26Ω	3	TK50B 30ΩJ (HF5B0416)	3	SC-N4	1								
	55	RHC45-4C											CR6L-200/UL	2	SC-N5	1						
	75	RHC55-4C	LR4-75C	1	LFC4-75C	1	CF4-75C	1	GRZG400 0.38Ω	3	TK50B 30ΩJ (HF5B0416)	3	CR6L-200/UL	2	SC-N5	1						
	90	RHC75-4C	LR4-110C	1	LFC4-110C	1	CF4-110C	1	GRZG400 0.53Ω (2 in parallel)	6	TK50B 30ΩJ (HF5B0416)	3	SC-N7	1								
	110	RHC90-4C											CR6L-300/UL	2	SC-N8	1						
	132	RHC110-4C	LR4-160C	1	LFC4-160C	1	CF4-160C	1	RF4-160C	1	GRZG120 2Ω	3	A50P400-4	2	SC-N11	1						
	160	RHC132-4C											A50P600-4	2	SC-N12	1						
	200	RHC160-4C	LR4-220C	1	LFC4-220C	1	CF4-220C	1	RF4-220C	1	GRZG400 1Ω	3	A70QS800-4	2	SC-N14	1						
	220	RHC200-4C																				
	280	RHC220-4C	LR4-280C	1	LFC4-280C	1	CF4-280C	1	RF4-280C	1	GRZG400 1Ω	3	SC-N3	1	SC-N14	1					SC-N4	1
	315	RHC280-4C	LR4-315C	1	LFC4-315C	1	CF4-315C	1	RF4-315C	1	GRZG400 1Ω (2 in parallel)	6	A70P1600-4TA	2	SC-N16	1						
355	RHC315-4C	LR4-355C	1	LFC4-355C	1	CF4-355C	1	RF4-355C	1	GRZG400 1Ω (2 in parallel)	6	A70P1600-4TA	2	SC-N11	3							
400	RHC355-4C	LR4-400C	1	LFC4-400C	1	CF4-400C	1	RF4-400C	1	GRZG400 1Ω (2 in parallel)	6	A70P1600-4TA	2	SC-N11	3							
500	RHC400-4C	LR4-500C	1	LFC4-500C	1	CF4-500C	1	RF4-500C	1	GRZG400 1Ω (2 in parallel)	6	A70P1600-4TA	2	SC-N11	3							

## 9.6.7 Loss Generated by Inverter Unit

Power supply	Unit inverter model	Loss caused by discrete unit [W]					
		CT use		VT use		HT use	
		Low carrier *1	High carrier *2	Low carrier *1	High carrier *2	Low carrier *1	High carrier *2
3-phase 200V	FRN0.75VG7S-2	95	110	125	140	—	—
	FRN1.5VG7S-2	125	150	160	180	—	—
	FRN2.2VG7S-2	160	195	250	280	—	—
	FRN3.7VG7S-2	210	280	320	370	180	230
	FRN5.5VG7S-2	310	400	440	510	240	320
	FRN7.5VG7S-2	380	490	560	640	300	390
	FRN11VG7S-2	500	650	700	810	390	520
	FRN15VG7S-2	630	840	780	920	490	670
	FRN18.5VG7S-2	840	1000	1000	1100	710	850
	FRN22VG7S-2	1000	1200	1300	1400	850	1000
	FRN30VG7S-2	1150	1400	1550	1700	950	1150
	FRN37VG7S-2	1400	1750	1800	2050	1150	1450
	FRN45VG7S-2	1700	2050	2100	2350	1450	1800
	FRN55VG7S-2	1950	2400	2800	3100	1750	2150
	FRN75VG7S-2	2750 *4	3100	3350 *5	3500	—	—
	FRN90VG7S-2	3250 *4	3650	3950 *5	4150	—	—
3-phase 400V	FRN3.7VG7S-4	160	240	210	280	140	210
	FRN5.5VG7S-4	210	330	280	370	180	280
	FRN7.5VG7S-4	270	430	380	500	220	360
	FRN11VG7S-4	330	530	430	590	270	430
	FRN15VG7S-4	420	690	520	710	340	560
	FRN18.5VG7S-4	650	850	700	850	540	730
	FRN22VG7S-4	750	1050	950	1250	650	1000
	FRN30VG7S-4	900	1400	1300	1600	750	1200
	FRN37VG7S-4	1000	1700	1450	1900	850	1450
	FRN45VG7S-4	1150	1950	1700	2200	1000	1650
	FRN55VG7S-4	1400	2300	2050	2700	1150	1900
	FRN75VG7S-4	2000 *4	2800	2650 *5	2950	—	—
	FRN90VG7S-4	2350 *4	3250	2950 *5	3300	—	—
	FRN110VG7S-4	2600 *4	3600	3300 *5	3750	—	—
	FRN132VG7S-4	2950 *4	4150	3900 *5	4450	—	—
	FRN160VG7S-4	3450 *4	4900	4450 *5	5150	—	—
	FRN200VG7S-4	3950 *4	5750	4950 *5	5700	—	—
	FRN220VG7S-4	4400 *4	6350	5800 *5	6700	—	—
FRN280VG7S-4	5550 *4	8050	6500 *5	7550	—	—	
FRN315VG7S-4	6250 *4	9000	7250 *5	8450	—	—	
FRN355VG7S-4	6950 *4	10200	8250 *5	9550	—	—	
FRN400VG7S-4	7850 *4	11400	10400 *5	12100	—	—	

Note: The carrier frequencies are listed below.

\*1: 2kHz, \*2: 15kHz, \*3: 10 kHz, \*4: 10kHz, \*5: 6kHz



# 9. Peripheral Equipment

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## 9.7 Compliance with Standards

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### 9.7.1 Compliance with UL/cUL Standard

#### 9.7.1.1 General

The UL standard stands for Underwriters Laboratories Inc. and it is an American safety standard intended to avoid fire and other accidents, thereby protecting users, service personnel and other general people. The cUL standard is established so that UL complies with the CSA standard. The cUL-certified product is equivalent to a CSA-certified product.

#### 9.7.1.2 Caution

To use our product as a UL/cUL-certified product, refer to the Requirements on page 8.

### 9.7.2 Compliance with European Standards

The CE mark attached on our product indicates compliance with Electromagnetic Compatibility Directives 89/336/EEC and Low Voltage Directives 73/23/EEC announced by Council of the European Union.

Complying standard

- EN61800-3: 1997
- EN50178: 1997

The FRENIC 5000 VG7S Series models complying with the above standards are only those in the 400V class. The 200V class is out of compliance. Among 400V class, CT/HT use 18.5kW and VT use 22kW are out of compliance. If you need a compliant product, use a larger capacity (CT/HT use 22kW or VT use 30kW).

### 9.7.3 Compliance with Low Voltage Directives

#### 9.7.3.1 General

The inverter is applicable to the European Low Voltage Directive. Our product is certified by a European auditor to be compliant with the standard and therefore we declare compliance with the Low Voltage Directives.

#### 9.7.3.2 Caution

To use our product as one certified to the European Low Voltage Directives, note Caution on page 13.

### 9.7.4 Compliance with EMC Standard

#### 9.7.4.1 General

This CE marking does not guarantee compliance of the entire equipment housing our product with the EMC Directive. Therefore indication of the CE marking on the entire equipment is responsible to the manufacturer of the machine. The reason is that the CE marking of our product is indicated under the condition that the product is operated so that a certain requirements are satisfied. Operating it while satisfying the requirements is responsible to the manufacturer of the complete machine.

In general, mechanical equipment includes various devices other than our product. The manufacturer of the machine must consider the entire equipment.

In addition to our inverter “FRENIC 5000 VG7S” Series, the above-mentioned conditions include combination of an RFI filter recommended in this supplementary document, installation in a metallic control panel, and installation according to the description given in this supplementary document,.

#### 9.7.4.2 RFI Filter

The model of the RFI filter we recommend and applicability of the inverter are shown in Table 9-7-1. The filter is developed for our inverters, and the inverter is installed on the side of the main body of the filter.

### 9.7.4.3 Recommended Installation Method

Follow the procedure below to perform wiring of the inverter, filter and motor. The wiring work must be conducted by an electrician. Installation following the procedure below is necessary so that the system complies with the EMC Directive.

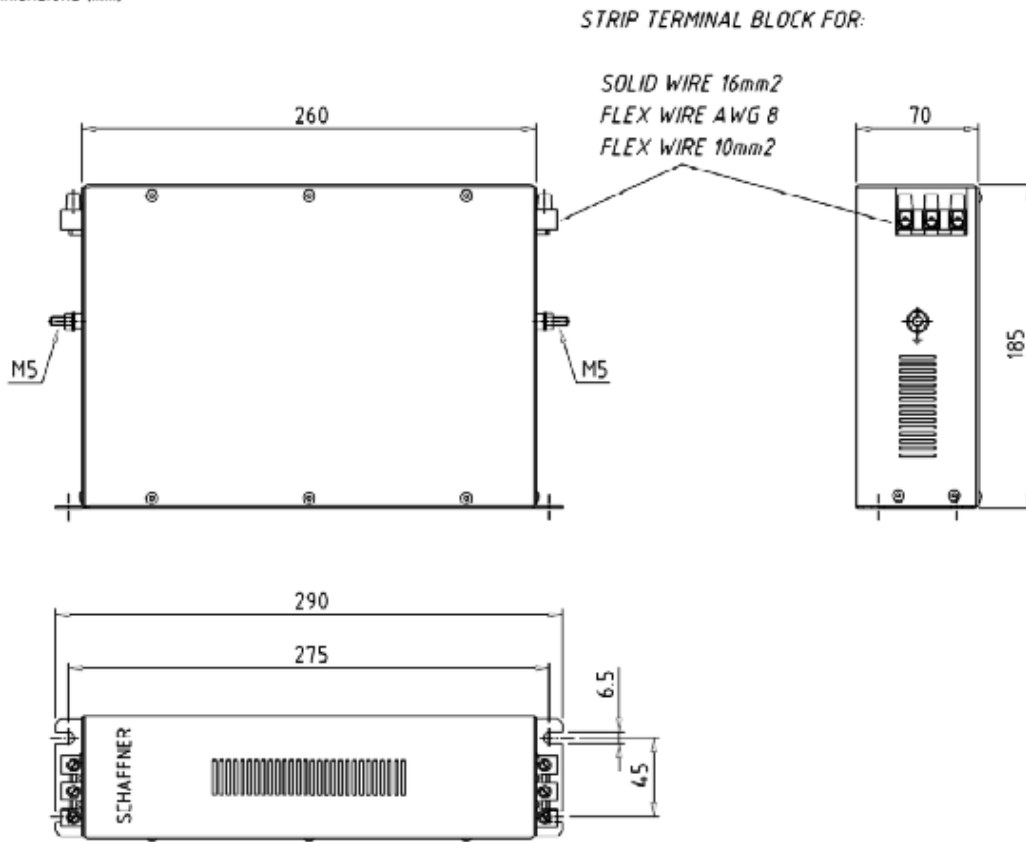
- 1) First, check if the rated current, voltage and model of the filter are correct.
- 2) Drill holes on the control panel where the filter is installed, according to the installation position of the filter. As well, to improve the grounding resistance between the filter and panel, peel off the paint around the mounting holes so that the metallic face makes sufficient contact with the installation face of the filter.
- 3) Connect the input power supply with the input terminal (LINE) of the filter and connect the grounding wire with the grounding stud. Next, connect the output terminal (LOAD) of the filter with the power supply input terminal of the inverter at as short a distance as possible.
- 4) Connect the output cables of the inverter, using shielded cables. The wiring length should be as short as possible. Connect the shield both on the motor side and on the inverter side to the corresponding grounding terminals. Electrically connect the shield of the shielded cable at the inlet of the control panel so that the entire periphery of the hole is completely blocked.
- 5) If a ferrite core is attached, pass the wiring through the ferrite core. The wiring method varies according to the inverter model. Refer to Fig. 9-7-8, 9-7-9 or 9-7-10.
- 6) Connect the control terminals of the inverter, using shielded cables. Ground the shield of the shielded cable securely. The wiring length of each cable should be as short as possible. Route the filter cables, inverter cables and motor cables as far from the power supply as possible.

Table 9-7-1 Dimensions of RFI filter

Model of filter	Applicable inverter model	Rated current	Max. rating	Dimensions L,W,H[mm]	Mounting pitch Y,X[mm]	Mounting hole	Ferrite core (qty)			Fig.
							Main circuit cable	Control terminal cable	Communication cable	
FS5941-40-47	FRN3.7VG7S-4(CT/HT/VT) FRN5.5VG7S-4(CT/HT/VT) FRN7.5VG7S-4(CT/HT/VT)	40A	3-phase 480VAC	290x70 x185	275x45	M6(4)	-	-	-	9-7-1
FS5941-60-52	FRN11VG7S-4(CT/HT/VT) FRN15VG7S-4(CT/HT/VT)	60A		329x80 x185	314x55	M6(4)	ACL-74B (1)	ZCAT203 2-0930 (2)	ZCAT203 2-0930 (2)	9-7-2 9-7-3
FS5941-86-52	FRN22VG7S-4(CT/HT/VT)	86A		-	-	-	-	-	-	9-7-2
RF3100-F11	FRN30VG7S-4(CT/HT)	100A		435x200 x130	408x166	M6(4)	-	-	-	9-7-4
RF3180-F11	FRN30VG7S-4(VT) FRN37VG7S-4(CT/HT/VT) FRN45VG7S-4(CT/HT/VT) FRN55VG7S-4(CT/HT/VT) FRN75VG7S-4(CT/VT) FRN90VG7S-4(CT)	180A		495x200 x160	468x166	M6(4)	-	-	-	
RF3280-F11	FRN90VG7S-4(VT) FRN110VG7S-4(CT/VT) FRN132VG7S-4(CT)	280A		250x587 x205	560x85	M6(6)	-	-	-	
RF3400-F11	FRN132VG7S-4(VT) FRN160VG7S-4(CT/VT) FRN200VG7S-4(CT/VT) FRN220VG7S-4(CT)	400A		250x587 x205	560x85	M6(6)	-	-	-	
RF3880-F11	FRN220VG7S-4(VT) FRN280VG7S-4(CT/VT) FRN315VG7S-4(CT/VT) FRN355VG7S-4(CT/VT) FRN400VG7S-4(CT/VT)	880A	688x364 x180	648x150	M6(6)	-	-	-	9-7-6	
						F200160 (3)	-	-	9-7-6 9-7-7	

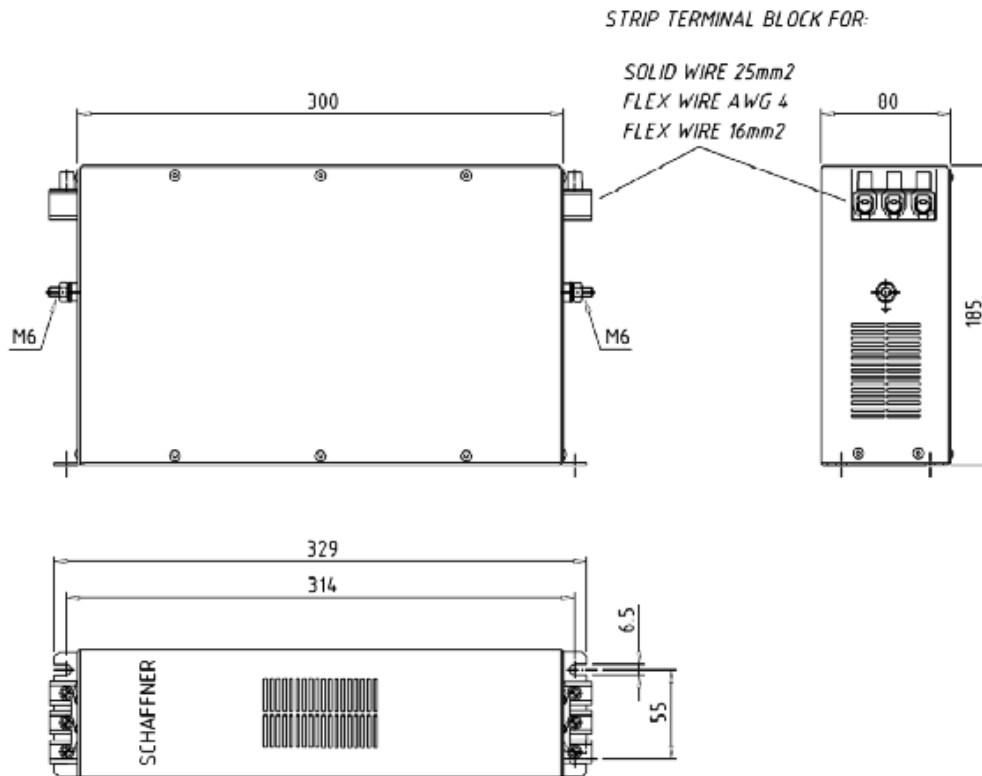
# 9. Peripheral Equipment

Dimensions (mm)

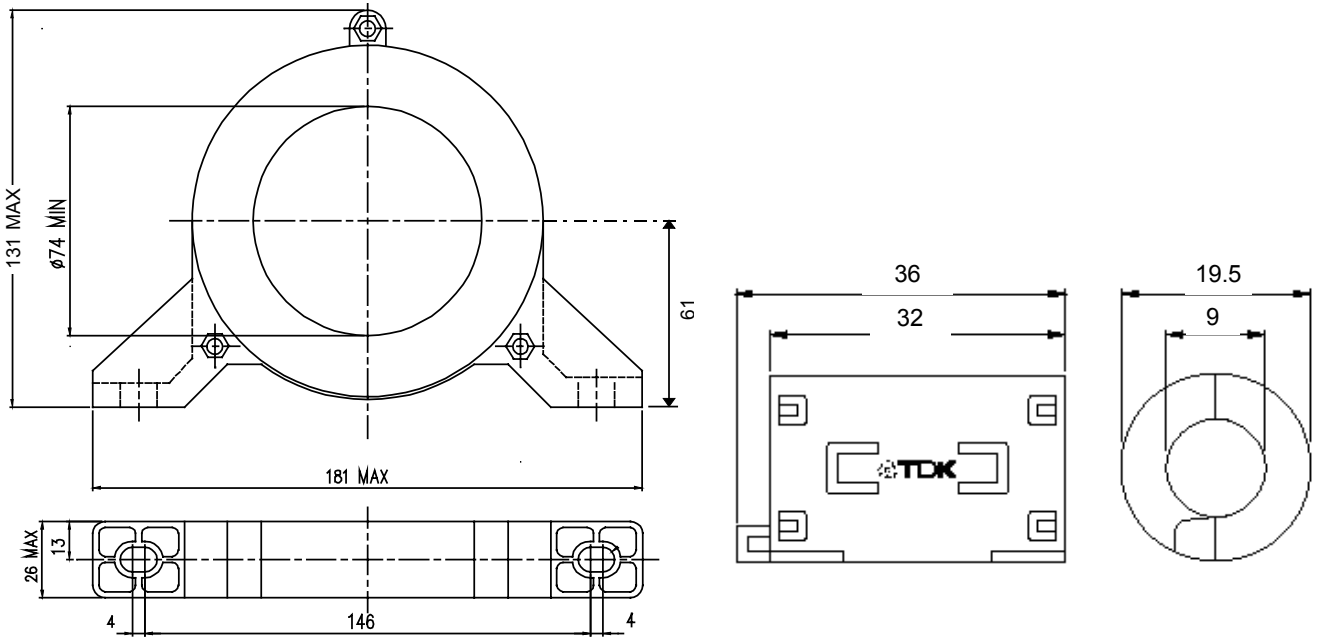


(FS5941-40-47)  
Fig. 9-7-1

Dimensions (mm)



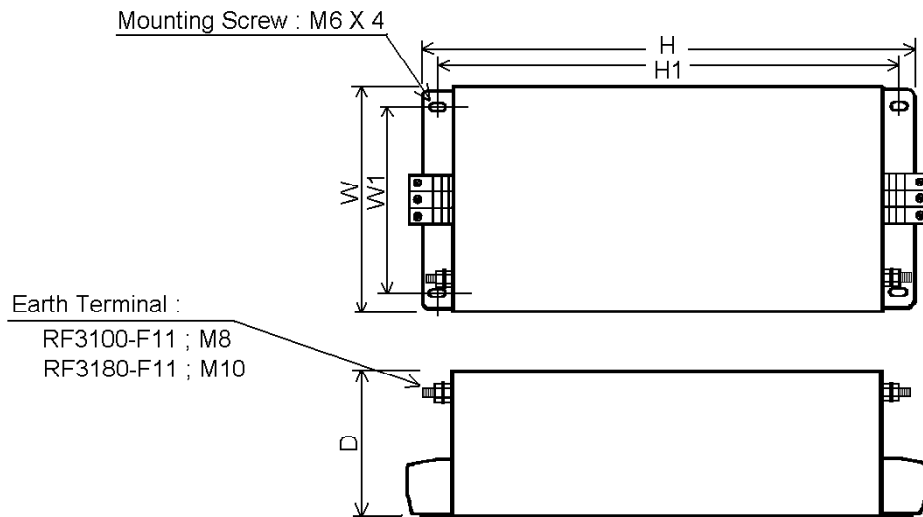
(FS5941-60-52,FS5941-86-52)  
Fig. 9-7-2



(ACL-74B)

(ZCAT2032-0930)

Fig. 9-7-3



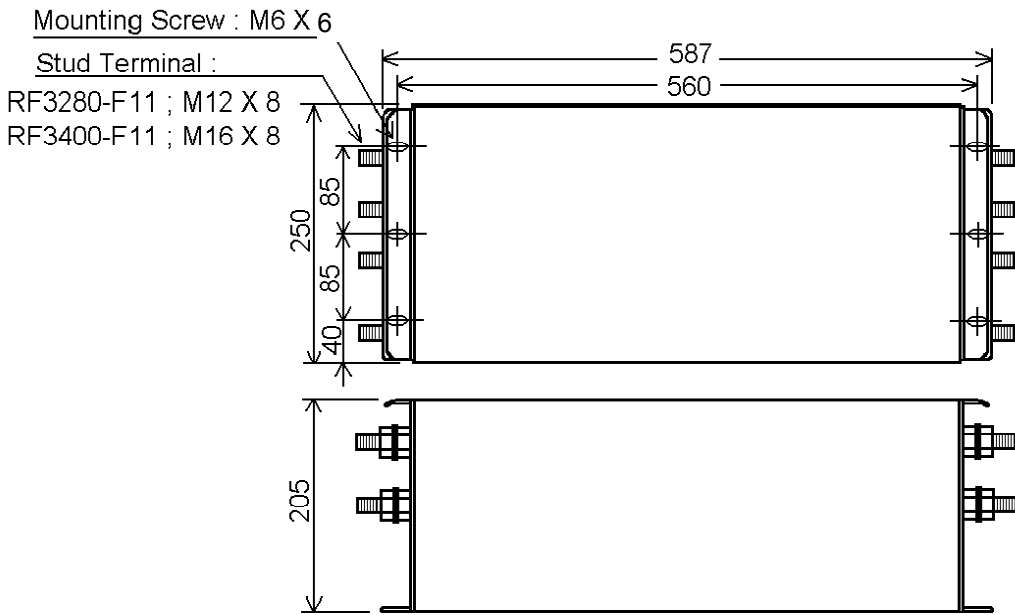
Earth Terminal :  
 RF3100-F11 ; M8  
 RF3180-F11 ; M10

Filter model	Dimensions [mm]				
	W	W1	H	H1	D
RF3100-F11	200	166	435	408	130
RF3180-F11	200	166	495	468	160

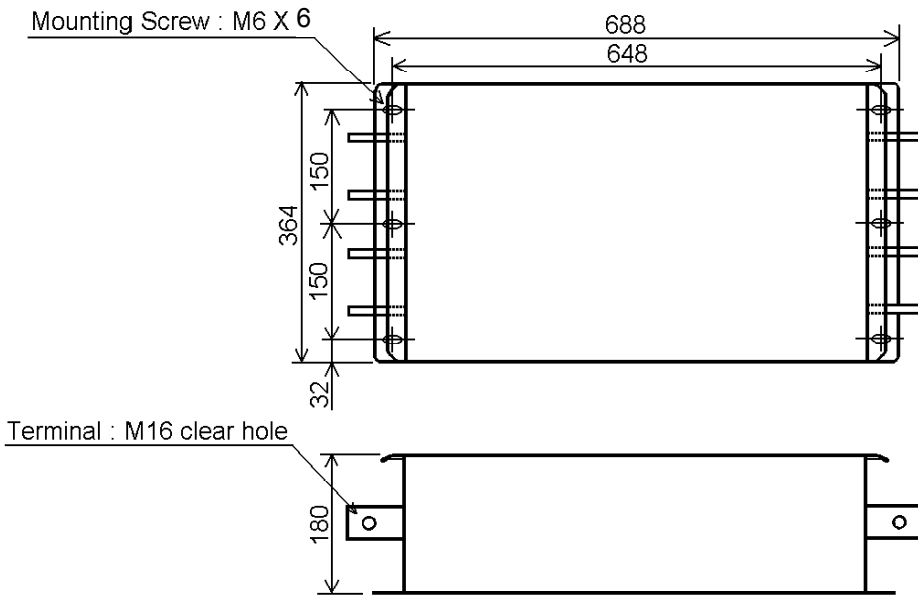
(RF3100-F11, RF3180-F11)

Fig. 9-7-4

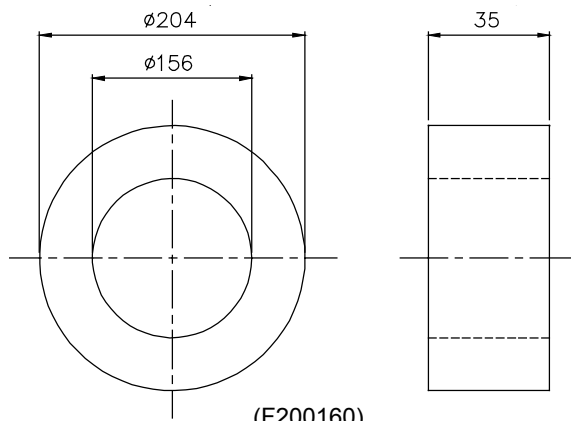
# 9. Peripheral Equipment



(RF3280-F11, RF3400-F11)  
Fig. 9-7-5



(RF3880-F11)  
Fig. 9-7-6



(F200160)

Metallic control panel

Fig. 9-7-7

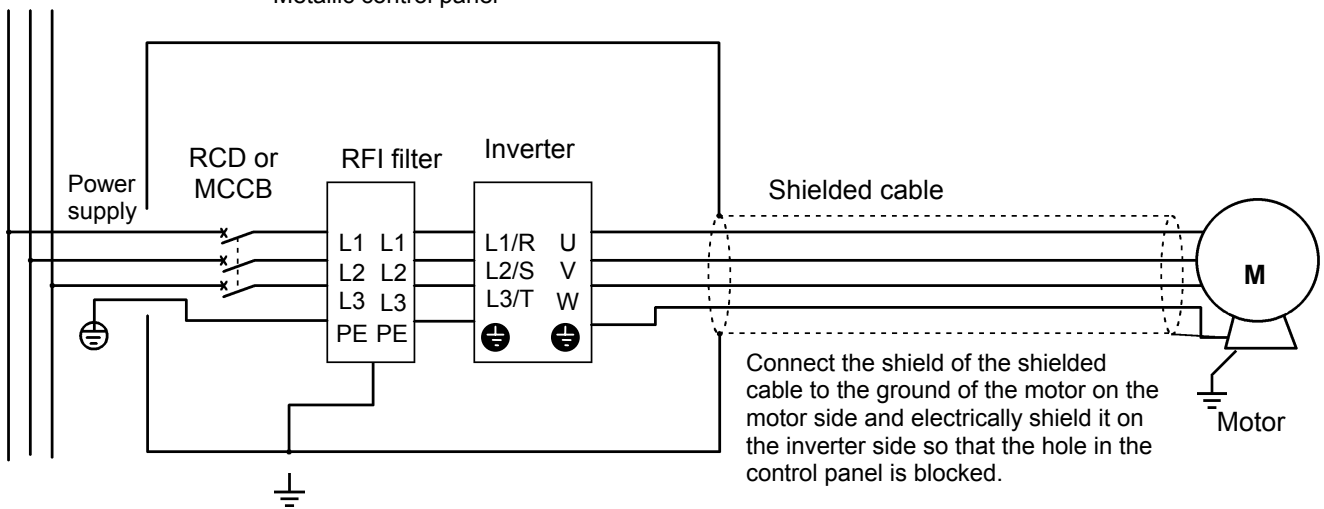


Fig. 9-7-8 Recommend installation and wiring diagram  
 In case of FRN3.7VG7S-4 to FRN7.5VG7S-4  
 FRN22VG7S-4 to FRN220VG7S-4

# 9. Peripheral Equipment

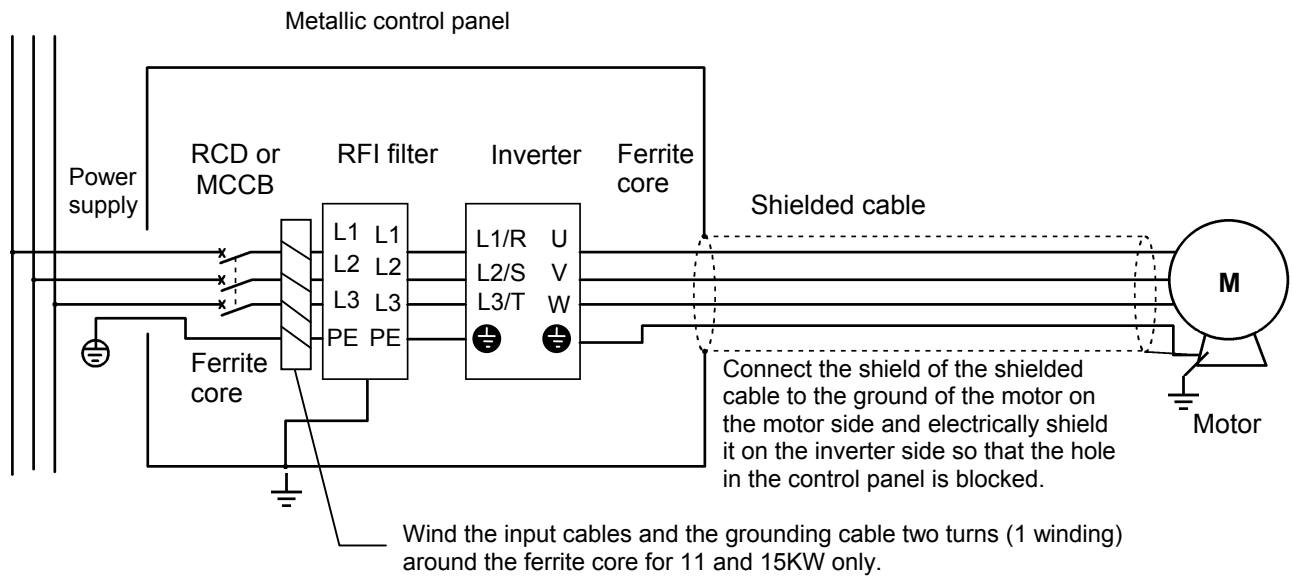


Fig. 9-7-9 Recommended installation and wiring diagram  
 · In case of FRN11VG7S-4 to FRN15VG7S-4

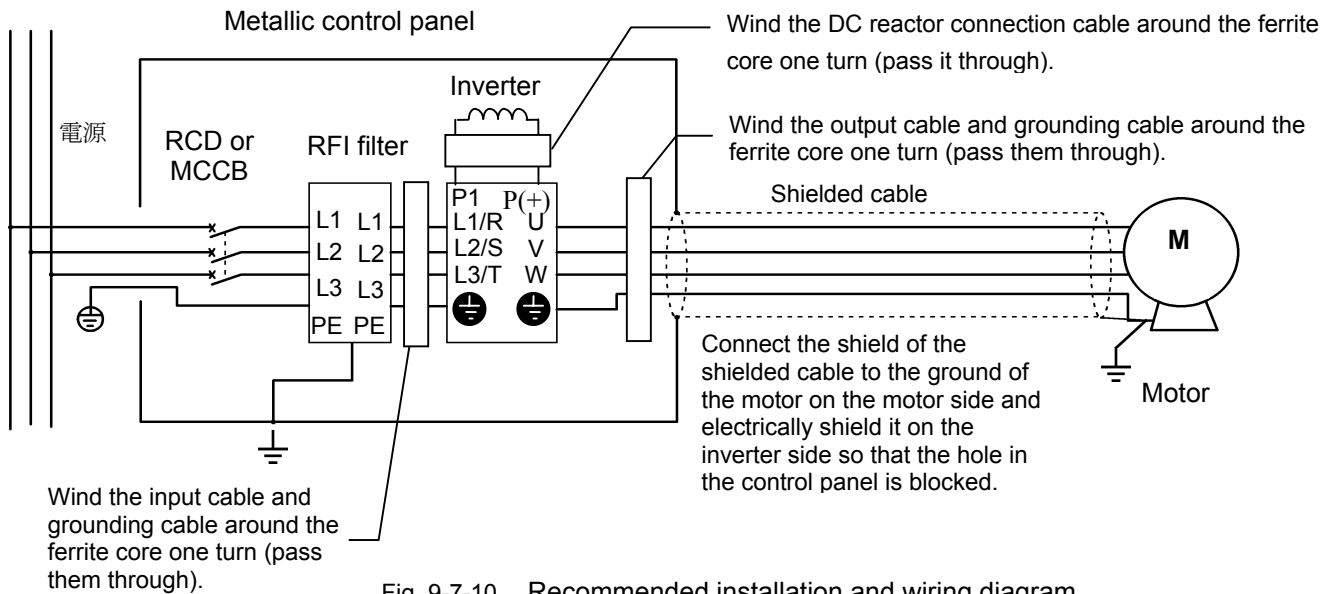


Fig. 9-7-10 Recommended installation and wiring diagram  
 · In case of FRN280VG7S-4 to FRN400VG7S-4

# THE INVERTER



## X . Selecting Inverter Capacity

10.1 Inverter and Motor Selection

10.2 Braking Unit and Braking Resistor  
Selection



# 10. Selecting Inverter Capacity

## 10.1 Inverter and Motor Selection

### 10.1.1 Characteristics of Output Torque

Figure 9.1 shows the output torque characteristics. The output torque is classified into the following quadrants by speed and torque-applied direction.

- |                | (Speed) | (Torque) |                             |
|----------------|---------|----------|-----------------------------|
| • Quadrant I   | : +     | + ...    | Driving in forward rotation |
| • Quadrant II  | : -     | + ...    | Braking in reverse rotation |
| • Quadrant III | : -     | - ...    | Driving in reverse rotation |
| • Quadrant IV  | : +     | - ...    | Braking in forward rotation |

In the figure below, the speed rate (%) is expressed by regarding the base speed as 100%, and the torque rate (%) is expressed by regarding the continuous rated torque as 100%.

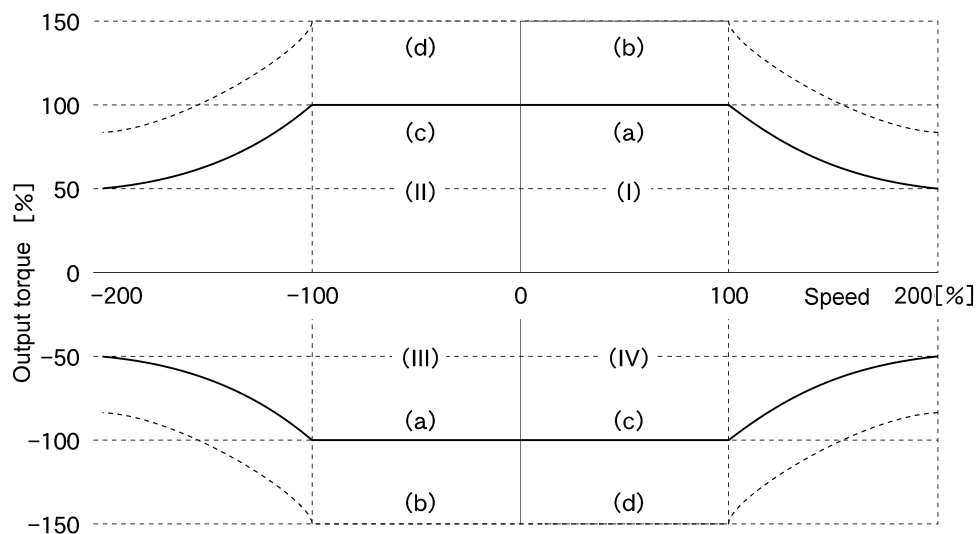


Figure 10-1 Characteristics of the Output Torque (CT Specification)

(1) Allowable continuous driving torque (curve (a) in the 1st and 3rd quadrants)

Curve (a) shows the torque that is available continuously in driving mode.

In the area below the base speed (100%) in the speed control range (0 to 200%), the rated torque is obtained. In the area above the base speed, the constant output is obtained, and the output torque is in inverse to proportion to the speed.

At very low speeds below the speed control range, the allowable torque drops to 80% for less than 0.5Hz converted into inverter output frequency. The motor can be operated continuously considering motor slip in practice.

(2) Max. driving torque in a short-time (curve (b) in the 1st and 3rd quadrants)

Curve (b) shows the torque that is allowed for a short-time (60 seconds) in driving mode.

In general, this torque is 150% of rated torque, and used for acceleration or deceleration.

At very low speeds below the speed control range, due to the restriction of inverter internal temperature, the allowable torque drops to 100% for less than 0.5Hz converted into inverter output frequency.

(3) Starting torque (around speed zero (0) in the 1st and 3rd quadrants)

The starting torque is the torque at speeds around 0 in the 1st and 3rd quadrants.

Although the continuous torque is 80%, the starting torque becomes as high as 150% because the curve passes the very low speed range in quite a short period (30 seconds or less).

---

#### (4) Braking torque (the 2nd and 4th quadrants)

The 2nd and 4th quadrants are the braking mode range. Curve (c) shows the braking torque that is available in the continuous rated current range of the inverter; curve (d) is the braking torque that is available for 60-second rated current. In the very low speed range, the torque drops to 80% similar to that in the driving mode.

The time rating of the braking torque is limited by the braking resistor and braking unit capacity, because the energy of the machine system is regenerated.

# 10. Selecting Inverter Capacity

## 10.1.2 Selection Procedure

Figure 9-5 shows the general selection procedure for optimal inverter selection. Inverter capacity can be easily selected if there are no limitation regarding acceleration and deceleration time. The cases such as “Lifting or lowering a load”, “Acceleration and deceleration time is restricted”, or “Highly frequent acceleration and deceleration” make the selection procedure a little bit complex.

### (1) Calculation of load torque during constant speed running

(For detailed calculation, see Section 10.1.3.1)

This step is necessary for capacity selection for all loads. Determine the rated torque of the motor during constant speed running higher than that of the load torque, and select a tentative capacity. To perform capacity selection efficiently, it is necessary to match the rated speeds (base speeds) of the motor and load.

To do this, select an appropriate reduction-gear (mechanical transmission) ratio and number of motor poles. If acceleration/deceleration time is not limited and the system is not a lifting machine, capacity selection is completed as it is.

### (2) Acceleration time

(For detailed calculation, see Section 10.1.3.2)

When there are specified requirements for the acceleration time, calculate it using the following procedure:

#### 1) Calculate moment of inertia for the load and motor.

Calculate moment of inertia for the load by referring to Section 10.1.3.2. The moment of inertia of motor is shown in Section 2.2.3.

#### 2) Calculate minimum acceleration torque. (See Figure 10-2)

The acceleration torque is the difference between motor short time output torque (60s rating) explained in Section 10.1.1(2) and load torque ( $\tau_L/\eta_G$ ) during constant speed running calculated in the above (1). Calculate minimum acceleration torque for the whole range of speed.

#### 3) Calculate the acceleration time.

Assign the value calculated above to the expression (3.15) in Section 10.1.3.2 to calculate the acceleration time.

If the calculated acceleration time is longer than the requested time, select one size larger capacity inverter and motor and calculate it again.

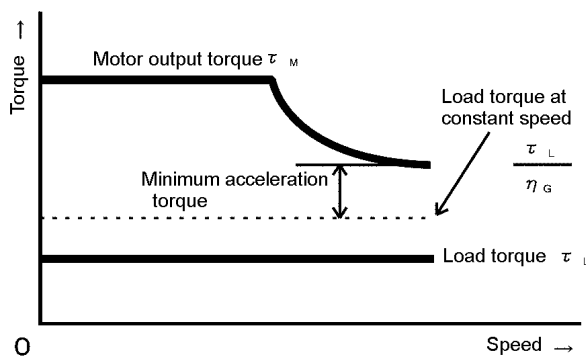


Figure 10-2 Example Study of Minimum Acceleration Time

**(3) Deceleration time**

(For detailed calculation, see Section 10.1.3.2)

To calculate the deceleration time, check the motor deceleration torque characteristics for the whole range of speed in the same way as for the acceleration time.

- 1) Calculate moment of inertia for the load and motor.  
\* Same as for acceleration time.
- 2) Calculate minimum deceleration torque. (See Figure 10-3)  
\* Same as for acceleration time.
- 3) Calculate the deceleration time.

Assign the value calculated above to the expression (3.16) in Section 10.1.3.2 to calculate the deceleration time.

If the calculated deceleration time is longer than the requested time, select one size larger capacity and calculate it again.

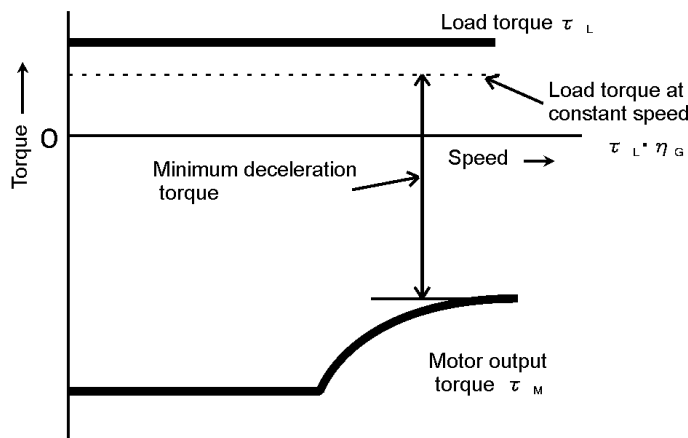


Figure 10-3 Example Study of Minimum Deceleration Torque (1)

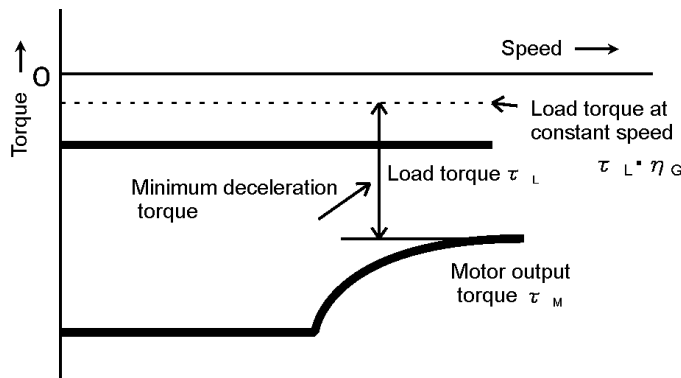


Figure 10-4 Example Study of Minimum Deceleration Torque (2)

However, note that minimum deceleration torque becomes smaller due to regenerative operation when lifting or lowering a load. (See Figure 10-4)

# 10. Selecting Inverter Capacity

---

## (4) Braking resistor rating

(For detailed calculation, see Section 10.1.3.3)

Braking resistor rating is divided into two types according to the braking periodic duty cycle:

1) When periodic duty cycle is 100s or less:

- Calculate average loss to determine rated values.

2) When periodic duty cycle is 100s or more:

- Allowable braking energy depends on maximum braking power.

The actual value for the maximum braking energy is indicated by the characteristics curve.

## (5) Motor RMS current

(For detailed calculation, see Section 10.1.3.4)

In metal processing machine and carriage machinery requiring positioning control, highly frequent running with short time rating is performed. In this case, calculate an equivalent RMS current value not to exceed the allowable value for the motor.

## (6) Notes for examining inverter capacity

- When selecting an inverter for driving a Fiji's inverter-dedicated motor, ensure that the root mean square of the motor torque is lower than the inverter rated torque (80% of the rated torque for HT use).
- When selecting a general-purpose motor, ensure that the root mean square of the motor current is lower than the motor rated current for effective motor cooling. In this case, select an inverter so that the root mean square of the current is lower than the inverter rated current (80% of the rated current for HT use).

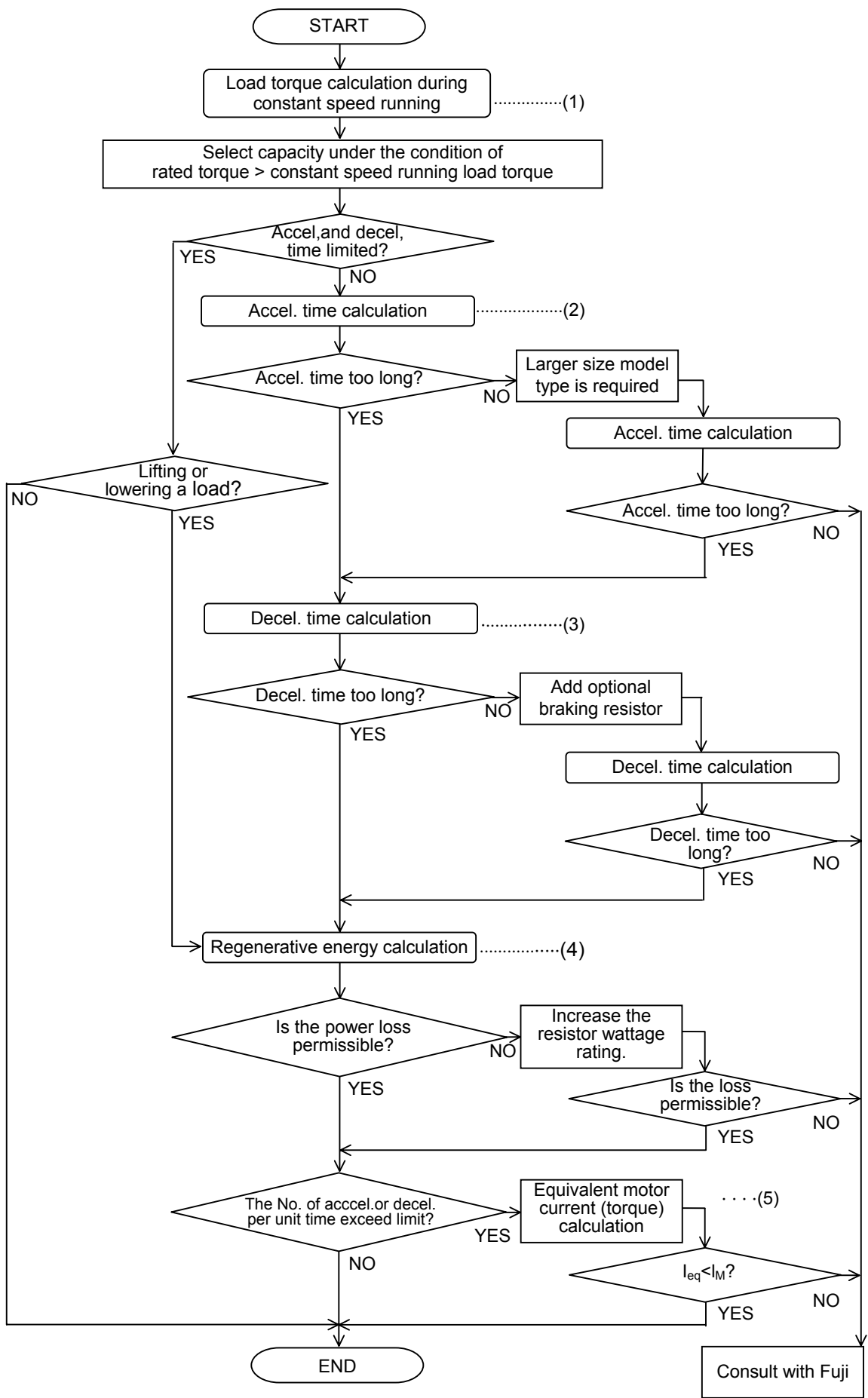


Figure 10-5 Selection Procedure

# 10. Selecting Inverter Capacity

## 10.1.3 Calculations for Selecting Capacity

### 10.1.3.1 Load Torque during Constant Speed Running

(1) General expression

The frictional force acting on a horizontally moved load must be calculated. For loads lifted or lowered vertically or along a slope, the gravity acting on the load must be calculated. Calculation for driving a load along a straight line with the motor is shown below.

Where the force to move a load linearly at constant speed  $v$  [m/s] is  $F$  [N] and the motor speed for driving this is  $N_M$  [r/min], the required motor output torque  $\tau_M$  [N·m] is as follows:

$$\tau_M = \frac{60 \cdot v}{2\pi \cdot N_M} \cdot \frac{F}{\eta_G} \text{ [N·m]} \quad \dots\dots\dots (3.1)$$

Where,  $\eta_G$ : Reduction-gear efficiency

When the motor is in braking mode, efficiency works inversely, so the required motor torque should be calculated as follows:

$$\tau_M = \frac{60 \cdot v}{2\pi \cdot N_M} \cdot F \cdot \eta_G \text{ [N·m]} \quad \dots\dots\dots (3.2)$$

$(60 \cdot v)/(2 \pi \cdot N_M)$  in the above expression is an equivalent rotation radius corresponding to speed  $v$  around the motor shaft.

The value  $F$  in the above expressions changes according to the load type.

(2) Moving a load horizontally

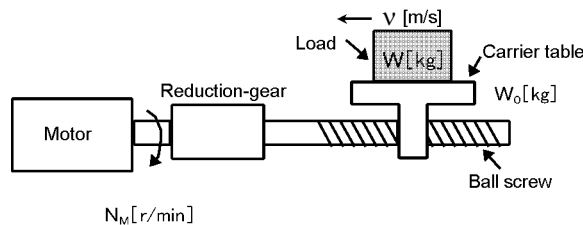


Figure 10-6 Moving a Load Horizontally

As shown in Figure 10-6, where the carrier table weight is  $W_0$  [kg], load is  $W$  [kg], and friction coefficient of the ball screw is  $\mu$ , friction force  $F$  [N] is expressed as follows:

$$F = (W_0 + W) \cdot g \cdot \mu \text{ [N]} \quad \dots\dots\dots (3.3)$$

Where,  $g$  : Gravity acceleration ( $\approx 9.8 \text{ m/s}^2$ )

Then, required driving torque around the motor shaft is expressed as follows:

$$\tau_M = \frac{60 \cdot v}{2\pi \cdot N_M} \cdot \frac{(W_0 + W) \cdot g \cdot \mu}{\eta_G} \text{ [N·m]} \quad \dots\dots\dots (3.4)$$

(3) Moving a load vertically

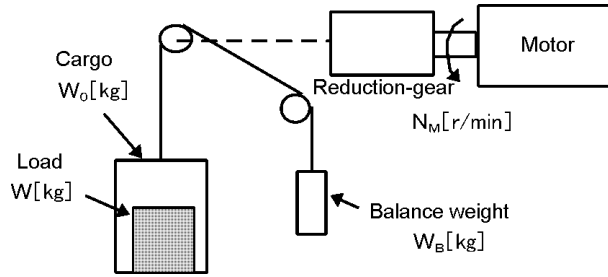


Figure 10-7 Moving a Load Vertically

As shown in Figure 10-7, where a cage weight, load weight, and balance-mass weight are  $W_o$ ,  $W$ , and  $W_B$  [kg], the force of gravity  $F$  [N] is as follows:

(Lifting)

$$F = (W_o + W - W_B) \cdot g \text{ [N]} \quad \dots\dots\dots (3.5)$$

(Lowering)

$$F = (W_B + W - W_o) \cdot g \text{ [N]} \quad \dots\dots\dots (3.6)$$

Where maximum load is  $W_{max}$ , generally  $W_B$  equals to  $(W_o + W_{max}) / 2$ . So,  $F$  may become a negative force to brake both lifting and lowering movements depending on the load weight.

Calculate the required torque  $\tau$  around the motor shaft in the driving mode by expression (3.1) and that in the braking mode by expression (3.2). That is, if  $F$  is positive, use expression (3.1); if it is negative, use expression (3.2).

(4) Moving a load along a slope

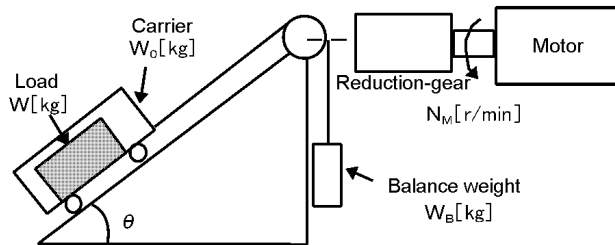


Figure 10-8 Moving a Load Along a Slope

Lifting and lowering a load along a slope may seem to be like lifting and lowering a load vertically, but friction force between the load and the slope cannot be ignored. Therefore, the expression for lifting a load is a little different from that for lowering a load. Where slope angle is  $\theta$  and friction coefficient is  $\mu$ , as shown in Figure 10-8, driving force  $F$  [N] is as follows:

(Lifting)

$$F = (W_o + W) (\sin\theta + \mu \cdot \cos\theta) - W_B \cdot g \text{ [N]} \quad \dots\dots\dots (3.7)$$

(Lowering)

$$F = (W_B - (W_o + W) (\sin\theta + \mu \cdot \cos\theta)) \cdot g \text{ [N]} \quad \dots\dots\dots (3.8)$$

The force of gravity  $F$  may become a negative force to brake both lifting and lowering movements, depending on the load weight. This is the same as for vertical lifting and lowering. Required torque around the motor shaft can be also calculated similarly.

That is, when  $F$  is positive, use expression (3.1); when it is negative, use expression (3.2).



# 10. Selecting Inverter Capacity

## 10.1.3.2 Acceleration and Deceleration Time Calculation

When an object whose moment of inertia is  $J$  [ $\text{kg}\cdot\text{m}^2$ ] rotates at the speed  $N$  [ $\text{r}/\text{min}$ ], it has the following kinetic energy:

$$E = \frac{J}{2} \cdot \left( \frac{2\pi \cdot N}{60} \right)^2 \quad [\text{J}] \quad \dots\dots\dots (3.9)$$

To accelerate the above rotation, kinetic energy will be increased; to decelerate, kinetic energy must be dis-charged.

The torque required for acceleration and deceleration can be expressed as follows:

$$\tau = J \cdot \frac{2\pi}{60} \left( \frac{dN}{dt} \right) \quad [\text{N} \cdot \text{m}] \quad \dots\dots\dots (3.10)$$

In this way, the mechanical moment of inertia is an important element in acceleration and deceleration. First, calculation method of moment of inertia is described, then that for acceleration and deceleration time are explained.

### (1) Calculation of moment of inertia

For an object that rotates around the rotation axis, virtually divide the object into small segments and square the distance from the rotation axis to each segment. Then, sum the squares of the distances and the masses of the segments to calculate the moment of inertia.

$$\text{Moment of inertia} \quad J = \sum (W_i \cdot r_i^2) \quad [\text{kg} \cdot \text{m}^2] \quad \dots\dots\dots (3.11)$$

#### 1) Hollow cylinder and solid cylinder

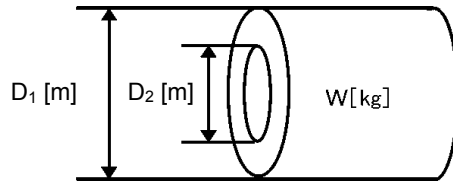


Figure 10-9 Hollow

The common shape of a rotating body is hollow cylinder. The moment of inertia  $J$  [ $\text{kg}\cdot\text{m}^2$ ] around the hollow cylinder center axis can be calculated as follows, where the outer and inner diameters are  $D_1$  and  $D_2$  [m] and total weight is  $W$  [kg] in Figure 10-9.

$$J = \frac{W \cdot (D_1^2 + D_2^2)}{60} \quad [\text{kg}\cdot\text{m}^2] \quad \dots\dots\dots (3.12)$$

For a similar shape, a solid cylinder, calculate the moment of inertia as  $D_2$  is 0.

#### 2) For a general rotating body

Table 10-1 lists the calculation expressions of moment of inertia of various rotating bodies including the above cylindrical rotating body.

#### 3) For a load running horizontally

As shown in Figure 10-6, a carrier table can be driven by a motor. If the table speed is  $v$  [m/s] when the motor rotation speed is  $N_M$  [ $\text{r}/\text{min}$ ], an equivalent distance from the rotation axis is  $60 v / (2\pi \cdot N_M)$  [m]. Then, the moment of inertia of table and load to the rotation axis is calculated as follows:

$$J = \left( \frac{60v}{2\pi \cdot N_M} \right)^2 \cdot (W_O + W) \quad [\text{kg} \cdot \text{m}^2] \quad \dots\dots\dots (3.13)$$

#### 4) For lifting and lowering load

As shown in Figures 10-7 and 10-8, two loads tied with the rope move in different directions. The moment of inertia can be calculated by obtaining the sum of the moving objects weight as follows:

$$J = \left( \frac{60v}{2\pi \cdot N_M} \right)^2 \cdot (W_O + W + W_B) \quad [\text{kg} \cdot \text{m}^2] \quad \dots\dots\dots (3.14)$$

(2) Calculation of the acceleration time

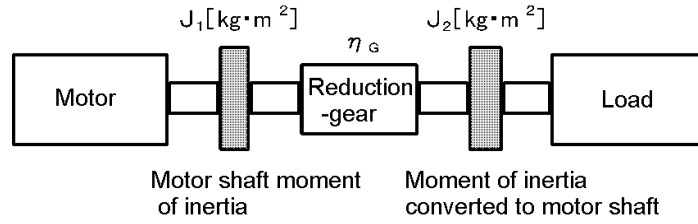


Figure 10-10 Load Model Including Reduction-gear

Figure 10-10 shows a general load model. Here, the load is tied via a reduction-gear with efficiency  $\eta_G$ . The time required to accelerate this load to a speed of  $N_M$  [r/min] is calculated with the following expression:

$$t_{ACC} = \frac{J_1 + J_2 / \eta_G}{\tau_M - \tau_L / \eta_G} \cdot \frac{2\pi \cdot (N_M - 0)}{60} \quad [s] \quad \dots\dots\dots (3.15)$$

Where,

- $J_1$  : Motor shaft moment of inertia [kg·m<sup>2</sup>]
- $J_2$  : Load shaft moment of inertia converted to motor shaft [kg·m<sup>2</sup>]
- $\tau_M$  : Minimum motor output torque in driving mode [N·m]
- $\tau_L$  : Maximum load torque converted to motor shaft [N·m]
- $\eta_G$  : Reduction-gear efficiency

As clarified in the above expression, equivalent moment of inertia becomes  $(J_1 + J_2/\eta_G)$  considering the reduction gear efficiency.

(3) Calculation of the deceleration time

In Figure 10-10, the time required to stop the motor rotating at a speed of  $N_M$  [r/min] is calculated with the following expression:

$$t_{DEC} = \frac{J_1 + J_2 \cdot \eta_G}{\tau_M - \tau_L \cdot \eta_G} \cdot \frac{2\pi \cdot (0 - N_M)}{60} \quad [s] \quad \dots\dots\dots (3.16)$$

Where,

- $J_1$  : Motor shaft moment of inertia [kg·m<sup>2</sup>]
- $J_2$  : Load shaft moment of inertia converted to motor shaft [kg·m<sup>2</sup>]
- $\tau_M$  : Minimum motor output torque in braking (deceleration) mode [N·m]
- $\tau_L$  : Maximum load torque converted to motor shaft [N·m]
- $\eta_G$  : Reduction-gear efficiency

In the above expression, generally output torque  $\tau_M$  is negative and load torque  $\tau_L$  is positive. So, deceleration time becomes shorter. However, in a lifted and lowered load,  $\tau_L$  may become a negative value in braking mode. In this case, the deceleration time becomes longer.

\* For lifting or lowering load

In inverter and motor capacity selection for lifted and lowered load, the deceleration time must be calculated by using the maximum value that makes the load torque negative.

(4) Non-linear (S-curve) accel./decel. time

For loads that are frequently accelerated and decelerated, it is often necessary to minimize the accel. and decel. time by using accel. and decel. torques. Vector control inverters are ideal for such operations.

# 10. Selecting Inverter Capacity

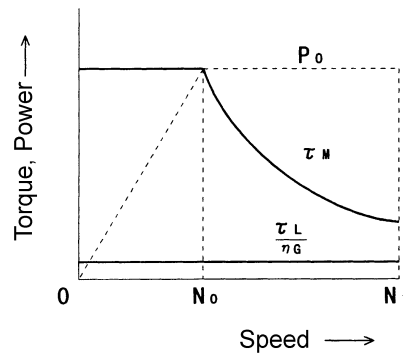


Figure 10-11 Sample of Driving Device which Includes the Constant Power Characteristic

In this operation, the accel. and decel. characteristic becomes non-linear, so the time required to accel. or decel. cannot be expressed by a simple formula.

Therefore, in general, the method employed divides speed  $N$  into small sections ( $\Delta N$ ) to calculate the partial accel./decel. time and sums these until accel. or decel. ends.

The smaller the divisions, the higher the calculation accuracy.

The above figure shows a sample torque-speed characteristic of a driving system: the curve shows a constant-torque in the range below  $N_0$  and constant-output in the range from  $N_0$  to  $N_1$ .

The accel. time is expressed as follows:

$$\Delta t_{ACC} = \frac{J_1 + J_2 / \eta_G}{\tau_M + \tau_L / \eta_G} \cdot \frac{2\pi \cdot \Delta N}{60} \quad [s] \quad \dots\dots\dots (3.17)$$

Obtaining in advance the moment of inertia of the motor shaft ( $J_1$ ) and of the load shaft (after conversion into motor shaft) ( $J_2$ ) and load torque  $\tau_L$  (after conversion into motor shaft) as well as the efficiency of the reduction speed device ( $\eta_G$ ), the maximum motor torque ( $\tau_M$ ) is calculated using one of the following formulas depending on the speed range:

- $\tau_M$  when  $N \leq N_0$ : constant-torque range

$$\tau_M = \frac{60 \cdot P_0}{2\pi \cdot N_0} \quad [N \cdot m] \quad \dots\dots\dots (3.18)$$

- $\tau_M$  when  $N_0 \leq N \leq N_1$ : constant-output range (torque is inversely proportional to speed)

$$\tau_M = \frac{60 \cdot P_0}{2\pi \cdot N} \quad [N \cdot m] \quad \dots\dots\dots (3.19)$$

If the result of the above calculation differs from the expected result, select a drive system by one frame larger.

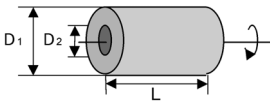
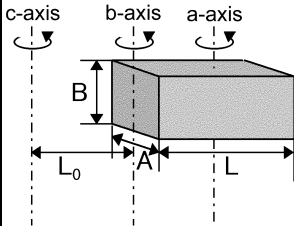
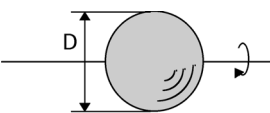
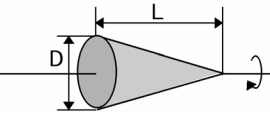
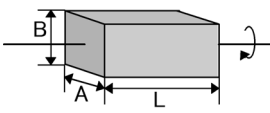
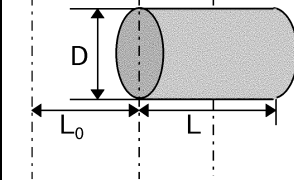
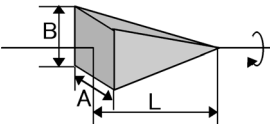
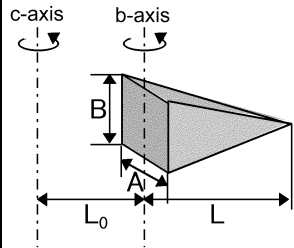
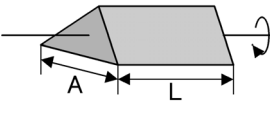
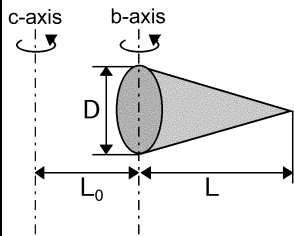
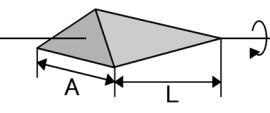
## (5) Calculation for nonlinear decelerating time

Decelerating time can be calculated by the same formula as used for calculating accelerating time.

$$\Delta t_{DEC} = \frac{J_1 + J_2 \cdot \eta_G}{\tau_M - \tau_L \cdot \eta_G} \cdot \frac{2\pi \cdot \Delta N}{60} \quad [s] \quad \dots\dots\dots (3.20)$$

In this formula, because both  $\tau_M$  and  $\Delta N$  are negative value, load torque  $\tau_L$  generally promotes deceleration. However, lift load has a mode in which  $\tau_L$  becomes negative. In this mode, the polarity differs between  $\tau_M$  and  $\tau_L$ , which blocks deceleration.

Table 10.1 Moment of Inertia of Various Rotating Bodies

Shape	Mass: W [kg] Moment of inertia: J [kg·m <sup>2</sup> ]	Shape	Mass: W [kg] Moment of inertia: J [kg·m <sup>2</sup> ]
Hollow cylinder 	$W = \frac{\pi}{4} \cdot (D_1^2 - D_2^2) \cdot L \cdot \rho$ $J = \frac{1}{8} \cdot W \cdot (D_1^2 + D_2^2)$		$W = A \cdot B \cdot L \cdot \rho$ $J_a = \frac{1}{12} \cdot W \cdot (L^2 + A^2)$ $J_b = \frac{1}{12} \cdot W \cdot (L^2 + \frac{1}{4} \cdot A^2)$ $J_c \approx W \cdot (L_0^2 + L_0 \cdot L + \frac{1}{3} \cdot L^2)$
Sphere 	$W = \frac{\pi}{6} \cdot D^3 \cdot \rho$ $J = \frac{1}{10} \cdot W \cdot D^2$		Cone 
Rectangular prism 	$W = A \cdot B \cdot L \cdot \rho$ $J = \frac{1}{12} \cdot W \cdot (A^2 + B^2)$		$W = \frac{\pi}{4} \cdot D^2 \cdot L \cdot \rho$ $J_a = \frac{1}{12} \cdot W \cdot (L^2 + \frac{3}{4} \cdot D^2)$ $J_b = \frac{1}{3} \cdot W \cdot (L^2 + \frac{3}{16} \cdot D^2)$ $J_c \approx W \cdot (L_0^2 + L_0 \cdot L + \frac{1}{3} \cdot L^2)$
Square cone (pyramid, rectangular base) 	$W = \frac{1}{3} \cdot A \cdot B \cdot L \cdot \rho$ $J = \frac{1}{20} \cdot W \cdot (A^2 + B^2)$		$W = \frac{1}{3} \cdot A \cdot B \cdot L \cdot \rho$ $J_b = \frac{1}{10} \cdot W \cdot (L^2 + \frac{1}{4} \cdot A^2)$ $J_c \approx W \cdot (L_0^2 + \frac{3}{2} \cdot L_0 \cdot L + \frac{3}{5} \cdot L^2)$
Triangular prism 	$W = \frac{\sqrt{3}}{4} \cdot A^2 \cdot L \cdot \rho$ $J = \frac{1}{3} \cdot W \cdot A^2$		$W = \frac{\pi}{12} \cdot D^2 \cdot L \cdot \rho$ $J_b = \frac{1}{10} \cdot W \cdot (L^2 + \frac{3}{8} \cdot D^2)$ $J_c \approx W \cdot (L_0^2 + \frac{3}{2} \cdot L_0 \cdot L + \frac{3}{5} \cdot L^2)$
Triangle cone (tetrahedron with equilateral triangular base) 	$W = \frac{\sqrt{3}}{12} \cdot A^2 \cdot L \cdot \rho$ $J = \frac{1}{5} \cdot W \cdot A^2$		

Main metal density (at 20°C)  $\rho$ [kg/m<sup>3</sup>]  
 Carbon steel: 7860, Copper: 8940, Aluminum: 2700

# 10. Selecting Inverter Capacity

## 10.1.3.3 Heat Energy Calculation of Braking Resistor

Braking by an inverter causes mechanical energy to be regenerated in the inverter circuit. This regenerative energy is often discharged to the resistor. In this section, braking resistor rating is explained.

### (1) Calculation of regenerative energy

Regenerative energy generated in the inverter operation consists of kinetic energy of a moving object and its potential energy.

#### 1) Kinetic energy of a moving object

When an object with moment of inertia  $J$  [kg·m<sup>2</sup>] rotates at a speed  $N_2$  [r/min], its kinetic energy is as follows:

$$E = \frac{J}{2} \cdot \left( \frac{2\pi \cdot N_2}{60} \right)^2 \text{ [J]} \dots\dots\dots (3.21)$$

$$\approx \frac{1}{182.4} \cdot J \cdot N_2^2 \text{ [J]} \dots\dots\dots (3.21)'$$

The output energy when this object is decelerated to a speed  $N_1$  [r/min] is as follows:

$$E = \frac{J}{2} \cdot \left[ \left( \frac{2\pi \cdot N_2}{60} \right)^2 - \left( \frac{2\pi \cdot N_1}{60} \right)^2 \right] \text{ [J]} \dots\dots\dots (3.22)$$

$$\approx \frac{1}{182.4} \cdot J \cdot (N_2^2 - N_1^2) \text{ [J]} \dots\dots\dots (3.22)'$$

The energy regenerated to the inverter as shown in Figure 9-10 is calculated by considering the reduction-gear efficiency  $\eta_G$  and motor efficiency  $\eta_M$  as follows:

$$E \approx \frac{1}{182.4} \cdot (J_1 + J_2 \cdot \eta_G) \cdot \eta_M \cdot (N_2^2 - N_1^2) \text{ [J]} \dots\dots\dots (3.23)$$

#### 2) Potential energy of an object

When an object of  $W$  [kg] is lowered from height  $h_2$  [m] to  $h_1$  [m], the output potential energy is expressed as follows:

$$E = W \cdot g \cdot (h_2 - h_1) \text{ [J]} \dots\dots\dots (3.24)$$

Where,  $g \approx 9.8065 \text{ [m/s}^2\text{]}$

Regenerative energy to the inverter circuit is calculated by considering the reduction-gear efficiency  $\eta_G$  and motor efficiency  $\eta_M$  as follows:

$$E = W \cdot g \cdot (h_2 - h_1) \cdot \eta_G \cdot \eta_M \text{ [J]} \dots\dots\dots (3.25)$$

### 10.1.3.4 Calculating RMS Rating of Motor

In case of the load which repeats the operation very frequently, the load current fluctuates largely and enters into the short-time rating range of the motor repeatedly. It is, therefore, required to review the thermal allowable value. The exothermicity is approximately considered to be in proportion to the square of the load current. In case of the dedicated motor of VG7S which utilizes the forced cooling fan method, the temperature will increase in proportion to the exothermicity itself.

When the operation is repeated in such an interval as to be short enough compared with the thermal time constant of the motor, calculate the “equivalent RMS current” as mentioned below, and select the unit such that this RMS current does not over the rated current of the motor.

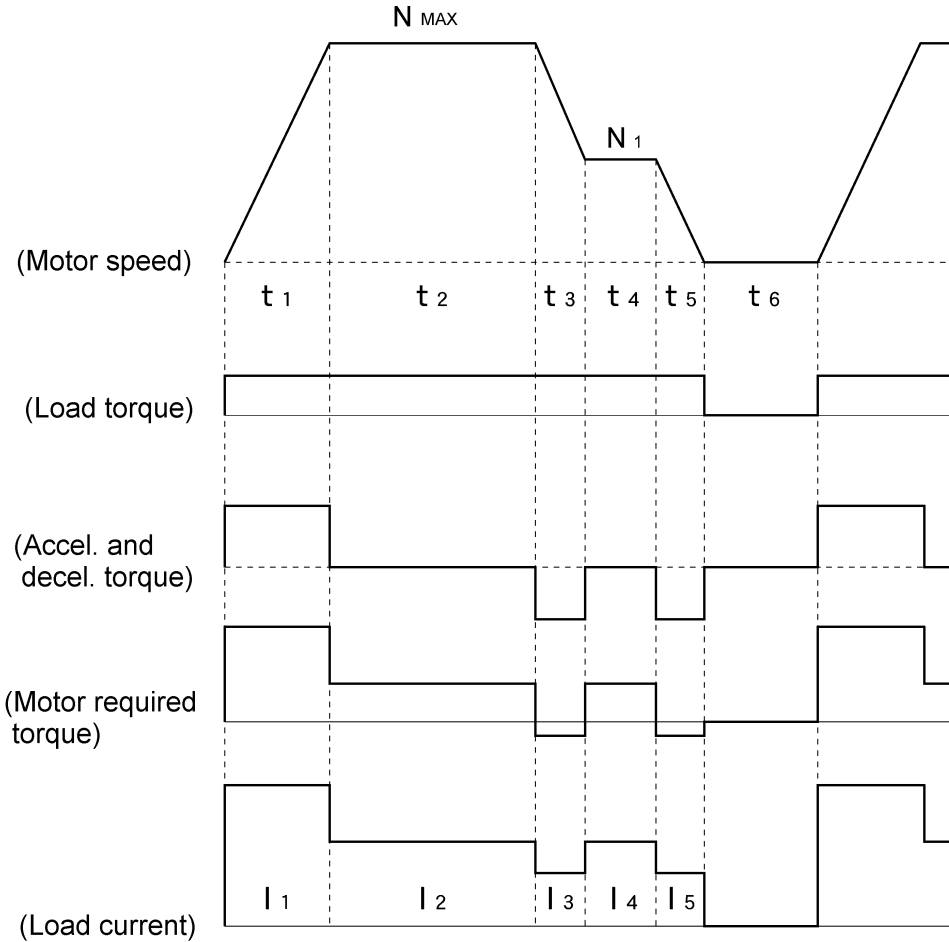


Figure 10-12 Sample of the Repetitive Operation

Firstly, calculate the required torque of each part based on the speed pattern. Then using the torque-current curve of motor, convert this torque to the pattern of the load current. The “equivalent RMS current,  $I_{eq}$ ” can be finally calculated by the following formula.

$$I_{eq} = \sqrt{\frac{I_1^2 \cdot t_1 + I_2^2 \cdot t_2 + I_3^2 \cdot t_3 + I_4^2 \cdot t_4 + I_5^2 \cdot t_5}{t_1 + t_2 + t_3 + t_4 + t_5 + t_6}} \quad [A] \quad \dots \quad (3.26)$$

The torque-current curve for the dedicated motor is not available for actual calculation. So, calculate the load current  $I$  from the load torque  $\tau_1$  using the following formula (3.27). Then, calculates the equivalent current  $I_{eq}$ .

$$I = \sqrt{\left( \frac{\tau_1}{100} \times I_{t100} \right)^2 + I_{m100}^2} \quad [A] \quad \dots \quad (3.27)$$

Here,  $\tau_1$ : load torque [%],  $I_{t100}$  = torque current (P09; M1 torque current),  $I_{m100}$  = (exciting current) (P08; M1 exciting current)

- For the function code data of P08 and P09, refer to Chapter 14 Replacement data.
- When using the second motor, refer to the torque current and exciting current of A code instead of those of P code.

# 10. Selecting Inverter Capacity

## 10.1.3.5 Appendix (Calculation for Other than in SI Unit)

All the expressions in this document are based on SI units (International System of Units). In this section, how to convert expressions to other units is explained.

### (1) Conversion of unit

#### 1) Force

$$1 \text{ [kgf]} \approx 9.8 \text{ [N]}$$

$$1 \text{ [N]} \approx 0.102 \text{ [kgf]}$$

#### 2) Torque

$$1 \text{ [kgf} \cdot \text{m]} \approx 9.8 \text{ [N} \cdot \text{m]}$$

$$1 \text{ [N} \cdot \text{m]} \approx 0.102 \text{ [kgf} \cdot \text{m]}$$

#### 3) Work and energy

$$1 \text{ [kgf} \cdot \text{m]} \approx 9.8 \text{ [N} \cdot \text{m]} = 9.8 \text{ [J]} = 9.8 \text{ [W} \cdot \text{s]}$$

#### 4) Power

$$1 \text{ [kgf} \cdot \text{m/s]} \approx 9.8 \text{ [N} \cdot \text{m/s]} = 9.8 \text{ [J/s]} = 9.8 \text{ [W]}$$

$$1 \text{ [N} \cdot \text{m/s]} \approx 1 \text{ [J/s]} = 1 \text{ [W]} \approx 0.102 \text{ [kgf} \cdot \text{m/s]}$$

#### 5) Rotation speed

$$1 \text{ [r/min]} = \frac{2\pi}{60} \text{ [rad/s]} \approx 0.1047 \text{ [rad/s]}$$

$$1 \text{ [rad/s]} = \frac{60}{2\pi} \text{ [r/min]} \approx 9.549 \text{ [r/min]}$$

#### 6) Inertia constant

J [kg · m<sup>2</sup>] : Moment of inertia

GD<sup>2</sup> [kg · m<sup>2</sup>] : Flywheel effect

$$GD^2 = 4J$$

$$J = \frac{GD^2}{4}$$

#### 7) Pressure and stress

$$1 \text{ [mmAq]} \approx 9.8 \text{ [Pa]} \approx 9.8 \text{ [N/m}^2\text{]}$$

$$1 \text{ [Pa]} \approx 1 \text{ [N/m}^2\text{]} \approx 0.102 \text{ [mmAq]}$$

$$1 \text{ [bar]} \approx 100000 \text{ [Pa]} \approx 1.02 \text{ [kg} \cdot \text{cm}^2\text{]}$$

$$1 \text{ [kg} \cdot \text{cm}^2\text{]} \approx 98000 \text{ [Pa]} \approx 980 \text{ [mbar]}$$

1 atmospheric pressure

$$= 1013 \text{ [mbar]} = 760 \text{ [mmHg]}$$

$$= 101300 \text{ [Pa]} \approx 1.033 \text{ [kg} \cdot \text{cm}^2\text{]}$$

### (2) Calculation formula

#### 1) Torque, power and rotation speed

$$P \text{ [W]} \approx \frac{2\pi}{60} \cdot N \text{ [r/min]} \cdot \tau \text{ [N} \cdot \text{m]}$$

$$P \text{ [W]} \approx 1.026 \cdot N \text{ [r/min]} \approx T \text{ [kgf} \cdot \text{m]}$$

$$\tau \text{ [N} \cdot \text{m]} \approx 9.55 \cdot \frac{P \text{ [W]}}{N \text{ [r/min]}}$$

$$T \text{ [kgf} \cdot \text{m]} \approx 0.974 \cdot \frac{P \text{ [W]}}{N \text{ [r/min]}}$$

#### 2) Kinetic energy

$$E \text{ [J]} \approx \frac{1}{182.4} \cdot J \text{ [kg} \cdot \text{m}^2\text{]} \cdot N^2 \text{ [(r/min)}^2\text{]}$$

$$E \text{ [J]} \approx \frac{1}{730} \cdot GD^2 \text{ [kg} \cdot \text{m}^2\text{]} \cdot N^2 \text{ [(r/min)}^2\text{]}$$

#### 3) Torque of linear moving load

[Driving mode]

$$\tau \text{ [N} \cdot \text{m]} \approx 0.159 \frac{V \text{ [m/min]}}{N_M \text{ [r/min]} \cdot \eta_G} \cdot F \text{ [N]}$$

$$T \text{ [kgf} \cdot \text{m]} \approx 0.159 \frac{V \text{ [m/min]}}{N_M \text{ [r/min]} \cdot \eta_G} \cdot F \text{ [kgf]}$$

[Braking mode]

$$\tau \text{ [N} \cdot \text{m]} \approx 0.159 \frac{V \text{ [m/min]}}{N_M \text{ [r/min]} \cdot \eta_G} \cdot F \text{ [N]}$$

$$T \text{ [kgf} \cdot \text{m]} \approx 0.159 \frac{V \text{ [m/min]}}{N_M \text{ [r/min]} \cdot \eta_G} \cdot F \text{ [kgf]}$$

#### 4) Acceleration torque

[Driving mode]

$$\tau \text{ [N} \cdot \text{m]} \approx \frac{J \text{ [kg} \cdot \text{m}^2\text{]} \cdot \Delta N \text{ [r/min]}}{9.55 \cdot \Delta t \text{ [s]} \cdot \eta_G}$$

$$T \text{ [kgf} \cdot \text{m]} \approx \frac{GD^2 \text{ [kg} \cdot \text{m}^2\text{]} \cdot \Delta N \text{ [r/min]}}{375 \cdot \Delta t \text{ [s]} \cdot \eta_G}$$

[Braking mode]

$$\tau \text{ [N} \cdot \text{m]} \approx \frac{J \text{ [kg} \cdot \text{m}^2\text{]} \cdot \Delta N \text{ [r/min]} \cdot \eta_G}{9.55 \cdot \Delta t \text{ [s]}}$$

$$T \text{ [kgf} \cdot \text{m]} \approx \frac{GD^2 \text{ [kg} \cdot \text{m}^2\text{]} \cdot \Delta N \text{ [r/min]} \cdot \eta_G}{375 \cdot \Delta t \text{ [s]}}$$

#### 5) Acceleration time

$$t_{ACC} \text{ [s]} = \frac{J_1 + J_2 / \eta_G \text{ [kg} \cdot \text{m}^2\text{]} \cdot \Delta N \text{ [r/min]}}{\tau_M - \tau_L / \eta_G \text{ [N} \cdot \text{m}^2\text{]} \cdot 9.55}$$

$$t_{ACC} \text{ [s]} = \frac{GD_1^2 + GD_2^2 / \eta_G \text{ [kg} \cdot \text{m}^2\text{]} \cdot \Delta N \text{ [r/min]}}{T_M - T_L / \eta_G \text{ [kgf} \cdot \text{m]} \cdot 375}$$

#### 6) Deceleration time

$$t_{DEC} \text{ [s]} = \frac{J_1 + J_2 \cdot \eta_G \text{ [kg} \cdot \text{m}^2\text{]} \cdot \Delta N \text{ [r/min]}}{\tau_M - \tau_L \cdot \eta_G \text{ [N} \cdot \text{m}^2\text{]} \cdot 9.55}$$

$$t_{DEC} \text{ [s]} = \frac{GD_1^2 + GD_2^2 / \eta_G \text{ [kg} \cdot \text{m}^2\text{]} \cdot \Delta N \text{ [r/min]}}{T_M - T_L / \eta_G \text{ [kgf} \cdot \text{m]} \cdot 375}$$

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## 10.2 Braking Unit and Braking Resistor Selection

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### 10.2.1 Selection Procedure

- The following three requirements must be satisfied simultaneously:
  - (1) Maximum braking torque must not exceed values listed in Tables 9.4.1(1) to 9.4.5(2) in Chapter 9.  
To use maximum braking torque exceeding values in the above tables, select one size larger capacity braking unit and resistor.
  - (2) Discharge energy for a single braking action must not exceed discharging capability [kW] listed in the Tables 9.4.1 (1) to 9.4.5 (2) in Chapter 9.
  - (3) Average loss obtained by dividing discharge energy by cyclic period must not exceed the average loss [kW] listed in the Table.

The selecting conditions depend on the periodic duty cycle as described follows:

- 1) If the periodic duty cycle is 100s or shorter, the above conditions 1) and 3) must be satisfied.
- 2) If the periodic duty cycle is longer than 100s, the above conditions 1) and 2) must be satisfied.

### 10.2.2 Notes on Selection

- Braking time and duty cycle (%ED) are converted under deceleration braking conditions based on the rated torque as shown below. However, these value need not be considered when selecting braking unit and resistor capacity.

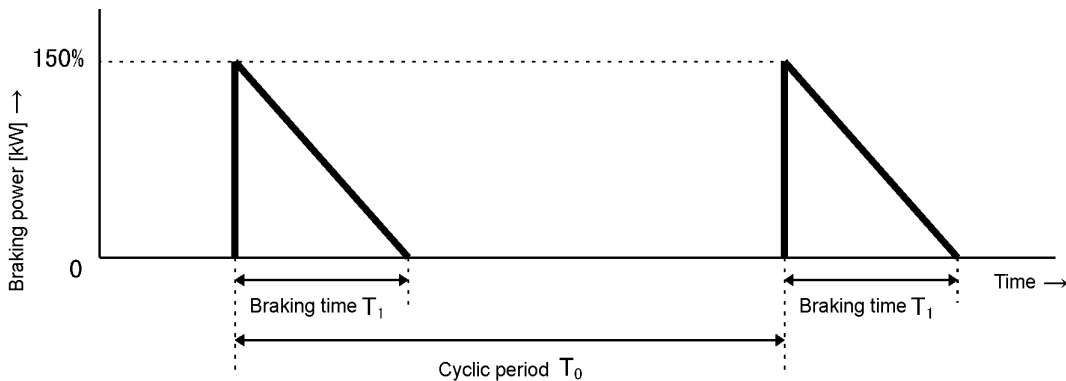


Figure 10-13 Duty Cycle

$$\text{Duty cycle (\%ED)} = \frac{T_1}{T_0} \times 100$$



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- MEMO -



## **XI. About Motors**

- 11.1 Vibration and Noise**
- 11.2 Acceleration Vibration Value**
- 11.3 Allowable Radial Load at Motor Shaft Extension**
- 11.4 Allowable Thrust Load**
- 11.5 List of Special Combinations**

# 11. About Motors

## 11.1 Vibration and Noise

\* Please refer to the “2-2-3 Dedicated Motor Specifications” for the specifications and the external dimensions of the dedicated motors.

Dedicated applicable motor [kW]	No. of poles	Motor type	Vibration level [ $\mu\text{m}$ ]		Noise level [ dB ] *3)			
		MVK__	At base speed 1500[r/min]	At max. speed *2) 3600[r/min]	At base speed 1500[r/min]	At max. speed 3600[r/min]		
0.75	4	8095A	less than 5	less than 7	56	60		
1.5		8097A						
2.2		8107A						
3.7		8115A			58	62		
5.5		8133A						
7.5		8135A			60	64		
11		8165A						
15		8167A			68	72		
18.5		8184A						
22		8185A			71	73		
30		8187A						
37		8207A			less than 7	73		
45		8208A			less than 5	less than 7 *2)	71	73
55		9224A			*1)	less than 15	*1)	88
75		9254A						
90		9256A						
110	9284A							
132	9286A							
160	931LA							
200	931MA							
220	931NA							

\*1) Please contact Fuji for the individual figures.

\*2) The maximum speed (max. speed) for 30 to 37[kW] is 3000[r/min], for 45 to 75[kW], 2400[r/min], and for 90 to 220[kW] max. speed is 2000[r/min].

\*3) This noise level was measured at the point which is 1[m] away to the direction of the terminal box from the motor.

## 11.2 Acceleration Vibration Value

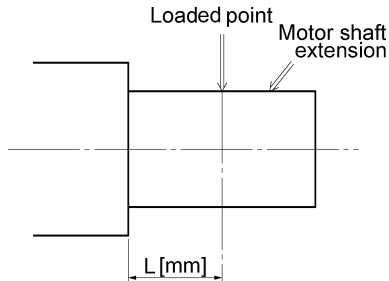
Dedicated applicable motor [kw]	No. of poles	Motor type	Acceleration vibration value, acceptable [m/s <sup>2</sup> ]
		MVK__A-C	
0.75	4	8095A	less than 6.4
1.5		8097A	
2.2		8107A	
3.7		8115A	
5.5		8133A	
7.5		8135A	
11		8165A	
15		8167A	
18.5		8184A	
22		8185A	
30		8187A	
37		8207A	
45		8208A	
55		9224A	less than 1.0
75		9254A	
90		9256A	
110		9284A	less than 6.4
132		9286A	
160		931LA	
200		931MA	
220	931NA		

Note: If the actual vibration is over the figure on this table, other countermeasure is required.

# 11. About Motors

## 11.3 Allowable Radial Load at Motor Shaft Extension

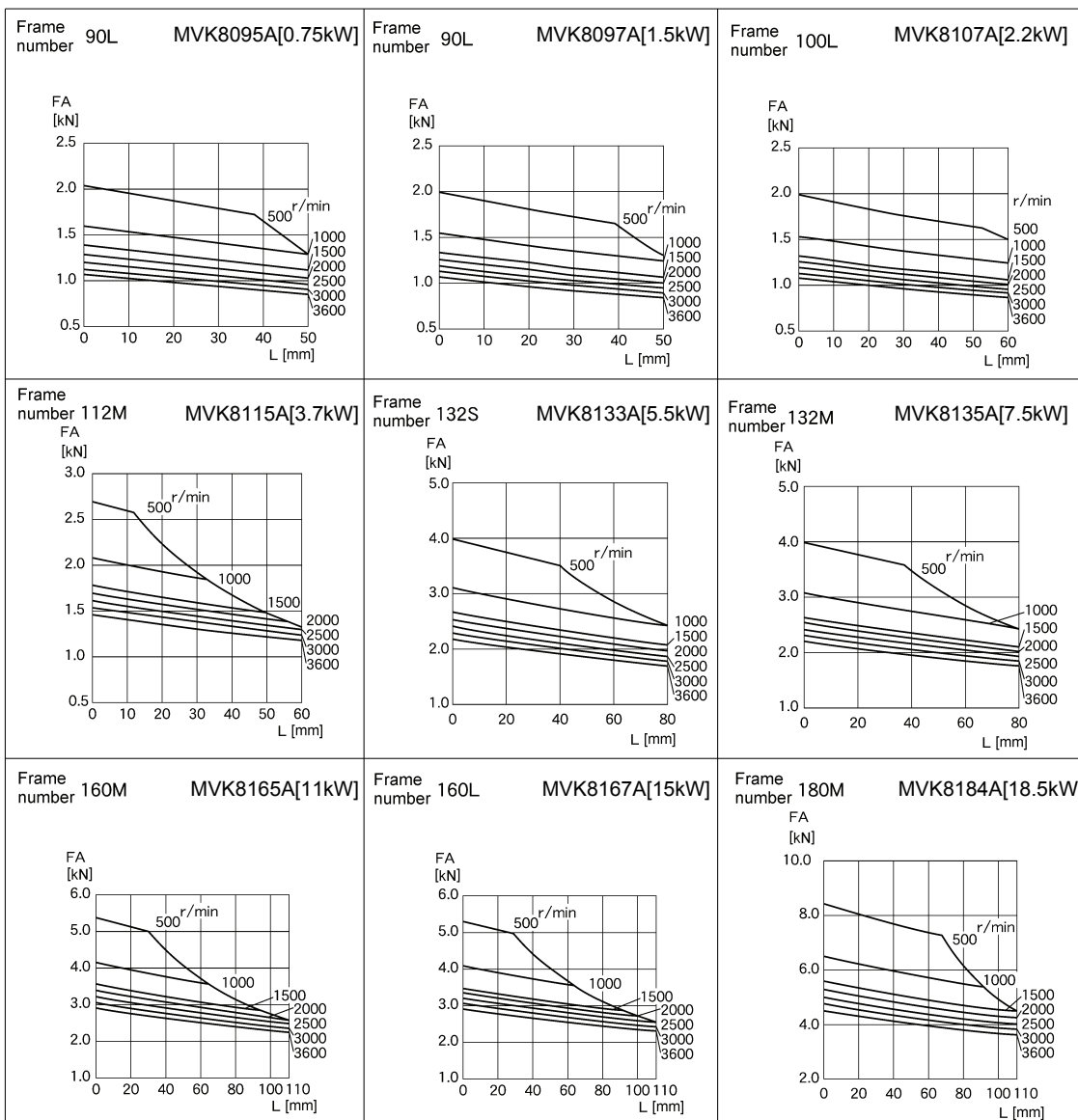
[Loaded point]

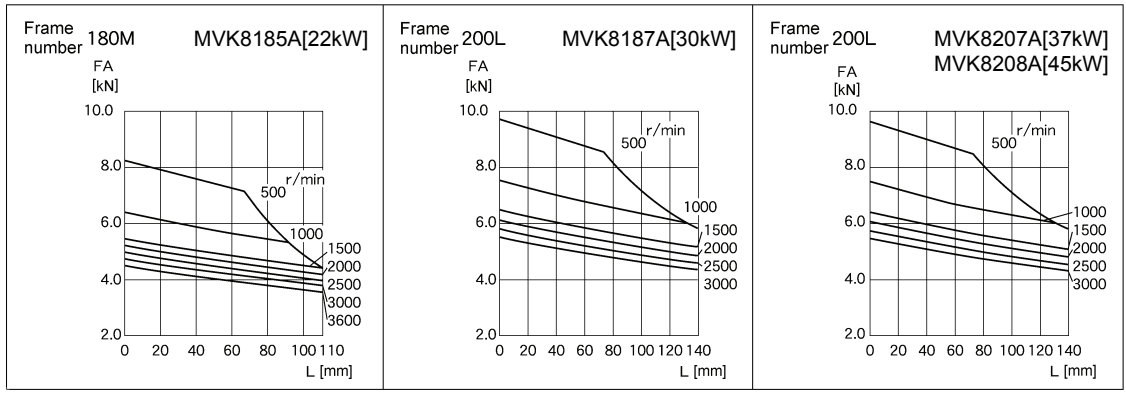


The maximum allowable value of radial load applied by the belt is shown in the figures below. The data is classified by the frame number and the rotation speed.

If the point which is decided by the radial load  $FA$  [kN] acting on the motor shaft and the length  $L$  [mm] from the stepped joint at shaft end to the center of the pulley (the distance to the  $FA$  load points) is within a curve, the motor can be operated by that pulley.

Please refer to the technical leaflet of the induction motor for the details.





Note: Please contact Fuji individually for the motors whose frame number is over 200L (more than 55kW).

# 11. About Motors

## 11.4 Allowable Thrust Load

(Unit:k-N)

Frame number	Type MVK	Horizontal use IM B3(F11), IM B5(L51)						Vertical use IM V5(F12), IM V1(L52)						Vertical use IM V6(F13), IM V3(L53)					
		Direction of thrust: FS			Direction of thrust: FU			Direction of thrust: FS			Direction of thrust: FU			Direction of thrust: FS			Direction of thrust: FU		
		2 Poles	4 Poles	6 Poles	2 Poles	4 Poles	6 Poles	2 Poles	4 Poles	6 Poles	2 Poles	4 Poles	6 Poles	2 Poles	4 Poles	6 Poles	2 Poles	4 Poles	6 Poles
90L	8095A 8097A	0.3	0.45	0.55	0.4	0.6	0.7	0.25	0.4	0.5	0.45	0.65	0.75	0.4	0.55	0.65	0.3	0.5	0.6
100L	8107A	-	0.65	0.8	-	0.55	0.65	-	0.6	0.7	-	0.6	0.6	-	0.5	0.6	-	0.75	0.85
112M	8115A	0.65	0.9	1.1	0.6	0.75	0.95	0.6	0.8	1	0.65	0.85	1	0.55	0.7	0.85	0.75	1	1.2
132S	8133A	1	1.4	1.7	0.75	1	1.2	1	1.3	1.7	0.9	1.1	1.4	0.65	0.9	1.1	1.2	1.5	1.9
132M	8135A	-			-			-		1.6	-			-		1	-		
160M	8165A	1.3	1.8	2.2	1.2	1.5	1.9	1.1	1.6	2	1.5	1.8	2.2	1	1.4	1.7	1.6	2.1	2.5
160L	8167A		1.7	2.1			1.8		1.5	1.8					1.3	1.5			
180M	8184A 8185A	2	2.7	3.3	1.9	2.3	2.8	1.8	2.3	2.9	2.2	2.7	3.4	1.6	2	2.6	2.4	3.2	3.9
200L	8187A 8207A	1.9	3.8	4.5	2	3.2	3.7	1.5	3.2	3.8	2.6	4	4.8		2.7	3	2.5	4.6	5.6
225S	8208A	1.2	5.4	6.5	1.2	5.4	6.5	0.4	4.4	5.3	2.3	6.9	8.2	0.4	4.4	5.3	2.3	6.9	8.2
250S	9224A	1.1	5.2	6.2	1.1	5.2	6.2	0.3	4.1	4.8				0.3	4.1	4.8			
250M	9254A	1	6.4	7.6	1	6.4	7.6	-	4.9	5.6	-	8.4	10.3	-	4.9	5.6	-	8.4	10.3
280S	9256A	0.9	6.2	7.3	0.9	6.2	7.3	-	4.5	5.1	-	8.5	10.4	-	4.5	5.1	-	8.5	10.4
280M	9284A	0.8	5.9	6.9	0.8	5.9	6.9	-	3.7	4.2	-	9.2	10.8	-	3.7	4.2	-	9.2	10.8
315S	9286A	0.7	5.7	6.7	0.7	5.7	6.7	-	3.1	3.8	-	9.3	10.9	-	3.1	3.8	-	9.3	10.9
315M	931LM 931MA 931NA	* Contact Fuji individually						* Contact Fuji individually						* Contact Fuji individually					
Mounting method and the direction of thrust																			

Note 1: The above-mentioned figures whose frame number are more than 250S are the allowable thrust (axial) load of the motor for direct connection

Note 2: The above-mentioned allowable thrust (axial) load is calculated on the assumption that the motor would bear the radial load through the normal sized half-coupling.

Note 3: For the motor with shielded type ball bearing, if the thrust load to the anti-driving direction is bigger than the pre-load spring pressure on the anti-driving side, the runout of shaft end shown in the following table will occur on the anti-driving side.

Frame number	90L, 100L	112M	132S, 132M	160M, 160L	180M to 225S	250S to 315M
Preload [N]	166	235	294	343	568	*Contact Fuji individually.
Runout of shaft end [mm]	*Std	0.6			1.2	
	Max.	1.4			2.0	

\*Std.: Standard

## 11.5 List of Special Combinations

### 11.5.1 List of Combinations of 380V Series

Type		4-pole non-standard special motor			4-pole standard motor		
Base speed [r/min]		1500			Base speed: 1,500[r/min], Max. speed: 1,500[r/min]		
Max. load torque [%]		150			150		
Model and item		Model		Max. speed Nmax[r/min]	Model		Potential max. speed Nmax[r/min]*2
		Motor	Inverter		Motor	Inverter	
Output [kW]	3.7	MVK8115A	FRN3.7VG7S-4	3600	MVK8115A	FRN3.7VG7S-4	3300
	5.5	MVK8133A	FRN5.5VG7S-4		MVK8133A	FRN5.5VG7S-4	3400
	7.5	MVK8135A	FRN7.5VG7S-4		MVK8135A	FRN7.5VG7S-4	2150
	11	MVK8165A	FRN11VG7S-4		MVK8165A	FRN11VG7S-4	1600
	15	MVK8167A	FRN15VG7S-4		MVK8167A	FRN15VG7S-4	3200
	18.5	MVK8184A	FRN22VG7S-4		MVK8184A	FRN18.5VG7S-4	2750
	22	MVK8185A	FRN30VG7S-4	MVK8185A	FRN22VG7S-4	2000	
	30	MVK8187A	FRN37VG7S-4	MVK8187A	FRN30VG7S-4	2200	
	37	MVK8207A	FRN45VG7S-4	MVK8207A	FRN37VG7S-4	1600	
	45	MVK8208A	FRN55VG7S-4	MVK8208A	FRN45VG7S-4	2100	
	55	MVK9224A	FRN75VG7S-4	2400	MVK9224A	FRN55VG7S-4	1600
	75	MVK9254A	FRN90VG7S-4		MVK9254A	FRN75VG7S-4	2000
	90	MVK9256A	FRN110VG7S-4	2000	MVK9256A	FRN90VG7S-4	2000
	110	MVK9284A	FRN132VG7S-4		MVK9284A	FRN110VG7S-4	2000
	132	MVK9286A	FRN160VG7S-4		MVK9286A	FRN132VG7S-4	1500
	160	MVK931LA	FRN200VG7S-4		MVK931LA	FRN160VG7S-4	2000
200	MVK931MA	FRN220VG7S-4	MVK931MA		FRN200VG7S-4	1800	
220	MVK931NA	FRN220VG7S-4	MVK931NA		FRN220VG7S-4	1600	

- \*1) The electric characteristics of the motor are the same as those of the standard motor. The frame size of the inverter is one frame larger.
- \*2) The maximum speed at which the 150% overload rating torque is obtained with 380V input is specified. If a 150% overload constant is necessary at a larger speed, select the inverter of a larger capacity.



# 11. About Motors

## 11.5.2 Low Base Speed Series Combination List

[200V class]

No. of poles, standard/non-standard		6-pole non-standard special motor					4-pole standard motor	
Base speed	500[r/min]	650[r/min]	750[r/min]	850[r/min]	1,000[r/min]		1,000[r/min]	
Max. speed	2,000[r/min]	2,000[r/min]	1,800[r/min]	1,700[r/min]	2,000[r/min]	2,400[r/min]	3,000[r/min]	3,600[r/min]
Output [kW]	0.75	MVK8115A FRN1.5VG7S-2		MVK8107A FRN1.5VG7S-2			MVK8097A FRN0.75VG7S-2	MVK8097A FRN1.5VG7S-2
	1.5	MVK8133A FRN3.7VG7S-2		MVK8115A FRN2.2VG7S-2			MVK8107A FRN2.2VG7S-2	MVK8107A FRN2.2VG7S-2
	2.2	MVK8135A FRN3.7VG7S-2		MVK8133A FRN3.7VG7S-2			MVK8115A FRN3.7VG7S-2	MVK8115A FRN3.7VG7S-2
	3.7	MVK8165A FRN5.5VG7S-2		MVK8135A FRN5.5VG7S-2			MVK8133A FRN5.5VG7S-2	MVK8133A FRN5.5VG7S-2
	5.5	MVK8167A FRN7.5VG7S-2		MVK8165A FRN7.5VG7S-2			MVK8135A FRN7.5VG7S-2	MVK8135A FRN7.5VG7S-2
	7.5	MVK8185A FRN11VG7S-2		MVK8167A FRN11VG7S-2			MVK8165A FRN7.5VG7S-2	MVK8165A FRN11VG7S-2
	11	MVK8187A FRN15VG7S-2		MVK8184A FRN15VG7S-2			MVK8167A FRN15VG7S-2	MVK8184A FRN15VG7S-2
	15	MVK8207A FRN22VG7S-2		MVK8185A FRN18.5VG7S-2			MVK8184A FRN18.5VG7S-2	MVK8185A FRN22VG7S-2
	18.5	MVK9256A FRN30VG7S-2	MVK9221A FRN30VG7S-2	MVK8187A FRN22VG7S-2			MVK8185A FRN22VG7S-2	MVK8187A FRN30VG7S-2
	22	MVK9284A FRN30VG7S-2	MVK9250A FRN30VG7S-2	MVK8207A FRN30VG7S-2		MVK8187A FRN30VG7S-2		MVK8207A FRN37VG7S-2
	30	MVK9284A FRN45VG7S-2	MVK9256A FRN45VG7S-2		MVK9221A FRN37VG7S-2	MVK8207A FRN37VG7S-2		MVK8208A FRN45VG7S-2
	37	MVK9286A FRN55VG7S-2	MVK9284A FRN45VG7S-2		MVK9224A FRN45VG7S-2	MVK9221A FRN45VG7S-2		
	45	MVK931LA FRN55VG7S-2	MVK9284A FRN55VG7S-2		MVK9250A FRN55VG7S-2	MVK9224A FRN55VG7S-2		
	55	MVK931NA FRN75VG7S-2	MVK9286A FRN75VG7S-2		MVK9256A FRN75VG7S-2	MVK9250A FRN75VG7S-2		
	75	MVK9354A FRN90VG7S-2	MVK931MA FRN90VG7S-2		MVK9284A FRN90VG7S-2	MVK9256A FRN90VG7S-2		

[400V class]

No. of poles, standard/ non-standard		6-pole non-standard special motor					4-pole standard motor	
Base speed		500[r/min]	650[r/min]	750[r/min]	850[r/min]	1,000[r/min]		1,000[r/min]
Max. speed		2,000[r/min]	2,000[r/min]	1,800[r/min]	1,700[r/min]	2,000[r/min]	2,400[r/min]	3,000[r/min] 3,600[r/min]
Output [kW]	0.75	MVK8115A FRN3.7VG7S-4		MVK8107A FRN3.7VG7S-4			MVK8097A FRN3.7VG7S-4	MVK8097A FRN1.5VG7S-4
	1.5	MVK8133A FRN3.7VG7S-4		MVK8115A FRN3.7VG7S-4			MVK8107A FRN3.7VG7S-4	MVK8107A FRN2.2VG7S-4
	2.2	MVK8135A FRN3.7VG7S-4		MVK8133A FRN3.7VG7S-4			MVK8115A FRN3.7VG7S-4	MVK8115A FRN3.7VG7S-4
	3.7	MVK8165A FRN5.5VG7S-4		MVK8135A FRN5.5VG7S-4			MVK8133A FRN5.5VG7S-4	MVK8133A FRN5.5VG7S-4
	5.5	MVK8167A FRN7.5VG7S-4		MVK8165A FRN7.5VG7S-4			MVK8135A FRN7.5VG7S-4	MVK8135A FRN7.5VG7S-4
	7.5	MVK8185A FRN11VG7S-4		MVK8167 FRN11VG7S-4			MVK8165A FRN7.5VG7S-4	MVK8165A FRN11VG7S-4
	11	MVK8187A FRN15VG7S-4		MVK8184 FRN15VG7S-4			MVK8167A FRN11VG7S-4	MVK8184A FRN18.5VG7S-4
	15	MVK8207A FRN22VG7S-4		MVK8185A FRN18.5VG7S-4			MVK8184A FRN18.5VG7S-4	MVK8185A FRN22VG7S-4
	18.5	MVK9256A FRN30VG7S-4	MVK9221A FRN30VG7S-4	MVK8187A FRN22VG7S-4			MVK8185A FRN22VG7S-4	MVK8187A FRN30VG7S-4
	22	MVK9284A FRN30VG7S-4	MVK9250A FRN30VG7S-4	MVK8207A FRN30VG7S		MVK8187A FRN30VG7S-4		MVK8207A FRN37VG7S-4
	30	MVK9284A FRN45VG7S-4	MVK9256A FRN45VG7S-4		MVK9221A FRN37VG7S-4	MVK8207A FRN37VG7S-4		MVK8208A FRN45VG7S-4
	37	MVK9286A FRN55VG7S-4	MVK9284A FRN45VG7S-4		MVK9224A FRN45VG7S-4	MVK9221A FRN45VG7S-4		
	45	MVK931LA FRN55VG7S-4	MVK9284A FRN55VG7S-4		MVK9250A FRN55VG7S-4	MVK9224A FRN55VG7S-4		
	55	MVK931NA FRN75VG7S-4	MVK9286A FRN75VG7S-4		MVK9256 FRN55VG7S-4	MVK9250A FRN75VG7S-4		
	75	MVK9354A FRN90VG7S-4	MVK931MA FRN90VG7S-4		MVK9284A FRN90VG7S-4	MVK9256A FRN90VG7S-4		
	90	MVK9356A FR110VG7S-4	MVK931PA FRN110VG7S-4		MVK9286A FRN110VG7S-4	MVK9284A FRN110VG7S-4		
	110		MVK9352A FRN132VG7S-4		MVK9310A FRN132VG7S-4	MVK9286A FRN132VG7S-4		
	132		MVK9356A FRN160VG7S-4		MVK931MA FRN160VG7S-4	MVK9310A FRN160VG7S-4		
	160					MVK931MA FRN200VG7S-4		
	200					*1)		

\*1) Contact us.



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- MEMO -

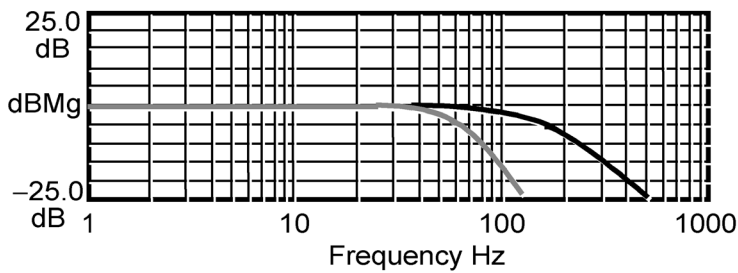
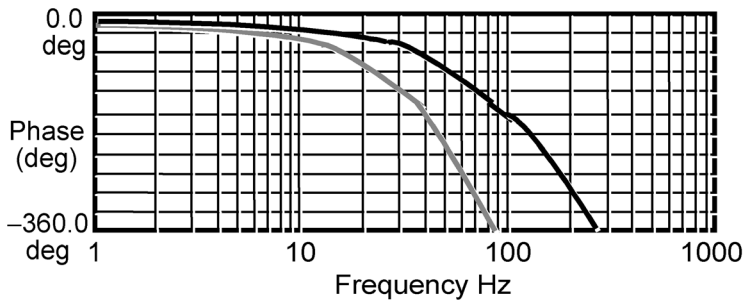
# XII

## **XII. Operation Data**

- 12.1 Frequency Response Characteristics**
- 12.2 Sample Measurement of Motor Wow**
- 12.3 Current Response Characteristics**
- 12.4 Torque Ripple**
- 12.5 Impact Load Characteristics**
- 12.6 Speed-torque Characteristics (PG Vector Control)**
- 12.7 Torque Control Accuracy (PG Vector Control)**
- 12.8 Speed-torque Characteristics (Sensorless Vector Control)**
- 12.9 Deceleration and Acceleration via Zero Speed (PG Vector Control)**
- 12.10 Deceleration and Acceleration via Zero Speed (Sensorless Vector Control)**
- 12.11 Comparison of Radiation Noise**

# 12. Operation Data

## 12.1 Frequency Response Characteristics

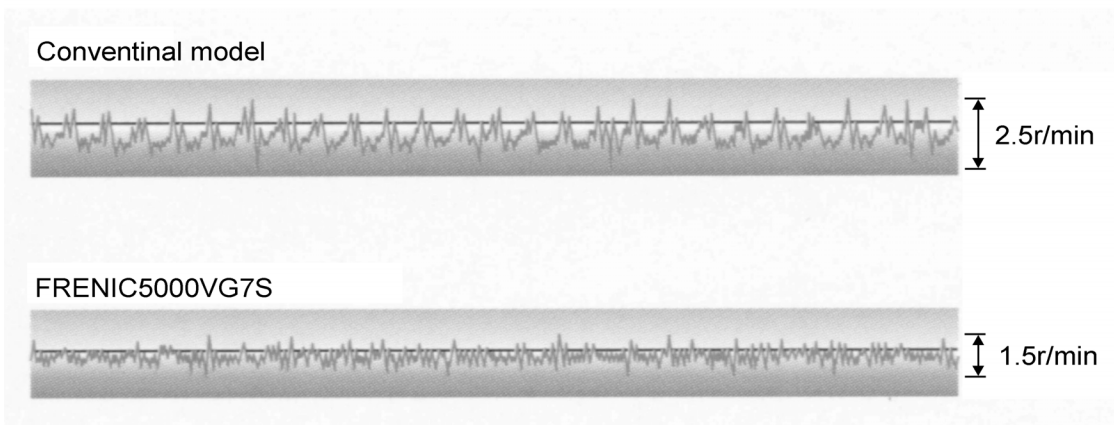


FRN37VG7S-4 — VG7S : 105Hz, -3dB  
 — VG5 (conventional model) : 54Hz, -3dB

Inverter ; FRN37VG7S-4  
 Motor ; MVK6207A-C, 37kW, 1500/3600r/min  
 Test condition ; Motor only

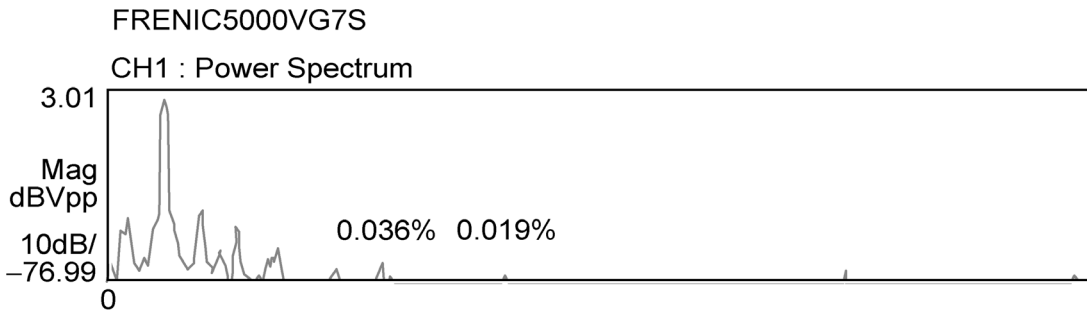
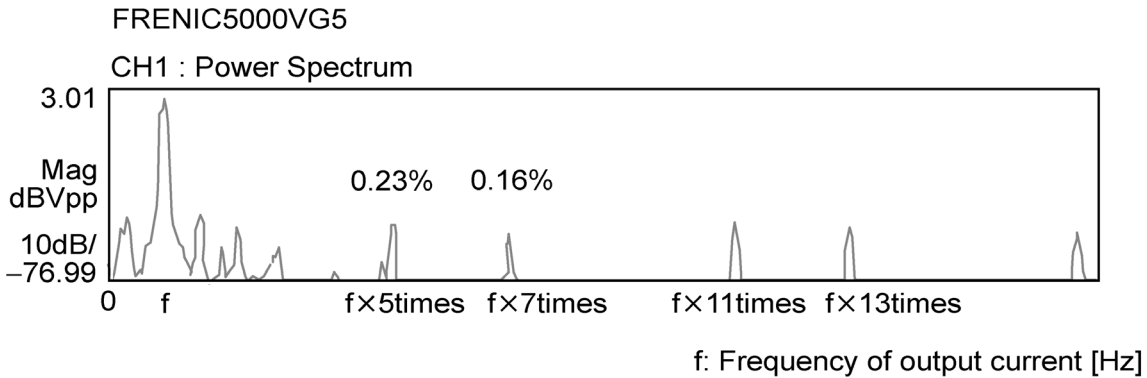
- Because of the improvement of the frequency response,
  - 1) The motor wow was reduced to approximately 60% of the conventional one.
  - 2) Follow-up characteristics at the time of load fluctuation improved.
  - 3) Position synchronizing accuracy improved.
  - 4) Step response characteristics of speed improved.

## 12.2 Sample Measurement of Motor Wow



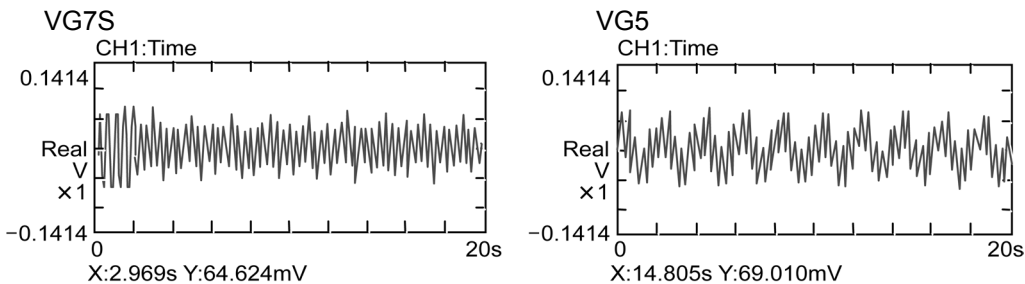
Inverter ; FRN37VG7S-4  
 Motor ; MVK6207A-C, 37kW, 1500/3600r/min  
 Test condition ; Motor only

## 12.3 Current Response Characteristics



- By realizing the current response of 800Hz, the waveform distortion of output current was reduced.
  - The harmonic of 5,7,11,13 times caused from PWM control was reduced. This leads to the reduction of torque ripple.
- Inverter ; FRN37VG7S-4  
 Motor ; MVK6207A-C, 37kW, 1500/3600r/min  
 Test condition ; 100% load

## 12.4 Torque Ripple

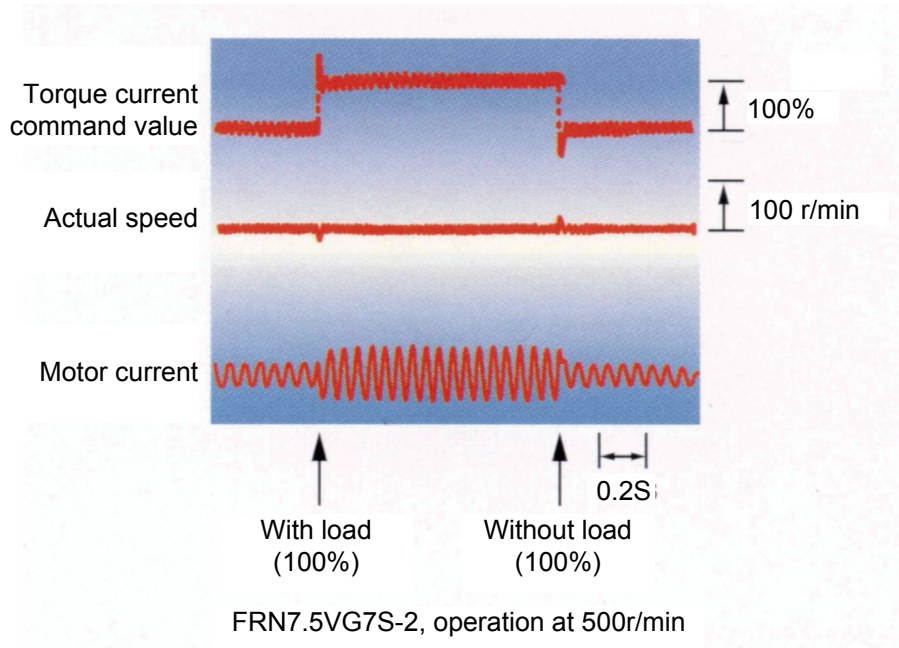


	Torque ripple P-P 100%:Rated torque			
	1 time	2 times	4 times	6 times
VG7S	0.23%	0.22%	0.10%	1.49%
VG5	0.70%	0.20%	0.09%	1.60%

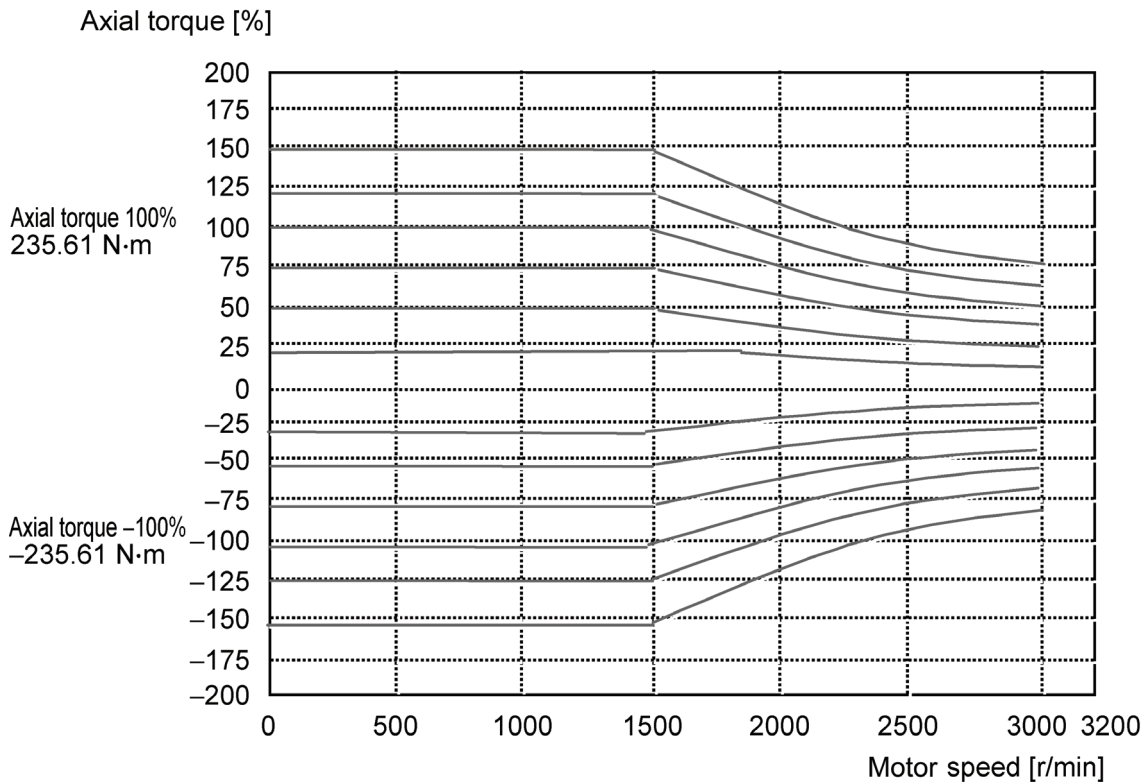
Inverter ; FRN37VG7S-4  
 Motor ; MVK6207A-C, 37kW, 1500/3600r/min  
 Test condition ; Motor constraint

## 12. Operation Data

### 12.5 Impact load characteristics



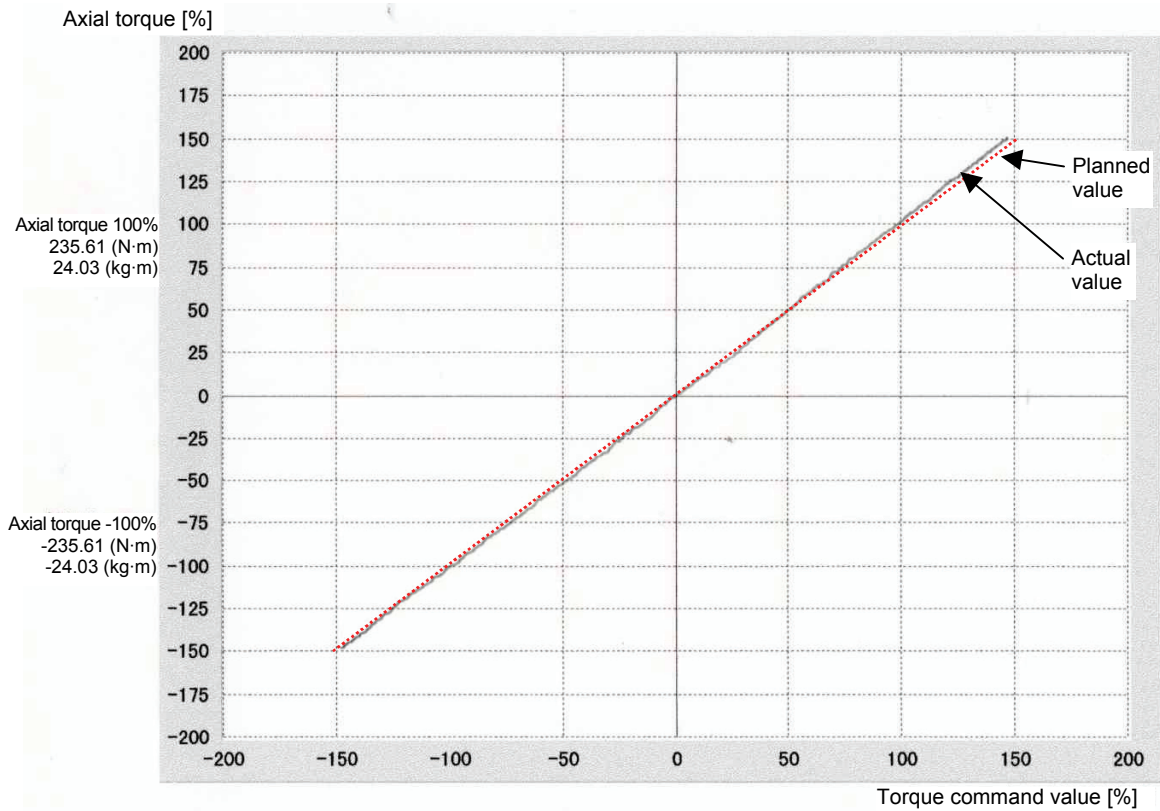
### 12.6 Speed-torque Characteristics (PG Vector Control)



Inverter ; FRN37VG7S-4

Motor ; MVK6207A-C, 37kW, 1500/3600r/min

## 12.7 Torque Control Accuracy (PG Vector Control)



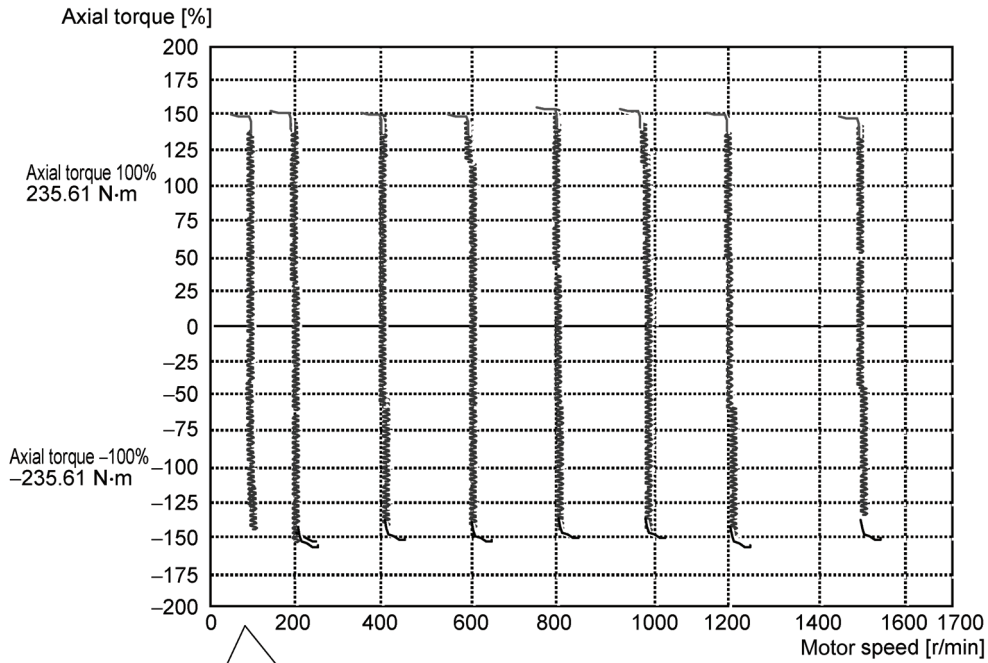
Inverter ; FRN37VG7S-4

Motor ; MVK6207A-C, 37kW, 1500/3600r/min

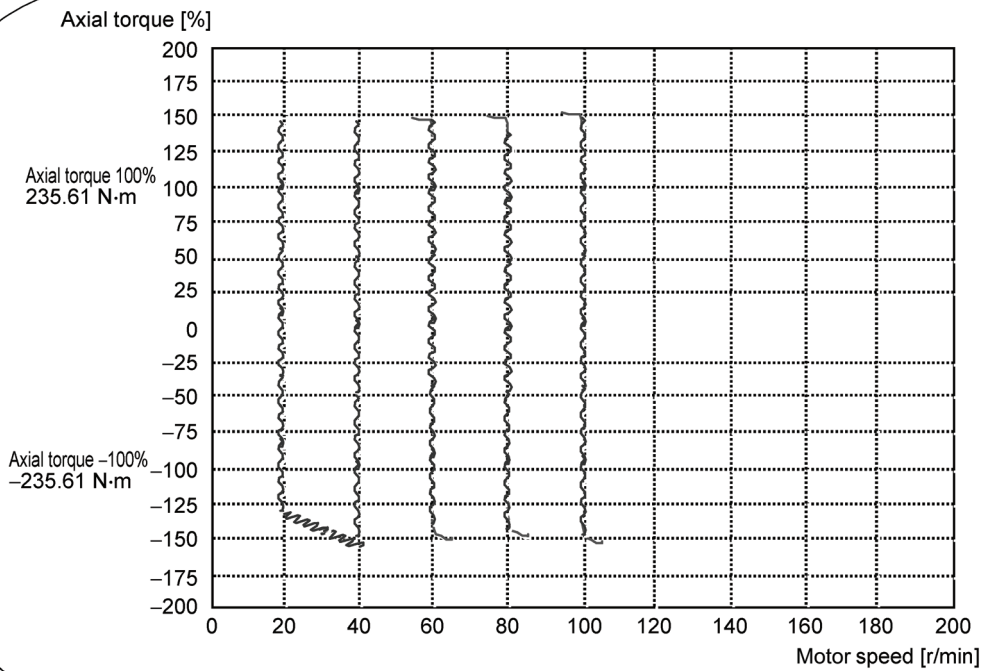


# 12. Operation Data

## 12.8 Speed-torque Characteristics (Sensorless Vector Control)

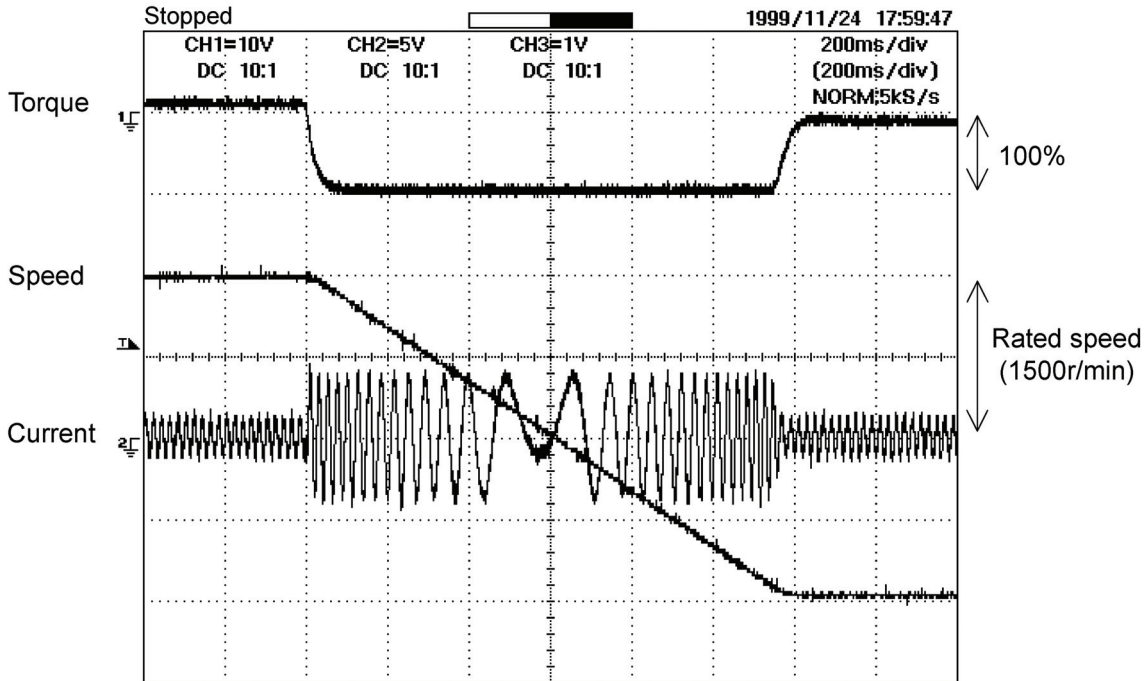


Inverter ; FRN37VG7S-4  
Motor ; MVK6207A-C, 37kW, 1500/3600r/min



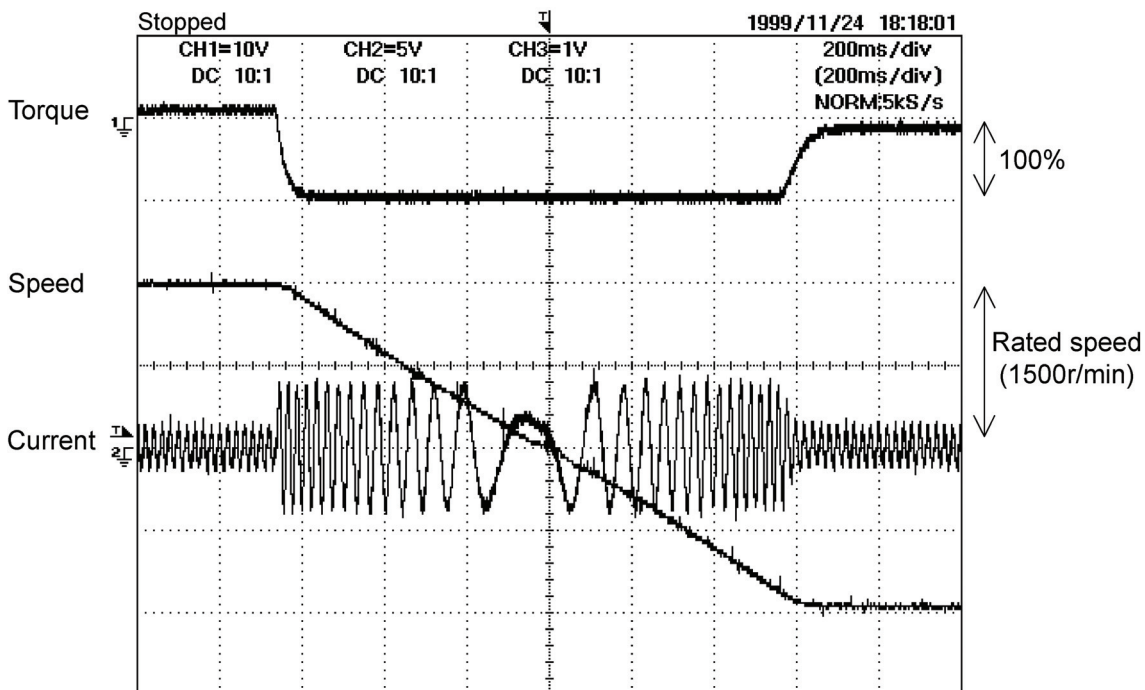
Inverter ; FRN37VG7S-4  
Motor ; MVK6207A-C, 37kW, 1500/3600r/min

## 12.9 Deceleration and Acceleration via Zero Speed (PG Vector Control)



Inverter ; FRN37VG7S-4  
Motor ; MVK6207A-C, 37kW, 1500/3600r/min

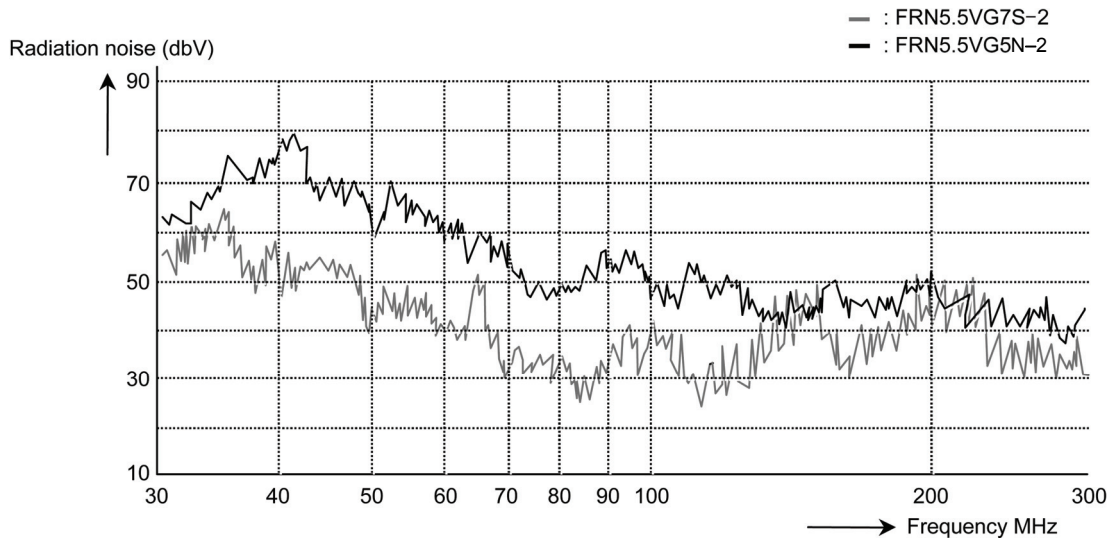
## 12.10 Deceleration and Acceleration via Zero Speed (Sensorless Vector Control)



Inverter ; FRN37VG7S-4  
Motor ; MVK6207A-C, 37kW, 1500/3600r/min

# 12. Operation Data

## 12.11 Comparison of Radiation Noise



1. Motor speed : 1000r/min
2. Measurement distance : 1.0m
3. Motor capacity : 5.5kW-200V
4. Carrier frequency : 10kHz



## **XIII. Function Code List**

**13.1 Function Code Configuration**

**13.2 Function Code List**

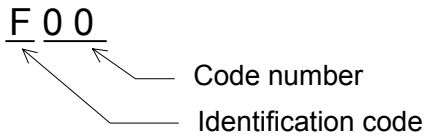
**13.3 Function Code List Dedicated to Communication**

**13.4 Data Format List**

# 13. Function Code List

## 13.1 Function Code Configuration

### 13.1.1 Identification Code Displayed on KEYPAD Panel



Function code		Function	Notes
<u>F</u> undamental functions	F00 to F80	Fundamental function	Displayed on KEYPAD panel always
<u>E</u> xtensional terminal functions	E01 to E84	Terminal function	Some codes are displayed only when options are installed
		E51, 52	Function codes for OPC-VG7-AIO option
		E55, 56	Function codes for OPC-VG7-AIO option
		E59, 60	Function codes for OPC-VG7-AIO option
		E63, 64	Function codes for OPC-VG7-AIO option
		E67, 68	Function codes for OPC-VG7-AIO option
		E72, 73	Function codes for OPC-VG7-AIO option
		E77, 78	Function codes for OPC-VG7-AIO option
E82, 83	Function codes for OPC-VG7-AIO option		
<u>C</u> ontrol functions of frequency	C01 to C73	Control function	Displayed on KEYPAD panel always
<u>P</u> arameters	P01 to P30	Motor parameter function for M1	
<u>H</u> igh performance functions	H01 to H73	High performance function	
<u>A</u> lternative motor parameters	A01 to A50	Motor parameters for M2 and M3	
<u>O</u> ptional functions	o01 to o41	Option function	Displayed when options are installed. PG (PR) option codes are displayed always.
		o01 to o04	Function codes for OPC-VG7-DIA and DIB options
		o05	Function codes for OPC-VG7-PG (PD) option
		o06 to o08	Function codes for OPC-VG7-PG (LD) digital line speed detection option
		o09 to o11	Function codes for OPC-VG7-PMMPG synchronous motor PG option
		o12 to o19	Function codes for OPC-VG7-PG (PR) pulse train input option
		o30 to o32	Function codes for OPC-VG7-TL field bus option
		o33, o34	Function code for OPC-VG7-SI (MWS) multi-winding system option
		o35 to o36	Function codes for OPC-VG7-SI (UPAC) option
		o37	Function code for OPC-VG7-RS option
o38 to o41	Function codes for OPC-VG7-UPAC option		
<u>L</u> ift functions	L01 to L15	Lift functions	
<u>U</u> ser functions	U01 to U64	User functions (UPAC)	You can use for UPAC option. Displayed on KEYPAD panel always.
<u>S</u> erial communication functions	S01 to S12	Command functions	You cannot refer to or change in LOC mode (KEYPAD panel).
<u>M</u> onitoring functions	M01 to M60	Data monitor functions	You can use in COM mode (T-Link, RS-485, SI, SX, and field bus) and UPAC.

## 13.2 Function Code List

### 13.2.1 Function Code List Description

Item	Description
Fcode	Identification codes for function codes.
Communication address 485 number	Address used with integrated RS-485 or UPAC option (OPC-VG7-UPAC) to refer to or change function codes.
Communication address Link number	Address used with field bus options (OPC-VG7-TL, OPC-VG7-SX and field bus options) to refer to or change function codes. You cannot use a field bus option for a function code without a communication address Link number.
Function code name	Name assigned to a group of function codes with a similar nature.
Function directory name	Name of an individual function of a function code.
Setting range	Indicates the setting range and the data definition.
Factory setting	Data specified by FUJI before delivery. Modified data are displayed with * (asterisk) on the KEYPAD panel. You can use the initialization function code to reset them to the factory setting.
Type	Indicates a format type used to refer to or change data through communication system (such as RS-485 and field bus). See 13.3 "Function Code List Dedicated for Communication" for more information.
Copy	Indicates whether to be copied or not to another inverter when you use the copy function of the KEYPAD panel to copy entire data stored in the KEYPAD panel.
Save all	Indicates the function code saved with H02 "save all function" (writing the non-volatile memory). O: Saved function. x: Function not saved.
Initialization	Indicates whether to be initialized (reset to the factory setting) or not by the function code H03 "Data initializing". O: Initialized, x: Not initialized.
Control type: Available/ Not available	Indicates whether available or not in individual control types (PG: Vector control with PG, LES: Sensorless vector control, VF: V/f control, SM: Vector control to drive synchronous motor).
Lifting machine	Indicates the parameter displayed on the keypad panel if H70 is set at "1 (lifting machine)." O: displayed, x: Not displayed

### 13.2.2 List

#### F: Fundamental Functions

Fcode	Communication address		Function code name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
F00	0h	50h	Data protection		0 to 1 <u>**</u> is displayed on the keypad panel. 0: Data change enable 1: Data protection This is a function to protect writing from the Keypad panel. The protection of writing from the link (T-Link, RS485, etc.) is defined with H29 "Link function protection".	40	x	o	o	o	o	o	o	o
F01	1h		Speed setting N1		0 to 7 0: KEYPAD operation ( <u>▲</u> and <u>▼</u> key) 1: Analog input (0 to ±10VDC) 2: Analog input (0 to +10VDC) 3: UP/DOWN control 1 (initial speed = 0 r/min) 4: UP/DOWN control 2 (initial speed = last value) 5: UP/DOWN control 3 (initial speed = Creep speed 1 or 2) 6: DIA card input 7: DIB card input	41	o	o	o	o	o	o	o	o

You can change the setting of a function indicated by  during operation. You should stop operation to change the setting of other functions.

Underline indicates a factory setting.

# 13. Function Code List

Fcode	Communication address		Function code name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
F02	2h		Operation method		0 to 1 The method of operation is set. 0 : KEYPAD operation (FWD or REV or STOP key) (LOCAL) 1 : FWD or REV signal input (REMOTE) The change of REMOTE/LOCAL is possible also by RST+STOP key to the keypad panel. This operation corresponds to writing data of F02.	42	o	o	o	o	o	o	o	o
F03	3h	51 h	M1 Maximum speed	M1 Maximum speed	50 to <u>1500</u> to 24000 r/min	0	o	o	x	o	o	x	o	o
F04	4h	52 h		M1-Rated speed	50 to 24000 r/min	0	o	o	x	o	o	x	o	o
F05	5h	53 h		M1-Rated voltage	80 to 999 V	0	o	o	x	o	o	x	o	o
F07	7h	54 h	Acceleration time 1		0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
F08	8h	55 h	Deceleration time 1		0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
F10	Ah	56 h	M1 Electronic thermal overload relay	M1 Electronic thermal overload relay (Select)	0 to 2 The motor overheating protection operates by using NTC thermistor with the motor only for VG. In this case, please make setting F10 Electronic thermal "Inactive". 0 : Inactive (When you use the motor only for VG) 1 : Active (for 4-pole standard motor, with self-cooling fan) 2 : Active (for Inverter motor, with separate cooling fan)	85	o	o	x	o	o	x	o	o
F11	Bh	57 h		M1 Electronic thermal overload relay (Level)	0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A	13	o	o	x	o	o	x	o	o
F12	Ch	58 h		M1 Electronic thermal overload relay (Thermal time constant)	0.5 to 75.0 min	2	o	o	x	o	o	x	o	o
F14	Eh		Restart mode after momentary power failure		0 to 5 0 : Inactive (Trip and alarm when power failure occurs.) 1 : Inactive (Trip, and alarm when power recovers.) 2 : Inactive (Deceleration to stop, and trip and alarm.) 3 : Active (Smooth recovery by continuous operation mode) 4 : Active (Momentarily stops and restarts at speed on power failure) 5 : Active (Momentarily stops and restarts at starting speed)	0	o	o	o	o	o	o	o	o
F17	11h		Gain (terminal 12 input)		0.0 to <u>100</u> to 200.0 %	2	o	o	o	o	o	o	o	o
F18	12h		Bias (terminal 12 input)		-24000 to <u>0</u> to 24000 r/min	5	o	o	o	o	o	o	o	x
F20	14h	59 h	DC brake (Starting speed)	DC brake (Starting speed)	<u>0</u> to 3600 r/min	0	o	o	o	o	o	o	x	o
F21	15h	5A h		DC brake (Braking level)	<u>0</u> to 100 %	16	o	o	o	o	o	o	x	o
F22	16h	5B h		DC brake (Braking time)	<u>0.0</u> to 30.0 s 0.0 : (Inactive) 0.1 to 30.0 s	2	o	o	o	o	o	o	x	o
F23	17h	5C h	Starting speed (Speed)		<u>0.0</u> to 150.0 r/min (The frequency is limited so as not to become 0.1Hz or less. (When using sensless or VF control))	2	o	o	o	o	o	o	o	o
F24	18h	5D h	Starting speed (Holding time)		<u>0.00</u> to 10.00 s	3	o	o	o	o	o	o	o	o
F26	1Ah	5E h	Motor sound (Carrier Freq.)		0.75 to <u>1</u> to 15 kHz	10	o	o	o	o	o	o	o	o
F27	1Bh	5F h	Motor sound (Sound tone)		<u>0</u> to 3 0 : level 0 1 : level 1 2 : level 2 3 : level 3	0	o	o	o	o	o	o	o	o
F36	24h		30RY operation mode		<u>0</u> to 1 0 : The relay(30) exits on trip mode. 1 : The relay(30) exits on normal mode.	43	o	o	o	o	o	o	o	o
F37	25h	60 h	Stop speed (Level)	Stop speed (Level)	0.0 to <u>10.0</u> to 150.0 r/min (The frequency is limited so as not to become 0.1Hz or less. (When using sensless or VF control))	2	o	o	o	o	o	o	o	o
F38	26h	61 h		Stop speed (Detection method)	<u>0</u> to 1 0 : Reference value 1 : Detected value It is fixed 0 to use the V/F control.	90	o	o	o	o	o	x	o	o

You can change the setting of a function indicated by  during operation.  
You should stop operation to change the setting of other functions.

Underline indicates a factory setting.

Fcode	Communication address		Function code name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
F 3 9	27h	62 h		Stop speed (Zerospeed holding time)	0.00 to <u>0.50</u> to 10.00 s	3	o	o	o	o	x	x	o	o
F 4 0	28h	63 h	Torque limiter	Torque limiting mode 1	0 to 3 0 : Torque limiting invalid 1 : Torque limiting 2 : Power limiting 3 : Torque current limiting	44	o	o	o	o	o	x	o	o
F 4 1	29h	64 h		Torque limiting mode 2	0 to 3 0 : Same limiting level (level 1) for 4 quadrants 1 : Drive torque limiting (level 1), and Brake torque limiting (level 2) 2 : Upper torque limiting (level 1), and Lower torque limiting (level 2) 3 : Same limiting level for 4 quadrants (level 1 and level 2 changeover) Level 1 and 2 is the data setting of the definition by F42, 43 ahead.	45	o	o	o	o	o	x	o	o
F 4 2	2Ah	65 h		Level 1 selection	0 to 5 0 : Internal preset value by F44 1 : Ai terminal input value [TL-REF1] 2 : DIA card input 3 : DIB card input 4 : Link enabled 5 : PID output	46	o	o	o	o	o	x	o	o
F 4 3	2Bh	66 h		Level 2 selection	0 to 5 0 : Internal preset value by F45 1 : Ai terminal input value [TL-REF2] 2 : DIA card input 3 : DIB card input 4 : Link enabled 5 : PID output	47	o	o	o	o	o	x	o	o
F 4 4	2Ch	67 h		Internal set 1	-300 to <u>150</u> to 300 %	5	o	o	o	o	o	x	o	o
F 4 5	2Dh	68 h		Internal set 2	-300 to <u>10</u> to 300 %	5	o	o	o	o	o	x	o	o
F 4 6	2Eh	69 h		Mechanical loss compensation	-300.00 to <u>0.00</u> to 300.00 % This is used when mechanical loss of the load makes amends.	7	o	o	o	o	o	x	o	o
F 4 7	2Fh	6A h		Torque bias set 1	-300.00 to <u>0.00</u> to 300.00 % This set value can be added to the torque reference value. TB1, 2 and 3 are switched by DI and are used.	7	o	o	o	o	o	x	o	o
F 4 8	30h			Torque bias set 2	-300.00 to <u>0.00</u> to 300.00 % This set value can be added to the torque reference value. TB1, 2 and 3 are switched by DI and are used.	7	o	o	o	o	o	x	o	o
F 4 9	31h			Torque bias set 3	-300.00 to 0.00 to 300.00 % This set value can be added to the torque reference value. TB1, 2 and 3 are switched by DI and are used.	7	o	o	o	o	o	x	o	o
F 5 0	32h			Torque bias activation timer	<u>0.00</u> to 1.00 s (300% / 1.00s) Time up to 300% is set.	3	o	o	o	o	o	x	o	o
F 5 1	33h	FB h		Torque command monitor (polarity)	0 to 1 Polarity selection of the data output related to torque (AO, Keypad panel, code M) 0 : Display with torque polarity 1 : (+) for driving mode, and (-) for braking mode	48	o	o	o	o	o	o	o	o
F 5 2	34h		LED monitor, LCD monitor	Display coefficient A	-999.00 to <u>1.00</u> to 999.00 The conversion coefficient to load axis rotation speed and decide the display value at the line speed displayed in LED are set. Display value = Motor speed × (0.01 to 200.00) The set data is effective only by 0.01 to 200.00 and outside the range is invalid.	12	o	o	o	o	o	o	o	o
F 5 3	35h			Display coefficient B	-999.00 to <u>1.00</u> to 999.00 The conversion coefficient to decide the reference value of the PID adjustment machine and the display value (amount of the process) of the amount of feedback is set by using display coefficient A and B. Display coefficient A ; Maximum value Display coefficient B ; Minimum value Display value = (Reference value or feedback value) * (Display coefficient A - B) + B	12	o	o	o	o	o	o	o	o
F 5 4	36h			LED display filter	0.0 to <u>0.2</u> to 5.0 s Filter to prevent LED from flickering by change of the display data. The filter is effective in all the data selected with F55.	2	o	o	o	o	o	o	o	o

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# 13. Function Code List

Fcode	Communication address		Function code name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
F 5 5	37h			LED (Selection)	0 to 28	49	o	o	o	o	o	o	o	o
					0 : Detected speed 1 or reference (r/min) (depending on F56 while motor is stopped)					o	o	x	o	
					1 : Speed reference value 4 (ASR input) (r/min)					o	o	o	o	
					2 : Output frequency after slip compensation (Hz)					o	o	o	o	
					3 : Torque current reference (%)					o	o	x	o	
					4 : Torque reference value (%)					o	o	x	o	
					5 : Torque (calculated value) (%)					o	o	o	o	
					6 : Inverter input power (kW or HP) (depending on F60)					o	o	o	o	
					7 : Output current (A)					o	o	o	o	
					8 : Output voltage (V)					o	o	o	o	
					9 : DC link circuit voltage (V)					o	o	o	o	
					10 : Magnetic flux command (%)					o	o	x	x	
					11 : Magnetic flux (calculated value) (%)					o	o	x	x	
					12 : Motor temperature (°C) ("—" is displayed when NTC thermistor unused.)					o	o	o	o	
					13 : Load shaft speed (r/min) (depending on F56)					o	o	x	o	
					14 : Line speed (m/min) (depending on F56)					o	o	o	o	
					15 : Ai adjusted value (I2) (%)					o	o	o	o	
					16 : Ai adjusted value (Ai1) (%)					o	o	o	o	
					17 : Ai adjusted value (Ai2) (%)					o	o	o	o	
					18 : Ai adjusted value (Ai3) (%)					o	o	o	o	
					19 : Ai adjusted value (Ai4) (%)					o	o	o	o	
					The following data becomes non-display by the mode on the option.					o	o	o	o	
					20 : PID reference (%) (Display at the PID mode)					o	o	o	o	
					21 : PID feedback value (%) (Display at the PID mode)					o	o	o	o	
					22 : PID output value (%) (Display at the PID mode)					o	o	o	o	
					23 : Option monitor 1 (HEX) (Display with use of option)					o	o	o	o	
					24 : Option monitor 2 (HEX) (Display with use of option)					o	o	o	o	
					25 : Option monitor 3 (DEC) (Display with use of option)					o	o	o	o	
26 : Option monitor 4 (DEC) (Display with use of option)	o	o	o	o										
27 : Option monitor 5 (DEC) (Display with use of option)	o	o	o	o										
28 : Option monitor 6 (DEC) (Display with use of option)	o	o	o	o										
F 5 6	38h			LED (Display at stop mode)	0 to 1 Change of the display on F55 when the motor is stopping. The corresponding data is speed (0), load shaft rotation speed (13), and line speed (14). 0 : Speed command (r/min) 1 : Speed feedback (r/min)	50	o	o	o	o	o	o	o	o
F 5 7	39h			LCD (Selection)	0 to 1 Change of operation mode display on Keypad panel 0 : Operation guide (State of operation, Direction of rotation)	51	o	o	o	o	o	o	o	o
F 5 8	3Ah			LCD (Language)	0 to 7 0 : Japanese 1 : English 2 : German 3 : French 4 : Spanish 5 : Italian 6 : Chinese 7 : Korean	52	o	o	o	o	o	o	o	o
F 5 9	3Bh			LCD (Contrast)	0 to <u>5</u> to 10 0 (Soft) to 10 (Hard)	0	o	o	o	o	o	o	o	o
F 6 0	3Ch		Output unit selection (kW or HP)		0 to 1 The unit of inverter power consumption and motor (M1,2,3) of the function setting is defined. 0 : kW 1 : HP	53	o	o	o	o	o	o	o	o
F 6 1	3Dh	6B h	ASR1	P-gain	0.1 to <u>10.0</u> to 200.0 (times)	2	o	o	o	o	o	x	o	o
F 6 2	3Eh	6C h		I-gain	0.010 to <u>0.200</u> to 1.000 s P control when setting 1.000	4	o	o	o	o	o	x	o	o
F 6 3	3Fh	6D h		Feed forward gain	<u>0.000</u> to 9.999 s	4	o	o	o	o	o	x	o	o
F 6 4	40h	6E h		Input filter	0.000 to <u>0.040</u> to 5.000 s	4	o	o	o	o	o	o	o	o

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Fcode	Communication address		Function code name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
F 6 6	42h	70 h		Output filter	0.000 to <u>0.002</u> to 0.100 s	4	o	o	o	o	o	x	o	o
F 6 7	43h	71 h		S-curve (Acc start side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
F 6 8	44h	72 h		S-curve (Acc end side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
F 6 9	45h	73 h		S-curve (Dec start side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
F 7 0	46h	74 h		S-curve (Dec end side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
F 7 3	49h		Magnetic flux at light leal	Magnetic flux at light leal	10 to <u>100</u> %	16	o	o	o	o	o	x	x	o
F 7 4	4Ah	75 h		Pre-exiting time	<u>0.0</u> to 10.0 s	2	o	o	o	o	o	x	x	o
F 7 5	4Bh	76 h		Pre-excitation initial Level	100 to 400 %	0	o	o	o	o	o	x	x	o
F 7 6	4Ch		Speed limited	Speed limiter (Mode select)	0 to 3 0 : Limiting level 1 for forward rotation, and limiting level 2 for reverse rotation 1 : Limiting level 1 for both side rotation 2 : Limiting level 1 for upper limit, and limiting level 2 for lower limit 3 : Forward (Level 1) and reverse (Level 2). Add the [12] input as a bias.	91	o	o	o	o	o	o	o	x
F 7 7	4Dh	4Fh		Speed limiting (Level 1)	-110.0 to <u>100.0</u> to 110.0 %	6	o	o	o	o	o	o	o	x
F 7 8	4Eh	FEh		Speed limiting (Level 2)	-110.0 to <u>100.0</u> to 110.0 %	6	o	o	o	o	o	o	o	x
F 7 9	4Fh	77 h	Motor selection (M1, M2, M3)		<u>0</u> to 2 An effective motor (M1, 2 or 3) is selected by the function or terminal. 0 : M1 select The signal input by the terminal is given to priority. M1 select ; (MCH2,MCH3)=(OFF,OFF) (ON,ON) (If there is no allocation) M2 select ; (MCH2,MCH3)=(ON ,OFF) M3 select ; (MCH2, MCH3)=(OFF, ON) 1 : M2 select (x function inactive) 2 : M3 select (x function inactive)	54	o	o	x	o	o	o	o	o
F 8 0	50h		Current rating switching		<u>0</u> to 2 0 : CT (Overload current 150%) 1 : VT (Overload current 110%) 2 : HT (Overload torque 200/170%)	56	o	o	x	o	o	o	o	o

You can change the setting of a function indicated by  during operation.  
You should stop operation to change the setting of other functions.

Underline indicates a factory setting.

# 13. Function Code List

## E: Extension Terminal Functions

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
E 0 :	101h	78 h	X1 terminal function	X1 terminal function	<u>0</u> to 63	57	o	o	o	o	o	o	o	o
					0 to 3 : Multistep speed selection (1 to 15 steps) (0 : SS1, 1 : SS2, 2 : SS4, 3 : SS8)					o	o	o	o	
					4, 5 : ASR and ACC/DEC time selection (4 steps) (4 : RT1, 5 : RT2)					o	o	o	o	
					6 : 3 wire operation stop command (HLD)					o	o	o	o	
					7 : Coast-to-stop command (BX)					o	o	o	o	
					8 : Alarm reset (RST)					o	o	o	o	
					9 : Trip command (External fault) (THR)					o	o	o	o	
					10 : Jogging operation (JOG)					o	o	o	o	
					11 : Speed setting 2 / Speed setting 1 (N2/N1)					o	o	o	o	
					12 : Motor M2 selection (M-CH2)					o	o	o	o	
					13 : Motor M3 selection (M-CH3)					o	o	o	o	
					14 : DC brake command (DCBRK)					o	o	o	x	
					15 : ACC/DEC cleared to zero (CLR)					o	o	o	o	
					16 : Creep speed switching in UP/DOWN control (CRP-N2/N1)					o	o	o	o	
					17 : Up command (UP)					o	o	o	o	
					18 : DOWN command (DOWN)					o	o	o	o	
					19 : Write enable for KEYPAD (WE-KP)					o	o	o	o	
					20 : PID control cancel (KP/PID)					o	o	o	o	
					21 : Inverse mode changeover (IVS)					o	o	o	o	
					22 : Interlock signal for 52-2 (IL)					o	o	o	o	
					23 : Write enable through link (WE-LK)					o	o	o	o	
					24 : Operation selection through link (LE)					o	o	o	o	
					25 : Universal DI (U-DI)					o	o	o	o	
					26 : Pick up start mode (STM)					o	o	x	o	
					27 : Synchronization command (PG (PR) optional function) (SYC)					o	x	x	o	
					28 : Zero speed locking command (LOCK)					o	x	x	o	
					29 : Pre-exiting command (EXITE)					o	o	x	x	
					30 : Speed reference limiter cancel (N-LIM) (Related function : F76, F77, F78)					o	o	o	o	
					31 : H41 [torque command] cancel (H41-CCL)					o	o	x	o	
					32 : H42 [torque current command] cancel (H42-CCL)					o	o	x	o	
					33 : H43 [magnetic flux command] cancel (H43-CCL)					o	o	x	x	
					34 : F40 [torque limiter mode 1] cancel (F40-CCL)					o	o	x	o	
					35 : Torque limiter 2 / Torque limiter 1 (TL2/TL1)					o	o	x	o	
					36 : Bypass from ramp function generator (BPS)					o	o	o	o	
					37, 38 : Torque bias command 1/2 (37 : TB1, 38 : TB2)					o	o	x	o	
					39 : DROOP selection (DROOP)					o	o	x	o	
					40 : Zero hold command for Ai1 (ZH-AI1)					o	o	o	o	
					41 : Zero hold command for Ai2 (ZH-AI2)					o	o	o	o	
					42 : Zero hold command for Ai3 (option) (ZH-AI3)					o	o	o	o	
					43 : Zero hold command for Ai4 (option) (ZH-AI4)					o	o	o	o	
					44 : Ai1 polarity change (REV-AI1)					o	o	o	o	
					45 : Ai2 polarity change (REV-AI2)					o	o	o	o	
					46 : Ai3 polarity change (option) (REV-AI3)					o	o	o	o	
					47 : Ai4 polarity change (option) (REV-AI4)					o	o	o	o	
					48 : Inverse mode of PID output (PID-INV)					o	o	o	o	
					49 : PG alarm cancel (PG-CCL)					o	x	x	o	
					50 : Undervoltage cancel (LU-CCL)					o	o	o	o	

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Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine	
	485 number	Link number								PG	LES	VF	SM		
					51 : Ai torque bias hold [H-TB]					o	o	x	o		
					52 : STOP1 (The motor stops with normal deceleration time.) (STOP1)					o	o	o	o		
					53 : STOP2 (The motor stops with deceleratime 4) (STOP2)					o	o	o	o		
					54 : STOP3 (The motor stops with max. torque.) (STOP3)					o	o	o	o		
					55 : DIA data latch (DIA option) (DIA)					o	o	o	o		
					56 : DIB data latch (DIB option) (DIB)					o	o	o	o		
					57 : Multiwinding motor cancel (SI (MWS) option) (MT-CCL)					o	x	x	x		
					58 to 63 : Option Di 1/2/3/4/5/6 (O-DI1 to 6)					o	o	o	o		
E 0 2	102h	79 h		X2 terminal function	0 to <u>1</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 0 3	103h	7A h		X3 terminal function	0 to <u>2</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 0 4	104h	7B h		X4 terminal function	0 to <u>3</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 0 5	105h	7C h		X5 terminal function	0 to <u>4</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 0 6	106h	7D h		X6 terminal function	0 to <u>5</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 0 7	107h	7E h		X7 terminal function	0 to <u>7</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 0 8	108h	7F h		X8 terminal function	0 to <u>8</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 0 9	109h	80 h		X9 terminal function	0 to <u>9</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 1 0	10Ah	81 h		X11 terminal function	0 to <u>25</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 1 1	10Bh	82 h		X12 terminal function	0 to <u>25</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 1 2	10Ch	83 h		X13 terminal function	0 to <u>25</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 1 3	10Dh	84 h		X14 terminal function	0 to <u>25</u> to 63 (Refer to X1 function selection.)	57	o	o	o	o	o	o	o	o	
E 1 4	10Eh		X terminal function normal open/close		<u>0000</u> to 01FF Setting of normal state of X1-X9. 0 : Normal open 1 : Normally closed	35	o	o	o	o	o	o	o	o	
E 1 5	10Fh	85 h	Y1 terminal function	Y1 terminal function	0 to <u>1</u> to 47 0 : Inverter running (RUN) 1 : Speed existence signal (N-EX) 2 : Speed agreement signal (N-AG) 3 : Speed egilivarent signal (N-AR) 4 : Speed level detection 1 (N-DT1) 5 : Speed level detection 2 (N-DT2) 6 : Speed level detection 3 (N-DT3) 7 : Stopping on undervoltage (LU) 8 : Detected torque polarity (Braking/Driving) (B/D) 9 : Torque limiting (TL) 10 : Torque detection 1 (T-DT1) 11 : Torque detection 2 (T-DT2) 12 : KEYPAD operation mode (KP) 13 : Inverter stopping (STP) 14 : Operation ready output (RDY) 15 : Magnetic flux detection signal (MF-DT) 16 : Motor M2 selection status (SW-M2) 17 : Motor M3 selection status (SW-M3) 18 : Mechanical brake release signal (BRK) 19 : Alarm indication signal 1 (AL1) 20 : Alarm indication signal 2 (AL2) 21 : Alarm indication signal 4 (AL4) 22 : Alarm indication signal 8 (AL8) 23 : Fan operation signal (FAN) 24 : Auto-resetting (TRY) 25 : Universal DO (U-DO) 26 : Heat sink overheat early warning (INV-OH)	58	o	o	o	o	o	o	o	o	o

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# 13. Function Code List

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
					27 : Synchronization completion signal (SY-C)					o	x	x	x	
					28 : Lifetime alarm (LIFE)					o	o	o	o	
					29 : Under acceleration (U-ACC)					o	o	o	o	
					30 : Under deceleration (U-DEC)					o	o	o	o	
					31 : Inverter overload early warning (INV-OL)					o	o	o	o	
					32 : Motor overheat early warning (M-OH)					o	o	o	o	
					33 : Motor overload early warning (M-OL)					o	o	o	o	
					34 : DB overload early warning (DB-OL)					o	o	x	o	
					35 : Link transmission error (LK-ERR)					o	o	o	o	
					36 : load adaptive control under limiting (ANL)					o	x	x	x	
					37 : load adaptive control under calculation (ANC)					o	x	x	x	
					38 : Analog torque bias hold (TBH)					o	o	x	o	
					39 to 47 : Option DO1 to 9 (O-DO1 to O-DO9)					o	o	o	o	
E 1 5	110h	86 h		Y2 terminal function	0 to <u>2</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 1 7	111h	87 h		Y3 terminal function	0 to <u>3</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 1 8	112h	88 h		Y4 terminal function	0 to <u>4</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 1 9	113h	89 h		Y5 terminal function	0 to <u>14</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 2 0	114h	8A h		Y11 terminal function	0 to <u>26</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 2 1	115h	8B h		Y12 terminal function	0 to <u>26</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 2 2	116h	8C h		Y13 terminal function	0 to <u>26</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 2 3	117h	8D h		Y14 terminal function	0 to <u>26</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 2 4	118h	8E h		Y15 terminal function	0 to <u>26</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 2 5	119h	8F h		Y16 terminal function	0 to <u>26</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 2 6	11Ah	90 h		Y17 terminal function	0 to <u>26</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 2 7	11Bh	91 h		Y18 terminal function	0 to <u>26</u> to 47 (Refer to Y1 function selection.)	58	o	o	o	o	o	o	o	o
E 2 8	11Ch		Y terminal function normally open/close		<u>0000</u> to 001F Setting of normal state of Y1to Y4,R.Y. 0 : Normally open 1 : Normally close	36	o	o	o	o	o	o	o	o
E 2 9	11Dh	92 h	PG pulse output selection		<u>0</u> to 9 0 : No dividing 1 : 1/2 2 : 1/4 3 : 1/8 4 : 1/16 5 : 1/32 6 : 1/64 0 to 6 : Internal PG inputs are output after being divided. 7 : Pulse oscillation mode (A/B 90° phase difference signal) Internal speed reference is output after pulse conversion. 8 : PG (PD) Pulse inputs for position encoder are directly output. 9 : PG (PR) Pulse inputs for position command are directly output.	92	o	o	o	o	x	x	o	o
E 3 0	11Eh		Motor OH protection	Motor OH protection (temperature)	100 to <u>150</u> to 200 °C It is effective when NTC thermistor is used with selected motor (M1,M2).	0	o	o	o	o	o	o	o	o
E 3 1	11Fh			M-OH early warning (temperature)	50 to <u>75</u> to 200 °C It is effective when NTC thermistor is used with selected motor (M1,M2).	0	o	o	o	o	o	o	o	o
E 3 2	120h	CD h		M1-M3 (operation level PTC)	0.00 to <u>1.60</u> to 5.00 V	3	o	o	o	o	o	o	o	o
E 3 3	121h			INV-OL early warning	25 to <u>90</u> to 100 %	0	o	o	o	o	o	o	o	o
E 3 4	122h			M-OL early warning	25 to <u>90</u> to 100 %	0	o	o	o	o	o	o	o	o
E 3 5	123h			DB overload protection	0 to <u>10</u> to 100 %	0	o	o	o	o	o	x	o	o
E 3 6	124h			DB-OL early warning	0 to <u>80</u> to 100 %	0	o	o	o	o	o	x	o	o
E 3 7	125h			DB thermal time constant	0 to <u>100</u> to 1000 s	0	o	o	o	o	o	x	o	o

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Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine		
	485 number	Link number								PG	LES	VF	SM			
E 3 8	126h	93h	Speed detection method	Speed detection method	000 to 111 (N-DT1) (N-DT2) (N-DT3) 0 : Detected speed 1 : Speed reference Only reference values are effective under VF control.	9	o	o	o	o	o	o	x	o	o	
E 3 9	127h	94h		N-DT1 Level	0 to <u>1500</u> to 24000 r/min	0	o	o	o	o	o	o	o	o	o	
E 4 0	128h	95h		N-DT2 Level	-24000 to 1500 to 24000 r/min	5	o	o	o	o	o	o	o	o	o	
E 4 1	129h	96h		N-DT3 Level	-24000 to 1500 to 24000 r/min	5	o	o	o	o	o	o	o	o	o	
E 4 2	12Ah	97h		N-AR detection width	1.0 to <u>3.0</u> to 20.0 %	2	o	o	o	o	o	o	x	o	o	
E 4 3	12Bh	98h		N-AG detection width	1.0 to <u>3.0</u> to 20.0 %	2	o	o	o	o	o	o	x	o	o	
E 4 4	12Ch	99h		N-AG off-delay timer	0.000 to <u>0.100</u> to 1.000 s	4	o	o	o	o	o	o	x	o	o	
E 4 5	12Dh	9A h		Speed disagreement alarm	<u>0</u> to 21 Place of 1: Speed disagreement alarm (Er9) 0: Not used 1: Used Place of 10: Lin phase loss detection 0: Level without DCR 1: Level with DCR 2: For manufacturer (Do not specify.)	9	o	o	o	o	o	o	x	o	o	
E 4 6	12Eh	9B h		Torque detection level 1	0 to <u>30</u> to 300 % When the V/F control is used, the calculation value is set.	16	o	o	o	o	o	o	o	o	o	
E 4 7	12Fh	9C h		Torque detection level 2	0 to <u>30</u> to 300 % When the V/F control is used, the calculation value is set.	16	o	o	o	o	o	o	o	o	o	
E 4 8	130h	9D h		Magnetic flux detection level	10 to <u>100</u> %	16	o	o	o	o	o	o	x	x	o	
E 4 9	131h		Ai function selection	Ai1 function selection	<u>0</u> to 18 0 : Input signal off (OFF) 1 : Auxiliary speed setting 1 (before ramp function) (AUX-N1) ±10V/±Nmax 2 : Auxiliary speed setting 2 (after ramp function) (AUX-N2) ±10V/±Nmax 3 : Torque limiter level 1 (TL-REF1) ±10V/±150% 4 : Torque limiter level 2 (TL-REF2) ±10V/±150% 5 : Torque bias level (TB-REF) ±10V/±150% 6 : Torque reference (before limit function) (T-REF) ±10V/±150% 7 : Torque current reference (IT-REF) ±10V/±150% 8 : Creep speed 1 for UP/DOWN control (CRP-N1) ±10V/±Nmax 9 : Creep speed 2 for UP/DOWN control (CRP-N2) ±10V/±Nmax 10 : Magnetic flux reference (MF-REF) ±10V/±100% 11 : Detected line speed (LINE-N) ±10V/±Nmax 12 : Motor temperature feedback (M-TMP) +10V/ 200°C 13 : Speed override (N-OR) ±10V/±50% 14 : Universal Ai (U-Ai) ±10V/±4000 (h) 15 : PID feedback (PID-FB) ±10V/±20000 (d) 16 : PID reference value (PID-REF) ±10V/±20000 (d) 17 : PID correction gain (PID-G) ±10V/±4000 (h) 18 : Option Ai (O-Ai) ±10V/±7FFF (h)	59	o	o	o	o	o	o	o	o	o	o
E 5 0	132h			Ai2 function selection	<u>0</u> to 18 (Refer to Ai1 function selection.)	59	o	o	o	o	o	o	o	o	o	
E 5 1	133h			Ai3 function selection	<u>0</u> to 18 (Refer to Ai1 function selection.) (Displayed when the AIO option is installed.)	59	o	o	o	o	o	o	o	o	x	
E 5 2	134h			Ai4 function selection	<u>0</u> to 18 (Refer to Ai1 function selection.) (Displayed when the AIO option is installed.)	59	o	o	o	o	o	o	o	o	x	

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# 13. Function Code List

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/Not available				Lifting machine		
	485 number	Link number								PG	LES	VF	SM			
E 5 3	135h		Gain adjustment for analog input	Gain (Ai1)	-10.000 to <u>1.000</u> to 10.000 (times)	8	o	o	o	o	o	o	o	o		
E 5 4	136h			Gain (Ai2)	-10.000 to <u>1.000</u> to 10.000 (times)	8	o	o	o	o	o	o	o	o		
E 5 5	137h			Gain (Ai3)	-10.000 to <u>1.000</u> to 10.000 (times) (When the AIO option is installed, this is displayed.)	8	o	o	o	o	o	o	o	x		
E 5 6	138h			Gain (Ai4)	-10.000 to <u>1.000</u> to 10.000 (times) (When the AIO option is installed, this is displayed.)	8	o	o	o	o	o	o	o	x		
E 5 7	139h		Bias adjustment for analog input	Bias (Ai1)	-100.0 to <u>0.0</u> to 100.0 %	6	o	o	o	o	o	o	o	o		
E 5 8	13Ah			Bias (Ai2)	-100.0 to <u>0.0</u> to 100.0 %	6	o	o	o	o	o	o	o	o		
E 5 9	13Bh			Bias (Ai3)	-100.0 to <u>0.0</u> to 100.0 % (When the AIO option is installed, this is displayed.)	6	o	o	o	o	o	o	o	x		
E 6 0	13Ch			Bias (Ai4)	-100.0 to <u>0.0</u> to 100.0 % (When the AIO option is installed, this is displayed.)	6	o	o	o	o	o	o	o	x		
E 6 1	13Dh		Filter adjustment for analog input	Filter (Ai1)	0.000 to <u>0.010</u> to 0.500 s	4	o	o	o	o	o	o	o	o		
E 6 2	13Eh			Filter (Ai2)	0.000 to <u>0.010</u> to 0.500 s	4	o	o	o	o	o	o	o	o		
E 6 3	13Fh			Filter (Ai3)	0.000 to <u>0.010</u> to 0.500 s (When the AIO option is installed, this is displayed.)	4	o	o	o	o	o	o	o	x		
E 6 4	140h			Filter (Ai4)	0.000 to <u>0.010</u> to 0.500 s (When the AIO option is installed, this is displayed.)	4	o	o	o	o	o	o	o	x		
E 6 5	141h		Increment/decrement limiter	Inc/dec limiter (Ai1)	<u>0.00</u> to 60.00 s	3	o	o	o	o	o	o	o	x		
E 6 6	142h			Inc/dec limiter (Ai2)	<u>0.00</u> to 60.00 s	3	o	o	o	o	o	o	o	x		
E 6 7	143h			Inc/dec limiter (Ai3)	<u>0.00</u> to 60.00 s (When the AIO option is installed, this is displayed.)	3	o	o	o	o	o	o	o	x		
E 6 8	144h			Inc/dec limiter (Ai4)	<u>0.00</u> to 60.00 s (When the AIO option is installed, this is displayed.)	3	o	o	o	o	o	o	o	x		
E 6 9	145h		AO function selection	AO1 function selection	0 to <u>1</u> to 31 0 : Detected speed 1 (0 to 10 Vdc / 0 to ±Nmax speed) (N-FB1+) 1 : Detected speed 1 (0 to ±10 Vdc / 0 to ±Nmax speed) (N-FB1±) 2 : Speed settg 2 (before ACC/DEC calculating) (0 to ±10 Vdc / 0 to ±Nmax) (N-REF2) 3 : Speed settg 4 (ASR input) (0 to ±10 Vdc / 0 to ±Nmax) (N-REF4) 4 : Detected speed 2 (ASR input) (0 to ±10 Vdc / 0 to ±Nmax) (N-FB2±) 5 : Detected line speed (0 to ±10 Vdc / 0 to ±Nmax) (LINE-N±) 6 : Torque current reference (0 to ±10 Vdc / 0 to ±150%) (IT-REF±) 7 : Torque current reference (0 to +10 Vdc / 0 to +150%) (IT-REF+) 8 : Torque reference (0 to ±10 Vdc / 0 to ±150%) (T-REF±) 9 : Torque reference (0 to +10 Vdc / 0 to +150%) (T-REF+) 10 : Motor current (0 to 10 Vdc / 0 to 200%) (I-AC) 11 : Motor voltage (0 to 10 Vdc / 0 to 200%) (V-AC) 12 : Input power (0 to 10 Vdc / 0 to 200%) (PWR) 13 : DC link circuit voltage (0 to 10 Vdc / 0 to 800V) (V-DC) 14 : Test voltage output (+10Vdc) (P10) 15 : Test voltage output (-10Vdc) (N10)	60	o	o	o	o	o	o	o	o	o	o

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Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
E 7 0	146h			AO2 function selection	0 to <u>6</u> to 31 (Refer to A01 function selection.)	60	o	o	o	o	o	o	o	o
E 7 1	147h			AO3function selection	0 to <u>3</u> to 31 (Refer to A01 function selection.)	60	o	o	o	o	o	o	o	o
E 7 2	148h			AO4 function selection	<u>0</u> to 31 (Refer to A01 function selection.) (Displayed when the AIO option is installed.)	60	o	o	o	o	o	o	o	o
E 7 3	149h			AO5 function selection	<u>0</u> to 31 (Refer to A01 function selection.) (Displayed when the AIO option is installed.)	60	o	o	o	o	o	o	o	o
E 7 4	14Ah		Gain adjustment for analog output	Gain (AO1)	-100.00 to <u>1.00</u> to 100.00 (times)	7	o	o	o	o	o	o	o	o
E 7 5	14Bh			Gain (AO2)	-100.00 to <u>1.00</u> to 100.00 (times)	7	o	o	o	o	o	o	o	o
E 7 6	14Ch			Gain (AO3)	-100.00 to <u>1.00</u> to 100.00 (times)	7	o	o	o	o	o	o	o	o
E 7 7	14Dh			Gain (AO4)	-100.00 to <u>1.00</u> to 100.00 (times) (When the AIO option is installed, this is displayed.)	7	o	o	o	o	o	o	o	o
E 7 8	14Eh			Gain (AO5)	-100.00 to <u>1.00</u> to 100.00 (times) (When the AIO option is installed, this is displayed.)	7	o	o	o	o	o	o	o	o
E 7 9	14Fh		Bias adjustment for analog output	Bias (AO1)	-100.0 to <u>0.0</u> to 100.0 %	6	o	o	o	o	o	o	o	o
E 8 0	150h			Bias (AO2)	-100.0 to <u>0.0</u> to 100.0 %	6	o	o	o	o	o	o	o	o
E 8 1	151h			Bias (AO3)	-100.0 to <u>0.0</u> to 100.0 %	6	o	o	o	o	o	o	o	o
E 8 2	152h			Bias (AO4)	-100.0 to <u>0.0</u> to 100.0 % (When the AIO option is installed, this is displayed.)	6	o	o	o	o	o	o	o	o
E 8 3	153h			Bias (AO5)	-100.0 to <u>0.0</u> to 100.0 % (When the AIO option is installed, this is displayed.)	6	o	o	o	o	o	o	o	o
E 8 4	154h		Filter adjustment for analog output ( AO1-5 )		0.000 to <u>0.010</u> to 0.500 s	4	o	o	o	o	o	o	o	o

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# 13. Function Code List

## C: Control Functions of Frequency

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
C 0 1	201h		Jump speed control	Jump speed (Speed 1)	0 to 24000 r/min	0	o	o	o	o	o	o	o	x
C 0 2	202h			Jump speed (Speed 2)	0 to 24000 r/min	0	o	o	o	o	o	o	o	x
C 0 3	203h			Jump speed (Speed 3)	0 to 24000 r/min	0	o	o	o	o	o	o	o	x
C 0 4	204h			Jump speed (Hysteresis)	0 to 1000 r/min	0	o	o	o	o	o	o	o	x
C 0 5	205h	9E h	Multistep speed setting	Multistep speed 1	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 0 6	206h	9F h		Multistep speed 2	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 0 7	207h	A0 h		Multistep speed 3	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 0 8	208h	A1 h		Multistep speed 4	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 0 9	209h	A2 h		Multistep speed 5	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 0	20Ah	A3 h		Multistep speed 6	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 1	20Bh	A4 h		Multistep speed 7	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 2	20Ch			Multistep speed 8	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 3	20Dh			Multistep speed 9	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 4	20Eh			Multistep speed 10	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 5	20Fh			Multistep speed 11	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 6	210h			Multistep speed 12	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 7	211h			Multistep speed 13	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 8	212h			Multistep speed 14 /Creep speed 1	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 1 9	213h			Multistep speed 15 /Creep speed 2	0 to 24000 r/min / <u>0.00</u> to 100.00 % / <u>0.0</u> to 999.9 m/m (Change by C21)	0	o	o	o	o	o	o	o	o
C 2 0	214h			Multistep speed agreement timer	<u>0.000</u> to 0.100 s	4	o	o	o	o	o	o	o	o
C 2 1	215h			Multistep speed setting definition	0 to 2 0 : 0 to 24000 r/min 1 : 0.00 to 100.00% 2 : 0.0 to 999.9 m/m Defines setting methods of C05 to C19. With selection of "1", the setting range applies to the max speeds (F03, A06, A40) of selected motor. Refer to F79 for motor selection.	93	o	o	o	o	o	o	o	o
C 2 5	219h		Speed setting N2		0 to 7 * Same as ( F01 )	41	o	o	o	o	o	o	o	x
C 2 9	21Dh		Jogging speed		0 to <u>50</u> to 24000 r/min	0	o	o	o	o	o	o	o	x
C 3 0	21Eh		ASR-JOG	P-gain	0.1 to <u>10.0</u> to 200.0 (times)	2	o	o	o	o	o	x	o	o
C 3 1	21Fh			I-gain	0.010 to <u>0.200</u> to 1.000 s P control when setting 1.000	4	o	o	o	o	o	x	o	o
C 3 2	220h			Input filter	0.000 to <u>0.040</u> to 5.000 s	4	o	o	o	o	o	o	o	o
C 3 3	221h			Detection filter	0.000 to <u>0.005</u> to 0.100 s	4	o	o	o	o	o	x	o	o
C 3 4	222h			Output filter	0.000 to <u>0.002</u> to 0.100 s	4	o	o	o	o	o	x	o	o
C 3 5	223h			Acceleration time JOG	0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
C 3 6	224h			Deceleration time JOG	0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
C 3 7	225h			S-curve JOG (Start side)	0 to 50 %	0	o	o	o	o	o	o	o	o
C 3 8	226h			S-curve JOG (End side)	0 to 50 %	0	o	o	o	o	o	o	o	o
C 4 0	228h		ASR2	P-gain	0.1 to <u>10.0</u> to 200.0 (times)	2	o	o	o	o	o	x	o	o
C 4 1	229h			I-gain	0.010 to <u>0.200</u> to 1.000 s P control when setting 1.000	4	o	o	o	o	o	x	o	o
C 4 2	22Ah			F/F-gain	<u>0.000</u> to 9.999 s	4	o	o	o	o	o	x	o	o
C 4 3	22Bh			Input filter	0.000 to <u>0.040</u> to 5.000 s	4	o	o	o	o	o	o	o	o

You can change the setting of a function indicated by  during operation.  
You should stop operation to change the setting of other functions.

Underline indicates a factory setting.

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
C 4 4	22Ch			Detection filter	0.000 to <u>0.005</u> to 0.100 s	4	o	o	o	o	o	x	o	o
C 4 5	22Dh			Output filter	0.000 to <u>0.002</u> to 0.100 s	4	o	o	o	o	o	x	o	o
C 4 6	22Eh			Acceleration time 2	0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
C 4 7	22Fh			Deceleration time 2	0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
C 4 8	230h			S-curve 2 (Start side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
C 4 9	231h			S-curve 2 (End side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
C 5 0	232h		ASR3	P-gain	0.1 to <u>10.0</u> to 200.0 (times)	2	o	o	o	o	o	x	o	o
C 5 1	233h			I-gain	0.010 to <u>0.200</u> to 1.000 s P control when setting 1.000	4	o	o	o	o	o	x	o	o
C 5 2	234h			F/F-gain	<u>0.000</u> to 9.999 s	4	o	o	o	o	o	x	o	o
C 5 3	235h			Input filter	0.000 to <u>0.040</u> to 5.000 s	4	o	o	o	o	o	o	o	o
C 5 4	236h			Detection filter	0.000 to <u>0.005</u> to 0.100 s	4	o	o	o	o	o	x	o	o
C 5 5	237h			Output filter	0.000 to <u>0.002</u> to 0.100 s	4	o	o	o	o	o	x	o	o
C 5 6	238h			Acceleration time 3	0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
C 5 7	239h			Deceleration time 3	0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
C 5 8	23Ah			S-curve 3 (Start side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
C 5 9	23Bh			S-curve 3 (End side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
C 6 0	23Ch		ASR4	P-gain	0.1 to <u>10.0</u> to 200.0 (times)	2	o	o	o	o	o	x	o	o
C 6 1	23Dh			I-gain	0.010 to <u>0.200</u> to 1.000 s P control when setting 1.000	4	o	o	o	o	o	x	o	o
C 6 2	23Eh			F/F-gain	<u>0.000</u> to 9.999 s	4	o	o	o	o	o	x	o	o
C 6 3	23Fh			Input filter	0.000 to <u>0.040</u> to 5.000 s	4	o	o	o	o	o	o	o	o
C 6 4	240h			Detection filter	0.000 to <u>0.005</u> to 0.100 s	4	o	o	o	o	o	x	o	o
C 6 5	241h			Output filter	0.000 to <u>0.002</u> to 0.100 s	4	o	o	o	o	o	x	o	o
C 6 6	242h			Acceleration time 4	0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
C 6 7	243h			Deceleration time 4	0.01 to <u>5.00</u> to 99.99s 100.0 to 999.9s 1000 to 3600s	13	o	o	o	o	o	o	o	o
C 6 8	244h			S-curve 4 (Start side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
C 6 9	245h			S-curve 4 (End side)	<u>0</u> to 50 %	0	o	o	o	o	o	o	o	o
C 7 0	246h		ASR switching time		0.00 to <u>1.00</u> to 2.55 s	3	o	o	o	o	o	x	o	o
C 7 1	247h	A5 h	ACC/DEC switching speed		<u>0.00</u> to 100.00 %	3	o	o	o	o	o	o	o	o
C 7 2	248h	A6 h	ASR switching time		<u>0.00</u> to 100.00 %	3	o	o	o	o	o	x	o	o
C 7 3	249h		Creep speed select (at UP/DOWN mode)		<u>00</u> to 11 (Creep Speed 1)(Creep Speed 2) 0:Function setting (C18.19) 1:Analog input (CRP-N1, CRP-N2)	9	o	o	o	o	o	o	o	x

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# 13. Function Code List

## P: Motor Parameters

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
P01	301h		M1 Control method		0 to 3 0: Vector control 1: Sensorless vector control 2: Simulation operation mode 3: Vector control (Synchronous motors)	55	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P02	302h		M1 selection	M1 selection (for Motor parameter setting)	0 to 50 Display (kW,HP) changes by setting F60. 0 to 35: Settings for motors dedicated for VG7 Data at F04, F05, and P03 to P27 are automatically set and write-protected. 36: P-OTHER Data at F04, F05, and P03 to P27 are write-protected and cannot be overwritten 38 to 50: Settings for the motor only for VG7 (New model) Data at F04, F05, and P03 to P27 are automatically set and write-protected.	82	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P03	303h	A7h	M1-Rated capacity		0.00 to 500.00kW at F60=0 } For 400kW or smaller inverter capacities 0.00 to 600.00HP at F60=1 } F60=0: 0.00 to 900.0kW } For 500kW or larger inverter capacities F60=1: 0.00 to 1200HP }	3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P04	304h	A8h	M1-Rated current		0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A	13	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P05	305h	A9h	M1-Poles		2 to 4 to 30 (poles)	1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P06	306h	AAh	M1-%R1		0.00 to 30.00 %	3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P07	307h	ABh	M1-%X		0.00 to 50.00 %	3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P08	308h	ACh	M1-Exciting current		0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A	13	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P09	309h	ADh	M1-Torque current		0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A	13	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P10	30Ah	AEh	M1-Slip (Driving)		0.001 to 10.000 Hz	4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P11	30Bh	AFh	M1-Slip (Braking)		0.001 to 10.000 Hz	4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P12	30Ch	B0h	M1-Iron loss coefficient 1		0.00 to 10.00 %	3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P13	30Dh	B1h	M1-Iron loss coefficient 2		0.00 to 10.00 %	3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P14	30Eh	B2h	M1-Iron loss coefficient 3		0.00 to 10.00 %	3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P15	30Fh	B3h	M1-Magnetic saturation coefficient 1		0.0 to 100.0 %	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P16	310h	B4h	M1-Magnetic saturation coefficient 2		0.0 to 100.0 %	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P17	311h	B5h	M1-Magnetic saturation coefficient 3		0.0 to 100.0 %	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P18	312h	B6h	M1-Magnetic saturation coefficient 4		0.0 to 100.0 %	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P19	313h	B7h	M1-Magnetic saturation coefficient 5		0.0 to 100.0 %	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P20	314h	B8h	M1-Secondary time constant		0.001 to 9.999 s	4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P21	315h	B9h	M1-Induced voltage coefficient		0 to 999 V	0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P22	316h	BAh	M1-R2 correction coefficient 1		0.500 to 5.000	4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P23	317h	BBh	M1-R2 correction coefficient 2		0.500 to 5.000	4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P24	318h	BCh	M1-R2 correction coefficient 3		0.010 to 5.000	4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P25	319h	BDh	M1-Exciting current correction coefficient.		0.000 to 5.000	4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
P26	31Ah	BEh	M1-ACR-P gain		0.1 to 20.0	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P27	31Bh	BFh	M1-ACR-I gain		0.5 to 100.0 ms	2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P28	31Ch	C0h	M1-PG pulses		100 to <u>1024</u> to 60000	0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P29	31Dh	D6h	M1-External PG correction coefficient		0000 to <u>4000</u> to 4FFF	9	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
P30	31Eh	C1h	M1-thermistor selection		0 to <u>1</u> to 3 0: No use thermistor 1: NTC thermistor 2: PTC thermistor 3: Ai (M-TMP) Please do the protection level setting of the motor at E30-E32.	84	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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## H: High Performance Functions

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine	
	485 number	Link number								PG	LES	VF	SM		
H 0 1	401h		Tuning operation selection		0 to 4 After writing the data, this function's data code automatically returns to 0. 0 : Inactive 1 : ASR system tuning 2 : R1,L tuning 3 : Motor parameters tuning at stopping mode 4 : Motor parameters tuning at runing mode The data after the tuning goes out when the power supply is turned off. H02 "All save function" must operate when the maintenance (preservation) of the data is necessary.	61	x	x	x	x	o	o	o	x	o
H 0 2	402h	E h	All Save Function		0 to 1 When tuning is executed at H01 and the internal data is written, or when the data is written by way of the link system (T-Link, field bus, and RS458, etc.), the data goes out when the power supply of the inverter is turned off. This function must operate when preservation is necessary. After writing the data, this function's data code automatically returns to 0.	11	x	x	x	x	o	o	o	o	o
H 0 3	403h		Data initializing (Data reset)		0 to 1 The data which the customer rewrote is returned to the state of the factory setting value. Target functions for initialization are all fields of F, E, C, H, o, L, and U except motor parameter field (P,A). After writing the data, this function's data code automatically returns to 0.	11	x	x	x	x	o	o	o	o	o
H 0 4	404h		Auto-reset (Times)		0 to 10 0 : (Inactive) 1 to 10 times The auto-resetting signal can be output to the output terminal.	0	o	o	o	o	o	o	o	o	x
H 0 5	405h		Auto-reset (Reset interval)		0.01 to <u>5.00</u> to 20.00 s	3	o	o	o	o	o	o	o	o	x
H 0 6	406h		Fan stop operation		0 to 1 The temperature of the cooling fan in the inverter is detected and it is a function to control the cooling fan automatically ON/OFF. It always rotates when inactive is selected. 0 : Inactive 1 : Active The signal indicating the cooling fan operation can be output by synchronizing with this function.	68	o	o	o	o	o	o	o	o	o
H 0 8	408h		Rev.phase sequence lock		0 to 1 0 : Inactive 1 : Active	68	o	o	o	o	x	x	o	x	
H 0 9	409h	C2 h	Start mode (rotating motor pick up )		0 to <u>2</u> 0 : Inactive 1 : Active (at after momentary power failure) 2 : Active (at all start mode)	0	o	o	o	o	o	o	x	o	x
H 1 0	40Ah	C3 h	Energy-saving operation		0 to 1 0 : Inactive 1 : Active	68	o	o	o	o	x	x	x	x	
H 1 1	40Bh		Automatic operation OFF function		0 to 2 It is a function when becoming following the stop speed setting to turn off the inverter automatically. 0 : Deceleration stop with FWD or REV shorted to CM between FWD-CM and REV-CM. 1 : The inverter is turned off below the stop speed even for ON between FWD-CM and REV-CM. 2: Coast-to-stop with FWD or REV shorted to CM	0	o	o	o	o	o	o	o	o	x
H 1 3	40Dh	C4h	Restart after momentary power failure	Restart waiting time	0.1 to <u>0.5</u> to 5.0 s	2	o	o	o	o	o	o	o	o	x
H 1 4	40Eh			Fall rate	1 to <u>500</u> to 3600 ( r/min/s)	0	o	o	o	o	x	x	o	x	x
H 1 5	40Fh			Holding voltage on continuous operation	3ph 200V : 200 to <u>235</u> to 300V 3ph 400V : 400 to <u>470</u> to 600V	0	o	o	o	o	o	o	o	o	x

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# 13. Function Code List

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
H 1 6	410h			Operation command selfhold setting	0 to 1 0 : Set at H17 1 : Maximum time (The inverter judges that it is a power failure momentarily and self-maintains the operation command while the control power supply in the inverter establishes or until the main circuit DC voltage becomes almost 0.)	94	o	o	o	o	o	o	o	x
H 1 7	411h			Operation command selfhold time	0.0 to <u>30.0</u> s	2	o	o	o	o	o	o	o	x
H 1 9	413h	C5 h	Active Drive		0 to 1 0 : Inactive 1 : Active	68	o	o	o	o	x	o	o	x
H 2 0	414h	C6 h	PID control	PID control (Mode select)	0 to 3 0: Inactive 1: Active 2: Inverse action 1 3: Inverse action 2	69	o	o	o	o	o	o	o	x
H 2 1	415h	C7 h		Command select	0 to 1 0 : Keypad panel or 12 input 1 : Analog input (PIDS)	70	o	o	o	o	o	o	o	x
H 2 2	416h	C9 h		P-gain	0.000 to <u>1.000</u> to 10.000 (times)	4	o	o	o	o	o	o	o	x
H 2 3	417h	CA h		I-gain	0.00 to <u>1.00</u> to 100.00 s	3	o	o	o	o	o	o	o	x
H 2 4	418h	CB h		D-gain	<u>0.000</u> to 10.000 s	4	o	o	o	o	o	o	o	x
H 2 5	419h	C8 h		PID control (Upper limit)	-300 to <u>100</u> to 300 %	5	o	o	o	o	o	o	o	x
H 2 6	41Ah	CC h		PID control (Lower limit)	-300 to <u>-100</u> to 300 %	5	o	o	o	o	o	o	o	x
H 2 7	41Bh	CE h		PID control (Speed reference)	0 to 2 0 : Inactive 1 : PID select 2 : Auxiliary speed	95	o	o	o	o	o	o	o	x
H 2 8	41Ch	CF h	Droop control		<u>0.0</u> to 25.0 %	2	o	o	o	o	o	x	o	x
H 2 9	41Dh		Link function	Data protect via serial link	0 to 1 Function not to write data from link (T-Link, RS485, etc.) by mistake. 0 : Non-protect 1 : Protect via serial link There are two writing from the link about usual function field and serial data field. This S field is defined at H30.	40	o	o	o	o	o	o	o	o
H 3 0	41Eh	D0 h		Serial link (Function select)	0 to 3 (Monitor) (Speed reference) (Operation command) 0 : o x x 1 : o o x 2 : o x o 3 : o o o	72	o	o	o	o	o	o	o	o
H 3 1	41Fh	RS485		RS485 (Address)	0 to <u>1</u> to 255 Setting of the station address of RS485. broadcast : (0 : RTU), (99 : Fuji) address : 1 to 255	0	o	o	x	o	o	o	o	o
H 3 2	420h			RS485 (Mode select on no response error)	0 to 3 0 : Trip and alarm (Er5) 1 : Operation for H33 timer. and alarm (Er5) 2 : Operation for H33 timer , and retry to communicate. * If the retry fails, then the inverter trips. ("Er5") 3 : Continuous operation	73	o	o	o	o	o	o	o	o
H 3 3	421h			RS485 (Timer)	0.01 to <u>2.00</u> to 20.00 s	3	o	o	o	o	o	o	o	o
H 3 4	422h			RS485 (Baud rate)	0 to 4 0 : 38400 bps 1 : 19200 bps 2 : 9600 bps 3 : 4800 bps 4 : 2400 bps	74	o	o	x	o	o	o	o	o
H 3 5	423h			RS485 (Data length)	0 to 1 0 : 8 bits 1 : 7 bits	75	o	o	x	o	o	o	o	o
H 3 6	424h			RS485 (Parity check)	0 to <u>1</u> to 2 0 : No checking 1 : Even parity 2 : Odd parity	76	o	o	x	o	o	o	o	o
H 3 7	425h			RS485 (Stop bits)	0 to <u>1</u> 0 : 2 bits 1 : 1 bit	77	o	o	x	o	o	o	o	o

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Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
H 3 8	426h			RS485 (No response error detection time)	0.0 to <u>60.0</u> s 0.0 : Detection of communication break invalid 0.1 to 60.0s : Detection of communication break valid It is a function to do Er5 trip detecting the access disappearing for each station which includes an own station in the set time due to some abnormality (no response etc.) from via RS485	2	o	o	o	o	o	o	o	o
H 3 9	427h			RS485 (Response interval)	0.00 to <u>0.01</u> to 1.00 s The time to return the response is set to the demand by a host device.	3	o	o	o	o	o	o	o	o
H 4 0	428h			RS485 (Protocol)	0 to 1 to 2 0 : FUJI inverter protocol 1 : SX bus (FUJI private link) protocol 2 : Modbus RTU protocol Please set 1 (SX bus protocol) when you use the PC loader of the VG7 exclusive use.	78	o	o	x	o	o	o	o	o
H 4 1	429h	D1 h	Torque reference selection	Torque reference selection	<u>0</u> to 5 0 : Internal ASR output 1 : Ai terminal input (T-REF) 2 : DIA input 3 : DIB input 4 : Link input 5 : PID	64	o	o	o	o	o	x	o	o
H 4 2	42Ah	D2 h		Torque current reference selection	<u>0</u> to 4 0 : Internal ASR output 1 : Ai terminal input (IT-REF) 2 : DI card A input 3 : DI card B input 4 : Link input	65	o	o	o	o	o	x	o	x
H 4 3	42Bh	D3 h		Magnetic flux reference selection	<u>0</u> to 3 0 : Internal calculation value 1 : Ai terminal input (MF-REF) 2 : Function setting value (H44) 3 : Link input	66	o	o	o	o	x	x	x	x
H 4 4	42Ch	D4 h		Magnetic flux reference value	10 to <u>100</u> %	16	o	o	o	o	x	x	x	x
H 4 5	42Eh	D7 h	Observer (Mode select)	Observer (Mode select)	<u>0</u> to 2 0 : Inactive 1 : Active (load disturbance observer) 2 : Active (oscillation suppressing observer)	79	o	o	o	o	o	x	o	o
H 4 7	42Fh	D8 h		(P-gain 1)(M1)	<u>0.00</u> to 1.00 (times)	3	o	o	o	o	o	x	o	o
H 4 8	430h			(P-gain 2)(M2)	<u>0.00</u> to 1.00 (times)	3	o	o	o	o	o	x	o	o
H 4 9	431h	D9 h		(I-gain 1)(M1)	0.005 to <u>0.100</u> to 1.000 s	4	o	o	o	o	o	x	o	o
H 5 0	432h			(I-gain 2)(M2)	0.005 to <u>0.100</u> to 1.000 s	4	o	o	o	o	o	x	o	o
H 5 1	433h	DA h		Load inertia M1	0.001 to 50.000 (kg.m <sup>2</sup> )	4	o	o	x	o	o	x	o	o
H 5 2	434h			Load inertia M2	<u>0.001</u> to 50.000 (kg.m <sup>2</sup> )	4	o	o	x	o	o	x	o	o
H 5 3	435h	D5 h	Line speed feedback selection		<u>0</u> to 3 0 : Line speed disabled 1 : Line speed (analog input) (LINE-N) 2 : Line speed (digital input) (PG(LD)) 3 : High level selected signal	67	o	o	o	o	o	o	o	x
H 5 5	437h		Zero speed control	Gain	0 to <u>5</u> to 100 (times)	0	o	o	o	o	x	x	o	o
H 5 6	438h			Completion range	0 to <u>100</u> (pulse)	0	o	o	o	o	x	x	o	o
H 5 7	439h		OU trip prevention	OU trip prevention	<u>0</u> to 1 0 : Inactive 1 : Active	68	o	o	o	o	o	o	o	x
H 5 8	43Ah			OC trip prevention	<u>0</u> to 1 0 : Inactive 1 : Active	68	o	o	o	o	o	o	o	x
H 6 0	43Ch		Load adaptive control function 1	Load adaptive control function 1	<u>0</u> to 3 0 : Inactive 1 : Method 1 2 : Method 2 3 : Method 3	80	o	o	o	o	x	x	o	x
H 6 1	43Dh			Load adaptive control function 2	<u>0</u> to 1 0 : Winding up on forward rotation 1 : Winding down on forward rotation	81	o	o	o	o	x	x	o	x
H 6 2	43Eh			Winding up speed	<u>0.0</u> to 999.9 m/min	2	o	o	o	o	x	x	o	x
H 6 3	43Fh			Counter weight	<u>0.00</u> to 600.00 (t)	3	o	o	o	o	x	x	o	x
H 6 4	440h			Safety coef. (for rated torque)	0.50 to <u>1.00</u> to 1.20	3	o	o	o	o	x	x	o	x
H 6 5	441h			Machine efficiency	<u>0.500</u> to 1.000	4	o	o	o	o	x	x	o	x
H 6 6	442h			Rated loading	<u>0.00</u> to 600.00 (t)	3	o	o	o	o	x	x	o	x
H 6 8	444h		Trip data delete		<u>0</u> to 1 If these tuning are finished, this data code returns to 0.	11	x	x	x	o	o	o	o	o
H 7 0	446h		Reserved	Reserved 1	<u>0</u> to 9999 0 : Standard 1 : Lift 2 to 9999 : Undecided	0	o	o	x	o	o	x	o	o

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# 13. Function Code List

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
H 7 1	447h			Reserved 2	0 to 6 It is not necessary to set usually. If these tuning are finished, this data code returns to 0. 0 : Inactive 1 : ACR system tuning 2 : Voltage gain tuning (execution without connecting motor) 3 : Voltage sensor offset tuning 4 : Current sensor balance tuning 5 : Magnet pole position tuning (for SM driving) 6 : Shunt resistor gain tuning	62	x	x	x	o	o	o	o	o
H 7 2	448h			Reserved 3	0 to 9999 0 : standard 1 to 9999 : Undecided	0	x	o	x	o	o	o	o	o
H 7 3	449h			Reserved 4	0 to 9999 0 : standard 1 to 9999 : Undecided	0	x	o	x	o	o	o	o	o

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## A: Alternative Motor Parameters

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
R 0 1	501h		Setting M2 parameter	M2-Control method	0 to 1 M2 is an induction motor only for the vector control. 0 : Vector control with PG 1 : Vector control without PG	55	o	o	x	o	o	x	x	o
R 0 2	502h			M2-Rated capacity	0.00 to 500.00kW at F60=0 0.00 to 600.00HP at F60=1	3	o	o	x	o	o	x	x	o
R 0 3	503h			M2-Rated current	0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A	13	o	o	x	o	o	x	x	o
R 0 4	504h			M2-Rated voltage	80 to 999 V	0	o	o	x	o	o	x	x	o
R 0 5	505h			M2-Rated speed	50 to <u>1500</u> to 24000 r/min	0	o	o	x	o	o	x	x	o
R 0 6	506h			M2-Maximum speed	50 to <u>1500</u> to 24000 r/min	0	o	o	x	o	o	x	x	o
R 0 7	507h			M2-Poles	2 to <u>4</u> to 12 (poles)	1	o	o	x	o	o	x	x	o
R 0 8	508h			M2-%R1	0.00 to 30.00 %	3	o	o	x	o	o	x	x	o
R 0 9	509h			M2-%X	0.00 to 50.00 %	3	o	o	x	o	o	x	x	o
R 1 0	50Ah			M2-Exciting current	0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A	13	o	o	x	o	o	x	x	o
R 1 1	50Bh			M2-Torque current	0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A	13	o	o	x	o	o	x	x	o
R 1 2	50Ch			M2-Slip (Driving)	0.001 to 10.000 Hz	4	o	o	x	o	o	x	x	o
R 1 3	50Dh			M2-Slip (Braking)	0.001 to 10.000 Hz	4	o	o	x	o	o	x	x	o
R 1 4	50Eh			M2-Iron loss coefficient 1	0.00 to 10.00 %	3	o	o	x	o	o	x	x	o
R 1 5	50Fh			M2-Iron loss coefficient 2	0.00 to 10.00 %	3	o	o	x	o	o	x	x	o
R 1 6	510h			M2-Iron loss coefficient 3	0.00 to 10.00 %	3	o	o	x	o	o	x	x	o
R 1 7	511h			M2-Magnetic saturation coefficient 1	0.0 to 100.0 %	2	o	o	x	o	o	x	x	o
R 1 8	512h			M2-Magnetic saturation coefficient 2	0.0 to 100.0 %	2	o	o	x	o	o	x	x	o
R 1 9	513h			M2-Magnetic saturation coef. 3	0.0 to 100.0 %	2	o	o	x	o	o	x	x	o
R 2 0	514h			M2-Magnetic saturation coef. 4	0.0 to 100.0 %	2	o	o	x	o	o	x	x	o
R 2 1	515h			M2-Magnetic saturation coef. 5	0.0 to 100.0 %	2	o	o	x	o	o	x	x	o
R 2 2	516h			M2-Secondary time constant	0.001 to 9.999 s	4	o	o	x	o	o	x	x	o
R 2 3	517h			M2-Induced voltage coefficient	0 to 999 V	0	o	o	x	o	o	x	x	o
R 2 4	518h			M2-R2 correction coef. 1	0.000 to 5.000	4	o	o	x	o	o	x	x	o

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Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
R 2 5	519h			M2-R2 correction coef. 2	0.000 to 5.000	4	o	o	x	o	o	x	x	o
R 2 6	51Ah			M2-R2 correction coef. 3	0.010 to 5.000	4	o	o	x	o	o	x	x	o
R 2 7	51Bh			M2-Exciting correction coef.	0.000 to 5.000	4	o	o	x	o	o	x	x	o
R 2 8	51Ch			M2-ACR-P gain	0.1 to <u>1.0</u> to 20.0	2	o	o	x	o	o	x	x	o
R 2 9	51Dh			M2-ACR I-gain	0.5 to <u>1.0</u> to 100.0 ms	2	o	o	x	o	o	x	x	o
R 3 0	51Eh		M2-PG pulses		100 to <u>1024</u> to 60000	0	o	o	x	o	x	x	x	o
R 3 1	51Fh		M2-thermistor selection		0 to <u>1</u> to 3 0 : No use thermistor 1 : NTC thermistor 2 : PTC thermistor 3 : Ai (M-TMP) Please do the protection level setting of the motor at E30-E37.	84	o	o	x	o	o	x	x	o
R 3 2	520h		M2-Electronic thermal overload relay (selection)	M2-Electronic thermal overload relay (Selection)	<u>0</u> to 2 The motor overheating protection operates by using NTC thermistor with the motor only for VG. In this case, please make setting a Electronic thermal "Inactive". 0 : Inactive 1 : Active (for standard motor, self-cooling fan) 2 : Active (for inverter motor, separate cooling fan)	85	o	o	x	o	o	x	x	o
R 3 3	521h			M2-Electronic thermal overload relay (Level)	<u>0.01</u> to 99.99A 100.0 to 999.9A 1000 to 2000A	13	o	o	x	o	o	x	x	o
R 3 4	522h			M2-Electronic thermal overload relay (Thermal time constant)	<u>0.5</u> to 75.0 min	2	o	o	x	o	o	x	x	o
R 3 5	523h	E5 h	M3-Rated capacity	M3-Rated capacity	<u>0.00</u> to 500.00kW at F60=0 <u>0.00</u> to 600.00HP at F60=1	3	o	o	x	x	x	o	x	x
R 3 6	524h	E6 h		M3-Rated current	<u>0.01</u> to 99.99A 100.0 to 999.9A 1000 to 2000A	13	o	o	x	x	x	o	x	x
R 3 7	525h	E7 h		M3-Rated voltage	<u>80</u> to 999 V	0	o	o	x	x	x	o	x	x
R 3 8	526h	E8 h		M3-Maximum voltage	<u>80</u> to 999 V	0	o	o	x	x	x	o	x	x
R 3 9	527h	E9 h		M3-Rated speed	50 to <u>1500</u> to 24000 r/min	0	o	o	x	x	x	o	x	x
R 4 0	528h	EA h		M3-Maximum speed	50 to <u>1500</u> to 24000 r/min	0	o	o	x	x	x	o	x	x
R 4 1	529h	EB h		M3-Poles	2 to <u>4</u> to 12 (poles)	1	o	o	x	x	x	o	x	x
R 4 2	52Ah	EC h		M3-%R1	<u>0.00</u> to 30.00 %	3	o	o	x	x	x	o	x	x
R 4 3	52Bh	ED h		M3-%X	<u>0.00</u> to 30.00 %	3	o	o	x	x	x	o	x	x
R 4 4	52Ch	EE h		M3-Exciting current	<u>0.01</u> to 99.99A 100.0 to 999.9A 1000 to 2000A	13	o	o	x	x	x	o	x	x
R 4 5	52Dh	EF h		M3-Slip compensation control	-20.000 to <u>0.000</u> to 5.000 Hz	8	o	o	x	x	x	o	x	x
R 4 6	52Eh	F0 h	M3-Torque boost		<u>0.0</u> to 20.0 0.0 : Automatic torque boost (for CT load) 0.1 to 0.9 : Manual torque boost (for Square torque load) 1.0 to 1.9 : Manual torque boost (for VT load) 2.0 to 20.0 : Manual torque boost (for CT load)	2	o	o	x	x	x	o	x	x
R 4 7	52Fh	F1 h	M3-Thermistor selection		0 to <u>1</u> to 3 0 : No use thermistor 1 : NTC thermistor 2 : PTC thermistor 3 : Ai (M-TMP) Please do the protection level setting of the motor at E30-E32.	84	o	o	x	x	x	o	x	x
R 4 8	530h	F2 h	M3-Electronic thermal overload relay (selection)	M3-Electronic thermal overload relay (Selection)	<u>0</u> to 2 0 : Inactive (when using PTC thermistor) 1 : Active (for standard motor, self-cooling fan) 2 : Active (for inverter motor, separate-cooling fan)	85	o	o	x	x	x	o	x	x
R 4 9	531h	F3 h		M3-Electronic thermal overload relay (Level)	<u>0.01</u> to 99.99A 100.0 to 999.9A 1000 to 2000A	13	o	o	x	x	x	o	x	x
R 5 0	532h	F4 h		M3-Electronic thermal overload relay (Thermal time constant)	<u>0.5</u> to 75.0 min	2	o	o	x	x	x	o	x	x

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# 13. Function Code List

## O: Optional Functions

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
001	601h	F5h	DIA, DIB option setting	DIA function select	0 to 1 0: Binary 1: BCD	86	o	o	o	o	o	o	o	o
002	602h	F6h		DIB function select	0 to 1 0: Binary 1: BCD	86	o	o	o	o	o	o	o	o
003	603h			DIA BCD input speed setting	99 to <u>1000</u> to 7999	0	o	o	o	o	o	o	o	o
004	604h			DIB BCD input speed setting	99 to <u>1000</u> to 7999	0	o	o	o	o	o	o	o	o
005	605h		PG (PD) option setting	Pulse feedback select	0 to 1 0: Build-in PG 1: PG(PD) option	96	o	o	o	o	x	x	o	x
006	606h		PG (LD) option setting	Line speed detection (digital) (PG pulses)	100 to <u>1024</u> to 60000 (P/R)	0	o	o	o	o	o	o	o	o
007	607h			Line speed detection (digital) (Pulse correction function 1)	0 to <u>1000</u> to 9999	0	o	o	o	o	o	o	o	o
008	608h			Line speed detection (digital) (Pulse correction function 2)	0 to <u>1000</u> to 9999	0	o	o	o	o	o	o	o	o
009	609h		PMPG option setting	Definition of absolute PG signal input	0 to 16	0	o	o	o	x	x	x	o	o
010	60Ah			Magnetic pole position offset	<u>0000</u> to FFFF	9	o	o	o	x	x	x	o	o
011	60Bh			Salient pole ratio	1.000 to 3.000	4	o	o	o	x	x	x	o	o
012	60Ch		PG (PR) pulse-train option setting	Pulse command select	0 to 2 0: PG (PR) option 1: Internal speed command 2: Function code S05 valid	97	o	o	o	o	x	x	o	x
013	60Dh			Pulse train input form selection	0 to 2 0: Phase difference 90° between A-phase and B-phase 1: A-phase: Reference pulse, B-phase: Reference sign 2: A-phase: Forward pulse, B-phase: Reverse pulse	98	o	o	o	o	x	x	o	x
014	60Eh	F7h		Reference pulse correction 1	1 to <u>1000</u> to 9999	0	o	o	o	o	x	x	o	x
015	60Fh	F8h		Reference pulse correction 2	1 to <u>1000</u> to 9999	0	o	o	o	o	x	x	o	x
016	610h	F9h		APR P-gain	0.1 to <u>1.0</u> to 999.9 (times)	2	o	o	o	o	x	x	o	x
017	611h	FAh		Feed forward gain	<u>0.0</u> to 1.5 (times)	2	o	o	o	o	x	x	o	x
018	612h			Deviation over width	0 to <u>65535</u> (pulse)	0	o	o	o	o	x	x	o	x
019	613h			Deviation zero width	0 to <u>20</u> to 1000 (pulse)	0	o	o	o	o	x	x	o	x
030	61Eh		Field option setting	Action on communication error	0 to 3 0: Forced stop 1: Stops after preset operation time. 2: Stops if transmission error continues longer than the operation time. 3: Continuous operation.	73	o	o	o	o	o	o	o	o
031	61Fh			LINK error (Timer)	0.01 to <u>0.10</u> to 20.00 s	3	o	o	o	o	o	o	o	o
032	620h			LINK format select	0 to 1 0: 4W + 4W 1: 8W + 8W	87	o	o	x	o	o	o	o	o
033	621h	FDh	Multi-winding motor system (mode)	Multi-winding motor system (mode)	0 to 1 0: Inactive 1: Active	68	o	o	o	o	x	x	x	o
034	622h			Multi-winding motor system (Slave station number)	1 to 5 The numbers of slave units except masterunit are set when multi-winding motor system is effective.	0	o	o	o	o	x	x	x	o
035	623h		S1/RS option setting	Link station address	0 to 255 Define the link station address of the SI option used in the UPAC link. 0: Master address 1 to 11: Slave address 100: Master address (broadcasting) 101 to 255: Slave address (broadcasting)	0	o	o	o	o	o	o	o	o

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Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
o 3 7	625h			Communication definition setting	00 to 10 to 24 Define initial communications settings of the RS option. Place of 1: Transmission rate 0 to 4 0: 38400bps 1: 19200bps 2: 9600bps 3: 4800bps 4: 2400bps Place of 10: Parity bit and stop bit selection 0 to 2 0: No parity (stop bit: 2) 1: Even	9	o	o	x	o	o	o	o	o
o 3 8	626h		UPAC (Mode)	UPAC (Start/stop)	<u>0</u> to 2 0 : Stop UPAC 1 : Start UPAC 2 : Start UPAC (Initialized start) The start/stop of the UPAC option is controlled.	68	o	o	o	o	o	o	o	o
o 3 9	627h			UPAC memory	<u>00</u> to 1F When the UPAC stop is changed, a pertinent field is set. 0 : Hold 1 : zero clear 1bit : IQ field 2bit : M field 3bit : RM field 4bit : FM field 5bit : SFM field	9	o	o	o	o	o	o	o	o
o 4 0	628h			UPAC address	<u>100</u> to 255 Setting of UPAC address number in which RS-485 communication is used when personal-computer accesses UPAC application. (Refer to download)	0	o	o	x	o	o	o	o	o

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## L: Lift Functions

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
L 0 1	901h		Password data 1		<u>0</u> to 9999	0	x	o	x	o	o	x	o	o
L 0 2	902h		Password data 2		<u>0</u> to 9999	0	x	o	x	o	o	x	o	o
L 0 3	903h		Lift rated speed		0.0 to <u>100.0</u> to 999.9 m/min	2	o	o	o	o	o	x	o	o
L 0 4	904h		Preset S-curve (selection)	Preset S-curve	<u>0</u> to 2 0 : Inactive <Normal accel/decel, S-curve (15 steps, S-curve 5)> 1 : Method 1 For VG3/VG5, accel/decel can be controlled via terminal 12 with SS1, SS2, and SS4 all OFF. 2 : Method 2 For VG7, zero speed is selected with SS1, SS2.	80	o	o	o	o	o	x	o	o
L 0 5	905h			S-curve 1	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 0 6	906h			S-curve 2	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 0 7	907h			S-curve 3	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 0 8	908h			S-curve 4	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 0 9	909h			S-curve 5	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 1 0	90Ah			S-curve 6	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 1 1	90Bh			S-curve 7	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 1 2	90Ch			S-curve 8	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 1 3	90Dh			S-curve 9	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 1 4	90Eh			S-curve 10	<u>0</u> to 50 %	0	o	o	o	o	o	x	o	o
L 1 5	90Fh		Setting for adjustment by manufacturer		<u>0</u> to 1 0: Not used 1: Method 1	80	o	o	o	o	o	x	o	o

You can change the setting of a function indicated by  during operation.  
You should stop operation to change the setting of other functions.

Underline indicates a factory setting.

# 13. Function Code List

## U: User Functions

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/ Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
U 0 1	B01h	DB h	USER P1		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 0 2	B02h	DC h	USER P2		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 0 3	B03h	DD h	USER P3		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 0 4	B04h	DE h	USER P4		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 0 5	B05h	DF h	USER P5		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 0 6	B06h	E0 h	USER P6		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 0 7	B07h	E1 h	USER P7		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 0 8	B08h	E2 h	USER P8		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 0 9	B09h	E3 h	USER P9		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 0	B0Ah	E4 h	USER P10		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 1	B0Bh		USER P11		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 2	B0Ch		USER P12		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 3	B0Dh		USER P13		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 4	B0Eh		USER P14		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 5	B0Fh		USER P15		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 6	B10h		USER P16		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 7	B11h		USER P17		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 8	B12h		USER P18		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 1 9	B13h		USER P19		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 0	B14h		USER P20		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 1	B15h		USER P21		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 2	B16h		USER P22		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 3	B17h		USER P23		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 4	B18h		USER P24		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 5	B19h		USER P25		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 6	B1Ah		USER P26		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 7	B1Bh		USER P27		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 8	B1Ch		USER P28		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 2 9	B1Dh		USER P29		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 0	B1Eh		USER P30		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 1	B1Fh		USER P31		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 2	B20h		USER P32		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 3	B21h		USER P33		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 4	B22h		USER P34		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 5	B23h		USER P35		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 6	B24h		USER P36		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 7	B25h		USER P37		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 8	B26h		USER P38		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 3 9	B27h		USER P39		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 4 0	B28h		USER P40		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 4 1	B29h		USER P41		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 4 2	B2Ah		USER P42		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 4 3	B2Bh		USER P43		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 4 4	B2Ch		USER P44		-32768 to 32767	5	o	o	o	o	o	o	o	o
U 4 5	B2Dh		USER P45		-32768 to 32767	5	o	o	o	o	o	o	o	o

You can change the setting of a function indicated by  during operation.  
 You should stop operation to change the setting of other functions.

Underline indicates a factory setting.

Fcode	Communication address		Function name	Function directory name	Setting range	Type	Copy	Save all	Initialization	Control type: Available/Not available				Lifting machine
	485 number	Link number								PG	LES	VF	SM	
<u>B2Eh</u>			USER P46		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B2Fh</u>			USER P47		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B30h</u>			USER P48		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B31h</u>			USER P49		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B32h</u>			USER P50		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B33h</u>			USER P51		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B34h</u>			USER P52		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B35h</u>			USER P53		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B36h</u>			USER P54		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B37h</u>			USER P55		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B38h</u>			USER P56		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B39h</u>			USER P57		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B3Ah</u>			USER P58		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B3Bh</u>			USER P59		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B3Ch</u>			USER P60		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B3Dh</u>	48 h		USER P61/U-Ai1		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B3Eh</u>	4C h		USER P62/U-Ai2		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B3Fh</u>	4D h		USER P63/U-Ai3		-32768 to 32767	5	0	0	0	0	0	0	0	0
<u>B40h</u>	4E h		USER P64/U-Ai4		-32768 to 32767	5	0	0	0	0	0	0	0	0

You can change the setting of a function indicated by  during operation.  
 You should stop operation to change the setting of other functions.

Underline indicates a factory setting.

# 13. Function Code List

## 13.2.3 Motor Parameters

### ● 200 class

Motor specification						Motor parameters												
		VG7S code No.				F03	F04	F05	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Max. speed [r/min]	Rated speed [r/min]	Rated voltage [V]	Rated capacity [kW]	Rated current [A]	No. of poles	%R1 [%]	%X [A]	Pre-exciting current [A]	Torque current [A]	Slip on driving [Hz]	Slip On braking [Hz]	Iron loss co-ef*. 1 [%]
MVK8187A	30	4	1500/3000	188	116	1500	1500	188	30	116	4	2.43	12.32	39.95	106.0	0.915	1.015	3.00
MVK9224A	55	4	1500/2400	180	225	1500	1500	180	55	225	4	2.04	14.42	72.66	202.3	0.742	0.742	3.00
MVK9254A	75	4	1500/2400	183	299	1500	1500	183	75	299	4	2.00	16.41	89.26	272.1	0.597	0.647	3.00
MVK9256A	90	4	1500/2000	185	362	1500	1500	185	90	362	4	1.72	14.10	124.40	321.7	0.680	0.680	3.00

Motor specification						Motor parameters												
		VG7S code No.				P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Iron loss co-ef*. 2 [%]	Iron loss co-ef*. 3 [%]	Magnetic saturation co-ef*. 1 [%]	Magnetic saturation co-ef*. 2 [%]	Magnetic saturation co-ef*. 3 [%]	Magnetic saturation co-ef*. 4 [%]	Magnetic saturation co-ef*. 5 [%]	Secondary time constant [s]	Induced voltage co-ef*. [V]	R2 correction co-ef*. 1	R2 correction co-ef*. 2	R3 correction co-ef*. 3	Pre-exciting current correction co-ef*.
MVK8187A	30	4	1500/3000	188	116	0.00	0.00	88.2	81.9	70.1	58.4	46.7	0.385	166	1.818	1.737	1.000	0.000
MVK9224A	55	4	1500/2400	180	225	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.544	167	1.000	1.000	1.000	0.000
MVK9254A	75	4	1500/2400	183	299	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.555	163	1.849	1.784	1.000	0.000
MVK9256A	90	4	1500/2000	185	362	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.549	172	1.000	1.000	1.000	0.000

\*co-ef.: coefficient

Note 1: The above table shows the setting value of VG7.

Note 2: 0.75 to 22, and 45kW motors have the same electrical performance and parameters as the previous model ("6"series). For motor parameters, see page 14-26.

### ● 400 class

Motor specification						Motor parameters												
		VG7S code No.				F03	F04	F05	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Max. speed [r/min]	Rated speed [r/min]	Rated voltage [V]	Rated capacity [kW]	Rated current [A]	No. of poles	%R1 [%]	%X [A]	Pre-exciting current [A]	Torque current [A]	Slip on driving [Hz]	Slip On braking [Hz]	Iron loss co-ef*. 1 [%]
MVK8187A	30	4	1500/3000	376	58	1500	1500	376	30	58	4	2.43	12.32	19.97	53.0	0.915	1.015	3.00
MVK9224A	55	4	1500/2400	365	111	1500	1500	365	55	111	4	1.99	13.96	37.76	99.0	0.721	0.721	3.00
MVK9254A	75	4	1500/2400	365	149	1500	1500	365	75	149	4	1.77	16.39	44.04	135.0	0.714	0.714	3.00
MVK9256A	90	4	1500/2000	370	179	1500	1500	370	90	179	4	1.51	13.93	62.28	159.2	0.600	0.600	3.00
MVK9284A	110	4	1500/2000	370	212	1500	1500	370	110	212	4	1.66	15.39	59.73	192.9	0.579	0.579	3.00
MVK9286A	132	4	1500/2000	375	247	1500	1500	375	132	247	4	1.57	15.65	68.05	237.4	0.592	0.592	3.00
MVK931LA	160	4	1500/2000	375	297	1500	1500	375	160	297	4	1.36	16.71	76.07	287.2	0.594	0.594	3.00
MVK931MA	200	4	1500/2000	375	376	1500	1500	375	200	376	4	1.17	13.73	121.00	357.0	0.492	0.492	3.00
MVK931NA	220	4	1500/2000	380	409	1500	1500	380	220	409	4	1.05	13.27	130.40	388.2	0.473	0.473	3.00

Motor specification						Motor parameters												
		VG7S code No.				P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Iron loss co-ef*. 2 [%]	Iron loss co-ef*. 3 [%]	Magnetic saturation co-ef*. 1 [%]	Magnetic saturation co-ef*. 2 [%]	Magnetic saturation co-ef*. 3 [%]	Magnetic saturation co-ef*. 4 [%]	Magnetic saturation co-ef*. 5 [%]	Secondary time constant [s]	Induced voltage co-ef*. [V]	R2 correction co-ef*. 1	R2 correction co-ef*. 2	R3 correction co-ef*. 3	Pre-exciting current correction co-ef*.
MVK8187A	30	4	1500/3000	376	58	0.00	0.00	88.2	81.9	70.1	58.4	46.7	0.385	332	1.818	1.737	1.000	0.000
MVK9224A	55	4	1500/2400	365	111	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.531	339	1.000	1.000	1.000	0.000
MVK9254A	75	4	1500/2400	365	149	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.627	339	1.000	1.000	1.000	0.000
MVK9256A	90	4	1500/2000	370	179	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.621	345	1.000	1.000	1.000	0.000
MVK9284A	110	4	1500/2000	370	212	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.824	346	1.000	1.000	1.000	0.000
MVK9286A	132	4	1500/2000	375	247	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.876	351	1.000	1.000	1.000	0.000
MVK931LA	160	4	1500/2000	375	297	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.948	351	1.000	1.000	1.000	0.000
MVK931MA	200	4	1500/2000	375	376	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.894	353	1.000	1.000	1.000	0.000
MVK931NA	220	4	1500/2000	380	409	0.00	0.00	89.3	83.3	71.4	59.5	47.6	0.935	359	1.000	1.000	1.000	0.000

\*co-ef.: coefficient

Note 1: The above table shows the setting value of VG7.

Note 2: 3.7 to 22, and 45kW motors have the same electrical performance and parameters as the previous model ("6"series). For motor parameters, see page 14-27.

## 13.3 Function Code List Dedicated to Communication

You can refer to or change the following functions only through the integrated RS-485 or the field bus options (T-link, SX, field bus). The S area is write-only and the M area is read-only. The S and the M areas are common to FUJI inverters. Any FUJI inverters that can link to communication system can use these areas.

See 13.4 "Data Format List" to monitor to or change a function code after you check the "Type" column of the function code in the list.

### 13.3.1 S Function Code

This is a write-only area. You should use the function code H30 "Serial link" to initialize. See the function description of H30 for more details.

Fcode	Communication address		Function code name	Setting range	Min increment	Unit	Type
	485 number	Link number					
S01	701h	1( 1 h)	Frequency/speed command (Setting 1)	-24000 to 24000 r/min : (data) *Nmax/20000	1	r/min	31
S02	702h	2( 2 h)	Torque command	-327.68 to 327.67 % 0.01% / 1d *1	0.01	%	7
S03	703h	3( 3 h)	Torque current command	-327.68 to 327.67 % 0.01% / 1d *1	0.01	%	7
S04	704h	4( 4 h)	Magnetic-flux command	-327.68 to 327.67 % 0.01% / 1d *1	0.01	%	7
S05	705h	5( 5 h)	Orientation position command	0000 to FFFF	1	-	9
S06	706h	6( 6 h)	Operation command 1	0000 to FFFF	1	-	32
S07	707h	7( 7 h)	Universal Do	0000 to FFFF	1	-	33
S08	708h	8( 8 h)	Acceleration time	0.0 to 3600.0 s	0.1	s	2
S09	709h	9( 9 h)	Deceleration time	0.0 to 3600.0 s	0.1	s	2
S10	70Ah	10( A h)	Torque limiter level 1	-327.68 to 327.67 % 0.01% / 1d *1	0.01	%	7
S11	70Bh	11( B h)	Torque limiter level 2	-327.68 to 327.67 % 0.01% / 1d *1	0.01	%	7
S12	70Ch	12( C h)	Operation command 2	0000 to FFFF	1	-	9

\*1 Do not write settings out of the data range. As well, be careful when handling positive or negative data as shown in the following example.

Example: To write "4000(d) in S02 ("40000" is not positive.)

$$4000 - 65536 = -25536$$

Therefore "-255.36%" is written actually.

This is related to the process using the hexadecimal.

No communication error is caused.

# 13. Function Code List

## 13.3.2 M Function Code

This is a read-only area. You can always access this area without any restrictions.

Fcode	Communication address		Function code name	Setting range	Min increment	Unit	Type
	485 number	Link number					
M01	801h	15( F h)	Speed setting 4 (ASR input)	-24000 to 24000 r/min : (data)*Nmax/20000	1	r/min	31
M02	802h	16( 10 h)	Torque reference	0.01% / 1d	0.01	%	7
M03	803h	17( 11 h)	Torque current reference	0.01% / 1d	0.01	%	7
M04	804h	18( 12 h)	Magnetic-flux reference	0.01% / 1d	0.01	%	7
M05	805h	19( 13 h)	Output frequency reference	0.1Hz / 1d	0.1	Hz	2
M06	806h	20( 14 h)	Detected speed value	-24000 to 24000 r/min : (data)*Nmax/20000	1	r/min	31
M07	807h	21( 15 h)	Calculated torque value	0.01% / 1d	0.01	%	7
M08	808h	22( 16 h)	Calculated torque current value	0.01% / 1d	0.01	%	7
M09	809h	23( 17 h)	Output frequency	0.1Hz / 1d	0.1	Hz	2
M10	80Ah	24( 18 h)	Motor output	0.1kW / 1d	0.1	kW	2
M11	80Bh	25( 19 h)	Output current rms value	0.1A / 1d	0.1	A	2
M12	80Ch	26( 1A h)	Output voltage rms value	0.1V / 1d	0.1	V	2
M13	80Dh	27( 1B h)	Operation method (final command)	0000 to FFFF	1	-	32
M14	80Eh	28( 1C h)	Operation status	0000 to FFFF	1	-	21
M15	80Fh	29( 1D h)	Output terminals Y1 -	0000 to FFFF	1	-	33
M16	810h	30( 1E h)	Latest alarm data	0 to 47	1	-	14
M17	811h	31( 1F h)	Last alarm data	0 to 47	1	-	15
M18	812h	32( 20 h)	Second last alarm data	0 to 47	1	-	15
M19	813h	33( 21 h)	Third last alarm data	0 to 47	1	-	15
M20	814h	34( 22 h)	Accumulated operation time	0 to 65535 h	1	h	0
M21	815h	35( 23 h)	DC link circuit voltage	1V / 1d	1	V	0
M22	816h	36( 24 h)	Motor temperature	1°C / 1d	1	°C	5
M23	817h	37( 25 h)	Type code	0000 to FFFF	1	-	29
M24	818h	38( 26 h)	Capacity code	0 to 29	1	-	28
M25	819h	39( 27 h)	Inverter ROM (main control) version	0000 to FFFF	1	-	9
M26	81Ah	40( 28 h)	Communication error	0 to 65535	1	-	34
M27	81Bh	41( 29 h)	Speed setting on alarm	-24000 to 24000 r/min : (data)*Nmax/20000	1	r/min	31
M28	81Ch	42( 2A h)	Torque reference on	0.01% / 1d	0.01	%	7
M29	81Dh	43( 2B h)	Torque current reference on alarm	0.01% / 1d	0.01	%	7
M30	81Eh	44( 2C h)	Magnetic-flux reference on alarm	0.01% / 1d	0.01	%	3
M31	81Fh	45( 2D h)	Output frequency reference on alarm	0.1Hz / 1d	0.1	Hz	2
M32	820h	46( 2E h)	Detected speed on alarm	-24000 to 24000 r/min : (data)*Nmax/20000	1	r/min	31
M33	821h	47( 2F h)	Calculated torque on	0.01% / 1d	0.01	%	7
M34	822h	48( 30 h)	Calculated torque current on alarm	0.01% / 1d	0.01	%	7
M35	823h	49( 31 h)	Output frequency on	0.1Hz / 1d	0.1	Hz	2
M36	824h	50( 32 h)	Motor output on alarm	0.1kW / 1d	0.1	kW	2
M37	825h	51( 33 h)	Output current rms value on alarm	0.1A / 1d	0.1	A	2

Fcode	Communication address		Function code name	Setting range	Min increment	Unit	Type
	485 number	Link number					
M38	826h	52( 34 h)	Output voltage rms value on alarm	0.1V / 1d	0.1	V	2
M39	827h	53( 35 h)	alarm	0000 to FFFF	1	-	32
M40	828h	54( 36 h)	alarm	0000 to FFFF	1	-	21
M41	829h	55( 37 h)	Output terminal on alarm	0000 to FFFF	1	-	33
M42	82Ah	56( 38 h)	Accumulated operation time on alarm	0 to 65535 h	1	h	0
M43	82Bh	57( 39 h)	DC link circuit voltage on alarm	0.1V / 1d	1	V	0
M44	82Ch	58( 3A h)	Inverter internal temperature on alarm	1°C / 1d	1	°C	5
M45	82Dh	59( 3B h)	Heat sink temperature on alarm	1°C / 1d	1	°C	5
M46	82Eh	60( 3C h)	Main circuit capacitor life on alarm	0 to 100 %	1	h	0
M47	82Fh	61( 3D h)	PC board capacitor life on alarm	0 to 65535 h	1	h	0
M48	830h	62( 3E h)	Cooling fan life	0 to 65535 h	1	h	0
M49	831h	63( 3F h)	Speed setting 1 (before multistep speed)	-24000 to 24000 r/min : (data)*Nmax/20000	1	r/min	31
M50	832h	64( 40 h)	Speed setting 2 (before calculation of)	-24000 to 24000 r/min : (data)*Nmax/20000	1	r/min	31
M51	833h	65( 41 h)	Speed setting 3 (after speed limit)	-24000 to 24000 r/min : (data)*Nmax/20000	1	r/min	31
M52	834h	66( 42 h)	Control output 1	0000 to FFFF	1	-	125
M53	835h	67( 43 h)	Control output 2	0000 to FFFF	1	-	126
M54	836h	68( 44 h)	Control output 3	0000 to FFFF	1	-	127
M55	837h	69( 45 h)	Option monitor 1	0000 to FFFF	1	-	9
M56	838h	70( 46 h)	Option monitor 2	0000 to FFFF	1	-	9
M57	839h	71( 47 h)	Option monitor 3	0 to 65535	1	-	0
M58	83Ah	72( 48 h)	Option monitor 4	0 to 65535	1	-	0
M59	83Bh	73( 49 h)	Option monitor 5	-32768 to 32767	1	-	5
M60	83Ch	74( 4A h)	Option monitor 6	-32768 to 32767	1	-	5



# 13. Function Code List

## 13.4 Data Format List

You can use the following formats to access function codes through the link and these formats are common to the FRENICS500VG7S models.

### 13.4.1 Data Type 0 to 13

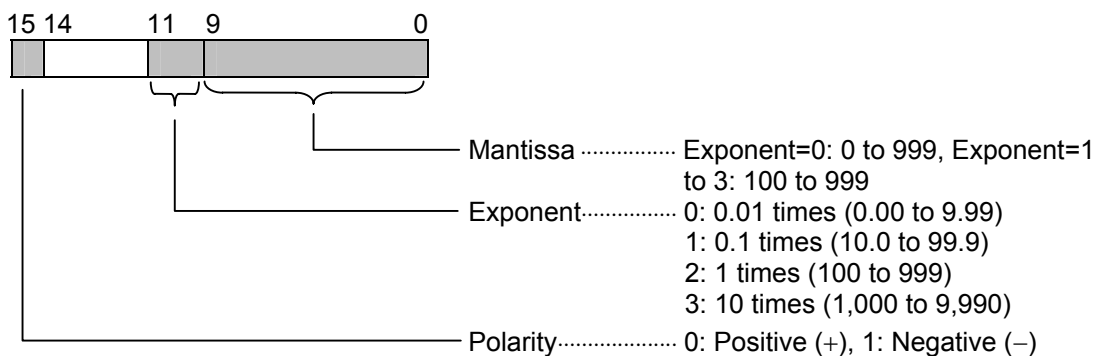
You can basically exchange data in the data types from 0 to 13.

Code	Description	Display/setting	Resolution	Notes
0	Integer	0, 1, 2, 3, .....	1	
1	Integer	0, 2, 4, 6, .....	2	Only for pole number of motor
2	Fixed point	0.0, 0.1, 0.2, .....	0.1	
3		0.00, 0.01, 0.02, .....	0.01	
4		0.001, 0.002, 0.003, .....	0.001	
5	Integer (signed)	-2, -1, 0, 1, 2, .....	1	
6	Fixed point (signed)	-0.1, 0.0, 0.1, .....	0.1	
7		-0.01, 0.00, 0.01, .....	0.01	
8		-0.001, 0.000, 0.001, .....	0.001	
9	Hexadecimal	1A8E	1h	Initial cursor position is left end. Cursor does not move automatically. When setting range is from 00 to 11, you should specify individual digits to set only 00, 01, 10, or 11.
10	Special data 3	0.75, 1, 2, ....., 14, 15		Carrier frequency setting
11	Operation data		1	Reset to 0 after writing
12	Exponent/mantissa 1		0.01	See 13.4.2 "Data Type 12 to 127"
13	Exponent/mantissa 2		0.01	

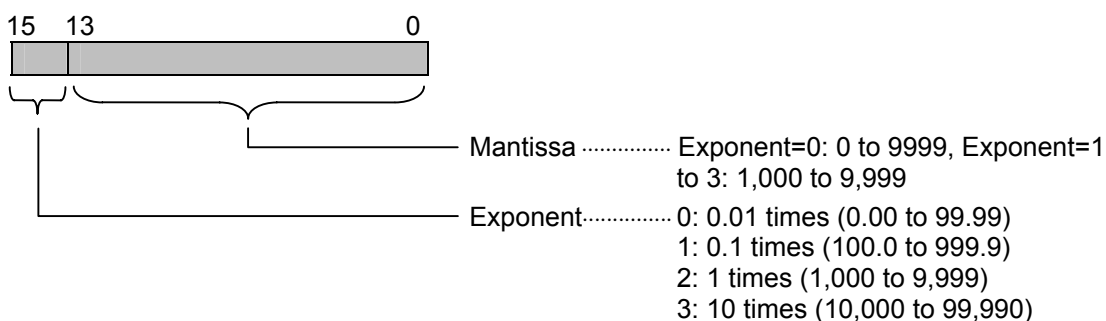
### 13.4.2 Data Type 12 to 127

The following data have special formats.

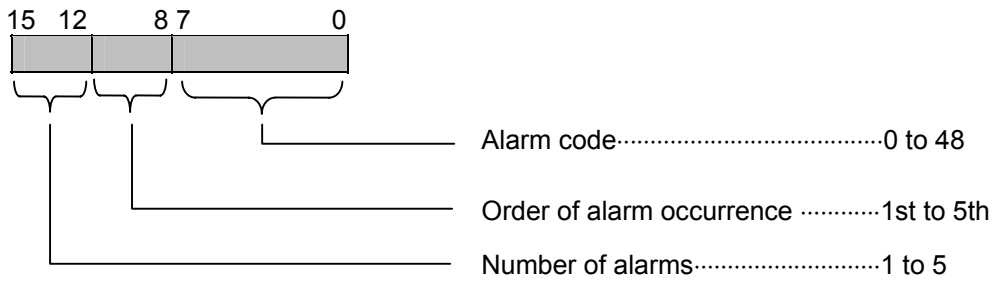
Type [12]: Time, current, power, PID process values



Type [13]: Current and others



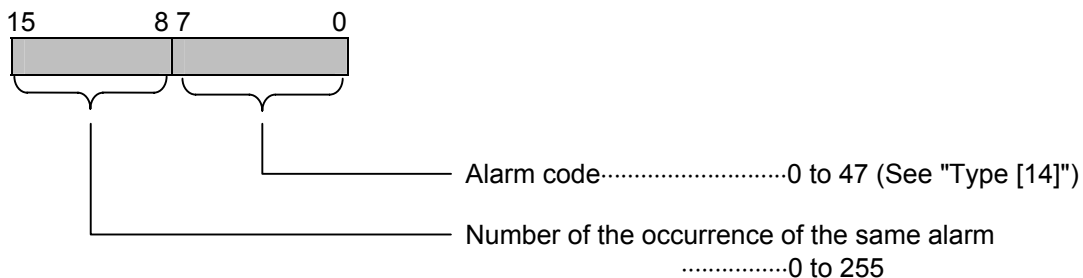
Type [14]: Cause of alarm



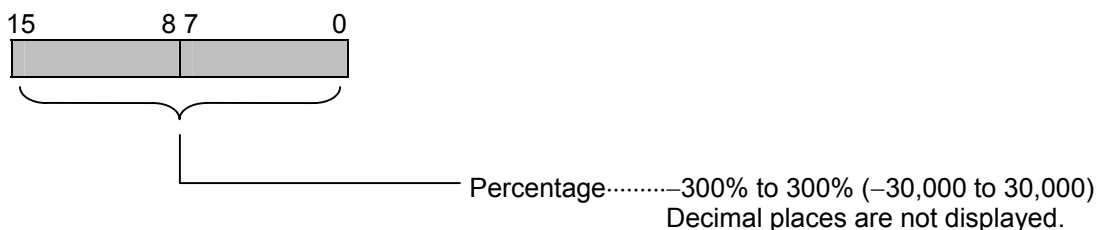
Alarm codes

Code	Display	Description	Code	Display	Description	Code	Display	Description
0	---	No alarm	17	Lin	Input phase loss	34	Ar2	Error code 2 for specific user application
1	IPE	IPM error	18	LU	Undervoltage	35	Ar3	Error code 3 for specific user application
2	dbH	DB resistor overheating	19	nrb	NTC thermistor disconnection	36	Ar4	Error code 4 for specific user application
3	dCF	DC fuse blown	20	OC	Overcurrent	37	Ar5	Error code 5 for specific user application
4	dO	Excessive position deviation	21	OH1	Overheating at heat sink	38	Ar6	Error code 6 for specific user application
5	EF	Ground fault	22	OH2	External alarm	39	Ar7	Error code 7 for specific user application
6	Er1	Memory error	23	OH3	Inverter internal overheat	40	Ar8	Error code 8 for specific user application
7	Er2	KEYPAD panel communication error	24	OH4	Motor overheat	41	Ar9	Error code 9 for specific user application
8	Er3	CPU error	25	OL1	Motor 1 overload	42	ArA	Error code A for specific user application
9	Er4	Network error	26	OL2	Motor 2 overload	43	ArB	Error code B for specific user application
10	Er5	RS485 communication error	27	OL3	Motor 3 overload	44	ArC	Error code C for specific user application
11	Er6	Operation procedure error	28	OLU	Inverter unit overload	45	ArD	Error code D for specific user application
12	Er7	Output wiring error	29	OS	Overspeed	46	ArE	Error code E for specific user application
13	Er8	A/D converter error	30	OU	Overvoltage	47	ArF	Error code F for specific user application
14	Er9	Speed disagreement	31	PbF	Charging circuit error			
15	ErA	UPAC error	32	PG	PG error			
16	ErB	Inter-inverter communication error	33	Ar1	Error code 1 for specific user application			

Type [15]: Alarm history

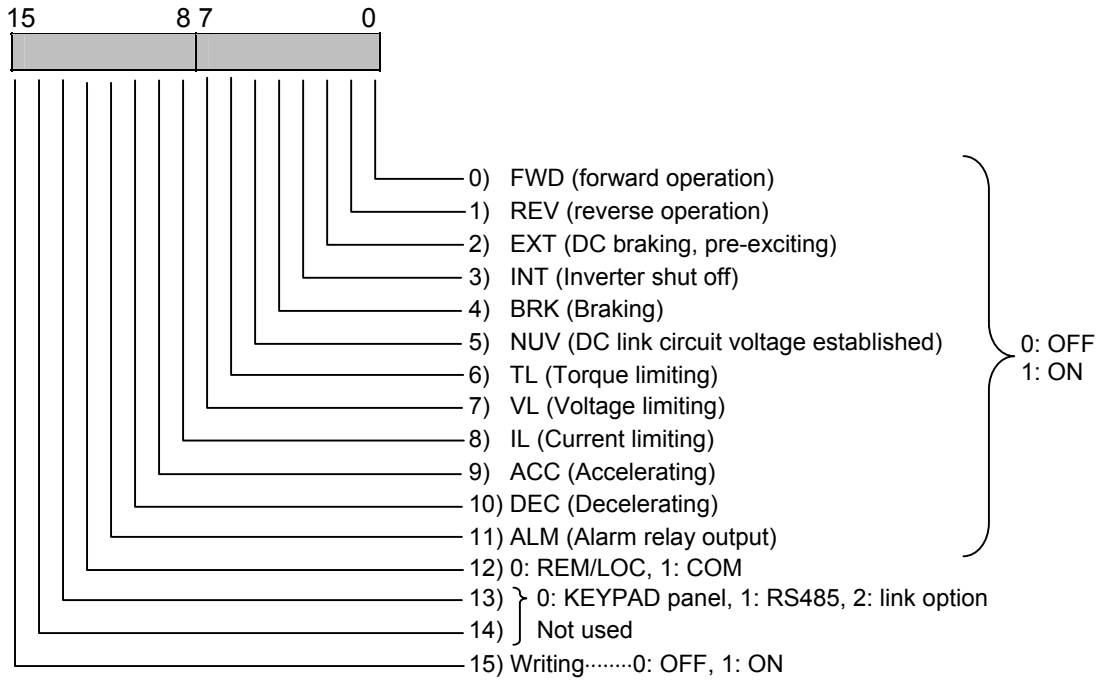


Type [16]: Percentage

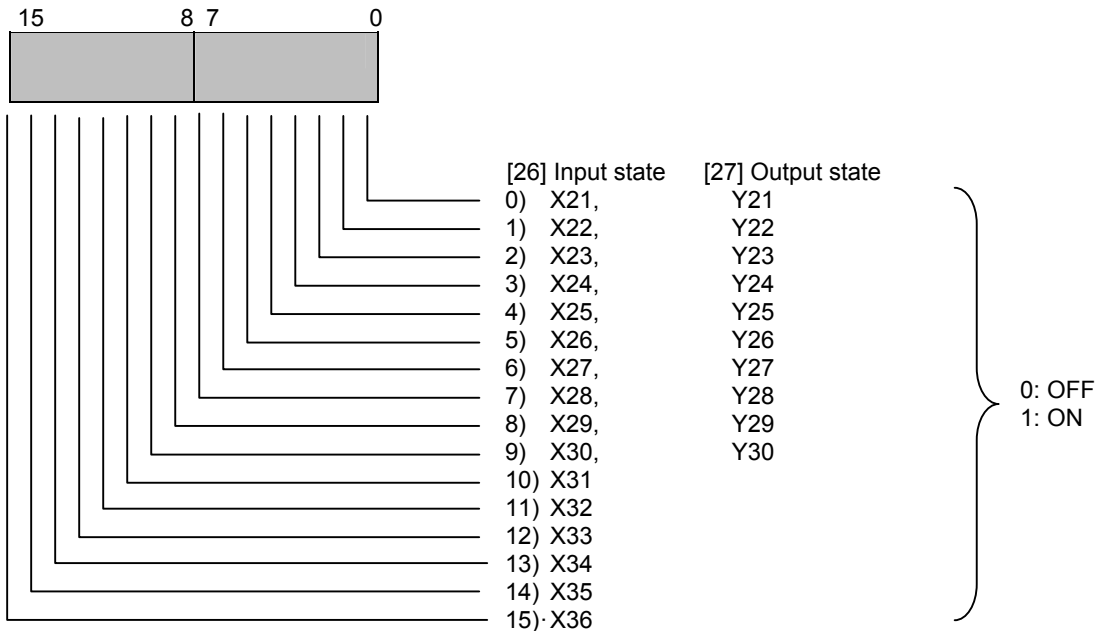


# 13. Function Code List

Type [21]: Operation status



Type [26]: DIOB option input state  
 Type [27]: DIOB option output state



Type [28]: Inverter capacity

Code	Inverter capacity	Code	Inverter capacity	Code	Inverter capacity	Code	Inverter capacity	Code	Inverter capacity
0	0.05	8	5.5	16	45	24	220	32	630
1	0.1	9	7.5	17	55	25	250	33	710
2	0.2	10	11	18	75	26	280	34	800
3	0.4	11	15	19	90	27	315		
4	0.75	12	18.5	20	110	28	355		
5	1.5	13	22	21	132	29	400		
6	2.2	14	30	22	160	30	OTHER		
7	3.7	15	37	23	200	31	500		

Type [29]: Inverter model (common to entire FUJI inverter system)

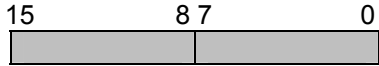
The number is fixed to 1213h or 1214h or 1216h for the VG inverters.

200V system: fixed to 1213h

400V system: fixed to 1214h

690V system: fixed to 1216h

Type [31]: Speed



Data (0 to ±20,000) → (0 to ±12,000 × r/min) : (Data) × Nmax/20,000 conversion

(Example) When the maximum speed is Nmax=1,500r/min,

- If you want to direct a speed command of 1,000r/min,

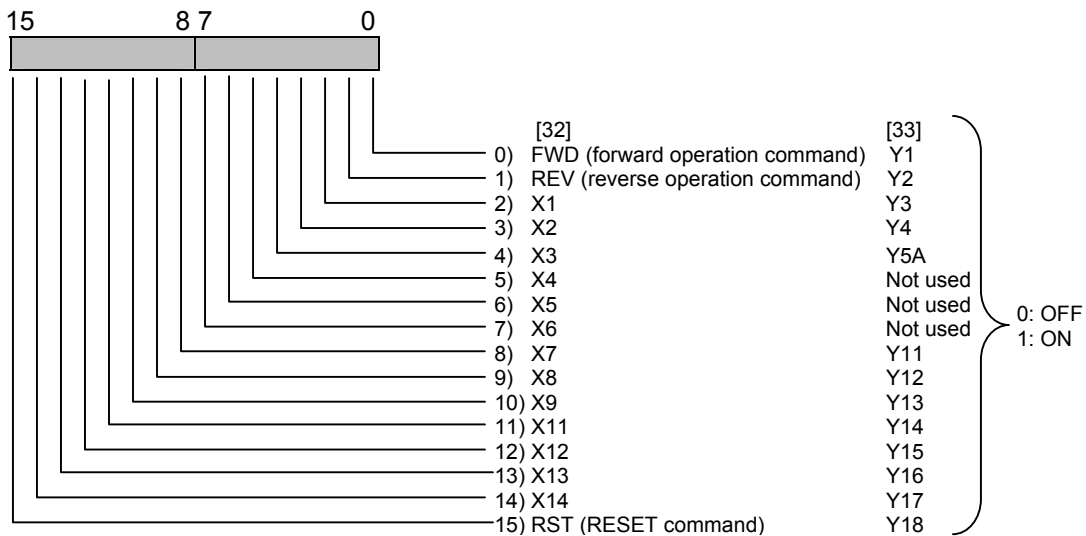
Specify a data of  $\frac{1,000}{1,500} \times 20,000 \rightarrow 13,333$ .

- If the read out data is 3,500,

You can determine the speed is  $\frac{1,500}{20,000} \times 3,500 \rightarrow 262.5\text{r/min}$ .

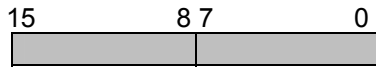
Type [32]: Operation commands, [33]: Y1 to Y18

This type is the same as S06 and S07.



# 13. Function Code List

Type [34]: Communication error codes

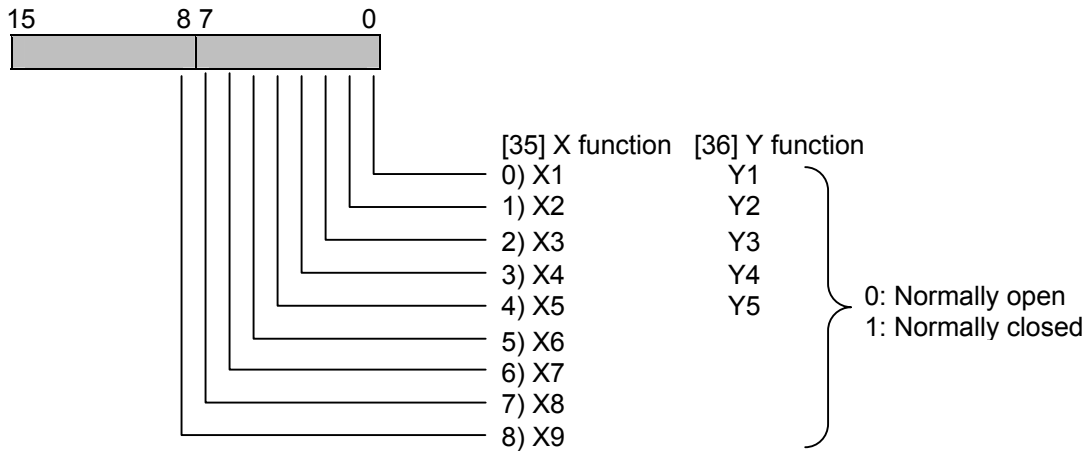


Description of alarms in the communication through the link (RS-485, T-Link, field bus). The following data is set to the monitor data M26 according to the communication status. The codes listed in the column "KEYPAD panel display" is displayed on the KEYPAD panel as a communication error .

Code	KEYPAD panel display	Communication error name	Description	
0	-	No communication error	1 Normal communication 2 A data is written to an unused address of the function code (writing to address out of the specified range is defined separately). 3 Data is read from missing function code address in the middle of continuous read. The data will be "0000". 4 Writing to the S area while link operation is disabled. The data will not be reflected and cause no error. 5 A data out of range is written to the S area. The data is written after adjusted to the upper or the lower limit. 6 Access from another link or the KEYPAD panel occurs during data writing (EEPROM other than the S area is accessed). 7 Writing to operation data (such as tuning or initialization) during multiple function codes are being written once through the link. The inverter decides that the procedure is canceled and continues the writing. 8 Writing to/reading from option function codes that are not displayed on the KEYPAD panel. 9 Writing/reading a special function code for the lifting machine in the standard mode 10 Writing/reading a function code for the standard mode in the lifting machine mode	
1 to 32	-	Alarm codes specific to the VG7S	Alarm codes specific to models other than communication errors.	
33 to 70	-	Not used		
71	04	Checksum error, CRC error	Software error	Checksum value or CRC value does not match.
72	05	Parity error	Hardware error	Parity does not match.
73	06	Others (such as overrun, framing)		Physical (reception) errors other than above.
74	01	Format error	Incorrect format. Characters requesting transmission are incorrect. Characters terminating transmission are not in the specified order.	
75	01	Command error	Codes other than the specified commands are transmitted.	
76	07	Link priority error	1 Writing to the S area through RS485 while a link option is installed. 2 Writing to the S area through a link with lower priority while multiple link options are installed.	
77	07	No right to write function code data	Not used for VG7S	
78	02	Function code error	1 Access to a data out of the address range of the function codes (such as access to a data over F80). 2 Writing data over 16 words.	
79	07	Error on writing to write-disabled data	1 Write-disabled function codes (Read-only data or the M area). 2 Function codes write-disabled during operation. 3 Writing through the link to data out of the S area in "write-disabled through link" mode. Note that F00 or "Write enable for KEYPAD" cannot protect from writing through the link. 4 Function codes that cannot be written through the link (link function codes: H31 to 40). 5 Writing to M1 function code (P) area when motor parameters are protected. 6 Writing through the link in the copy mode operation of the KEYPAD panel.	
80	03	Data error	Written data is out of the setting range in the area other than the S area.	
81	07	Error during writing	Another writing request comes from the same source while writing function code data (EEPROM other than the S area is accessed).	

Note: The alarm codes 1 to 32 constitute a code system specific to the VG7S different from the assignment for the general-purpose inverters.  
 The communication error codes 71 to 81 are common to the different models. Note that some causes of alarm are specific to models.  
 The KEYPAD panel does not display raw communication error codes but the values in the "KEYPAD panel display" column in the table above.  
 The KEYPAD panel displays "\*" when it receives data that does not have a corresponding "KEYPAD panel display" in the table above.

Type [35]: X function normally open/closed  
 Type [36]: Y function normally open/closed



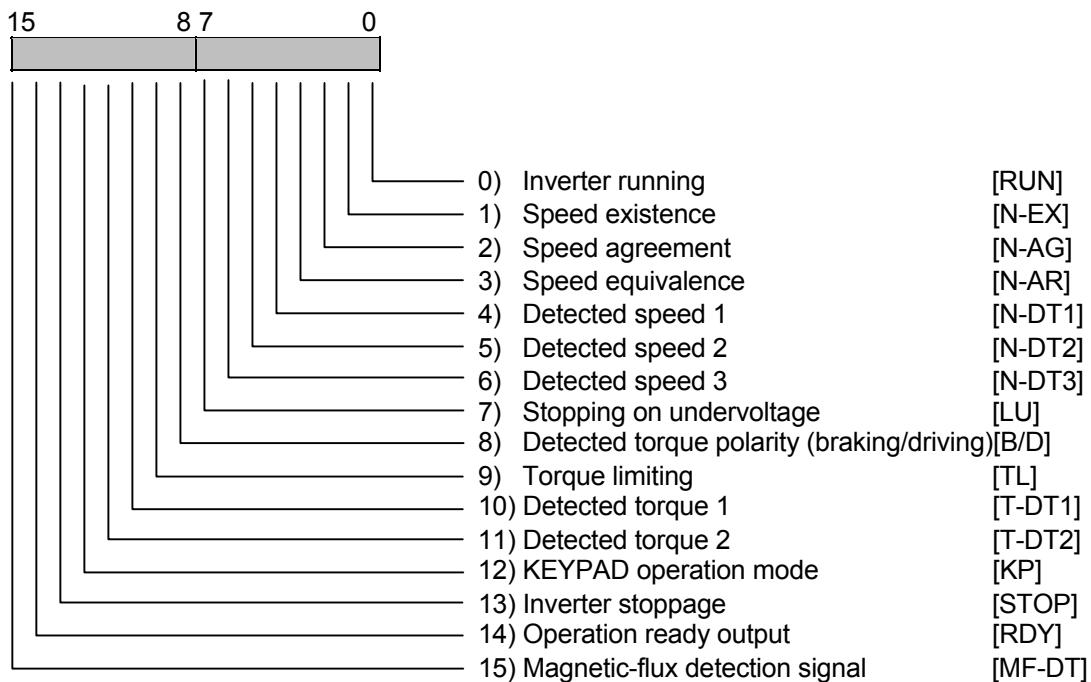
Type [40] to [99]

These types are reserved for the manufacturer. Users can consider these types as type [0] to use.

Type [82]: M1 Motor Selection

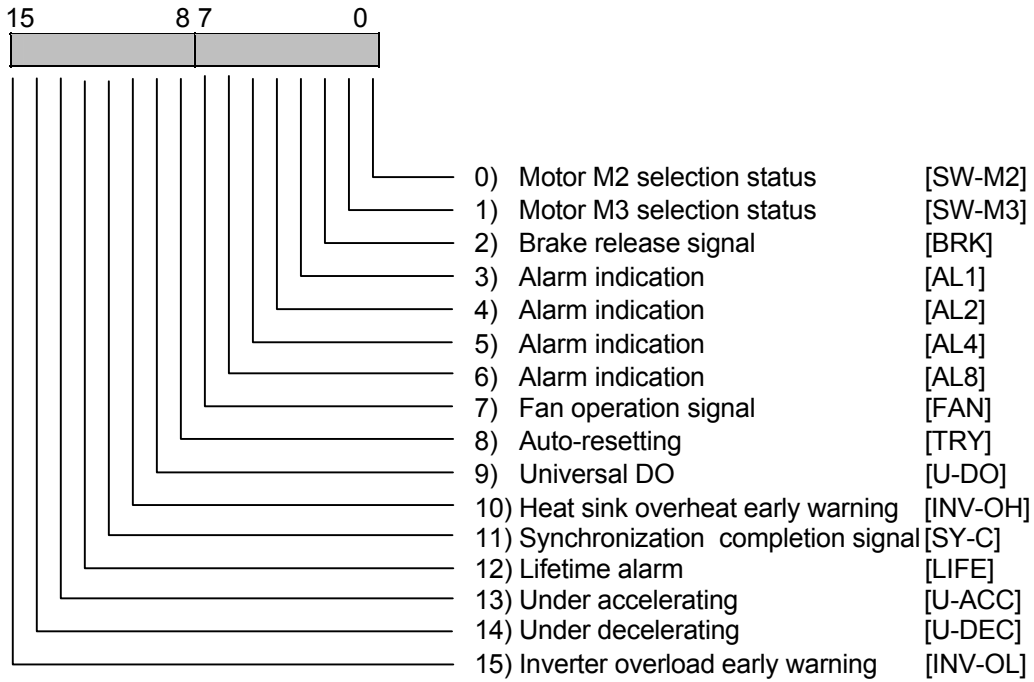
Code	KW display	HP display	Code	KW display	HP display	Code	KW display	HP display
0	00 : 0.75-2	00 : 1-2	13	13 : 45-2S	13 : 60-2S	26	26 : 45-4Y	26 : 60-4Y
1	01 : 1.5-2	01 : 2-2	14	14 : 55-2	14 : 75-2	27	27 : 45-4S	27 : 60-4S
2	02 : 2.2-2	02 : 3-2	15	15 : 75-2	15 : 100-2	28	28 : 55-4	28 : 75-4
3	03 : 3.7-2	03 : 5-2	16	16 : 90-2	16 : 125-2	29	29 : 75-4	29 : 100-4
4	04 : 5.5-2	04 : 7.5-2	17	17 : 3.7-4	17 : 5-4	30	30 : 90-4	30 : 125-4
5	05 : 7.5-2	05 : 10-2	18	18 : 5.5-4	18 : 7.5-4	31	31 : 110-4	31 : 150-4
6	06 : 11-2	06 : 15-2	19	19 : 7.5-4	19 : 10-4	32	32 : 132-4	32 : 175-4
7	07 : 15-2	07 : 20-2	20	20 : 11-4	20 : 15-4	33	33 : 160-4	33 : 200-4
8	08 : 18.5-2	08 : 25-2	21	21 : 15-4	21 : 20-4	34	34 : 200-4	34 : 250-4
9	09 : 22-2	09 : 30-2	22	22 : 18.5-4	22 : 25-4	35	35 : 220-4	35 : 300-4
10	10 : 30-2	10 : 40-2	23	23 : 22-4	23 : 30-4	36	36 : P-OTR	36 : P-OTR
11	11 : 37-2	11 : 50-2	24	24 : 30-4	24 : 40-4	37	37 : OTHER	37 : OTHER
12	12 : 45-2Y	12 : 60-2Y	25	25 : 37-4	25 : 50-4			

Type [125]: Control output 1

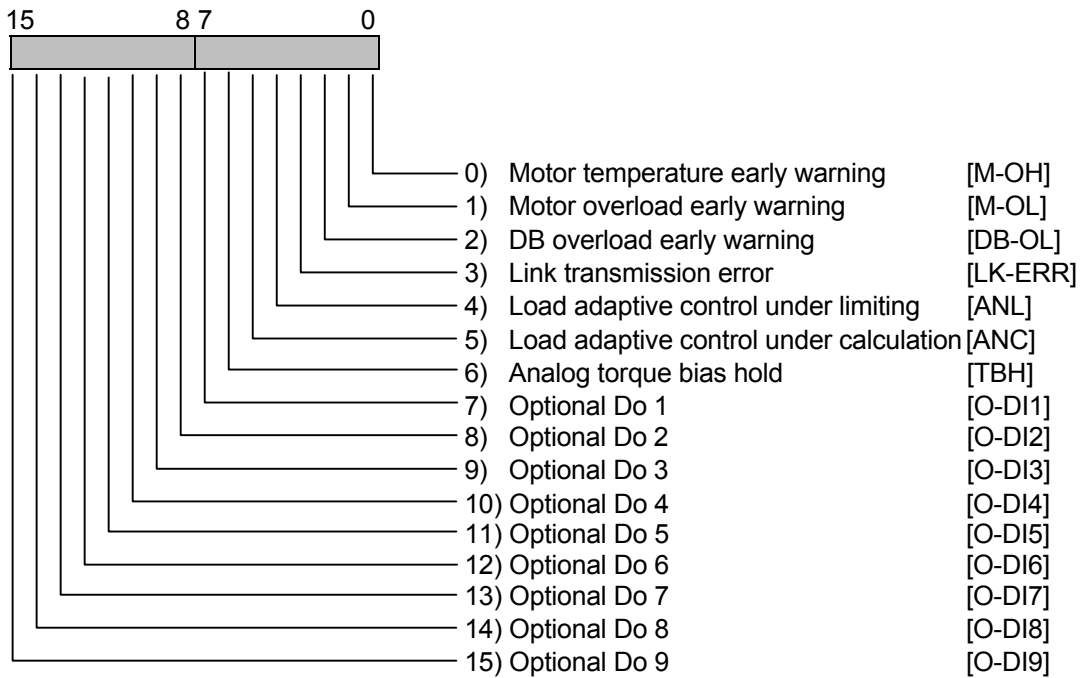


# 13. Function Code List

Type [126]: Control output 2



Type [127]: Control output 3



**THE INVERTER**

**XIV**

## **XIV. Replacement Data**

**14.1 Classification of Replacement**

**14.2 External Dimensions Comparison**

**14.3 Terminal Size**

**14.4 Terminal Symbol**

**14.5 KEYPAD Panel**

**14.6 Function Codes**

**14.7 Motor Parameters**

**14.8 Protective Functions**

**14.9 Options**



# 14. Replacement Data

When replacing the former inverters (VG, VG3, VG5) with VG7, please refer to this section.

## 14.1 Classification of Replacement

	Inverter	Motor	Possibility
A: Both inverter and motor are replaced.	VG5 ⇒ VG7S	VG ⇒ VG7	Possible
	VG3/VG3N ⇒ VG7S	VG3 ⇒ VG7	Possible
	VG5S/VG5N ⇒ VG7S	VG5 ⇒ VG7 (Same product)	Possible
B: Only the inverter is replaced.	VG5 ⇒ VG7S	VG	Possible (Note1)
	VG3/VG3N ⇒ VG7S	VG3	Possible (Note1)
	VG5S/VG5N ⇒ VG7S	VG5	Possible
C: Only the motor is replaced.	VG	VG ⇒ VG7	Impossible (Note2)
	VG3	VG3 ⇒ VG7	Impossible (Note2)
	VG5	VG5 ⇒ VG7 (Same product)	Possible

**Note 1:** The rated current of VG and VG3 is bigger than that of VG5, VG7. For this reason, the inverter in one-rank upper grade is required if only the inverter is changed from VG or VG3.

**Note 2:** For VG and VG3, the maximum output voltage, to which the stable current control is possible, is lower than that of VG5 and VG7. Therefore, if these inverters are combined with VG5 or VG7 motors, the characteristics (torque accuracy or motor wow) at around the base speed or at higher speed will deteriorate.

**Note 3:** Because the encoder pulse count of VG is 512P/R, operation is impossible if the VG7 motor encoder pulse count setting (P28) is different.

## 14.2 External Dimensions Comparison




### 14.2.1 Replacing VG5S

#### ● 200V series

Capacity (kW)	FRENIC5000 VG5S							FRENIC5000 VG7S							
	External Dimensions			Installation dimensions		Mounting Method	Mass (kg)	External dimensions			Installation dimensions		Mounting method	Mass (kg)	
	W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)			W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)			
0.75	205	350	245	183	328	Wall type	10	205	300	245	181	278	Wall type	8	
1.5															
2.2															
3.7															
5.5	205	350	245	183	328		11	205	300	245	181	278		8	
7.5															
11	255	440	255	233	418		17	250	380	245	226	358		12.5	
15															320
18.5	320	480	255	298	458		25	340	480	255	240	460		25	
22															
30	340	550	255	326	530		36	340	550	255	240	530		30	
37															375
45	530	750	270	430	720		58	740	270	275	720	46			
55														285	76
75	680	880	360	580	860		Floor type	141	680	880	360	580			
90															

#### ● 400V series

Capacity (kW)	FRENIC5000 VG5S							FRENIC5000 VG7S							
	External dimensions			Installation dimensions		Mounting Method	Mass (kg)	External dimensions			Installation dimensions		Mounting method	Mass (kg)	
	W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)			W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)			
3.7	205	350	245	183	328	Wall type	10	205	300	245	181	278	Wall type	8	
5.5															
7.5															
11															255
15															
18.5	320	480	255	298	458		25	340	480	255	240	460		25	
22															
30	340	550	255	240	530		35	340	550	255	240	530		30	
37															375
45	530	740	315	430	710		53	375	270	655	41				
55												270		60	530
75	530	740	315	430	710		86	530	430	970	72				
90												680		1000	360
110															
132	116	970	100												
160				121	1000		360	580	970						
200	220														

-  Larger than VG5.
-  An adapter is required for replacement.
-  The control panel containing VG5S should be modified.

# 14. Replacement Data

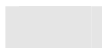
## 14.2.2 Replacing VG3

### ● 200V series

Capacity (Kw)	FRENIC5000 VG3						FRENIC5000 VG7S						Mounting method	Mass (kg)		
	External dimensions			Installation dimensions			External dimensions			Installation dimensions						
	W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)	W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)						
0.75	255	440	252	155	425	Wall type	14	205	300	245	181	278	Wall type	8		
1.5																
2.2																
3.7																
5.5																
7.5	280	480	252	180	465			16	205	300	245	181			278	
11	320	480	252	220	460			20	250	380	245	226			358	12.5
15		520						500								
18.5	340	550	252	240	530			30	340	480	255	240			460	25
22								40								
30	375	615	252	275	596	53	375	615	270	275	595	30				
37	390	800		290	775	740	270	275	595	720	720	46				
45				70	375								270	275	720	
55	540	750	267	440	720	70	375	270	275	720	48					
75	850	880	-	750	855	Floor type	130	530	750	285	430	70				
90						680	880	360	580	850	115					

### ● 400V series

Capacity (kW)	FRENIC5000 VG3						FRENIC5000 VG7S						Mounting method	Mass (kg)		
	External dimensions			Installation dimensions			External dimensions			Installation dimensions						
	W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)	W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)						
3.7	280	440	252	180	425	Wall type	20	205	300	245	181	278	Wall type	8		
5.5															205	300
7.5	280	480	252	180	465			22	250	380	245	226			358	12.5
11								320								
15	340	550	252	240	530				30	340	480	255			240	460
18.5								35								
22	375	615	252	275	656			35	375	675	270	275			655	30
30								43								
37	530	880	322	430	850			43	375	675	270	275			655	35
45								85								
55	90	880	322	430	850	85	375	675	270	275	655	41				
75						95							740	315	710	720
90	110	1050	337	1020	1025	95	530	675	270	275	655	50				
110						105							740	315	710	720
132	160	850	-	580	1025	105	530	675	270	275	655	72				
160						135							1000	360	970	100
200	220	-	-	-	-	Floor type	170	680	1000	360	580	970	140			
220						-	-							-	-	-



Larger than VG3.



An adapter is required for replacement.



The control panel containing VG3 should be modified.

## 14.2.3 Replacing VG

### ● 200V series

Ca- pac- ity (Kw)	VG						VG7S																
	External dimensions			Installation dimensions			Mounting method	Mass (kg)	External dimensions			Installation dimensions		Mounting method	Mass (kg)								
	W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)	W (mm)			H (mm)	D (mm)	W1 (mm)	H1 (mm)											
0.75						Wall type	-	205	300	235	181	278	Wall type	8									
1.5	-	-	-	-	-																		
2.2	-	-	-	-	-																		
3.7	240	500	280	180	480			15	205	300	235	181			278	8							
5.5																							
7.5	280	550	280	200	530			25	250	380	235	226			358	12.5							
11	350	550	310	280	530			30															
15																							
18.5	420	650	310	280	620			45	340	480	255	240			460	25							
22																							
30	420	750	310	280	720			60	340	550	255	240			530	30							
37	500	900	320	380	870			80									375	615	270	275	595	37	
45								740	375	740	270	275			720	46							
55	880	1000	445	750	975			Floor type									180	375	740	270	275	720	48
75																							
90	-	-	-	-	-		-	680	880	360	580	850	115										

### ● 400V series

Ca- pac- ity (kW)	VG						VG7S																	
	External dimensions			Installation dimensions			Mounting method	Mass (kg)	External dimensions			Installation dimensions		Mounting method	Mass (kg)									
	W (mm)	H (mm)	D (mm)	W1 (mm)	H1 (mm)	W (mm)			H (mm)	D (mm)	W1 (mm)	H1 (mm)												
3.7	240	550	295	180	530	Wall type	20	205	300	235	181	278	Wall type	8										
5.5															205	300	235	181	278					
7.5	350	600	340	280	580			35	250	380	235	226								358	12.5			
11																								
15																								
18.5	420	700	360	280	670			50	340	480	255	240			460	25								
22																								
30	420	800	360	280	770			65	340	550	255	240			530	30								
37	500	900	370	380	870			85									375	675	270	275	655	35		
45								Floor type	110	375	675	270			275	655							41	
55	580	1150	410	450	1125												150	375	675	270	275	655		50
75	730	1150	415	600	1125																			
90										530	740	315			430	710	72							
110																		530	740	315	430	710	72	
132										740	315	430			710	72								
160	-	-	-	-	-			1000	360				580	970			100							
200										680	1000	360			580	970		140						
220																								

 The control panel containing VG should be modified

# 14. Replacement Data

## 14.3 Terminal Size

### 14.3.1 Replacing VG5S

● Main circuit terminal (200V series)

Ca- pac- ity (kW)	FRENIC5000 VG5S					FRENIC5000 VG7S				
	Terminal size and arrangement					Terminal size and arrangement				
	Input R,S,T	DC link P1,P(+),DB, N(-)	Output U,V,W	GRD* E(G)	APS* R0,T0	Input L1/R,L2/S, L3/T	DC link DB,P1, P(+),N(-)	Output U,V,W	GRD* G	APS* R0,T0
0.75	M5	M5	M5	M5	M4	M4	M4	M4	M4	M4
1.5										
2.2										
3.7	M5	M5	M5	M5	M4	M5	M5	M5	M5	M4
5.5										
7.5										
11	M6	M6	M6	M6	M4	M6	M6	M6	M6	M4
15	M8	M8	M8	M8						
18.5	M8	M8	M8	M8	M4	M6	M6	M6	M6	M4
22										
	R,S,T	P1,P(+),DB, N(-)	U,V,W	E(G)	R0,T0	L1/R,L2/S, L3/T	P1,P(+),DB, N(-)	U,V,W	G	R0,T0
30	M8	M8	M8	M8	M4	M8	M8	M8	M8	M4
37	M10	M10	M10	M8	M4	M10	M10	M10	M8	M4
45										
55										
	R,S,T	P1,P(+), N(-)	U,V,W	E(G)	R0,T0	L1/R,L2/S, L3/T	P1,P(+), N(-)	U,V,W	G	R0,T0
75	M10	M10	M10	M8	M4	M12	M12	M12	M10	M4
90	M12	M12	M12	M10	M4					

\*GRD: Ground

\*APS: Auxiliary power supply

● Main circuit terminal (400V series)

		FRENIC5000 VG5S					FRENIC5000 VG7S				
Ca- pac- ity (kW)	Terminal size and arrangement					Terminal size and arrangement					
	Input	DC link	Output	GRD*	APS*	Input	DC link	Output	GRD*	APS*	
	R,S,T	P1,P(+),DB, N(-)	U,V,W	E(G)	R0,T0	L1/R,L2/S, L3/T	DB,P1, P(+),N(-)	U,V,W	G	R0,T0	
3.7	M5	M5	M5	M5	M4	M5	M5	M5	M5	M4	
5.5											
7.5											
11	M6	M6	M6	M6	M4	M6	M6	M6	M6	M4	
15											
18.5	M8	M8	M8	M8	M4	M6	M6	M6	M6	M4	
22											
	R,S,T	P1,P(+), DB, N(-)	U, V, W	E(G)	R0,T0	L1/R,L2/S, L3/T	P1,P(+), DB,N(-)	U,V,W	G	R0,T0	
30	M8	M8	M8	M8	M4	M8	M8	M8	M8	M4	
37											
45											
55											
	R,S,T	DB,P1,P(+), N(-)	U,V,W	E(G)	R0,T0	L1/R,L2/S, L3/T	P1,P(+), DB,N(-)	U,V,W	G	R0,T0	
75	M10	M10	M10	M8	M4	M10	M10	M10	M8	M4	
90											
110		M10 (No DB terminal)									
	R,S,T	P1,P(+), N(-)	U,V,W	E(G)	R0,T0	L1/R,L2/S, L3/T	P1,P(+), N(-)	U,V,W	G	R0,T0	
132	M10	M10	M10	M8	M4	M12	M12	M12	M10	M4	
160	M12	M12	M12	M10							
200											
220											

\*GRD: Ground

\*APS: Auxiliary power supply

● Control circuit terminal (Common to 200V series and 400V series)

FRENIC5000 VG5S	FRENIC5000 VG7S
Common to all capacities M3	Common to all capacities M3

# 14. Replacement Data

## 14.3.2 Replacing VG3

● Main circuit terminal (200V series)

Ca- pac- ity (kW)	FRENIC5000 VG3					FRENIC5000 VG7S											
	Terminal size and arrangement					Terminal size and arrangement											
	Input R,S,T	Output U,V,W	DC link DB,P	GRD* E(G)	APS* R0,T0	Input L1/R,L2/S, L3/T	DC link DB,P1,P(+), N(-)	Output U,V,W	GRD* G	APS* R0,T0							
0.75	M5	M5	M5	M5	M4	M4	M4	M4	M4	M4							
1.5						M5	M5	M5	M4	M5	M5	M5	M5	M4			
2.2										M6	M6	M6	M6	M6	M6	M6	M4
3.7																	
5.5																	
7.5																	
11	M8	M8	M8	M6	M4	M6	M6	M6	M4								
15																	
18.5																	
22	R,S,T	U,V,W	DB,P1,P	E(G)	R0,T0	M6	M6	M6	M6	M4							
	M8	M8	M8	M6	M4												
	R,S,T	U,V,W	DB,P1,P	E(G)	R0,T0	L1/R,L2/S, L3/T	P1,P(+),DB, N(-)	U,V,W	G	R0,T0							
30	M8	M8	M8	M8	M4	M8	M8	M8	M8	M4							
37	M10	M10	M10	M8	M4	M10	M10	M10	M8	M4							
45																	
55																	
	Input/Output R,U,S,V,T,W	DC link N,P1,P	GRD* E(G)	APS* R0,T0	Input L1/R,L2/S, L3/T	DC link P1,P(+), N(-)	Output U,V,W	GRD* G	APS* R0,T0								
75	M12	M12	M12	M10	M4	M12	M12	M12	M10	M4							
90																	

\*GRD: Ground

\*APS: Auxiliary power supply

● Main circuit terminal (400V series)

Ca- pac- ity (kW)	FRENIC5000 VG3					FRENIC5000 VG7S				
	Terminal size and arrangement					Terminal size and arrangement				
	Input	Output	DC link	GRD*	APS*	Input	DC link	Output	GRD*	APS*
	R,S,T	U,V,W	DB,P	E(G)	R0,T0	L1/R,L2/S, L3/T	DB,P1,P(+), N(-)	U,V,W	G	R0,T0
3.7	M4	M4	M4	M4	M4	M5	M5	M5	M5	M4
5.5										
7.5	M5	M5	M5	M5	M4					
11										
15	M6	M6	M6	M6	M4					
18.5										
	R,S,T	U,V,W	DB,P1,P	E(G)	R0,T0	M6	M6	M6	M6	M4
22	M6	M6	M6	M6	M4					
	R,S,T	P1,P(+), DB,N(-)	U,V,W	E(G)	R0,T0	L1/R,L2/S, L3/T	P1,P(+),DB, N(-)	U,V,W	G	R0,T0
30	M8	M8	M8	M8	M4	M8	M8	M8	M8	M4
37										
45										
55										
75	M10	M10	M10	M8	M4	M10	M10	M10	M8	M4
90										
110										
	Input/Output R,U,S,V,T,W	DC link N,P1,P	GRD* E(G)	APS* R0,T0		L1/R,L2/S, L3/T	P1,P(+), N(-)	U,V,W	G	R0,T0
132	M12	M12	M12	M10	M4	M12	M12	M12	M10	M4
160										
200										
220										

\*GRD: Ground

\*APS: Auxiliary power supply

● Control circuit terminal (Common to 200V series and 400V series)

FRENIC5000 VG3	FRENIC5000 VG7S
Common to all capacities M3	Common to all capacities M3



# 14. Replacement Data

## 14.3.3 Replacing VG

● Main circuit terminal (200V series)

Capacity (kW)	FRENIC5000 VG					FRENIC5000 VG7S				
	Terminal size and arrangement					Terminal size and arrangement				
	Input R,S,T	Output U,V,W	DC link DC2,DB1, DB2	GRD* E(G)	APS* R0,S0, T0	Input L1/R,L2/S, L3/T	DC link DB,P1, P(+), N(-)	Output U,V,W	GRD* G	APS* R0,T0
0.75	-	-	-	-	-	M4	M4	M4	M4	M4
1.5	-	-	-	-	-	M4	M4	M4	M4	M4
2.2	-	-	-	-	-	M4	M4	M4	M4	M4
3.7	M4	M4	M4	M3.5	M3.5	M5	M5	M5	M5	M4
5.5	M6	M6	M5	M3.5	M3.5					
7.5	M6	M6	M5	M3.5	M3.5					
11	R,S,T	U,V,W	DC1,DC2, DB1,DB2	E(G)	R0,S0, T0	M6	M6	M6	M6	M4
15										
18.5	M6	M6	M6	M3.5	M3.5	M6	M6	M6	M6	M4
22	M6	M6	M6	M3.5	M3.5	M6	M6	M6	M6	M4
	R,S,T	U,V,W	DC1,DC2, DB1,DB2	E(G)	R0,S0, T0	L1/R,L2/S, L3/T	P1,P(+), DB, N(-)	U,V,W	G	R0,T0
30	M8	M8	M8	M3.5	M3.5	M8	M8	M8	M8	M4
37						M10	M10	M10	M8	M4
45										
	DC link DB1,DB2, DC1,DC2	Input/ Output R,U,S,V,T,W		GRD* E(G)	APS* R0,S0, T0	M10	M10	M10	M8	M4
55	M10	M10	M4	M4						
	M10	M10	M4	M4	M4	L1/R,L2/S, L3/T	P1,P(+), N(-)	U,V,W	G	R0,T0
75						M12	M12	M12	M10	M4
90	-	-	-	-	-	-	-	-	-	-

\*GRD: Ground

\*APS: Auxiliary power supply

● Main circuit terminal (400V series)

Capacity (kW)	FRENIC5000 VG					FRENIC5000 VG7S				
	Terminal size and arrangement					Terminal size and arrangement				
	Input	Output	DC link	GRD*	APS*	Input	DC link	Output	GRD*	APS*
	R,S,T	U,V,W	DC2, DB1, DB2	E(G)	R0,S0, T0	L1/R,L2/S, L3/T	DB,P1,P(+), N(-)	U,V,W	G	R0,T0
3.7	M4	M4	M4	M3.5	M3.5					
5.5						M5	M5	M5	M5	M4
7.5	M5	M5	M5	M3.5	M3.5					
11						M6	M6	M6	M6	M4
	R,S,T	U,V,W	DC1,DC2, DB1,DB2	E(G)	R0,S0, T0					
15										
18.5						M6	M6	M6	M6	M4
22	M6	M6	M6	M3.5	M3.5					
						L1/R,L2/S, L3/T	P1,P(+),DB, N(-)	U,V,W	G	R0,T0
30										
37	M8	M8	M8	M3.5	M3.5	M8	M8	M8	M8	M4
45										
	DC link DC1,DC2, DB1,DB2	Input/Output R,U,S,V,T,W		GRD* E(G)	APS* R0,S0, T0					
55										
	M8	M8		M4	M4	L1/R,L2/S, L3/T	P1,P(+),DB, N(-)	U,V,W	G	R0,T0
75										
90						M10	M10	M10	M8	M4
110										
						L1/R,L2/S, L3/T	P1,P(+),N(-)	U,V,W	G	R0,T0
132	-	-	-	-	-					
160										
200						M12	M12	M12	M10	M4
220										

\*GRD: Ground

\*APS: Auxiliary power supply

# 14. Replacement Data

## 14.4 Terminal Symbol

### 14.4.1 Replacing VG5

Category	FRENIC5000 VG5S		FRENIC5000 VG7S	
	Terminal symbol	Terminal name	Terminal symbol	Terminal name
Main circuit	R,S,T	Power input	L1/R,L2/S,L3/T	Power input
	U,V,W	Inverter output	U,V,W	Inverter output
	P1,P(+)	Connects a DC REACTOR	P1,P(+)	Connects a DC REACTOR
	P(+),N(-)	Connects a braking unit	P(+),N(-)	Connects a braking unit
	P(+),DB	Connects an external braking resistor	P(+),DB	Connects an external braking resistor
	E(G)	To ground the inverter	G	To ground the inverter
	R0,T0	Auxiliary control power supply	R0,T0	Auxiliary control power supply
	Analog input	13	Power supply for potentiometer	13
12		Voltage input for speed setting	12	Voltage input for speed setting
11		Analog input common	11	Analog input common
Ai1		Analog input 1	Ai1	Analog input 1
Ai2		Analog input 2	Ai2	Analog input 2
[AOFF]		Input signal off	[OFF]	Input signal off
[AAS1]		Auxiliary speed setting 1	[AUX-N1]	Auxiliary speed setting 1
[AAS2]		Auxiliary speed setting 2	[AUX-N2]	Auxiliary speed setting 2
[ATL1]		Torque limiter (level 1)	[TL-REF1]	Torque limiter (level 1)
[ATL2]		Torque limiter (level 2)	[TL-REF2]	Torque limiter (level 2)
[ATBS]		Torque bias	[TB-REF]	Torque bias
[ATS]		Torque command (before limit)	[T-REF]	Torque command (before limit)
[ATCS]		Torque current command	[IT-REF]	Torque current command
[AJSS1]		Creep speed 1	[CRP-N1]	Creep speed 1
[AJSS2]		Creep speed 2	[CRP-N2]	Creep speed 2
[AFLUX]		Magnetic-flux command	[MF-REF]	Magnetic-flux command
[ASFB]		Speed feedback	[LINE-N]	Speed override
[AMTMP]		Motor temperature	[M-TMP]	Motor temperature
[ASOR]		Speed override	[N-OR]	Speed override
Digital input		M	Analog input common	M
	FWD	Forward operation · stop command	FWD	Forward operation · stop command
	REV	Reverse operation · stop command	REV	Reverse operation · stop command
	X1	Digital input 1	X1	Digital input 1
	X2	Digital input 2	X2	Digital input 2
	X3	Digital input 3	X3	Digital input 3
	X4	Digital input 4	X4	Digital input 4
	X5	Digital input 5	X5	Digital input 5
			X6	Digital input 6
			X7	Digital input 7
			X8	Digital input 8
			X9	Digital input 9
	[COPC]	Operation command switch over		
	[CSR1]	Speed setting value switch over	[N2/N1]	Speed setting N2/N1
	[CMCS]	Coast-to-stop command	[BX]	Coast-to-stop command
	[CPEX]	Pre-exciting command	[EXITE]	Pre-exciting command
	[CHLD]	Operation signal hold	[HLD]	Operation signal hold
	[CSR1]	Multistep speed selection 1	[SS1]	Multistep speed selection 1
	[CSR2]	Multistep speed selection 2	[SS2]	Multistep speed selection 2
	[CSR4]	Multistep speed selection 4	[SS4]	Multistep speed selection 4
	[CUP]	ACC command in UP/DOWN setter	[UP]	UP command in UP/DOWN setting
	[CDOWN]	DEC command in UP/DOWN setter	[DOWN]	DOWN command in UP/DOWN setting
[CCLR]	Zero clear command in UP/DOWN setter	[CLR]	ACC/DEC zero clear command	
[CJSC]	Creep switch	[CRP-N2/N1]	Creep speed switching in UP/DOWN setting	
[CSUC]	ACC/DEC · UP/DOWN switch	[N2/N1]	Speed setting N2/N1	
[CSRL]	Speed reference limiter	[N-LIM]	Speed command cancel	
[CSTC]	Speed control/Torque limiter switch	[H41-CCL]	H41 [torque command] cancel	
[CTL]	Torque limiter	[F40-CCI]	F40 [torque limiter mode] cancel	
[CADT]	ACC/DEC time selection	[RT1][RT2]	ASR, ACC/DEC selection	

Category	FRENIC5000 VG5S		FRENIC5000 VG7S	
	Terminal symbol	Terminal name	Terminal symbol	Terminal name
Digital input	[CADB]	ACC/DEC time bypass	[BPS]	Bypass
	[CTB1]	Torque bias command 1	[TB1]	Torque bias command 1
	[CTB2]	Torque bias command 2	[TB2]	Torque bias command 2
	[CDRP]	Droop function	[DROOP]	Droop selection
	[CPI]	ASR PI switch	[RT1][RT2]	ASR,ACC/DEC selection
	[CPP1]	ASR P/PI switch	[RT1][RT2]	ASR,ACC/DEC selection
	[CA1Z]	Ai1-ACC/DEC zero hold	[ZH-Ai1]	Ai1 zero hold
	[CA2Z]	Ai2-ACC/DEC zero hold	[ZH-Ai2]	Ai2 zero hold
	[CSAD]	Analog/Digital switch (speed)	[N2/N1]	Speed setting N2/N1
	[CTAD]	Analog/Digital switch (torque)	[H41-CCL]	H41[torque command]cancel
	[CDILS]	Di card input latch signal (speed)	[DIA]	DiA card input latch signal
	[CDILT]	Di card input latch signal (torque)	[DIB]	DiB card input latch signal
	[CTEN]	T-Link enable	[LE],[WE-LK]	Operation selection through link, Write enable command through link
	[CTDI]	DI command for transmission	[U-DI]	Universal DI
	[CREN]	RS485 enable	[LE],[WE-LK]	Operation selection through link, Write enable command through link
	RST	Alarm reset	[RST]	Alarm reset
	THR	External alarm	[THR]	External alarm
–		PLC	PLC signal power supply	
CM	Digital input common	CM	Digital input common	
Analog output	Ao1	Analog output 1	Ao1	Analog output 1
	Ao2	Analog output 2	Ao2	Analog output 2
	Ao3	Analog output 3	Ao3	Analog output 3
	[BSM1]	Speedometer (one-way deflection)	[N-FB1+]	Speed detection (Speedometer, one-way deflection)
	[BSM2]	Speedometer (two-way deflection)	[N-FB1±]	Speed detection (Speedometer, two-way deflection)
	[BSR0]	Speed setting 0	[N-REF2]	Speed setting2 (before ACC/DEC calculation)
	[BSR1]	Speed setting 1	[N-REF4]	Speed setting4 (ASR input)
	[BSR2]	Speed setting 2	[N-REF4]	Speed setting4 (ASR input)
	[BSR]	Speed setting	[N-REF4]	Speed setting4 (ASR input)
	[BSFB]	Speed feedback	[N-FB2±]	Speed detection (ASR input)
	[BTC1]	Torque ammeter (two-way deflection)	[IT-REF±]	Torque current command (torque ammeter, two-way deflection)
	[BTC2]	Torque ammeter (one-way deflection)	[IT-REF+]	Torque current command (torque ammeter, one-way deflection)
	[BTM1]	Torque meter (two-way deflection)	[T-REF±]	Torque command (torque meter, two-way deflection)
	[BTM2]	Torque meter (one-way deflection)	[T-REF+]	Torque command (torque meter, one-way deflection)
	[BTR]	Torque command output	[T-REF±]	Torque command (torque meter, two-way deflection)
	[BMC]	Effective detected value of motor current	[I-AC]	Motor current
	[BMV]	Effective detected value of motor voltage	[V-AC]	Motor voltage
	[BMTMP]	Motor temperature detected value	[TMP-M]	Motor temperature
	[BVDC]	Main circuit DC voltage	[V-DC]	DC link circuit voltage
	M	Analog output common	M	Analog output common
Transistor output	Y1	Digital output 1	Y1	Digital output 1
	Y2	Digital output 2	Y2	Digital output 2
	Y3	Digital output 3	Y3	Digital output 3
	–		Y4	Digital output 4
	[DVDC]	Establishment of main circuit DC voltage	[RDY]	Ready for operation
	[DRUN]	Running	[RUN]	Running
	[DACC]	Accelerating	[U-ACC]	Accelerating
	[DDEC]	Decelerating	[U-DEC]	Decelerating
	[DNZS]	Speed existence	[N-EX]	Speed existence
	[DSAR]	Arrival at the preset speed	[N-AR]	Arrival at the preset speed
	[DSAG]	Speed agreement	[N-AG]	Speed agreement
	[DSD1]	Speed detection	[N-DT1]	Speed detection 1
	[DSD2]	Speed detection	[N-DT2]	Speed detection 2
	[DSD3]	Speed detection	[N-DT3]	Speed detection 3
	[DTLM]	Torque limiting	[TL]	Torque limiting
	[DTD]	Torque detection	[T-DT1]	Torque detection
	[DOL]	Inverter overload early warning	[INV-OL]	Inverter overload early warning
[DMOH]	Motor temperature overheat early warning	[M-OH]	Motor temperature overheat early warning	

# 14. Replacement Data

Category	FRENIC5000 VG5S		FRENIC5000 VG7S	
	Terminal symbol	Terminal name	Terminal symbol	Terminal name
Transistor output	[DMOL]	Motor overload early warning	[M-OL]	Motor overload early warning
	[DBRS]	Brake release signal	[BRK]	Brake release signal
	[DBRK]	Braking	[B/D]	Torque polarity detection
	[DTDO]	DO for transmission	[U-DO]	Universal DO
	[DTER]	Transmission error	[LK-ERR]	Transmission error
	[DSYN]	Synchronizing	[SY-C]	Synchronization control completion
	CME	Digital output common	CME	Digital output common
Relay output	RYA,RYC	Relay output	Y5A,Y5C	Relay output
	30A,30B,30C	Alarm output for any fault	30A,30B,30C	Alarm output for any fault
Communication	DXA,DXB	RS-485 communication input/output	RX(+),RX(-), TX(+),TX(-),SD	RS-485 communication input/output (dedicated connector)
Speed detection	PA,PB	Pulse generator 2-phase signal input	PA,PB	Pulse generator 2-phase signal input
	PGP,PGM	Pulse generator power supply	PGP,PGM	Pulse generator power supply
	FA,FB	Pulse generator output	FA,FB	Pulse generator output
	CM	Common to pulse generator output	CM	Common to pulse generator output
Temperature detection	TH1	Connects a motor thermistor	TH1	Connects a motor thermistor (Motor temperature can be detected with NTC,PTC thermistors)
	THC	Common to motor thermistor	THC	Common to motor thermistor
Option power supply	P24	Power supply to option (+24V)	-	Please utilize the power supply on the market.
	M24	Common terminal to +24V	-	
	P15	Power supply for option (+15V)	-	
	(M)	Common terminal to ±15V	-	
	N15	Power supply to option (-15V)	-	

## 14.4.2 Replacing VG3

Category	FRENIC5000 VG3		FRENIC5000 VG7S	
	Terminal symbol	Terminal name	Terminal symbol	Terminal name
Main circuit	R,S,T	Power input	L1/R,L2/S,L3/T	Power input
	U,V,W	Inverter output	U,V,W	Inverter output
	P,DB	Connects a braking resistor	P(+),DB	Connects a braking resistor
	P,N	Connects a braking unit	P(+),N(-)	Connects a braking unit
	P,P1	Connects a DC REACTOR	P(+),P1	Connects a DC REACTOR
	P,N1	Connects a backup capacitor	P(+),N(-)	Connects a backup condenser
	E(G)	To ground the inverter	G	To ground the inverter
	R0,T0	Auxiliary control power supply	R0,T0	Auxiliary control power supply
Analog input	11	Common to analog input	11	Common to analog input
	13	Power supply for potentiometer	13	Power supply for potentiometer
	12	Speed setting voltage input	12	Speed setting voltage input
	M	Common to analog input	M	Common to analog input
	Ai1	Analog input 1	Ai1	Analog input 1
	Ai2	Analog input 2	Ai2	Analog input 2
	[AV2]	Auxiliary speed setting 2	[AUX-N1]	Auxiliary speed setting 1
	[AV3]	Auxiliary speed setting 3	[AUX-N2]	Auxiliary speed setting 2
	[ATL1]	Torque limiter value 1 / Torque bias command value 1	[TL-REF1]	Torque limiter (level 1)
	[ATL2]	Torque limiter value 2 / Torque bias command value 2	[TL-REF2]	Torque limiter (level 2)
	[ATL3]	Torque limiter value 3 / Torque bias command value 3	-	-
	[ATL4]	Torque limiter value 4	-	-
	[ATIN]	Torque command input	[T-REF]	Torque command (before limit)
	[ATR]	Torque command	[T-REF]	Torque command (before limit)
	[AFAI]	Magnetic-flux command input	[MF-REF]	Magnetic-flux command
	[ANFI]	Speed feedback input	[LINE-N]	Speed override
	[ANJF]	Creep setting value in UP/DOWN setter	[CRP-N1]	Creep speed 1
			[CRP-N2]	Creep speed 2
	[ATM]	Motor temperature input	[M-TMP]	Motor temperature
	V1	Voltage input for auxiliary speed setting	[AUX-N1]	Auxiliary speed setting 1
Digital input	CM	Digital input common	CM	Digital input common
	FWD	Forward operation · stop command	FWD	Forward operation · stop command
	REV	Reverse operation · stop command	REV	Reverse operation · stop command
	X1	Digital input 1	X1	Digital input 1
	X2	Digital input 2	X2	Digital input 2
	X3	Digital input 3	X3	Digital input 3
	X4	Digital input 4	X4	Digital input 4
	X5	Digital input 5	X5	Digital input 5
			X6	Digital input 6
			X7	Digital input 7
			X8	Digital input 8
			X9	Digital input 9
	[CNR1]	Multistep speed setting selection 1	[SS1]	Multistep speed setting selection 1
	[CNR2]	Multistep speed setting selection 2	[SS2]	Multistep speed setting selection 2
	[CNR4]	Multistep speed setting selection 4	[SS4]	Multistep speed setting selection 4
	[CUP]	ACC command in UP/DOWN setter	[UP]	UP command in UP/DOWN setting
	[CDWN]	DEC command in UP/DOWN setter	[DOWN]	DOWN command in UP/DOWN setting
	[CCLR]	Clear command in UP/DOWN setter	[CLR]	ACC/DEC zero clear command
	[CBSS]	Soft start · stop bypass	[BPS]	Bypass
	[CRT]	Soft start · stop time switch	[RT1]	ASR,ACC/DEC selection
	[CNL]	Reverse rotation lock command	H08	Reverse rotation lock
	[CPI]	ASR PI switch	[RT1][RT2]	ASR,ACC/DEC selection
	[CPP1]	ASR P/PI switch	[RT1][RT2]	ASR,ACC/DEC selection
	[CSTC]	Speed control/Torque control switch	[H41-CCL]	H41 [Torque command] cancel
	[CDRP]	Droop function	[DROOP]	Droop selection
	[CTL]	Torque limiter	[F40-CCL]	F40 (Torque limiter mode) cancel
	[CTB1]	Torque bias command 1	[TB1]	Torque bias command 1
[CTB2]	Torque bias command 2	[TB2]	Torque bias command 2	

# 14. Replacement Data

Category	FRENIC5000 VG3		FRENIC5000 VG7S	
	Terminal symbol	Terminal name	Terminal symbol	Terminal name
	[CPOS]	Simplified position control command	—	—
	RST	Alarm reset	[RST]	Alarm reset
	THR	External alarm	[THR]	External alarm
	EXT	Pre-exciting command	[EXITE]	Pre-exciting command
Analog output	—		PLC	PLC signal power supply
	Ao	Analog output	Ao1	Analog output 1
			Ao2	Analog output 2
			Ao3	Analog output 3
	[BNF0]	Speed feedback output 0	[N-FB1+]	Speedometer one-way deflection
	[BNR0]	Speed setting 0	[N-REF2]	Speed setting 2
	[BNR1]	Speed setting 1	[N-REF4]	Speed setting 4
	[BNR2]	Speed setting 2	[N-REF4]	Speed setting 4
	[BT0]	Torque command output 0	[T-REF±]	Torque meter two-way deflection
	[BT1]	Torque command output 1	[T-REF±]	Torque meter two-way deflection
	[BIT]	Torque current command	[IT-REF±]	Torque ammeter two-way deflection
	[BNR]	Speed setting	[N-REF4]	Speed setting 4
	[BNA]	Speed feedback	[N-FB2±]	Speed detection
	[BNAB]	Speed feedback absolute value	[N-FB1+]	Speedometer one-way deflection
	[BTAB]	Torque command output absolute value	[T-REF+]	Torque meter one-way deflection
	[BITAB]	Torque current command output absolute value	[IT-REF+]	Torque ammeter one-way deflection
	[BIM]	Motor current detected value	[I-AC]	Motor current
	LM	For load meter	[IT-REF±]	Torque current command (torque ammeter two-way deflection)
			[IT-REF+]	Torque current command (torque ammeter one-way deflection)
			[T-REF±]	Torque command (torque meter two-way deflection)
[T-REF+]			Torque command (torque meter one-way deflection)	
SM	For speedometer	[N-FB1+]	Speed detection (speedometer one-way deflection)	
		[N-FB1±]	Speed detection (speedometer two-way deflection)	
M	Common to analog output	M	Common to analog output	
Transistor output	Y1	Digital output 1	Y1	Digital output 1
	Y2	Digital output 2	Y2	Digital output 2
	Y3	Digital output 3	Y3	Digital output 3
	—		Y4	Digital output 4
	[DUV]	Establishment of link voltage (undervoltage)	[RDY]	Ready for operation
	[DZS]	Speed existence (zero speed)	[N-EX]	Speed existence
	[DSAR]	Arrival at the preset speed	[N-AR]	Arrival at the preset speed
	[DSAG]	Speed agreement	[N-AG]	Speed agreement
	[DSDA]	Arbitrary speed (absolute value)	[N-DT1]	Speed detection 1
	[DSDP]	Arbitrary speed (with polarity)	[N-DT2]	Speed detection 2
	[DTLM]	Torque limiting	[TL]	Torque limiting
	[DTD1]	Torque detection	[T-DT1]	Torque detection 1
	[DAX]	Inverter running	[RUN]	Inverter running
	[DACC]	Accelerating	[U-ACC]	Accelerating
	[DDEC]	Decelerating	[U-DEC]	Decelerating
	[DOL]	Inverter overload early warning	[INV-OL]	Inverter overload early warning
	[DOLM]	Motor temperature overheat early warning	[M-OH]	Motor temperature overheat early warning
	[DTY4]	Transmission data Y4	[U-DO]	Universal DO
	[DTY5]	Transmission data Y5		
[DTFT]	Transmission data error	[LK-ERR]	Transmission error	
CME	Digital output common	CME	Digital output common	
Relay output	RYA,RYC	Relay output	Y5A,Y5C	Relay output
	30A,30B,30C	Alarm output for any fault	30A,30B,30C	Alarm output for any fault
Relay output	RYA,RYC	Relay output	Y5A,Y5C	Relay output
	30A,30B,30C	Alarm output for any fault	30A,30B,30C	Alarm output for any fault
Speed detection	PA,PB	Pulse generator 2-phase signal input	PA,PB	Pulse generator 2-phase signal input
	PGP,PGM	Pulse generator power supply	PGP,PGM	Pulse generator power supply
Temperature detection	THT	Connects motor thermistor	TH1	Connects motor thermistor (Motor temperature can be detected with the NTC and the PTC thermistors).
	THC	Common to motor thermistor	THC	Common to motor thermistor

Category	FRENIC5000 VG3		FRENIC5000 VG7S	
	Terminal symbol	Terminal name	Terminal symbol	Terminal name
Option power supply	P24	Power supply for option (+24V)	-	Please utilize the power supply on the market.
	M24	For +24V common	-	
	P15	Power supply for option (+15V)	-	
	(M)	For ±15V common	-	
	N15	Power supply for option (-15V)	-	



# 14. Replacement Data

## 14.4.3 Replacing VG

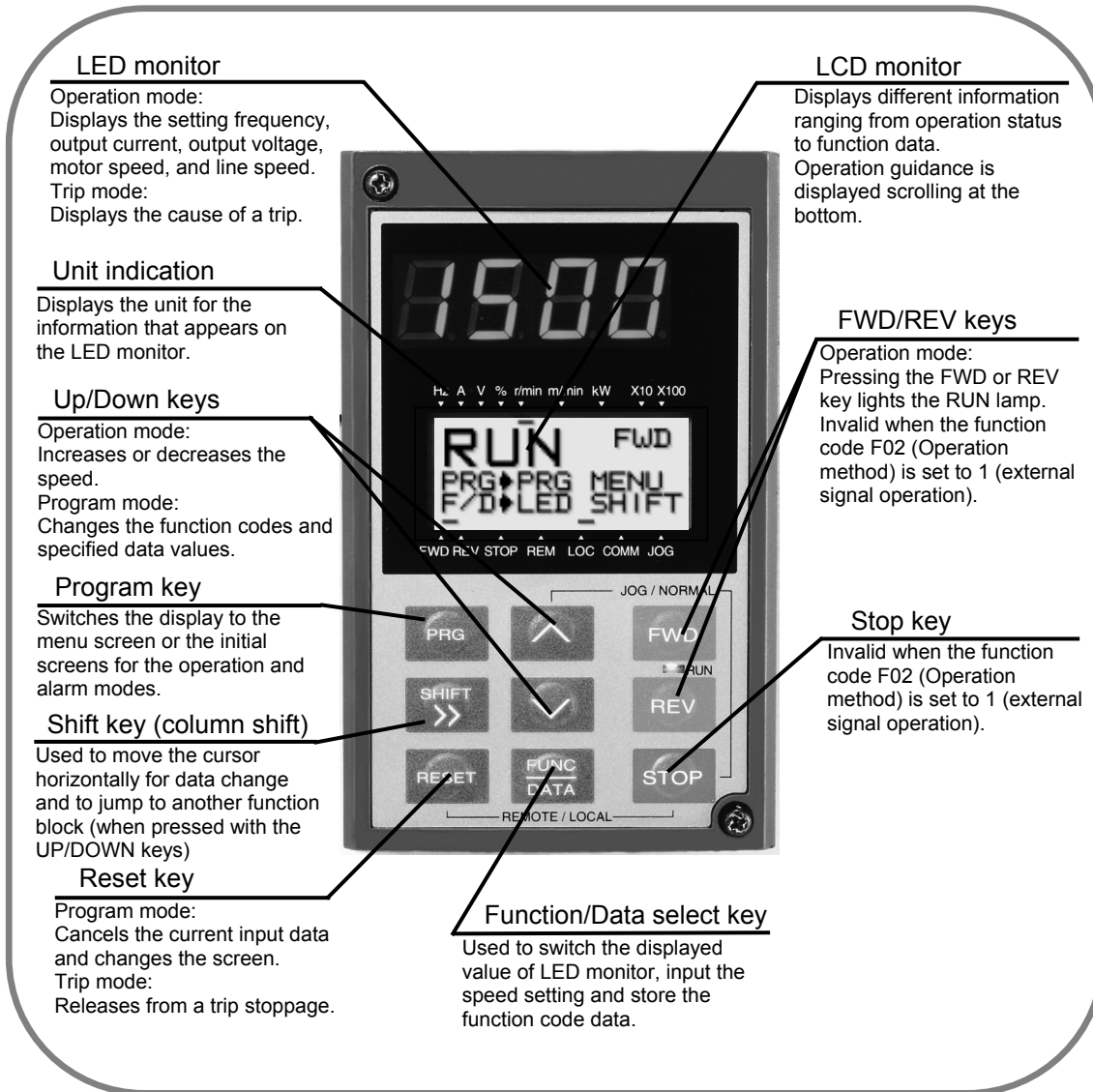
Category	FRENIC5000 VG		FRENIC5000 VG7S	
	Terminal symbol	Terminal name	Terminal symbol	Terminal name
Main circuit	R,S,T	Power input	L1/R,L2/S,L3/T	Power input
	U,V,W	Inverter output	U,V,W	Inverter output
	DC1,DC2	Connects a DC REACTOR	P1,P(+)	Connects a DC REACTOR
	DB1,DB2	Connects a braking unit	P(+),N(-)	Connects a braking unit
	DB1,DB2	Connects a braking resistor	P(+),DB	Connects a braking resistor
	E	To ground the inverter	G	To ground the inverter
	DBR1,DBR2	Connects a braking resistor thermal sensor.	[THR]	External fault
	R0,S0,T0	Auxiliary control power supply	R0,T0	Auxiliary control power supply
Analog input	13	Power supply for potentiometer	13	Power supply for potentiometer
	12	Voltage input for speed setting	12	Voltage input for speed setting
	11	Analog input common	11	Analog input common
	V1	Auxiliary speed setting input	[AUX-N1]	Auxiliary speed setting input 1
	M	Analog input common	M	Analog input common
Digital input	FWD	Forward operation · stop command	FWD	Forward operation · stop command
	REV	Reverse operation · stop command	REV	Reverse operation · stop command
	BX	Inverter cut-off command	[BX]	Coast-to stop command
	ILS	DEC stop command of torque limiter	[STOP3]	STOP3 (Torque limiter stop)
	ITL	External torque limiter command	[F40-CCL]	Torque limiter (mode 1) cancel
	RST	Reset command of external fault	[RST]	Alarm reset
	EXT	Pre-exciting command	[EXITE]	Pre-exciting command
	CM	Digital input common	CM	Digital input common
Analog output	SM+,SM-	Speedometer signal	[N-FB1+]	Speedometer (one-way deflection)
	SP	Speed signal with polarity	[N-FB1±]	Speedometer (two-way deflection)
	LM+,LM-	Torque ammeter signal	[IT-REF±]	Torque ammeter (two-way deflection)
	DM+,DM-	Speedometer (digital) signal	FA,FB	Pulse generator output
	M	Analog output common	M	Analog output common
Relay output	SST1,SST2	Speed existence signal	[N-EX]	Speed existence* <sup>1)</sup>
	SAR1,SAR2	Signal for arrival at the preset speed.	[N-AR]	Arrival at the preset speed* <sup>1)</sup>
	UV1,UV2	Link voltage existence signal	[RDY]	Ready for operation* <sup>1)</sup>
	30A,30B,30C	Alarm output for any fault	30A,30B,30C	Alarm output for any fault
Speed detection	A+,B+	Pulse generator 2-phase signal input	PA,PB	Pulse generator 2-phase signal input
	PGP,PGM	Pulse generator power supply	PGP,PGM	Pulse generator power supply
Temperature detection	TH1, TH2	Connects the standard motor thermistor Connects the spare motor thermistor	TH1	Connects the motor thermistor (Motor temperature can be detected with the NTC and the PTC thermistors).
	THRC, PGS	Common to motor thermistor Shield terminal for motor thermistor	THC	Common to motor thermistor
Option power supply	P24	Power supply for option (+24V)	-	Please utilize the power supply on the market.
	M24	For +24V common	-	
	P15	Power supply for option (+15V)	-	
	(M)	For ±15V common	-	
	N15	Power supply for option (-15V)	-	

\*1) VG7 has only one terminal for relay output, and the remaining are for transistor output.

Therefore, when replacing the relay output signal of VG, take some measures such as sending the signals to the external relays.

## 14.5 KEYPAD Panel

### ● Appearance



# 14. Replacement Data

## ● Difference of operationability of the KEYPAD panel

Item	FRENIC5000 VG5S		FRENIC5000 VG7S	
LED Monitor	<ul style="list-style-type: none"> <li>Displays the set speed and the actual speed.</li> <li>Displays the inverter's operation status.</li> <li>Alarm display.</li> </ul>		<ul style="list-style-type: none"> <li>Displays the set speed and the actual speed.</li> <li>Displays the inverter's operation status.</li> <li>Alarm display.</li> </ul>	
LCD Monitor	<ul style="list-style-type: none"> <li>Displays the function codes and their abbreviations.</li> <li>Displays the function data and the setting range.</li> <li>Alarm display.</li> <li>Displays the operation status (selection) in a graph.</li> <li>Displays the operation guidance.</li> <li>Function code display scrolls.</li> <li>The shift of the digit is possible when the function data is changed.</li> <li>Displays the list of the changed function codes.</li> <li>Displays the current value and the changed value.</li> </ul>		<ul style="list-style-type: none"> <li>Displays the function codes and their abbreviations.</li> <li>Displays the function data and the setting range.</li> <li>Alarm display.</li> <li>Displays the operation status (selection) in a graph.</li> <li>Displays the operation guidance.</li> <li>Function code display scrolls.</li> <li>The shift of the digit is possible when the function data is changed.</li> <li>Displays the list of the changed function codes.</li> <li>Displays the current value and the changed value.</li> </ul>	
	Screen size : 13chr. x 4lines		Screen size : 13chr. x 5lines (One line is for the indicator display).	
Touch Keys	RUN	Command key to operate the inverter.	FWD,REV	Command key to operate the inverter.
	STOP	Command key to stop the inverter.	STOP	Command key to stop the inverter.
	∧	<ul style="list-style-type: none"> <li>Increases/Decreases the setting value of the speed.</li> <li>Up/Down the cursor (screen scrolls).</li> <li>Increases/Decreases the setting value of the function.</li> </ul>	∧	<ul style="list-style-type: none"> <li>Increases/Decreases the setting value of the speed.</li> <li>Up/Down the cursor (screen scrolls).</li> <li>Increases/Decreases the setting value of the function.</li> </ul>
	∨		∨	
	PRG	Switches the operation mode and program mode.	PRG	Switches the operation mode and program mode.
	>>	Switches the unit indication. Digit shift in case of the function data change.	SHIFT >>	Switches the unit indication. Digit shift in case of the function data change.
	FUNC DATA	Reads and writes the function data.	FUNC DATA	Reads and writes the function data.
	RESET	Reset of the alarm state.	RESET	Reset of the alarm state.
Operation Mode	Displays the switching between the KEYPAD panel and external signal operation.		Displays the switching between the KEYPAD panel and external signal operation. REM/LOC/COMM/JOG,etc. displays the mode.	
Unit Indication	r/min,Hz,A,V,%		r/min,Hz,A,V,kW,%	
Function Code	<ul style="list-style-type: none"> <li>Fundamental function and 7 function block</li> <li>The number of function codes : 165</li> </ul>		<ul style="list-style-type: none"> <li>Fundamental function and 10 function block</li> <li>The number of function codes : 539</li> </ul>	
Language	Japanese/English		Japanese/English/German/French/Italian/Spanish/Chinese/Korean	
LCD brightness	Electrical volume (to be adjusted through the function code)		Electrical volume (to be adjusted through the function code)	
Mode Switch	-		<ul style="list-style-type: none"> <li>Switches remote and local.</li> <li>Switches JOG mode.</li> </ul>	

## 14.6 Function Codes

### 14.6.1 Replacing VG5

FRENIC5000 VG5S		FRENIC5000 VG7S	
Function codes	Name	Function codes	Name
01	Speed setting	F01	Speed setting N1
02	Operation method	F02	Operation method
03	Max. speed	F03	M1 max. speed
04	Acceleration time 1	F07	Acceleration time 1
05	Deceleration time 1	F08	Deceleration time 1
06	S-curve acceleration/deceleration 1	F67 to F70	S-curve acceleration/deceleration 1
07	Multistep speed 1	C05	Multistep speed 1
08	Multistep speed 2	C06	Multistep speed 2
09	Multistep speed 3	C07	Multistep speed 3
10	Multistep speed 4	C08	Multistep speed 4
11	Multistep speed 5	C09	Multistep speed 5
12	Multistep speed 6 / Creep speed 1	C10/C18	Multistep speed 6 / Creep speed 1
13	Multistep speed 7 / Creep speed 2	C11/C19	Multistep speed 7 / Creep speed 2
14	ASR1 (P gain)	F61	ASR1-P(Gain)
15	(I gain)	F62	ASR1-I (Constant of integration)
16	Constant on filtering (Speed setting)	F64	ASR1 input filter
17	(Speed detection)	F65	ASR1 detection filter
18	Torque limiter (Method selection)	F40,41	Torque limiter mode
19	(Limiter value selection)	F42,43	Torque limiter value selection
20	Torque limiter (Level 1)	F44	Torque limiter (Level 1)
21	(Level 2)	F45	(Level 2)
22	Motor electronic thermal (Select)	F10	M1 motor electronic thermal (Select)
23	(Level)	F11	(Level)
24	Restart after momentary power failure	F14	Restart after momentary power failure (Operation selection)
25	DC brake (Time)	F22	DC brake (Braking time)
26	(Level)	F21	(Operation level)
27	Pre-excitation (Time)	F74	Pre-excitation time
30	Function block (31-44) selection	-	
31	Droop control	H28	Droop control
32	Filtering time constant (ASR output)	F66	ASR1 output filter
33	Acceleration time 2	C46	Acceleration time 2
34	Deceleration time 2	C47	Deceleration time 2
35	S-curve acceleration/deceleration 2	C49,C50	S-curve acceleration/deceleration 2
36	Ratio setting	F17	Gain (Speed setting signal 12)
37	ASR2 (P gain)	C40	ASR2-P (Gain)
38	(I gain)	C41	ASR2-I (Constant of integration)
39	ASR1,2 switching characteristic	C70	ASR switching time
40	Torque bias (Level1)	F47	Torque bias T1
41	(Level2)	F48	Torque bias T2
42	Selection between torque control and torque current control	H41,H42	Torque command and torque current command selection
43	Magnetic-flux command (Select)	H43	Magnetic-flux command selection
44	Magnetic-flux command at light load	F73	Magnetic-flux level at light load
50	Function block (51-55) selection	-	
51	ASR tuning (Action selection)	H46	Observer type selection
52	(Operation selection)	H01	Tuning operation selection
53	Observer data (Compensation gain)	H47,H48	Observer settings (Compensation gain)
54	(Integration time)	H49,H50	(Integration time)
55	(Load inertia)	H51,H52	(Load inertia)
60	Function block (61-74) selection	-	
61	Motor overheat protection (temp.)	E30	Motor overheat protection (temp.)
62	Motor overheat early warning (temp.)	E31	Motor overheat early warning (temp.)
63	Inverter overload early warning (Level)	E33	Inverter overload early warning
64	Motor overload early warning (Level)	E34	Motor overload early warning
65	Zero speed detection (Level)	F37	Stop speed

# 14. Replacement Data

FRENIC5000 VG5S		FRENIC5000 VG7S	
Function codes	Name	Function codes	Name
66	Speed detection (Level 1)	E39	Speed detection level 1
67	(Level 2)	E40	Speed detection level 2
68	(Level 3)	E41	Speed detection level 3
69	Speed detection method	E38	Speed detection method
70	Speed equivalence (Detection range)	E42	Speed equivalence (Detection range)
71	Speed agreement (Detection range)	E43	Speed agreement (Detection range)
72	(Off delay timer)	E44	(Off delay timer)
73	Torque detection (Level)	E46	Torque detection level 1
74	Timer for continuous operation	F39	Stop speed (Zero speed holding time)
80	Function block (81-101) selection	-	
81	Auto-restart (Times)	H04	Auto-restart (Times)
82	(Interval)	H05	(Interval)
83	Speed bias setting	F18	Bias (Speed setting signal 12)
84	Speed limiter (Method selection)	F76	Speed limiter (Method selection)
85	Speed limiter (Level 1)	F77	Speed limiter level 1
86	(Level 2)	F78	Speed limiter level 2
87	Creep selection (Setting selection)	C73	Creep speed switching (on UP/DOWN control)
88	Operation method changeover switch	-	Function selection Di [IVS]
89	Speed feedback (Signal selection)	H53	Line speed feedback selection
90	Suppressing function	H57	Overvoltage suppressing function
91	Operation method selection	H11	Automatic operation OFF function
92	Torque command monitor	F51	Torque command monitor (Polarity selection)
93	Language	F58	LCD monitor (Language selection)
94	LCD brightness adjustment	F59	LCD monitor (Contrast adjustment)
95	LED monitor selection	F55	LED monitor (Display selection)
96	Display of load speed (Coefficient 1)	F52	LED monitor (Display coefficient A)
97	(Coefficient 2)	F53	LED monitor (Display coefficient B)
98	LCD monitor selection	F57	LCD monitor (Display selection)
99	Motor sound selection	F26	Motor sound (Carrier freq.)
100	Data initialization	H03	Data initialization
101	All save	H02	All save
110	Function block (111-134) selection	-	
111	(X1,X2)	E01,E02	Selection of X1 function, Selection of X2 function
112	Selection of X1 to X5 functions (X3,X4)	E03,E04	Selection of X3 function, Selection of X4 function
113	(X5)	E05	X5 function selection
114	Timer for multistep speed reference agreement	C20	Timer for multistep speed reference agreement
115	Y1 to Y3,RY function selection (Y1,Y2)	E15,E16	Y1 function selection,Y2 function selection
116	(Y3,RY)	E17,E19	Y3 function selection,Y5 function selection
117	Ai1,Ai2 function selection	E49,E50	Ai1 function selection, Ai2 function selection
118	Increment/decrement limiter (Ai1)	E65	Increment/decrement limiter (Ai1)
119	(Ai2)	E66	Increment/decrement limiter (Ai2)
120	Offset setting (12)	F18	Bias (Speed setting signal 12)
121	(Ai1)	E57	Ai1 bias setting
122	(Ai2)	E58	Ai2 bias setting
123	Gain setting (12)	F17	Gain (Speed setting signal 12)
124	(Ai1)	E53	Ai1 gain setting
125	(Ai2)	E54	Ai2 gain setting
126	AO1 to AO3 function selection	E69 to E71	AO1 function selection, AO2 function selection, AO3 function selection
127	Bias adjustment (AO1)	E79	AO1 bias setting
128	(AO2)	E80	AO2 bias setting
129	(AO3)	E81	AO3 bias setting
130	Gain adjustment (AO1)	E74	AO1 gain setting
131	(AO2)	E75	AO2 gain setting
132	(AO3)	E76	AO3 gain setting
133	Filter selection (AO1,AO2,AO3)	E84	AO1-5 filter setting
140	Function block (140-169) selection	-	
141	Operation command selection	H30	Serial link
142	Control input through transmission	S06	Operation method 1 (through communication)

FRENIC5000 VG5S			FRENIC5000 VG7S		
Function codes	Name		Function codes	Name	
143	Speed command through transmission		S01	Speed command	
144	Action on T-Link error (Mode)		o30	T-Link option setting	(Action on transmission error)
145	(Action time)				
146	Standard built-in RS-485 address		H31	RS-485 (Station address)	
147	Action on RS-485 error (Mode)		H32	Action on RS-485 error Operation	(Mode select on error)
148	(Action time)		H33		
149	(No response error detection time)		H38		
150	(Response interval)		H39		
151	X11 to X14 function selection	(X11,X12)	E10,E11	X11 function selection, X12 function selection	
152		(X13,X14)	E12,E13	X13 function selection, X14 function selection	
153	Y11 to Y13 function selection	(Y11,Y12)	E20,E21	Y11 function selection, Y12 function selection	
154		(Y13)	E22	Y13 function selection	
155	Function selection of OPCII-VG5-DI		o01,o02	DIA function selection, DIB function selection	
156	BCD input speed		o03,o04	DIA BCD input setting, DIB BCD input setting	
157	Command pulse correction 1		o14	Command pulse correction 1	
158	Command pulse correction 2		o15	Command pulse correction 2	
159	APR gain		o16	APR gain	
160	F/F gain		o17	F/F gain	
161	Deviation excess range		o18	Deviation excess range	
162	Deviation zero range		o19	Deviation zero range	
170	Function block (171-197) selection		-		
171	Motor selection		P02	M1 motor selection	
172	PG pulse number		P28	M1-PG pulse number	
173	NTC thermistor selection		P30	M1 thermistor selection	
174	Motor ratings	(Capacity)	P03	M1 rated capacity	
175		(Voltage)	F05	M1 rated voltage	
176		(Current)	P04	M1 rated current	
177		(Base speed)	F04	M1 rated speed	
178		(No. of pole)	P05	M1 number of pole	
179	Overload capability		-		
180	Auto-tuning of motor characteristic		-		
181	(Protection)		H01	Tuning operation selection	
182	Motor characteristic	(%R1)	P06	M1-%R1	
183		(%X)	P07	M1-%X	
184		(Exciting current)	P08	M1 exciting current	
185		(Torque current)	P09	M1 torque current	
186		(Slip on driving)	P10	M1 slip on driving	
187		(Slip on braking)	P11	M1 slip on braking	
188		(Iron loss coefficient 1)	P12	M1 iron loss coefficient 1	
189		(Iron loss coefficient 2)	P13	M1 iron loss coefficient 2	
190		(Iron loss coefficient 3)	P14	M1 iron loss coefficient 3	
191		(Magnetic saturation coefficient 1)	P15	M1 magnetic saturation coefficient 1	
192		(Magnetic saturation coefficient 2)	P16	M1 magnetic saturation coefficient 2	
193		(Magnetic saturation coefficient 3)	P17	M1 magnetic saturation coefficient 3	
194		(Magnetic saturation coefficient 4)	P18	M1 magnetic saturation coefficient 4	
195		(Magnetic saturation coefficient 5)	P19	M1 magnetic saturation coefficient 5	
196		(Magnetic saturation coefficient 4)	P20	M1 secondary time constant	
197		(Magnetic saturation coefficient 5)	P21	M1 induced voltage coefficient	
		(Secondary time constant)			
		(Induced voltage coefficient)			
200	Data protection		F00	Data protection	

# 14. Replacement Data

## 14.6.2 Replacing VG3

FRENIC5000 VG3		FRENIC5000 VG7S	
Function codes	Name	Function codes	Name
01	Motor rotating speed detection value display	–	LED monitor
02	Motor rotating speed setting value display	–	LED monitor
03	Load speed detection value display	–	LED monitor
04	Torque current reference value display	–	LED monitor
05	Torque reference value display	–	LED monitor
06	Motor output display	–	LED monitor
07	Inverter output current display	–	LED monitor
08	Motor temperature display	–	LED monitor
09	Input signal (1) display	–	LCD monitor
0A	Input signal (2) display	–	LCD monitor
0B	Output signal display	–	LCD monitor
0C	Operation mode display	–	LCD monitor
0D	Soft switch (1) display	–	LCD monitor
0E	Soft switch (2) display	–	LCD monitor
0F	Magnetic-flux quantity	–	LED monitor
10	Protection of setting data (11-3F)	–	–
11	Acceleration time 1	F07	Acceleration time 1
12	Deceleration time 1	F08	Deceleration time 1
13	S-curve applied range	F67	S-curve acceleration start side 1
		F68	S-curve acceleration end side 1
		F69	S-curve deceleration start side 1
		F70	S-curve deceleration end side 1
14	Multistep speed setting value 1	C05	Multistep speed 1
15	Multistep speed setting value 2	C06	Multistep speed 2
16	Multistep speed setting value 3	C07	Multistep speed 3
17	Multistep speed setting value 4	C08	Multistep speed 4
18	Multistep speed setting value 5	C09	Multistep speed 5
19	Acceleration time 2	C46	Acceleration time 2
1A	Deceleration time 2	C47	Deceleration time 2
1B	Speed reference input gain	F17	Gain(Speed setting signal 12)
20	ASR P(1)	F61	ASR1 P
21	ASR I(1)	F62	ASR1 I
22	Speed setting constant on filtering (1)	F64	ASR1 input filter
23	Speed detection constant on filtering (1)	F65	ASR1 detection filter
24	ASR P(2)	C40	ASR2 P
25	ASR I(2)	C41	ASR2 I
26	Speed setting constant on filtering (2)	C43	ASR2 input filter
27	Speed detection constant on filtering (2)	C44	ASR2 detection filter
28	Droop quantity	H28	Droop control
29	ASR time constant of P changeover switch	C70	ASR switching time
2A	Torque limiter value 1/Torque bias command value 1	F44	Torque limiter value (Level 1)
2B	Torque limiter value 2/Torque bias command value 2	F45	Torque limiter value (Level 2)
2C	Torque limiter value 3/Torque bias command value 3	–	–
2D	Torque limiter value 4	–	–
2E	Magnetic-flux command level	H44	Magnetic-flux command value
2F	Magnetic-flux command level at light load	F73	Magnetic-flux level at light load
30	Zero speed detection level	F37	Stop speed
31	Arbitrary speed detection level (Absolute value)	E39	Speed detection level 1
32	Arbitrary speed detection level (With polarity)	E40	Speed detection level 2
33	Speed equivalence detection level	E42	Speed equivalence
34	Speed agreement detection level	E43	Speed agreement
35	Torque detection level	E46	Torque detection level 1
36	Overload early warning detection level	E33	Inverter overload early warning
37	Motor overheat early warning detection level	E31	Motor overheat early warning
38	Output calibration coefficient of load meter	–	Adjustment is possible through E69 to 71, by allocating the torque meter into AO1 to 3.
39	Output calibration coefficient of speedometer	–	Adjustment is possible through E69 to 71, by allocating the speedometer into AO1 to 3.

FRENIC5000 VG3		FRENIC5000 VG7S	
Function codes	Name	Function codes	Name
3A	Stop position by the simplified position control	-	
40	First fault	-	LED monitor
41	Second fault	-	LED monitor
42	Fault condition	-	LCD monitor
43	Speed setting value at the occurrence of fault.	-	LCD monitor
44	Speed detection value at the occurrence of fault.	-	LCD monitor
45	Torque current reference value at the occurrence of fault.	-	LCD monitor
46	Motor current value (U-phase) at the occurrence of fault.	-	LCD monitor
47	Motor current value (W-phase) at the occurrence of fault.	-	LCD monitor
48	Operation mode (LED display) at the occurrence of fault.	-	LCD monitor
49	Operation mode (HEX display) at the occurrence of fault.	-	LCD monitor
4A	Soft switch 1 (LED display) at the occurrence of fault.	-	LCD monitor
4B	Soft switch 2 (LED display) at the occurrence of fault.	-	LCD monitor
4C	Soft switch (HEX display) at the occurrence of fault.	-	LCD monitor
4D	Last fault (First fault)	-	LCD monitor
4E	Fault before last (First fault)	-	LCD monitor
4F	Fault before and before last (First fault)	-	LCD monitor
50	Protection of setting data (51-8F)	-	
51	Max. speed of motor	F03	M1 max. speed
52	Base speed of motor	F04	M1 rated speed
53	DC brake using/not using.	F22	DC brake (Braking time)
54			
55	DC braking time	F22	DC brake (Braking time)
56			
57	Speed setting limiter value (Upper limit)	F77	Speed limiter level 1
58	Definition of the operation method (1)	-	
59	Definition of the operation method (2)	H11	Automatic operation OFF function
5A	Definition of the Speed setting method (1)	F01	Speed setting N1
5B	Definition of forward·reverse command	-	Possible through function selection DI [IVS].
5C	Calibration coefficient of load speed	F52,53	LED monitor (Display coefficient)
5D	Definition of the speed detection area	H53	Line speed feedback selection
5E	Definition of the Speed setting method (2)	C25	Speed setting N2
5F	Creep setting of U/D setter	C73	Creep speed switching
60	Definition of the torque limiter method	F40	Torque limiter mode
61	Definition of the torque limiter value 1/Torque bias reference value 1.	F42	Torque limiter value (Level1) selection
62	Definition of the torque limiter value 2/Torque bias reference value 2.	F43	Torque limiter value (Level2) selection
63	Definition of the torque limiter value 3/Torque bias reference value 3.	-	
64	Definition of the torque limiter value 4.	-	
65	In use/not in use of external Ai for the torque reference.	H41	Torque reference selection
66	Definition of the magnetic-flux reference value.	H43	Magnetic-flux command selection
70	LM terminal definition	-	Possible through function selection from AO1 to 3.
71	SM terminal definition	-	Possible through function selection from AO1 to 3.
72	DI definition (X1 to X4,X6,X7)	E01 to 04	X1 to X4 function selection
73	DI definition (X5)	E05	X5 function selection
74	DO definition (Y1 to Y5)	E15 to 18	Y1 to Y4 function selection
75	DO definition (RY)	E19	Y5 function selection
76	AI definition (Ai1)	E49	Ai1 function selection
77	AI definition (Ai2)	E50	Ai2 function selection
78	AO definition (AO1)	E69	AO1 function selection
79	AO definition (AO2,AO3)	E70,71	AO2,AO3 function selection
7A	No. of motor poles, specification for the pulse generator	P28	No. of PG pulses
7B	V1 enabled/disabled	-	Possible through function selection Ai [OFF].
80	Calibration coefficient of BCD input for speed setting	o03,04	DI BCD input setting.
81	Definition of the initial setting value of UP/DOWN settor.	F01,C25	Speed setting N1,N2
82	Enabled/disabled of transmission data	H30	Serial link
83	Transmission ID code	-	



# 14. Replacement Data

FRENIC5000 VG3		FRENIC5000 VG7S	
Function codes	Name	Function codes	Name
84			
85	AO adjustment	–	Possible through AO function selection [P10], [N10].
86	AI1 filter	E61	Ai1 filter
87	AI2 filter	E62	Ai2 filter
88	12 offset adjustment value	–	Bias (Speed setting signal 12)
89	12 gain adjustment value	F17	Gain (Speed setting signal 12)
8A	V1 offset adjustment value	–	
8B	V1 gain adjustment value	–	
8C	AI1 offset adjustment value	E57	AI1 bias setting
8D	AI1 gain adjustment value	E53	AI1 gain setting
8E	AI2 offset adjustment value	E58	AI2 bias setting
8F	AI2 gain adjustment value	E54	AI2 gain setting
90	Display of the transmitted and written DI data	S06	Operation method 1
91	Transmission speed setting mode selection	H30	Serial link
92	Transmission speed setting	S01	Speed command
93	Transmission speed setting bias	–	
94	Transmission torque command mode selection	H41	Torque command selection
95	Transmission torque command	S02	Torque command
96	General purpose DO	S07	Universal DO
97	Trace data mode	–	
98			
99			
9A	Confirmation of data saving condition	–	All save
9B	ALL SAVE function	H02	All save

# 14.7 Motor Parameters

## 14.7.1 Replacing VG5S

### ● 200V series

Motor specification			Motor parameters															
			VG5S code No.		03	177	175	174	176	178	182	183	184	185	186	187	188	
			VG7S code No.		F03	F04	F05	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Max. speed [r/min]	Rated speed [r/min]	Rated voltage [V]	Rated capacity [kW]	Rated current [A]	No. of poles	%R1 [%]	%X [A]	Pre-exciting current [A]	Torque current [A]	Slip on driving [Hz]	Slip On braking [Hz]	Iron loss co-ef*. 1 [%]
MVK6096	0.75	4	1500/3600	188	4.3	1500	1500	188	0.75	4.3	4	4.34	9.07	3.21	2.92	1.320	1.185	7.60
MVK6097	1.5	4	1500/3600	188	7.0	1500	1500	188	1.5	7.0	4	7.06	14.76	3.21	5.83	2.640	2.370	3.80
MVK6107	2.2	4	1500/3600	188	11	1500	1500	188	2.2	11	4	8.27	12.95	3.81	9.75	2.622	3.059	3.00
MVK6115	3.7	4	1500/3600	188	18	1500	1500	188	3.7	18	4	6.86	12.69	8.11	15.69	2.500	2.370	3.00
MVK6133	5.5	4	1500/3600	188	30	1500	1500	188	5.5	30	4	6.05	13.44	12.98	21.92	1.490	1.440	3.00
MVK6135	7.5	4	1500/3600	188	37	1500	1500	188	7.5	37	4	6.70	12.45	15.62	30.66	1.771	1.871	2.32
MVK6165	11	4	1500/3600	188	50	1500	1500	188	11	50	4	4.26	11.64	24.79	40.30	0.988	0.824	4.53
MVK6167	15	4	1500/3600	188	65	1500	1500	188	15	65	4	4.47	12.25	26.99	53.96	1.067	1.067	0.00
MVK6184	18.5	4	1500/3600	188	74	1500	1500	188	18.5	74	4	3.22	10.68	30.58	72.83	0.934	0.931	3.50
MVK6185	22	4	1500/3600	188	90	1500	1500	188	22	90	4	3.59	11.78	34.17	83.43	0.606	0.855	1.30
MVK6206	30	4	1500/3000	188	116	1500	1500	188	30	116	4	2.53	12.13	53.42	108.1	0.606	0.648	2.50
MVK6207	37	4	1500/3000	188	143	1500	1500	188	37	143	4	2.47	14.69	60.09	133.2	0.497	0.536	1.80
MVK6208	45	4	1500/3000	188	170	1500	1500	188	45	170	4	2.73	15.26	56.71	169.7	0.947	0.901	1.00
MVK9250	55	4	1500/2400	185	216	1500	1500	185	55	216	4	2.08	12.36	66.22	197.9	0.621	0.595	3.00
MVK9252	75	4	1500/2400	183	276	1500	1500	183	75	276	4	1.70	15.29	99.34	261.6	0.638	0.665	2.00
MVK9280	90	4	1500/2000	183	345	1500	1500	183	90	345	4	2.28	20.12	89.3	332.3	0.669	0.546	0.00

Motor specification			Motor parameters															
			VG5S code No.		189	190	191	192	193	194	195	196	197	C03	C04	-	C14	
			VG7S code No.		P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Iron loss co-ef*. 2 [%]	Iron loss co-ef*. 3 [%]	Magnetic saturation co-ef*. 1 [%]	Magnetic saturation co-ef*. 2 [%]	Magnetic saturation co-ef*. 3 [%]	Magnetic saturation co-ef*. 4 [%]	Magnetic saturation co-ef*. 5 [%]	Secondary time constant [s]	Induced voltage co-ef*. [V]	R2 correction co-ef*. 1	R2 correction co-ef*. 2	R3 correction co-ef*. 3	Pre-exciting current correction co-ef*.
MVK6096	0.75	4	1500/3600	188	4.3	7.60	10.00	93.0	85.8	72.6	60.0	47.6	0.108	149	1.360	1.480	1.000	0.000
MVK6097	1.5	4	1500/3600	188	7.0	3.80	5.00	93.0	85.8	72.6	60.0	47.6	0.108	149	1.360	1.480	1.000	0.000
MVK6107	2.2	4	1500/3600	188	11	4.00	1.00	85.2	73.7	59.1	47.6	37.4	0.051	140	2.530	1.133	1.000	0.000
MVK6115	3.7	4	1500/3600	188	18	2.95	2.50	88.4	80.1	66.4	54.1	43.0	0.084	146	0.899	1.320	1.000	0.022
MVK6133	5.5	4	1500/3600	188	30	2.50	3.00	88.3	79.5	66.0	54.1	43.0	0.090	149	1.925	1.985	1.000	0.026
MVK6135	7.5	4	1500/3600	188	37	1.76	3.00	85.3	70.7	53.8	43.7	34.4	0.070	155	0.900	0.900	1.000	0.000
MVK6165	11	4	1500/3600	188	50	1.88	0.22	84.9	75.0	61.6	50.0	39.4	0.087	175	0.900	2.343	1.000	0.000
MVK6167	15	4	1500/3600	188	65	1.50	1.00	88.7	80.7	67.2	55.2	44.0	0.133	160	1.689	1.689	1.000	0.000
MVK6184	18.5	4	1500/3600	188	74	0.50	0.50	90.7	83.2	69.5	56.8	44.4	0.240	160	1.465	1.803	1.000	0.097
MVK6185	22	4	1500/3600	188	90	0.77	2.00	91.1	83.2	69.1	56.8	44.6	0.387	160	4.000	2.200	1.000	0.089
MVK6206	30	4	1500/3000	188	116	3.50	5.00	84.4	74.0	59.5	48.9	38.0	0.173	166	2.268	2.078	1.000	0.000
MVK6207	37	4	1500/3000	188	143	3.00	5.00	85.4	75.7	62.3	50.5	39.9	0.184	168	3.200	2.560	1.000	0.180
MVK6208	45	4	1500/3000	188	170	0.00	0.15	89.2	81.6	67.6	56.2	43.4	0.295	164	1.229	1.813	1.000	0.178
MVK9250	55	4	1500/2400	185	216	0.83	0.21	91.5	83.8	70.6	57.8	45.6	0.413	168	1.615	1.753	1.000	0.000
MVK9252	75	4	1500/2400	183	276	2.00	0.00	90.4	83.0	68.4	57.4	46.4	0.409	165	1.856	1.785	1.000	0.091
MVK9280	90	4	1500/2000	183	345	5.00	0.00	91.1	85.1	70.9	59.2	48.7	0.490	181	1.331	1.428	1.000	0.000

\*co-ef.: coefficient

Note : The above table shows the setting values of VG7.

# 14. Replacement Data

## ● 400V series

Motor specification			Motor parameters																
			VG5S code No.		03	177	175	174	176	178	182	183	184	185	186	187	188	189	
			VG7S code No.		F03	F04	F05	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Max. speed [r/min]	Rated speed [r/min]	Rated voltage [V]	Rated capacity [kW]	Rated current [A]	No. of poles	%R1 [%]	%X [A]	Pre-exciting current [A]	Torque current [A]	Slip on driving [Hz]	Slip On braking [Hz]	Iron loss co-ef*. 1 [%]	Iron loss co-ef*. 2 [%]
MVK6115	3.7	4	1500/3600	376	9	1500	1500	376	3.7	9	4	6.86	13.94	3.93	7.78	2.510	2.340	2.35	2.55
MVK6133	5.5	4	1500/3600	376	15	1500	1500	376	5.5	15	4	5.50	12.78	7.15	10.74	1.311	1.370	2.00	5.00
MVK6135	7.5	4	1500/3600	376	18.5	1500	1500	376	7.5	18.5	4	4.37	13.72	7.81	15.33	1.465	1.686	7.61	2.00
MVK6165	11	4	1500/3600	376	25.0	1500	1500	376	11	25	4	4.27	11.67	12.39	20.15	0.988	0.824	4.53	1.88
MVK6167	15	4	1500/3600	376	31.7	1500	1500	376	15	31.7	4	4.48	13.69	14.47	26.63	1.290	1.269	1.00	0.50
MVK6184	18.5	4	1500/3600	376	37	1500	1500	376	18.5	37	4	2.66	12.45	14.02	36.06	0.882	0.882	1.00	3.00
MVK6185	22	4	1500/3600	376	45	1500	1500	376	22	45	4	3.61	14.06	16.81	41.72	0.903	0.891	1.50	1.50
MVK6206	30	4	1500/3000	376	58	1500	1500	376	30	58	4	2.55	12.16	25.74	52.52	0.666	0.648	2.50	3.50
MVK6207	37	4	1500/3000	376	71	1500	1500	376	37	71	4	2.49	14.11	30.07	65.54	0.497	0.498	1.79	1.80
MVK6208	45	4	1500/3000	376	85	1500	1500	376	45	85	4	2.73	15.30	28.36	84.85	0.947	0.937	0.50	1.50
MVK9250	55	4	1500/2400	376	108	1500	1500	376	55	108	4	2.05	12.20	33.11	98.98	0.621	0.595	3.00	0.83
MVK9252	75	4	1500/2400	365	138	1500	1500	365	75	138	4	1.71	15.39	49.67	130.8	0.638	0.665	2.00	2.00
MVK9280	90	4	1500/2000	370	173	1500	1500	370	90	173	4	2.23	16.47	44.37	164.1	0.685	0.647	0.00	2.00
MVK9282	110	4	1500/3000	375	206	1500	1500	375	110	206	4	2.14	16.83	53.03	195.8	0.557	0.606	0.44	0.00
MVK9310	132	4	1500/3000	375	248	1500	1500	375	132	248	4	1.56	17.21	62.05	237.3	0.481	0.531	0.00	0.39
MVK9312	160	4	1500/2400	375	297	1500	1500	375	160	297	4	1.15	17.47	70.71	286.3	0.518	0.518	0.00	0.00
MVK9316	200	4	1500/2400	375	369	1500	1500	375	200	369	4	1.15	14.98	107.7	341.5	0.470	0.441	0.00	2.50
MVK9318	220	4	1500/2000	370	409	1500	1500	370	220	409	4	1.63	14.54	98.64	385.3	0.447	0.458	1.00	1.00

Motor specification			Motor parameters																
			VG5S code No.		190	191	192	193	194	195	196	197	C03	C04	-	C14			
			VG7S code No.		P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25			
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Iron loss co-ef*. 3 [%]	Magnetic saturation co-ef*. 1 [%]	Magnetic saturation co-ef*. 2 [%]	Magnetic saturation co-ef*. 3 [%]	Magnetic saturation co-ef*. 4 [%]	Magnetic saturation co-ef*. 5 [%]	Secondary time constant [s]	Induced voltage co-ef*. [V]	R2 correction co-ef*. 1	R2 correction co-ef*. 2	R3 correction co-ef*. 3	Pre-exciting current correction co-ef*.		
MVK6115	3.7	4	1500/3600	376	9	1.20	90.5	82.4	68.7	57.0	45.3	0.104	294	0.880	1.440	1.000	0.028		
MVK6133	5.5	4	1500/3600	376	15	7.00	88.0	79.2	65.6	53.6	42.2	0.078	299	2.361	1.985	1.000	0.019		
MVK6135	7.5	4	1500/3600	376	18.5	1.00	85.9	76.9	63.4	51.6	40.5	0.064	310	1.607	1.427	1.000	0.000		
MVK6165	11	4	1500/3600	376	25.0	0.22	84.9	75.0	61.6	50.0	39.4	0.087	348	0.910	2.343	1.000	0.000		
MVK6167	15	4	1500/3600	376	31.7	1.00	88.7	81.7	67.2	55.2	44.0	0.133	306	1.090	1.318	1.000	0.027		
MVK6184	18.5	4	1500/3600	376	37	3.00	92.5	84.3	70.3	57.1	45.1	0.295	321	1.825	1.825	1.000	0.018		
MVK6185	22	4	1500/3600	376	45	3.00	91.1	83.2	69.1	56.5	44.6	0.387	320	1.357	1.673	1.000	0.037		
MVK6206	30	4	1500/3000	376	58	9.50	84.4	74.0	59.5	48.9	38.0	0.173	331	2.268	2.078	1.000	0.070		
MVK6207	37	4	1500/3000	376	71	5.00	85.4	75.7	62.3	50.5	39.9	0.184	336	3.200	3.064	1.000	0.095		
MVK6208	45	4	1500/3000	376	85	1.85	89.2	81.6	67.6	56.2	43.4	0.295	328	1.229	1.502	1.000	0.089		
MVK9250	55	4	1500/2400	376	108	0.21	91.5	83.8	70.6	57.8	45.6	0.413	336	1.615	1.753	1.000	0.000		
MVK9252	75	4	1500/2400	365	138	0.00	90.4	83.0	68.4	57.4	46.4	0.409	330	1.856	1.785	1.000	0.091		
MVK9280	90	4	1500/2000	370	173	0.00	90.7	83.7	69.0	57.1	44.9	0.590	348	1.093	1.212	1.000	0.163		
MVK9282	110	4	1500/3000	375	206	0.00	90.1	82.6	67.7	56.3	44.2	0.577	350	1.488	1.172	1.000	0.090		
MVK9310	132	4	1500/3000	375	248	0.00	90.1	81.2	67.7	56.2	45.9	0.689	336	1.468	1.424	1.000	0.000		
MVK9312	160	4	1500/2400	375	297	0.00	91.0	84.3	71.8	59.1	47.7	1.127	330	1.496	1.496	1.000	0.000		
MVK9316	200	4	1500/2400	375	369	0.00	93.8	87.6	74.8	60.6	48.2	1.026	342	1.175	1.358	1.000	0.104		
MVK9318	220	4	1500/2000	370	409	0.00	95.1	88.5	75.0	63.1	51.3	1.758	361	1.535	1.513	1.000	0.078		

\*co-ef.: coefficient

Note : The above table shows the setting values of VG7.

## 14.7.2 Replacing VG3

### ● 200V series

Motor specification						Motor parameters												
			VG7S code No.			F03	F04	F05	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Max. speed [r/min]	Rated speed [r/min]	Rated voltage [V]	Rated capacity [kW]	Rated current [A]	No. of poles	%R1 [%]	%X [%]	Pre-exciting current [A]	Torque current [A]	Slip on driving [Hz]	Slip on braking [Hz]	Iron loss co-ef.* 1 [%]
MVK6096	0.75	4	1500/3600	160	4.0	1500	1500	160	0.75	5.4	4	4.62	9.16	2.65	4.55	2.360	2.560	2.30
MVK6097	1.5	4	1500/3600	160	8.0	1500	1500	160	1.5	9.8	4	8.36	16.59	2.65	9.09	4.700	5.100	2.30
MVK6107	2.2	4	1500/3600	160	12.5	1500	1500	160	2.2	12.2	4	7.82	13.73	4.15	11.00	3.340	3.600	4.80
MVK6115	3.7	4	1500/3600	160	20	1500	1500	160	3.7	19.9	4	7.06	14.40	7.25	18.60	2.540	3.440	0.00
MVK6133	5.5	4	1500/3600	160	31	1500	1500	160	5.5	30.2	4	4.88	13.44	14.93	26.10	1.680	2.200	0.00
MVK6135	7.5	4	1500/3600	160	41	1500	1500	160	7.5	41.8	4	4.96	13.75	18.90	37.30	1.960	2.000	0.00
MVK6165	11	4	1500/3600	160	58	1500	1500	160	11	54.7	4	3.80	13.99	24.00	49.10	1.320	1.500	0.00
MVK6167	15	4	1500/3600	160	74	1500	1500	160	15	70.5	4	3.17	13.21	28.20	64.60	1.320	1.520	0.00
MVK6185	18.5	4	1500/3600	160	90	1500	1500	160	18.5	89.6	4	2.63	13.94	36.80	81.70	0.820	0.940	0.00
MVK6187	22	4	1500/3600	160	106	1500	1500	160	22	104.3	4	2.49	13.21	45.70	93.80	0.780	1.000	0.00
MVK6205	30	4	1500/3000	160	142	1500	1500	160	30	140.6	4	2.59	15.06	51.20	130.9	0.800	0.940	0.00
MVK6206	37	4	1500/3000	160	177	1500	1500	160	37	164.5	4	2.46	14.03	51.10	156.3	0.720	0.940	0.00
MVK6207	45	4	1500/3000	160	203	1500	1500	160	45	195.6	4	2.50	16.36	54.40	187.9	0.960	1.100	0.00

Motor specification						Motor parameters												
			VG7S code No.			P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Iron loss co-ef.* 2 [%]	Iron loss co-ef.* 3 [%]	Magnetic saturation co-ef.* 1 [%]	Magnetic saturation co-ef.* 2 [%]	Magnetic saturation co-ef.* 3 [%]	Magnetic saturation co-ef.* 4 [%]	Magnetic saturation co-ef.* 5 [%]	Secondary time constant [s]	Induced voltage co-ef.* [V]	R2 correction co-ef.* 1	R2 correction co-ef.* 2	R3 correction co-ef.* 3	Pre-exciting current correction co-ef.*
MVK6096	0.75	4	1500/3600	160	4.0	1.90	0.10	94.1	87.8	74.9	62.7	50.2	0.152	96	1.000	1.000	1.000	0.000
MVK6097	1.5	4	1500/3600	160	8.0	1.90	0.10	94.1	87.8	74.9	62.7	50.2	0.152	96	1.000	1.000	1.000	0.000
MVK6107	2.2	4	1500/3600	160	12.5	0.00	0.10	93.7	87.1	74.1	60.8	47.8	0.096	116	1.000	1.000	1.000	0.000
MVK6115	3.7	4	1500/3600	160	20	0.00	0.10	89.4	80.4	66.7	54.5	42.7	0.172	115	1.000	1.000	1.000	0.000
MVK6133	5.5	4	1500/3600	160	31	0.00	0.00	87.1	77.6	63.5	51.8	40.8	0.200	122	1.000	1.000	1.000	0.000
MVK6135	7.5	4	1500/3600	160	41	0.00	0.00	82.8	72.3	58.6	48.0	38.3	0.220	120	1.000	1.000	1.000	0.000
MVK6165	11	4	1500/3600	160	58	0.00	0.00	77.6	79.6	65.9	53.7	43.1	0.320	130	1.000	1.000	1.000	0.000
MVK6167	15	4	1500/3600	160	74	0.00	0.00	91.0	83.1	69.0	56.9	45.1	0.336	135	1.000	1.000	1.000	0.000
MVK6185	18.5	4	1500/3600	160	90	0.00	0.00	89.4	80.0	62.7	50.2	40.0	0.364	131	1.000	1.000	1.000	0.000
MVK6187	22	4	1500/3600	160	106	0.00	0.00	89.4	81.2	67.5	50.2	43.9	0.384	136	1.000	1.000	1.000	0.000
MVK6205	30	4	1500/3000	160	142	0.00	0.00	89.8	80.4	65.9	53.7	42.4	0.568	133	1.000	1.000	1.000	0.000
MVK6206	37	4	1500/3000	160	177	0.00	0.00	90.6	80.4	65.9	54.1	43.1	0.484	137	1.000	1.000	1.000	0.000
MVK6207	45	4	1500/3000	160	203	0.00	0.00	91.4	82.7	69.0	57.3	45.5	0.732	138	1.000	1.000	1.000	0.000

\*co-ef.: coefficient

Note : The above value is the setting value of VG7.

# 14. Replacement Data

## ● 400V series

Motor specification						Motor parameters												
			VG7S code No.			F03	F04	F05	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Max. speed [r/min]	Rated speed [r/min]	Rated voltage [V]	Rated capacity [kW]	Rated current [A]	No. of poles	%R1 [%]	%X [%]	Pre-exciting current [A]	Torque current [A]	Slip on driving [Hz]	Slip on braking [Hz]	Iron loss co-ef. 1 [%]
MVK6115	3.7	4	1500/3600	320	10	1500	1500	320	3.7	10	4	7.07	14.40	3.62	9.30	2.540	3.280	0.00
MVK6133	5.5	4	1500/3600	320	15.5	1500	1500	320	5.5	15.1	4	4.89	13.44	7.50	13.10	1.680	1.880	0.00
MVK6135	7.5	4	1500/3600	320	20.5	1500	1500	320	7.5	20.3	4	4.84	13.35	9.30	18.00	1.960	2.000	0.00
MVK6165	11	4	1500/3600	320	29	1500	1500	320	11	27.4	4	3.79	14.03	12.00	24.60	1.320	1.420	0.00
MVK6167	15	4	1500/3600	320	37	1500	1500	320	15	35.3	4	3.17	13.24	14.10	32.30	1.200	1.400	0.00
MVK6185	18.5	4	1500/3600	320	45	1500	1500	320	18.5	44.5	4	2.60	13.86	18.10	39.00	0.940	0.960	1.10
MVK6187	22	4	1500/3600	320	53	1500	1500	320	22	53.2	4	2.52	13.46	19.90	47.60	0.960	1.000	2.20
MVK6205	30	4	1500/3000	320	71	1500	1500	320	30	70.3	4	2.57	15.08	25.60	65.50	0.800	0.940	0.00
MVK6206	37	4	1500/3000	320	89	1500	1500	320	37	78.4	4	2.35	13.38	25.20	74.30	0.740	0.860	0.00
MVK6207	45	4	1500/3000	320	102	1500	1500	320	45	97.8	4	2.49	16.38	27.20	94.00	0.840	1.100	0.00
MVK5256	75	4	1500/2400	320	170	1500	1500	320	75	170	4	1.73	14.88	47.38	162.8	0.840	0.960	0.00

Motor specification						Motor parameters													
			VG7S code No.			P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Iron loss co-ef. 2 [%]	Iron loss co-ef. 3 [%]	Magnetic saturation co-ef. 1 [%]	Magnetic saturation co-ef. 2 [%]	Magnetic saturation co-ef. 3 [%]	Magnetic saturation co-ef. 4 [%]	Magnetic saturation co-ef. 5 [%]	Secondary time constant [s]	Induced voltage co-ef. [V]	R2 correction co-ef. 1	R2 correction co-ef. 2	R3 correction co-ef. 3	Pre-exciting current correction co-ef.	
MVK6115	3.7	4	1500/3600	320	10	0.00	0.00	89.4	80.4	66.7	54.5	42.7	0.172	230	1.000	1.000	1.000	0.000	
MVK6133	5.5	4	1500/3600	320	15.5	0.00	0.00	87.1	77.6	63.5	51.8	40.8	0.200	242	1.000	1.000	1.000	0.000	
MVK6135	7.5	4	1500/3600	320	20.5	0.00	0.00	86.7	76.1	60.8	49.4	38.4	0.224	241	1.000	1.000	1.000	0.000	
MVK6165	11	4	1500/3600	320	29	0.00	0.00	88.6	79.6	65.9	53.7	43.1	0.320	258	1.000	1.000	1.000	0.000	
MVK6167	15	4	1500/3600	320	37	0.00	0.00	91.0	83.1	69.0	56.9	45.1	0.336	268	1.000	1.000	1.000	0.000	
MVK6185	18.5	4	1500/3600	320	45	3.10	1.70	91.4	83.1	68.6	56.1	45.9	0.412	274	1.000	1.000	1.000	0.000	
MVK6187	22	4	1500/3600	320	53	1.60	0.70	92.9	85.1	71.4	58.8	46.7	0.412	267	1.000	1.000	1.000	0.000	
MVK6205	30	4	1500/3000	320	71	0.00	0.00	89.8	80.4	65.9	53.7	42.4	0.568	265	1.000	1.000	1.000	0.000	
MVK6206	37	4	1500/3000	320	89	0.00	0.00	90.6	80.8	67.5	52.5	40.8	0.460	288	1.000	1.000	1.000	0.000	
MVK6207	45	4	1500/3000	320	102	0.00	0.00	91.4	82.7	69.0	57.3	45.5	0.732	277	1.000	1.000	1.000	0.000	
MVK5256	75	4	1500/2400	320	170	0.00	0.00	92.6	85.2	72.3	60.5	48.4	0.576	266	1.000	1.000	1.000	0.000	

\*co-ef.: coefficient

Note : The above value is the setting value of VG7.

## 14.7.3 Replacing VG

### ● 200V series

Motor specification					Motor parameters														
					VG7S code No.		F03	F04	F05	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Max. speed [r/min]	Rated speed [r/min]	Rated voltage [V]	Rated capacity [kW]	Rated current [A]	No. of poles	%R1 [%]	%X [%]	Pre-exciting current [A]	Torque current [A]	Slip on driving [Hz]	Slip on braking [Hz]	Iron loss co-ef.* 1 [%]	
MVK3115	3.7	4	1500/3600	160	20	1500	1500	160	3.7	19.9	4	7.07	14.40	7.25	18.60	2.540	3.440	0.00	
MVK3133	5.5	4	1500/3600	160	31	1500	1500	160	5.5	30.2	4	4.89	13.44	14.93	26.10	1.680	2.200	0.00	
MVK3135	7.5	4	1500/3600	160	41	1500	1500	160	7.5	41.8	4	4.98	13.75	18.90	37.30	1.960	2.000	0.00	
MVK3165	11	4	1500/3600	160	58	1500	1500	160	11	54.7	4	3.79	13.97	24.00	49.10	1.320	1.500	0.00	
MVK3167	15	4	1500/3600	160	74	1500	1500	160	15	70.5	4	3.17	13.21	28.20	64.60	1.320	1.520	0.00	
MVK3184	18.5	4	1500/3600	160	86.3	1500	1500	160	18.5	86.3	4	2.55	13.58	31.69	80.28	0.920	1.060	0.00	
MVK5187	22	4	1500/3600	160	106	1500	1500	160	22	106	4	2.49	13.21	42.28	95.60	0.960	0.960	0.00	
MVK5206	30	4	1500/3000	160	142	1500	1500	160	30	142	4	2.49	11.74	57.83	135.3	1.200	1.200	0.00	
MVK5207	37	4	1500/3000	160	178	1500	1500	160	37	178	4	1.24	7.30	70.97	160.9	0.685	0.685	0.00	
MVK5223	45	4	1500/3000	160	210	1500	1500	160	45	210	4	2.01	14.34	68.97	191.9	0.854	0.854	0.00	

Motor specification					Motor parameters															
					VG7S code No.		P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P28
Type	Capacity [kw]	No. of poles	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Iron loss co-ef.* 2 [%]	Iron loss co-ef.* 3 [%]	Magnetic saturation co-ef.* 1 [%]	Magnetic saturation co-ef.* 2 [%]	Magnetic saturation co-ef.* 3 [%]	Magnetic saturation co-ef.* 4 [%]	Magnetic saturation co-ef.* 5 [%]	Secondary time constant [s]	Induced voltage co-ef.* [V]	R2 correction co-ef.* 1	R2 correction co-ef.* 2	R3 correction co-ef.* 3	Pre-exciting current correction co-ef.*	PG pulse count	
MVK3115	3.7	4	1500/3600	160	20	0.00	0.00	89.4	80.4	66.7	54.5	42.7	0.172	115	1.000	1.000	1.000	0.000	512	
MVK3133	5.5	4	1500/3600	160	31	0.00	0.00	87.1	77.6	63.5	51.8	40.8	0.200	122	1.000	1.000	1.000	0.000	512	
MVK3135	7.5	4	1500/3600	160	41	0.00	0.00	82.8	72.3	58.6	48.0	38.3	0.220	120	1.000	1.000	1.000	0.000	512	
MVK3165	11	4	1500/3600	160	58	0.00	0.00	77.6	79.6	65.9	53.7	43.1	0.320	130	1.000	1.000	1.000	0.000	512	
MVK3167	15	4	1500/3600	160	74	0.00	0.00	91.0	83.1	69.0	56.9	45.1	0.336	135	1.000	1.000	1.000	0.000	512	
MVK3184	18.5	4	1500/3600	160	86.3	0.00	0.00	91.8	84.0	71.1	58.2	45.7	0.312	133	1.000	1.000	1.000	0.000	512	
MVK5187	22	4	1500/3600	160	106	0.00	0.00	92.6	84.8	71.1	58.6	46.5	0.412	136	1.000	1.000	1.000	0.000	512	
MVK5206	30	4	1500/3000	160	142	0.00	0.00	92.7	85.4	70.8	57.6	45.0	0.349	129	1.000	1.000	1.000	0.000	512	
MVK5207	37	4	1500/3000	160	178	0.00	0.00	90.5	81.3	67.3	55.3	44.3	0.423	146	1.000	1.000	1.000	0.000	512	
MVK5223	45	4	1500/3000	160	210	0.00	0.00	91.0	83.1	69.5	57.9	46.3	0.483	149	1.000	1.000	1.000	0.000	512	

\*co-ef.: coefficient

Note : The above value is the setting value of VG7.

# 14. Replacement Data

## ● 400V series

Motor specification			VG7S code No.		Motor parameters													
					F03	F04	F05	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	
Type	Capacity [kw]	No. of pole	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Max. speed [r/min]	Rated speed [r/min]	Rated voltage [V]	Rated capacity [kw]	Rated current [A]	No. of pole	%R1 [%]	%X [%]	Pre-exciting current [A]	Torque current [A]	Slip on driving [Hz]	Slip on braking [Hz]	Iron loss co-ef. 1 [%]
MVK3115	3.7	4	1500/3600	320	10	1500	1500	320	3.7	10	4	7.07	14.40	3.62	9.30	2.540	3.280	0.00
MVK3133	5.5	4	1500/3600	320	15.5	1500	1500	320	5.5	15.1	4	4.89	13.44	7.50	13.10	1.680	1.880	0.00
MVK3135	7.5	4	1500/3600	320	20.5	1500	1500	320	7.5	20.3	4	4.84	13.35	9.30	18.00	1.960	2.000	0.00
MVK3165	11	4	1500/3600	320	29	1500	1500	320	11	27.4	4	3.79	14.03	12.00	24.60	1.320	1.420	0.00
MVK3167	15	4	1500/3600	320	37	1500	1500	320	15	35.3	4	3.17	13.24	14.10	32.30	1.200	1.400	0.00
MVK3184	18.5	4	1500/3600	320	45	1500	1500	320	18.5	45	4	2.55	13.58	15.85	40.14	0.920	1.060	0.00
MVK5187	22	4	1500/3600	320	53	1500	1500	320	22	53	4	2.49	13.21	21.14	47.79	0.960	0.960	0.00
MVK5206	30	4	1500/3000	320	69.8	1500	1500	320	30	69.8	4	2.49	11.74	28.92	67.66	1.200	1.200	0.00
MVK5207	37	4	1500/3000	320	89	1500	1500	320	37	89	4	2.52	14.59	35.49	80.40	0.685	0.685	0.00
MVK5223	45	4	1500/3000	320	105	1500	1500	320	45	105	4	2.01	14.34	34.49	95.93	0.854	0.854	0.00

Motor specification			VG7S code No.		Motor parameters																	
					P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P28				
Type	Capacity [kw]	No. of pole	Speed (Rated/Max.) [r/min]	Voltage [V]	Current [A]	Iron loss co-ef. 2	Iron loss co-ef. 3	Magnetic saturation co-ef. 1	Magnetic saturation co-ef. 2	Magnetic saturation co-ef. 3	Magnetic saturation co-ef. 4	Magnetic saturation co-ef. 5	Secondary time constant	Induced voltage co-ef.	R2 correction co-ef. 1	R2 correction co-ef. 2	R3 correction co-ef. 3	Pre-exciting current correction co-ef.	PG pulse count			
MVK3115	3.7	4	1500/3600	320	10	0.00	0.00	89.4	80.4	66.7	54.5	42.7	0.172	230	1.000	1.000	1.000	0.000	512			
MVK3133	5.5	4	1500/3600	320	15.5	0.00	0.00	87.1	77.6	63.5	51.8	40.8	0.200	242	1.000	1.000	1.000	0.000	512			
MVK3135	7.5	4	1500/3600	320	20.5	0.00	0.00	86.7	76.1	60.8	49.4	38.4	0.224	241	1.000	1.000	1.000	0.000	512			
MVK3165	11	4	1500/3600	320	29	0.00	0.00	88.6	79.6	65.9	53.7	43.1	0.320	258	1.000	1.000	1.000	0.000	512			
MVK3167	15	4	1500/3600	320	37	0.00	0.00	91.0	83.1	69.0	56.9	45.1	0.336	268	1.000	1.000	1.000	0.000	512			
MVK3184	18.5	4	1500/3600	320	45	0.00	0.00	91.8	84.0	71.1	58.2	45.7	0.312	267	1.000	1.000	1.000	0.000	512			
MVK5187	22	4	1500/3600	320	53	0.00	0.00	92.6	84.8	71.1	58.6	46.5	0.412	267	1.000	1.000	1.000	0.000	512			
MVK5206	30	4	1500/3000	320	69.8	0.00	0.00	92.7	85.4	70.8	57.6	45.0	0.349	257	1.000	1.000	1.000	0.000	512			
MVK5207	37	4	1500/3000	320	89	0.00	0.00	90.5	81.3	67.3	55.3	44.3	0.423	291	1.000	1.000	1.000	0.000	512			
MVK5223	45	4	1500/3000	320	105	0.00	0.00	91.0	83.1	69.5	57.9	46.3	0.483	298	1.000	1.000	1.000	0.000	512			

\*co-ef.: coefficient

Note : The above value is the setting value of VG7

## 14.8 Protective Functions

### 14.8.1 Replacing VG5

FRENIC5000 VG5S		FRENIC5000 VG7S	
–		dbH	DB resistor overheat
dcF	DC fuse blown	dcF	DC fuse blown
–		dO	Excessive position deviation
EF	Ground fault	EF	Ground fault
Er1	Memory error	Er1	Memory error
Er2	KEYPAD panel communication error	Er2	KEYPAD panel communication error
Er3	CPU error	Er3	CPU error
Er4	T-Link communication error	Er4	Network error
Er5	RS485 error	Er5	RS485 communication error
Er6	Operation procedure error	Er6	Operation procedure error
Er7	Output wiring error	Er7	Output wiring error
Er8	A/D converter error	Er8	A/D converter error
–		Er9	Speed disagreement
–		ErA	UPAC error
–		Erb	Inter-inverter communication error
–		IPE	IPM error
–		Lin	Input phase loss
LU	Undervoltage	LU	Undervoltage
nrb	NTC thermistor disconnection	nrb	NTC thermistor disconnection
OC	Overcurrent	OC	Overcurrent
OH1	Overheating at heat sink	OH1	Overheating at heat sink
OH2	External alarm	OH2	External alarm
OH3	Inverter internal overheat	OH3	Inverter internal overheat
OH4	Motor overheat	OH4	Motor overheat
OL	Motor overload	OL1	Motor 1 overload
–		OL2	Motor 2 overload
–		OL3	Motor 3 overload
OLU	Inverter overload	OLU	Inverter unit overload
OS	Overspeed	OS	Overspeed
OU	Overvoltage	OU	Overvoltage
PbF	Charging circuit error	PbF	Charging circuit error
P9	PG disconnection	P9	PG disconnection



# 14. Replacement Data

## 14.8.2 Replacing VG3

FRENIC5000 VG3		FRENIC5000 VG7S	
–		dBH	DB resistor overheat
dcF	DC fuse blown	dcF	DC fuse blown
–		dO	Excessive position deviation
EF	Ground fault	EF	Ground fault
Rf	Memory error	Er1	Memory error
–		Er2	KEYPAD panel communication error
–		Er3	CPU error
OPF	T-Link communication error	Er4	Network error
–		Er5	RS-485 communication error
–		Er6	Operation procedure error
–		Er7	Output wiring error
CF	Current detection circuit error	–	
–		Er8	A/D converter error
–		Er9	Speed disagreement
–		ErA	UPAC error
–		ErB	Inter-inverter communication error
–		IPE	IPM error
–		Lin	Input phase loss
LU	Undervoltage	LU	Undervoltage
rb	NTC thermistor disconnection	nrb	NTC thermistor disconnection
OC	Overcurrent	OC	Overcurrent
OH1	Inverter overheat	OH1	Overheating at heat sink
OH3	External alarm	OH2	External alarm
–		OH3	Inverter internal overheat
OH2	Motor overheat	OH4	Motor overheat
–		OL1	Motor 1 overload
–		OL2	Motor 2 overload
–		OL3	Motor 3 overload
OL	Inverter overload	OLU	Inverter unit overload
OS	Overspeed	OS	Overspeed
OU	Overvoltage	OU	Overvoltage
–		PbF	Charging circuit error
–		P9	PG disconnection

### 14.8.3 Replacing VG

FRENIC5000 VG		FRENIC5000 VG7S	
–		dbH	DB resistor overheat
–	DC fuse blown	dcF	DC fuse blown
–		dO	Excessive position deviation
–		EF	Ground fault
–		Er1	Memory error
–		Er2	KEYPAD panel communication error
–	CPU error	Er3	CPU error
–		Er4	Network error
–		Er5	RS485 communication error
–		Er6	Operation procedure error
–		Er7	Output wiring error
–		Er8	A/D converter error
–		Er9	Speed disagreement
–		ErA	UPAC error
–		ErB	Inter-inverter communication error
–		IPE	IPM error
–		Lin	Input phase loss
–	Undervoltage	LU	Undervoltage
–	NTC thermistor disconnection	nrb	NTC thermistor disconnection
–	Overcurrent	OC	Overcurrent
–	Inverter overheat	OH1	Overheating at heat sink
–	DB resistor overheat	OH2	External alarm
–		OH3	Inverter internal overheat
–	Motor overheat	OH4	Motor overheat
–		OL1	Motor 1 overload
–		OL2	Motor 2 overload
–		OL3	Motor 3 overload
–	Inverter overload	OLU	Inverter unit overload
–	Overspeed	OS	Overspeed
–	Overvoltage	OU	Overvoltage
–		PbF	Charging circuit error
–		P9	PG disconnection

# 14. Replacement Data

## 14.9 Options

### 14.9.1 Replacing VG5S

Name	FRENIC5000 VG5S option	Possibility of combination with VG7	Alternative FRENIC5000 VG7S option
Adder	OPCII-VG3-AD	Impossible	
I/V, V/I converter	OPCII-VG3-IV	Impossible	
Comparator	OPCII-VG3-CP	Impossible	
Isolation converter	OPCII-VG3-IA	Impossible	
F/V converter	OPCII-VG3-FV	Impossible	OPC-VG7-FV
Synchro. interface	OPCII-VG3-SN	Impossible	OPC-VG7-SN
Di interface card	OPCII-VG5-DIN	Impossible	OPC-VG7-DI (DIA, DIB)
	OPCII-VG5-DIT	Impossible	OPC-VG7-DI (DIA, DIB)
DIO expansion card	OPCII-VG5-DIO	Impossible	OPC-VG7-DIO (DIOA)
T-Link interface card	OPCII-VG5-TL	Impossible	OPC-VG7-TL
PG interface extension card	OPCII-VG5-PG1	Impossible	Built-in.
	OPCII-VG5-PG2	Impossible	OPC-VG7-PG
Pulse train interface card	OPCII-VG5-PTI	Impossible	OPC-VG7-PG
Adder	MCAII-VG3-AD	Impossible	
I/V, V/I converter	MCAII-VG3-IV	Impossible	
Comparator	MCAII-VG3-CP	Impossible	
Isolation converter	MCAII-VG3-IA	Impossible	
F/V converter	MCAII-VG3-FV	Impossible	MCA-VG7-FV
Synchro. interface	MCAII-VG5-SN	Impossible	MCA-VG7-SN
Dancer controller	MCAII-PU	Possible	
Relay unit	MCAII-RY	Impossible	
PG switcher	MCAII-VG5-CPG	Possible	
Braking unit	Depends on the capacity	Possible	Depends on the capacity (Built-in for 55kW or less of 200V series, and for 110kW or less of 400V series)
Braking resistor	Depends on the capacity	Possible	Depends on the capacity
AC reactor	Depends on the capacity	Possible	Depends on the capacity
DC REACTOR	Depends on the capacity	Possible	Depends on the capacity (Provided as standard for units of more than 75kW).
Ferrite ring for reducing radio noise.	ACL-40B, ACL-74B	Possible	
KEYPAD panel extension cable	CBIII-10R-2S CBIII-10R-1C CBIII-10R-2C	Possible	

## 14.9.2 Replacing VG3

Name	FRENIC5000 VG3 option	Possibility of combination with VG7	Alternative FRENIC5000 VG7S option
Adder	OPCII-VG3-AD	Impossible	
I/V,V/I converter	OPCII-VG3-IV	Impossible	
Comparator	OPCII-VG3-CP	Impossible	
Isolation converter	OPCII-VG3-IA	Impossible	
F/V converter	OPCII-VG3-FV	Impossible	OPC-VG7-FV
Synchro. interface	OPCII-VG3-SN	Impossible	OPC-VG7-SN
Di interface card	OPCII-VG3-DI	Impossible	OPC-VG7-DI (DIA,DIB)
AO interface	OPCII-VG3-AO	Impossible	OPC-VG7-AIO
T-Link interface card	OPCII-VG3-T2 OPCII-VG3-TL	Impossible	OPC-VG7-TL
Adder	MCAII-VG3-AD	Impossible	
I/V,V/I converter	MCAII-VG3-IV	Impossible	
Comparator	MCAII-VG3-CP	Impossible	
Isolation converter	MCAII-VG3-IA	Impossible	
F/V converter	MCAII-VG3-FV	Impossible	MCA-VG7-FV
Synchro. interface	MCAII-VG5-SN	Impossible	MCA-VG7-SN
Dancer controller	MCAII-PU	Possible	
Relay unit	MCAII-RY	Impossible	
Ground fault detection unit	MCAII-GFD-1 MCAII-GFD-2	Impossible	Ground fault detection function of the output wiring is a standard built-in for the inverter more than 18.5kW.
Braking unit	Depends on the capacity	Possible	Depends on the capacity (Built-in for 55kW or less of 200V series, and for 110kW or less of 400V series)
Braking resistor	Depends on the capacity	Possible	Depends on the capacity
AC reactor	Depends on the capacity	Possible	Depends on the capacity
DC REACTOR	Depends on the capacity	Possible	Depends on the capacity (Provided as standard for units of more than 75kW)
Ferrite ring for reducing radio noise.	ACL-10A	Possible	

## 14. Replacement Data

### 14.9.3 Replacing VG

Name	FRENIC5000 VG option	Possibility of combination with VG7	Alternative FRENIC5000 VG7S option
Adder	OPCII-AD	Impossible	
I/V,V/I converter	OPCII-IV	Impossible	
Comparator	OPCII-CP	Impossible	
Isolation converter	OPCII-IA	Impossible	
F/V converter	OPCII-FV	Impossible	OPC-VG7-FV
Soft start stop	OPCII-RA	Impossible	Standard built-in.
Di interface card	OPCII-BI OPCII-BC	Impossible	OPC-VG7-DI (DIA,DIB)
T-Link interface card	OPCII-TL-1 OPCII-TL-2	Impossible	OPC-VG7-TL
Adder	MCAII-AD	Impossible	
I/V,V/I converter	MCAII-IV	Impossible	
Comparator	MCAII-CP	Impossible	
Isolation converter	MCAII-IA	Impossible	
F/V converter	MCAII-FV	Impossible	MCA-VG7-FV
Dancer controller	MCAII-PU	Possible	
High-precision correction unit	MCAII-SP	Impossible	Standard built-in.
Soft start/stop	MCAII-RA	Impossible	Standard built-in.
Braking unit	Depends on the capacity	Possible	Depends on the capacity (Built-in for 55kW or less of 200V series, and for 110kW or less of 400V series)
Braking resistor	Depends on the capacity	Possible	Depends on the capacity
AC reactor	Depends on the capacity	Possible	Depends on the capacity
DC REACTOR	Depends on the capacity	Possible	Depends on the capacity (Provided as standard for units of more than 75kW)
REACTOR for noise reduction (For elevators)	Depends on the capacity	Impossible	Not necessary because of the high carrier PWM.

# THE INVERTER

# XV

## **XV. Appendix**

- Appendix 1. Advantageous Use of Inverters  
(with Regard to Electrical Noise)**
- Appendix 2. Effect on Insulation of General-  
purpose Motor Driven with 400V  
Class Inverter**
- Appendix 3. Example Calculation of Energy  
Savings**

# 15. Appendix

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## Appendix 1. Advantageous Use of Inverters (with Regard to Electrical Noise)

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Excerpt from Technical Document  
of the Japan Electrical  
Manufacturers' Association (JEMA)  
(April, 1994)

### 1 Effect of Inverters on other Devices

This paper describes the effect that inverters, for which the field of applications is expanding, have on electronic devices already installed and on devices installed in the same system as the inverters. Measures to counter these effects are also introduced.

(Refer to 3.3 Specific examples for further details.)

#### 1.1 Effect on AM Radios

- (1) When operating an inverter, nearby AM radios may pickup noise from the inverter. (The inverter has almost no effect on FM radios or televisions)
- (2) It is considered that radios receive noise radiated from the inverter.
- (3) Measures to provide a noise filter on the power supply side of the inverter are effective.

#### 1.2 Effect on Telephones

- (1) When operating an inverter, telephones may pickup noise during a conversation, making it difficult to hear.
- (2) It is considered that a high-frequency leakage current radiated from the inverter and motors enters shielded telephone cables.
- (3) It is effective to commonly connect the grounding terminals of the motors and return the common grounding line to the grounding terminal of the inverter.

#### 1.3 Effect on Proximity Limit Switches

- (1) When operating an inverter, proximity limit switches (capacitance-type) may malfunction.
- (2) It is considered that malfunction occurs because the capacitance-type proximity limit switches have inferior noise immunity.
- (3) Connecting a filter to the input terminals of the inverter or changing the power supply treatment of the proximity limit switches is effective. In addition, the proximity limit switches can be changed to superior noise immunity types such as the magnetic type.

#### 1.4 Effect on Pressure Sensors

- (1) When operating an inverter, pressure sensors may malfunction.
- (2) It is considered that malfunction occurs because noise penetrates through a grounding wire into the signal line.
- (3) It is effective to install a noise filter on the power supply side of the inverter or to change the wiring.

#### 1.5 Effect on Position Detectors (Pulse Generators; PGs, or Pulse Encoders)

- (1) When operating an inverter, erroneous pulses from pulse converters may shift the stop position of a machine.
- (2) Erroneous pulses are liable to occur when the signal lines of the PG and power lines are bundled together.
- (3) The influence of induction noise and radiation noise can be reduced by separating the signal lines of the PG and power lines. Providing noise filters at the input and output terminals is also an effective measure.

## 2 Noise

A summary of the noise generated in inverters and its effect on devices susceptible to noise is described below.

### 2.1 Inverter Noise

Figure 1 shows an outline of the inverter configuration. The inverter converts AC to DC (rectification) in a converter unit, and converts DC to AC (inversion) with 3-phase variable voltage and variable frequency. The conversion (inversion) is performed by PWM implemented by switching 6 transistors, and is used for variable speed motor control.

Switching noise is generated by the high-speed on/off switching of the 6 transistors. Noise current ( $i$ ) is emitted and at each high-speed on/off switching the noise current flows through stray capacitance ( $C$ ) of the inverter, cable and motor to the ground. The amount of the noise current,

$$i = C \cdot dv / dt$$

is related to the stray capacitance ( $C$ ) and  $dv/dt$  (switching speed of the transistors). Further, this noise current is related to the carrier frequency since the noise current flows each time the transistors are switched on/off.

The frequency band of this noise is less than approximately 30 to 40MHz. Therefore, devices such as AM radios that use the low frequency band are affected by the noise, but FM radios and television using higher frequency than this frequency band are virtually unaffected.

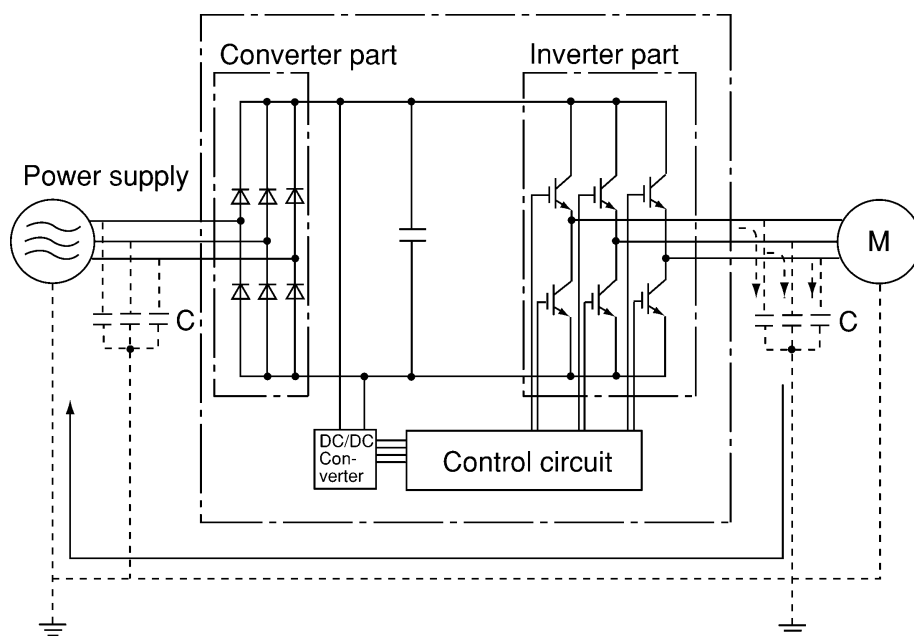


Figure 1 Outline of Inverter Configuration



# 15. Appendix

## 2.2 Types of Noise

The noise generated in the inverter is propagated through the main circuit wiring to the power supply and the motor, and effects a wide range from the power supply transformer to the motor. The various propagation routes are shown in Figure 2, but these are roughly classified into 3 routes of conduction noise, induction noise and radiation noise.

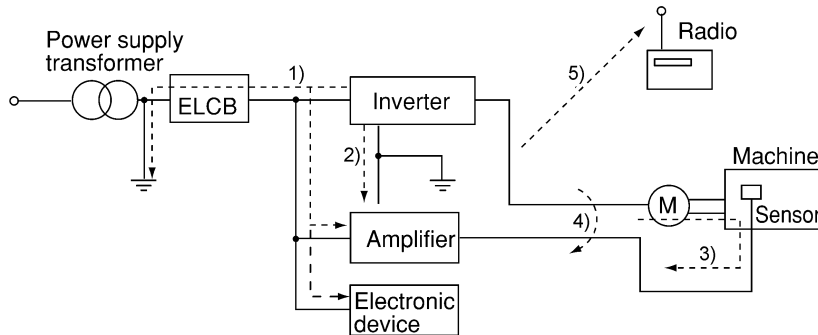


Figure 2 Noise Propagation Routes

### (1) Conduction noise

Conduction noise is generated in the inverter, propagates through the conductor and power supply, and effects peripheral devices of the inverter (Figure 3). Some conduction noise 1) propagates through the main circuit. If the ground lines are connected with a common connection, there is conduction through route 2). There is also noise 3) through the signal line and shielded wire.

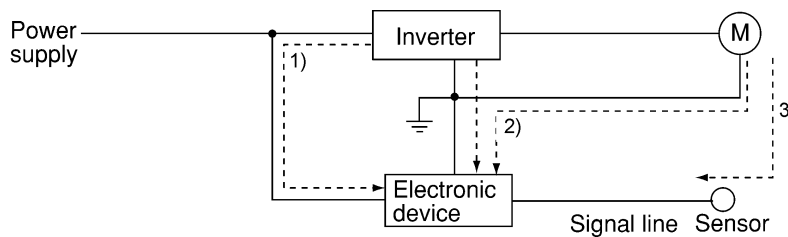


Figure 3 Conduction Noise

### (2) Induction noise

When the wire and signal lines of peripheral devices are brought close to the wires on the input and output sides of the inverter, noise is induced in the wire and signal lines of the devices by electromagnetic induction (Figure 4) and electrostatic induction (Figure 5). This is induction noise 4).

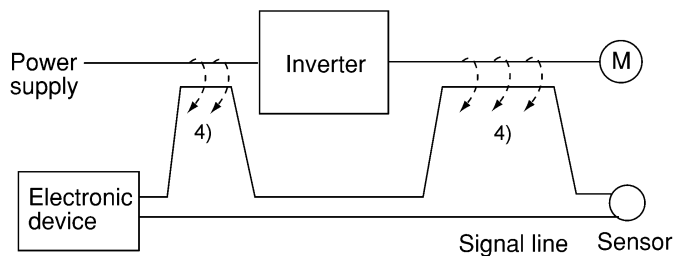


Figure 4 Electromagnetic Noise

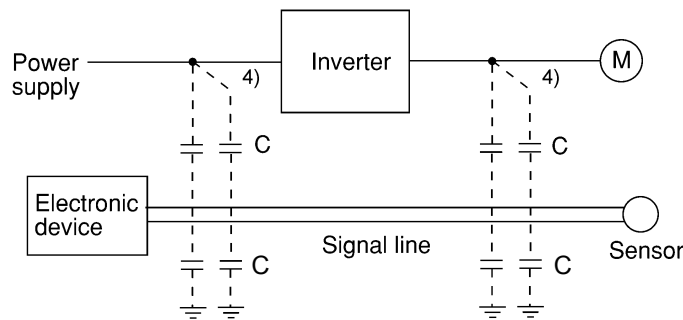


Figure 5 Electrostatic Noise

**(3) Radiation noise**

Noise generated in the inverter is radiated through the air from antennas consisting of wires at the input and output sides of the inverter. This noise is radiation noise 5) (Figure 6). The antennas that emit radiation noise are not limited only to wires, the motor frame and panel containing the inverter may also act as antennas.

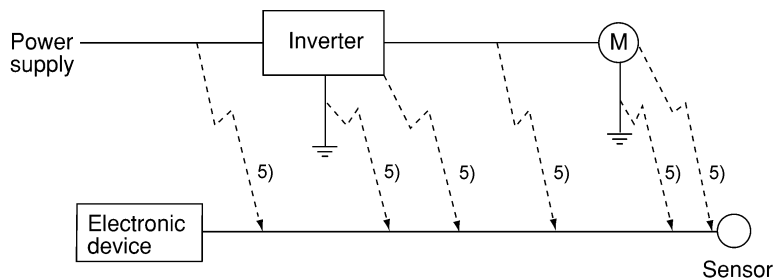


Figure 6 Radiation Noise

### 3 Noise Prevention Measures

As noise prevention measures are strengthened, they become more effective. With the use of appropriate measures, noise problems may be resolved simply. Therefore, it is necessary to implement economical noise prevention measures according to the noise level and the equipment condition.

#### 3.1 Noise Prevention Treatments Prior to Installation

Before inserting an inverter in a control panel or installing an inverter panel, it is necessary to consider the noise. Once noise problems occur, great expenditures of apparatuses, materials and time are required.

Noise prevention treatments prior to installation are listed below.

- 1) Separation of the wiring of the main circuit and control circuit
- 2) Insertion of the main circuit wiring into a metal pipe (conduit pipe)
- 3) Use of shielded wire or twisted shielded wire in the control circuit.
- 4) Implementation of appropriate grounding work and grounding wiring.

These treatments can avoid most noise problems.

# 15. Appendix

## 3.2 Implementation of Noise Prevention Measures

There are two types of noise prevention measures, those that correspond to the propagation route and those that counteract the effect of noise on the receiving side (side that is adversely affected by the noise).

The basic measure to lessen the effect of noise on the receiving side is to:

- 1) Separate the main circuit wiring from the control circuit wiring, making it more difficult to receive noise.

The basic measures to lessen the effect of noise on the generating side are to:

- 2) Install a noise filter to reduce the noise level.
- 3) Apply a metal conduit pipe or metal control panel to confine the noise level, and
- 4) Apply an insulated transformer for the power supply to cut off the noise propagation route.

Table 1 lists the methods for preventing the noise problems, their goals and the propagation routes.

Next, noise prevention measures are presented for the inverter drive configuration.

### (1) Wiring and grounding

Separating the main circuit and control circuit as much as possible, both inside and outside the control panel, and the use of shielded wire and twisted shielded wire, makes it more difficult to receive noise and allows wiring distances to be minimized (refer to Figure 7). Take notice that the wiring of the main circuit and control circuit does not become bundled or parallel wiring.

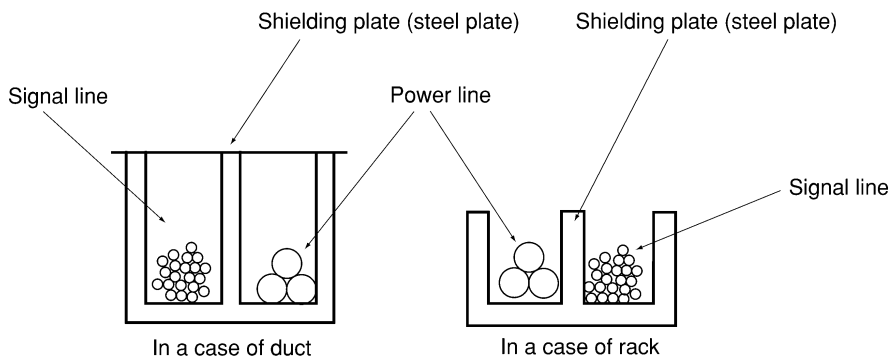


Figure 7 Method of Separating Wiring

For the main circuit wiring, a metal conduit pipe is used and grounded through a grounding wiring to prevent noise propagation (refer to Figure 8).

The shield (braided wire) of the shielded wire is securely connected to the base (common) side of the signal line at only one point to avoid the loop formation resulting from a multi-point connection (refer to Figure 9).

The grounding is effective to not only to reduce the risk of electric shocks, but also to block noise penetration and radiation. Corresponding to the main circuit voltage, the grounding work should be No. 3 grounding work (300V AC or less) and special No. 3 grounding work (300 to 600V AC). Each ground wire is to be provided with its own ground or separately wired to a grounding point.

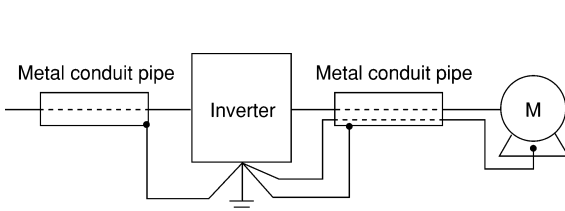


Figure 8 Grounding of Metal Conduit Pipe

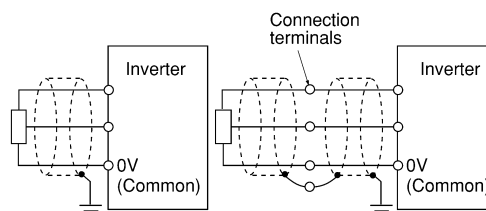


Figure 9 Treatment of Braided Wire of Shielded Wire

Table 1 Noise Prevention Methods

Noise prevention method		Goal of noise prevention measure				Conduction route		
		Make it more difficult to receive noise	Cutoff noise conduction	Confine noise	Reduce noise level	Conduction noise	Induction noise	Radiation noise
Wiring and installation	Separate main circuit and control circuit	○				○		
	Minimum wiring distance	○			○		○	○
	Avoid parallel and bundled wiring	○					○	
	Use appropriate grounding	○			○	○	○	
	Use shielded wire and twisted shielded wire	○					○	○
	Use shielded cable in main circuit			○			○	○
	Use metal conduit pipe			○			○	○
Control panel	Appropriate arrangement of devices in panel	○					○	○
	Metal control panel			○			○	○
Anti-noise device	Line filter	○			○	○		○
	Insulation transformer		○			○		○
Treatment on the noise receiving side	Use passing capacitor	○					○	○
	Use ferrite core for control circuit	○			○		○	○
	Line filter	○		○		○		
Others	Separate power supply systems		○			○		
	Lower the carrier frequency				△	○	○	○

## (2) Control panel

The control panel containing the inverter is generally made of metal, and this metal box can shield noise radiated from the inverter itself.

Further, when installing other electronic devices such as a programmable logic controller in the same control panel, attention should be paid to the arrangement of each device. When necessary, a noise prevention measure should be implemented, such as installing a shielding plate between the inverter and peripheral devices.

# 15. Appendix

## (3) Anti-noise devices

To reduce the noise propagated through the electrical circuits and the noise radiated from the main circuit wiring to the air, a line filter and power supply transformer are utilized (refer to Figure 10). Among line filters, there are the simple type filters, such as a capacitive filter connected in parallel to the power supply line and an inductive filter connected in series to the power supply line, as well as orthodox filters (LC filters). These filters are used according to the targeted effect for reducing noise. In power supply transformers, there are common insulated transformers, shielded transformers, noise-cut transformers, etc. These transformers have different effectiveness in blocking noise propagation.

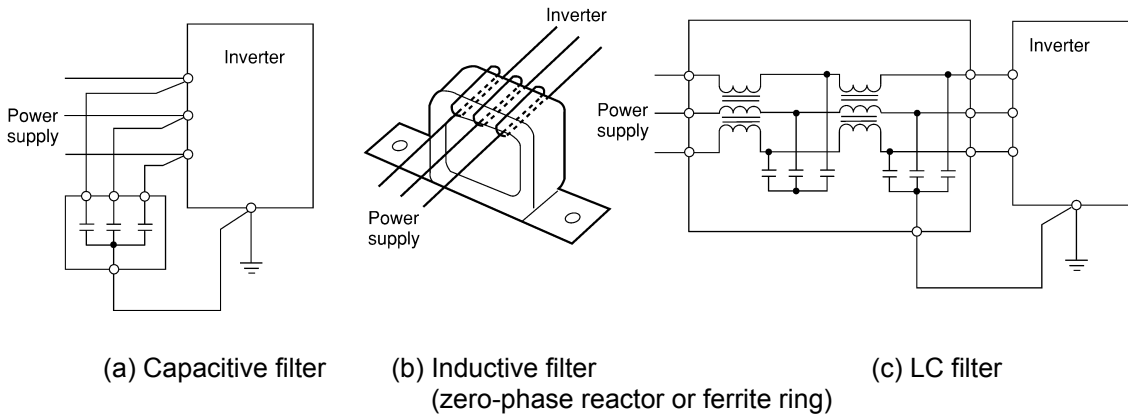


Figure 10 Various Filters and their Connection Methods

## (4) Noise prevention measures on the receiving side

It is important to strengthen the noise immunity of those electronic devices installed in the same control panel as the inverter and/or located near the inverter. Line filters and shielded or twisted shielded wire is used to block the penetration of noise in the signal lines of these devices. The following treatments are also implemented.

- 1) The circuit impedance is lowered by connecting capacitors or resistors to the input and output terminals of the signal circuit in parallel.
- 2) The circuit impedance for noise is increased by inserting choke coils in series in the signal circuit, or, passing the signal through ferrite core beads.  
It is also effective to widen the signal base line (0 V line) or grounding line.

## (5) Other

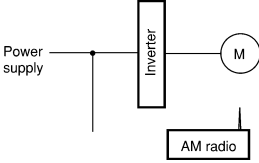
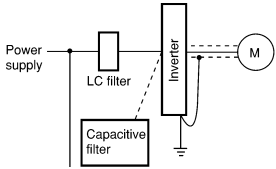
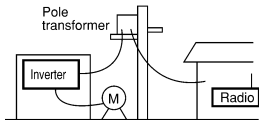
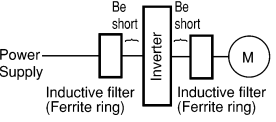
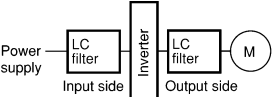
The generating (propagating) level of noise changes with the carrier frequency of the inverter, the higher the carrier frequency, the higher the generated level of noise.

In the case of an inverter for which the carrier frequency can be changed, lowering the carrier frequency can reduce the generation of electrical noise and result in a good balance with the audible noise of the motor under driving conditions.

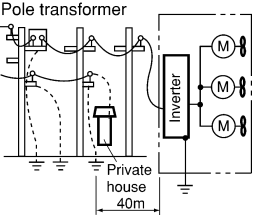
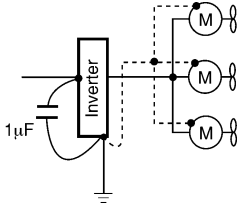
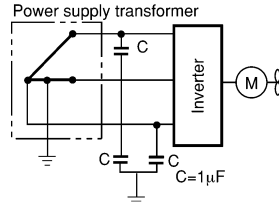
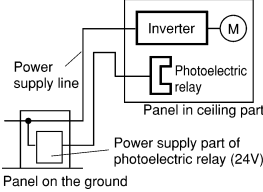
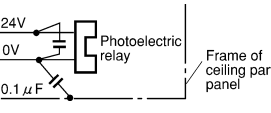
### 3.3 Specific Examples

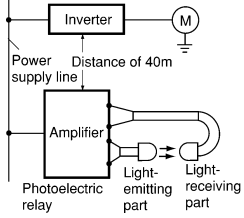
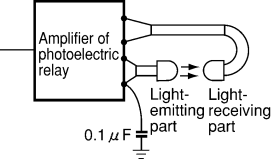
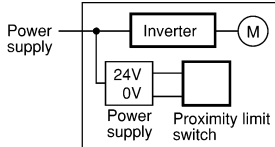
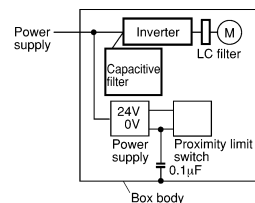
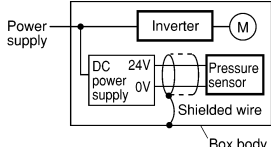
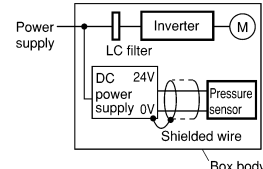
Table 2 lists specific examples of the measures to prevent noise generated by operation of the inverter.

Table 2 Specific Examples of Noise Prevention Measures

No.	Target device	Phenomena	Noise prevention measures	Notes
1	AM radio	<p>When operating an inverter, noise entered into AM radio broadcast (500 to 1500kHz).</p>  <p>&lt;Estimated cause&gt; It is considered that the AM radio receives noise radiated from wires at the power supply and output sides of the inverter.</p>	<p>1) Install an LC filter on the power supply side of the inverter. (A simple method is to install a capacitive filter.)</p> <p>2) Install a metal conduit wiring between the motor and inverter.</p>  <p>Note: Minimize the distance between the LC filter and inverter as much as possible (within 1m).</p>	<p>1) The radiation noise of the wiring is reduced.</p> <p>2) The conduction noise to the power supply side is reduced. Further, shielded wiring is used.</p> <p>Note: Sufficient improvement may not be expected in narrow regions such as between mountains.</p>
2	AM radio	<p>When operating an inverter, noise entered into AM radio broadcast (500 to 1500kHz).</p>  <p>&lt;Estimated cause&gt; It is considered that the AM radio receives noise radiated from the power line at the power supply side of the inverter.</p>	<p>1) Install inductive filters at the input and output sides of the inverter.</p>  <p>The number of turns of the zero-phase reactor (or ferrite ring) should be as large as possible. Further, wiring between the inverter and the zero-phase reactor (or ferrite ring) should be short as possible. (within 1m)</p> <p>2) When further improvement is necessary, install LC filters.</p> 	<p>1) The radiation noise of the wiring is reduced.</p>

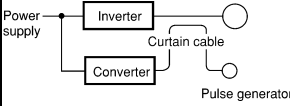
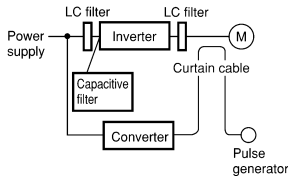
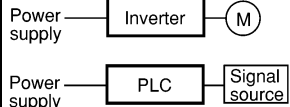
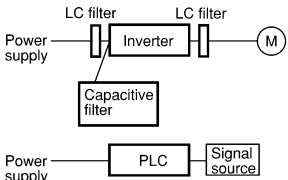
# 14. Appendix

No.	Target device	Phenomena	Noise prevention measures	Notes
3	Telephone (in a common private residence at a distance of 40m)	<p>When driving a ventilation fan with an inverter, noise entered a telephone in a private residence at a distance of 40m.</p>  <p>&lt;Estimated cause&gt; A high-frequency leakage current from the inverter and motor flowed to grounded part of the telephone cable shield. During the current's return trip, it flowed through a grounded pole transformer, and noise entered the telephone by electrostatic induction.</p>	<p>1) Connect the ground terminals of the motors in a common connection. Return to the inverter panel, and insert a 1<math>\mu</math>F capacitor between the input terminal of the inverter and ground.</p> 	<p>1) The effect of the inductive filter and LC filter may not be expected because of sound frequency component.</p> <p>2) In the case of a V-connection power supply transformer in a 200V system, it is necessary to connect capacitors as shown in the following figure, because of different potentials to the ground.</p> 
4	Photoelectric relay	<p>A photoelectric relay malfunctioned when the inverter was operated. [The inverter and motor are installed in the same place (for overhead traveling)]</p>  <p>&lt;Estimated cause&gt; It is considered that induction noise entered the photoelectric relay since the inverter's input power supply line and the photoelectric relay's wiring are in parallel separated by approximately 25mm over a distance of 30 to 40m. Due to conditions of the installation, these lines cannot be separated.</p>	<p>1) As a temporary measure, insert a 0.1<math>\mu</math>F capacitor between the 0V terminal of the power supply circuit in the detection unit of the overhead photoelectric relay and a frame of the overhead panel.</p>  <p>2) As a permanent measure, move the 24V power supply from the ground to the overhead unit so that signals are sent to the ground side with relay contacts in the ceiling part.</p>	<p>1) The wiring is separated. (by more than 30cm.)</p> <p>2) When separation is impossible, signals can be received and sent with dry contacts etc.</p> <p>3) Do not wire weak-current signal lines and power lines in parallel.</p>

No.	Target device	Phenomena	Noise prevention measures	Notes
5	Photoelectric relay	<p>A photoelectric relay malfunctioned when the inverter was operated.</p>  <p>&lt;Estimated cause&gt; Although the inverter and photoelectric relay are separated by a sufficient distance, since the power supplies share a common connection, it is considered that conduction noise entered through the power supply line into the photoelectric relay.</p>	<p>1) Insert a 0.1μF capacitor between the output common terminal of the amplifier of the photoelectric relay and a frame.</p> 	<p>1) If a weak-current circuit on the malfunctioning side is observed, the countermeasures may be simple and economical.</p>
6	Proximity limit switch (electrostatic type)	<p>A proximity limit switch malfunctioned.</p>  <p>&lt;Estimated cause&gt; It is considered that the capacitance type proximity limit switch is susceptible to conduction and radiation noise because of its low noise immunity.</p>	<p>1) Install an LC filter on the output side of the inverter. 2) Install a capacitive filter on the input side of the inverter. 3) Ground the 0 V (common) line of the DC power supply of the proximity limit switch through a capacitor to the box body of the machine.</p> 	<p>1) Noise generated in the inverter is reduced. 2) The switch is superseded by a proximity limit switch of superior noise immunity (such as a magnetic type).</p>
7	Pressure sensor	<p>A pressure sensor malfunctioned.</p>  <p>&lt;Estimated cause&gt; It is considered that the pressure sensor signal malfunction was due to noise that came from the box body and traveled through the shield of the shielded wire.</p>	<p>1) Install an LC filter on the input side of the inverter. 2) Connect the shield of the shielded wire of the pressure sensor to the 0 V line (common) of the pressure sensor, changing the original connection.</p> 	<p>1) The shielded parts of shield wire for sensor signals are connected to a common point in the system. 2) Conduction noise from the inverter is reduced.</p>



# 15. Appendix

No.	Target device	Phenomena	Noise prevention measures	Notes
8	Position detector (pulse generator: PG)	<p>Erroneous-pulse outputs from a pulse converter caused a shift in the stop position of a crane.</p>  <p>&lt;Estimated cause&gt; It is considered that erroneous pulses are output by induction noise since the power line of the motor and the signal line of the PG are bundled in a lump.</p>	<p>1) Install an LC filter and a capacitive filter on the input side of the inverter. 2) Install an LC filter on the output side of the inverter.</p> 	<p>1) This is an example of a measure where the power line and signal line cannot be separated. 2) Induction noise and radiation noise on the output side of the inverter are reduced.</p>
9	Programmable logic controller (PLC)	<p>The PLC program sometimes malfunctions.</p>  <p>&lt;Estimated cause&gt; Since the power supply system is the same for the PLC and inverter, it is considered that noise enters the PLC through the power supply.</p>	<p>1) Install a capacitive filter and an LC filter on the input side of the inverter. 2) Install an LC filter on the output side of the inverter. 3) Lower the carrier frequency of the inverter.</p> 	<p>1) Total conduction noise and induction noise in the electric line are reduced.</p>

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## Appendix 2. Effect on Insulation of General-purpose Motor Driven with 400V Class Inverter

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Excerpt from Technical Document  
of the Japan Electrical  
Manufacturers' Association (JEMA)  
(March, 1995)

### Introduction

When an inverter drives a motor, surge voltages generated by switching the inverter elements are superimposed on the inverter output voltage and applied to the motor terminals. If the surge voltages are too high they may have an effect on the motor insulation and some cases have resulted in damage.

For preventing such cases this document describes the generating mechanism of the surge voltages and countermeasures against them.

## 1 Operating Principle of Inverter

### 1.1 Main Circuit Configuration of Inverter

The main circuit of an inverter is configured with a converter part and an inverter part. The former part rectifies a commercial power source voltage and eliminates resulting ripple components, and the latter part converts DC voltage to AC voltage through a 3-phase bridge circuit composed of switching elements like transistors. (Refer to Figure 1)

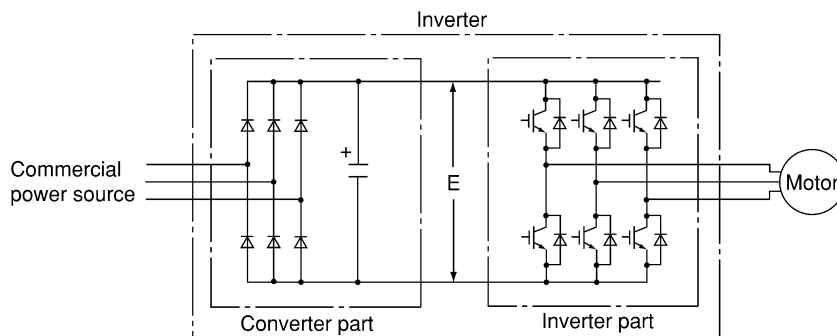


Figure 1 Main Circuit Configuration of Inverter

### 1.2 Control Method of Inverter

The PWM (Pulse Width Modulation) control is commonly adopted in general-purpose inverters. This method generates multiple switching pulses in one output cycle because both the output voltage and frequency are simultaneously controlled in the inverter part. The output voltage control is carried out by varying the pulse width while the pulse magnitude is kept constant.

The number of switching pulses generated in one second is designated as a carrier frequency and is normally high up to 0.7 to 16kHz. So transistors capable of high-speed switching (IGBT, etc.) are used for inverter elements.

# 15. Appendix

## 2 Generating Mechanism of Surge Voltages

As the inverter rectifies a commercial power source voltage and smoothes into a DC voltage, the magnitude  $E$  of the DC voltage becomes about  $\sqrt{2}$  times of that of the source voltage (about 620V in case of an input voltage of 440V AC). The peak value of the output voltage is usually close to this DC voltage value.

But, as there exists inductance ( $L$ ) and stray capacitance ( $C$ ) in wiring between the inverter and the motor, the voltage variation due to switching the inverter elements causes a surge voltage originating in LC resonance and results in the addition of a high voltage to the motor terminals. (Refer to Figure 2)

This voltage sometimes reaches up to about twice of the inverter DC voltage ( $620V \times 2 =$  about 1,200V) depending on a switching speed of the inverter elements and a wiring condition.

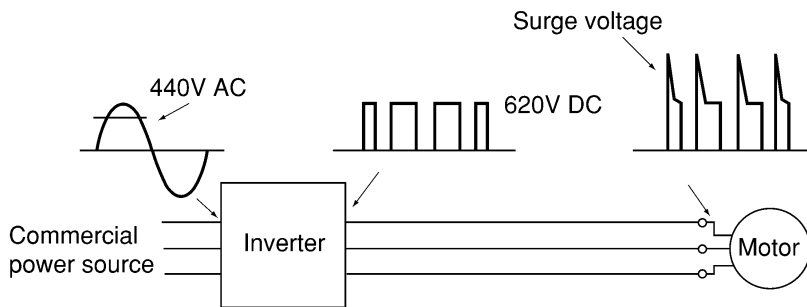
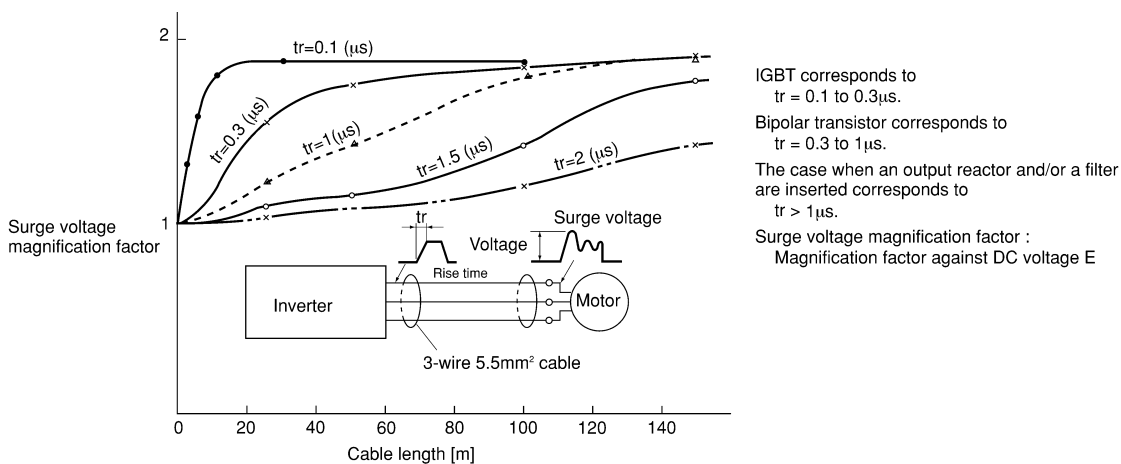


Figure 2 Voltage Wave Shapes of Individual Positions

A measured example in Figure 3 illustrates relation of a peak value of the motor terminal voltage with a wiring length between the inverter and the motor.

From this it can be confirmed that the peak value of the motor terminal voltage ascends as the wiring length increases and becomes saturated at about twice of the inverter DC voltage.

Besides the shorter a pulse rise time becomes, the higher the motor terminal voltage rises even in case of a short wiring length.



Excerpt from [J. IEE Japan, Vol. 107, No.7, 1987]

Figure 3 Measured Example of Wiring Length and Peak Value of Motor Terminal Voltage

## 3 Effect of Surge Voltages

The surge voltages originating in LC resonance of wiring may be applied to the motor input terminals and depending on their magnitude sometimes cause damage to the motor insulation.

When the motor is driven with a 200V class inverter, as for dielectric strength of the insulation it is no problem that the peak value at the motor terminal voltage increases twice due to the surge voltages, since the DC voltage is only about 300V.

But in case of a 400V class inverter the DC voltage becomes about 600V and depending on wiring length the surge voltages may highly rise and sometimes result in damage to the insulation.

## 4 Countermeasures Against Surge Voltages

The following methods are countermeasures against damage to the motor insulation by the surge voltages in case of a motor driven with a 400V class inverter.

### 4.1 Method to Use Motors with Enhanced Insulation

Enhanced insulation of a motor winding allows its surge proof strength to be improved.

### 4.2 Method to Suppress Surge Voltages

There are two methods for suppressing the surge voltages, one is to reduce the voltage rising and another is to reduce the voltage peak value.

#### (1) Output reactor

If wiring length is relatively short the surge voltages can be suppressed by reducing the voltage rising ( $dv/dt$ ) with installation of an AC reactor on the output side of the inverter. (Refer to Figure 4 (1))

However, if the wiring length becomes long, suppressing the peak voltage due to surge voltage may be difficult.

#### (2) Output filter

Installing a filter on the output side of the inverter allows a peak value of the motor terminal voltage to be reduced. (Refer to Figure 4 (2))

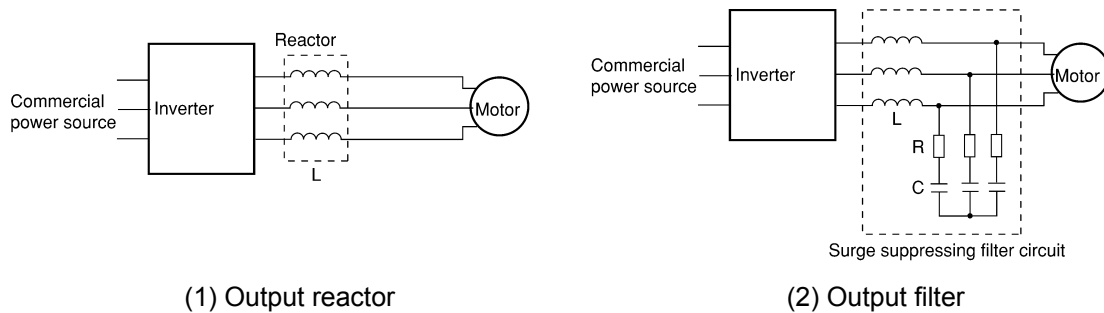


Figure 4 Method to Suppress Surge Voltage

## 5 Regarding Existing Equipment

### 5.1 In Case of Motor being Driven with 400V Class Inverter

The last five years survey on motor insulation damage due to the surge voltages originating from switching of inverter elements shows that the damage incidence is 0.013% under the surge voltage condition of over 1,100V and most of the damage occurs in several months after commissioning of the inverter. Therefore there seems to be little probability of occurrence of motor insulation damage after a lapse of several months of commissioning.

### 5.2 In Case of Existing Motor Driven Newly with 400V Class Inverter

We recommend to suppress the surge voltages with the method of 4.2.

# 15. Appendix

## Appendix 3. Example Calculation of Energy Savings

The energy saving that results from use of an inverter is calculated based on a specific calculation result (in the case of a fan and pump). The Q-P characteristic curve corresponding to damper use in Figure 1 changes depending on the motor capacity and manufacturer. Therefore, characteristic curves should be obtained individually when performing a detailed calculation.

### 1 Calculating Condition

[Use]

- Fan for air conditioning

[Usage period]

- 250 days / year (24 hours / day)

[Reduced rate of air flow with damper]

- In accordance with general output characteristics (Q-P curve) in Figure 1

[Reducing rate of air flow with an inverter (frequency)]

- 60Hz → 40Hz

[Electric power at maximum air flow rate :  $P_0$  [kW]]

- $P_0 = \text{Applied motor [kW]} \times 1 / \text{Motor efficiency} \rightarrow P_0$   
 $= \text{Applied motor [kW]} \times 1 / 0.9$

<In a case of a motor of 37kW>

- $P_0 = 37 \times 1 / 0.9$   
 $= 41.1 \text{ kW}$

[Power rate per 1 kWh :  $M_2$  [US\$]]

- Suppose US\$0.14 / kWh

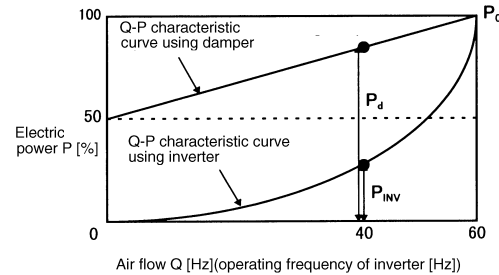


Figure 1 Q-P Characteristic Curve

### 2 Calculation of Shaft Driving Power

[Shaft driving power with damper control :  $P_d$  ]

$$P_d = ((50 + 50 \times (40 / 60)) / 100) \times P_0$$

$$= 0.833 P_0 \text{ [kW]}$$

[Shaft driving power with inverter control :  $P_{INV}$ ]

$$P_{INV} = (40 / 60)^3 \times P_0$$

$$= 0.296 \times P_0 \text{ [kW]}$$

### 3 Calculation of Energy Savings

A specific example of the energy savings is calculated with the following formula.

<Formula>

- $M_1 = (P_d - P_{INV}) \times T \times M_2$  [US\$ / year]  
 where  $M_2$  : Electricity bill of the energy saving [US\$ / year]  
 $T$  : Operating time per year [h]  
 $M_2$  : Power rate per 1 kWh [US\$]

#### ■ Calculation example

- $M_1 = (P_d - P_{INV}) \times T \times M_2$  [US\$ / year]  
 $= (0.833 - 0.296) \times P_0 \times T \times M_2$   
 $= 0.537 \times 41.1 \times (250 \times 24) \times 0.14$   
 $= 18,539 \text{ [US$ / year]}$

Therefore, energy savings of approximately US\$18,500 / year are obtained.

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