Read and Understand this Manual

Please read and understand this manual before using the product. Please consult your OMRON representative if you have any questions or comments.

Warranty and Limitations of Liability

WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall the responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

Application Considerations

SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

• Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.
• Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
• Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

Disclaimers

CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

PERFORMANCE DATA

Performance data given in this manual is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

ERRORS AND OMISSIONS

The information in this manual has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

General Precautions

Observe the following precautions when using the SYSDRIVE Inverters and peripheral devices.

This manual may include illustrations of the product with protective covers removed in order to describe the components of the product in detail. Make sure that these protective covers are on the product before use.

Consult your OMRON representative when using the product after a long period of storage.

⚠ **WARNING**   Do not touch the inside of the Inverter. Doing so may result in electrical shock.

⚠ **WARNING**   Operation, maintenance, or inspection must be performed after turning OFF the power supply, confirming that the CHARGE indicator (or status indicators) are OFF, and after waiting for the time specified on the front cover. Not doing so may result in electrical shock.

⚠ **WARNING**   Do not damage, pull on, apply stress to, place heavy objects on, or pinch the cables. Doing so may result in electrical shock.

⚠ **WARNING**   Do not touch the rotating parts of the motor under operation. Doing so may result in injury.

⚠ **WARNING**   Do not modify the product. Doing so may result in injury or damage to the product.

⚠ **Caution**   Do not store, install, or operate the product in the following places. Doing so may result in electrical shock, fire or damage to the product.

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to exposure to combustibles.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.

⚠ **Caution**   Do not touch the Inverter radiator, regenerative resistor, or AC Motor surface while the power is being supplied or soon after the power is turned OFF. Doing so may result in a skin burn due to the hot surface.

⚠ **Caution**   Do not conduct a dielectric strength test on any part of the Inverter. Doing so may result in damage to the product or malfunction.

⚠ **Caution**   Take appropriate and sufficient countermeasures when installing systems in the following locations. Not doing so may result in equipment damage.

- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields and magnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.

Transportation Precautions

⚠️ **Caution**   Do not hold by front cover or panel, instead, hold by the radiation fin (heat sink) while transporting the product. Doing so may result in injury.

⚠️ **Caution**   Do not pull on the cables. Doing so may result in damage to the product or malfunction.

⚠️ **Caution**   Use the eye-bolts only for transporting the Inverter. Using them for transporting the machinery may result in injury or malfunction.

Installation Precautions

⚠️ **WARNING**   Provide an appropriate stopping device on the machine side to secure safety. (A holding brake is not a stopping device for securing safety.) Not doing so may result in injury.

⚠️ **WARNING**   Provide an external emergency stopping device that allows an instantaneous stop of operation and power interruption. Not doing so may result in injury.

⚠️ **Caution**   Be sure to install the product in the correct direction and provide specified clearances between the Inverter and control panel or with other devices. Not doing so may result in fire or malfunction.

⚠️ **Caution**   Do not allow foreign objects to enter inside the product. Doing so may result in fire or malfunction.

⚠️ **Caution**   Do not apply any strong impact. Doing so may result in damage to the product or malfunction.

Wiring Precautions

⚠️ **WARNING**   Wiring must be performed only after confirming that the power supply has been turned OFF. Not doing so may result in electrical shock.

⚠️ **WARNING**   Wiring must be performed by authorized personnel. Not doing so may result in electrical shock or fire.

⚠️ **WARNING**   Be sure to confirm operation only after wiring the emergency stop circuit. Not doing so may result in injury.

⚠️ **WARNING**   Always connect the ground terminals to a ground of 100 Ω or less for the 200-V AC class, or 10 Ω or less for the 400-V AC class. Not connecting to a proper ground may result in electrical shock.

⚠️ **Caution**   Install external breakers and take other safety measures against short-circuiting in external wiring. Not doing so may result in fire.

⚠️ **Caution**   Confirm that the rated input voltage of the Inverter is the same as the AC power supply voltage. An incorrect power supply may result in fire, injury, or malfunction.

⚠️ **Caution**   Connect the Braking Resistor and Braking Resistor Unit as specified in the manual. Not doing so may result in fire.

⚠ **Caution**   Be sure to wire correctly and securely. Not doing so may result in injury or damage to the product.

⚠ **Caution**   Be sure to firmly tighten the screws on the terminal block. Not doing so may result in fire, injury, or damage to the product.

⚠ **Caution**   Do not connect any power source to the U, V, or W output. Doing so may result in damage to the product or malfunction.

⚠ **Caution**   Do not connect a load to the motor when performing auto-tuning. Doing so may result in personal injury or equipment damage.

Operation and Adjustment Precautions

⚠ **WARNING**   Turn ON the input power supply only after mounting the front cover, terminal covers, bottom cover, Operator, and optional items. Not doing so may result in electrical shock.

⚠ **WARNING**   Do not remove the front cover, terminal covers, bottom cover, Operator, or optional items while the power is being supplied. Not doing so may result in electrical shock or damage to the product.

⚠ **WARNING**   Do not operate the Operator or switches with wet hands. Doing so may result in electrical shock.

⚠ **WARNING**   Do not touch the inside of the Inverter. Doing so may result in electrical shock.

⚠ **WARNING**   Do not come close to the machine when using the error retry function because the machine may abruptly start when stopped by an alarm. Doing so may result in injury.

⚠ **WARNING**   Do not come close to the machine immediately after resetting momentary power interruption to avoid an unexpected restart (if operation is set to be continued in the processing selection function after momentary power interruption is reset). Doing so may result in injury.

⚠ **WARNING**   Provide a separate emergency stop switch because the STOP Key on the Operator is valid only when function settings are performed. Not doing so may result in injury.

⚠ **WARNING**   Be sure confirm that the RUN signal is turned OFF before tuning ON the power supply, resetting the alarm, or switching the LOCAL/REMOTE selector. Doing so while the RUN signal is turned ON may result in injury.

⚠ **Caution**   Be sure to confirm permissible ranges of motors and machines before operation because the Inverter speed can be easily changed from low to high. Not doing so may result in damage to the product.

⚠ **Caution**   Provide a separate holding brake when necessary. Not doing so may result in injury.

⚠ **Caution**   Do not perform a signal check during operation. Doing so may result in injury or damage to the product.

⚠ **Caution**   Do not carelessly change settings. Doing so may result in injury or damage to the product.

Maintenance and Inspection Precautions

⚠ **WARNING**   Do not touch the Inverter terminals while the power is being supplied.

⚠ **WARNING**   Maintenance or inspection must be performed only after turning OFF the power supply, confirming that the CHARGE indicator (or status indicators) is turned OFF, and after waiting for the time specified on the front cover. Not doing so may result in electrical shock.

⚠ **WARNING**   Maintenance, inspection, or parts replacement must be performed by authorized personnel. Not doing so may result in electrical shock or injury.

⚠ **WARNING**   Do not attempt to take the Unit apart or repair. Doing either of these may result in electrical shock or injury.

⚠ **Caution**   Carefully handle the Inverter because it uses semiconductor elements. Careless handling may result in malfunction.

⚠ **Caution**   Do not change wiring, disconnect connectors, the Operator, or optional items, or replace fans while power is being supplied. Doing so may result in injury, damage to the product, or malfunction.

Warning Information and Position

There is warning information on the Inverter in the position shown in the following illustration. Always heed the warnings.

Warning information position

Illustration shows the 3G3RV-A2004
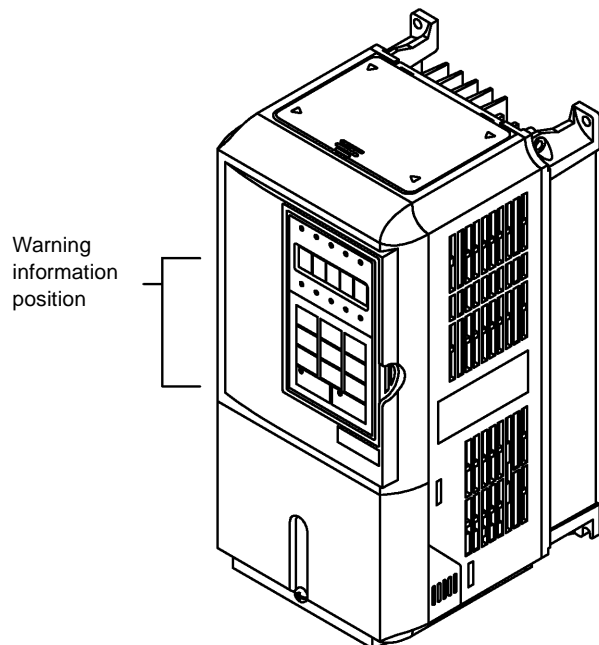
Warning information position
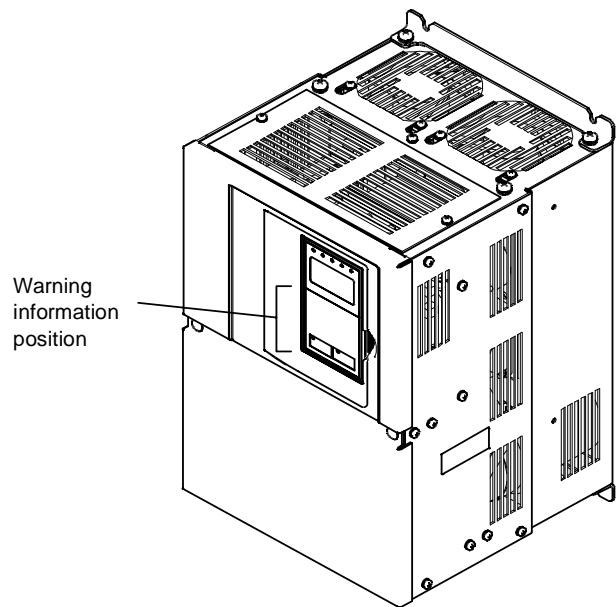
Illustration shows the 3G3RV-B2220

Warning Information

For Europe (-E suffix) Models

> ⚠ WARNING
>
> ⚡ Risk of electric shock.
> •Read manual before installing.
> •Wait 5 minutes for capacitor discharge after disconnecting power supply.
>
> ⚠ AVERTISSEMENT
>
> ⚡ Risque de dØcharge Ølectrique.
> •Lire le manuel avant l' installation.
> •Attendre 5 minutes aprØs la coupure de l' allmentation. Pour permettre la dØcharge des condensateurs.

For ASIA Model (No suffix)

> ⚠ WARNING
>
> ⚡ Risk of electric shock.
> •Read manual before installing.
> •Wait 5 minutes for capacitor discharge after disconnecting power supply.
>
> ⚠ AVERTISSEMENT
>
> ⚡ Risque de dØcharge Ølectrique.
> •Lire le manuel avant l' installation.
> •Attendre 5 minutes aprØs la coupure de l' allmentation. Pour permettre la dØcharge des condensateurs.
>
> ⚠ 危険
>
> ⚡ けが・感電のおそれがあります。
> •据え付け・運転の前には必ず取扱説明書をお読み下さい。
> •通電中及び電源遮断後5分以内はフロントカバーを外さないで下さい。

Registered Trademarks

The following registered trademarks are used in this manual.

- DeviceNet is a registered trademark of the ODVA (Open DeviceNet Vendors Association, Inc.).
- MODBUS is a trademark of the AEG Schneider Automation, Inc.

Contents

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Chapter 1

Handling Inverters

This chapter describes the checks required upon receiving or installing an Inverter.

SYSDRIVE RV Introduction

◆ SYSDRIVE RV Applications

The SYSDRIVE RV is ideal for the following applications.

- Fan, blower, and pump applications
- Conveyors, pushers, metal tooling machines, etc.

Settings must be adjusted to the application for optimum operation. Refer to *Chapter 4 Trial Operation.*

◆ RV-series Inverter Models

RV-series Inverters have different models and specifications by the area (Asia and Europe) to support widely used applications and different power supply situations in each area.

Be sure to confirm the models and the specifications you are going to purchase in *RV-series Inverter Models* and *Differences by Model*, below.

In each area, only the products for the area are available (e.g., in Europe, only the models with "-E" are sold).

RV-series Inverters have two types of voltage class: 200-V class and the 400-V class. The capacity range of applicable motors is 0.4 kW to 160 kW. All the models comply with EC Directives.

■200-V Class RV-series Inverter Models

Table 1.1 RV-series Inverter Models (200-V Class)

Protective Structure	Maximum Applied Motor Capacity	Model (Asia)	Model (Europe)
NEMA 1 type IP20	0.4 kW	3G3RV-A2004	3G3RV-A2004-E
	0.75 kW	3G3RV-A2007	3G3RV-A2007-E
	1.5 kW	3G3RV-A2015	3G3RV-A2015-E
	2.2 kW	3G3RV-A2022	3G3RV-A2022-E
	3.7 kW	3G3RV-A2037	3G3RV-A2037-E
	5.5 kW	3G3RV-A2055	3G3RV-A2055-E
	7.5 kW	3G3RV-A2075	3G3RV-A2075-E
	11 kW	3G3RV-A2110	3G3RV-A2110-E
	15 kW	3G3RV-A2150	3G3RV-A2150-E
	18.5 kW	3G3RV-A2185	3G3RV-A2185-E
	22 kW	Not available Use IP00 type	3G3RV-A2220-E
	30 kW		3G3RV-A2300-E
	37 kW		3G3RV-A2370-E
	45 kW		3G3RV-A2450-E
	55 kW		3G3RV-A2550-E
	75 kW		3G3RV-A2750-E
	90 kW		Not available Use IP00 type
	110 kW		

Protective Structure	Maximum Applied Motor Capacity	Model (Asia)	Model (Europe)
Open Chassis type IP00	22 kW	3G3RV-B2220	3G3RV-B2220-E
	30 kW	3G3RV-B2300	3G3RV-B2300-E
	37 kW	3G3RV-B2370	3G3RV-B2370-E
	45 kW	3G3RV-B2450	3G3RV-B2450-E
	55 kW	3G3RV-B2550	3G3RV-B2550-E
	75 kW	3G3RV-B2750	3G3RV-B2750-E
	90 kW	3G3RV-B2900	3G3RV-B2900-E
	110 kW	3G3RV-B211K	3G3RV-B211K-E

Note To make IP00 Inverters satisfy the IP20 protective structure, install the Inverter into an IP20 structured box.

■400-V Class RV-series Inverter Models

Table 1.2 RV-series Inverter Models (400-V Class)

Protective Structure	Maximum Applied Motor Capacity	Model （Asia）	Model （Europe）
NEMA1type IP20	0.4 kW	3G3RV-A4004	3G3RV-A4004-E
	0.75 kW	3G3RV-A4007	3G3RV-A4007-E
	1.5 kW	3G3RV-A4015	3G3RV-A4015-E
	2.2 kW	3G3RV-A4022	3G3RV-A4022-E
	3.7 kW	3G3RV-A4037	3G3RV-A4037-E
	4.0 kW	Not Available	3G3RV-A4040-E
	5.5 kW	3G3RV-A4055	3G3RV-A4055-E
	7.5 kW	3G3RV-A4075	3G3RV-A4075-E
	11 kW	3G3RV-A4110	3G3RV-A4110-E
	15 kW	3G3RV-A4150	3G3RV-A4150-E
	19 kW	3G3RV-A4185	3G3RV-A4185-E
	22 kW		3G3RV-A4220-E
	30 kW		3G3RV-A4300-E
	37 kW		3G3RV-A4370-E
	45 kW		3G3RV-A4450-E
	55 kW	Not available Use IP00 type	3G3RV-A4550-E
	75 kW		3G3RV-A4750-E
	90 kW		3G3RV-A4900-E
	110 kW		3G3RV-A411K-E
	132 kW		3G3RV-A413K-E
	160 kW		3G3RV-A416K-E
Open Chassis type IP00	22 kW	3G3RV-B4220	3G3RV-B4220-E
	30 kW	3G3RV-B4300	3G3RV-B4300-E
	37 kW	3G3RV-B4370	3G3RV-B4370-E
	45 kW	3G3RV-B4450	3G3RV-B4450-E
	55 kW	3G3RV-B4550	3G3RV-B4550-E
	75 kW	3G3RV-B4750	3G3RV-B4750-E
	90 kW	3G3RV-B4900	3G3RV-B4900-E
	110 kW	3G3RV-B411K	3G3RV-B411K-E
	132 kW	3G3RV-B413K	3G3RV-B413K-E
	160 kW	3G3RV-B416K	3G3RV-B416K-E

Note To make IP00 Inverters satisfy the IP20 protective structure, install the Inverter into an IP20 structured box.

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Differences by Model

The RV-series products differ in specifications by model. This section explains the differences.

◆ Differences in Hardware

For details, refer to *Chapter 3 The Digital Operator* and *Chapter 2 Wiring*.

Table 1.3 Differences in Hardware

		Asia	Europe (suffixed -E)
Digital Operator		LED type attached (LCD type is sold separately.) LED type: 3G3IV-PJVOP161 LCD type: 3G3IV-PJVOP160	LED type attached (LCD type is sold separately.) LED type: 3G3IV-PJVOP161 LCD type: 3G3IV-PJVOP160
Digital outputs	Multi-function output 1	P1-PC Transistor output	M3-M4 Relay contact output (SPST-N.O.)
	Multi-function output 2	P2-PC Transistor output	M5-M6 Relay contact output (SPST-N.O.)
Analog Input A1		Unsigned 10 bits 0 V to +10 V	Unsigned 12 bits -10 V to 10 V
Control Circuit Terminal Block		M3.5 screw terminal	Phoenix type

Note Abbreviations in the table have the following meanings.
SPDT: Single-pole Double-throw
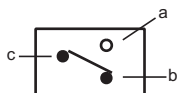
SPST-N.O.: Single-pole Single-throw with Normally Open Contact
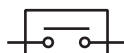
◆ Differences in Software (Function, Factory Setting, and Setting Range)

Refer to *Chapter 5 Parameters* for details.

Table 1.4 Differences in Software

Name	Parameter Number	Asia	Europe (suffixed -E)
Prohibition of reverse operation	b1-04	Setting range: 0 or 1 0: Reverse enabled 1: Reverse disabled	Setting range: 0 to2 0: Reverse enabled 1: Reverse disabled 2: Phase order changed (Only for V/f control)
DC injection braking time at stop	b2-04	Factory setting 0.50 s	Factory setting 0.00 s
Timer function ON/ OFF-delay time	b4-01 b4-02	Setting range 0.0 to 300.0 s	Setting range 0.0 to 3000.0 s
PID set point setting	b5-18 b5-19	Disabled	Enable the PID set point setting

Table 1.4 Differences in Software (Continued)

Name	Parameter Number	Asia	Europe (suffixed -E)
Torque value setting	C4-03 to C4-05	Disabled	C4-03/C4-04: Set the rated torque of the motor. C4-05: Set the time constant (ms) for the rising start torque value. Note: The filter is disabled if set between 0 ms and 4 ms.
Motor constant	E1/E3	Factory setting 200-V class = 200 V 60 Hz 400-V class = 400 V 60 Hz	Factory setting 200-V class = 200 V 50 Hz 400-V class = 400 V 50 Hz
PG constant	F1-01	Factory setting 600 pulses/rotation	Factory setting 1024 pulses/rotation
Display unit selection for current monitor	F6-05	Disabled	Setting range 0 to 1 0: Amperage display 1: 100% for 8192
Multi-function inputs	H1-01 to H1-05	Setting range: 0 to 68 69 and 6A: Disabled	Setting range: 0 to 6 A 69: JOG2 6A: Drive Enable 0 to 68: Same for all models
Multi-function outputs	H2-02	Terminal P1 function select	Terminal M3-M4 function select (Transistor output)
	H2-03	Terminal P2 function select	Terminal M5-M6 function select (Transistor output)
Signal select terminal A1 (voltage)	H3-01	Disabled with 0 setting. 0: Voltage Limit enabled unchangeable	Setting range: 0 or 1 0: Voltage Limit enabled 1: Voltage Limit disabled
Gain (terminal FM)	H4-02	Setting range 0.0 to 2.5 Factory setting 1.00	Setting range 0.0 to 1000.0% Factory setting 100.0%
Gain (terminal AM)	H4-05	Setting range 0.0 to 2.5 Factory setting 0.50	Setting range 0.0 to 1000.0% Factory setting 50.0%
Bias (terminal FM)	H4-03	Setting range -10.0% to +10.0%	Setting range -110.0% to +110.0%
Bias (terminal AM)	H4-06	Setting range -10.0% to +10.0%	Setting range -110.0% to +110.0%
Analog output 1 signal level selection	H4-07	Setting range: 0 to 1	Setting range: 0 to 2
Analog output 2 signal level selection	H4-08	0: 0 to +10 V 1: -10 to +10 V	0: 0 to +10 V 1: -10 to +10 V 2: 4 to 20 mA
Frequency reference for loss of frequency reference	L4-06	Uses the factory setting value (80%) and unchangeable.	Set reference frequency for operation when frequency lost. The output frequency is (Specified Frequency) x L4-06.
Input open-phase protection selection	L8-05	Factory setting 0 (Disabled)	Factory setting 1 (Enabled)
Output open-phase protection selection	L8-07	Factory setting 0 (Disabled)	Factory setting 1 (Enabled)

1

Table 1.4 Differences in Software (Continued)

Name	Parameter Number	Asia	Europe (suffixed -E)
LCD brightness adjustment	o1-05	Cannot change.	Setting Range: 0 to 5 Adjusts the brightness in five steps.
Operation selection when Digital Operator is disconnected	o2-06	Factory setting 0 (Disabled)	Factory setting 0 (Disabled)
Cumulative operation time selection	o2-08	Factory setting = 0 (Cumulative time when the Inverter power is ON)	Factory setting = 1 (Cumulative Inverter run time)
Fault trace and fault history initialization	o2-12	Cannot clear	0: Disabled (U2, U3 are held.) 1: Initialize Enabled (U2, U3 are cleared and o2-12 returns to 0.)
Fault history	U3-01 to U3-20	Four fault history records are stored. U3-01 to U3-08 are enabled. Serial communications addresses 90H to 97H are enabled. (800H to 813H are disabled)	Ten fault history records are stored. U3-01 to U3-20 are enabled. Serial communications addresses 800H to 813H and 90H to 97H are both enabled.

Confirmations upon Delivery

◆ Checks

Check the following items as soon as the Inverter is delivered.

Table 1.5 Checks

Item	Method
Has the correct model of Inverter been delivered?	Check the model number on the nameplate on the side of the Inverter.
Is the Inverter damaged in any way?	Inspect the entire exterior of the Inverter to see if there are any scratches or other damage resulting from shipping.
Are any screws or other components loose?	Use a screwdriver or other tools to check for tightness.

If you find any irregularities in the above items, contact the dealer from which you purchased the Inverter or your OMRON representative immediately.

◆ Nameplate Information

There is a nameplate attached to the side of each Inverter. The nameplate shows the model number, specifications, lot number, serial number, and other information on the Inverter.

■ Example Nameplate

The following nameplate is an example for an Asian-model Inverter: 3-phase, 200 VAC, 37 kW, IEC IP00 standards.
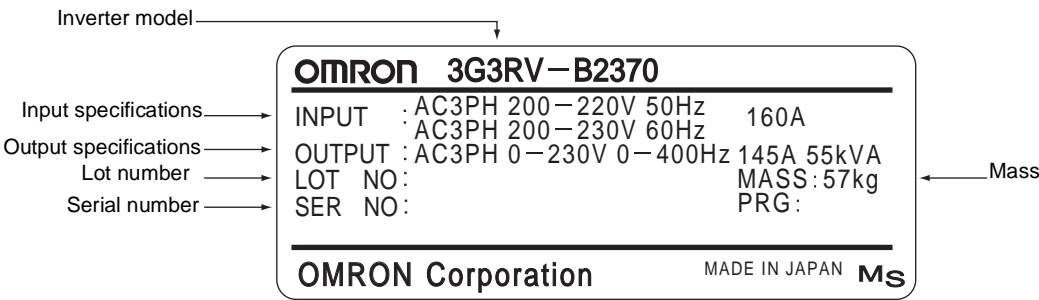
Fig 1.1 Nameplate

■Inverter Model Numbers

The model number of the Inverter on the nameplate indicates the specifications, voltage class, and maximum motor capacity of the Inverter in alphanumeric codes.

3G3RV - A 2 037 -E

Specifications

None	Asian model
-E	European model

Maximum Applicable Motor Capacity

004	0.4 kW	055	5.5 kW	220	22 kW	750	75 kW
007	0.75 kW	075	7.5 kW	300	30 kW	900	90 kW
015	1.5 kW	110	11 kW	370	37 kW	11K	110 kW
022	2.2 kW	150	15 kW	450	45 kW	13K	132 kW
037	3.7 kW	185	18.5 kW	550	55 kW	16K	160 kW
040	4.0 kW						

Voltage class

2	AC input, 3-phase, 200 V (200-V class)
4	AC input, 3-phase, 400 V (400-V class)

Installation type

A	Panel mounting or closed wall-mounting (IEC IP20, NEMA 1)
B	Open chassis (IEC IP00)

Series name: 3G3RV Series

Fig 1.2   Inverter Model Numbers

TERMS

Enclosed Wall-mounted Type (IEC IP20, NEMA 1)
The Inverter is structured so that it is shielded from the exterior, and can thus be mounted to the interior wall of a standard building (not necessarily enclosed in a control panel). The protective structure conforms to the standards of NEMA 1 in the USA.

Open Chassis Type (IEC IP00)
Protected so that parts of the human body cannot reach electrically charged parts from the front when the Inverter is mounted in a control panel.

◆ Component Names

■ Inverter Appearance

The external appearance and component names of the Inverter are shown in *Figs. 1.3*. and *1.4*
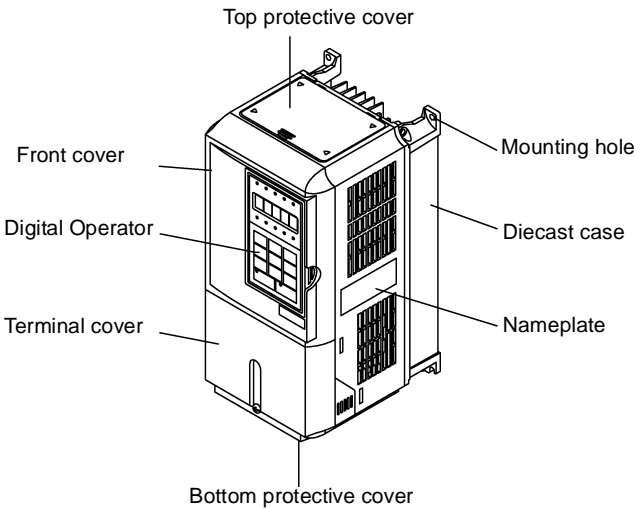
Fig 1.3 18.5 kW or Less
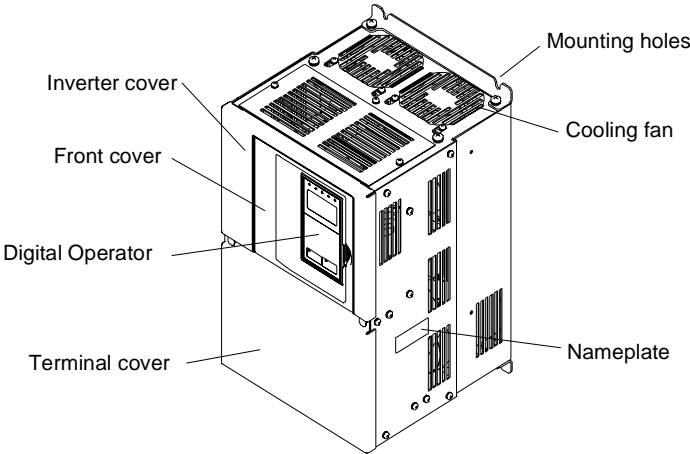
Fig 1.4 22 kW or More

■Terminal Arrangement for Asian Models

Views with the terminal cover removed are shown in *Figs. 1.5* and *1.6*.
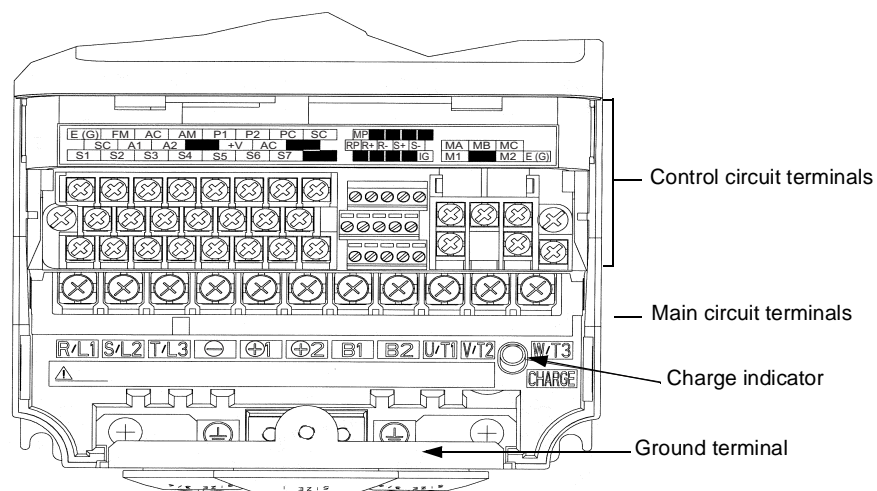
Fig 1.5 18.5 kW or Less
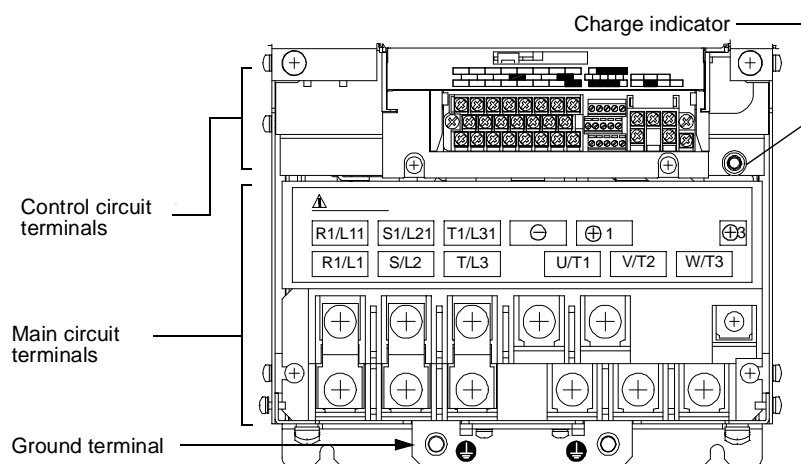
Fig 1.6 22 kW or More

■ Terminal Arrangement for European Models

Views with the terminal cover removed are shown in *Figs. 1.7* and *1.8*.
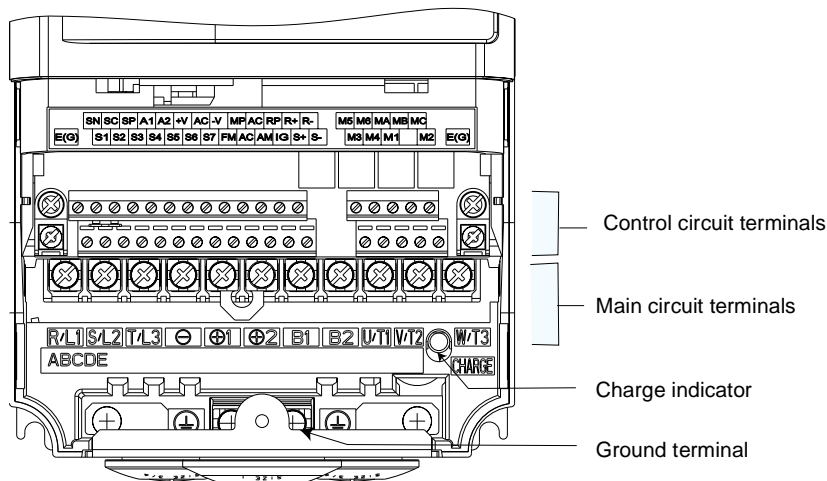
Fig 1.7 18.5 kW or Less
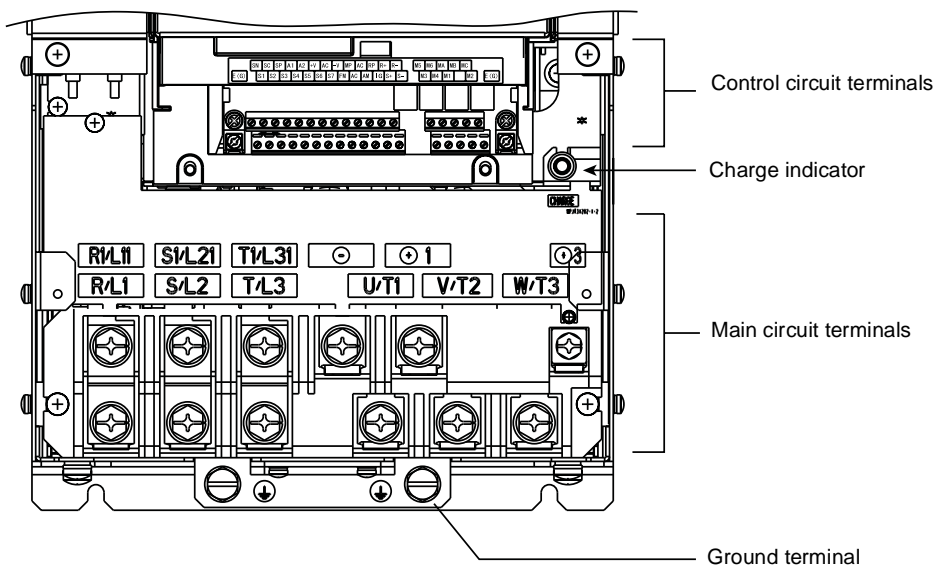
Fig 1.8 22 kW or More

Exterior and Mounting Dimensions

◆ Open Chassis Inverters (IP00)

Exterior diagrams of the Open Chassis Inverters are shown below.

A. 200-V class Inverters of 22 to 30 kW
  400-V class Inverters of 22 to 55 kW

B. 200-V class Inverters of 37 to 110 kW
  400-V class Inverters of 75 to 160 kW
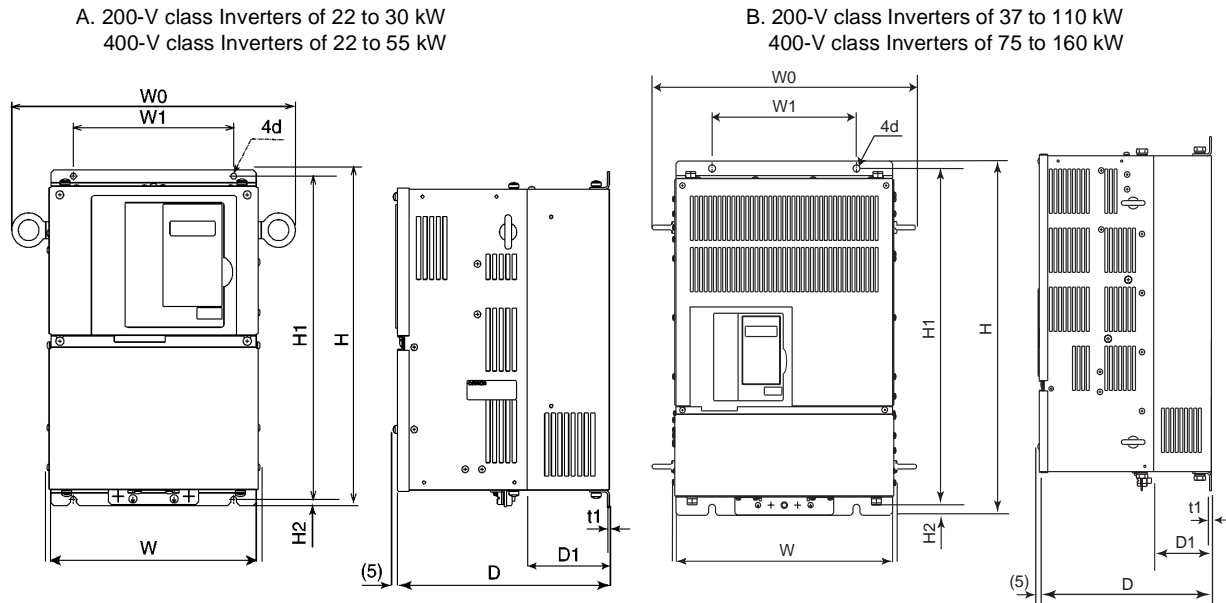
Fig 1.9 Exterior Diagrams of Open Chassis Inverters

◆ Enclosed Wall-mounted Inverters (NEMA 1)

Exterior diagrams of the Enclosed Wall-mounted Inverters (NEMA 1) are shown below.

C. 200-V/400-V class Inverters of 0.4 to 18.5 kW

D. 200-V class Inverters of 22 to 75 kW
  400-V class Inverters of 22 to 160 kW

(A 200-V class, 22-kW Inverter is shown as an example
sold only in Europe.)
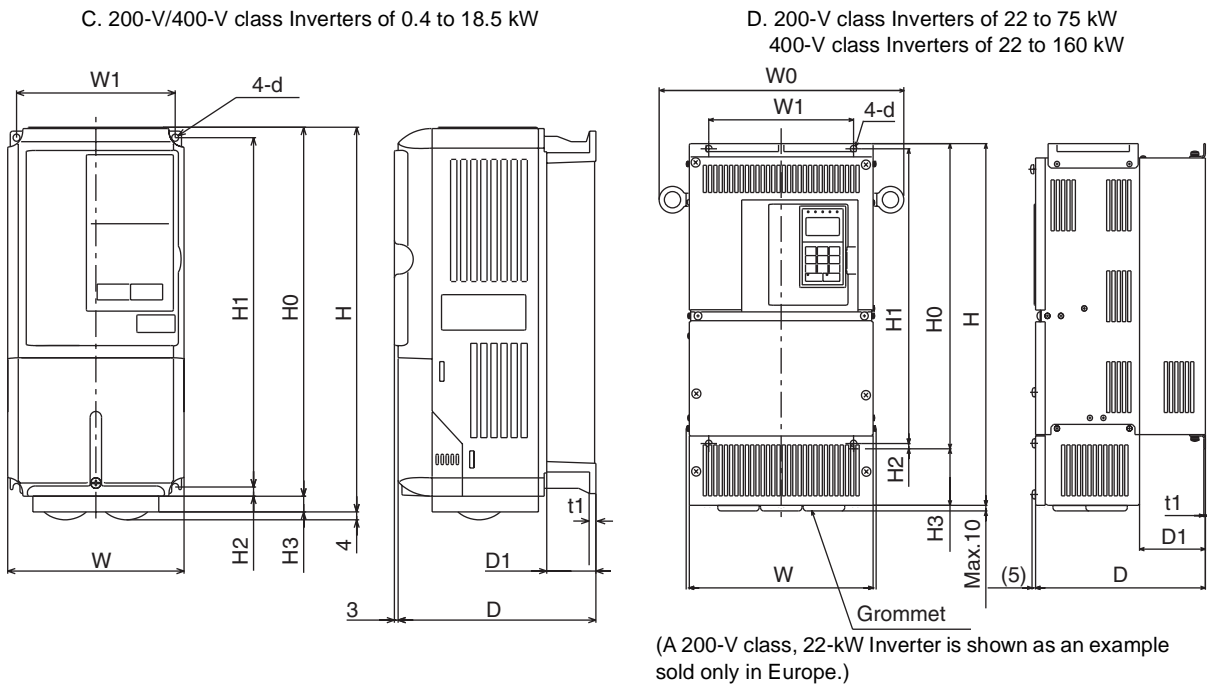
Fig 1.10 Exterior Diagrams of Enclosed Wall-mounted Inverters

Table 1.6 Open Chassis Type (IP00)

Voltage Class	Max. Motor Output (kW)	Model (-E included)	Figure	Dimensions (mm)									Approx. Mass (kg)	Mounting Holes d*	Caloric Value (W)			Cooling Method
				W0	W	H	D	W1	H1	H2	D1	t1			External	Internal	Total Heat Generated	
200 V 3-phase	0.4	-																Natural
	0.75	-																
	1.5	-																
	2.2	-																
	3.7	-		Not available. Use NEMA1 1 type by removing the top and the bottom cover.														Fan
	5.5	-																
	7.5	-																
	11	-																
	15	-																
	18.5	-																
	22	3G3RV-B2220	A	345	254.2	400	258	195	385	7.5	100	2.3	21	M6	586	274	860	
	30	3G3RV-B2300	A	370	279.2	450	258	220	435	7.5	100	2.3	24	M6	865	352	1217	
	37	3G3RV-B2370	B	470	379.2	600	298	250	575	13	100	3.2	57	M10	1015	411	1426	
	45	3G3RV-B2450	B	470	379.2	600	328	250	575	13	100	3.2	63	M10	1266	505	1771	
	55	3G3RV-B2550	B	545	454.2	725	348	325	700	13	130	3.2	86	M10	1588	619	2206	
	75	3G3RV-B2750	B	545	454.2	725	348	325	700	13	130	3.2	87	M10	2019	838	997	
	90	3G3RV-B2900	B	615	505.2	850	358	370	820	15	130	4.5	108	M12	2437	997	3434	
	110	3G3RV-B211K	B	690	579.2	885	378	445	855	15	140	4.5	150	M12	2733	1242	3975	
400 V 3-phase	0.4	-																Natural
	0.75	-																
	1.5	-																
	2.2	-																
	3.7	-		Not available. Use NEMA1 1 type by removing the top and the bottom cover.														Fan
	4.0	-																
	5.5	-																
	7.5	-																
	11	-																
	15	-																
	18.5	-																
	22	3G3RV-B4220	A	370	280	450	258	220	435	7.5	100	2.3	21	M6	466	259	725	Fan
	30	3G3RV-B4300	A	370	280	450	258	220	435	7.5	100	2.3	21	M6	678	317	995	
	37	3G3RV-B4370	A	370	280	450	258	220	435	7.5	100	2.3	36	M6	784	360	1144	
	45	3G3RV-B4450	A	420	329.2	550	283	260	535	7.5	105	2.3	36	M6	901	415	1316	
	55	3G3RV-B4550	A	420	329.2	550	283	260	535	7.5	105	2.3	36	M6	1203	495	1698	
	75	3G3RV-B4750	B	545	454.2	725	348	325	700	13	130	3.2	88	M10	1399	575	1974	
	90	3G3RV-B4900	B	545	454.2	725	348	325	700	13	130	3.2	89	M10	1614	671	2285	
	110	3G3RV-B411K	B	615	505.2	850	358	370	820	15	130	4.5	102	M12	2097	853	2950	
	132	3G3RV-B413K	B	615	505.2	850	358	370	820	15	130	4.5	120	M12	2388	1002	3390	
	160	3G3RV-B416K	B	689	579.2	916	378	445	855	15	140	4.5	160	M12	2791	1147	3938	

1

Table 1.7 NEMA 1 Type (IP20)

Voltage Class	Max. Motor Output (kW)	Model (-E included)	Figure	W0	W	H	D	W1	H0	H1	h2	H3	D1	t1	Approx. Mass (kg)	Mounting Holes d*	External	Internal	Total heat generated	Cooling Method
200 V 3-phase	0.4	3G3RV-A2004	C	-	140	280	157	126	280	266	7	0	39	5	3	M5	20	39	59	Natural
	0.75	3G3RV-A2007															27	42	69	
	1.5	3G3RV-A2015															50	50	100	
	2.2	3G3RV-A2022															70	59	129	
	3.7	3G3RV-A2037					177							59		4		112	74	186	Fan
	5.5	3G3RV-A2055															164	84	248	
	7.5	3G3RV-A2075			200	300	197	186	300	285		10	65.5		6	M6	219	113	332	
	11	3G3RV-A2110				310									7		374	170	544	
	15	3G3RV-A2150			240	350	207	216	350	335	7.5	0	78	2.3	11		429	183	612	
	18.5	3G3RV-A2185				380						30					501	211	712	
	22	3G3RV-A2220	D	345	255	535	258	195	400	385		135	100		21		586	274	860	
	30	3G3RV-A2300		370	280	615		220	450	435		165			24		865	352	1217	
	37	3G3RV-A2370		470	380	809	300	250	600	575		210	100		62	M10	1015	411	1426	
	45	3G3RV-A2450					330				13			3.2	68		1266	505	1771	
	55	3G3RV-A2550		545	455	1027	350	325	725	700		305	130		94		1588	619	2206	
	75	3G3RV-A2750													95		2019	838	997	
	90	-																		
	110	-									Not available. Use IP00 type.									
400 V 3-phase	0.4	3G3RV-A4004	C	-	140	280	157	126	280	266	7	0	39	5	3	M5	14	39	53	Natural
	0.75	3G3RV-A4007															17	41	58	
	1.5	3G3RV-A4015															36	48	84	
	2.2	3G3RV-A4022															59	56	115	Fan
	3.7	3G3RV-A4037					177							59		4		80	68	148	
	4.0	3G3RV-A4040															90	70	160	
	5.5	3G3RV-A4055															127	82	209	
	7.5	3G3RV-A4075			200	300	197	186	300	285			65.5		6		193	114	307	
	11	3G3RV-A4110															252	158	410	
	15	3G3RV-A4150			240	350	207	216	350	335			78		10		326	172	498	
	18.5	3G3RV-A4185															426	208	634	
	22	3G3RV-A4220	D	370	280	535	258	220	450	435	7.5	85	100	2.3	21	M6	466	259	725	Fan
	30	3G3RV-A4300															678	317	995	
	37	3G3RV-A4370		420	329.2	635	283	260	550	535			105		36		784	360	1144	
	45	3G3RV-A4450				715						165					901	415	1316	
	55	3G3RV-A4550															1203	495	1698	
	75	3G3RV-A4750		545	454.2	1100	348	325	725	700	13	305	130	3.2	88	M10	1399	575	1974	
	90	3G3RV-A4900													89		1614	671	2285	
	110	3G3RV-A411K		615	505.2	1245	358	370	850	820		395			102	M12	2097	853	2950	
	132	3G3RV-A413K									15			4.5	120		2388	1002	3390	
	160	3G3RV-A416K		689	579.2	1325	378	445	916	855		400	140		160		2791	1147	3938	

Checking and Controlling the Installation Site

Install the Inverter in an installation site as described below and maintain optimum conditions.

◆ Installation Site

Install the Inverter under the following conditions and in a pollution degree 2 environment.

Table 1.8 Installation Site

Type	Ambient Operating Temperature	Humidity
Closed wall-mounting	-10 to + 40 °C	95% RH or less (no condensation)
Open chassis	-10 to + 45 °C	95% RH or less (no condensation)

Protection covers are attached to the top and bottom of the Inverter. Be sure to remove the protection covers before installing a 200 or 400-V class Inverter with an output of 18.5 kW or less in a panel.

Observe the following precautions when mounting the Inverter.

- Install the Inverter in a clean location free from oil mist and dust. It can be installed in a totally enclosed panel that is completely shielded from floating dust.
- When installing or operating the Inverter, always take special care so that metal powder, oil, water, or other foreign matter does not get into the Inverter.
- Do not install the Inverter on combustible material, such as wood.
- Install the Inverter in a location free from radioactive materials and combustible materials.
- Install the Inverter in a location free from harmful gasses and liquids.
- Install the Inverter in a location without excessive oscillation.
- Install the Inverter in a location free from chlorides.
- Install the Inverter in a location not in direct sunlight.

1

◆ Controlling the Ambient Temperature

To enhance the reliability of operation, the Inverter should be installed in an environment free from extreme temperature increases. If the Inverter is installed in an enclosed environment, such as a box, use a cooling fan or air conditioner to maintain the internal air temperature below 45°C.

◆ Protecting the Inverter from Foreign Matter

Place a cover over the Inverter during installation to shield it from metal powder produced by drilling.

Always remove the cover from the Inverter after completing installation. Otherwise, ventilation will be reduced, causing the Inverter to overheat.

Installation Orientation and Space

⚠ **WARNING**   Provide an appropriate stopping device on the machine side to secure safety. (A holding brake is not a stopping device for securing safety.) Not doing so may result in injury.

⚠ **WARNING**   Provide an external emergency stopping device that allows an instantaneous stop of operation and power interruption. Not doing so may result in injury.

⚠ **Caution**   Be sure to install the product in the correct direction and provide specified clearances between the Inverter and control panel or with other devices. Not doing so may result in fire or malfunction.

⚠ **Caution**   Do not allow foreign objects to enter inside the product. Doing so may result in fire or malfunction.

⚠ **Caution**   Do not apply any strong impact. Doing so may result in damage to the product or malfunction.

◆ Inverter Installation Orientation and Space

Install the Inverter vertically so as not to reduce the cooling effect. When installing the Inverter, always provide the following installation space to allow normal heat dissipation.

Horizontal Space
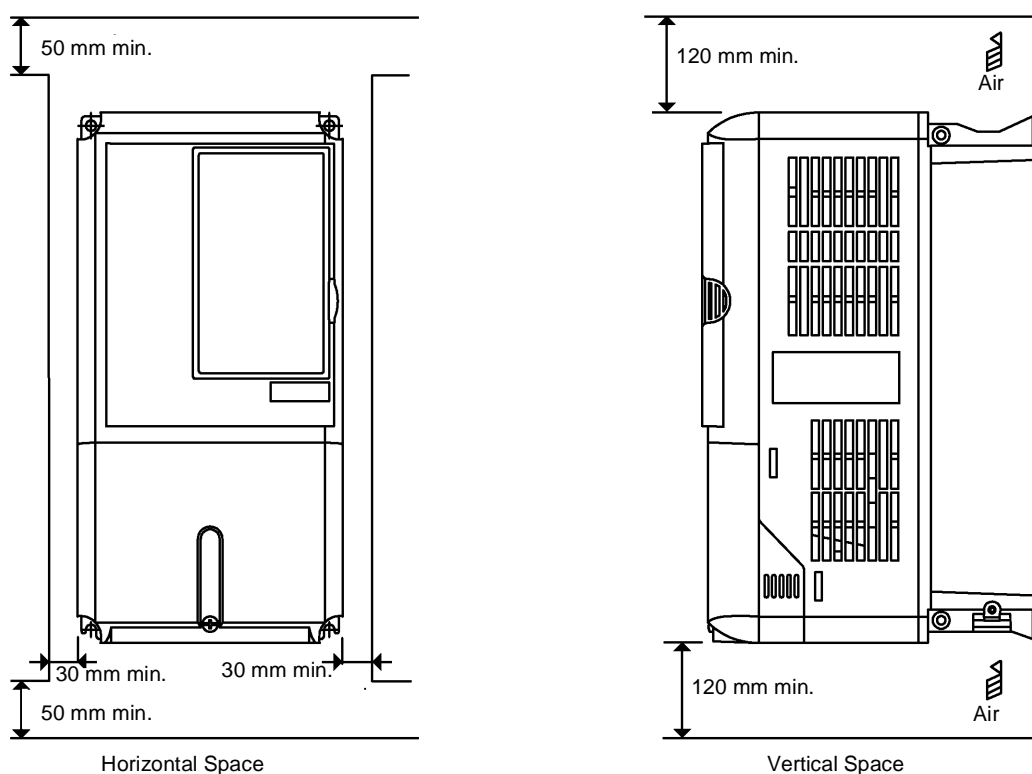
Vertical Space

Fig 1.11 Inverter Installation Orientation and Space

◆ Digital Operator Panel Cutout Dimensions
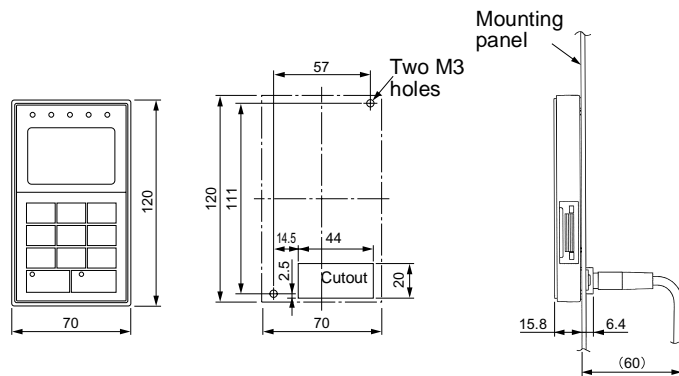
Fig 1.12 Digital Operator Panel Cutout Dimensions

IMPORTANT

1. The same space is required horizontally and vertically for both Closed Wall-mounting (IP20, NEMA 1)and Open Chassis (IP00) Inverters.
2. The top and bottom covers must be romoved before installing a 200 or 400-V class Inverter with an output of 18.5 kW or less in a panel.
   Always provide enough space for suspension eye bolts and the main circuit lines when installing a 200 or 400-V class Inverter with an output of 22 kW or more in a panel.

1

Removing and Attaching the Terminal Cover

Remove the terminal cover to wire cables to the control circuit and main circuit terminals.

◆ Removing the Terminal Cover

■ Inverters of 18.5 kW or Less

Loosen the screws at the bottom of the terminal cover, press in on the sides of the terminal cover in the directions of arrows 1, and then lift up on the terminal in the direction of arrow 2.
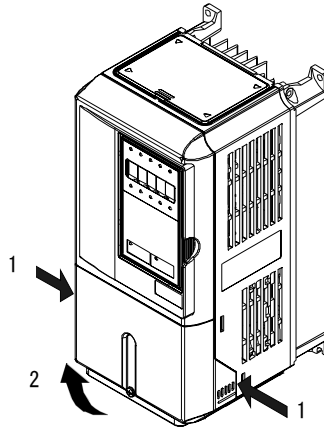
Fig 1.13 Removing the Terminal Cover (3G3RV-A2055 Shown Above)

■ Inverters of 22 kW or More

Loosen the screws on the left and right at the top of the terminal cover, pull out the terminal cover in the direction of arrow 1 and then lift up on the terminal in the direction of arrow 2.
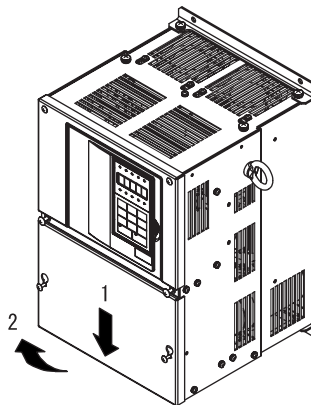
Fig 1.14 Removing the Terminal Cover (3G3RV-B2220 Shown Above)

◆ Attaching the Terminal Cover

When the terminal block wiring is completed, attach the terminal cover by reversing the removal procedure.

For Inverters with an output of 18.5 kW or less, insert the tab on the top of the terminal cover into the groove on the Inverter and press in on the bottom of the terminal cover until it clicks into place.

Removing/Attaching the Digital Operator and Front Cover

The methods for removing and attaching the Digital Operator and front cover are described in this section.

◆ Inverters of 18.5 kW or Less

To attach optional cards or change the terminal card connector, remove the Digital Operator and front cover in addition to the terminal cover. Always remove the Digital Operator from the front cover before removing the terminal cover.

The removal and attachment procedures are given below.

■Removing the Digital Operator

Press the lever on the side of the Digital Operator in the direction of arrow 1 to unlock the Digital Operator, and lift the Digital Operator in the direction of arrow 2 to remove it as shown in the following illustration.
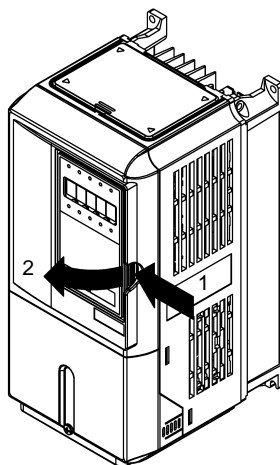
Fig 1.15 Removing the Digital Operator (3G3RV-A4055 Shown Above)

■Removing the Front Cover

Press the left and right sides of the front cover in the directions of arrows 1 and lift the bottom of the cover in the direction of arrow 2 to remove the front cover as shown in the following illustration.
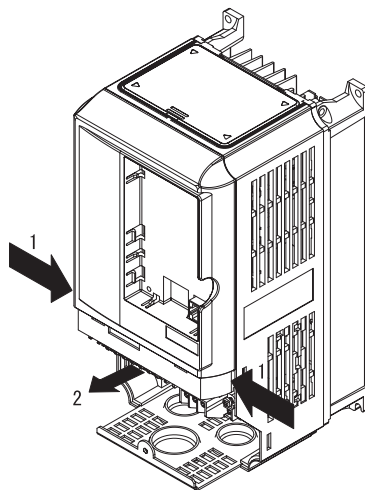
Fig 1.16 Removing the Front Cover (3G3RV-A4055 Shown Above)

■Mounting the Front Cover

After wiring the terminals, mount the front cover to the Inverter by performing in reverse order the steps to remove the front cover.

1. Do not mount the front cover with the Digital Operator attached to the front cover; otherwise, the Digital Operator may malfunction due to imperfect contact.

2. Insert the tab of the upper part of the front cover into the groove of the Inverter and press the lower part of the front cover onto the Inverter until the front cover snaps shut.

■Mounting the Digital Operator

After attaching the terminal cover, mount the Digital Operator onto the Inverter using the following procedure.

1. Hook the Digital Operator at A (two locations) on the front cover in the direction of arrow 1 as shown in the following illustration.

2. Press the Digital Operator in the direction of arrow 2 until it snaps in place at B (two locations).
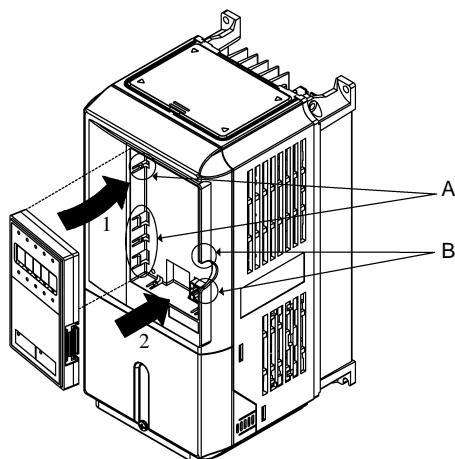
Fig 1.17 Mounting the Digital Operator

IMPORTANT

1. Do not remove or attach the Digital Operator or mount or remove the front cover using methods other than those described above, otherwise the Inverter may break or malfunction due to imperfect contact.
2. Never attach the front cover to the Inverter with the Digital Operator attached to the front cover. Imperfect contact can result.
   Always attach the front cover to the Inverter by itself first, and then attach the Digital Operator to the front cover.

◆ Inverters of 22 kW or More

For Inverters with an output of 22 kW or more, remove the terminal cover and then use the following procedure to remove the Digital Operator and front cover.

■Removing the Digital Operator

Use the same procedure as for Inverters with an output of 18.5 kW or less.

1

■Removing the Front Cover

Lift up at the location labeled 1 at the top of the control circuit terminal card in the direction of arrow 2.
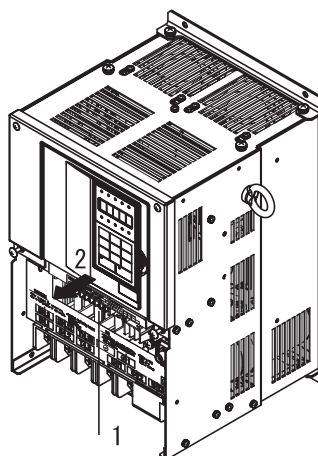
Fig 1.18 Removing the Front Cover (Model 3G3RV-B2220 Shown Above)

■ Attaching the Front Cover

After completing the necessary work, such as mounting an optional card or setting the terminal card, attach the front cover by reversing the procedure to remove it.

1. Confirm that the Digital Operator is not mounted on the front cover. Contact faults can occur if the cover is attached while the Digital Operator is mounted to it.

2. Insert the tab on the top of the front cover into the slot on the Inverter and press in on the cover until it clicks into place on the Inverter.

■Attaching the Digital Operator

Use the same procedure as for Inverters with an output of 18.5 kW or less.

2

Chapter 2
Wiring

This chapter describes wiring terminals, main circuit terminal connections, main circuit terminal wiring specifications, control circuit terminals, and control circuit wiring specifications.

Wiring

⚠ **WARNING**   Wiring must be performed only after confirming that the power supply has been turned OFF. Not doing so may result in electrical shock.

⚠ **WARNING**   Wiring must be performed by authorized personnel. Not doing so may result in electrical shock or fire.

⚠ **WARNING**   Be sure to confirm operation only after wiring the emergency stop circuit. Not doing so may result in injury.

⚠ **WARNING**   Always connect the ground terminals to a ground of 100 Ω or less for the 200-VAC class, or 10 Ω or less for the 400-VAC class. Not connecting to a proper ground may result in electrical shock.

⚠ **Caution**   Install external breakers and take other safety measures against short-circulating in external wiring. Not doing so may result in fire.

⚠ **Caution**   Confirm that the rated input voltage of the Inverter is the same as the AC power supply voltage. An incorrect power supply may result in fire, injury, or malfunction.

⚠ **Caution**   Connect the Braking Resistor and Braking Resistor Unit as specified in the manual. Not doing so may result in fire.

⚠ **Caution**   Be sure to wire correctly and securely. Not doing so may result in injury or damage to the product.

⚠ **Caution**   Be sure to firmly tighten the screws on the terminal block. Not doing so may result in fire, injury, or damage to the product.

⚠ **Caution**   Do not connect any power source to the U, V, or W output. Doing so may result in damage to the product or malfunction.

Connections to Peripheral Devices

Examples of connections between the Inverter and typical peripheral devices are shown in *Fig 2.1*.

Power supply

Molded-case circuit breaker or ground fault interrupter

Magnetic contactor (MC)

AC reactor for power factor improvement

Braking resistor

Input noise filter

DC reactor for power factor improvement

Inverter

Ground

Output noise filter

Motor

Ground
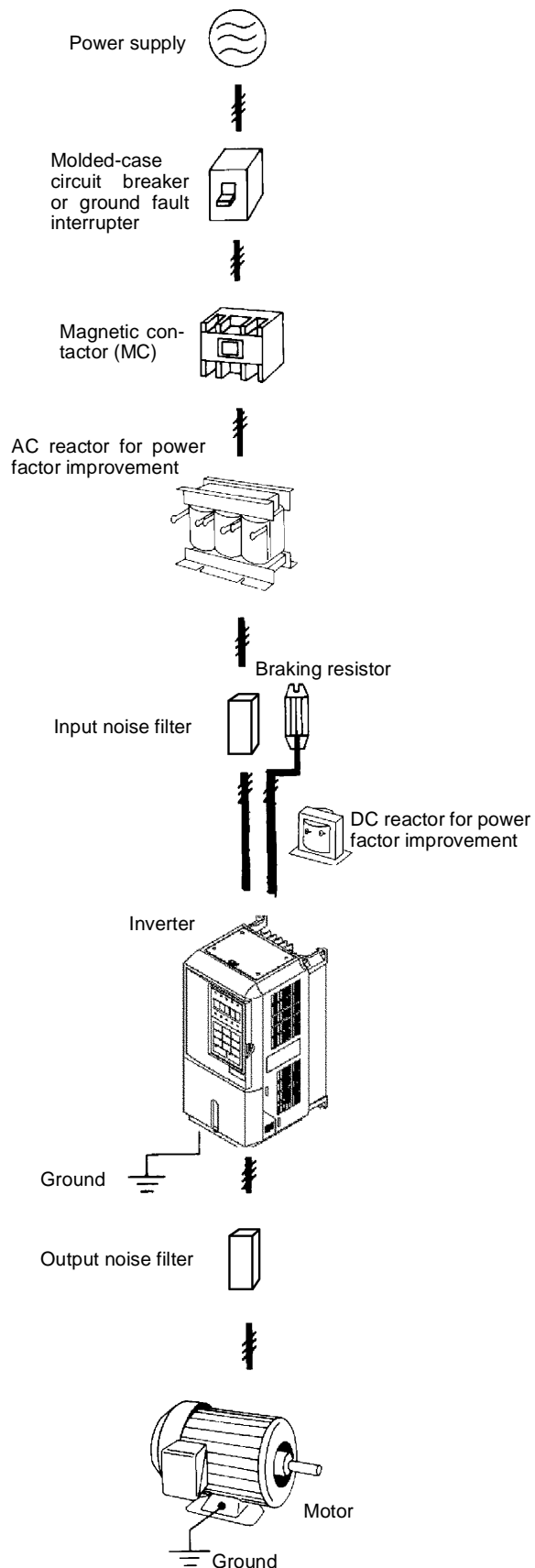
Fig 2.1 Example Connections to Peripheral Devices

Connection Diagrams

The connection diagrams for the Inverter are shown in this section.

◆ Asian Models

The connection diagram for Asian models is shown in *Fig. 2.2*.

When using the Digital Operator, the motor can be operated by wiring only the main circuits.
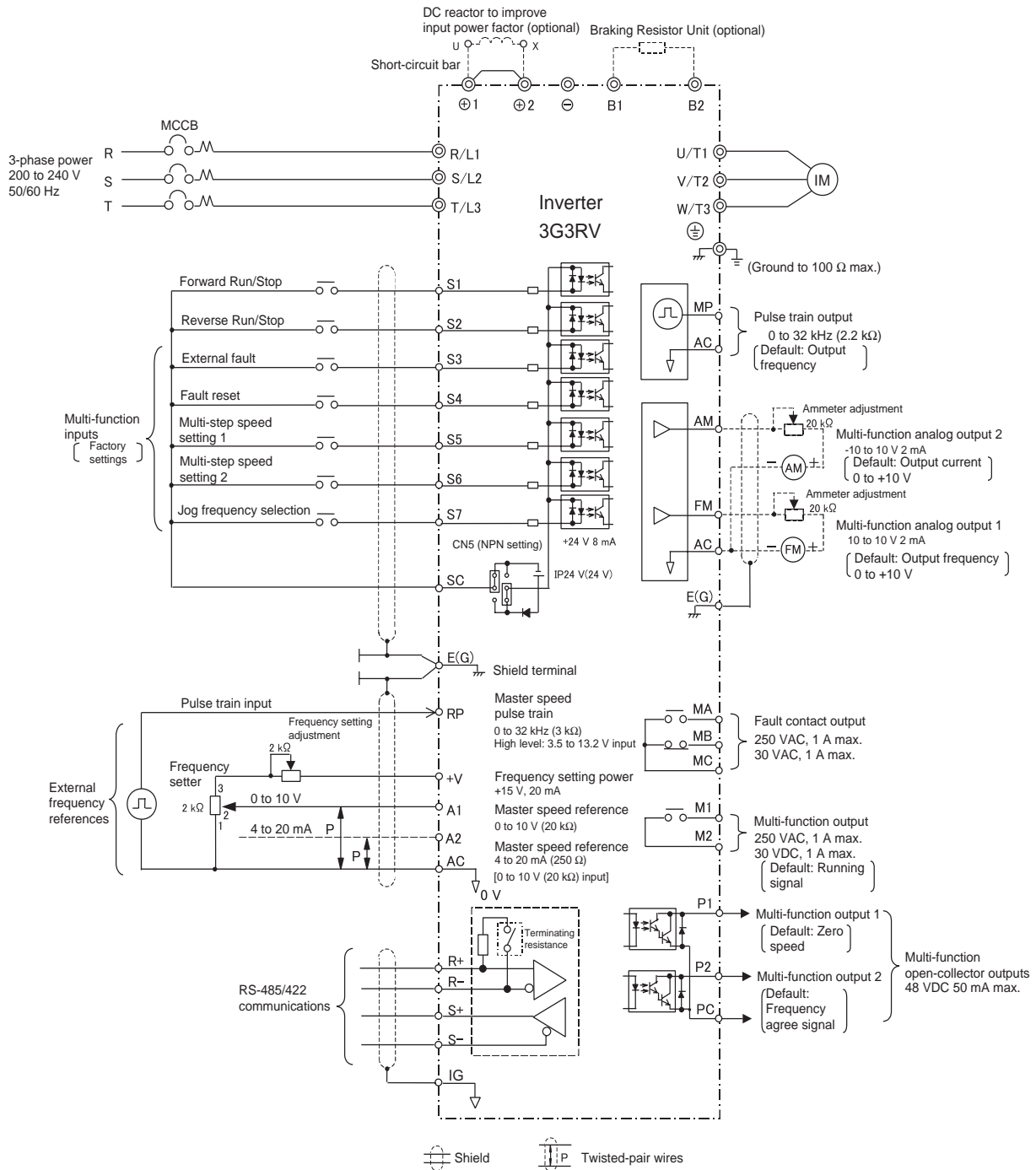
Fig 2.2 Connection Diagram for Asian Models

◆ European Models

The connection diagram for the European models is shown in *Fig. 2.3*.
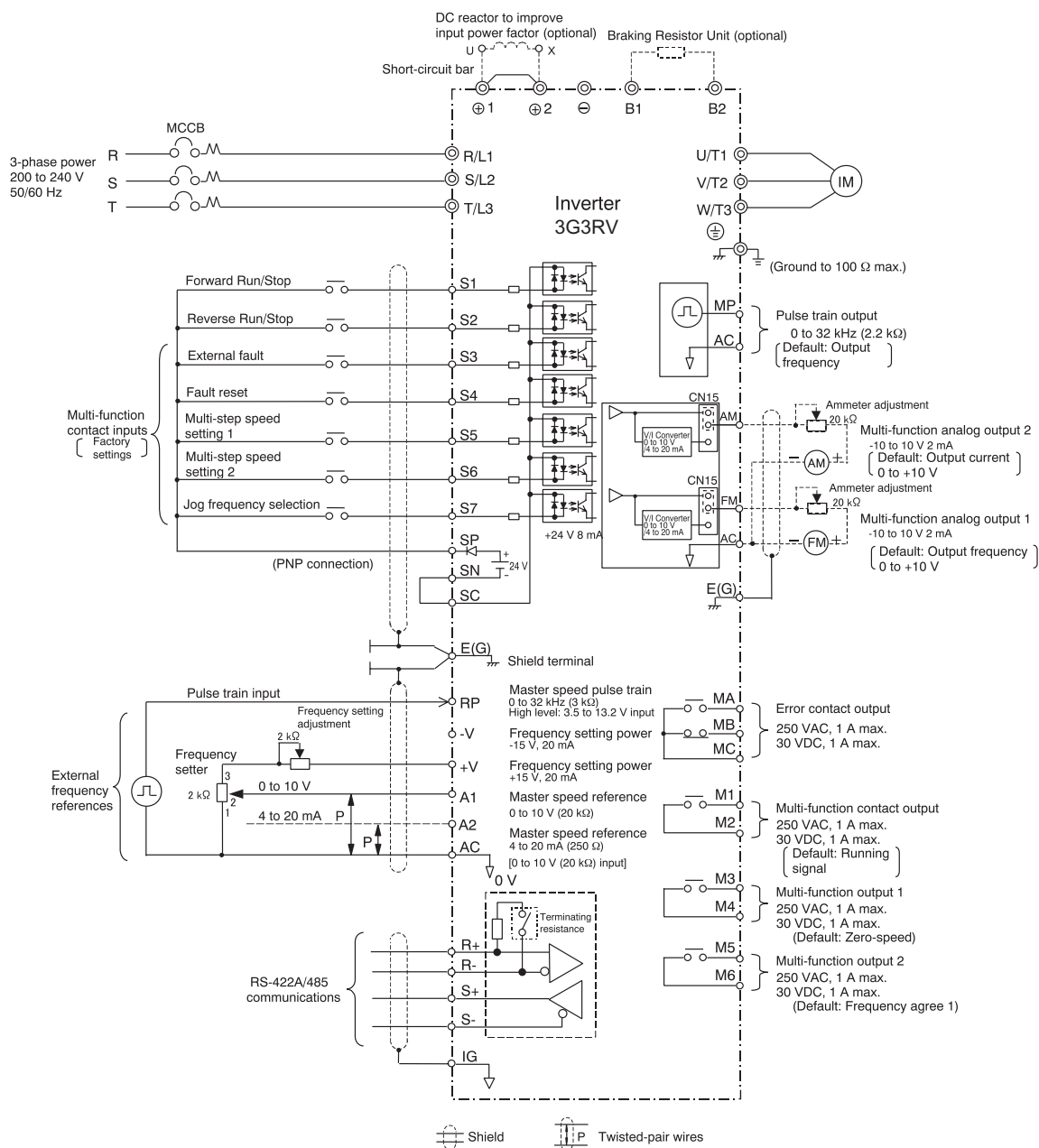
Fig 2.3 Connection Diagram for European (-E) Models

Terminal Block Configuration

◆ Terminal Arrangement for Asian Models

The terminal arrangement for Asian-model Inverters is shown in *Fig 2.4* and *Fig 2.5*.
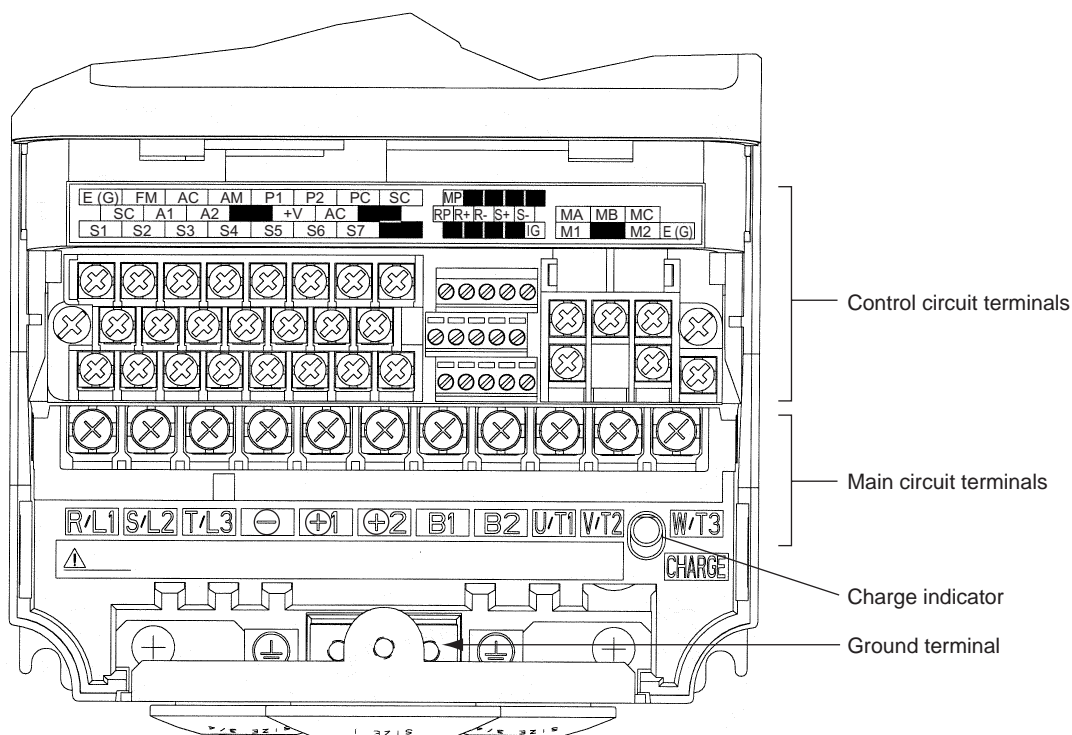
Fig 2.4 200-V Class Inverter for 0.4 kW
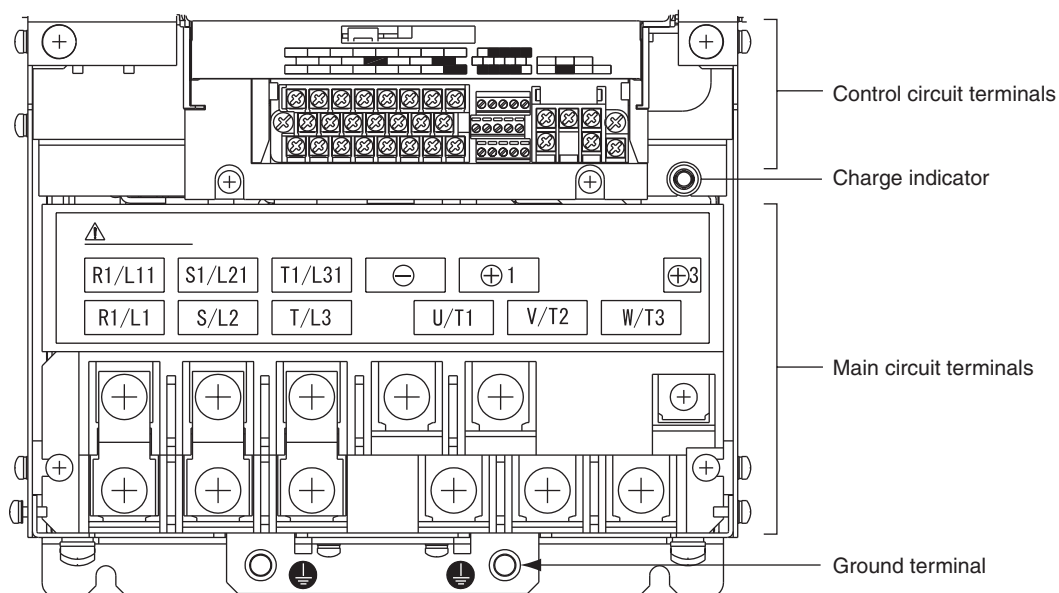
Fig 2.5 200-V class Inverter for 22 kW

◆ Terminal Arrangement for European Models

The terminal arrangement for European-model Inverters is shown in *Fig 2.6* and *Fig 2.7*.
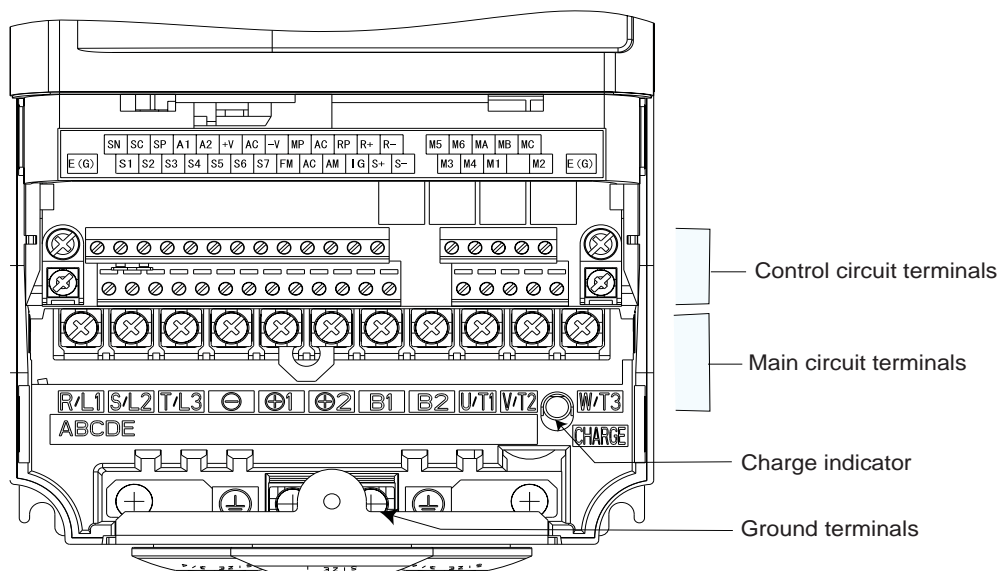
Fig 2.6 18.5 kW or Less
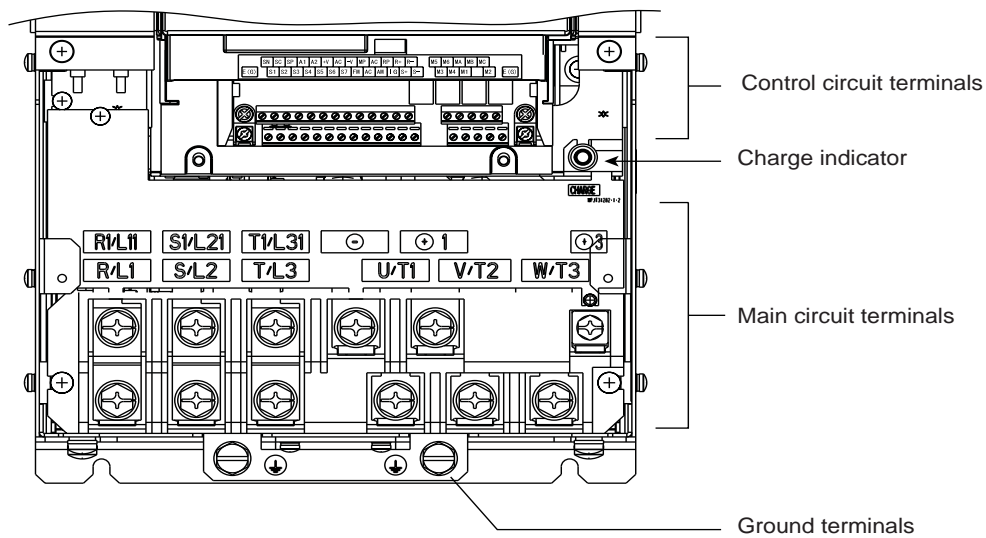
Fig 2.7 22 kW or More

◆ Terminal Functions

The functions of the main-circuit and control-circuit terminals are shown below.

■Asian Models

The terminal functions for the Asian-model Inverters are shown below.

Main-circuit Terminals

The functions for the main-circuit terminals by symbol are shown in *Table 2.1*. Be sure to wire correctly.

Table 2.1 Main-circuit Terminal Functions

Voltage Class	200-V Class			400-V Class		
3G3RV	A2004 to A2185	B2220 to B2300	B2370 to B211K	A4004 to A4185	B4220 to B4550	B4750 to B416K
Maximum Applied Motor Capacity	0.4 to 18.5 kW	22 to 30 kW	37 to 110 kW	0.4 to 18.5 kW	22 to 55 kW	75 to 160 kW
R/L1	Main-circuit power supply input	Main-circuit power supply input R-R1, S-S1, T-T1 are wired when shipped from the factory.		Main-circuit power supply input	Main-circuit power supply input R-R1, S-S1, T-T1 are wired when shipped from the factory.	
S/L2						
T/L3						
R1/L11	-			-		
S1/L21						
T1/L31						
U/T1	Inverter output			Inverter output		
V/T2						
W/T3						
B1	For Braking Resistor Unit connection	-		For Braking Resistor Unit connection	-	
B2						
⊖	For DC reactor connection (⊕1 and ⊕2)	For DC power supply input (⊕1 and ⊖) For Braking Unit connection (⊕3 and ⊖)		For DC reactor connection (⊕1 and ⊕2) For DC power supply input (⊕1 and ⊖)	For DC power supply input (⊕1 and ⊖) For Braking Unit connection (⊕3 and ⊖)	
⊕1						
⊕2	For DC power supply input (⊕1 and ⊖)					
⊕3	-			-		
⊥/ℓ2	-		Cooling fan power supply input *1	-		
r/ℓ1						Cooling fan power supply input *2
⊥200/ℓ2200	-			-		
⊥400/ℓ2400						
⏚	Ground (to resistance of 100 Ω or less)			Ground (to resistance of 10 Ω or less)		

Note Dashes (-) in the table indicate the absence of an item.

* 1. Cooling fan power supply input r/ℓ1- ⊥/ℓ2: 200 to 220-VAC, 50-Hz input or 200 to 230-VAC, 60-Hz input (A transformer is required for 230-VAC, 50-Hz input or 240-VAC, 50/60-Hz input.)

* 2. Cooling fan power supply input r/ℓ1- ⊥200/ℓ2200: 200 to 220-VAC, 50-Hz input or 200 to 230-VAC, 60-Hz input; r/ℓ1- ⊥400/ℓ2400: 380 to 480-VAC, 50/60 Hz input

Control-circuit Terminals (Same for 200-V and 400-V Class)

The functions for the control-circuit terminals by symbol are shown in *Table 2.2*.

Table 2.2 Control-circuit Terminal Functions

Type	Signal Symbol	Signal Name	Terminal Function	Signal Level
Sequence Input	S1	Forward-stop command	Forward when ON, stop when OFF	+24 VDC, 8 mA photocoupler isolation
	S2	Reverse-stop command	Reverse when ON, stop when OFF	
	S3	Multi-function input selection 1	Factory setting: External fault detected when ON	
	S4	Multi-function input selection 2	Factory setting: Fault reset when ON	
	S5	Multi-function input selection 3	Factory setting: Multi-step speed command 1 effective when ON	
	S6	Multi-function input selection 4	Factory setting: Multi-step speed command 2 effective when ON	
	S7	Multi-function input selection 5	Factory setting: Inching frequency selected when ON	
	SC	Sequence control input common	-	
Analog Input	+V	+15-V power supply	+15-V power supply for analog reference	+15 V (20 mA maximum allowable current)
	A1	Main speed frequency reference	0 to 10 V/100%	0 to 10 V (input impedance: 20 kΩ)
	A2	Multi-function analog input	4 to 20 mA/100%, 0 to 10 V/100% Factory setting: Add to terminal A1 (H3-09 = 0)	4 to 20 mA (input impedance: 20 kΩ) 0 to 10 V (input impedance: 20 kΩ)
	AC	Analog common	0 V	-
	E (G)	Shield wire, optional ground connection	-	-
Sequence Output	P1	Multi-function output 1	Factory setting: Zero speed Zero level (b2-01) or below when ON.	Open collector output +48 VDC, 50 mA
	P2	Multi-function output 2	Factory setting: Frequency agreement detection ON when the frequency is within ±2 Hz of the set frequency.	
	PC	Photocoupler output common	-	
	MA	Fault output (NO contact)	ON between MA and MC during fault	Relay output Dry contacts Contact capacity 250 VAC, 1 A max. 30 VDC, 1 A max.
	MB	Fault output (NC contact)	ON between MB and MC during fault.	
	MC	Relay contact output common	-	
	M1	Multi-function output (NO contact)	Factory setting: RUN ON between M1 and M2 during operation.	
	M2			
Analog Monitor Output	FM	Multi-function analog monitor 1	Factory setting: Output frequency 0 to 10 V/100% frequency	0 to +10 VDC ±5% 2 mA max.
	AM	Multi-function analog monitor 2	Factory setting: Current monitor 5 V/Inverter rated current	
	AC	Analog common	-	
Pulse Input/Output	RP	Multi-function pulse input	Factory setting: Frequency reference input (H6-01 = 0)	0 to 32 kHz (3 kΩ)
	MP	Multi-function pulse monitor	Factory setting: Output frequency (H6-06 = 2)	0 to 32 kHz (2.2 kΩ)

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Communications-circuit Terminals (Same for 200-V and 400-V Class)

The functions for the communications-circuit terminals by symbol are shown in *Table 2.3*.

Table 2.3 Communications-circuit Terminal Functions

Type	Signal Symbol	Signal Name	Terminal Function	Signal Level
RS-422A/485 Communications	R+	RS-422A/485 receive data	For 2-wire RS-485, short R+ and S+, as well as R- and S-.	Differential input, photocoupler isolation
	R-			
	S+	RS-422A/485 send data		Differential input, photocoupler isolation
	S-			
	IG	Shield wire for communications	-	-

■European Models

The terminal functions for European model Inverters are described below.

Main-circuit Terminals

The functions of the main-circuit termina.s by symbol are shown in Table 2.4. Be sure to wire correctly.

Table 2.4 Main-circuit Terminal Functions

Voltage Class	200-V Class			400-V Class		
3G3RV	A2004 to A2185	B2220 to B2300	B2370 to B211K	A4004 to A4185	B4220 to B4550	B4750 to B416K
Maximum Applied Motor Capacity	0.4 to 18.5 kW	22 to 30 kW	37 to 110 kW	0.4 to 18.5 kW	22 to 55 kW	75 to 160 kW
R/L1 S/L2 T/L3	Main-circuit power supply input	Main-circuit power supply input . R-R1, S-S1, T-T1 are wired when shipped from the factory.		Main-circuit power supply input	Main-circuit power supply input R-R1, S-S1, T-T1 are wired when shipped from the factory.	
R1/L11 S1/L21 T1/L31	-			-		
U/T1 V/T2 W/T3	Inverter output			Inverter output		
B1 B2	For Braking Resistor Unit connection	-		For Braking Resistor Unit connection	-	
⊖ ⊕1 ⊕2	For DC reactor connection (⊕1 and ⊕2) For DC power input (⊕1 and ⊖)	For DC power supply input (⊕1 and ⊖) For Braking Unit connection (⊕3 and ⊖)		For DC reactor connection (⊕1 and ⊕2) For DC power supply input (⊕1 and ⊖)	For DC power supply input (⊕1 and ⊖) For Braking Unit connection (⊕3 and ⊖)	
⊕3	-			-		
♨ /ℓ 2	-		Cooling fan power supply input *1	-		
r/ℓ 1				-		Cooling fan power supply input *2
♨ 200/ℓ 2200 ♨ 400/ℓ 2400	-			-		
⏚	Ground (to resistance of 100 Ω or less)			Ground (to resistance of 10 Ω or less)		

Note Dashes (-) in the table indicate the absence of an item.

* 1. Cooling fan power supply input r/ℓ 1- ♨ /ℓ 2: 200 to 220-VAC, 50-Hz input or 200 to 230-VAC, 60-Hz input (A transformer is required for 230-VAC, 50-Hz input or 240-VAC, 50/60-Hz input.)

* 2. Cooling fan power supply input r/ℓ 1- ♨ 200/ℓ 2200: 200 to 220-VAC, 50-Hz input or 200 to 230-VAC, 60-Hz input; r/ℓ 1- ♨ 400/ℓ 2400: 380 to 480-VAC, 50/60 Hz input

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Control-circuit Terminals (Same for 200-V and 400-V Class)

The functions for the control-circuit terminals by symbol are shown in *Table 2.5*.

Table 2.5 Control-circuit Terminal Functions

Type	Signal Symbol	Signal Name	Terminal Function	Signal Level
Sequence Input	S1	Forward-stop command	Forward when ON, stop when OFF	+24 VDC, 8 mA photocoupler isolation
	S2	Reverse-stop command	Reverse when ON, stop when OFF	
	S3	Multi-function input selection 1	Factory setting: External fault detected when ON	
	S4	Multi-function input selection 2	Factory setting: Fault reset when ON	
	S5	Multi-function input selection 3	Factory setting: Multi-step speed command 1 effective when ON	
	S6	Multi-function input selection 4	Factory setting: Multi-step speed command 2 effective when ON	
	S7	Multi-function input selection 5	Factory setting: Inching frequency selected when ON	
	SC	Sequence control input common	-	
	SP	Isolation power supply for sequence input +24 V	-	+24 VDC ±20%
	SN	Isolation power supply for sequence input 0 V	-	
Analog Input	+V	+15-V power supply	+15-V power supply for analog reference	+15 V (20 mA maximum allowable current)
	-V	-15-V power supply	-15-V power supply for analog reference	-15 V (20 mA maximum allowable current)
	A1	Main speed frequency reference	0 to +10 V/100%	0 to +10 V (input impedance 20 kΩ)
	A2	Multi-function analog input	4 to 20 mA/100%, 0 to +10 V/100% Factory setting: Add to terminal A1 (H3-09 = 0)	4 to 20 mA (input impedance 20 kΩ) 0 to +10 V (input impedance 20 kΩ)
	AC	Analog common	0 V	-
	E (G)	Shield wire, optional ground connection	-	-
Sequence Output	MA	Fault output (NO contact)	ON between MA and MC during fault	Relay output Dry contacts Contact capacity 250 VAC, 1 A max. 30 VDC, 1 A max.
	MB	Fault output (NC contact)	ON between MB and MC during fault	
	MC	Relay contact output common	-	
	M1	Multi-function contact output (NO contact)	Factory setting: RUN ON between M1 and M2 during operation	
	M2			
	M3	Multi-function output 1	Factory setting: Zero speed Zero level (b2-01) or below when ON	
	M4			
	M5	Multi-function output 2	Factory setting: Frequency agreement detection ON when the frequency is within ±2 Hz of the set frequency	
	M6			
Analog Monitor Output	FM	Multi-function analog monitor 1	Factory setting: Output frequency 0 to +10 V/100% frequency	0 to +10 VDC ±5% 2 mA max.
	AM	Multi-function analog monitor 2	Factory setting: Current monitor 5 V/Inverter rated current	
	AC	Analog common	-	

Table 2.5 Control-circuit Terminal Functions (Continued)

Type	Signal Symbol	Signal Name	Terminal Function	Signal Level
Pulse Input/Out-put	RP	Multi-function pulse input	Factory setting: Frequency reference input (H6-01 = 0)	0 to 32 kHz (3 kΩ)
	MP	Multi-function pulse monitor	Factory setting: Output frequency (H6-06 = 2)	0 to 32 kHz (2.2 kΩ)

Communications-circuit Terminals (Same for 200-V and 400-V class)

The functions for the communications-circuit terminals by symbol are shown in *Table 2.6*.

Table 2.6 Communications-circuit Terminal Functions

Type	Signal Symbol	Signal Name	Terminal Function	Signal Level
RS-422A/485 Com-muni-cations	R+	RS-422A/485 receive data	For 2-wire RS-485, short R+ and S+, as well as R- and S-.	Differential input, photocoupler isolation
	R-			
	S+	RS-422A/485 send data		Differential input, photocoupler isolation
	S-			
	IG	Shield wire for communications	-	-

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Wiring Main Circuit Terminals

◆ Applicable Wire Sizes and Closed-loop Connectors

Select the appropriate wires and crimp terminals from *Table 2.7* to *Table 2.9* (same for all countries). Refer to USER'S MANUAL (I526-E1-☐) for wire sizes for Braking Resistor Units and Braking Units.

Table 2.7 200-V class Wire Sizes

Inverter Model 3G3RV-	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recommended Wire Size mm^2 (AWG)	Wire Type
A2004	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A2007	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A2015	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A2022	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A2037	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	3.5 to 5.5 (12 to 10)	3.5 (12)	
A2055	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	5.5 (10)	5.5 (10)	
A2075	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M5	2.5	8 to 14 (8 to 6)	8 (8)	Power cables, e.g., 600 V vinyl power cables
A2110	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M5	2.5	14 to 22 (6 to 4)	14 (6)	
A2150	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M6	4.0 to 5.0	30 to 38 (4 to 2)	30 (4)	
	B1, B2	M5	2.5	8 to 14 (8 to 6)	-	
	⏚	M6	4.0 to 5.0	22 (4)	22 (4)	
A2185	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M8	9.0 to 10.0	30 to 38 (3 to 2)	30 (3)	
	B1, B2	M5	2.5	8 to 14 (8 to 6)	-	
	⏚	M6	4.0 to 5.0	22 (4)	22 (4)	
B2220	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	30 to 60 (3 to 1)	30 (3)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
B2300	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	50 to 60 (1 to 1/0)	50 (1)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	

Inverter Model 3G3RV-	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm²(AWG)	Recommended Wire Size mm² (AWG)	Wire Type
B2370	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	60 to 100 (2/0 to 4/0)	60 (2/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 22 (10 to 4)	-	
	⏚	M10	17.6 to 22.5	30 to 60 (2 to 2/0)	30 (2)	
	r/ℓ1, ⚮/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B2450	R/L1, S/L2, T/L3, ⊖, ⊕1 U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	80 (3/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 22 (10 to 4)	-	
	⏚	M10	17.6 to 22.5	38 to 60 (1 to 2/0)	38 (1)	
	r/ℓ1, ⚮/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B2550	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	100 (4/0)	100 (4/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	-	Power cables, e.g., 600 V vinyl power cables
	⏚	M10	17.6 to 22.5	30 to 60 (3 to 4/0)	50 (1/0)	
	r/ℓ1, ⚮/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B2750	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	80 to 125 (3/0 to 250)	80 × 2P (3/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	80 × 2P (3/0 × 2P)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	-	
	⏚	M10	17.6 to 22.5	100 to 200 (3/0 to 400)	100 (3/0)	
	r/ℓ1, ⚮/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B2900	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	150 to 200 (250 to 400)	150 × 2P (250 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	31.4 to 39.2	100 to 150 (4/0 to 300)	100 × 2P (4/0 × 2P)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	-	
	⏚	M12	31.4 to 39.2	60 to 150 (2/0 to 300)	60 × 2P (2/0 × 2P)	
	r/ℓ1, ⚮/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B211K	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	200 to 325 (350 to 600)	200 × 2P, or 50 × 4P (350 × 2P, or 1/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M12	31.4 to 39.2	150 to 325 (300 to 600)	150 × 2P, or 50 × 4P (300 × 2P, or 1/0 × 4P)	
	⊕3	M8	8.8 to 10.8	5.5 to 60 (10 to 2/0)	-	
	⏚	M12	31.4 to 39.2	150 (300)	150 × 2P (300 × 2P)	
	r/ℓ1, ⚮/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	

* The wire thickness is set for copper wires at 75°C

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Table 2.8 400-V class Wire Sizes

Inverter Model 3G3RV	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm² (AWG)	Recommended Wire Size mm² (AWG)	Wire Type
A4004	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4007	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4015	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4022	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4037	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	3.5 (12) / 2 (14)	
A4040	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	3.5 (12) / 2 (14)	
A4055	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	3.5 to 5.5 (12 to 10) / 2 to 5.5 (14 to 10)	3.5 (12) / 2 (14)	
A4075	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M4	1.2 to 1.5	5.5(10) / 3.5 to 5.5 (12 to 10)	5.5 (10) / 3.5 (12)	Power cables, e.g., 600 V vinyl power cables
A4110	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3 ⏚	M5	2.5	5.5 to 14 (10 to 6)	8 (8) / 5.5 (10)	
A4150	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, B1, B2, U/T1, V/T2, W/T3	M5	2.5	8 to 14 (8 to 6)	8 (8)	
A4150	⏚	M5 (M6)	2.5 (4.0 to 5.0)	5.5 to 14 (10 to 6)	5.5 (10)	
A4185	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕2, U/T1, V/T2, W/T3	M6	4.0 to 5.0	8 to 38 (8 to 2)	8 (8)	
A4185	B1, B2	M5	2.5	8 (8)	8 (8)	
A4185	⏚	M6	4.0 to 5.0	8 to 22 (8 to 4)	8 (8)	
B4220	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕3, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M6	4.0 to 5.0	14 to 22 (6 to 4)	14 (6)	
B4220	⏚	M8	9.0 to 10.0	14 to 38 (6 to 2)	14 (6)	
B4300	R/L1, S/L2, T/L3, ⊖, ⊕1, ⊕3, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M6	4.0 to 5.0	22 (4)	22 (4)	
B4300	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
B4370	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	22 to 60 (4 to 1/0)	38 (2)	
B4370	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
B4370	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	

Inverter Model 3G3RV	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm² (AWG)	Recommended Wire Size mm² (AWG)	Wire Type
B4450	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	38 to 60 (2 to 1/0)	38 (2)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
B4550	R/L1, S/L2, T/L3, ⊖, ⊕1, U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M8	9.0 to 10.0	50 to 60 (1 to 1/0)	50 (1)	
	⊕3	M6	4.0 to 5.0	8 to 22 (8 to 4)	-	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
B4750	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	60 to 100 (2/0 to 4/0)	60 (2/0)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	50 to 100 (1/0 to 4/0)	50 (1/0)	
	⊕3	M8	8.8 to 10.8	5.5 to 22 (10 to 4)	-	
	⏚	M12	31.4 to 39.2	38 to 60 (2 to 2/0)	38 (2)	
	r/ℓ1, ≁200/ℓ2200, ≁400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B4900	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	80 to 100 (3/0 to 4/0)	100 (4/0)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M10	17.6 to 22.5	80 to 100 (3/0 to 4/0)	100 (4/0)	
	⊕3	M8	8.8 to 10.8	8 to 22 (8 to 4)	-	
	⏚	M12	31.4 to 39.2	50 to 100 (1 to 4/0)	50 (1)	Power cables, e.g., 600 V vinyl power cables
	r/ℓ1, ≁200/ℓ2200, ≁400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B411K	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M12	31.4 to 39.2	50 to 100 (1/0 to 4/0)	50 × 2P (1/0 × 2P)	
	⊕3	M8	8.8 to 10.8	8 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	60 to 150 (2/0 to 300)	600 (2/0)	
	r/ℓ1, ≁200/ℓ2200, ≁400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B413K	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	80 to 100 (3/0 to 4/0)	80 × 2P (3/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M12	31.4 to 39.2	60 to 100 (2/0 to 4/0)	60 × 2P (2/0 × 2P)	
	⊕3	M8	8.8 to 10.8	8 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	100 to 150 (4/0 to 300)	100 (4/0)	
	r/ℓ1, ≁200/ℓ2200, ≁400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B416K	R/L1, S/L2, T/L3, ⊖, ⊕1	M12	31.4 to 39.2	100 to 200 (4/0 to 400)	100 × 2P (4/0 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L33	M12	31.4 to 39.2	80 to 200 (3/0 to 400)	80 × 2P (3/0 × 2P)	
	⊕3	M8	8.8 to 10.8	80 to 60 (8 to 2/0)	-	
	⏚	M12	31.4 to 39.2	50 to 150 (1/0 to 300)	50 × 2P (1/0 × 2P)	
	r/ℓ1, ≁200/ℓ2200, ≁400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	

* The wire thickness is set for copper wires at 75°C.

2

Table 2.9 Closed-loop Connector Sizes (JIS C2805) (200-V class and 400-V class)

Wire Thickness (mm^2)	Terminal Screws	Size
0.5	M3.5	1.25 to 3.5
	M4	1.25 to 4
0.75	M3.5	1.25 to 3.5
	M4	1.25 to 4
1.25	M3.5	1.25 to 3.5
	M4	1.25 to 4
2	M3.5	2 to 3.5
	M4	2 to 4
	M5	2 to 5
	M6	2 to 6
	M8	2 to 8
3.5/5.5	M4	5.5 to 4
	M5	5.5 to 5
	M6	5.5 to 6
	M8	5.5 to 8
8	M5	8 to 5
	M6	8 to 6
	M8	8 to 8
14	M6	14 to 6
	M8	14 to 8
22	M6	22 to 6
	M8	22 to 8
30/38	M8	38 to 8
50/60	M8	60 to 8
	M10	60 to 10
80	M10	80 to 10
100		100 to 10
100	M12	100 to 12
150		150 to 12
200		200 to 12
325	M12 x 2	325 to 12
	M16	325 to 16

IMPORTANT

Determine the wire size for the main circuit so that line voltage drop is within 2% of the rated voltage. Line voltage drop is calculated as follows:

Line voltage drop (V) = $\sqrt{3}$ x wire resistance (W/km) x wire length (m) x current (A) x 10^{-3}

◆ Main Circuit Configurations

The main circuit configurations of the Inverter are shown in the table below.

Table 2.10 Inverter Main Circuit Configurations

200-V Class	400-V Class
3G3RV-A2004 to A2185	3G3RV-A4004 to A4185
3G3RV-B2220, B2300	3G3RV-B4220 to B4550
3G3RV-B2370 to B211K	3G3RV-B4750 to B416K

◆ Standard Connection Diagrams

Standard Inverter connection diagrams are shown in *Fig 2.8*. The connections depend on the Inverter capacity.

■3G3RV-A2004 to A2185, A4004 to A4185
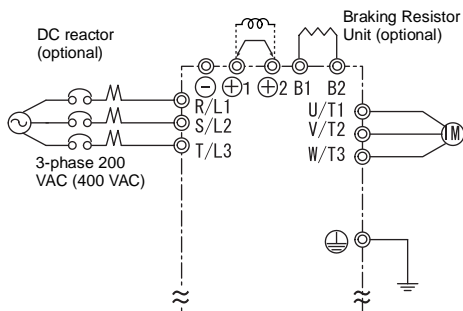
Be sure to remove the short-circuit bar before connecting the DC reactor.

■3G3RV-B2220, B2300, B4220 to B4550
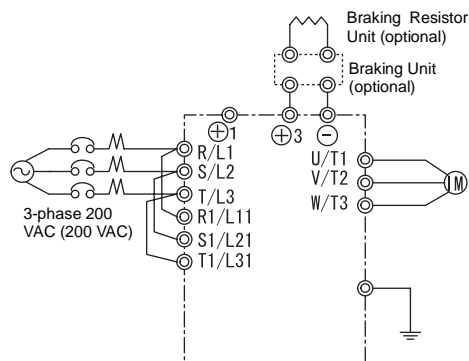
The DC reactor is built in.

■3G3RV-B2370 to B211K
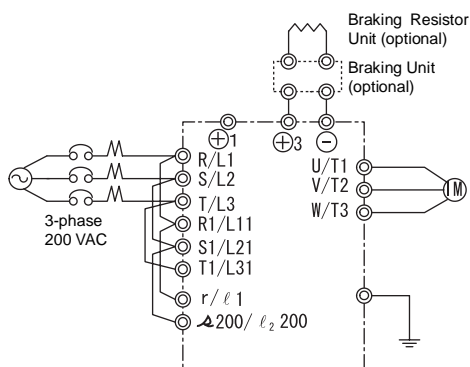
■3G3RV-B4750 to B416K
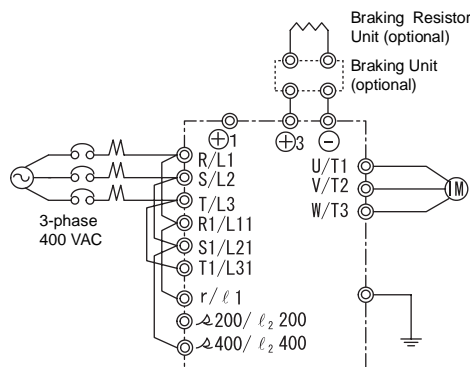
Control power is supplied internally from the main circuit DC power supply for all Inverter models.

Fig 2.8 Main Circuit Terminal Connections

◆ Wiring the Main Circuits

This section describes wiring connections for the main circuit inputs and outputs.

■Wiring Main Circuit Inputs

Observe the following precautions for the main circuit power supply input.

Installing a Molded-case Circuit Breaker

Always connect the power input terminals (R, S, and T) and power supply via a molded-case circuit breaker (MCCB) suitable for the Inverter.

- Provide one MCCB for each Inverter.
- Choose an MCCB with a capacity of 1.5 to 2 times the Inverter's rated current.
- For the MCCB's time characteristics, be sure to consider the Inverter's overload protection (one minute at 150% of the rated output current).
- If the same MCCB is to be used for more than one Inverter, or other devices, set up a sequence so that the power supply will be turned OFF by a fault output, as shown in *Fig 2.9*.
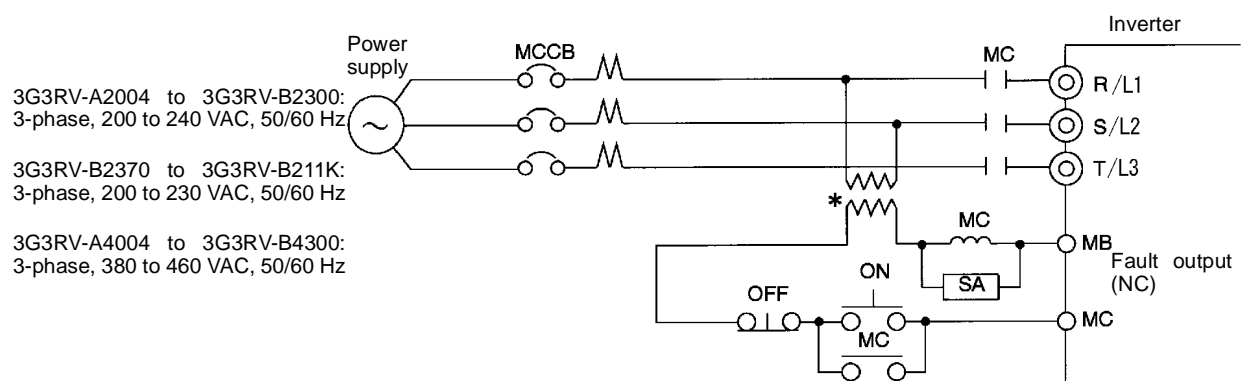
* For 400-V class Inverters, connect a 400/200-V transformer.

Fig 2.9 MCCB Installation

Installing a Ground Fault Interrupter

Inverter outputs use high-speed switching, so high-frequency leakage current is generated. Therefore, at the Inverter primary side, use a ground fault interrupter to detect only the leakage current in the frequency range that is hazardous to humans and exclude high-frequency leakage current.

- For the special-purpose ground fault interrupter for Inverters, choose a ground fault interrupter with a sensitivity amperage of at least 10 mA per Inverter.
- When using a general ground fault interrupter, choose a ground fault interrupter with a sensitivity amperage of 200 mA or more per Inverter and with an operating time of 0.1 s or more.

2

Installing a Magnetic Contactor

If the power supply for the main circuit is to be shut off during a sequence, a magnetic contactor can be used.

When a magnetic contactor is installed on the primary side of the main circuit to forcibly stop the Inverter, however, the regenerative braking does not work and the Inverter will coast to a stop.

- The Inverter can be started and stopped by opening and closing the magnetic contactor on the primary side. Frequently opening and closing the magnetic contactor, however, may cause the Inverter to break down. Start and stop the Inverter at most once every 30 minutes.
- When the Inverter is operated with the Digital Operator, automatic operation cannot be performed after recovery from a power interruption.
- If the Braking Resistor Unit is used, program the sequence so that the magnetic contactor is turned OFF by the contact of the Unit's thermal overload relay.

Connecting Input Power Supply to the Terminal Block

Input power supply can be connected to any terminal R, S or T on the terminal block; the phase sequence of input power supply is irrelevant to the phase sequence.

Installing an AC Reactor

If the Inverter is connected to a large-capacity power transformer (600 kW or more) or the phase advancing capacitor is switched, an excessive peak current may flow through the input power circuit, causing the converter unit to break down.

To prevent this, install an optional AC Reactor on the input side of the Inverter or a DC reactor to the DC reactor connection terminals.

This also improves the power factor on the power supply side.

Installing a Surge Absorber

Always use a surge absorber or diode for inductive loads near the Inverter. These inductive loads include magnetic contactors, electromagnetic relays, solenoid valves, solenoids, and magnetic brakes.

Installing a Noise Filter on Power Supply Side

Install a noise filter to eliminate noise transmitted between the power line and the Inverter.

- Correct Noise Filter Installation

Use a special-purpose noise filter for Inverters.
Ordinary: 3G3EV-PLNFD□/3G3IV-PFN□
EMC compatible: 3G3RV-PFS□
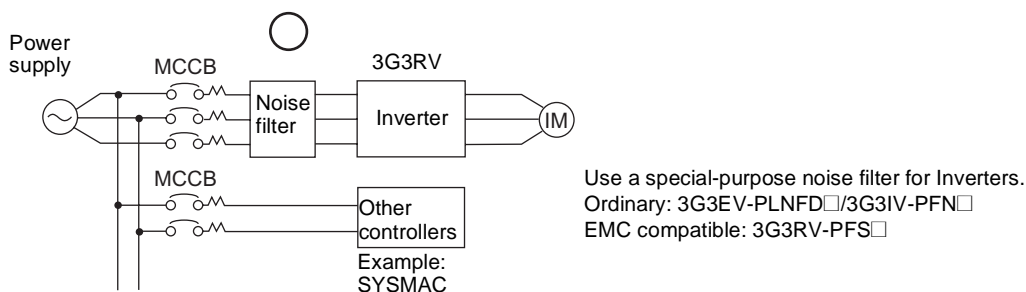
Fig 2.10 Correct Power supply Noise Filter Installation

• Incorrect Noise Filter Installation
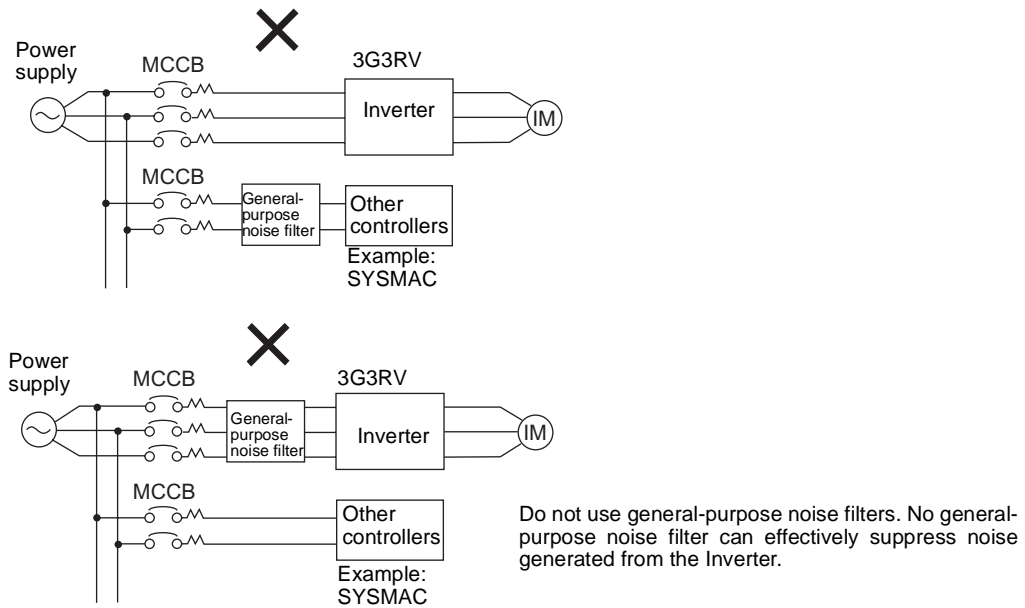
Fig 2.11 Incorrect Power supply Noise Filter Installation

■Wiring the Output Side of Main Circuit

Observe the following precautions when wiring the main output circuits.

Connecting the Inverter and Motor

Connect output terminals U, V, and W to motor lead wires U, V, and W, respectively.

Check that the motor rotates forward with the forward run command. Switch over any two of the output terminals to each other and reconnect if the motor rotates in reverse with the forward run command.

Never Connect a Power Supply to Output Terminals

Never connect a power supply to output terminals U, V, and W. If voltage is applied to the output terminals, the internal circuits of the Inverter will be damaged.

Never Short or Ground Output Terminals

If the output terminals are touched with bare hands or the output wires come into contact with the Inverter casing, an electric shock or grounding will occur. This is extremely hazardous. Do not short the output wires.

Do Not Use a Phase Advancing Capacitor or Noise Filter

Never connect a phase advancing capacitor or LC/RC noise filter to an output circuit. The high-frequency components of the Inverter output may result in overheating or damage to these part or may result in damage to the Inverter or cause other parts to burn.

Do Not Use an Electromagnetic Switch

Never connect an electromangetic switch (MC) between the Inverter and motor and turn it ON or OFF during operation. If the MC is turned ON while the Inverter is operating, a large inrush current will be created and the overcurrent protection in the Inverter will operate.

When using an MC to switch to a commercial power supply, stop the Inverter and motor before operating the MC. Use the speed search function if the MC is operated during operation. If measures for momentary power interrupts are required, use a delayed release MC.

Installing a Thermal Overload Relay

This Inverter has an electronic thermal protection function to protect the motor from overheating. If, however, more than one motor is operated with one Inverter or a multi-polar motor is used, always install a thermal relay (THR) between the Inverter and the motor and set L1-01 to 0 (no motor protection). The sequence should be designed so that the contacts of the thermal overload relay turn OFF the magnetic contactor on the main circuit inputs.

Installing a Noise Filter on Output Side

Connect a noise filter to the output side of the Inverter to reduce radio noise and inductive noise.
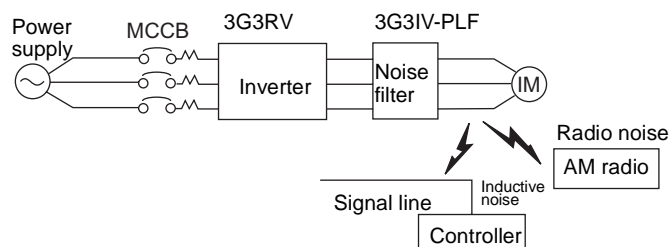
Inductive Noise:	Electromagnetic induction generates noise on the signal line, causing the controller to malfunction.
Radio Noise:	Electromagnetic waves from the Inverter and cables cause the broadcasting radio receiver to make noise.

Fig 2.12 Installing a Noise Filter on the Output Side

Countermeasures Against Inductive Noise

As described previously, a noise filter can be used to prevent inductive noise from being generated on the output side. Alternatively, cables can be routed through a grounded metal pipe to prevent inductive noise. Keeping the metal pipe at least 30 cm away from the signal line considerably reduces inductive noise.
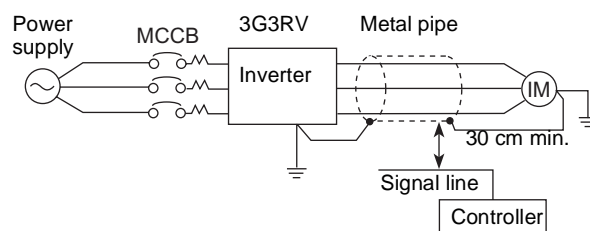
Fig 2.13 Countermeasures Against Inductive Noise

Countermeasures Against Radio Interference

Radio noise is generated from the Inverter as well as from the input and output lines. To reduce radio noise, install noise filters on both input and output sides, and also install the Inverter in a totally enclosed steel box.

The cable between the Inverter and the motor should be as short as possible.
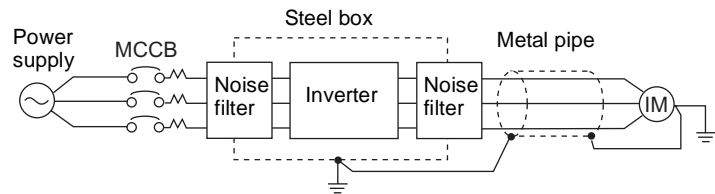
Fig 2.14 Countermeasures Against Radio Interference

Cable Length between Inverter and Motor

If the cable between the Inverter and the motor is long, the high-frequency leakage current will increase, causing the Inverter output current to increase as well. This may affect peripheral devices. To prevent this, adjust the carrier frequency (set in C6-01, C6-02) as shown in *Table 2.11*. (For details, refer to *Chapter 5 Parameters*.)

Table 2.11 Cable Length between Inverter and Motor

Cable length	50 m max.	100 m max.	More than 100 m
Carrier frequency	15 kHz max.	10 kHz max.	5 kHz max.

Restriction on Using Single-phase Motors

Single-phase motors are not suited for variable-speed operation using the Inverter. There are two methods used to determine the operating direction for a single-phase motor upon startup: Capacitor startup and split-phase startup. With the capacitor startup method, there is a possibility that the steep charge and discharge of the Inverter output will damage the capacitor. Likewise, with the split-phase startup method, there is a possibility of damaging the starting coil because there is no centrifugal switch operation.

■Ground Wiring

Observe the following precautions when wiring the ground line.

- Always use the ground terminal of the 200-V Inverter with a ground resistance of less than 100 Ω and that of the 400-V Inverter with a ground resistance of less than 10 Ω.
- Do not share the ground wire with other devices, such as welding machines or power tools.
- Always use a ground wire that complies with technical standards on electrical equipment and minimize the length of the ground wire.
  Leakage current flows through the Inverter. Therefore, if the distance between the ground electrode and the ground terminal is too long, potential on the ground terminal of the Inverter will become unstable.
- When using more than one Inverter, be careful not to loop the ground wire.
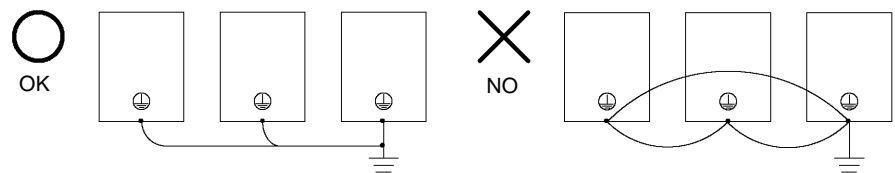
Fig 2.15 Ground Wiring

■Connecting the Braking Resistor (Mounting 3G3IV-PERF)

A Braking Resistor that mounts to the Inverter can be used with 200-V and 400-V Class Inverters with outputs from 0.4 to 11 kW.

Connect the braking resistor as shown in *Fig 2.16*.

Table 2.12

L8-01 (Protect selection for internal DB resistor)	1 (Enables overheat protection)
L3-04 (Stall prevention selection during deceleration) (Select either one of them.)	0 (Disables stall prevention function)
	3 (Enables stall prevention function with braking resistor)
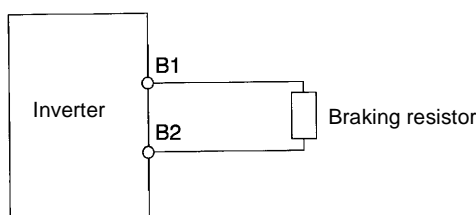
Fig 2.16 Connecting the Braking Resistor

IMPORTANT

The braking resistor connection terminals are B1 and B2. Do not connect to any other terminals. Connecting to any terminals other than B1 or B2 can cause the resistor to overheat, resulting in damage to the equipment.

■Connecting the Braking Resistor Unit (3G3IV-PLKB□) and Braking Unit (3G3IV-PCDBR□)

Connect the Braking Resistor Unit and Braking Unit to the Inverter as shown in the *Fig 2.17*.

A Braking Resistor that mounts to the Inverter can also be used with Inverters with outputs from 0.4 to 11 kW.

Table 2.13

L8-01 (Protect selection for internal DB resistor)	0 (Disables overheat protection)
L3-04 (Stall prevention selection during deceleration) (Select either one of them.)	0 (Disables stall prevention function)
	3 (Enables stall prevention function with braking resistor)

L8-01 is used when a braking resistor without thermal overload relay trip contacts (3G3IV-PERF□ mounted to Inverter) is connected.

The Braking Resistor Unit cannot be used and the deceleration time cannot be shortened by the Inverter if L3-04 is set to 1 (i.e., if stall prevention is enabled for deceleration).

To prevent the Unit from overheating, design the sequence to turn OFF the power supply for the thermal overload relay trip contacts of the Unit as shown in *Fig 2.17*.

200-V and 400-V Class Inverters with 0.4 to 18.5 kW Output
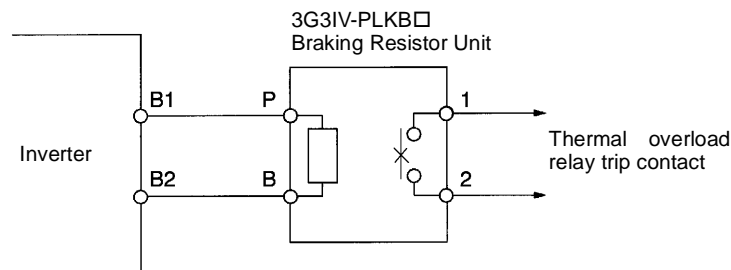
200-V and 400-V class Inverters with 22 kW or higher Output
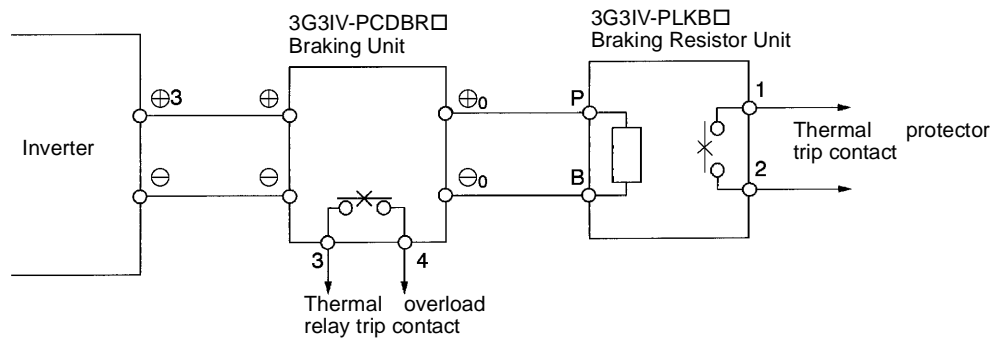
Fig 2.17 Connecting the Braking Resistor Unit and Braking Unit

Connecting Braking Units in Parallel

When connecting two or more Braking Units in parallel, use the wiring and connectors shown in *Fig 2.18*. There are connectors for selecting whether each Braking Unit is to be a Master or Slave. Select "Master" for the first Braking Unit only, and select "Slave" for all other Braking Units (i.e., from the second Unit onwards).
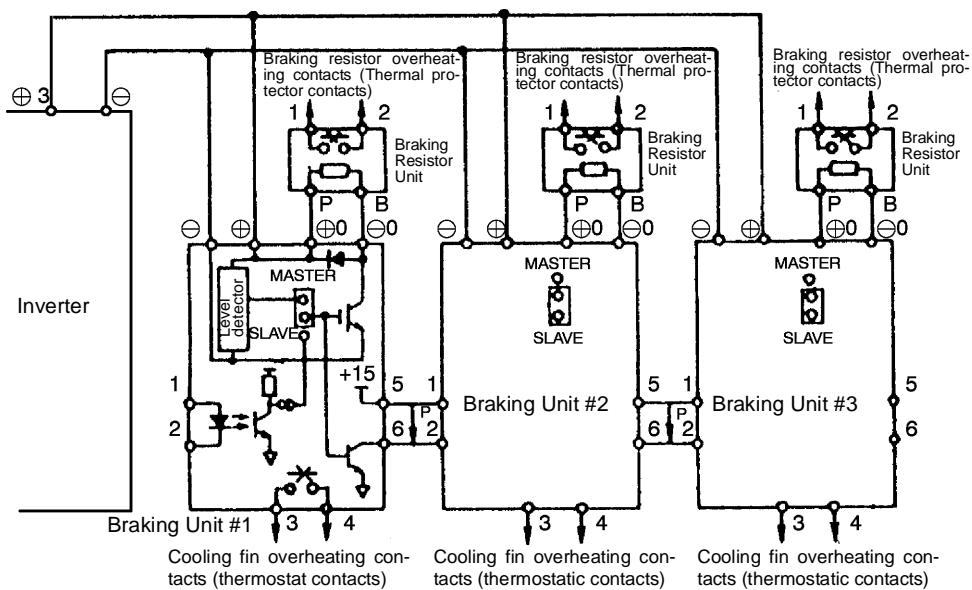
Fig 2.18 Connecting Braking Units in Parallel

Breaking Unit Application Precautions

When using a Braking Resistor Unit, create a sequence to detect overheating of the braking resistor and turn OFF the power supply to the Inverter.

* Use a transformer with 200 and 400 V outputs for the power 400 V Inverter.
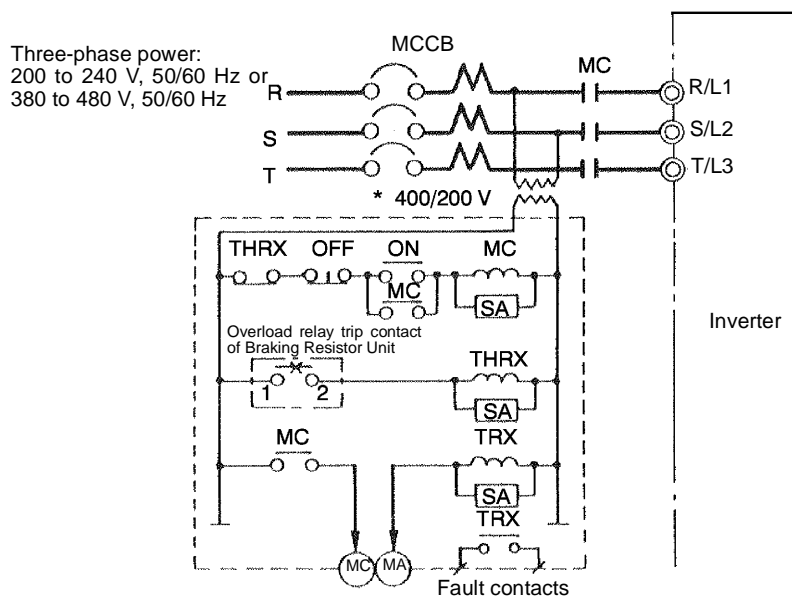
Fig 2.19 Power Shutoff Sequence

Wiring Control Circuit Terminals for Asian Models

◆ Wire Sizes and Closed-loop Connectors

For remote operation using analog signals, keep the control line length between the Digital Operator or operation signals and the Inverter to 50 m or less, and separate the lines from high-power lines (main circuits or relay sequence circuits) to reduce induction from peripheral devices.

When setting frequencies from an external frequency setter (and not from a Digital Operator), use shielded twisted-pair wires and ground the shield to terminal E (G), as shown in the following diagram.
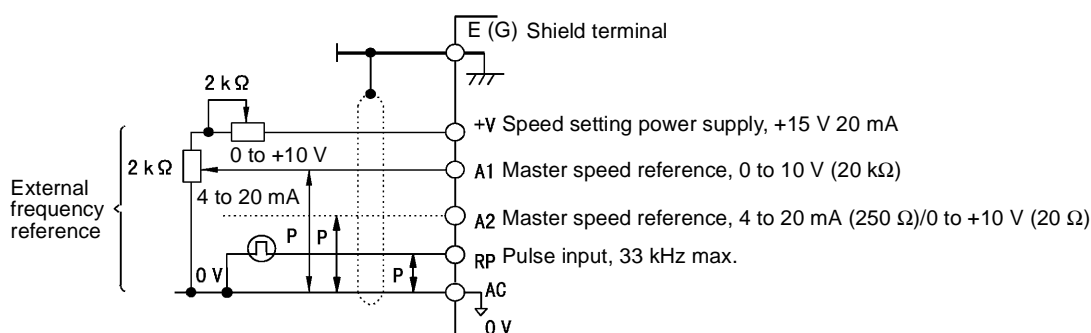
Fig 2.20

Terminal numbers and wire sizes are shown in *Table 2.14*.

Table 2.14 Terminal Numbers and Wire Sizes (for Asian Models)

Terminals	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recommended Wire Size mm^2(AWG)	Wire Type
FM, AC, AM, P1, P2, PC, SC, A1, A2, +V, S1, S2, S3, S4, S5, S6, S7 MA, MB, MC, M1, M2, IG	M3.5	0.8 to 1.0	0.5 to 2[*2] (20 to 14)	0.75 (18)	• Shielded, twisted-pair wire[*1] • Shielded, polyethylene-covered, vinyl sheath cable (KPEV-S by Hitachi Electrical Wire or equivalent)
MP, RP, R+, R-, S+, S-, IG	Phoenix type	0.5 to 0.6	Single wire[*3]: 0.14 to 2.5 Stranded wire: 0.14 to 1.5 (26 to 14)	0.75 (18)	
E (G)	M3.5	0.8 to 1.0	0.5 to 2[*2] (20 to 14)	1.25 (12)	

* 1. Use shielded twisted-pair cables to input an external frequency reference.
* 2. Refer to *Table 2.9 Closed-loop Connector Sizes (JIS C2805) (200-V class and 400-V class)* for suitable closed-loop crimp terminal sizes for the wires.
* 3. We recommend using straight solderless terminals on signal lines to simplify wiring and improve reliability.

■ Straight Solderless Terminals for Signal Lines

Models and sizes of straight solderless terminal are shown in the following table.

Table 2.15 Straight Solderless Terminal Sizes

Wire Size mm² (AWG)	Model	d1	d2	L	Manufacturer
0.25 (24)	AI 0.25 - 8YE	0.8	2	12.5	
0.5 (20)	AI 0.5 - 8WH	1.1	2.5	14	
0.75 (18)	AI 0.75 - 8GY	1.3	2.8	14	Phoenix Contact
1.25 (16)	AI 1.5 - 8BK	1.8	3.4	14	
2 (14)	AI 2.5 - 8BU	2.3	4.2	14	
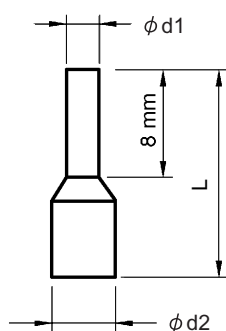
Fig 2.21 Straight Solderless Terminal Sizes

■Wiring Method

Use the following procedure to connect wires to the terminal block.

1. Loosen the terminal screws with a thin-slot screwdriver.
2. Insert the wires from underneath the terminal block.
3. Tighten the terminal screws firmly.
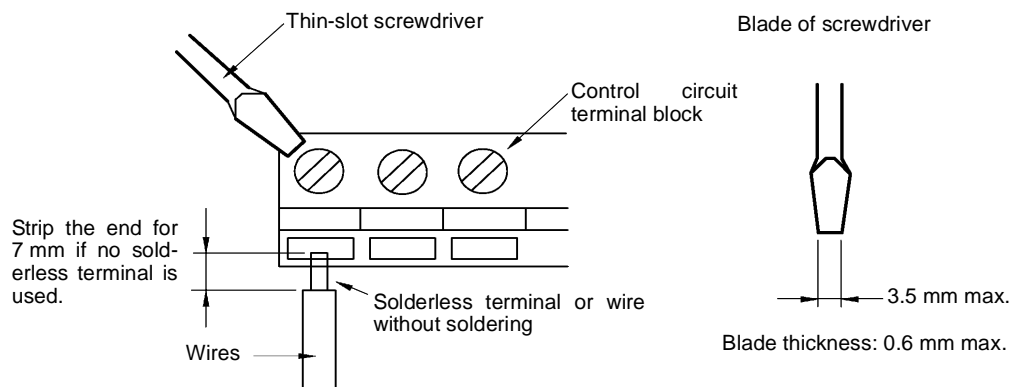
Fig 2.22 Connecting Wires to Terminal Block

◆ Control Circuit Terminal Connections

Connections to Inverter control circuit terminals are shown in *Fig 2.23*.
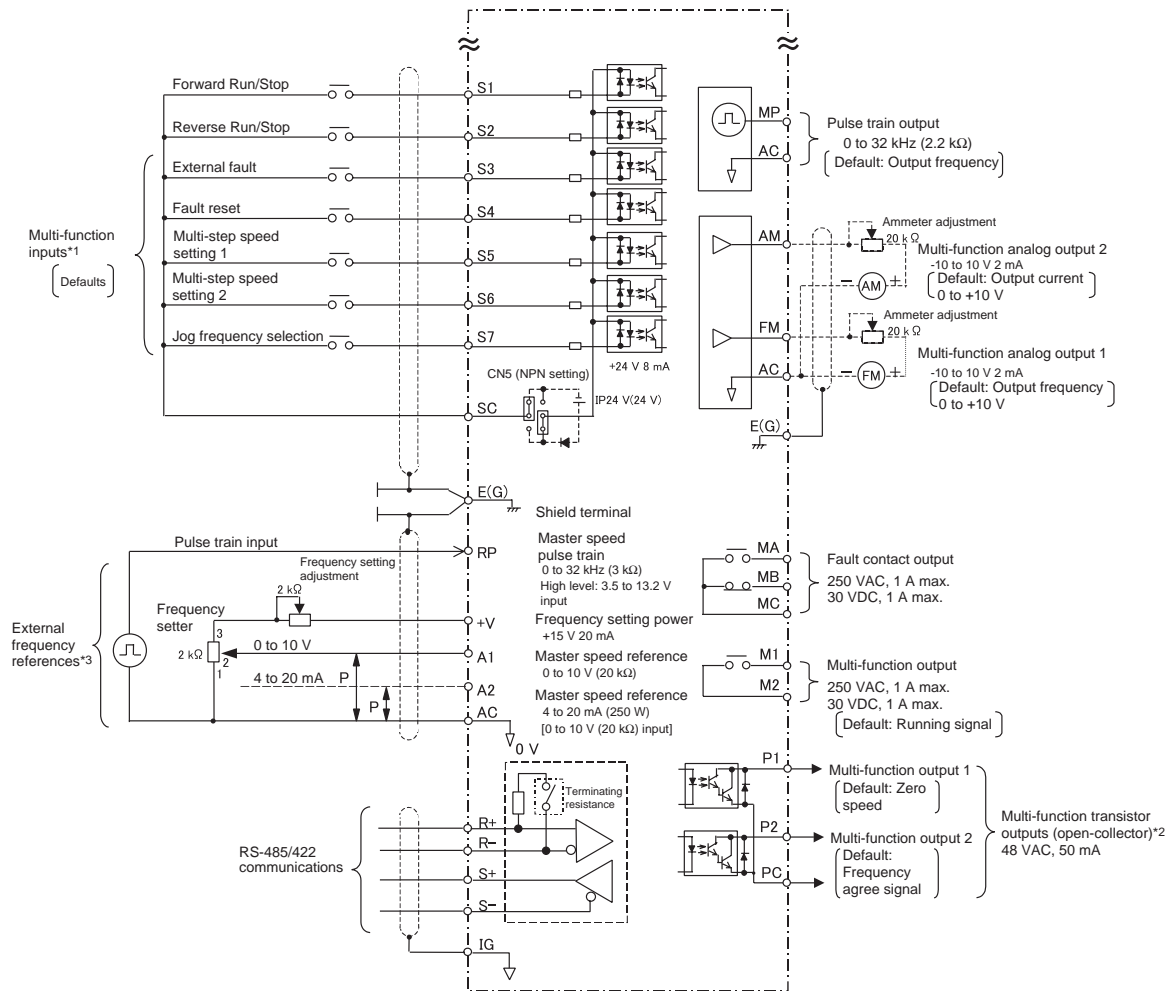
Fig 2.23 Control Circuit Terminal Connections (Asian Models)

1. Control circuit terminals are arranged as shown below.

E(G)	FM	AC	AM	P1	P2	PC	SC		MP						MA	MB	MC
	SC	A1	A2		+V	AC			RP	R+	R−	S+	S−		M1		M2	E(G)
S1	S2	S3	S4	S5	S6	S7							IG					

2. The output current capacity of the +V terminal is 20 mA.
3. Disable the stall prevention during deceleration (set parameter L3-04 to 0) when using a Braking Resistor Unit. If this parameter is not changed to disable stall prevention, the system may not stop during deceleration.
4. Main circuit terminals are indicated with double circles and control circuit terminals are indicated with single circles.
5. Sequence input signals S1 to S7 are labeled for sequence connections (0 V common and sinking mode) for no-voltage contacts or NPN transistors. These are the default settings.
   For PNP transistor sequence connections (+24-V common and sourcing mode) or to provide a 24-V external power supply, refer to *Table 2.18*.
6. The master speed frequency reference can set to input either a voltage (terminal A1) or current (terminal A2) by changing the setting of parameter H3-13. The default setting is for a voltage reference input.
7. The multi-function analog output is a dedicated meter output for an analog frequency meter, ammeter, voltmeter, wattmeter, etc. Do not use this output for feedback control or for any other control purpose.
8. DC reactors to improve the input power factor built into 200-V class Inverters for 22 to 110 kW and 400-V class Inverters for 22 to 160 kW. A DC reactor is thus an option only for Inverters for 18.5 kW or less. Remove the short bar when connecting a DC reactor to Inverters for 18.5 kW or less.
9. Set parameter L8-01 to 1 when using a Braking Resistor (3G3IV-PERF). When using a Braking Resistor Unit, a cutoff sequence for the power supply must be made using a thermal relay trip.

◆ Control Circuit Terminal Functions

The functions of the control circuit terminals are shown in *Table 2.16*. Use the appropriate terminals for the correct purposes.

Table 2.16 Control Circuit Terminals

Type	No.	Signal Name	Function		Signal Level
Sequence input signals	S1	Forward run/stop command	Forward run when ON; stopped when OFF.		24 VDC, 8 mA Photocoupler isolation
	S2	Reverse run/stop command	Reverse run when ON; stopped when OFF.		
	S3	External fault input[*1]	Fault when ON.	Functions are selected by setting H1-01 to H1-05.	
	S4	Fault reset[*]	Reset when ON		
	S5	Multi-step speed reference 1[*1] (Master/auxiliary switch)	Auxiliary frequency reference when ON.		
	S6	Multi-step speed reference 2[*1]	Multi-step setting 2 when ON.		
	S7	Jog frequency reference[*1]	Jog frequency when ON.		
	SC	Sequence input common	-		-
Analog input signals	+V	15 V power output	15 V power supply for analog references		15 V (Max. current: 20 mA)
	A1	Frequency reference	0 to +10 V/100%		0 to +10 V(20 kΩ)
	A2	Multi-function analog input	4 to 20 mA/100% 0 to +10 V/100%	Function is selected by setting H3-09.	4 to 20 mA(250Ω) 0 to +10 V(20kΩ)
	AC	Analog reference common	-		-
	E(G)	Shield wire, optional ground line connection point	-		-
Sequence output signals	M1	Running signal (1NO contact)	Operating when ON.	Multi-function contact outputs	Dry contacts Contact capacity: 1 A max. at 250 VAC 1 A max. at 30 VDC
	M2				
	P1	Zero speed	Zero level (b2-01) or below when ON	Multi-function PHC outputs	Open-collector output 50 mA max. at 48 V[*2]
	P2	Speed agreement detection	Within ±2 Hz of set frequency when ON.		
	PC	Open-collector output common	-		-
	MA	Fault output signal (SPDT)	Fault when CLOSED across MA and MC Fault when OPEN across MB and MC		Dry contacts Contact capacity: 1 A max. at 250 VAC 1 A max. at 30 VDC
	MB				
	MC				
Analog output signals	FM	Multi-function analog output (frequency output)	0 to +10 V/100% frequency	Multi-function analog monitor 1	0 to +10 V max. ±5% 2 mA max.
	AC	Analog common (copy)	-		
	AM	Multi-function analog output (current monitor)	5 V/Inverter's rated current	Multi-function analog monitor 2	

2

Table 2.16 Control Circuit Terminals (Continued)

Type	No.	Signal Name	Function	Signal Level
Pulse I/O	RP	Pulse input[*3]	H6-01 (Frequency reference input)	0 to 32 kHz (3 kΩ) High level voltage 3.5 to 13.2 V
	MP	Pulse monitor	H6-06 (Output frequency)	0 to 32 kHz +5 V output (Load: 1.5 kΩ)
RS-485/ 422	R+	MEMOBUS communications input	For 2-wire RS-485, short R+ and S+ as well as R- and S-.	Differential input, photocoupler isolation
	R-			
	S+	MEMOBUS communications output		Differential input, photocoupler isolation
	S-			
	IG	Signal common	-	-

* 1. The default settings are given for terminals S3 to S7. For a 3-wire sequence, the default settings are a 3-wire sequence for S5, multi-step speed setting 1 for S6 and multi-step speed setting 2 for S7.
* 2. When driving a reactive load, such as a relay coil, always insert a flywheel diode as shown in *Fig 2.24*.
* 3. Pulse input specifications are given in the following table.

Low level voltage	0.0 to 0.8 V
High level voltage	3.5 to 13.2 V
H duty	30% to 70%
Pulse frequency	0 to 32 kHz
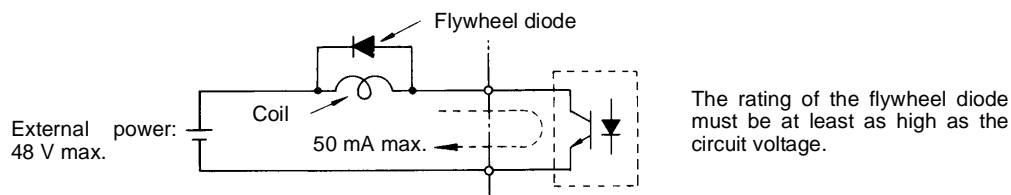
Fig 2.24 Flywheel Diode Connection

■Shunt Connector CN5 and DIP Switch S1

The shunt connector CN 5 and DIP switch S1 are described in this section.
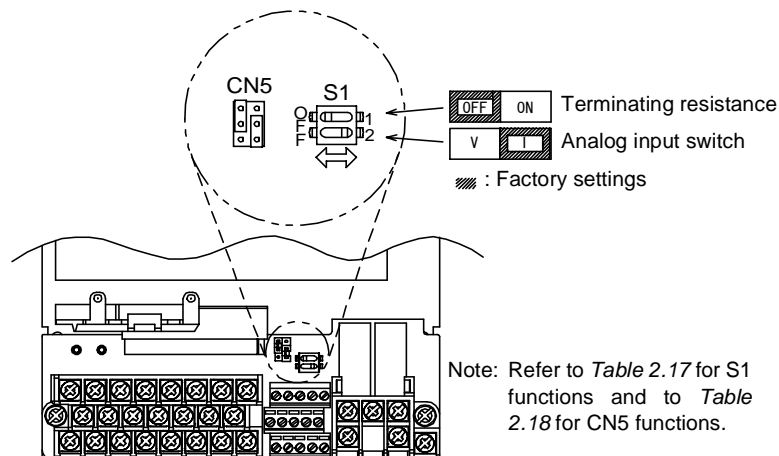
Fig 2.25   Shunt Connector CN5 and DIP Switch S1

The functions of DIP switch S1 are shown in the following table.

Table 2.17 DIP Switch S1

Name	Function	Setting
S1-1	RS-485 and RS-422A terminating resistance	OFF: No terminating resistance ON: Terminating resistance of 110 Ω
S1-2	Input method for analog input A2	OFF: 0 to 10 V (internal resistance: 20 kΩ) ON: 4 to 20 mA (internal resistance: 250 Ω)

■ **Sinking/Sourcing Mode**

The input terminal logic can be switched between sinking mode (0-V common) and sourcing mode (+24-V common) if shunt connector CN5 is used. An external 24-V power supply is also supported, providing more freedom in signal input methods.

Table 2.18 Sinking/Sourcing Mode and Input Signals
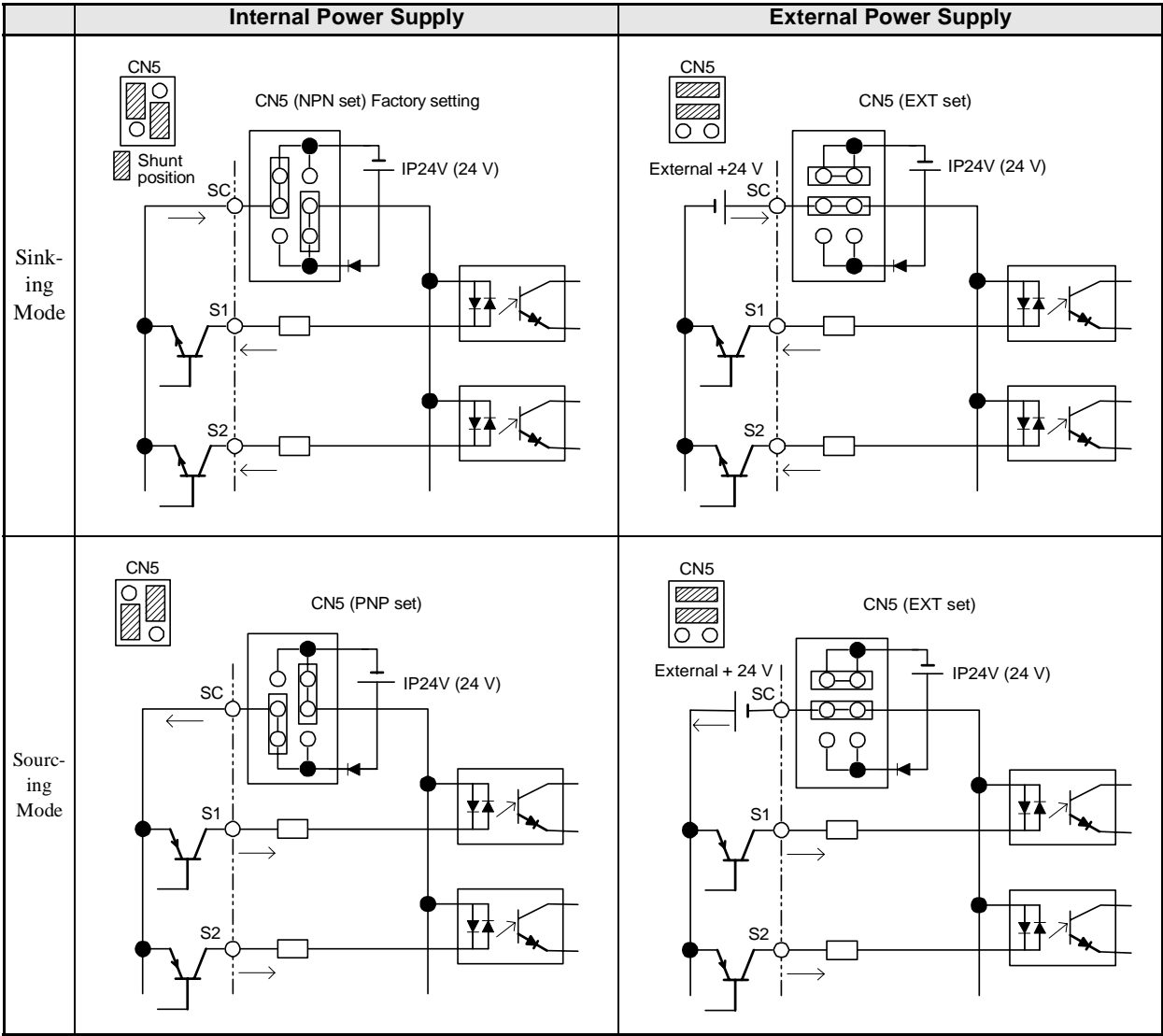
◆ Control Circuit Wiring Precautions

Observe the following precautions when wiring control circuits.

- Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3, $\ominus$, $\oplus$1, $\oplus$2, and $\oplus$3) and other high-power lines.

- Separate wiring for control circuit terminals MA, MB, MC, M1, and M2 (contact outputs) from wiring to other control circuit terminals.

- If using an optional external power supply, it must be a UL-listed Class 2 power supply source.

- Use twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults. Process cable ends as shown in *Fig 2.26*.

- Connect the shield wire to terminal E (G).

- Insulate the shield with tape to prevent contact with other signal lines and equipment.

Shield sheath   Armor

Do not connect here.

Connect to shield sheath terminal at Inverter (terminal E (G))   Insulate with tape
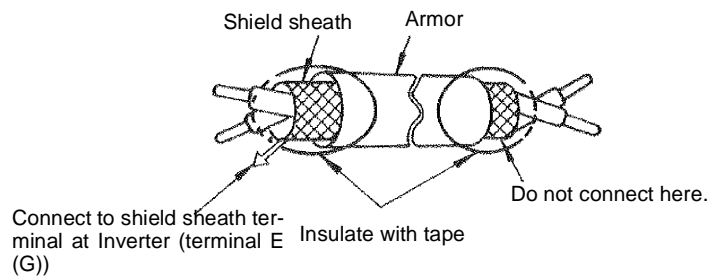
Fig 2.26 Processing the Ends of Twisted-pair Cables

Wiring Control Circuit Terminals for European Models

◆ Wire Sizes and Closed-loop Connectors

For remote operation using analog signals, keep the control line length between the Digital Operator or operation signals and the Inverter to 50 m or less, and separate the lines from high-power lines (main circuits or relay sequence circuits) to reduce induction from peripheral devices.

When setting frequencies from an external frequency setter (and not from a Digital Operator), use shielded twisted-pair wires and ground the shield to terminal E (G), as shown in the following diagram.
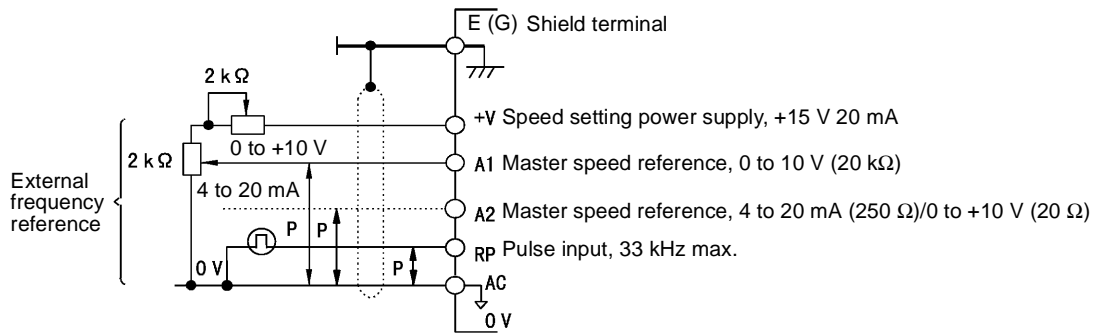
Fig 2.27

Terminal numbers and wire sizes are shown in *Table 2.19*.

Table 2.19 Terminal Numbers and Wire Sizes [For European (-E) Models]

Terminals	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm^2(AWG)	Recommended Wire Size mm^2(AWG)	Wire Type
S1, S2, S3, S4, S5, S6, S7, FM, AC, AM, IG, S+, S-, SN, SC, SP, A1, A2, +V, -V, MP, RP, R+, R-, M3, M4, M1, M2, M5, M6, MA, MB, MC	Phoenix type	0.5 to 0.6	0.14 to 1.5[3] (26 to 16)	0.75 (18)	• Shielded, twisted-pair wire[1] • Shielded, polyethylene-covered, vinyl sheath cable (KPEV-S by Hitachi Electrical Wire or equivalent)
E (G)	M3.5	0.8 to 1.0	0.5 to 2[2] (20 to 14)	1.25 (12)	

* 1. Use shielded twisted-pair cables to input an external frequency reference.
* 2. Refer to *Table 2.9 Close-loop Connector Sizes (JIS C2805) (200-V class and 400-V class)* for suitable closed-loop crimp terminal sizes for the wires.
* 3. We recommend using straight solderless terminal on signal lines to simplify wiring and improve reliability.

■ Straight Solderless Terminals for Signal Lines

Models and sizes of straight solderless terminal are shown in the following table.

Table 2.20 Straight Solderless Terminal Sizes

Wire Size mm^2 (AWG)	Model	d1	d2	L	Manufacturer
0.25 (24)	AI 0.25 - 8YE	0.8	2	12.5	
0.5 (20)	AI 0.5 - 8WH	1.1	2.5	14	
0.75 (18)	AI 0.75 - 8GY	1.3	2.8	14	Phoenix Contact
1.25 (16)	AI 1.5 - 8BK	1.8	3.4	14	
2 (14)	AI 2.5 - 8BU	2.3	4.2	14	

Fig 2.28 Straight Solderless Terminal Sizes

■Wiring Method

Use the following procedure to connect wires to the terminal block.

1. Loosen the terminal screws with a thin-slot screwdriver.
2. Insert the wires from underneath the terminal block.
3. Tighten the terminal screws firmly.
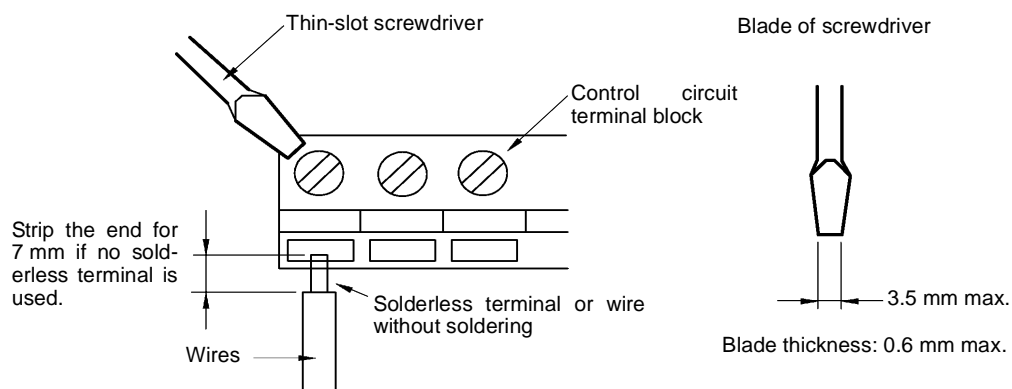
Fig 2.29 Connecting Wires to Terminal Block

◆ Control Circuit Terminal Connections

Connections to Inverter control circuit terminals are shown in *Fig 2.30*.
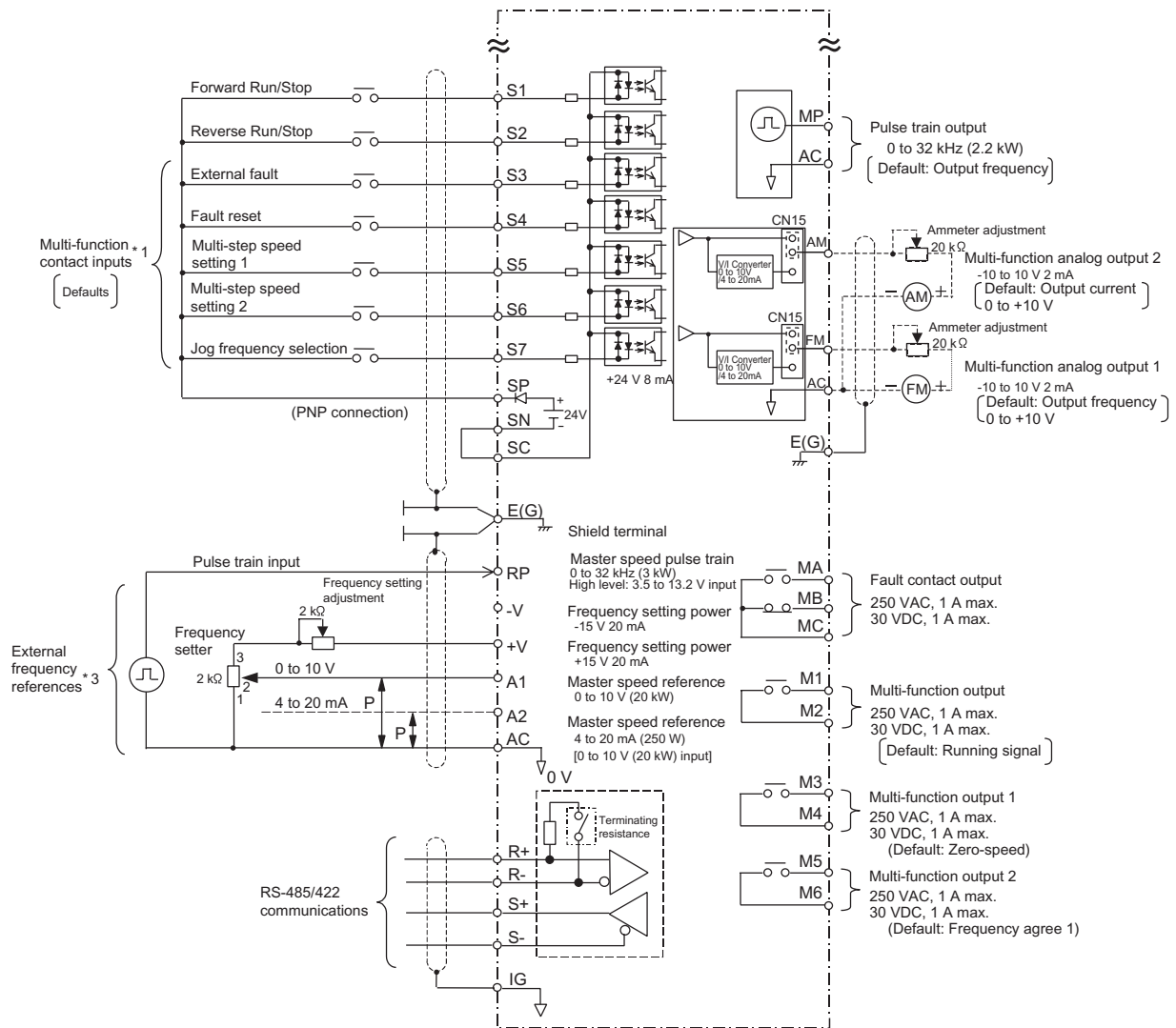
Fig 2.30 Control Circuit Terminal Connections (European (-E) Models)

1. Control circuit terminals are arranged as shown below.

SM	SC	SP	A1	A2	+V	AC	-V	MP	AC	RP	R+	R-		M5	M6	MA	M8	MC	
E(G)	S1	S2	S3	S4	S5	S6	S7	FM	AC	AM	IG	S+	S-		M3	M4	M1		M2	E(G)
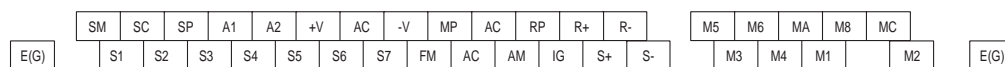
2. The output current capacity of the +V and -V terminal is 20 mA.

3. Disable the stall prevention during deceleration (set parameter L3-04 to 0) when using a Braking Resistor Unit. If this parameter is not changed to disable stall prevention, the system may not stop during deceleration.

4. Main circuit terminals are indicated with double circles and control circuit terminals are indicated with single circles.

5. Sequence input signals S1 to S7 are shown in *Table 2.23 Sinking/Sourcing Mode and Input Signals* for sourcing mode connections (+24 V common) for PNP transistor sequence and contacts for European use.
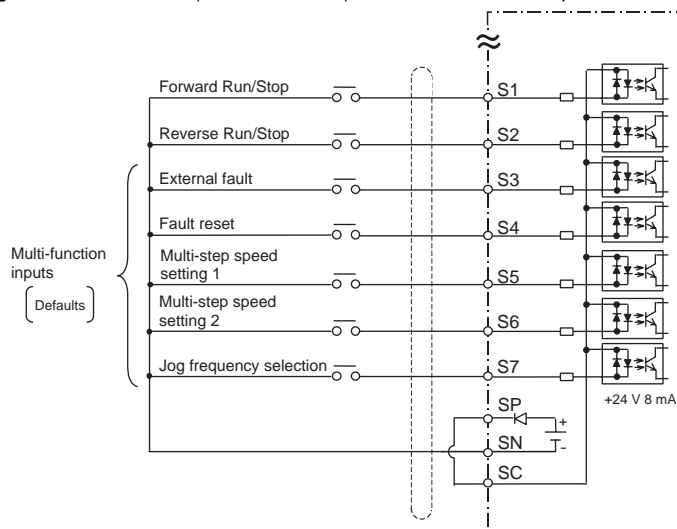
Check your system and select sinking mode or sourcing mode. Refer to *Table 2.18 Sinking/Sourcing Mode and Input Signals*.

6. The master speed frequency reference can set to input either a voltage (terminal A1) or current (terminal A2) by changing the setting of parameter H3-13. The default setting is for a voltage reference input.
   See Chapter 6 for the bi-directional voltage input for terminal A1.

7. The multi-function analog output is a dedicated meter output for an analog frequency meter, ammeter, voltmeter, wattmeter, etc. Do not use this output for feedback control or for any other control purpose.

8. DC reactors to improve the input power factor built into 200-V class Inverters for 22 to 110 kW and 400-V class Inverters for 22 to 160 kW. A DC reactor is thus an option only for Inverters for 18.5 kW or less. Remove the short bar when connecting a DC reactor to Inverters for 18.5 kW or less.

9. Set parameter L8-01 to 1 when using a Braking Resistor (3G3IV-PERF). When using a Braking Resistor Unit, a shutoff sequence for the power supply must be made using a thermal relay trip.

◆ Control Circuit Terminal Functions

The functions of the control circuit terminals are shown in *Table 2.21*. Use the appropriate terminals for the correct purposes.

Table 2.21 Control Circuit Terminals

Type	No.	Signal Name	Function		Signal Level
Sequence input signals	S1	Forward run/stop command	Forward run when ON; stopped when OFF.		24 VDC, 8 mA Photocoupler isolation
	S2	Reverse run/stop command	Reverse run when ON; stopped when OFF.		
	S3	External fault input[1]	Fault when ON.	Functions are selected by setting H1-01 to H1-05.	
	S4	Fault reset[*]	Reset when ON		
	S5	Multi-step speed reference 1[1] (Master/auxiliary switch)	Auxiliary frequency reference when ON.		
	S6	Multi-step speed reference 2[1]	Multi-step setting 2 when ON.		
	S7	Jog frequency reference[1]	Jog frequency when ON.		
	SC	Sequence input common			-
	SP	+24 V power for S1 to S7	-		
	SN	-24 V power for S1 to S7			
Analog input signals	+V	15 V power output	15 V power supply for analog references		15 V (Max. current: 20 mA)
	-V	-15 V power output	-15 V power supply for analog references		-15 V (Max. current: 20 mA)
	A1	Frequency reference	0 to +10 V/100% (when H3-01 = 0) -10 to +10 V/-100% to +100% (when H3-01 = 1)[4]		0 to +10 V(20 kΩ)
	A2	Multi-function analog input	4 to 20 mA/100% 0 to +10 V/100%	Function is selected by setting H3-09.	4 to 20 mA(250Ω) 0 to +10 V(20kΩ)
	AC	Analog reference common	-		-
	E(G)	Shield wire, optional ground line connection point	-		-
Sequence output signals	M1	Running signal (1NO contact)	Operating when ON.	Multi-function contact outputs	Dry contacts Contact capacity: 1 A max. at 250 VAC 1 A max. at 30 VDC
	M2				
	M3	Zero speed	Zero level (b2-01) or below when ON	Multi-function contact outputs	Dry contacts Contact capacity: 1 A max. at 250 VAC 1 A max. at 30 VDC
	M4				
	M5	Frequency agree 1	Within ±2 Hz of set frequency when ON		
	M6				
	MA	Fault output signal (SPDT)	Fault when CLOSED across MA and MC Fault when OPEN across MB and MC		Dry contacts Contact capacity: 1 A max. at 250 VAC 1 A max. at 30 VDC
	MB				
	MC				

2

Table 2.21 Control Circuit Terminals (Continued)

Type	No.	Signal Name	Function		Signal Level
Analog output signals	FM	Multi-function analog output (frequency output)	0 to +10 V/100% frequency	Multi-function analog monitor 1	0 to +10 V max. ±5% 2 mA max.
	AC	Analog common (copy)	-		
	AM	Multi-function analog output (current monitor)	5 V/Inverter's rated current	Multi-function analog monitor 2	
Pulse I/O	RP	Pulse input[*3]	H6-01 (Frequency reference input)		0 to 32 kHz (3 kΩ) High level voltage 3.5 to 13.2 V
	MP	Pulse monitor	H6-06 (Output frequency)		0 to 32 kHz +5 V output (Load: 1.5 kΩ)
RS-485/422A	R+	RS-422A/485 communications input	For 2-wire RS-485, short R+ and S+ as well as R- and S-.		Differential input, photocoupler isolation
	R-				
	S+	RS-422A/485 communications output			Differential input, photocoupler isolation
	S-				
	IG	Signal common	-		-

* 1. The default settings are given for terminals S3 to S7. For a 3-wire sequence, the default settings are a 3-wire sequence for S5, multi-step speed setting 1 for S6 and multi-step speed setting 2 for S7.

* 2. When driving a reactive load, such as a relay coil, always insert a flywheel diode as shown in *Fig 2.31*.

* 3. Pulse input specifications are given in the following table.

Low level voltage	0.0 to 0.8 V
High level voltage	3.5 to 13.2 V
H duty	30% to 70%
Pulse frequency	0 to 32 kHz
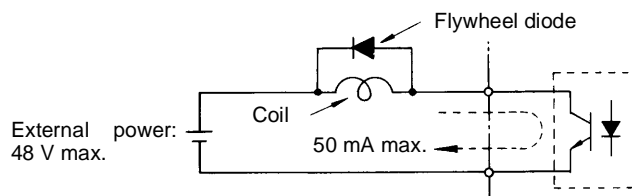
Fig 2.31 Flywheel Diode Connection

■Shunt Connector CN15 and DIP Switch S1

The shunt connector CN 15 and DIP switch S1 are described in this section.
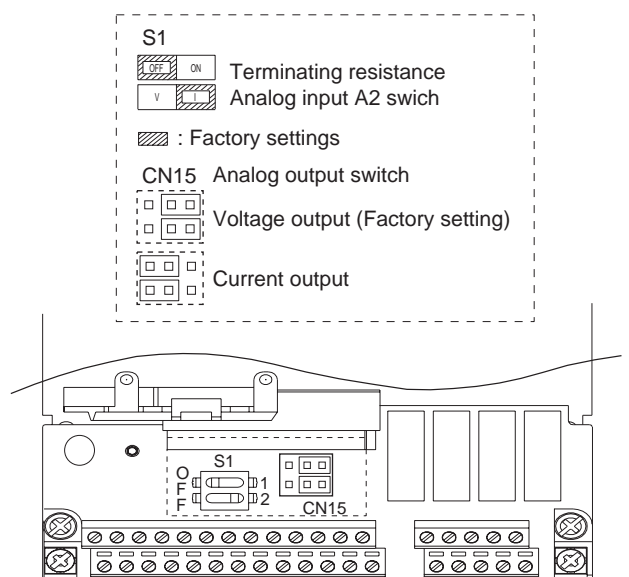
Note: Refer to Table 2.13 for S1 functions

Fig 2.32   Shunt Connector CN15 and DIP Switch S1

The functions of DIP switch S1 are shown in the following table.

Table 2.22 DIP Switch S1

Name	Function	Setting
S1-1	RS-485 and RS-422A terminating resistance	OFF: No terminating resistance ON: Terminating resistance of 110 Ω
S1-2	Input method for analog input A2	OFF: 0 to 10 V (internal resistance: 20 kΩ) ON: 4 to 20 mA (internal resistance: 250 Ω)

■ Sinking/Sourcing Mode

The input terminal logic can be selected between sinking mode (0-V common) and sourcing mode (+24-V common) as shown in *Table 2.23*. An external power supply is also supported, providing more freedom in signal input methods.

Table 2.23 Sinking/Sourcing Mode and Input Signals

◆ Control Circuit Wiring Precautions

Observe the following precautions when wiring control circuits.

- Separate control circuit wiring from main circuit wiring (terminals R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3, ⊖, ⊕1, ⊕2, and ⊕3) and other high-power lines.

- Separate wiring for control circuit terminals MA, MB, MC, M1, and M2 (contact outputs) from wiring to other control circuit terminals.

- If using an optional external power supply, it must be a UL-listed Class 2 power supply source.

- Use twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults. Process cable ends as shown in *Fig 2.33*.

- Connect the shield wire to terminal E (G).

- Insulate the shield with tape to prevent contact with other signal lines and equipment.

2
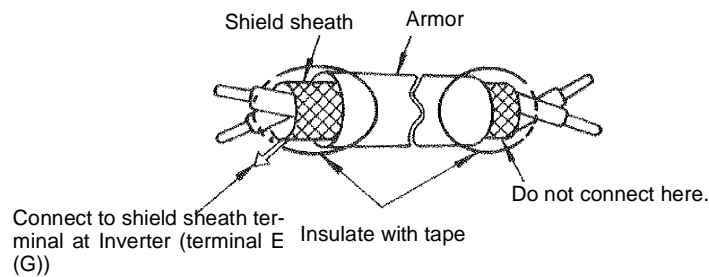
Fig 2.33 Processing the Ends of Twisted-pair Cables

Wiring Check

◆ Checks

Check all wiring after wiring has been completed. Do not perform a buzzer check on control circuits. Perform the following checks on the wiring.

- Is all wiring correct?
- Have any wire clippings, screws, or other foreign material been left?
- Are all screws tight?
- Are any wire ends contacting other terminals?

Installing and Wiring Option Cards

◆ Option Card Models and Specifications

Up to three Option Cards can be mounted in the Inverter. You can mount up one Card into each of the three places on the controller card (A, C, and D) shown in *Fig 2.34*.

Table 2.24 lists the type of Option Cards and their specifications.

Table 2.24   Option Card Specifications

Card	Model	Specifications	Mounting Location
PG Speed Control Cards	3G3FV-PPGA2	Serial open-collector/complimentary inputs	A
	3G3FV-PPGB2	Phase A/B complimentary inputs	A
	3G3FV-PPGD2	Single line-driver inputs	A
	3G3FV-PPGX2	Phase A/B line-driver inputs	A
DeviceNet Communications Card	3G3FV-PDRT1-SIN	DeviceNet communications support	C
Analog Monitor Card	3G3FV-PA008	8-bit analog outputs, 2 channels	D
	3G3FV-PA012	12-bit analog outputs, 2 channels	D

*   An Option Card in Mounting Location D is supported by Asian Models only. Other models do not have the CN3 connector shown in *Fig 2.34*.

◆ Installation

Before mounting an Option Card, remove the terminal cover and be sure that the charge indicator inside the Inverter is not lit. After confirming that the charge indicator is not lit, remove the Digital Operator and front cover and then mount the Option Card.

Refer to documentation provided with the Option Card for actual mounting instructions for option slots A, C, and D.

2

■ Preventing C and D Option Card Connectors from Rising

After installing an Option Card into slot C or D, insert an Option Clip to prevent the side with the connector from rising. The Option Clip can be easily removed by holding onto the protruding portion of the Clip and pulling it out.
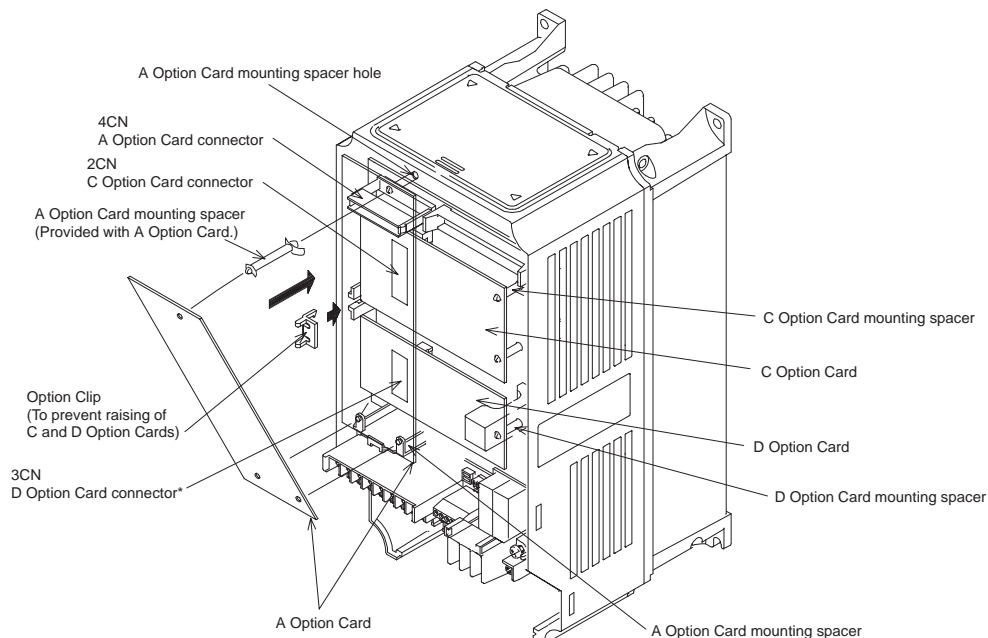
* An Option Card in Mounting Location D is supported by Asian Models only. Other models do not have the CN3 connector shown in *Fig 2.34*.

Fig 2.34 Mounting Option Cards

◆ PG Speed Control Card Terminals and Specifications

The terminal specifications for the PG Speed Control Cards are given in the following tables.

■3G3FV-PPGA2

The terminal specifications for the 3G3FV-PPGA2 are given in the following table.

Table 2.25 3G3FV-PPGA2 Terminal Specifications

Terminal	No.	Contents	Specifications
TA1	1	Power supply for pulse generator	12 VDC (±5%), 200 mA max.
	2		0 VDC (GND for power supply)
	3	+12 V/open collector switching terminal	Terminal for switching between12 V voltage input and open collector input. For open collector input, short across 3 and 4.
	4		
	5	Pulse input terminal	H: +4 to 12 V; L: +1 V max. (Maximum response frequency: 30 kHz)
	6		Pulse input common
	7	Pulse motor output terminal	12 VDC (±10%), 20 mA max.
	8		Pulse monitor output common
TA2	(E)	Shield connection terminal	-

■3G3FV-PPGB2

The terminal specifications for the 3G3FV-PPGB2 are given in the following table.

Table 2.26 3G3FV-PPGB2 Terminal Specifications

Terminal	No.	Contents	Specifications
TA1	1	Power supply for pulse generator	12 VDC (±5%), 200 mA max.
	2		0 VDC (GND for power supply)
	3	A-phase pulse input terminal	H: +8 to 12 V L: +1 V max. (Maximum response frequency: 30 kHz)
	4		Pulse input common
	5	B-phase pulse input terminal	H: +8 to 12 V L: +1 V max. (Maximum response frequency: 30 kHz)
	6		Pulse input common
TA2	1	A-phase monitor output terminal	Open collector output, 24 VDC, 30 mA max.
	2		A-phase monitor output common
	3	B-phase monitor output terminal	Open collector output, 24 VDC, 30 mA max.
	4		B-phase monitor output common
TA3	(E)	Shield connection terminal	-

■3G3FV-PPGD2

The terminal specifications for the 3G3FV-PPGD2 are given in the following table.

Table 2.27 3G3FV-PPGD2 Terminal Specifications

Terminal	No.	Contents	Specifications
TA1	1	Power supply for pulse generator	12 VDC (±5%), 200 mA max.*
	2		0 VDC (GND for power supply)
	3		5 VDC (±5%), 200 mA max.*
	4	Pulse input + terminal	Line driver input (RS-422 level input) Maximum response frequency: 300 kHz
	5	Pulse input - terminal	
	6	Common terminal	-
	7	Pulse monitor output + terminal	Line driver output (RS-422 level output)
	8	Pulse monitor output - terminal	
TA2	(E)	Shield connection terminal	-

* 5 VDC and 12 VDC cannot be used at the same time.

■3G3FV-PPGX2

The terminal specifications for the 3G3FV-PPGX2 are given in the following table.

Table 2.28 3G3FV-PPGX2 Terminal Specifications

Terminal	No.	Contents	Specifications
TA1	1	Power supply for pulse generator	12 VDC (±5%), 200 mA max.*
	2		0 VDC (GND for power supply)
	3		5 VDC (±5%), 200 mA max.*
	4	A-phase + input terminal	Line driver input (RS-422 level input) Maximum response frequency: 300 kHz
	5	A-phase - input terminal	
	6	B-phase + input terminal	
	7	B-phase - input terminal	
	8	Z-phase + input terminal	
	9	Z-phase - input terminal	
	10	Common terminal	0 VDC (GND for power supply)
TA2	1	A-phase + output terminal	Line driver output (RS-422 level output)
	2	A-phase - output terminal	
	3	B-phase + output terminal	
	4	B-phase - output terminal	
	5	Z-phase + output terminal	
	6	Z-phase - output terminal	
	7	Control circuit common	Control circuit GND
TA3	(E)	Shield connection terminal	-

* 5 VDC and 12 VDC cannot be used at the same time.

◆ Wiring

Wiring examples are provided in the following illustrations for the Control Cards.

■ Wiring the 3G3FV-PPGA2

Wiring examples are provided in the following illustrations for the 3G3FV-PPGA2.
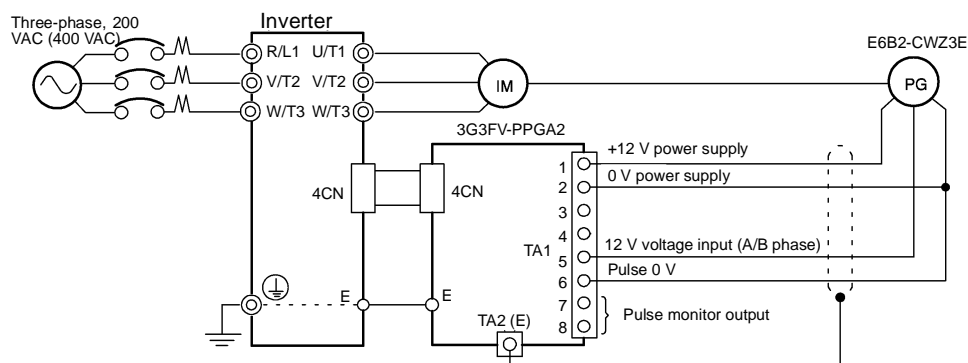
Fig 2.35 Wiring a 12-V Voltage Input

- Shielded twisted-pair wires must be used for signal lines.
- Do not use the pulse generator's power supply for anything other than the pulse generator (encoder). Using it for another purpose can cause malfunctions due to noise.
- The length of the pulse generator's wiring must not be more than 30 meters.

Fig 2.36 Wiring an Open-collector Input

Fig 2.37 I/O Circuit Configuration of the 3G3FV-PPGA2

■ Wiring the 3G3FV-PPGB2

Wiring examples are provided in the following illustrations for the 3G3FV-PPGB2.
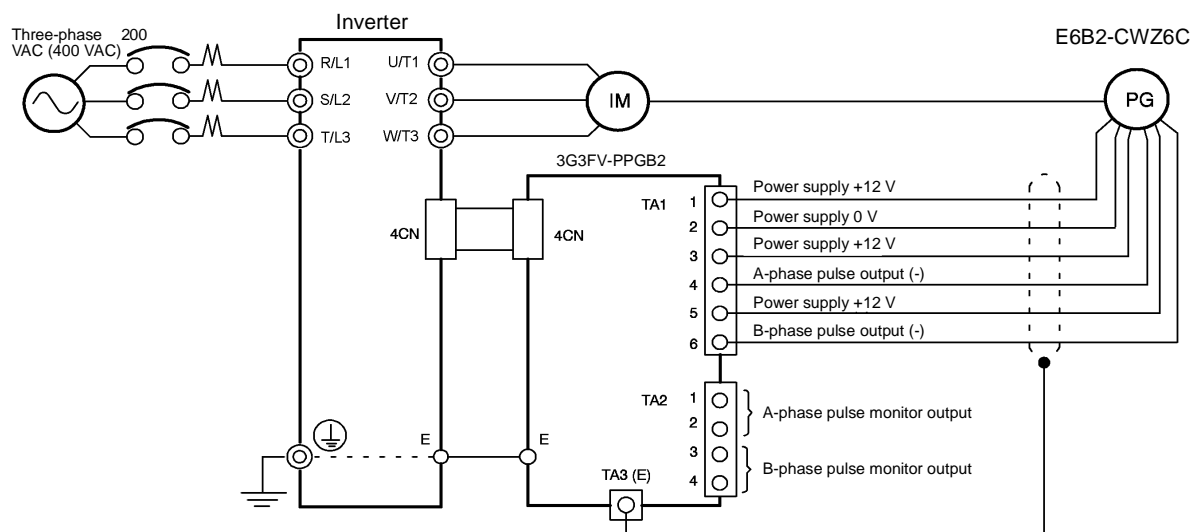
- Shielded twisted-pair wires must be used for signal lines.
- Do not use the pulse generator's power supply for anything other than the pulse generator (encoder). Using it for another purpose can cause malfunctions due to noise.
- The length of the pulse generator's wiring must not be more than 30 meters.
- The direction of rotation of the PG can be set in parameter F1-05. The factory preset if for forward rotation, A-phase advancement.

Fig 2.38 3G3FV-PPGB2 Wiring
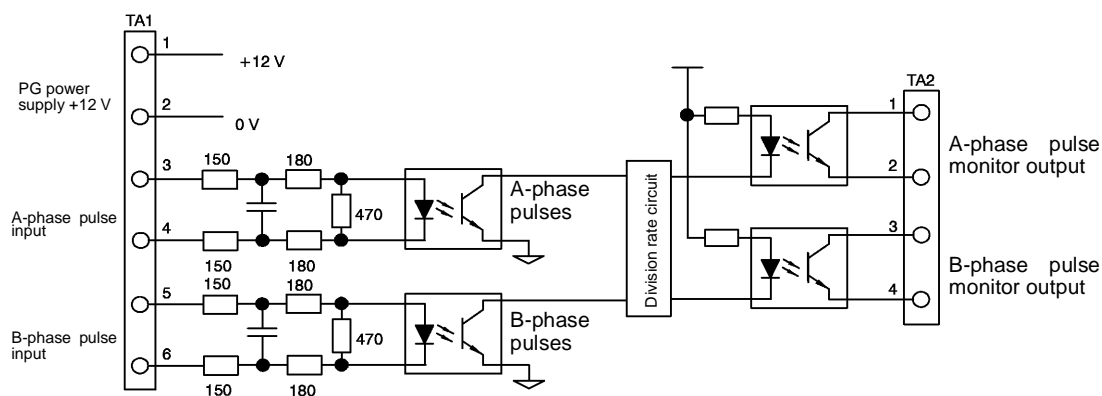
- When connecting to a voltage-output-type PG (encoder), select a PG that has an output impedance with a current of at least 12 mA to the input circuit photocoupler (diode).
- The pulse monitor dividing ratio can be changed using parameter F1-06.

A-phase pulses

B-phase pulses

Fig 2.39 I/O Circuit Configuration of the 3G3FV-PPGB2

■Wiring the 3G3FV-PPGD2

Wiring examples are provided in the following illustrations for the 3G3FV-PPGD2.
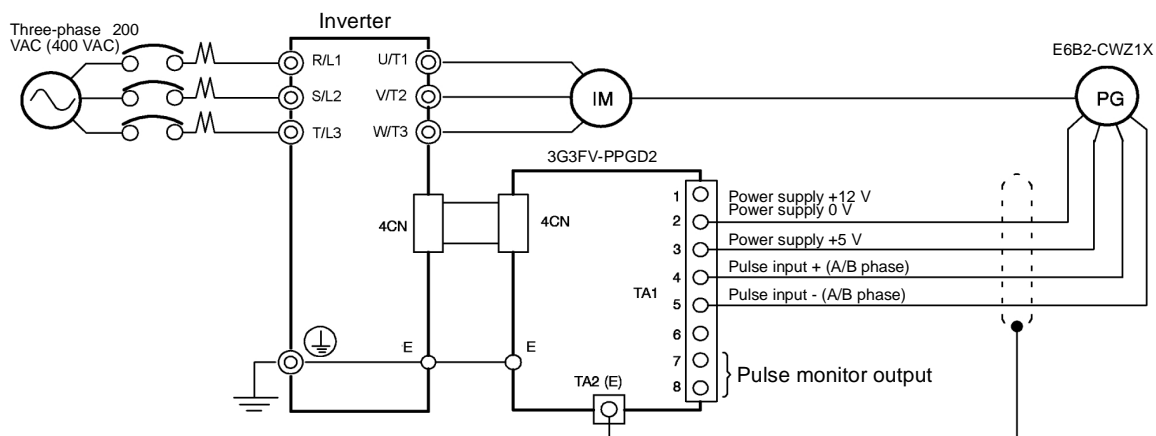
- Shielded twisted-pair wires must be used for signal lines.
- Do not use the pulse generator's power supply for anything other than the pulse generator (encoder). Using it for another purpose can cause malfunctions due to noise.
- The length of the pulse generator's wiring must not be more than 50 meters.

Fig 2.40 3G3FV-PPGD2 Wiring

■Wiring the 3G3FV-PPGX2

Wiring examples are provided in the following illustrations for the 3G3FV-PPGX2.
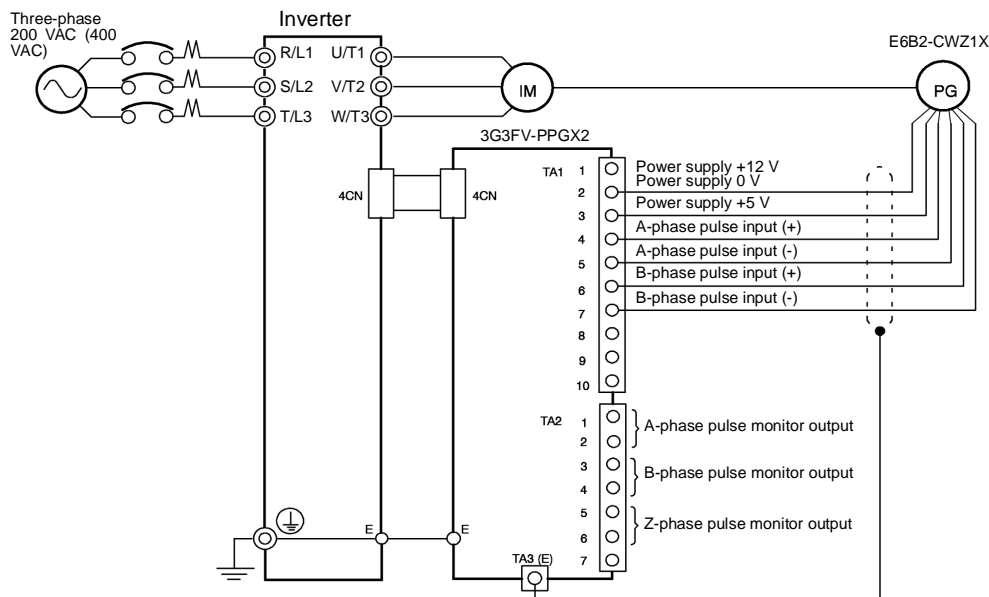
- Shielded twisted-pair wires must be used for signal lines.
- Do not use the pulse generator's power supply for anything other than the pulse generator (encoder). Using it for another purpose can cause malfunctions due to noise.
- The length of the pulse generator's wiring must not be more than 50 meters.
- The direction of rotation of the PG can be set in parameter F1-05 (PG Rotation). The factory preset if for motor forward rotation, A-phase advancement.

Fig 2.41 3G3FV-PPGX2 Wiring

2

◆ Wiring Terminal Blocks

Use no more than 30 meters of wiring for PG (encoder) signal lines for the 3G3FV-PPGA2/PPGB2 or 50 meters for the 3G3FV-PPGD2/PPGX2, and keep the wiring separate from power lines.

Use shielded, twisted-pair wires for pulse inputs and pulse output monitor wires, and connect the shield to the shield connection terminal.

■Wire Sizes (Same for All Models)

Terminal wire sizes are shown in *Table 2.29.*

Table 2.29 Wire Sizes

Terminal	Terminal Screws	Wire Thickness (mm^2)	Wire Type
Pulse generator power supply Pulse input terminal Pulse monitor output terminal	-	Stranded wire: 0.5 to 1.25 Single wire: 0.5 to 1.25	• Shielded, twisted-pair wire • Shielded, polyethylene-covered, vinyl sheath cable (KPEV-S by Hitachi Electric Wire or equivalent)
Shield connection terminal	M3.5	0.5 to 2	

■Straight Solderless Terminals for Control Circuit Terminals

We recommend using straight solderless terminal on signal lines to simplify wiring and improve reliability.

Refer to *Table 2.15 Straight Solderless Terminal Sizes* for specifications.

■Closed-loop Connector Sizes and Tightening Torque

The closed-loop connectors and tightening torques for various wire sizes are shown in *Table 2.30*.

Table 2.30 Closed-loop Connectors and Tightening Torques

Wire Thickness [mm^2]	Terminal Screws	Crimp Terminal Size	Tightening Torque (N • m)
0.5	M3.5	1.25 - 3.5	0.8
0.75		1.25 - 3.5	
1.25		1.25 - 3.5	
2		2 - 3.5	

■Wiring Method and Precautions

The wiring method is the same as the one used for straight solderless terminals. Refer to page 2-30. Observe the following precautions when wiring.

• Separate the control signal lines for the PG Speed Control Card from main circuit lines and power lines.

• Connect the shield when connecting to a PG. The shield must be connected to prevent operational errors caused by noise. Also, do not use any lines that are longer than the recommended length. Refer to *Fig 2.26* for details on connecting the shield.

• Connect the shield to the shield terminal (E).

• Do not solder the ends of wires. Doing so may cause contact faults.

• When not using straight solderless terminals, strip the wires to a length of approximately 5.5 mm.

◆ Selecting the Number of PG (Encoder) Pulses

The setting for the number of PG pulses depends on the model of PG Speed Control Card being used. Set the correct number for your model.

■3G3FV-PPGA2/3G3FV-PPGB2

The maximum response frequency is 32,767 Hz.

Use a PG that outputs a maximum frequency of approximately 20 kHz for the rotational speed of the motor.

$$\frac{\text{Motor speed at maximum frequency output (r/min)}}{60} \times \text{PG rating (p/rev)} = 20,000 \text{ Hz}$$

Some examples of PG output frequency (number of pulses) for the maximum frequency output are shown in *Table 2.31*.

Table 2.31 PG Pulse Selection Examples

Motor's Maximum Speed (r/min)	PG Rating (p/rev)	PG Output Frequency for Maximum Frequency Output (Hz)
1800	600	18,000
1500	800	20,000
1200	1000	20,000
900	1200	18,000

Note 1. The motor speed at maximum frequency output is expressed as the sync rotation speed.
　　 2. The PG power supply is 12 V.
　　 3. A separate power supply is required if the PG power supply capacity is greater than 200 mA. (If momentary power loss must be handled, use a backup capacitor or other method.)
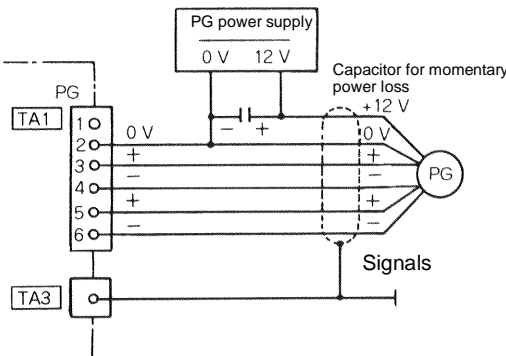
Fig 2.42 3G3FV-PPGB2 Connection Example

■3G3FV-PPGD2/3G3FV-PPGX2

There are 5 V and 12 V PG power supplies.
Check the PG power supply specifications before connecting.

The maximum response frequency is 300 kHz.

Use the following equation to computer the output frequency of the PG (f_{PG}).

$$f_{PG}(Hz) = \frac{\text{Motor speed at maximum frequency output (r/min)}}{60} \times \text{PG rating (p/rev)}$$

A separate power supply is required if the PG power supply capacity is greater than 200 mA. (If momentary power loss must be handled, use a backup capacitor or other method.)
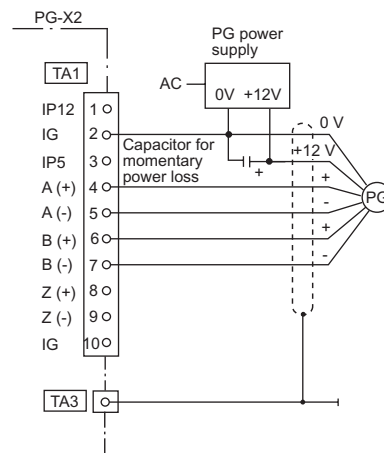
Fig 2.43 3G3FV-PPGD2 Connection Example (for 12-V PG power supply)

3

Chapter 3

Digital Operator and Modes

This chapter describes Digital Operator displays and functions, and provides an overview of operating modes and switching between modes.

Digital Operator

This section describes the displays and functions of the Digital Operator.

◆ Digital Operator Display

The key names and functions of the Digital Operator are described below.

Digital Operator with LED Display (3G3IV-PJVOP161)

Drive Mode Indicators

FWD: Lit when there is a forward run command input.
REV: Lit when there is a reverse run command input.
SEQ: Lit when the run command from the control circuit terminal is enabled.
REF: Lit when the frequency reference from control circuit terminals A1 and A2 is enabled.
ALARM: Lit when an error or alarm has occurred.

Data Display

Displays monitor data, parameter numbers, and settings (in five digits).

Mode Display

DRIVE: Lit in Drive Mode.
QUICK: Lit in Quick Programming Mode.
ADV: Lit in Advanced Programming Mode.
VERIFY: Lit in Verify Mode.
A. TUNE: Lit in Autotuning Mode.

Keys

Execute operations such as setting parameters, monitoring, jogging, and autotuning.

Digital Operator with LCD Display (3G3IV-PJVOP160)

Drive Mode Indicators

FWD: Lit when there is a forward run command input.
REV: Lit when there is a reverse run command input.
SEQ: Lit when the run command from the control circuit terminal is enabled.
REF: Lit when the frequency reference from control circuit terminals A1 and A2 is enabled.
ALARM: Lit when an error or alarm has occurred.

Data Display

Displays monitor data, parameter numbers, and settings.

Keys

Execute operations such as setting parameters, monitoring, jogging, and autotuning.

Fig 3.1 Digital Operator Component Names and Functions

◆ Digital Operator Keys

The names and functions of the Digital Operator Keys are described in *Table 3.1*.

Table 3.1 Key Functions

Key	Name	Function
LOCAL / REMOTE	LOCAL/REMOTE Key	Switches between operation via the Digital Operator (LOCAL) and control circuit terminal operation (REMOTE). This Key can be enabled or disabled by setting parameter o2-01.
MENU	MENU Key	Selects menu items (modes).
ESC	ESC Key	Returns to the status before the ENTER Key was pressed.
JOG	JOG Key	Enables jog operation when the Inverter is being operated from the Digital Operator.
FWD / REV	FWD/REV Key	Selects the rotation direction of the motor when the Inverter is being operated from the Digital Operator.
≫ / RESET	Digit Selection/RESET Key	Sets the number of digits for parameter settings. Also acts as the Reset Key when a fault has occurred.
⌃	Increment Key	Selects menu items, sets parameter numbers, and increments set values. Used to move to the next item or data.
⌄	Decrement Key	Selects menu items, sets parameter numbers, and decrements set values. Used to move to the previous item or data.
↵	ENTER Key	Pressed to enter menu items, parameters, and set values. Also used to switch from one screen to another.
RUN	RUN Key	Starts the Inverter operation when the Inverter is being controlled by the Digital Operator.
STOP	STOP Key	Stops Inverter operation. This Key can be enabled or disabled when operating from the control circuit terminal by setting parameter o2-02.

Note Except in diagrams, Keys are referred to using the Key names listed in the above table.

3

There are indicators on the upper left of the RUN and STOP Keys on the Digital Operator. These indicators will light and flash to indicate operating status.

The RUN Key indicator will flash and the STOP Key indicator will light during initial excitation of the dynamic brake. The relationship between the indicators on the RUN and STOP Keys and the Inverter status is shown in the *Fig 3.2*.
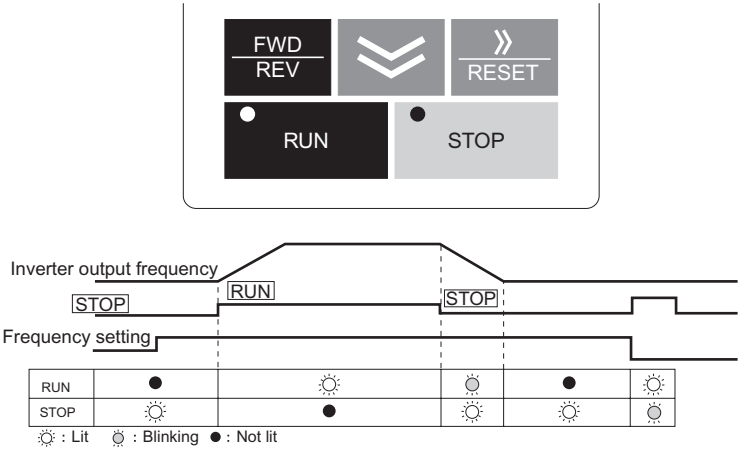
Fig 3.2 RUN and STOP Indicators

Modes

This section describes the Inverter's modes and switching between modes.

◆ Inverter Modes

The Inverter's parameters and monitoring functions are organized in groups called modes that make it easier to read and set parameters. The Inverter is equipped with 5 modes.

The 5 modes and their primary functions are shown in the *Table 3.2*.

Table 3.2 Modes

Mode	Primary function(s)
Drive Mode	The Inverter can be run in this mode. Use this mode when monitoring values such as frequency references or output current, displaying fault information, or displaying the fault history.
Quick Programming Mode	Use this mode to reference and set the minimum parameters to operate the Inverter (e.g., the operating environment of the Inverter and Digital Operator).
Advanced Programming Mode	Use this mode to reference and set all parameters.
Verify Mode	Use this mode to read/set parameters that have been changed from their factory-set values.
Autotuning Mode*	Use this mode when running a motor with unknown motor constants in the vector control mode. The motor constants are calculated and set automatically. This mode can also be used to measure only the motor line-to-line resistance.

* Always perform autotuning with the motor before operating using vector control. Autotuning Mode will not be displayed during operation or when an error has occurred.

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◆ Switching Modes

The mode selection display will appear when the MENU Key is pressed from a monitor or setting display. Press the MENU Key from the mode selection display to switch between the modes.

Press the DATA/ENTER Key from the mode selection key to monitor data and from a monitor display to access the setting display.
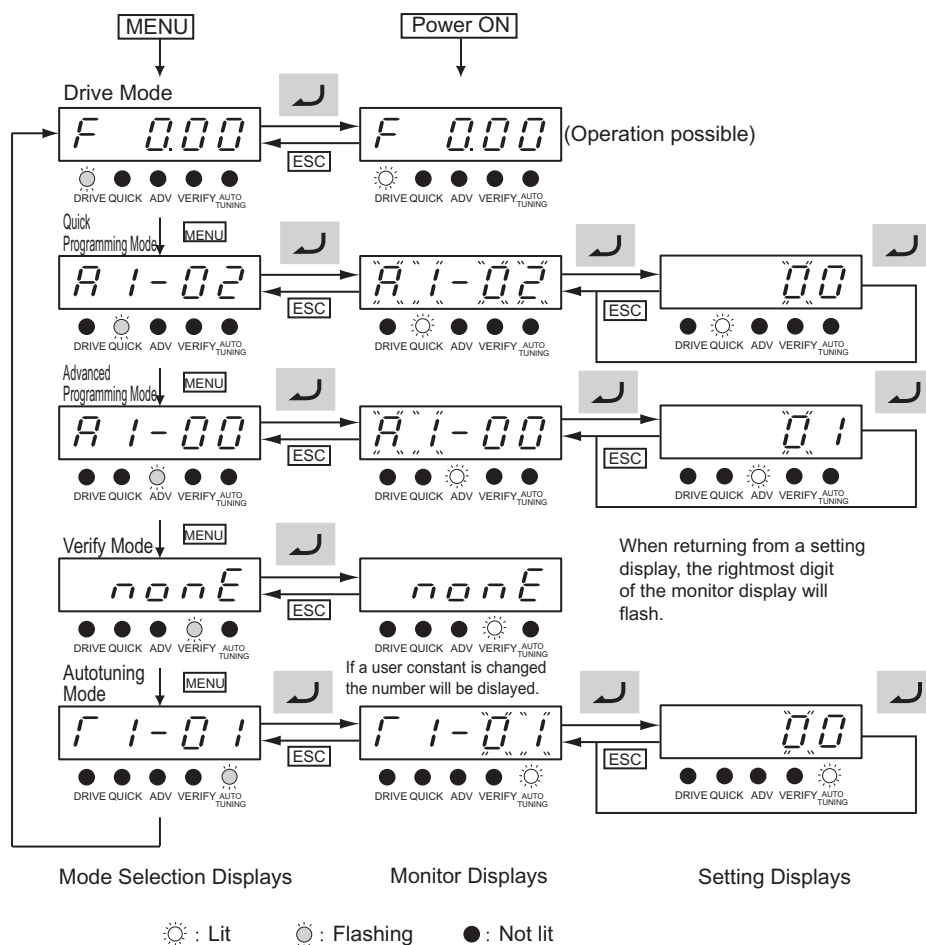
Fig 3.3 Mode Transitions (Example for the 3G3IV-PJVOP161)

IMPORTANT	When running the Inverter after using Digital Operator, press the MENU Key to enter the Drive Mode (DRIVE indicator will flash) and then press the ENTER Key from the Drive Mode display to bring up the monitor display (DRIVE indicator will light). Run commands can't be received from any other display. (Monitor display in Drive Mode will appear when the power is turned ON.)

◆ Drive Mode

Drive Mode is the mode in which the Inverter can be operated. The following monitor displays are possible in Drive Mode: The frequency reference, output frequency, output current, and output voltage, as well as fault information and the fault history.

When b1-01 (Reference selection) is set to 0, the frequency can be changed from the frequency setting display. Use the Increment, Decrement, and Digit Selection/RESET Keys to change the frequency. The parameter will be written and the monitor display will be returned to when the ENTER Key is pressed after changing the setting.

■ Example Operations

Key operations in Drive Mode are shown in the following figure.
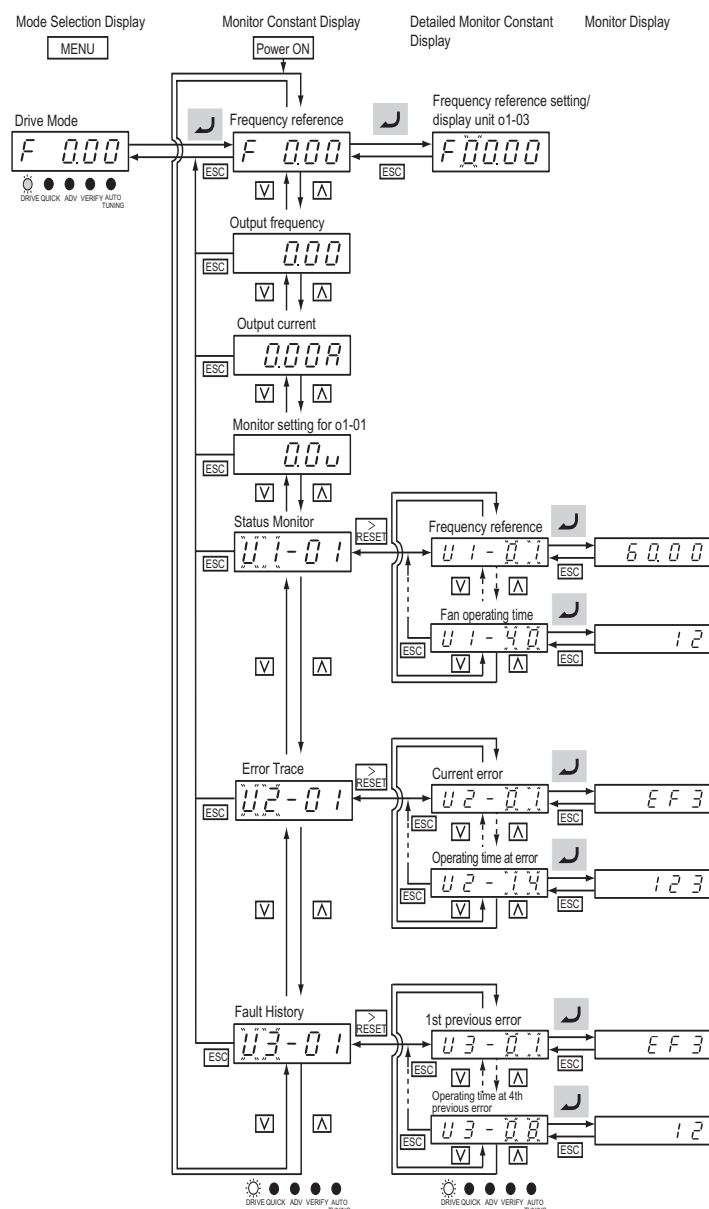
Fig 3.4 Operations in Drive Mode (Example for the 3G3IV-PJVOP161)

IMPORTANT

The display for the first monitor parameter (frequency reference) will be displayed when power is turned ON. The monitor item displayed at startup can be set in o1-02 (Monitor Selection after Power Up). Operation cannot be started from the Mode Selection Display.

◆ Quick Programming Mode

In Quick Programming Mode, the parameters required for Inverter trial operation can be monitored and set.

Parameters can be changed from the setting displays. Use the Increment, Decrement, and Digit Selection/ RESET Keys to change the frequency. The parameter will be written and the monitor display will be returned to when the ENTER Key is pressed after changing the setting.

Refer to *Chapter 5 Parameters* for details on the parameters displayed in Quick Programming Mode.

■Example Operations

Key operations in Quick Programming Mode are shown in the following figure.
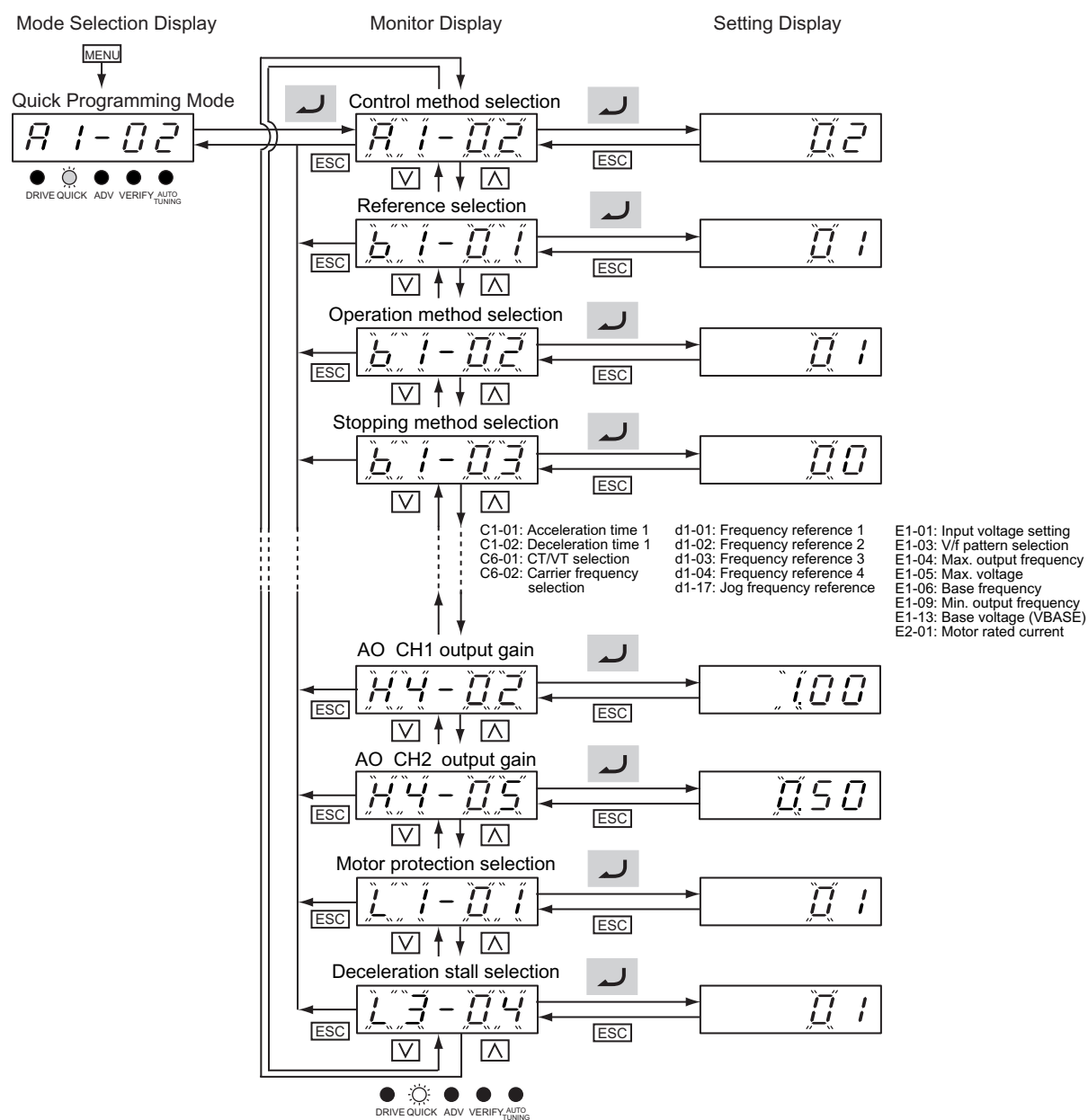
Fig 3.5 Operations in Quick Programming Mode (Example for the 3G3IV-PJVOP161)

◆ Advanced Programming Mode

In Advanced Programming Mode, all Inverter parameters can be monitored and set.

Parameters can be changed from the setting displays. Use the Increment, Decrement, and Digit Selection/RESET Keys to change the frequency. The parameter will be written and the monitor display will be returned to when the ENTER Key is pressed after changing the setting.

Refer to *Chapter 5 Parameters* for details on the parameters.

■Example Operations

Key operations in Advanced Programming Mode are shown in the following figure.
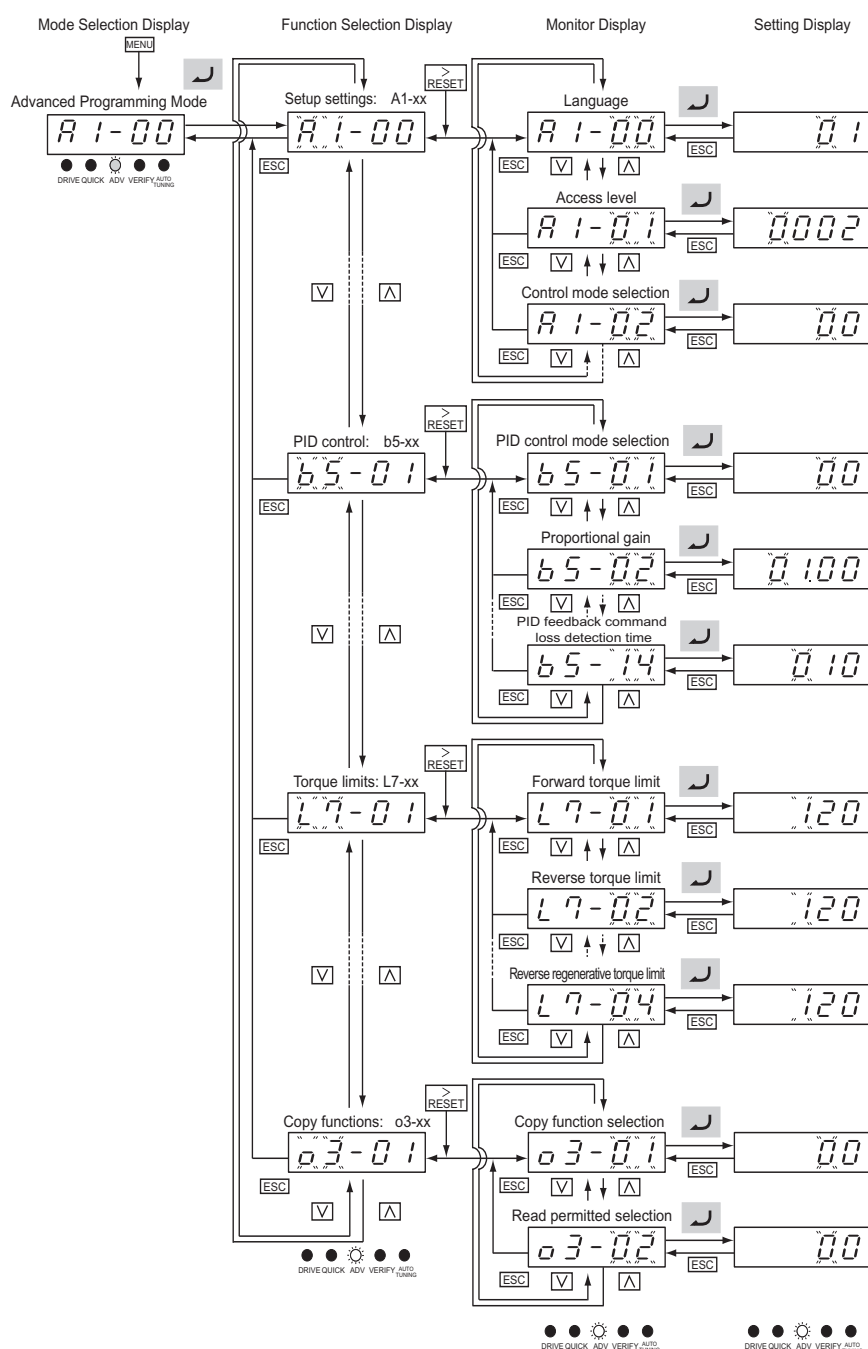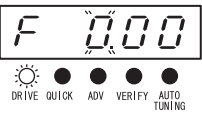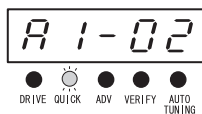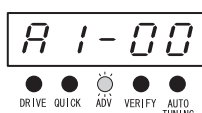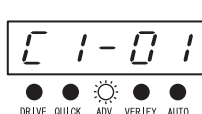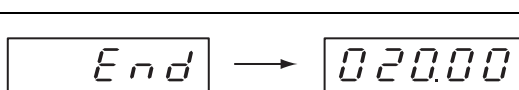
Fig 3.6 Operations in Advanced Programming Mode (Example for the 3G3IV-PJVOP161)

3

■Setting Parameters

Here, the procedure is shown to change C1-01 (Acceleration Time 1) from 10 s to 20 s.

Table 3.3 Setting Parameters in Advanced Programming Mode

Step No.	Digital Operator Display	Description
1	F 0.00	Power supply turned ON.
2	F 0.00	MENU Key pressed to enter Drive Mode.
3	A1-02	MENU Key pressed to enter Quick Programming Mode.
4	A1-00	MENU Key pressed to Enter Advanced Programming Mode.
5	A1-00	ENTER pressed to access monitor display.
6	C1-01	Increment or Decrement Key pressed to display C1-01 (Acceleration Time 1).
7	0 10.00	ENTER Key pressed to access setting display. The setting of C1-01 (10.00) is displayed.
8	0 10.00	Digit Selection/RESET Key pressed to move the flashing digit to the right.
9	0 20.00	Increment Key pressed to change set value to 20.00 s.
10	End → 0 20.00	ENTER Key pressed to enter the set data. "END" is displayed for 10 s and then the entered value is displayed for 0.5 s.
11	C1-01	The monitor display for C1-01 returns.

◆ Verify Mode

Verify Mode is used to display any parameters that have been changed from their default settings in a Programming Mode or by autotuning. "None" will be displayed if no settings have been changed.

Of the Environment Mode settings, only A1-02 will be displayed if it has been changed. Other Environment Modes settings will not be displayed even if they have been changed from their default settings.

Even in Verify Mode, the same procedures can be used to change settings as are used in the Programming Modes. Use the Increment, Decrement, and Digit Selection/RESET Keys to change the frequency. The parameter will be written and the monitor display will be returned to when the ENTER Key is pressed after changing the setting.

■ Example Operations

An example of key operations is given below for when the following settings have been changed from their default settings: b1-01 (Reference Selection), C1-01 (Acceleration Time 1), E1-01 (Input Voltage Setting), and E2-01 (Motor Rated Current).
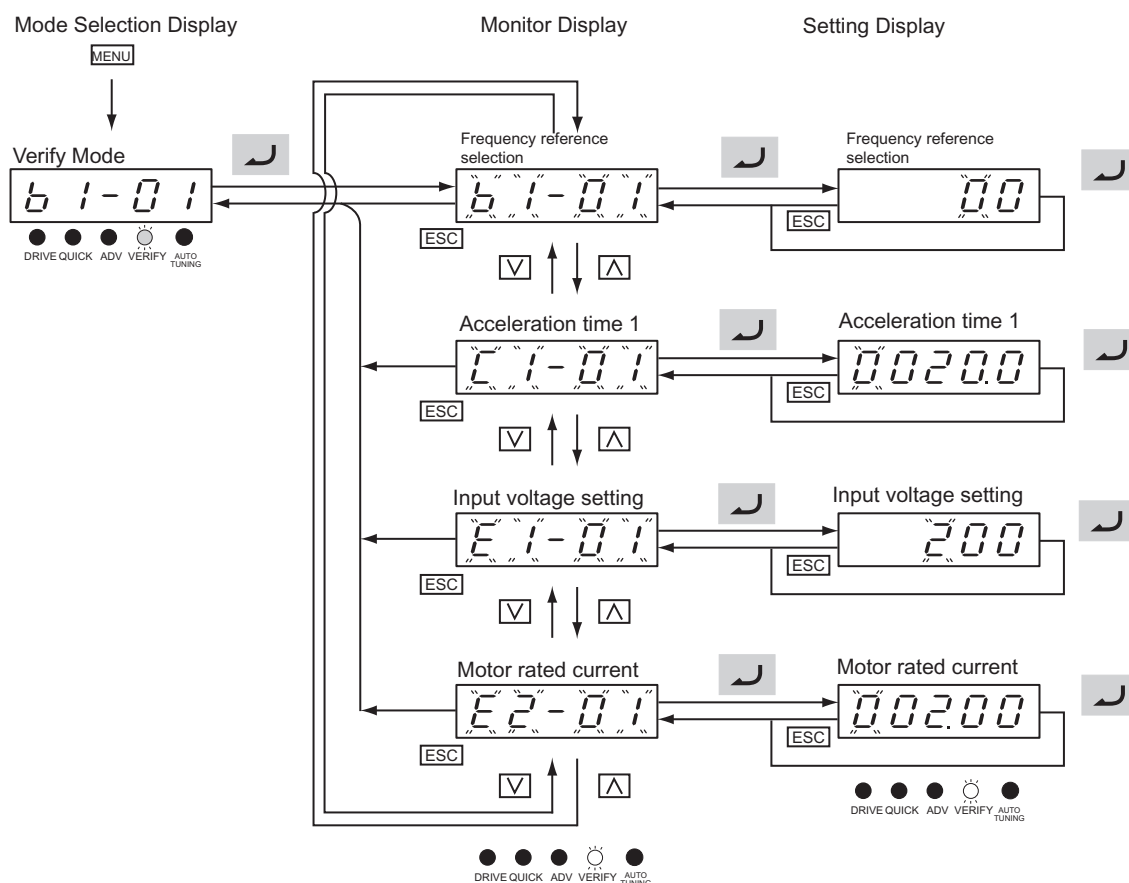
Fig 3.7 Operations in Verify Mode (Example for the 3G3IV-PJVOP161)

◆ Autotuning Mode

Autotuning automatically tunes and sets the required motor constants when operating in the open-loop V/f, V/f with PG, or open-loop vector control modes. Always perform autotuning before starting operation when using open-loop vector control mode.

When V/f control has been selected, stationary autotuning for only line-to-line resistance can be selected.

When the motor cannot be disconnected from the load, perform stationary autotuning. Contact your dealer to set motor constants by calculation.

The Inverter's autotuning function automatically determines the motor constants, while a servo system's auto-tuning function determines the size of a load, so these autotuning functions are fundamentally different.

■Example of Operation

Set the motor output power (in kW), rated voltage, rated current, rated frequency, rated speed, and number of poles specified on the nameplate on the motor and then press the RUN Key. The motor is automatically run and the motor constants measured based on these settings and autotuning will be set.

Always set the above items. Autotuning cannot be started otherwise, e.g., it cannot be started from the motor rated voltage display.

Parameters can be changed from the setting displays. Use the Increment, Decrement, and Digit Selection/ RESET Keys to change the frequency. The parameter will be written and the monitor display will be returned to when the ENTER Key is pressed after changing the setting.

The following example shows autotuning for open-loop vector control while operating the motor without switching to motor 2.

Fig 3.8 Operation in Autotuning Mode (Example for the 3G3IV-PJVOP161)
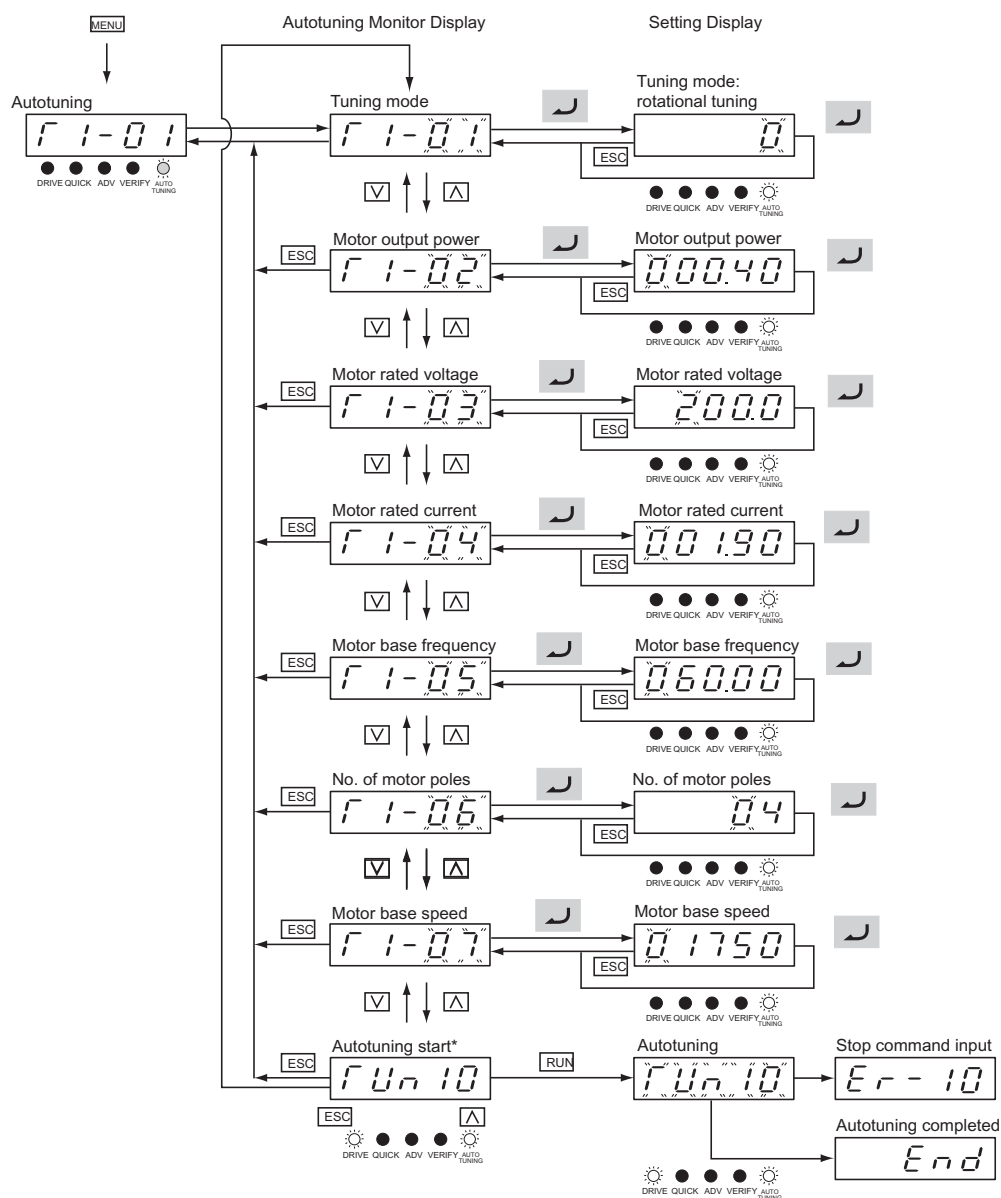
* TUn10 will be displayed during rotational autotuning and TUn11 will be displayed during stationary autotuning. The DRIVE indicator will light when autotuning starts.

IMPORTANT   If a fault occurs during autotuning, refer to *Chapter 7 Troubleshooting.*

4

Chapter 4

Trial Operation

This chapter describes the procedures for trial operation of the Inverter and provides an example of trial operation.

Cautions and Warnings

⚠ **WARNING**　Turn ON the input power supply only after mounting the front cover, terminal covers, bottom cover, Digital Operator, and optional items. Not doing so may result in electrical shock.

⚠ **WARNING**　Do not remove the front cover, terminal covers, bottom cover, Digital Operator, or optional items while the power is being supplied. Not doing so may result in electrical shock or damage to the product.

⚠ **WARNING**　Do not operate the Digital Operator or switches with wet hands. Doing so may result in electrical shock.

⚠ **WARNING**　Do not touch the inside of the Inverter. Doing so may result in electrical shock.

⚠ **WARNING**　Do not come close to the machine when using the error retry function because the machine may abruptly start when stopped by an alarm. Doing so may result in injury.

⚠ **WARNING**　Do not come close to the machine immediately after resetting momentary power interruption to avoid an unexpected restart (if operation is set to be continued in the processing selection function after momentary power interruption is rest). Doing so may result in injury.

⚠ **WARNING**　Provide a separate emergency stop switch because the STOP Key on the Digital Operator is valid only when function settings are performed. Not doing so may result in injury.

⚠ **WARNING**　Be sure to confirm that the RUN signal is turned OFF before turning ON the power supply, resetting the alarm, or switching the LOCAL/REMOTE selector. Doing so while the RUN signal is turned ON may result in injury.

⚠ **Caution**　Be sure to confirm permissible ranges of motors and machines before operation because the Inverter speed can be easily changed from low to high. Not doing so may result in damage to the product.

⚠ **Caution**　Provide a separate holding brake when necessary. Not doing so may result in injury.

⚠ **Caution**　Do not perform a signal check during operation. Doing so may result in injury or damage to the product.

⚠ **Caution**　Do not carelessly change settings. Doing so may result in injury or damage to the product.

Trial Operation Procedure

Perform trial operation according to the following flowchart. When setting the basic parameters, always set C6-01 (CT/VT Selection) according to the application.

START

Installation

Wiring

Set power supply voltage.

Turn ON power.   *1

Confirm status.

Initialize parameters

Basic settings
(Quick programming mode)

Select operating method.

V/f control? — NO — Open-loop vector control (A1-02 = 2)

YES

PG? — YES (A1-02 = 1)

NO (Default: A1-02 = 0)

Set E1-03 and E2-04.
V/f default: 200 V/60 Hz(400 V/60 Hz)
(-E) 200 V/50 Hz (400 V/50 Hz)

Set E1-03, E2-04, and F1-01.   *2
V/f default: 200 V/60 Hz(400 V/60 Hz)
(-E) 200 V/50 Hz (400 V/50 Hz)

Settings according to control mode

Motor cable over 50 m or heavy load possibly causing motor to stall or overload? — YES

NO

OK to operate motor during autotuning?   *3 — NO

YES

Stationary autotuning for *4 line-to-line resistance only

Rotational autotuning

Stationary autotuning

Application settings
(Advanced programming mode)

No-load operation

Loaded operation

Optimum adjustments and constant settings

Check/record constants.

END

*1 Set for 400 V Class Inverter for 75 kW or more.

*2 If there is a reduction gear between the motor and PG, set the reduction ratio in F1-12 and F1-13 in advanced programming mode.

*3 Use rotational autotuning to increase autotuning accuracy whenever it is okay for the motor to be operated.

*4 If the motor cable changes to 50 m or longer for the actual installation, perform stationary autotuning for the line-to-line resistance only on-site.

Fig 4.1 Trial Operation Flowchart

4

Trial Operation Procedures

The procedure for trial operation is described in order in this section.

◆ Application Confirmation

First, confirm the application before using the Inverter.

- Fan, blower, pump
- Other equipment

For any Inverter application other than a fan, blower, or pump, set C6-01 (CT/VT Selection) to 0 (CT: low carrier, fixed torque). The default setting is 1 (VT: high carrier, variable torque).

◆ Setting the Power Supply Voltage Jumper (400-V Class Inverters of 75 kW or Higher)

For 400-V class Inverters of 75 kW or higher, the power supply terminal for the external fan and internal contact is separated from the main circuit.

Set the power supply voltage jumper after setting E1-01 (Input Voltage Setting). Insert the jumper into the voltage connector nearest to the actual power supply voltage.

The jumper is factory-set to 440 V when shipped. If the power supply voltage is not 440 V, use the

following procedure to change the setting.

1. Turn OFF the power supply and wait for at least 5 minutes.

2. Confirm that the CHARGE indicator has gone out.

3. Remove the terminal cover.

4. Insert the jumper at the position for the voltage supplied to the Inverter (see *Fig 4.2*).

5. Return the terminal cover to its original position.
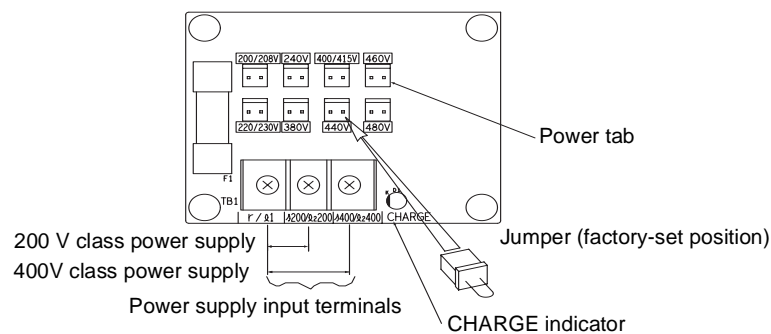
Fig 4.2 Large-capacity Inverter Connections

◆ Power ON

Confirm all of the following items before turning ON the power supply.

- Check that the power supply is of the correct voltage.
    200-V class: 3-phase 200 to 240 V, 50 Hz/60 Hz
    400-V class: 3-phase 380 to 480 V, 50 Hz/60 Hz

- Make sure that the motor output terminals (U, V, W) and the motor are connected correctly.

- Make sure that the Inverter control circuit terminal and the control device are wired correctly.

- Set all Inverter control circuit terminals to OFF.

- When using a PG Speed Control Card, make sure that it is wired correctly.

- Make sure that the motor is not connected to the mechanical system (no-load status)

◆ Checking the Display Status

If the Digital Operator's display at the time the power is connected is normal, it will read as follows:

Display for normal operation

$$F \quad 0.00$$

☼ ● ● ● ●
DRIVE QUICK ADV VERIFY AUTO TUNING
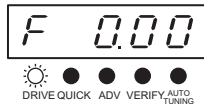
The frequency reference monitor is displayed in the data display section.

When an fault has occurred, the details of the fault will be displayed instead of the above display. In that case, refer to *Chapter 7 Troubleshooting*. The following display is an example of a display for faulty operation.

Display for fault operation

$$U u$$

☼ ● ● ● ●
DRIVE QUICK ADV VERIFY AUTO TUNING
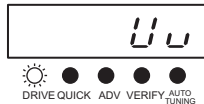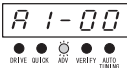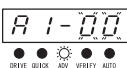
The display will differ depending on the type of fault.
A low voltage alarm is shown at left.

4

◆ Initializing Parameters

Initialize parameters by following the table below. Set A1-03 to 2220 when initializing a 2-wire sequence.

Table 4.1 Initializing Parameters

Step	Key	Operator Screen Displays	Description
1		F 0.00	Turn ON the power.
2	MENU	A1-00	Press to shift to Advanced Programming Mode.
3	↵	A1-00	Press to show parameter reference screen.
4	≫ RESET	A1-00	Press to confirm A1.
5	⌃ × 3	A1-03	Press three times to display A1-03 (initialize).
6	↵	0000	Press to show the set value for the initializing method.
7	⌃	2220	Use to change the set value to "2220."
8	↵		Press to execute the initialization.
9		End → A1-03	When the initializing is completed, the "End" indication appears, and the display returns to the parameter reference screen.

◆ Basic Settings

Switch to the quick programming mode (the QUICK indicator on the Digital Operation should be lit) and then set the following parameters. Refer to *Chapter 3 Digital Operator and Modes* for Digital Operator operating procedures and to *Chapter 5 Parameters* and *Chapter 6 Parameter Settings by Function* for details on the parameters.

Parameters that must be set are listed in *Table 4.2* and those that are set according to the application are listed in *Table 4.3*.

Table 4.2 Parameters that must be set

Parameter Number	Name	Description	Setting Range	Factory Setting	Page
A1-02	Control method selection	Set the control method for the Inverter. 0: V/f control 1: V/f control with PG (Pulse generator as encoder) 2: Open-loop vector control	0 to 2	0	5-9
b1-01	Reference selection	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card 4: Pulse train input	0 to 4	1	5-11 6-6 6-62 6-76
b1-02	Operation method selection	Set the run command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	5-12 6-12 6-62 6-76
C1-01	Acceleration time 1	Set the acceleration time in seconds for the output frequency to climb from 0% to 100%.	0.0 to 6000.0	10.0 s	5-19 6-19
C1-02	Deceleration time 1	Set the deceleration time in seconds for the output frequency to fall from 100% to 0%.	0.0 to 6000.0	10.0 s	5-19 6-19

C6-01	CT/VT selection	Set to CT (not low noise, maximum current overload: 150%) or VT (low noise, maximum current overload:120%).
		  0: CT
		  1: VT
			0 or 1	1	5-25
					6-2

E1-01	Input voltage setting	Set the Inverter's nominal input voltage in volts.	155 to 255 V (200 V class) 310 to 510 V (400 V class)	200 V (200 V class) 400 V (400 V class)	5-31 6-129
E2-01	Motor rated current	Set the motor rated current.	10% to 200% of Inverter's rated current	Setting for general-purpose motor of same capacity as Inverter	5-33 6-47 6-127

4

4-7

Table 4.2 Parameters that must be set (Continued)

Parameter Number	Name	Description	Setting Range	Factory Setting	Page
L1-01	Motor protection selection	Set to enable or disable the motor overload protection function using the electronic thermal relay. 0: Disabled 1: General motor protection 2: Inverter motor protection 3: Vector motor protection	0 to 3	1	5-56 6-47

IMPORTANT

When C6-01 is set to 0 (CT), not-low noise will apply and the Inverter overload withstand ratio will be 150% of the Inverter rating per minute. When C6-01 is set to 1 (VT), low noise will apply and the Inverter overload withstand ratio will be 120% of the Inverter rating per minute. If C6-01 is set to 1 (VT) when overload withstand capability is required by the application, the life of the Inverter may be reduced.

Table 4.3 Parameters that are set as required

Parameter Number	Name	Description	Setting Range	Factory Setting	Page
b1-03	Stopping method selection	The stopping method when the stop command is input. 0: Deceleration to stop 1: Coast to stop 2: DC braking stop 3: Coast to stop with timer	0 to 3	0	5-13 6-14
C6-02	Carrier frequency selection	The carrier frequency is set low if the motor cable is 50 m or longer or to reduce radio noise or leakage current. The factory setting and setting range depends on the setting of C6-01.	0 to F	Depends on setting of C6-01.	5-25
d1-01 to d1-04 and d1-17	Frequency references 1 to 4 and jog frequency reference	Set the required speed references for multi-step speed operation or jogging.	0 to 400.00 Hz	d1-01 to d1-04: 0.00 Hz d1-17: 6.00 Hz	5-27 6-6
H4-02 and H4-05	FM and AM terminal output gain	Adjust when an instrument is connected to the FM or AM terminal.	0.00 to 2.50	H4-02: 1.00 H4-05: 0.50	5-52
L3-04	Stall prevention selection during deceleration	If using the dynamic brake option (Braking Resistor, Braking Resistor Units, and Braking Units), be sure to set parameter L3-04 to 0 (disabled) or 3 (enabled with Braking Resistor).	0 to 3	1	5-60 6-25

◆ Settings for the Control Methods

Autotuning methods depend on the control method set for the Inverter. Make the settings required by the control method.

■ Overview of Settings

Make the required settings in quick programming mode and autotuning mode according to the following flow-chart.

```
                        START
                          │
                          ▼
                    ┌───────────┐        NO
                    │ V/f control? │──────── Open-loop vector control (A1-02 = 2)
                    └───────────┘
                          │ YES
                          │ (A1-02 = 0 or 1)
                          ▼
                    ┌───────────┐
                    │    PG?     │──── YES
                    └───────────┘      (A1-02 = 1)
                          │ NO
                          │ (Default: A1-02 = 0)
                          ▼
```

Control mode selection

Set E1-03 and E2-04.
V/f default: 200 V/60 Hz(400 V/60 Hz)
(-E) 200 V/50 Hz (400 V/50 Hz)

Set E1-03, E2-04, and F1-01.
V/f default: 200 V/60 Hz(400 V/60 Hz)
(-E) 200 V/50 Hz (400 V/50 Hz) *2

Motor cable over 50 m or heavy load possibly causing motor to stall or overload? ── YES

OK to operate motor during autotuning?*1 ── NO

NO / YES

Stationary autotuning for line-to-line resistance only

Rotational autotuning

Stationary autotuning

END

Note If the motor cable changes to 50 m or longer for the actual installation, perform stationary autotuning for the line-to-line resistance only on-site.
* 1. Use rotational autotuning to increase autotuning accuracy whenever it is okay for the motor to be operated.
* 2. If there is a reduction gear between the motor and PG, set the reduction ratio in F1-12 and F1-13.

Fig 4.3 Settings According to the Control Method

◼Setting the Control Method

Any of the following three control methods can be set.

- V/f control without PG (normal speed control)
- V/f control with PG (simple speed feedback control)
- Open-loop vector control (high-performance control without PG)

V/f Control without PG (A1-02 = 0)

- Set either one of the fixed patterns (0 to E) in E1-03 (V/f Pattern Selection) or set F in E1-03 to specify a user-set pattern as required for the motor and load characteristics in E1-04 to E1-13 in advanced programming mode.

Simple operation of a general-purpose motor at 50 Hz:	E1-03 = 0
Simple operation of a general-purpose motor at 60 Hz:	E1-03 = F (default) or 1 If E1-03 = F, the default setting in the user setting from E1-04 to E1-13 are for 60 Hz (50 Hz for -E models)

- Perform stationary autotuning for the line-to-line resistance only if the motor cable is 50 m or longer for the actual installation or the load is heavy enough to produce stalling. Refer to the following section on *Autotuning* for details on stationary autotuning.

V/f Control with PG (A1-02=1)

- Set either one of the fixed patterns (0 to E) in E1-03 (V/f Pattern Selection) or set F in E1-03 to specify a user-set pattern as required for the motor and load characteristics in E1-04 to E1-13 in advanced programming mode.

Simple operation of a general-purpose motor at 50 Hz:	E1-03 = 0
Simple operation of a general-purpose motor at 60 Hz:	E1-03 = F (default) or 1 If E1-03 = F, the default setting in the user setting from E1-04 to E1-13 are for 60 Hz (50 Hz for -E models)

- Set the number of motor poles in E2-04 (Number of Motor Poles)
- Set the number of rotations per pulse in F1-01 (PG Constant). If there is a reduction gear between the motor and PG, set the reduction ratio in F1-12 and F1-13 in advanced programming mode.
- Perform stationary autotuning for the line-to-line resistance only if the motor cable is 50 m or longer for the actual installation or the load is heavy enough to produce stalling. Refer to the following section on *Autotuning* for details on stationary autotuning.

Open-loop Vector Control (A1-02 = 2)

Perform autotuning. If the motor can be operated without a load, perform rotational autotuning. If the motor cannot be operated, perform stationary autotuning. Refer to the following section on *Autotuning* for details on autotuning.

◆ Autotuning

Use the following procedure to perform autotuning to automatically set motor constants when using the open-loop vector control method, when the cable length is long, etc.

■ Setting the Autotuning Mode

One of the following three autotuning modes can be set.

- Rotational autotuning
- Stationary autotuning
- Stationary autotuning for line-to-line resistance only

Rotational Autotuning (T1-01 = 0)

Rotational autotuning is used only for open-vector control. Set T1-01 to 0, input the data from the nameplate, and then press the RUN Key on the Digital Operator. The Inverter will run the motor at zero speed for approximately 1 minute, and run the motor for approximately 1 minute to set the required motor constants.

> **IMPORTANT**
> 1. Always disconnect the motor from the machine and confirm that it is safe to operate the motor before performing rotational autotuning.
> 2. If the motor cannot be operated by itself, perform stationary autotuning, but always use rotational autotuning whenever it is possible to operate the motor by itself to increase performance.

Stationary Autotuning (T1-01 = 1)

Stationary autotuning is used only for open-vector control. Set T1-01 to 1, input the data from the nameplate, and then press the RUN Key on the Digital Operator. The Inverter will supply power to the stationary motor for approximately 1 minute and some of the motor constants will be set automatically. The remaining motor constants will be set automatically the first time operation is started in drive mode.

> **IMPORTANT**
> 1. Power will be supplied to the motor when stationary autotuning is performed even though the motor will not turn. Do not touch the motor until autotuning has been completed.
> 2. When performing stationary autotuning connected to a conveyor or other machine, ensure that the holding brake is not activated during autotuning.
> 3. Keep the motor load ratio to 50% or less the first time the system is operated in drive mode after performing stationary autotuning.

Stationary Autotuning for Line-to-Line Resistance Only (T1-01 = 2)

Stationary autotuning for line-to-line resistance only can be used in any control method. This is the only autotuning possible for V/f control and V/f control with PG modes.

Autotuning can be used to prevent control errors when the motor cable is long or the cable length has changed or when the motor and Inverter have different capacities.

To perform autotuning in V/f control or V/f control with PG, set T1-01 to 2, and then press the RUN Key on the Digital Operator. The Inverter will supply power to the stationary motor for approximately 20 seconds and the Motor Line-to-Line Resistance (E2-05) and cable resistance will be automatically measured. This can be performed for open-loop vector control.

> **IMPORTANT**
> 1. Power will be supplied to the motor when stationary autotuning for line-to-line resistance is performed even though the motor will not turn. Do not touch the motor until autotuning has been completed.
> 2. When performing stationary autotuning connected to a conveyor or other machine, ensure that the holding brake is not activated during autotuning.

4

■ Precautions Before Using Autotuning

Read the following precautions before using autotuning.

- Autotuning the Inverter is fundamentally different from autotuning the servo system. Inverter autotuning automatically adjusts parameters according to detected motor constants, whereas servo system autotuning adjusts parameters according to the detected size of the load.

- When speed precision is required at high speeds (i.e., 90% of the rated speed or higher), use a motor with a rated voltage that is 20 V less than the input power supply voltage of the Inverter for 200V-class Inverters and 40 V less for 400V-class Inverters. If the rated voltage of the motor is the same as the input power supply voltage, the voltage output from the Inverter will be unstable at high speeds and sufficient performance will not be possible.

- Use stationary autotuning whenever performing autotuning for a motor that is connected to a load.

- Use rotational autotuning whenever performing autotuning for a motor that has fixed output characteristics or for a motor that is not connected to a load.

- If rotational autotuning is performed for a motor connected to a load, the motor constants will not be found accurately and the motor may exhibit abnormal operation. Never perform rotational autotuning for a motor connected to a load.

- If the wiring between the Inverter and motor changes by 50 m or more between auto tuning and motor installation, perform stationary autotuning for line-to-line resistance only.

- If the motor cable is long (50 m or longer), perform stationary autotuning for line-to-line resistance only even when using V/f control.

- The status of the multi-function inputs and multi-function outputs will be as shown in the following table during autotuning. When performing autotuning with the motor connected to a load, be sure that the holding brake is not applied during autotuning, especially for conveyor systems or similar equipment.

Tuning Mode	Multi-function Inputs	Multi-function Outputs
Rotational autotuning	Do not function.	Same as during normal operation
Stationary autotuning	Do not function.	Maintain same status as when autotuning is started.
Stationary autotuning for line-to-line resistance only	Do not function.	Maintain same status as when autotuning is started.

- To cancel autotuning, always use the STOP Key on the Digital Operator.

■ Precautions for Rotational and Stationary Autotuning

Use the following procedure to perform autotuning when the rated voltage of the motor is higher than the voltage of the power supply to the Inverter.

1. Input the voltage of the input power supply to T1-03 (Motor rated voltage).

2. Input the results of the following formula to T1-05 (Motor base frequency):
   (Base frequency from the motor's nameplate × setting of T1-03)/(Rated voltage from motor's nameplate)

3. Perform autotuning.

After completing autotuning, set E1-04 (Maximum output frequency) to the base frequency from the motor's nameplate.

IMPORTANT
1. When speed precision is required at high speeds (i.e., 90% of the rated speed or higher), set T1-03 (Motor rated voltage) to the input power supply voltage multipled by 0.9.
2. When operating at high speeds (i.e., 90% of the rated speed or higher), the output current will increase as the input power supply voltage is reduced. Be sure to provide sufficient margin in the Inverter current.

■ Parameter Settings for Autotuning

The following parameters must be set before autotuning.

Table 4.4 Parameter Settings before Autotuning

Param-eter Number	Name	Display	Setting Range	Factory Setting	Data Displays during Autotuning		
					V/f	V/f with PG	Open Loop Vector
T1-00	Motor 1/2 selection	Set the location where the autotuned motor constants are to be stored. 1: E1 to E2 (motor 1) 2: E3 to E4 (motor 2)*1	1 or 2	1	Yes	Yes	Yes
T1-01	Autotuning mode selection	Set the autotuning mode. 0: Rotational autotuning 1: Stationary autotuning 2: Stationary autotuning for line-to-line resistance only	0 to 2	2 (V/f and V/f with PG) 0 (open-loop vec-tor)*2	Yes (only for 2)	Yes (only for 2)	Yes
T1-02	Motor output power	Set the output power of the motor in kilowatts.*3	10% to 200% of Inverter rated output *5	Same as Inverter rated output	Yes	Yes	Yes
T1-03	Motor rated voltage	Set the rated voltage of the motor in volts.*3 *4	0 to 255.0 V (200 V class) 0 to 510.0 V (400 V class)	200.0 V (200 V class) 400.0 V (400 V class)	-	-	Yes
T1-04	Motor rated current	Set the rated current of the motor in amps.*3	10% to 200% of Inverter rated cur-rent*5	Same as general-purpose motor with same capacity as Inverter	Yes	Yes	Yes
T1-05	Motor base frequency	Set the base frequency of the motor in hertz.*3 *4	0 to 400.0 Hz *6	60.0 Hz	-	-	Yes
T1-06	Number of motor poles	Set the number of motor poles.	2 to 48 poles	4 poles	-	-	Yes
T1-07	Motor base speed	Set the base speed of the motor in r/min.*3	0 to 24000 *6	1750 r/min	-	-	Yes

* 1. Not normally displayed. Displayed only when a motor switch command is set for a multi-function digital input (one of H1-01 to H1-05 set to 16).

* 2. Only a setting of 2 (stationary autotuning for line-to-line resistance only) is possible for V/f control or V/f control with PG.

* 3. For a constant-output motor, set the value at the base speed.

* 4. For an inverter motor or vector motor, the voltage and frequency may be lower than for a general-purpose motor. Always confirm setting on the name-plate or in test reports. Also, if you know the no-load values, set the no-load voltage in T1-03 and the no-load frequency in T1-05 to obtain better accuracy.
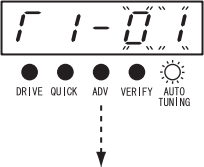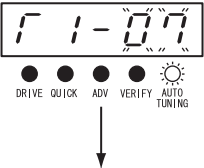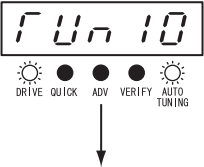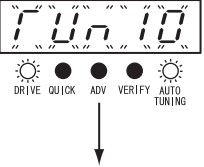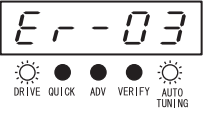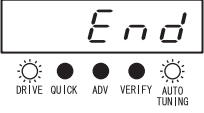
* 5. Stable vector control will be possible when the setting is between 50% and 100%.

* 6. The setting range depends on the Inverter capacity and the setting of C6-01 (CT/VT Selection).

4

■Digital Operator Displays during Autotuning

The following displays will appear on the Digital Operator during autotuning.

Table 4.5 Digital Operator Displays during Autotuning

Digital Operator Display	Description
Autotuning mode selection: T1-01 `T1-01` ● ● ● ● ☼ DRIVE QUICK ADV VERIFY AUTO TUNING ↓	Using the same procedures as for the programming modes check and set the T1 parameters according to information on the previous page. Be sure that T1-01 (Autotuning Mode Selection) is set correctly and check safety around the motor and machine.
Motor base speed: T1-07 (For rotational autotuning) `T1-07` ● ● ● ● ☼ DRIVE QUICK ADV VERIFY AUTO TUNING ↓	The autotuning start display will appear when all settings through T1-07 have been completed. The A.TUNE and DRIVE indicators will be lit.
Autotuning started: TUn10 `TUn10` ☼ ● ● ● ☼ DRIVE QUICK ADV VERIFY AUTO TUNING ↓	Autotuning will start when the RUN Key is pressed from the autotuning start display. The digit second from the right in TUnOO is the Motor 1/2 Selection (T1-00) and the right digit is the Autotuning Mode Selection (T1-01).
Autotuning Stop command input `TUn10` → `Er-03` ☼ ● ● ● ☼ ☼ ● ● ● ☼ DRIVE QUICK ADV VERIFY AUTO TUNING DRIVE QUICK ADV VERIFY AUTO TUNING ↓	If the STOP Key is pressed or a measurement error occurs during autotuning, and error message will be display and autotuning will be stopped. Refer to *Errors during Autotuning* on page 7-12.
Autotuning completed `End` ☼ ● ● ● ☼ DRIVE QUICK ADV VERIFY AUTO TUNING	END will be displayed after approximately 1 to 2 minutes, indicating that autotuning has been completed.

�■**Precautions After Using Autotuning**

When using a spindle motor, the maximum output speed is higher than the rated frequency (or Base Frequency, FA (E1-06)). For the region greater than FA, defined as the constant output range, output torque is reduced because the voltage does not increase for an increase in the frequency.

For application in the constant output range, the V/f characteristics must be reconfigured manually after autotuning is performed. Set E1-03=F, and parameters E1-04 through E1-10 to the correct values. Do not change E1-06 (Base Frequency) and E1-13 (Base Voltage) because they are auto-turned to the optimum values.

Increasing the Motor's Rated Speed by 1 to 1.2 Times

To increase the motor's rated speed by 1 to 1.2 times, use the following formula to change the setting of E1-04 (Maximum output voltage):

E1-04 = (Motor's rated speed) $\times$ (No. of motor poles)/120 (Hz) $\times$ (1 to 1.2)

If the motor's speed is increased beyond the rated speed, fixed output characteristics will be used at high speeds and motor torque will be reduced.

Applications to Constant Output Motors Such as Motors for Machine Tools

Use the following formula to change the settings of E1-04 (Maximum output frequency) and E1-05 (Maximum voltage) when using a motor with a fixed output, e.g., a motor for a machine tool:

E1-04 = Frequency (Hz) at maximum speed under no-load conditions (load rate = 0)
E1-05 = Voltage (V) at maximum speed under no-load conditions (load rate = 0)

Do not change the E2 motor constants after performing autotuning.

4

■ **Precautions for Precision Settings**

Settings for autotuning are different when performing autotuning using motor test reports or design data. Use the following table as reference.

Operator Display	Simple Setting	Precision Setting
T1-03	Motor rated voltage	Voltage under no-load conditions at motor rated speed
T1-05	Motor base frequency	Frequency under no-load conditions at rated speed

◆ Application Settings

Parameters are set as required in advanced programming mode (i.e., with the ADV indicator lit on the Digital Operator). All the parameters that can be set in quick programming mode can also be displayed and set in advanced programming mode.

■Setting Examples

The following are examples of settings for applications.

- When using an Inverter-mounted Braking Resistor (3G3IV-PEPF□), set L8-01 to 1 to enable Braking Resistor overheating protection.
- To prevent the machine from being operated in reverse, set b1-04 to 1 to disable reverse operation.
- To increase the speed of a 60 Hz motor by 10%, set E1-04 to 66.0 Hz.
- To use a 0 to 10-V analog signal for a 60 Hz motor for variable-speed operation between 0 and 54 Hz (0% to 90% speed deduction), set H3-02 to 90.0%.
- To control speed between 20% and 80% to ensure smooth gear operation and limit the maximum speed of the machine, set d2-01 to 80.0% and set d2-02 to 20.0%.

◆ No-load Operation

To start no-load operation (without connecting the machine to the motor), press the LOCAL/REMOTE Key on the Digital Operator to change to LOCAL mode (the SEQ and REF indicators on the Digital Operator should be OFF).

The motor and the machine must be checked for safety before starting Inverter operation from the Digital Operator. Confirm that the motor works normally and that no errors are displayed at the Inverter.

Jog Frequency Reference (d1-17, default: 6.00 Hz) can be started and stopped by pressing and releasing the JOG Key on the Digital Operator. If the external sequence prevent operation from the Digital Operator, confirm that emergency stop circuits and machine safety mechanisms are functioning, and then start operation in REMOTE mode (i.e., with a signal from the control signal terminals). The safety precautions must always be taken before starting the Inverter with the motor connected to the machine.

> **INFO**
> Both a RUN command (forward or reverse) and a frequency reference (or multi-step speed command) must be provided to start Inverter operation.
> Input these commands and reference regardless of the operation method (i.e., LOCAL of REMOTE).

◆ Loaded Operation

Connect the machine to the motor and then start operation as described for no-load operation (i.e., from the Digital Operator or by using control circuit terminal signals).

■Connecting the Load

- After confirming that the motor has stopped completely, connect the mechanical system.
- Be sure to tighten all the screws when securing the motor shaft to the mechanical system.

■Operation Using the Digital Operator

- Use the Digital Operator to start operation in LOCAL mode in the same way as in no-load operation.

- Make sure the STOP Key on the Digital Operator is easily accessible so that any unexpected movement can be stopped.

- At first, set the frequency reference to a low speed of one tenth the normal operating speed.

■ Checking Operating Status

- Having checked that the operating direction is correct and that the machine is operating smoothly at slow speed, increase the frequency reference.

- After changing the frequency reference or the rotation direction, check that there is no oscillation or abnormal sound from the motor. Check the monitor display to ensure that U1-03 (Output Current) is not too high.

- Refer to *Adjustment Suggestions* on page 4-18 if hunting, vibration, or other problems originating in the control system occur.

◆ Check and Recording Parameters

Use verify mode (i.e., when the VERIFY indicator on the Digital Operator is lit) to check parameters that have been changed for trial operation and record them in a parameter table.

Any parameters that have been change by autotuning will also be displayed in verify mode.

If required, the copy function in parameters o3-01 and o3-02 displayed in advanced programming mode can be used to copy the changed settings from the Inverter to a recording area in the Digital Operator. If changed settings are saved in the Digital Operator, they can be easily copied back to the Inverter to speed up system recovery if for any reason the Inverter has to be replaced.

The following functions can also be used to manage parameters.

- Recording parameters
- Setting access levels for parameters
- Setting a password

■ Recording Parameters (o2-03)

If o2-03 is set to 1 after completing trial operation, the settings of parameters will be saved in a separate memory area in the Inverter. Later, after Inverter settings have been changed, the parameters can be initialized to the settings saved in the separate memory area when o2-03 was set to 1 by setting A1-03 (Initialize) to 1110.

■Parameter Access Levels (A1-01)

A1-01 can be set to 0 (monitoring-only) to prevent parameters from being changed. A1-01 can also be set to 1 (User-specified Parameters) and used along with A2 parameters to display only parameters required by the machine or application in a programming mode.

■Password (A1-04 and A1-05)

When the access level is set to monitoring-only (A1-01 = 0), a password can be set so that parameters will be displayed only when the correct password is input.

4

Adjustment Suggestions

If hunting, vibration, or other problems originating in the control system occur during trial operation, adjust the parameters listed in the following table according to the control method. This table lists only the most commonly used parameters.

Table 4.6 Adjusted Parameters

Control Method	Name (Parameter Number)	Performance	Factory Setting	Recommended Setting	Adjustment Method
V/f control (A1-02 = 0 or 1)	Hunting-prevention gain (N1-02)	Controlling hunting and vibration in middle-range speeds (10 to 40 Hz)	1.00	0.50 to 2.00	• Reduce the setting if torque is insufficient for heavy loads. • Increase the setting if hunting or vibration occurs for light loads.
	Carrier frequency selection (C6-02)	• Reducing motor magnetic noise • Controlling hunting and vibration at low speeds	Depends on capacity	0 to default	• Increase the setting if motor magnetic noise is high. • Reduce the setting if hunting or vibration occurs at low to middle-range speeds.
	Torque compensation primary delay time constant (C4-02)	• Increasing torque and speed response • Controlling hunting and vibration	Depends on capacity	200 to 1000 ms	• Reduce the setting if torque or speed response is slow. • Increase the setting if hunting or vibration occurs.
	Torque compensation gain (C4-01)	• Improving torque at low speeds (10 Hz or lower) • Controlling hunting and vibration	1.00	0.50 to 1.50	• Increase the setting if torque is insufficient at low speeds. • Reduce the setting if hunting or vibration occurs for light loads.
	Middle output frequency voltage (E1-08) Minimum output frequency voltage (E1-10)	• Improving torque at low speeds • Controlling shock at startup	Depends on capacity and voltage	Default to Default + 3 to 5 V[*]	• Increase the setting if torque is insufficient at low speeds. • Reduce the setting if shock at startup is large.
Open-loop vector control (A1-02 = 2)	Speed feedback detection control (AFR) gain (N2-01)	• Increasing torque and speed response • Controlling hunting and vibration in middle-range speeds (10 to 40 Hz)	1.00	0.50 to 2.00	• Reduce the setting if torque or speed response is slow. • Increase the setting if hunting or vibration occurs.
	Torque compensation primary delay time constant (C4-02)	• Increasing torque and speed response • Controlling hunting and vibration	20 ms	20 to 100 ms	• Reduce the setting if torque or speed response is slow. • Increase the setting if hunting or vibration occurs.
	Slip compensation primary delay time (C3-02)	• Increasing speed response • Improving speed stability	200 ms	100 to 500 ms	• Reduce the setting if speed response is slow. • Increase the setting if the speed is not stable.
	Slip compensation gain (C3-01)	• Improving speed accuracy	1.0	0.5 to 1.5	• Increase the setting if speed response is slow. • Reduce the setting if the speed is too fast.

Table 4.6 Adjusted Parameters (Continued)

Control Method	Name (Parameter Number)	Performance	Factory Setting	Recommended Setting	Adjustment Method
Open-loop vector control (A1-02 = 2)	Carrier frequency selection (C6-02)	• Reducing motor magnetic noise • Controlling hunting and vibration at low speeds (10 Hz or less)	Depends on capacity	0 to default	• Increase the setting if motor magnetic noise is high. • Reduce the setting if hunting or vibration occurs at low speeds.
	Middle output frequency voltage (E1-08) Minimum output frequency voltage (E1-10)	• Improving torque at low speeds • Controlling shock at startup	Depends on capacity and voltage	Default to Default + 3 to 5 V*	• Increase the setting if torque or speed response is slow. • Reduce the setting if shock at startup is large.

* The setting is given for 200 V Class Inverters. Double the voltage for 400 V Class Inverters.

• Do not change the Torque Compensation Gain (C4-01) from its default setting of 1.00 when using open-loop vector control.

• If speeds are inaccurate during regeneration in open-loop vector control, enable Slip Compensation During Regeneration (C3-04 = 1).

• Use slip compensation to improve speed control during V/f control (A1-02 = 0).
Set the Motor Rated Current (E2-01), Motor Rated Slip (E2-02), and Motor No-load Current (E2-03), and then adjust the Slip Compensation Gain (C3-01) to between 0.5 and 1.5. The default setting for V/f control is C3-01 = 0.0 (slip compensation disabled).

• To improve speed response and stability in V/f control with a PG (A1-02 = 1), set the ASR parameters (C5-01 to C5-05) to between 0.5 and 1.5 times the default. (It is not normally necessary to adjust this setting.) ASR for V/f control with a PG will only control the output frequency; a high gain, such as is possible for open-loop vector control, cannot be set.

The following parameters will also indirectly affect the control system.

Table 4.7 Parameters Indirectly Affecting Control and Applications

Name (Parameter Number)	Application
CT/VT selection (C6-01)	Sets the maximum torque and overload capability to 120% or 150%.
DWELL function (b6-01 to b6-04)	Used for heavy loads or large machine backlashes.
Acceleration/deceleration times (C1-01 to C1-11)	Adjust torque during acceleration and deceleration.
S-curve characteristics (C2-01 to C2-04)	Used to prevent shock when completing acceleration.
Jump frequencies (d3-01 to d3-04)	Used to avoid resonance points during operation.
Analog input filter time constant (H3-12)	Used to prevent fluctuations in analog input signals caused by noise.
Stall prevention (L3-01 to L3-06)	Used to prevent 0 V (overvoltage errors) and motor stalling for heavy loads or rapid acceleration/deceleration. Stall prevention is enabled by default and the setting does not normally need to be changed. When using a Braking Resistor, however, disable stall prevention during deceleration by setting L3-04 to 0.
Torque limits (L7-01 to L7-04)	Set the maximum torque during vector control. If a setting is increased, use a motor with higher capacity than the Inverter. If a setting is reduced, stalling can occur under heavy loads.

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Chapter 5
Parameters

This chapter describes all parameters that can be set in the Inverter.

Parameter Descriptions

This section describes the contents of the parameter tables.

◆ Description of Parameter Tables

Parameter tables are structured as shown below. Here, b1-01 (Frequency Reference Selection) is used as an example.

| Param-eter Number | Name | | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display						V/f	V/f with PG	Open Loop Vec-tor		
b1-01	Reference selection Reference Source		Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card 4: Pulse train input	0 to 4	1	No	Q	Q	Q	180H	-

- Parameter Number: The number of the parameter.
- Name: The name of the parameter.
- LCD Display: The name of the parameter displayed on the LCD-type Digital Operator.
- Description: Details on the function or settings of the parameter.
- Setting Range: The setting range for the parameter.
- Factory Setting: The factory setting (each control method has its own factory setting. Therefore the factory setting changes when the control method is changed.)
  Refer to page 5-83 for factory settings by control method.
- Change during Operation: Indicates whether or not the parameter can be changed while the Inverter is in operation.

  Yes: Changes possible during operation.

  No: Changes not possible during operation.
- Control Methods: Indicates the control methods in which the parameter can be monitored or set.

  Q: Items which can be monitored and set in either quick programming mode or advanced programming mode.

  A: Items which can be monitored and set only in advanced programming mode.

  No: Items which cannot be monitored or set for the control method.
- Register: The register number used for RS-422A/485 communications.
- Page: Reference page for more detailed information on the parameter.

Digital Operator Display Functions and Levels

The following figure shows the Digital Operator display hierarchy for the Inverter.

No.	Function	Display	Page
U1	Status Monitor Parameters	Monitor	5-75
U2	Fault Trace	Fault Trace	5-79
U3	Fault History	Fault History	5-80
A1	Initialize Mode	Initialization	5-9
A2	User-set Parameters	User Parameters	5-10
b1	Operation Mode Selections	Sequence	5-11
b2	DC Injection Braking	DC Braking	5-12
b3	Speed Search	Speed Search	5-13
b4	Timer Function	Delay Timers	5-14
b5	PID Control	PID Control	5-15
b6	Dwell Functions	Reference Hold	5-17
b8	Energy Saving	Energy Saving	5-18
C1	Acceleration/Deceleration	Accel/Decel	5-19
C2	S-curve Acceleration/Deceleration	S-Curve Acc/Dcc	5-21
C3	Motor Slip Compensation	Motor-Slip Comp	5-22
C4	Torque Compensation	Torque Comp	5-23
C5	Speed Control (ASR)	ASR Tuning	5-24
C6	Carrier Frequency	Carrier Freq	5-25
d1	Preset Reference	Preset Reference	5-27
d2	Reference Limits	Reference Limits	5-29
d3	Jump Frequencies	Jump Frequencies	5-29
d4	Reference Frequency Hold	Sequence	5-30
d6	Field Weakening	Field-weakening	5-31
E1	V/f Pattern	V/f Pattern	5-31
E2	Motor Setup	Motor Setup	5-33
E3	Motor 2 V/f Pattern	V/f Pattern 2	5-35
E4	Motor 2 Setup	Motor Setup 2	5-37
F1	PG Option Setup	PG Option Setup	5-38
F4	Analog Monitor Cards	A0-08, 12 Setup	5-41
F5	Not Used	D0-02, 08 Setup	5-43
F6	Communications Option Card	CP-916 Setup	5-44
H1	Multi-function Digital Inputs	Digital Inputs	5-45
H2	Multi-function Digital Outputs	Digital Outputs	5-47
H3	Analog Inputs	Analog Inputs	5-49
H4	Multi-function Analog Outputs	Analog Outputs	5-52
H5	RS-422A/485 Communications	Serial Com Setup	5-53
H6	Pulse Train	Pulse I/O Setup	5-54
L1	Motor Overload	Motor Overload	5-56
L2	Power Loss Ridethrough	PwrLoss Ridethru	5-57
L3	Stall Prevention	Stall Prevention	5-59
L4	Reference Detection	Ref Detection	5-61
L5	Fault Restart	Fault Restart	5-62
L6	Torque Detection	Torque Detection	5-63
L7	Torque Limits	Torque Limit	5-65
L8	Hardware Protection	Hdwe Protection	5-65
N1	Hunting Prevention Function	Hunting Prev	5-67
N2	Speed Feedback Protection Control	AFR	5-68
N3	High-slip Braking	High Slip	5-69
o1	Monitor Select	Monitor Select	5-69
o2	Multi-function Selections	Key Selections	5-71
o3	Copy Function	COPY Function	5-73
T	Motor Autotuning	Auto-Tuning	5-73

MENU

Drive Mode

Inverter can be operated and its status can be displayed.

Quick Programming Mode

Minimum parameters required for operation can be monitored or set.

Advanced Programming Mode

All parameters can be monitored or set.

Verify Mode

Parameters changed from the default settings can be monitored or set.

Autotuning Mode

Automatically sets motor constants if autotuning data (from motor nameplate) is input for open-loop vector control or to measure the line-to-line resistance for V/f control.

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◆ Parameters Settable in Quick Programming Mode

The minimum parameters required for Inverter operation can be monitored and set in quick programming mode. The parameters displayed in quick programming mode are listed in the following table. These, and all other parameters, are also displayed in advanced programming mode.

Refer to the overview of modes on page 3-5 for an overview of quick programming mode.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop Vec-tor	Regis-ter
A1-02	Control method selection / Control Method	Set the control method for the Inverter. 0: V/f control 1: V/f control with PG (Pulse generator as encoder) 2: Open-loop vector control	0 to 2	0	No	Q	Q	Q	102H
b1-01	Reference selection / Reference Source	Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card 4: Pulse train input	0 to 4	1	No	Q	Q	Q	180H
b1-02	Operation method selection / Run Source	Set the run command input method 0: Digital Operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q	Q	Q	181H
b1-03	Stopping method selection / Stopping Method	Set the stopping method when a stop command is input. 0: Deceleration to stop 1: Coast to stop 2: DC braking stop (Stops faster than coast to stop, without regenerative operation.) 3: Coast to stop with timer (Run commands are disregarded during deceleration time.)	0 to 3	0	No	Q	Q	Q	182H

| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Regis-ter |
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor	
C1-01	Accelera-tion time 1	Set the acceleration time in seconds for the output frequency to climb from 0% to 100%.	0.0 to 6000.0 *1	10.0 s	Yes	Q	Q	Q	200H
	Accel Time 1								
C1-02	Decelera-tion time 1	Set the deceleration time in seconds for the output frequency to fall from 100% to 0%.			Yes	Q	Q	Q	201H
	Decel Time 1								
C6-01	CT/VT selection	0: CT (low carrier, constant torque, 150% per minute) 1: VT (high carrier, variable torque, 120% per minute)	0 or 1	1	No	Q	Q	Q	223H
	Heavy/Nor-mal Duty								
C6-02	Carrier fre-quency selection	Select carrier wave fixed pattern. Select F to enable detailed settings using parameters C6-03 to C6-07.	0 to F	6 *2	No	Q	Q	Q	224H
	CarrierFreq Sel								
d1-01	Frequency reference 1	Set the frequency reference in the unit specified in o1-03 (Frequency Units for Reference Setting And Monitor, default: Hz)		0.00 Hz	Yes	Q	Q	Q	280H
	Reference 1								
d1-02	Frequency reference 2	Frequency reference when multi-step speed command 1 is ON for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	Q	Q	281H
	Reference 2								
d1-03	Frequency reference 3	Frequency reference when multi-step speed command 2 is ON for a multi-function input (unit: Set in o1-03).	0 to 400.00	0.00 Hz	Yes	Q	Q	Q	282H
	Reference 3								
d1-04	Frequency reference 4	Frequency reference when multi-step speed command 1 and 2 are ON for a multi-function input (unit: Set in o1-03).		0.00 Hz	Yes	Q	Q	Q	283H
	Reference 4								
d1-17	Jog frequency reference	Frequency reference when Jog Fre-quency Selection, FJOG command, or RJOG command is ON for a multi-function input (unit: Set in o1-03).		6.00 Hz	Yes	Q	Q	Q	292H
	Jog Reference								
E1-01	Input volt-age setting	Set the Inverter input voltage in 1 volt. This set value will be the basis for the protection functions.	155 to 255 *3	200 V *3	No	Q	Q	Q	300H
	Input Volt-age								

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Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop Vector	Register
E1-03	V/f pattern selection / V/F Selection	0 to E: Select from 15 preset patterns. F: Custom user-set patterns (Applicable for setting E1-04 to E1-10).	0 to F	F	No	Q	Q	No	302H
E1-04	Max. output frequency (FMAX) / Max Frequency		40.0 to 400.0 *4	60.0 Hz *5	No	Q	Q	Q	303H
E1-05	Max. voltage (VMAX) / Max Voltage		0.0 to 255.0 *3	200.0 V *3*5	No	Q	Q	Q	304H
E1-06	Base frequency (FA) / Base Frequency		0.0 to 400.0	60.0 Hz *5	No	Q	Q	Q	305H
E1-09	Min. output frequency (FMIN) / Min Frequency		0.0 to 400.0	1.5 Hz *5	No	Q	Q	Q	308H
E1-13	Base voltage (VBASE) / Base Voltage	Change this setting only when making advanced adjustments for V/f in the fixed outputs area. Normally, there is no need to make these settings.	0.0 to 255.0 *3	0.0 V *6	No	A	A	Q	30CH
E2-01	Motor rated current / Motor Rated FLA	Set the motor rated current in amps. This set value becomes the base value for motor protection, torque limit, and torque control. It is set automatically when using autotuning.	0.32 to 6.40 *8	1.90 A *7	No	Q	Q	Q	30EH
E2-04	Number of motor poles / Number of Poles	Set the number of motor poles. The value is set automatically during auto-tuning.	2 to 48	4	No	No	Q	No	311H
F1-01	PG constant / PG Pulses/Rev	Set the number of pulses per rotation for the PG (pulse generator or encoder) being used. (Do not set as a multiple.)	0 to 60000	600 (1024) *9	No	No	Q	No	380H

The E1-05 / E1-06 / E1-09 rows share a diagram in the Description column:

Output voltage (V)
VMAX (E1-05)
VBASE (E1-13)
VMIN (E1-10)
FMIN (E1-09)   FA (E1-06)   FMAX (E1-04)
Frequency (Hz)

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Regis-ter
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor	
H4-02	Gain (termi-nal FM)	Set the voltage level gain for multi-function analog output 1. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. Voltage output from the terminals, however, is 10 V max. A meter calibration function is avail-able.	0.00 to 2.50	1.00	Yes	Q	Q	Q	41EH
	Terminal FM Gain								
H4-05	Gain (termi-nal AM)	Set the voltage level gain for multi-function analog output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. Voltage output from the terminals, however, is 10 V max. A meter calibration function is avail-able.	0.00 to 2.50	0.50	Yes	Q	Q	Q	421H
	Terminal AM Gain								
L1-01	Motor pro-tection selection	Set to enable or disable the motor overload protection function using the electronic thermal relay. 0: Disabled 1: General-purpose motor protection 2: Inverter motor protection 3: Vector motor protection In some applications when the Inverter power supply is turned off, the thermal value is reset, so even if this parameter is set to 1, protection may not be effective. When several motors are connected to one Inverter, set to 0 and ensure that each motor is installed with a protec-tion device.	0 to 3	1	No	Q	Q	Q	480H
	MOL Fault Select								

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| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Regis-ter |
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor	
L3-04	Stall pre-vention selection during deceleration / StallP Decel Sel	0: Disabled (Deceleration as set. If deceleration time is too short, a main circuit overvoltage may result.) 1: Enabled (Deceleration is stopped when the main circuit voltage exceeds the overvoltage level. Deceleration restarts when voltage is returned.) 2: Intelligent deceleration mode (Deceleration rate is automatically adjusted so that in Inverter can decelerate in the shortest possible time. Set deceleration time is disregarded.) 3: Enabled (with Braking Resistor Unit) When a braking option (Braking Resistor, Braking Resistor Unit, Brak-ing Unit) is used, always set to 0 or 3.	0 to 3	1	No	Q	Q	Q	492H

* 1. The setting ranges for acceleration/deceleration times depends on the setting of C1-10 (Acceleration/deceleration Time Setting Unit). If C1-10 is set to 0, the setting range is 0.00 to 600.00 (s).
* 2. The factory setting depends on the Inverter capacity.
* 3. These are values for a 200-V class Inverter. Values for a 400-V class Inverter are double.
* 4. The upper setting limit will be 150.0 Hz when C6-01 is set to 0.
* 5. The factory setting will change when the control method is changed. (V/f control factory settings are given.)
* 6. After autotuning, E1-13 will contain the same value as E1-05.
* 7. The factory setting depends on the Inverter capacity. (The value for a 200-V class Inverter for 0.4 kW is given.)
* 8. The setting range is from 10% to 200% of the Inverter rated output current. (The value for a 200-V class Inverter for 0.4 kW is given.)
* 9. The factory setting for (-E) models is 1024.

Parameter Tables

◆ A: Setup Settings

The following settings are made with the environment parameters (A parameters): Language displayed on the Digital Operator, access level, control method, initialization of parameters.

■ Initialize Mode: A1

Parameters for the environment modes are shown in the following table.

Param-eter Number	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display						V/f	V/f with PG	Open Loop		
A1-00	Language selection for Digital Operator display	Select Lan-guage	Used to select the language displayed on the Digital Operator (LED). 0: English 1: Japanese 2: German 3: French 4: Italian 5: Spanish 6: Portuguese This parameter is not initial-ized by the initialize opera-tion.	0 to 6	1	Yes	A	A	A	100H	-
A1-01	Parameter access level	Access Level	Used to set the parameter access level (set/read.) 0: Monitoring only (Monitoring drive mode and setting A1-01 and A1-04.) 1: Used to select parameter (Only parameters set in A2-01 to A2-32 can be read and set.) 2: Advanced (Parameters can be read and set in both quick programming mode and advanced programming (A) mode.)	0 to 2	2	Yes	A	A	A	101H	6-141 6-142
A1-02	Control method selection	Control Method	Used to select the control method for the Inverter 0: V/f control 1: V/f with PG feedback (Pulse generator as encoder) 2: Open loop vector This parameter is not initial-ized by the initialize opera-tion.	0 to 2	0	No	Q	Q	Q	102H	4-7 4-9 4-18

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Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
A1-03	Initialize	Used to initialize the param-eters using the specified method.	0 to 3330	0	No	A	A	A	103H	-
	Init Parame-ters	0: No initializing 1110: Initializes using the Parameters 2220: Initializes using a two-wire sequence. (Initializes to the factory setting.) 3330: Initializes using a three-wire sequence.								
A1-04	Password	Password input when a pass-word has been set in A1-05. This function write-protects some parameters of the ini-tialize mode. If the password is changed, A1-01 to A1-03 and A2-01 to A2-32 parameters can no longer be changed. (Pro-gramming mode parameters can be changed.)	0 to 9999	0	No	A	A	A	104H	6-141
	Enter Pass-word									
A1-05	Password setting	Used to set a four digit num-ber as the password. This parameter is not usually displayed. When the Pass-word (A1-04) is displayed, hold down the RESET Key and press the Menu Key and the password will be dis-played.	0 to 9999	0	No	A	A	A	105H	6-141
	Select Pass-word									

■User-set Parameters: A2

The parameters set by the user are listed in the following table.

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Regis-ter	Page
	LCD Display					V/f	V/f with PG	Open Loop		
A2-01 to A2-32	User setting parameters	Used to set the parameter numbers that can be set/read. Maximum 32.	b1-01 to o2-08	-	No	A	A	A	106H to 125H	6-142
	User Param 1 to 32	Effective when the Parame-ter Access Level (A1-01) is set to User Program (1). Parameters set in parameters A2-01 to A2-32 can be set/read in programming mode.								

◆ Application Parameters: b

The following settings are made with the application parameters (B parameters): Operation method selection, DC injection braking, speed searching, timer functions, dwell functions, and energy saving functions.

■Operation Mode Selections: b1

Parameters for operation mode selection are shown in the following table.

Param- eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
b1-01	Reference selection / Reference Source	Sets the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communi- cations 3: Option Card 4: Pulse train input	0 to 4	1	No	Q	Q	Q	180H	4-7 6-6 6-62 6-76
b1-02	Operation method selection / Run Source	Sets the run command input method. 0: Digital Operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communi- cations 3: Option Card	0 to 3	1	No	Q	Q	Q7	181H	4-7 6-12 6-62 6-76
b1-03	Stopping method selection / Stopping Method	Sets the stopping method when a stop command is input. 0: Deceleration to stop 1: Coast to stop 2: DC injection braking stop (Stops faster than coast to stop, no regenerative operation.) 3: Coast to stop with timer (Run commands are disregarded during deceleration.)	0 to 3	0	No	Q	Q	Q	182H	4-8 6-14
b1-04	Prohibition of reverse operation / Reverse Oper	0: Reverse enabled 1: Reverse disabled 2: Switch phase order (reverse enabled)*	0 or 1 (0 to 2)*	0	No	A	A	A	183H	6-51
b1-06	Read sequence input twice / Cntl Input Scans	Used to set the responsive- ness of the control inputs (forward/reverse and multi- function inputs.) 0: Two scans every 2 ms (Use for fast responses.) 1: Two scans every 5 ms (Use for possible malfunction due to noise.)	0 or 1	1	No	A	A	A	185H	-

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Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
b1-07	Operation selection after switching to remote mode / LOC/REM RUN Sel	Used to set the operation mode by switching to the Remote mode using the Local/Remote Key. 0: Run signals that are input during mode switching are disregarded. (Input Run signals after switching the mode.) 1: Run signals become effective immediately after switching to the Remote mode.	0 or 1	0	No	A	A	A	186H	-
b1-08	Run command selection in programming modes / RUN CMD at PRG	Used to set an operation interlock in programming modes. 0: Cannot operate. 1: Can operate (Disabled when Digital Operator is set to select run command (when b1-02 = 0)).	0 or 1	0	No	A	A	A	187H	-

* Only for (-E) model with V/f. Disabled for V/f with PG.

■DC Injection Braking: b2

Parameters for injection braking are shown in the following table.

Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
b2-01	Zero speed level (DC injection braking starting frequency) / DCInj Start Freq	Used to set the frequency which starts DC injection braking in units of Hz when deceleration to stop is selected. When b2-01 is less than E1-09, E1-09 becomes the DC injection braking starting frequency.	0.0 to 10.0	0.5 Hz	No	A	A	A	189H	6-14
b2-02	DC injection braking current / DCInj Current	Sets the DC injection braking current as a percentage of the Inverter rated current.	0 to 100	50%	No	A	A	A	18AH	6-14 6-17
b2-03	DC injection braking time at start / DCInj Time@Start	Used to set the time to perform DC injection braking at start in units of 1 second. Used to stop coasting motor and restart it. When the set value is 0, DC injection braking at start is not performed.	0.00 to 10.00	0.00 s	No	A	A	A	18BH	6-17

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
b2-04	DC Injection brak-ing time at stop / DCInj Time@Stop	Sets the time in units of 1 second to perform DC injection braking at stop. Used to prevent coasting after the stop command is input. When the set value is 0.00, DC injection braking at stop is not performed.	0.00 to 10.00	0.50 s	No	A	A	A	18CH	6-14

■Speed Search: b3

Parameters for the speed search are shown in the following table.

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Regis-ter	Page
	LCD Display					V/f	V/f with PG	Open Loop		
b3-01	Speed search selection (current detection or speed calcula-tion) / SpdSrch at Start	Enables/disables the speed search function for the run command and sets the speed search method. 0:Disabled, speed calculation 1: Enabled, speed calculation 2: Disabled, current detection 3: Enabled, current detection Speed Calculation: When the search is started, the motor speed is calculated and acceleration/deceleration is performed from the calculated speed to the specified frequency (motor direction is also searched). Current Detection: The speed search is started from the frequency when power was momentarily lost and the maximum frequency, and the speed is detected at the search current level.	0 to 3	2*	No	A	A	A	191H	6-53
b3-02	Speed search operating current (current detection) / SpdSrch Current	Sets the speed search operation current as a percentage, taking the Inverter rated current as 100%. Not usually necessary to set. When restarting is not possible with the factory settings, reduce the value.	0 to 200	120%*	No	A	No	A	192H	6-53

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| Param- eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | | Regis- ter | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
b3-03	Speed search decelera- tion time (current detection)	Sets the output frequency deceleration time during speed search in 1-second units. Set the time for deceleration from the maximum output fre- quency to the minimum out- put frequency.	0.1 to 10.0	2.0 s	No	A	No	A	193H	6-53
	SpdSrch Dec Time									
b3-05	Speed search wait time (cur- rent detec- tion or speed cal- culation)	Sets the contactor operating delay time when there is a con- tactor on the output side of the Inverter. When a speed search is performed after recovering from a momentary power loss, the search operation is delayed by the time set here.	0.0 to 20.0	0.2 s	No	A	A	A	195H	6-53
	Search Delay									

* The factory setting will change when the control method is changed. (V/f control factory settings are given.)

■Timer Function: b4

Parameters for timer functions are shown in the following table.

| Param- eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
b4-01	Timer func- tion ON- delay time	Sets the timer function out- put ON-delay time (dead band) for the timer function input, in 1-second units. Enabled when a timer func- tion is set in H1-□□ or H2- □□.	0.0 to 300.0 (0.0 to 3000.0) *	0.0 s	No	A	A	A	1A3H	6-116
	Delay-ON Timer									
b4-02	Timer func- tion OFF- delay time	Sets the timer function out- put OFF-delay time (dead band) for the timer function input, in 1-second units. Enabled when a timer func- tion is set in H1-□□ or H2- □□	0.0 to 300.0 (0.0 to 3000.0) *	0.0 s	No	A	A	A	1A4H	6-116
	Delay-OFF Timer									

* For (-E) models.

■PID Control: b5

Parameters for PID control are shown in the following table.

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
b5-01	PID control mode selection / PID Mode	0: Disabled 1: Enabled (Deviation is D-controlled.) 2: Enabled (Feedback value is D-controlled.) 3: PID control enabled (frequency reference + PID output, D control of deviation) 4: PID control enabled (frequency reference + PID output, D control of feedback value).	0 to 4	0	No	A	A	A	1A5H	6-118
b5-02	Proportional gain (P) / PID Gain	Sets P-control proportional gain as a percentage. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A	A	A	1A6H	6-118
b5-03	Integral (I) time / PID I Time	Sets I-control integral time in 1-second units. I-control is not performed when the setting is 0.0.	0.0 to 360.0	1.0 s	Yes	A	A	A	1A7H	6-118
b5-04	Integral (I) limit / PID I Limit	Sets the I-control limit as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	A	A	1A8H	6-118
b5-05	Derivative (D) time / PID D Time	Sets D-control derivative time in 1-second units. D-control is not performed when the setting is 0.00.	0.00 to 10.00	0.00 s	Yes	A	A	A	1A9H	6-118
b5-06	PID limit / PID Limit	Sets the limit after PID-control as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	A	A	1AAH	6-118
b5-07	PID offset adjustment / PID Offset	Sets the offset after PID-control as a percentage of the maximum output frequency.	-100.0 to +100.0	0.0%	Yes	A	A	A	1ABH	6-118
b5-08	PID primary delay time constant / PID Delay Time	Sets the time constant for low pass filter for PID-control outputs in 1-second units. Not usually necessary to set.	0.00 to 10.00	0.00 s	Yes	A	A	A	1ACH	6-118
b5-09	PID output characteristics selection / Output Level Sel	Select forward/reverse for PID output. 0: PID output is forward. 1: PID output is reverse (highlights the output code)	0 or 1	0	No	A	A	A	1ADH	6-118

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| Param- eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
b5-10	PID output gain / Output Gain	Sets output gain.	0.0 to 25.0	1.0	No	A	A	A	1AEH	6-118
b5-11	PID reverse output selection / Output Rev Sel	0: 0 limit when PID output is negative. 1: Reverses when PID output is negative. 0 limit when reverse prohibit is selected using b1-04.	0 or 1	0	No	A	A	A	1AFH	6-118
b5-12	Selection of PID feed- back com- mand loss detection / Fb los Det Sel	0: No detection of loss of PID feedback. 1: Detection of loss of PID feedback. Operation continues during detection, with the malfunctioning contact not operating. 2: Detection of loss of PID feedback. Coasts to stop during detection, and fault contact operates.	0 to 2	0	No	A	A	A	1B0H	6-118
b5-13	PID feed- back com- mand loss detection level / Fb los Det Lvl	Sets the PID feedback loss detection level as a percent units, with the maximum output frequency at 100%.	0 to 100	0%	No	A	A	A	1B1H	6-118
b5-14	PID feed- back com- mand loss detection time / Fb los Det Time	Sets the PID feedback loss detection level in seconds.	0.0 to 25.5	1.0 s	No	A	A	A	1B2H	6-118
b5-15	PID sleep function operation level / PID Sleep Level	Set the PID sleep function start level as a frequency. Always enabled for (-E) models. On other models, it is disabled when the PID control is not selected (b5-01=0).	0.0 to 400.0	0.0 Hz	No	A	A	A	1B3H	6-118
b5-16	PID sleep operation delay time / PID Sleep Time	Set the delay time until the PID sleep function starts in seconds.	0.0 to 25.5	0.0 s	No	A	A	A	1B4H	6-119

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop	Register	Page
b5-17	Accel/decel time for PID reference / PID Acc/Dec Time	Set the accel/decel time for PID reference in seconds.	0.0 to 25.5	0.0 s	No	A	A	A	1B5H	6-118
b5-18	PID set point selec-tion / PID Set-point Sel	0: PID set point disabled 1: PID set point enabled	0 or 1	0	No	A*	A*	A*	1DCH	6-118
b5-19	PID set point / PID Set-point	PID set point	0.0 to 100.0	0.0%	No	A*	A*	A*	1DDH	6-118

* The parameters b5-18 and b5-19 are enabled only with (-E) models.

∎Dwell Functions: b6

Parameters for dwell functions are shown in the following table.

Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop	Register	Page
b6-01	Dwell fre-quency at start / Dwell Ref @Start		0.0 to 400.0	0.0 Hz	No	A	A	A	1B6H	6-22
b6-02	Dwell time at start / Dwell Time@ Start	Run command ON OFF Output frequency b6-01 b6-03 Time b6-02 b6-04 The dwell function is used to output frequency temporarily when driving a motor with a heavy load.	0.0 to 10.0	0.0 s	No	A	A	A	1B7H	6-22
b6-03	Dwell fre-quency at stop / Dwell Ref @Stop		0.0 to 400.0	0.0 Hz	No	A	A	A	1B8H	6-22
b6-04	Dwell time at stop / Dwell Time @Stop		0.0 to 10.0	0.0 s	No	A	A	A	1B9H	6-22

■Energy Saving: b8

Parameters for energy-saving control functions are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	V/f with PG	Open Loop	Register	Page
b8-01	Energy-saving mode selection / Energy Save Sel	Select whether to enable or disable energy-saving control. 0: Disable 1: Enable	0 or 1	0	No	A	A	A	1CCH	6-125
b8-02	Energy-saving gain / Energy Save Gain	Set the energy-saving gain with the open loop vector control method.	0.0 to 10.0	0.7 *1	Yes	No	No	A	1CDH	6-125
b8-03	Energy-saving filter time constant / Energy Save F.T	Set the energy-saving filter time constant with the open loop vector control method.	0.00 to 10.0	0.50 s *2	Yes	No	No	A	1CEH	6-125
b8-04	Energy-saving coefficient / Energy Save COEF	Set the maximum motor efficiency value. Set the motor rated capacity in E2-11, and adjust the value by 5% at a time until output power reaches a minimum value.	0.0 to 655.00 *3	*4	No	A	A	No	1CFH	6-125
b8-05	Power detection filter time constant / kW Filter Time	Set the time constant for output power detection.	0 to 2000	20 ms	No	A	A	No	1D0H	6-125
b8-06	Search operation voltage limiter / Search V Limit	Set the limit value of the voltage control range during search operation. Perform search operation to optimize operations using minute variations in voltage using energy-saving control. Set to 0 to disable the search operation. 100% is the motor base voltage.	0 to 100	0%	No	A	A	No	1D1H	6-125

* 1. The factory setting is 1.0 when using V/f control with PG.
* 2. The factory setting is 2.00 s when Inverter capacity is 55 kW and over.
* 3. The same capacity as the Inverter will be set by initializing the parameters.
* 4. The factory settings depend on the Inverter capacity.

◆ Tuning Parameters: C

The following settings are made with the tuning parameters (C parameters): Acceleration/deceleration times, s-curve characteristics, slip compensation, torque compensation, speed control, and carrier frequency functions.

■Acceleration/Deceleration: C1

Parameters for acceleration and deceleration times are shown in the following table.

| Param- eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
C1-01	Accelera- tion time 1 / Accel Time 1	Sets the acceleration time to accelerate from 0 to the max- imum output frequency, in 1- second units.	0.0 to 6000.0 *	10.0 s	Yes	Q	Q	Q	200H	4-7 6-19
C1-02	Decelera- tion time 1 / Decel Time 1	Sets the deceleration time to decelerate from the maxi- mum output frequency to 0, in 1-second units.			Yes	Q	Q	Q	201H	4-7 6-19
C1-03	Accelera- tion time 2 / Accel Time 2	The acceleration time when the multi-function input "accel/decel time 1" is set to ON.			Yes	A	A	A	202H	6-19
C1-04	Decelera- tion time 2 / Decel Time 2	The deceleration time when the multi-function input "accel/decel time 1" is set to ON.			Yes	A	A	A	203H	6-19
C1-05	Accelera- tion time 3 / Accel Time 3	The acceleration time when the multi-function input "accel/decel time 2" is set to ON.			No	A	A	A	204H	6-19
C1-06	Decelera- tion time 3 / Decel Time 3	The deceleration time when the multi-function input "accel/decel time 2" is set to ON.			No	A	A	A	205H	6-19
C1-07	Accelera- tion time 4 / Accel Time 4	The acceleration time when the multi-function input "accel/decel time 1" and "accel/decel time 2" are set to ON.			No	A	A	A	206H	6-19
C1-08	Decelera- tion time 4 / Decel Time 4	The deceleration time when the multi-function input "accel/decel time 1" and "accel/decel time 2" are set to ON.			No	A	A	A	207H	6-19

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| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
C1-09	Decelera-tion Stop Time	The deceleration time when the multi-function input "Deceleration stop" is set to ON. This function can be used a stopped method when a fault has been detected.	0.0 to 6000.0 *	10.0 s	No	A	A	A	208H	6-18
	Fast Stop Time									
C1-10	Accel/decel time setting unit	0: 0.01-second units 1: 0.1-second units	0 or 1	1	No	A	A	A	209H	6-19
	Acc/Dec Units									
C1-11	Accel/decel time switch-ing fre-quency	Sets the frequency for auto-matic acceleration/decelera-tion switching. Below set frequency: Accel/decel time 4 Above set frequency: Accel/decel time 1 The multi-function input "accel/decel time 1" or "accel/decel time 2" take pri-ority.	0.0 to 400.0	0.0 Hz	No	A	A	A	20AH	6-19
	Acc/Dec SW Freq									

* The setting range for acceleration/deceleration times will depends on the setting for C1-10. When C1-10 is set to 0, the setting range for acceleration/decel-eration times becomes 0.00 to 600.00 seconds.

■S-curve Acceleration/Deceleration: C2

Parameters for S-curve characteristics are shown in the following table.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop	Register	Page
C2-01	S-curve characteristic time at acceleration start / SCrv Acc @ Start		0.00 to 2.50	0.20 s	No	A	A	A	20BH	6-20
C2-02	S-curve characteristic time at acceleration end / SCrv Acc @ End	All sections of the S-curve characteristic time are set in seconds. When the S-curve characteristic time is set, the accel/decel times will increase by only half of the S-curve characteristic times at start and end.	0.00 to 2.50	0.20 s	No	A	A	A	20CH	6-20
C2-03	S-curve characteristic time at deceleration start / SCrv Dec @ Start	Run command OFF / Output frequency ON / C2-02 C2-03 / C2-01 C2-04 / Time	0.00 to 2.50	0.20 s	No	A	A	A	20DH	6-20
C2-04	S-curve characteristic time at deceleration end / SCrv Dec @ End		0.00 to 2.50	0.00 s	No	A	A	A	20EH	6-20

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■Motor Slip Compensation: C3

Parameters for slip compensation are shown in the following table.

Param- eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera- tion	V/f	V/f with PG	Open Loop	Register	Page
C3-01	Slip com- pensation gain / Slip Comp Gain	Used to improve speed accu- racy when operating with a load. Usually setting is not neces- sary. Adjust this parameter at the following times. • When actual speed is low, increase the set value. • When actual speed is high, decrease the set value.	0.0 to 2.5	0.0*	Yes	A	No	A	20FH	4-18 6-34
C3-02	Slip com- pensation primary delay time / Slip Comp Time	Slip compensation primary delay time is set in ms. Usually setting is not neces- sary. Adjust this parameter at the following times. • Reduce the setting when slip compensation respon- sive is slow. • When speed is not stabi- lized, increase the setting.	0 to 10000	2000 ms *	No	A	No	A	210H	4-18 6-34
C3-03	Slip com- pensation limit / Slip Comp Limit	Sets the slip compensation limit as a percentage of motor rated slip.	0 to 250	200%	No	A	No	A	211H	6-34
C3-04	Slip com- pensation selection during regeneration / Slip Comp Regen	0: Disabled. 1: Enabled. When the slip compensation during regeneration function has been activated, as regen- eration capacity increases momentarily, it may be nec- essary to use a braking option (braking resistor, Braking Resistor Unit or Braking Unit.)	0 or 1	0	No	A	No	A	212H	6-34
C3-05	Output volt- age limit operation selection / V/F Slip Cmp Sel	0: Disabled. 1: Enabled. (The motor flux will be lowered automati- cally when the output voltage become satu- rated.)	0 or 1	0	No	No	No	A	213H	6-34

* The factory setting will change when the control method is changed. (V/f control factory settings are given.)

■**Torque Compensation: C4**

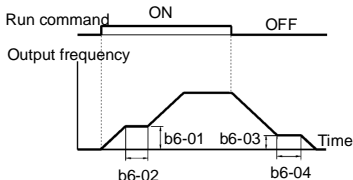Parameters for are torque compensation shown in the following table.

| Param-eter Number | Name | | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display						V/f	V/f with PG	Open Loop		
C4-01	Torque compensa-tion gain	Torq Comp Gain	Sets torque compensation gain as a ratio. Usually setting is not neces-sary. Adjust in the following cir-cumstances: • When the cable is long; increase the set value. • When the motor is smaller than the Inverter capacity (Max. applicable motor capacity), increase the set values. • When the motor is oscil-lating, decrease the set values. Adjust the output current range at minimum speed rotation so that it does not exceed the Inverter rated output current. Do not alter the torque com-pensation gain from its default (1.00) when using the open loop vector control method.	0.00 to 2.50	1.00	Yes	A	A	A	215H	4-18 6-37
C4-02	Torque compensa-tion pri-mary delay time con-stant	Torq Comp Time	The torque compensation delay time is set in ms. Usually setting is not neces-sary. Adjust in the following cir-cumstances: • When the motor is oscil-lating, increase the set val-ues. • When the responsiveness of the motor is low, decrease the set values.	0 to 10000	200 ms *1	No	A	A	A	216H	4-18 6-37
C4-03	Starting torque value (forward)	F TorqCmp@ start	Sets the value based on 100% motor's rated torque.	0.0 to 200.0	0.0%	No	No	No	A*2	217H	6-37
C4-04	Starting torque value (reverse)	R TorqCmp@ start	Sets the value based on 100% motor's rated torque.	-200.0 to 0.0	0.0%	No	No	No	A*2	218H	6-37

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Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
C4-05	Starting torque time constant / TorqCmp Delay T	Sets the rise time constant (ms) for the starting torque value. The filter is disabled if set between 0 and 4 ms.	0 to 200	10 ms	No	No	No	A[*2]	219H	6-37

* 1. The factory setting will change when the control method is changed. (V/f control factory settings are given.)
* 2. The starting torque value can be set only for (-E) models.

■Speed Control (ASR): C5

Parameters for speed control are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
C5-01	ASR proportional (P) gain 1 / ASR P Gain 1	Sets the proportional gain of the speed loop (ASR.)	0.00 to 300.00	0.20	Yes	No	A	No	21BH	-
C5-02	ASR integral (I) time 1 / ASR I Time 1	Sets the integral time of the speed loop (ASR) in 1-second units.	0.000 to 10.000	0.200 s	Yes	No	A	No	21CH	-
C5-03	ASR proportional (P) gain 2 / ASR P Gain 2	Usually setting is not necessary. Set to change the rotational speed gain.	0.00 to 300.00	0.02	Yes	No	A	No	21DH	-
C5-04	ASR integral (I) time 2 / ASR I Time 2		0.000 to 10.000	0.050 s	Yes	No	A	No	21EH	-
C5-05	ASR limit / ASR Limit	Sets the upper limit for the compensation frequency for the speed control loop (ASR) to a percentage of the maximum output frequency.	0.0 to 20.0	5.0%	No	No	A	No	21FH	-

■Carrier Frequency: C6

Parameters for the carrier frequency are shown in the following table.

| Param-eter Num-ber | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
C6-01	CT/VT selection	0: CT (low carrier, constant torque, 150% for 1 munite max.)	0 or 1	1	No	Q	Q	Q	223H	4-7 6-2
	Heavy/ Normal Duty	1: VT (high carrier, variable torque, 120% for 1 munite max.)								
C6-02	Carrier frequency selection	Select carrier wave fixed pattern. Select F to enable detailed settings using parameters C6-03 to C6-05.	0 to F	6 *1	No	Q	Q	Q	224H	4-8 4-18 6-2
	Carrier-Freq Sel									

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Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	V/f with PG	Open Loop	Register	Page
C6-03	Carrier frequency upper limit / Carrier-Freq Max	Set the carrier frequency upper limit and lower limit in kHz units. The carrier frequency gain is set as follows: With the vector control method, the upper limit of the carrier frequency is fixed in C6-03. Carrier frequency C6-03 C6-04 Output frequency x (C6-05) x K Output frequency E1-04 (Max. output frequency) K is a coefficient that depends on the setting of C6-03. C6-03 ≥ 10.0 kHz: K = 3 10.0 kHz > C6-03 ≥ 5.0 kHz: K = 2 5.0 kHz > C6-03: K = 1	2.0 to 15.0 *2 *3	15.0 kHz *1	No	A	A	A	225H	6-2
C6-04	Carrier frequency lower limit / Carrier-Freq Min		0.4 to 15.0 *2 *3	15.0 kHz *1	No	A	A	No	226H	6-2
C6-05	Carrier frequency propor-tional gain / Carrier-Freq Gain		00 to 99 *3	00	No	A	A	No	227H	6-2

* 1. The factory setting depends on the capacity of the Inverter.
* 2. The setting range depends on the capacity of the Inverter.
* 3. This parameter can be monitored or set only when 1 is set for C6-01 and F is set for C6-02.

◆ Reference Parameters: d

The following settings are made with the reference parameters (d parameters): Frequency references.

■Preset Reference: d1

Parameters for frequency references are shown in the following table.

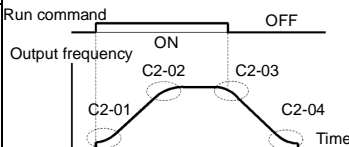| Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
d1-01	Frequency reference 1 / Reference 1	Sets the frequency reference in the units used in o1-03.		0.00 Hz	Yes	Q	Q	Q	280H	4-8 6-10
d1-02	Frequency reference 2 / Reference 2	The frequency reference when multi-step speed command 1 is ON for a multi-function input.		0.00 Hz	Yes	Q	Q	Q	281H	4-8 6-10
d1-03	Frequency reference 3 / Reference 3	The frequency reference when multi-step speed command 2 is ON for a multi-function input.		0.00 Hz	Yes	Q	Q	Q	282H	4-8 6-10
d1-04	Frequency reference 4 / Reference 4	The frequency reference when multi-step speed commands 1 and 2 are ON for multi-function inputs.	0 to 400.00	0.00 Hz	Yes	Q	Q	Q	283H	4-8 6-10
d1-05	Frequency reference 5 / Reference 5	The frequency when multi-step speed command 3 is ON for a multi-function input.		0.00 Hz	Yes	A	A	A	284H	6-10
d1-06	Frequency reference 6 / Reference 6	The frequency reference when multi-step speed commands 1 and 3 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	285H	6-10
d1-07	Frequency reference 7 / Reference 7	The frequency reference when multi-step speed commands 2 and 3 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	286H	6-10
d1-08	Frequency reference 8 / Reference 8	The frequency reference when multi-step speed commands 1, 2, and 3 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	287H	6-10

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| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
d1-09	Frequency reference 9 / Reference 9	The frequency reference when multi-step speed command 4 is ON for a multi-function input.		0.00 Hz	Yes	A	A	A	288H	-
d1-10	Frequency reference 10 / Reference 10	The frequency reference when multi-step speed commands 1 and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	28BH	-
d1-11	Frequency reference 11 / Reference 11	The frequency reference when multi-step speed commands 2 and 4 are ON for a multi-function inputs.		0.00 Hz	Yes	A	A	A	28CH	-
d1-12	Frequency reference 12 / Reference 12	The frequency reference when multi-step speed commands 1, 2, and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	28DH	-
d1-13	Frequency reference 13 / Reference 13	The frequency reference when multi-step speed commands 3 and 4 are ON for multi-function inputs.	0 to 400.00	0.00 Hz	Yes	A	A	A	28EH	-
d1-14	Frequency reference 14 / Reference 14	The frequency reference when multi-step speed commands 1, 3, and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	28FH	-
d1-15	Frequency reference 15 / Reference 15	The frequency reference when multi-step speed commands 2, 3, and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	290H	-
d1-16	Frequency reference 16 / Reference 16	The frequency reference when multi-step speed commands 1, 2, 3, and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	291H	-
d1-17	Jog frequency reference / Jog Reference	The frequency reference when the jog frequency reference selection, FJOG command, or RJOG command is ON.		6.00 Hz	Yes	Q	Q	Q	292H	4-8 6-10 6-70

Note The unit is set in o1-03 (frequency units of reference setting and monitor, default: 0.01 Hz).

■**Reference Limits: d2**

Parameters for frequency reference limits are shown in the following table.

Parameter Number	Name		Description	Setting Range	Factory Setting	Change during Operation	Control Methods			Register	Page
	LCD Display						V/f	V/f with PG	Open Loop		
d2-01	Frequency reference upper limit	Ref Upper Limit	Set the output frequency upper limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	100.0%	No	A	A	A	289H	6-32 6-65
d2-02	Frequency reference lower limit	Ref Lower Limit	Sets the output frequency lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A	A	A	28AH	6-32 6-65
d2-03	Master speed reference lower limit	Ref1 Lower Limit	Set the master speed reference lower limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	0.0%	No	A	A	A	293H	6-32 6-65

■**Jump Frequencies: d3**

Parameters for jump frequencies are shown in the following table.

Parameter Number	Name		Description	Setting Range	Factory Setting	Change during Operation	Control Methods			Register	Page
	LCD Display						V/f	V/f with PG	Open Loop		
d3-01	Jump frequency 1	Jump Freq 1	Set the center values of the jump frequencies in Hz. This function is disabled by setting the jump frequency to 0 Hz. Always ensure that the following applies: d3-01 ≥ d3-02 ≥ d3-03 Operation in the jump frequency range is prohibited but during acceleration and deceleration, speed changes smoothly without jump.	0.0 to 400.0	0.0 Hz	No	A	A	A	294H	6-29
d3-02	Jump frequency 2	Jump Freq 2			0.0 Hz	No	A	A	A	295H	6-29
d3-03	Jump frequency 3	Jump Freq 3			0.0 Hz	No	A	A	A	296H	6-29
d3-04	Jump frequency width	Jump Bandwidth	Sets the jump frequency bandwidth in Hz. The jump frequency will be the jump frequency ± d3-04.	0.0 to 20.0	1.0 Hz	No	A	A	A	297H	6-29

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■Reference Frequency Hold: d4

Parameters for the reference frequency hold function are shown in the following table.

| Param-eter Number | Name | | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display						V/f	V/f with PG	Open Loop		
d4-01	Frequency reference hold func-tion selec-tion		Sets whether or not frequen-cies on hold will be recorded. 0: Disabled (when operation is stopped or the power is turned on again starts at 0.) 1: Enabled (when operation is stopped or the power is turned on again starts at the previous hold frequency.) This function is available when the multi-function inputs "accel/decel Ramp Hold" or "up/down" com-mands are set.	0 or 1	0	No	A	A	A	298H	6-64
	MOP Ref Memory										
d4-02	+ - Speed limits		Set the frequency to be add to or subtracted from the analog frequency reference as a percent, taking the max-imum output frequency to be 100%. Enabled when the increase (+) speed command or decrease (-) speed command is set for a multi-function input.	0 to 100	10%	No	A	A	A	299H	6-68
	Trim Con-trol Lvl										

■**Field Weakening: d6**

Parameters for the field weakening command are shown in the following table.

| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
d6-01	Field weak-ening level / Field-Weak Lvl	Set the Inverter output volt-age when the field weaken-ing command is input. It is enabled when the field weakening command is set for a multi-function input. Set the level as a percentage taking the voltage set in the V/f pattern as 100%.	0 to 100	80%	No	A	A	No	2A0H	-
d6-02	Field frequency / Field-Weak Freq	Set the lower limit in hertz of the frequency range where field control is valid. The field weakening com-mand is valid only at fre-quencies above this setting and only when the speed is in agreement with the cur-rent speed reference.	0.0 to 400.0	0.0 Hz	No	A	A	No	2A1H	-

◆ **Motor Constant Parameters: E**

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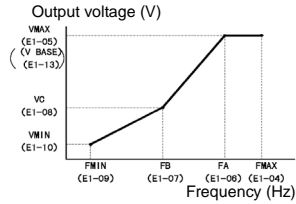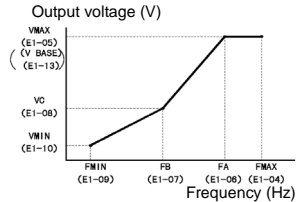
The following settings are made with the motor constant parameters (E parameters): V/f characteristics and motor constants.

■**V/f Pattern: E1**

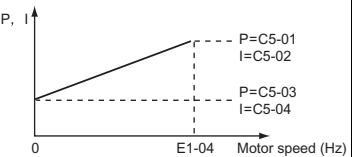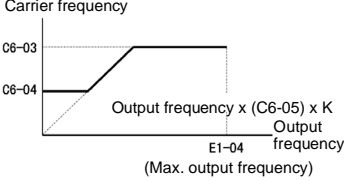Parameters for V/f characteristics are shown in the following table.

| Param-eter Num-ber | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
E1-01	Input voltage setting / Input Voltage	Set the Inverter input voltage in 1 volt. This setting is used as a reference value in protection functions.	155 to 255 *1	200 V *1	No	Q	Q	Q	300H	4-7 6-129
E1-03	V/f pat-tern selec-tion / V/F Selection	0 to E: Select from the 15 preset patterns. F: Custom user-set patterns (Applicable for settings E1-04 to E1-10.)	0 to F	F	No	Q	Q	No	302H	6-129

Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop	Register	Page
E1-04	Max. output frequency / Max Frequency		40.0 to 400.0 *5	60.0 Hz *2 (50.0 Hz) *6	No	Q	Q	Q	303H	6-129
E1-05	Max. voltage / Max Voltage		0.0 to 255.0 *1	200.0 V *1 *2	No	Q	Q	Q	304H	6-129
E1-06	Base frequency / Base Frequency	To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 400.0	60.0 Hz *2 (50.0 Hz) *6	No	Q	Q	Q	305H	6-129
E1-07	Mid. output frequency / Mid Frequency A		0.0 to 400.0	3.0 Hz *2	No	A	A	A	306H	6-129
E1-08	Mid. output frequency voltage / Mid Voltage A		0.0 to 255 *1	15.0 V *1 *2	No	A	A	A	307H	4-19 6-129
E1-09	Min. output frequency / Min Frequency		0.0 to 400.0	1.5 Hz *2	No	Q	Q	Q	308H	6-129
E1-10	Min. output frequency voltage / Min Voltage	To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded. Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 255.0 *1	9.0 V *1 *2	No	A	A	A	309H	4-18 4-19 6-129

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
E1-11	Mid. output frequency 2 / Mid Frequency B	Set only to fine-adjust V/f for the output range. Normally, this setting is not required.	0.0 to 400.0	0.0 Hz *3	No	A	A	A	30AH	6-129
E1-12	Mid. output frequency voltage 2 / Mid Voltage B		0.0 to 255.0 *1	0.0 V *3	No	A	A	A	30BH	6-129
E1-13	Base voltage / Base Voltage		0.0 to 255.0 *1	0.0 V *4	No	A	A	Q	30CH	6-129

* 1. These are values for a 200-V class Inverter. Values for a 400-V class Inverter are double.
* 2. The factory setting will change when the control method is changed. (V/f control factory settings are given.)
* 3. E1-11 and E1-12 are disregarded when set to 0.0.
* 4. E1-13 is set to the same value as E1-05 by autotuning.
* 5. When C6-01 is set to 0, the upper limit of the setting range is 150.0 Hz.
* 6. For (-E) models. Factory setting for base frequency is 50 Hz.

■ **Motor Setup: E2**

Parameters for motor 1 are shown in the following table.

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
E2-01	Motor rated current / Motor Rated FLA	Sets the motor rated current in 1 A units. These set values will become the reference values for motor protection and torque limits. This parameter is automatically set during autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q	Q	Q	30EH	6-47 6-127
E2-02	Motor rated slip / Motor Rated Slip	Sets the motor rated slip in Hz units. These set values will become the reference values for slip compensation. This parameter is automatically set during autotuning.	0.00 to 20.00	2.90 Hz *1	No	A	A	A	30FH	6-127
E2-03	Motor no-load current / No-Load Current	Sets the motor no-load current in 1 A units. This parameter is automatically set during autotuning.	0.00 to 1.89 *3	1.20 A *1	No	A	A	A	310H	6-127
E2-04	Number of motor poles / Number of Poles	Sets the number of motor poles. This parameter is automatically set during autotuning.	2 to 48	4 poles	No	No	Q	No	311H	6-127

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| Param-
eter
Number | Name
LCD
Display | Description | Setting
Range | Factory
Setting | Change
during
Opera-
tion | Control Methods | | | Register | Page |
						V/f	V/f with PG	Open Loop		
E2-05	Motor line- to-line resis- tance Term Resis- tance	Sets the motor phase-to- phase resistance in Ω units. This parameter is automati- cally set during autotuning.	0.000 to 65.000	9.842 Ω *1	No	A	A	A	312H	6-127
E2-06	Motor leak inductance Leak Induc- tance	Sets the voltage drop due to motor leakage inductance as a percentage of the motor rated voltage. This parameter is automati- cally set during autotuning.	0.0 to 40.0	18.2% *1	No	No	No	A	313H	6-127
E2-07	Motor iron saturation coefficient 1 Saturation Comp1	Sets the motor iron satura- tion coefficient at 50% of magnetic flux. This parameter is automati- cally set during autotuning.	0.00 to 0.50	0.50	No	No	No	A	314H	6-127
E2-08	Motor iron saturation coefficient 2 Saturation Comp2	Sets the motor iron satura- tion coefficient at 75% of magnetic flux. This parameter is automati- cally set during autotuning.	0.00 to 0.75	0.75	No	No	No	A	315H	6-127
E2-10	Motor iron loss for torque com- pensation Tcomp Iron Loss	Sets motor iron loss in W units.	0 to 65535	14 W *1	No	A	A	No	317H	6-127
E2-11	Motor rated output Mtr Rated Power	Set the rated output of the motor in units of 0.01 kW. This parameter is automati- cally set during autotuning.	0.00 to 650.00	0.40 *1	No	Q	Q	Q	318H	-

* 1. The factory setting depends upon the Inverter capacity. The value for a 200-V class Inverter of 0.4 kW is given.
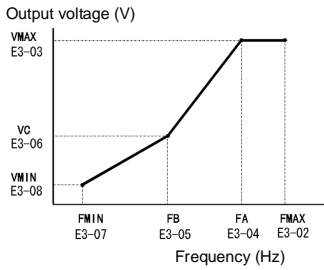
* 2. The setting range is 10% to 200% of the Inverter's rated output current. The value for a 200-V class Inverter of 0.4 kW is given.

* 3. The factory setting depends upon the Inverter capacity. The value for a 200-V class Inverter of 0.4 kW is given.

■ Motor 2 V/f Pattern: E3

Parameters for motor 2 V/f characteristics are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	V/f	V/f with PG	Open Loop	Register	Page
E3-01	Motor 2 control method selection / Control Method	0: V/f control 1: V/f control with PG 2: Open-loop vector control	0 to 2	0	No	A	A	A	319H	-
E3-02	Motor 2 max. output frequency (FMAX) / Max Frequency		40.0 to 400.0 *3	60.0 Hz (50.0 Hz) *4	No	A	A	A	31AH	-
E3-03	Motor 2 max. voltage (VMAX) / Max Voltage		0.0 to 255.0 *1	200.0 V *2	No	A	A	A	31BH	-
E3-04	Motor 2 max. voltage frequency (FA) / Base Frequency		0.0 to 400.0	60.0 Hz (50.0 Hz) *4	No	A	A	A	31CH	-
E3-05	Motor 2 mid. output frequency 1 (FB) / Mid Frequency	To set V/f characteristics in a straight line, set the same values for E3-05 and E3-07. In this case, the setting for E3-06 will be disregarded. Always ensure that the four frequencies are set in the following manner: E3-02 (FMAX) ≥ E3-04 (FA) > E3-05 (FB) > E3-07 (FMIN)	0.0 to 400.0	3.0 Hz *2	No	A	A	A	31DH	-
E3-06	Motor 2 mid. output frequency voltage 1 (VC) / Mid Voltage		0.0 to 255.0 *1	15.0 V *1	No	A	A	A	31EH	-
E3-07	Motor 2 min. output frequency (FMIN) / Min Frequency		0.0 to 400.0	1.5 Hz *2	No	A	A	A	31FH	-

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Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	V/f with PG	Open Loop	Register	Page
E3-08	Motor 2 min. out-put fre-quency voltage (VMIN) / Min Volt-age	Output voltage (V) ... VMAX E3-03, VC E3-06, VMIN E3-08 ... FMIN E3-07, FB E3-05, FA E3-04, FMAX E3-02, Frequency (Hz) To set V/f characteristics in a straight line, set the same values for E3-05 and E3-07. In this case, the setting for E3-06 will be disregarded. Always ensure that the four fre-quencies are set in the following manner: E3-02 (FMAX) ≥ E3-04 (FA) > E3-05 (FB) > E3-07 (FMIN)	0.0 to 255.0 *1	9.0 V *1	No	A	A	A	320H	-

* 1. These are values for a 200-V class Inverter. Values for a 400-V class Inverter are double.
* 2. The factory setting will change when the control method is changed. (V/f control factory settings are given.)
* 3. When C6-01 is set to 0, the upper limit of the setting range is 150.0 Hz.
* 4. For (-E) models. Factory setting for base frequency is 50 Hz.

■**Motor 2 Setup: E4**

Parameters for motor 2 are shown in the following table.

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
E4-01	Motor 2 rated current	Sets the motor rated current in 1 A units. These set values will become the reference values for motor protection, torque lim-its and torque control. This parameter is automati-cally set during autotuning.	0.32 to 6.40 *2	1.90 A *1	No	A	A	A	321H	6-47
	Motor Rated FLA									
E4-02	Motor 2 rated slip	Sets the motor rated slip in Hz units. These set values will become the reference values for slip compensation. This parameter is automati-cally set during autotuning.	0.00 to 20.00	2.90 Hz *1	No	A	A	A	322H	-
	Motor Rated Slip									
E4-03	Motor 2 no-load current	Sets the motor no-load cur-rent in 1 A units. This parameter is automati-cally set during autotuning.	0.00 to 1.89 *3	1.20 A *1	No	A	A	A	323H	-
	No-Load Current									
E4-04	Motor 2 number of poles (num-ber of poles)	Sets the number of motor poles. This parameter is automati-cally set during autotuning.	2 to 48	4 poles	No	No	A	No	324H	-
	Number of Poles									
E4-05	Motor 2 line-to-line resistance	Sets the motor phase-to-phase resistance in Ω units. This parameter is automati-cally set during autotuning.	0.000 to 65.000	9.842 Ω *1	No	A	A	A	325H	-
	Term Resis-tance									
E4-06	Motor 2 leak induc-tance	Sets the voltage drop due to motor leakage inductance as a percentage of the motor rated voltage. This parameter is automati-cally set during autotuning.	0.0 to 40.0	18.2% *1	No	No	No	A	326H	-
	Leak Induc-tance									
E4-07	Motor 2 rated capac-ity	Set the rated output of the motor in units of 0.01 kW. This parameter is automati-cally set during autotuning.	0.40 to 650.00	0.40 *1	No	A	A	A	327H	-
	Mtr Rated Power									

* 1. The factory setting depends upon the Inverter capacity. The value for a 200-V class Inverter of 0.4 kW is given.
* 2. The setting range is 10% to 200% of the Inverter's rated output current. The values for a 200-V class Inverter of 0.4 kW is given.
* 3. If a multi-function input is set for motor 2 (H1-□□ = 16), the factory setting will depend upon the Inverter capacity. The value for a 200-V class Inverter of 0.4 kW is given.

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◆ Option Parameters: F

The following settings are made with the option parameters (F parameters): Settings for Option Cards

■PG Option Setup: F1

Parameters for the PG Speed Control Card are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
F1-01	PG constant / PG Pulses/ Rev	Sets the number of PG (pulse generator or encoder) pulses. Sets the number of pulses per motor revolution.	0 to 60000	600 (1024)*	No	No	Q	No	380H	6-143
F1-02	Operation selection at PG open circuit (PGO) / PG Fdbk Loss Sel	Sets the PG disconnection stopping method. 0: Ramp to stop (Deceleration stop using Deceleration Time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (To protect the motor or machinery, do not normally make this setting.)	0 to 3	1	No	No	A	No	381H	6-143
F1-03	Operation selection at overspeed (OS) / PG Over-speed Sel	Sets the stopping method when an overspeed (OS) fault occurs. 0: Ramp to stop (Deceleration stop using Deceleration Time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (To protect the motor or machinery, do not normally make this setting.)	0 to 3	1	No	No	A	No	382H	6-143

* Factory setting for (-E) models is 1024.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
F1-04	Operation selection at deviation / PG Deviation Sel	Sets the stopping method when a speed deviation (DEV) fault occurs. 0: Ramp to stop (Deceleration stop using Deceleration Time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (DEV is displayed and operation continued.)	0 to 3	3	No	No	A	No	383H	6-143
F1-05	PG rotation / PG Rotation Sel	0: Phase A leads with forward run command. (Phase B leads with reverse run command.) 1: Phase B leads with forward run command. (Phase A leads with reverse run command.)	0 or 1	0	No	No	A	No	384H	6-143
F1-06	PG division rate (PG pulse monitor) / PG Output Ratio	Sets the division ratio for the PG Speed Control Card pulse output. Division ratio = $(1+ n)/m$ (n=0 or 1 m=1 to 32) $F1\text{-}06 = \underset{n}{\square}\ \underset{m}{\square\square}$ This parameter is only effective when a PG-B2 is used. The possible division ratio settings are: $1/32 \leq F1\text{-}06 \leq 1$.	1 to 132	1	No	No	A	No	385H	6-144
F1-07	Integral value during accel/decel enable/disable / PG Ramp PI/I Sel	Sets integral control during acceleration/deceleration to either enabled or disabled. 0: Disabled (The integral function isn't used while accelerating or decelerating; it is used at constant speeds.) 1: Enabled (The integral function is used at all times.)	0 or 1	0	No	No	A	No	386H	6-144

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Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
F1-08	Overspeed detection level / PG Over-spd Level	Sets the overspeed detection method. Frequencies above that set for F1-08 (set as a percentage of the maximum output frequency) that continue to exceed this frequency for the time set in F1-09 are detected as overspeed faults.	0 to 120	115%	No	No	A	No	387H	6-144
F1-09	Overspeed detection delay time / PG Over-spd Time		0.0 to 2.0	1.0 s	No	No	A	No	388H	6-144
F1-10	Excessive speed deviation detection level / PG Deviate Level	Sets the speed deviation detection method. Any speed deviation above the F1-10 set level (set as a percentage of the maximum output frequency) that continues for the time set in F1-11 is detected as a speed deviation. Speed deviation is the difference between actual motor speed and the reference command speed.	0 to 50	10%	No	No	A	No	389H	6-144
F1-11	Excessive speed deviation detection delay time / PG Deviate Time		0.0 to 10.0	0.5 s	No	No	A	No	38AH	6-144
F1-12	Number of PG gear teeth 1 / PG# Gear Teeth1	Sets the number of teeth on the gears if there are gears between the PG and the motor. $$\frac{\text{Input pulses from PG} \times 60}{\text{F1-01}} \times \frac{\text{F1-13}}{\text{F1-12}}$$ A gear ratio of 1 will be used if either of these parameters is set to 0.	0 to 1000	0	No	No	A	No	38BH	6-144
F1-13	Number of PG gear teeth 2 / PG# Gear Teeth2			0	No	No	A	No	38CH	6-144
F1-14	PG open-circuit detection time / PGO Detect Time	Used to set the PG disconnection detection time. PGO will be detected if the detection time continues beyond the set time.	0.0 to 10.0	2.0 s	No	No	A	No	38DH	6-144

■Analog Monitor Cards: F4

Parameters for the Analog Monitor Card are shown in the following table.

| Param- eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
F4-01	Channel 1 monitor selection		1 to 40	2	No	A*	A*	A*	391H	6-73
	AO Ch1 Select									
F4-02	Channel 1 gain	Effective when the Analog Monitor Card is used. Monitor selection: Set the number of the moni- tor item to be output. (U1-□□) Gain: Set the multiple of 10 V for outputting monitor items. 4, 10 to 14, 28, 34, 39, 40 cannot be set. 17, 23, 25, 29, 30, 31, 35 are not used. When the AO-12 Analog Monitor Card is used, out- puts of ± 10 V are possible. To output ± 10 V, set F4-07 or F4-08 to 1. When the AO- 08 Analog Monitor Card is used, only outputs of 0 to +10 V are possible. A meter calibration function is available.	0.00 to 2.50	1.00	Yes	A*	A*	A*	392H	6-73
	AO Ch1 Gain									
F4-03	Channel 2 monitor selection		1 to 40	3	No	A*	A*	A*	393H	6-73
	AO Ch2 Select									
F4-04	Channel 2 gain		0.00 to 2.50	0.50	Yes	A*	A*	A*	394H	6-73
	AO Ch2 Gain									
F4-05	Channel 1 output mon- itor bias	Sets the channel 1 item bias to 100%/10 V when the Ana- log Monitor Card is used.	-10.0 to 10.0	0.0	Yes	A*	A*	A*	395H	6-73
	AO Ch1 Bias									

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| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
| | | | | | | V/f | V/f with PG | Open Loop | | |
	LCD Display									
F4-06	Channel 2 output mon-itor bias	Sets the channel 2 item bias to 100%/10 V when the Ana-log Monitor Card is used.	-10.0 to 10.0	0.0	Yes	A*	A*	A*	396H	6-73
	AO Ch2 Bias									
F4-07	Analog out-put signal level for channel 1	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A*	A*	A*	397H	-
	AO Opt Level Ch1									
F4-08	Analog out-put signal level for channel 2	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A*	A*	A*	398H	6-73
	AO Opt Level Ch2									

* Analog Monitor Cards are not available for (-E) models. Use the AM or FM terminal as a substitute.

◼Not Used: F5

Parameters for the Digital Output Card are shown in the following table.

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
F5-01	Not used		-	0	No	A	A	A	399H	-
	DO Ch1 Select									
F5-02	Not used		-	1	No	A	A	A	39AH	-
	DO Ch2 Select									
F5-03	Not used		-	2	No	A	A	A	39BH	-
	DO Ch3 Select									
F5-04	Not used		-	4	No	A	A	A	39CH	-
	DO Ch4 Select									
F5-05	Not used	Do not set.	-	6	No	A	A	A	39DH	-
	DO Ch5 Select									
F5-06	Not used		-	37	No	A	A	A	39EH	-
	DO Ch6 Select									
F5-07	Not used		-	0F	No	A	A	A	39FH	-
	DO Ch7 Select									
F5-08	Not used		-	0F	No	A	A	A	3A0H	-
	DO Ch8 Select									
F5-09	Not used		-	0	No	A	A	A	3A1H	-
	DO-08 Selection									

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■Communications Option Cards: F6

Parameters for a Communications Option Card (DeviceNet) are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
F6-01	DeviceNet fault opera-tion selec-tion / Comm Bus Flt Sel	0: Decelerates to a stop using C1-02 deceleration time/fault detection 1: Coast to a stop/fault detection 2: Decelerates to stop using C1-09 deceleration time/fault detection 3: Continues operating/alarm detection[*1]	0 to 3	1	No	A	A	A	3A2H	-
F6-02	Communi-cations external fault input detection method selection / EF0 Detec-tion	0: Fault detection during power ON 1: Fault detected during running only (when RUN commands are input)	0 or 1	0	No	A	A	A	3A3H	-
F6-03	Communi-cations external fault input operation selection / EF0 Fault Action	0: Decelerates to a stop using C1-02 deceleration time/fault detection 1: Coast to a stop/fault detection 2: Decelerates to a stop using C1-09 deceleration time/fault detection 3: Continues operating/alarm detection[*1]	0 to 3	1	No	A	A	A	3A4H	-
F6-04	Not used / Trace Sam-ple Tim	Do not set.	-	0	No	A	A	A	3A5H	-
F6-05	Display unit selection for current monitor / Current Unit Sel	0: Amperes 1: 100%/8192	0 or 1	0	No	A[*2]	A[*2]	A[*2]	3A6H	-

Note For details on Communications Option Cards, refer to the manual for each *Option Card (DeviceNet Communications Card/3G3FV-PDRT1-SIN* (Cat. No. I525-E1)).

* 1. If F6-01 or F6-03 is set to 3, the Inverter will continue operating. Be sure to install a limit switch or an emergency stop switch as a safety precaution.

* 2. For (-E) models.

◆ Terminal Function Parameters: H

The following settings are made with the terminal function parameters (H parameters): Settings for external terminal functions.

■Multi-function Digital Inputs: H1

Parameters for multi-function digital inputs are shown in the following tables.

Param- eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			Register	Page
						V/f	V/f with PG	Open Loop		
H1-01	Terminal S3 function selection / Terminal S3 Sel	Multi-function contact input 1	0 to 68	24	No	A	A	A	400H	-
H1-02	Terminal S4 function selection / Terminal S4 Sel	Multi-function contact input 2	0 to 68	14	No	A	A	A	401H	-
H1-03	Terminal S5 function selection / Terminal S5 Sel	Multi-function contact input 3	0 to 68	3 (0)*	No	A	A	A	402H	-
H1-04	Terminal S6 function selection / Terminal S6 Sel	Multi-function contact input 4	0 to 68	4 (3)*	No	A	A	A	403H	-
H1-05	Terminal S7 function selection / Terminal S7 Sel	Multi-function contact input 5	0 to 68	6 (4)*	No	A	A	A	404H	-

* The values in parentheses indicate initial values when initialized in 3-wire sequence.

Multi-function Digital Input Functions

Set- ting Value	Function	Control Methods			Page
		V/f	V/f with PG	Open Loop Vec- tor	
0	3-wire sequence (Forward/Reverse Direction)	Yes	Yes	Yes	6-13
1	Local/Remote selection (ON: Operator, OFF: Parameter setting)	Yes	Yes	Yes	6-62
2	Option/Inverter selection (ON: Option Card)	Yes	Yes	Yes	6-70
3	Multi-step speed reference 1 When H3-09 is set to 0, this function works as the master/auxiliary speed switch.	Yes	Yes	Yes	6-10
4	Multi-step speed reference 2	Yes	Yes	Yes	6-10

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Set-ting Value	Function	Control Methods			Page
		V/f	V/f with PG	Open Loop Vec-tor	
5	Multi-step speed reference 3	Yes	Yes	Yes	6-10
6	Jog frequency command (higher priority than multi-step speed reference)	Yes	Yes	Yes	6-10
7	Accel/decel time 1	Yes	Yes	Yes	6-20
8	External baseblock NO (NO contact: Baseblock at ON)	Yes	Yes	Yes	6-63
9	External baseblock NC (NC contact: Baseblock at OFF)	Yes	Yes	Yes	6-63
A	Acceleration/deceleration ramp hold (ON: Acceleration/deceleration stopped, fre-quency on hold)	Yes	Yes	Yes	6-64
B	OH2 alarm signal input (ON: OH2 will be displayed)	Yes	Yes	Yes	-
C	Multi-function analog input selection (ON: Enable)	Yes	Yes	Yes	-
D	No V/f control with PG (ON: Speed feedback control disabled,) (normal V/f con-trol)	No	Yes	No	-
E	Speed control integral reset (ON: Integral control disabled)	No	Yes	No	-
F	Not used (Set when a terminal is not used)	-	-	-	-
10	Up command (Always set with the down command)	Yes	Yes	Yes	6-65
11	Down command (Always set with the up command)	Yes	Yes	Yes	6-65
12	FJOG command (ON: Forward run at jog frequency d1-17)	Yes	Yes	Yes	6-70
13	RJOG command (ON: Reverse run at jog frequency d1-17)	Yes	Yes	Yes	6-70
14	Fault reset (Reset when turned ON)	Yes	Yes	Yes	7-2
15	Deceleration stop. (Normally open condition: Deceleration to stop in deceleration time set in C1-09 when ON.)	Yes	Yes	Yes	6-18
16	Motor switch command (Motor 2 selection)	Yes	Yes	Yes	-
17	Deceleration stop (Normally closed condition: Deceleration to stop in deceleration time set in C1-09 when OFF)	Yes	Yes	Yes	6-18
18	Timer function input (Functions are set in b4-01 and b4-02 and the timer function outputs are set in H1-□□ and H2-□□.)	Yes	Yes	Yes	6-116
19	PID control disable (ON: PID control disabled)	Yes	Yes	Yes	6-120
1A	Accel/Decel time 2	Yes	Yes	Yes	6-20
1B	Parameters write enable (ON: All parameters can be written-in. OFF: All parame-ters other than frequency monitor are write protected.)	Yes	Yes	Yes	6-141
1C	Trim control increase (ON: d4-02 frequency is added to analog frequency refer-ence.)	Yes	Yes	Yes	6-68
1D	Trim control decrease (ON: d4-02 frequency is subtracted from analog frequency reference.)	Yes	Yes	Yes	6-68
1E	Analog frequency reference sample/hold	Yes	Yes	Yes	6-69
20 to 2F	External fault (Desired settings possible) Input mode: NO contact/NC contact, Detection mode: Normal/during operation	Yes	Yes	Yes	6-71
30	PID control integral reset (reset when reset command is input or when stopped dur-ing PID control)	Yes	Yes	Yes	6-120
31	PID control integral hold (ON: Hold)	Yes	Yes	Yes	6-120
32	Multi-step speed command 4	Yes	Yes	Yes	-

Set-ting Value	Function	Control Methods			Page
		V/f	V/f with PG	Open Loop Vec-tor	
34	PID soft starter	Yes	Yes	Yes	6-120
35	PID input characteristics switch	Yes	Yes	Yes	6-120
60	DC injection braking command (ON: Performs DC injection braking)	Yes	Yes	Yes	6-17
61	External search command 1 (ON: Speed search from maximum output frequency)	Yes	No	Yes	6-54
62	External search command 2 (ON: Speed search from set frequency)	Yes	No	Yes	6-54
63	Field weakening command (ON: Field weakening control set for d6-01 and d6-02)	Yes	Yes	No	-
64	External speed search command 3	Yes	Yes	Yes	-
65	KEB (deceleration at momentary power loss) command (NC contact)	Yes	Yes	Yes	-
66	KEB (deceleration at momentary power loss) command (NO contact)	Yes	Yes	Yes	-
67	Communications test mode	Yes	Yes	Yes	6-90
68	High-slip braking (HSB)	Yes	Yes	No	-
69*	JOG 2 (for (-E) models)	Yes	Yes	Yes	-
6A*	Drive Enable (for (-E) models)	Yes	Yes	Yes	-

* The setting values 69 and 6A can be set for (-E) models.

■ Multi-function Digital Outputs: H2

Parameters for multi-function digital outputs are shown in the following tables.

Parameter Num-ber		Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
		LCD Display					V/f	V/f with PG	Open Loop		
H2-01		Terminal M1-M2 Select	Multi-function output	0 to 37	0	No	A	A	A	40BH	-
		Term M1-M2 Sel									
H2-02	3G3RV (Asia)	Terminal P1 function select (open collector)	Multi-function output 1	0 to 37	1	No	A	A	A	40CH	-
		Term P1 Sel									
	3G3RV (-E) (Europe)	Terminal M3-M4 function select (con-tact)									
		Term M3-M4 Sel									

Parameter Number	Name		Description	Setting Range	Factory Setting	Change during Operation	Control Methods			Register	Page
		LCD Display					V/f	V/f with PG	Open Loop		
H2-03	3G3RV (Asia)	Terminal P2 function select (contact)	Multi-function output 2	0 to 37	2	No	A	A	A	40DH	-
		Term P2 Sel									
	3G3RV (-E) (Europe)	Terminal M5-M6 function select (contact)									
		Term M5-M6 Sel									

Multi-function Digital Output Functions

Setting Value	Function	Control Methods			Page
		V/f	V/f with PG	Open loop Vector	
0	During run (ON: run command is ON or voltage is being output)	Yes	Yes	Yes	-
1	Zero-speed	Yes	Yes	Yes	-
2	Frequency agree 1 (L4-02 used.)	Yes	Yes	Yes	-
3	Desired frequency agree 1 (ON: Output frequency = ±L4-01, L4-02 used and during frequency agree)	Yes	Yes	Yes	-
4	Frequency (FOUT) detection 1 (ON: +L4-01 ≥ output frequency ≥ -L4-01, L4-02 used)	Yes	Yes	Yes	-
5	Frequency (FOUT) detection 2 (ON: Output frequency ≥ +L4-01 or output frequency ≤ -L4-01, L4-02 used)	Yes	Yes	Yes	-
6	Inverter operation ready READY: After initialization, no faults	Yes	Yes	Yes	-
7	During DC bus undervoltage (UV) detection	Yes	Yes	Yes	-
8	During baseblock (ON: during baseblock)	Yes	Yes	Yes	-
9	Frequency reference selection (ON: Frequency reference from Operator)	Yes	Yes	Yes	-
A	Run command selection status (ON: Run command from Operator)	Yes	Yes	Yes	-
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque/undertorque detection at ON)	Yes	Yes	Yes	6-44
C	Loss of frequency reference (Effective when 1 is set for L4-05)	Yes	Yes	Yes	6-58
D	Braking resistor fault (ON: Resistor overheat or braking transistor fault)	Yes	Yes	Yes	6-60
E	Fault (ON: Digital Operator communications error or fault other than CPF00 and CPF01 has occurred.) (See *Table 7.1* for faults.)	Yes	Yes	Yes	-
F	Not used. (Set when the terminals are not used.)	-	-	-	-
10	Alarm (ON: Alarm displayed) (See *Table 7.2* for alarms.)	Yes	Yes	Yes	-
11	Fault reset command active	Yes	Yes	Yes	-
12	Timer function output	Yes	Yes	Yes	6-116
13	Frequency agree 2 (L4-04 used)	Yes	Yes	Yes	-

Set-ting Value	Function	Control Methods			Page
		V/f	V/f with PG	Open loop Vec-tor	
14	Desired frequency agree 2 (ON: Output frequency = L4-03, L4-04 used, and dur-ing frequency agree)	Yes	Yes	Yes	-
15	Frequency detection 3 (ON: Output frequency ≤L4-03, L4-04 used)	Yes	Yes	Yes	-
16	Frequency detection 4 (ON: Output frequency ≥L4-03, L4-04 used)	Yes	Yes	Yes	-
17	Overtorque/undertorque detection 1 NC (NC Contact: Torque detection at OFF)	Yes	Yes	Yes	6-44
18	Overtorque/undertorque detection 2 NO (NO Contact: Torque detection at ON)	Yes	Yes	Yes	6-44
19	Overtorque/undertorque detection 2 NC (NC Contact: Torque detection at OFF)	Yes	Yes	Yes	6-44
1A	During reverse run (ON: During reverse run)	Yes	Yes	Yes	-
1B	During baseblock 2 (OFF: During baseblock)	Yes	Yes	Yes	-
1C	Motor selection (Motor 2 selected)	Yes	Yes	Yes	-
1D	Not used (Set when the terminals are not used)	Yes	Yes	Yes	-
1E	Restart enabled (ON: Restart enabled)	Yes	Yes	Yes	6-58
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detec-tion level)	Yes	Yes	Yes	6-47
20	Inverter overheat (OH) pre-alarm (ON: Temperature exceeds L8-02 setting)	Yes	Yes	Yes	-
30	During torque limit (current limit) (ON: During torque limit)	No	No	Yes	-
37	During run 2 (ON: Frequency output, OFF: Base block, DC injection braking, ini-tial excitation, operation stop)	Yes	Yes	Yes	-

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■Analog Inputs: H3

Parameters for analog inputs are shown in the following table.

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
H3-01	Signal select termi-nal A1 (voltage) / Term A1 Lvl Sel	0: Voltage limit enabled (Below 0 V is 0 V) 1: Voltage limit disabled The setting value 1 can be set for (-E) models.	0 or 1	0	No	A*	A*	A*	410H	-
H3-02	Gain (termi-nal A1) / Terminal A1 Gain	Sets the frequency when 10 V is input, as a percentage of the maximum output fre-quency.	0.0 to 1000.0	100.0%	Yes	A	A	A	411H	6-27
H3-03	Bias (termi-nal A1) / Terminal A1 Bias	Sets the frequency when 0 V is input, as a percentage of the maximum frequency.	-100.0 to +100.0	0.0%	Yes	A	A	A	412H	6-27

Param-eter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	V/f with PG	Open Loop	Register	Page
H3-08	Multi-func-tion analog input termi-nal A2 sig-nal level selection / Term A2 Signal	0: Limit negative frequency settings for gain and bias settings to 0. 1: Do not limit negative frequency settings for gain and bias settings to 0 (i.e., allow reverse operation). 2: 4 to 20 mA (9-bit input). A switch for current or volt-age input is located on the terminal circuit board.	0 to 2	2	No	A	A	A	417H	6-27
H3-09	Multi-func-tion analog input termi-nal A2 func-tion selection / Terminal A2 Sel	Select multi-function analog input function for terminal A2. Refer to the next table.	0 to 1F	0	No	A	A	A	418H	6-27
H3-10	Gain (termi-nal A2) / Terminal A2 Gain	Sets the input gain (level) when terminal 14 is 10 V (20 mA). Set according to the 100% value for the function set for H3-09.	0.0 to 1000.0	100.0%	Yes	A	A	A	419H	6-27
H3-11	Bias (termi-nal A2) / Terminal A2 Bias	Sets the input gain (level) when terminal 14 is 0 V (4 mA). Set according to the 100% value for the function set for H3-09.	-100.0 to +100.0	0.0%	Yes	A	A	A	41AH	6-27
H3-12	Analog input filter time con-stant / Filter Avg Time	Sets primary delay filter time constant in seconds for the two analog input terminal (A1 and A2). Effective for noise control etc.	0.00 to 2.00	0.00 s	No	A	A	A	41BH	6-27
H3-13	Terminal A1/A2 switching / TA1/A2 Select	0: Use terminal A1 analog input as main speed frequency reference. 1: Use terminal A2 analog input as main speed frequency reference. Effective when H3-09 is set to 2.	0 or 1	0	No	A	A	A	41CH	-

* For (-E) models.

H3-09 Settings

Set-ting Value	Function	Contents (100%)	V/f	V/f with PG	Open Loop Vec-tor	Page
			Control Methods			
0	Add to terminal A1	Maximum output frequency	Yes	Yes	Yes	6-28
1	Frequency gain	Frequency reference (voltage) command value	Yes	Yes	Yes	6-28
2	Auxiliary frequency reference (2nd step analog)	Maximum output frequency	Yes	Yes	Yes	6-28
4	Voltage bias	Motor rated voltage (E1-05)	Yes	Yes	No	-
5	Accel/decel change (reduction coefficient)	Set acceleration and deceleration times (C1-01 to C1-08)	Yes	Yes	Yes	6-21
6	DC injection braking current	Inverter rated output current	Yes	Yes	Yes	6-18
7	Overtorque/undertorque detection level	Motor rated torque for vector control Inverter rated output current for V/f control	Yes	Yes	Yes	6-46
8	Stall prevention level during run	Inverter rated output current	Yes	Yes	No	6-43
9	Frequency reference lower limit level	Maximum output frequency	Yes	Yes	Yes	6-33
A	Jump frequency	Maximum output frequency	Yes	Yes	Yes	6-30
B	PID feedback	Maximum output frequency	Yes	Yes	Yes	6-120
C	PID target value	Maximum output frequency	Yes	Yes	Yes	6-120
E	Motor temperature input	10 V = 100%	Yes	Yes	Yes	6-51
10	Positive torque limit	Motor's rated torque	No	No	Yes	6-40
11	Negative torque limit	Motor's rated torque	No	No	Yes	6-40
12	Regenerative torque limit	Motor's rated torque	No	No	Yes	6-40
15	Positive/negative torque limit	Motor's rated torque	No	No	Yes	6-40
1F	Analog input not used.	-	Yes	Yes	Yes	
13, 14, 16 to 1F	Not used	-	-	-	-	-

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■Multi-function Analog Outputs: H4

Parameters for multi-function analog outputs are shown in the following table.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
H4-01	Monitor selection (terminal FM) / Terminal FM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal FM. 4, 10 to 14, 28, 34, 39, 40 cannot be set. 17, 23, 25, 29, 30, 31, 35 are not used.	1 to 40	2	No	A	A	A	41DH	6-72
H4-02	Gain (terminal FM) / Terminal FM Gain	Sets the multi-function analog output 1 voltage level gain. Sets whether the monitor item output will be output in multiples of 10 V. The maximum output from the terminal is 10 V.	0.00 to 2.50 (0.0 to 1000.0) *	1.00 (100.0%) *	Yes	Q	Q	Q	41EH	4-8 6-72
H4-03	Bias (terminal FM) / Terminal FM Bias	Sets the multi-function analog output 1 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V.	-10.0 to +10.0 (-110.0 to +110.0) *	0.0%	Yes	A	A	A	41FH	4-8
H4-04	Monitor selection (terminal AM) / Terminal AM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal AM. 4, 10 to 14, 28, 34, 39, 40 cannot be set. 17, 23, 25, 29, 30, 31, 35 are not used.	1 to 40	3	No	A	A	A	420H	4-8 6-72
H4-05	Gain (terminal AM) / Terminal AM Gain	Set the voltage level gain for multi-function analog output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. The maximum output from the terminal is 10 V.	0.00 to 2.50 (0.0 to 1000.0) *	0.50 (50.0%) *	Yes	Q	Q	Q	421H	4-8 6-72
H4-06	Bias (terminal AM) / Terminal AM Bias	Sets the multi-function analog output 2 voltage level bias. Sets output characteristic up/down parallel movement as a percentage of 10 V. The maximum output from the terminal is 10 V.	-10.0 to +10.0 (-110.0 to +110.0) *	0.0%	Yes	A	A	A	422H	6-72
H4-07	Analog output 1 signal level selection / AO Level Select1	Sets the signal output level for multi-function output 1 (terminal FM) 0: 0 to +10 V output 1: 0 to ±10 V output (2: 4 to 20 mA)*	0 or 1 (0 to 2) *	0	No	A	A	A	423H	6-72

| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
H4-08	Analog out-put 2 signal level selec-tion	Sets the signal output level for multi-function output 2 (terminal AM) 0: 0 to +10 V output 1: 0 to ±10 V output (2: 4 to 20 mA)*	0 or 1 (0 to 2) *	0	No	A	A	A	424H	6-72
	AO Level Select2									

* For (-E) models. The shunt connector CN15 must be set. For details, refer to page 2-43.

◼RS-422A/485 Communications: H5

Parameters for RS-422A/485 communications are shown in the following table.

| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
H5-01	Slave address	Set the Inverter's slave address.	0 to 20 *	1F	No	A	A	A	425H	6-76
	Serial Comm Adr									
H5-02	Communi-cation speed selection	Set the baud rate for 6CN RS-422A/485 communica-tions. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps	0 to 4	3	No	A	A	A	426H	6-76
	Serial Baud Rate									
H5-03	Communi-cation parity selection	Set the parity for 6CN RS-422A/485 communications. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A	A	A	427H	6-76
	Serial Com Sel									
H5-04	Stopping method after com-munication error	Set the stopping method for RS-422A/485 communica-tions error. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to stop 2: Emergency stop using deceleration time in C1-09 3: Continue operation	0 to 3	3	No	A	A	A	428H	6-76
	Serial Fault Sel									
H5-05	Communi-cation error detection selection	Set whether or not a commu-nications timeout is to be detected as a communica-tions error (CE). 0: Do not detect. 1: Detect	0 or 1	1	No	A	A	A	429H	6-76
	Serial Flt Dtct									

5

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
H5-06	Send wait time / Transmit WaitTIM	Set the time from the Inverter receiving data to when the Inverter starts to send.	5 to 65	5 ms	No	A	A	A	42AH	6-76
H5-07	RTS control ON/OFF / RTS Control Sel	Select to enable or disable RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A	A	A	42BH	6-76

* Set H5-01 to 0 to disable Inverter responses to RS-422A/485 communications.

■Pulse Train I/O: H6

Parameters for pulse I/O are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
H6-01	Pulse train input function selection / Pulse Input Sel	0: Frequency reference 1: PID feedback value 2: PID target value	0 to 2	0	No	A	A	A	42CH	6-6 6-30 6-119
H6-02	Pulse train input scaling / Pulse In Scaling	Set the number of pulses in hertz, taking the reference to be 100%.	1000 to 32000	1440 Hz	Yes	A	A	A	42DH	6-6 6-30
H6-03	Pulse train input gain / Pulse Input Gain	Set the input gain level as a percent when the pulse train set in H6-02 is input.	0.0 to 1000.0	100.0%	Yes	A	A	A	42EH	6-30
H6-04	Pulse train input bias / Pulse Input Bias	Set the input bias when the pulse train is 0.	-100.0 to 100.0	0.0%	Yes	A	A	A	42FH	6-30
H6-05	Pulse train input filter time / Pulse In Filter	Set the pulse train input primary delay filter time constant in seconds.	0.00 to 2.00	0.10 s	Yes	A	A	A	430H	6-30
H6-06	Pulse train monitor selection / Pulse Moni Sel	Select the pulse train monitor output items (value of the □□ part of U1-□□). There are two types of monitor items: Speed-related items and PID-related items.	1, 2, 5, 20, 24, 36	2	Yes	A	A	A	431H	6-74

| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
H6-07	Pulse train monitor scaling	Set the number of pulses output when speed is 100% in hertz. Set H6-06 to 2, and H6-07 to 0, to make the pulse train monitor output synchro-nously to the output fre-quency.	0 to 32000	1440 Hz	Yes	A	A	A	432H	6-74
	Pulse Moni Scale									

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◆ Protection Function Parameters: L

The following settings are made with the protection function parameters (L parameters): Motor selection function, power loss ridethrough function, stall prevention function, frequency detection, torque limits, and hardware protection.

■ Motor Overload: L1

Parameters for motor overloads are shown in the following table.

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
L1-01	Motor protection selection / MOL Fault Select	Sets whether the motor overload function is enabled or disabled at electric thermal overload relay. 0: Disabled 1: General-purpose motor protection 2: Inverter motor protection 3: Vector motor protection In some applications when the Inverter power supply is turned off, the thermal value is reset, so even if this parameter is set to 1, protection may not be effective. When several motors are connected to one Inverter, set to 0 and ensure that each motor is installed with a protection device.	0 to 3	1	No	Q	Q	Q	480H	4-8 6-47
L1-02	Motor protection time constant / MOL Time Const	Sets the electric thermal detection time in seconds. Usually setting is not necessary. The factory setting is 150% overload for one minute. When the motor's overload resistance is known, also set the overload resistance protection time for when the motor is hot started.	0.1 to 5.0 (0.1 to 20.0)	1.0 min (8.0 min)	No	A	A	A	481H	6-47

Param- eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
L1-03	Alarm oper- ation selec- tion during motor over- heating Mtr OH Alarm Sel	Set H3-09 to E and select the operation when the input motor temperature (ther- mistor) input exceeds the alarm detection level (1.17 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1- 09. 3: Continue operation (H3 on the Operator flashes).	0 to 3	3	No	A	A	A	482H	6-50
L1-04	Motor over- heating operation selection Mtr OH Fault Sel	Set H3-09 to E and select the operation when the motor temperature (thermistor) input exceeds the operation detection level (2.34 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1- 09.	0 to 2	1	No	A	A	A	483H	6-50
L1-05	Motor tem- perature input filter time con- stant Mtr Temp Filter	Set H3-09 to E and set the primary delay time constant for motor temperature (ther- mistor) inputs in seconds.	0.00 to 10.00	0.20 s	No	A	A	A	484H	6-50

■Power Loss Ridethrough: L2

Parameters for power loss ridethroughs are shown in the following table.

Param- eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
L2-01	Momentary power loss detection PwrL Selec- tion	0: Disabled (main circuit undervoltage (UV) detection) 1: Enabled (Restarted when the power returns within the time for L2-02. When L2-02 is exceeded, main circuit undervoltage detection.) 2: Enabled while CPU is operating. (Restarts when power returns during control operations. Does not detect main circuit undervoltage.)	0 to 2	0	No	A	A	A	485H	6-52

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Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
L2-02	Momentary power loss ridethru time	Ridethrough time, when Momentary Power Loss Selection (L2-01) is set to 1, in units of seconds.	0 to 2.0	0.1 s *1	No	A	A	A	486H	6-52
	PwrL Ride-thru t									
L2-03	Min. base-block time	Sets the Inverter's minimum baseblock time in units of one second, when the Inverter is restarted after power loss ridethrough. Sets the time to approxi-mately 0.7 times the motor secondary circuit time con-stant. When an overcurrent or overvoltage occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.1 s *1	No	A	A	A	487H	6-52 6-53
	PwrL Base-block t									
L2-04	Voltage recovery time	Sets the time required to return the Inverter output voltage to normal voltage at the completion of a speed search, in units of one sec-ond. Sets the time required to recover from 0 V to the max-imum voltage.	0.0 to 5.0	0.3 s *1	No	A	A	A	488H	6-52 6-53
	PwrL V/F Ramp t									
L2-05	Undervolt-age detec-tion level	Sets the main circuit under-voltage (UV) detection level (main circuit DC voltage) in V units. Usually setting is not neces-sary. Insert an AC reactor in the Inverter input side to lower the main circuit undervolt-age detection level.	150 to 210 *2	190 V *2	No	A	A	A	489H	6-52
	PUV Det Level									
L2-06	KEB decel-eration time	Sets in seconds the time required to decelerate from the speed where the deceler-ation at momentary power loss command (KEB) is input to zero speed.	0.0 to 200.0	0.0 s	No	A	A	A	48AH	-
	KEB Fre-quency									
L2-07	Momentary recovery time	Set in seconds the time to accelerate to the set speed after recovery from a momentary power loss.	0.0 to 25.5	0 s *3	No	A	A	A	48BH	-
	UV RETURN TIME									

| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
L2-08	Frequency reduction gain at KEB start	Sets as a percent the about to reduce the output frequency at the beginning of decelera-tion at momentary power loss (KEB). Reduction = slip frequency before KEB operation × L2-08 × 2	0 to 300	100	No	A	A	A	48CH	-
	KEB Decel Time									

* 1. The factory setting depends upon the Inverter capacity. The value for a 200-V class Inverter of 0.4 kW is given.
* 2. These are values for a 200-V class Inverter. Value for a 400-V class Inverter is double.
* 3. If the setting is 0, the axis will accelerate to the specified speed over the specified acceleration time (C1-01 to C1-08).

■ **Stall Prevention: L3**

Parameters for the stall prevention function are shown in the following table.

| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
L3-01	Stall pre-vention selection during accel	0: Disabled (Acceleration as set. With a heavy load, the motor may stall.) 1: Enabled (Acceleration stopped when L3-02 level is exceeded. Acceleration starts again when the current is returned.) 2: Intelligent acceleration mode (Using the L3-02 level as a basis, acceleration is automatically adjusted. Set acceleration time is disregarded.)	0 to 2	1	No	A	A	A	48FH	6-23
	StallP Accel Sel									
L3-02	Stall pre-vention level during accel	Effective when L3-01 is set to 1 or 2. Set as a percentage of Inverter rated current. Usually setting is not neces-sary. The factory setting reduces the set values when the motor stalls.	0 to 200	120% *	No	A	A	A	490H	6-23
	StallP Accel Lvl									
L3-03	Stall pre-vention limit during accel	Sets the lower limit for stall prevention during accelera-tion, as a percentage of the Inverter rated current, when operation is in the frequency range above E1-06. Usually setting is not neces-sary.	0 to 100	50%	No	A	A	A	491H	6-23
	StallP CHP Lvl									

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Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop	Register	Page
L3-04	Stall pre-vention selection during decel / StallP Decel Sel	0: Disabled (Deceleration as set. If deceleration time is too short, a main circuit overvoltage may result.) 1: Enabled (Deceleration is stopped when the main circuit voltage exceeds the overvoltage level. Deceleration restarts when voltage is returned.) 2: Intelligent deceleration mode (Deceleration rate is automatically adjusted so that in Inverter can decelerate in the shortest possible time. Set deceleration time is disregarded.) 3: Enabled (with Braking Resistor Unit) When a braking option (Braking Resistor, Braking Resistor Unit, Braking Unit) is used, always set to 0 or 3.	0 to 3	1	No	Q	Q	Q	492H	4-8 6-25
L3-05	Stall pre-vention selection during run-ning / StallP Run Sel	0: Disabled (Runs as set. With a heavy load, the motor may stall.) 1: Deceleration time 1 (the deceleration time for the stall prevention function is C1-02.) 2: Deceleration time 2 (the deceleration time for the stall prevention function is C1-04.)	0 to 2	1	No	A	A	No	493H	6-42
L3-06	Stall pre-vention level during running / StallP Run Level	Effective when L3-05 is 1 or 2. Set as a percentage of the Inverter rated current. Usually setting is not neces-sary. The factory setting reduces the set values when the motor stalls.	30 to 200	120% *	No	A	A	No	494H	6-42

* The initial value when C6-01 is set to 1 is given. If C6-01 is set to 0, the initial value will be 150%.

■**Reference Detection: L4**

Parameters for the reference detection function are shown in the following table.

| Param- eter Number | Name | | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | | Register | Page |
	LCD Display						V/f	V/f with PG	Open Loop		
L4-01	Speed agreement detection level		Effective when "Desired fre- quency (ref/setting) agree 1," "Frequency detection 1," or "Frequency detection 2" is set for a multi-function output. Frequencies to be detected are set in Hz units.	0.0 to 400.0	0.0 Hz	No	A	A	A	499H	-
	Spd Agree Level										
L4-02	Speed agreement detection width		Effective when "Frequency (speed) agree 1," "Desired frequency (speed) agree 1," or "Frequency (FOUT) detection 1," is set for a multi-function output. Sets the frequency detection width in Hz units.	0.0 to 20.0	2.0 Hz	No	A	A	A	49AH	-
	Spd Agree Width										
L4-03	Speed agreement detection level (+/-)		Effective when "Desired fre- quency (speed) agree 2," "Desired frequency (speed) agree 1" "Frequency (FOUT) detection 3," or "Frequency (FOUT) detec- tion 4" is set for a multi- function output. Frequency detection width is set in Hz units.	-400.0 to +400.0	0.0 Hz	No	A	A	A	49BH	-
	Spd Agree Lvl+-										
L4-04	Speed agreement detection width (+/-)		Effective when "Frequency (speed) agree 2," "Desired frequency (speed) agree 1," or "Frequency detection 4" is set for a multi-function output. Frequency detection width is set in Hz units.	0.0 to 20.0	2.0 Hz	No	A	A	A	49CH	-
	Spd Agree Width+-										
L4-05	Operation when fre- quency ref- erence is lost		0: Stop (Operation follows the frequency reference.) 1: Continue speed opera- tion according to setting of L4-06. (At 80% of speed before the fre- quency reference was lost) Frequency reference is lost: Frequency reference dropped over 90% in 400 ms.	0 or 1	0	No	A	A	A	49DH	6-58
	Ref Loss Sel										
L4-06	Frequency reference for loss of frequency reference		Enables operation selection when frequency reference is lost and operation at the fol- lowing speed: (Speed prior to loss) x L4-06	0.0 to 100.0%	80.0	No	A[*]	A[*]	A[*]	4C2H	-
	Fref at Floss										

* For (-E) models only. Otherwise always 80.0%.

■Fault Restart: L5

Parameters for restarting faults are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
L5-01	Number of auto restart attempts / Num of Restarts	Sets the number of auto restart attempts. Automatically restarts after a fault and conducts a speed search from the run frequency.	0 to 10	0	No	A	A	A	49EH	6-59
L5-02	Auto restart operation selection / Restart Sel	Sets whether a fault contact output is activated during fault restart. 0: Not output (Fault contact is not activated.) 1: Output (Fault contact is activated.)	0 or 1	0	No	A	A	A	49FH	6-59

■**Torque Detection: L6**

Parameters for the torque detection function are shown in the following table.

Param-eter Number	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display						V/f	V/f with PG	Open Loop		
L6-01	Torque detection selection 1	Torq Det 1 Sel	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agree-ment; operation continues after overtorque (warning). 2: Overtorque detected continuously during operation; operation continues after overtorque (warning). 3: Overtorque detection only with speed agree-ment; output stopped upon detection (protected operation). 4: Overtorque detected continuously during operation; output stopped upon detection (protected operation). 5: Undertorque detection only with speed agree-ment; operation continues after overtorque (warning). 6: Undertorque detected continuously during operation; operation continues after overtorque (warning). 7: Undertorque detection only with speed agree-ment; output stopped upon detection (protected operation). 8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).	0 to 8	0	No	A	A	A	4A1H	6-44
L6-02	Torque detection level 1	Torq Det 1 Lvl	Open loop vector control: Motor rated torque is set as 100%. V/f control: Inverter rated current is set as 100%.	0 to 300	150%	No	A	A	A	4A2H	6-44
L6-03	Torque detection time 1	Torq Det 1 Time	Sets the overtorque/under-torque detection time in 1-second units.	0.0 to 10.0	0.1 s	No	A	A	A	4A3H	6-44

| Param- eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
L6-04	Torque detection selection 2		0 to 8	0	No	A	A	A	4A4H	6-44
	Torq Det 2 Sel									
L6-05	Torque detection level 2	Output of torque detection 1 is enabled by setting 17 for H2-□□ and output of torque detection 1 is enabled by set- ting 18 or 18 for H2-□□.	0 to 300	150%	No	A	A	A	4A5H	6-44
	Torq Det 2 Lvl									
L6-06	Torque detection time 2		0.0 to 10.0	0.1 s	No	A	A	A	4A6H	6-44
	Torq Det 2 Time									

■ **Torque Limits: L7**

Parameters for torque limits are shown in the following table.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop	Register	Page
L7-01	Forward drive torque limit / Torq Limit Fwd	Sets the torque limit value as a percentage of the motor rated torque. Four individual regions can be set.	0 to 300	200%	No	No	No	A	4A7H	6-40
L7-02	Reverse drive torque limit / Torq Limit Rev		0 to 300	200%	No	No	No	A	4A8H	6-40
L7-03	Forward regenerative torque limit / Torq Lmt Fwd Rgn		0 to 300	200%	No	No	No	A	4A9H	6-40
L7-04	Reverse regenerative torque limit / Torq Lmt Rev Rgn		0 to 300	200%	No	No	No	A	4AAH	6-40

■ **Hardware Protection: L8**

Parameters for hardware protection functions are shown in the following table.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop	Register	Page
L8-01	Protect selection for internal DB resistor / DB Resistor Prot	0: Disabled (no overheating protection) 1: Enabled (overheating protection)	0 or 1	0	No	A	A	A	4ADH	6-60
L8-02	Overheat pre-alarm level / OH Pre-Alarm Lvl	Sets the detection temperature for the Inverter overheat detection pre-alarm in °C. The pre-alarm detects when the cooling fin temperature reaches the set value.	50 to 130	95 °C*	No	A	A	A	4AEH	6-61

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| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
L8-03	Operation selection after over-heat pre-alarm / OH Pre-Alarm Sel	Sets the operation for when the Inverter overheat pre-alarm goes ON. 0: Decelerate to stop in deceleration time C1-02. 1: Coast to stop 2: Fast stop in fast-stop time C1-09. 3: Continue operation (Monitor display only.) A fault will be given in set-ting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A	A	A	4AFH	6-61
L8-05	Input open-phase pro-tection selection / Ph Loss In Sel	0: Disabled 1: Enabled (Detects if input current open-phase, power supply voltage imbalance or main circuit electrostatic capacitor deterioration occurs.)	0 or 1	0 (1)*	No	A	A	A	4B1H	-
L8-07	Output open-phase protection selection / Ph Loss Out Sel	0: Disabled 1: Enabled (Output open-phase detected at less than 5% of Inverter rated current.) When applied motor capac-ity is small for Inverter capacity, output open-phase may be detected inadvert-ently or open-phase may not be detected. In this case, set to 0.	0 or 1	0	No	A	A	A	4B3H	-
L8-09	Ground pro-tection selection / Ground Fault Sel	0:Disabled 1:Enabled	0 or 1	1	No	A	A	A	4B5H	-
L8-10	Cooling fan control selection / Fan On/Off Sel	Set the ON/OFF control for the cooling fan. 0: ON only when Inverter is ON 1: ON whenever power is ON	0 or 1	0	No	A	A	A	4B6H	-
L8-11	Cooling fan control delay time / Fan Delay Time	Set the time in seconds to delay turning OFF the cool-ing fan after the cooling fan OFF command is received.	0 to 300	60 s	No	A	A	A	4B7H	-
L8-12	Ambient temperature / Ambient Temp	Set the ambient temperature. No need to change the set-tings for normal usage.	45 to 60	45 °C	No	A	A	A	4B8H	-

| Param-eter Number | Name | | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display						V/f	V/f with PG	Open Loop		
L8-15	OL2 charac-teristics selection at low speeds		0: OL2 characteristics at low speeds disabled. 1: OL2 characteristics at low speeds enabled.	0 or 1	1	No	A	A	A	4BBH	-
	OL2 Sel @ L-Spd										
L8-18	Soft CLA selection		0: Disable (gain = 0) 1: Enable	0 or 1	1	No	A	A	A	4BFH	-
	Soft CLA Sel										

* For (-E) models.

◆ N: Special Adjustments

The following settings are made with the special adjustments parameters (N parameters): Hunting prevention and speed feedback detection control.

■Hunting Prevention Function: N1

Parameters for hunting prevention are shown in the following table.

| Param-eter Number | Name | | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display						V/f	V/f with PG	Open Loop		
N1-01	Hunting-prevention function selection		0: Hunting-prevention function disabled 1: Hunting-prevention function enabled The hunting-prevention function suppresses hunt-ing when the motor is operating with a light load. This function is enabled in V/f control method only. If high response is to be given priority over vibration suppression, disable the hunting-prevention function.	0 or 1	1	No	A	A	No	580H	6-38
	Hunt Prev Select										

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Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop	Register	Page
N1-02	Hunting-prevention gain / Hunt Prev Gain	Set the hunting-prevention gain multiplication factor. Normally, there is no need to make this setting. Make the adjustments as follows: • If vibration occurs with light load, increase the setting. • If the motor stalls, reduce the setting. If the setting is too large, the voltage will be too suppressed and the motor may stall.	0.00 to 2.50	1.00	No	A	A	No	581H	4-18 6-38

■**Speed Feedback Protection Control Functions: N2**

Parameters for speed feedback protection control functions are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop	Register	Page
N2-01	Speed feed-back detection control (AFR) gain / AFR Gain	Set the internal speed feedback detection control gain using the multiplication function. Normally, there is no need to make this setting. Adjust this parameter as follows: • If hunting occurs, increase the set value. • If response is low, decrease the set value. Adjust the setting by 0.05 at a time, while checking the response.	0.00 to 10.00	1.00	No	No	No	A	584H	4-18 6-39
N2-02	Speed feed-back detection control (AFR) time constant / AFR Time	Set the time constant to decide the rate of change in the speed feedback detection control.	0 to 2000	50 ms	No	No	No	A	585H	6-39
N2-03	Speed feed-back detection control (AFR) time constant 2 / AFR Time 2	Set the time constant to decide the amount of change in the speed.	0 to 2000	750 ms	No	No	No	A	586H	6-39

■**High-slip Braking: N3**

Parameters for high-slip braking are shown in the following table.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Register	Page
N3-01	High-slip braking deceleration frequency width / HSB Decel Width	Sets the frequency width for deceleration during high-slip braking as a percent, taking the Maximum Frequency (E1-04) as 100%.	1 to 20	5%	No	A	A	588H	-
N3-02	High-slip braking current limit / HSB Current Ref	Sets the current limit for deceleration during high-slip braking as a percent, taking the motor rated current as 100%. The resulting limit must be 150% of the Inverter rated current or less.	100 to 200	150%	No	A	A	589H	-
N3-03	High-slip braking stop dwell time / HSB Dwel-Tim@Stp	Set in seconds the dwell time for the output frequency for FMIN (1.5 Hz) during V/f control. Effective only during deceleration for high-slip braking.	0.1 to 10.0	1.0 s	No	A	A	58AH	-
N3-04	High-slip braking OL time / HSB OL Time	Set the OL time when the output frequency does not change for some reason during deceleration for high-slip braking.	30 to 1200	40 s	No	A	A	58BH	-

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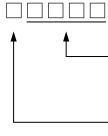
◆ **Digital Operator Parameters: o**

The following settings are made with the Digital Operator parameters (o parameters): Multi-function selections and the copy function.

■**Monitor Select: o1**

Parameters for Digital Operator Displays are shown in the following table.

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
o1-01	Monitor selection / User Monitor Sel	Set the number of monitor item. (U1-□□) It is displayed on the digital operator in 4th item in Drive mode. The factory setting (Output voltage monitor) can be changed.	4 to 40	6	Yes	A	A	A	500H	-

Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
	LCD Display					V/f	V/f with PG	Open Loop		
o1-02	Monitor selection after power up — Power-On Monitor	Sets the monitor item to be displayed when the power is turned on. 1: Frequency reference 2: Output frequency 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A	A	A	501H	6-135
o1-03	Frequency units of reference setting and monitor — Display Scaling	Sets the units that will be set and displayed for the frequency reference and frequency monitor. 0: 0.01 Hz units 1: 0.01% units (Maximum output frequency is 100%) 2 to 39: r/min units (Sets the motor poles.) 40 to 39999: User desired display Set the desired values for setting and display for the max. output frequency. ☐☐☐☐☐ Set 4-digit number excluding the decimal point. Set the number of digits below the decimal point to display. Example: When the max. output frequency value is 200.0, set 12000	0 to 39999	0	No	A	A	A	502H	6-135
o1-05	LCD bright-ness — LCD Con-trast	Lowering the brightness adjustment value for the LCD Operator lowers the LCD display contrast. Raising the value increases the contrast.	0 to 5	3	Yes	A*	A*	A*	504H	-

* For (-E) models.

■Multi-function Selections: o2

Parameters for Digital Operator key functions are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop	Register	Page
o2-01	LOCAL/ REMOTE key enable/ disable / Local/ Remote Key	Sets the Digital Operator Local/Remote Key 0: Disabled 1: Enabled (Switches between the Digital Operator and the parameter settings.)	0 or 1	1	No	A	A	A	505H	6-135
o2-02	STOP key during control circuit terminal operation / Oper STOP Key	Sets the Stop Key in the run mode. 0: Disabled (When the run command is issued from and external terminal, the Stop Key is disabled.) 1: Enabled (Effective even during run.)	0 or 1	1	No	A	A	A	506H	6-135
o2-03	Parameter initial value / User Defaults	Clears or stores user initial values. 0: Stores/not set 1: Begins storing (Records the set parameters as user initial values.) 2: All clear (Clears all recorded user initial values) When the set parameters are recorded as user initial values, 1110 will be set in A1-03.	0 to 2	0	No	A	A	A	507H	6-135
o2-04	kVA selection / Inverter Model#	Do not set unless using a control board from an Inverter with a different capacity.	0 to FF	0[*1]	No	A	A	A	508H	-
o2-05	Frequency reference setting method selection / Operator M.O.P.	When the frequency reference is set on the Digital Operator frequency reference monitor, sets whether the Enter Key is necessary. 0: Enter Key needed 1: Enter Key not needed When set to 1, the Inverter accepts the frequency reference without Enter Key operation.	0 or 1	0	No	A	A	A	509H	6-135

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Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods			Register	Page
						V/f	V/f with PG	Open Loop		
o2-06	Operation selection when digital operator is discon-nected / Oper Detection	Sets the operation when the Digital Operator is discon-nected. 0: Disabled (Operation continues even if the Digital Operator is disconnected.) 1: Enabled (OPR is detected at Digital Operator disconnection. Inverter output is cut off, and fault contact is operated.)	0 or 1	0	No	A	A	A	50AH	-
o2-07	Cumulative operation time setting / Elapsed Time Set	Sets the cumulative opera-tion time in hour units. Operation time is calculated from the set values.	0 to 65535	0 hr	No	A	A	A	50BH	6-135
o2-08	Cumulative operation time selec-tion / Elapsed Time Run	0: Cumulative time when the Inverter power is on. (All time while the Inverter power is on is accumulated.) 1: Cumulative Inverter run time. (Only Inverter output time is accumulated.)	0 or 1	0 (1)*2	No	A	A	A	50CH	-
o2-09	Factory use / Init Mode Sel	Do not change.	-	-	No	A	A	A	-	-
o2-10	Fan opera-tion time setting / Fan ON Time Set	Set the initial value of the fan operation time using time units. The operation time accumu-lates from the set value.	0 to 65535	0 hr	No	A	A	A	50EH	6-135
o2-12	Fault trace/ fault his-tory initial-ization / FLT Trace Init	0: Disable (U2, U3 are held) 1: Enable (U2, U3 are ini-tialized and o2-12 returns to 0.) For (-E) models only.	0 or 1	0	No	A*2	A*2	A*2	510H	-

* 1. The factory setting depends upon the Inverter capacity. The value for a 200-V class Inverter of 0.4 kW is given.
* 2. For (-E) models.

■ **Copy Function: o3**

Parameters for the copy function are shown in the following table.

| Param-eter Number | Name | | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
							V/f	V/f with PG	Open Loop		
o3-01	Copy func-tion selec-tion		0: Normal operation 1: READ (Inverter to Operator) 2: COPY (Operator to Inverter) 3: Verify (compare)	0 to 3	0	No	A	A	A	515H	6-137
	Copy Func Select										
o3-02	Read per-mitted selection		0: Read prohibited 1: Read permitted	0 or 1	0	No	A	A	A	516H	6-137
	Copy Allowable										

◆ **T: Motor Autotuning**

The following settings are made with the motor autotuning parameters (T parameters): Settings for autotuning.

| Param-eter Number | Name | | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display						V/f	V/f with PG	Open Loop		
T1-00	Motor 1/2 selection		Set the location where the autotuned motor constants are to be stored. 1: E1 to E2 (motor 1) 2: E3 to E4 (motor 2)	1 or 2	1	No	No	No	A	700H	4-13
	Select Motor										
T1-01	Autotuning mode selec-tion		Set the autotuning mode. 0: Rotational autotuning 1: Stationary autotuning 2: Stationary autotuning for line-to-line resistance only	0 to 2 *1	0	No	A	A	A	701H	4-11 4-13
	Tuning Mode Sel										
T1-02	Motor out-put power		Set the output power of the motor in kilowatts.	0.00 to 650.00	0.40 kW	No	A	A	A	702H	4-13
	Mtr Rated Power										
T1-03	Motor rated voltage		Set the rated voltage of the motor in volts.	0 to 255.0*2	200.0 V *2	No	No	No	A	703H	4-13
	Rated Volt-age										

| Param-eter Number | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | | Register | Page |
	LCD Display					V/f	V/f with PG	Open Loop		
T1-04	Motor rated current	Set the rated current of the motor in amps.	0.32 to 6.40 *4	1.90 A *3	No	A	A	A	704H	4-13
	Rated Cur-rent									
T1-05	Motor base frequency	Set the base frequency of the motor in hertz.	0 to 400.0*5	60.0 Hz	No	No	No	A	705H	4-13
	Rated Fre-quency									
T1-06	Number of motor poles	Set the number of motor poles.	2 to 48 poles	4 poles	No	No	No	A	706H	4-13
	Number of Poles									
T1-07	Motor base speed	Set the base speed of the motor in r/min.	0 to 24000	1750 r/min	No	No	No	A	707H	4-13
	Rated Speed									

* 1. Set T1-02 and T1-04 when 2 is set for T1-01. Only set value 2 is possible for V/f control or V/f control with PG.
* 2. These are values for a 200-V class Inverter. Values for a 400-V class Inverter are double.
* 3. The factory setting depends on the Inverter capacity. (The value for a 200-V class Inverter for 0.4 kW is given.)
* 4. The setting range is from 10% to 200% of the Inverter rated output current. (The value for a 200-V class Inverter for 0.4 kW is given.)
* 5. The upper setting limit will be 150.0 Hz when C6-01 is set to 0.

◆ U: Monitor Parameters
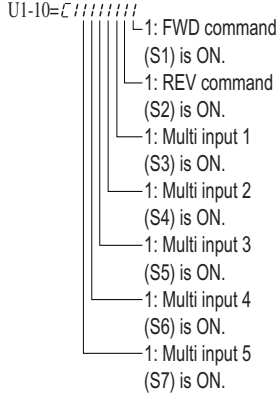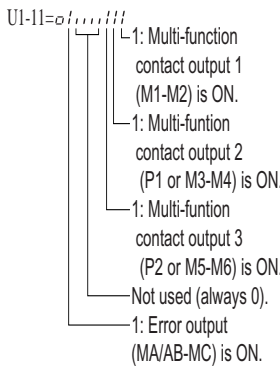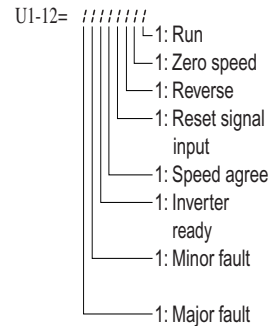
The following settings are made with the monitor parameters (U parameters): Setting parameters for monitoring in drive mode.

■ Status Monitor Parameters: U1
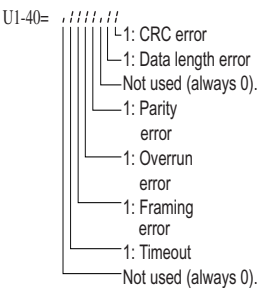
The parameters used for monitoring status are listed in the following table.

Param-eter Number	Name / LCD Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop Vector	Register
U1-01	Frequency reference / Frequency Ref	Monitors/sets the frequency reference value.*	10 V: Max. frequency (0 to ± 10 V possible)	0.01 Hz	A	A	A	40H
U1-02	Output frequency / Output Freq	Monitors the output frequency.*	10 V: Max. frequency (0 to ± 10 V possible)	0.01 Hz	A	A	A	41H
U1-03	Output current / Output Current	Monitors the output current.	10 V: Inverter rated output current (0 to +10 V, absolute value output)	0.1 A	A	A	A	42H
U1-04	Control method / Control Method	Checks the current control method.	(Cannot be output.)	-	A	A	A	43H
U1-05	Motor speed / Motor Speed	Monitors the detected motor speed.*	10 V: Max. frequency (0 to ± 10 V possible)	0.01 Hz	No	A	A	44H
U1-06	Output voltage / Output Voltage	Monitors the output voltage reference value in the Inverter.	10 V: 200 VAC (400 VAC) (0 to +10 V output)	0.1 V	A	A	A	45H
U1-07	DC bus voltage / DC Bus Voltage	Monitors the main DC voltage in the Inverter.	10 V: 400 VDC (800 VDC) (0 to +10 V output)	1 V	A	A	A	46H
U1-08	Output power / Output kWatts	Monitors the output power (internally detected value).	10 V: Inverter capacity (max. applicable motor capacity) (0 to ± 10 V possible)	0.1 kW	A	A	A	47H

* The unit is set in o1-03 (frequency units of reference setting and monitor).

Parameter Number	Name — LCD Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	V/f	V/f with PG	Open Loop Vector	Register
U1-09	Torque reference / Torque Reference	Monitor in internal torque reference value for vector control.	10 V: Motor rated torque (0 to ± 10 V possible)	0.1%	No	No	A	48H
U1-10	Input terminal status / Input Term Sts	Shows input ON/OFF status. U1-10=ⵉⵉⵉⵉⵉⵉⵉⵉ 1: FWD command (S1) is ON. 1: REV command (S2) is ON. 1: Multi input 1 (S3) is ON. 1: Multi input 2 (S4) is ON. 1: Multi input 3 (S5) is ON. 1: Multi input 4 (S6) is ON. 1: Multi input 5 (S7) is ON.	(Cannot be output.)	-	A	A	A	49H
U1-11	Output terminal status / Output Term Sts	Shows output ON/OFF status. U1-11=oⵉⵉⵉⵉⵉⵉⵉ 1: Multi-function contact output 1 (M1-M2) is ON. 1: Multi-funtion contact output 2 (P1 or M3-M4) is ON. 1: Multi-funtion contact output 3 (P2 or M5-M6) is ON. Not used (always 0). 1: Error output (MA/AB-MC) is ON.	(Cannot be output.)	-	A	A	A	4AH
U1-12	Operation status / Int Ctl Sts 1	Inverter operating status. U1-12= ⵉⵉⵉⵉⵉⵉⵉⵉ 1: Run 1: Zero speed 1: Reverse 1: Reset signal input 1: Speed agree 1: Inverter ready 1: Minor fault 1: Major fault	(Cannot be output.)	-	A	A	A	4BH
U1-13	Cumulative operation time / Elapsed Time	Monitors the total operating time of the Inverter. The initial value and the operating time/power ON time selection can be set in o2-07 and o2-08.	(Cannot be output.)	1 hr	A	A	A	4CH

Param-eter Number	Name	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods			Register
	LCD Display				V/f	V/f with PG	Open Loop Vec-tor	
U1-14	Software No. (flash memory) FLASH ID	(Manufacturer's ID number)	(Cannot be output.)	-	A	A	A	4DH
U1-15	Terminal A1 input voltage Term A1 Level	Monitors the input voltage of the voltage frequency reference. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (0 to ± 10 V possible)	0.1%	A	A	A	4EH
U1-16	Terminal A2 input voltage Term A2 Level	Monitors the input voltage of the multi-function analog input. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (0 to ±10 V possible)	0.1%	A	A	A	4FH
U1-18	Motor secondary current (Iq) Mot SEC Current	Monitors the calculated value of the motor secondary current. The motor rated secondary current corresponds to 100%.	10 V:Motor rated secondary current) (0 to ±10 V output)	0.1%	A	A	A	51H
U1-19	Motor exciting current (Id) Mot EXC Current	Monitors the calculated value of the motor excitation current. The motor rated secondary current corresponds to 100%.	10 V:Motor rated secondary current) (0 to ±10 V output)	0.1%	No	No	A	52H
U1-20	Output frequency after soft-start SFS Output	Monitors the output frequency after a soft start. The frequency given does not include compensations, such as slip compensation. The unit is set in o1-03.	10 V: Max. frequency (0 to ± 10 V possible)	0.01 Hz	A	A	A	53H
U1-21	ASR input ASR Input	Monitors the input to the speed control loop. The maximum frequency corresponds to 100%.	10 V: Max. frequency (0 to ± 10 V possible)	0.01 %	No	A	No	54H
U1-22	ASR output ASR Output	Monitors the output from the speed control loop. The motor rated secondary current corresponds to 100%.	10 V:Motor rated secondary current) (0 to ± 10 V possible)	0.01 %	No	A	No	55H
U1-24	PID feedback value PID Feedback	Monitors the feedback value when PID control is used. The input for the max. frequency corresponds to 100%.	10 V: Max. frequency (0 to ± 10 V possible)	0.01 %	A	A	A	57H
U1-26	Output voltage reference (Vq) Voltage Ref (Vq)	Monitors the Inverter internal voltage reference for motor secondary current control.	10 V: 200 VAC (400 VAC) (0 to ± 10 V possible)	0.1 V	No	No	A	59H

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Param- eter Number	Name LCD Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	V/f	V/f with PG	Open Loop Vec- tor	Register
U1-27	Output volt- age refer- ence (Vd) / Voltage Ref (Vd)	Monitors the Inverter inter- nal voltage reference for motor excitation current con- trol.	10 V: 200 VAC (400 VAC) (0 to ± 10 V possible)	0.1 V	No	No	A	5AH
U1-28	Software No. (CPU) / CPU ID	(Manufacturer's CPU soft- ware No.)	(Cannot be output.)	-	A	A	A	5BH
U1-32	ACR out- put of q axis / ACR (q) Output	Monitors the current control output value for the motor secondary current.	10 V: 100% (0 to ± 10 V possible)	0.1 %	No	No	A	5FH
U1-33	ACR out- put of d axis / ACR (d) Output	Monitors the current control output value for the motor excitation current.	10 V: 100% (0 to ± 10 V possible)	0.1 %	No	No	A	60H
U1-34	OPE fault parameter / OPE Detected	Shows the first parameter number where an OPE fault was detected.	(Cannot be output.)	-	A	A	A	61H
U1-36	PID input volume / PID Input	PID feedback volume Given as maximum fre- quency/100%	10 V: Max. frequency (0 to ± 10 V possible)	0.01 %	A	A	A	63H
U1-37	PID output volume / PID Output	PID control output Given as maximum fre- quency/100%	10 V: Max. frequency (0 to ± 10 V possible)	0.01 %	A	A	A	64H
U1-38	PID com- mand / PID Set- point	PID command + PID com- mand bias Given as maximum fre- quency/100%	10 V: Max. frequency	0.01 %	A	A	A	65H
U1-39	RS-422A/ 485 Com- munica- tions Error / Transmit Err	Shows RS-422A/485 com- munications errors. U1-40= (see diagram) L 1: CRC error L 1: Data length error Not used (always 0). 1: Parity error 1: Overrun error 1: Framing error 1: Timeout Not used (always 0).	(Cannot be output.)	-	A	A	A	66H
U1-40	Cooling fan operating time / FAN Elapsed Time	Monitors the total operating time of the cooling fan. The time can be set in 02-10.	(Cannot be output.)	1 hr	A	A	A	68H

■ **Fault Trace: U2**

Parameters for error tracing are shown in the following table.

Param-eter Number	Name / LCD Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	V/f	V/f with PG	Open Loop Vec-tor	Register
U2-01	Current fault / Current Fault	The contents of the current fault.		-	A	A	A	80H
U2-02	Previous fault / Last Fault	The contents of the error that occurred just prior to the current fault.		-	A	A	A	81H
U2-03	Reference frequency at fault / Frequency Ref	The reference frequency when the previous fault occurred.		0.01 Hz	A	A	A	82H
U2-04	Output frequency at fault / Output Freq	The output frequency when the previous fault occurred.		0.01 Hz	A	A	A	83H
U2-05	Output current at fault / Output Current	The output current when the previous fault occurred.	(Cannot be output.)	0.1 A	A	A	A	84H
U2-06	Motor speed at fault / Motor Speed	The motor speed when the previous fault occurred.		0.01 Hz	No	A	A	85H
U2-07	Output voltage reference at fault / Output Voltage	The output reference voltage when the previous fault occurred.		0.1 V	A	A	A	86H
U2-08	DC bus voltage at fault / DC Bus Voltage	The main current DC voltage when the previous fault occurred.		1 V	A	A	A	87H
U2-09	Output power at fault / Output kWatts	The output power when the previous fault occurred.		0.1 kW	A	A	A	88H

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| Parameter Number | Name | Description | Output Signal Level During Multi-Function Analog Output | Min. Unit | Control Methods | | | Register |
	LCD Display				V/f	V/f with PG	Open Loop Vector	
U2-10	Torque reference at fault / Torque Reference	The reference torque when the previous fault occurred. The motor rated torque corresponds to 100%.	(Cannot be output.)	0.1%	No	No	A	89H
U2-11	Input terminal status at fault / Input Term Sts	The input terminal status when the previous fault occurred. The format is the same as for U1-10.		-	A	A	A	8AH
U2-12	Output terminal status at fault / Output Term Sts	The output terminal status when the previous fault occurred. The format is the same as for U1-11.		-	A	A	A	8BH
U2-13	Operation status at fault / Inverter Status	The operating status when the previous fault occurred. The format is the same as for U1-12.		-	A	A	A	8CH
U2-14	Cumulative operation time at fault / Elapsed time	The operating time when the previous fault occurred.		1 hr	A	A	A	8DH

Note The following errors are not included in the error trace: CPF00, 01, 02, 03, UV1, and UV2.

■Fault History: U3

Parameters for the error log are shown in the following table.

| Parameter Number | Name | Description | Output Signal Level During Multi-Function Analog Output | Min. Unit | Control Methods | | | Register |
	LCD Display				V/f	V/f with PG	Open Loop Vector	
U3-01	Most recent fault / Last Fault	The error contents of 1st previous fault.	(Cannot be output.)	-	A	A	A	90H (800H)
U3-02	Second most recent fault / Fault Message 2	The error contents of 2nd previous fault.		-	A	A	A	91H (801H)
U3-03	Third most recent fault / Fault Message 3	The error contents of 3rd previous fault.		-	A	A	A	92H (802H)

| Param-eter Number | Name | Description | Output Signal Level During Multi-Function Analog Output | Min. Unit | Control Methods | | | Register |
	LCD Display				V/f	V/f with PG	Open Loop Vec-tor	
U3-04	Fourth/old-est fault	The error contents of 4th previous fault.		-	A	A	A	93H (803H)
	Fault Mes-sage 4							
U3-05	Cumulative operation time at fault	The total operating time when the 1st previous fault occurred.		1 hr	A	A	A	94H (80AH)
	Elapsed Time 1							
U3-06	Accumu-lated time of second fault	The total operating time when the 2nd previous fault occurred.		1 hr	A	A	A	95H (80BH)
	Elapsed Time 2							
U3-07	Accumu-lated time of third fault	The total operating time when the 3rd previous fault occurred.		1 hr	A	A	A	96H (80CH)
	Elapsed Time 3							
U3-08	Accumu-lated time of fourth/old-est fault	The total operating time when the 4th previous fault occurred.	(Cannot be output.)	1 hr	A	A	A	97H (80DH)
	Elapsed Time 4							
U3-09	5th previ-ous fault	5th previous fault		-	A*	A*	A*	804H
	Fault Mes-sage 5							
U3-10	6th previ-ous fault	6th previous fault		-	A*	A*	A*	805H
	Fault Mes-sage 6							
U3-11	7th previ-ous fault	7th previous fault		-	A*	A*	A*	806H
	Fault Mes-sage 7							
U3-12	8th previ-ous fault	8th previous fault		-	A*	A*	A*	807H
	Fault Mes-sage 8							
U3-13	9th previ-ous fault	9th previous fault		-	A*	A*	A*	808H
	Fault Mes-sage 9							

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| Param-eter Number | Name | Description | Output Signal Level During Multi-Function Analog Output | Min. Unit | Control Methods | | | Register |
	LCD Display				V/f	V/f with PG	Open Loop Vec-tor	
U3-14	10th previous fault	10th previous fault		-	A*	A*	A*	809H
	Fault Message 10							
U3-15	Accumulative operating time at 5th previous fault	Accumulative operating time at 5th previous fault		1H	A*	A*	A*	80EH
	Elapsed Time 5							
U3-16	Accumulative operating time at 6th previous fault	Accumulative operating time at 6th previous fault		1H	A*	A*	A*	80FH
	Elapsed Time 6							
U3-17	Accumulative operating time at 7th previous fault	Accumulative operating time at 7th previous fault	(Cannot be output.)	1H	A*	A*	A*	810H
	Elapsed Time 7							
U3-18	Accumulative operating time at 8th previous fault	Accumulative operating time at 8th previous fault		1H	A*	A*	A*	811H
	Elapsed Time 8							
U3-19	Accumulative operating time at 9th previous fault	Accumulative operating time at 9th previous fault		1H	A*	A*	A*	812H
	Elapsed Time 9							
U3-20	Accumulative operating time at 10th previous fault	Accumulative operating time at 10th previous fault		1H	A*	A*	A*	813H
	Elapsed Time 10							

Note The following errors are not recorded in the error log: CPF00, 01, 02, 03, UV1, and UV2.

*   U3-09 to U3-20 are not supported for Asian models. Addresses 800H to 813H are not supported for Asian models.

◆ Factory Settings that Change with the Control Method (A1-02)

The factory settings of the following parameters will change if the control method (A1-02) is changed.

Param-eter Number	Name	Setting Range	Unit	Factory Setting		
				V/f Control A1-02=0	V/F with PG A1-02=1	Open Loop Vector A1-02=2
b3-01	Speed search selection	0 to 3	1	2	3	2
b3-02	Speed search operating current	0 to 200	1%	120	-	100
C3-01	Slip compensation gain	0.0 to 2.5	0.1	0.0	-	1.0
C3-02	Slip compensation primary delay time constant	0 to 10000	1 ms	2000	-	200
C4-02	Torque compensation primary delay time constant	0 to 10000	1 ms	200	200	20
E1-04 E3-02	Max. output frequency (FMAX)	0.0 to 400.0	0.1 Hz	60.0 *2	60.0 *2	60.0
E1-05 E3-03	Max. voltage (VMAX)	0.0 to 255.0	0.1 V	200.0 *2	200.0 *2	200.0
E1-06 E3-04	Base frequency (FA)	0.0 to 400.0	0.1 Hz	60.0 *2	60.0 *2	60.0
E1-07 E3-05	Mid. output frequency (FB)	0.0 to 400.0	0.1 Hz	3.0 *2	3.0 *2	3.0
E1-08 E3-06	Mid. output frequency voltage (VC)[1]	0.0 to 255.0 (0.0 to 510.0)	0.1 V	15.0 *2	15.0 *2	11.0
E1-09 E3-07	Min. output frequency (FMIN)	0.0 to 400.0	0.1 Hz	1.5 *2	1.5 *2	0.5
E1-10 E3-08	Min. output frequency voltage (VMIN)[1]	0.0 to 255.0 (0.0 to 510.0)	0.1 V	9.0 *2	9.0 *2	2.0

* 1. The settings shown are for 200-V class Inverters. The values will double for 400-V class Inverters.
* 2. Settings vary as shown in the following tables depending on the Inverter capacity and E1-03.

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■200-V and 400-V Class Inverters of 0.4 to 1.5 kW

Parameter Number	Unit	Factory Setting																Open Loop Vector Control
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	60.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
E1-07 *	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0
E1-08 *	V	15.0	15.0	15.0	15.0	35.0	50.0	35.0	50.0	19.0	24.0	19.0	24.0	15.0	15.0	15.0	15.0	11.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5	0.5
E1-10 *	V	9.0	9.0	9.0	9.0	8.0	9.0	8.0	9.0	11.0	13.0	11.0	15.0	9.0	9.0	9.0	9.0	2.0

* The settings shown are for 200-V class Inverters. The values will double for 400-V class Inverters.

■200-V and 400-V Class Inverters of 2.2 to 45 kW

Parameter Number	Unit	Factory Setting																Open Loop Vector Control
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	60.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
E1-07 *	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0
E1-08 *	V	14.0	14.0	14.0	14.0	35.0	50.0	35.0	50.0	18.0	23.0	18.0	23.0	14.0	14.0	14.0	14.0	11.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5	0.5
E1-10 *	V	7.0	7.0	7.0	7.0	6.0	7.0	6.0	7.0	9.0	11.0	9.0	13.0	7.0	7.0	7.0	7.0	2.0

* The settings shown are for 200-V class Inverters. The values will double for 400-V class Inverters.

■200-V class Inverters of 55 to 110 kW and 400-V Class Inverters of 55 to 300 kW

Parameter Number	Unit	Factory Setting																Open Loop Vector Control
E1-03	-	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
E1-04	Hz	50.0	60.0	60.0	72.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	90.0	120.0	180.0	60.0	60.0
E1-05 *	V	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
E1-06	Hz	50.0	60.0	50.0	60.0	50.0	50.0	60.0	60.0	50.0	50.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
E1-07 *	Hz	2.5	3.0	3.0	3.0	25.0	25.0	30.0	30.0	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	3.0
E1-08 *	V	12.0	12.0	12.0	12.0	35.0	50.0	35.0	50.0	15.0	20.0	15.0	20.0	12.0	12.0	12.0	12.0	11.0
E1-09	Hz	1.3	1.5	1.5	1.5	1.3	1.3	1.5	1.5	1.3	1.3	1.5	1.5	1.5	1.5	1.5	1.5	0.5
E1-10 *	V	6.0	6.0	6.0	6.0	5.0	6.0	5.0	6.0	7.0	9.0	7.0	11.0	6.0	6.0	6.0	6.0	2.0

* The settings shown are for 200-V class Inverters. The values will double for 400-V class Inverters.

◆ Factory Settings that Change with the Inverter Capacity (o2-04)

The factory settings of the following parameters will change if the Inverter capacity (o2-04) is changed.

■200-V Class Inverters

Parameter Number	Name	Unit	Factory Setting								
-	Inverter Capacity	kW	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15
o2-04	kVA selection	-	0	1	2	3	4	5	6	7	8
b8-03	Energy-saving filter time constant	s	0.50 (Open loop vector control)								
b8-04	Energy-saving coefficient	-	288.20	223.70	169.40	156.80	122.90	94.75	72.69	70.44	63.13
C6-02	Carrier frequency selection*	-	6	6	6	6	6	6	6	6	6
-	Carrier frequency selection upper limit	-	6	6	6	6	6	6	6	6	6
E2-01 (E4-01)	Motor rated current	A	1.90	3.30	6.20	8.50	14.00	19.60	26.60	39.7	53.0
E2-02 (E4-02)	Motor rated slip	Hz	2.90	2.50	2.60	2.90	2.73	1.50	1.30	1.70	1.60
E2-03 (E4-03)	Motor no-load current	A	1.20	1.80	2.80	3.00	4.50	5.10	8.00	11.2	15.2
E2-05 (E4-05)	Motor line-to-line resistance	Ω	9.842	5.156	1.997	1.601	0.771	0.399	0.288	0.230	0.138
E2-06 (E4-06)	Motor leak inductance	%	18.2	13.8	18.5	18.4	19.6	18.2	15.5	19.5	17.2
E2-10	Motor iron loss for torque compensation	W	14	26	53	77	112	172	262	245	272
L2-02	Momentary power loss ridethru time	s	0.1	0.1	0.2	0.3	0.5	1.0	1.0	1.0	2.0
L2-03	Min. baseblock (BB) time	s	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
L2-04	Voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat pre-alarm level	°C	95	95	95	100	95	95	95	95	90

5

Parameter Number	Name	Unit	Factory Setting								
-	Inverter Capacity	kW	18.5	22	30	37	45	55	75	90	110
o2-04	kVA selection	-	9	A	B	C	D	E	F	10	11
b8-03	Energy-saving filter time constant	s	0.50 (Open loop vector control)					2.00 (Open loop vector control)			
b8-04	Energy-saving coefficient	-	57.87	51.79	46.27	38.16	35.78	31.35	23.10	23.10	23.10
C6-02	Carrier frequency selection*	-	6	6	4	3	3	3	3	3	1
-	Carrier frequency selection upper limit	-	6	6	6	4	4	4	4	4	1
E2-01 (E4-01)	Motor rated current	A	65.8	77.2	105.0	131.0	160.0	190.0	260.0	260.0	260.0
E2-02 (E4-02)	Motor rated slip	Hz	1.67	1.70	1.80	1.33	1.60	1.43	1.39	1.39	1.39
E2-03 (E4-03)	Motor no-load current	A	15.7	18.5	21.9	38.2	44.0	45.6	72.0	72.0	72.0
E2-05 (E4-05)	Motor line-to-line resistance	Ω	0.101	0.079	0.064	0.039	0.030	0.022	0.023	0.023	0.023
E2-06 (E4-06)	Motor leak inductance	%	20.1	19.5	20.8	18.8	20.2	20.5	20.0	20.0	20.0
E2-10	Motor iron loss for torque compensation	W	505	538	699	823	852	960	1200	1200	1200
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Min. baseblock (BB) time	s	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.5	1.7
L2-04	Voltage recovery time	s	0.6	0.6	0.6	0.6	0.6	1.0	1.0	1.0	1.0
L8-02	Overheat pre-alarm level	°C	100	90	90	95	100	105	95	100	95

Note Attach a Momentary Power Interruption Compensation Unit if compensation for power interruptions of up to 2.0 seconds is required for 200-V class Inverters with outputs of 0.4 to 11 kW.

* If C6-02 is set to 0, 1, or F and the initial value of C6-03 and C6-04 is 2.0 kHz, the initial settings for C6-02 are as follows: 2: 5.0 kHz, 3: 8.0 kHz, 4: 10 kHz, 5: 12.5 kHz, and 6: 15 kHz. If the carrier frequency is set higher than the factory setting for Inverters with outputs of 7.5 kW or more, the Inverter rated current will need to be reduced.

■**400-V Class Inverters**

Parameter Number	Name	Unit	Factory Setting									
-	Inverter Capacity	kW	0.4	0.75	1.5	2.2	3.7	4.0	5.5	7.5	11	15
o2-04	kVA selection	-	20	21	22	23	24	25	26	27	28	29
b8-03	Energy-saving filter time constant	s	0.50 (Open loop vector control)									
b8-04	Energy-saving coefficient	-	576.40	447.40	338.80	313.60	245.80	236.44	189.50	145.38	140.88	126.26
C6-02	Carrier frequency selection *	-	6	6	6	6	6	6	6	6	6	6
-	Carrier frequency selection upper limit	-	6	6	6	6	6	6	6	6	6	6
E2-01 (E4-01)	Motor rated current	A	1.00	1.60	3.10	4.20	7.00	7.00	9.80	13.30	19.9	26.5
E2-02 (E4-02)	Motor rated slip	Hz	2.90	2.60	2.50	3.00	2.70	2.70	1.50	1.30	1.70	1.60
E2-03 (E4-03)	Motor no-load current	A	0.60	0.80	1.40	1.50	2.30	2.30	2.60	4.00	5.6	7.6
E2-05 (E4-05)	Motor line-to-line resistance	W	38.198	22.459	10.100	6.495	3.333	3.333	1.595	1.152	0.922	0.550
E2-06 (E4-06)	Motor leak inductance	%	18.2	14.3	18.3	18.7	19.3	19.3	18.2	15.5	19.6	17.2
E2-10	Motor iron loss for torque compensation	W	14	26	53	77	130	130	193	263	385	440
L2-02	Momentary power loss ridethru time	s	0.1	0.1	0.2	0.3	0.5	0.5	0.8	0.8	1.0	2.0
L2-03	Min. baseblock (BB) time	s	0.1	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.9
L2-04	Voltage recovery time	s	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L8-02	Overheat pre-alarm level	°C	95	95	95	90	95	95	95	90	95	95

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Parame-ter Number	Name	Unit	Factory Setting									
-	Inverter Capacity	kW	18.5	22	30	37	45	55	75	90	110	132
o2-04	kVA selection	-	2A	2B	2C	2D	2E	2F	30	31	32	33
b8-03	Energy-saving filter time constant	s	0.50 (Open loop vector control)					2.00 (Open loop vector control)				
b8-04	Energy-saving coefficient	-	115.74	103.58	92.54	76.32	71.56	67.20	46.20	41.22	36.23	33.18
C6-02	Carrier frequency selection *	-	6	6	4	4	4	4	3	3	3	3
-	Carrier frequency selection upper limit	-	6	6	6	6	6	6	4	4	4	4
E2-01 (E4-01)	Motor rated current	A	32.9	38.6	52.3	65.6	79.7	95.0	130.0	156.0	190.0	223.0
E2-02 (E4-02)	Motor rated slip	Hz	1.67	1.70	1.80	1.33	1.60	1.46	1.39	1.40	1.40	1.38
E2-03 (E4-03)	Motor no-load current	A	7.8	9.2	10.9	19.1	22.0	24.0	36.0	40.0	49.0	58.0
E2-05 (E4-05)	Motor line-to-line resistance	Ω	0.403	0.316	0.269	0.155	0.122	0.088	0.092	0.056	0.046	0.035
E2-06 (E4-06)	Motor leak inductance	%	20.1	23.5	20.7	18.8	19.9	20.0	20.0	20.0	20.0	20.0
E2-10	Motor iron loss for torque compensation	W	508	586	750	925	1125	1260	1600	1760	2150	2350
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
L2-03	Min. baseblock (BB) time	s	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.5	1.7	1.7
L2-04	Voltage recovery time	s	0.6	0.6	0.6	0.6	0.6	1.0	1.0	1.0	1.0	1.0
L8-02	Overheat pre-alarm level	°C	98	78	85	85	90	90	98	108	100	95

Parameter Number	Name	Unit	Factory Setting			
-	Inverter Capacity	kW	160	185	220	300
o2-04	kVA selection	-	34	35	36	37
b8-03	Energy-saving filter time constant	s	2.00 (Open loop vector control)			
b8-04	Energy-saving coefficient	-	30.13	30.57	27.13	21.76
C6-02	Carrier frequency selection *	-	3	3	1	1
-	Carrier frequency selection upper limit	-	4	4	1	1
E2-01 (E4-01)	Motor rated current	A	270.0	310.0	370.0	500.0
E2-02 (E4-02)	Motor rated slip	Hz	1.35	1.30	1.30	1.25
E2-03 (E4-03)	Motor no-load current	A	70.0	81.0	96.0	130.0
E2-05 (E4-05)	Motor line-to-line resistance	Ω	0.029	0.025	0.020	0.014
E2-06 (E4-06)	Motor leak inductance	%	20.0	20.0	20.0	20.0
E2-10	Motor iron loss for torque compensation	W	2850	3200	3700	4700
L2-02	Momentary power loss ridethru time	s	2.0	2.0	2.0	2.0
L2-03	Min. baseblock (BB) time	s	1.8	1.9	2.0	2.1
L2-04	Voltage recovery time	s	1.0	1.0	1.0	1.0
L8-02	Overheat pre-alarm level	°C	95	95	95	95

Note Attach a Momentary Power Interruption Compensation Unit if compensation for power interruptions of up to 2.0 seconds is required for 200-V class Inverters with outputs of 0.4 to 11 kW.

* If C6-02 is set to 0, 1, or F and the initial value of C6-03 and C6-04 is 2.0 kHz, the initial settings for C6-02 are as follows: 2: 5.0 kHz, 3: 8.0 kHz, 4: 10 kHz, 5: 12.5 kHz, and 6: 15 kHz. If the carrier frequency is set higher than the factory setting for Inverters with outputs of 7.5 kW or more, the Inverter rated current will need to be reduced.

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6

Chapter 6
Parameter Settings by Function
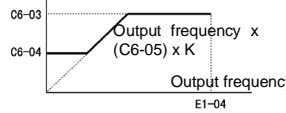
Application and Overload Selections

◆ Select the Overload to Suit the Application

Set C6-01 (CT: Low carrier constant torque, VT: High carrier variable torque) depending on the application for which the Inverter is used. The setting ranges for the Inverter carrier frequency, overload tolerance, and maximum output frequency depend on the setting in C6-01. If using the Inverter with C6-01 set to the factory setting (1: VT), use a load application in which load torque reduces with the speed, e.g., fans and pumps.
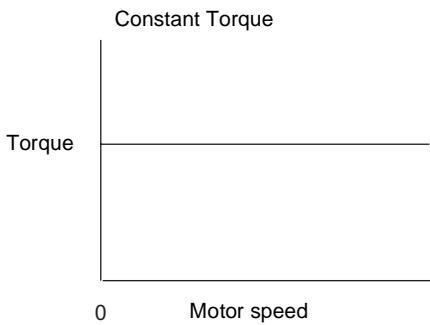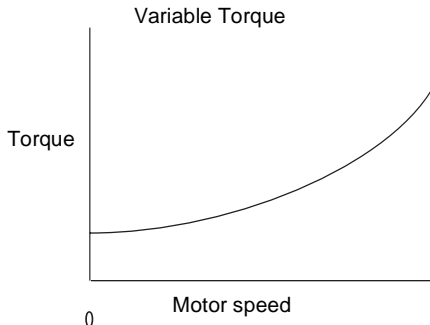
■Related Parameters

Param- eter Num- ber	Name		Description	Setting Range	Factory Setting	Change s during Opera- tion	Control Methods		
	LCD Display						V/f	V/f with PG	Open Loop vec- tor
C6-01	CT/VT selection		0: CT (low carrier, constant torque, 150% per minute) 1: VT (high carrier, variable torque, 120% per minute)	0 or 1	1	No	Q	Q	Q
	Heavy/Normal Duty								
C6-02	Carrier frequency selection		Select carrier wave fixed pattern. Select F to enable detailed settings using parameters C6-03 to C6-05.	0 to F	6*1	No	Q	Q	Q
	CarrierFreq Sel								
C6-03	Carrier frequency upper limit			2.0 to 15.0 *2 *3	15.0 kHz *1	No	A	A	A
	CarrierFreq Max		Set upper and lower carrier frequency limits in kHz. Set the carrier wave gain as shown below. In vector control method, the carrier frequency is fixed according to C6-03 (Carrier Frequency Upper Limit). Carrier frequency C6-03 C6-04 Output frequency x (C6-05) x K Output frequency E1-04 (Maximum output frequency) K is the coefficient determined by the set value in C6-03. C6-03 ≥ 10.0 kHz: K = 3 10.0 kHz > C6-03 ≥ 5.0 kHz : K = 2 5.0 kHz > C6-03: K = 2						
C6-04	Carrier frequency lower limit			0.4 to 15.0 *2 *3	15.0 kHz *1	No	A	A	No
	CarrierFreq Min								
C6-05	Carrier frequency proportional gain			00 to 99 *3	00	No	A	A	No
	CarrierFreq Gain								

* 1. The factory settings depend on the Inverter capacity.
* 2. The setting ranges depend on the Inverter capacity.
* 3. Can be set and referenced only when C6-01 is set to 1, and C6-02 is set to F.

■Difference between CT and VT

The characteristics of CT (low carrier, constant torque) and VT (high carrier, variable torque) are shown below.

CT: Low Carrier, Constant Torque	VT: High Carrier, Variable Torque
Constant torque means a fixed load torque for all motor speed, and it requires overload resistance capability. Applications include pushers, conveyors, cranes, and other friction or heavy loads.	Variable torque means that the load torque will decrease as the speed decreases. Normally, overload resistance capability is not required. Applications include fans and pumps.
Low carrier: Acoustic noise is present.	High carrier: Acoustic noise is not present.

■Setting Precautions

C6-01 (CT/VT Selection)

When setting C6-01, observe the following precautions.

- Depending on the set value in C6-01, the setting range of the related parameters is limited as follows:

C6-01 Set Value	0 (Low Carrier, Constant Torque)	1 (High Carrier, Variable Torque)
Inverter Overload Protection Level	150% Inverter rated current/1 min.	120% Inverter rated current/1 min.
C6-02 (Carrier Frequency Selection)	0: Low carrier, low noise 1: Carrier 2 kHz	0: Low carrier low noise 1: Carrier 2 kHz 2: Carrier 5 kHz 3: Carrier 8.0 kHz 4: Carrier 10.0 kHz 5: Carrier 12.5 kHz 6: Carrier 15 kHz F: User-set*
E1-04 and E3-02 (Max. Output Frequency)	150 Hz	400 Hz
L3-02 (Stall Prevention Level During Acceleration)	150%	120%
L3-06 (Stall Prevention Level During Operation)	150%	120%

* Factory settings depend on Inverter capacity.
  200 V and 400 V Class Inverters for 0.4 to 22 kW: 6 (15 kHz)
  200 V Class Inverters for 30 to 90 kW, or 400 V Class Inverters for 30 to 185 kW: 4 (10 kHz)
  200 V Class Inverter for 110 kW, or 400 V Class Inverters for 220 to 300 kW: 1 (2 kHz)

- When the setting in E1-04 or E3-02 is greater than 150 Hz, if C6-01 is set to 0, an OPE02 (Parameter setting range error) will occur.

6

Carrier Frequency

When selecting the carrier frequency, observe the following precautions items.

- When using a device with C6-01 set to 1 (VT), adjust the carrier frequency according to the cases shown below.
  If the wiring distance between Inverter and motor is long: Set the carrier frequency low. (Use the following values as guidelines.

Wiring Length	50 m or less	100 m or less	Over 100 m
C6-02 (carrier frequency) setting	0 to 6 (15 kHz)	0 to 4 (10 kHz)	0 to 2 (5 kHz)

  If speed and torque are inconsistent at low speeds: Set the carrier frequency low.
  If Inverter noise is affecting peripheral devices: Set the carrier frequency low.
  If leakage current from the Inverter is large: Set the carrier frequency low.
  If metallic noise from the motor is large: Set the carrier frequency high.

Carrier frequency upper limit depends on the Inverter capacity. Refer to *Factory Settings that Change with the Inverter Capacity (o2-04)* on page 5-85.

- When using V/f control or V/f control with PG, you can vary the carrier frequency to match the output frequency, as shown in the following diagram, by setting C6-03 (Carrier Frequency Upper Limit), C6-04 (Carrier Frequency Lower Limit), and C6-05 (Carrier Frequency Proportional Gain).
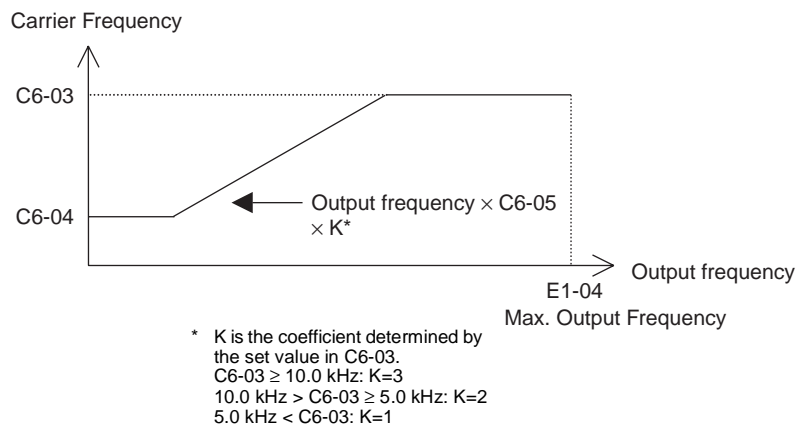
Fig 6.1

- With vector control, the carrier frequency is fixed by the Carrier Frequency Upper Limit in C6-03 if user-set, or by the carrier frequency set in C6-02.

- To fix the carrier frequency, set C6-03 and C6-04 to the same value, or set C6-05 to 0.

- If the settings are as shown below, OPE11 (Data setting error) will occur.

  If Carrier Frequency Proportional Gain (C6-05) > 6 and C6-03 < C6-04.
  If C6-01 = 0 and Carrier Frequency Selection C6-02 is set from 2 to E.
  If C6-01 = 1 and Carrier Frequency Selection C6-02 is set from 7 to E.

■**Carrier Frequency and Inverter Overload Current Level**

When C6-01 is set to 1, the Inverter overload level will be reduced. Even when the overload current falls to below 120%, OL2 (Inverter overload) will be detected. The Inverter overload current reduction level is shown below.
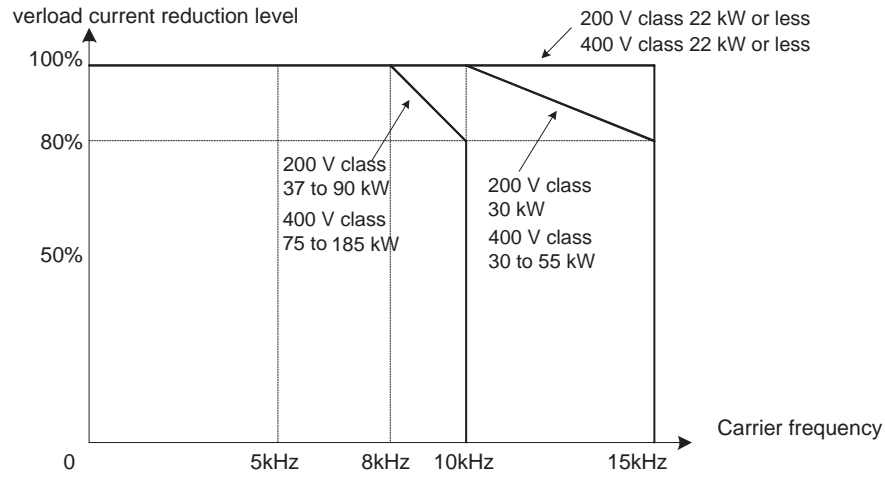
Fig 6.2 Overload Current Reduction Level

6

Frequency Reference

This section explains how to input the frequency reference.

◆ Selecting the Frequency Reference Source

Set parameter b1-01 to select the frequency reference source.

■Related Parameters

Param-eter Num-ber	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
		LCD Display					V/f	V/f with PG	Open Loop Vec-tor
b1-01	Reference selection		Set the frequency reference source 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card 4: Pulse train input	0 to 4	1	No	Q	Q	Q
	Reference Source								
H6-01	Pulse train input function selection		0: Frequency reference 1: PID feedback value 2: PID target value	0 to 2	0	No	A	A	A
	Pulse Input Sel								
H6-02	Pulse train input scaling		Set the number of pulses taking the reference to be 100%, in Hz.	1000 to 32000	1440 Hz	Yes	A	A	A
	Pulse Input Gain								

■Input the Reference Frequency from the Digital Operator

When b1-01 is set to 0, you can input the reference frequency from the Digital Operator.

Input the reference frequency from the Digital Operator's reference frequency setting display.

For details on setting the reference frequency, refer to *Chapter 3*.

$$F\ddot{6}0.00$$
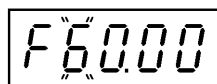
Fig 6.3   Frequency Setting Display

◼Inputting the Frequency Reference Using Voltage (Analog Setting)

When b1-01 is set to 1, you can input the frequency reference from control circuit terminal A1 (voltage input), or control circuit terminal A2 (voltage or current input).

Inputting Master Speed Frequency Reference Only (Asian Model)

If inputting the master speed frequency reference only, input the voltage reference to control circuit terminal A1.
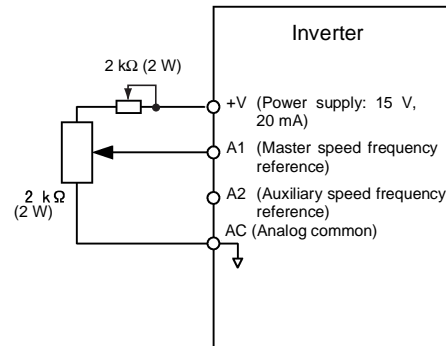
Fig 6.4   Master Speed Frequency Reference Input

2-Step Switching: Master/Auxiliary (Asian Model)

If performing 2-step switching between master and auxiliary speed frequencies, input the master speed frequency reference to control circuit terminal A1, and input the auxiliary speed frequency reference to A2.

When terminal S3 (multi-step speed command 1) is OFF, terminal A1 (master speed frequency reference) will be the Inverter frequency reference, and when terminal S3 is ON, terminal A2 (auxiliary speed frequency reference) will be the Inverter frequency reference.

6
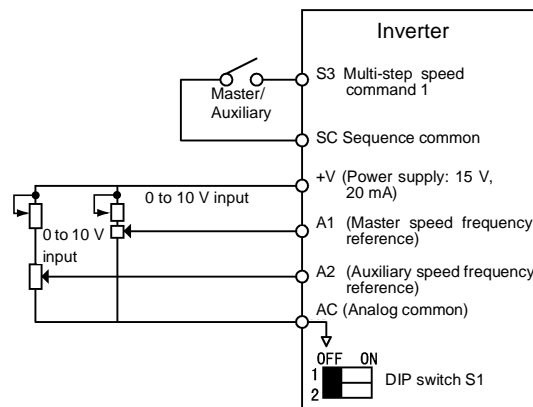
Fig 6.5   Master/Auxiliary Frequency Reference Input

Setting Precautions

When inputting a voltage signal to terminal A2, observe the following precautions.

• Turn OFF pin 2 on DIP switch S1 for switching between voltage and current (factory setting is ON).

6-7

Inputting Master Speed Frequency Reference Only (European Model)

If inputting the master speed frequency reference only, input the voltage reference to control circuit terminal A1. The voltage range canbe selected by setting H3-01.

When H3-01 = 0

When H3-01 = 1
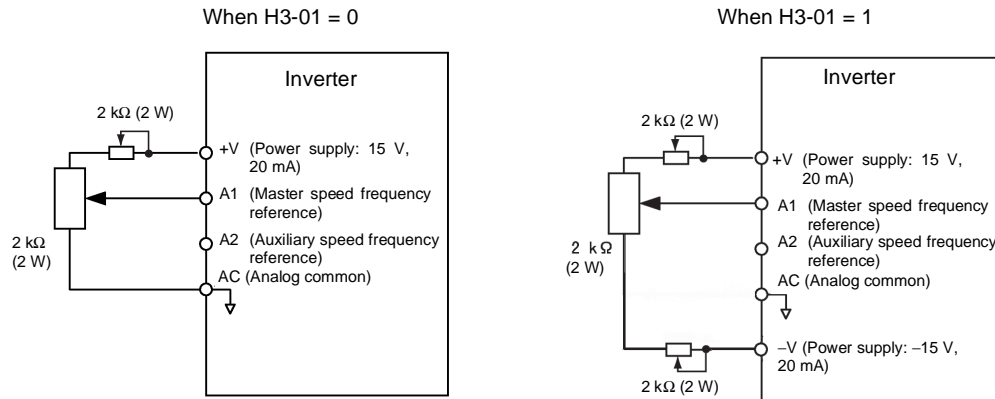
Fig 6.6 Master Speed Frequency Reference Input

2-Step Switching: Master/Auxiliary (European Model)

If performing 2-step switching between master and auxiliary speed frequencies, input the master speed frequency reference to control circuit terminal A1, and input the auxiliary speed frequency reference to A2.

When terminal S3 (multi-step speed command 1) is OFF, terminal A1 (master speed frequency reference) will be the Inverter frequency reference, and when terminal S3 is ON, terminal A2 (auxiliary speed frequency reference) will be the Inverter frequency reference. The voltage range can be selected by setting H3-01.

When H3-01 = 0

When H3-01 = 1
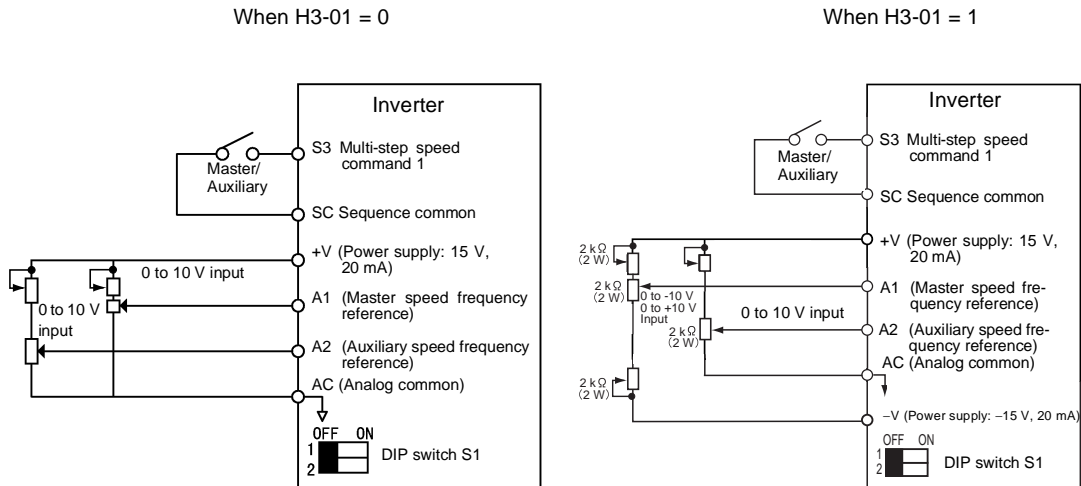
Fig 6.7 Master/Auxiliary Frequency Reference Input

Setting Precautions

When inputting a voltage signal to terminal A2, observe the following precautions.

- Turn OFF pin 2 on DIP switch S1 for switching between voltage and current (factory setting is ON).

■Inputting Frequency Reference Using Current

When b1-01 is set to 1, you can input the frequency reference from control circuit terminal A2. Input the current (4 to 20 mA) in control circuit terminal A2.

When H3-09 (Multi-Function Analog Input Terminal A2 Signal Level Selection) is set to 0 (factory setting) the input on A2 is added to A1.
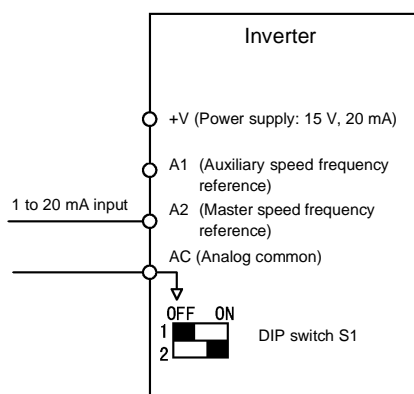
Fig 6.8 Frequency Reference Using Current

Setting Precautions

- When inputting a current signal to terminal A2, turn ON pin 2 on DIP switch S1 (factory setting: ON).
- If using terminal A2 to input the master speed reference and terminal A1 to input the auxiliary frequency reference, set H3-13 (Terminal A1/A2 Switching) to 1.

■Setting Frequency Reference Using Pulse Train Signals

When b1-01 is set to 4, the pulse train input to control circuit terminal RP is used as the frequency reference.

Set H6-01 (PulseTrain Input Function Selection) to 0 (frequency reference), and then set the 100% reference pulse frequency to H6-02 (Pulse Train Input Scaling).

Pulse Input Specifications	
Low level voltage	0.0 to 0.8 V
High level voltage	3.5 to 13.2 V
Heavy duty	30 to 70%
Pulse frequency	0 to 32 kHz
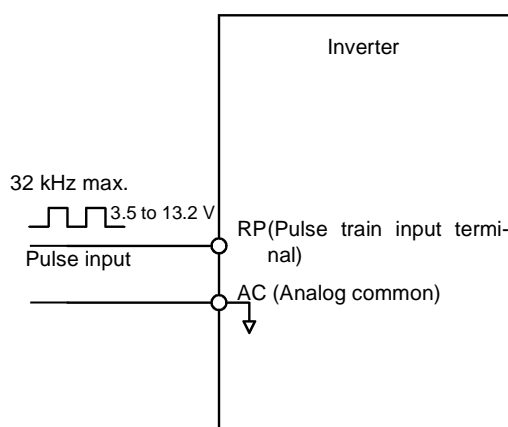
Fig 6.9 Frequency Reference Using Pulse Train Input

◆ Using Multi-Step Speed Operation

With SYSDRIVE RV series Inverters, you can change the speed to a maximum of 17 steps, using 16 frequency references, and one jog frequency reference.

The following example of a multi-function input terminal function shows a 9-step operation using multi-step references 1 to 3 and jog frequency selection functions.

■Related Parameters

To switch frequency references, set multi-step references 1 to 3 and the jog reference selection in the multi-function contact inputs.

Multi-function Digital Inputs (H1-01 to H1-05)

Terminal	Parameter Number	Set Value	Details
S4	H1-02	3	Multi-step speed reference 1 (Also used for master speed/auxiliary speed switching when multi-function analog input H3-09 is set to 2 (auxiliary frequency reference).)
S5	H1-03	4	Multi-step speed reference 2
S6	H1-04	5	Multi-step speed reference 3
S7	H1-05	6	Jog frequency selection (given priority over multi-step speed reference)

Multi-step Speed by Combining Multi-Function Digital Inputs

The speed can be changed by combining the ON/OFF status of S4 to S7 (multi-function digital input terminals) to set multi-step speed references 1 to 3 and the jog frequency selection. The following table shows the possible combinations.

Speed	TerminalS4 Multi-step Speed Reference 1	TerminalS5 Multi-step Speed Reference 2	TerminalS6 Multi-step Speed Reference 3	TerminalS7 Jog Frequency Selection	Selected Frequency
1	OFF	OFF	OFF	OFF	Frequency reference 1 d1-01, master speed frequency
2	ON	OFF	OFF	OFF	Frequency reference 2 d1-02, auxiliary frequency
3	OFF	ON	OFF	OFF	Frequency reference 3 d1-03
4	ON	ON	OFF	OFF	Frequency reference 4 d1-04
5	OFF	OFF	ON	OFF	Frequency reference 5 d1-05
6	ON	OFF	ON	OFF	Frequency reference 6 d1-06
7	OFF	ON	ON	OFF	Frequency reference 7 d1-07
8	ON	ON	ON	OFF	Frequency reference 8 d1-08
9	-	-	-	ON[*]	Jog frequency d1-17

* Terminal S7's jog frequency selection is given priority over multi-step speed references.

Setting Precautions

When setting analog inputs to speed 1 and speed 2, observe the following precautions.

- When setting terminal A1's analog input to speed 1, set b1-01 to 1, and when setting d1-01 (Frequency Reference 1) to speed 1, set b1-01 to 0.

- When setting terminal A2's analog input to speed 2, set H3-09 to 2 (auxiliary frequency reference). When setting d1-02 (Frequency Reference 2) to speed 2, set H3-09 to 1F (do not use analog inputs).

■Connection Example and Time Chart

The following diagram shows a time chart and control circuit terminal connection example during a 9-step operation.
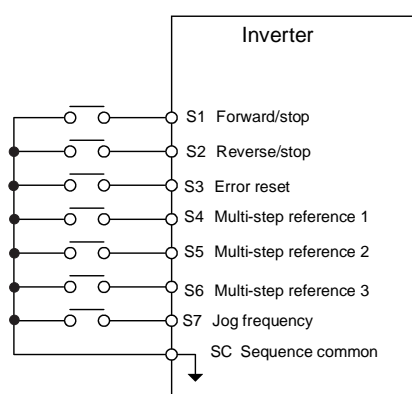
Fig 6.10 Control Circuit Terminal During 9-step Operation
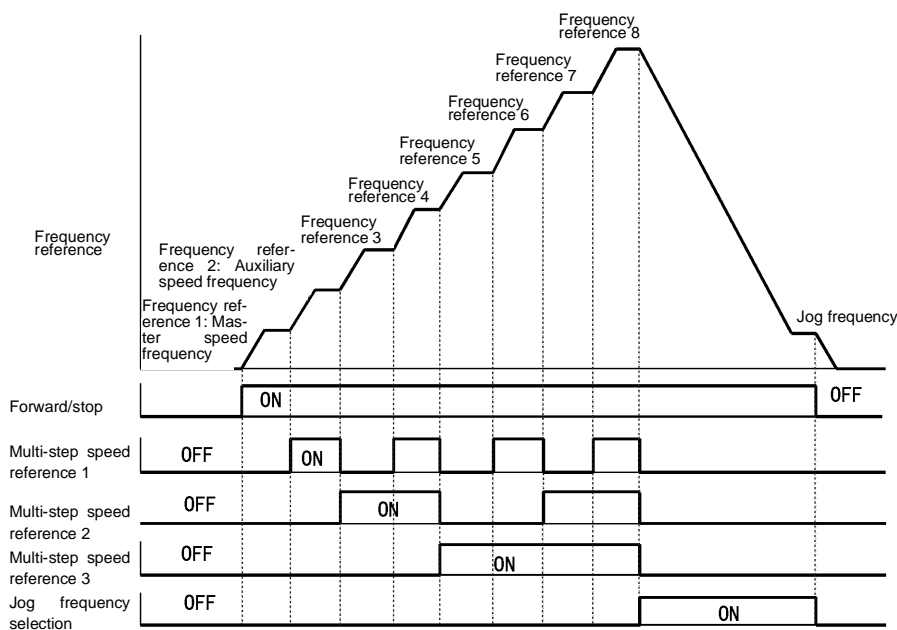
Fig 6.11 Multi-step Speed Reference/Jog Frequency Selection Time Chart

Run Command

This section explains input methods for the run command.

◆ Selecting the Run Command Source

Set parameter b1-02 to select the source for the run command.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
b1-02	Operation method selection	Set the run command source. 0: Digital operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q	Q	Q
	Run Source							

■Performing Operations Using a Digital Operator

When b1-02 is set to 0, you can perform Inverter operations using the Digital Operator keys (RUN, STOP, JOG, and FWD/REV). For details on the Digital Operator, refer to *Chapter 3*.

■Performing Operations Using Control Circuit Terminals

When b1-02 is set to 1, you can perform Inverter operations using the control circuit terminals.

Performing Operations Using a 2-wire Sequence

The factory setting is set to a 2-wire sequence. When control circuit terminal S1 is set to ON, forward operation will be performed, and when S1 is turned OFF, the Inverter will stop. In the same way, when control circuit terminal S2 is set to ON, reverse operation will be performed, and when S2 is turned OFF, the Inverter will stop.
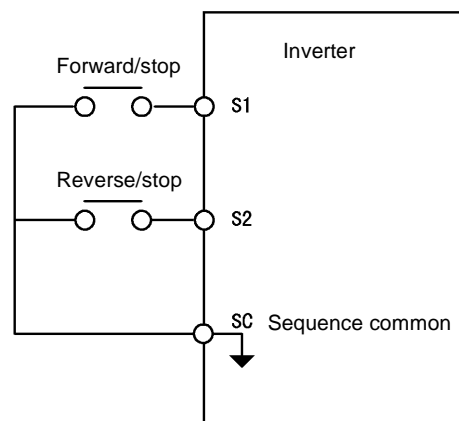
Fig 6.12 2-wire Sequence Wiring Example

Performing Operations Using a 3-wire Sequence

By selecting 0 for any parameter from H1-01 to H1-05 (related to terminals S3 to S7), the selected terminal functions as a forward/reverse run command, and terminals S1 and S3 change functions to 3-wire sequence commands.

When the Inverter is initialized for 3-wire sequence control (A1-03=3330), multi-function input 3 (terminal S5) will be the forward/reverse direction.
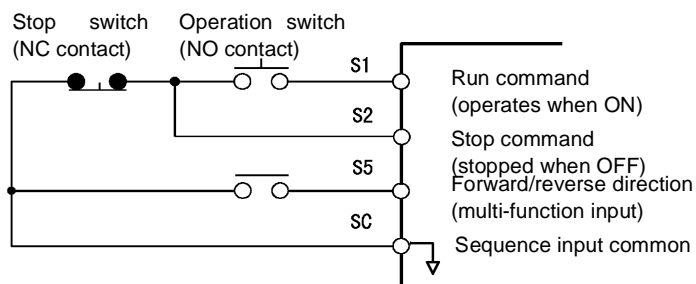
Fig 6.13 3-wire Sequence Wiring Example
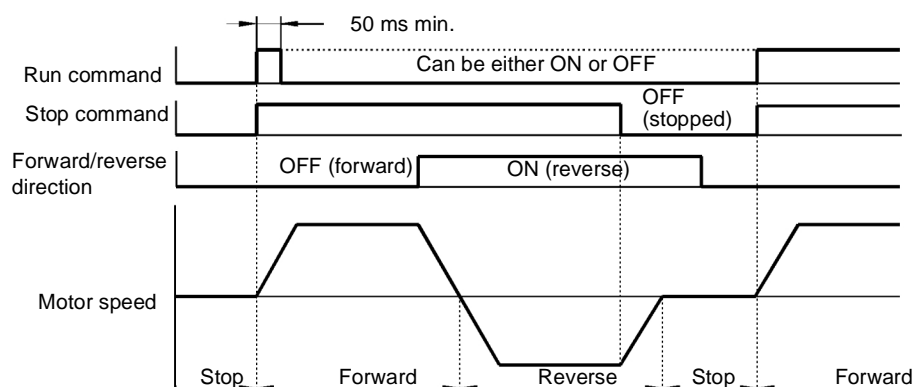
Fig 6.14 Three-wire Sequence Time Chart

INFO

Use a sequence that turns ON terminal S1 for 50 ms or longer for the run command. This will make the run command self-holding in the Inverter.

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Stopping Methods

This section explains methods of stopping the Inverter.

◆ Selecting the Stopping Method

There are four methods of stopping the Inverter when a stop command is set:

- Deceleration to stop
- Coast to stop
- DC braking stop
- Coast to stop with timer

Set parameter b1-03 to select the stopping method.

■Related Parameters

Param- eter Num- ber	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec- tor
b1-03	Stopping method selection / Stopping Method	Sets the stopping method when a stop command is input. 0: Deceleration to stop 1: Coast to stop 2: DC braking stop (Stops faster than coast to stop, without regenerative operation.) 3: Coast to stop with timer (Run commands are ignored during deceleration time.)	0 to 3	0	No	Q	Q	Q
b2-01	Zero speed level (DC injection braking starting frequency) / DCInj Start Freq	Sets the frequency to start the DC injection braking in units of Hz when deceleration to stop is selected. DC injection braking starts from E1-09 when b2-01 < E1-09.	0.0 to 10.0	0.5 Hz	No	A	A	A
b2-02	DC injection braking current / DCInj Current	Sets the DC injection braking current as a percent, with the Inverter rated current as 100%.	0 to 100	50%	No	A	A	A
b2-04	DC injection braking time at stop / DCInj Time@Stop	Sets the DC injection braking time in seconds. The motor coasts to a stop after the deceleration time due to inertia. DC injection breaking stops coasting. The value 0.00 disables DC injection.	0.00 to 10.00	0.50 s	No	A	A	A

◼**Deceleration to Stop**

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 0, the motor decelerates to a stop according to the deceleration time that has been set. (Factory setting: C1-02 (Deceleration Time 1))

If the output frequency when decelerating to a stop falls below b2-01, the DC injection brake will be applied using the DC current set in b2-02 only for the time set in b2-04.

For deceleration time settings, refer to *page 6-20 Setting Acceleration and Deceleration Times*.
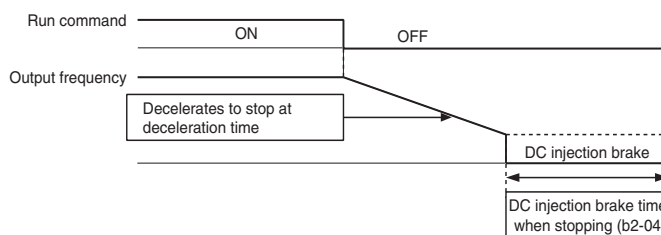
Fig 6.15 Deceleration to Stop

◼**Coast to Stop**

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 1, the Inverter output voltage is interrupted. The motor coasts to a stop at the deceleration rate that counterbalances damage to the machine and inertia including the load.
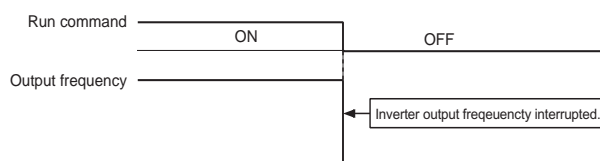
Fig 6.16 Coast to Stop

INFO

After the stop command is input, run commands are ignored until the Minimum Baseblock Time (L2-03) has elapsed.

6

■DC Braking Stop

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 2, a wait is made for the time set in L2-03 (Minimum Baseblock (BB) Time) and then the DC injection brake current set in b2-02 is sent to the motor to apply a DC injection brake to stop the motor. The DC injection brake time is determined by the set value in b2-04 and the output frequency when the stop command is input.
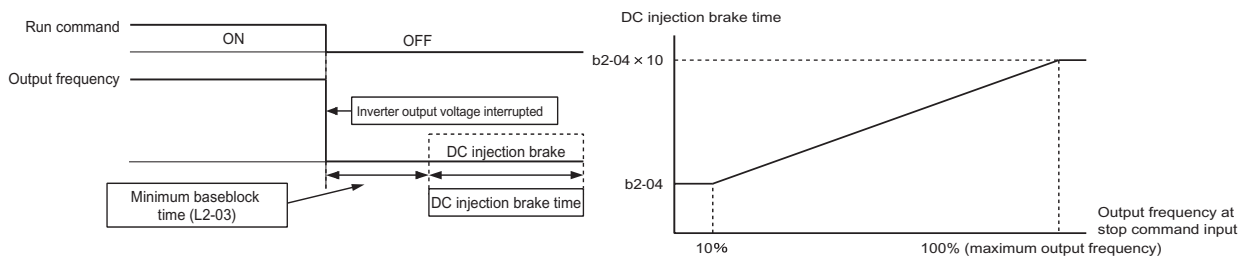
Fig 6.17 DC Injection Braking (DB) Stop

INFO

Lengthen the Minimum Baseblock Time (L2-03) when an overcurrent (OC) occurs during stopping.

■Coast to Stop with Timer

If the stop command is input (i.e., the run command is turned OFF) when b1-03 is set to 3, the Inverter output is interrupted to coast the motor to a stop. After the stop command is input, run commands are ignored until the time T has elapsed. The time T depends upon the output frequency when the stop command is input and the deceleration time.
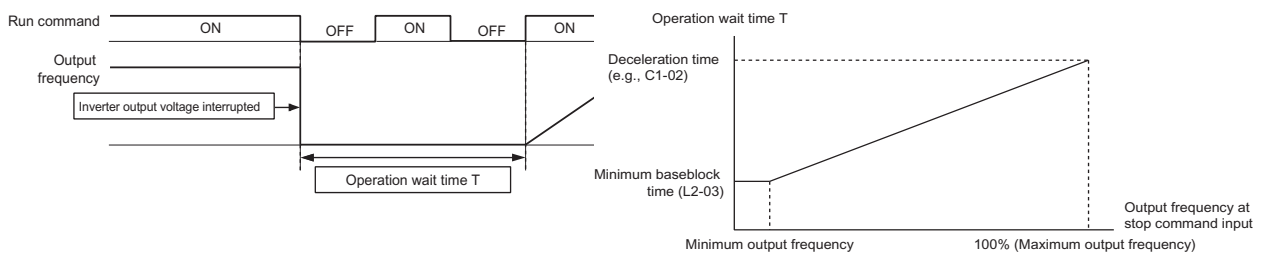
Fig 6.18 Coast to Stop with Timer

◆ Using the DC Injection Brake

Set parameter b2-03 to apply the DC injection brake voltage to the motor while it is coasting to a stop, to stop the motor and then restart it.

Set b2-03 to 0 to disable the DC injection brake at start.

Set the DC injection brake current using b2-02.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
b2-02	DC injection braking current	Set the DC Injection Braking Current as a percent-age of the Inverter rated current.	0 to 100	50%	No	A	A	A
	DCInj Current							
b2-03	DC injection braking time at start	Used to set the time to perform DC injection brak-ing at start in units of 1 second. Used to stop coasting motor and restart it. When the set value is 0, DC injection braking at start is not performed.	0.00 to 10.00	0.00 s	No	A	A	A
	DCInj Time@Start							

■Inputting the DC Injection Brake Command from Control Circuit Terminals

If a multi-function input terminal (H1-□□) is set to 60 (DC injection brake command), the DC injection brake is applied to the motor by turning ON the terminal (the DC injection brake command) when the Inverter is being stopped.

The time chart for the DC injection brake is shown below.
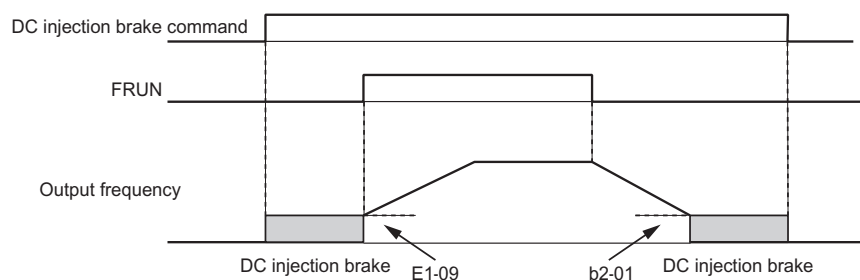
If you input the DC injection brake command from an external terminal, or if the run command and jog command are input, the DC injection brake will be disabled, and operation will resume.

Fig 6.19 DC Injection Brake Time Chart

6

■Changing the DC Injection Brake Current Using an Analog Input

When H3-09 (Multi-function Analog Input Terminal A2 Function Selection) is set to 6 (DC injection brake current), the DC injection brake current level is specified by the analog input.

At 10 V input (voltage) or 20 mA input (current), 100% of the Inverter rated current will be applied.

DC injection brake voltage level

100%
Inverter rated current

0   10 V
(4)   (20 mA)
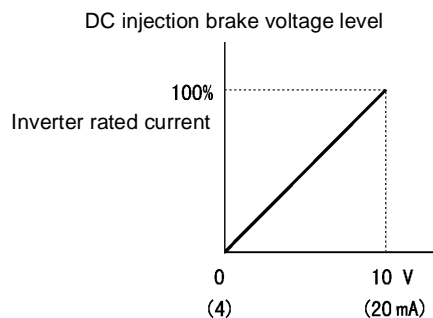
If you set this parameter to 7 and use overtorque detection in the multi-function output, you can apply the brake only when overtorque detection 1 turns ON.

Fig 6.20   DC Injection Brake Current Using an Analog Input

◆ Using a Deceleration Stop from an External Input

Set a multi-function input terminal (H1-□□) to 15 or 17 (deceleration stop) to decelerate to a stop at the deceleration time set in C1-09. If the deceleration stop uses normally open logic, set the multi-function input terminal (H1-□□) to 15, and if it uses normally closed logic, set the multi-function input terminal (H1-□□) to 17.

After deceleration stop command has been given from an external input, operation cannot be restarted until the Inverter has stopped. To cancel the deceleration stop, turn OFF the run command and deceleration stop command.

■Related Parameters

| Param-eter Num-ber | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | |
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
C1-09	Deceleration stop time	The deceleration time when the multi-function input "Deceleration stop" is ON. This function can be used a stopped method when a fault has been detected.	0.0 to 6000.0*	10.0 s	No	A	A	A
	Fast Stop Time							

* The acceleration and deceleration settings range varies depending on the setting in C1-10. When C1-10 is set to 0, the acceleration/deceleration settings range is 0.00 to 600.00 (seconds).

Acceleration and Deceleration Characteristics
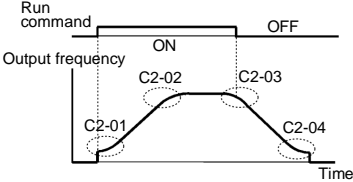
This section explains the acceleration and deceleration characteristics of the Inverter.

◆ Setting Acceleration and Deceleration Times

Acceleration time indicates the time taken for the output frequency to climb from 0% to 100%. Deceleration time indicates the time taken for the output frequency to reduce to 0%. The factory setting of the acceleration time is C1-01, and the factory setting of the deceleration time is C1-02.

■Related Parameters

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop Vector
C1-01	Acceleration time 1 / Accel Time 1	Set the acceleration time to accelerate from 0 to the maximum output frequency, in 1-second units.			Yes	Q	Q	Q
C1-02	Deceleration time 1 / Decel Time 1	Set the deceleration time in seconds for the output frequency to fall from 100% to 0%.			Yes	Q	Q	Q
C1-03	Acceleration time 2 / Accel Time 2	Acceleration time when multi-function input "Acceleration/deceleration time selection 1" is ON.			Yes	A	A	A
C1-04	Deceleration time 2 / Decel Time 2	Deceleration time when multi-function input "Acceleration/deceleration time selection 1" is ON.			Yes	A	A	A
C1-05	Acceleration time 3 / Accel Time 3	Acceleration time when multi-function input "Acceleration/deceleration time selection 2" is ON.	0.0 to 6000.0*	10.0 s	No	A	A	A
C1-06	Deceleration time 3 / Decel Time 3	Deceleration time when multi-function input "Acceleration/deceleration time selection 2" is ON.			No	A	A	A
C1-07	Acceleration time 4 / Accel Time 4	Acceleration time when multi-function input "Acceleration/deceleration time selection 1" and "Acceleration/deceleration time selection 2" are ON.			No	A	A	A
C1-08	Deceleration time 4 / Decel Time 4	Deceleration time when multi-function input "Acceleration/deceleration time selection 1" and "Acceleration/deceleration time 2" are ON.			No	A	A	A
C1-10	Acceleration/deceleration time setting unit / Acc/Dec Units	0: 0.01 s 1: 0.1 s	0 or 1	1	No	A	A	A
C1-11	Acceleration/deceleration time switching frequency / Acc/Dec SW Freq	Set the frequency at which acceleration/deceleration time switches automatically. Less than set frequency: Acceleration/deceleration time 4 Set frequency or above: Acceleration/deceleration time 1 Multi-function inputs "Acceleration/deceleration time selection 1" and "Acceleration/deceleration time selection 2" are given priority.	0.0 to 400.0	0.0 Hz	No	A	A	A

6

| Param- eter Num- ber | Name | | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | |
	LCD Display						V/f	V/f with PG	Open Loop Vec- tor
C2-01	S-curve characteristic time at acceleration start		Set the S-curve characteristic time for each part in seconds. When you set the S-curve characteristic time, the start time and end time S-curve characteristic time's acceleration/deceleration time is lengthened by 1/2 only.	0.00 to 2.50	0.20 s	No	A	A	A
	SCrv Acc@ Start								
C2-02	S-curve characteristic time at acceleration end			0.00 to 2.50	0.20 s	No	A	A	A
	SCrv ACC@ End								
C2-03	S-curve characteristic time at deceleration start			0.00 to 2.50	0.20 s	No	A	A	A
	SCrv Dec@ Start								
C2-04	S-curve characteristic time at deceleration end			0.00 to 2.50	0.00 s	No	A	A	A
	SCrv Dec@ End								

Run command — ON — OFF
Output frequency   C2-02   C2-03
C2-01   C2-04   Time

* The acceleration and deceleration settings range varies depending on the setting in C1-10. When C1-10 is set to 0, the acceleration/deceleration settings range is 0.00 to 600.00 (seconds).

■ Setting Acceleration and Deceleration Time Units

Set the acceleration/deceleration time units using C1-10. Parameter C1-10 is set to 1 at the factory.

Set value	Details
0	The acceleration/deceleration time settings range is 0.00 to 600.00 in units of 0.01 s.
1	The acceleration/deceleration time settings range is 0.00 to 600.00 in units of 0.1 s.

■ Switching Acceleration and Deceleration Time Using Multi-Function Input Terminal Commands

Using the Inverter, you can set four acceleration times and four deceleration times. When the multi-function input terminals (H1-□□) are set to 7 (acceleration/deceleration time selection 1) and 1A (acceleration/deceleration time selection 2), you can switch the acceleration/deceleration time even during operation by combining the ON/OFF status of the terminals.

The following table shows the acceleration/deceleration time switching combinations.

Acceleration/Deceleration Time Selection 1 Terminal	Acceleration/Deceleration Time Selection 2 Terminal	Acceleration Time	Deceleration Time
OFF	OFF	C1-01	C1-02
ON	OFF	C1-03	C1-04
OFF	ON	C1-05	C1-06
ON	ON	C1-07	C1-08

■ Switching Acceleration and Deceleration Time Automatically

Use this setting when you want to switch acceleration/deceleration time automatically using the set frequency.

When the output frequency reaches the set value in C1-11, the Inverter switches the acceleration/deceleration time automatically as shown in the following diagram.

Set C1-11 to a value other than 0.0 Hz. If C1-11 is set to 0.0 Hz, the function will be disabled.

Output frequency

Acceleration/
deceleration   time
switching frequency
(C1-11)

C1-07 rate   C1-01 rate   C1-02 rate   C1-08 rate

When output frequency ≥ C1-11, acceleration and deceleration are performed using
Acceleration/deceleration Time 1 (C1-01, C1-02).

When output frequency < C1-11, acceleration and deceleration are performed using
Acceleration/deceleration Time 4 (C1-07, C1-08).

Fig 6.21   Acceleration/deceleration Time Switching Frequency

■**Adjusting Acceleration and Deceleration Time Using an Analog Input**

If you set H3-09 (Multi-function Analog Input Terminal A2 Function Selection) to 5 (acceleration/deceleration time gain), you can adjust the acceleration/deceleration time using terminal A2's input voltage.

The Inverter's acceleration time when the acceleration time has been set in C1-01 is as follows:

Acceleration time = C1-01 set value x acceleration/deceleration time gain

Acceleration/deceleration time gain (set value: 5)

100%

(Acceleration/deceleration gain from 1 to
10 V) = 10 V/Input voltage (V) x 10 (%)

50%

20%
10%

0 1V 2V   5 V   10 V
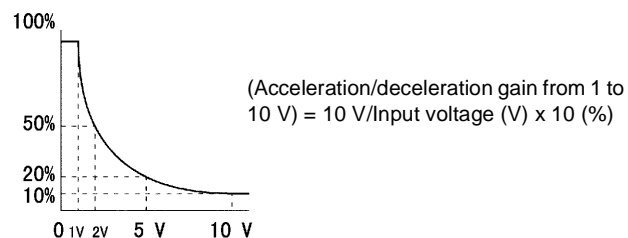
Fig 6.22   Acceleration/Deceleration Time Gain Using an Analog Input

6

■Entering S-curve Characteristics in the Acceleration and Deceleration Time

By performing acceleration and deceleration using an S-curve pattern, you can reduce shock when starting and stopping the machine.

Using the Inverter, you can set an S-curve characteristic time for each of the following: Acceleration start time, deceleration start time, acceleration end time, and deceleration end time.

> **INFO**
>
> Set the S-curve characteristic time to lengthen acceleration/deceleration time as follows:
> Acceleration time = Selected acceleration time + (Acceleration start time S-curve characteristic time + Acceleration end time S-curve characteristic time) / 2
> Deceleration time = Selected deceleration time + (Deceleration start time S-curve characteristic time + Deceleration end time S-curve characteristic time) / 2

Setting Example

The S-curve characteristic when switching operation (forward/reverse) is shown in the following diagram.
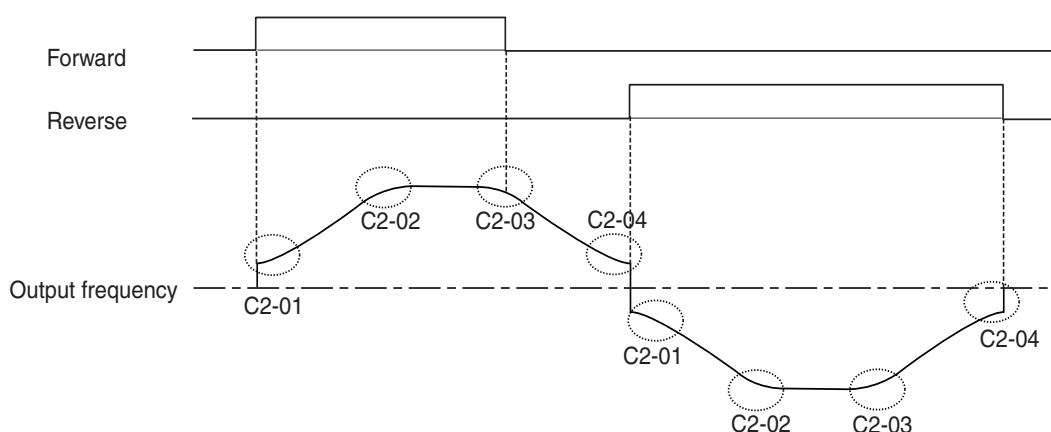
Fig 6.23 S-curve Characteristic during Operation Switching

◆ Accelerating and Decelerating Heavy Loads (Dwell Function)

The dwell function stores the output frequency when starting or stopping heavy loads. By temporarily storing the output frequency, the motor can be prevented from stalling.

The deceleration stop must be selected when using the dwell function. Set b1-03 (Stopping Method Selection) to 0.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
b6-01	Dwell frequency at start		0.0 to 400.0	0.0 Hz	No	A	A	A
	Dwell Ref@Start							
b6-02	Dwell time at start		0.0 to 10.0	0.0 s	No	A	A	A
	Dwell Time@Start							
b6-03	Dwell frequency at stop		0.0 to 400.0	0.0 Hz	No	A	A	A
	Dwell Ref@Stop							
b6-04	Dwell time at stop	The dwell function is used to output a frequency temporarily when driving a motor with a heavy load.	0.0 to 10.0	0.0 s	No	A	A	A
	Dwell Time@Stop							

◆ Preventing the Motor from Stalling During Acceleration (Stall Prevention During Acceleration Function)

The Stall Prevention During Acceleration function prevents the motor from stalling if a heavy load is placed on the motor, or sudden rapid acceleration is performed.

If you set L3-01 to 1 (enabled) and the Inverter output current exceeds the -15% level of the set value in L3-02, the acceleration rate will begin to slow down. When L3-02 is exceeded, acceleration will stop.

If you set L3-01 to 2 (optimum adjustment), the motor current accelerates to the value set in L3-02. With this setting, the acceleration time setting is ignored.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
L3-01	Stall prevention selection during acceleration	0: Disabled (Accelerates according to the setting. Motor may stall if the load is too great.) 1: Enabled (Acceleration stops when the level set in L3-02 is exceeded. Acceleration restarts using current value recovery.) 2: Optimum adjustment (Adjusts acceleration using the level set in L3-02 as the standard. The acceleration time setting is ignored.)	0 to 2	1	No	A	A	A
	StallP Accel Sel							
L3-02	Stall prevention level dur-ing acceleration	Set as a percent taking the Inverter rated voltage to be 100%. Normally, it is not necessary to change this setting. Lower the set value if the motor stalls using the factory setting.	0 to 200	120%*	No	A	A	A
	StallP Accel Lvl							
L3-03	Stall prevention limit dur-ing acceleration	If using the motor at a frequency higher than the setting in E1-06, set the lower limit of the stall pre-vention level during acceleration as a percent, tak-ing the Inverter rated current to be 100%. Normally, it is not necessary to change this setting.	0 to 100	50%	No	A	A	A
	StallP CHP Lvl							

* Shows the initial value when C6-01 is set to 1. If C6-01 is set to 0, the initial value is 150%.

6

■Time Chart

The following figure shows the frequency characteristics when L3-01 is set to 1.
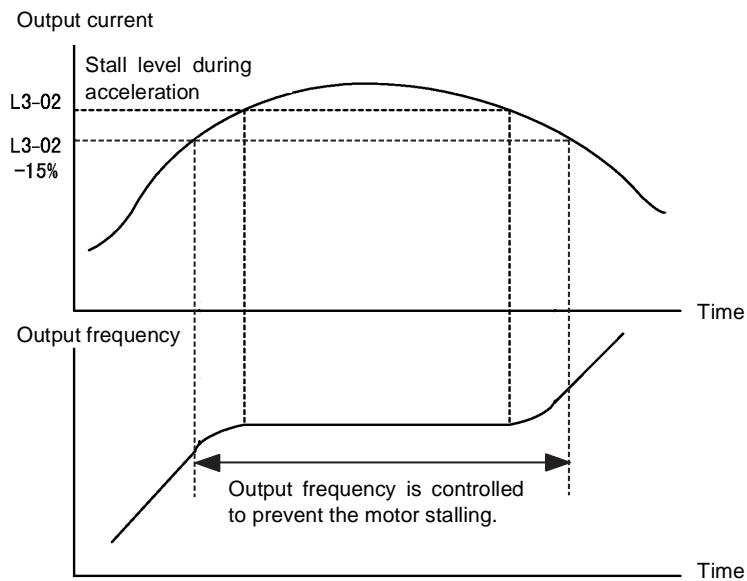
Fig 6.24 Time Chart for Stall Prevention During Acceleration

■Setting Precautions

- If the motor capacity is small compared to the Inverter capacity, or if the motor is operated using the factory settings, resulting in the motor stalling, lower the set value of L3-02.

- If using the motor in the constant output range, L3-02 will be automatically lowered to prevent stalling. L3-03 is the limit value to prevent the stall prevention level in the constant output range from being reduced more than necessary.

- Set the parameters as a percent taking the inverter rated voltage to be 100%.
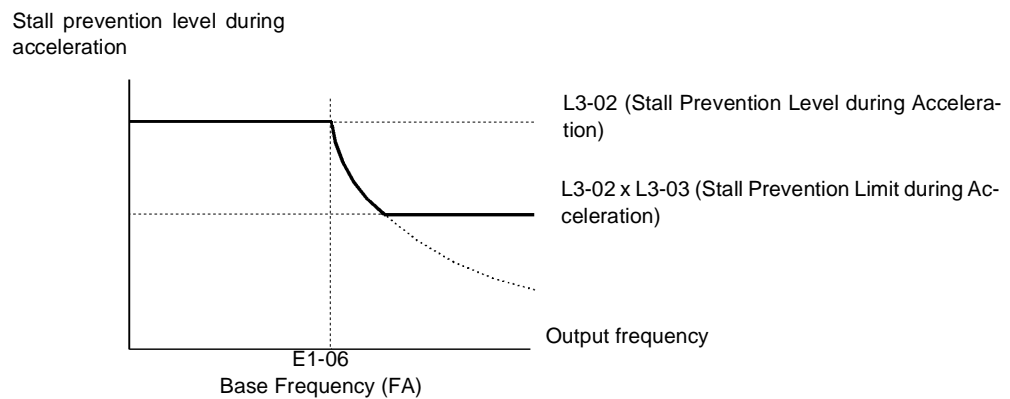
Fig 6.25 Stall Prevention Level and Limit During Acceleration

◆ Preventing Overvoltage During Deceleration (Stall Prevention During Deceleration Function)

The Stall Prevention During Deceleration function makes the rate of deceleration more gentle to suppress increases in DC bus voltage when the DC bus voltage exceeds the set value during motor deceleration.

This function automatically lengthens the deceleration time with respect to the bus voltage, even if the deceleration time has been set to a considerably small value.

If L3-04 is set to 1 or 2, when the main circuit DC voltage approaches the stall prevention level during deceleration, deceleration stops, and when deceleration falls below the level, is restarted. Using this operation, deceleration time is automatically lengthened. If L3-04 is set to 1, deceleration time returns to the set value, and if L3-04 is set to 2, deceleration is automatically adjusted to a faster deceleration time within the range of the stall prevention level during deceleration.

■ Related Parameters

| Param-eter Num-ber | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | |
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
L3-04	Stall prevention selection during deceleration function selection / StallP Decel Sel	0: Disabled (Motor decelerates according to setting. When the deceleration time is short, there is a risk of main circuit overvoltage (0V) occurring.) 1: Enabled (Prevents deceleration when main circuit voltage reaches the overvoltage level. Deceleration restarts after voltage has been restored.) 2: Intelligent deceleration mode (Minimizes deceleration judging from main circuit voltage. The deceleration time setting is ignored.) 3: Enabled (with dynamic braking) If using the dynamic brake option (braking resistor, Braking Resistor Units, and Braking Units), be sure to set parameter L3-04 to 0 or 3.	0 to 3	1	No	Q	Q	Q

6

■Setting Example

An example of stall prevention during deceleration when L3-04 is set to 1 as shown below.
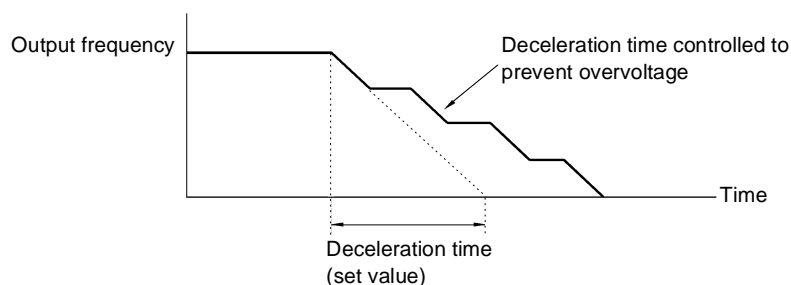
Fig 6.26   Stall Prevention During Deceleration Operation

■Setting Precautions

- The stall prevention level during deceleration differs depending on the Inverter capacity. Refer to the following table for details.

Inverter Capacity		Stall Prevention Level during Deceleration (V)
200 V class		380
400 V class	E1-01 ≥ 400 V	760
	E1-01 < 400 V	660

- When using the braking option (braking resistor, Braking Resistor Units, and Braking Units), be sure to set parameter L3-04 to 0 or 3.

- To decelerate at a shorter time than the deceleration time set when L3-04 is set to 0 with the braking option enabled, set L3-04 to 3.

Adjusting Frequency References

This section explains methods of adjusting frequency references.

◆ Adjusting Analog Frequency References

Gain and bias are among the parameters used to adjust analog inputs.

■Related Parameters

Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop Vec-tor
H3-01	Signal select terminal A1 (voltage) / Term A1 Lvl Sel	0: Voltage limit enabled (Below 0 V is 0 V) 1: Voltage limit disabled Set value 1 can be set for (-E) models.	0 or 1	0	No	A*	A*	A*
H3-02	Gain (terminal A1) / Terminal A1 Gain	Set the frequency during 10 V input as a percent, taking max. output frequency to be 100%.	0.0 to 1000.0	100.0%	Yes	A	A	A
H3-03	Bias (terminal A1) / Terminal A1 Bias	Set the frequency during 0 V input as a percent, taking max. output frequency to be 100%.	-100.0 to +100.0	0.0%	Yes	A	A	A
H3-08	Multi-function analog input terminal A2 signal level selection / Term A2 Signal	0: Limit negative frequency settings for gain and bias settings to 0. 1: Do not limit negative frequency settings for gain and bias settings to 0 (i.e., allow reverse operation). 2: 4 to 20 mA (9-bit input). Switch current and voltage input using the switch on the control panel.	0 to 2	2	No	A	A	A
H3-09	Multi-function analog input terminal A2 function selection / Terminal A2 Sel	Select multi-function analog input function for terminal A2.	0 to 1F	0	No	A	A	A
H3-10	Gain (terminal A2) / Terminal A2 Gain	Set the reference capacity for each function during 10 V (20 mA) input as a percent. Set the 100% content function selected using H3-09 to 100%.	0.0 to 1000.0	100.0%	Yes	A	A	A
H3-11	Bias (terminal A2) / Terminal A2 Bias	Set the reference capacity for each function during 0 V (4 mA) input as a percent. Set the 100% content function selected using H3-09 to 100%.	-100.0 to +100.0	0.0%	Yes	A	A	A

* For (-E) models.

■Adjusting Analog Frequency Reference Using Parameters

The frequency reference is input from the control circuit terminals using analog voltage and current.

If using frequency reference terminal A1 as an input terminal, perform adjustments using parameters H3-02 and H3-03. If using multi-function analog input terminal A2 as a frequency reference terminal, perform adjustments using H3-10 and H3-11.

6

Frequency reference

H3-02

H3-03

0 V   10 V

Terminal A1 input

Terminal A1 input voltage

Frequency reference

H3-10

H3-11

0 V (4 mA)   10 V (20 mA)

Terminal A2 input

Terminal A2 input voltage (current)
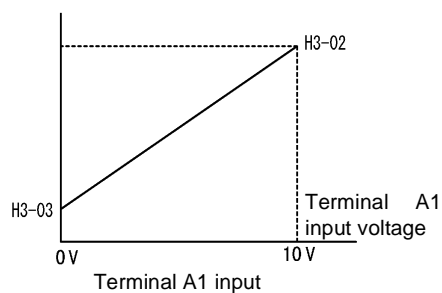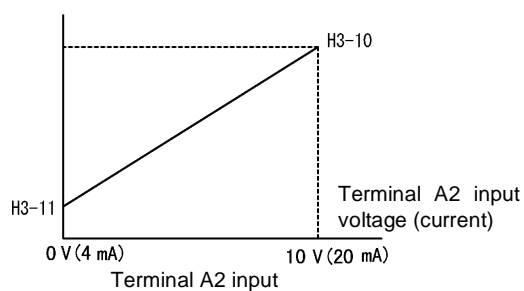
Fig 6.27   Terminals A1 and A2 Inputs

■Adjusting Frequency Gain Using an Analog Input

When H3-09 is set to 1 (frequency gain), you can adjust the frequency gain using an analog input.

Frequency gain

100%

0 V (4 mA)   10 V (20 mA)

Multi-function analog input terminal A2 input level
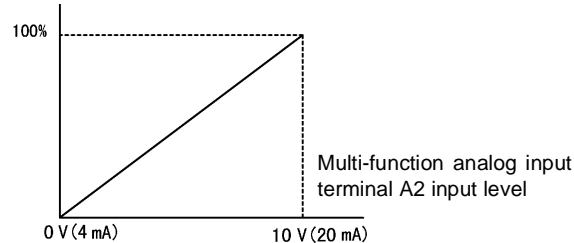
Fig 6.28 Frequency Gain Adjustment (Terminal A2 Input)

The frequency gain for terminal A1 is the sum of H3-02 and terminal A2 gain. For example, when H3-02 is set to 100% and terminal A2 is set to 5 V, the terminal A1 frequency reference will be 50%.

Frequency reference

100%   H3-02

50%   H3-02 × 0.5

0   10 V

Terminal A1 input voltage
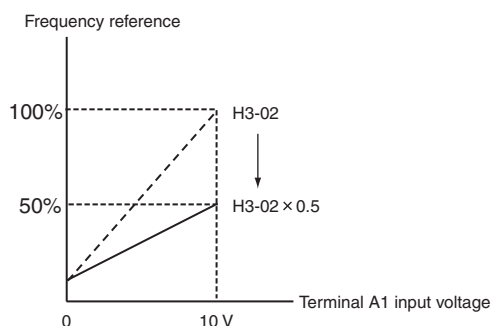
■Adjusting Frequency Bias Using an Analog Input

When parameter H3-09 is set to 0 (add to terminal A1), the frequency equivalent to the terminal A2 input voltage is added to A1 as a bias.

Frequency bias

100%

Multi-function analog input
terminal A2 input level

0 V (4 mA)   10 V (20 mA)
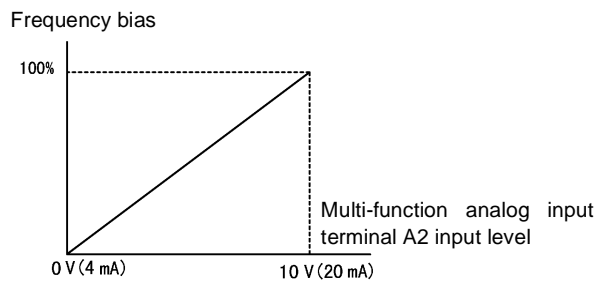
Fig 6.29 Frequency Bias Adjustment (Terminal A2 Input)

For example, if H3-02 is 100%, H3-03 is 0%, and terminal A2 is set to 1 V, the frequency reference from terminal A1 when 0 V is input to A1 will be 10%.

Frequency reference

H3-02

10%
Bias

Terminal A1 input voltage

0 V   10 V
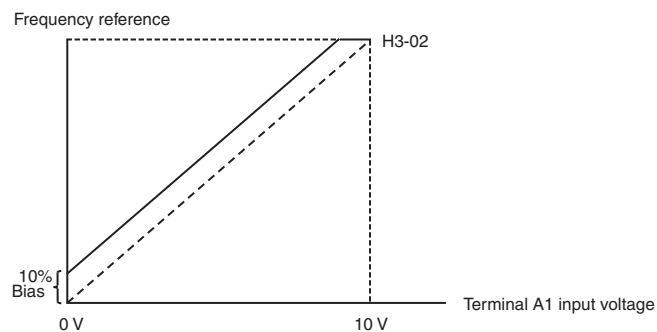
◆ Operation Avoiding Resonance (Jump Frequency Function)

The jump frequency function operates the motor while avoiding resonance caused by characteristic frequencies in the machinery.

This function is effective in creating a frequency reference dead band.

During constant-speed operation, operation within the jump frequency range is prohibited. Smooth operation still used during acceleration and deceleration, i.e., jumps are not performed.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
d3-01	Jump frequency 1	Set the frequency center value at which to prohibit settings, in hertz. Set to 0.0 to disable the jump frequency. Make sure the settings are as follows: d3-01 ≥ d3-02 ≥ d3-03. Operation within the jump frequency range is prohibited. Changes during acceleration and deceleration are made gradually without performing jumps.	0.0 to 400.0	0.0 Hz	No	A	A	A
	Jump Freq 1							
d3-02	Jump frequency 2			0.0 Hz	No	A	A	A
	Jump Freq 2							
d3-03	Jump frequency 3			0.0 Hz	No	A	A	A
	Jump Freq 3							
d3-04	Jump frequency width	Set the jump frequency width in hertz. The jump frequency range is as follows: (Jump frequency ±d3-04).	0.0 to 20.0	1.0 Hz	No	A	A	A
	Jump Bandwidth							

6

The relationship between the output frequency and the jump frequency reference is as follows:
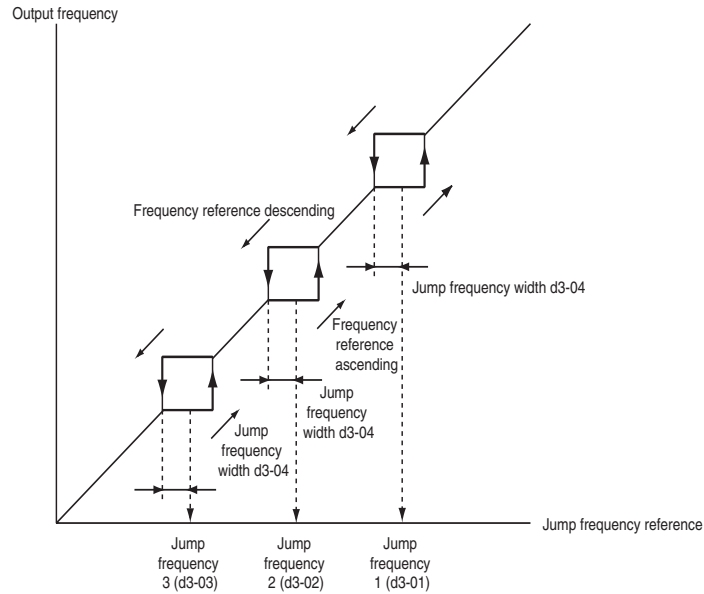
Fig 6.30 Jump Frequency

■**Setting Jump Frequency Reference Using an Analog Input**

When parameter H3-09 (Multi-function Analog Input Terminal A2 Function Selection) is set to A (jump frequency), you can change the jump frequency using the terminal A2 input level.
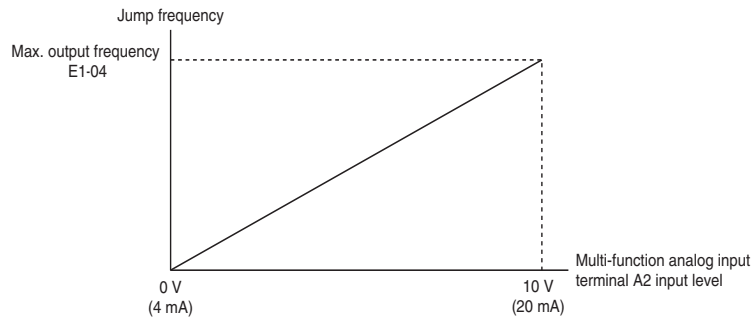
Fig 6.31   Jump Frequency Setting Using an Analog Input

■**Setting Precautions**

- Set the jump frequency according to the following formula: d3-01 ≥ d3-02 ≥ d3-03 > Analog input.
- When parameters d3-01 to d3-03 are set to 0 Hz, the jump frequency function is disabled.

◆ **Adjusting Frequency Reference Using Pulse Train Inputs**

The frequency reference can be adjusted when b1-01 (Reference Selection) is set to 4 (Pulse Train Input). Set the pulse frequency in parameter H6-02 to 100% reference, and then adjust the gain and bias accordingly using H6-03 and H6-04.

■**Related Parameters**

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
H6-01	Pulse train input function selection	0: Frequency reference 1: PID feedback value 2: PID target value	0 to 2	0	No	A	A	A
	Pulse Input Sel							
H6-02	Pulse train input scaling	Set the number of pulses in Hz, taking the refer-ence to be 100%.	1000 to 32000	1440 Hz	Yes	A	A	A
	Pulse In Scaling							
H6-03	Pulse train input gain	Set the input gain level as a percent when the pulse train set in H6-02 is input.	0.0 to 1000.0	100.0%	Yes	A	A	A
	Pulse Input Gain							
H6-04	Pulse train input bias	Set the input bias when the pulse train is 0.	-100.0 to 100.0	0.0%	Yes	A	A	A
	Pulse Input Bias							
H6-05	Pulse train input filter time	Set the pulse train input primary delay filter time constant in seconds.	0.00 to 2.00	0.10 s	Yes	A	A	A
	Pulse In Filter							

The following diagram shows the method for adjusting the frequency reference using pulse inputs.
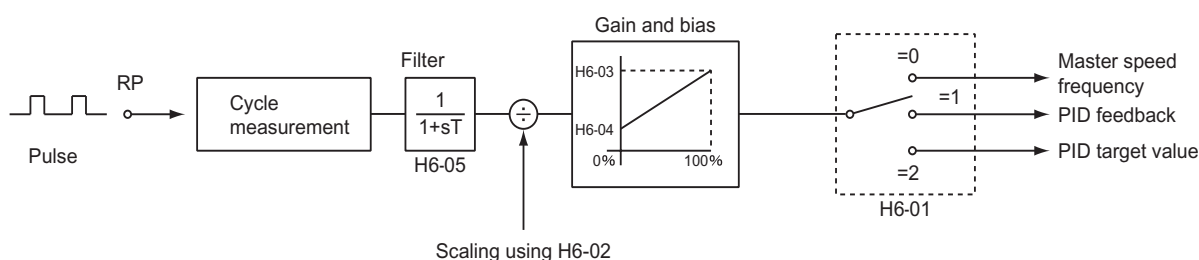
Fig 6.32   Frequency Reference Adjustments Using Pulse Train Inputs

■**Setting example**

This example results in an output frequency of 30 Hz when a 2-kHz pulse is input (maximum frequency: 60 Hz).

2000 Hz: 30 Hz = Set value: 60 Hz

Set value = 2000 x 60/30 = 4000 Hz (4 kHz)

■**Setting precautions**

The pulse train inputs of the Inverter do not control positioning as they do for servomotors and stepper motors. Speed control is thus absolutely necessary. Make adjustments with the following procedure.

1. First, adjust the pulse train input bias setting.
    Adjust the output with respect to the pulse input near the minimum output frequency.

2. Next, adjust the pulse train input gain setting.
    Adjust the output with respect to the pulse input near the maximum output frequency.

6

Speed Limit (Frequency Reference Limit Function)

This section explains how to limit the motor speed.

◆ Limiting Maximum Output Frequency

If you do not want the motor to rotate above a given frequency, use parameter d2-01.

Set the upper limit value of the Inverter output frequency as a percent, taking E1-04 (Maximum Output Frequency) to be 100%.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
d2-01	Frequency reference upper limit / Ref Upper Limit	Set the output frequency upper limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	100.0%	No	A	A	A

◆ Limiting Minimum Frequency

If you do not want the motor to rotate at below a given frequency, use parameters d2-02 or d2-03.

There are two methods of limiting the minimum frequency, as follows:

- Adjust the minimum level for all frequencies.
- Adjust the minimum level for the master speed frequency (i.e., the lower levels of the jog frequency, multi-step speed frequency, and auxiliary frequency will not be adjusted).

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
d2-02	Frequency reference lower limit / Ref Lower Limit	Set the output frequency lower limit as a percent, taking the base reference to be 100%.	0.0 to 110.0	0.0%	No	A	A	A
d2-03	Master speed reference lower limit / Ref1 Lower Limit	Set the master speed reference lower limit as a percent, taking the max. output frequency to be 100%.	0.0 to 110.0	0.0%	No	A	A	A

■Adjusting Frequency Lower Limit Using an Analog Input

If you set parameter H3-09 (Multi-function Analog Input Terminal A2 Function Selection) to 9 (output frequency lower level), you can adjust the frequency lower level using the terminal A2 input level.

Output frequency lower level

Max. output frequency
E1-04

0 V
(4 mA)

10 V
(20 mA)

Multi-function analog input
terminal A2 input level
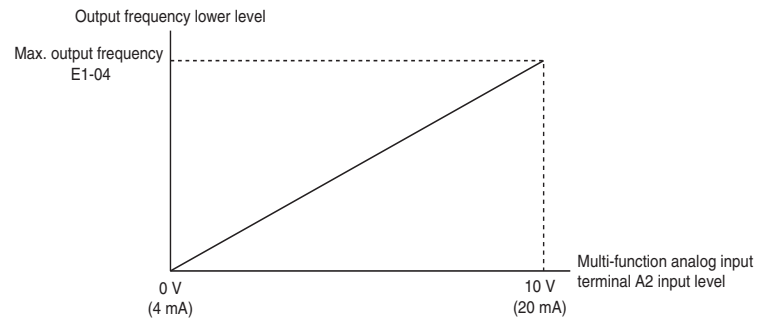
Fig 6.33   Analog Output Characteristics of Output Frequency Lower Level

INFO

If parameter d2-02 and terminal A2 output frequency lower level have been set at the same time, the larger set value will become the frequency lower limit.

6

Improved Operating Efficiency

This section explains functions for improving motor operating efficiency.

◆ Reducing Motor Speed Fluctuation (Slip Compensation Function)

When the load is large, the amount of motor slip also grows large and the motor speed decreases. The slip compensation function controls the motor at a constant speed, regardless of changes in load. When the motor is operating at the rated load, parameter E2-02 (Motor Rated Slip) × the frequency in parameter C3-01 is added to the output frequency.

■Related Parameters

Param-eter Num-ber	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
							V/f	V/f with PG	Open Loop Vec-tor
	LCD Display								
C3-01	Slip compensation gain		Use this parameter to improve speed accuracy when operating under a load. Normally, there is no need to make this setting. Adjust parameter C3-01 under the following conditions: • Increase the set value when the speed falls to below the target value. • Decrease the set value when the speed rises to above the target value.	0.0 to 2.5	0.0*	Yes	A	No	A
	Slip Comp Gain								
C3-02	Slip compensation primary delay time		Set the primary delay time constant for the slip compensation function in seconds. Normally, there is no need to make this setting. Adjust parameter C3-02 under the following conditions: • When the slip compensation response is low, lower the set value. • When the speed is unstable, increase the set value.	0 to 10000	2000 ms *	No	A	No	A
	Slip Comp Time								
C3-03	Slip compensation limit		Set the upper limit of the compensation amount for the slip compensation function as a percent, taking the motor rated slip amount to be 100%.	0 to 250	200%	No	A	No	A
	Slip Comp Limit								
C3-04	Slip compensation during regeneration		0: Slip compensation is disabled during regeneration. 1: Slip compensation is enabled during regeneration. If the slip compensation function operates during regeneration, you might have to use the braking option (braking resistor, Braking Resistor Unit, or Braking Unit) to momentarily increase the regenerative amount.	0 or 1	0	No	A	No	A
	Slip Comp Regan								
C3-05	Output voltage limit operation selection		0: Disabled. 1: Enabled. (The motor flux will be lowered automatically when the output voltage become saturated.)	0 or 1	0	No	No	No	A
	V/F Slip Cmp Sel								

* The factory setting will change when the control method is changed. (V/f control factory settings are given.)

■Adjusting Slip Compensation Gain

The C3-01 parameter is initialized as shown below for the control method.

- V/f control without PG: 0.0
- Open loop vector control: 1.0

Set C3-01 to 1.0 to compensate the rated slip set using the rated torque output status.

Adjust the slip compensation gain using the following procedure.

1. Set E2-02 (Motor Rated Slip) and E2-03 (Motor No-load Current) correctly.
   The motor rated slip is calculated from the values on the motor nameplate using the following formula.
   Amount of motor rated slip (Hz) = Motor rated frequency (Hz) - No. of rated rotations (r/min.) × No. of motor poles / 120
   Set the values for rated voltage, rated frequency, and no-load current in the motor unladen current. The motor rated slip is set automatically in the vector control using autotuning.

2. In V/f control, set C3-01 to 1.0. Setting this parameter to 0.0 disables slip compensation.

3. Apply a load, and measure the speed to adjust the slip compensation gain. Adjust the slip compensation gain by 0.1 at a time. If the speed is less than the target value, increase the slip compensation gain, and if the speed is greater than the target value, reduce the slip compensation gain.

■Adjusting Slip Compensation Primary Delay Time Constant

Set the slip compensation primary delay time constant in ms.

The factory setting is related to the control method as follows:

- V/f control without PG: 2000 ms
- Open loop vector control: 200 ms

Normally, there is no need to make these settings. When the slip compensation response is low, lower the set value. When the speed is unstable, increase the set value.

■Adjusting Slip Compensation Limit

Set the upper limit for the slip compensation amount as a percent, taking the motor rated slip amount as 100%.

If the speed is lower than the target value but does not change even when you adjust the slip compensation gain, the motor may have reached the slip compensation limit. Increase the limit, and check the speed again. Make the settings, however, to make sure that the value of the slip compensation limit and reference frequency does not exceed the tolerance of the machine.

The following diagram shows the slip compensation limit for the constant torque range and fixed output range.

E1-06: Base frequency
E1-04: Maximum output frequency
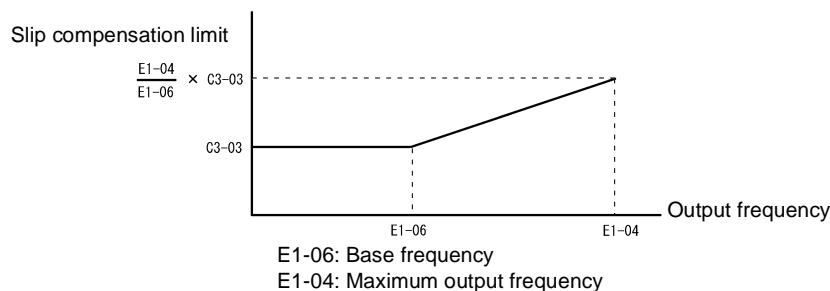
Fig 6.34 Slip Compensation Limit

6

■Selecting Slip Compensation Function During Regeneration

Set whether to enable or disable the slip compensation function during regeneration.

For the slip compensation function operates during regeneration, the braking option (braking resistor, Braking Resistor Unit, and Braking Unit) may be useful to momentarily increase the regenerative amount.

■Selecting Output Voltage Limit Operation

If output voltage saturation occurs while the output voltage limit operation is disabled, the output current will not change, but torque control accuracy will be lost. If torque control accuracy is required, change the settings to enable the output voltage limit operation.

If the output voltage limit operation is enabled, motor magnetic flux current is controlled automatically, and torque control accuracy is maintained to limit the output voltage references. Consequently, the output current will increase by approximately 10% maximum (with rated load) compared with when the output voltage limit operation is disabled, so check the Inverter current margin.

Setting Precautions

- If using the device at medium to low speed only, if the power supply voltage is 10% or more higher than the motor rated voltage, or if the torque control accuracy at high speeds is insufficient, it is not necessary to change the output voltage limit operation.

- If the power supply voltage is too low compared with the motor rated voltage, torque control accuracy may be lost even if the output voltage limit operation is enabled.

◆ Compensating for Insufficient Torque at Startup and Low-speed Operation (Torque Compensation)

The torque compensation function detects that the motor load has increased, and increases the output torque.

V/f control calculates and adjusts the motor primary loss voltage according to the output voltage (V), and compensates for insufficient torque at startup and during low-speed operation. Calculate the compensation voltage as follows: Motor primary voltage loss × parameter C4-01.

Vector control separates the motor excitation current and the torque current by calculating the motor primary current, and controlling each of the two separately.

Calculate the torque current as follows: Calculated torque reference × C4-01

■**Related Parameters**

| Param-eter Num-ber | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | |
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
C4-01	Torque compensation gain / Torq Comp Gain	Set the torque compensation gain using the multi-plication factor. Normally, there is no need to change this parameter. Adjust the torque compen-sation gain in the following circumstances. • If the cable is very long, increase the set value. • If the motor is smaller than the maximum applicable motor of the Inverter, increase the set value. • If the motor is vibrating, reduce the set value. Adjust this parameter so that the output current during low-speed rotation does not exceed the Inverter rated output current range.	0.00 to 2.50	1.00	Yes	A	A	A
C4-02	Torque compensation pri-mary delay time constant / Torq Comp Time	Set the primary delay for the torque compensation function in ms. Normally, there is no need to make this setting. Adjust this parameter in the following circum-stances. • If the motor is vibrating, increase the set value. • If the motor response is low, decrease the set value.	0 to 10000	200 ms *1	No	A	A	A
C4-03	Starting torque value (for-ward) / F TorqCmp@start	Sets the value based on 100% motor's rated torque.	0.0 to 200.0	0.0%	No	No	No	A*2
C4-04	Starting torque value (reverse) / R TorqCmp@start	Sets the value based on 100% motor's rated torque.	-200.0 to 0.0	0.0%	No	No	No	A*2
C4-05	Starting torque time con-stant / TorqCmp Delay T	Sets the rise time constant (ms) for the starting torque value. The filter is disabled if set between 0 and 4 ms.	0 to 200	10 ms	No	No	No	A*2

* 1. The factory setting will change when the control method is changed. (V/f control factory settings are given.)

* 2. The starting torque value can be set only for (-E) models.

■**Adjusting Torque Compensation Gain**

Normally, there is no need to make this adjustment. Do not adjust the torque compensation gain when using open loop vector control.

For V/f control, adjust the torque compensation gain in the following circumstances.

• If the cable is very long, increase the set value.

• If the (maximum applicable) motor capacity is smaller than the Inverter capacity, increase the set value.

• If the motor is vibrating, reduce the set value.

Adjust this parameter so that the output current during low-speed rotation does not exceed the Inverter rated output current range.

6

■Adjusting the Torque Compensation Primary Delay Time Constant

Set the torque compensation function primary delay in ms.

The factory setting is related to the control method as follows:

- V/f control without PG: 200 ms
- V/f control with PG: 200 ms
- open loop vector control: 20 ms

Normally, there is no need to change the set value. The parameter can be adjusted as follows:

- If the motor is vibrating, increase the set value.
- If the motor response is low, decrease the set value.

◆ Hunting-prevention Function

The hunting-prevention function suppresses hunting when the motor is operating with a light load. This function can be used in V/f without PG and V/f with PG.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
N1-01	Hunting-prevention function selection Hunt Prev Select	0: Hunting-prevention function disabled 1: Hunting-prevention function enabled The hunting-prevention function suppresses hunting when the motor is operating with a light load. This function is enabled in V/f control method only. If high response is to be given priority over vibration suppression, disable the hunting-prevention function.	0 or 1	1	No	A	A	No
N1-02	Hunting-prevention gain Hunt Prev Gain	Set the hunting-prevention gain multiplication factor. Normally, there is no need to make this setting. Make the adjustments as follows: • If vibration occurs with light load, increase the setting. • If the motor stalls, reduce the setting. If the setting is too large, the voltage will be too suppressed and the motor may stall.	0.00 to 2.50	1.00	No	A	A	No

◆ Stabilizing Speed (Speed Feedback Detection Function)

The speed feedback detection control (AFR) stabilizes the speed when a load changes swiftly.

The speed is compensated by the amount of fluctuation from the current feedback torque.

■Related Parameters

Param-eter Num-ber	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display						V/f	V/f with PG	Open Loop Vec-tor
N2-01	Speed feedback detection control (AFR) gain		Set the internal speed feedback detection control gain using the multiplication function. Normally, there is no need to make this setting. Adjust this parameter as follows: • If hunting occurs, increase the set value. • If response is low, decrease the set value. Adjust the setting by 0.05 at a time, while checking the response.	0.00 to 10.00	1.00	No	No	No	A
	AFR Gain								
N2-02	Speed feedback detection control (AFR) time con-stant		Set the time constant to decide the rate of change in the speed feedback detection control.	0 to 2000	50 ms	No	No	No	A
	AFR Time								
N2-03	Speed feedback detection control (AFR) time con-stant 2		Set the time constant to decide the amount of change in the speed.	0 to 2000	750 ms	No	No	No	A
	AFR Time 2								

6

Machine Protection

This section explains functions for protecting the machine.

◆ Limiting Motor Torque (Torque Limit Function)

The motor torque limit function is enabled only in open-loop vector control. The output torque to the motor is calculated internally in open loop vector control. The Torque Limit Function limits this internal torque value to output within a user set value.

This function is used when a load can handle only limited torque, or when limiting the regeneration amount.

■Related Parameters

Param-eter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop Vector
L7-01	Forward drive torque limit / Torq Limit Fwd	Set the torque limit value as a percent of the motor rated torque. You can set up to four separate limits.	0 to 300	200%	No	No	No	A
L7-02	Reverse drive torque limit / Torq Limit Rev		0 to 300	200%	No	No	No	A
L7-03	Forward regenerative torque limit / Torq Lmt Fwd Rgn		0 to 300	200%	No	No	No	A
L7-04	Reverse regenerative torque limit / Torq Lmt Rev Rgn		0 to 300	200%	No	No	No	A

Multi-function Analog Input (H3-09)

Set Value	Function	100% of Contents	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop Vector
10	Positive torque limit	Motor rated torque	No	No	Yes
11	Negative torque limit	Motor rated torque	No	No	Yes
12	Regenerative torque limit	Motor rated torque	No	No	Yes
15	Positive/negative torque limit	Motor rated torque	No	No	Yes

Note The forward torque limit is the limit value when the analog input signal generates forward torque. This torque limit setting is enabled even when the analog input signal generates forward torque while the motor is operating (regeneration).

■Setting the Torque Limit in Parameters

Using L7-01 to L7-04, you can set individually four torque limits in the following directions: Forward drive, reverse drive, forward regeneration, and reverse regeneration.

■Set the Torque Limit Value Using an Analog Input

You can change the analog input level torque limit value by setting the torque limit in multi-function analog input terminal A2.

The analog input terminal signal level is factory-set as follows:

Multi-function analog input terminal A2: 4 to 20 mA (20 mA at input, torque limited to 100% motor rated torque). The following diagram shows the relationship between the torque limits.
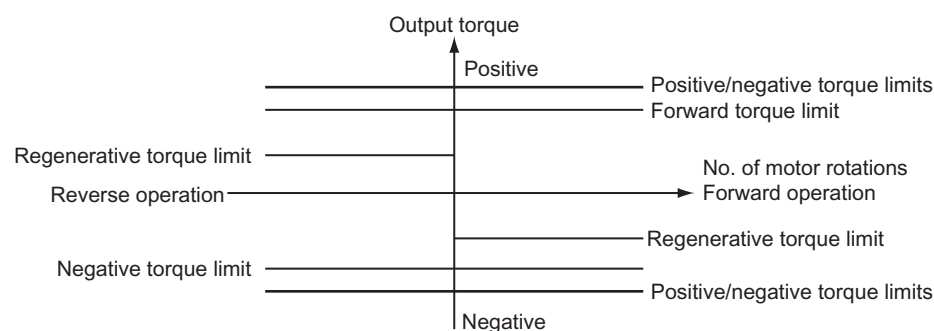
Fig 6.35 Torque Limit by Analog Input

■Setting Torque Limits Using Parameters and an Analog Input

The following block diagram shows the relationship between torque limit using parameters and torque limit using an analog input.

The lowest torque limit set from among the following is enabled: Torque limit using parameters, torque limit using an analog input, 150% of Inverter rating (when set to CT), or 120% of Inverter rating (when set to VT) set in C6-01.
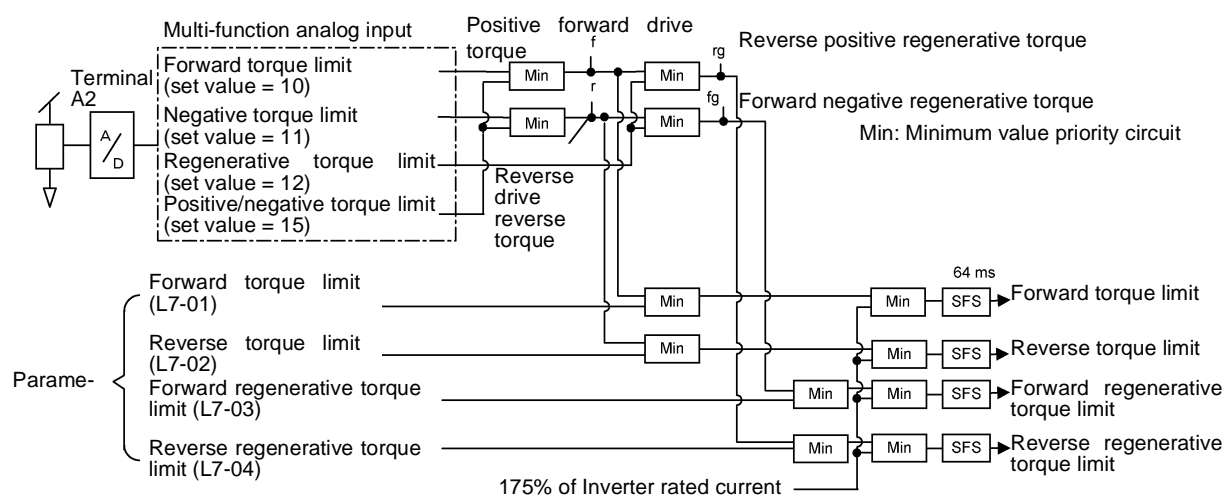
Fig 6.36 Torque Limit Using Parameters and an Analog Input

■**Setting Precautions**

- When the torque limit function is operating, control and compensation of the motor speed is disabled because torque control is given priority.

- When using the torque limit to raise and lower loads, do not carelessly lower the torque limit value, as this may result in the motor falling or slipping.

- Torque limits using an analog input are the upper limit value (during 10 V or 20 mA input) of 100% of the motor rated torque. To make the torque limit value during 10 V or 20 mA input 150% of the rated torque, set the input terminal gain to 150.0 (%). Adjust the gain for multi-function analog input terminal A2 using H3-10.

- The torque limit accuracy is ±5% at the output frequency of 10 Hz or above. When output frequency is less than 10 Hz, accuracy is lowered.

◆ **Preventing Motor Stalling During Operation**

Stall prevention during operation prevents the motor from stalling by automatically lowering the Inverter's output frequency when a transient overload occurs while the motor is operating at a constant speed.

Stall prevention during operation is enabled only during V/f control. If the Inverter output current continues to exceed the setting in parameter L3-06 for 100 ms or longer, the motor speed is reduced. Set whether to enable or disable deceleration time using parameter L3-05. Set the deceleration time using C1-02 (Acceleration time 1) or C1-04 (Acceleration Time 2).

If the Inverter output current reaches the set value in L3-06 - 2% (Inverter Rated Output Current), the motor will accelerate again at the frequency set or the acceleration time set.

■**Related Parameters**

| Param-eter Num-ber | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | |
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
L3-05	Stall prevention selection during running function selection StallP Run Sel	0: Disabled (Operates according to the setting. Motor may stall when the load is large.) 1: Enabled--Deceleration time 1 (Stall prevention function during operation deceleration time is set in C1-02.) 2: Enabled--Deceleration time 2 (Stall prevention function during operation deceleration time is set in C1-04.)	0 to 2	1	No	A	A	No
L3-06	Stall prevention level dur-ing running StallP Run Level	Enabled when L3-05 is set to 1 or 2. Set as a per-cent, taking Inverter rated current to be 100%. Normally, there is no need to make this setting. Lower the set value if the motor stalls at the fac-tory setting.	30 to 200	120% *	No	A	A	No

* The initial value when C6-01 is set to 1 is given. If C6-01 is set to 0, the initial value will be 150%.

◆ Changing Stall Prevention Level during Operation Using an Analog Input

If you set H3-09 (Multi-function Analog Input Terminal A2 Function Selection) to 8 (stall prevention during operation level), you can change the stall level during operation by setting H3-10 (Gain (Terminal A2)) and H3-11 (Bias (Terminal A2)).

The stall prevention level during operation enabled is the multi-function analog input terminal A2 input level or the set value in parameter L3-06, whichever is the smaller.

Stall prevention level during operation
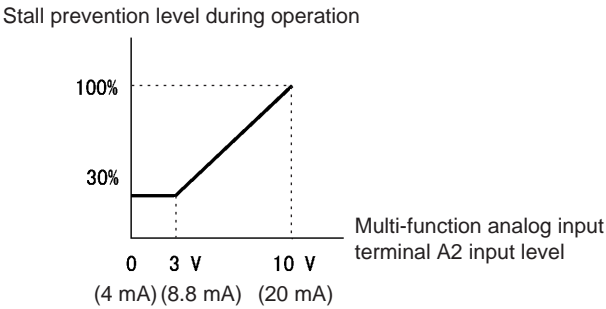
Fig 6.37   Stall Prevention Level during Operation Using an Analog Input

INFO: If the motor capacity is smaller than the Inverter capacity or the motor stalls when operating at the factory settings, lower the stall prevention level during operation.

◆ Detecting Motor Torque

If an excessive load is placed on the machinery (overtorque) or the load is suddenly lightened (undertorque), an alarm signal can be set to multi-function output terminal M1-M2, M3-M4/P1-PC, or M5-M6/P2-PC.

To use the overtorque/undertorque detection function, set B, 17, 18, 19 (overtorque/undertorque detection NO/NC) in one of the following parameters: H2-01 to H2-03 (selects functions for multi-function output terminals M1-M2, M3-M4/P1-PC, or M5-M6/P2-PC).

The overtorque/undertorque detection level is the current level (Inverter rated output current 100%) in V/f control, and the motor torque (motor rated torque 100%) in vector control.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
L6-01	Torque detection selection 1	0: Overtorque/undertorque detection disabled. 1: Overtorque detection only with speed agreement; operation continues after overtorque (warning). 2: Overtorque detected continuously during operation; operation continues after overtorque (warning). 3: Overtorque detection only with speed agreement; output stopped upon detection (protected operation). 4: Overtorque detected continuously during operation; output stopped upon detection (protected operation). 5: Undertorque detection only with speed agreement; operation continues after overtorque (warning). 6: Undertorque detected continuously during operation; operation continues after overtorque (warning). 7: Undertorque detection only with speed agreement; output stopped upon detection (protected operation). 8: Undertorque detected continuously during operation; output stopped upon detection (protected operation).	0 to 8	0	No	A	A	A
	Torq Det 1 Sel							
L6-02	Torque detection level 1	Open-loop vector control: Motor rated torque is set as 100%. V/f control: Inverter rated current is set as 100%.	0 to 300	150%	No	A	A	A
	Torq Det 1 Lvl							
L6-03	Torque detection time 1	Set the overtorque/undertorque detection time in 1-second units.	0.0 to 10.0	0.1 s	No	A	A	A
	Torq Det 1 Time							
L6-04	Torque detection selection 2	Output of torque detection 1 is enabled by setting 17 for H2-☐☐ and output of torque detection 1 is enabled by setting 18 or 18 for H2-☐☐.	0 to 8	0	No	A	A	A
	Torq Det 2 Sel							
L6-05	Torque detection level 2		0 to 300	150%	No	A	A	A
	Torq Det 2 Lvl							
L6-06	Torque detection time 2		0.0 to 10.0	0.1 s	No	A	A	A
	Torq Det 2 Time							

Multi-function Digital Outputs (H2-01 to H2-03)

Set Value	Function	Control Methods		
		V/f	V/f with PG	Open Loop Vec-tor
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque detection and undertorque detection enabled when contact is ON)	Yes	Yes	Yes
17	Overtorque/undertorque detection 1 NC (NC contact: Overtorque detection and undertorque detection enabled when contact is OFF)	Yes	Yes	Yes
18	Overtorque/undertorque detection 2 NO (NO contact: Overtorque detection and undertorque detection enabled when contact is ON)	Yes	Yes	Yes
19	Overtorque/undertorque detection 2 NC (NC contact: Overtorque detection and undertorque detection enabled when contact is OFF)	Yes	Yes	Yes

■L6-01 and L6-04 Set Values and LED Indicators

The relationship between alarms displayed by the Digital Operator when overtorque or undertorque is detected, and the set values in L6-01 and L6-04, is shown in the following table.

Set Value	Function	LED Indicator	
		Overtorque/ Undertorque Detection 1	Overtorque/ Undertorque Detection 2
0	Overtorque/undertorque detection disabled.	-	-
1	Overtorque detection only with speed matching; operation continues after overtorque (warning).	OL3 flashes	OL4 flashes
2	Overtorque detected continuously during operation; operation continues after overtorque (warning).	OL3 flashes	OL4 flashes
3	Overtorque detection only with speed matching; output stopped upon detection (protected operation).	OL3 lit	OL4 lit
4	Overtorque detected continuously during operation; output stopped upon detection (protected operation).	OL3 lit	OL4 lit
5	Undertorque detection only with speed matching; operation continues after overtorque (warning).	UL3 flashes	UL4 flashes
6	Undertorque detected continuously during operation; operation continues after overtorque (warning).	UL3 flashes	UL4 flashes
7	Undertorque detection only with speed matching; output stopped upon detection (protected operation).	UL3 lit	UL4 lit
8	Undertorque detected continuously during operation; output stopped upon detection (protected operation).	UL3 lit	UL4 lit

■Setting Example

The following diagram shows the time chart for overtorque and undertorque detection.

• Overtorque Detection

Motor current (output torque)

L6-02 or L6-05

*

Overtorque detection 1 NO or overtorque detection 2 NO

L6-03 or L6-06

ON
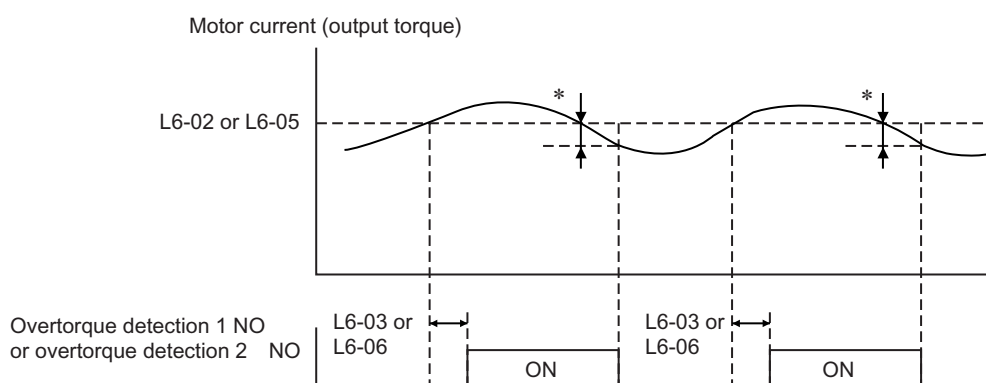
* Overtorque detection disabled band is approximately 10% of the Inverter rated output current (or motor rated torque).

6

• Undertorque Detection

Motor current (output torque)

L6-02 or L6-05

∗

Undertorque detection 1 NO
or Undertorque detection 2 NO

L6-03
or
L6-06   ON   L6-03
or
L6-06   ON

∗ The undertorque detection disabled margin is approximately 10% of the Inverter rated output current (or motor rated torque)
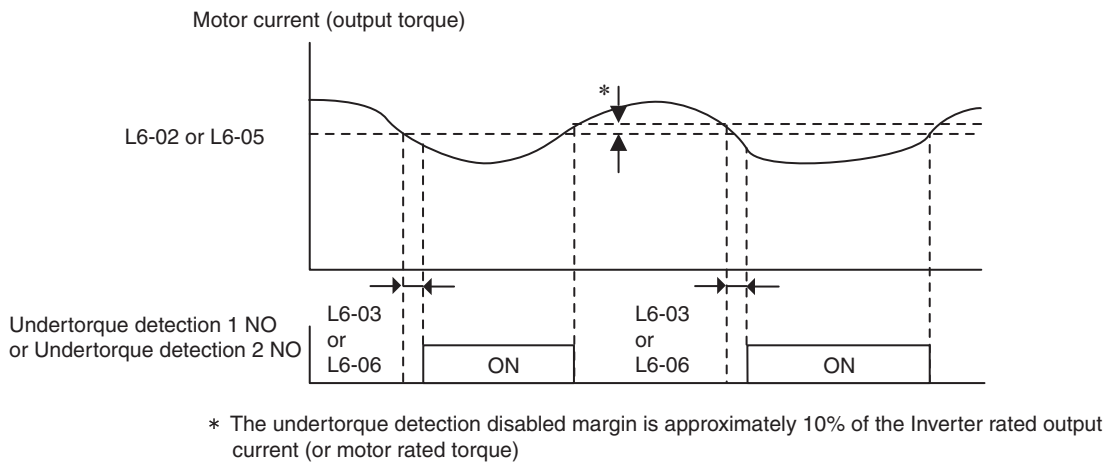
◆ Changing Overtorque and Undertorque Detection Levels Using an Analog Input

If you set parameter H3-09 (Multi-function Analog Input Terminal A2 Function Selection) to 7 (overtorque/undertorque detection level), you can change the overtorque/undertorque detection level.

If you change the overtorque/undertorque detection level using the multi-function analog input, only overtorque/undertorque detection level 1 will be enabled.

The following diagram shows the overtorque/undertorque detection level using an analog input.

Detection level

100 %

0   10 V
(4 mA)   (20 mA)

Multi-function analog input
terminal A2 input level
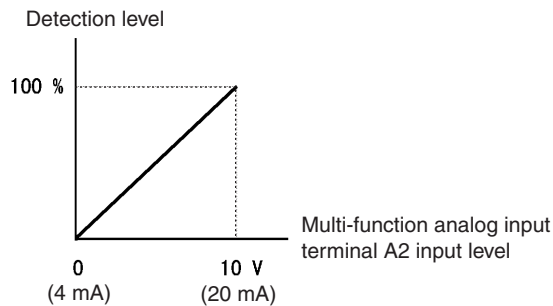
Fig 6.38 Overtorque/Undertorque Detection Level Using an Analog Input

Multi-Function Analog Input (H3-09)

Set Value	Function	Content at 100%	Control Methods		
			V/f	V/f with PG	Open loop Vector
7	Overtorque/Undertorque Detection Level	Motor rated torque (vector control), Inverter rated current (V/f control)	Yes	Yes	Yes

◆ Motor Overload Protection

You can protect the motor from overload using the Inverter's built-in electronic thermal overload relay.

■Related Parameters

Param-eter Num-ber	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display						V/f	V/f with PG	Open Loop Vec-tor
E2-01	Motor rated current		Set the motor rated current in amps. This set value becomes the base value for motor protection and torque limit. It is set automatically when using autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q	Q	Q
	Motor Rated FLA								
E4-01	Motor 2 rated current		Set the motor rated current in Amps. This set value becomes the base value for motor protection and torque limit. It is set automatically when using autotuning.	0.32 to 6.40 *2	1.90 A *1	No	A	A	A
	Motor Rated FLA								
L1-01	Motor protection selection		Set to enable or disable the motor overload protec-tion function using the electronic thermal relay. 0: Disabled 1: General motor protection 2: Inverter special motor protection 3: Vector motor protection With applications where the power supply is often turned ON and OFF, there is a risk that the circuit cannot be protected even if this parameter has been set to 1, as the thermal value will be reset. If multiple motors are connected to one Inverter, set this parameter to 0, and install a thermal relay in	0 to 3	1	No	Q	Q	Q
	MOL Fault Select								
L1-02	Motor protection time con-stant		Set the electronic thermal detection time in min-utes. Normally, there is no need to make this setting. The factory setting is resistance at 150% for 1 min. If the motor overload resistance is clear, set the overload resistance protection time during hot start to suit the motor.	0.1 to 5.0 (0.1 to 20.0)	1.0 min (8.0 min)	No	A	A	A
	MOL Time Const								

* 1. Factory settings depend on Inverter capacity. (The values shown are for a 200 V Class Inverter for 0.4 kW.)
* 2. The settings range is 10% to 200% of the Inverter rated output current. (The values shown are for a 200 V Class Inverter for 0.4 kW.)

Multi-Function Digital Outputs (H2-01 to H2-03)

Set Value	Function	Control Methods		
		V/f	V/f with PG	Open Loop Vec-tor
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)	Yes	Yes	Yes

6

■Setting Motor Rated Current

Set the rated current value on the motor nameplate in parameters E2-01 (for motor 1) and E4-01 (for motor 2). This set value is the electronic thermal base current.

■Setting Motor Overload Protection Characteristics

Set the overload protection function in L1-01 according to the applicable motor.

The induction motor's cooling abilities differ according to the speed control range. Consequently, you must select the electronic thermal protection characteristics to match the applicable motor's tolerance load characteristics.

The following table shows the motor type and tolerance load characteristics.

L1-01 Set Value	Motor Type	Tolerance Load Characteristics	Cooling Ability	Electronic Thermal Operation (at 100% Motor Load)
1	General-purpose motor (standard motor)		Use this motor for operations using a commercial power supply. This motor construction yields best cooling effect when operating at 50/60 Hz.	When operating continuously at 50/60 Hz or less, motor overload detection (OL1) is detected. The Inverter outputs the error contact, and the motor coasts to a stop.
2	Inverter motor (constant torque) (1:10)		This motor yields a cooling effect even when operating at low speeds (approx. 6 Hz).	Operates continuously at 6 to 50/60 Hz.
3	Vector motor (1:100)		This motor yields a cooling effect even when operating at extremely low speeds (approx. 0.6 Hz).	Operates continuously at 0.6 to 60 Hz.

�■**Setting Motor Protection Operation Time**

Set the motor protection operation time in L1-02.

If, after operating the motor continuously at the rated current, a 150% overload is experienced, set the (hot start) electronic thermal protection operation time. The factory setting is resistance to 150% for 60 seconds.

The following diagram shows an example of the characteristics of the electronic thermal protection operation time (L1-02 = 1.0 min., operation at 60 Hz, general-purpose motor characteristics, when L1-01 is set to 1)

Operating time (min.)

Cold start

Hot start

Motor current (%)
E2-01 is set to 100%
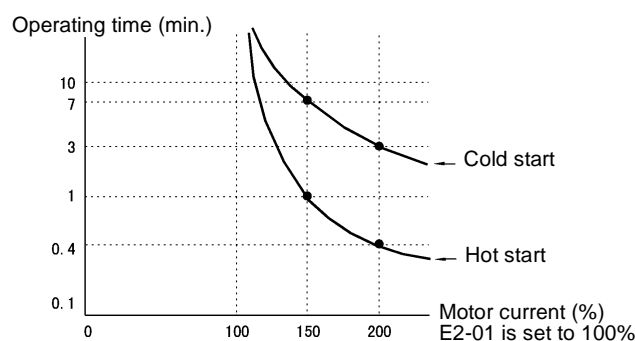
Fig 6.39 Motor Protection Operation Time

�■**Setting Precautions**

- If multiple motors are connected to one Inverter, set parameter L1-01 to 0 (disabled). To protect the motor, install a thermal relay in the motor power cable, and perform overload protection on each motor.
- With applications where the power supply is often turned ON and OFF, there is a risk that the circuit cannot be protected even if this parameter has been set to 1 (enabled), because the thermal value will be reset.
- To detect overloads in good time, set the set value in parameter L1-02 to a low setting.
- When using a general-purpose motor (standard motor), the cooling ability will be lowered by $f^{1/4}$ (frequency). Consequently, the frequency may cause motor overload protection (OL1) to occur, even below the rated current. If operating using the rated current at a low frequency, use a special motor.

�■**Setting the Motor Overload Pre-Alarm**

If the motor overload protection function is enabled (i.e., L1-01 is set to other than 0) and you set H2-01 to H2-03 (multi-function output terminals M1-M2, P1-PC, M3-M4, M5-M6, and P2-PC function selection) to 1F (motor overload OL1 pre-alarm), the motor overload pre-alarm will be enabled. If the electronic thermal value reaches minimum 90% of the overload detection level, the output terminal that has been set will be turned ON.

6

◆ Motor Overheating Protection Using PTC Thermistor Inputs

Perform motor overheating protection using the thermistor temperature resistance characteristics of the PTC (Positive Temperature Coefficient) built into the windings of each motor phase.

■Related Parameters

Param- eter Num- ber	Name		Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods		
	LCD Display						V/f	V/f with PG	Open Loop Vec- tor
L1-03	Alarm operation selection during motor overheating Mtr OH Alarm Sel		Set H3-09 to E, and select the operation when the input motor temperature (thermistor) input exceeds the alarm detection level (1.17 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09. 3: Continue operation (H3 on the Digital Opera- tor flashes).	0 to 3	3	No	A	A	A
L1-04	Motor overheating opera- tion selection Mtr OH Fault Sel		Set H3-09 to E, and select the operation when the motor temperature (thermistor) input exceeds the operation detection level (2.34 V). 0: Decelerate to stop 1: Coast to stop 2: Emergency stop using the deceleration time in C1-09.	0 to 2	1	No	A	A	A
L1-05	Motor temperature input filter time constant Mtr Temp Filter		Set H3-09 to E, and set the primary delay time constant for motor temperature (thermistor) inputs in seconds.	0.00 to 10.00	0.20 s	No	A	A	A

■PTC Thermistor Characteristics

The following diagram shows the characteristics of the PTC thermistor temperature to the resistance value.
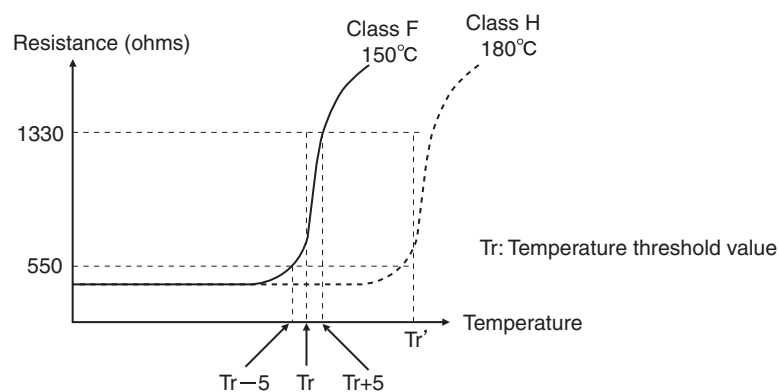
Fig 6.40 PTC Thermistor Temperature-Resistance Value Characteristics

■Operation during Motor Overheating

Set the operation if the motor overheats in parameters L1-03 and L1-04. Set the motor temperature input filter time parameter in L1-05. If the motor overheats, the OH3 and OH4 error codes will be displayed on the Digital Operator.

Error Codes If the Motor Overheats

Error Code	Details
OH3	Inverter stops or continues to operate, according to the setting in L1-03.
OH4	Inverter stops according to the setting in L1-04.

By setting H3-09 (Multi-function Analog Input Terminal A2 Function Selection) to E (Motor temperature input), you can detect alarm OH3 or OH4 using the PTC temperature-resistance characteristics, and protect the motor. The terminal connections are shown in the following diagram.
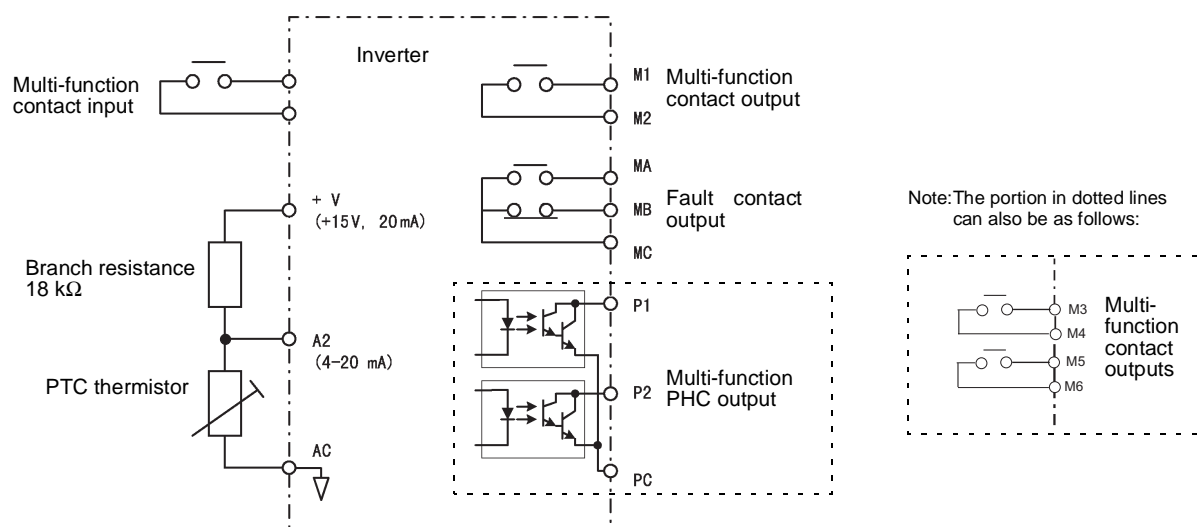
Fig 6.41 Mutual Connections During Motor Overheating Protection

◆ Limiting Motor Rotation Direction

If you set motor reverse rotation prohibited, a reverse run command will not be accepted even if it is input. Use this setting for applications in which reverse motor rotation can cause problems (e.g., fans, pumps, etc.)

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
b1-04	Prohibition of reverse operation	0: Reverse enabled 1: Reverse disabled 2: Switch phase order (reverse enabled)*	0 or 1 (0 to 2)*	0	No	A	A	A
	Reverse Oper							

* Can be set only for (-E)) model. Disabled for V/f with PG.

Continuing Operation

This section explains functions for continuing or automatically restarting Inverter operation even if an error occurs.

◆ Restarting Automatically After Power Is Restored

Even if a temporary power loss occurs, you can restart the Inverter automatically after power is restored to continue motor operation.

To restart the Inverter after power is restored, set L2-01 to 1 or 2.

If L2-01 is set to 1, when power is restored within the time set in L2-02, the Inverter will restart. If the time set in L2-02 is exceeded, alarm UV1 (main circuit undervoltage) will be detected.

If L2-01 is set to 2, when the main power supply is restored while the control power supply (i.e., power supply to the control panel) is backed up, the Inverter will restart. Consequently, alarm UV1 (main circuit undervoltage) will not be detected.

■Related Parameters

Param- eter Num- ber	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec- tor
L2-01	Momentary power loss detection	0: Disabled (main circuit undervoltage (UV) detection) 1: Enabled (Restarted when the power returns within the time for L2-02. When L2-02 is exceeded, main circuit undervoltage detec- tion.) 2: Enabled while CPU is operating. (Restarts when power returns during control operations. Does not detect main circuit undervoltage.)	0 to 2	0	No	A	A	A
	PwrL Selection							
L2-02	Momentary power loss ridethru time	Ridethrough time, when momentary power loss selection (L2-01) is set to 1, in units of seconds.	0 to 2.0	0.1 s *1	No	A	A	A
	PwrL Ridethru t							
L2-03	Min. baseblock (BB) time	Set the Inverter's minimum baseblock time in units of one second, when the Inverter is restarted after power loss ridethrough. Sets the time to approximately 0.7 times the motor secondary circuit time constant. When an overcurrent or overvoltage occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.1 s *1	No	A	A	A
	PwrL Baseblock t							
L2-04	Voltage recovery time	Set the time required to return the Inverter output voltage to normal voltage at the completion of a speed search, in units of one second. Set the time required to recover from 0 V to the maximum voltage.	0.0 to 5.0	0.3 s *1	No	A	A	A
	PwrL V/F Ramp t							
L2-05	Undervoltage (UV) detec- tion level	Sets the main circuit undervoltage (UV) detection level (main circuit DC voltage) in V units. Usually setting is not necessary. Insert an AC reactor in the Inverter input side to lower the main circuit undervoltage detection level.	150 to 210 *2	190 V *2	No	A	A	A
	PUV Det Level							

* 1. Factory settings depend on Inverter capacity. (The values shown are for a 200 V Class Inverter for 0.4 kW.)
* 2. These values are for a 200 V Class Inverter. For a 400 V Class Inverter, double the values.

■Setting Precautions

- Error output signals are not output during momentary power loss recovery.
- To continue Inverter operation after power has been restored, make settings so that run commands from the control main circuit terminal are stored even while power is suspended.

• If the momentary power loss operation selection is set to 0 (Disabled), when the momentary power loss exceeds 15 ms during operation, alarm UV1 (main circuit undervoltage) will be detected.

◆ Speed Search

The speed search function finds the actual speed of the motor that is rotating using inertia, and then starts smoothly from that speed. When restoring power after a temporary power loss, the speed search function switches connection from the commercial power supply, and then restarts, for example, a fan that is rotating due to the mechanical inertia.

■Related Parameters

Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods		
						V/f	V/f with PG	Open Loop Vector
b3-01	Speed search selection (current detection or speed calculation) / Slip Comp Gain	Enables/disables the speed search function for the run command and sets the speed search method. 0: Disabled, speed calculation 1: Enabled, speed calculation 2: Disabled, current detection 3: Enabled, current detection Speed Calculation When the search is started, the motor speed is calculated and acceleration/deceleration is performed from the calculated speed to the specified frequency (motor direction is also searched). Current Detection The speed search is started from the frequency when power was momentarily lost and the maximum frequency, and the speed is detected at the search current level.	0 to 3	2[*1]	No	A	A	A
b3-02	Speed search operating current (current detection) / Spd Srch Current	Sets the speed search operation current as a percentage, taking the Inverter rated current as 100%. Not usually necessary to set. When restarting is not possible with the factory settings, reduce the value.	0 to 200	120%	No	A	No	A
b3-03	Speed search deceleration time (current detection) / SpdSrch Dec time	Sets the output frequency deceleration time during speed search in 1-second units. Set the time for deceleration from the maximum output frequency to the minimum output frequency.	0.1 to 10.0	2.0 s	No	A	No	A
b3-05	Speed search wait time (current detection or speed calculation) / Search Delay	Sets the contactor operating delay time when there is a contactor on the output side of the Inverter. When a speed search is performed after recovering from a momentary power loss, the search operation is delayed by the time set here.	0.0 to 20.0	0.2 s	No	A	A	A
L2-03	Min. base-block time / PwrL Base-block t	Sets the Inverter's minimum baseblock time in units of one second, when the inverter is restarted after power loss ridethrough. Sets the time to approximately 0.7 times the motor secondary circuit time constant. If an overcurrent or undercurrent occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.1 s [*2]	No	A	A	A
L2-04	Voltage recovery time / PwrL V/F Ramp t	Sets the time required to return the Inverter output voltage to normal voltage at the completion of a speed search, in units of one second. Sets the time required to recover from 0 V to the maximum voltage.	0.0 to 5.0	0.3 s[*2]	No	A	A	A

* 1. The factory setting will change when the control method is changed. (V/f control factory settings are given.)
* 2. Factory settings depend on Inverter capacity. (The values shown are for a 200 V Class Inverter for 0.4 kW.)

6

Multi-function Digital Inputs (H1-01 to H1-05)

Set Value	Function	Control Methods		
		V/f	V/f with PG	Open Loop Vector
61	External search command 1 OFF: Speed search disabled (Start from lowest output frequency) ON: Speed estimation (Estimate the motor speed, and start search from estimated speed) 　　Current detection (Start speed search from maximum output frequency)	Yes	No	Yes
62	External search command 2 OFF: Speed search disabled (Start from lowest output frequency) ON: Speed estimation (Estimate the motor speed, and start search from estimated speed) (Same operation as external search command 1) 　　Current detection: Start speed search from set frequency (reference frequency when search command was input).	Yes	No	Yes

■Setting Precautions

- When both external search commands 1 and 2 are set for the multi-function contact terminals, an OPE03 (invalid multi-function input selection) operation error may occur. Set either external search command 1 or external search command 2.

- If speed search during startup is selected when using V/f control with PG, the Unit will start from the frequency detected by PG.

- If performing speed search using external search commands, add an external sequence so that the period when the run command and external search command are both ON is at the very least the Minimum Baseblock Time (L2-03).

- If the Inverter output is equipped with a contact, set the contact operation delay time in the Speed Search Wait Time (b3-05). The factory setting is 0.2 s. When not using the contact, you can reduce the search time by making the setting 0.0 s. After waiting for the speed search wait time, the Inverter starts the speed search.

- Parameter b3-02 is a current detection speed search (current detection level for search completion). When the current falls below the detection level, the speed search is viewed as completed, and the motor accelerates or decelerates to the set frequency. If the motor cannot restart, lower the set value.

- If an overcurrent (OC) is detected when using speed search after recovery following a power loss, lengthen the Minimum Baseblock Time (L2-03).

■Application Precautions for Speed Searches Using Estimated Speed

- When using V/f control with or without a PG, always perform stationary autotuning for only line-to-line resistance before using speed searches based on estimated speeds.

- When using open loop vector control, always perform rotational autotuning before using speed searches based on estimated speeds.

- If the cable length between the motor and Inverter is changed after autotuning has been performed, perform stationary autotuning for only line-to-line resistance again.

> **IMPORTANT**
>
> The motor will not operate when stationary autotuning or stationary autotuning only for line-to-line resistance is performed.

■**Speed Search Selection**

Set whether to enable or disable speed search at startup, and set the type of speed search (estimated speed or current detection) using setting b3-01. To perform speed search when inputting the run command, set b3-01 to 1 or 3.

Table 6.1 Search Methods

Search Name	Estimated Speed	Current Detection
Search Method	Estimates the motor speed when the search starts, and accelerates and decelerates from the estimated speed to the set frequency. You can also search including direction of motor rotation.	Starts speed search from the frequency when the temporary power loss was detected, or from the highest frequency, and performs speed detection at the current level during the search.
External Speed Search Command	External search command 1 and external search command 2 become the same operation, estimating the motor speed and starting the search from the estimated speed.	External speed search command 1: Starts speed search from the maximum output frequency. External speed search command 2: Starts speed search from the frequency reference set before the search command.
Application Precautions	Cannot be used multi-motor drives, motors two or more frames smaller than the Inverter capacity, and high-speed motors (130 Hz min.)	In control method without PG, the motor may accelerate suddenly with light loads.

■**Estimated Speed Search**

The time chart for estimated speed searches is shown below.

Search at Startup

The time chart for when speed search at startup and speed search to multi-function input terminals us shown below.

6
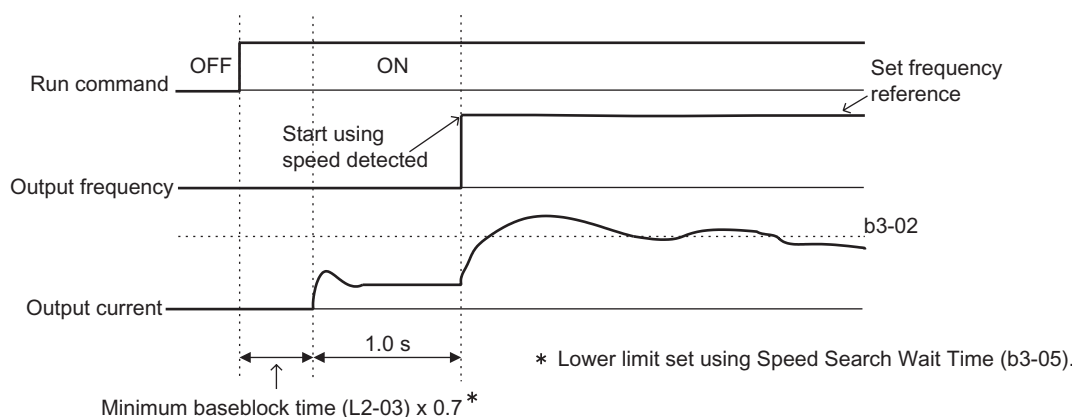
Note: If the stopping method is set to coast to stop, and the run command turns ON in a short time, the operation may be the same as the search in case 2.

Fig 6.42 Speed Search at Startup (Estimated Speed)

Speed Search after Short Baseblock (during Power Loss Recovery, etc.)

- Loss Time Shorter Than the Minimum Baseblock Time (L2-03)

AC power supply — ON / OFF / Start using speed detected / Set frequency reference

Output frequency

Output current — 10 ms

Minimum baseblock time (L2-03) x 0.75*1

*2

*1 Baseblock time may be reduced by the output frequency immediately before the baseblock.
*2 After AC power supply recovery, motor waits for the minimum Speed Search Wait Time (b3-05).
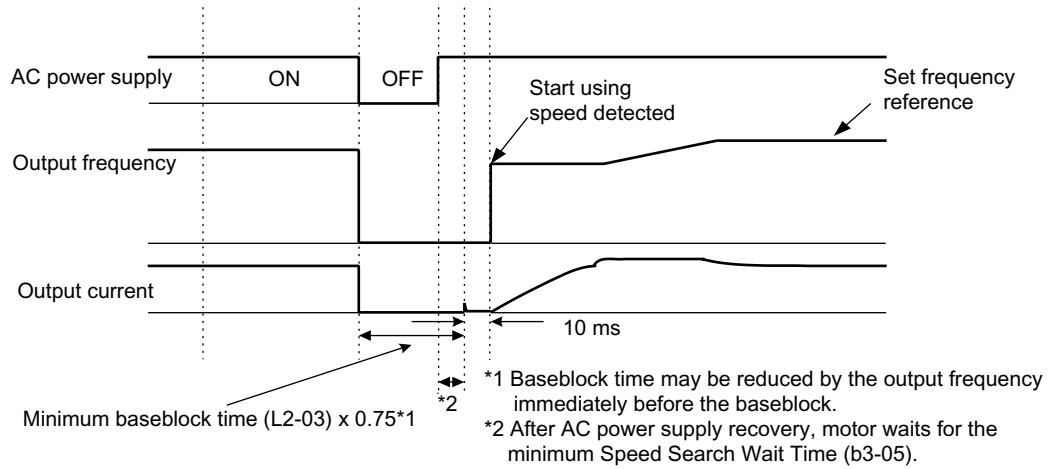
Fig 6.43 Speed Search after Baseblock (When Estimated Speed: Loss Time Is Set in L2-03)

- Loss Time Longer Than the Minimum Baseblock Time (L2-03)

AC power supply — ON / OFF / Start using speed detected / Set frequency reference

Output frequency

Output current — 10 ms

Minimum baseblock time (L2-03)

Speed Search Wait Time (b3-05)
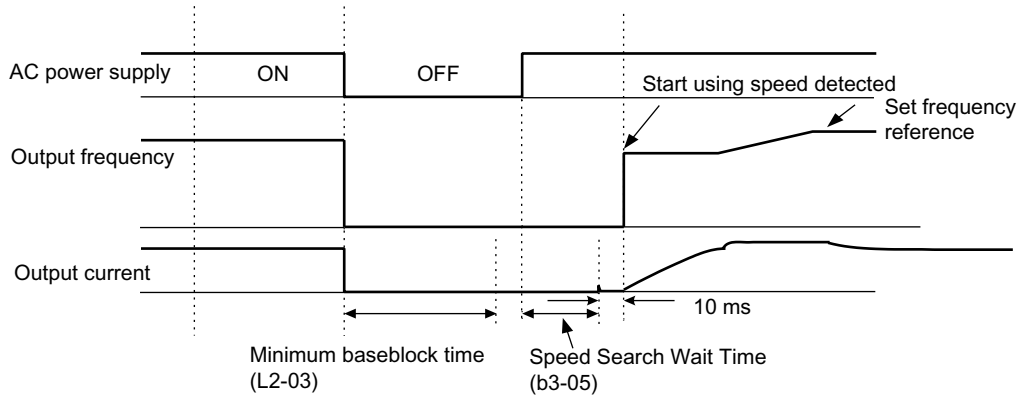
Fig 6.44 Speed Search After Baseblock (Estimated Speed: Loss Time > L2-03)

■**Current Detection Speed Search**

The time charts for current detection speed search is shown below.

Speed Search at Startup

The time chart when speed search at startup or external speed search command is selected is shown below.
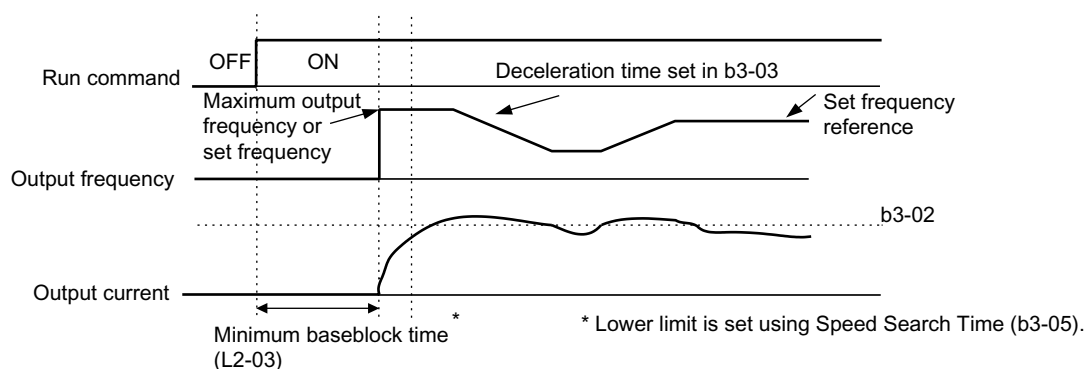
Fig 6.45   Speed Search at Startup (Using Current Detection)

Speed Search after Short Baseblock (during Power Loss Recovery, etc.)

- Loss Time Shorter Than Minimum Baseblock Time
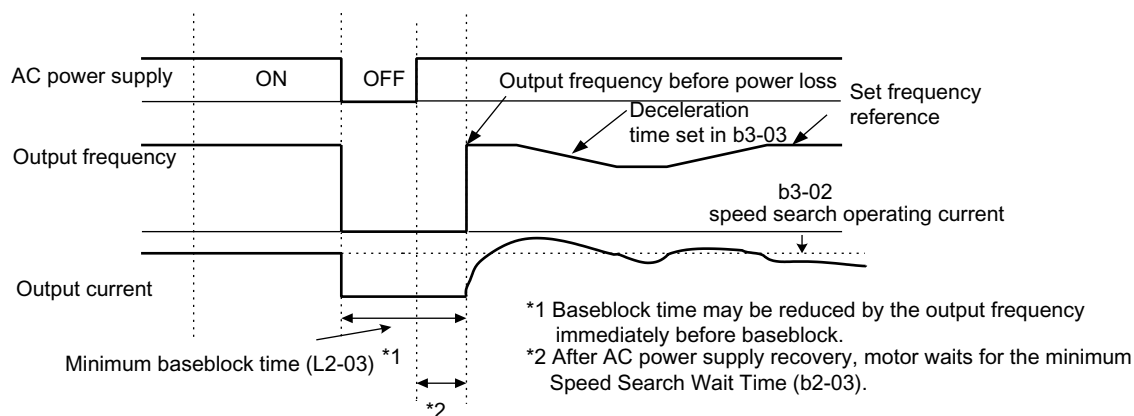
Fig 6.46   Speed Search After Baseblock (Current Detection: Loss Time < L2-03)

- Loss Time Longer Than Minimum Baseblock Time
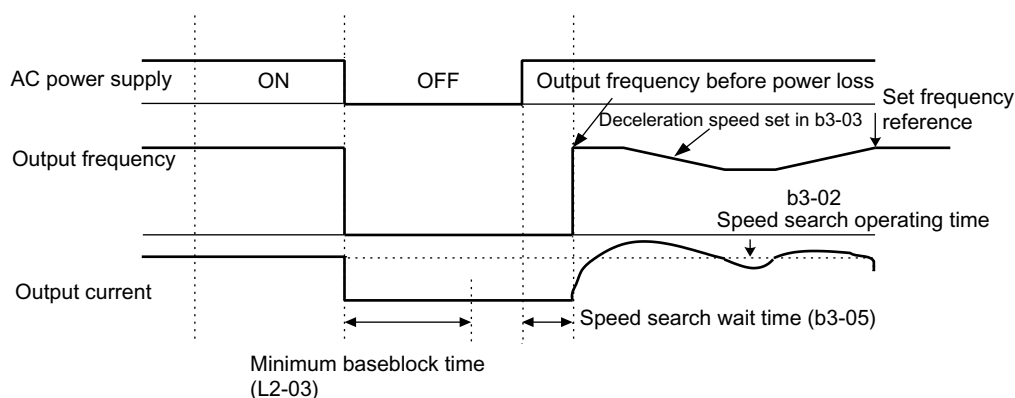
Fig 6.47   Speed Search After Baseblock (Current Detection: Loss Time > L2-03)

6

◆ Continuing Operation at Constant Speed When Frequency Reference Is Lost

The frequency reference loss detection function continues operation using 80% speed of the frequency reference before loss when the frequency reference using an analog input is reduced 90% or more in 400 ms.

When the error signal during frequency reference loss is output externally, set H2-01 to H2-03 (multi-function contact output terminal M1-M2, P1-PC/M3-M4, and P2-PC/M5-M6 function selection) to C (frequency reference lost).

■Related Parameters

Param- eter Num- ber	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec- tor
L4-05	Operation when frequency reference is missing	0: Stopped (Operation follows frequency refer- ence.) 1: Operation at 80% speed continues (At 80% of speed before the frequency reference was lost.) Frequency reference is lost: Frequency reference dropped over 90% in 400 ms.	0 or 1	0	No	A	A	A
	Ref Loss Sel							
L4-06	Frequency reference for loss of frequency reference	Enables operation selection when frequency ref- erence is lost and operation at the following speed: (Speed prior to loss) x L4-06	0.0 to 100.0%	80.0	No	A*	A*	A*
	Fref at Floss							

* For (-E) models only. Otherwise always 80.0%.

◆ Restarting Operation After Transient Fault (Auto Restart Function)

If an Inverter error occurs during operation, the Inverter will perform self-diagnosis. If no error is detected, the Inverter will automatically restart. This is called the auto restart function.

Set the number of auto restarts in parameter L5-01.

The auto restart function can be applied to the following faults. If an fault not listed below occurs, the protection function will operate and the auto restart function will not.

- OC (Overcurrent)
- GF (Ground fault)
- PUF (Fuse blown)
- OV (Main circuit overvoltage)
- UV1 (Main Circuit Undervoltage, Main Circuit MC Operation Failure)*
- PF (Main circuit voltage fault)
- LF (Output phase failure)

- RH (Braking resistor overheated)
- RR (Braking transistor fault)
- OL1 (Motor overload)
- OL2 (Inverter overload)
- OH1 (Motor overheat)
- OL3 (Overtorque)
- OL4 (Overtorque)

* When L2-01 is set to 1 or 2 (continue operation during momentary power loss)

■**Auto Restart External Outputs**

To output auto restart signals externally, set H2-01 to H2-03 (multi-function output terminals M1-M2, M3-M4, M5-M6, P1-PC, and P2-PC function selection) to 1E (auto restart).

■**Related Parameters**

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
L5-01	Number of auto restart attempts	Set the number of auto restarts attempts. Automatically restarts after a fault and conducts a speed search from the run frequency.	0 to 10	0	No	A	A	A
	Num of Restarts							
L5-02	Auto restart operation selection	Sets whether a fault contact output is activated during fault restart. 0: Not output (Fault contact is not activated.) 1: Output (Fault contact is activated.)	0 or 1	0	No	A	A	A
	Restart Sel							

■ **Application Precautions**

• The number of auto restarts count is reset under the following conditions:

After auto restart, normal operation has continued for 10 minutes.

After the protection operation has been performed, and the error has been verified, and an error reset has been input.

After the power supply is turned OFF, and then ON again.

• Do not use the auto restart function with variable loads.

6

Inverter Protection

This section explains the functions for protecting the Inverter and the braking resistor.

◆ Performing Overheating Protection on Mounted Braking Resistors

Perform overheating protection on Inverter-mounted braking resistors (3G3IV-PERF☐).

When overheating in a mounted braking resistor is detected, an alarm RH (Mounted braking resistor overheating) is displayed on the Digital Operator, and the motor coasts to a stop.

■ Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
L8-01	Protect selection for inter-nal DB resistor	0: Disabled (no overheating protection) 1: Enabled (overheating protection)	0 or 1	0	No	A	A	A
	DB Resistor Prot							

Multi-function Digital Outputs (H2-01 to H2-03)

Set Value	Details	Control Methods		
		V/f	V/f with PG	Open Loop Vec-tor
D	Braking resistor fault (ON: Resistor overheats or brake transistor fault)	Yes	Yes	Yes

INFO

The most likely causes of RH (Mounted braking resistor overheating) being detected are that the deceleration time is too short or that the motor regeneration energy is too large. In these cases, lengthen the deceleration time or replace the Braking Resistor Unit with one with a higher breaking capacity.

◆ Reducing Inverter Overheating Pre-Alarm Warning Levels

The Inverter detects the temperature of the cooling fins using the thermistor, and protects the Inverter from overheating. You can receive Inverter overheating pre-alarms in units of 10°C.

The following overheating pre-alarm warnings are available: Stopping the Inverter as error protection, and continuing operation, with the alarm OH (Radiation fins overheating) on the Digital Operator flashing.

■Related Parameters

Param- eter Num- ber	Name		Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods		
	LCD Display						V/f	V/f with PG	Open Loop Vec- tor
L8-02	Overheat pre-alarm level		Sets the detection temperature for the Inverter overheat detection pre-alarm in °C. The pre-alarm detects when the cooling fin temperature reaches the set value.	50 to 130	95°C	No	A	A	A
	OH Pre-Alarm Lvl								
L8-03	Operation selection after overheat pre-alarm		Sets the operation for when the Inverter overheat pre-alarm goes ON. 0: Decelerate to stop in deceleration time C1-02. 1: Coast to stop 2: Fast stop in fast-stop time C1-09. 3: Continue operation (Monitor display only.) A fault will be given in setting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A	A	A
	OH Pre-Alarm Sel								

6

Input Terminal Functions

This section explains input terminal functions, which set operating methods by switching functions for the multi-function contact input terminals (S3 to S7).

◆ Temporarily Switching Operation between Digital Operator and Control Circuit Terminals

You can switch the Inverter run command inputs and frequency reference inputs between local (i.e., Digital Operator) and remote (input method using b1-01 and b1-02).

You can switch between local and remote by turning ON and OFF the terminals if an output from H1-01 to H1-05 (multi-function input terminal S3 to S7 function selection) has been set to 1 (local/remote selection).

To set the control circuit terminals to remote, set b1-01 and b1-02 to 1 (Control circuit terminals).

■ Related Parameters

Param-eter Num-ber	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display						V/f	V/f with PG	Open Loop Vec-tor
b1-01	Reference selection		Set the frequency reference input method. 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card 4: Pulse input	0 to 4	1	No	Q	Q	Q
	Reference Source								
b1-02	Operation method selec-tion		Set the run command input method 0: Digital Operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q	Q	Q
	Run Source								

INFO

You can also perform local/remote switching using the LOCAL/REMOTE Key on the Digital Operator. When the local/remote function has been set in the external terminals, the LOCAL/REMOTE Key function on the Digital Operator will be disabled.

◆ Blocking Inverter Outputs (Baseblock Commands)

Set 8 or 9 (Baseblock command NO/NC) in one of the parameters H1-01 to H1-05 (multi-function input terminal S3 to S7 function selection) to perform baseblock commands using the terminal's ON/OFF operation, and prohibit Inverter voltage output using the baseblock commands.

Clear the baseblock command to restart the operating using speed search from frequency references from the previous baseblock command input.

Multi-function Digital Inputs (H1-01 to H1-05)

Set Value	Function	Control Methods		
		V/f	V/f with PG	Open Loop Vector
8	External baseblock NO (Normally Open contact: Baseblock when ON)	Yes	Yes	Yes
9	External baseblock NC (Normally Closed contact: Baseblock when OFF)	Yes	Yes	Yes

■Time Chart

The time chart when using baseblock commands is shown below.
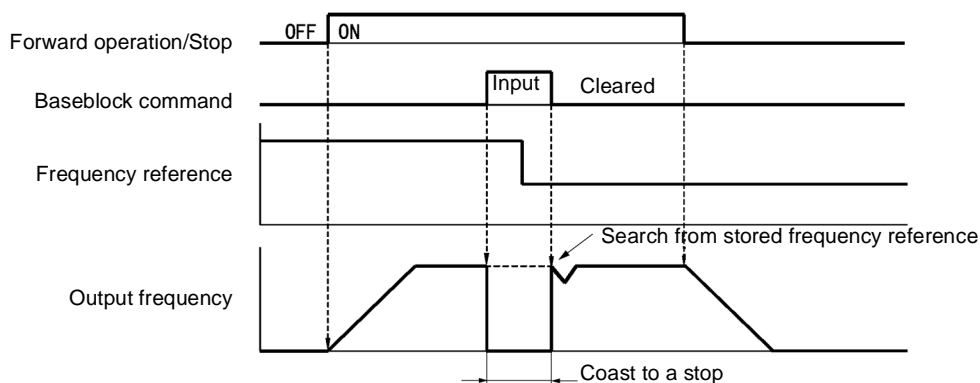
Fig 6.48 Baseblock Commands

IMPORTANT

If using baseblock commands with a variable load, do not frequently input baseblock commands during operation, as this may cause the motor to suddenly start coasting, and may result in the motor falling or slipping.

6

◆ Stopping Acceleration and Deceleration (Acceleration/Deceleration Ramp Hold)

The acceleration/deceleration ramp hold function stops acceleration and deceleration, stores the output frequency at that point in time, and then continues operation.

Set one of the parameters H1-01 to H1-05 (multi-function input terminal S3 to S7 function selection) to A (acceleration/deceleration ramp hold) to stop acceleration and deceleration when the terminal is turned ON and to store the output frequency at that point in time. Acceleration and deceleration will restart when the terminal is turned OFF.

If d4-01 is set to 1 and the Acceleration/Deceleration Ramp Hold command is input, the output frequency is still stored even after the power supply is turned OFF.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
d4-01	Frequency reference hold function selection	Set whether or not frequencies on hold will be recorded. 0: Disabled (when operation is stopped or the power is turned ON again starts at 0.) 1: Enabled (when operation is stopped or the power is turned ON again starts at the previ-ous hold frequency.) This function is available when the multi-function inputs "Accel/Decel Ramp Hold" or "up/down" commands are set.	0 or 1	0	No	A	A	A
	MOP Ref Memory							

■Time Chart

The time chart when using Acceleration/Deceleration Ramp Hold commands is given below.
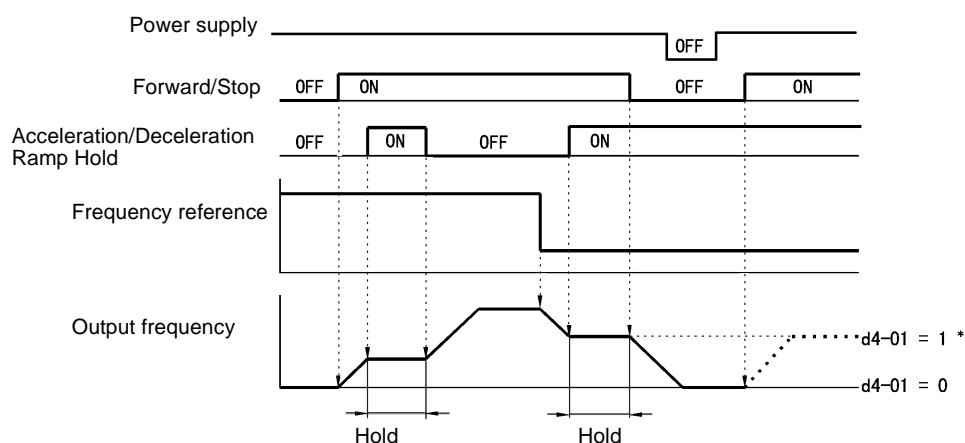
Fig 6.49   Acceleration/Deceleration Ramp Hold

■**Application Precautions**

- When d4-01 is set to 1, the output frequency on hold is stored even after the power supply is turned OFF. If performing operations using this frequency after the Inverter has also been turned OFF, input the run command with the Acceleration/Deceleration Ramp Hold turned ON.

- When d4-01 is set to 0 and a run command is input while the Acceleration/Deceleration Ramp Hold is turned ON, the output frequency will be set to zero.

- If you input an Acceleration/Deceleration Ramp Hold command by error when decelerating during positioning, deceleration may be canceled.

◆ Raising and Lowering Frequency References Using Contact Signals (UP/DOWN)

The UP and DOWN commands raise and lower Inverter frequency references by turning ON and OFF a multi-function contact input terminal S3 to S7.

To use this function, set one of the parameters H1-01 to H1-05 (multi-function input terminal S3 to S7 function selection) to 10 (UP command) and 11 (DOWN command). Be sure to allocate two terminals so that the UP and DOWN commands can be used as a pair.

The output frequency depends on the acceleration and deceleration time. Be sure to set b1-02 (Run command selection) to 1 (Control circuit terminal).

■**Related Parameters**

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
d2-01	Frequency reference upper limit	Set the output frequency upper limit as a percent, taking the maximum output frequency to be 100%.	0.0 to 110.0	100.0%	No	A	A	A
	Ref Upper Limit							
d2-02	Frequency reference lower limit	Set the output frequency lower limit as a percentage of the maximum output frequency.	0.0 to 110.0	0.0%	No	A	A	A
	Ref Lower Limit							
d2-03	Master speed reference lower limit	Set the master speed frequency reference lower limit as a percent, taking the maximum output frequency to be 100%.	0.0 to 110.0	0.0%	No	A	A	A
	Ref1 Lower Limit							

■**Precautions**

When setting and using UP and DOWN commands, observe the following precautions.

Setting Precautions

If multi-function input terminals S3 to S7 are set as follows, operation error OPE03 (Invalid multi-function input selection) will occur:

- Only either the UP command or DOWN command has been set.

- UP/DOWN commands and Acceleration/Deceleration Ramp Hold have been allocated at the same time.

6

Application Precautions

- Frequency outputs using UP/DOWN commands are limited by the frequency reference upper and lower limits set in parameters d2-01 to d2-03. Here, frequency references from analog frequency reference terminal A1 becomes the frequency reference lower limit. If using a combination of the frequency reference from terminal A1 and the frequency reference lower limit set in either parameter d2-02 or d2-03, the larger lower limit will become the frequency reference lower limit.

- If inputting the run command when using UP/DOWN commands, the output frequency accelerates to the frequency reference lower limit.

- When using UP/DOWN commands, multi-step operations are disabled.

- When d4-01 (Frequency Reference Hold Function Selection) is set to 1, the frequency reference held using the UP/DOWN functions is stored even after the power supply is turned OFF. When the power supply is turned ON and the run command is input, the motor accelerates to the frequency reference that has been stored. To reset (i.e., to 0 Hz) the stored frequency reference, turn ON the UP or DOWN command while the run command is ON.

■Connection Example and Time Chart

The time chart and settings example when the UP command is allocated to the multi-function contact input terminal S3, and the DOWN command is allocated to terminal S4, are shown below.

Parameter	Name	Set Value
H1-01	Multi-function input (terminal S3)	10
H1-02	Multi-function input (terminal S4)	11
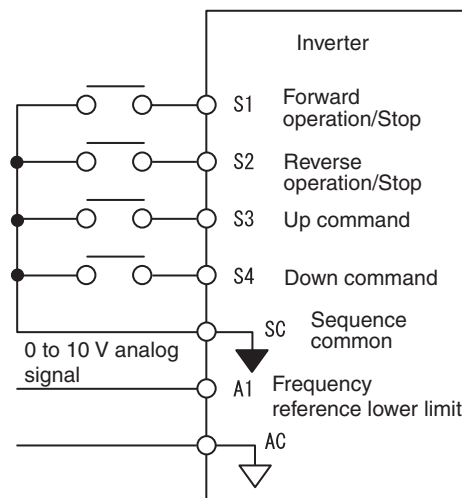
Fig 6.50 Connection Example when UP/DOWN Commands Are Allocated
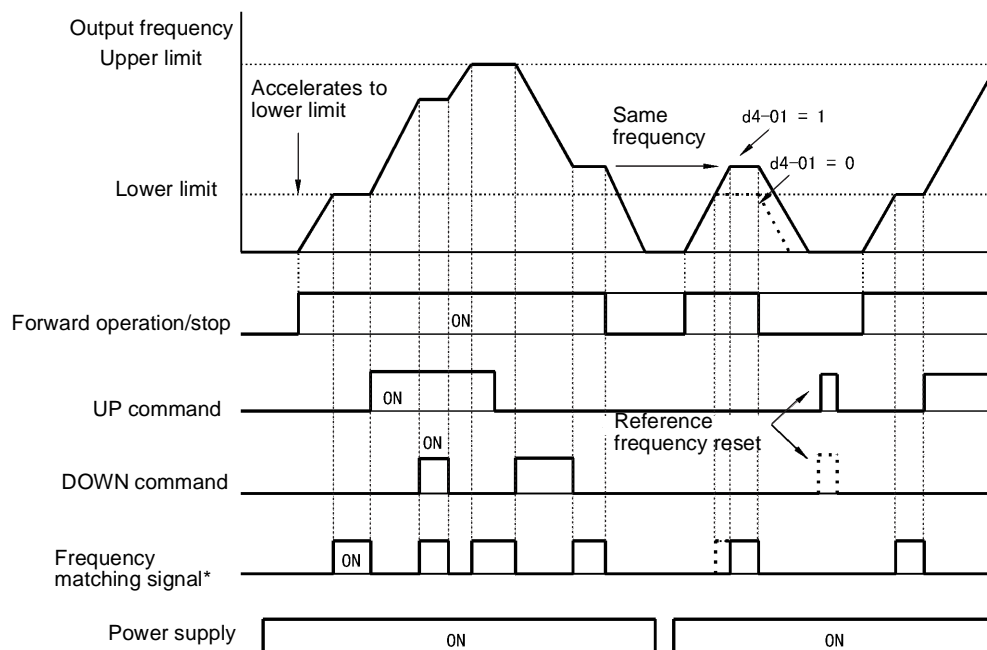
* The frequency matching signal turns ON when the motor is not accelerating/
decelerating while the run command is ON.

Fig 6.51 UP/DOWN Commands Time Chart

◆ Accelerating and Decelerating Constant Frequencies in the Analog References (+/- Speed)

The +/- speed function increments or decrements the frequency set in analog frequency reference d4-02 (+/- Speed Limit) using two contact signal inputs.

To use this function, set one of the parameters H1-01 to H1-05 (multi-function terminal inputs S3 to S7 function selection) to 1C (Trim Control Increase command) and 1D (Trim Control Decrease command). Be sure to allocate two terminals so that the Trim Control Increase command and Trim Control Decrease command can be used as a pair.

■Related Parameters

Param- eter Num- ber	Name		Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods			Parame- ter Num- ber
	LCD Display						V/f	V/f with PG	Open Loop Vec- tor	
d4-02	+/- speed limits		Set the frequency to be add to or subtracted from the analog frequency reference as a per- cent, taking the maximum output frequency to be 100%. Enabled when the increase (+) speed command or decrease (-) speed command is set for a multi-function input.	0 to 100	10%	No	A	A	A	299H
	Trim Control Lvl									

■Trim Control Increase/Decrease Command and Frequency Reference

The frequency references using Trim Control Increase/Decrease command ON/OFF operations are shown below.

Frequency Reference	Set Frequency Refer- ence + d4-02	Set Frequency Refer- ence - d4-02	Frequency Reference (d4-02 not added or subtracted)	
Trim Control Increase Command Terminal	ON	OFF	ON	OFF
Trim Control Decrease Command Terminal	OFF	ON	ON	OFF

■Application Precautions

- Trim Control Increase/Decrease command is enabled when speed reference > 0 and the speed reference is from an analog input.
- When the master speed frequency reference value from the analog input - d4-02 < 0, the frequency refer- ence is set to 0.
- The auxiliary frequency reference is added after calculating the master speed frequency reference ±d4-02.
- If only the Trim Control Increase command or Trim Control Decrease command has been set for a multi- function contact input terminal S3 to S7, operation error OPE03 (invalid multi-function input selected) will occur.

◆ Hold Analog Frequency Using User-set Timing

When one of H1-01 to H1-05 (multi-function input terminal S3 to S7 function selection) is set to 1E (sample/hold analog frequency command), the analog frequency reference will be held from 100 ms after the terminal is turned ON, and operation will continue thereafter at that frequency.

The analog value 100 ms after the command is turned ON is used as the frequency reference.
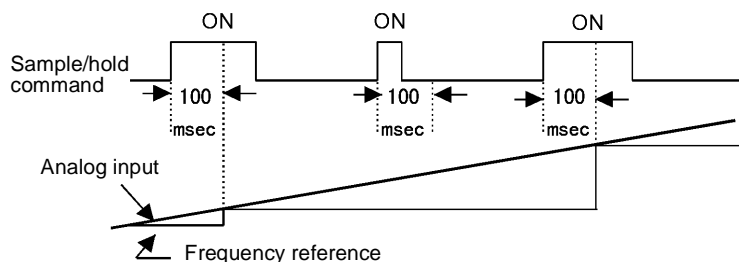
Fig 6.52 Sample/Hold Analog Frequency

■Precautions

When setting and executing sample and hold for analog frequency references, observe the following precautions.

Setting Precautions

When using sample/hold of analog frequency reference, you cannot use the following commands at the same time. If these commands are used at the same time, operation error OPE03 (invalid multi-function input selection) will occur.

- Acceleration/Deceleration Ramp Hold command
- UP/DOWN command
- Trim Control Increase/Decrease command

Application Precautions

- When performing sample/hold of analog frequency references, be sure to store references of 100 ms minimum. If the reference time is less than 100 ms, the frequency reference will not be held.
- The analog frequency reference that is held will be deleted when the power supply is turned OFF.

6

◆ Switching Operations between a Communications Option Card and Control Circuit Terminals

You can switch reference input between the Communications Option Card and the control circuit terminals. Set one of the parameters H1-01 to H1-05 (multi-function input terminal S3 to S7 function selection) to 2 (Option/Inverter selection) to enable switching reference input using the terminal ON/OFF status when the Inverter is stopped.

■ Setting Precautions

To switch command inputs between the Communications Option Card and the control circuit terminals, set the following parameters.

- Set b1-01 (Reference Selection) to 1 (Control circuit terminal [analog input])
- Set b1-02 (Operation Method Selection to 1 (Control circuit terminal (sequence inputs])
- Set one of the parameters H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) to 2 (Option/Inverter selection).

Terminal Status	Frequency Reference and Run Command Selection
OFF	Inverter (Can be operated from frequency reference or control circuit terminal from analog input terminal.)
ON	Communications Option Card (Frequency reference and run command are enabled from communications Option Card.)

◆ Jog Frequency Operation without Forward and Reverse Commands (FJOG/RJOG)

The FJOG/RJOG command functions operate the Inverter using jog frequencies by using the terminal ON/OFF operation. When using the FJOG/RJOG commands, there is no need to input the run command.

To use this function, set one of the parameters H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) to 12 (FJOG command) or 13 (RJOG command).

■ Related Parameters

Param- eter Num- ber	Name LCD Display	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods		
						V/f	V/f with PG	Open Loop Vec- tor
d1-17	Jog frequency reference Jog Reference	The frequency reference when the jog frequency reference selection, FJOG command, or RJOG command is ON.	0 to 400.00	6.00 Hz	Yes	Q	Q	Q

Multi-Function Digital Inputs (H1-01 to H1-05)

Set Value	Function	Control Methods		
		V/f	V/f with PG	Open Loop Vec- tor
12	FJOG command (ON: Forward run at jog frequency d1-17)	Yes	Yes	Yes
13	RJOG command (ON: Reverse run at jog frequency d1-17)	Yes	Yes	Yes

■Application Precautions

- Jog frequencies using FJOG and RJOG commands are given priority over other frequency references.
- When both FJOG command and RJOG commands are ON for 500 ms or longer at the same time, the Inverter stops according to the setting in b1-03 (stopping method selection).

◆ Stopping the Inverter by Notifying Programming Device Errors to the Inverter (External Error Function)

The external error function performs the error contact output, and stops the Inverter operation if the Inverter peripheral devices break down or an error occurs. The digital operator will display EFx (External error [input terminal Sx]). The x in EFx shows the terminal number of the terminal that input the external error signal. For example, if an external error signal is input to terminal S3, EF3 will be displayed.

To use the external error function, set one of the values 20 to 2F in one of the parameters H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection).

Select the value to be set in H1-01 to H1-05 from a combination of any of the following three conditions.

- Signal input level from peripheral devices
- External error detection method
- Operation during external error detection

The following table shows the relationship between the combinations of conditions and the set value in H1-□□.

Set Value	Input Level (See Note 1.)		Error Detection Method (See Note 2.)		Operation During Error Detection			
	NO Contact	NC Contact	Constant Detection	Detection During Operation	Decelerate to Stop (Error)	Coast to Stop (Error)	Emergency Stop (Error)	Continue Operation (Warning)
20	Yes		Yes		Yes			
21		Yes	Yes		Yes			
22	Yes			Yes	Yes			
23		Yes		Yes	Yes			
24	Yes		Yes			Yes		
25		Yes	Yes			Yes		
26	Yes			Yes		Yes		
27		Yes		Yes		Yes		
28	Yes		Yes				Yes	
29		Yes	Yes				Yes	
2A	Yes			Yes			Yes	
2B		Yes		Yes			Yes	
2C	Yes		Yes					Yes
2D		Yes	Yes					Yes
2E	Yes			Yes				Yes
2F		Yes		Yes				Yes

Note1. Set the input level to detect errors using either signal ON or signal OFF. (NO contact: External error when ON; NC contact: External error when OFF).
 2. Set the detection method to detect errors using either constant detection or detection during operation.
   Constant detection: Detects while power is supplied to the Inverter.
   Detection during operation: Detects only during Inverter operation.

Monitor Parameters

This section explains the analog monitor and pulse monitor parameters.

◆ Using the Analog Monitor Parameters

This section explains the analog monitor parameters.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
H4-01	Monitor selection (termi-nal FM)	Sets the number of the monitor item to be output (U1-□□) from terminal FM. 4, 10 to 14, 28, 34, 39, 40 cannot be set. 17, 23, 25, 29, 30, 31, 35 are not used.	1 to 40	2	No	A	A	A
	Terminal FM Sel							
H4-02	Gain (terminal FM)	Sets the multi-function analog output 1 voltage level gain. Sets whether the monitor item output will be out-put in multiples of 10 V. The maximum output from the terminal is 10 V.	0.00 to 2.50 (0.0 to 1000.0)[*1]	1.00 (100.0%) [*1]	Yes	Q	Q	Q
	Terminal FM Gain							
H4-03	Bias (terminal FM)	Sets the multi-function analog output 1 voltage level bias. Sets output characteristic up/down parallel move-ment as a percentage of 10 V. The maximum output from the terminal is 10 V.	-10.0 to +10.0 (-100.0 to +110.0)[*1]	0.0%	Yes	A	A	A
	Terminal FM Bias							
H4-04	Monitor selection (termi-nal AM)	Sets the number of the monitor item to be output (U1-□□) from terminal AM. 4, 10 to 14, 28, 34, 39, 40 cannot be set. 17, 23, 25, 29, 30, 31, 35 are not used.	1 to 40	3	No	A	A	A
	Terminal AM Sel							
H4-05	Gain (terminal AM)	Set the voltage level gain for multi-function ana-log output 2. Set the number of multiples of 10 V to be output as the 100% output for the monitor items. The maimum output from the terminal is 10 V.	0.00 to 2.50 (0.0 to 1000.0)[*1]	0.50 (50.0%) [*1]	Yes	Q	Q	Q
	Terminal AM Gain							
H4-06	Bias (terminal AM)	Set the multi-function analog output 2 voltage level bias. Sets output characteristic up/down parallel move-ment as a percentage of 10 V. The maximum output from the terminal is 10 V.	-10.0 to +10.0 (-100.0 to +110.0)[*1]	0.0%	Yes	A	A	A
	Terminal AM Bias							
H4-07	Analog output 1 signal level selection	Sets the signal output level for multi-function output 1 (terminal FM) 0: 0 to 10 V output 1: 0 to ±10 V output (2: 4 to 20 mA)*	0 or 1 (0 to 2)[*1]	0	No	A	A	A
	AO Level Select1							
H4-08	Analog output 2 signal level selection	Sets the signal output level for multi-function out-put 2 (terminal AM) 0: 0 to +10 V output 1: 0 to ±10 V output (2: 4 to 20 mA)*1	0 or 1 (0 to 2)[*1]	0	No	A	A	A
	AO Level Select2							

Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop Vec-tor
F4-01	Channel 1 monitor selection / AO Ch1 Select	Effective when the Analog Monitor Card is used. Monitor selection: Set the number of the monitor item to be output. (U1-☐☐) Gain: Set the multiple of 10 V for outputting monitor items. 4, 10 to 14, 28, 34, 39, 40 cannot be set. 17, 23, 25, 29, 30, 31, 35 are not used. When the AO-12 Analog Monitor Card is used, outputs of ±10 V are possible. To output ±10 V, set F4-07 or F4-08 to 1. When the AO-08 Analog Monior Card is used, only outputs of 0 to +10 V are possible. A meter calibration function is available.	1 to 40	2	No	A*2	A*2	A*2
F4-02	Channel 1 gain / AO Ch1 Gain		0.00 to 2.50	1.00	Yes	A*2	A*2	A*2
F4-03	Channel 2 monitor selection / AO Ch2 Select		1 to 40	3	No	A*2	A*2	A*2
F4-04	Channel 2 gain / AO Ch2 Gain		0.00 to 2.50	0.50	Yes	A*2	A*2	A*2
F4-05	Channel 1 output monitor bias / AO Ch1 Bias	Set the channel 1 item bias to 100%/10 V when the analog monitor card is used.	-10.0 to 10.0	0.0	Yes	A*2	A*2	A*2
F4-06	Channel 2 output monitor bias / AO Ch2 Bias	Set the channel 2 item bias to 100%/10 V when the analog monitor card is used.	-10.0 to 10.0	0.0	Yes	A*2	A*2	A*2
F4-08	Analog output signal level for channel 2 / AO Opt Level Ch1	0: 0 to 10 V 1: -10 to 10 V	0 or 1	0	No	A*2	A*2	A*2

* 1. For (-E) models. The shunt connector CN15 must be set. For details, refer to page 2-43.

* 2. Analog Monitor Cards are not available for (-E) models. Use the AM or FM terminal as a substitute.

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■Selecting Analog Monitor Items

The digital operator monitor items (U1-☐☐ [status monitor]) are output from multi-function analog output terminals FM-AC and AM-AC. Refer to *Chapter 5 Parameters*, and set the values for the ☐☐ part of U1-☐☐ (status monitor).

Alternatively, you can output monitor items (U1-☐☐ [status monitor]) from analog output option terminal channels 1 and 2 on analog monitor cards AO-08 and AO-12. Refer to the table of parameters, and set the values.

■Adjusting the Analog Monitor Items

Adjust the output voltage for multi-function analog output terminals FM-AC and AM-AC using the gain and bias in H4-02, H4-03, H4-05, and H4-06. Also, adjust the output voltage for output channels 1 and 2 of Analog Output Option Cards AO-08 and AO-12 using the gain and bias in F4-02, F4-04, and F4-06.

Adjusting the Meter

Display the data setting display for the gain and bias constants corresponding to the output channel of the Inverter Unit and the AO Option Card while the Inverter is stopped to output the following voltages to the analog monitor terminal, to enable meter adjusting while the Inverter is stopped.

$$10 \text{ V}/100\% \text{ monitor output} \times \text{output gain} + \text{output bias}$$

Output voltage

Gain x 10 V

10 V

Bias x 10/100 V

0 V

0 %   100 %
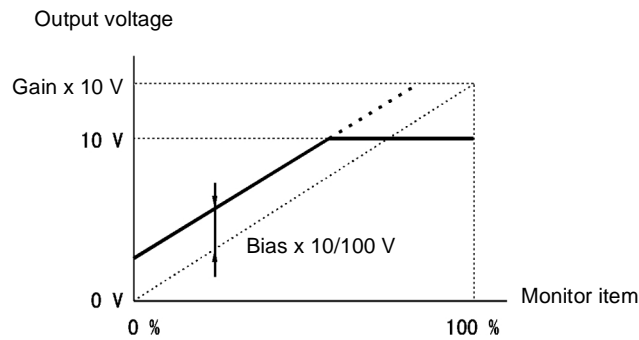
Monitor item

Fig 6.53 Monitor Output Adjustment

■Switching Analog Monitor Signal Levels

Monitor items corresponding to 0 to ±10 V output 0 to 10 V signals when the monitor value is positive (+), and 0 to -10 V signals when the monitor value is negative (-). For monitor items corresponding to 0 to ±10 V, refer to *Chapter 5 Parameters.*

INFO

You can select the signal levels separately for multi-function analog output terminals and analog output option terminals.

◆ Using Pulse Train Monitor Parameters

This section explains pulse monitor parameters.

■Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
H6-06	Pulse train monitor selection	Select the pulse train monitor output items (value of the □□ part of U1-□□). There are two types of monitor items: Speed-related items and PID-related items.	1, 2, 5, 20, 24, 36	2	Yes	A	A	A
	Pulse Moni Sel							
H6-07	Pulse train monitor scaling	Set the number of pulses output when speed is 100% in hertz. Set H6-06 to 2, and H6-07 to 0, to make the pulse train monitor output synchronously to the output frequency.	0 to 32000	1440 Hz	Yes	A	A	A
	Pulse Moni Scale							

■Selecting Pulse Monitor Items

Output digital operator monitor items (U1-□□ [status monitor]) from pulse monitor terminal MP-SC. Refer to *Chapter 5 Parameters*, and set the □□ part of U1-□□ (Status monitor). The possible monitor selections are limited as follows: U1-01, 02, 05, 20, 24, 36.

■**Adjusting the Pulse Monitor Items**

Adjust the pulse frequency output from pulse monitor terminal MP-SC. Set the pulse frequency output when 100% frequency is output to H6-07.

Set H6-06 to 2, and H6-07 to 0, to output the frequency synchronous with the Inverter's U-phase output.

■**Application Precautions**

When using a pulse monitor parameter, connect a peripheral device according to the following load conditions. If the load conditions are different, there is a risk of characteristic insufficiency or damage to other devices.

Using a Sourcing Output

Output Voltage (Isolated) VRL (V)	Load Impedance (kΩ)
+5 V min.	1.5 kΩ min.
+8 V min.	3.5 kΩ min.
+10 V min.	10 kΩ min.
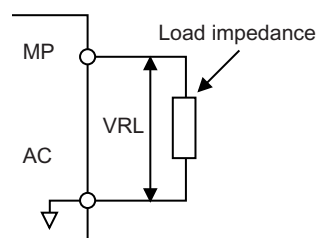
Using a Sinking Input

External Power Supply (V)	12 VDC±10%, 15 VDC±10%
Sink Current (mA)	16 mA Max

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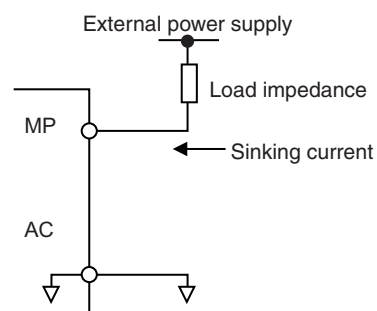
Communications Functions

This section explains the individual communications functions.

◆ Using RS-422A/485 Communications

You can perform serial communications with SYSMAC CS-series Programmable Controllers (PLCs) or similar devices using the RS-422A/485 protocol.

■Related Parameters

Param- eter Num- ber	Name		Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods		
		LCD Display					V/f	V/f with PG	Open Loop Vec- tor
b1-01	Reference selection		Set the frequency reference input method 0: Digital Operator 1: Control circuit terminal (analog input) 2: RS-422A/485 communications 3: Option Card 4: Pulse train input	0 to 4	1	No	Q	Q	Q
	Reference Source								
b1-02	Operation method selec- tion		Set the run command input method 0: Digital Operator 1: Control circuit terminal (sequence input) 2: RS-422A/485 communications 3: Option Card	0 to 3	1	No	Q	Q	Q
	Run Source								
H5-01	Slave address		Set the Inverter slave address.	0 to 20 *	1F	No	A	A	A
	Serial Comm Adr								
H5-02	Communication speed selection		Set the baud rate for 6CN RS-422A/485 communications. 0: 1200 bps 1: 2400 bps 2: 4800 bps 3: 9600 bps 4: 19200 bps	0 to 4	3	No	A	A	A
	Serial Baud Rate								
H5-03	Communications parity selection		Set the parity for 6CN RS-422A/485 communica- tions. 0: No parity 1: Even parity 2: Odd parity	0 to 2	0	No	A	A	A
	Serial Com Sel								
H5-04	Stopping method after communication error		Set the stopping method for communications errors. 0: Deceleration to stop using deceleration time in C1-02 1: Coast to a stop 2: Emergency stop using deceleration time in C1-02 3: Continue operation	0 to 3	3	No	A	A	A
	Serial Fault Sel								
H5-05	Communications error detection selection		Set whether or not a communications timeout is to be detected as a communications error. 0: Do not detect 1: Detect	0 or 1	1	No	A	A	A
	Serial Flt Dtct								
H5-06	Send wait time		Set the time from the Inverter receiving data to when the Inverter starts to send.	5 to 65	5 ms	No	A	A	A
	Transmit Wait TIM								
H5-07	RTS control ON/OFF		Select to enable or disable RTS control. 0: Disabled (RTS is always ON) 1: Enabled (RTS turns ON only when sending)	0 or 1	1	No	A	A	A
	RTS Control Sel								
o1-03	Frequency units of refer- ence setting and monitor		0: 0.01 Hz units 1: 0.01% units 2 to 39: r/min units 40 to 39999: User desired display	0 to 39999	0	No	A	A	A
	Display Scaling								

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
U1-39	RS-422A/485 communications error	Bit 0: CRC error Bit 1: Data length error Bit 2: Not used. Bit 3: Parity error Bit 4: Overrun error Bit 5: Framing error Bit 6: Timeout Bit 7: Not used. Refer to the parameter tables for Digital Operator displays.	0 to FF	-	-	A	A	A
	Transmit Err							

* Set H5-01 to 0 to disable Inverter responses to RS-422A/485 communications.

RS-422A/485 communications can perform the following operations regardless of the settings in b1-01 and b1-02.

- Monitoring operation status from the PLC

- Setting and reading parameters

- Resetting errors

- Inputting multi-function commands

An OR operation is performed between the multi-function commands input from the PLC and commands input from multi-function contact input terminals S3 to S7.

■RS-422A/485 Communications Configuration

RS-422A/485 communications are configured using 1 master (PLC) and a maximum of 32 slaves. Serial communications between master and slave are normally started by the master, and the slave responds.

The master performs signal communications with one slave at a time. Consequently, you must set the address of each slave beforehand, so the master can perform signal communications using that address. Slaves receiving commands from the master perform the specified function, and send a response to the master.

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SYSMAC-series PLC

Inverter   Inverter   Inverter

RS-485 connections example
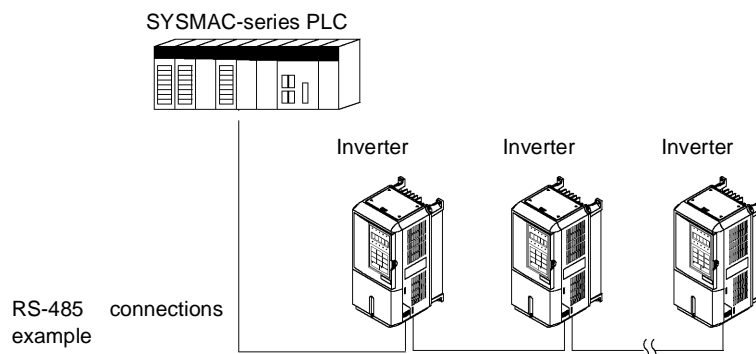
Fig 6.54   Example of Connections between PLC and Inverter

■Communications Specifications

The RS-422A/485 communications specifications are shown in the following table.

Item	Specifications
Interface	RS-422, RS-485
Communications Cycle	Asynchronous (Start-stop synchronization)
Communications Parameters	Baud rate: Select from 1,200, 2,400, 4,800, 9,600, and 19,200 bps. Data length: 8 bits fixed Parity: Select from even, odd, or none. Stop bits: 1 bit fixed
Communications Protocol	MODBUS
Number of Connectable Units	32 units max. (when using RS-485)

■Communications Connection Terminal

RS-422A/485 communications use the following terminals: S+, S-, R+, and R-. Set the terminating resistance by turning ON pin 1 of switch S1 for the last Inverter only, as seen from the PLC.
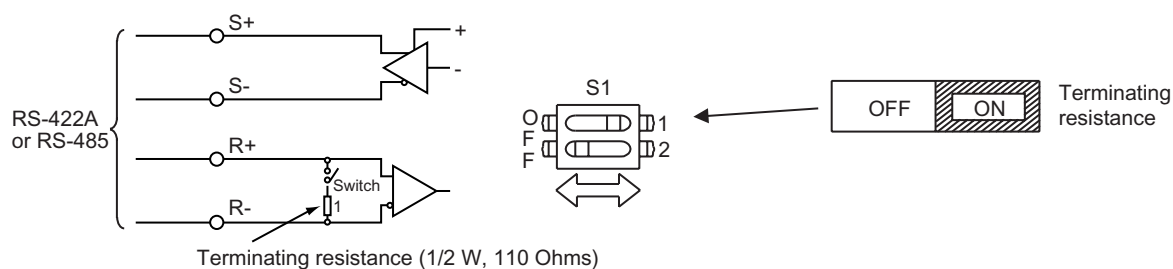
Fig 6.55 Communications Connection Terminal

IMPORTANT
1. Separate the communications cables from the main circuit cables and other wiring and power cables.
2. Use shielded cables for the communications cables, connect the shield cover to the Inverter earth terminal, and arrange the terminals so that the other end is not connected to prevent operating errors due to noise.
3. When using RS-485 communications, connect S+ to R+, and S- to R-, on the Inverter exterior.
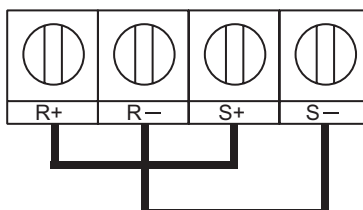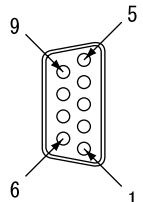
■Connection Example to a PLC

This section provides a connector pin arrangements and standard wiring diagram for the Serial Communications Boards/Units.

Connector Pin Arrangement for Serial Communications Board/Unit

The connector pin arrangement for the CS1W-SCB41, CS1W-SCU41, and C200HW-COM06-V1 Serial Communications Boards/Units is shown below.

Pin No.	Code	Signal name	I/O	Pin No.	Code	Signal name	I/O
1	SDA	Send data (-)	Output	6	RDA	Receive data (-)	Input
2	SDB	Send data (+)	Output	7	NC	-	-
3	NC	-	-	8	RBD	Receive data (+)	Input
4	NC	-	-	9	NC	-	-
5	NC	-	-	Frame	FG	FG	-

Standard Wiring Diagrams

Wiring diagrams are provided below for RS-485 and RS-422A.

• RS-485 (2-wire)
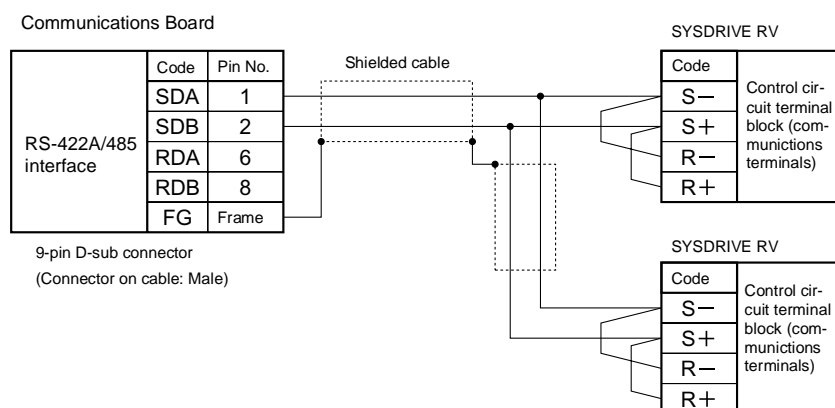
Note Turn ON the terminating resistance switches at the end Inverters. Turn OFF the terminating resistance switches at all other Inverters.

Fig 6.56 RS-485 Wiring

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• RS-422A (4-wire)
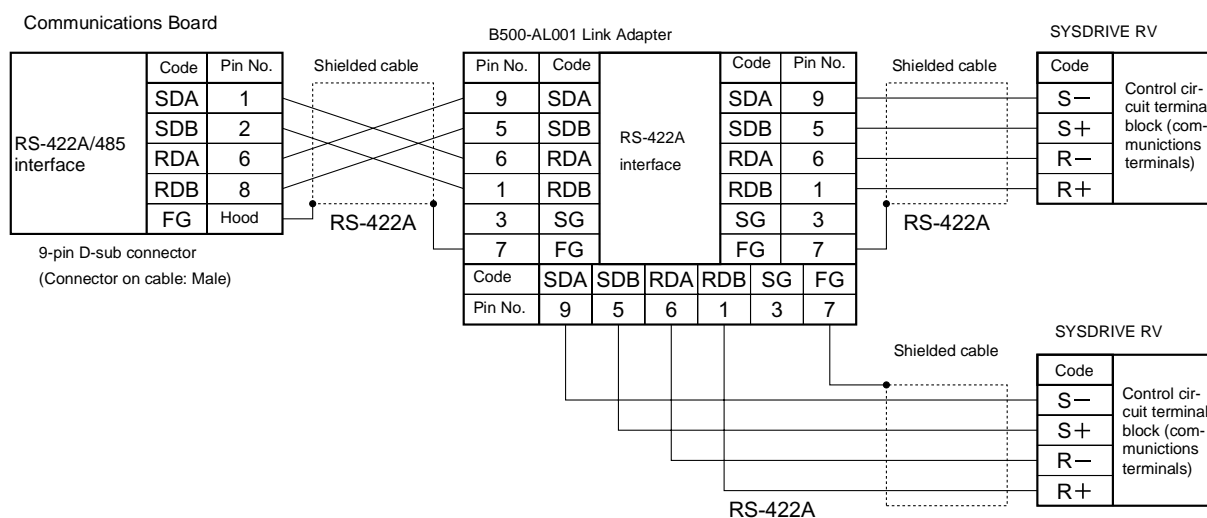
Note Turn ON the terminating resistance switch at all Inverters.

Fig 6.57 RS-422A Wiring

■ **Message Format**

In RS-422A/485 communications, the master sends commands to the slave, and the slave responds. The message format is configured for both sending and receiving as shown below, and the length of data packets is changed by the command (function) contents.
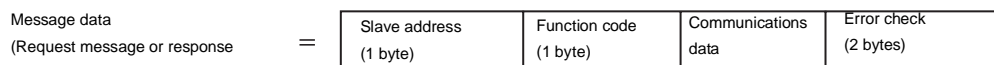
The space between messages must support the following.
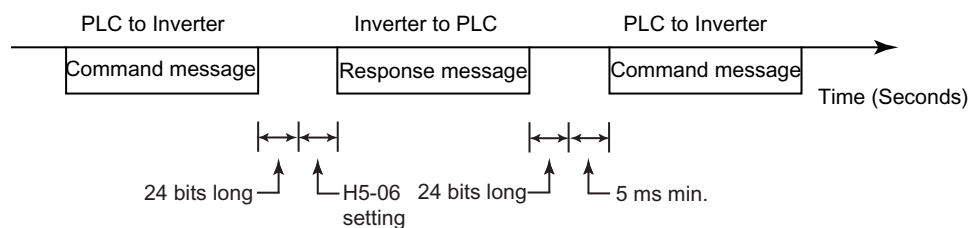
Fig 6.58 Message Spacing

Slave Address

Set the Inverter address from 0 to 32. If you set 0, commands from the master will be broadcast (i.e., the Inverter will not return responses).

Function Code

The function code specifies commands. There are three function codes, as shown below.

Function Code (Hexadecimal)	Function	Command Message		Response Message	
		Min. (Bytes)	Max. (Bytes)	Min. (Bytes)	Max. (Bytes)
03H	Read storage register contents	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write multiple storage registers	11	41	8	8

Data

Configure consecutive data by combining the storage register address (test code for a loopback address) and the data the register contains. The data length changes depending on the command details.

Error Check

Errors are detected during communications using CRC-16. The CRC-16 data is the remainder of dividing all of the message data blocks as a continuous string of data by a specific binary number (1 1000 0000 0000 0101), as shown in the following diagram.
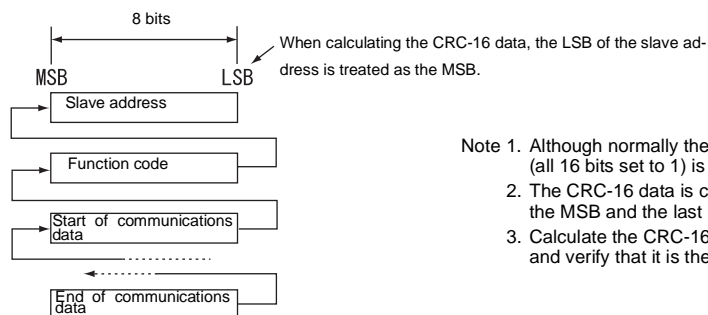
Note 1. Although normally the initial value for the CRC-16 calculation is 0, "-1" (all 16 bits set to 1) is used here instead.
2. The CRC-16 data is calculated using the LSB of the slave address as the MSB and the last MSB of the communications data as the LSB.
3. Calculate the CRC-16 data for the response message from the slave and verify that it is the same as the one in the response message.

Fig 6.59

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■DSR Message

An example of command/response messages is given below.

Reading Storage Register Contents (Function Code: 03 Hex)

Read the contents of the storage register only for specified quantities whose addresses are consecutive, starting from a specified address. The contents of the storage register are separated into higher place 8 bits and lower place 8 bits, and comprise the data within response messages in address order.

The following table shows message examples when reading status signals, error details, data link status, and frequency references from the slave 2 Inverter.

Command Message

Slave Address		02H
Function Code		03H
Start Address (register number)	Higher place	00H
	Lower place	20H
Quantity (10H max.)	Higher place	00H
	Lower place	04H
CRC-16	Higher place	45H
	Lower place	F0H

Response Message (Normal Meesage)

Slave Address		02H
Function Code		03H
Number of attached data bytes		08H
Lead storage register	Higher place	00H
	Lower place	65H
Next storage register	Higher place	00H
	Lower place	00H
Next storage register	Higher place	00H
	Lower place	00H
Next storage register	Higher place	01H
	Lower place	F4H
CRC-16	Higher place	AFH
	Lower place	82H

Response Message (Error Message)

Slave Address		02H
Function Code		83H
Error code		03H
CRC-16	Higher place	F1H
	Lower place	31H

Note The MSB of the function code will be set to 1 when an error occurs.

Loopback Test (Function Code: 08 Hex)

The loopback test returns command messages directly as response messages without changing the contents to check the communications between the master and slave. You can set user-defined test code and data values.

The following table shows a message example when performing a loopback test with the slave 1 Inverter.

Command Message

Slave address		01H
Function code		08H
Test Code	Higher place	00H
	Lower place	00H
Data	Higher place	A5H
	Lower place	37H
CRC-16	Higher place	DAH
	Lower place	8DH

Response Message (Normal Message)

Slave address		01H
Function code		08H
Test Code	Higher place	00H
	Lower place	00H
Data	Higher place	A5H
	Lower place	37H
CRC-16	Higher place	DAH
	Lower place	8DH

Response Message (Error Message)

Slave address		01H
Function code		88H
Error Code		01H
CRC-16	Higher place	86H
	Lower place	50H

Note The MSB of the function code will be set to 1 when an error occurs.

Writing to Multiple Storage Registers (Function Code: 10 Hex)

Write the specified data to each specified storage register from the specified addresses. The written data must be in the following order in the command message: Higher place 8 bits, then lower place 8 bits, in storage register address order.

The following table shows an example of a message when forward operation has been set at a frequency reference of 60.0 Hz in the slave 1 Inverter by the PLC.

Command Message

Slave Address		01H
Function Code		10H
Start Address (register number)	Higher place	00H
	Lower place	01H
Quantity (10H max.)	Higher place	00H
	Lower place	02H
Number of attached data bytes		04H
Lead data	Higher place	00H
	Lower place	01H
Next data	Higher place	02H
	Lower place	58H
CRC-16	Higher place	63H
	Lower place	39H

Response Message (Normal Message)

Slave Address		01H
Function Code		10H
Start Address	Higher place	00H
	Lower place	01H
Quantity	Higher place	00H
	Lower place	02H
CRC-16	Higher place	10H
	Lower place	08H

Response Message (Error Message)

Slave Address		01H
Function Code		90H
Error code		02H
CRC-16	Higher place	CDH
	Lower place	C1H

Note The MSB of the function code will be set to 1 when an error occurs.

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Set the number of data specified using command messages as quantity of specified messages x 2. Handle response messages in the same way.

■**Data Tables**

The data tables are shown below. The types of data are as follows: Reference data, monitor data, and broadcast data.

Reference Data

The reference data table is shown below. You can both read and write reference data.

Register No.	Contents		
0000H	Reserved		
0001H	Frequency reference		
	Bit 0	Run/stop command	1: Run 0: Stop
	Bit 1	Forward/reverse operation	1: Reverse 0: Forward
	Bit 2	External error	1: Error (EFO)
	Bit 3	Error reset	1: Reset command
	Bit 4	ComNet	
	Bit 5	ComCtrl	
	Bit 6	Multi-function input command 3	
	Bit 7	Multi-function input command 4	
	Bit 8	Multi-function input command 5	
	Bit 9	Multi-function input command 6	
	Bit A	Multi-function input command 7	
	Bits B to F	Not used	
0002H	Frequency reference (Set units using parameter o1-03)		
0003H to 0005H	Not used		
0006H	PID target value		
0007H	Analog output 1 setting (-11 V/-726 to 11 V/726)		
0008H	Analog output 2 setting (-11 V/-726 to 11 V/726)		
0009H	Multi-function contact output setting		
	Bit 0	Contact output (Terminal M1-M2)	1: ON 0: OFF
	Bit 1	PHC1(Contact P1-PC)	1: ON 0: OFF
	Bit 2	PHC2(Contact P2-PC)	1: ON 0: OFF
	Bits 3 to 5	Not used	
	Bit 6	Set error contact (terminal MA-MC) output using bit 7. 1: ON 0: OFF	
	Bit 7	Error contact (terminal MA-MC)	1: ON 0: OFF
	Bits 8 to F	Not used	
000AH to 000EH	Not used		

Register No.	Contents	
000FH	Reference selection settings	
	Bit 0	Not used
	Bit 1	PID target value (register 0006H) 1: Enabled 0: Disabled
	Bits 3 to B	Not used
	C	Broadcast data S5 1: Enabled 0: Disabled
	D	Broadcast data S6 1: Enabled 0: Disabled
	E	Broadcast data S7 1: Enabled 0: Disabled
	F	Not used

Note Write 0 to all unused bits. Also, do not write data to reserved registers.

Monitor Data

The following table shows the monitor data. Monitor data can only be read.

Register No.	Contents	
0020H	Inverter status	
	Bit 0	Operation 1: Operating 0: Stopped
	Bit 1	Reverse operation 1: Reverse operation 0: Forward operation
	Bit 2	Inverter startup complete 1: Completed 2: Not completed
	Bit 3	Error 1: Error
	Bit 4	Data setting error 1: Error
	Bit 5	Multi-function contact output (terminal M1 - M2) 1: ON 0: OFF
	Bit 6	Multi-function output 1 (terminal P1 - PC) (M3-M4)1: ON 0: OFF
	Bit 7	Multi-function output 2 (terminal P2 - PC) (M5-M6) 1: ON 0: OFF
	Bits 8 to F	Not used
0021H	Error details	
	Bit 0	Overcurrent (OC) Ground fault (GF)
	Bit 1	Main circuit overvoltage (OV)
	Bit 2	Inverter overload (OL2)
	Bit 3	Inverter overheat (OH1, OH2)
	Bit 4	Injection brake transistor resistance overheat (rr, rH)
	Bit 5	Fuse blown (PUF)
	Bit 6	PID feedback reference lost (FbL)
	Bit 7	External error (EF, EFO)
	Bit 8	Hardware error (CPF)
	Bit 9	Motor overload (OL1) or overtorque 1 (OL3) detected
	Bit A	PG broken wire detected (PGO), Overspeed (OS), Speed deviation (DEV)
	Bit B	Main circuit undervoltage (UV) detected
	Bit C	Main circuit undervoltage (UV1), control power supply error (UV2), inrush prevention circuit error (UV3), power loss
	Bit D	Missing output phase (LF)
	Bit E	RS-422A/485 communications error (CE)
	Bit F	Operator disconnected (OPR)

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Register No.	Contents	
0022H	Data link status	
	Bit 0	Writing data
	Bit 1	Not used
	Bit 2	Not used
	Bit 3	Upper and lower limit errors
	Bit 4	Data integrity error
	Bits 5 to F	Not used
0023H	Frequency reference	Monitors U1-01
0024H	Output frequency	Monitors U1-02
0025H	Output voltage reference (U1-06)	
0026H	Output current	U1-03
0027H	Output power	U1-08
0028H	Torque reference	U1-09
0029H	Not used	
002AH	Not used	
002BH	Sequence input status	
	Bit 0	Multi-function input terminal S1 1: ON 0: OFF
	Bit 1	Multi-function input terminal S2 1: ON 0: OFF
	Bit 2	Multi-function input terminal S3 1: ON 0: OFF
	Bit 3	Multi-function input terminal S4 1: ON 0: OFF
	Bit 4	Multi-function input terminal S5 1: ON 0: OFF
	Bit 5	Multi-function input terminal S6 1: ON 0: OFF
	Bit 6	Multi-function input terminal S7 1: ON 0: OFF
	Bits 7 to F	Not used

Register No.	Contents			
002CH	Inverter status			
	Bit 0	Operation	1: Operating	
	Bit 1	Zero speed	1: Zero speed	
	Bit 2	Frequency matching	1: Matched	
	Bit 3	User-defined speed matching	1: Matched	
	Bit 4	Frequency detection 1	1: Output frequency ≤ L4-01	
	Bit 5	Frequency detection 2	Output frequency ≥ L4-01	
	Bit 6	Inverter startup completed	1: Startup completed	
	Bit 7	Low voltage detection 1: Detected		
	Bit 8	Baseblock	1: Inverter output baseblock	
	Bit 9	Frequency reference mode	1: Not communications 0: Communications	
	Bit A	Run command mode	1: Not communications 0: Communications	
	Bit B	Overtorque detection	1: Detected	
	Bit C	Frequency reference lost	1: Lost	
	Bit D	Retrying error	1: Retrying	
	Bit E	Error (including RS-422A/485 communications time-out) 1:Error occurred		
	Bit F	Communications time-out 1: Timed out		
002DH	Multi-function output status			
	Bit 0	Multi-function output (terminal M1-M2) 1: ON 0: OFF		
	Bit 1	Multi-function output 1 (terminal P1-PC, M3-M4): 1: ON 0: OFF		
	Bit 2	Multi-function output 2 (terminal P1-PC, M5-M6): 1: ON 0: OFF		
	Bits 3 to F	Not used		
002EH - 0030H	Not used			
0031H	Main circuit DC voltage			
0032H - 0037H	Not used			
0038H	PID feedback quantity (Input equivalent to 100%/Max. output frequency; 10/1%; without sign)			
0039H	PID input quantity (±100%/±Max. output frequency; 10/1%; with sign)			
003AH	PID output quantity (±100%/±Max. output frequency; 10/1%; with sign)			
003BH	CPU software number			
003CH	Flash software number			
003DH	Communications error details			
	Bit 0	CRC error		
	Bit 1	Invalid data length		
	Bit 2	Not used		
	Bit 3	Parity error		
	Bit 4	Overrun error		
	Bit 5	Framing error		
	Bit 6	Time-out		
	Bits 7 to F	Not used		

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Register No.	Contents
003EH	kVA setting
003FH	Control method

Note Communications error details are stored until an error reset is input (you can also reset while the Unit is operating). Communications error details can also be read by using the register numbers given in the *Register* column in the *U: Monitor* parameter table.

Broadcast Data

The following table shows the broadcast data. This is write data only.

Register Address	Contents	
0001H	Operation signal	
	Bit 0	Run command 1: Operating 0: Stopped
	Bit 1	Reverse operation command 1: Reverse 0: Forward
	Bits 2 and 3	Not used
	Bit 4	External error 1: Error (set using H1-01)
	Bit 5	Error reset 1: Reset command (set using H1-02)
	Bits 6 to B	Not used
	Bit C	Multi-function input S5
	Bit D	Multi-function input S6
	Bit E	Multi-function input S7
	Bit F	Not used.
0002H	Frequency reference	30000/100%

Note Bit signals not defined in the broadcast operation signals use local node data signals continuously.

■ENTER Command

When writing parameters to the Inverter from the PLC using RS-422A/485 communications, the parameters are temporarily stored in the parameter data area in the Inverter. To enable these parameters in the parameter data area, use the ENTER command.

There are two types of ENTER commands: ENTER commands that enable parameter data in RAM, and ENTER commands that write data to EEPROM (non-volatile memory) in the Inverter at the same time as enabling data in RAM.

The following table shows the ENTER command data. ENTER command data can only be written.

The ENTER command is enabled by writing 0 to register number 0900H or 0901H.

Register No.	Contents
0900H	Write parameter data to EEPROM
0910H	Parameter data is not written to EEPROM, but refreshed in RAM only.

INFO

The maximum number of times you can write to EEPROM using the Inverter is 100,000. Do not frequently execute ENTER commands (0900H) written to EEPROM.
The ENTER command registers are write-only. Consequently, if reading these registers, the register address will become invalid (Error code: 02H).

■Error Codes

The following table shows RS-422A/485 communications error codes.

Error Code	Contents
01H	Function code error A function code other than 03H, 08H, or 10H has been set by the PLC.
02H	Invalid register number error • The register address you are attempting to access is not recorded anywhere. • With broadcast sending, a start address other than 0000H, 0001H, or 0002H has been set.
03H	Invalid quantity error • The Quantity (number of data item) in the command message must be in range between 1 to 16. • In the write command message, the Numbers of attached data bytes must be twice of the Quantity.
21H	Data setting error • A simple upper limit or lower limit error has occurred in the control data or when writing parameters. • When writing parameters, the parameter setting is invalid.
22H	Write mode error • Attempting to write parameters during operation. • Attempting to write an ENTER command during operation. • Attempting to write parameters other than A1-00 to A1-05, E1-03, or 02-04 when warning alarm CPF03 (defective EEPROM) has occurred. • Attempting to write read-only data.
23H	Writing during main circuit undervoltage (UV) error • Writing parameters from the PLC during UV (main circuit undervoltage) alarm. • Writing ENTER commands from the PLC during UV (main circuit undervoltage) alarm.
24H	Writing error during parameters processing Attempting to write parameters from the PLC while processing parameters in the Inverter.

■Slave Not Responding

In the following cases, the slave will ignore the write function. If the slave address specified in the command message is 0, all slaves execute the write function, but do not return response messages to the master.

• When a communications error (overrun, framing, parity, or CRC-16) is detected in the command message.

• When the slave address in the command message and the slave address in the Inverter do not agree.

• When the data that configures the message and the data time length exceeds 24 bits.

• When the command message data length is invalid.

Application Precautions

Set a timer in the master to monitor response time from the slaves. Make the setting so that if no response is sent to the master from the slave within the set time, the same command message is sent again from the master.

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■Self-Diagnosis

The Inverter has a built-in function for self-diagnosing the operations of serial communications interface circuits. This function is called the self-diagnosis function. The self-diagnosis function connects the communications parts of the send and receive terminals, receives the data sent by the Inverter, and checks if communications are being performed normally.

Perform the self-diagnosis function using the following procedure.

1. Turn ON the power supply to the Inverter, and set 67 (communications test mode) in parameter H1-05 (Terminal S7 Function Selection).

2. Turn OFF the power supply to the Inverter.

3. Perform wiring according to the following diagram while the power supply is turned OFF.

4. Turn ON the terminating resistance. (Turn ON pin 1 on DIP switch 1.)

5. Turn ON the power supply to the Inverter again.

SC								RP	R+	R—	S+	S—
S1	S2	S3	S4	S5	S6	S7						
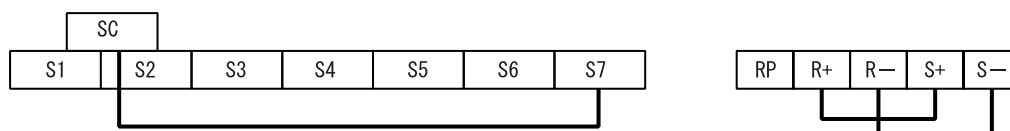
Fig 6.60   Details of Communications Terminals

Pass will be displayed on the Digital Operator if the diagnosis have finished correctly.

If an error occurs, a CE (RS-422A/485 communications error) alarm will be displayed on the Digital Operator, the error contact output will be turned ON, and the Inverter operation ready signal will be turned OFF.

■Converting Register Data

Register data (such as monitor values or parameter set value data) is placed in the communications data block of the message data (i.e., request message or response data). The data in each register is sent as 2-byte data. It is processed under the following rules and sent in hexadecimal.

The data is converted to a hexadecimal value using a minimum setting unit for each register of 1

For example, if the frequency reference is 60 Hz and the minimum unit of setting is 0.01 Hz, the data will be converted as follows:

60 Hz/0.01 (Hz) = 6000 = 1770 Hex

The minimum unit of setting of each parameter is given in the description of the parameter and in the parameter tables in *Chapter 5 Parameters*.

The minimum unit of setting of frequency reference data or frequency monitor data is determined by o1-03 (register 502 Hex: frequency reference/monitor unit selection). The unit of setting of each of the three registers below is determined by the set value in o1-03. The set value in o1-03 has nothing to do with frequency data items set as parameters (e.g., frequency references 1 through 16, inching frequency reference, maximum frequency, minimum output frequency, jump frequency). For these items, the unit of setting is as shown in *Chapter 5 Parameters*.

- Monitor Items
  Register 0023H: Frequency reference monitor
  Register 0024H: Output frequency monitor

- Communications Register
  Register 0002H: Frequency reference
  In spite of the set value in o1-03, however, set the maximum frequency to 30000 when the frequency reference is executed with a broadcast message. In this case, the Inverter rounds off any value less than 0.01 Hz.

If the jump frequency is 100.0 Hz and the minimum unit of setting is 0.01 Hz, the data will be converted as follows:

100.0 (Hz)/0.01 (Hz) = 10000 = 2710 Hex

Negative values are expressed in 2's complements

If the frequency bias in H3-03 is -100%, the minimum unit of setting will be 1% and the data will be converted as follows:

100 (%)/1 (%) = 100 = 0064 Hex

→ 2's complement: FF9C Hex

| 0064 Hex = | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |

Bit reversed.

| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | = FF9B Hex |

1 is added.

| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | = FF9C Hex |
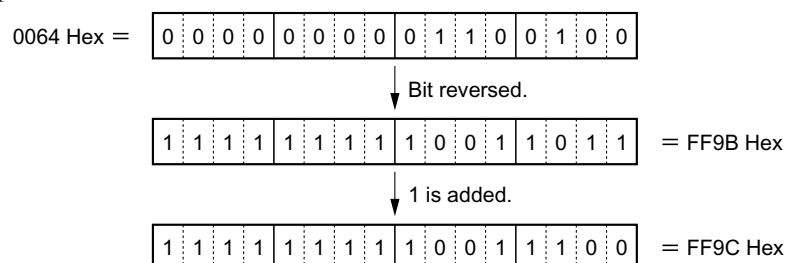
Fig 6.61

Whether the data is positive or negative is determined by the parameter set value.
The MSB of negative-value data is always set to 1. Data with its MSB set to 1 is not, however, always negative-value data.
For example, the setting range of parameter d3-01 (register 294 Hex: jump frequency 1) is within a range from 0.00 to 400.0 Hz. If the jump frequency is 400.0 Hz, the data is obtained from the following formula and its

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MSB will be 1.

400.0 (Hz)/0.01 (Hz) = 40000 = 9C40 Hex

Set All Unused Bits to 0

Bits 11 through 15 of the RUN command (register 0001H) are not used. When writing the data, be sure to set all of these bits to 0. These bits when read are set to 0.

No Data Settings in Unused Registers

Registers described "not used" may be used for internal processing. Do not write any data to such registers.

◆ Communications with a Programmable Controller

The RS-422A/485 communications of the 3G3RV Inverter conform to the MODBUS Communications Protocol. This protocol cannot share the same line with any other communications protocol.

To control the 3G3RV through RS-422A/485 communications with the Programmable Controller, mount a Serial Communications Board or Unit to the Programmable Controller and use the protocol macro function. The following settings and operations are necessary for serial communications using the protocol macro function.

- Configure system settings for the Serial Communications Board or Unit

- Create Send & Recv procedures conforming to the MODBUS Communications Protocol by means of protocol macro tools (CX-Protocol or Protocol Support Tool), and transfer them to the Serial Communications Board.

- Execute the PMCR instruction on the CPU Unit of the Programmable Controller.

■ Applicable Programmable Controllers and Peripheral Devices

A Serial Communications Board or Unit can be mounted to the following SYSMAC CPU Units.

Table 6.2 Applicable Programmable Controllers

Series	CPU Unit models
SYSMAC CS	High-speed models: CS1H-CPU67-E/66-E/65-E/64-E/63-E Low-speed models: CS1G-CPU45-E/44-E/43-E/42-E
SYSMAC CJ	CJ1G-CPU44/45
SYSMAC C200HX/HG/HE	C200HX-CPU34-E/44-E/54-E/64-E/34-ZE/44-ZE/54-ZE/64-ZE/65-ZE/85-ZE C200HG-CPU33-E/43-E/53-E/63-E/33-ZE/43-ZE/53-ZE/63-ZE C200HE-CPU32-E/42-E/32-ZE/42-ZE
SYSMAC CQM1H	CQM1H-CPU61/51

■ Applicable Serial Communications Boards and Unit

The following Serial Communications Boards and Unit can be used with the RS-422A/485 port.
The RS-232C port can be used if an RS-422/485 Conversion Adapter is installed. For ease of wiring, however, it is recommended that the RS-422/485 port be used. The following information is for the RS-422/485 port.

Table 6.3 Applicable Serial Communications Boards

Series	Serial Communications Board/Unit	Mounting method	Specifications
SYSMAC CS	CS1W-SCB41	As an Inner Board of the CPU Unit	• One RS-232C port • One RS-422A/485 port • Protocol macro function
SYSMAC CJ	CJ1W-SCU41	CPU Bus Unit	• One RS-232C port • One RS-422A/485 port • Protocol macro function
SYSMAC C200HX/HG/HE	C200HW-COM06-EV1 Make sure that the model number has the suffix "EV1," otherwise the CRC-16 check code cannot be used.	Mounted to an optional slot of the CPU Unit	• One RS-232C port • One RS-422A/485 port • Protocol macro function
SYSMAC CQM1H	CQM1H-CPU61/51-E	As an Inner Board of the CPU Unit	• One RS-232C port • One RS-422A/485 port • Protocol macro function

■ Peripheral Devices

The following peripheral devices are required to use the protocol macro function.

Table 6.4 Peripheral Devices

Name	Model	Specification	
CX-Protocol	WS02-PSTC1-E	The following peripheral devices support the protocol macro function of the entire SYSMAC series.	
		Personal computer environment	
		Personal computer	IBM PC/AT or compatible computer
		CPU	Minimum requirement: Pentium 90 MHz Recommended: Pentium 166 MHz or faster
		OS	Microsoft Windows 95 or Windows 98
		Memory	Minimum: 16 MB Recommended: 24 MB min.
		Hard disk	Minimum: Available space of 24 MB Recommended: Available space of 50 MB
		Monitor	SVGA or better
		Drive	FDD: 1 or more CD-ROM drive: 1 or more

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Table 6.4 Peripheral Devices

Name	Model	Specification	
Protocol Support Tool	WS01-PSTF1-E	The following peripheral devices support the protocol macro function of the SYSMAC C200HX/HG/HE series.	
		Personal computer environment	
		Personal computer	IBM PC/AT or compatible computer
		CPU	Minimum requirement: Pentium 90 MHz Recommended: Pentium 166 MHz or faster
		OS	Microsoft Windows 95 or Windows 98
		Memory	Minimum: 16 MB Recommended: 24 MB min.
		Hard disk	Minimum: Available space of 24 MB Recommended: Available space of 50 MB
		Monitor	SVGA or better
		Drive	FDD: 1 or more CD-ROM drive: 1 or more

■Manuals for Related Equipment and the Support Tool

The following manuals provide details on equipment and the Protocol Support Tool.

Table 6.5 List of manuals

Name, series, model	Cat. No.
SYSMAC CS series, CPU Unit	W339 Users Manual W340 Instruction Reference Manual W394 Programming Manual
SYSMAC CJ series, CPU Unit	W393 Operation Manual W340 Instruction Reference Manual W394 Programming Manual
SYSMAC C200HX/HG/HE, CPU Unit	W302 Installation Guide W303 Operation Manual
SYSMAC CQM1H CPU Unit	W363 Operation Manual W364 Programming Manual
Serial Communications Board, CS1W-SCB21/41 Serial Communications Unit, CS1W-SCU21 Serial Communications Unit, CS1W-SCU41	W336 Users Manual
Serial Communications Board, C200HW-COM06-V1	W304 Operation Manual
Serial Communications Board, CQM1H-SCB41	W365 Operation Manual
CX-Protocol, WS02-PSTC1-E	W344 Operation Manual
Protocol Support Tool WS01-PSTF1-E	W319 Operation Manual

■Serial Communications Board/Unit SystemSettings

The system settings for the Serial Communications Board and Unit are given below.

For the CS/CJ series:

Use the following ports for the CS/CJ series.

- CS1W-SCB41 Serial Communications Board: Port 2
- CJ1W-SCU41 Serial Communications Unit: Port 2

m = D30000 + 100 x Unit No. (Wd)

DM Area				Bit	Setting	Value
Board		**Unit**				
Port 1	Port 2	Port 1	Port 2			
D32000	D32010	m	m+10	15	Port setting -- 0: Default, 1*: Desired setting	860E
				14 to 12	Reserved	
				11 to 08	Serial communications mode (6 Hex*: Protocol macro)	
				07 to 05	Reserved	
				04	Start bit -- 0*: 1 bit, 1: 1 bit (fixed at 1 bit regardless of the setting)	
				03	Data length -- 0: 7 bits, 1*: 8 bits	
				02	Stop bit -- 0: 2 bits, 1*: 1 bit	
				01	Parity -- 0: With, 1*: Without	
				00	Parity -- 0*: Even, 1: Odd	
D32001	D32011	m+1	m+11	15 to 04	Reserved	0006
				03 to 00	Transmission rate (unit: bps) 0: Default (9,600), 3: 1,200, 4: 2,400, 5: 4,800, 6*: 9,600, 7: 19,200, 8: 38,400	
-	-	-	-			—
D32008	D32018	m+8	m+18	15	Transmission method -- 0: Half-duplex, 1*: Full-duplex	8000
				14 to 00	Reserved	
D32009	D32019	m+9	m+19	15 to 00	Max. number of bytes in send/receive data -- 00C8* to 03E8 Hex	00C8

* Set to this value.

For the SYSMAC C200HX/HG/HE and CQM1H Series:

Use the following ports for the SYSMAC C200HX/HG/HE and CQM1H series.

• C200HW-COM06-V1 Communications Board: Port A

• CQM1H-SCB41 Serial Communications Board: Port 2

Communications Board		Bit	Setting	Value
Port 1 Port A	Port 2 Port B			
DM6555	DM6550	00 to 03	Standard format setting 0 Hex: Standard setting (default) 1 Hex*: Settings in bits 00 to 15 of DM6656 and DM 6551 are used.	6001
		04 to 11	00: Default	
		12 to 15	Serial Communications Board 0 Hex: Host link (default) 1 Hex: Not protocol 2 Hex: 1:1 Link slave 3 Hex: 1:1 Link master 4 Hex: NT link (1:1 mode) 5 Hex: Hex: NT link (1:N mode) 6 Hex*: Protocol macro	

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Communications Board		Bit	Setting					Value
Port 1 Port A	**Port 2 Port B**							
DM6556	DM6551	00 to 07	Communications speed 00 Hex: 1,200 bps (default) 01 Hex: 2,400 bps 02 Hex: 4,800 bps 03 Hex*: 9,600 bps 04 Hex: 19,200 bps					0803
		08 to 15	Frame format					
				Start bits	Data	Stop bits	Parity	
			00 Hex:	1	7	1	Even (default)	
			01 Hex:	1	7	1	Odd	
			02 Hex:	1	7	1	None	
			03 Hex:	1	7	2	Even	
			04 Hex:	1	7	2	Odd	
			05 Hex:	1	7	2	None	
			06 Hex:	1	8	1	Even	
			07 Hex:	1	8	1	Odd	
			08 Hex*:	1	8	1	None	
			09 Hex:	1	8	2	Even	
			10 Hex:	1	8	2	Odd	
			11 Hex:	1	8	2	None	

* Set to this value.

■Protocol Macro Function

The protocol macro function makes it possible to customize a communications protocol in order to create a macro according to the specifications of the serial communications port of a general-purpose peripheral device.

The protocol macro function is mainly used for the following jobs.

- Creation of the message communications frame
- Creation of Send & Recv procedures for the message communications frame

TERMS

This manual uses the terms "message, DSR message, and response" to express the communications data exchanged.

Message: A DSR message or response.

DSR message: A message sent by the Master for instructions to the Inverter.

Response: A message that the Inverter returns in compliance with a DSR message from the Master.

Creating a Message

The message can be created according to the communications specifications of the general-purpose peripheral device (Inverter) as a counterpart.

A DSR message can include variables to set data in the I/O memory (such as data memory) of the CPU Unit or write response data to the I/O memory.

Each component of a message is in the memory of the Communications Board. Therefore, the CPU Unit can just execute the PMCR instruction to send or receive the data, with no need to write ladder programs for the communications protocol.
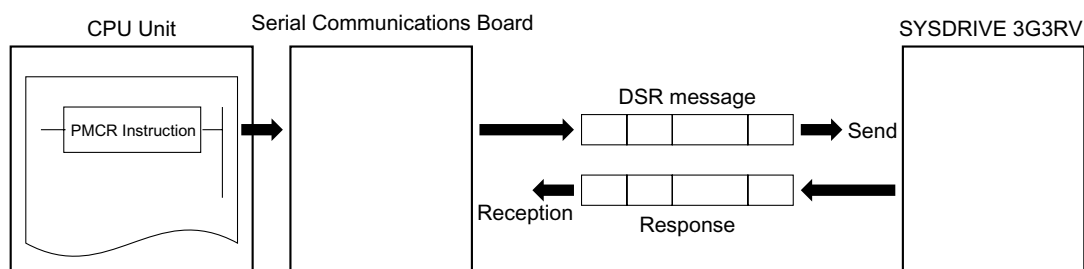
Fig 6.62 Creating a Message

Step to Send and Receive Messages

Sending and receiving messages as a single step includes step-type commands, such as Send, Recv, Send & Recv, and Wait commands.

The step can be finished or switched to another step according to the result of the step.
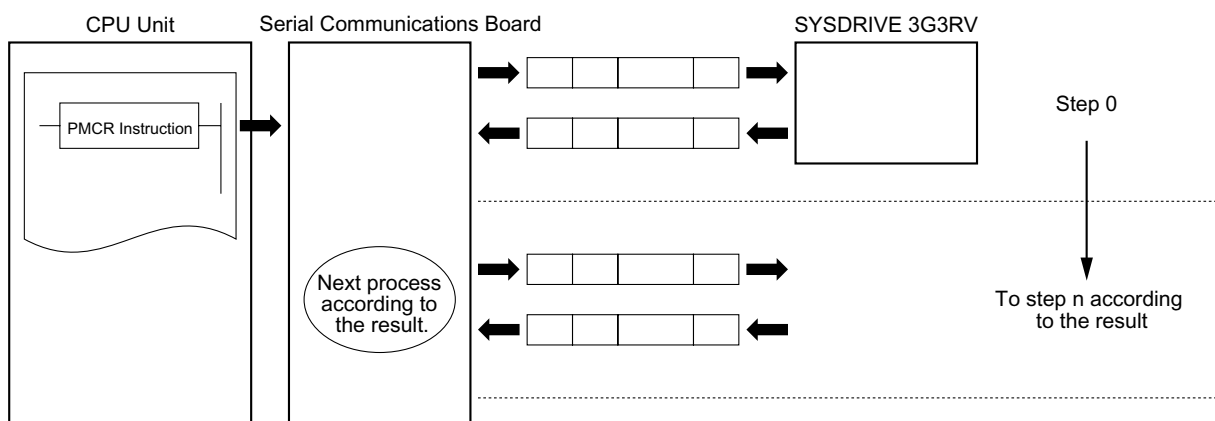
Fig 6.63 Sending and Receiving Messages

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■Configuration of the Protocol Macro Function

The protocol consists of one or more sequences. A sequence is an independent set of actions to perform together with a general-purpose peripheral device, such as an Inverter. For example, the RUN command and the frequency reference are given to the Inverter and the status of the Inverter is read in a single sequence.

A sequence consists of one or more steps. A step consists of a Send & Recv command + a Send & Recv message + a step branch in accordance with the processing result + Completion.

Sequence

When repeating actions to give the RUN command and frequency reference to the Inverter and read the status of the Inverter, for example, the actions can be registered as one sequence, or more than one if necessary. On page *101* under *Creating a Project File*, an example is shown with all actions registered as a single sequence. A sequence may include the following parameters.

Parameter	Description
Transmission control	Set the method of control, such as flow control. Select only modem control for communications with the 3G3RV.
Link word	Set the area for sharing the data between the Programmable Controller and Communications Board. On page *101* under *Creating a Project File*, an example is shown without such an area set.
Monitor time	Set the periods to monitor the transmission and reception steps with timers Tr, Tfr, and Tfs. Set a period of approximately 0.5 s each for communictions with the 3G3RV.
Response notify method	A method to write reception data to the I/O memory of the Programmable Controller. Select "notify by scan" for communictions with the 3G3RV.
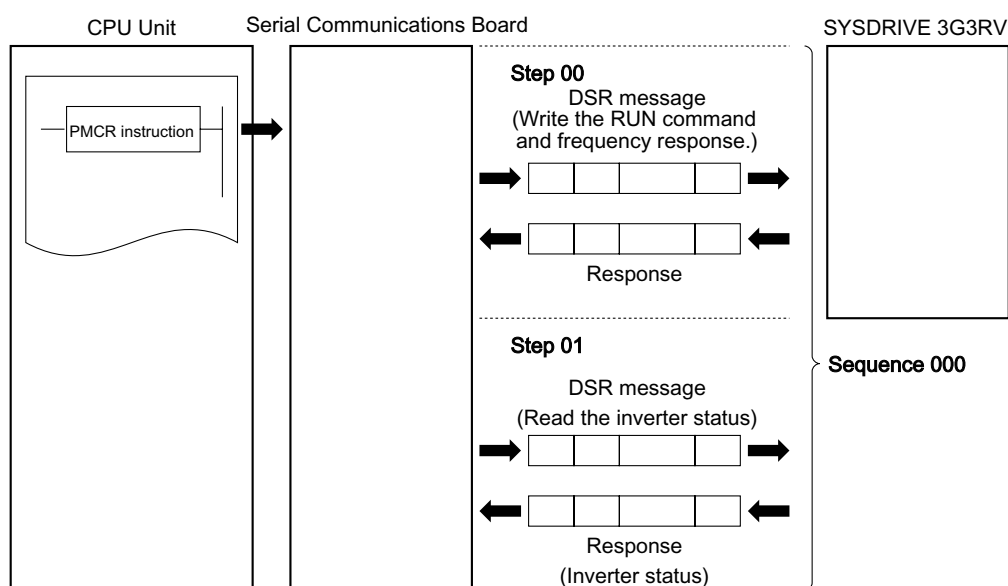
Fig 6.64

Step

In a single step, a DSR message is sent and a response for the DSR message is received. A step may not include a response if it is a broadcast message.

In the case of repetitive actions to issue the RUN command and frequency reference to the Inverter and read the status of the Inverter, for example, the actions to give the RUN command and frequency reference constitute one step. The reason is that these register numbers are consecutive and can be sent with a single DSR message. The action to read the status of the Inverter is another step.

A step includes a command and a maximum of two messages. The above example uses the Send & Recv command. The DSR message and response are both messages.

A step may include the following parameters.

Parameter		Description
Command		The Send, Recv, Send & Recv, Wait, Flush, Open (ER-ON) or Close (ER-OFF) is set. Under *Creating a Project File*, an example is shown with the Send & Recv command used. The Send command is used for a broadcast message.
Message	Send message	A DSR message is set for the Send command used.
	Recv message	A response is set for the Recv command.
	Send & Recv message	A DSR message and response are set for the Send & Recv command.
	Recv matrix	If there are two or more responses for the Send or Send & Recv command, the next process is selected per response.
Repeat counter		The number (N) of times to repeat the step is set within a range from 0 to 255. It is possible to change messages by making use of the number (N). Under *Creating a Project File*, an example is shown with this function used for enabling three Slaves to repeat the same process.
Number of retries		The number of times to retry the command can be set within a range from 0 to 9 only when the Send & Recv command is used. It is recommended that the number be set to 3 or larger.
Send Wait Time		The waiting time until data is sent with the Send or Send & Recv command executed.
Response Write (with operand specified)		Determines whether or not to write the reception data in the response. Under *Creating a Project File*, an example is shown with this function used for writing the Inverter status to the memory.
Next process		Determines which step is to be processed next, or finishes the opertion after the step is finished normally.
Error processing		Determines which step is to be processed next, or finishes the operation, if the the step has an error.

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■Data Created by Protocol Support Tool and CX-Protocol

A project file is used by the Protocol Support Tool to create and control data. A project
file consists of the following data.
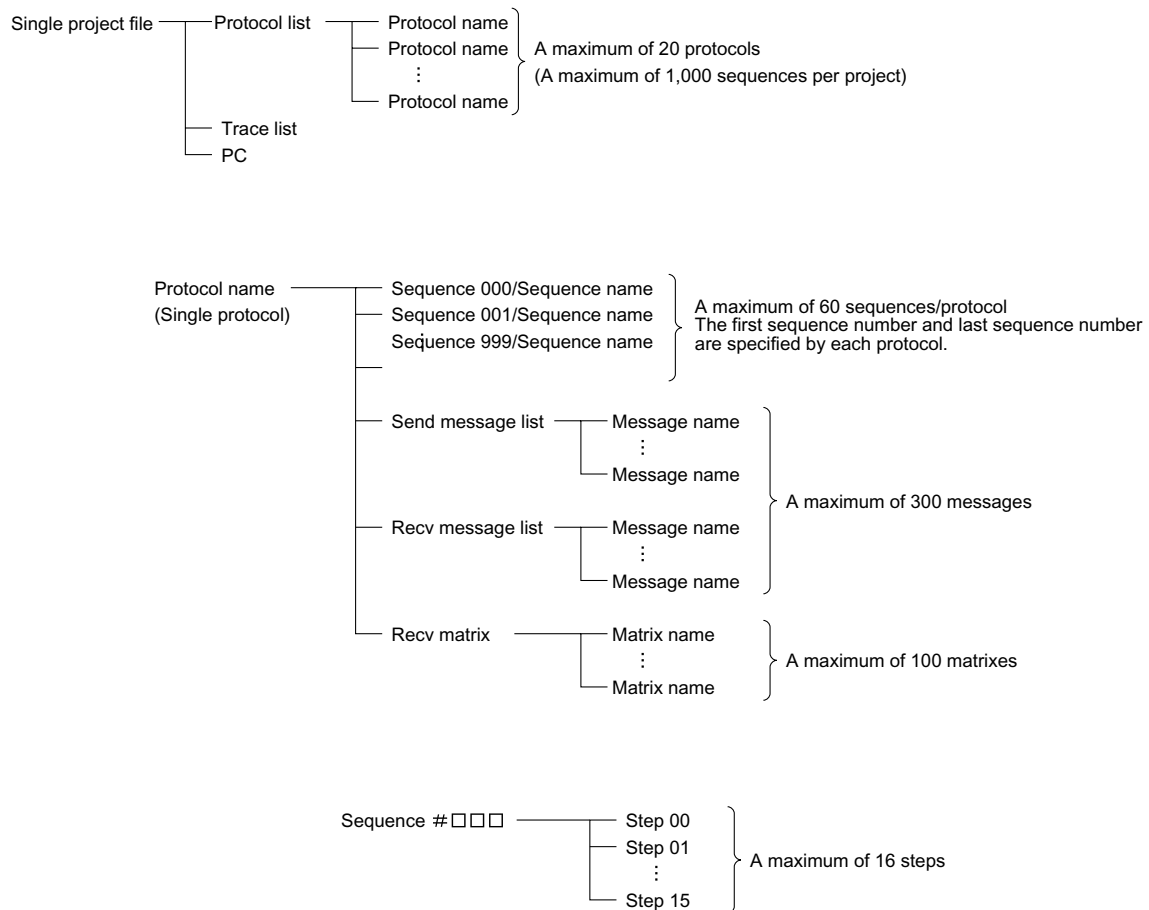
Fig 6.65 Project File Configuration

The standard system protocol incorporated by the Communications Board cannot be edited or transferred. To make use of
the standard system protocol, copy it to the project file and edit it.
Under *Creating a Project File,* an example to create a new project file is shown without making use of the standard system
protocol.

■**Creating a Project File**

The following descripton provides information about how to create a project file to send the RUN command and frequency references to three Inverters and read the Inverter status. ("PST" indicates the WS01-PSTF1-J Protocol Support Tool.)

First, select from I/O items, monitor items, and parameters the data to be exchanged according to the application. Then consider what sequence is required by using the protocol macro function.

Example: Writes control input items (such as the RUN command and multi-function input) of the Inverter and frequency reference, monitors the control output (such as error output and RUN output) of the Inverter, and monitors the Inverter status.

Three Inverters with Slave addresses from 01 to 03 are installed for communications.

Checking the Register Numbers

In the above example, the following three registers are required.

Control Input: Register 0001 Hex for RUN command

Frequency Reference: Register 0002 Hex

Control Output: Register 002C Hex for Inverter status

Memory Allocations

The PMCR instruction sends each Slave the data in consecutive words specified by the operand and beginning with the first word (S), and writes in the memory area beginning with the first word (D) the data received. The following memory allocations are made in the above example.
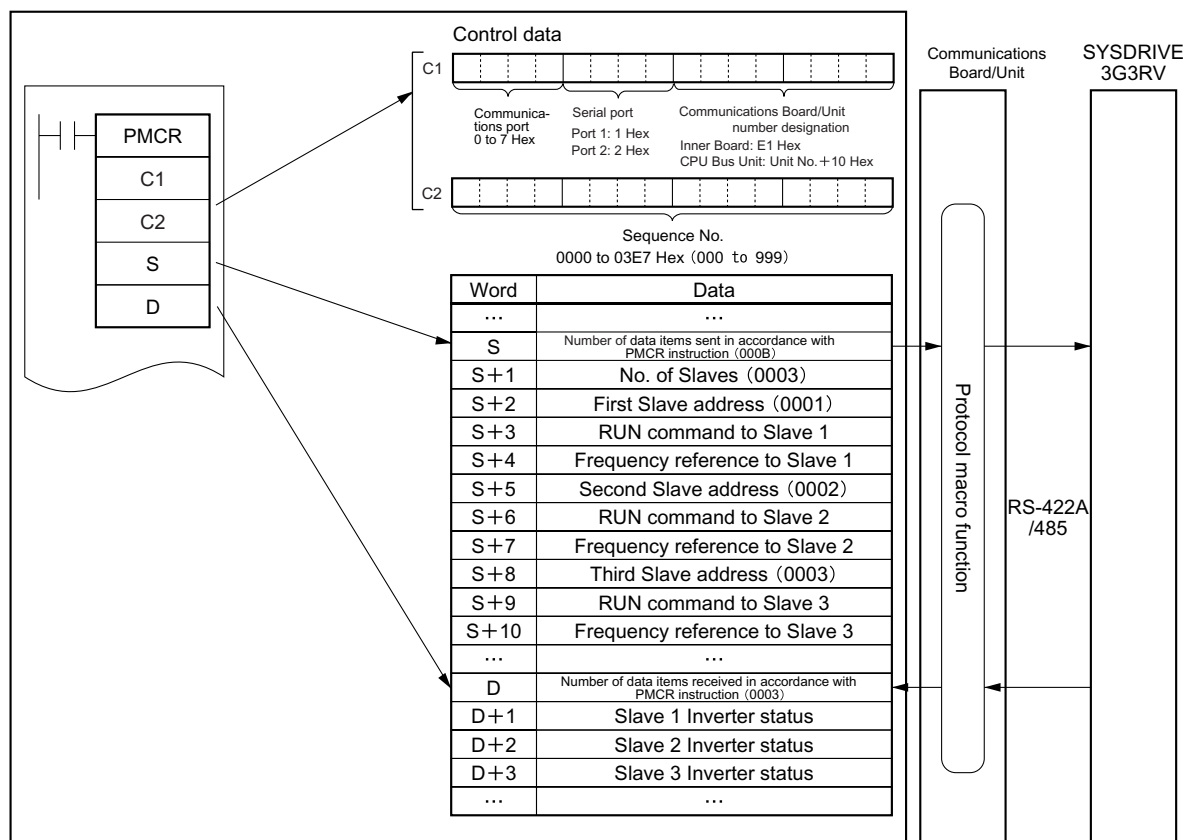
SYSMAC CS or CJ-series Programmable Controllers

C: Control data (See note.)

```
 15        12 11                                    0
```

Communications port
  1: Port A
  2: Port B

Sequence No.
000 to 999（BCD）

Word	Data
…	…
S	No. of data items sent in accordance with PMCR instruction（000B）
S+1	No. of Slaves（0003）
S+2	First Slave address（0001）
S+3	RUN command to Slave 1
S+4	Frequency reference to Slave 1
S+5	Second Slave address（0002）
S+6	RUN command to Slave 2
S+7	Frequency reference to Slave 2
S+8	Third Slave address（0003）
S+9	RUN command to Slave 3
S+10	Frequency reference to Slave 3
…	…
D	No. of data items received in accordance with PMCR instruction（0003）
D+1	Slave 1 Inverter status
D+2	Slave 2 Inverter status
D+3	Slave 3 Inverter status
…	…

Note Control data for the SYSMAC C200HX/HG/HE is indicated. The SYSMAC CS1 Series uses different control data.

SYSMAC C200HX/HG/HE or CQM1H Programmable Controllers

Fig 6.66 Memory Allocations

■Creating a New Project and Protocol

Use the following procedure to create a new project and protocol.

1. Select **New** from **File** in the Menu Bar or click on the **New** icon with the left button of the mouse to create a new project.

2. If CX-Protocol is used, set the PC name, PC model, and network type according to the actual conditions. The network type refers to the type of the network conected to the Support Software and it does not refer to the communications configuration between the Programmable Controller and the SYSDRIVE RV.
   The above settings will not be displayed if the PST is used.

3. Double-click on **New Project** with the left button of the mouse to display **Protocol List**.

4. Click on **Protocol List** with the left button of the mouse and click on a blank space with the right button of the mouse.

5. Select **Create Protocol**.

■Creating a Sequence

Use the following procedure to create a new sequence.

1. Click on **New Protocol** with the left button of the mouse. Then click on a blank space with the right button of the mouse.

2. Select **Create Communication Sequence**.
   The following table will appear. Set the parameters related to the sequence in the table.

*	#	Communication sequence	Link word	Control	Response	Timer Tr	Timer Tfr	Timer Tfs
	000	Inverter I/O Send & Recv	— — —	Set (Setting required)	Scan	0.5	0.5	0.5

#

Sequence number. The sequence number is automatically set.

Communication Sequence

The label (name) of the sequence. Input an appropriate, easy-to-distinguish name.

Link Word

Set the area for sharing the data between the Programmable Controller and Communications Board.
In this example, the link word is specified by the operand of the PMCR instruction. Therefore no link word is set here.

Control

Set the control method, such as flow control.

Select only "modem control" for communications with the 3G3RV.

Response

A method to write reception data to the I/O memory of the Programmable Controller.
Select "notify by scan" for communications with the 3G3RV.

Timer Tr, Timer Tfr, and Timer Tfs

Set the periods to monitor the transmission and reception steps with timers Tr, Tfr, and Tfs. The following timing chart shows the meaning of each monitor.
Be sure to set the periods according to the application.
The step will be retried if the step is not completed within the monitor periods. An error will occur if the step is not completed within the monitor time again.

Set a period of approximately 0.5 s each for communications with the 3G3RV.
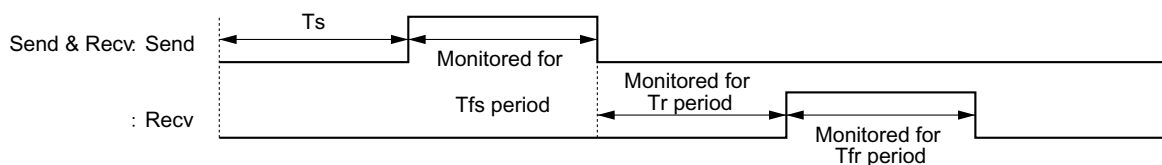
Ts: Send wait time set per step. Nothing is sent during this period.
Tfs: Monitors the completion of the data sent. If the data transmission is not finished within this period, the data will be re-transmitted.
Tr: Monitors the response to be received. If the response is not returned within this period, the response will be re-transmitted.
Tfr: Monitors the reception completion of the response. If the response transmission is not finished within this period, the response will be re-transmitted.

Note If the Tr period is too long, the time to detect a communications error will be longer, during which the Inverter cannot be controlled. Therefore, be sure to set an appropriate period.

Fig 6.67

6

6-103

■Creating a Step

1. Double-click on **New Protocol** with the left button of the mouse.

2. Click on **New Sequence** with the left button of the mouse and click on a blank space with the right button of the mouse.

3. Select **Create Step**.

The following table will appear. Set the parameters related to the step in the table.

*	Step	Repeat	Command	Retry	Send wait	Send message	Recv message	Response	Next	Error
☐	00	Reset/R (1)	Send & Recv	3	0.02	Input send	Input response	Yes	Next	Abort
☐	01	Reset/R (1)	Send & Recv	3	0.02	Status	Read response	Yes	End	Abort
☐										

Step

Step number. The step number is automatically set.

Repeat

The number (N) of times to repeat the step is set within a range from 0 to 255. It is possible to change messages by making use of the number (N).

In this example, the same message is sent to three Slaves with addresses different to each other. Therefore, the number is set to 3 in word $S + 1$. The number of Slaves is specified by the operand. Therefore, select **Channel**, use the Edit command to set **Data Address** to **Operand**, and set $0N + 1$ in order to select word $S + 1$. In the above table, "Reset" means that the repeat counter must be reset first in the step.

Command

Set the commands, such as Send, Recv, and Send & Recv.

Only the Send & Recv command is used for communications with the 3G3RV except for broadcasting messages, in which case the Send command is used.

Retry

Set the number of times to retry the command within a range from 0 to 9.

It is recommended that the number be set to 3 or larger. If a transmission error occurs due to noise, the transmission of the command will be retried. If the number is set to 3, an error will be detected if the transmission fails three times.

Send Wait

The waiting time until the data is sent.

For communications with the 3G3RV, if data is repeatedly transmitted to the same Slave, set the waiting time to 20 ms or more.

Send Message and Recv Message

Set the labels of the DSR message and response to be used.

Make these settings after deciding the labels in **Send Message Detail Settings** and **Recv Message Detail Settings**.

Response

Determine whether or not to write the reception data in the response.

Always set this parameter to Yes for communications with the 3G3RV.

Next

Determine which step is to be processed next or finish the operation after the step finishes normally.

In this example, step 00 is set to Next and step 01 is set to END because the sequence completes be executing steps 00 and 01.

Error

If the step has an error, determine which step is to be processed next or finish the operation.

In this example, the parameter will be set to Abort to interrupt the sequence if an error occurs.

■Send Message Detail Settings

1. Click on **Send Message List** with the left button of the mouse, and then click on a blank space with the right button of the mouse.
2. Select **Create Send Message**. The following table will appear. Set the send message in the table.

*	Message name	Header <h>	Terminator <t>	Check code <c>	Length <l>	Address <a>
→□	Input send			~CRC-16(65535) (2Byte BIN)	(0) (1Byte BIN)	~(R(3N+2), 1)
→□	Status			~CRC-16(65535) (2Byte BIN)		~(R(3N+2), 1)
→□						

Data
〈a〉＋[10]＋[00]＋[01]＋[00]＋[02]＋〈l〉＋(R(3N+3), 4)＋〈c〉
〈a〉＋[03]＋[00]＋[2C]＋[00]＋[01]＋〈c〉

6

Message name

The label (name) of the sequence. Input an appropriate, easy-to-distinguish name.

Set the label in the send message box in the table shown under *Creating a Step*.

Header <h> and Terminator <t>

Set the header and terminator.

No header or terminator is used for communications with the 3G3RV. Therefore, set both to **None**.

Check code <c>

Set the check code.

The CRC-16 check code is used for communications with the 3G3RV. Select the CRC-16 check code and set the default value to 65535.
Select **Reverse** for the conversion method. Then select **BIN** for data type.

Length <l>

Set the length of the data.

All communications with the 3G3RV are performed in byte units. Select **1 Byte** and **BIN**. Select **No** for reading data because there is no data to be read.

Address <a>

Set the addresses of the Slaves.

In this example, the Slave addresses are set in S + 2, S + 5, and S + 8. Therefore, retrieve the data from those locations.
The address is set in the LSB of each word. To read the byte, select **Variable Reverse**, otherwise the data is read from the MSB. Then click on **Edit Variable** with the left button of the mouse. Select **Read R ()** and set **Data/Address** to the operand (3N + 2) using the number (N) of times to repeat the step.
Set **Edit Length** to 1 byte as a default. If the default value has been changed, set it to 0N + 1.

Data

Set the DSR message in detail.

- DSR Message Requesting that the RUN Command and Frequency Reference Be Written
  The DSR message to write data to two registers from register 0001 Hex (the RUN command) consists of the following items.
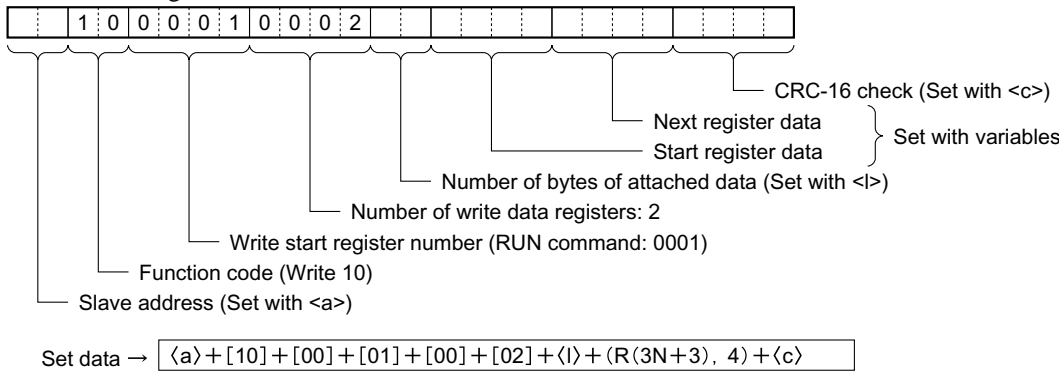
Set data → $\langle a \rangle + [10] + [00] + [01] + [00] + [02] + \langle l \rangle + (R(3N+3), 4) + \langle c \rangle$

⟨a⟩
The Slave address is set in the address box. Insert the address with the Insert icon.
[10] + [00] + [01] + [00] + [02]
Set the constants contained in the DSR message.
Use Set Constant and set the constants in Hex.

⟨l⟩
The length is set in the length box. Insert the length by using the Insert icon. The length is the number of bytes of the succeeding data (R(3N +3), 4). The length is automatically set by the CX-Protocol.
(R(3N +3), 4)
The Inverter's actual data to be sent. This example selects Variable and Read R() and sets the operand. Set Data to 3N + 3 because the RUN command data uses four bytes each from S + 3, S +6, and S + 9.
Set Edit Length to 0N + 4 so that it will be set to four bytes.

⟨c⟩
The check code is set in the check code box. Insert the check code by using the Insert icon. All the data including the address data before the check code is operated. Mark all the items if the PST is used. The check code is automatically set by the CX-Protocol.

Fig 6.68 DSR Message to Write Data

- DSR Message to Read the Inverter Status

    The DSR message to read the Inverter status from register 002C Hex consists of the following items.

| 0 | 3 | 0 | 0 | 2 | C | 0 | 0 | 0 | 1 | | | |

CRC-16 check (Set with <c>)
Number of read data registers: 1
Read start register number (Inverter status: 002C)
Function code (Read 03)
Slave address (Set with <a>)

Set data → 〈a〉+[03]+[00]+[2C]+[00]+[01]+〈c〉

Set the address data, constant data, and check code data.
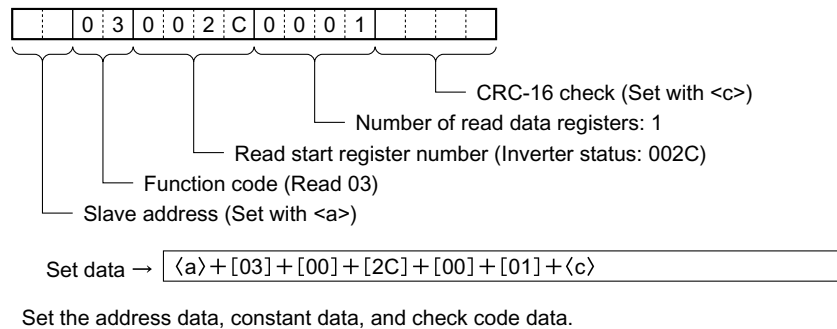
Fig 6.69   DSR Message to Read

■Recv Message Detail Settings

1. With the left button of the mouse, click on **Receive Message List**. Then click on a blank space with the right button of the mouse.

2. Select Create Receive Message.

The following table will appear. Set the Receive message in the table.

✱	Message	Header <h>	Terminator <t>	Check code <c>	Length <l>	Address <a>
→☐	Input response			~CRC-16(65535)(2Byte BIN)		~(R(3N+2),1)
→☐	Read response			~CRC-16(65535)(2Byte BIN)	(0)(1Byte BIN)	~(R(3N+2),1)
→☐						

Data
〈a〉+[10]+[00]+[01]+[00]+[02]+〈c〉
〈a〉+[03]+〈l〉+(W(1N+1),2)+〈c〉

Message

The label (name) of the response. Input an appropriate, easy-to-distinguish name.

Set the label in the Recv message box in the table shown under *Creating a Step*.

Header <h> and Terminator <t>

Set the header and terminator.

No header or terminator is used for communications with the 3G3RV. Therefore, set both to **None**.

Check Code <c>

Set the check code.
The CRC-16 check code is used for communications with the 3G3RV. Select the CRC-16 check code and set the initial value to 65535.
Select **Reverse** for the conversion method. Then select **BIN** as the data type.

6

Length <l>

Set the length of the data.

All communications with the 3G3RV are performed in byte units. Select **1 Byte** and **BIN**. Select **No** for reading data because there is no data to be read.

Address <a>

Set the addresses of the Slaves.

In this example, the Slave addresses are set in S + 2, S + 5, and S + 8. Therefore, retrieve the data from those locations.
The address is set in the LSB of each word. To read the byte, select **Variable Reverse**, otherwise the data will be read from the MSB. Then click on **Edit Variable** with the left button of the mouse. Select **Read R ()** and set **Data/Address** to the operand (3N + 2) using the number (N) of times to repeat the step.
Set **Edit length** to 1 byte as a default. If the default value has been changed, set it to 0N + 1.

Data

Set the expected response in detail.

- Response to the RUN Command and Frequency Reference
  The response to the DSR message written consists of the following items.
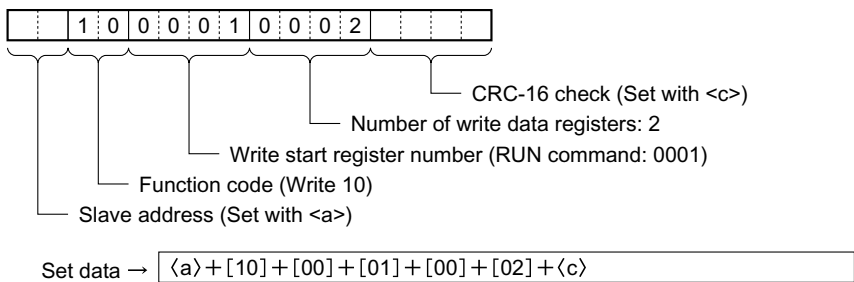
Set data → $\langle a \rangle + [10] + [00] + [01] + [00] + [02] + \langle c \rangle$

⟨a⟩

The Slave address is set in the address box. Insert the address with the Insert icon.

$[10] + [00] + [01] + [00] + [02]$

Set the constants contained in the response.

Use Set Constant and set the constants in Hex.

⟨c⟩

The check code is set in the check code box. Insert the check code by using the Insert icon. All the data including the address data before the check code is used. Mark all the items if the PST is used. The check code is automatically set by the CX-Protocol.

Fig 6.70 Response to DSR Message Written

• Response to the Inverter Status Read

The response to the DSR message to request the Inverter status in register 002C Hex consists of the following items.
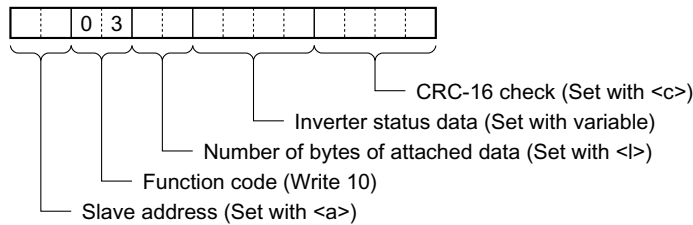
Set data → $\langle a \rangle + [03] + \langle I \rangle + (W(1N+1), 2) + \langle c \rangle$

⟨a⟩, [03], ⟨c⟩

The address data, constant data, and check code data are the same as the above.

⟨I⟩

The length is set in the length box. Insert the length by using the Insert icon. The length is the number of bytes of the succeeding data (W(1N + 1), 2). The length is automatically set by the CX-Protocol.

(W(1N+1), 2)

The Inverter's actual data is to be sent. This example selects Variable and Write W () (ntlp: English reference mistakenly(?) says Read R () here) and sets the operand. Set the data to 1N + 1 because the RUN command data uses two bytes each from D + 1, D + 2, and D + 3. (ntlp: English reference mistakenly(?) says the RUN command data uses four bytes each from D + 3, D + 6, and D + 9. here)

Set Edit Length to 0N + 2 so that it will be set to two bytes.

Fig 6.71   Response to DSR Message Read

■**Ladder Program**

Connect the PST and the Communications Board, and read the Communications Board system settings from the PST. Set the start/stop bits both to 1 bit, and data length to 8 bits.

Transfer the created protocol to the Communications Board. The following example describes how to control the Inverter with this protocol.

IMPORTANT

· Before using this program in your system, be sure to check the word and data memory allocations and change them if necessary so that there will be no word or data memory duplication.

·This program will stop all communications if a communications error or fault occurs. Be sure to set H5-05 for communications error detection selection to 1 (effective) and H5-04 for communications error detection operation selection to 0 through 2 so that the system will stop with time-over detection.

■**Memory Allocations**

Starting Communications and Status Signals

Word	Functions common to all Slaves
00000	Inverter control communications (continued when set to ON)
00001	Communications error output (on hold when a communications error or fault occurs
00002	Communications fault reset

Inverter Control Inputs (Register 0001 RUN Command)

The Inverter control inputs for the register 0001 RUN command are listed in the following table.

Word	Slave 1 function	Word	Slave 2 function	Word	Slave 3 function
00100	RUN command	00200	RUN command	00300	RUN command
00101	Forward/Reverse	00201	Forward/Reverse	00301	Forward/Reverse
00102	External fault	00202	External fault	00302	External fault
00103	Fault reset	00203	Fault reset	00303	Fault reset
00104	Multi-function input 1	00204	Multi-function input 1	00304	Multi-function input 1
00105	Multi-function input 2	00205	Multi-function input 2	00305	Multi-function input 2
00106	Multi-function input 3	00206	Multi-function input 3	00306	Multi-function input 3
00107	Multi-function input 4	00207	Multi-function input 4	00307	Multi-function input 4
00108	Multi-function input 5	00208	Multi-function input 5	00308	Multi-function input 5
00109	Multi-function input 6	00209	Multi-function input 6	00309	Multi-function input 6
00110	Multi-function input 7	00210	Multi-function input 7	00310	Multi-function input 7
00111	Always set to 0.	00211	Always set to 0.	00311	Always set to 0.
00112	Always set to 0.	00212	Always set to 0.	00312	Always set to 0.
00113	Always set to 0.	00213	Always set to 0.	00313	Always set to 0.
00114	Always set to 0.	00214	Always set to 0.	00314	Always set to 0.
00115	Always set to 0.	00215	Always set to 0.	00315	Always set to 0.

Frequency References of Inverter (Register 0002 Frequency Reference)

The frequency references of the Inverter for register 0002 frequency references are listed in the following table.

DM	Function
D0001	Slave 1 frequency reference
D0002	Slave 2 frequency reference
D0003	Slave 3 frequency reference

Inverter Control Outputs (Register 002C Inverter Status)

The Inverter control outputs for register 002C Inverter status are listed in the following table.

Word	Slave 1 function	Word	Slave 2 function	Word	Slave 3 function
01100	During RUN	01200	During RUN	01300	During RUN
01101	Zero speed	01201	Zero speed	01301	Zero speed
01102	Frequency agree	01202	Frequency agree	01302	Frequency agree
01103	Custom speed agree	01203	Custom speed agree	01303	Custom speed agree
01104	Frequency detection 1	01204	Frequency detection 1	01304	Frequency detection 1
01105	Frequency detection 2	01205	Frequency detection 2	01305	Frequency detection 2
01106	Inverter ready	01206	Inverter ready	01306	Inverter ready
01107	UV	01207	UV	01307	UV
01108	Base block	01208	Base block	01308	Base block
01109	Frequency reference mode	01209	Frequency reference mode	01309	Frequency reference mode
01110	RUN command mode	01210	RUN command mode	01310	RUN command mode
01111	Overtorque detection	01211	Overtorque detection	01311	Overtorque detection
01112	Frequency reference loss	01212	Frequency reference loss	01312	Frequency reference loss
01113	Fault retry	01213	Fault retry	01313	Fault retry
01114	Fault	01214	Fault	01314	Fault
01115	Communications time-over	01215	Communications time-over	01315	Communications time-over

Area Used by Operand of PMCR Instruction

The area used by the operand of the PMCR instruction in the CS-series is shown here.

Control Data: C1

DM	Word
D0100	0 1 1 0 0 1 0 1 1 1 0 0 0 0 1

Communications port 7   Serial port 2   Communications port E1

Control Data: C2

DM	Word
D0101	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Sequence 000 set

Send Data: S

DM	Area
D1000	000B (Number of Send data items: 11) See note 1.)
D1001	0003 (Number of Slaves)
D1002	0001 (Slave 1 address)
D1003	RUN command to Slave 1
D1004	Frequency reference to Slave 1
D1005	0002 (Slave 2 address)
D1006	RUN command to Slave 2
D1007	Frequency reference to Slave 2
D1008	0003 (Slave 3 address)
D1009	RUN command to Slave 3
D1010	Frequency reference to Slave 3

Recv Data: D

DM	Area
D2000	0003(Number of Recv data items: 3) See note 2.)
D2001	Slave 1 Inverter status
D2002	Slave 2 Inverter status
D2003	Slave 3 Inverter status

Note 1. Set the number of Send data items in Hex to the number of words of D1000 through D1010 (11).

Note 2. The number of words of D2001 through D2003 is written in Hex for the number of Recv data items.

6

Status flags

- Communications Port Enabled Flag
  Flag bit for communications port 7: A20207

- Protocol Macro Execution Flag
  The Protocol Macro Execution Flag is described below.

Unit/Board	Port 1	Port 2
CS1 Board	CIO 190915	CIO 191915
CS1 Unit	Bit 15 of CIO n + 9	Bit 15 of CIO n + 19

n = CIO 1500 + (25 x number of units)

- Communications Port Abort Flag
  The Communications Port Abort Flag is described below.

Unit/Board	Port 1	Port 2
CS1 Board	CIO 190913	CIO 191913
CS1 Unit	Bit 13 of CIO N + 9	Bit 13 of CIO n+19

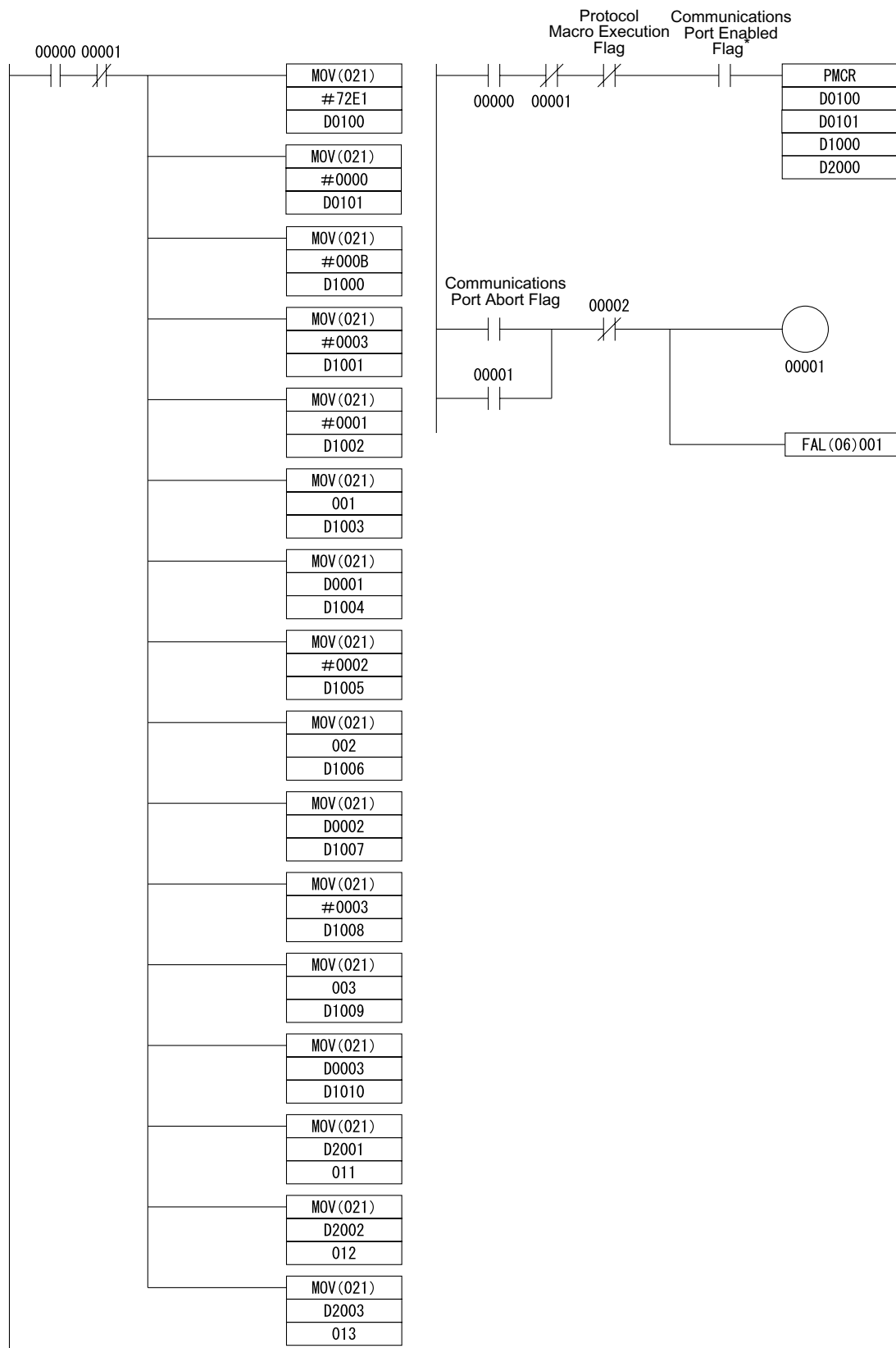n = CIO 1500 + (25 x number of units)

Ladder Program

Fig 6.72 Ladder Program

■Communications Response Time

The communications response times for communications with an Inverter via the RS-422/485 port of an Omron-made Communications Board are detailed below. Use this information as a reference when deciding the number of Slaves to be connected to one network, and when considering the timing of input and output signals.

Communications Time for One Message

A wide variety of programs for RS-422/485 communications can be created using the protocol macro function. The communications times will vary according to the contents of the program.
In general, the communications time for one message can be calculated using the following formula.

Communications time = [Number of bytes in DSR message x 10 (See note 1.) x (1/baud rate) x 1,000 (ms)]

+ [Number of bytes in response x 10 x (1/baud rate) x 1,000 (ms)] + [24 x (1/baud rate) x 1,000 (ms)] + send wait time setting (ms) + protocol macro waiting time (See note 2.) (ms)

The reason that the number of bytes in the DSR message and response is multiplied by 10 is because both the start bit and the stop bit require one bit each.
(1 byte = 8 bits) + (start bit: 1 bit) + (stop bit: 1 bit) = 10 bits

With RS-422A/485 communications, set at least 20 ms as the protocol macro waiting time.

Calculation Example

The communications time required for one Slave in the protocol macro created under *Creating a Project File*, can be calculated according to the following formula. (Baud rate = 19,200 bps.)

Communications time = [DSR message to write data (13 bytes) + DSR message to read (8 bytes)) x 10 x (1/ 19,200) x 1,000 (ms)] + [write response (8 bytes) + read response (7 bytes)) x 10 x (1/19,200) x 1,000 (ms)] + [24 x (1/19,200) x 1,000 (ms) x 2] + [10 (ms) x 2] + [20 (ms) x 2] = 81.2 (ms)

If there are N Slaves, the total communications time will be N x 81.2 ms. Consequently, the more Slaves that are used, the longer the communications time will be. If the number of Slaves is too high, it is possible that the detection time of 2 s for communications time-over will be exceeded. In this case, either disable the time-over detection function and use a different sequence to detect communications errors, or increase the number of Masters thereby decreasing the number of Slaves per Master.

I/O Response Time

The communications processing times for the Inverter are as follows.

- Inverter communications input scan: 8 ms

- Inverter communications output scan: 8 ms

- Internal processing time for the Inverter: Approx. 20 ms

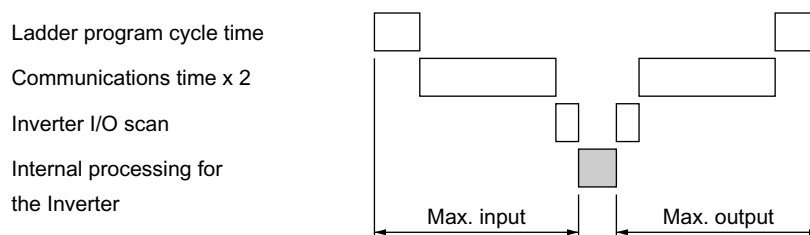The I/O response times for the Inverter are illustrated in the following diagram.

Ladder program cycle time

Communications time x 2

Inverter I/O scan

Internal processing for
the Inverter

Max. input   Max. output

Fig 6.73 I/O Response Time

6

Individual Functions

This section explains the individual functions used in special applications.

◆ Using the Timer Function

Multi-function contact input terminals S3 to S7 can be designated as timer function input terminals, and multi-function output terminals M1-M2, M3-M4, M5-M6, P1-PC, and P2-PC can be designated as timer function output terminals. By setting the delay time, you can erase chattering from the sensors and switches.

- Set one of the parameters H1-01 to H1-05 (multi-function contact input terminal S3 to S7) to 18 (timer function input).
- Set H2-01 to H2-03 (multi-function output terminals M1-M2, M3-M4, M5-M6, P1-PC, and P2-PC function selection) to 12 (timer function output).

■ Related Parameters

Param-eter Num-ber	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
b4-01	Timer function ON-delay time	Set the timer function output ON delay time (dead band) for the timer function input in 1-second units. Enabled when a timer function is set in H1-☐☐ and H2-☐☐.	0.0 to 300.0 (0.0 to 3000.0)*	0.0 s	No	A	A	A
	Delay-ON Timer							
b4-02	Timer function OFF-delay time	Set the timer function output OFF delay time (dead band) for the timer function input in 1-second units. Enabled when the timer function is set in H1-☐☐ and H2-☐☐.	0.0 to 300.0 (0.0 to 3000.0)*	0.0 s	No	A	A	A
	Delay-OFF Timer							

* For (-E) models.

■ Setting Example

When the timer function input ON time is longer than the value set in b4-01, the timer output function is turned ON. When the timer function input OFF time is longer than the value set in b4-02, the timer output function is turned OFF. An example of timer function operation is given in the following diagram.
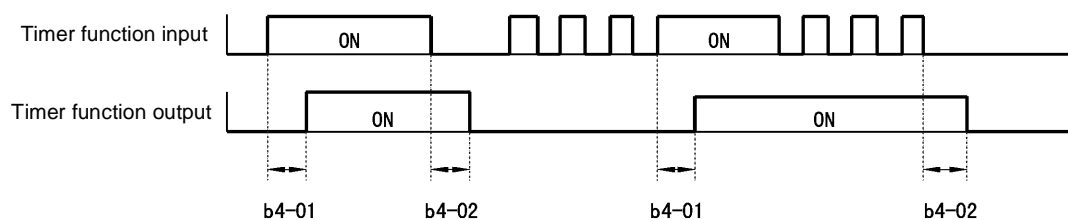

Fig 6.74   Timer Function Operation Example

◆ Using PID Control

PID control is a method of making the feedback value (detection value) match the set target value. By combining proportional control (P), integral control (I), and derivative control (D), you can even control targets (machinery) with play time.

The characteristics of the PID control operations are given below.

P control   Outputs the amount of operation proportional to the deviation. You cannot, however, set the deviation to zero using P control alone.

I control   Outputs the amount of operation that integrates the deviation. Used for matching feedback value to the target value. I control is not suited, however, to rapid variations.

D control   Outputs the amount of operation derived from the deviation. Can respond promptly to rapid variations.

■PID Control Operation

To understand the differences between each PID control operation (P, I, and D, the variation in the amount of operation (output frequency) is as shown in the following diagram when the deviation (i.e., the difference between the target value and feedback value) is fixed.
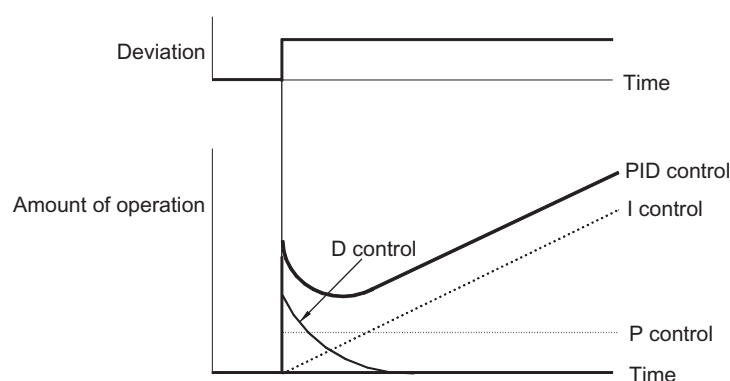

Fig 6.75 PID Control Operation

■PID Control Applications

The following table shows examples of PID control applications using the Inverter.

Application	Control Details	Example of Sensor Used
Speed Control	• Feeds back machinery speed information, and matches speed to the target value. • Inputs speed information from other machinery as the target value, and performs synchronous control using the actual speed feedback.	Tachometer generator
Pressure Control	Feeds back pressure information, and performs constant pressure control.	Pressure sensor
Flow Rate Control	Feeds back flow rate information, and controls the flow rate highly accurately.	Flow rate sensor
Temperature Control	Feeds back temperature information, and performs temperature adjustment control by rotating the fan.	• Thermocouple • Thermistor

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■Related Parameters

| Param- eter Num- ber | Name | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | |
	LCD Display					V/f	V/f with PG	Open Loop Vec- tor
b5-01	PID control mode selection	0: Disabled 1: Enabled (Deviation is D-controlled.) 2: Enabled (Feedback value is D-controlled.) 3: PID control enabled (frequency reference + PID output, D control of deviation) 4: PID control enabled (frequency reference + PID output, D control of feedback value).	0 to 4	0	No	A	A	A
	PID Mode							
b5-02	Proportional gain (P)	Sets P-control proportional gain as a percentage. P-control is not performed when the setting is 0.00.	0.00 to 25.00	1.00	Yes	A	A	A
	PID Gain							
b5-03	Integral (I) time	Sets I-control integral time in 1-second units. I-control is not performed when the setting is 0.0.	0.0 to 360.0	1.0 s	Yes	A	A	A
	PID I Time							
b5-04	Integral (I) limit	Sets the I-control limit as a percentage of the maximum output frequenc.	0.0 to 100.0	100.0%	Yes	A	A	A
	PID I Limit							
b5-05	Derivative (D) time	Sets D-control derivative time in 1-second units. D-control is not performed when the setting is 0.00.	0.00 to 10.00	0.00 s	Yes	A	A	A
	PID D Time							
b5-06	PID limit	Sets the limit after PID-control as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	A	A
	PID Limit							
b5-07	PID offset adjustment	Sets the offset after PID-control as a percentage of the maximum outut frequency.	-100.0 to +100.0	0.0%	Yes	A	A	A
	PID Offset							
b5-08	PID primary delay time constant	Sets the time constant for low pass filter for PID-control outputs in 1-second units. Not usually necessary to set.	0.00 to 10.00	0.00 s	Yes	A	A	A
	PID Delay Time							
b5-09	PID output characteristics selection	Select forward/reverse for PID output. 0: PID output is forward. 1: PID output is reverse (highlights the output code)	0 or 1	0	No	A	A	A
	Output Level Sel							
b5-10	PID output gain	Sets output gain.	0.0 to 25.0	1.0	No	A	A	A
	Output Gain							
b5-11	PID reverse output selection	0: 0 limit when PID output is negative. 1: Reverse when PID output is negative. 0 limit when reverse prohibit is selected using b1-04.	0 or 1	0	No	A	A	A
	Output Rev Sel							
b5-12	Selection of PID feedback command loss detection	0: No detection of loss of PID feedback 1: Detection of loss of PID feedback. Operation continues during detection, with the malfunc- tioning contact not operating. 2: Detection of loss of PID feedback. Coasts to stop during detection, and fault contact	0 to 2	0	No	A	A	A
	Fb los Det Sel							
b5-13	PID feedback command loss detection level	Set the PID feedback loss detection level as a per- cent, with the maximum output frequency at 100%.	0 to 100	0%	No	A	A	A
	Fb los Det Lvl							
b5-14	PID feedback command loss detection time	Sets the PID feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	A	A	A
	Fb los Det Time							
b5-15	PID sleep function opera- tion level	Set the PID sleep function start level as a fre- quency.	0.0 to 400.0	0.0 Hz	No	A	A	A
	PID Sleep Level							

| Param-eter Num-ber | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | |
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
b5-16	PID sleep operation delay time	Set the delay time until the PID sleep function starts in seconds.	0.0 to 25.5	0.0 s	No	A	A	A
	PID Sleep Time							
b5-17	Accel/decel time for PID reference	Set the accel/decel time for PID reference in seconds.	0.0 to 25.5	0.0 s	No	A	A	A
	PID Acc/Dec Time							
b5-18	PID set point selection	0: PID set point disabled 1: PID set point enabled	0 or 1	0	No	A*	A*	A*
	PID Setpoint Sel							
b5-19	PID set point	PID set point	0.0 to 100.0	0.0%	No	A*	A*	A*
	PID Setpoint							
H6-01	Pulse train input function selection	0: Frequency reference 1: PID feedback value 2: PID target value	0 to 2	0	No	A	A	A
	Pulse Input Sel							

* The parameters b5-18 and b5-19 are enabled only with (-E) models.

| Param-eter Num-ber | Name | Description | Output Signal Level During Multi-Function Analog Output | Min. Unit | Control Methods | | |
	LCD Display				V/f	V/f with PG	Open Loop Vec-tor
U1-24	PID feedback value	Monitors the feedback value when PID control is used. The input for the max. frequency corresponds to 100%.	10 V: Max. frequency (0 to ± 10 V possible)	0.01%	A	A	A
	PID Feedback						
U1-36	PID input volume	PID feedback volume Given as maximum frequency/100%	10 V: Max. frequency (0 to ± 10 V possible)	0.01%	A	A	A
	PID Input						
U1-37	PID output volume	PID control output Given as maximum frequency/100%	10 V: Max. frequency (0 to ± 10 V possible)	0.01%	A	A	A
	PID Output						
U1-38	PID command	PID command + PID command bias Given as maximum frequency/100%	10 V: Max. frequency	0.01%	A	A	A
	PID Setpoint						

Multi-Function Digital Inputs (H1-01 to H1-05)

| Set Value | Function | Control Methods | | |
		V/f	V/f with PG	Open loop Vec-tor
19	PID control disable (ON: PID control disabled)	Yes	Yes	Yes
30	PID control integral reset (reset when reset command is input or when stopped during PID control)	Yes	Yes	Yes
31	PID control integral hold (ON: Integral hold)	Yes	Yes	Yes
34	PID soft starter	Yes	Yes	Yes
35	PID input characteristics switch	Yes	Yes	Yes

Multi-Function Analog Input (H3-09)

| Set Value | Function | Control Methods | | |
		V/f	V/f with PG	Open loop Vec-tor
B	PID feedback	Max. output frequency	Yes	Yes	Yes
C	PID target value	Max. output frequency	Yes	Yes	Yes

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■PID Control Methods

There are four PID control methods. Select the method by setting parameter b5-01.

Set Value	Control Method
1	PID output becomes the Inverter output frequency, and D control is used in the difference between PID target value and feedback value.
2	PID output becomes the Inverter output frequency, and D control is used in the PID feedback value.
3	PID output is added as compensation value of the Inverter output frequency, and D control is used in the difference between PID target value and feedback value.
4	PID output is added as compensation value of the Inverter output frequency, and D control is used in the PID feedback value.

■PID Input Methods

Enable PID control using parameter b5-01, and set the PID target value and PID feedback value.

PID Target Value Input Methods

Select the PID control target value input method according to the setting in b1-01 (Reference Selection). Normally, the frequency reference selected in b1-01 is the PID target value, but you can also set the PID target value as shown in the following table.

PID Target Input Method	Setting Conditions
Multi-Function Analog Terminal A2 Input	Set H3-09 to C (PID target value). Also, be sure to set H6-01 (pulse train input function selection) to 1 (PID feedback value).
RS-422A/485 register 0006H	Set RS-422A/485 bit 1 in register address 000FH to 1 (enable/disable PID target value from communications) to be able to use register number 0006H as the PID target value.
Pulse train input	Set H6-01 to 2 (PID target value).

PID Feedback Input Methods

Select one of the following PID control feedback input methods.

Input Method	Setting Conditions
Multi-function analog input	Set H3-09 (Multi-function Analog Input Terminal A2 Selection) to B (PID feedback).
Pulse train input	Set H6-01 to 1 (PID feedback).

INFO

Adjust PID target value and PID feedback value using the following items.
- Analog input: Adjust using the analog input terminal gain and bias.
- Pulse train input: Adjust using pulse train scaling, pulse train input gain, and pulse train input bias.

■PID Adjustment Methods

Use the following procedure to adjust PID while performing PID control and measuring the response waveform.

1. Set b5-01 (PID Control Mode Selection) to 1, 2, 3 or 4 (PID control enabled).

2. Increase b5-02 (Proportional Gain (P)) to within a range that does not vibrate.

3. Reduce b5-03 (Integral (I) time) to within a range that does not vibrate.

4. Increase b5-05 (Derivative (D) time) to within a range that does not vibrate.

■PID Fine Adjustment Methods

This section explains the fine adjustment of PID after setting the PID control constants.
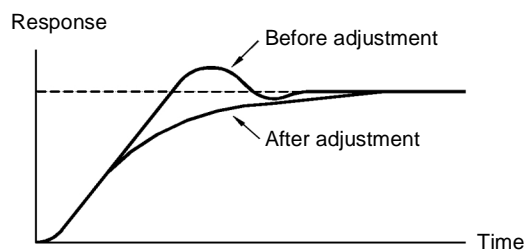
Suppressing Overshoot

If overshoot occurs, reduce derivative time (D), and increase integral time (I).
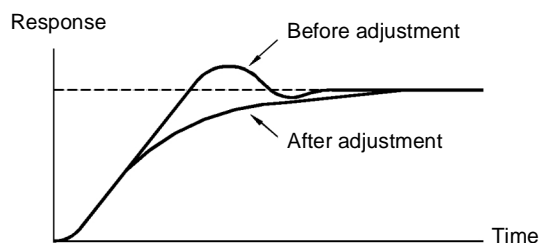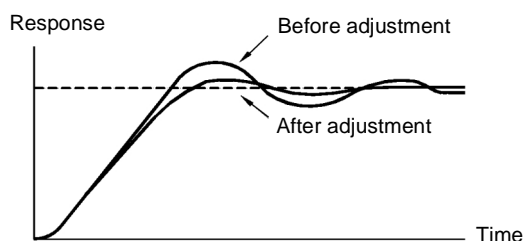

Set a Rapidly Stabilizing Control Condition

To rapidly stabilize the control even if overshoot occurs, reduce integral time (I), and lengthen derivative time (D).

### Suppressing Long-cycle Vibration

If vibration occurs with a longer cycle than the integral time (I) set value, the integral operation is too strong. Lengthen the integral time (I) to suppress the vibration.

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Suppressing Short Cycle Vibration

If vibration occurs when the vibration cycle is short, and the cycle is almost identical to the derivative time (D) set value, the differential operation is too strong. Shorten the derivative time (D) to suppress the vibration.

If vibration continues even when the derivative time (D) is set to 0.00 (D control disabled), reduce the proportional gain (P), or increase the PID primary delay time constant.
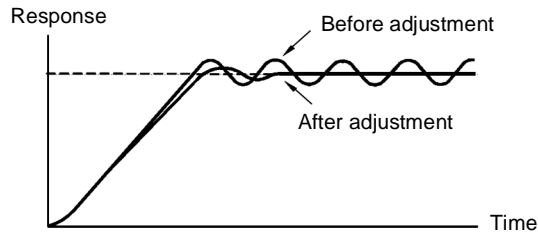
■Setting Precautions

- In PID control, the b5-04 parameter is used to prevent the calculated integral control value from exceeding a specified amount. When the load varies rapidly, Inverter response is delayed, and the machine may be damaged or the motor may stall. In this case, reduce the set value to speed up Inverter response.

- The b5-06 parameter is used to prevent the arithmetic operation following the PID control calculation from exceeding a specified amount. Set taking the maximum output frequency to be 100%.

- The b5-07 parameter is used to adjust PID control offset. Set in increments of 0.1%, taking the maximum output frequency to be 100%.

- Set the low pass filter time constant for the PID control output in b5-08. Enable this parameter to prevent machinery resonance from occurring when machinery adhesive abrasion is great, or rigidity is poor. In this case, set the constant to be greater than the resonance frequency cycle. Increase this time constant to reduce Inverter responsiveness.

- Using b5-09, you can invert the PID output polarity. Consequently, if you increase the PID target value, you can apply this parameter to applications to lower the Inverter output frequency.

- Using b5-10, you can apply gain to the PID control output. Enable this parameter to adjust the amount of compensation if adding PID control output to the frequency reference as compensation.

- When the PID control output is negative, the output direction can be reversed by the parameter b5-11. However, PID control output is limited to 0 when b1-04 (Prohibition of reverse operation) is set to 1 (enabled).

- With the Inverter, by setting an independent acceleration/deceleration time in parameter b5-17, you can increase or decrease the PID target value using the acceleration/deceleration time. The acceleration/ deceleration function (C1 parameters) used normally, however, is allocated after PID control, so depending on the settings, resonance with PID control and hunting in the machinery may occur. If this happens, reduce C1 parameters until hunting does not occur, and maintain the acceleration/deceleration time using b5-17. Also, you can disable the set value in b5-17 from the external terminals during operation using multi-function input set value 34 (PID soft starter).

■PID Control Block

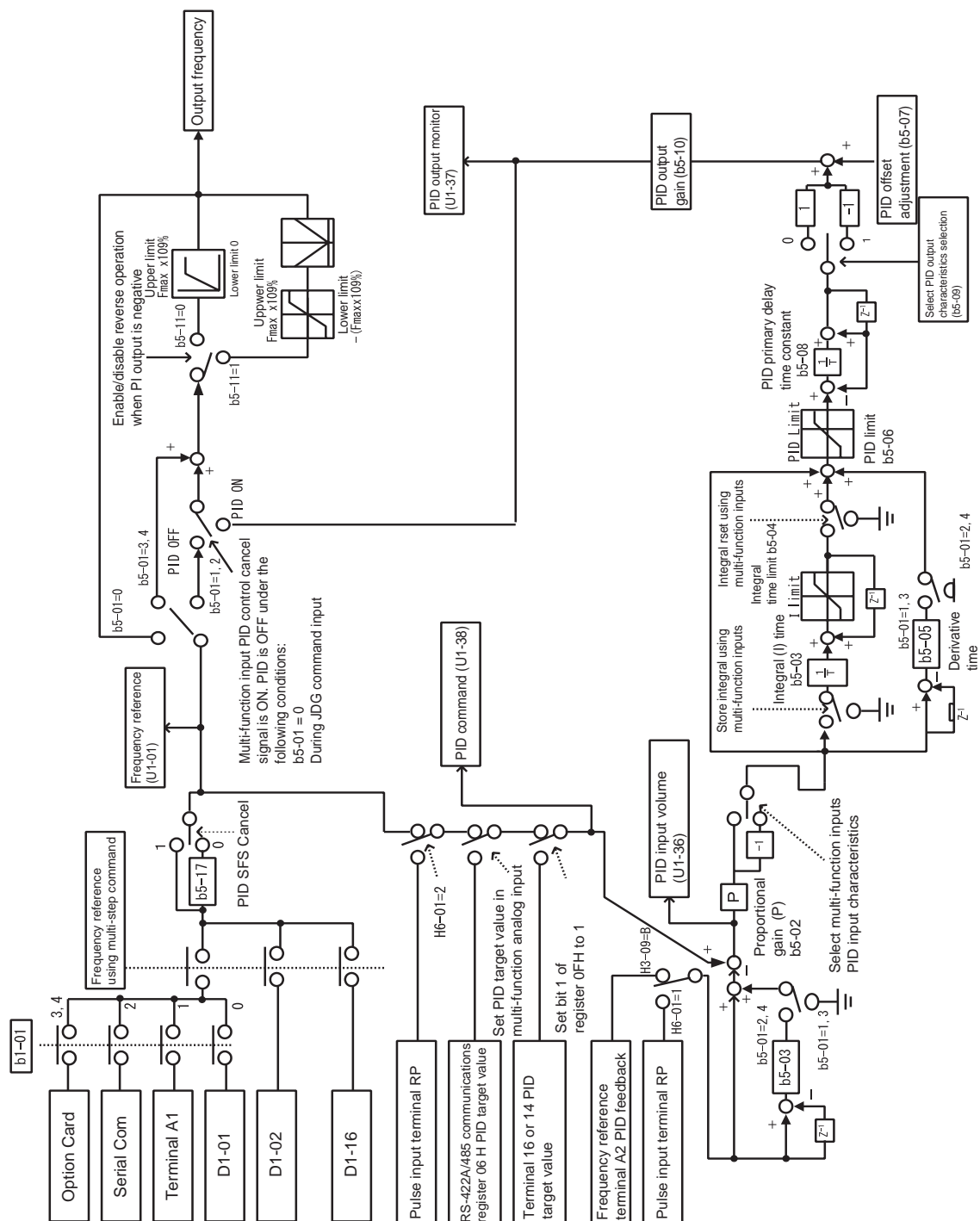The following diagram shows the PID control block in the Inverter.

Fig 6.76 PID Control Block

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■PID Feedback Loss Detection

When performing PID control, be sure to use the PID feedback loss detection function. If PID feedback is lost, the Inverter output frequency may accelerate to the maximum output frequency.

When setting b5-12 to 1 and the status of the PID feedback value detection level in b5-13 is insufficient and continues for the time set in b5-14, an FbL (PID feedback reference lost) alarm will be displayed on the Digital Operator and Inverter operation will continue.

When b5-12 is set to 2, an FbL (PID feedback reference lost) error alarm will be displayed on the Digital Operator, the error contact will operate, and Inverter operation will be stopped.

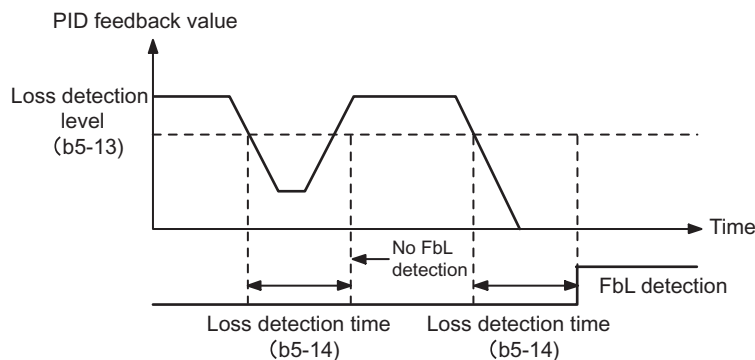The time chart for PID feedback loss detection (set b5-12 to 2) is shown below.

Fig 6.77 PID Feedback Loss Detection Time Chart

■PID Sleep

The PID sleep function stops the Inverter when the PID sleep function delay time continues while the PID control target value is at an insufficient level to operate the PID sleep function. When the PID sleep delay time continues and the PID control target value is above the PID sleep function operation level, Inverter operation will automatically resume.

When PID control is disabled, the PID sleep function is also disabled. When using the PID sleep function, select decelerate to stop or coast to stop as the stopping method.

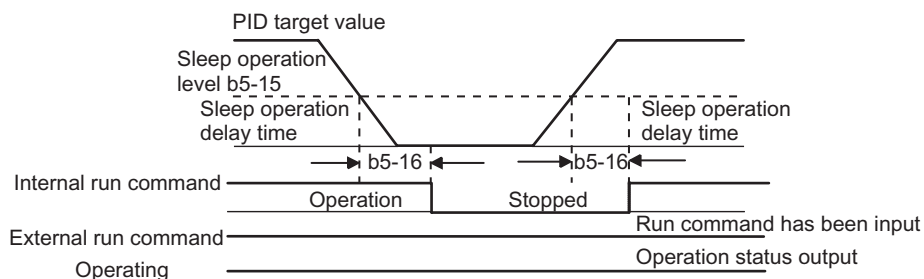The PID sleep time chart is shown below.

Fig 6.78 PID Sleep Time Chart

◆ Energy-saving

To perform energy saving, set b8-01 (Energy Saving Mode Selection) to 1. Energy-saving control can be performed using both V/f control and open loop vector control. The parameters to be adjusted are different for each. In V/f control, adjust b8-04 to b8-06, and in open loop vector, adjust b8-02 and b8-03.

■Related Parameters

Param-eter Num-ber	Name / LCD Display	Details	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
						V/f	V/f with PG	Open Loop Vec-tor
b8-01	Energy-saving mode selection / Energy Save Sel	Select whether to enable or disable energy-saving control. 0: Disable 1: Enable	0 or 1	0	No	A	A	A
b8-02	Energy-saving gain / Energy Save Gain	Set the energy-saving gain with the open loop vector control method.	0.0 to 10.0	0.7 *1	Yes	No	No	A
b8-03	Energy-saving filter time con-stant / Energy Save F.T	Set the energy-saving filter time constant with the open loop vector control method.	0.00 to 10.0	0.50 s *2	Yes	No	No	A
b8-04	Energy-saving coefficient / Energy Save COEF	Set the maximum motor efficiency value. Set the motor rated capacity in E2-11, and adjust the value by 5% at a time until output power reaches a mini-mum value.	0.0 to 655.00 *3	*4	No	A	A	No
b8-05	Power detec-tion filter time constant / kW Filter Time	Set the time constant for output power detection.	0 to 2000	20 ms	No	A	A	No
b8-06	Search opera-tion voltage limiter / Search V Limit	Set the limit value of the voltage control range during search operation. Perform search operation to optimize operations using minute variations in voltage using energy-saving con-trol. Set to 0 to disable the search operation. 100% is the motor base voltage.	0 to 100	0%	No	A	A	No
E2-02	Motor rated slip / Motor Rated Slip	Sets the motor rated slip in hertz. These set values will become the reference values for slip compensation. This parameter is automatically set during autotuning.	0.00 to 20.00	2.90 Hz *5	No	A	A	A
E2-11	Motor rated output / Mtr Rated Power	Set the rated output of the motor in units of 0.01 kW. This parameter is automatically set during autotuning.	0.00 to 650.00	0.40 *5	No	Q	Q	Q

* 1. The factory setting is 1.0 when using V/f control with PG.
* 2. The factory setting is 2.00 s for an Inverter capacity of 55 kW and over.
* 3. The same capacity as the Inverter will be set by initializing the parameters.
* 4. The factory settings depend on the Inverter capacity.
* 5. The factory settings depend on the Inverter capacity. (The values shown are for 200-V class, 0.4 kW Inverters.)

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■Adjusting Energy-saving Control

The method of adjustment during energy-saving control operations differs depending on the control method. Refer to the following when making adjustments.

V/f Control

In V/f control method, the voltage for optimum motor efficiency is calculated and becomes the output voltage reference.

- b8-04 (Energy-saving Coefficient) is set at the factory for motor use applied to the Inverter. If the motor capacity differs from the motor applied to the Inverter, set the motor capacity in E2-11 (Motor Rated Output). Also, adjust the output voltage in steps of 5 until it reaches minimum. The larger the energy-saving coefficient, the greater the output voltage.

- To improve response when the load fluctuates, reduce the power detection filter time parameter b8-05. If b8-05 is set too small, however, motor rotations when the load is light may become unstable.

- Motor efficiency varies due to temperature fluctuations and differences in motor characteristics. Consequently, control motor efficiency online to optimize efficiency by causing minute variations in voltage using the search operation. Parameter b8-06 (Search Operation Voltage Limiter) controls the range that control the voltage using the search operation. For 200 V Class Inverters, set the range to 100%/200 V, and for 400 V Class Inverters, set the range to 100%/400 V. Set to 0 to disable the search operation.

Open loop vector control

In open loop vector control, control the slip frequency so that motor efficiency is maximized.

- Taking the motor rated slip for the base frequency as optimum slip, calculate the optimum slip for motor efficiency for each frequency. In vector control, be sure to perform autotuning, and set the motor rated slip.

- If the motor performs hunting when using energy-saving control in vector control, reduce the set value in b8-02 (Energy-saving Gain), or increase the set value in b8-03 (Energy-saving Filter Time Constant).

◆ Setting Motor Constant Parameters

In vector control method, the motor constant parameter are set automatically using autotuning. If autotuning does not complete normally, set them manually.

■Related Parameters

Param-eter Num-ber	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display						V/f	V/f with PG	Open Loop Vec-tor
E2-01	Motor rated current		Sets the motor rated current in 1 A units. These set values will become the reference values for motor protection and torque limits. This parameter is automatically set during auto-tuning.	0.32 to 6.40 *2	1.90 A *1	No	Q	Q	Q
	Motor Rated FLA								
E2-02	Motor rated slip		Sets the motor rated slip in Hz units. These set values will become the reference values for slip compensation. This parameter is automatically set during auto-tuning.	0.00 to 20.00	2.90 Hz *1	No	A	A	A
	Motor Rated Slip								
E2-03	Motor no-load current		Sets the motor no-load current in 1 A units. This parameter is automatically set during auto-tuning.	0.00 to 1.89 *3	1.20 A *1	No	A	A	A
	No-Load Current								
E2-04	Number of motor poles		Sets the number of motor poles. This parameter is automatically set during auto-tuning.	2 to 48	4 poles	No	No	Q	No
	Number of Poles								
E2-05	Motor line-to-line resis-tance		Sets the motor phase-to-phase resistance in Ω units. This parameter is automatically set during auto-tuning.	0.000 to 65.000	9.842 Ω *1	No	A	A	A
	Term Resistance								
E2-06	Motor leak inductance		Sets the voltage drop due to motor leakage induc-tance as a percentage of the motor rated voltage. This parameter is automatically set during auto-tuning.	0.0 to 40.0	18.2%	No	No	No	A
	Leak Inductance								
E2-07	Motor iron saturation coef-ficient 1		Sets the motor iron saturation coefficient at 50% of magnetic flux. This parameter is automatically set during auto-tuning.	0.00 to 0.50	0.50	No	No	No	A
	Saturation Comp1								
E2-08	Motor iron saturation coef-ficient 2		Sets the motor iron saturation coefficient at 75% of magnetic flux. This parameter is automatically set during auto-tuning.	0.00 to 0.75	0.75	No	No	No	A
	Saturation Comp2								
E2-10	Motor iron loss for torque compensation		Sets motor iron loss in W units.	0 to 65535	14 W *1	No	A	A	No
	Tcomp Iron Loss								

Note All factory-set parameters are for a standard 4-pole motor.

* 1. The factory settings depend on Inverter capacity (the values shown are for a 200 V Class Inverter for 0.4 kW).

* 2. The setting range is 10% to 200% of the Inverter rated output current (the values shown are for a 200 V Class Inverter for 0.4 kW).

* 3. The setting range depends on Inverter capacity (the values shown are for a 200 V Class Inverter for 0.4 kW).

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■Manual Motor Constant Parameter Setting Methods

The motor constant parameters settings methods are given below. Make (enter) settings referring to the motor test report.

Motor Rated Current Setting

Set E2-01 to the rated current on the motor nameplate.

Motor Rated Slip Setting

Set E2-02 to the motor rated slip calculated from the number of rated rotations on the motor nameplate.

Amount of motor rated slip = Motor rated frequency (Hz) - No. of rated rotations (r/min) x No. of motor poles/120.

Motor No-Load Current Setting

Set E2-03 to the motor no-load current using the rated voltage and rated frequency. The motor no-load current is not normally written on the motor nameplate. Consult the motor manufacturer.

Factory setting is the no-load current value for a standard Yaskawa 4-pole motor.

Number of Motor Poles Setting

E2-04 is displayed only when V/f control method with PG is selected. Set the number of motor poles (number of poles) as written on the motor nameplate.

Motor Line-to-Line Resistance Setting

E2-05 is set automatically when performing motor line-to-line resistance autotuning. When you cannot perform tuning, consult the motor manufacturer for the line-to-line resistance value. Calculate the resistance from the line-to-line resistance value in the motor test report using the following formula, and then make the setting accordingly.

- E-type isolation: [Line-to line resistance (Ω) at 75°C of test report] × 0.92 (Ω)
- B-type isolation: [Line-to line resistance (Ω) at 75°C of test repor]t × 0.92 (Ω)
- F-type isolation: [Line-to line resistance (Ω) at 115°C of test report] × 0.87 (Ω)

Motor Leak Inductance Setting

Set the amount of voltage drop due to motor leak inductance in E2-06 using the percentage over the motor rated voltage. Make this setting when the high-speed motor inductance is small. If the inductance is not written on the motor nameplate, consult the motor manufacturer.

Motor Iron Saturation Coefficients 1 and 2 Settings

E2-07 and E2-08 are set automatically using autotuning.

Motor Iron Loss for Torque Compensation Setting

E2-10 is displayed only when in V/f control method. To increase the torque compensation accuracy when in V/f control method, set the motor iron loss in Watts.

◆ Setting the V/f Pattern

In V/f control method, you can set the Inverter input voltage and the V/f pattern as the need arises.

■Related Parameters

Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop Vec-tor
E1-01	Input voltage setting / Input Voltage	Set the Inverter input voltage in 1 volt. This setting is used as a reference value in protection func-tions.	155 to 255 *1	200 V *1	No	Q	Q	Q
E1-03	V/f pattern selection / V/F Selection	0 to E: Select from the 15 preset V/f patterns. F: Custom user-set patterns (Application for settings E1-04 to E1-10.)	0 to F	F	No	Q	Q	No
E1-04	Max. output frequency (FMAX) / Max Frequency		40.0 to 400.0 *5	60.0 Hz (50.00 Hz)*6	No	Q	Q	Q
E1-05	Max. voltage (VMAX) / Max Voltage		0.0 to 255.0 *1	200.0 V *1 *2	No	Q	Q	Q
E1-06	Base frequency (FA) / Base Frequency		0.0 to 400.0	60.0 Hz (50.00 Hz)*6	No	Q	Q	Q
E1-07	Mid. output frequency / Mid Frequency A		0.0 to 400.0	3.0 Hz *2	No	A	A	A
E1-08	Mid. output frequency voltage / Mid Voltage A	To set V/f characteristics in a straight line, set the same values for E1-07 and E1-09. In this case, the setting for E1-08 will be disregarded.	0.0 to 255.0	15.0 V *1 *2	No	A	A	A
E1-09	Min. output frequency (FMIN) / Min Frequency	Always ensure that the four frequencies are set in the following manner: E1-04 (FMAX) ≥ E1-06 (FA) >E1-07 (FB) ≥ E1-09 (FMIN)	0.0 to 400.0	1.5 Hz *2	No	Q	Q	Q
E1-10	Min. output frequency voltage / Min Voltage		0.0 to 255.0 *1	9.0 V *1 *2	No	A	A	A
E1-11	Mid. output frequency 2 / Mid Frequency B		0.0 to 400.0	0.0 Hz *3	No	A	A	A
E1-12	Mid. output frequency voltage 2 / Mid Voltage B	Set only to fine-adjust V/f for the output range. Normally, this setting is not required.	0.0 to 255.0 *1	0.0 V *3	No	A	A	A
E1-13	Base voltage / Base Voltage		0.0 to 255.0 *1	0.0 V *4	No	A	A	Q

Within the Description column, the following diagram appears:

Output voltage (V)

VMAX (E1-05) (V BASE) (E1-13)

VC (E1-08)

VMIN (E1-10)

FMIN (E1-09) FB (E1-07) FA (E1-06) FMAX (E1-04)

Frequency (Hz)

* 1. These are values for a 200-V Class Inverter. Values for a 400-V Class Inverter are double.
* 2. The factory setting will change when the control method is changed. (V/f control factory settings are given.)
* 3. The contents of parameters E1-11 and E1-12 are ignored when set to 0.00.
* 4. E1-13 is set to the same value as E1-05 by autotuning.
* 5. When C6-01 is set to 0, the upper limit of the setting range is 150.0 Hz.
* 6. For (-E) models. Factory setting for base frequency is 50 Hz.

6

■**Setting Inverter Input Voltage**

Set the Inverter input voltage correctly in E1-01 to match the power supply voltage. This set value will be the standard value for the protection function and similar functions.

■**Setting V/f Pattern**

Set the V/f pattern in E1-03. There are two methods of setting the V/f pattern: Select one of the 15 pattern types (set value: 0 to E) that have been set beforehand, or set a user-defined V/f pattern (set value: F).

The factory setting for E1-03 is F. The contents of E1-03 when factory-set to F are the same as when E1-03 is set to 1.

To select one of the existing patterns, refer to the following table.

Characteristic	Application	Set Value	Specifications
Constant Torque Characteristic	This pattern is used in general applications. Used when the load torque is fixed, regardless of rotation speed, for linear transport systems.	0	50 Hz specifications
		1 (F)	60 Hz specifications
		2	60 Hz specifications, voltage saturation at 50 Hz
		3	72 Hz specifications, voltage saturation at 60 Hz
Variable torque characteristic	This pattern is used for loads with torque proportional to two or three times the rotation speed, such as fans and pumps.	4	50 Hz specifications, × 3 decrement
		5	50 Hz specifications, × 2 decrement
		6	60 Hz specifications, × 3 decrement
		7	60 Hz specifications, × 2 decrement
High Startup Torque (See Note)[*]	Select the high startup torque V/f pattern only in the following cases. • The wiring distance between Inverter and motor is large (approx. 150 m min.) • A large torque is required at startup (elevator loads, etc.) • An AC reactor is inserted in the Inverter input or output. • You are operating a motor that is less than optimum.	8	50 Hz specifications, medium startup torque
		9	50 Hz specifications, large startup torque
		A	60 Hz specifications, medium startup torque
		B	60 Hz specifications, large startup torque
Fixed Output Operation	This pattern is used for frequencies of 60 Hz or higher. A fixed voltage is applied.	C	90 Hz specifications, voltage saturation at 60 Hz
		D	120 Hz specifications, voltage saturation at 60 Hz
		E	180 Hz specifications, voltage saturation at 60 Hz

* The torque is protected by the fully automatic torque boost function, so normally there is no need to use this pattern.

When you select these patterns, the values of parameters E1-04 to E1-10 are changed automatically. There are three types of values for E1-04 to E1-10, depending on the Inverter capacity.
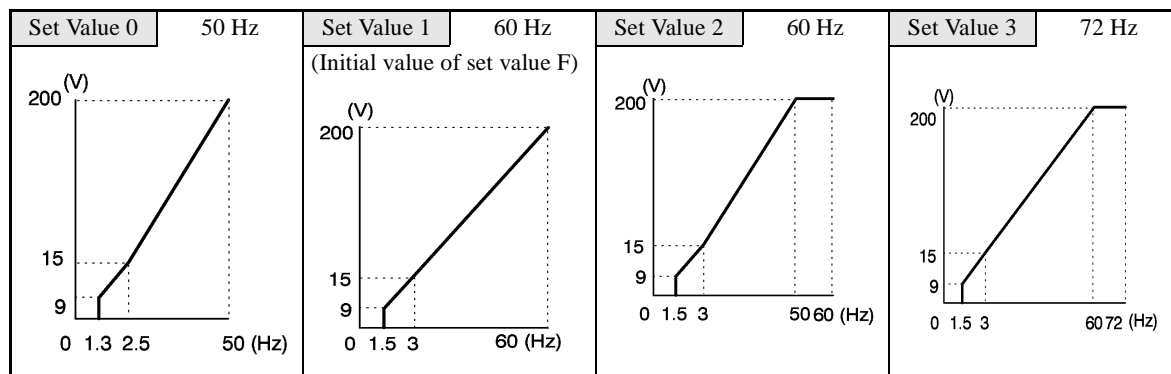
• 0.4 to 1.5 kW V/f pattern
• 2.2 to 45 kW V/f pattern
• 55 to 300 kW V/f pattern

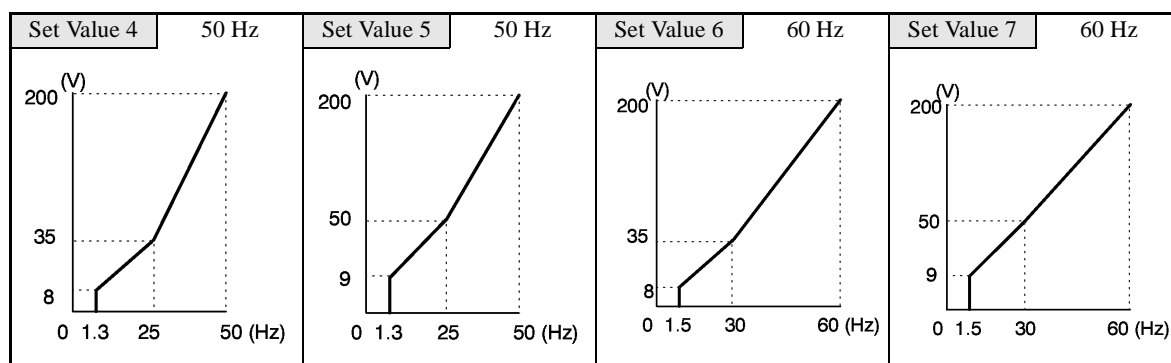The characteristics diagrams for each are shown in the following pages.

0.4 to 1.5 kW V/f Pattern

The diagrams show characteristics for a 200-V class motor. For a 400-V class motor, multiply all voltages by 2.
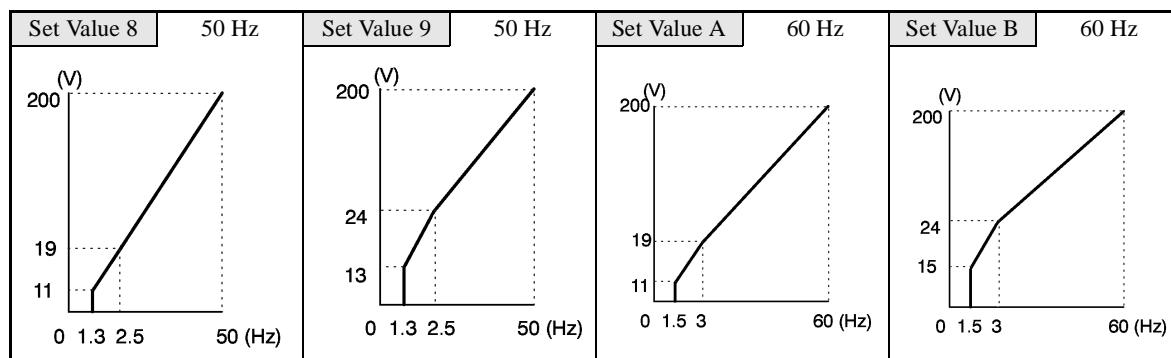
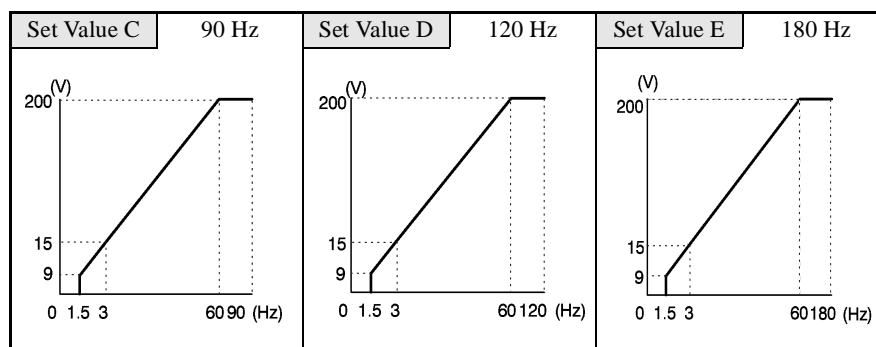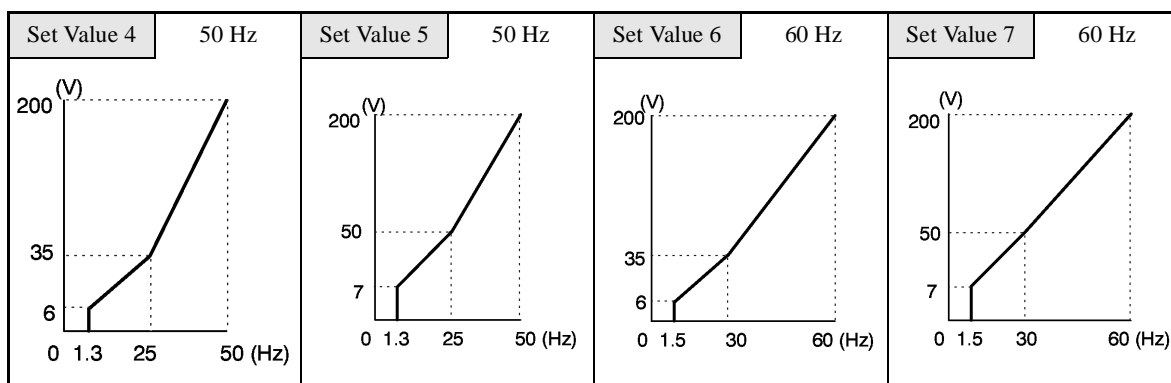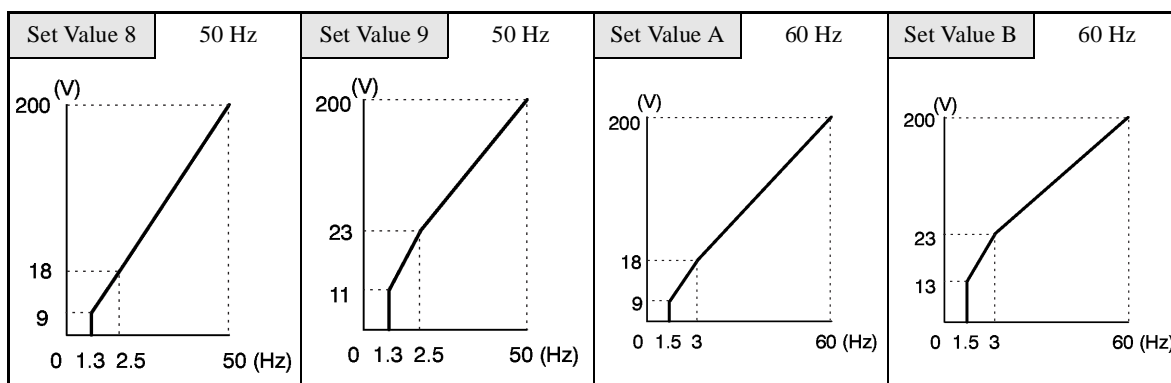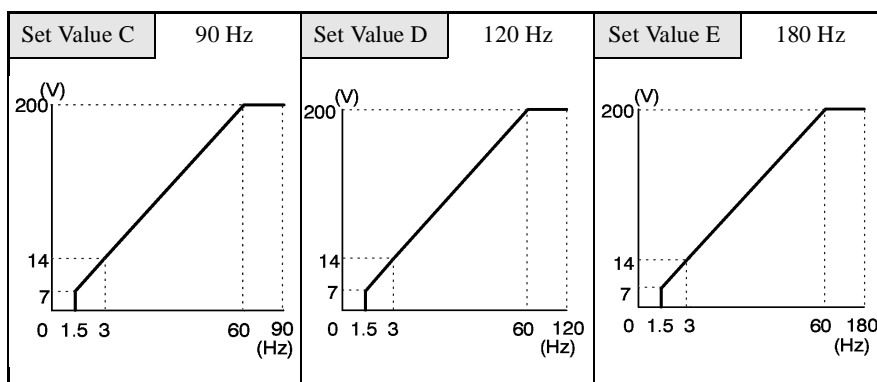- Constant Torque Characteristics (Set Value: 0 to 3)

Set Value 0 — 50 Hz	Set Value 1 — 60 Hz (Initial value of set value F)	Set Value 2 — 60 Hz	Set Value 3 — 72 Hz

- Decrement Torque Characteristics (Set Value: 4 to 7)

Set Value 4 — 50 Hz	Set Value 5 — 50 Hz	Set Value 6 — 60 Hz	Set Value 7 — 60 Hz

- High startup torque (Set value 8: to b)

Set Value 8 — 50 Hz	Set Value 9 — 50 Hz	Set Value A — 60 Hz	Set Value B — 60 Hz

- Fixed Output Operation (Set Value: C to E)

Set Value C — 90 Hz	Set Value D — 120 Hz	Set Value E — 180 Hz

6

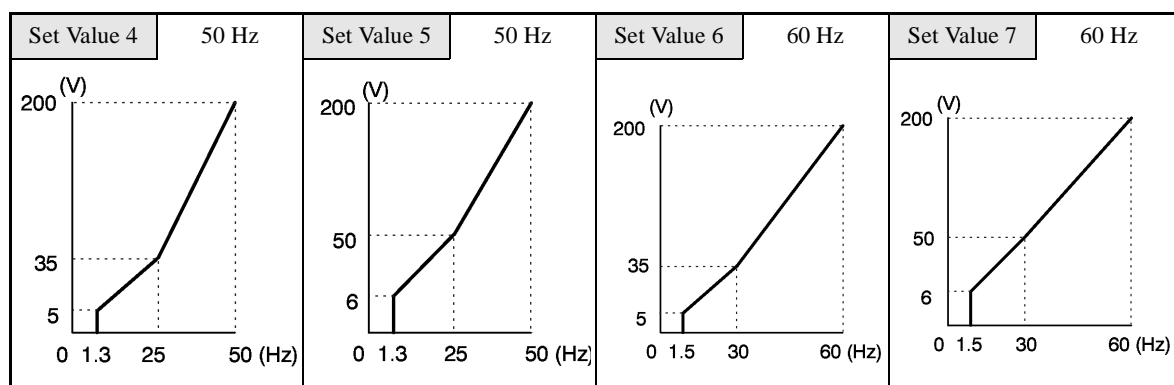### 2.2 to 45 kW V/f Pattern

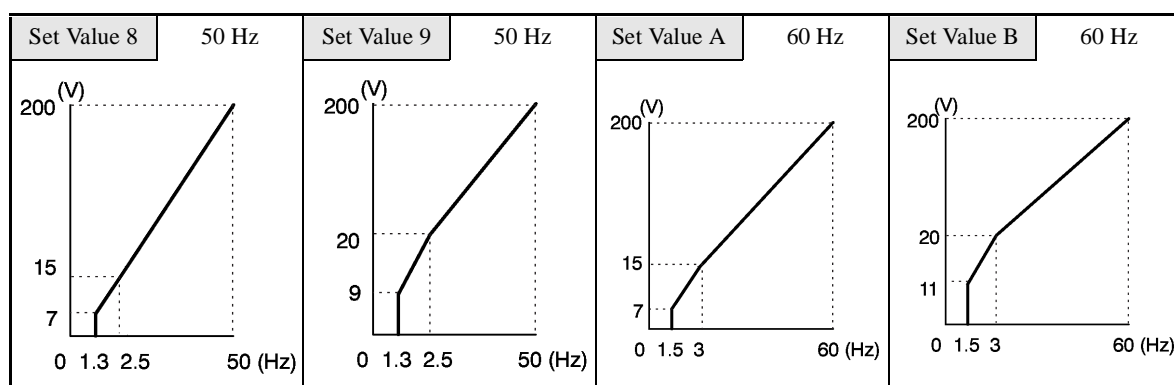The diagrams show characteristics for a 200-V class motor. For a 400-V class motor, multiply all voltages by 2.
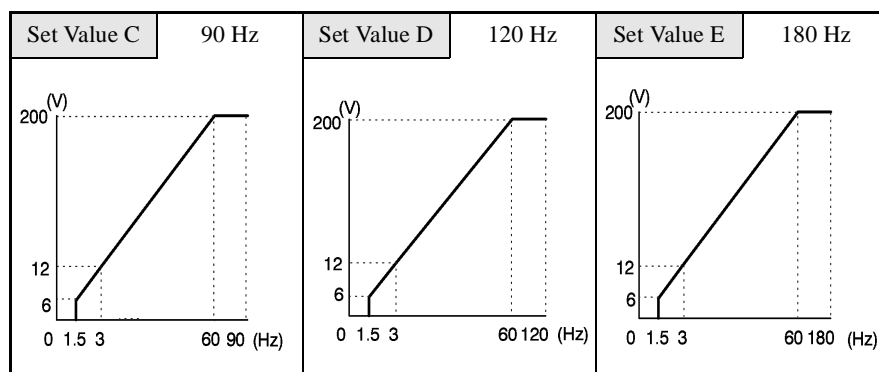
• Constant Torque Characteristics (Set Value: 0 to 3)

Set Value 0	50 Hz	Set Value 1	60 Hz	Set Value 2	60 Hz	Set Value 3	72 Hz

(Initial value of set value F)

• Decrement Torque Characteristics (Set Value: 4 to 7)

Set Value 4	50 Hz	Set Value 5	50 Hz	Set Value 6	60 Hz	Set Value 7	60 Hz

• High Startup Torque (Set Value: 8 to b)

Set Value 8	50 Hz	Set Value 9	50 Hz	Set Value A	60 Hz	Set Value B	60 Hz

• Fixed Output Operation (Set Value: C to E)

Set Value C	90 Hz	Set Value D	120 Hz	Set Value E	180 Hz

55 to 300 kW V/f Pattern

The diagrams show characteristics for a 200-V class motor. For a 400-V class motor, multiply all voltages by 2.

- Constant Torque Characteristics (Set Value: 0 to 3)

Set Value 0	50 Hz	Set Value 1	60 Hz	Set Value 2	60 Hz	Set Value 3	72 Hz

(Initial value of set value F)

- Decrement Torque Characteristics (Set Value: 4 to 7)

Set Value 4	50 Hz	Set Value 5	50 Hz	Set Value 6	60 Hz	Set Value 7	60 Hz

- High Startup Torque (Set Value: 8 to b)

Set Value 8	50 Hz	Set Value 9	50 Hz	Set Value A	60 Hz	Set Value B	60 Hz

- Fixed Output Operation (Set Value: C to E)

Set Value C	90 Hz	Set Value D	120 Hz	Set Value E	180 Hz

6

When E1-03 is set to F (User-defined V/f pattern), you can set parameters E1-04 to E1-10. If E1-03 is set to anything other than F, you can only refer to parameters E1-04 to E1-10. If the V/f characteristics are linear, set E1-07 and E1-09 to the same value. In this case, E1-08 will be ignored.
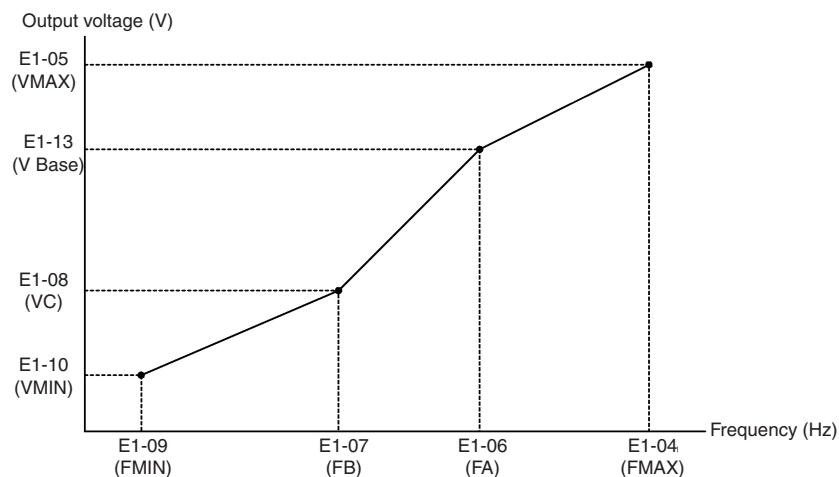

Fig 6.79 User-Set V/f Pattern

■Setting Precautions

When the setting is to user-defined V/f pattern, beware of the following points.

- When changing control method, parameters E1-07 to E1-10 will change to the factory settings for that control method.
- Be sure to set the four frequencies as follows:
  E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN)

Digital Operator Functions

This section explains the Digital Operator functions.

◆ Setting Digital Operator Functions

You can set Digital Operator-related parameters such as selecting the Digital Operator display, multi-function selections, and copy functions.

■Related Parameters

Param- eter Num- ber	Name	Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods		
	LCD Display					V/f	V/f with PG	Open Loop Vec- tor
o1-02	Monitor selection after power up Power-On Monitor	Set the monitor item to be displayed when the power supply is turned ON. 1: Frequency reference 2: Output frequency 3: Output current 4: The monitor item set for o1-01	1 to 4	1	Yes	A	A	A
o1-03	Frequency units of refer- ence setting and monitor Display Scaling	Sets the units that will be set and displayed for the frequency reference and frequency monitor. 0: 0.01 Hz units 1: 0.01% (Maximum output fre- quency is 100%) 2 to 39: r/min units (Sets the motor poles) 40 to 39999: User desired display Set the desired values for setting and display for the max. output frequency. □□□□□ Set 4-digit number excluding the decimal point. Set the number of digits below the decimal point to display. Example: When the max. output frequency value is 200.0, set 12000.	0 to 39999	0	No	A	A	A
o2-01	LOCAL/REMOTE key enable/disable Local/Remote Key	Set the run method selection key (LOCAL/ REMOTE Key) function. 0: Disabled 1: Enabled (Switches between the Digital Opera- tor and the parameter settings.)	0 or 1	1	No	A	A	A
o2-02	STOP Key during control circuit terminal operation Oper STOP Key	Set the STOP Key in the run mode. 0: Disabled (When the run command is issued from an external terminal, the Stop Key is dis- abled.) 1: Enabled (Effective even during run.)	0 or 1	1	No	A	A	A
o2-03	Parameter initial value User Defaults	When the frequency reference is set on the Digital Operator frequency reference monitor, sets whether the Enter key is necessary. 0: Enter Key needed 1: Enter Key not needed 2: All clear (clears all recorded user initial val- ues) When set to 1, the Inverter accepts the frequency reference without Enter Key operation.	0 to 2	0	No	A	A	A

6

| Param- eter Num- ber | Name | Description | Setting Range | Factory Setting | Change during Opera- tion | Control Methods | | |
						V/f	V/f with PG	Open Loop Vec- tor
	LCD Display							
o2-05	Frequency reference set- ting method selection	Sets the operation when the Digital Operator is disconnected. 0: Enter key needed 1: Enter key not needed Inverter output is cut off, and fault contact is operated.)	0 or 1	0	No	A	A	A
	Operator M.O.P.							
o2-07	Cumulative operation time setting	Sets the cumulative operation time in hour units. Operation time is calculated from the set values.	0 to 65535	0	No	A	A	A
	Elapsed Time Set							
o2-10	Fan operation time setting	Set the initial value of the fan operation time using time units. The operation time accumulates from the set value.	0 to 65535	0	No	A	A	A
	Fan ON Time Set							

* Factory settings depend on Inverter capacity. (The values shown are for a 200 V Class Inverter for 0.4 kW.)

■Changing Frequency Reference and Display Units

Set the Digital Operator frequency reference and display units using parameter o1-03. You can change the units for the following parameters using o1-03.

- U1-01 (Frequency Reference)
- U1-02 (Output Frequency)
- U1-05 (Motor Speed)
- U1-20 (Output Frequency after Soft Start)
- d1-01 to d1-17 (Frequency references)

■Switching Monitors when the Power Supply Is ON

Using parameter o1-02, select the monitor item (U1-□□ [status monitor]) to be displayed on the Digital Operator when the power supply is turned ON. For monitors that can be displayed, refer to U1-□□ in *Chapter 5 Parameters*.

Setting Precautions

If selecting monitor parameters other than U1-01 (Frequency Reference), U1-02 (Output Frequency), and U1-03 (Output Current), first select the monitor items to be displayed in o1-01, and then set o1-02 to 4.

■Disabling the STOP Key

If b1-02 (Operation Method Selection) is set to 1, 2, or 3, the stop command from the STOP Key on the Digital Operator is an emergency stop command.

Set o2-02 to 0 to disable emergency stop commands from the STOP Key on the Digital Operator.

■Disabling the LOCAL/REMOTE Key

Set o2-01 to 0 to disable the LOCAL/REMOTE Key on the Digital Operator. You cannot switch Inverter reference inputs set using reference inputs from the Digital Operator, b1-01 (Reference Selection), or b1-02 (Operation Method Selection).

■**Initializing Changed Parameter Values**

You can save to the Inverter parameter set values that you have changed as parameter initial values. Change the set values from the Inverter factory settings, and then set o2-03 to 1.

Set A1-03 (Initialize) to 1110 to initialize the Inverter parameters using the user-set initial values in memory. To clear the user-set initial values in memory, set o2-03 to 2.

■**Setting the Frequency Reference using the UP and DOWN Keys without Using the Enter Key**

Use this function when inputting frequency references from the Digital Operator. When o2-05 is set to 1, you can increment and decrement the frequency reference using the UP and DOWN Keys without using the Enter Key.

For example, enter the Run command using a 0 Hz reference, and then continuously press the UP Key to increment the frequency reference by 0.01 Hz only for the first 0.5 s, and then by 0.01 Hz every 80 ms for 3 s thereafter. Press and hold down the UP Key for 3 s minimum to reach the maximum output frequency 10 s after that. The frequency reference that has been set will be stored in memory 5 s after the UP or DOWN Keys are released.

■**Clearing Cumulative Operation Time**

Set the cumulative operation time initial value in time units in parameter o2-07. Set o2-07 to 0 to clear U1-13 (Inverter Operating Time).

■**Clearing Inverter Cooling Fan Operation Time**

Set the fan operation time initial value in time units in parameter o2-10. Set o2-10 to 0 to clear U1-40 (Cooling Fan Operating Time).

6

◆ **Copying Parameters**

The Digital Operator can perform the following three functions using the built-in EEPROM (non-volatile memory).

- Store Inverter parameter set values in the Digital Operator (READ)
- Write parameter set values stored in the Digital Operator to the Inverter (COPY)
- Compare parameter set values stored in the Digital Operator with Inverter parameters (VERIFY)
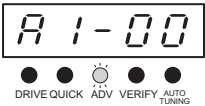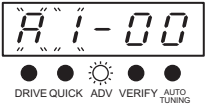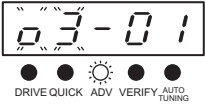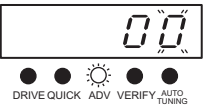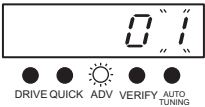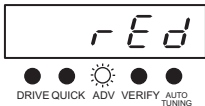
■**Related Parameters**

| Param- eter Num- ber	Name		Description	Setting Range	Factory Setting	Change during Opera- tion	Control Methods		
							V/f	V/f with PG	Open Loop Vec- tor
	LCD Display								
o3-01	Copy function selection		0: Normal operation 1: READ (Inverter to Operator) 2: COPY (Operator to Inverter) 3: Verify (compare)	0 to 3	0	No	A	A	A
	Copy Func Select								
o3-02	Read permitted selection		0: Read prohibited 1: Read permitted	0 or 1	0	No	A	A	A
	Copy Allowable								

■Storing Inverter set values in the Digital Operator (READ)

To store Inverter set values in the Digital Operator, make the settings using the following method. Set o3-02 (Read permitted selection) to 1 (read permitted).

Table 6.6 READ Function Procedure

Step No.	Digital Operator Display	Explanation
1	$A1-00$ ● ● ◌ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Press the Menu Key, and select advanced programming mode.
2	$A1-00$ ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Press the ENTER Key, and select the parameters monitor display.
3	$o3-01$ ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Display o3-01 (Copy Function Selection) using the Increment Key and Decrement Key.
4	00 ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Press the ENTER Key, and select the parameters setting display.
5	01 ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Change the set value to 1 using the Increment Key.
6	rEd ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Set the changed data using the ENTER Key. The READ function will start.
7	End ⟶ $o3-01$	If the READ function ends normally, End is displayed on the Digital Operator. Parameter o3-01 is automatically reset to 0, and then the display returns to o3-01.

An error may occur while saving to memory. If an error is displayed, press any key to cancel the error display and return to the o3-01 display. Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.*)

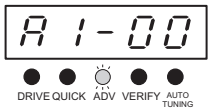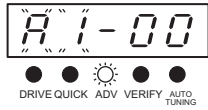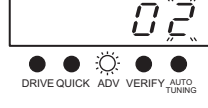| Error Display	Meaning
PrE	You are attempting to set o3-01 to 1 while o3-02 is set to 0.
iFE	Read data length mismatch or read data error.
rdE	Tried to write parameters to EEPROM on the Digital Operator, but unable to perform write operation.

Select READ Permitted

Prevent overwriting the data stored in EEPROM in the Digital Operator by mistake. With o3-02 set to 0, if you set o3-01 to 1, and perform the write operation, PrE will be displayed on the Digital Operator, and the write operation will be stopped.
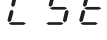
■Writing Parameter Set Values Stored in the Digital Operator to the Inverter (COPY)

To write parameter set values stored in the Digital Operator to the Inverter, make the settings using the following method.

Table 6.7 COPY Function Procedure

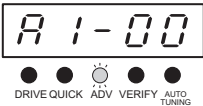| Step No.	Digital Operator Display	Explanation
1	$A1-00$ ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Press the MENU Key, and select advanced programming mode.
2	$A1-00$ ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Press the ENTER Key, and select the parameters monitor display.
3	$o3-01$ ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Display o3-01 (Copy Function Selection) using the Increment Key and Decrement Key.
4	00 ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Press the ENTER Key, and select the parameters setting display.
5	02 ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Change the set value to 2 using the Increment Key.
6	CPY ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Set the changed data using the ENTER Key. The COPY function will start.
7	End ⟶ $o3-01$	If the COPY function ends normally, End is displayed on the Digital Operator. Parameter o3-01 is automatically reset to 0, and then the display returns to o3-01.
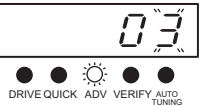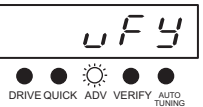
During the copy operation, errors may occur. If an error is displayed, set the parameters again. Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.*)

Error Display	Meaning
CPE	Inverter product code and Inverter software number are different.
uAE	Inverter capacity with which you are trying to copy, and the Inverter capacity stored in the Digital Operator are different.
CrE	The Inverter control method in which you are trying to copy, and the Inverter control method stored in the Digital Operator are different.
CYE	Comparison between the parameter written to the Inverter and the parameter in the Digital Operator shows they are different.
CSE	After copying has ended, comparison between the sum value of the Inverter parameter area and the sum value of the Digital Operator parameter area shows they are different.

6

■Comparing Inverter Parameters and Digital Operator Parameter Set Values (VERIFY)

To compare Inverter parameters and Digital Operator parameter set values, make the settings using the following method.

Table 6.8 VERIFY Function Procedure

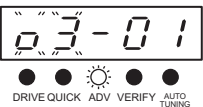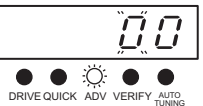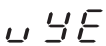| Step No.	Digital Operator Display	Explanation
1	A1-00 ● ● ◐ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Press the MENU Key. and select advanced programming mode.
2	A1-00 ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Press the ENTER Key, and select the parameters monitor display.
3	o3-01 ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Display o3-01 (Copy Function Selection) using the Increment Key and Decrement Key.
4	00 ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Press the ENTER Key, and select the function setting display.
5	03 ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Change the set value to 3 using the Increment Key.
6	uFY ● ● ☼ ● ● DRIVE QUICK ADV VERIFY AUTO TUNING	Set the changed data using the ENTER Key. The VERIFY function will start.
7	End ⟶ o3-01	If the VERIFY function ends normally, End is displayed on the Digital Operator. Parameter o3-01 is automatically reset to 0, and then the display returns to o3-01.

An error may occur during the comparison. If an error is displayed, press any key to cancel the error display and return to the o3-01 display. Error displays and their meanings are shown below. (Refer to *Chapter 7 Errors when Using Digital Operator Copy Function.)*

Error Display	Meaning
uYE	Verify error (Settings in the Digital Operator and the Inverter do not match).

■Application Precautions

When using the copy function, check that the following settings are the same between the Inverter and the Digital Operator.

- Inverter product and type
- Inverter capacity and voltage
- Software number
- Control method

◆ Prohibiting Writing Parameters from the Digital Operator

If you set A1-01 to 0, you can refer to and set the A1 and A2 parameter groups, and refer to drive mode, using the Digital Operator.

If you set one of the parameters H1-01 to H1-05 (multi-function contact input terminal S3 to S7 function selection) to 1B (write parameters permitted), you can write parameters from the digital operator when the terminal that has been set is ON. When the set terminal is OFF, writing parameters other than the frequency reference is prohibited. You can, however, reference parameters.

■Related Parameters

Param-eter Num-ber	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display						V/f	V/f with PG	Open Loop Vec-tor
A1-01	Parameter access level		Used to set the parameter access level (set/read.) 0: Monitoring only (Monitoring drive mode and setting A1-01 and A1-04.) 1: Used to select parameter (Only parameters set in A2-01 to A2-32 can be read and set.) 2: ADVANCED (Parameters can be read and set in both quick programming mode and advanced program-ming (A) mode.)	0 to 2	2	Yes	A	A	A
	Access Level								

◆ Setting a Password

When a password is set in A1-05, if the set values in A1-04 and A1-05 do not match, you cannot refer to or change the settings of parameters A1-01 to A1-03, or A2-01 to A2-32.

You can prohibit the setting and referencing of all parameters except A1-00 by using the password function in combination with setting A1-01 to 0 (Monitor only).

■Related Parameters

Param-eter Num-ber	Name		Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods		
	LCD Display						V/f	V/f with PG	Open Loop Vec-tor
A1-01	Parameter access level		Used to set the parameter access level (set/read.) 0: Monitoring only (Monitoring drive mode and setting A1-01 and A1-04.) 1: Used to select parameter (Only parameters set in A2-01 to A2-32 can be read and set.) 2: ADVANCED (Parameters can be read and set in both quick programming mode and advanced program-ming (A) mode.)	0 to 2	2	Yes	A	A	A
	Access Level								
A1-04	Password		Password input when a password has been set in A1-05. This function write-protects some parameters of the initialize mode. If the password is changed, A1-01 to A1-03 and A2-01 to A2-32 parameters can no longer be changed. (Programming mode parameters can be changed.)	0 to 9999	0	No	A	A	A
	Enter Password								

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| Param-eter Num-ber | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | |
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
A1-05	Password setting	Used to set a four digit number as the password. This parameter is not usually displayed. When the password (A1-04) is displayed, hold down the RESET Key and press the Menu Key and the pass-word will be displayed.	0 to 9999	0	No	A	A	A
	Select Password							

■Setting Precautions

Parameter A1-05 cannot be displayed using normal key operations. To display A1-05, hold down the RESET Key and press the MENU Key while A1-04 is displayed.

◆ Displaying User-set Parameters Only

You can set and refer to parameters necessary to the Inverter only, using the A2 parameters (user-set parame-ters) and A1-01 (Parameters Access Level).

Set the number of the parameter to which you want to refer in A2-01 to A2-32, and then set A1-01 to 1. You can set and refer to parameters set in A1-01 to A1-03 and A2-01 to A2-32 only, using advanced programming mode.

■Related Parameters

| Param-eter Num-ber | Name | Description | Setting Range | Factory Setting | Change during Opera-tion | Control Methods | | |
	LCD Display					V/f	V/f with PG	Open Loop Vec-tor
A2-01 to A2-32	User setting parameters	Used to set the parameter numbers that can be set/read. Maximum 32. Effective when the access level (A1-01) is set to User Program (1). Parameters set in A2-01 to A2-32 can be set/read in programming mode.	b1-01 to o2-08	-	No	A	A	A
	User Param 1 to 32							

Options

This section explains the Inverter option functions.

◆ Performing Speed Control with PG

This section explains functions with V/f control with PG.

■Related Parameters

Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop Vec-tor
F1-01	PG constant / PG Pulsed/Rev	Set the number of PG (pulse generator or encoder) pulses. Sets the number of pulses per motor revo-lution.	0 to 60000	600 (1024)*	No	No	Q	No
F1-02	Operation selection at PG open circuit (PGO) / PG Fdbk Loss Sel	Sets the PG disconnection stopping method. 0: Ramp to stop (Deceleration stop using the deceleration time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the decelera-tion time in C1-09.) 3: Continue operation (To protect the motor or machinery, do not make this setting.)	0 to 3	1	No	No	A	No
F1-03	Operation selection at overspeed (OS) / PG Overspeed Sel	Sets the stopping method when an overspeed (OS) fault occurs. 0: Ramp to stop (Deceleration stop using the deceleration time 1, C1-02.) 1: Coast to stop 2: Fast stop (Emergency stop using the decelera-tion time in C1-09.) 3: Continue operation (To protect the motor or machinery, do not make this setting.)	0 to 3	1	No	No	A	No
F1-04	Operation selection at deviation (DEV) / PG Deviation Sel	Sets the stopping method when a speed deviation (DEV) fault occurs. 0: Decelerate to stop (Deceleration stop using the deceleration time 1, C1-02.) 1: Coast to stop 2: Emergency stop (Emergency stop using the deceleration time in C1-09.) 3: Continue operation (DEV is displayed and operation continued.)	0 to 3	3	No	No	A	No
F1-05	PG rotation / PG Rotation Sel	0: Phase A leads with forward run command. (Phase B leads with reverse run command.) 1: Phase B leads with forward run command. (Phase A leads with reverse run command.)	0 or 1	0	No	No	A	No
F1-06	PG division rate (PG pulse monitor) / PG Output Ratio	Sets the division ratio for the PG speed control card pulse output. Division ratio = $(1 + n)/m$ ($n = 0$ or 1, $m = 1$ to 32) F1-06 = □ □□ n m This parameter is effective only when a PG-B2 is used. The possible division ratio settings are $1/32 \le$ F1-06 ≤ 1	1 to 132	1	No	No	A	No
F1-07	Integral value during accel/decel enable/disable / PG Ramp PI/I Sel	Sets integral control during acceleration/decelera-tion to either enabled or disabled. 0: Disabled (The integral function isn't used while accelerating or decelerating; it is used at constant speeds.) 1: Enabled (The integral function is used at all times.)	0 or 1	0	No	No	A	No

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Param-eter Num-ber	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop Vec-tor
F1-08	Overspeed (OS) detection level / PG Overspd Level	Sets the overspeed detection method. Frequencies above that set for F1-08 (set as a percentage of the maximum output frequency) that continue to exceed this frequency for the time set in F1-09 are detected as overspeed faults.	0 to 120	115%	No	No	A	No
F1-09	Overspeed detection delay time (OS) / PG Overspd Time		0.0 to 2.0	1.0 s	No	No	A	No
F1-10	Excessive speed deviation (DEV) detection level / PG Deviate Level	Sets the speed deviation detection method. Any speed deviation above the F1-10 set level (set as a percentage of the maximum output frequency) that continues for the time set in F1-11 is detected as a speed deviation. Speed deviation is the difference between actual motor speed and the reference command speed.	0 to 50	10%	No	No	A	No
F1-11	Excessive speed deviation detection delay time (DEV) / PG Deviate Time		0.0 to 10.0	0.5 s	No	No	A	No
F1-12	Number of PG gear teeth 1 / PG# Gear Teeth1	Sets the number of teeth on the gears if there are gears between the PG and the motor. $$\frac{\text{Input pulses input from PG} \times 60}{\text{F1-01}} \times \frac{\text{F1-13}}{\text{F1-12}}$$ A gear ratio of 1 will be used if either of these parameters is set to 0.	0 to 1000	0	No	No	A	No
F1-13	Number of PG gear teeth 2 / PG# Gear Teeth2			0	No	No	A	No
F1-14	PG open-circuit detection time / PGO Detect Time	Used to set the PG disconnection detection time. PGO will be detected if the detection time continues beyond the set time.	0.0 to 10.0	2.0 s	No	No	A	No

* The factory setting for (-E) models is 1024.

■Using PG Speed Control Card

There are four types of PG Speed Control Card that can be used in V/f control with PG.

- 3G3FV-PPGA2: A-phase (single) pulse input, compatible with open collector or complimentary outputs.
- 3G3FV-PPGB2: A/B-phase pulse input, compatible with complimentary outputs.
- 3G3FV-PPGD2: A-phase (single) pulse input, compatible with line drivers.
- 3G3FV-PPGX2: A/B/Z-phase pulse input, compatible with line drivers.

For the connection diagram, refer to *page 2*-50.

■Setting Number of PG Pulses

Set the number of PG (Pulse Generator/Encoder) pulses in pulses/rotation. Set the number of A-phase or B-phase pulses per 1 motor rotation in F1-01.

■Matching PG Rotation Direction and Motor Rotation Direction

Parameter F1-05 matches the PG rotation direction and the motor rotation direction. If the motor is rotating forwards, set whether it is A-phase driven or B-phase driven. Make this setting when using 3G3FV-PPGB2 or 3G3FV-PPGX2.
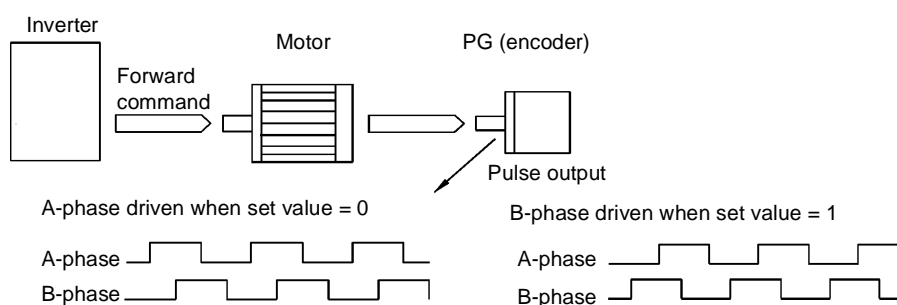
Example: Forward rotation of standard Yaskawa motor (PG used: E6B2-CWZ6C)
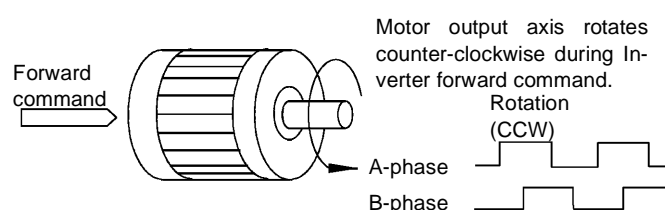
The standard PG has A-phase driven (CCW) when motor rotation is forward.

Generally, PG is A-phase driven when rotation is clockwise (CW) see from the input axis. Also, motor rotation is counter-clockwise (CCW) seen from the output side when forward commands are output. Consequently, when motor rotation is forward, PG is normally A-phase driven when a load is applied, and B-phase driven when a load is not applied.

■ **Setting Number of Gear Teeth Between PG and Motor**

Set the number of PG gear teeth in F1-12 and F1-13. If there are gears between the motor and PG, you can operate the motor by setting the number of gear teeth.

When the number of gear teeth has been set, the number of motor rotations within the Inverter is calculated using the following formula.

No. of motor rotations (r/min.) = No. of input pulses from PC $\times$ 60 / F1-01 $\times$ F1-13 (No. of gear teeth on load side) / F1-12 (No. of gear teeth on motor side)

■ **Matching Motor Speed During Acceleration and Deceleration to Frequency Reference**

You can select whether to enable or disable integral operation during acceleration and deceleration.

To match the motor speed as closely as possible to the frequency reference even during acceleration and deceleration, set F1-07 to 1.

If F1-01 is set to 1, overshoot or undershoot may occur easily immediately after acceleration and deceleration. To minimize the possibility of overshoot or undershoot occurring, set F1-01 to 0.

IMPORTANT

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■Setting PG Pulse Monitor Output Dividing Ratio

This function is enabled only when using PG speed control card 3G3FV-PPGB2. Set the dividing ratio for the PG pulse monitor output. The set value is expressed as n for the higher place digit, and m for the lower place 2 digits. The dividing ratio is calculated as follows:

Dividing ratio = $(1 + n)/m$ (Setting range) n: 0 or 1, m: 1 to 32

F1-06 = $\underset{n}{\square}$ $\underset{m}{\square\square}$

The dividing ratio can be set within the following range: $1/32 \le$ F1-06 ≤ 1. For example, if the dividing ratio is 1/2 (set value 2), half of the number of pulses from the PG are monitor outputs.

■Detecting PG Open Circuit

Set F1-09 (PG0 detection time) to detect PG cable disconnection and select the stopping method when PG cable disconnection is detected.

PG disconnection is detected when the speed feedback from the PG is 0 for the time set in F1-14 whenever the frequency reference is 1% or more of the maximum speed. PG0 is not detected during DC braking.

■Detecting Motor Overspeed

An error is detected when the motor speed exceeds the limit. An overspeed (OS) is detected when a PG Input frequency that exceeds the set value in F1-08 continues for longer than the time set in F1-09. After detecting an overspeed (OS), the Inverter stops according to the setting in F1-03.

■Detecting Speed Difference between the Motor and Speed Reference

An error is detected when the speed deviation (i.e., the difference between the designated speed and the actual motor speed) is too great. Speed deviation (DEV) is detected after a speed agreement is detected and when the speed reference and actual workpiece speed are within the setting of L4-02, if a speed deviation great than the set value in F1-10 continues for longer than the time set in F1-11. After a speed deviation is detected, the Inverter stops according to the setting in F1-04.

7

Chapter 7
Troubleshooting

This chapter describes the fault displays and countermeasures for the Inverter, and motor problems and countermeasures.

7

Protective and Diagnostic Functions

This section describes the alarm functions of the Inverter. The alarm functions include fault detection, alarm detection, operation error detection, and autotuning error detection.

◆ Fault Detection

When the Inverter detects a fault, the fault contact output operates, and the Inverter output is shut OFF causing the motor to coast to a stop. (The stopping method can be selected for some faults, and the selected stopping method will be used with these faults.) A fault code is displayed on the Digital Operator.

When a fault has occurred, refer to the following table to identify and correct the cause of the fault.

Use one of the following methods to reset the fault after restarting the Inverter:

- Set a multi-function contact input (H1-01 to H1-05) to 14 (Fault Reset) and turn ON the error reset signal.
- Press the RESET Key on the Digital Operator.
- Turn the main circuit power supply OFF and then ON again.

Table 7.1 Fault Displays and Processing

Display	Meaning	Probable Causes	Corrective Actions
o C Over Current	Overcurrent The Inverter output current exceeded the overcurrent detection level. (200% of rated current)	• A short-circuit or ground fault occurred at the Inverter output. (A short or ground fault can be caused by motor burn damage, worn insulation, or a damaged cable.) • The load is too large or the acceleration/deceleration time is too short. • A special-purpose motor or motor with a capacity too large for the Inverter is being used. • A magnetic switch was switched at the Inverter output.	Reset the fault after correcting its cause.
G F Ground Fault	Ground Fault The ground fault current at the Inverter output exceeded approximately 50% of the Inverter rated output current.	A ground fault occurred at the Inverter output. (A ground fault can be caused by motor burn damage, worn insulation, or a damaged cable.)	Reset the fault after correcting its cause.
P UF DC BUS Fuse Open	Fuse Blown The fuse in the main circuit is blown.	The output transistor has failed because of a short-circuit or ground fault at the Inverter output. Check whether there is a short-circuit between the following terminals. A short-circuit will damage the output transistor: B1 ($\oplus$3) ←→ U, V, W $\ominus$ ←→ U, V, W	Replace the Inverter after correcting the cause.
o U DC Bus Overvolt	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class: Approx. 410 V 400 V class: Approx. 820 V	The deceleration time is too short and the regenerative energy from the motor is too large.	Increase the deceleration time or connect a braking resistor (or Braking Resistor Unit).
		The power supply voltage is too high.	Decrease the voltage so it's within specifications.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
$Uu1$ DC Bus Undervolt	Main Circuit Undervoltage The main circuit DC voltage is below the Undervoltage Detection Level (L2-05). 200 V class: Approx. 190 V 400 V class: Approx. 380 V Main Circuit MC Operation Failure The MC stopped responding during Inverter operation. Applicable Inverter Capacities 200 V class: 37 to 110 kW 400 V class: 75 to 300 kW	• An open-phase occurred with the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose. • The voltage fluctuations in the input power supply are too large. • A fault occurred in the surge prevention circuit.	Reset the fault after correcting its cause.
$Uu2$ CTL PS Undervolt	Control Power Fault The control power supply voltage dropped.	-	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.
$Uu3$ MC Answer- back	Inrush Prevention Circuit Fault Overheating occurred in the inrush resistor. The MC did not respond for 10 s even though the MC ON signal has been output. Applicable Inverter Capacities 200 V class: 37 to 110 kW 400 V class: 75 to 300 kW	• The MC in the main circuit failed. • The MC excitation coil is burned out.	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.
PF Input Pha Loss	Main Circuit Voltage Fault The main circuit DC voltage oscillates unusually (not when regenerating). This fault is detected when L8-05 is set to "Enabled."	• An open-phase occurred in the input power supply. • A momentary power loss occurred. • The wiring terminals for the input power supply are loose. • The voltage fluctuations in the input power supply are too large. • The voltage balance between phases is bad.	Reset the fault after correcting its cause.
LF Output Pha Loss	Output Open-phase An open-phase occurred at the Inverter output. This fault is detected when L8-07 is set to "Enabled."	• There is a broken wire in the output cable. • There is a broken wire in the motor winding. • The output terminals are loose.	Reset the fault after correcting its cause.
		The motor being used has a capacity less than 5% of the Inverter's maximum motor capacity.	Check the motor and Inverter capacity.
oH Heatsnk Overtmp ($oH1$) Heatsink MAX Temp	Cooling Fin Overheating The temperature of the Inverter's cooling fins exceeded the setting in L8-02 or 105°C. OH: The temperature exceeded the setting in L8-02 (Stopping method can be changed by L8-03.). OH1: The temperature exceeded 100°C (Stopping method: Coast to stop).	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source.
		The Inverter's cooling fan has stopped.	Replace the cooling fan. (Contact our sales representative.)
	Inverter's Cooling Fan Stopped	The Inverter's cooling fan has stopped.	

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Table 7.1 Fault Displays and Processing (Continued)

| Display	Meaning	Probable Causes	Corrective Actions
o H 3 Motor Overheat 1	Motor Overheating Alarm The Inverter will stop or will continue to operate according to the setting of L1-03.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A1 and A2.
o H 4 Motor Overheat 2	Motor Overheating Fault The Inverter will stop according to the setting of L1-04.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A1 and A2.
r H DynBrk Resistor	Installed Braking Resistor Overheating The braking resistor is overheated and the protection function has operated if it has been enabled in L8-01.	The deceleration time is too short and the regenerative energy from the motor is too large.	• Reduce the load, increase the deceleration time, or reduce the motor speed. • Change to a Braking Resistor Unit.
r r DynBrk Transistr	Internal Braking Transistor Fault The braking transistor is not operating properly.	-	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.
o L 1 Motor Overloaded	Motor Overload The motor overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time, and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
		The V/f characteristics voltage is too high or too low.	Check the V/f characteristics.
		The Motor Rated Current (E2-01) is incorrect.	Check the Motor Rated Current (E2-01).
o L 2 Inv Overloaded	Inverter Overload The Inverter overload protection function has operated based on the internal electronic thermal value.	The load is too heavy. The acceleration time, deceleration time and cycle time are too short.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
		The V/f characteristics voltage is too high or too low.	Check the V/f characteristics.
		The Inverter capacity is too low.	Replace the Inverter with one that has a larger capacity.
o L 3 Overtorque Det 1	Overtorque Detected 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
o L 4 Overtorque Det 2	Overtorque Detected 2 There has been a current greater than the setting in L6-05 for longer than the setting in L6-06.	-	• Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. • Check the mechanical system and correct the cause of the overtorque.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
o L 7 HSB-OL	High-slip Braking OL The output frequency did not change for longer than the time set in N3-04.	The inertia returned to the load is too large.	• Make sure the load is an inertial load. • Set the system so that the deceleration time that does not produce 0 V is 120 s or less.
U L 3 Undertorq Det 1	Undertorque Detected 1 There has been a current less than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
U L 4 Undertorq Det 2	Undertorque Detected 2 There has been a current less than the setting in L6-05 for longer than the setting in L6-06.	-	• Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
o 5 Overspeed Det	Overspeed The speed has been greater than the setting in F1-08 for longer than the setting in F1-09.	Overshooting/Undershooting are occurring.	Adjust the gain again.
		The reference speed is too high.	Check the reference circuit and reference gain.
		The settings in F1-08 and F1-09 aren't appropriate.	Check the settings in F1-08 and F1-09.
P G o PG Open	PG Disconnection Detected PG pulses were input when the Inverter was outputting a frequency (soft start output ≥ E1-09).	There is a break in the PG wiring.	Fix the broken/disconnected wiring.
		The PG is wired incorrectly.	Fix the wiring.
		Power isn't being supplied to the PG.	Supply power to the PG properly.
		-	Check for open circuit when using brake (motor).
d E u Speed Deviation	Excessive Speed Deviation The speed deviation has been greater than the setting in F1-10 for longer than the setting in F1-11.	The load is too heavy.	Reduce the load.
		The acceleration time and deceleration time are too short.	Lengthen the acceleration time and deceleration time.
		The load is locked.	Check the mechanical system.
		The settings in F1-10 and F1-11 aren't appropriate.	Check the settings in F1-10 and F1-11.
		-	Check for open circuit when using brake (motor).
C F Out of Control	Control Fault The torque limit was reached continuously for 3 seconds or longer during a deceleration stop during open-loop vector control.	-	Check the motor constants.
F b L Feedback Loss	PID Feedback Reference Lost A PID feedback reference loss was detected (b5-12 = 2) and the PID feedback input was less than b5-13 (PID feedback loss detection level) for longer than the time set in b5-14 (PID feedback loss detection time).	-	-

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Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
ᴇ ꜰ ᴏ Opt Exter- nal Flt	External fault input from Communi- cations Option Card	-	Check the Communications Option Card and communications signals.
ᴇ ꜰ ꝫ Ext Fault S3	External fault (Input terminal 3)	An "external fault" was input from a multi-function input terminal (S3 to S7).	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the exter- nal fault.
ᴇ ꜰ ꝡ Ext Fault S4	External fault (Input terminal 4)		
ᴇ ꜰ 5 Ext Fault S5	External fault (Input terminal 5)		
ᴇ ꜰ ᴆ Ext Fault S6	External fault (Input terminal 6)		
ᴇ ꜰ ꝯ Ext Fault S7	External fault (Input terminal 7)		
ᴏ ᴘ ᴦ Oper Dis- connect	Digital Operator Connection Fault The connection to the Digital Operator was broken during operation for a RUN command from the Digital Operator.	-	Check the connection to the Digi- tal Operator.
ᴄ ᴇ Memobus Com Err	RS-422A/485 Communications Error A normal reception was not possible for 2 s or longer after control data was received once.	-	Check the communications devices and communications sig- nals.
ᴮ ᴜ 5 Option Com Err	Option Communications Error A communications error was detected during a run command or while setting a frequency reference from a Commu- nications Option Card.	-	Check the communications devices and communications sig- nals.
ᴄ ᴘ ꜰ ᴏ ᴏ CPF	Digital Operator Communications Error 1 Communications with the Digital Operator were not established within 5 seconds after the power was turned on.	The Digital Operator's connector isn't connected properly.	Disconnect the Digital Operator and then connect it again.
		The Inverter's control circuits are faulty.	Replace the Inverter.
	CPU External RAM Fault	-	Try turning the power supply off and on again.
		The control circuits were destroyed.	Replace the Inverter.
ᴄ ᴘ ꜰ ᴏ ᴉ CPF01	Digital Operator Communications Error 2 After communications were estab- lished, there was a communications error with the Digital Operator for more than 2 seconds.	The Digital Operator isn't connected properly.	Disconnect the Digital Operator and then connect it again.
		The Inverter's control circuits are faulty.	Replace the Inverter.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
CPF02 BB Circuit Err	Baseblock circuit error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF03 EEROM Error	EEPROM error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF04 Internal A/D Err	CPU internal A/D converter error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF05 External A/D Err	CPU internal A/D converter error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF06 Option error	Option Card connection error	The Option Card is not connected properly.	Turn off the power and insert the Card again.
		The Inverter or Option Card is faulty.	Replace the Option Card or the Inverter.
CPF07 RAM-Err	ASIC internal RAM fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF08 WAT-Err	Watchdog timer fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF09 CPU-Err	CPU-ASIC mutual diagnosis fault	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
CPF10 ASIC-Err	ASIC version fault	The Inverter control circuit is faulty	Replace the Inverter.
CPF20 Option A/D error	Communications Option Card A/D converter error	The Option Card is not connected properly.	Turn off the power and insert the Card again.
		The Option Card's A/D converter is faulty.	Replace the Communications Option Card.
CPF21 Option CPU down	Communications Option Card self diagnostic error	Communications Option Card fault.	Replace the Option Card.
CPF22 Option Type Err	Communications Option Card model code error		
CPF23 Option DPRAM Err	Communications Option Card DPRAM error		

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◆ Alarm Detection

Alarms are detected as a type of Inverter protection function and do not operate the fault contact output. The system will automatically return to its original status once the cause of the alarm has been removed.

The Digital Operator display flashes and the alarm is output from the multi-function outputs (H2-01 to H2-03).

When an alarm occurs, take appropriate countermeasures according to the table below.

Table 7.2 Alarm Displays and Processing

Display	Meaning	Probable causes	Corrective Actions
EF (blinking) External Fault	Forward/Reverse Run Commands Input Together Both the forward and reverse run commands have been ON for more than 0.5 s.	-	Check the sequence of the forward and reverse run commands. Since the rotational direction is unknown, the motor will be decelerated to a stop when this minor fault occurs.
Uu (blinking) DC Bus Undervolt	Main Circuit Undervoltage The following conditions occurred when there was no Run signal. • The main circuit DC voltage was below the Undervoltage Detection Level Setting (L2-05). • The surge current limiting contactor opened. • The control power supply voltage when below the CUV level.	See causes for UV1, UV2, and UV3 faults in the previous table.	See corrective actions for UV1, UV2, and UV3 faults in the previous table.
ou (blinking) DC Bus Overvolt	Main Circuit Overvoltage The main circuit DC voltage exceeded the overvoltage detection level. 200 V class: Approx. 400 V 400 V class: Approx. 800 V	The power supply voltage is too high.	Decrease the voltage so it's within specifications.
oH (blinking) Heatsnk Over-temp	Cooling Fin Overheating The temperature of the Inverter's cooling fins exceeded the setting in L8-02.	The ambient temperature is too high.	Install a cooling unit.
		There is a heat source nearby.	Remove the heat source
		The Inverter cooling fan has stopped.	Replace the cooling fan. (Contact your dealer.)
$oH2$ (blinking) Over Heat 2	Inverter Overheating Pre-alarm An OH2 alarm signal (Inverter overheating alarm signal) was input from a multi-function input terminal (S3 to S7).	-	Clear the multi-function input terminal's overheating alarm input.
$oH3$ (blinking) Motor Over-heat 1	Motor overheating E was set for H3-09 and the motor temperature thermistor input exceeded the alarm detection level.	The motor has overheated.	Check the size of the load and the length of the acceleration, deceleration, and cycle times.
			Check the V/f characteristics.
			Check the motor temperature input on terminals A1 and A2.

Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
oL3 (blinking) Overtorque Det 1	Overtorque 1 There has been a current greater than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
oL4 (blinking) Overtorque Det 2	Overtorque 2 There has been a current greater than the setting in L6-05 for longer than the setting in L6-06.	-	• Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
UL3 (blinking) Undertorq Det 1	Undertorque 1 There has been a current less than the setting in L6-02 for longer than the setting in L6-03.	-	• Make sure that the settings in L6-02 and L6-03 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
UL4 (blinking) Undertorq Det 2	Undertorque 2 There has been a current less than the setting in L6-05 for longer than the setting in L6-06.	-	• Make sure that the current setting in L6-05 and time setting in L6-06 are appropriate. • Check the mechanical system and correct the cause of the overtorque.
o5 (blinking) Overspeed Det	Overspeed The speed has been greater than the setting in F1-08 for longer than the setting in F1-09.	Overshooting/undershooting are occurring.	Adjust the gain again.
		The reference speed is too high.	Check the reference circuit and reference gain.
		The settings in F1-08 and F1-09 aren't appropriate.	Check the settings in F1-08 and F1-09.
PGo (blinking) PG Open	The PG is disconnected The Inverter is outputting a frequency, but PG pulses aren't being input.	There is a break in the PG wiring.	Fix the broken/disconnected wiring.
		The PG is wired incorrectly.	Fix the wiring.
		Power isn't being supplied to the PG.	Supply power to the PG properly.
dEv (blinking) Speed Deviation	Excessive Speed Deviation The speed deviation has been greater than the setting in F1-10 for longer than the setting in F1-11.	The load is too large.	Reduce the load.
		The acceleration time and deceleration time are too short.	Lengthen the acceleration time and deceleration time.
		The load is locked.	Check the mechanical system.
		The settings in F1-10 and F1-11 aren't appropriate.	Check the settings in F1-10 and F1-11.
EF0 Opt External Flt	External error detected for Communications Card other than SI-K2 Continuing operation was specified for EF0 (F6-03 = 3)and an external fault was input from the Option Card.	-	Remove the cause of the external fault.

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Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
$EF3$ (blinking) Ext Fault S3	External fault (Input terminal S3)	An external fault was input from a multi-function input terminal (S3 to S7).	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
$EF4$ (blinking) Ext Fault S4	External fault (Input terminal S4)		
$EF5$ (blinking) Ext Fault S5	External fault (Input terminal S5)		
$EF6$ (blinking) Ext Fault S6	External fault (Input terminal S6)		
$EF7$ (blinking) Ext Fault S7	External fault (Input terminal S7)		
FbL (blinking) Feedback Loss	PID Feedback Reference Lost A PID feedback reference loss was detected (b5-12 = 2) and the PID feedback input was less than b5-13 (PID feedback loss detection level) for longer than the time set in b5-14 (PID feedback loss detection time).	-	-
CE (blinking) Memobus Com Err	RS-422A/485 Communications Error Normal reception was not possible for 2 s or longer after received control data.	-	Check the communications devices and signals.
bUS (blinking) Option Com Err	Option Card Communications Error A communications error occurred in a mode where the run command or a frequency reference is set from an Communications Option Card.	-	Check the communications devices and signals.
$CALL$ (blinking) ComCall	Communications on Standby Control data was not normally received when power was turned ON.	-	Check the communications devices and signals.

◆ Operation Errors

An operation error will occur if there is an invalid setting or a contradiction between two parameter settings. It won't be possible to start the Inverter until the parameters have been set correctly. (The alarm output and fault contact outputs will not operate either.)

When an operation error has occurred, refer to the following table to identify and correct the cause of the errors.

Table 7.3 Operation Error Displays and Incorrect Settings

Display	Meaning	Incorrect settings
oPE01 kVA Selection	Incorrect Inverter capacity setting	The Inverter capacity setting doesn't match the Unit. (Contact your dealer.)
oPE02 Limit	Parameter setting range error	The parameter setting is outside of the valid setting range.
oPE03 Terminal	Multi-function input selection error	One of the following errors has been made in the multi-function input (H1-01 to H1-06) settings: • The same setting has been selected for two or more multi-function inputs. • An up or down command was selected independently. (They must be used together.) • The up/down commands (10 and 11) and Accel/Decel Ramp Hold (A) were selected at the same time. • Speed Search 1 (61, maximum output frequency) and Speed Search 2 (62. set frequency) were selected at the same time. • External Baseblock NO (8) and External Baseblock NC (9) were selected at the same time. • The up/down commands (10 and 11) were selected while PID Control Mode Selection (b5-01) was enabled. • The Multi-function Analog Input Terminal (A2) Function Selection (H3-09) was set to a value other than 1F and the Terminal 13/14 Switch (1F) was selected, but the Terminal A1/A2 Switching (H3-13) was set to use the main speed frequency for A2 (H3-13 = 1). • Positive and negative speed commands have not been set at the same time. • The emergency stop command NO and NC have been set at the same time.
oPE05 Sequence Select	Option Card selection error	The Option Card was selected as the frequency reference source by setting b1-01 to 3, but an Option Card isn't connected (C option).
oPE06 PG Opt Missing	Control method selection error	V/f control with PG feedback was selected by setting A1-02 to 1, but a PG Speed Control Card isn't connected.
oPE07 Analog Selection	Multi-function analog input selection error	The same setting has been selected for the analog input selection and the PID function selection. • H3-09 = B and H6-01 = 1 • H3-09 = C and H6-01 = 2 b1-01 (Reference Selection) is set to 4 (pulse input) and H6-01 (Pulse Train Input Function Selection) is set to a value other than 0 (frequency reference).
oPE08	Parameter selection error	A setting has been made that is not required in the current control method. Ex.: A function used only with open loop vector control was selected for V/f control.
oPE09	PID control selection error	The following settings have been made at the same time. • b5-01 (PID Control Mode Selection) has been set to a value other than 0. • b5-15 (PID Sleep Function Operation Level) has been set to a value other than 0. • b1-03 (Stopping Method Selection) has been set to 2 or 3.

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Table 7.3 Operation Error Displays and Incorrect Settings (Continued)

Display	Meaning	Incorrect settings
o P E 10 V/f Ptrn Setting	V/f data setting error	Parameters E1-04, E1-06, E1-07, and E1-09 do not satisfy the following conditions: • E1-04 (FMAX) ≥ E1-06 (FA) > E1-07 (FB) ≥ E1-09 (FMIN) • E3-02 (FMAX) ≥ E3-04 (FA) > E3-05 (FB) ≥ E3-07 (FMIN)
o P E 11 CarrFrq/On-Delay	Parameter setting error	One of the following parameter setting errors exists. • C6-05 (Carrier Frequency Gain) > 6, the Carrier Frequency Lower Limit (C6-04) > the Carrier Frequency Gain(C6-05) • Upper/lower limit error in C6-03 to 05. • C6-01 is 0 and C6-02 is 2 to E. • C6-01 is 1 and C6-02 is 7 to E.
E r r EEPROM R/W Err	EEPROM write error	A verification error occurred when writing EEPROM. • Try turning the power supply off and on again. • Try setting the parameters again.

◆ Errors During Autotuning

The errors that can occur during autotuning are given in the following table. If an error is detected, the motor will coast to a stop and an error code will be displayed on the Digital Operator. The error contact output and alarm output will not function.

Table 7.4 Errors During Autotuning

Display	Meaning	Probable causes	Corrective Actions
E r - 01 Data Invalid	Motor data error	There is an error in the data input for autotuning. There is an error in the relationship between the motor output and the motor rated current. The is an error between the no-load current setting and the input motor rated current (when autotuning for only line-to-line resistance is performed for vector control).	• Check the input data. • Check the capacity of the Inverter and motor. • Check the motor rated current and no-load current.
E r - 02 Minor Fault	Alarm	A minor fault occurred during autotuning (xxx).	• Check the input data. • Check wiring and the machine. • Check the load.
E r - 03 STOP Key	STOP key input	The STOP Key was pressed to cancel autotuning.	
E r - 04 Resistance	Line-to-line resistance error	Autotuning was not completed in the specified time. The results of autotuning has exceeded the setting range for a parameter.	• Check the input data. • Check motor wiring. • If the motor is connected to the machine, disconnect it. • If the setting of T1-03 is higher than the Inverter input power supply voltage for Er-08, change the input data.
E r - 05 No-load current	No-load current error		
E r - 08 Rated Slip	Rated slip error		
E r - 09 Accelerate	Acceleration error (detected only for rotational autotuning)	The motor did not accelerate in the specified time.	• Increase C1-01 (Acceleration Time 1). • Increase L7-01 and L7-02 (Reverse Torque Limits) if they are low. • If the motor is connected to the machine, disconnect it.

Table 7.4 Errors During Autotuning (Continued)

Display	Meaning	Probable causes	Corrective Actions
$Er-11$ Motor Speed	Motor speed error (detected only for rotational autotuning)	The torque reference was too high (100%) during acceleration (for open loop vector control only).	• If the motor is connected to the machine, disconnect it. • Increase C1-01 (Acceleration Time 1). • Check the input data (particularly the number of PG pulses and the number of motor poles).
$Er-12$ I-det Circuit	Current detection error	The current flow exceeded the motor rated current. The detected current sign was the opposite of what it should be. There is a phase fault for U, V, or W.	Check the current detection circuit, motor wiring, current detector, and installation methods.
$Er-13$ Leak Inductance	Leakage inductance error	Autotuning was not completed in the specified time.	Check motor wiring.
$End1$ V/f Over Setting	V/f settings excessive*	The torque reference exceeded 100% and the no-load torque exceeded 70% during autotuning.	• Check and correct the settings. • Disconnect the load from the motor.
$End2$ Saturation	Motor core saturation error (detected only for rotational autotuning)	Autotuning for the motor core saturation value could not be completed in the specified time. The results of autotuning has exceeded the setting range for a parameter so a temporary setting was made for the motor core saturation coefficient.	• Check the input data. • Check motor wiring. • If the motor is connected to the machine, disconnect it.
$End3$ Rated FLA Alm	Rated current setting alarm*	The rated current is set high.	Check the input data (particularly the motor output current and motor rated current).

* Displayed after autotuning has been completed.

◆ Errors when Using the Digital Operator Copy Function

The errors that can occur when using the copy function from the Digital Operator are given in the following table. An error code will be displayed on the Digital Operator. If a Digital Operator key is pressed when an error code is being displayed, the display will be cleared and 03-01 will be displayed. The error contact output and alarm output will not function.

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Table 7.5 Errors during Copy Function

Func-tion	Display	Meaning	Probable causes	Corrective Actions
Read	$P \ulcorner E$ READ IMPOSSIBLE	Digital Operator write-protected	o3-01 was set to 1 to write a parameter when the Digital Operator was write-protected (o3-02 = 0).	Set o3-02 to 1 to enable writing parameters with the Digital Operator.
	$\iota F E$ READ DATA ERROR	Illegal read data	The read data length does not agree.	Repeat the read. Check the Digital Operator cable. Replace the Digital Operator.
			The write data is incorrect.	
	$\ulcorner d E$ DATA ERROR	Illegal write status	An attempted write of a parameter to EEPROM on the Digital Writer failed.	A low Inverter voltage has been detected. Repeat the read. Replace the Digital Operator.
Copy	$C P E$ ID UNMATCH	ID not matched	The Inverter product code or software number is different.	Use the copy function for the same product code and software number.
	$\cup A E$ INV. KVA UNMATCH	Inverter capacity matched	The capacity of the Inverter being copied and the capacity in the Digital Operator are different.	Use the copy function for the same Inverter capacity.
	$C \ulcorner E$ CONTROL UNMATCH	Control method matched	The control method of the Inverter being copied and the control method in the Digital Operator are different.	Use the copy function for the same control method.
	$C \forall E$ COPY ERROR	Verify error	The parameter written to the Inverter was compared with the parameter in the Digital Operator and they were different.	Retry the copy.
	$C 5 E$ SUM CHECK ERROR	Checksum error	The checksum in the Inverter parameter area was compared with the checksum in the Digital Operator parameter area and they were different.	Retry the copy.

Troubleshooting

Due to parameter setting errors, faulty wiring, and so on, the Inverter and motor may not operate as expected when the system is started up. If that should occur, use this section as a reference and apply the appropriate measures.

If the contents of the fault are displayed, refer to *Protective and Diagnostic Functions*.

◆ If Parameters Cannot Be Set

Use the following information if an Inverter parameter cannot be set.

■The display does not change when the ⊗ and ⊗ Keys are pressed.

The following causes are possible.

The Inverter is operating (drive mode).

There are some parameters that cannot be set during operation. Turn the Inverter off and then make the settings.

Parameter write enable is turned OFF.

This occurs when "parameter write enable" (set value: 1B) is set for a multi-function input terminal (H1-01 to H1-05). If the parameter write enable input is OFF, the parameters cannot be changed. Turn it ON and then set the parameters.

Passwords do not match. (Only when a password is set.)

If the parameter A1-04 (Password) and A1-05 (Password Setting) numbers are different, the parameters for the initialize mode cannot be changed. Reset the password.

If you cannot remember the password, display A1-05 (Password Setting) by pressing the Reset Key and the Menu Key simultaneously while in the A1-04 display. Then reset the password. (Input the reset password in parameter A1-04.)

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■OPE01 through OPE11 is displayed.

The set value for the parameter is wrong. Refer to *Operation Errors* in this chapter and correct the setting.

■CPF00 or CPF01 is displayed./Nothing appears on Digital Operator display.

This is a Digital Operator communications error. The connection between the Digital Operator and the Inverter may be faulty. Remove the Digital Operator and then re-install it.

◆ If the Motor Does Not Operate

Use the following information if the motor does not operate.

■The motor does not operate when the RUN Key on the Digital Operator is pressed.

The following causes are possible.

> **IMPORTANT**
> If the Inverter is not in drive mode, it will remain in ready status and will not start. Press the Menu Key to make the DRIVE indicator flash, and enter the drive mode by pressing the DATA/ENTER Key. The DRIVE indicator will light when drive mode is entered.

The operation method setting is wrong.

If parameter b1-02 (Operation Method Selection) is set to 1 (control circuit terminal), the motor will not operate when the Run Key is pressed. Either press the LOCAL/REMOTE Key to switch to Digital Operator operation or set b1-02 to 0 (Digital Operator).

> **INFO**
> The LOCAL/REMOTE Key is enabled by setting o2-01 to 1 and disabled by setting o2-01 to 2. It is enabled when the drive mode is entered.

The frequency reference is too low.

If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the Inverter will not operate.

Raise the frequency reference to at least the minimum output frequency.

There is a multi-function analog input setting error.

If multi-function analog input H3-09 is set to 1 (frequency gain), and if no voltage (current) is input, then the frequency reference will be zero. Check to be sure that the set value and analog input value are correct.

■The motor does not operate when an external operation signal is input.

The following causes are possible.

The Inverter is not in drive mode.

If the Inverter is not in drive mode, it will remain in ready status and will not start. Press the MENU Key make the DRIVE indicator flash, and enter the drive mode by pressing the ENTER Key. The DRIVE indicator will light when drive mode is entered.

The operation method selection is wrong.

If parameter b1-02 (reference selection) is set to 0 (Digital Operator), the motor will not operate when an external operation signal is input. Set b1-02 to 1 (control circuit terminal) and try again.

Similarly, the motor will also not operate if the LOCAL/REMOTE Key has been pressed to switch to Digital Operator operation. In that case press the LOCAL/REMOTE Key* again to return to the original setting.

INFO

The LOCAL/REMOTE Key is enabled by setting o2-01 to 1 and disabled by setting o2-01 to 2. It is enabled when the drive mode is entered.

The wiring to the Inverter control circuit terminal is faulty.

If the input wiring to the control circuit terminal is faulty, the Inverter input signal cannot be confirmed. Use the Digital Operator to check U1-10 (input terminal status).

The sequence input method can be switched between an NPN (factory setting) and PNP input. For details, refer to *Chapter 2 Wiring*.

A 3-wire sequence is in effect.

The input method for a 3-wire sequence is different than when operating by forward/stop and reverse/stop (2-wire sequence). When 3-wire sequence is set, the motor will not operate even when an input terminal suitable for forward run/stop and reverse run/stop is turned ON.

When using a 3-wire sequence, refer to the timing chart and input the proper signals.

When using a 2-wire sequence, set the multi-function input terminal (H1-01 through H1-05, terminals S3 to S7) to a value other than 0.

The frequency reference is too low.

If the frequency reference is set below the frequency set in E1-09 (Minimum Output Frequency), the Inverter will not operate. Raise the frequency reference to at least the minimum output frequency.

There is a multi-function analog input setting error.

If multi-function analog inputs H3-05 and H3-09 are set to 1 (frequency gain), and if no voltage (current) is input, then the frequency reference will be zero. Check to be sure that the set value and analog input value are correct.

■**The motor stops during acceleration or when a load is connected.**

The load may be too heavy. The Inverter has a stall prevention function and an automatic torque boost function, but the motor responsiveness limit may be exceeded if acceleration is too rapid or if the load is too heavy. Lengthen the acceleration time or reduce the load. Also consider increasing the motor capacity.

■**The motor only rotates in one direction.**

"Reverse run prohibited" is selected. If b1-04 (Prohibition of Reverse Operation) is set to 1 (reverse run prohibited), the Inverter will not receive reverse run commands. To use both forward and reverse operation, set b1-04 to 0.

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◆ If the Direction of the Motor Rotation is Reversed

If the motor operates in the wrong direction, the motor output wiring is faulty. When the Inverter T1(U), T2(V), and T3(W) are properly connected to the motor T1(U), T2(V), and T3(W), the motor operates in a forward direction when a forward run command is executed. The forward direction depends on the manufacturer and the motor type, so be sure to check the specifications.

The direction of rotation can be reversed by switching two wires among U, V, and W.

◆ If the Motor Does Not Put Out Torque or If Acceleration Is Slow

Use the following information if the motor does not output torque or if acceleration is too slow.

■ The torque limit has been reached.

When a torque limit has been set in parameters L7-01 to L7-04, no torque will be output beyond that limit. This can cause the torque to be insufficient, or the acceleration time to be too long. Check to be sure that the value set for the torque limit is suitable.

If torque limits have been set for the multi-function analog input (H3-09 = 10 to 12 or 15), check to be sure that the analog input value is suitable.

■ The stall prevention level during acceleration is too low.

If the value set for L3-02 (Stall Prevention Level during Acceleration) is too low, the acceleration time will be too long. Check to be sure that the set value is suitable.

■ The stall prevention level during running is too low.

If the value set for L3-06 (Stall Prevention Level during Running) is too low, the speed will drop before outputting torque. Check to be sure that the set value is suitable.

■ V/f control limit

The output torque at low frequencies is smaller with V/f control than it is for vector control. Consider whether it is possible to change to vector control (A1-02 = 2).

■ Autotuning has not been performed for vector control

Vector control will not be perform if autotuning has not been performed. Perform autotuning separately for the motor, or set the motor constants through calculations. Alternatively, change the Control Method Selection (A1-02) to V/f control (0 or 1).

◆ If the Motor Operates Higher Than the Reference

Use the following information if the motor operates higher than the reference.

■**The analog frequency reference bias setting is wrong (the gain setting is wrong).**

The frequency reference bias set in parameter H3-03 is added to the frequency reference. Check to be sure that the set value is suitable.

■**A signal is being input to the frequency reference (current) terminal A1.**

When 1F (frequency reference) is set for parameter H3-09 (Multi-function Analog Input Terminal A2 Function Selection), a frequency corresponding to the terminal A2 input voltage (current) is added to the frequency reference. Check to be sure that the set value and analog input value are suitable.

◆ **If the Slip Compensation Function Has Low Speed Precision**

If speed control accuracy is low for the slip compensation function, the slip compensation limit has been reached. With the slip compensation function, compensation cannot be carried out beyond the slip compensation limit set in parameter C3-03. Check to be sure that the set value is suitable.

◆ **If There Is Low Speed Control Accuracy at High-speed Rotation in Open-loop Vector Control Mode**

The motor's rated voltage is high.

The Inverter's maximum output voltage is determined by its input voltage. (For example, if 200 VAC is input, then the maximum output voltage will be 200 VAC.) If, as a result of vector control, the output voltage reference value exceeds the Inverter output voltage maximum value, the speed control accuracy will decrease. Use a motor with a low rated voltage (i.e., a special motor for use with vector control), or change to flux vector control.

◆ **If Motor Deceleration Is Slow**

Use the following information when the motor deceleration is slow.

■**The deceleration time is long even when braking resistor is connected.**

The following causes are possible.

"Stall prevention during deceleration enabled" is set.

When braking resistor is connected, set parameter L3-04 (Stall Prevention Selection during Deceleration) to 0 (disabled) or 3 (with braking resistor). When this parameter is set to 1 (enabled, the factory setting), braking resistor does not fully function.

The deceleration time setting is too long.

Check the deceleration time setting (parameters C1-02, C1-04, C1-06, and C1-08).

Motor torque is insufficient.

If the parameters are correct and there is no overvoltage fault, then the motor's power is limited. Consider increasing the motor capacity.

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The torque limit has been reached.

When a torque limit has been set in parameters L7-01 to L7-04, no torque will be output beyond that limit. This can cause the deceleration time to be too long. Check to be sure that the value set for the torque limit is suitable.

If torque limits have been set for the multi-function analog input terminal A2 Function H3-09 (set value: 10 to 12 or 15), check to be sure that the analog input value is suitable.

■If the Vertical-axis Load Drops When Brake Is Applied

The following causes are possible.

There is a fault in the sequence.

The sequence is incorrect. The Inverter goes into DC injection braking status for 0.5 seconds after deceleration is completed. (This is the factory-set default.)

To ensure that the brake holds, set frequency detection 2 (H2-01 = 5) for the multi-function contact output terminals (M1 and Mw) so that the contacts will turn OFF when the output frequency is greater than L4-01 (3.0 to 5.0 Hz). (The contacts will turn ON below L4-01.)

There is hysteresis in frequency detection 2 (i.e., a frequency detection width, L4-02 = 2.0 Hz). Change the setting to approximately 0.5 Hz if there are drops during stop. Do not use the multi-function contact output run signal (H2-01 = 0) for the brake ON/OFF signal.

DC braking is insufficient.

If the DC braking power is insufficient, increase the b2-02 setting (DC injection braking current).

The wrong brake is being used.

Use the main brake rather than the holding brake.

◆ If the Motor Overheats

Take the following steps if the motor overheats.

■The load is too big.

If the motor load is too heavy and the motor is used with the effective torque exceeding the motor's rated torque, the motor will overheat. Some motor ratings are given for short period performance and are not continuous ratings. Reduce the load amount by either lightening the load or lengthening the acceleration/deceleration time. Also consider increasing the motor capacity.

■The ambient temperature is too high.

The motor rating is determined within a particular ambient operating temperature range. The motor will burn out if it is run continuously at the rated torque in an environment in which the maximum ambient operating temperature is exceeded. Lower the motor's ambient temperature to within the acceptable ambient operating temperature range.

■The withstand voltage between the motor phases is insufficient.

When the motor is connected to the Inverter output, a surge is generated between the Inverter switching and the motor coil. Normally the maximum surge voltage is three times the Inverter's input power supply voltage

(i.e., 1,200 V for 400 V class). Be sure to use a motor with a withstand voltage between the motor phases that is greater than the maximum surge voltage. In particular, when using a 400 V class Inverter, use a special motor for Inverters.

■Autotuning has not been performed for vector control

Vector control will not perform if autotuning has not been performed. Perform autotuning, or set the motor constants through calculations. Alternatively, change the Control Method Selection (A1-02) to V/f control (0 or 1).

◆ If There Is Noise When the Inverter Is Started or From an AM Radio

If noise is generated by Inverter switching, implement the following countermeasures:

- Change the Inverter's Carrier Frequency Selection (C6-02) to lower the carrier frequency. This will help to some extent by reducing the amount of internal switching.
- Install an Input Noise Filter at the Inverter's power supply input area.
- Install an Output Noise Filter at the Inverter's power supply output area.
- Use metal tubing. Electric waves can be shielded by metal, so encase the Inverter with metal (steel).
- Ground the Inverter and motor.
- Separate main circuit wiring from control wiring.

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◆ If the Ground Fault Interrupter Operates When the Inverter Is Run

The Inverter performs internal switching, so there is a certain amount of leakage current. This may cause the ground fault interrupter to operate and cut off the power supply. Change to a ground fault interrupter with a high leakage detection level (i.e., a sensitivity current of 200 mA or greater per Unit, with an operating time of 0.1 s or more), or one that incorporates high frequency countermeasures (i.e., one designed for use with Inverters). It will also help to some extent to change the Inverter's Carrier Frequency Selection (C6-02) to lower the carrier frequency. In addition, remember that the leakage current increases as the cable is lengthened.

◆ If There Is Mechanical Oscillation

Use the following information when there is mechanical oscillation.

■ The machinery is making unusual sounds.

The following causes are possible.

There may be resonance between the mechanical system's characteristic frequency and the carrier frequency.

If the motor is running with no problems and the machinery is oscillating with a high-pitched whine, it may indicate that this is occurring. To prevent this type of resonance, adjust the carrier frequency with parameters C6-02 to C6-05.

There may be resonance between a machine's characteristic frequency and the output frequency of the Inverter.

To prevent this from occurring, either use the jump frequency functions in parameters d3-01 to d3-04 or install rubber padding on the motor base to reduce oscillation.

■ The motor vibrates strongly and won't operate normally.

This may be caused by open phases in the motor output. Failure in one or two of the phases in a three-phase motor output will cause extremely strong vibration and prevent the motor from operating. Check for a faulty motor power line or disconnection. The same condition will also occur if the Inverter's output transistor is open and damaged. Check the balance of the Inverter output voltage.

■ Oscillation and hunting are occurring with open-loop vector control.

The gain adjustment may be insufficient. Reset the gain to a more effective level by adjusting parameters C4-02 (torque compensation time constant), C2-01 (S-curve Characteristic Time at Acceleration Start), and C3-02 (Slip Compensation Primary Delay Time) in order. Lower the gain setting and raise the primary delay time setting.

Vector control will not perform if autotuning has not been performed. Perform autotuning separately for the motor, or set the motor constants through calculations. Alternatively, change the control method selection (A1-02) to V/f control (0 or 1).

■Oscillation and hunting are occurring with V/f control.

The gain adjustment may be insufficient. Reset the gain to a more effective level by adjusting parameters C4-02 (Torque Compensation Primary Delay Time Constant), N1-02 (Hunting Prevention Gain), and C3-02 (Slip Compensation Primary Delay Time) in order. Lower the gain setting and raise the primary delay time setting.

■Oscillation and hunting are occurring with V/f w/PG control.

The gain adjustment may be insufficient. Adjust the various types of speed control loop (ASR) gain.

If the oscillation cannot be eliminated in this way, set the hunting prevention selection (parameter N1-01) to 0 (disabled) and then try adjusting the gain again.

■Oscillation and hunting are occurring with PID control.

If there is oscillation or hunting during PID control, check the oscillation cycle and individually adjust P, I, and D parameters. (Refer to page 6-120.)

■PID control diverges.

The following causes are possible.

Feedback is not being input.

If no feedback is being input and the detection value is zero, PID control will fail to function and the output will diverge. This will cause the motor speed to increase to the maximum frequency. Check for a break in the feedback signal or for an incorrect setting of either H3-09 (multi-function analog input terminal A2 function selection) = B or H6-01 (pulse train input function selection) = 1. Also check to make sure that the PID-related parameters are correct.

The target values and detection values do not agree.

PID control brings the difference (error) between the target value and detection value to zero. Because of this, it is necessary to unify the input levels for the target value and detection value. Set the gain so that the level of detection coincides.

Example: H3-10/H3-11 (gain (terminal A2)/bias (terminal A2)) or H6-03/H6-04 (pulse train input gain/pulse train input bias)

The Inverter output frequency and detection value relationship is reversed.

If the Inverter is set so that the detection value decreases when the output frequency increases, the PID control will diverge. Correct this by switching the forward/reverse status of b5-09 (PID output characteristics selection). For example, if 0 is being used, change it to 1.

■Autotuning has not been performed with vector control.

Vector control will not perform if autotuning has not been performed. Perform autotuning separately for the motor, or set the motor constants through calculations. Alternatively, change the Control Method Selection (A1-02) to V/f control.

◆ If the Motor Rotates Even When Inverter Output Is Stopped

If the motor rotates even when the Inverter output is stopped, the DC injection braking is insufficient. If the motor continues operating at low speed, without completely stopping, and after a deceleration stop has been

executed, it means that the DC injection braking is not decelerating enough. Adjust the DC injection braking as follows:

- Increase the parameter b2-02 (DC Injection Braking Current) setting.
- Increase the parameter b2-04 (DC Injection Braking (initial excitation) Time at Stop) setting.

◆ If 0 V Is Detected When the Fan Is Started, or the Fan Stalls

Generation of 0 V (main circuit voltage) and stalling can occur if the fan is turning when it is started. The DC injection braking is insufficient when starting.

This can be prevented by slowing fan rotation by DC injection braking before starting the fan. Increase the parameter b2-03 (DC injection braking time (initial excitation) at start) setting.

◆ If Output Frequency Does Not Rise to Frequency Reference

Use the following information if the output frequency does not rise to the frequency reference.

■ The frequency reference is within the jump frequency range.

When the jump frequency function is used, the output frequency does not change within the jump frequency range. Check to be sure that the Jump Frequency (parameters d3-01 to d3-03) and Jump Frequency Width (parameter d3-04) settings are suitable.

■ The frequency reference upper limit has been reached.

The output frequency upper limit is determined by the following formula:
Maximum Output Frequency (E1-04) × Frequency Reference Upper Limit (d2-01) / 100
Check to be sure that the parameter E1-04 and d2-01 settings are suitable.

◆ Oscillation occurs when using energy-saving control

The energy-saving control setting may be incorrect. If oscillation occurs during energy-saving operation, measure the oscillation frequency. If the oscillation cycle matches b8-05 (power detection filter time constant), the search operation will be adversely affected. Set b8-06 (search operation voltage limiter) to 0 to disable search operation, or increase the power detection filter time constant.

◆ An EF (Forward/Reverse Run Commands Input Together) was detected and the Inverter will not operate, or the motor operates for only an instant when the control equipment power supply is turned OFF.

When the EF is detected and the Inverter will not operate, use one of the following measures.

■ Incorrect Sequence

If the EF is detected when the forward reference and reverse reference are input simultaneously for 0.5 second or more, revise the sequence.

■Incorrect operation due to sneak current.

The Inverter input can become indefinitely ON due to an unwanted current path in the control section output. If, in the wiring diagram shown below, the output power supply for the control section is lower than 24 VDC or the power supply is OFF, current will flow as shown by the arrows and the Inverter input will operate. If this occurs, insert a diode at section A in the diagram.

7
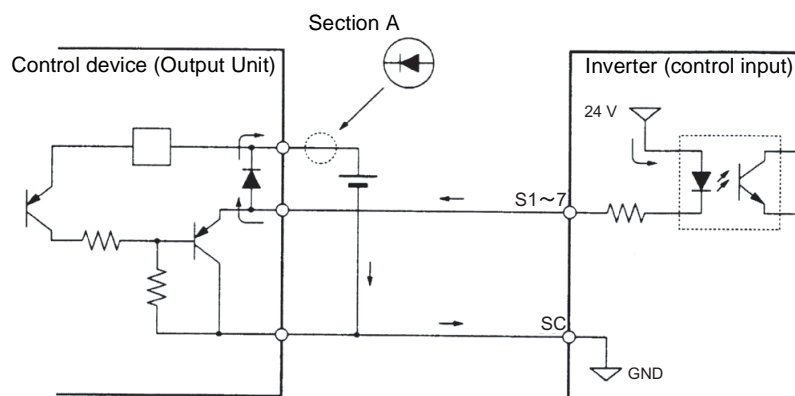
8

Chapter 8
Maintenance and Inspection

This chapter describes basic maintenance and inspection for the Inverter

Maintenance and Inspection

◆ Daily Inspection

Check the following items with the system in operation.

- The motor should not be vibrating or making unusual noises.
- There should be no abnormal heat generation.
- The ambient temperature should not be too high.
- The output current value shown on the monitor displays should not be higher than normal.
- The cooling fan on the bottom of the Inverter should be operating normally.

◆ Periodic Inspection

Check the following items during periodic maintenance.

Always turn OFF the power supply before beginning inspection. Confirm that the LED indicators on the front cover have all turned OFF, and then wait until at least five minutes has elapsed before beginning the inspection. Be sure not to touch terminals right after the power has been turned off. Doing so can result in electric shock.

Fig 8.1 Periodic Inspections

Item	Inspection	Corrective Procedure
External terminals, mounting bolts, connectors, etc.	Are all screws and bolts tight?	Tighten loose screws and bolts firmly.
	Are connectors tight?	Reconnect the loose connectors.
Cooling fins	Are the fins dirty or dusty?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2).
PCBs	Is there any conductive dirt or oil mist on the PCBs?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2). Replace the boards if they cannot be made clean.
Cooling fan	Is there any abnormal noise or vibration or has the total operating time exceeded 20,000 hours?	Replace the cooling fan.
Power elements	Is there any conductive dirt or oil mist on the elements?	Clean off any dirt and dust with an air gun using dry air at a pressure of 39.2×10^4 to 58.8×10^4 Pa (4 to 6 kg•cm^2).
Smoothing capacitor	Are there any irregularities, such as discoloration or odor?	Replace the capacitor or Inverter.

◆ Periodic Maintenance of Parts

The Inverter is configured of many parts, and these parts must be operating properly in order to make full use of the Inverter functions.

Among the electronic components, there are some that require maintenance depending on their usage conditions. In order to keep the Inverter operating normally over a long period of time, it is necessary to perform period inspections and replace parts according to their service life.

Periodic inspection standards vary depending on the Inverter's installation environment and usage conditions. The Inverter's maintenance periods are noted below. Keep them as reference.

Fig 8.2 Part Replacement Guidelines

Part	Standard Replacement Period	Replacement Method
Cooling fan	2 to 3 years	Replace with new part.
Smoothing capacitor	5 years	Replace with new part. (Determine need by inspection.)
Breaker relays	-	Determine need by inspection.
Fuses	10 years	Replace with new part.
Aluminum capacitors on PCBs	5 years	Replace with new board. (Determine need by inspection.)

Note The standard replacement period is based on the following usage conditions:
　　Ambient temperature:Yearly average of 30°C
　　Load factor: 80% max.
　　Operating rate: 12 hours max. per day

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◆ Cooling Fan Replacement Outline

■200-V and 400-V Class Inverters of 18.5 kW or Less

A cooling fan is attached to the bottom of the Inverter.

If the Inverter is installed using the mounting holes on the back of the Inverter, the cooling fan can be replaced without removing the Inverter from the installation panel.

Removing the Cooling Fan

1. Press in on the right and left sides of the fan cover in the direction of arrows 1 and then pull the fan out in the direction of arrow 2.
2. Pull out the cable connected to the fan from the fan cover and disconnect the relay connector.
3. Open the fan cover on the left and right sides and remove the fan cover from the fan.
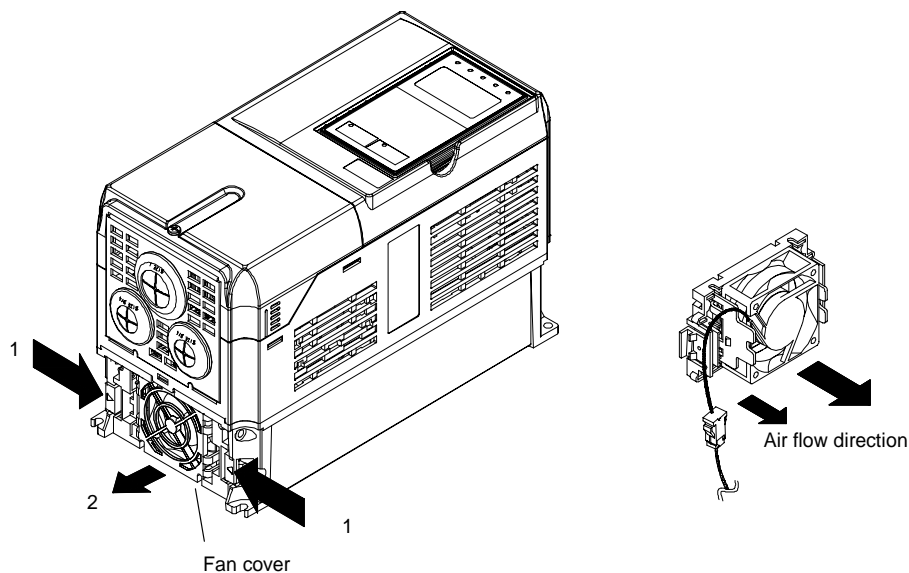
Fig 8.3   Cooling Fan Replacement (Inverters of 18.5 kW or Less)

Mounting the Cooling Fan

1. Attach the fan cover to the cooling fan. Be sure that the air flow direction indicated by the arrows above faces into the Inverter.
2. Connect the relay connector securely and place the relay connector and cable into the fan cover.
3. Mount the fan cover on the Inverter. Be sure that the tabs on the sides of the fan cover click into place on the Inverter.

■200-V and 400-V Class Inverters of 22 kW or More

A cooling fan is attached to the top panel inside the Inverter.

The cooling fan can be replaced without removing the Inverter from the installation panel.

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove the controller bracket to which the cards are mounted. Remove all cables connected to the controller.
3. Remove the cooling fan power cable connector (CN26 and CN27) from the gate driver positioned at the back of the controller.
4. Remove the fan cover screws and pull out the fan cover from the Inverter.
5. Remove the cooling fan from the fan cover.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components.
When attaching the cooling fan to the mounting bracket, be sure that the air flow faces the top of the Inverter.
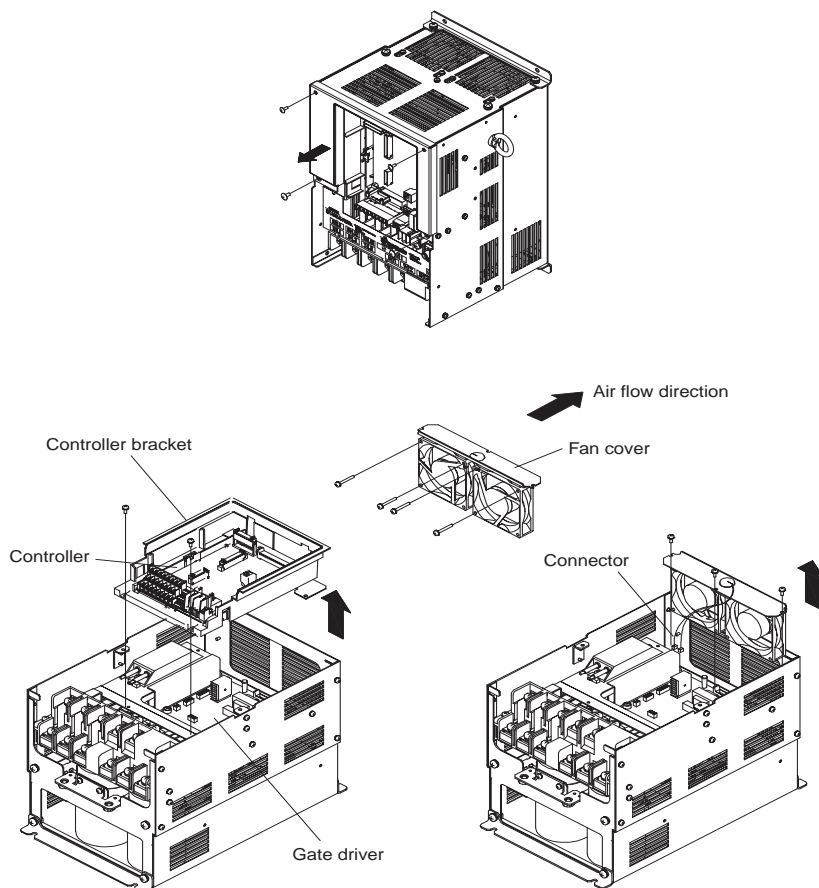
Fig 8.4 Cooling Fan Replacement (Inverters of 22 kW or More)

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◆ Removing and Mounting the Control Circuit Terminal Card

The control circuit terminal card can be removed and mounted without disconnecting the cables.

> **IMPORTANT**
>
> Always confirm that the charge indicator is not lit before removing or mounting the control circuit terminal card.

■Removing the Control Circuit Terminal Card

1. Remove the Digital Operator and front cover.

2. Remove the connecting line connectors connected to FE and NC on the control circuit terminal card.

3. Loosen the mounting screws (1) on the left and right sides of the control terminals until they are free. (It is not necessary to remove these screws completely. They are self-rising.)

4. Pull the terminal card out sideways (in direction 2) with the screws sticking out from the card.

■Mounting the Control Circuit Terminal Card

Reverse the removal procedure to mount the terminal card.

Confirm that the terminal circuit card and the controller properly meet at connector CN5 before pressing in on the card.

The connector pins may be bent if the card is forced into place, possibly preventing correct Inverter operation.
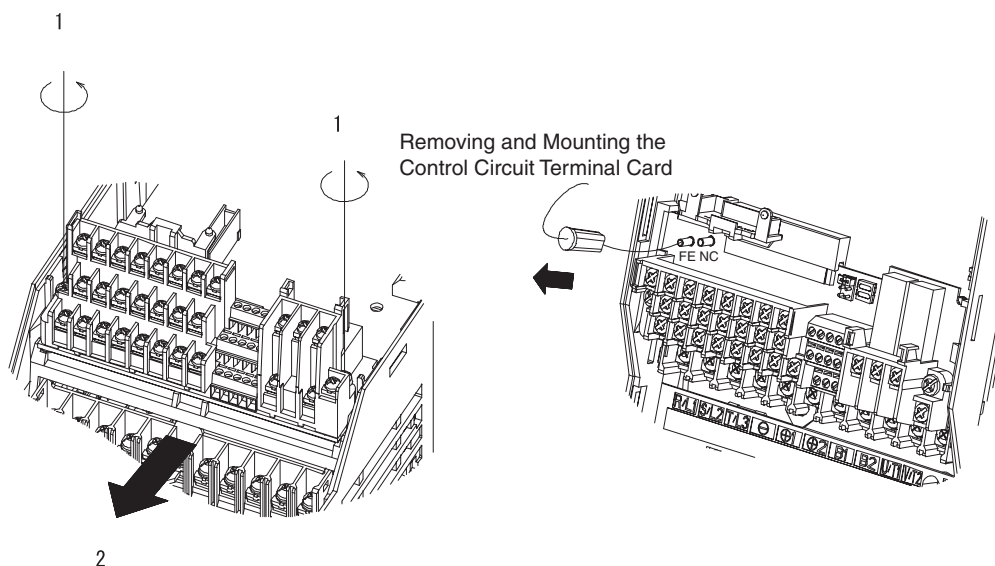
Fig 8.5   Removing the Control Circuit Terminal Card

9

Chapter 9
Specifications

This chapter describes the basic specifications of the Inverter and specifications for options and peripheral devices.

Standard Inverter Specifications

The standard Inverter specifications are listed by capacity in the following tables.

◆ Specifications by Model

Specifications are given by model in the following tables.

■ 200-V Class Inverters

Table 9.1 Specifications for 200-V Class Inverters

Model 3G3RV-	A2004	A2007	A2015	A2022	A2037	A2055	A2075	A2110	A2150	A2185	B2220	B2300	B2370	B2450	B2550	B2750	B2900	B211K
Max. applicable motor output (kW)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110
Output specifications — Rated output capacity (kVA)	1.2	1.6	2.7	3.7	5.7	8.8	12	17	22	27	32	44	55	69	82	110	130	160
Rated output current (A)	3.2	4.1	7	9.6	15	23	31	45	58	71	85	115	145	180	215	283	346	415
Max. output voltage (V)	3-phase, 200 to 240 VAC (Depends on input voltage.)																	
Max. output frequency (Hz)	CT (low carrier, fixed torque applications): 150 Hz VT (high carrier, variable torque applications): 400 Hz																	VT: 400 Hz
Power supply specifications — Rated voltage (V) Rated frequency (Hz)	3-phase, 200 to 240 VAC, 50/60 Hz										3-phase, 200 to 240 VAC, 50/60 Hz Cooling Fan: 200 to 220 VAC at 50 Hz, 200 to 230 VAC at 60 Hz							
Allowable voltage fluctuation	-15% to +10%																	
Allowable frequency fluctuation	±5%																	
Power supply capacity (kVA)	1.5	1.9	3.2	4.5	7.0	9.3	14	20	26	33	36	46	62	76	91	122	147	176
Power consumption (W)	59	69	100	129	186	248	332	544	612	712	860	1217	1416	1771	2206	997	3434	3975
Approx. weight (kg)	3.0	3.0	3.0	3.0	4.0	4.0	6.0	7.0	11	11	21	24	57	63	86	87	108	150
Measures for power supply harmonics	Optional DC reactor										Built-in DC reactor							
Protective structure	Enclose, wall-mounting (NEMA1: Equivalent to IP20) or Mounted in a panel (equivalent to IP00)*										Mounted in a panel (equivalent to IP00)							

Note The specifications for the 3G3RV-A2220 to 3G3RV-A2750 for Europe are the same as those for the 3G3RV-B2220 to 3G3RV-B2750.

* For applications of a NEMA1 mounting, remove the top and bottom covers and treat as IP00.

■400-V Class Inverters

Table 9.2 Specifications for 400-V Class Inverters

Model 3G3RV-		A4004	A4007	A4015	A4022	A4037	A4040	A4055	A4075	A4110	A4150	A4185
Max. applicable motor output (kW)		0.4	0.75	1.5	2.2	3.7	4	5.5	7.5	11	15	18.5
Output specifications	Rated output capacity (kVA)	1.4	1.6	2.8	4	5.8	6.6	9.5	13	18	24	30
	Rated output current (A)	1.8	2.1	3.7	5.3	7.6	8.7	12.5	17	24	31	39
	Max. output voltage (V)	3-phase, 380 to 480 VAC (Depends on input voltage.)										
	Max. output frequency (Hz)	CT (low carrier, fixed torque applications): 150 Hz VT (high carrier, variable torque applications): 400 Hz										
Power supply specifications	Rated voltage (V) Rated frequency (Hz)	3-phase, 380 to 480 VAC 50/60 Hz										
	Allowable voltage fluctuation	-15% to +10%										
	Allowable frequency fluctuation	±5%										
	Power supply capacity (kVA)	1.7	1.9	3.3	4.9	6.9	7.9	12	15	22	28	36
Power consumption (W)		53	58	84	115	148	148	209	307	410	498	634
Approx. weight (kg)		3.0	3.0	3.0	4.0	4.0	4.0	4.0	6.0	6.0	10	10
Measures for power supply harmonics		Optional DC reactor										
Protective structure		Enclose, wall-mounting (NEMA1: Equivalent to IP20) or Mounted in a panel (equivalent to IP00)[*]										

Model 3G3RV-		B4220	B4300	B4370	B4450	B4550	B4750	B4900	B411K	B413K	B416K
Max. applicable motor output (kW)		22	30	37	45	55	75	90	110	132	160
Output specifications	Rated output capacity (kVA)	34	46	57	69	85	110	140	160	200	230
	Rated output current (A)	45	60	75	91	112	150	180	216	260	304
	Max. output voltage (V)	3-phase, 380 to 480 VAC (Depends on input voltage.)									
	Max. output frequency (Hz)	CT (low carrier, fixed torque applications): 150 Hz VT (high carrier, variable torque applications): 400 Hz									
Power supply specifications	Rated voltage (V) Rated frequency (Hz)	3-phase, 380 to 480 VAC 50/60 Hz									
	Allowable voltage fluctuation	-15% to +10%									
	Allowable frequency fluctuation	±5%									
	Power supply capacity (kVA)	38	52	63	76	91	125	151	181	217	254
Power consumption (W)		725	995	1144	1316	1698	1974	2285	2950	3390	3938
Approx. weight (kg)		21	21	36	36	36	88	89	102	120	160
Measures for power supply harmonics		Built-in DC reactor				Built-in DC reactor					
Protective structure		Mounted in a panel (equivalent to IP00)				Mounted in a panel (equivalent to IP00)[*]					

* For applications of a NEMA1 mounting, remove the top and bottom covers and treat as IP00.

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◆ Common Specifications

The following specifications apply to both 200 V and 400 V Class Inverters.

Table 9.3 Common Specifications

Model Number 3G3RV-□		Specification
Control characteristics	Control method	Sine wave PWM Open loop vector control, V/f control, V/f with PG control (switched by parameter setting)
	Speed control range	1:100 (Open loop vector control)
	Speed control accuracy	±0.2% (25°C ± 10°C) (Open loop vector control)
	Speed control response	5 Hz (Open loop vector control)
	Torque characteristics	CT selected (low carrier, fixed torque applications): 150% /0.5 Hz VT selected (high carrier, variable torque applications): 120%/0.5 Hz (Open loop vector control)
	Torque limits	Can be set using parameter settings for open loop vector control only.
	Frequency control range	0.01 to 150 Hz (CT selected.), 0.01 to 400 Hz (VT selected.)
	Frequency accuracy (temperature characteristics)	Digital references: ± 0.01% (-10°C to +40°C)
		Analog references: ±0.1% (25°C ±10°C)
	Frequency setting resolution	Digital references: 0.01 Hz
		Analog references: 0.06 Hz/60 Hz (10 bit with no sign)
	Output frequency resolution	0.001 Hz
	Overload capacity and maximum current [*2]	CT selected: 150% of rated output current per minute[*1] VT selected: 120% of rated output current per minute
	Frequency setting signal	Voltage input of 0 to ±10 or 0 to 10 (20 kΩ) VDC or current input of 4 to 20 mA
	Acceleration/Deceleration time	0.01 to 6000.0 s (4 selectable combinations of independent acceleration and deceleration settings)
	Braking torque	Approximately 20% (Approximately 125% with Braking Resistor option
	Main control functions	Restarting for momentary power loss, speed searches, overtorque detection, torque limits, 16-speed control (maximum), acceleration/deceleration time changes, S-curve acceleration/deceleration, 3-wire sequence, autotuning (rotational or stationary), dwell functions, cooling fan ON/OFF control, slip compensation, torque compensation, jump frequencies, upper and lower limits for frequency references, DC braking for starting and stopping, high-slip braking, PID control (with sleep function), energy-saving control, RS-485/422A communications (Conforms to MODBUS,19.2 kbps maximum), fault reset, and function copying.
Protective functions	Motor protection	Protection by electronic thermal overload relay.
	Instantaneous overcurrent protection	Stops at approx. 200% of rated output current.
	Overload protection	CT selected (low carrier, fixed torque applications): 150% of rated output current per minute (except for 110 kW Inverters) VT selected (high carrier, variable torque applications): 120% of rated output current per minute
	Overvoltage protection	200 Class Inverter: Stops when main-circuit DC voltage is above 410 V. 400 Class Inverter: Stops when main-circuit DC voltage is above 820 V.
	Undervoltage protection	200 Class Inverter: Stops when main-circuit DC voltage is below 190 V. 400 Class Inverter: Stops when main-circuit DC voltage is below 380 V.
	Momentary power loss ridethru	Stops for 15 ms or more. By selecting the momentary power loss method, operation can be continued if power is restored within 2 s.
	Cooling fin overheating	Protection by thermistor.
	Grounding protection	Protection by electronic circuits. (Overcurrent level)
	Charge indicator	Lit when the main circuit DC voltage is approx. 50 V or more.
Environment	Application site	Indoor (no corrosive gas, dust, etc.)
	Ambient operating temperature	-10°C to 40°C (Closed wall-mounted type) 10°C to 45°C (Open chassis type)
	Ambient operating humidity	95% max. (with no condensation)
	Storage temperature	- 20°C to + 60°C (short-term temperature during transportation)
	Altitude	1000 m max.
	Insulation resistance	5 MW max. (Do not perform insulation resistance with withstand voltage tests.)
	Vibration	10 to 20 Hz, 9.8 m/s^2 max.; 20 to 50 Hz, 2 m/s^2 max, oscillation vibration of 20 Hz
	Protective structure	Enclose, wall-mounting (NEMA1: Equivalent to IP20) or Mounted in a panel (equivalent to IP00) Mounted in a panel (equivalent to IP00)

Note Rotational autotuning is required to obtain the specifications labeled as open loop vector control.

* 1. Not including the 200 V Class Inverter for 110 kW and the 400 V Class Inverters for 220 and 300 kW.

* 2. Increase the Inverter capacity if loads exceeding these current values are expected.

Specifications of Options and Peripheral Devices

The following options and peripheral devices can be used for the Inverter. Select them according to the application.

Table 9.4 Options and Peripheral Devices

Purpose	Name	Model (Code)	Description
Protect Inverter wiring	MCCB or Ground Fault Interrupter*	Example: Mitsubishi Electric's NV Series	Always connect a breaker to the power supply line to protect Inverter wiring. Use a ground fault interrupter suitable for high frequencies.
Prevents burning when a Braking Resistor is used.	Magnetic Contactor	Example: Fuji Electric's SC Series	Install to prevent the braking resistor from burning out when one is used. Always attach a surge absorber to the coil.
Contains switching surge	Surge Absorber	DCR2-□	Absorbs surge from the magnetic contactor and control relays. Connect surge absorbers to all magnetic contactors and relays near the Inverter.
Isolates I/O signals	Isolator	DGP□	Isolates the I/O signals of the Inverter and is effective against inductive noise.
Improve the input power factor of the Inverter	DC Reactor AC Reactor	3G3HV-PUZDAB□ 3G3IV-PUZBAB□	Used to improve the input power factor of the Inverter. All Inverters of 22 kW or higher contain built-in DC reactors. These are optional for Inverters of 18.5 kW or less. Install DC and AC reactors for applications with a large power supply capacity (600 kVA or higher).
Reduce the affects of radio and control device noise	Input Noise Filter	3G3IV-PFN□ 3G3EV-PLNF□	Reduces noise coming into the inverter from the power supply line and to reduce noise flowing from the inverter into the power supply line. Connect as close to the Inverter as possible.
	Output Noise Filter	3G3IV-PLF□	Reduces noise generated by the Inverter. Connect as close to the Inverter as possible.
Enable stopping the machine in a set time	Braking Resistor	3G3IV-PERF150WJ□01	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 3% ED).
	Braking Resistor Unit	3G3IV-PLKEB□	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 10% ED).
	Braking Unit	3G3IV-PCDBR□B	Used with a Braking Resistor Unit to reduce the deceleration time of the motor.
Operates the Inverter externally	Analog Operator (small plastic Operator)	3G3IV-PJVOP95□	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.). Frequency counter specifications: 60/120 Hz, 90/180Hz
	Analog Operator (Standard steel-plate Operator)	3G3IV-PJVOP96□	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.). Frequency counter specifications: 75 Hz, 150 Hz, 220 Hz
	Digital Operator Connection Cable	1 m cable: (3G3IV-PCN126) 3 m cable: (3G3IV-PCN326)	Extension cable to use a Digital Operator remotely. Cable length: 1 m or 3 m
Provides Inverter momentary power loss recovery time	Momentary Power Loss Recovery Unit	3G3IV-PCN□26	Handles momentary power losses for the control power supply for models 2.2 kW or less (maintains power for 2 s).
Set/monitor frequencies and voltages externally.	Scaling Meter	K3TJ-V11□	Measures the output voltage externally and designed for use with a PWM Inverter.
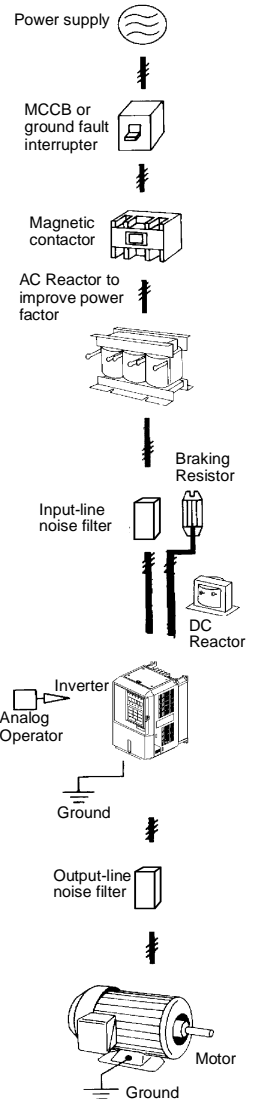
* Use a ground fault interrupter with a current sensitivity of 200 mA minimum and an operating time of 0.1 s minimum to prevent operating errors. The interrupter must be suitable for high-frequency operation.
Example: NV series by Mitsubishi Electric Corporation (manufactured in or after 1988)
EG, SG series by Fuji Electric Co., Ltd. (manufactured in or after 1984)

Power supply

MCCB or ground fault interrupter

Magnetic contactor

AC Reactor to improve power factor

Braking Resistor

Input-line noise filter

DC Reactor

Inverter

Analog Operator

Ground

Output-line noise filter

Motor

Ground

9

Options and Peripheral Devices

There are several types of options and peripheral devices for Inverters: Separately installed options, special options, Option Cards, and recommended separately installed options. The specifications of these options are provided in this sections.

Separately Installed Options

K3TJ-V11☐
Scaling Meter

3G3IV-PJVOP96☐
Analog Operator
(standard, steel panels)

3G3IV-PJVOP95☐
Analog Operator
(small, plastic)

Special Options

3G3IV-PCDBR☐B
Braking Unit

3G3IV-PLKEB☐
Braking Resistor Unit

3G3IV-PERF150WJ☐01
Braking Resistor

3G3HV-PUZDAB☐
DC Reactor

3G3FV-PCN☐25
Digital Operator
Connection Cable

Digital Operator
3G3IV-PJVOP161 (LED)
3G3IV-PJVOP160 (LCD)

Recommended Separately Installed Options

3G3EV-PLNFD☐
Simple Input Noise Filter

3G3IV-PUZBAB☐
AC Reactor

3G3IV-PFN☐
Input Noise Filter

R S T

Power supply
3-phase, 200 VAC (200-V Class)
3-phase, 400 VAC (400-V Class)

Recommended Separately Installed Options

U
V
W

3G3IV-PLF☐
Output Noise Filter

IM

3-phase inductive motor

Option Cards

3G3IV-PA008 Analog Monitor Card	3G3IV-PA012 Analog Monitor Card	3G3FV-PPGA2 PG Speed Control Card	3G3FV-PPGB2 PG Speed Control Card	3G3FV-PPGD2 PG Speed Control Card	3G3FV-PPGX2 PG Speed Control Card	3G3FV-PDRT1-SIN DeviceNet Communications Card

Fig. 3.1 Options and Peripheral Devices

Table 9.1 Options and Peripheral Devices

Type	Name	Model number	Application
Special Mounted Options	Fan Unit	3G3IV-PFAN□	Replacement fan for Inverters equipped with a cooling fan. Replace the Cooling Fan when the fan replacement time has come or a cooling fan fault (FAN) alarm has been displayed.
Separately Installed Options	Scaling Meter	K3TJ-V11□	Connects to a multi-function analog output from the Inverter. Used to display rotational speeds of motors, line speeds, etc., in physical units.
	Analog Operator (standard with steel panels)	3G3IV-PJVOP96□	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.). Frequency counter specifications: 75 Hz, 150 Hz, 220 Hz
	Analog Operator (small, plastic)	3G3IV-PJVOP95□	Allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.). Frequency counter specifications: 60/120 Hz, 90/180Hz
Special Options	Braking Unit	3G3IV-PCDBR□B	Used with a Braking Resistor Unit to reduce the deceleration time of the motor. Not required with Inverters of 7.5 kW or less for 200-V class Inverters or for Inverters of 15 kW or less for 400-V class Inverters.
	Braking Resistor Unit	3G3IV-PLKEB□	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 10% ED).
	Braking Resistor	3G3IV-PERF150WJ□01	Consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 3% ED). Not required with Inverters of 3.7 kW or less for 200-V class Inverters or for Inverters of 2.2 kW or less for 400-V class Inverters.
	DC Reactor	3G3HV-PUZDAB□	Used to control harmonics generated by the Inverter and to improve the input power factor of the Inverter. All Inverters of 18.5 kW or higher contain built-in DC reactors.
	Digital Operator with LCD Display	3G3IV-PJVOP160	Displays messages on an LCD.
	Digital Operator with LED Display	3G3IV-PJVOP161	Display messages on an LED display. Standard in Asia and Europe.
	Digital Operator Connection Cable	3G3IV-PCN126 (1 m) 3G3IV-PCN326 (3 m)	Extension cable to use a 3G3RV-series Digital Operator remotely. Cable length: 1 m or 3 m
Option Cards	Analog Monitor Cards*2	3G3IV-PAO08 3G3IV-PAO12	The resolution of the analog output from the Inverter is 11 bits. Use this Card if there are not enough analog outputs. The output resolution of the 3G3IV-PAO08 is (0 to 10 V output for frequency meters or output current meters) and the output resolution of the 3G3IV-PAO12 is 1/2048 (0 to 10 V for control applications).
	PG Speed Control Cards	3G3FV-PPGA2	Phase-A (single-phase) pulse input and open collector output for V/f control with a PG. Maximum response frequency: 30 kHz, with pulse monitor output.
		3G3FV-PPGB2	Phase-A/B pulse inputs and open collector output for flux vector control. Maximum response frequency: 30 kHz, with pulse monitor output.
		3G3FV-PPGD2	Phase-A (single-phase) pulse input and line driver output (RS-422) for V/f control with a PG. Maximum response frequency: 300 kHz, with pulse monitor output.
		3G3FV-PPGX2	Phase-A/B/Z pulse inputs and line driver output (RS-422) for flux vector control. Maximum response frequency: 300 kHz, with pulse monitor output
	DeviceNet Communications Card	3G3FV-PDRT1-SIN	Used for DeviceNet communications with a Programmable Controller or other DeviceNet master device.
Recommended Separately Installed Options*1	AC Reactor (Yaskawa)	3G3IV-PUZBAB□	Used to control harmonics generated by the Inverter or when the power supply capacity is greatly larger than the Inverter's capacity. Also used to increase the power factor.
	Simple Input Noise Filter (Yaskawa)	3G3EV-PLNFD□	Reduces noise coming into the inverter from the power supply line and to reduce noise flowing from the inverter into the power supply line. Connected to the power supply input side.
	Input Noise Filter (Schaffner)	3G3IV-PFN□	Reduces noise coming into the inverter from the power supply line and to reduce noise flowing from the inverter into the power supply line. Connected to the power supply input side.
	Input Noise Filter (Schaffner) for EMC Directive	3G3RV-PFS□	Required for the 3GRV Inverter to meet the EMC Directive.
	Output Noise Filter (Tokin)	3G3IV-PLF□	Controls noise generated by the Inverter so it does not enter the power supply. Connected to the motor output side.

* 1. Recommended Options can be ordered from OMRON using the above model numbers.

* 2. Not applicable to (-E) models.

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◆ Special Mounted Options

The special mounted options are described in this section.

■ Fan Unit

Replacement fan for Inverters equipped with a cooling fan.

Replace the Cooling Fan when the fan replacement time has come or a cooling fan fault (FAN) alarm has been displayed.

Models and Application

The standard models of Fan Units are listed in the following table.

Inverter			Replacement Cooling Fan	
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Model No.	Qty Used
3-phase, 200 VAC	0.4	3G3RV-A2004	No Fan	-
	0.75	3G3RV-A2007		
	1.5	3G3RV-A2015		
	2.2	3G3RV-A2022		
	3.7	3G3RV-A2037	3G3IV-PFAN001041	1
	5.5	3G3RV-A2055		
	7.5	3G3RV-A2075		2
	11	3G3RV-A2110		
	15	3G3RV-A2150	3G3IV-PFAN001042	2
	18.5	3G3RV-A2185		
	22	3G3RV-B2220	3G3IV-PFAN001039	2
	30	3G3RV-B2300		
	37	3G3RV-B2370	3G3IV-PFAN001049	2
	45	3G3RV-B2450		
	55	3G3RV-B2550	3G3IV-PFAN001052	2
	75	3G3RV-B2750		
	90	3G3RV-B2900	3G3IV-PFAN000111	2
	110	3G3RV-B211K		
3-phase, 400 VAC	0.4	3G3RV-A4004	No Fan	-
	0.75	3G3RV-A4007		
	1.5	3G3RV-A4015		
	2.2	3G3RV-A4022	3G3IV-PFAN001041	1
	3.7	3G3RV-A4037		
	5.5	3G3RV-A4055		
	7.5	3G3RV-A4075	3G3IV-PFAN001042	2
	11	3G3RV-A4110		
	15	3G3RV-A4150		
	18.5	3G3RV-A4185		
	22	3G3RV-B4220	3G3IV-PFAN001039	2
	30	3G3RV-B4300		
	37	3G3RV-B4370	3G3IV-PFAN001044	2
	45	3G3RV-B4450		
	55	3G3RV-B4550		
	75	3G3RV-B4750	3G3IV-PFAN001052	2
	90	3G3RV-B4900		
	110	3G3RV-B411K	3G3IV-PFAN000111	2
	132	3G3RV-B413K		
	160	3G3RV-B416K		

Refer to *Chapter 8 Maintenance and Inspection* for the Fan Unit replacement procedure.

◆ Separately Installed Options

The separately installed options include Scaling Meters and Analog Operators.

■ Scaling Meters

A Scaling Meter is attached to a multi-function analog output from the Inverter and is used to display rotational speeds of motors, line speeds, etc., in physical units.
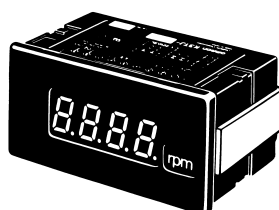
K3TJ–V11□

Models and Application

The standard models of Scaling Meters are listed in the following table.

Model No.	Control Power Supply	Display
K3TJ-V111R	100 to 200 VAC	Red LED
K3TJ-V111G		Green LED
K3TJ-V116R	24 VDC, isolated (See note.)	Red LED
K3TJ-V116G		Green LED

Note The power supply circuit is isolated from the input circuits.

Standard Specifications

The standard specifications of the Scaling Meters are listed below.

K3TJ-V11□	Specifications
Sampling Period	2 times/s
Display Refresh Cycle	2 times/s
Measurement Averaging Methods	Simple average or moving average
Number of Samples for Averaging	1, 2, 4, or 8 samples
Max. No. of Display Digits	4 digits (-1999 to 9999)
Display	7-segment LEDs, character height: 14.2 mm
Decimal Point Display	User-set using function selection switch and up/down keys.
Scaling Method	Shifting and scaling are user-set using function selection switch and up/down keys.
Scaling Range	-1999 to 9999
Zero Limit Range	0 to 99 digits
Overrange Values	Flashing display
Zero Suppression	Supported
External Controls	Present value hold (by short-circuiting terminal on front panel)
Protective Structure (conforming to IEC standards)	Front panel display: IP51[*] Case: IP20 Terminal section: IP00
Memory Protection	Non-volatile memory

＊ IP51 requires that the optional K32-L49SC Drop-proof Cover be used. The protective structure is IP50 without it.

9

Wiring Example

A wiring example for a Scaling Meter is shown below.
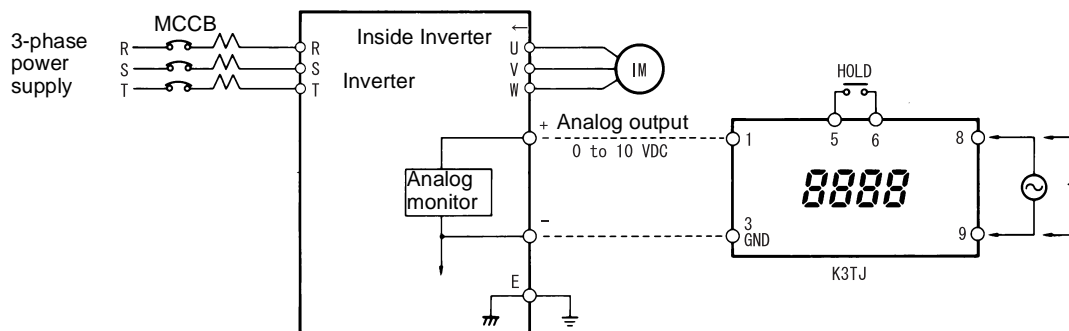
Dimensions

The dimensions of a Scaling Meter are given below.

Recommended Panel Cutout Dimensions

Display LED Size

Weight: 200 g
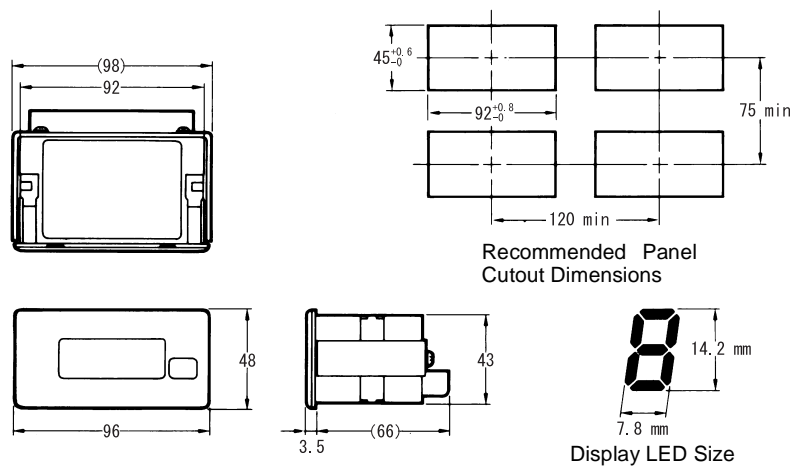
■ Analog Operators: Standard with Steel Panels or Small in Plastic

An Analog Operator allows frequency reference settings and ON/OFF operation control to be performed by analog references from a remote location (50 m max.)

3G3IV-PJV0P96□
Analog Operator
(standard steel panels)
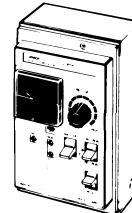
3G3IV-PJV0P95□
Analog Operator
(small, plastic)

Models and Application

The standard models of Analog Operators are listed in the following table.

Model No.	Frequency Meter Specifications
3G3IV-PJVOP961	DCF-6A, 3 V, 1 mA, 75 Hz
3G3IV-PJVOP962	DCF-6A, 3 V, 1 mA, 150 Hz
3G3IV-PJVOP963	DCF-6A, 3 V, 1 mA, 220 Hz
3G3IV-PJVOP951	TRM-45, 3 V, 1 mA, 60/120 Hz
3G3IV-PJVOP952	TRM-45, 3 V, 1 mA, 60/120 Hz

Dimensions

The dimensions of an Analog Operator are given below.
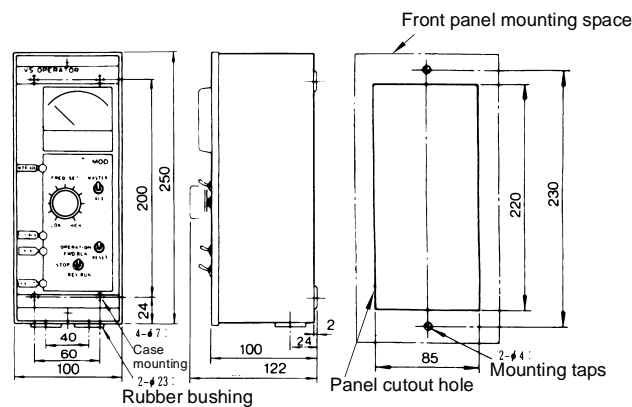
Weight: 1.8 kg   Panel Cutout

Standard Analog Operator with Steel Panels
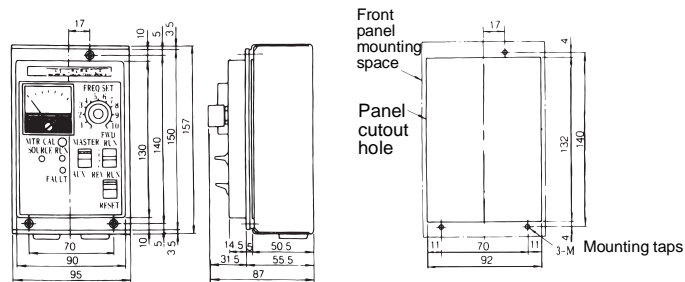
Weight: 0.8 kg   Panel Cutout

Small Plastic Analog Operator

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■ Braking Unit

A Braking Unit is used with a Braking Resistor Unit to reduce the deceleration time of the motor. It is not required with Inverters of 18.5 kW or less.
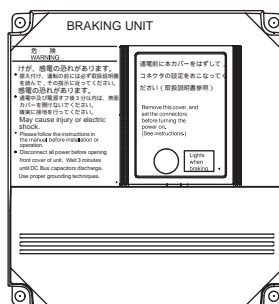
3G3IV-PCDBR□B

Models and Application

The standard models of Braking Units are listed in the following table.

Inverter		Braking Unit		Min. Resistance[*] (Ω)
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Qty Used.	
200-V Class	0.4	Built-in		48
	0.75			48
	1.5			48
	2.2			16
	3.7			16
	5.5			16
	7.5			9.6
	11			9.6
	15			9.6
	18.5			9.6
	22	3G3IV-CDBR2022B	1	6.4
	30	3G3IV-CDBR2015B	2	9.6
	37	3G3IV-CDBR2015B	2	9.6
	45	3G3IV-CDBR2022B	2	6.4
	55	3G3IV-CDBR2022B	2	6.4
	75	3G3IV-CDBR2022B	3	6.4
	90	3G3IV-CDBR2022B	4	6.4
	110	3G3IV-CDBR2022B	5	6.4
400-V Class	0.4	Built-in		96
	0.75			96
	1.5			64
	2.2			64
	3.7			32
	5.5			32
	7.5			32
	11			20
	15			20
	18.5			19.2
	22	3G3IV-CDBR4030B	1	19.2
	30	3G3IV-CDBR4030B	1	19.2
	37	3G3IV-CDBR4045B	1	12.8
	45	3G3IV-CDBR4045B	1	12.8
	55	3G3IV-CDBR4030B	2	19.2
	75	3G3IV-CDBR4045B	2	12.8
	90	3G3IV-CDBR4045B	2	12.8
	110	3G3IV-CDBR4030B	3	19.2
	132	3G3IV-CDBR4045B	3	12.8
	160	3G3IV-CDBR4045B	4	12.8

＊ The minimum resistance is the minimum value per Braking Unit except for Inverters of 18.5 kW or less, in which case it the minimum value per Inverter.

Dimensions

The dimensions of a Braking Unit are given below.

Up

Mounting direction ⇧

Four, M4 mounting holes

138
150

38 38
128
140

30 min.

30 min

Three, wire pullout holes
(with 22-mm-dia. rubber bushings)

72   66.5

100 min.

114.5
138.5

100 min.

9
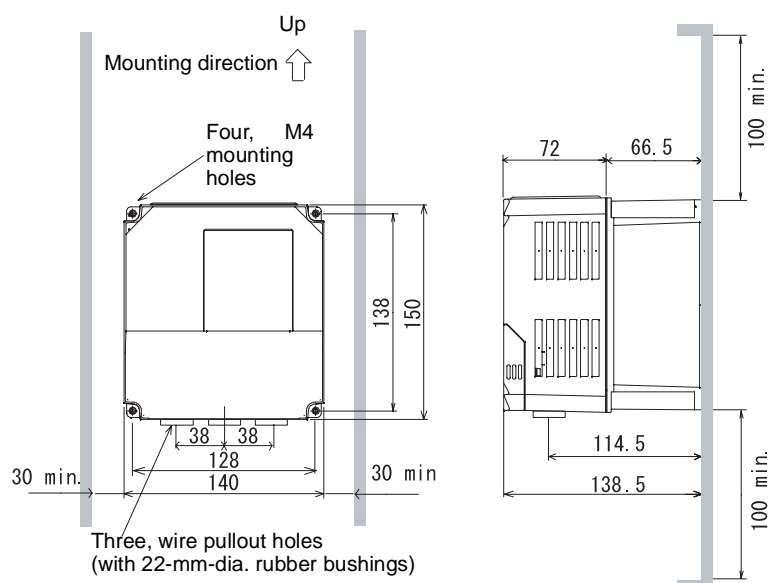
■ Braking Resistor Unit

A Braking Resistor Unit is used to absorb the regenerative motor energy with a resistor to reduce deceleration time (use rate: 10% ED). A 10% ED means that the 10% of the operating cycle time can be used to control braking (deceleration time).
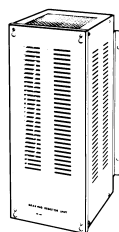
3G3IV-PLKEB□

Models and Application

The standard models of Braking Resistor Units are listed below.

Inverter		Braking Resistor Unit			
Voltage Class	Applicable Motor Capacity (kW)	Model No.	Resistor Specifications (per Unit)	Qty Used	Approx Braking Torque (%)
200-V Class	0.4	3G3IV-PLKEB20P7	70 W, 200 Ω	1	220
	0.75	3G3IV-PLKEB20P7	70 W, 200 Ω	1	125
	1.5	3G3IV-PLKEB21P5	260 W, 100 Ω	1	125
	2.2	3G3IV-PLKEB22P2	260 W, 100 Ω	1	120
	3.7	3G3IV-PLKEB23P7	390 W, 40 Ω	1	125
	5.5	3G3IV-PLKEB25P5	520 W, 30 Ω	1	115
	7.5	3G3IV-PLKEB27P5	780 W, 20 Ω	1	125
	11	3G3IV-PLKEB2011	2400 W, 13.6 Ω	1	125
	15	3G3IV-PLKEB2015	3000 W, 10 Ω	1	125
	18.5	3G3IV-PLKEB2015	3000 W, 10 Ω	1	125
	22	3G3IV-PLKEB2022	4800 W, 6.8 Ω	1	125
	30	3G3IV-PLKEB2015	3000 W, 10 Ω	2	125
	37	3G3IV-PLKEB2015	3000 W, 10 Ω	2	100
	45	3G3IV-PLKEB2022	4800 W, 6.8 Ω	2	120
	55	3G3IV-PLKEB2022	4800 W, 6.8 Ω	2	100
	75	3G3IV-PLKEB2022	4800 W, 6.8 Ω	3	110
	90	3G3IV-PLKEB2022	4800 W, 6.8 Ω	4	120
	110	3G3IV-PLKEB2018	4800 W, 8 Ω	5	100
400-V Class	0.4	3G3IV-PLKEB40P7	70 W, 750 Ω	1	230
	0.75	3G3IV-PLKEB40P7	70 W, 750 Ω	1	130
	1.5	3G3IV-PLKEB41P5	260 W, 400 Ω	1	125
	2.2	3G3IV-PLKEB42P2	260 W, 250 Ω	1	135
	3.7	3G3IV-PLKEB43P7	390 W, 150 Ω	1	135
	5.5	3G3IV-PLKEB45P5	520 W, 100 Ω	1	135
	7.5	3G3IV-PLKEB47P5	780 W, 75 Ω	1	130
	11	3G3IV-PLKEB4011	1040 W, 50 Ω	1	135
	15	3G3IV-PLKEB4015	1560 W, 40 Ω	1	125
	18.5	3G3IV-PLKEB4018	4800 W, 32 Ω	1	125
	22	3G3IV-PLKEB4022	4800 W, 27.2 Ω	1	125
	30	3G3IV-PLKEB4030	6000 W, 20 Ω	1	125
	37	3G3IV-PLKEB4037	9600 W, 16 Ω	1	125
	45	3G3IV-PLKEB4045	9600 W, 13.6 Ω	1	125
	55	3G3IV-PLKEB4030	6000 W, 20 Ω	2	135
	75	3G3IV-PLKEB4045	9600 W, 13.6 Ω	2	145
	90	3G3IV-PLKEB4045	9600 W, 13.6 Ω	2	100
	110	3G3IV-PLKEB4030	6000 W, 20 Ω	3	100
	132	3G3IV-PLKEB4045	9600 W, 13.6 Ω	4	140
	160	3G3IV-PLKEB4045	9600 W, 13.6 Ω	4	140

Dimensions

The dimensions of a Braking Resistor Unit are given below.

Voltage Class	Model No. 3G3IV-PLKEB□	Dimensions Diagram	Dimensions (mm)					Weight (kg)
			A	B	C	D	Mounting Screws	
200-V Class	20P7	1	105	275	50	260	M5 × 3	3.0
	21P5	1	130	350	75	335	M5 × 4	4.5
	22P2	1	130	350	75	335	M5 × 4	4.5
	23P7	1	130	350	75	335	M5 × 4	5.0
	25P5	1	250	350	200	335	M6 × 4	7.5
	27P5	1	250	350	200	335	M6 × 4	8.5
	2011	2	266	543	246	340	M8 × 4	10
	2015	2	356	543	336	340	M8 × 4	15
	2018	2	446	543	426	340	M8 × 4	19
	2022	2	446	543	426	340	M8 × 4	19
400-V Class	40P7	1	105	275	50	260	M5 × 3	3.0
	41P5	1	130	350	75	335	M5 × 4	4.5
	42P2	1	130	350	75	335	M5 × 4	4.5
	43P7	1	130	350	75	335	M5 × 4	5.0
	45P5	1	250	350	200	335	M6 × 4	7.5
	47P5	1	250	350	200	335	M6 × 4	8.5
	4011	2	266	543	246	340	M8 × 4	10
	4015	2	356	543	336	340	M8 × 4	15
	4018	2	446	543	426	340	M8 × 4	19
	4022	2	446	543	426	340	M8 × 4	19
	4030	2	356	956	336	740	M8 × 4	25
	4037	2	446	956	426	740	M8 × 4	33
	4045	2	446	956	426	740	M8 × 4	33

Dimensions Diagram 1

Dimensions Diagram 2

9
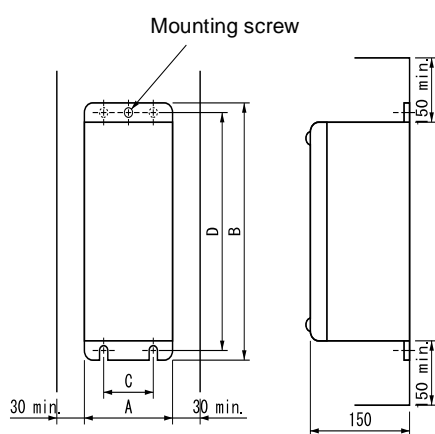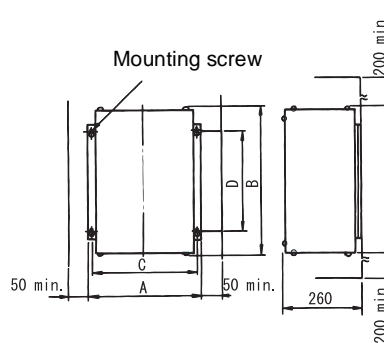
■ Braking Resistors

A Braking Resistor consumes the regenerative motor energy with a resistor to reduce deceleration time (use rate: 3% ED). A 3% ED means that the 3% of the operating cycle time can be used to control braking (deceleration time).

3G3IV-PERF□ (Yaskawa)

Models and Application

The standard models of Braking Resistors are listed below.

Inverter		Braking Resistor			Abbreviated Braking Torque (3%ED) (%)
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Resistor Specifications	Qty Used	
200-V Class	0.4	3G3IV-PERF150WJ201	150 W, 200 Ω	1	220
	0.75			1	125
	1.5	3G3IV-PERF150WJ101	150 W, 100 Ω	1	125
	2.2	3G3IV-PERF150WJ700	150 W, 70 Ω	1	120
	3.7	3G3IV-PERF150WJ620	150 W, 62 Ω	1	100
400-V Class	0.4	3G3IV-PERF150WJ751	150 W, 750 Ω	1	230
	0.75			1	130
	1.5	3G3IV-PERF150WJ401	150 W, 400 Ω	1	125
	2.2	3G3IV-PERF150WJ301	150 W, 300 Ω	1	115
	3.7	3G3IV-PERF150WJ201	150 W, 400 Ω	1	110*

∗ Application rate: 2%ED

Dimensions

The dimensions of a Braking Resistor are given below.
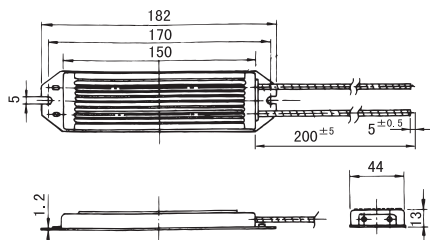
■ **Digital Operator Connection Cable**

Connected the Inverter to a Digital Operator in a remote locations. Both 1-m and 2-m Cables are available.
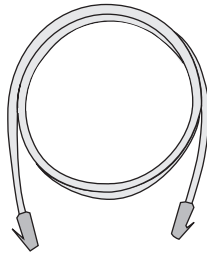
3G3IV-PCN□26

Models and Application

Model No.	Specifications
3G3IV-PCN126	Cable length: 1 m
3G3IV-PCN326	Cable length: 3 m

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■ DC Reactor

A DC Reactor is used to control harmonics generated by the Inverter. It is more effective than and can be used in combination with an AC Reactor. It is also used to increase the power factor.
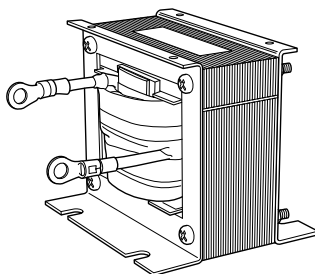
3G3HV-PUZDAB□ (Yaskawa)

Models and Application

The standard models of DC Reactors are listed below.

Inverter		DC Reactor				
Voltage Class	Max. Appli-cable Motor Capacity (kW)	Model No.	Rated Voltage (V)	Rated Current (A)	Inductance (mH)	Loss (W)
200-V Class	0.4/0.75	3G3HV-PUZDAB5.4A8MH	DC800	5.4	8	8
	1.5 to 3.7	3G3HV-PUZDAB18A3MH		18	3	18
	5.5/7.5	3G3HV-PUZDAB36A1MH		36	1	22
	11/15	3G3HV-PUZDAB72A0.5MH		72	0.5	29
	18.5	3G3HV-PUZDAB90A0.4MH		90	0.4	45
400-V Class	0.4/0.75	3G3HV-PUZDAB3.2A28MH	DC800	3.2	28	9
	1.5 to 2.2	3G3HV-PUZDAB5.7A11MH		5.7	11	11
	3.7	3G3HV-PUZDAB12A6.3MH		12	6.3	16
	5.5/7.5	3G3HV-PUZDAB23A3.6MH		23	3.6	27
	11/15	3G3HV-PUZDAB33A1.9MH		33	1.9	26
	18.5	3G3HV-PUZDAB47A1.3MH		47	1.3	42

Dimensions

The dimensions of a DC Reactor are given below.

Model 3G3HV-PUZDAB□	Dimensions Diagram	Dimensions (mm)									Weight (kg)
		H	W	W1	D	D1	D2	t	d1	d2	
5.4A8MH	1	53	85	74	60	32	-	0.8	M4	-	0.8
18A3MH	2	76	86	60	72	55	80	1.2	M4	M5	2.0
36A1MH	2	93	105	64	92	80	90	1.6	M6	M6	3.2
72A0.5MH	2	93	105	64	112	100	105	1.6	M6	M8	4.9
90A0.4MH	2	117	133	86	105	80	120	1.6	M6	M8	6.5
3.2A28MH	1	53	85	74	60	32	-	0.8	M4	-	0.8
5.7A11MH	1	60	90	80	60	32	-	0.8	M4	-	1.0
12A6.3MH	2	76	86	60	72	55	80	1.2	M4	M5	2.0
23A3.6MH	2	93	105	64	92	80	90	1.6	M6	M5	3.2
33A1.9MH	2	93	105	64	102	90	95	1.6	M6	M6	4.0
47A1.3MH	2	100	115	72	115	90	125	1.6	M6	M6	6.0
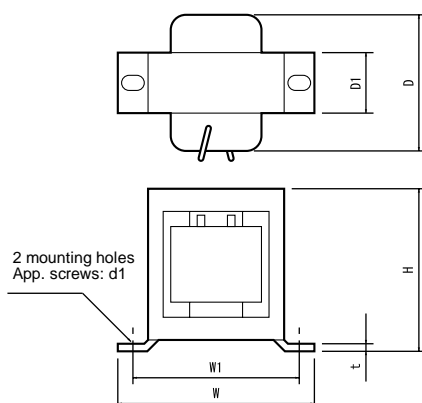
Dimensions Diagram 1
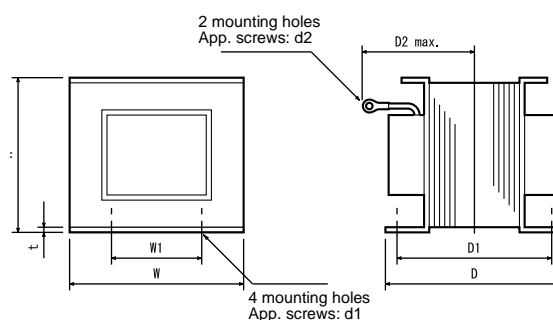
Dimensions Diagram 2

◼ AC Reactor

An AC Reactor is used to control harmonics generated by the Inverter or when the power supply capacity is greatly larger than the Inverter's capacity. It is also used to increase the power factor. Select the AC Reactor from the following table according to the motor capacity.
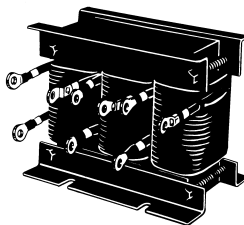
3G3IV-PUZBAB□ (Yaskawa)

Models and Application

The standard models of AC Reactors are listed in the following table.

Inverter		AC Reactor			
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Current (A)	Inductance (mH)	Loss (W)
200-V Class	0.4	3G3IV-PUZBAB2.5A4.2MH	2.5	4.2	15
	0.75	3G3IV-PUZBAB5A2.1MH	5	2.1	15
	1.5	3G3IV-PUZBAB10A1.1MH	10	1.1	25
	2.2	3G3IV-PUZBAB15A0.7MH	15	0.71	30
	3.7	3G3IV-PUZBAB20A0.53MH	20	0.53	35
	5.5	3G3IV-PUZBAB30A0.35MH	30	0.35	45
	7.5	3G3IV-PUZBAB40A0.265MH	40	0.265	50
	11	3G3IV-PUZBAB60A0.18MH	60	0.18	65
	15	3G3IV-PUZBAB80A0.13MH	80	0.13	75
	18.5	3G3IV-PUZBAB90A0.12MH	90	0.12	90
	22	3G3IV-PUZBAB120A0.09MH	120	0.09	90
	30	3G3IV-PUZBAB160A0.07MH	160	0.07	100
	37	3G3IV-PUZBAB200A0.05MH	200	0.05	110
	45	3G3IV-PUZBAB240A0.044MH	240	0.044	125
	55	3G3IV-PUZBAB280A0.038MH	280	0.038	130
400-V Class	0.4	3G3IV-PUZBAB1.3A18.0MH	1.3	18.0	15
	0.75	3G3IV-PUZBAB2.5A8.4MH	2.5	8.4	15
	1.5	3G3IV-PUZBAB5A4.2MH	5	4.2	25
	2.2	3G3IV-PUZBAB7.5A3.6MH	7.5	3.6	35
	3.7	3G3IV-PUZBAB10A2.2MH	10	2.2	43
	5.5	3G3IV-PUZBAB15A1.42MH	15	1.42	50
	7.5	3G3IV-PUZBAB20A1.06MH	20	1.06	50
	11	3G3IV-PUZBAB30A0.7MH	30	0.7	65
	15	3G3IV-PUZBAB40A0.53MH	40	0.53	90
	18.5	3G3IV-PUZBAB50A0.42MH	50	0.42	90
	22	3G3IV-PUZBAB60A0.36MH	60	0.36	90
	30	3G3IV-PUZBAB80A0.26MH	80	0.26	95
	37	3G3IV-PUZBAB90A0.24MH	90	0.24	110
	45	3G3IV-PUZBAB120A0.18MH	120	0.18	130
	55	3G3IV-PUZBAB150A0.15MH	150	0.15	150

Wiring Example

A wiring example for an AC Reactor is shown below.
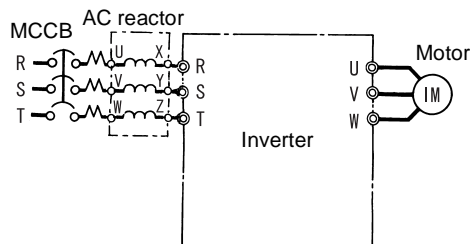
Dimensions

The dimensions of a DC Reactor are given below.

Model 3G3IV -PUZBAB□	Dimen-sions Diagram	Dimensions (mm)												Weight (kg)
		A	B	B1	C	D	E	F	H	J	K	L	M	
2.5A4.2MH	1	120	71	-	120	40	50	105	20	M6	10.5	7	M4	2.5
5A2.1MH		120	71	-	120	40	50	105	20	M6	10.5	7	M4	2.5
10A1.1MH		130	88	-	130	50	65	130	22	M6	11.5	7	M4	3
15A0.71MH		130	88	-	130	50	65	130	22	M6	11.5	7	M4	3
20A0.53MH	2	130	88	114	105	50	65	130	22	M6	11.5	7	M5	3
30A0.35MH		130	88	119	105	50	70	130	22	M6	9	7	M5	3
40A0.265MH		130	98	139	105	50	75	130	22	M6	11.5	7	M6	4
60A0.18MH		160	105	147.5	130	75	85	160	25	M6	10	7	M6	6
80A0.13MH		180	100	155	150	75	80	180	25	M6	10	7	M8	8
90A0.12MH		180	100	150	150	75	80	180	25	M6	10	7	M8	8
120A0.09MH		180	100	155	150	75	80	180	25	M6	10	7	M10	8
160A0.07MH		210	100	170	175	75	80	205	25	M6	10	7	M10	12
200A0.05MH		210	115	182.8	175	75	95	205	25	M6	10	7	M10	15
240A0.044MH		240	126	218	215±5	150	110	240	25	M6	8	7	M10	23
280A0.038MH		240	126	218	215±5	150	110	240	25	M8	8	10	M12	23
1.3A18.0MH	1	120	71	-	120	40	50	105	20	M6	10.5	7	M4	2.5
2.5A8.4MH		120	71	-	120	40	50	105	20	M6	10.5	7	M4	2.5
5A4.2MH		130	88	-	130	50	70	130	22	M6	9	7	M4	3
7.5A3.6MH		130	88	-	130	50	70	130	22	M6	9	7	M4	3
10A2.2MH		130	88	-	130	50	65	130	22	M6	11.5	7	M4	3
15A1.42MH		130	98	-	130	50	75	130	22	M6	11.5	7	M4	4
20A1.06MH	2	160	90	115	130	75	70	160	25	M6	10	7	M5	5
30A0.7MH		160	105	132.5	130	75	85	160	25	M6	10	7	M5	6
40A0.53MH		180	100	140	150	75	80	180	25	M6	10	7	M6	8
50A0.42MH		180	100	145	150	75	80	180	25	M6	10	7	M6	8
60A0.36MH		180	100	150	150	75	75	180	25	M6	10	7	M6	8.5
80A0.26MH		210	100	150	175	75	80	205	25	M6	10	7	M8	12
90A0.24MH		210	115	177.5	175	75	95	205	25	M6	10	7	M8	15
120A0.18MH		240	126	193	205±5	150	110	240	25	M8	8	10	M10	23
150A0.15MH		240	126	193	205±5	150	110	240	25	M8	8	10	M10	23

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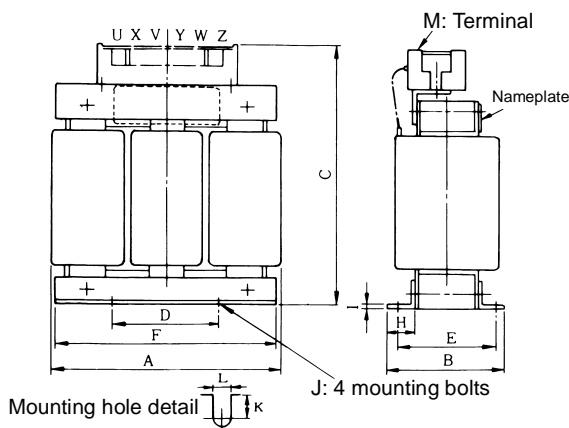
Dimensions Diagram 1
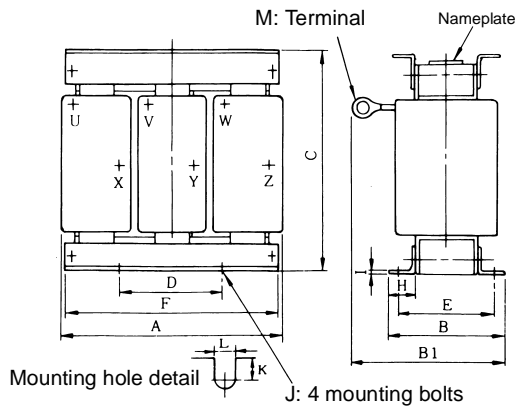
Dimensions Diagram 2

■ Input Noise Filters for EMC Directives (3G3RV-PFS□, by Schaffner)

When conformance to the EMC Directives in the EC Directives is required, always use one of these Filters. The Filter is connected between the Inverter's power supply input terminals (R/L1, S/L2, T/L3) and the power supply.

There are holes for mounting the Noise Filters to Inverters on the top of the Noise Filters. Use these holes to secure the Noise Filters to the Inverters.

Models and Application

The standard models of Input Noise Filters for EMC Directives are listed in the following table.

Inverter		Input Noise Filter for EMC Directives			
Voltage Class	Max. Applicable Motor Capacity (kW)	Rated Current (A)	Model No.	Weight (kg)	Dimensions Diagram
3-phase, 200 VAC	0.4	10	3G3RV-PFS5972-10-07	1.1	1
	0.75				
	1.5				
	2.2	18	3G3RV-PFS5972-18-07	1.3	
	3.7	35	3G3RV-PFS5973-35-07	1.4	
	5.5				
	7.5	60	3G3RV-PFS5973-60-07	3	2
	11				
	15	100	3G3RV-PFS5973-100-07	4.9	3
	18.5				
	22	130	3G3RV-PFS5973-130-35	4.3	5
	30				
	37	160	3G3RV-PFS5973-160-40	6	6
	45	240	3G3RV-PFS5973-240-37	11	7
	55				
3-phase, 400 VAC	0.4	10	3G3RV-PFS5972-10-07	1.1	1
	0.75				
	1.5				
	2.2				
	3.7	18	3G3RV-PFS5972-18-07	1.3	
	4.0				
	5.5				
	7.5	35	3G3RV-PFS5972-35-07	2.1	2
	11				
	15	60	3G3RV-PFS5972-60-07	4	3
	18.5				
	22	70	3G3RV-PFS5972-70-52	3.4	4
	30				
	37	130	3G3RV-PFS5972-130-35	4.7	5
	45				
	55				

Wiring Example

A wiring example for an Input Noise Filter for EMC Directives is shown below.
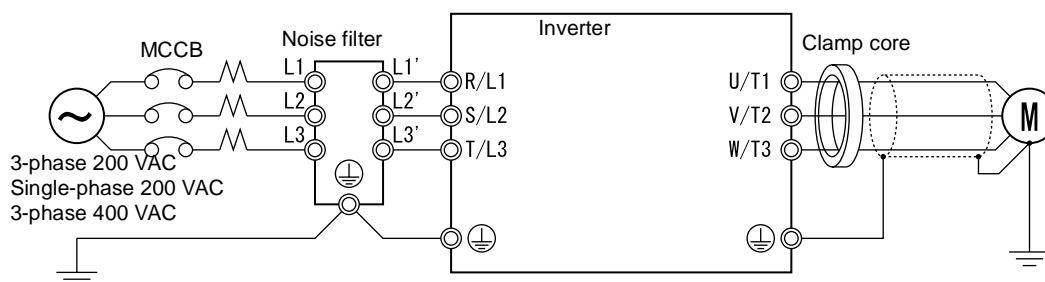
Dimensions

The dimensions of an Input Noise Filter for EMC Directives are given below.
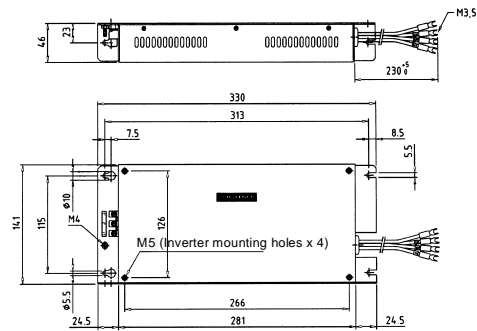
Dimensions Diagram 1
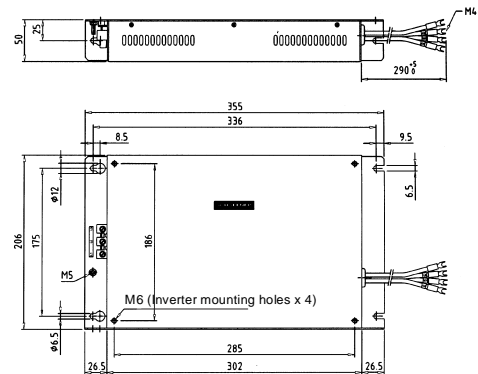
Dimensions Diagram 2
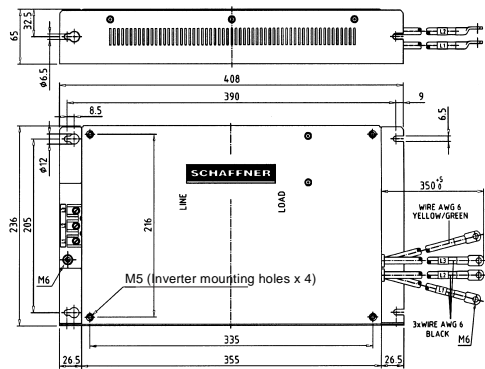
Dimensions Diagram 3
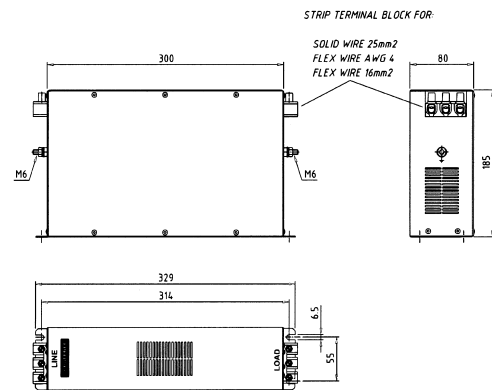
Dimensions Diagram 4
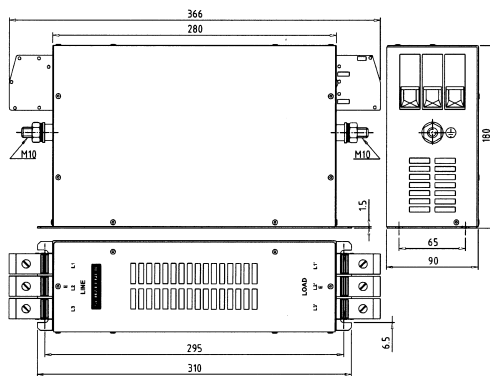
Dimensions Diagram 5
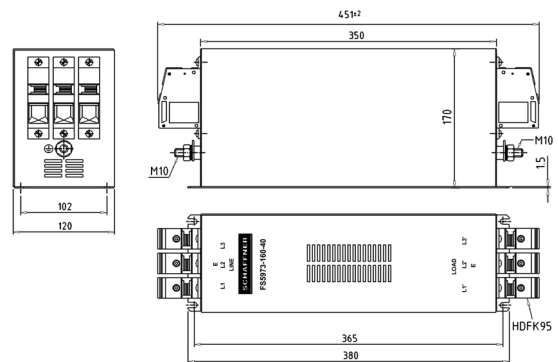
Dimensions Diagram 6
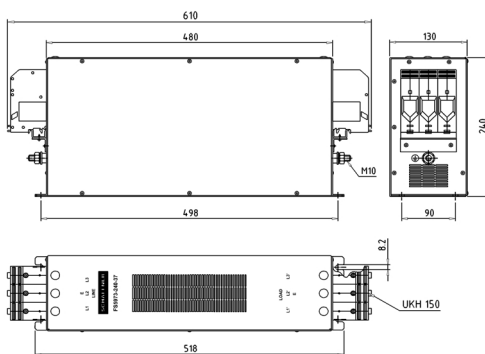
Dimensions Diagram 7

■ Simple Input Noise Filter

A Simple Input Noise Filter reduces noise coming into the inverter from the power supply line and to reduce noise flowing from the inverter into the power supply line. Connected the Filter to the power supply input side.
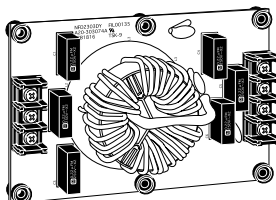

3G3EV-PLNFD□(Yaskawa)

Models and Application

The standard models of Simple Input Noise Filters listed in the following table.

Inverter		Simple Input Noise Filter		
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Qty	Rated Current (A)
200-V Class	0.4	3G3EV-PLNFD2103DY	1	10
	0.75	3G3EV-PLNFD2103DY	1	10
	1.5	3G3EV-PLNFD2103DY	1	10
	2.2	3G3EV-PLNFD2153DY	1	15
	3.7	3G3EV-PLNFD2303DY	1	30
	5.5	3G3EV-PLNFD2203DY	2	40
	7.5	3G3EV-PLNFD2303DY	2	60
	11	3G3EV-PLNFD2303DY	3	90
	15	3G3EV-PLNFD2303DY	3	90
	18.5	3G3EV-PLNFD2303DY	4	120
	22	3G3EV-PLNFD2303DY	4	120
400-V Class	0.4	3G3EV-PLNFD4053DY	1	5
	0.75	3G3EV-PLNFD4053DY	1	5
	1.5	3G3EV-PLNFD4103DY	1	10
	2.2	3G3EV-PLNFD4103DY	1	10
	3.7	3G3EV-PLNFD4153DY	1	15
	5.5	3G3EV-PLNFD4203DY	1	20
	7.5	3G3EV-PLNFD4303DY	1	30
	11	3G3EV-PLNFD4203DY	2	40
	15	3G3EV-PLNFD4303DY	2	60
	18.5	3G3EV-PLNFD4303DY	2	60
	22	3G3EV-PLNFD4303DY	3	90
	30	3G3EV-PLNFD4303DY	3	90
	37	3G3EV-PLNFD4303DY	4	120
	45	3G3EV-PLNFD4303DY	4	120

Wiring Example

A wiring example for a Simple Input Noise Filter is shown below.
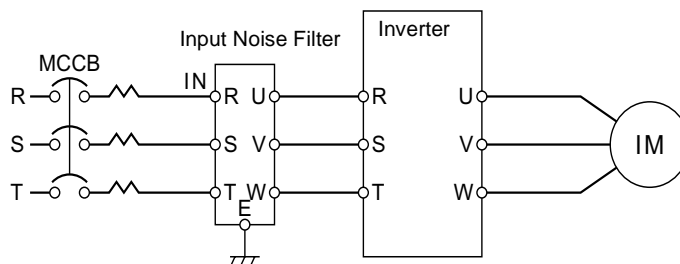
Dimensions

The dimensions of a Simple Input Noise Filter are given below.

Model 3G3EV-	Dimensions Diagram	Dimensions							Weight (kg)
		W	D	Hmax	A	A'	B	Mounting Screws	
PLNFD2103DY		120	80	55	108	-	68	M4 × 4 20 mm	0.2
PLNFD2153DY	1	120	80	55	108	-	68	M4 × 4 20 mm	0.2
PLNFD2203DY		170	90	70	158	-	78	M4 × 4 20 mm	0.4
PLNFD2303DY		170	110	70	-	79	98	M4 × 6 20 mm	0.5
PLNFD4053DY		170	130	75	-	79	118	M4 × 6 30 mm	0.3
PLNFD4103DY		170	130	95	-	79	118	M4 × 6 30 mm	0.4
PLNFD4153DY	2	170	130	95	-	79	118	M4 × 6 30 mm	0.4
PLNFD4203DY		200	145	100	-	94	133	M4 × 6 30 mm	0.5
PLNFD4303DY		200	145	100	-	94	133	M4 × 6 30 mm	0.6

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Dimensions Diagram 1

Dimensions Diagram 2
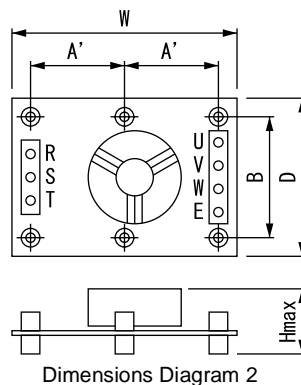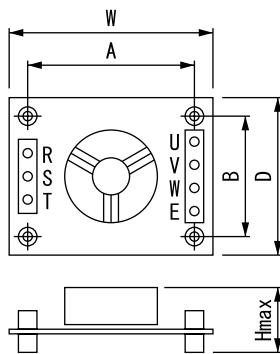
■ Input Noise Filter

An Input Noise Filter reduces noise coming into the inverter from the power supply line and to reduce noise flowing from the inverter into the power supply line. Connected the Filter to the power supply input side.

3G3IV-PFN□(Schaffner)

Models and Application

The standard models of Input Noise Filters are listed in the following table.

Inverter		Input Noise Filter		
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Qty	Rated (A)
200-V Class	5.5	3G3IV-PFN258L4207	1	42
	7.5	3G3IV-PFN258L5507	1	55
	11	3G3IV-PFN258L7534	1	75
	15	3G3IV-PFN258L10035	1	100
	18.5	3G3IV-PFN258L13035	1	130
	22	3G3IV-PFN258L13035	1	130
	30	3G3IV-PFN258L18007	1	180
	37	3G3IV-PFN359P25099	1	250
	45	3G3IV-PFN359P25099	1	250
	55	3G3IV-PFN359P30099	1	300
	75	3G3IV-PFN359P25099	2	500
	90	3G3IV-PFN359P25099	2	500
	110	3G3IV-PFN359P30099	2	600
400-V Class	11	3G3IV-PFN258L4207	1	42
	15	3G3IV-PFN258L5507	1	55
	18.5	3G3IV-PFN258L5507	1	55
	22	3G3IV-PFN258L7534	1	75
	30	3G3IV-PFN258L10035	1	100
	37	3G3IV-PFN258L13035	1	130
	45	3G3IV-PFN258L13035	1	130
	55	3G3IV-PFN258L18007	1	180
	75	3G3IV-PFN359P25099	1	250
	90	3G3IV-PFN359P30099	1	300
	110	3G3IV-PFN359P30099	1	300
	132	3G3IV-PFN359P25099	2	500
	160	3G3IV-PFN359P25099	2	500

Wiring Example

Wiring for an Input Noise Filter is the same as that for a Simple Input Noise Filter.

Dimensions

The dimensions of an Input Noise Filter are given below.

Model 3G3IV-	Dimensions Diagram	Dimensions (mm)									Weight (kg)
		A	B	C	D	E	F	G	H	J	
PFN258L4207	1	329	300	325	185	70	M6	45	314	4-M5	2.8
PFN258L5507		329	300	353	185	80	M6	55	314	4-M5	3.1
PFN258L7534	2	329	300	377	220	80	M6	55	314	4-M5	4
PFN258L10035		379	350	436	220	90	M10	65	364	4-M5	5.5
PFN258L13035		439	400	486	240	110	M10	80	414	4-M5	7.5
PFN258L18007	3	438	400	480	240	110	M10	80	413	4-M5	11
PFN359L25099	4	-	-	-	-	-	-	-	-	-	16
PFN359L30099		-	-	-	-	-	-	-	-	-	16
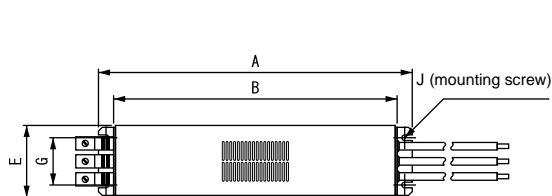
Dimensions Diagram 1

Dimensions Diagram 2

Dimensions Diagram 3

Dimensions Diagram 4

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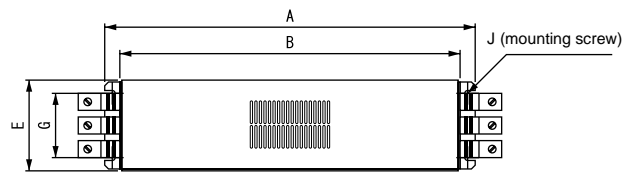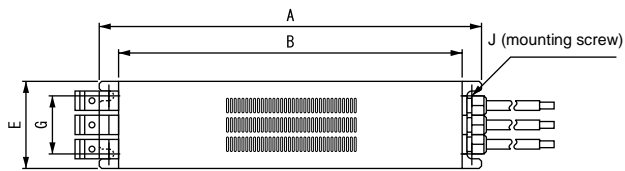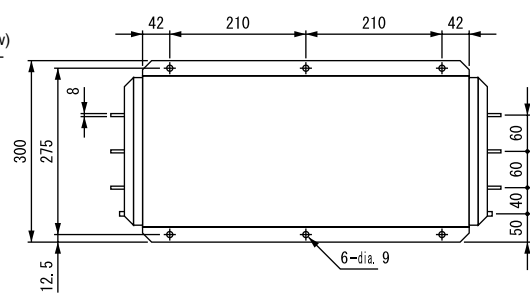
■ Output Noise Filter

An Output Noise Filter controls noise generated by the Inverter so it does not enter the power supply. It is connected to the motor output side.
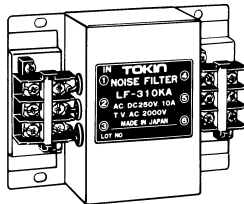
3G3IV-PLF□ (Tokin)

Models and Application

The standard models of Output Noise Filters are listed in the following table.

Inverter			Output Noise Filter		
Voltage Class	Max. Applicable Motor Capacity (kW)	Inverter Capacity (kVA)	No.	Qty	Rated Current (A)
200-V Class	0.4	1.2	3G3IV-PLF310KA	1	10
	0.75	1.6	3G3IV-PLF310KA	1	10
	1.5	2.7	3G3IV-PLF310KA	1	10
	2.2	3.7	3G3IV-PLF310KA	1	10
	3.7	5.7	3G3IV-PLF320KA	1	20
	5.5	8.8	3G3IV-PLF350KA	1	50
	7.5	12	3G3IV-PLF350KA	1	50
	11	17	3G3IV-PLF350KA	2	100
	15	22	3G3IV-PLF350KA	2	100
	18.5	27	3G3IV-PLF350KA	2	100
	22	32	3G3IV-PLF350KA	3	150
	30	44	3G3IV-PLF350KA	3	150
	37	55	3G3IV-PLF3110KB	2	220
	45	69	3G3IV-PLF3110KB	2	220
	55	82	3G3IV-PLF3110KB	3	330
	75	110	3G3IV-PLF3110KB	4	440
	90	130	3G3IV-PLF3110KB	4	440
	110	160	3G3IV-PLF3110KB	5	550
400-V Class	0.4	1.4	3G3IV-PLF310KB	1	10
	0.75	1.6	3G3IV-PLF310KB	1	10
	1.5	2.8	3G3IV-PLF310KB	1	10
	2.2	4	3G3IV-PLF310KB	1	10
	3.7	5.8	3G3IV-PLF310KB	1	10
	5.5	9.5	3G3IV-PLF320KB	1	20
	7.5	13	3G3IV-PLF320KB	1	20
	11	18	3G3IV-PLF335KB	1	35
	15	24	3G3IV-PLF335KB	1	35
	18.5	30	3G3IV-PLF345KB	1	45
	22	34	3G3IV-PLF375KB	1	75
	30	46	3G3IV-PLF375KB	1	75
	37	57	3G3IV-PLF3110KB	1	110
	45	69	3G3IV-PLF3110KB	1	110
	55	85	3G3IV-PLF375KB	2	150
	75	110	3G3IV-PLF3110KB	2	220
	90	140	3G3IV-PLF3110KB	3	330
	110	160	3G3IV-PLF3110KB	3	330
	132	200	3G3IV-PLF3110KB	4	440
	160	230	3G3IV-PLF3110KB	4	440

＊ Connect the Filters in parallel when connecting more than one Filter, and use a relay terminal block to balance the current.

Wiring Example

A wiring example for an Output Noise Filter is shown below.
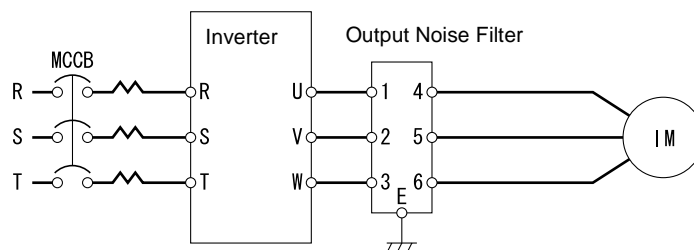
Dimensions

The dimensions of an Output Noise Filter are given below.

Model 3G3IV-	Terminal	A	B	C	D	E	F	G (Diameter)	H (Diameter)	Weight (kg)
PLF310KA	TE-K5.5 M4	140	100	100	90	70	45	7 × 4.5	4.5	0.5
PLF320KA	TE-K5.5 M4	140	100	100	90	70	45	7 × 4.5	4.5	0.6
PLF350KA	TE-K22 M6	260	180	180	160	120	65	7 × 4.5	4.5	2.0
PLF310KB	TE-K5.5 M4	140	100	100	90	70	45	7 × 4.5	4.5	0.5
PLF320KB	TE-K5.5 M4	140	100	100	90	70	45	7 × 4.5	4.5	0.6
PLF335KB	TE-K5.5 M4	140	100	100	90	70	45	7 × 4.5	4.5	0.8
PLF345KB	TE-K22 M6	260	180	180	160	120	65	7 × 4.5	4.5	2.0
PLF375KB	TE-K22 M6	540	320	480	300	340	240	9 × 6.5	6.5	12.0
PLF3110KB	TE-K60 M8	540	340	480	300	340	240	9 × 6.5	6.5	19.5
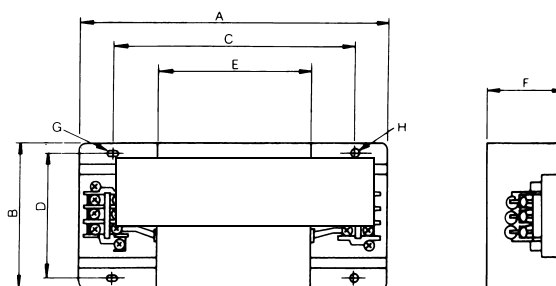
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Appendix

This chapter provides precautions for the Inverter, motor, and peripheral devices and also provides lists of parameters.

Inverter Application Precautions

This section provides precautions for selecting, installing, setting, and handling Inverters.

◆ Selection

Observe the following precautions in selecting an Inverter.

■Installing Reactors

A large peak current will flow in the power input circuit when the Inverter is connected to a large-capacity power transformer (600 kVA or higher) or when switching a phase capacitor. Excessive peak current can destroy the convertor section. To prevent this, install a DC or AC reactor (optional) to improve the power supply power factor.

DC reactors are built into 200-V class Inverters of 22 to 110 kW and 400-V class Inverters of 22 to 300 kW.

If a thyristor convertor, such as a DC drive, is connected in the same power supply system, connect a DC or AC reactor regardless of the power supply conditions shown in the following diagram.
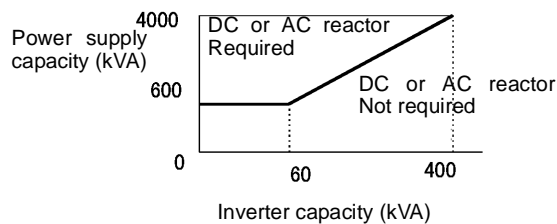
Fig 10.1

■Inverter Capacity

When connecting special motors or multiple motors in parallel to an Inverter, select the Inverter capacity so that the rated output current of the Inverter is 1.1 times the sum of all the motor rated currents.

■Initial Torque

The startup and acceleration characteristics of the motor are restricted by the overload current ratings of the Inverter that is driving the motor. The torque characteristics are generally less than those required when starting using a normal commercial power supply. If a large initial torque is required, select an Inverter with a somewhat larger capacity or increase the capacity of both the motor and the inverter.

■Emergency Stop

Although the Inverter's protective functions will stop operation when a fault occurs, the motor will not stop immediately. Always provide mechanical stop and protection mechanisms on equipment requiring an emergency stop.

■Options

Terminals B1, B2, ⊖, ⊕1, ⊕2, ⊕3 are for connecting only the options specifically provided by OMRON. Never connect any other devices to these terminals.

◆ Installation

Observe the following precautions when installing an Inverter.

■Installation in Enclosures

Either install the Inverter in a clean location not subject to oil mist, airborne matter, dust, and other contaminants, or install the Inverter in a completely enclosed panel. Provide cooling measures and sufficient panel space so that the temperature surrounding the Inverter does not go beyond the allowable temperature. Do not install the Inverter on wood or other combustible materials.

■Installation Direction

Mount the Inverter vertically to a wall or other horizontal surface.

◆ Settings

Observe the following precautions when making settings for an Inverter.

■Upper Limits

The Digital Operator can be used to set high-speed operation up to a maximum of 400 Hz (depends on the carrier frequency). Incorrect settings can be dangerous. Use the maximum frequency setting functions to set upper limits. (The maximum output frequency is factory-set to 60 Hz.)

■DC Injection Braking

The motor can overheat if the DC injection braking voltage or braking time is set to a large value.

■Acceleration/Deceleration Times

The motor's acceleration and deceleration times are determined by the torque generated by the motor, the load torque, and the load's inertial moment ($GD^2/4$). If the stall prevention functions are activated during acceleration or deceleration, increase the acceleration or deceleration time. The stall prevention functions will increase the acceleration or deceleration time by the amount of time the stall prevention function is active.

To reduce the acceleration or deceleration times, increase the capacity of the motor and Inverter.

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◆ Handling

Observe the following precautions when wiring or performing maintenance for an Inverter.

■Wiring Check

The Inverter will be internally damaged if the power supply voltage is applied to output terminal U, V, or W. Check wiring for any mistakes before supplying power. Check all wiring and sequences carefully.

■Magnetic Contactor Installation

Do not start and stop operation frequently with a magnetic contactor installed on the power supply line. Doing so can cause the Inverter to malfunction. Do not turn the Inverter ON and OFF with a magnetic contactor more than one time every 30 minutes.

■Maintenance and Inspections

After turning OFF the main circuit power supply, always confirm that the CHARGE indicator is not lit before performing maintenance or inspections. The voltage remaining in the capacitor may cause electric shock.

Motor Application Precautions

This section provides precautions for motor application.

◆ Using the Inverter for an Existing Standard Motor

When a standard motor is operated with the Inverter, power loss is slightly higher than when operated with a commercial power supply. Observe the following precautions when using an Inverter for an existing standard motor.

■ Low-speed Range

Cooling effects diminish in the low-speed range, resulting in an increase in the motor temperature. Therefore, the motor torque should be reduced in the low-speed range whenever using a motor not made by OMRON. If 100% torque is required continuously at low speed, consider using a special inverter or vector motor.

■ Installation Withstand Voltage

If the input voltage is high (440 V or higher) or the wiring distance is long, the motor insulation voltage must be considered. Contact your dealer for details.

■ High-speed Operation

When using the motor at a high speed (60 Hz or more), problems may arise in dynamic balance and bearing durability. Contact your dealer for details.

■ Torque Characteristics

The motor may require more acceleration torque when the motor is operated with the Inverter than when operated with a commercial power supply. Check the load torque characteristics of the machine to be used with the motor to set a proper V/f pattern.

■ Vibration

The Inverter uses a high carrier PWM to reduce motor vibration. (A parameter can be set to select low carrier, PWM modulation control as well.) When the motor is operated with the Inverter, motor vibration is almost the same as when operated with a commercial power supply.
Motor vibration may, however, become greater in the following cases.

Resonance with the Natural Frequency of the Mechanical System

Take special care when a machine that has been operated at a constant speed is to be operated in variable speed mode. If resonance occurs, install vibration-proof rubber on the motor base or use the frequency jump function to skip any frequency resonating the machine.

Unbalanced Rotor

Take special care when the motor is operated at a higher speed (60 Hz or more).

■ Noise

Noise varies with the carrier frequency. At high carrier frequencies, the noise is almost the same as when the motor is operated with a commercial power supply. Motor noise, however, becomes louder when the motor is operated at a speed higher than the rated speed (60 Hz).

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◆ Using the Inverter for Special Motors

Observe the following precautions when using a special motor.

■Pole-changing Motor

The rated input current of pole-changing motors differs from that of standard motors. Select, therefore, an appropriate Inverter according to the maximum input current of the motor to be used. Before changing the number of poles, always make sure that the motor has stopped. Otherwise, the overvoltage protective or over-current protective mechanism will be actuated, resulting in an error.

■Submersible Motor

The rated input current of submersible motors is higher than that of standard motors. Therefore, always select an Inverter by checking its rated output current. When the distance between the motor and Inverter is long, use a cable thick enough to connect the motor and Inverter to prevent motor torque reduction.

■Explosion-proof Motor

When an explosion-proof motor is to be used, it must be subject to an explosion-proof test in conjunction with the Inverter. This is also applicable when an existing explosion-proof motor is to be operated with the Inverter. Since the Inverter itself is, however, not explosion-proof, always install it in a safe place.

■Gearmotor

The speed range for continuous operation differs according to the lubrication method and motor manufacturer. In particular, continuous operation of an oil-lubricated motor in the low-speed range may result in burning. If the motor is to be operated at a speed higher than 60 Hz, consult with the manufacturer.

■Synchronous Motor

A synchronous motor is not suitable for Inverter control. If a group of synchronous motors is individually turned ON and OFF, synchronism may be lost.

■Single-phase Motor

Do not use an Inverter for a single-phase motor. The motor should be replaced with a 3-phase motor.

◆ Power Transmission Mechanism (Speed Reducers, Belts, and Chains)

If an oil-lubricated gearbox or speed reducer is used in the power transmission mechanism, oil lubrication will be affected when the motor operates only in the low-speed range. The power transmission mechanism will make noise and the service life and durability will be reduced if the motor is operated at a speed higher than 60 Hz.

Wiring Examples

This section provides wiring examples to connect a Braking Unit and other peripheral devices to the main circuits, examples of wiring a transformer to Inverter I/O, and other aspects of Inverter wiring.

◆ Using a Braking Resistor Unit

This example shows wiring for a Braking Resistor Unit.

3G3RV-A2004 to 3G3RV-A2185 (200-V class Inverters of 0.4 to 18.5 kW)
3G3RV-4004 to 3G3RV-A4185 (400-V class Inverters of 0.4 to 18.5 kW)
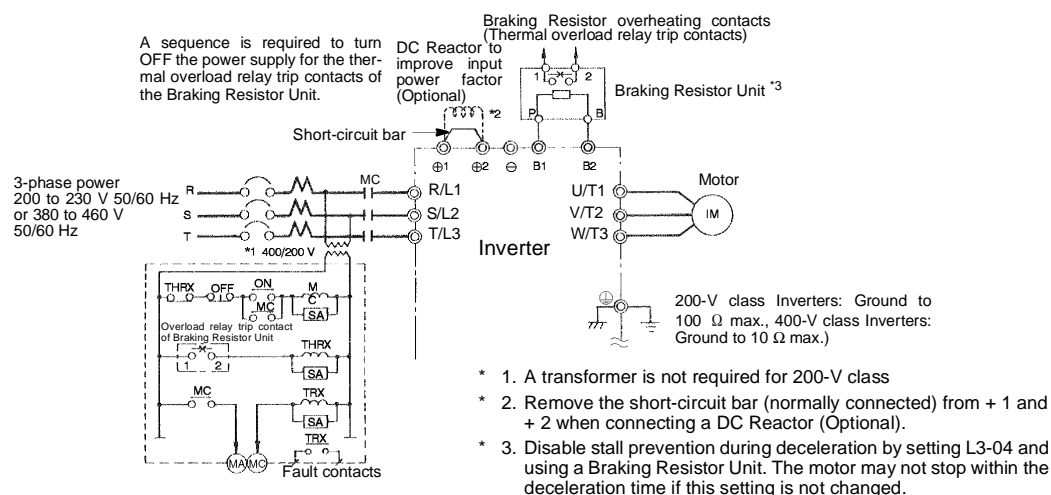
Fig 10.2

* 1. A transformer is not required for 200-V class
* 2. Remove the short-circuit bar (normally connected) from + 1 and + 2 when connecting a DC Reactor (Optional).
* 3. Disable stall prevention during deceleration by setting L3-04 and using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

◆ Using a Braking Unit and Braking Resistor Unit

This example shows wiring for a Braking Unit and Braking Resistor Unit.

3G3RV-A2220, 3G3RV-A2300 (200-V class Inverters of 22 kW, 30 kW)

* 1. Remove the short-circuit bar (normally connected) from + 1 and + 2 when connecting a DC Reactor (Optional).
* 2. Disable stall prevention during deceleration by setting L3-04 and using a Braking Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

Fig 10.3

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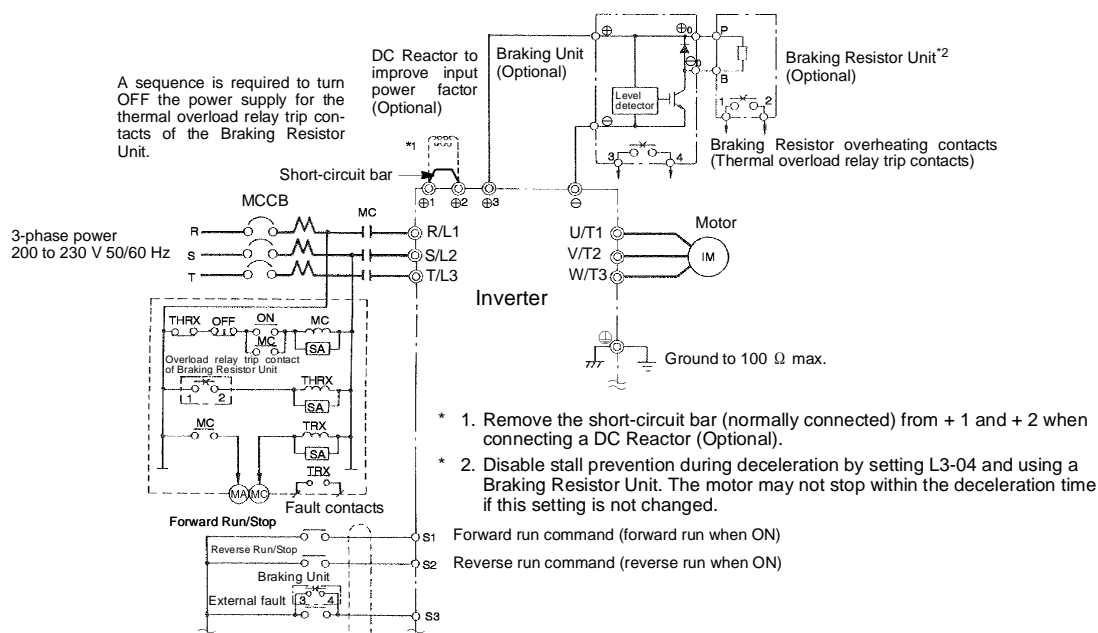
◆ Using Braking Units in Parallel

This example shows wiring for using two Braking Units in parallel.
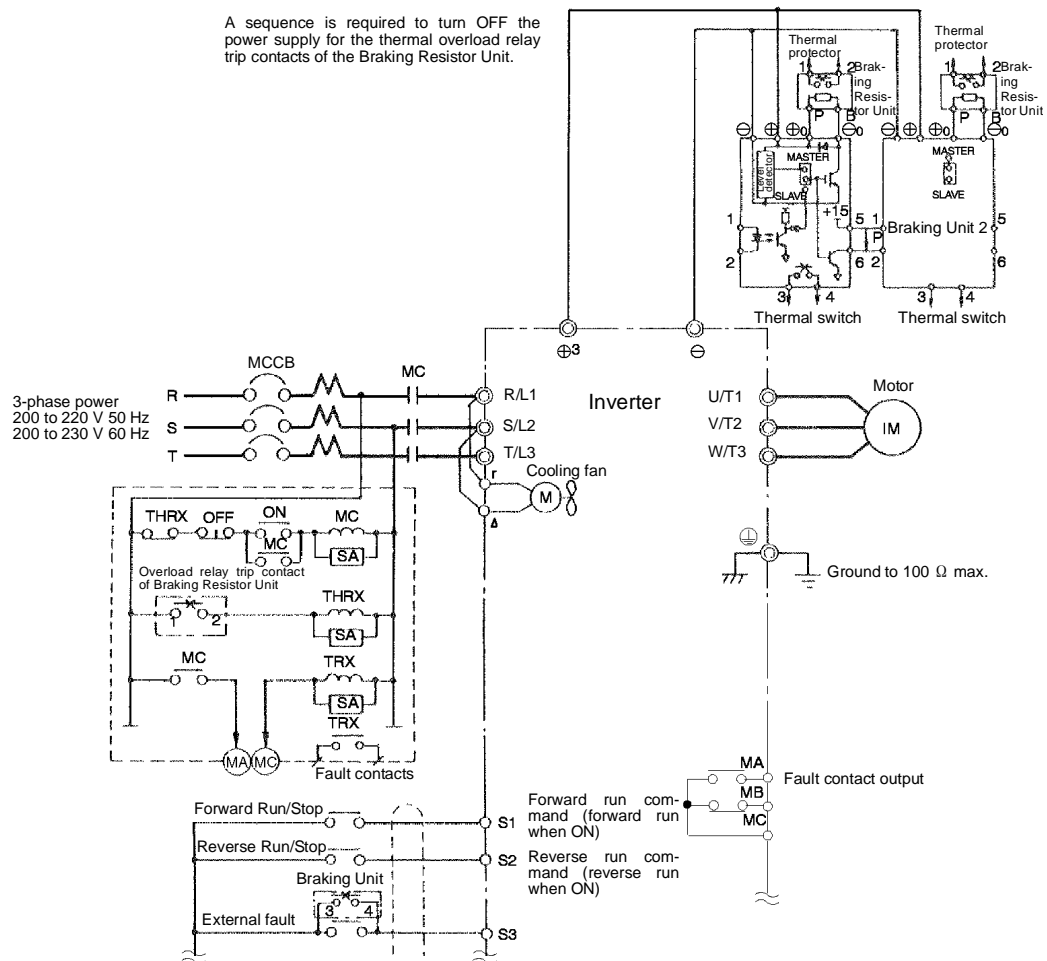
*   Disable stall prevention during deceleration by setting L3-04 to Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

Fig 10.4

◆ Using a Braking Unit and Three Braking Resistor Units in Parallel

This example shows wiring for using three Braking Resistor Units in parallel.
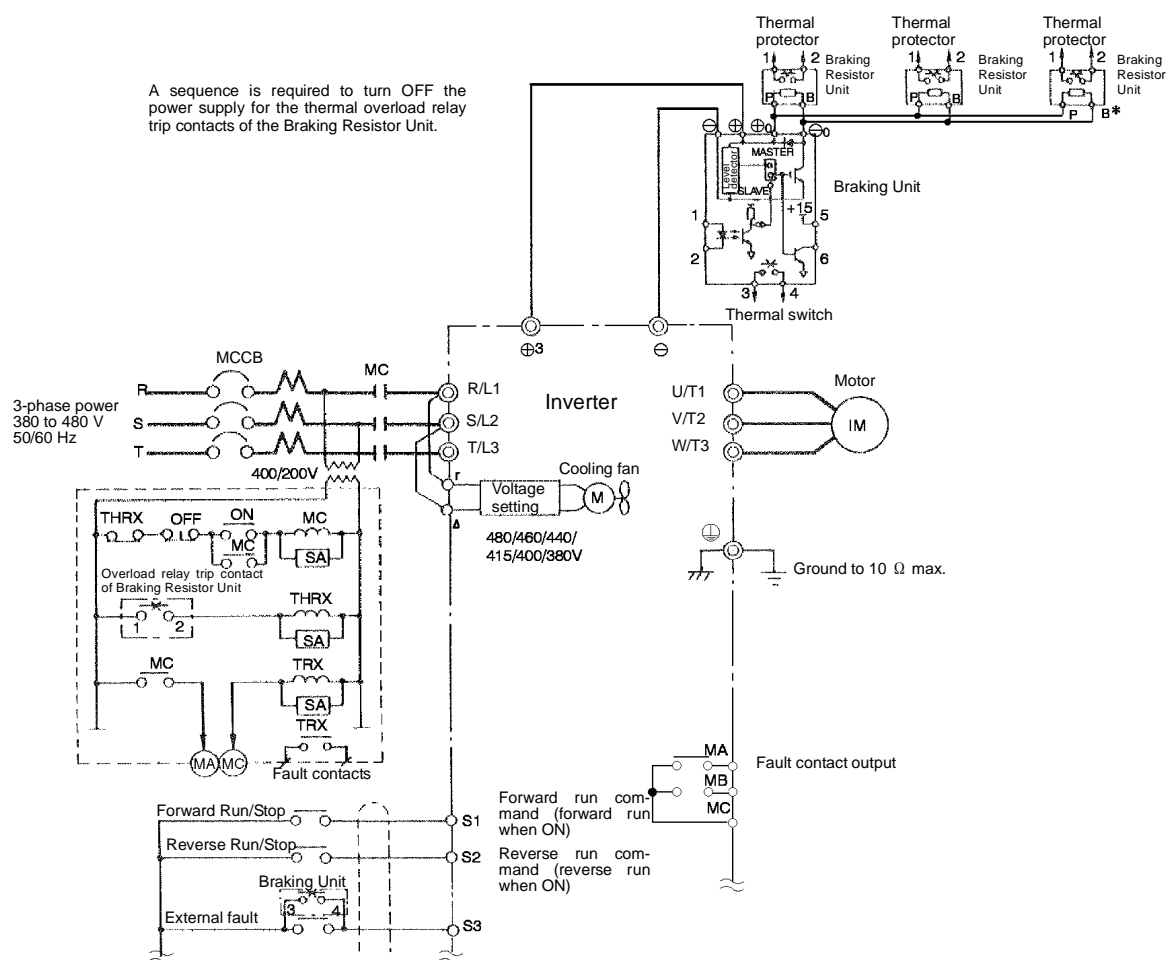
Fig 10.5

* Disable stall prevention during deceleration by setting L3-04 to Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

◆ Using an Analog Operator

This example shows wiring for using an Analog Operator. The Analog Operator model number is 3G3IV-PJVOP95□ or 3G3IV-PJVOP96□.

This example shows wiring for the 3G3RV-A2075 (200-V class Inverters of 7.5 kW)
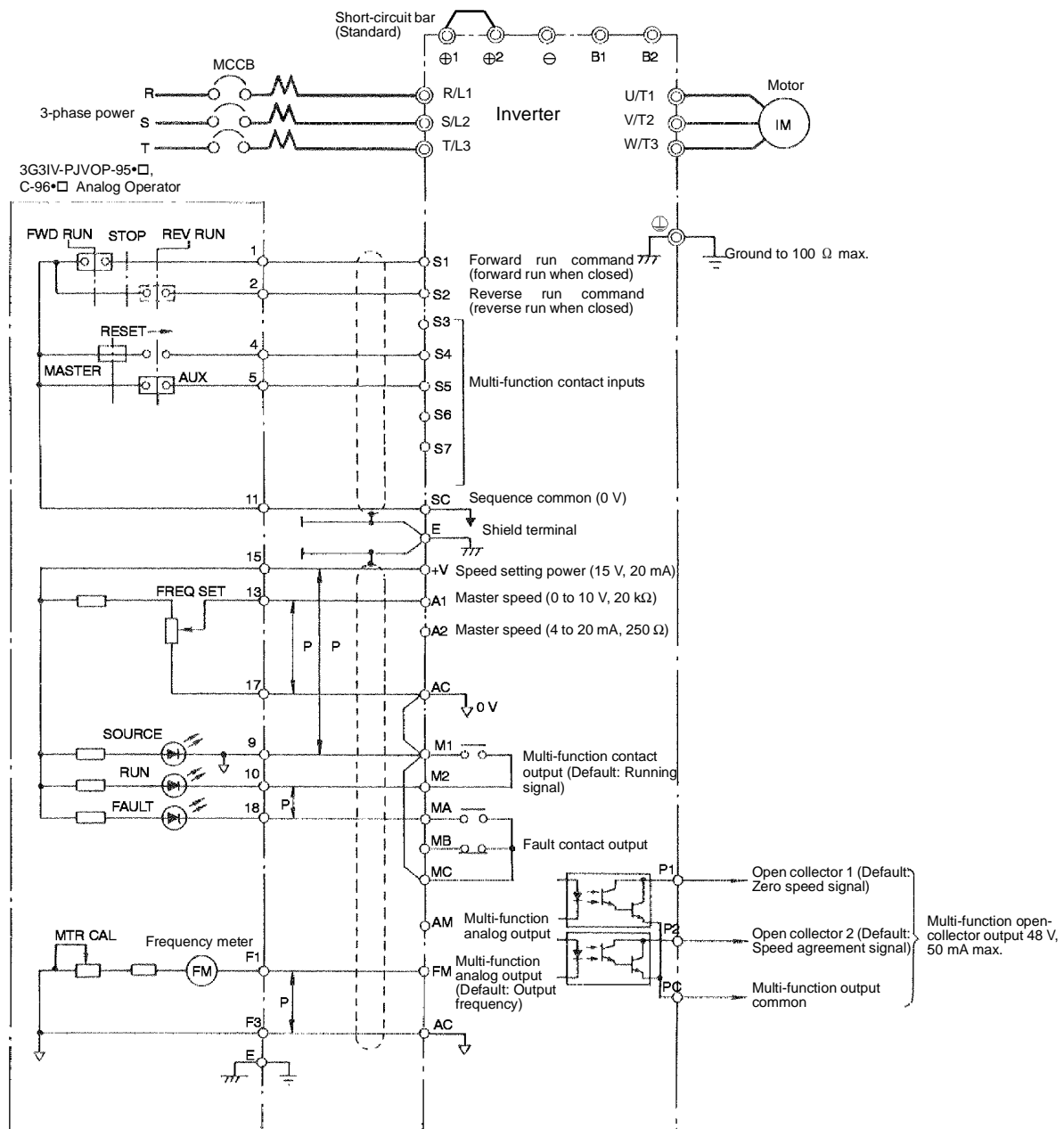
Fig 10.6

◆ Using Transistors for Input Signals and a 0-V Common in Sinking Mode with an Internal Power Supply

Set CN5 (shunt connector) on the control card to NPN as shown below for a sequence that uses an NPN transistor for an input signal (0-V command and sinking mode) and an internal +24-V power supply.

Fig 10.7

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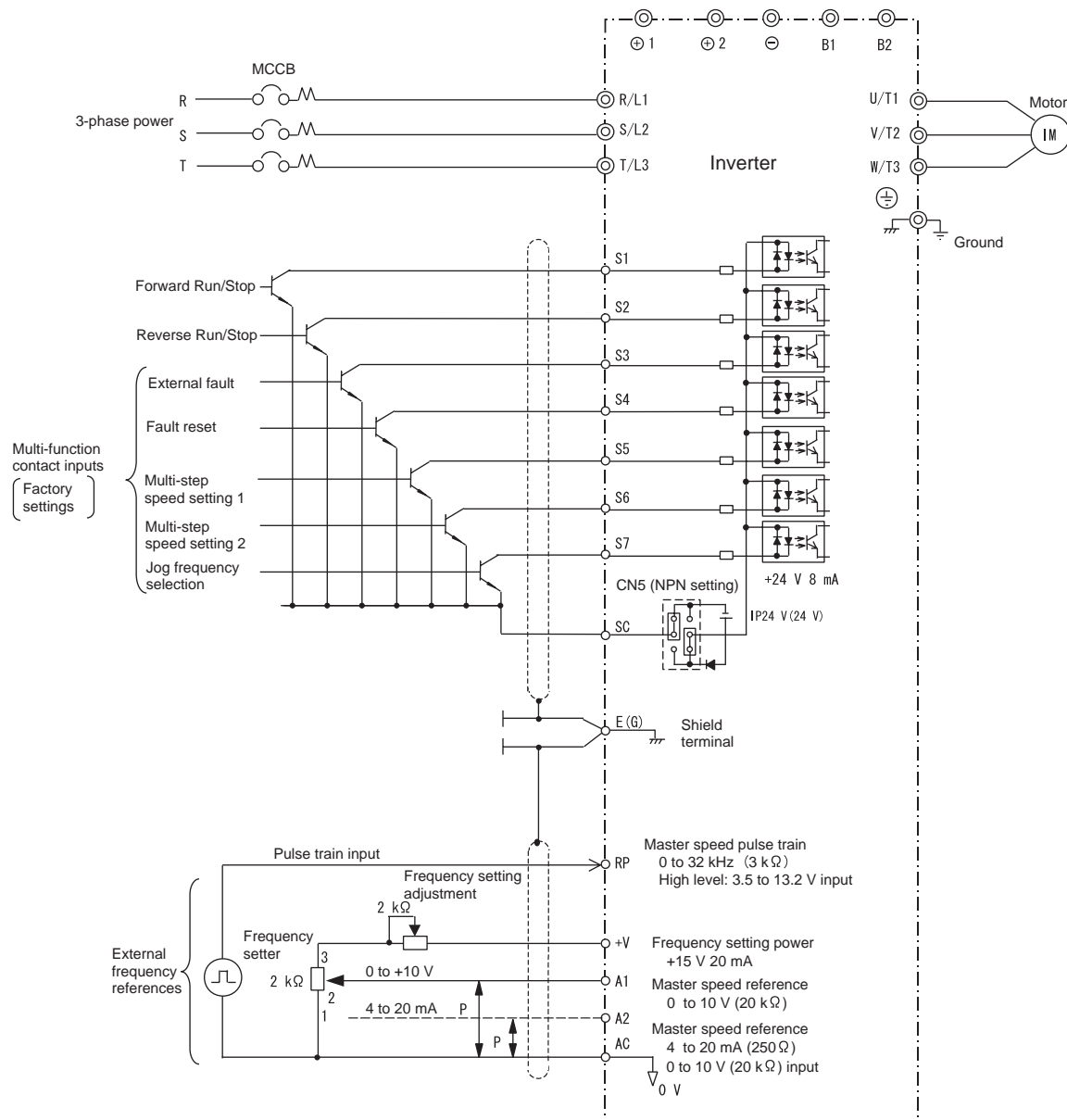
◆ Using Transistors for Input Signals and a 0-V Common in Sinking Mode with an External Power Supply

Set CN5 (shunt connector) on the control card to EXT as shown below for a sequence that uses an NPN transistor for an input signal (0-V command and sinking mode) and an external +24-V power supply.

Note:

When using an external +24-V power supply for a sequence connection for a PNP tansistor input signal, set the EXT as shown at the right.
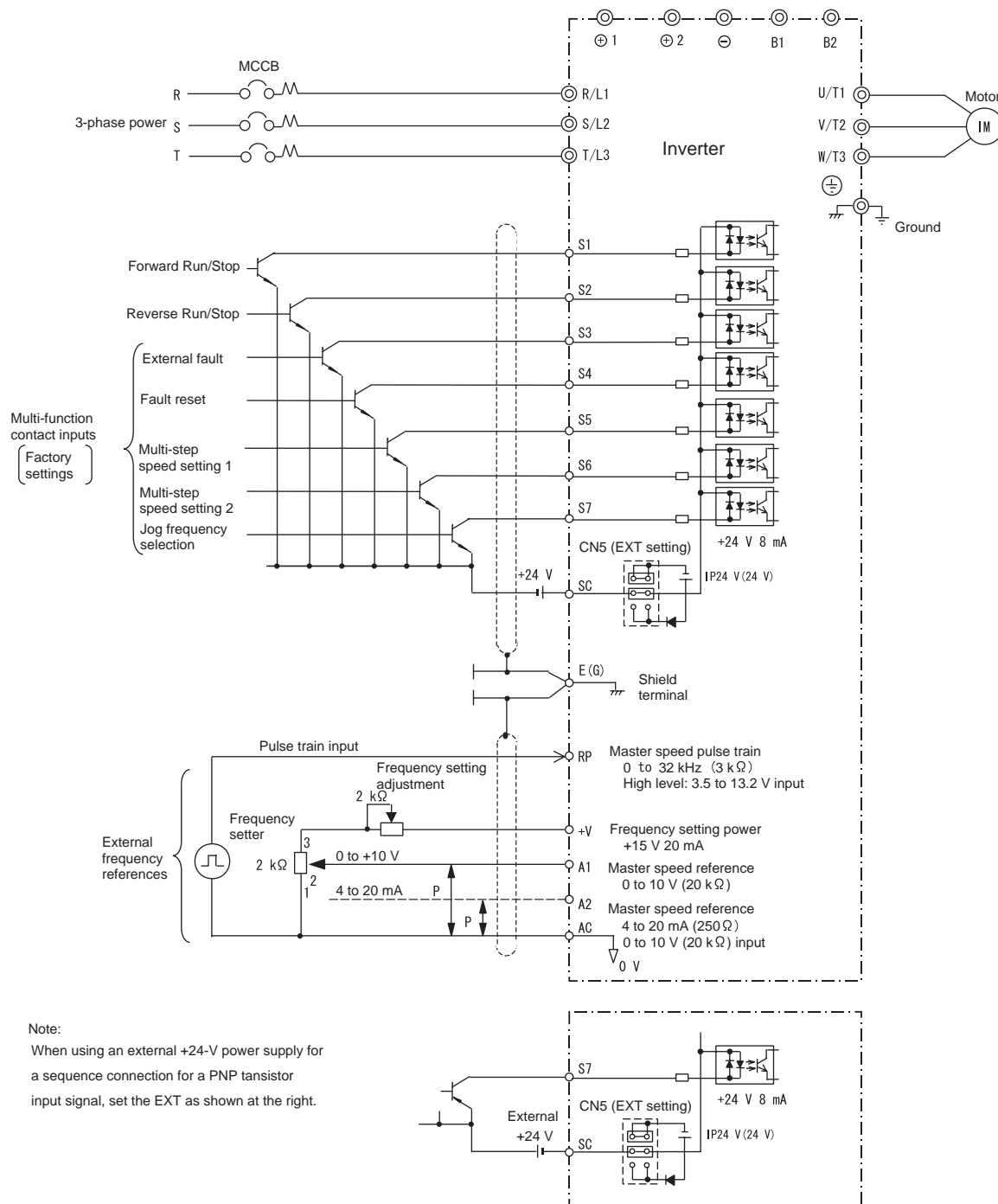
Fig 10.8

◆ Using Contact and Open Collector Outputs

This example shows wiring for contact outputs and open collector outputs.

The following example is for the 3G3RV-A2075 (200-V class Inverter for 7.5 kW).
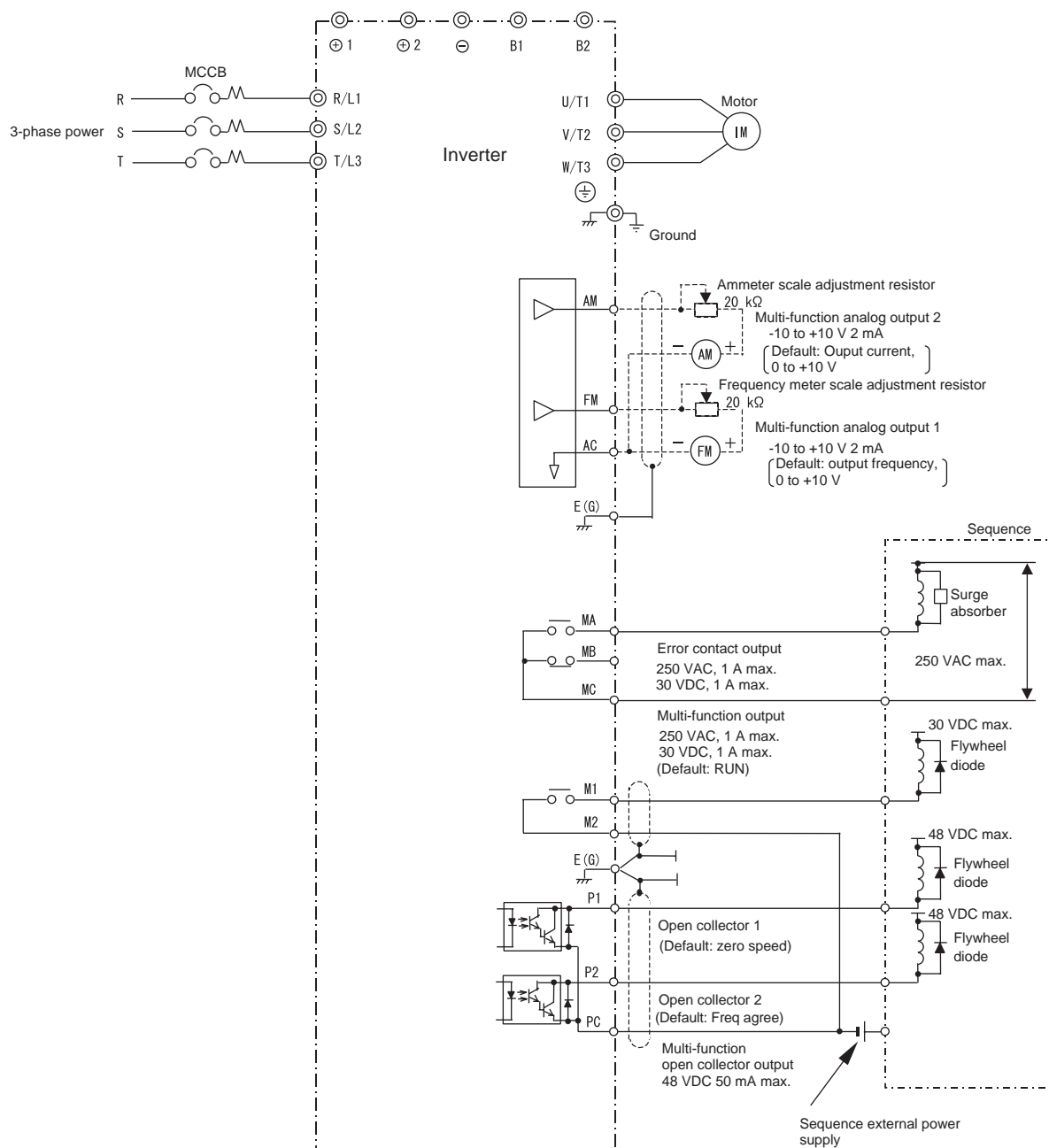
Fig 10.9

Parameters

Factory settings are given in the following table. These settings are for a 200-V class Inverter of 0.4 kW set to factory set control method (open loop vector control).

Table 10.1 Parameters

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
A1-00	Language selection for digital operator display	1[*1]		b5-14	PID feedback command loss detection time	1.0	
A1-01	Parameter access level	2		b5-15	PID sleep function operation level	0.0	
A1-02	Control method selection	0[*1]		b5-16	PID sleep operation delay time	0.0	
A1-03	Initialize	0		b5-17	Acceleration/deceleration time for PID reference	0.0	
A1-04	Password	0		b5-18	PID set point selection	0	
A1-05	Password setting	0		b5-19	PID set point	0.0	
A2-01 to A2-32	User setting parameters	-		b6-01	Dwell frequency at start	0.0	
b1-01	Reference selection	1		b6-02	Dwell time at start	0.0	
b1-02	Operation method selection	1		b6-03	Dwell frequency at stop	0.0	
b1-03	Stopping method selection	0		b6-04	Dwell time at stop	0.0	
b1-04	Prohibition of reverse operation	0		b8-01	Energy-saving mode selection	0	
b1-06	Read sequence input twice	1		b8-02	Energy-saving gain	0.7[*4]	
b1-07	Operation selection after switching to remote mode	0		b8-03	Energy-saving filter time constant	0.50[*5]	
b1-08	Run command selection in programming modes	0		b8-04	Energy-saving coefficient	[*6]	
b2-01	Zero speed level (DC injection braking starting frequency)	0.5		b8-05	Power detection filter time constant	20	
b2-02	DC injection braking current	50		b8-06	Search operation voltage limiter	0	
b2-03	DC injection braking time at start	0.00		C1-01	Acceleration time 1	10.0	
b2-04	DC injection braking time at stop	0.50		C1-02	Deceleration time 1	10.0	
b3-01	Speed search selection	2[*2][*3]		C1-03	Acceleration time 2	10.0	
b3-02	Speed search operating current	120[*2]		C1-04	Deceleration time 2	10.0	
b3-03	Speed search deceleration time	2.0		C1-05	Acceleration time 3	10.0	
b3-05	Speed search wait time	0.2		C1-06	Deceleration time 3	10.0	
b4-01	Timer function ON-delay time	0.0		C1-07	Acceleration time 4	10.0	
b4-02	Timer function OFF-delay time	0.0		C1-08	Deceleration time 4	10.0	
b5-01	PID control mode selection	0		C1-09	Deceleration stop time	10.0	
b5-02	Proportional gain (P)	1.00		C1-10	Accel/decel time setting unit	1	
b5-03	Integral (I) time	1.0		C1-11	Accel/decel time switching frequency	0.0	
b5-04	Integral (I) limit	100.0		C2-01	S-curve characteristic time at acceleration start	0.20	
b5-05	Derivative (D) time	0.00		C2-02	S-curve characteristic time at acceleration end	0.20	
b5-06	PID limit	100.0		C2-03	S-curve characteristic time at deceleration start	0.20	
b5-07	PID offset adjustment	0.0		C2-04	S-curve characteristic time at deceleration end	0.00	
b5-08	PID primary delay time constant	0.00		C3-01	Slip compensation gain	0.0[*3]	
b5-09	PID output characteristics selection	0		C3-02	Slip compensation primary delay time	2000[*2]	
b5-10	PID output gain	1.0		C3-03	Slip compensation limit	200	
b5-11	PID reverse output selection	0		C3-04	Slip compensation selection during regeneration	0	
b5-12	Selection of PID feedback command loss detection	0		C3-05	Output voltage limit operation selection	0	
b5-13	PID feedback command loss detection level	0		C4-01	Torque compensation gain	1.00	

Table 10.1 Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
C4-02	Torque compensation primary delay time constant	200[*2]		d6-01	Field weakening level	80	
C4-03	Starting torque value (forward)	0.0		d6-02	Field frequency	0.0	
C4-04	Starting torque value (reverse)	0.0		E1-01	Input voltage setting	200[*7]	
C4-05	Starting torque time constant	10		E1-03	V/f pattern selection	F	
C5-01	ASR proportional (P) gain 1	0.20		E1-04	Max. output frequency	60.0	
C5-02	ASR integral (I) time 1	0.200		E1-05	Max. voltage	200.0 [*2][*7]	
C5-03	ASR proportional (P) gain 2	0.02		E1-06	Base frequency	60.0[*2]	
C5-04	ASR integral (I) time 2	0.050		E1-07	Mid. output frequency	3.0[*2]	
C5-05	ASR limit	5.0		E1-08	Mid. output frequency voltage	15.0[*2][*7]	
C6-01	CT/VT selection	1		E1-09	Min. output frequency	1.5[*2]	
C6-02	Carrier frequency selection	6[*6]		E1-10	Min. output frequency voltage	9.0[*2][*7]	
C6-03	Carrier Frequency Upper Limit	15.0[*6]		E1-11	Mid. output frequency 2	0.0[*9]	
C6-04	Carrier Frequency Lower Limit	15.0[*6]		E1-12	Mid. output frequency voltage 2	0.0[*9]	
C6-05	Carrier Frequency Proportional Gain	00		E1-13	Base voltage	0.0[*10]	
d1-01	Frequency reference 1	0.00		E2-01	Motor rated current	1.90[*6]	
d1-02	Frequency reference 2	0.00		E2-02	Motor rated slip	2.90[*6]	
d1-03	Frequency reference 3	0.00		E2-03	Motor no-load current	1.20[*6]	
d1-04	Frequency reference 4	0.00		E2-04	Number of motor poles	4	
d1-05	Frequency reference 5	0.00		E2-05	Motor line-to-line resistance	9.842[*6]	
d1-06	Frequency reference 6	0.00		E2-06	Motor leak inductance	18.2[*6]	
d1-07	Frequency reference 7	0.00		E2-07	Motor iron saturation coefficient 1	0.50	
d1-08	Frequency reference 8	0.00		E2-08	Motor iron saturation coefficient 2	0.75	
d1-09	Frequency reference 9	0.00		E2-10	Motor iron loss for torque compensation	14[*4]	
d1-10	Frequency reference 10	0.00		E2-11	Motor rated output	0.40[*4]	
d1-11	Frequency reference 11	0.00		E3-01	Motor 2 control method selection	0	
d1-12	Frequency reference 12	0.00		E3-02	Motor 2 max. output frequency (FMAX)	60.0[*2]	
d1-13	Frequency reference 13	0.00		E3-03	Motor 2 max. voltage (VMAX)	200.0[*2]	
d1-14	Frequency reference 14	0.00		E3-04	Motor 2 max. voltage frequency (FA)	60.0	
d1-15	Frequency reference 15	0.00		E3-05	Motor 2 mid. output frequency 1 (FB)	3.0[*2]	
d1-16	Frequency reference 16	0.00		E3-06	Motor 2 mid. output frequency voltage 1 (VC)	15.0[*7]	
d1-17	Jog frequency reference	6.00		E3-07	Motor 2 min. output frequency (FMIN)	1.5[*2]	
d2-01	Frequency reference upper limit	100.0		E3-08	Motor 2 min. output frequency voltage (VMIN)	9.0[*7]	
d2-02	Frequency reference lower limit	0.0		E4-01	Motor 2 rated current	1.90[*6]	
d2-03	Master speed reference lower limit	0.0		E4-02	Motor 2 rated slip	2.90[*6]	
d3-01	Jump frequency 1	0.0		E4-03	Motor 2 no-load current	1.20[*6]	
d3-02	Jump frequency 2	0.0		E4-04	Motor 2 number of poles (number of poles)	4	
d3-03	Jump frequency 3	0.0		E4-05	Motor 2 line-to-line resistance	9.842[*6]	
d3-04	Jump frequency width	1.0		E4-06	Motor 2 leak inductance	18.2[*6]	
d4-01	Frequency reference hold function selection	0		E4-07	Motor 2 rated capacity	0.40[*6]	
d4-02	+ - Speed limits	10		F1-01	PG constant	600	

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Table 10.1 Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
F1-02	Operation selection at PG open circuit (PGO)	1		H1-04	Terminal S6 function selection	4 (3)[*8]	
F1-03	Operation selection at overspeed (OS)	1		H1-05	Terminal S7 function selection	6 (4)[*8]	
F1-04	Operation selection at deviation	3		H2-01	Terminal M1-M2 select	0	
F1-05	PG rotation	0		H2-02	Terminal P1 function select (open collector) / Terminal M3-M4 function select (contact)	1	
F1-06	PG division rate (PG pulse monitor)	1		H2-03	Terminal P2 function select (open collector) / Terminal M5-M6 function select (contact)	2	
F1-07	Integral value during accel/decel enable/disable	0		H3-01	Signal select terminal A1 (voltage)	0	
F1-08	Overspeed detection level	115		H3-02	Gain (terminal A1)	100.0	
F1-09	Overspeed detection delay time	1.0		H3-03	Bias (terminal A1)	0.0	
F1-10	Excessive speed deviation detection level	10		H3-08	Multi-function analog input terminal A2 signal level selection	2	
F1-11	Excessive speed deviation detection delay time	0.5		H3-09	Multi-function analog input terminal A2 function selection	0	
F1-12	Number of PG gear teeth 1	0		H3-10	Gain (terminal A2)	100.0	
F1-13	Number of PG gear teeth 2	0		H3-11	Bias (terminal A2)	0.0	
F1-14	PG open-circuit detection time	2.0		H3-12	Analog input filter time constant	0.00	
F4-01	Channel 1 monitor selection	2		H3-13	Terminal A1/A2 switching	0	
F4-02	Channel 1 gain	1.00		H4-01	Monitor selection (terminal FM)	2	
F4-03	Channel 2 monitor selection	3		H4-02	Gain (terminal FM)	1.00	
F4-04	Channel 2 gain	0.50		H4-03	Bias (terminal FM)	0.0	
F4-05	Channel 1 output monitor bias	0.0		H4-04	Monitor selection (terminal AM)	3	
F4-06	Channel 2 output monitor bias	0.0		H4-05	Gain (terminal AM)	0.50	
F4-07	Analog output signal level for channel 1	0		H4-06	Bias (terminal AM)	0.0	
F4-08	Analog output signal level for channel 2	0		H4-07	Analog output 1 signal level selection	0	
F5-01	Not used	0		H4-08	Analog output 2 signal level selection	0	
F5-02	Not used	1		H5-01	Slave address	1F	
F5-03	Not used	2		H5-02	Communication speed selection	3	
F5-04	Not used	4		H5-03	Communication parity selection	0	
F5-05	Not used	6		H5-04	Stopping method after communication error	3	
F5-06	Not used	37		H5-05	Communication error detection selection	1	
F5-07	Not used	0F		H5-06	Send wait time	5	
F5-08	Not used	0F		H5-07	RTS control ON/OFF	1	
F5-09	Not used	0		H6-01	Pulse train input function selection	0	
F6-01	DeviceNet fault operation selection	1		H6-02	Pulse train input scaling	1440	
F6-02	Communications external fault input detection method selection	0		H6-03	Pulse train input gain	100.0	
F6-03	Communications external fault input operation selection	1		H6-04	Pulse train input bias	0.0	
F6-04	Not used	0		H6-05	Pulse train input filter time	0.10	
F6-05	Display unit selection for current monitor	0		H6-06	Pulse train monitor selection	2	
H1-01	Terminal S3 function selection	24		H6-07	Pulse train monitor scaling	1440	
H1-02	Terminal S4 function selection	14					
H1-03	Terminal S5 function selection	3 (0)[*8]					

Table 10.1 Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
L1-01	Motor protection selection	1		L7-03	Forward regenerative torque limit	200	
L1-02	Motor protection time constant	1.0		L7-04	Reverse regenerative torque limit	200	
L1-03	Alarm operation selection during motor overheating	3		L8-01	Protect selection for internal DB resistor	0	
L1-04	Motor overheating operation selection	1		L8-02	Overheat pre-alarm level	95	
L1-05	Motor temperature input filter time constant	0.20		L8-03	Operation selection after overheat pre-alarm	3	
L2-01	Momentary power loss detection	0		L8-05	Input open-phase protection selection	0	
L2-02	Momentary power loss ridethru time	0.1[*6]		L8-07	Output open-phase protection selection	0	
L2-03	Min. baseblock time	0.1		L8-09	Ground protection selection	1	
L2-04	Voltage recovery time	0.3		L8-10	Cooling fan control selection	0	
L2-05	Undervoltage detection level	190[*7]		L8-11	Cooling fan control delay time	60	
L2-06	KEB deceleration time	0.0		L8-12	Ambient temperature	45	
L2-07	Momentary recovery time	0[*11]		L8-15	OL2 characteristics selection at low speeds	1	
L2-08	Frequency reduction gain at KEB start	100		L8-18	Soft CLA selection	1	
L3-01	Stall prevention selection during accel	1		N1-01	Hunting-prevention function selection	1	
L3-02	Stall prevention level during accel	120		N1-02	Hunting-prevention gain	1.00	
L3-03	Stall prevention limit during accel	50		N2-01	Speed feedback detection control (AFR) gain	1.00	
L3-04	Stall prevention selection during decel	1		N2-02	Speed feedback detection control (AFR) time constant	50	
L3-05	Stall prevention selection during running	1		N2-03	Speed feedback detection control (AFR) time constant 2	750	
L3-06	Stall prevention level during running	120		N3-01	High-slip braking deceleration frequency width	5	
L4-01	Speed agreement detection level	0.0		N3-02	High-slip braking current limit	150	
L4-02	Speed agreement detection width	2.0		N3-03	High-slip braking stop dwell time	1.0	
L4-03	Speed agreement detection level (+/-)	0.0		N3-04	High-slip braking OL time	40	
L4-04	Speed agreement detection width (+/-)	2.0		o1-01	Monitor selection	6	
L4-05	Operation when frequency reference is lost	0		o1-02	Monitor selection after powerup	1	
L4-06	Frequency reference for loss of frequency reference	80.0		o1-03	Frequency units of reference setting and monitor	0	
L5-01	Number of auto restart attempts	0		o1-05	LCD brightness	3	
L5-02	Auto restart operation selection	0		o2-01	LOCAL/REMOTE key enable/disable	1	
L6-01	Torque detection selection 1	0		o2-02	STOP key during control circuit terminal operation	1	
L6-02	Torque detection level 1	150		o2-03	Parameter initial value	0	
L6-03	Torque detection time 1	0.1		o2-04	kVA selection	0[*6]	
L6-04	Torque detection selection 2	0		o2-05	Frequency reference setting method selection	0	
L6-05	Torque detection level 2	150		o2-06	Operation selection when digital operator is disconnected	0	
L6-06	Torque detection time 2	0.1		o2-07	Cumulative operation time setting	0	
L7-01	Forward drive torque limit	200		o2-08	Cumulative operation time selection	0	
L7-02	Reverse drive torque limit	200		o2-09	Factory use	-	

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Table 10.1 Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
o2-10	Fan operation time setting	0		T1-02	Motor output power	0.40	
o2-12	Fault trace/fault history initialization	0		T1-03	Motor rated voltage	200.0[*7]	
o3-01	Copy function selection	0		T1-04	Motor rated current	1.90[*6]	
o3-02	Read permitted selection	0		T1-05	Motor base frequency	60.00	
T1-00	Motor 1/2 selection	1		T1-06	Number of motor poles	4	
T1-01	Autotuning mode selection	0		T1-07	Motor base speed	1750	

* 1. Not initialized. (Japanese standard specifications: A1-01 = 1, A1-02 = 2)
* 2. The factory setting will change if the control method is changed. The factory settings given above are for V/f with PG control.
* 3. Factory setting depends on the control method (A1-02).
* 4. For V/f with PG control: 1.0
* 5. For Inverters with a capacity of 55 kW or more: 2.00
* 6. Setting range and initial setting depend on Inverter capacity.
* 7. Setting for 200-V class Inverters. For 400-V class Inverters, double the value.
* 8. Factory setting in the parentheses is for 3-wire sequence.
* 9. The contents is ignored if the setting is 0.0.
* 10.E1-13 will have the same value as E1-05 after autotuning.
* 11.If the set value is 0, acceleration will be to the speeds for the acceleration times (C1-01 to C1-08)
* 12.The setting range is 10% to 200% of the Inverter rated output. (The value given is for a 200-V class Inverter for 0.4 kW.)

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Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.

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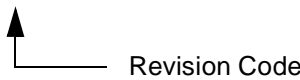
Revision Code

The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
1	July 2001	Original production