Cat. No. I549-E1-01

OMRON

USER'S MANUAL

SYSDRIVE RV Series

Models 3G3RV-V1

High-function General-purpose Inverters

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.

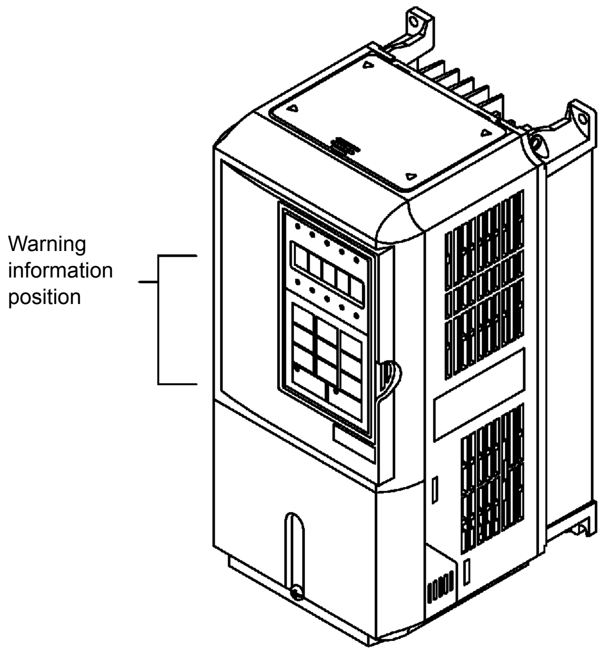

Illustration shows the 3G3RV-A2004-V1

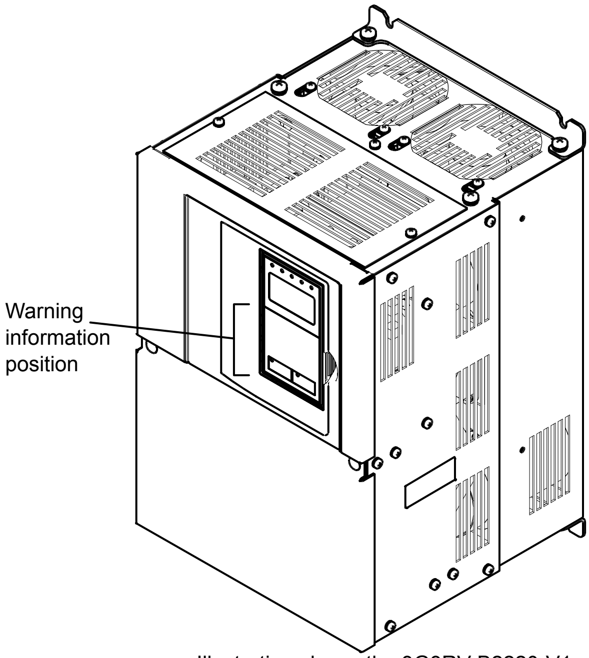

Illustration shows the 3G3RV-B2220-V1

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 décharge électrique.

- Lire le manuel avant l' installation.
- Attendre 5 minutes aprés la coupure de l' allmentation. Pour permettre la décharge 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 décharge électrique.

- Lire le manuel avant l' installation.
- Attendre 5 minutes aprés la coupure de l' allmentation. Pour permettre la décharge 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.

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6 Parameter Settings by Function

7 Troubleshooting

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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 300 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)
NEMA 1 (Type 1) type IP20	0.4 kW	3G3RV-A2004-V1
	0.75 kW	3G3RV-A2007-V1
	1.5 kW	3G3RV-A2015-V1
	2.2 kW	3G3RV-A2022-V1
	3.7 kW	3G3RV-A2037-V1
	5.5 kW	3G3RV-A2055-V1
	7.5 kW	3G3RV-A2075-V1
	11 kW	3G3RV-A2110-V1
	15 kW	3G3RV-A2150-V1
	18.5 kW	3G3RV-A2185-V1
Open Chassis type IP00	22 kW	3G3RV-B2220-V1
	30 kW	3G3RV-B2300-V1
	37 kW	3G3RV-B2370-V1
	45 kW	3G3RV-B2450-V1
	55 kW	3G3RV-B2550-V1
	75 kW	3G3RV-B2750-V1
	90 kW	3G3RV-B2900-V1
	110 kW	3G3RV-B211K-V1

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)
NEMA1 (Type 1) type IP20	0.4 kW	3G3RV-A4004-V1
	0.75 kW	3G3RV-A4007-V1
	1.5 kW	3G3RV-A4015-V1
	2.2 kW	3G3RV-A4022-V1
	3.7 kW	3G3RV-A4037-V1
	4.0 kW	Not Available
	5.5 kW	3G3RV-A4055-V1
	7.5 kW	3G3RV-A4075-V1
	11 kW	3G3RV-A4110-V1
	15 kW	3G3RV-A4150-V1
	19 kW	3G3RV-A4185-V1
Open Chassis type IP00	22 kW	3G3RV-B4220-V1
	30 kW	3G3RV-B4300-V1
	37 kW	3G3RV-B4370-V1
	45 kW	3G3RV-B4450-V1
	55 kW	3G3RV-B4550-V1
	75 kW	3G3RV-B4750-V1
	90 kW	3G3RV-B4900-V1
	110 kW	3G3RV-B411K-V1
	132 kW	3G3RV-B413K-V1
	160 kW	3G3RV-B416K-V1
	185 kW	3G3RV-B418K-V1
	220 kW	3G3RV-B422K-V1
	300 kW	3G3RV-B430K-V1

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

About New Functions

◆ Added or Improved Functions for the 3G3RV-V1 Inverter

■Added Functions with Flux Vector Control

If a PG speed control board is used, the drive will have a high degree of accuracy, and the following functions are available.

- Torque Control
  Controls the motor's output torque with a torque reference from an analog input terminal.
  Multi-function contact input terminals can be used to switch between speed and torque control while the motor is running.
- Droop Control
  Allows the user to set the amount of allowable motor slip.
  Can be used to smooth motor torque or balance loads among Inverters.
- Zero-servo Function
  Holds the motor when the motor is stopped in what is call a zero-servo status.
  Can be used to stop the motor even with an external force acts on the motor or the analog reference input is offset.
- Feed Forward Function
  Improves speed control accuracy with flux vector control.
  Effective for machines in which the ASR gain cannot be increased to a large value because doing so would result in vibrations.
  Has an additional effect of making the system less prone to overshoot.

■Added Input/Output Points for Interface

The following input/output points have been added for the 3G3RV-V1 Inverter, and various controls are available.

- Sequence input terminals: 8 points (3G3RV Inverter: 7 points)
  3G3RV-V1: Photocoupler (+24 VDC 8 mA) × 8 points
  3G3RV: Photocoupler (+24 VDC 8 mA) × 7 points
- Multi-function analog input terminals: 3 points (3G3RV Inverter: 2 points)
  For the 3G3RV-V1 Inverter, three points can be selected from the following input terminals.

3G3RV-V1 (3 points)		3G3RV (2 points)	
Input Terminal	Number of Terminals	Input Terminal	Number of Terminals
-10 to 10 V (11 bits + signal)	2	0 to 10 V (10 bits)	2
4 to 20 mA (10 bits)	1	4 to 20 mA (9 bits)	1

- -15 V speed setting power supply
  -15 V speed setting power supply has been added in addition to +15V speed setting power supply.
- Input Boards (Optional): 3G3IV-PAI14U, 3G3IV-PAI14B, 3G3IV-PDI08, and 3G3IV-PDI16H2
  (Only the option boards for communications are available for the 3G3RV Inverter)
  The 3G3IV-PAI14U and 3G3IV-PAI14B option boards allow the user to use analog speed reference with high accuracy and resolution. The 3G3IV-PDI08 and 3G3IV-PDI16H2 option boards allow the user to use digital speed references.

■Added Parameters for the 3G3RV-V1 Inverter

Parameter Number	Name	V/f	V/f with PG	Open Loop Vector	Flux Vector	Factory Setting	Remarks
b1-05	Operation selection for setting E1-09 or less	No	No	No	Yes	0	Used to set the method of operation when the frequency reference input is less than the minimum output frequency (E1-09).
b3-10	Sets the magnetic flux compensation as a percentage of the no-load current.	Yes	No	Yes	No	1.10G3	Operation restarts at a speed obtained by multiplying the speed from the speed search by the compensation gain (excitation search only.)
b3-14	Rotation direction search selection	Yes	Yes	Yes	No	1	
b3-17	Speed search retrial current level	Yes	No	Yes	No	150%	Sets the current level to retry a speed search as a percentage, taking the Inverter rated current as 100%.
b3-18	Speed search retrial detection time	Yes	No	Yes	No	0.01 sec	Sets the time for detection in a speed search retrial in units of seconds.
b3-19	Number of speed search retrials	Yes	No	Yes	No	0	Sets the number of times that a speed search can be retried.
b7-01	Droop control gain	No	No	No	Yes	0.0%	Sets the slip as a percentage of maximum frequency when the maximum output frequency is specified and the rated torque occurs.
b7-02	Droop control delay time	No	No	No	Yes	0.05 sec	Droop control responsiveness parameter
b9-01	Zero-servo gain	No	No	No	Yes	5	Adjust the strength of the zero-servo lock.
b9-02	Zero-servo completion width	No	No	No	Yes	10	Sets the output width of the zero-servo completion signal.
C5-06	ASR primary delay time	No	No	No	Yes	0.004 sec	Sets the filter time constant for outputting torque references from the speed control loop (ASR). It is set in 1-second units.
C5-07	ASR switching frequency	No	No	No	Yes	0.0 Hz	Sets the frequency for switching between Proportion Gain 1, 2 and Integral Time 1, 2 in Hz units.
C5-08	ASR integral (I) limit	No	No	No	Yes	400%	Sets the upper limit for the integral (I) amount for the speed control loop (ASR) to a percentage of the rated load.
d5-01	Torque control selection	No	No	No	Yes	0	This function is only available in flux vector control method.
d5-02	Torque reference delay time	No	No	No	Yes	0 ms	Set the torque reference delay time in ms units.
d5-03	Speed limit selection	No	No	No	Yes	1	Set the speed limit command method for the torque control method.
d5-04	Speed limit	No	No	No	Yes	0%	Set the speed limit during torque control as a percentage of the maximum output frequency.
d5-05	Speed limit bias	No	No	No	Yes	10%	Set the speed limit bias as a percentage of the maximum output frequency.
d5-06	Speed/torque control switching timer	No	No	No	Yes	0 ms	Set the delay time from inputting the multi-function input “speed/torque control change” (from On to OFF or OFF to ON) until the control is actually changed, in ms units.
d6-03	Field forcing function selection	No	No	Yes	Yes	0	Set the field forcing function.
d6-06	Field forcing limit	No	No	Yes	Yes	400%	Set the excitation current reference’s upper limit for field forcing. Set the limit as a percentage, taking the motor’s no-load current as 100%.

Parameter Number	Name	V/f	V/f with PG	Open Loop Vector	Flux Vector	Factory Setting	Remarks
F2-01	Bi-polar or uni-polar input selection	Yes	Yes	Yes	Yes	0	Sets the functions for channel 1 to 3 which are effective when the 3G3IV-PAI14B Analog Reference Board is used.
F3-01	Digital input option	Yes	Yes	Yes	Yes	0	Sets the Digital Reference Board input method.
F6-06	Torque reference/torque limit selection from optical option	No	No	No	Yes	0	
H1-06	Terminal S8 function selection	Yes	Yes	Yes	Yes	8	The factory setting is 6 when initialized in 3-wire sequence.
H3-01	Signal level selection (terminal A1)	Yes	Yes	Yes	Yes	0	Select the signal level of the frequency reference (voltage) from 0 to 10 V or -10 to 10V.
H3-04	Signal level selection (terminal A3)	Yes	Yes	Yes	Yes	0	Select the signal level of the frequency reference (voltage) from 0 to 10 V or -10 to 10V.
H3-05	Multi-function analog input (terminal A3) function selection	Yes	Yes	Yes	Yes	1F	The factory setting is “Not used.”
H3-06	Gain (terminal A3)	Yes	Yes	Yes	Yes	100.0%	Sets the input gain (level) when 10V is input.
H3-07	Bias (terminal A3)	Yes	Yes	Yes	Yes	0.0%	Sets the input gain (level) when 0V is input.
L3-11	Overvoltage inhibit selection	No	No	Yes	Yes	0	Used to enable or disable the function for inhibiting main circuit overvoltages by reducing the regenerative torque limit according to the main circuit overvoltage level.
L3-12	Overvoltage inhibit voltage level	No	No	Yes	Yes	380 V	Sets the main circuit voltage level for which the regenerative torque limit is restricted to 0.
L7-06	Integral time setting for torque limit	No	No	Yes	No	200 ms	Set the integral time for the torque limit.
L7-07	Control method selection for torque limit during acceleration and deceleration	No	No	Yes	No	0	Select the control method for the torque limit during acceleration and deceleration.
N5-01	Feed forward control selection	No	No	No	Yes	0	Select the feed forward control. 0: Disabled 1: Enabled
N5-02	Motor acceleration time	No	No	No	Yes	0.178 sec	The factory setting depends on the Inverter capacity.
N5-03	Feed forward proportional gain	No	No	No	Yes	1.0	Set the proportional gain for feed forward control.
N5-04	Response frequency for speed command	No	No	No	Yes	40.00 Hz	Sets the response frequency to a speed command in units of 0.01 Hz.
o1-04	Setting unit for frequency parameters related to V/f characteristics	No	No	No	Yes	0	Select the setting unit for frequency reference-related parameters E1-04, E1-06, and E1-09.
o2-12	Fault trace/fault history clear function	Yes	Yes	Yes	Yes	0	
o2-14	Output power monitor clear selection	Yes	Yes	Yes	Yes	0	
T1-08	Number of PG pulses when turning	No	No	No	Yes	600	Set the number of pulses per revolution for the PG being used (pulse generator or encoder)
T1-09	Motor no-load current	No	No	Yes	Yes	1.20 A	Set the current value recorded in the motor’s test results for a motor without a load.

■Difference with Factory Settings of the 3G3RV Inverter

Parameter Number	Name	V/f	V/f with PG	Open Loop Vector	Flux Vector	Factory Setting		Remarks
C6-01	CT/VT selection	Yes	Yes	Yes	Yes	1	0	The factory setting is CT for the 3G3RV-V1 Inverter.
C6-02	Carrier frequency selection	Yes	Yes	Yes	Yes	6	1	Select carrier wave fixed pattern. The factory setting depends on the Inverter capacity
C6-03	Carrier frequency upper limit	Yes	Yes	Yes	Yes	15.0	2.0	Set the carrier frequency upper limit and lower limit in kHz units. The factory setting depends on the Inverter capacity
C6-04	Carrier frequency lower limit	Yes	Yes	Yes	Yes	15.0	2.0	
H3-12	Analog input filter time constant	Yes	Yes	Yes	Yes	0.00	0.03	Sets primary delay filter time constant in seconds for the analog input terminal. Usually setting is not necessary.
L3-02	Stall prevention level during accel	Yes	Yes	Yes	Yes	120	150	Effective when L3-01 is set to 1 or 2. Set as a percentage of Inverter rated current. If C6-01 is changed to VT, the factory setting is 120%
L3-06	Stall prevention level during running	No	No	Yes	Yes	120	150	Effective when L3-05 is 1 or 2. Set as a percentage of Inverter rated current. If C6-01 is changed to VT, the factory setting is 120%

Confirmations upon Delivery

◆ Checks

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

Table 1.3 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.

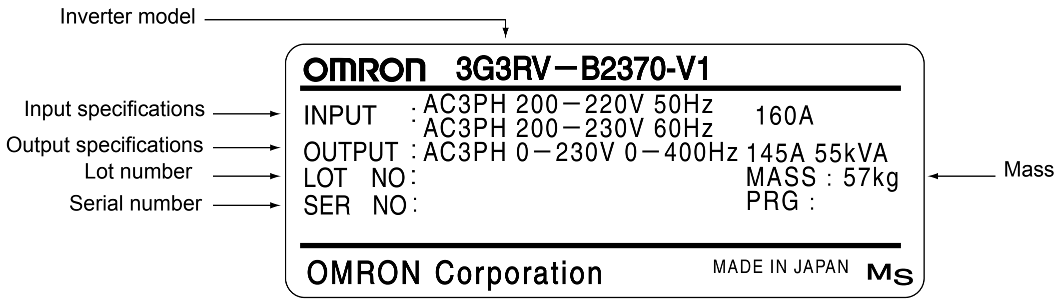


Fig 1.1 Nameplate

■ 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 -V1

Specifications

None	First version
-V1	Revision "V1"

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					18K	185 kW
						22K	220 kW
						30K	300 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 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(Type 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 (Type 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*.

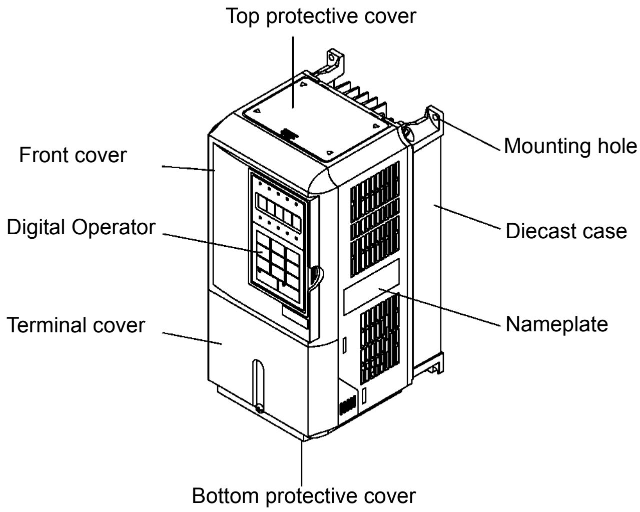


Fig 1.3 18.5 kW or Less

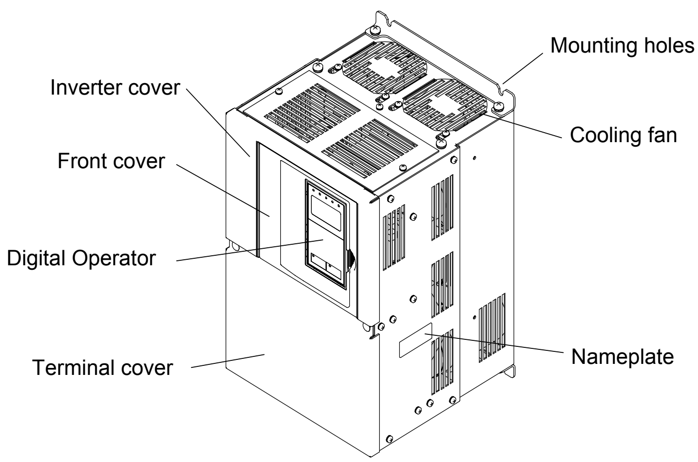


Fig 1.4 22 kW or More

■ Terminal Arrangement

Views with the terminal cover removed are shown in *Fig 1.5* and *Fig 1.6*.

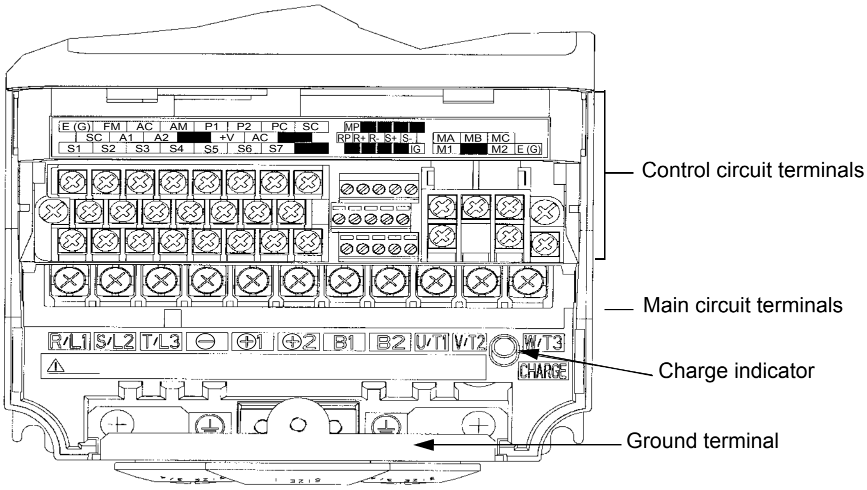


Fig 1.5 18.5 kW or Less

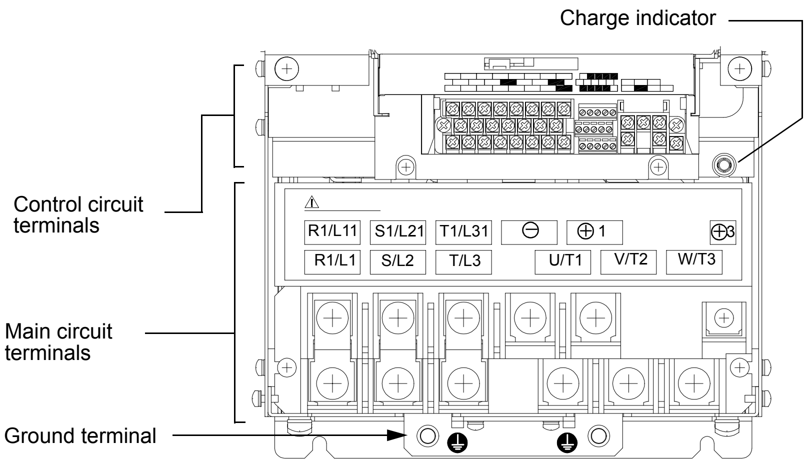


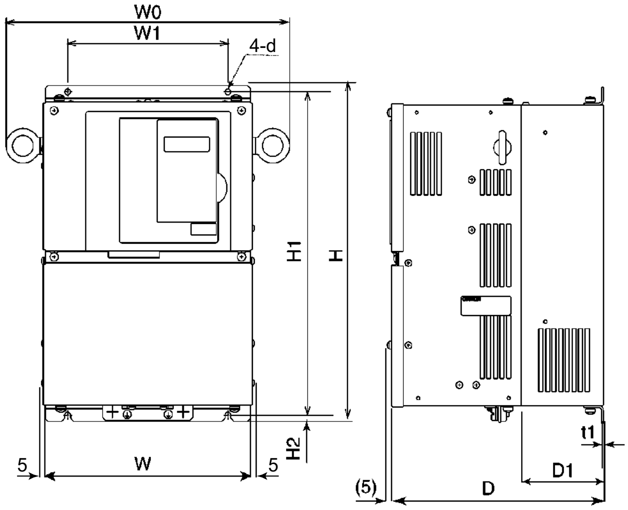
Fig 1.6 22 kW or More

Exterior and Mounting Dimensions

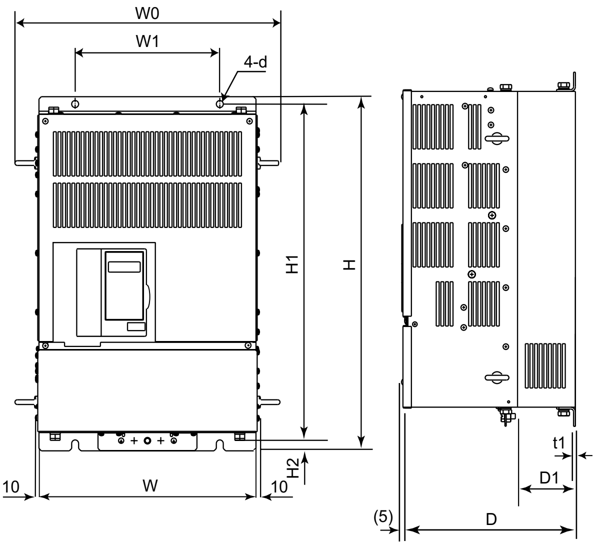
◆ Open Chassis Inverters (IP00)

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



C. 400 V Class Inverters of 185 to 300 kW

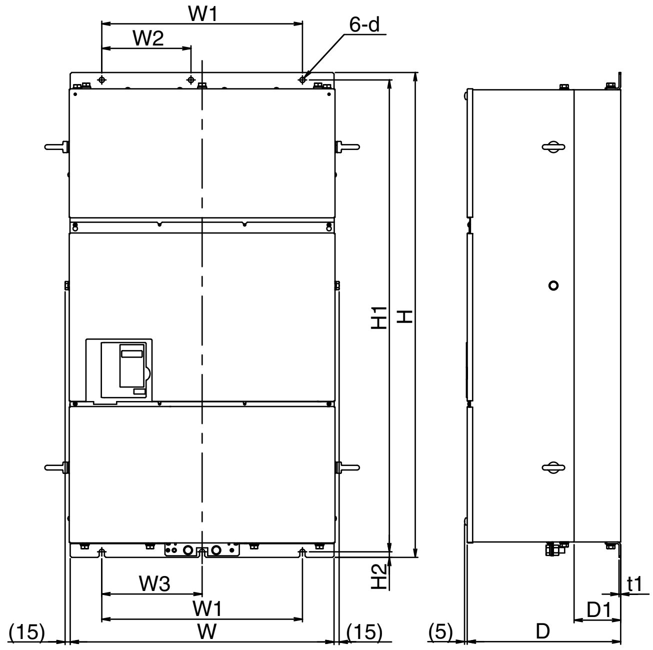


Fig 1.7 Exterior Diagrams of Open Chassis Inverters

◆ Enclosed Wall-mounted Inverters (NEMA 1)

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

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

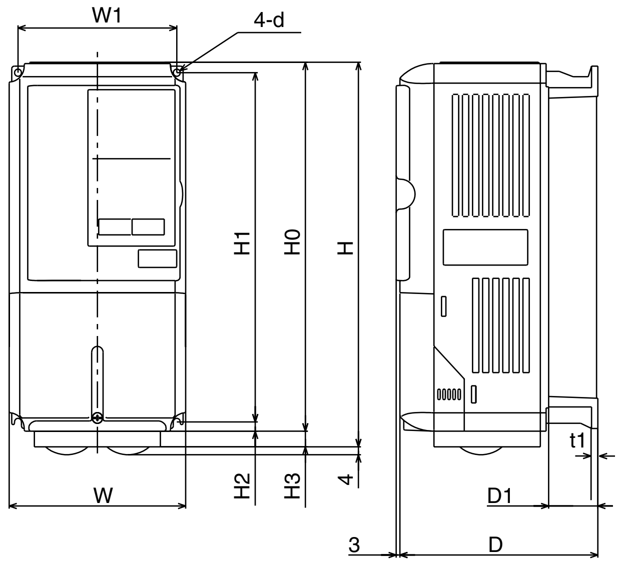


Fig 1.8 Exterior Diagrams of Enclosed Wall-mounted Inverters

Table 1.4 Open Chassis Type (IP00)

Voltage Class	Max Motor Output (kW)	Model	Figure	Dimensions(mm)											Approx. Mass (kg)	Mounting Holes d*	Caloric Value (W)			Cooling Method
				W0	W	H	D	W1	H0	H1	H2	H3	D1	t1			External	Internal	Total Heat Generated	
200V 3-phase	22	3G3RV-B2220-V1	A	345	250	400	258	195	-	385	7.5	-	100	2.3	21		586	274	860	Natural
	30	3G3RV-B2300-V1		370	275	450	258	220		435	7.5		100	2.3	24		865	352	1217	
	37	3G3RV-B2370-V1	B	470	375	600	298	250		575	12.5		100	3.2	57	M10	1015	411	1426	
	45	3G3RV-B2450-V1		470	375	600	328	250		575	12.5		130	3.2	63		1266	505	1771	
	55	3G3RV-B2550-V1		535	450	725	348	325		700	12.5		130	3.2	86		1588	619	2207	
	75	3G3RV-B2750-V1		535	450	725	348	325		700	12.5		130	3.2	87		2019	838	2857	
	90	3G3RV-B2900-V1		602	500	850	358	370		820	15		130	4.5	108	M12	2437	997	3434	
	110	3G3RV-B211K-V1		690	575	885	378	445		855	15		140	4.5	150		2733	1242	3975	
400V 3-phase	22	3G3RV-B4220-V1	A	370	275	450	258	220	-	435	7.5	-	100	2.3	21		466	259	725	Fan
	30	3G3RV-B4300-V1		370	275	450	258	220		435	7.5		100	2.3			678	317	995	
	37	3G3RV-B4370-V1		420	325	550	283	260		535	7.5		105	2.3	36		784	360	1144	
	45	3G3RV-B4450-V1		420	325	550	283	260		535	7.5		105	2.3			901	415	1316	
	55	3G3RV-B4550-V1		420	325	550	283	260		535	7.5		105	2.3			1203	495	1698	
	75	3G3RV-B4750-V1	B	535	450	725	348	325		700	12.5		130	3.2	88	M10	1399	575	1974	
	90	3G3RV-B4900-V1		535	450	725	348	325		700	12.5		130	3.2	89		1614	671	2285	
	110	3G3RV-B411K-V1		602	500	850	358	370		820	15		130	4.5	102	M12	2097	853	2950	
	132	3G3RV-B413K-V1		602	500	850	358	370		820	15		130	4.5	120		2388	1002	3390	
	160	3G3RV-B416K-V1		690	575	916	378	445		855	46		140	4.5	160		2791	1147	3938	
	185	3G3RV-B418K-V1	C	846	710	1305	413	540		1270	15		12.5	4.5	260		3237	1372	4609	
	220	3G3RV-B422K-V1		846	710	1305	413	540		1270	15		12.5	4.5	280		3740	1537	5277	
	300	3G3RV-B430K-V1		1036.5	916	1475	413	730		1440	15		12.5	4.5	405		5838	2320	8158	

Voltage Class	Max Motor Output (kW)	Model	Figure	Dimen-sions(mm)	
				W0	W
400V 3-phase	185	3G3RV-B418K-V1	C	240	270
	220	3G3RV-B422K-V1			
	300	3G3RV-B430K-V1		365	365

Table 1.5 NEMA 1 (Type 1) Type (IP20)

Voltage Class	Max Motor Output (kW)	Model	Figure	Dimensions (mm)											Approx. Mass (kg)	Mounting Holes d*	Caloric Value (W)			Cooling Method
				W0	W	H	D	W1	H0	H1	H2	H3	D1	t1			External	Internal	Total Heat Generated	
200V 3-phase	0.4	3G3RV-A2004-V1	D	-	140	280	157	126	280	266	7	0	39	5	3	M5	20	39	59	Natural
	0.75	3G3RV-A2007-V1			140	280	157	126	280	266	7	0	39	5			27	42	69	
	1.5	3G3RV-A2015-V1			140	280	157	126	280	266	7	0	39	5			50	50	100	
	2.2	3G3RV-A2022-V1			140	280	157	126	280	266	7	0	39	5			70	59	129	
	3.7	3G3RV-A2037-V1			140	280	177	126	280	266	7	0	59	5	4		112	74	186	Fan
	5.5	3G3RV-A2055-V1			140	280	177	126	280	266	7	0	59	5			164	84	248	
	7.5	3G3RV-A2075-V1			200	300	197	186	300	285	8	0	65.5	2.3	6	M6	219	113	332	
	11	3G3RV-A2110-V1			200	310	197	186	300	285	8	10	65.5	2.3	7		374	170	544	
	15	3G3RV-A2150-V1			240	350	207	216	350	335	7.5	0	78	2.3	11		429	183	612	
	18.5	3G3RV-A2185-V1			240	380	207	216	350	335	7.5	30	78	2.3			501	211	712	
400V 3-phase	0.4	3G3RV-A4004-V1	D	-	140	280	157	126	280	266	7	0	39	5	3	M5	14	39	53	Natural
	0.75	3G3RV-A4007-V1			140	280	157	126	280	266	7	0	39	5			17	41	58	
	1.5	3G3RV-A4015-V1			140	280	157	126	280	266	7	0	39	5			36	48	84	
	2.2	3G3RV-A4022-V1			140	280	177	126	280	266	7	0	59	5	4		59	56	115	Fan
	3.7	3G3RV-A4037-V1			140	280	177	126	280	266	7	0	59	5			80	68	148	
	5.5	3G3RV-A4055-V1			140	280	177	126	280	266	7	0	59	5			127	82	209	
	7.5	3G3RV-A4075-V1			200	300	197	186	300	285	8	0	65.5	2.3	6	M6	193	114	307	
	11	3G3RV-A4110-V1			200	300	197	186	300	285	8	0	65.5	2.3			252	158	410	
	15	3G3RV-A4150-V1			240	350	207	216	350	335	7.5	0	78	2.3	10		326	172	498	
	18.5	3G3RV-A4185-V1			240	350	207	216	350	335	7.5	0	78	2.3			426	208	634	

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 a pollution level of 2 or less (UL standard).

Table 1.6 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. Refer to Page 1-22 on how to remove the protection covers.

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.

◆ 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.

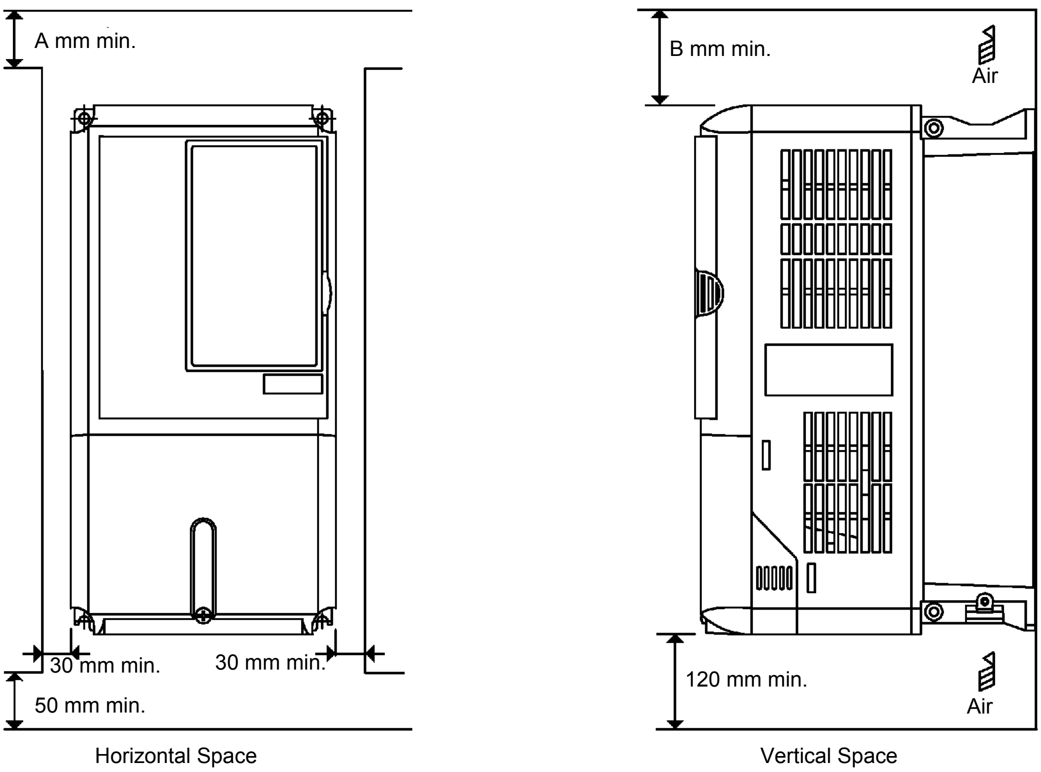
⚠ **Caution** Be sure to install the product in the correct direction and provide specified clearances between the Inverter and control panel or with other devices. Not doing so may result in fire or malfunction.

⚠ **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.



200 V Class Inverters of 110 kW or 400 V Class Inverters of 160 to 220 kW*: A = 120, B = 120
400 V Class Inverters of 300 kW*: A = 300, B = 300
All other Inverters*: A = 50, B = 120

*If, however, there is a fan in the top of the control panel with sufficient exhaust capacity, the following dimensions may be used: A = 50, B = 120.

Fig 1.9 Inverter Installation Orientation and Space

◆ Digital Operator Panel Cutout Dimensions

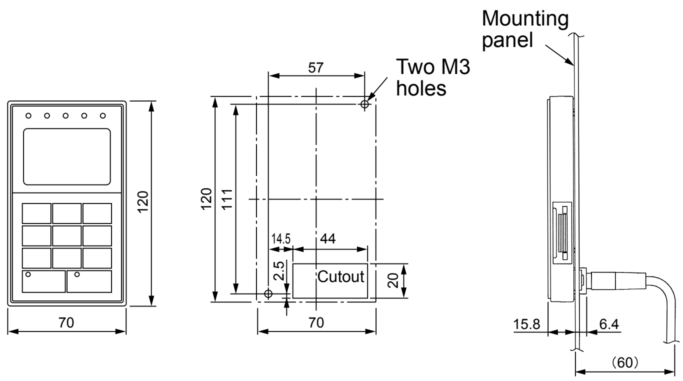


Fig 1.10 Digital Operator Panel Cutout Dimensions

IMPORTANT

1. The same space is required horizontally and vertically for both Closed Wall-mounting (IP20, NEMA 1(Type 1))and Open Chassis (IP00) Inverters.
2. The top and bottom covers must be removed 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.

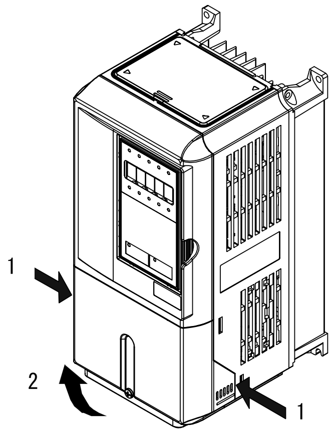


Fig 1.11 Removing the Terminal Cover (3G3RV-A2055-V1 Shown Above)

■ 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.

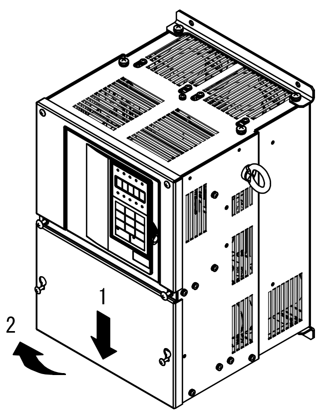


Fig 1.12 Removing the Terminal Cover (3G3RV-B2220-V1 Shown Above)

◆ 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.

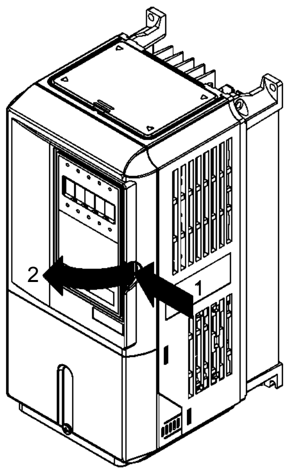


Fig 1.13 Removing the Digital Operator (3G3RV-A4055-V1 Shown Above)

■ 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.

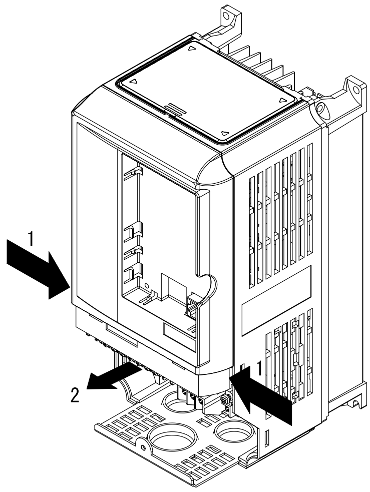


Fig 1.14 Removing the Front Cover (3G3RV-A4055-V1 Shown Above)

■ 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).

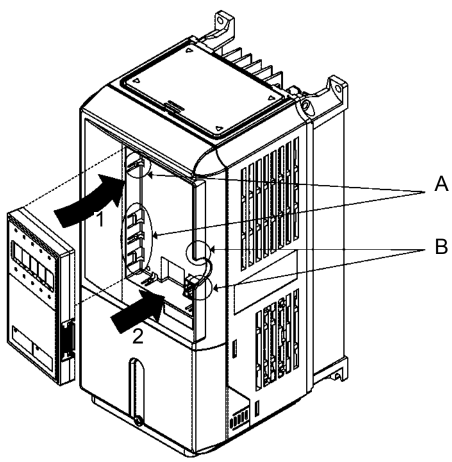


Fig 1.15 Mounting the Digital Operator

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.

■ 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.

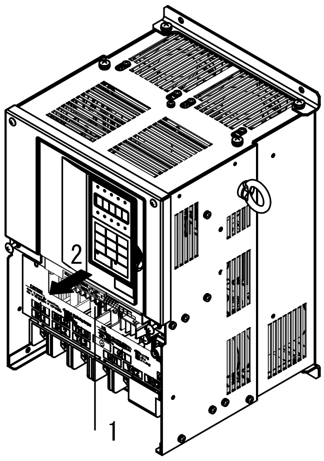


Fig 1.16 Removing the Front Cover (Model 3G3RV-B2220-V1 Shown Above)

■ 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.

Removing and Attaching the Protection Cover

Inverters of 18.5 kW or less have protection covers on the top and bottom as shown in *Fig 1.3* and *Fig 1.4* Always remove the protection covers before installing an Inverter of 18.5 kW or less in a panel. Use the following procedure to remove and attach a protection cover.

◆ Removing the Protection Cover

■ Top Protection Cover

Insert the tip of the straightedge screwdriver in the slot. Then, lift the cover up in the direction shown by the arrow to remove it.

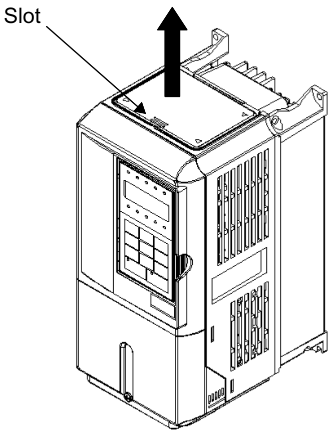


Fig 1.17 Removing the Top Protection Cover (Model 3G3RV-A4055-V1 Shown Above)

■ Bottom Protection Cover

1. Remove the terminal cover as described on Page 1-18.
2. Loosen the two screws, and remove the protection cover.
3. Return the screws to their original position and tighten (them).
4. Reattach the terminal cover as described on Page 1-18.

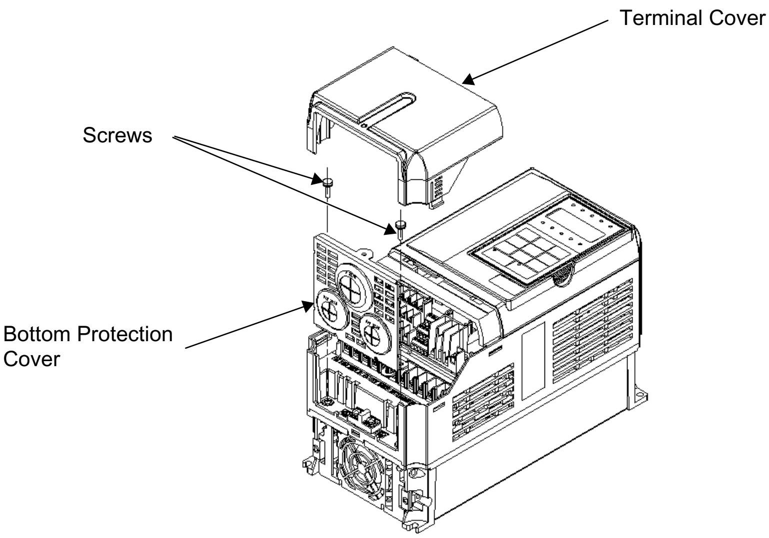


Fig 1.18 Removing the Bottom Protection Cover (Model 3G3RV-A4055-V1 Shown Above)

◆ Attaching the Protection Cover

■ Top Protection Cover

The protection cover has four hooks: two hooks on the bottom and two on the sides. Fit the bottom hooks into the holes, bend the cover slightly, and press the cover down until the hooks on the side snap.

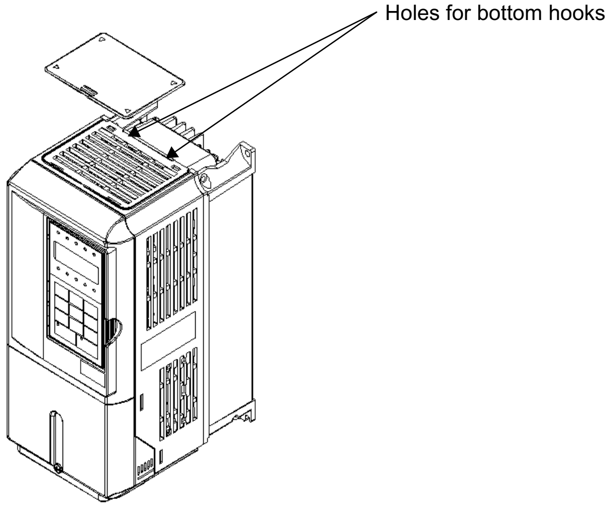


Fig 1.19 Attaching the Top Protection Cover (Model 3G3RV-A4055-V1 Shown Above)

■ Bottom Protection Cover

To attach the bottom protection cover, reverse the procedure used to remove it.

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*.

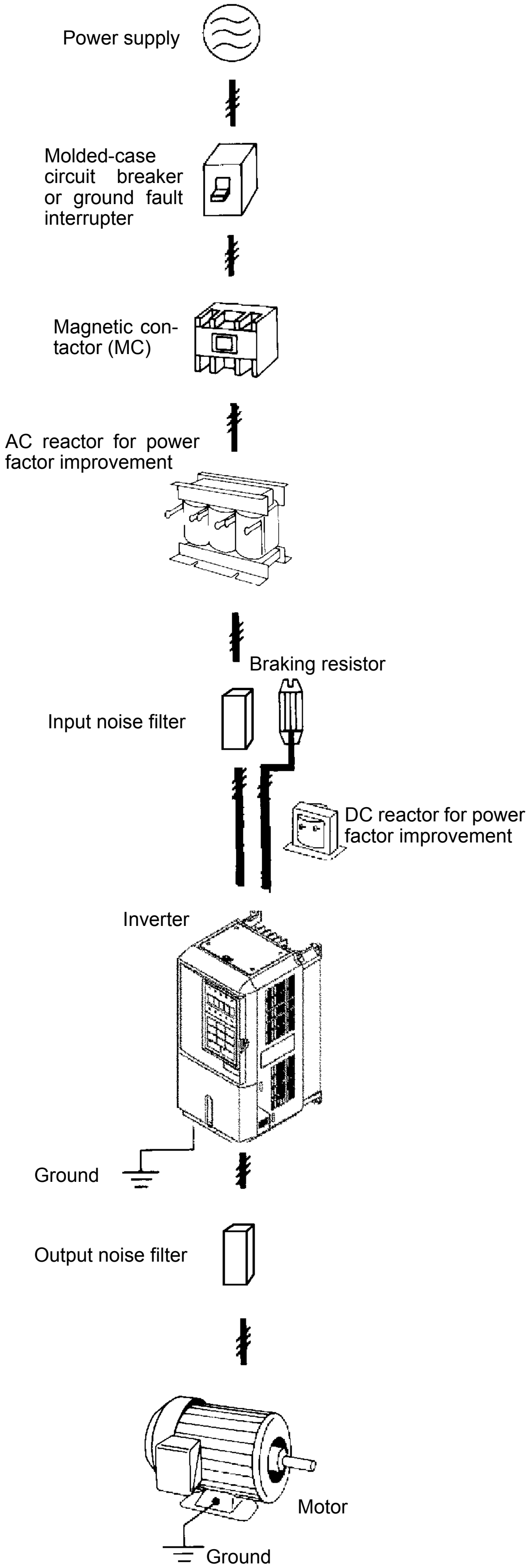


Fig 2.1 Example Connections to Peripheral Devices

Connection Diagrams

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

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

When using the Digital Operator, the motor can be operated by wiring only the main circuits.

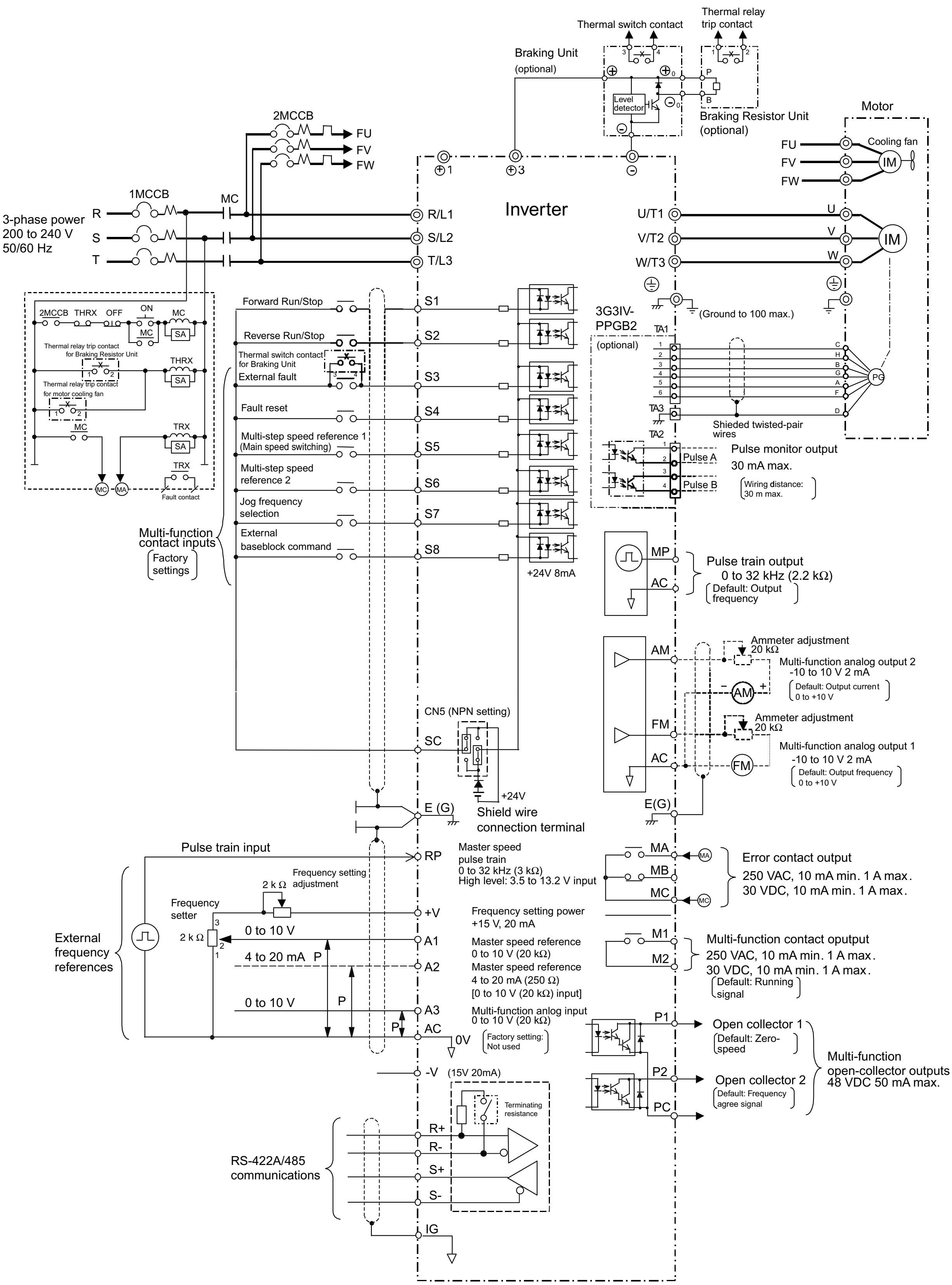


Fig 2.2 Connection Diagram

Terminal Block Configuration

◆ Terminal Arrangement

The terminal arrangement for 200 V class Inverters is shown in *Fig 2.3* and *Fig 2.4*.

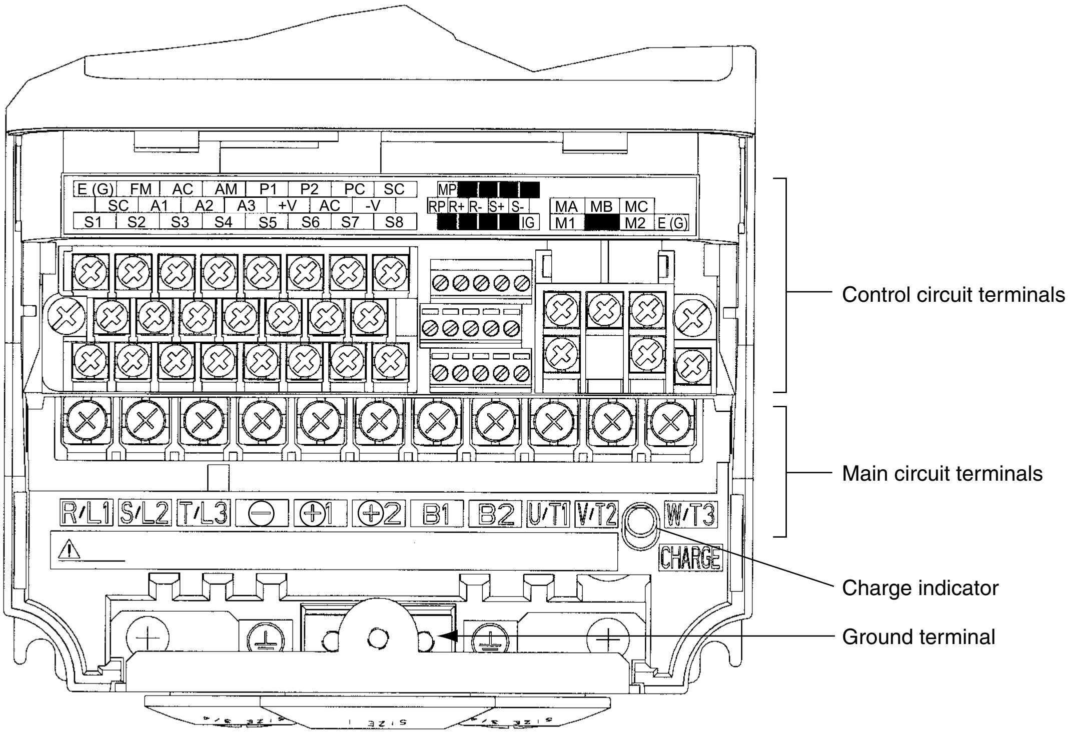


Fig 2.3 200-V Class Inverter for 0.4 kW

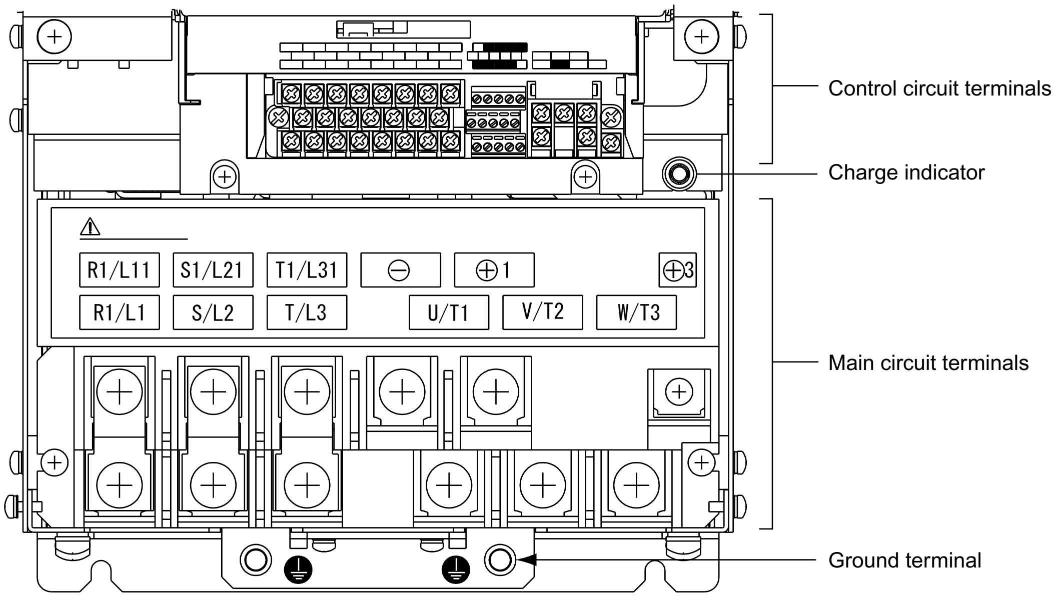


Fig 2.4 200-V Class Inverter for 22 kW

2

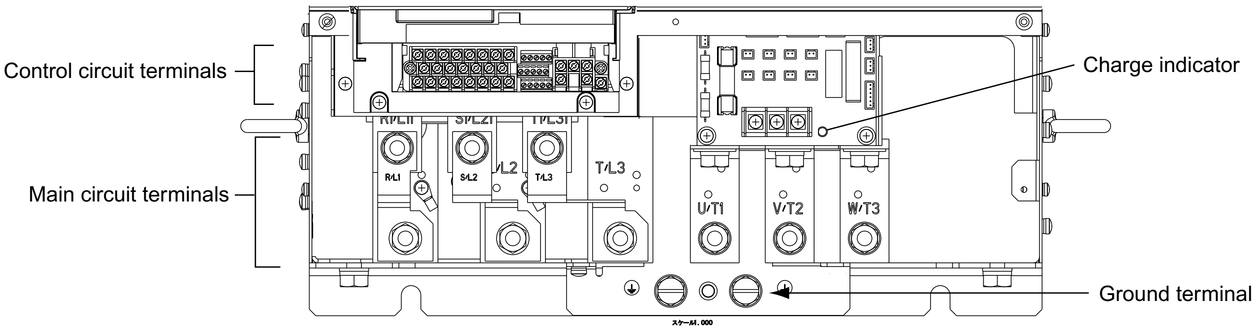


Fig 2.5 400-V Class Inverter for 75 kW

◆ Terminal Functions

The functions of the main-circuit and control-circuit terminals 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

<table>
<tr><th>Voltage Class</th><th colspan="3">200-V Class</th><th colspan="3">400-V Class</th></tr>
<tr><th>3G3RV-☐-V1</th><th>A2004 to A2185</th><th>B2220 to B2300</th><th>B2370 to B211K</th><th>A4004 to A4185</th><th>B4220 to B4550</th><th>B4750 to B430K</th></tr>
<tr><th>Maximum Applied Motor Capacity</th><th>0.4 to 18.5 kW</th><th>22 to 30 kW</th><th>37 to 110 kW</th><th>0.4 to 18.5 kW</th><th>22 to 55 kW</th><th>75 to 300 kW</th></tr>
<tr><td>R/L1</td><td rowspan="3">Main-circuit power supply input</td><td colspan="2" rowspan="6">Main-circuit power supply input
R-R1, S-S1, T-T1 are wired when shipped from the factory.</td><td rowspan="3">Main-circuit power supply input</td><td colspan="2" rowspan="6">Main-circuit power supply input
R-R1, S-S1, T-T1 are wired when shipped from the factory.</td></tr>
<tr><td>S/L2</td></tr>
<tr><td>T/L3</td></tr>
<tr><td>R1/L11</td><td rowspan="3">-</td><td rowspan="3">-</td></tr>
<tr><td>S1/L21</td></tr>
<tr><td>T1/L31</td></tr>
<tr><td>U/T1</td><td colspan="3" rowspan="3">Inverter output</td><td colspan="3" rowspan="3">Inverter output</td></tr>
<tr><td>V/T2</td></tr>
<tr><td>W/T3</td></tr>
<tr><td>B1</td><td rowspan="2">For Braking Resistor Unit connection</td><td colspan="2" rowspan="2">-</td><td rowspan="2">For Braking Resistor Unit connection</td><td colspan="2" rowspan="2">-</td></tr>
<tr><td>B2</td></tr>
<tr><td>⊖</td><td rowspan="3">For DC reactor connection (⊕1 and ⊕2)
For DC power supply input (⊕1 and ⊖)</td><td colspan="2" rowspan="4">For DC power supply input (⊕1 and ⊖)
For Braking Unit connection (⊕3 and ⊖)</td><td rowspan="3">For DC reactor connection (⊕1 and ⊕2)
For DC power supply input (⊕1 and ⊖)</td><td colspan="2" rowspan="4">For DC power supply input (⊕1 and ⊖)
For Braking Unit connection (⊕3 and ⊖)</td></tr>
<tr><td>⊕1</td></tr>
<tr><td>⊕2</td></tr>
<tr><td>⊕3</td><td>-</td><td>-</td></tr>
<tr><td>∆/ℓ2</td><td colspan="2" rowspan="2">-</td><td rowspan="2">Cooling fan power supply input *1</td><td colspan="3">-</td></tr>
<tr><td>r/ℓ1</td><td colspan="2" rowspan="3">-</td><td rowspan="3">Cooling fan power supply input *2</td></tr>
<tr><td>∆200/ℓ2200</td><td colspan="3" rowspan="2">-</td></tr>
<tr><td>∆400/ℓ2400</td></tr>
<tr><td>⏚</td><td colspan="3">Ground (to resistance of 100 Ω or less)</td><td colspan="3">Ground (to resistance of 10 Ω or less)</td></tr>
</table>

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 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	Multi-function input 1*1	Factory setting: External fault when ON.	
	S4	Multi-function input 2*1	Factory setting: Fault reset when ON.	
	S5	Multi-function input 3*1	Factory setting: Multi-speed reference 1 effective when ON.	
	S6	Multi-function input 4*1	Factory setting: Multi-speed reference 2 effective when ON.	
	S7	Multi-function input 5*1	Factory setting: Jog frequency selected when ON.	
	S8	Multi-function input 6*1	Factory setting: External baseblock 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)
	-V	-15 V power output	-15 V power supply for analog references	-15 V (Max. current: 20 mA)
	A1	Master speed frequency reference	-10 to +10 V/-100 to 100% 0 to +10 V/100%	-10 to +10 V, 0 to +10 V (Input impedance: 20 kΩ)
	A2	Multi-function analog input	4 to 20 mA/100%, -10 to +10 V/-100 to +100%, 0 to +10 V/100% Factory setting: Added to terminal A1 (H3-09 = 0)	4 to 20 mA (Input impedance: 250 Ω) -10 to +10 V, 0 to +10 V (Input impedance: 20 kΩ)
	A3	Multi-function analog input	-10 to +10 V/-100 to +100%, 0 to +10 V/100% Factory setting: Not used (H3-05 = 1F)	-10 to +10 V, 0 to +10 V (Input impedance: 20 kΩ)
	AC	Analog reference common	0 V	-
	E(G)	Shield wire, optional ground line connection point	-	-
Photo-coupler outputs	P1	Multi-function PHC output 1	Factory setting: Zero-speed Zero-speed level (b2-01) or below when ON.	50 mA max. at 48 VDC*2
	P2	Multi-function PHC output 2	Factory setting: Frequency agreement detection Frequency within 2 Hz of set frequency when ON.	
	PC	Photocoupler output common for P1 and P2	-	

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Table 2.2 Control Circuit Terminals (Continued)

Type	No.	Signal Name	Function	Signal Level
Relay outputs	MA	Fault output signal (NO contact)	Fault when CLOSED across MA and MC Fault when OPEN across MB and MC	Dry contacts Contact capacity: 10 mA min., 1 A max. at 250 VAC 10 mA min., 1 A max. at 30 VDC Minimum permissible load: 5 VDC, 10 mA*4
	MB	Fault output signal (NC contact)		
	MC	Relay contact output common	-	
	M1	Multi-function contact output (NO contact)	Factory setting: Operating Operating when CLOSED across M1 and M2.	
	M2			
Analog monitor outputs	FM	Multi-function analog monitor 1	Factory setting: Output frequency 0 to 10 V/100% frequency	-10 to +10 VDC ±5% 2 mA max.
	AM	Multi-function analog monitor 2	Factory setting: Current monitor 5 V/Inverter's rated current	
	AC	Analog common	-	
Pulse I/O	RP	Multi-function pulse input*3	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)

* 1. 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 2.6*.
* 3. Pulse input specifications are given in the following table.
* 4. Use the photocoupler outputs when the minimum permissible load is 5 VDC or less and 10 mA or less.

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

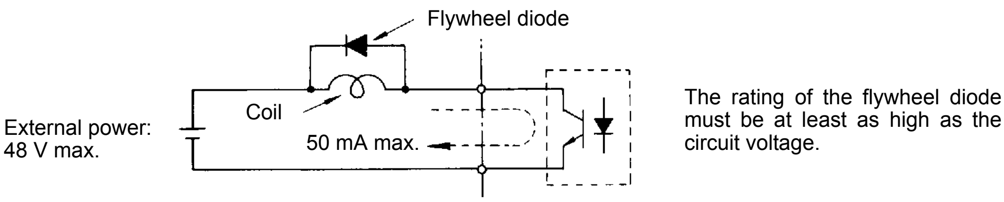

Fig 2.6 Flywheel Diode Connection

■ 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	-	-

Wiring Main Circuit Terminals

◆ Applicable Wire Sizes and Closed-loop Connectors

Select the appropriate wires and crimp terminals from *Table 2.4* to *Table 2.6* (same for all countries). Refer to USER'S MANUAL (I526-E1-☐) for wire sizes for Braking Resistor Units and Braking Units.

Table 2.4 200-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
A2004-V1	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)	Power cables, e.g., 600 V vinyl power cables
	⏚					
A2007-V1	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-V1	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-V1	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-V1	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-V1	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-V1	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)	
	⏚					
A2110-V1	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-V1	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-V1	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-V1	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-V1	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)	

Table 2.4 200-V class Wire Sizes (Continued)

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
B2370-V1	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)	Power cables, e.g., 600 V vinyl power cables
	⊕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, Δ/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B2450-V1	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, Δ/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B2550-V1	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)	-	
	⏚	M10	17.6 to 22.5	30 to 60 (3 to 4/0)	50 (1/0)	
	r/ℓ1, Δ/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B2750-V1	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, Δ/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B2900-V1	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, Δ/ℓ2	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B211K-V1	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, Δ/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 2.5 400-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
A4004-V1	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)	Power cables, e.g., 600 V vinyl power cables
	⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4007-V1	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)	
	⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4015-V1	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)	
	⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4022-V1	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)	
	⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4037-V1	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)	
	⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4040-V1	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)	
	⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4055-V1	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)	
	⏚	M4	1.2 to 1.5	2 to 5.5 (14 to 10)	2 (14)	
A4075-V1	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)	
	⏚	M4	1.2 to 1.5	3.5 to 5.5 (12 to 10)	3.5 (12)	
A4110-V1	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)	
	⏚	M5	2.5	5.5 to 14 (10 to 6)	5.5 (10)	
A4150-V1	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)	
	⏚	M5 (M6)	2.5 (4.0 to 5.0)	5.5 to 14 (10 to 6)	5.5 (10)	
A4185-V1	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)	
	B1, B2	M5	2.5	8 (8)	8 (8)	
	⏚	M6	4.0 to 5.0	8 to 22 (8 to 4)	8 (8)	
B4220-V1	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)	
	⏚	M8	9.0 to 10.0	14 to 38 (6 to 2)	14 (6)	
B4300-V1	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)	
	⏚	M8	9.0 to 10.0	22 to 38 (4 to 2)	22 (4)	
B4370-V1	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)	
	⊕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)	

Table 2.5 400-V class Wire Sizes (Continued)

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
B4450-V1	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)	Power cables, e.g., 600 V vinyl power cables
	⊕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-V1	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-V1	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, Δ200/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B4900-V1	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)	
	r/ℓ1, Δ200/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B411K-V1	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, Δ200/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B413K-V1	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, Δ200/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B416K-V1	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, Δ200/ℓ2200, Δ400/ℓ2400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	

2

Table 2.5 400-V class Wire Sizes (Continued)

Inverter Model 3G3RV	Terminal Symbol	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm² (AWG)	Recommended Wire Size mm² (AWG)	Wire Type
B418K-V1	R/L1, S/L2, T/L3	M16	78.4 to 98	100 to 325 (4/0 to 600)	150 × 2P (300 × 2P)	Power cables, e.g., 600 V vinyl power cables
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 2P (250 × 2P)	
	⊖, ⊕1	M16	78.4 to 98	100 to 325 (4/0 to 600)	325 × 2P (600 × 2P)	
	⊕3	M16	78.4 to 98	100 to 325 (4/0 to 600)	-	
	⏚	M16	78.4 to 98	100 to 325 (4/0 to 600)	100 × 2P (3/0 × 2P)	
	r/ℓ1, Δ200/$\ell_2$200, Δ400/$\ell_2$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B422K-V1	R/L1, S/L2, T/L3	M16	78.4 to 98	100 to 325 (4/0 to 600)	250 × 2P (500 × 2P)	
	U/T1, V/T2, W/T3, R1/L11, S1/L21, T1/L31	M16	78.4 to 98	100 to 325 (4/0 to 600)	200 × 2P (400 × 2P)	
	⊖, ⊕1	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 4P (250 × 4P)	
	⊕3	M16	78.4 to 98	100 to 325 (4/0 to 600)	-	
	⏚	M16	78.4to 98	100 to 325 (4/0 to 600)	125 × 2P (250 × 2P)	
	r/ℓ1, Δ200/$\ell_2$200, Δ400/$\ell_2$400	M4	1.3 to 1.4	0.5 to 5.5 (20 to 10)	1.25 (16)	
B430K-V1	R/L1, S/L2, T/L3	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 4P (250 × 4P)	
	R1/L11, S1/L21, T1/L31	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 2P (250 × 2P)	
	U/T1, V/T2, W/T3	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 4P (4/0 × 4P)	
	⊖, ⊕1	M16	78.4 to 98	100 to 325 (4/0 to 600)	200 × 4P (400 × 4P)	
	⊕3	M16	78.4 to 98	100 to 325 (4/0 to 600)	-	
	⏚	M16	78.4 to 98	100 to 325 (4/0 to 600)	125 × 2P (250 × 2P)	
	r/ℓ1, Δ200/$\ell_2$200, Δ400/$\ell_2$400	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.

Table 2.6 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

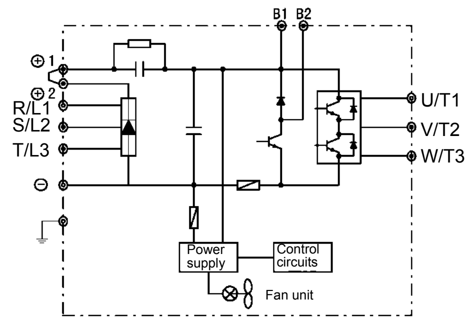
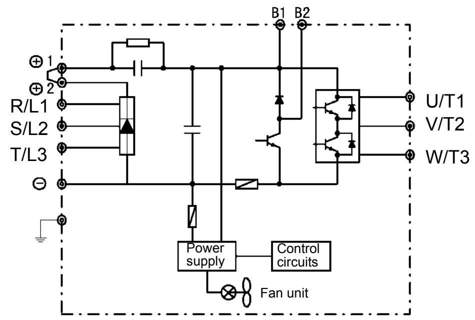
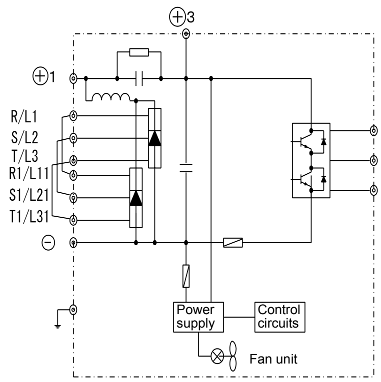
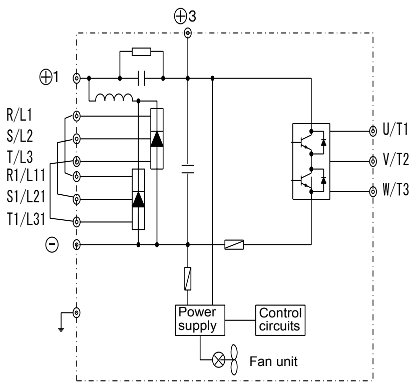
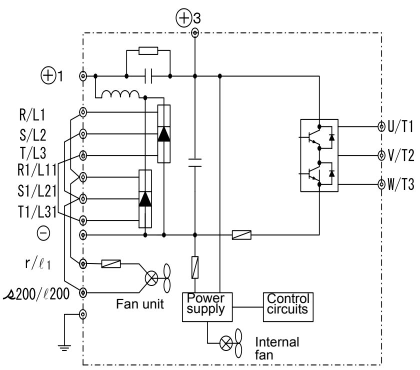
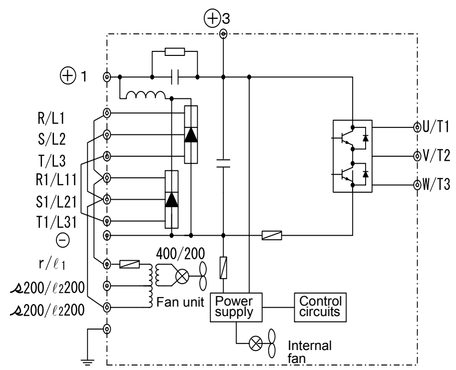
1. Determine the wire size for the main circuit so that line voltage drop is within 2% of the rated voltage. Line voltage drop is calculated as follows:

   Line voltage drop (V) = $\sqrt{3}$ x wire resistance (W/km) x wire length (m) x current (A) x 10^{-3}
2. Use a closed-loop connector (made by J.S.T. Mfg. Co., Ltd. or an equivalent) for the main circuit input and output terminals of Inverters of 200V 11 kW or more and those of 400V 22 kW or more.

◆ Main Circuit Configurations

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

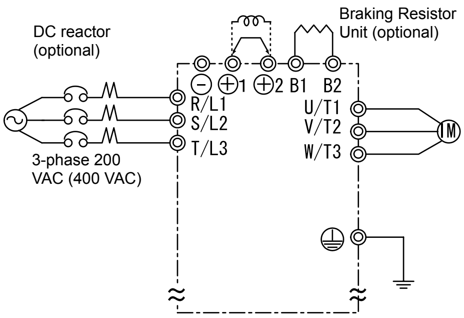
Table 2.7 Inverter Main Circuit Configurations

200-V Class	400-V Class
3G3RV-A2004-V1 to A2185-V1 	3G3RV-A4004-V1 to A4185-V1 
3G3RV-B2220-V1, B2300-V1 	3G3RV-B4220-V1 to B4550-V1 
3G3RV-B2370-V1 to B211K-V1 	3G3RV-B4750-V1 to B430K-V1 

◆ Standard Connection Diagrams

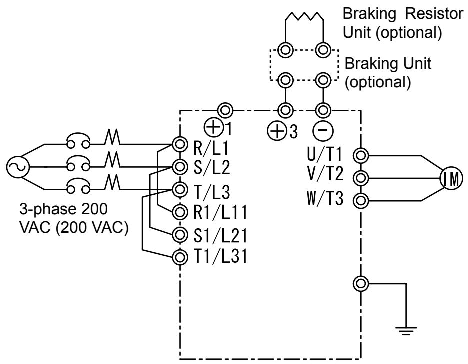
Standard Inverter connection diagrams are shown in *Fig 2.8.* The connections depend on the Inverter capacity.

■ 3G3RV-A2004-V1 to A2185-V1, A4004-V1 to A4185-V1



Be sure to remove the short-circuit bar before connecting the DC reactor.

■ 3G3RV-B2220-V1, B2300-V1, B4220-V1 to B4550-V1



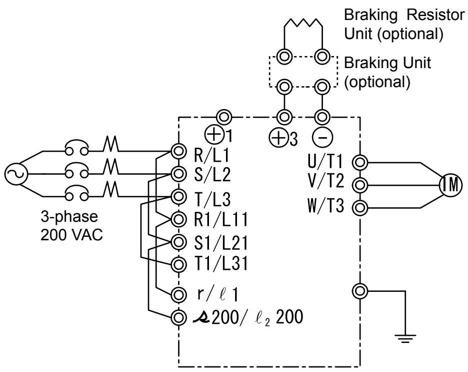
The DC reactor is built in.

2

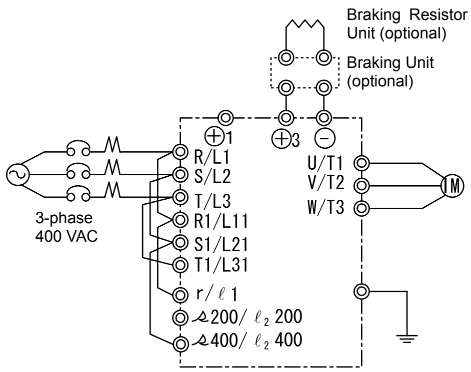
IMPORTANT

When connecting a braking unit (model 3G3IV-PCDBR☐), connect the B1 terminal of the Inverter to the + terminal of the Braking Unit and connect the – terminal of the Inverter to the – terminal of the Braking Unit. The B2 terminal is not used in this case. See *Chapter 10 Wiring Examples* for correct wiring.

■ 3G3RV-B2370-V1 to B211K-V1



■ 3G3RV-B4750-V1 to B430K-V1



Control power is supplied internally from the main circuit DC power supply for all Inverter models.

Fig 2.7 Main Circuit Terminal Connections

IMPORTANT

If a Braking Unit or a Braking Resistor Unit is connected to a wrong terminal, the Inverter, Braking Unit, or Braking Resistor Unit can be damaged. See *Chapter 10 Wiring Examples* for correct wiring.

◆ 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 2.8*.

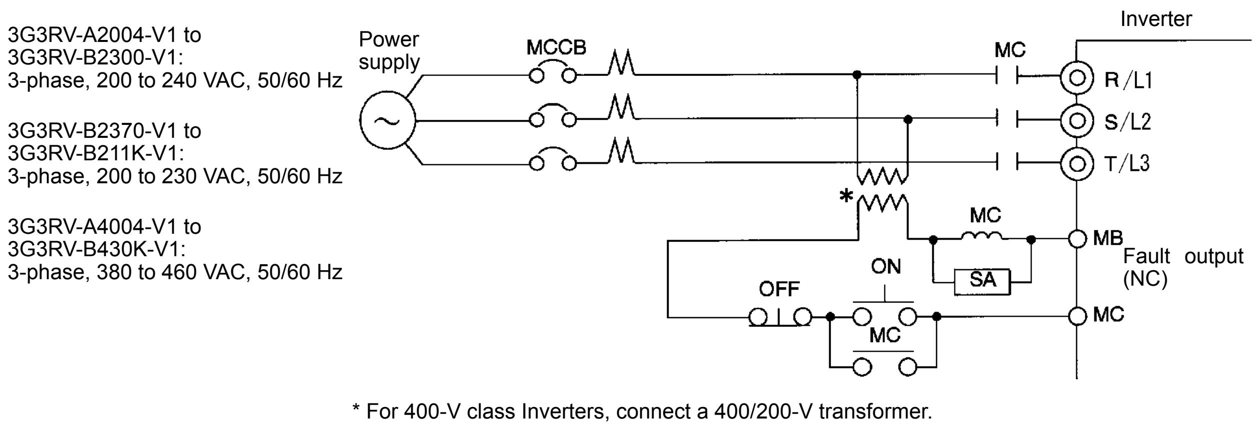


Fig 2.8 MCCB Installation

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.

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

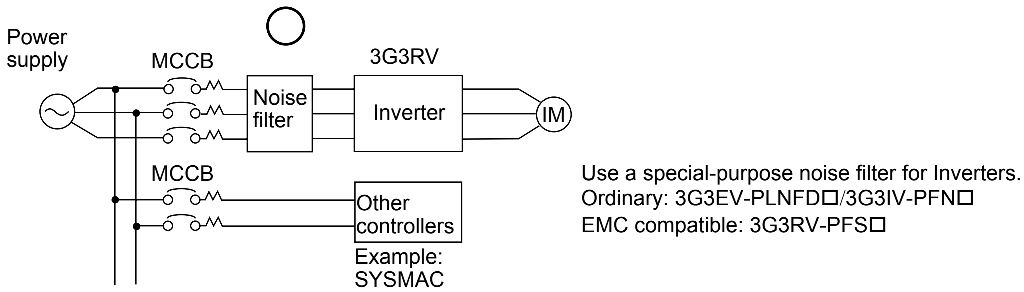


Fig 2.9 Correct Power supply Noise Filter Installation

• Incorrect Noise Filter Installation

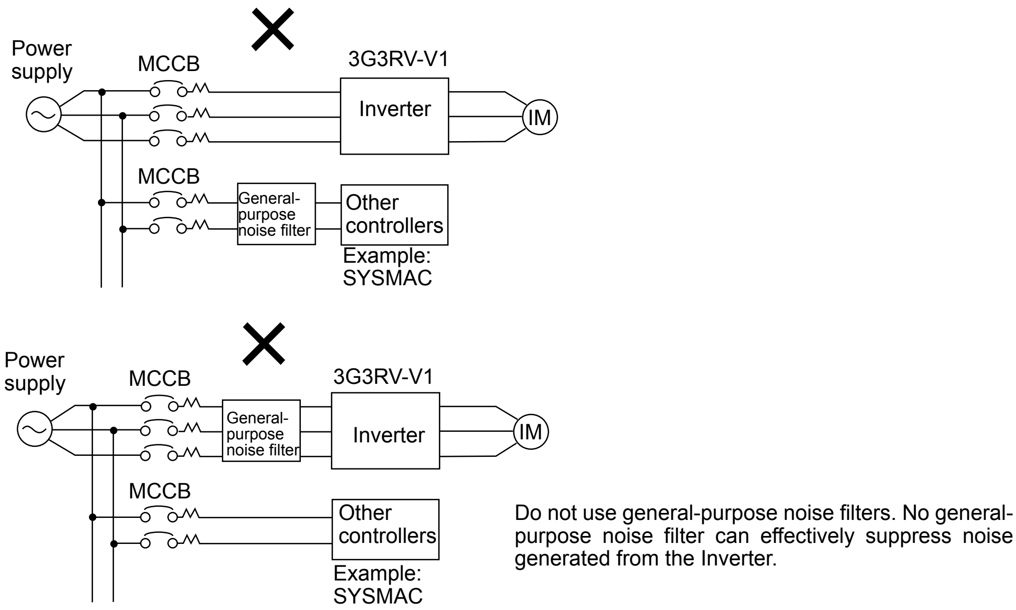


Fig 2.10 Incorrect Power supply Noise Filter Installation

■ 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.

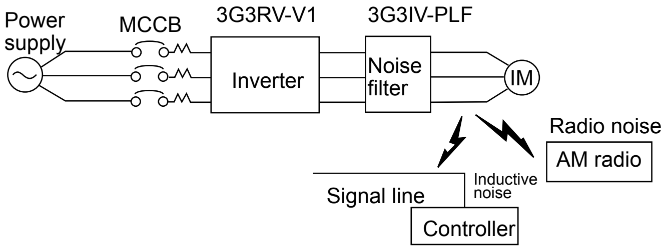
When using an MC to switch to a commercial power supply, stop the Inverter and motor before operating the MC. Use the speed search function if the MC is operated during operation. If measures for momentary power interrupts are required, use a delayed release MC.

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 2.11 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.

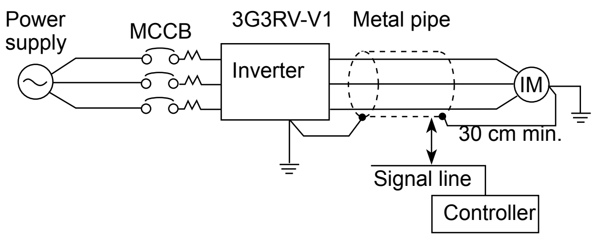


Fig 2.12 Countermeasures Against Inductive Noise

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.

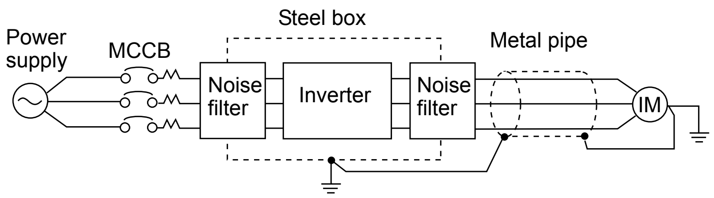


Fig 2.13 Countermeasures Against Radio Interference

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 2.8*. (For details, refer to *Chapter 5 Parameters*.)

Table 2.8 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.

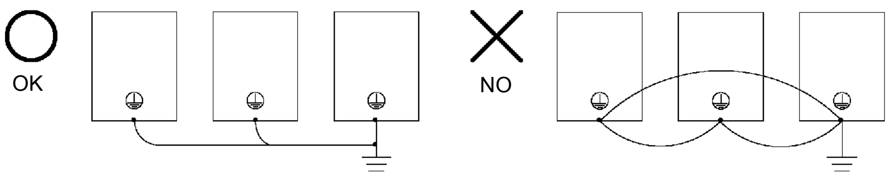


Fig 2.14 Ground Wiring

■ 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 37 kW.

Connect the braking resistor as shown in *Fig 2.15*.

Table 2.9

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)

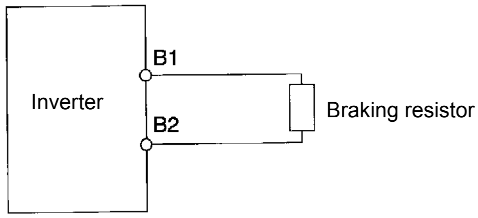


Fig 2.15 Connecting the Braking Resistor

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 2.15*.

A Braking Resistor that mounts to the Inverter can also be used with Inverters with outputs from 0.4 to 3.7 kW.

Table 2.10

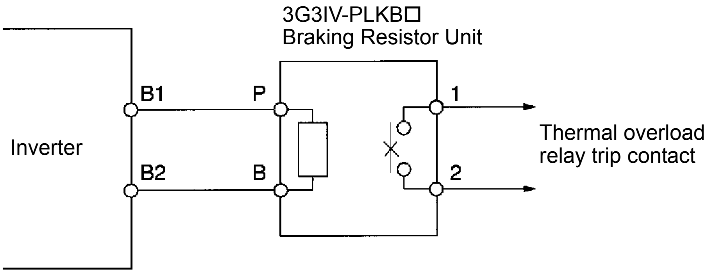
L8-01 (Protect selection for internal DB resistor)	0 (Disables overheat protection)
L3-04 (Stall prevention selection during deceleration) (Select either one of them.)	0 (Disables stall prevention function)
	3 (Enables stall prevention function with braking resistor)

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 2.16*.

200-V and 400-V Class Inverters with 0.4 to 18.5 kW Output



IMPORTANT

When connecting a braking unit (model 3G3IV-PCDBR□), connect the B1 terminal of the Inverter to the + terminal of the Braking Unit and connect the – terminal of the Inverter to the – terminal of the Braking Unit. The B2 terminal is not used in this case. See *Chapter 10 Wiring Examples* for correct wiring.

200-V and 400-V class Inverters with 22 kW or higher Output

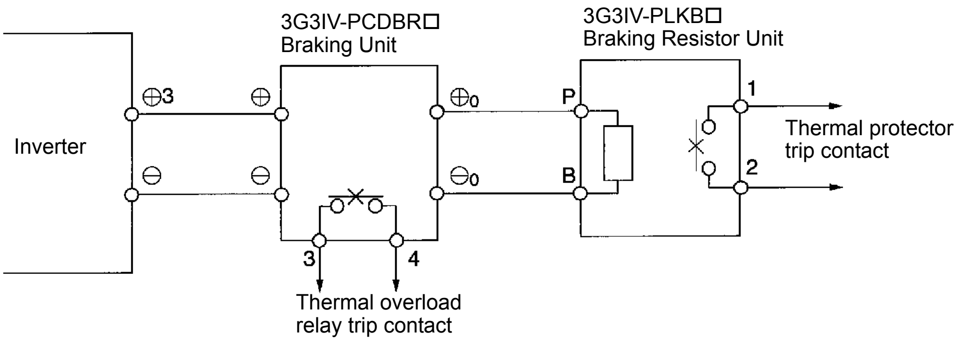


Fig 2.16 Connecting the Braking Resistor Unit and Braking Unit

Connecting Braking Units in Parallel

When connecting two or more Braking Units in parallel, use the wiring and connectors shown in *Fig 2.17*. 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).

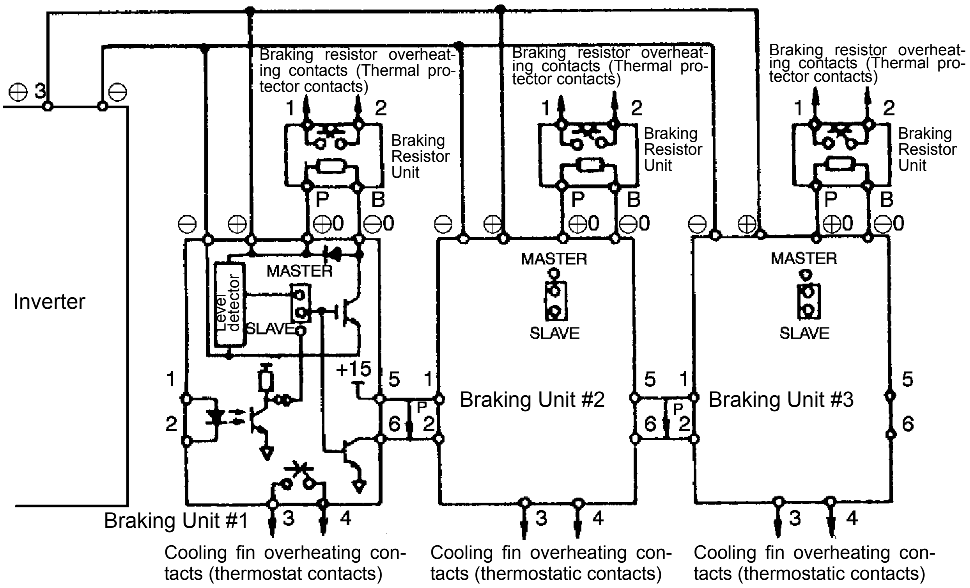
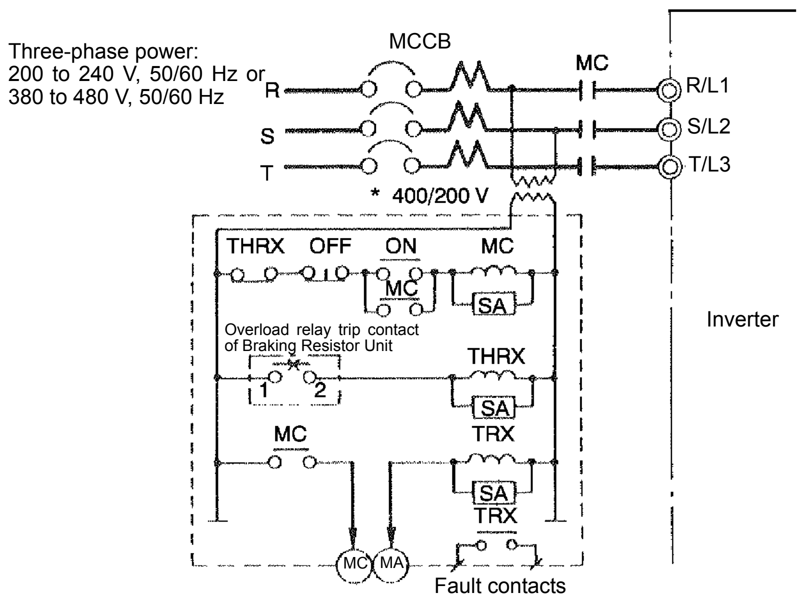


Fig 2.17 Connecting Braking Units in Parallel

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 2.18 Power Shutoff Sequence

Wiring Control Circuit Terminals

◆ 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.

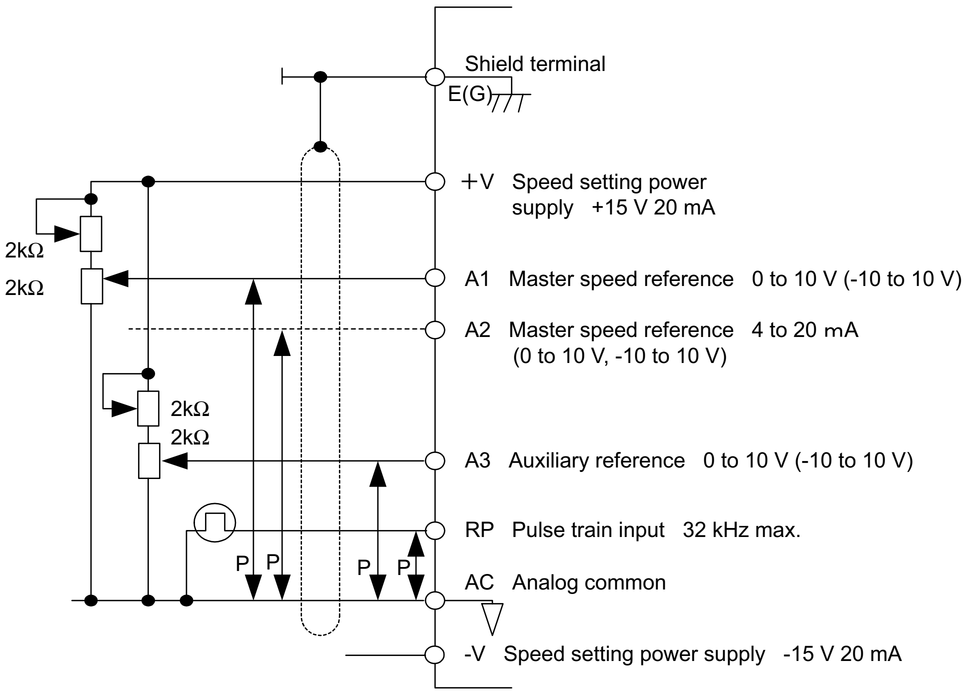


Fig 2.19

Terminal numbers and wire sizes are shown in *Table 2.11*.

Table 2.11 Terminal Numbers and Wire Sizes (Same for all Models)

Terminals	Terminal Screws	Tightening Torque (N•m)	Possible Wire Sizes mm2(AWG)	Recommended Wire Size mm2(AWG)	Wire Type
FM, AC, AM, P1, P2, PC, SC, A1, A2, A3, +V, -V, S1, S2, S3, S4, S5, S6, S7, S8, MA, MB, MC, M1, M2	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 2.6 Close-loop Connector Sizes* (JIS (2805) (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 2.12 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	Phoenix Contact
0.5 (20)	AI 0.5 - 8WH	1.1	2.5	14	
0.75 (18)	AI 0.75 - 8GY	1.3	2.8	14	
1.25 (16)	AI 1.5 - 8BK	1.8	3.4	14	
2 (14)	AI 2.5 - 8BU	2.3	4.2	14	

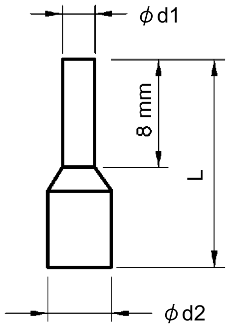


Fig 2.20 Straight Solderless Terminal Sizes

■ 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.

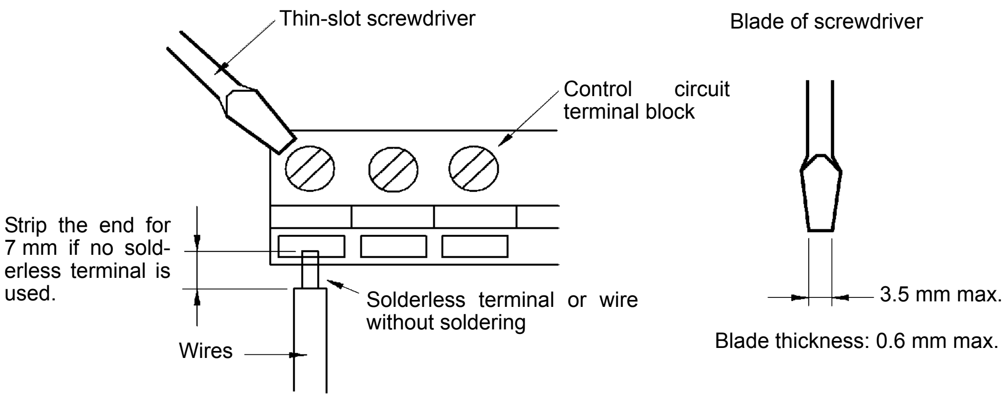


Fig 2.21 Connecting Wires to Terminal Block

◆ Control Circuit Terminal Connections

Connections to Inverter control circuit terminals are shown in *Fig 2.22*.

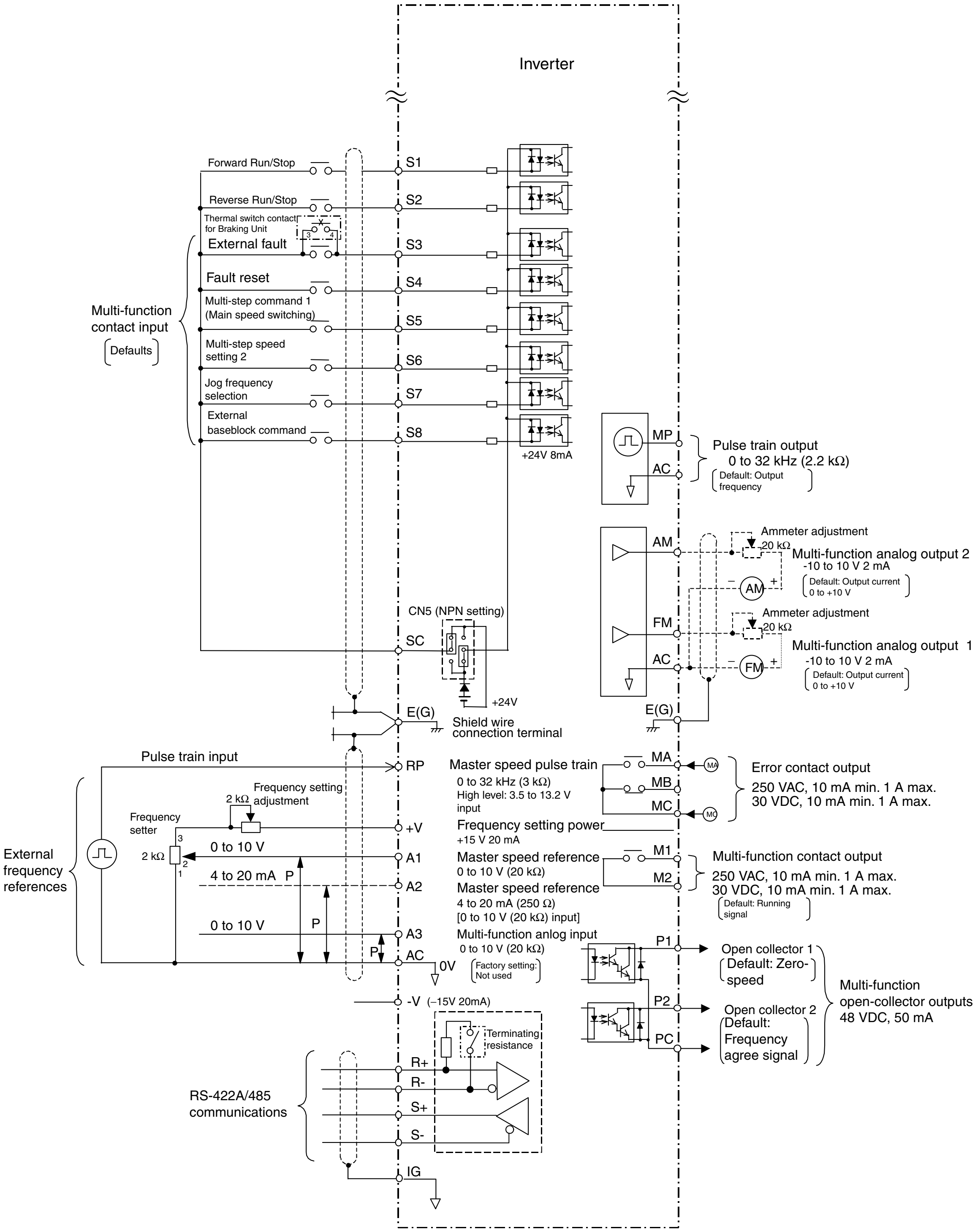


Fig 2.22 Control Circuit Terminal Connections

IMPORTANT

1. Control circuit terminals are arranged as shown below.

E(G)	FM	AC	AM	P1	P2	PC	SC		MP										
	SC	A1	A2	A3	+V	AC	-V		RP	R+	R-	S+	S-		MA	MB	MC		
S1	S2	S3	S4	S5	S6	S7	S8						IG		M1		M2	E(G)	

2. The output current capacity of the +V, –V terminal is 20 mA. Do not short-circuit between the +V, –V, and AC terminals. Doing so may result in a malfunction or a breakdown of the Inverter.
3. Disable the stall prevention during deceleration (set constant L3-04 to 0) when using a Braking Resistor Unit. If this user constant 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. The wiring for a motor with a cooling fan is not required for self-cooling motors.
6. PG circuit wiring (i.e., wiring to the 3G3IV-PPGB2 Board) is not required for control without a PG.
7. Sequence input signals S1 to S8 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 (+24V common and sourcing mode) or to provide a 24-V external power supply, refer to *Table 2.14*.
8. 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.
9. 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.
10. DC reactors to improve the input power factor are built into 200 V Class Inverters for 22 to 110 kW and 400 V Class Inverters for 22 to 300 kW. A DC reactor is thus an option only for Inverters for 18.5 kW or less.
11. Set parameter L8-01 to 1 when using a breaking resistor (ERF). When using a Braking Resistor Unit, a shutoff sequence for the power supply must be made using a thermal relay trip.
12. The permissible load of a multi-function contact output and an error contact output is 10 mA. Use a multi-function open-collector output for a load less than 10 mA.
13. Do not ground the AC terminal. Doing so may result in a malfunction or a breakdown of the Inverter.

2

■ Shunt Connector CN5 and DIP Switch S1

The shunt connector CN 5 and DIP switch S1 are described in this section.

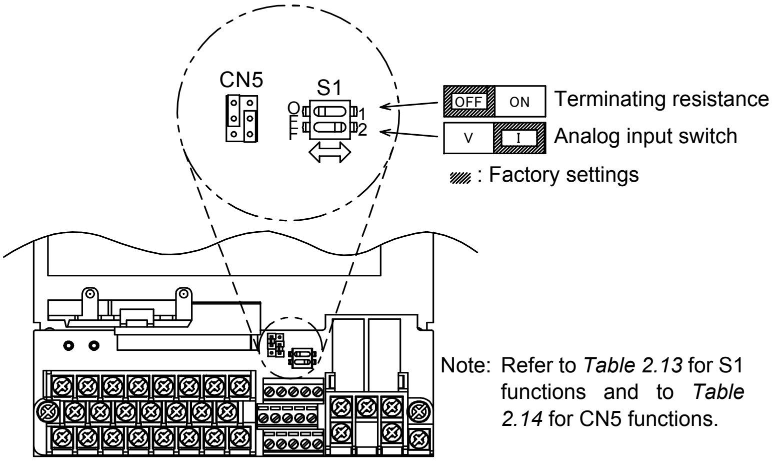


Fig 2.23 Shunt Connector CN5 and DIP Switch S1

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

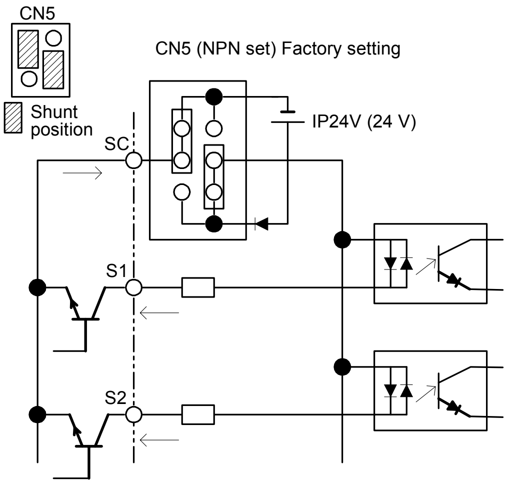
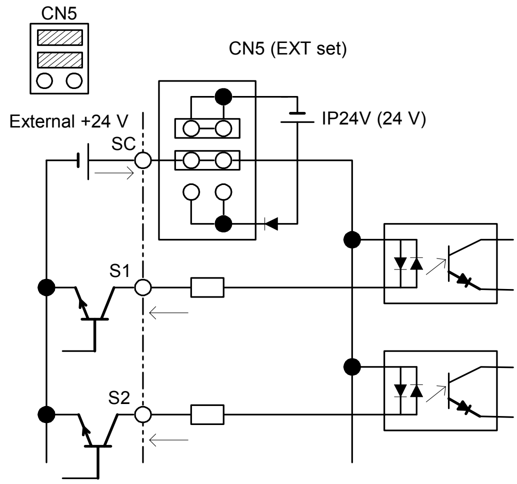
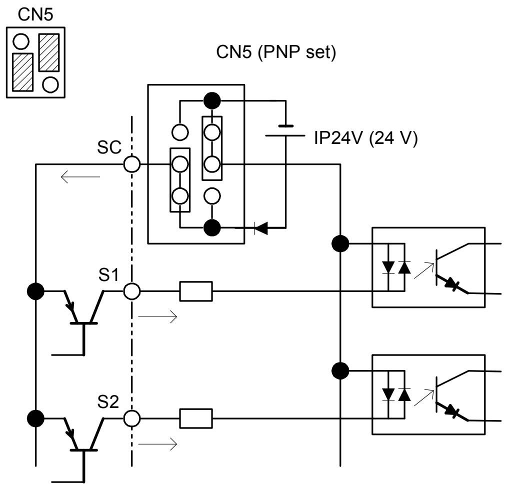
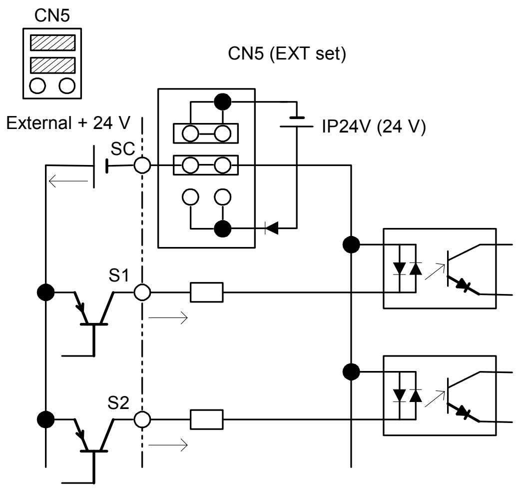
Table 2.13 DIP Switch S1

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: -10 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 2.14 Sinking/Sourcing Mode and Input Signals

	Internal Power Supply	External Power Supply
Sinking Mode		
Sourcing Mode		

◆ 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 2.24*.
- Connect the shield wire to terminal E (G).
- Insulate the shield with tape to prevent contact with other signal lines and equipment.
- Use a class 2 power supply (UL standard) when connecting to the control terminals.

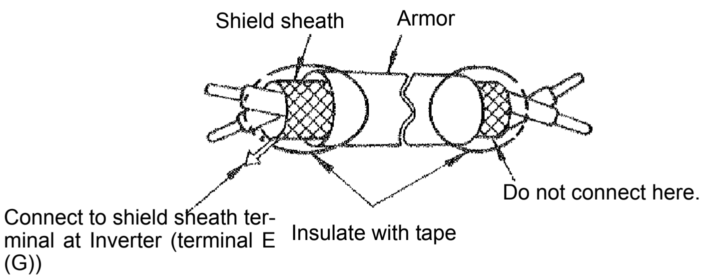


Fig 2.24 Processing the Ends of Twisted-pair Cables

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 2.25*.

Table 2.15 lists the type of Option Cards and their specifications.

Table 2.15 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
Speed Reference Boards	3G3IV-PAI14U	Input signal levels 0 to 10 V DC (20 kΩ), 1 channel 4 to 20 mA (250 Ω), 1 channel Input resolution: 14-bit	C
	3G3IV-PAI14B	Input signal levels 0 to 10 V DC (20 kΩ) 4 to 20 mA (250 Ω), 3 channels Input resolution: 13-bit with sign bit	C
	3G3IV-PDI08	8-bit digital speed reference setting	C
	3G3IV-PDI16H2	16-bit digital speed reference setting	C
DeviceNet Communications Card	3G3RV-PDRT2	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 2.25*.

◆ 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.

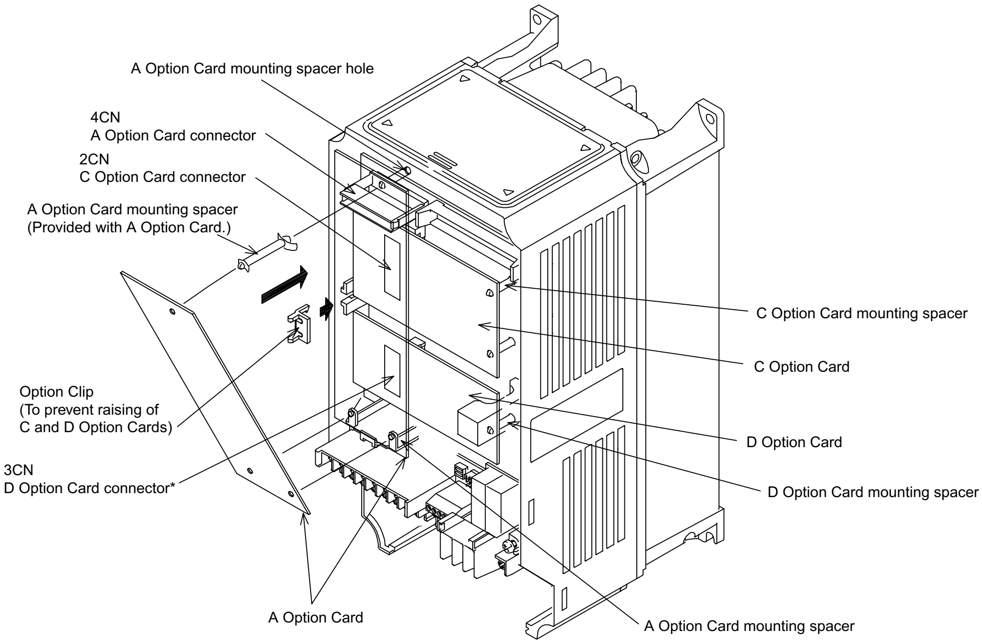
The side of the front cover of the Inverter for 200/400 V Class 0.4 to 5.5 kW can be cut out as described in *Fig 2.26* to make wiring of the option board easy. If the side of the front cover is cut out, the protective structure will be open chassis (IEC IP00).

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

■ 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.

Remove the option clip before installing an option board into slot C or D. The option board cannot be installed completely and may not function property if it is installed with the option clip attached.



* An Option Card in Mounting Location D is supported by Asian Models only. Other models do not have the CN3 connector shown in *Fig 2.25*.

Fig 2.25 Mounting Option Cards

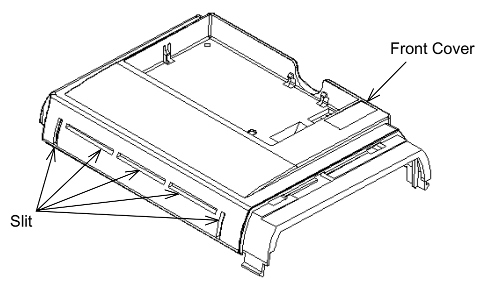


Fig 2.26 Cutting the Front Cover

◆ 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 2.16 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 2.17 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 2.18 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 2.19 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.

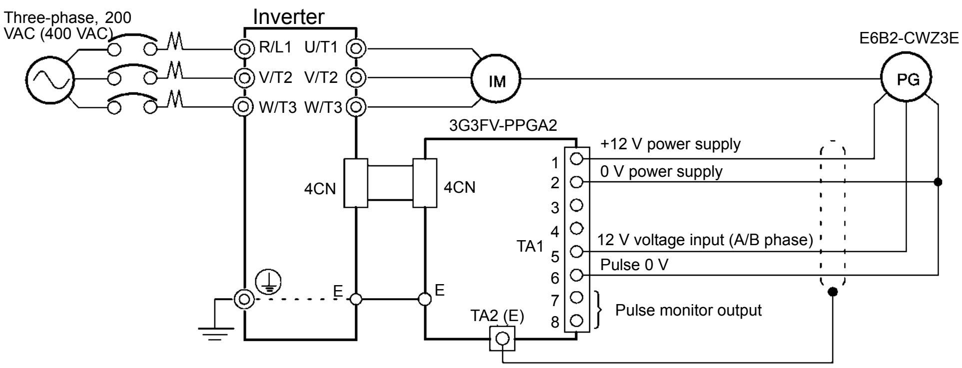
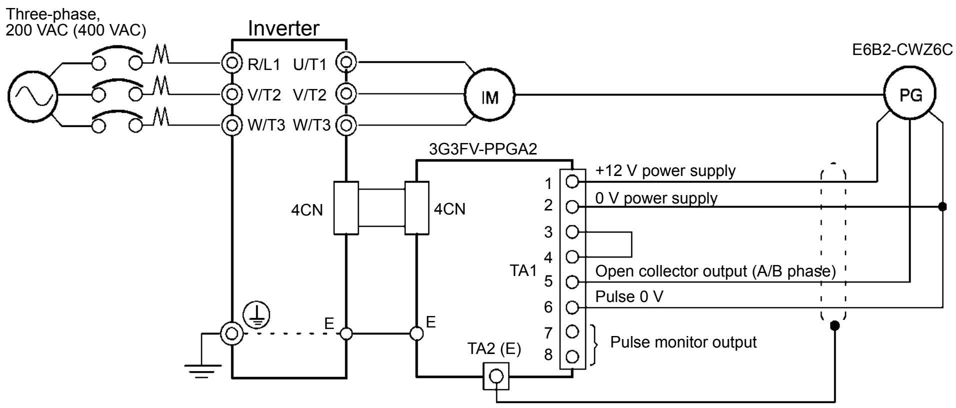


Fig 2.27 Wiring a 12-V Voltage Input



- 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 2.28 Wiring an Open-collector Input

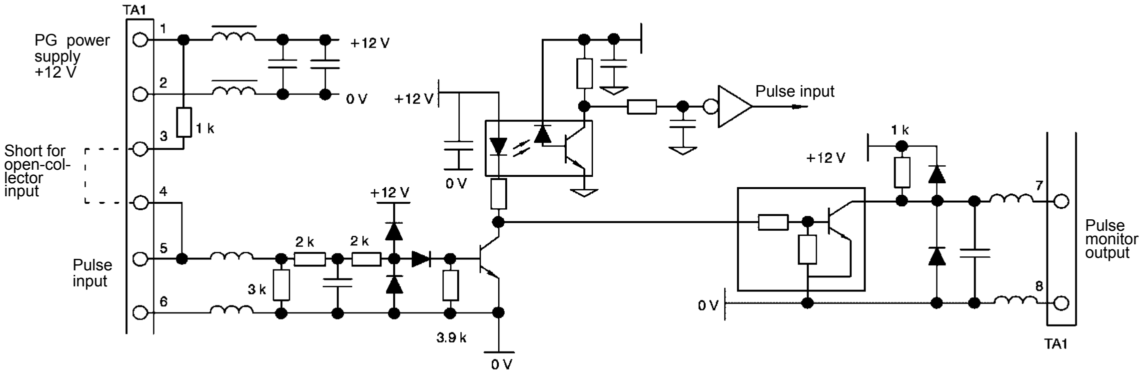
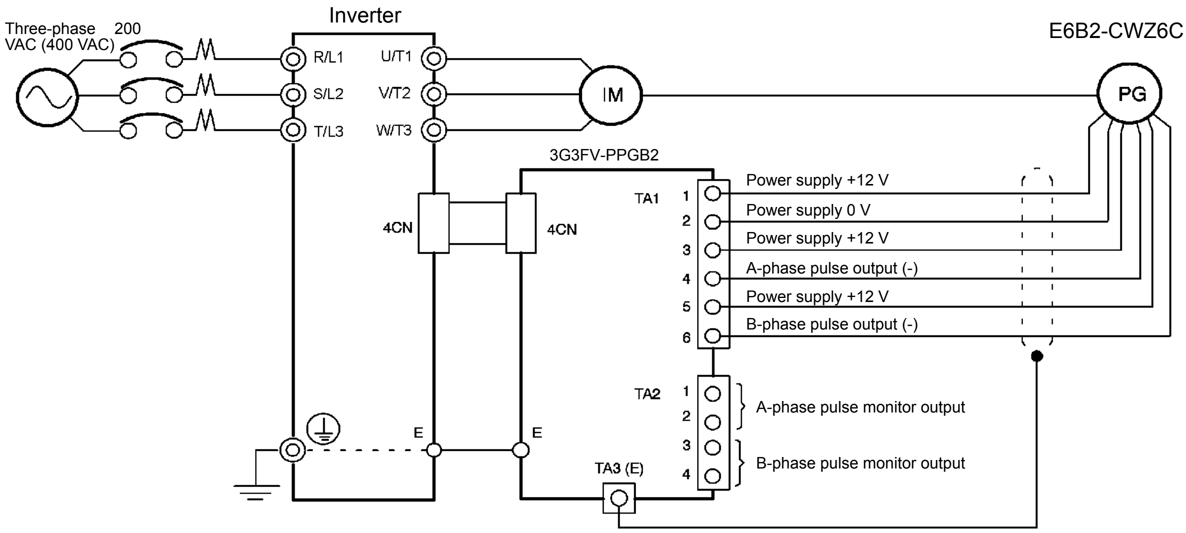


Fig 2.29 I/O Circuit Configuration of the 3G3FV-PPGA2

■ Wiring the 3G3FV-PPGB2

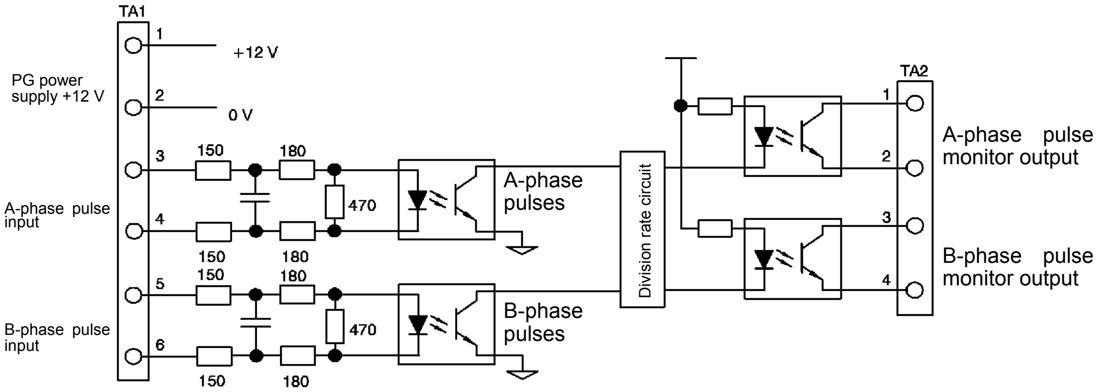
Wiring examples are provided in the following illustrations for the 3G3FV-PPGB2.



- 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 2.30 3G3FV-PPGB2 Wiring

2



- 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.

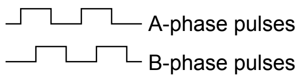
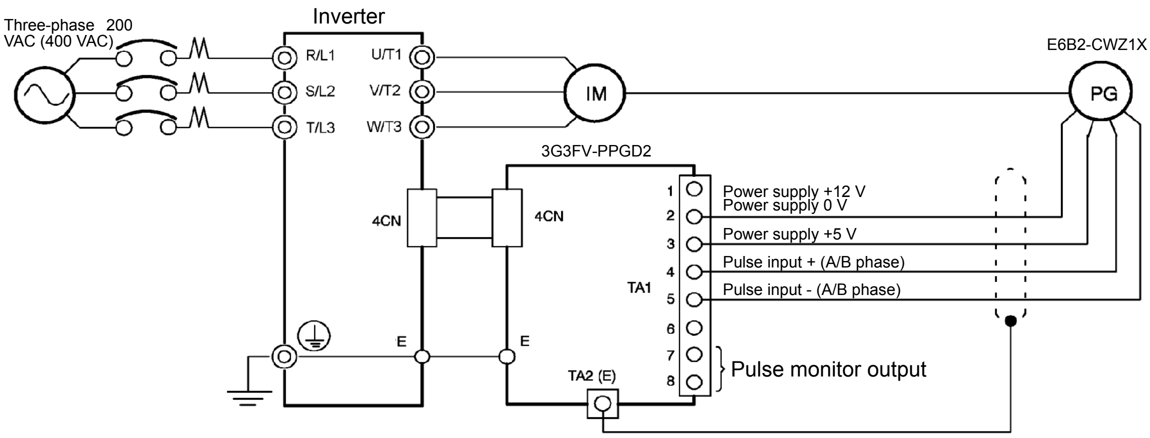


Fig 2.31 I/O Circuit Configuration of the 3G3FV-PPGB2

■ Wiring the 3G3FV-PPGD2

Wiring examples are provided in the following illustrations for the 3G3FV-PPGD2.

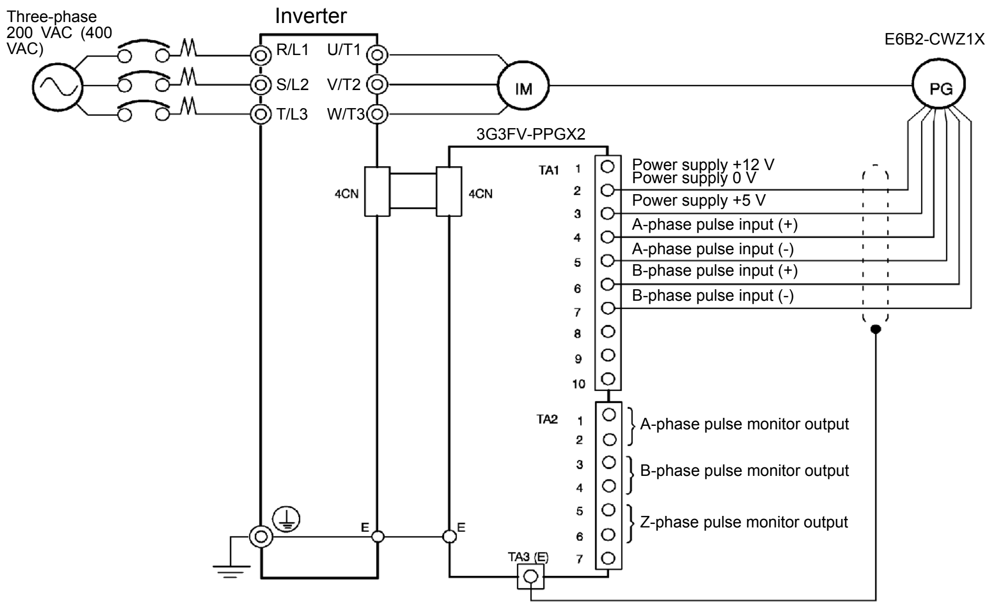


- Shielded twisted-pair wires must be used for signal lines.
- Do not use the pulse generator's power supply for anything other than the pulse generator (encoder). Using it for another purpose can cause malfunctions due to noise.
- The length of the pulse generator's wiring must not be more than 50 meters.

Fig 2.32 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 2.33 3G3FV-PPGX2 Wiring

◆ 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 2.20*.

Table 2.20 Wire Sizes

Terminal	Terminal Screws	Wire Thickness (mm2)	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 2.12 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 2.21*.

Table 2.21 Closed-loop Connectors and Tightening Torques

Wire Thickness [mm2]	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 2-27. 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 2.24* 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 2.22*.

Table 2.22 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.)

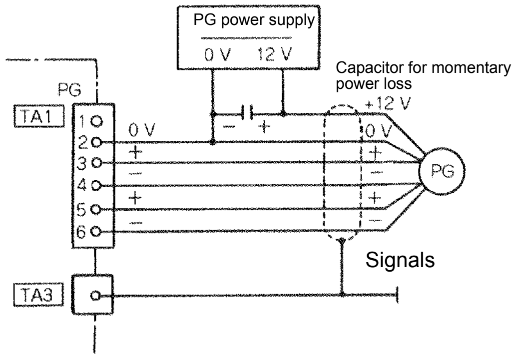


Fig 2.34 3G3FV-PPGB2 Connection Example

■ 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}).

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

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.)

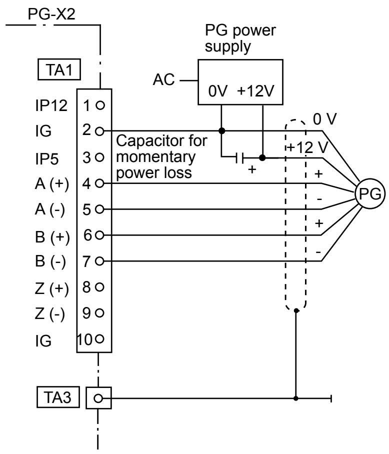


Fig 2.35 3G3FV-PPGD2 Connection Example (for 12-V PG power supply)

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.

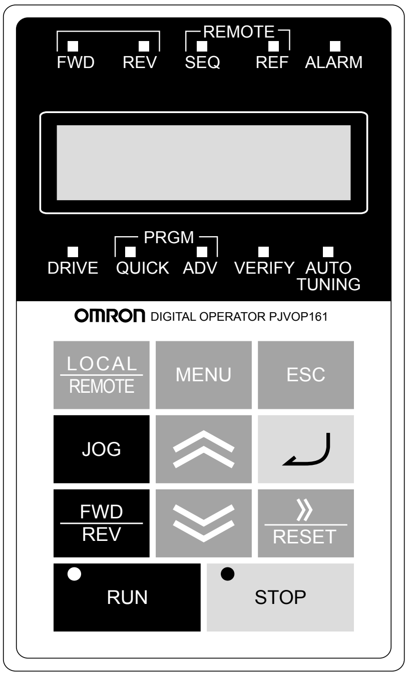
Digital Operator

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).

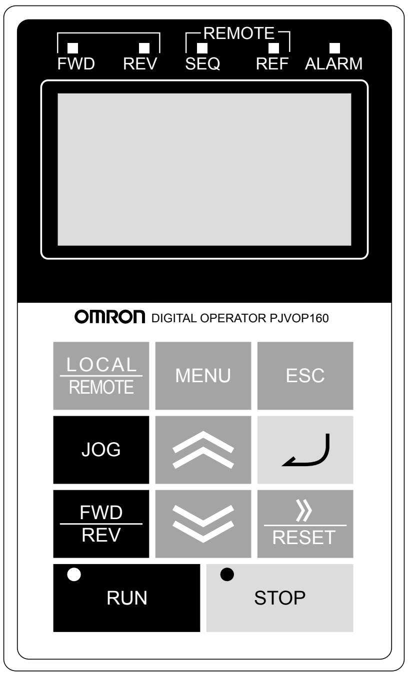
Mode Display

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*.

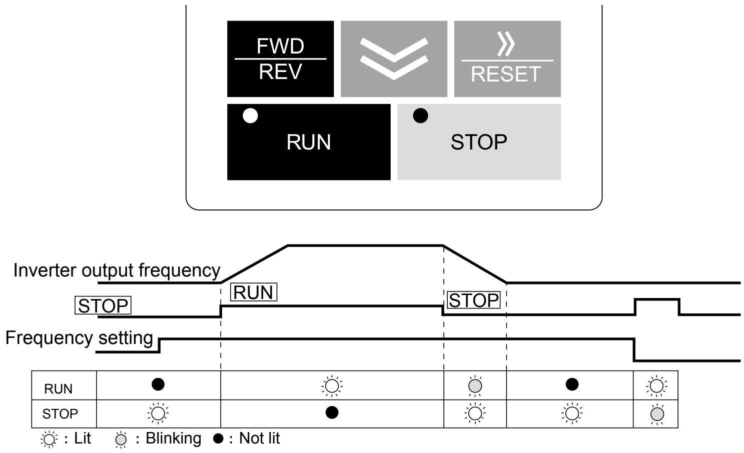


Fig 3.2 RUN and STOP Indicators

Table 3.2 Relation of Inverter to RUN and STOP Indicators

Priority	RUN Indicator	STOP Indicator	Inverter Status	Conditions
1	●	●	Stopped	Power supply is shut down.
2	●	◌	Stopped*	Emergency stop • Stop Command is sent from the Digital Operator when the control circuit terminals were used to operate the Inverter. • Emergency Stop Command is sent from the control circuit terminal. Switched from LOCAL (operation using the Digital Operator) to REMOTE (operation using the control circuit terminals) when the Run Command is sent from the external terminal. Switched from the Quick or Advanced Quick programming mode to the Drive mode when the Run Command is sent from the external terminal.
3	☼	◌	Stopped	The Inverter is run at a frequency below the minimum output frequency. The Run Command is carried out when the External Baseblock Command using the multi-function contact input terminal is issued.
4	●	☼	Stopped	Stopped
5	◌	☼	Running	During deceleration to a stop During DC injection braking when using the multi-function contact input terminal. During initial excitation of DC injection braking while the Inverter is stopped.
6	◌	◌	Running	During emergency deceleration • Stop Command is sent from the Digital Operator when operating the Inverter using the control circuit terminals. • Emergency Stop Command is sent from the control circuit terminal.
7	☼	●	Running	Run Command is issued. During initial excitation of DC injection braking when starting the Inverter.

Note ☼: Lit ◌: Blinking ●: Not lit

* If planning to run the Inverter again, first turn OFF the Run Command and Emergency Stop Command from the control circuit terminal and send the Run Command.

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 3.3*.

Table 3.3 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. The factory setting of the Inverter is A1-02 = 0 for V/f control.

◆ 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.

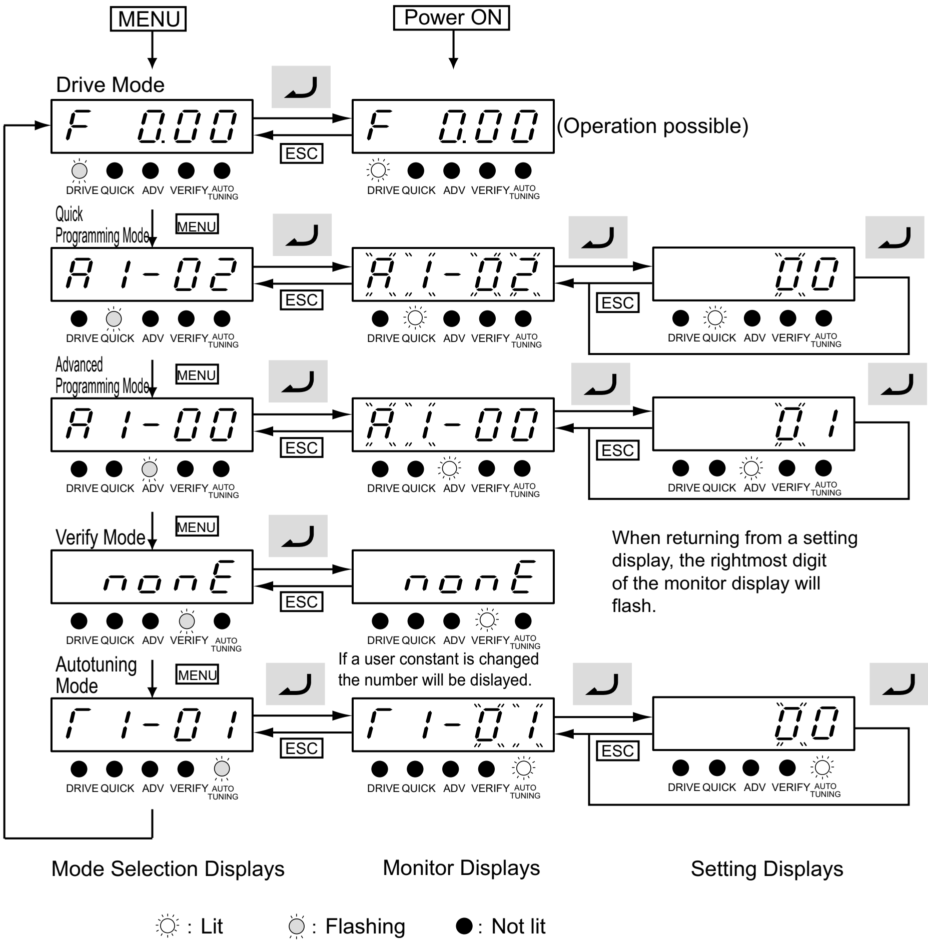


Fig 3.3 Mode Transitions (Example for the 3G3IV-PJVOP161)

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.

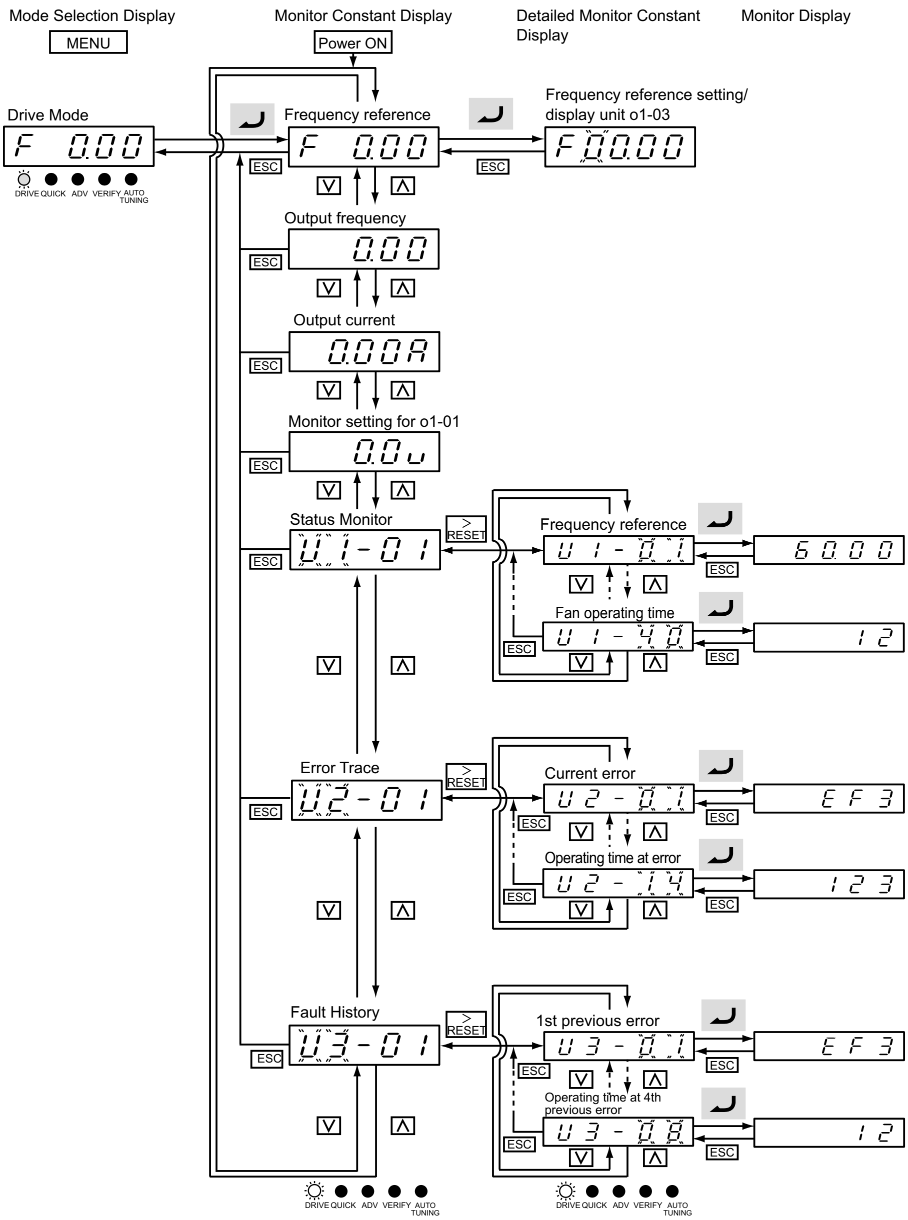


Fig 3.4 Operations in Drive Mode (Example for the 3G3IV-PJVOP161)

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.

3

◆ 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.

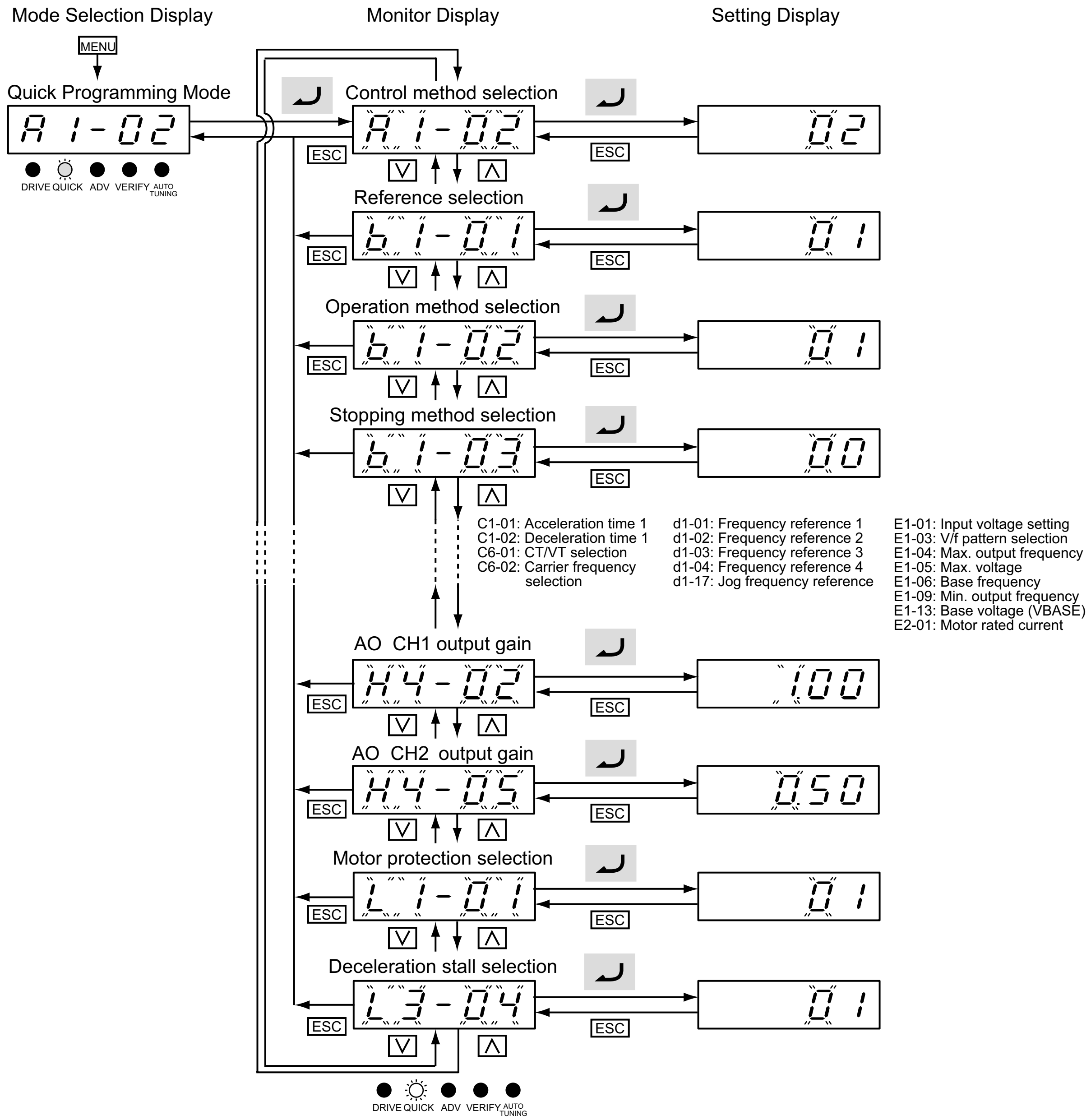


Fig 3.5 Operations in Quick Programming Mode (Example for the 3G3IV-PJVOP161)

◆ 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.

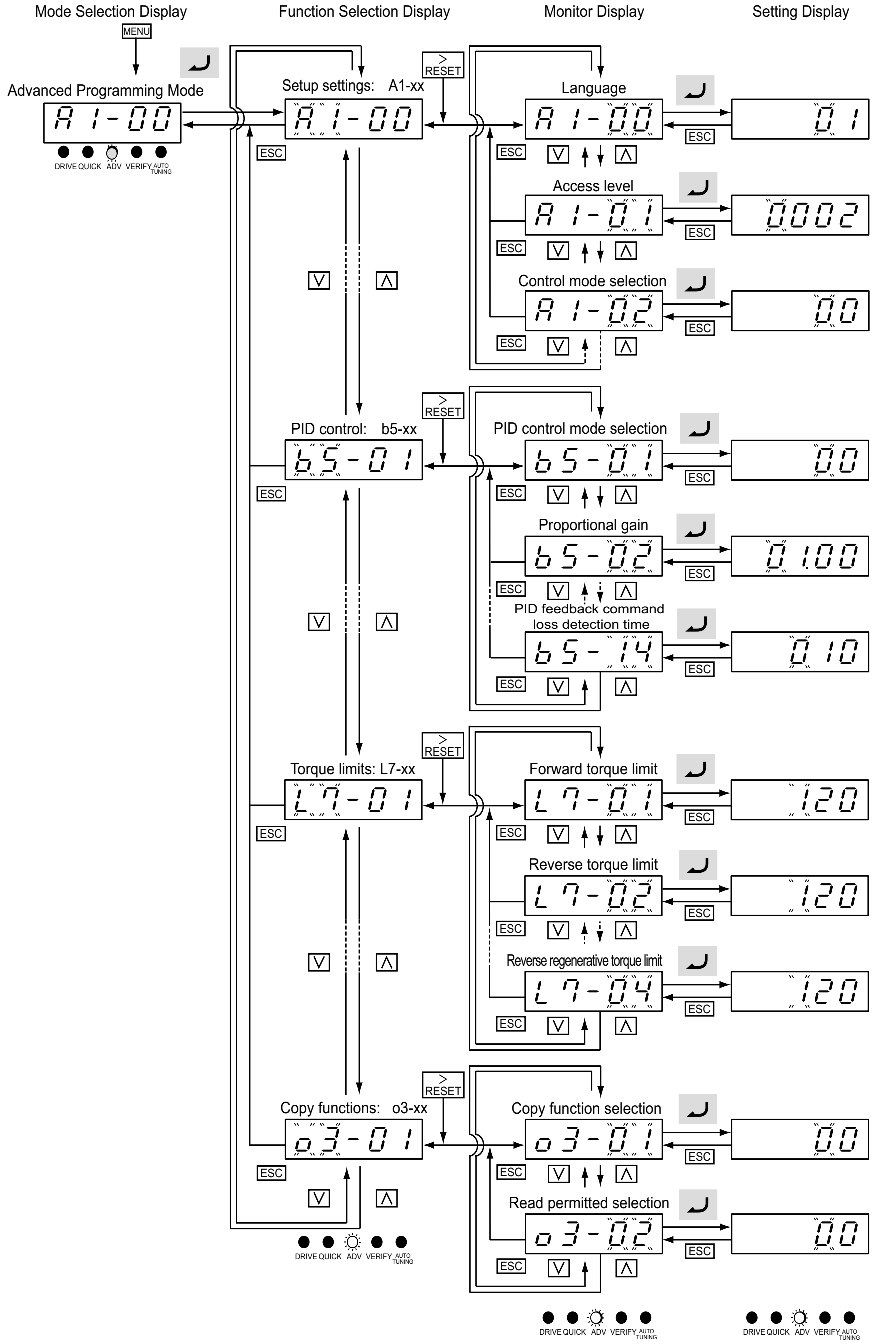


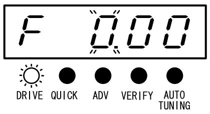
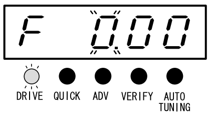
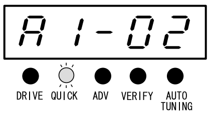
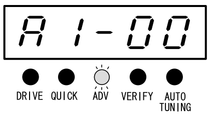
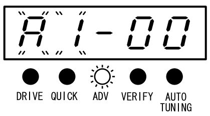
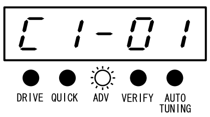
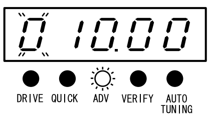
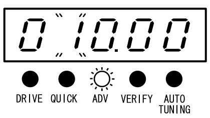
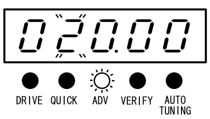
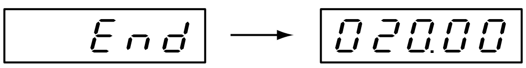
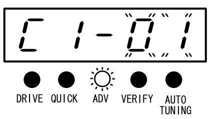
Fig 3.6 Operations in Advanced Programming Mode (Example for the 3G3IV-PJVOP161)

3

■ Setting Parameters

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

Table 3.4 Setting Parameters in Advanced Programming Mode

Step No.	Digital Operator Display	Description
1		Power supply turned ON.
2		MENU Key pressed to enter Drive Mode.
3		MENU Key pressed to enter Quick Programming Mode.
4		MENU Key pressed to Enter Advanced Programming Mode.
5		ENTER pressed to access monitor display.
6		Increment or Decrement Key pressed to display C1-01 (Acceleration Time 1).
7		ENTER Key pressed to access setting display. The setting of C1-01 (10.00) is displayed.
8		Digit Selection/RESET Key pressed to move the flashing digit to the right.
9		Increment Key pressed to change set value to 20.00 s.
10		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		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).

3

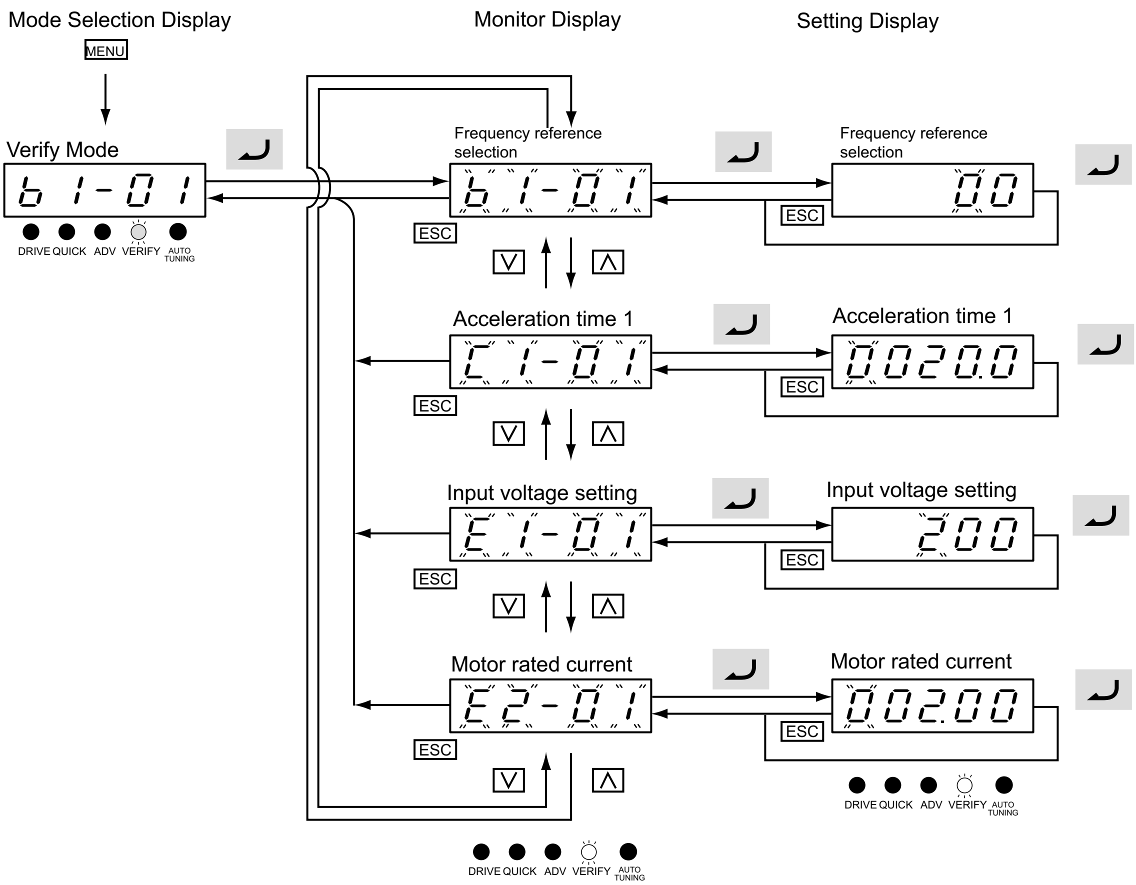


Fig 3.7 Operations in Verify Mode (Example for the 3G3IV-PJVOP161)

◆ 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 autotuning function determines the size of a load, so these autotuning functions are fundamentally different.

The factory setting of the Inverter is A1-02 = 0 for V/f control.

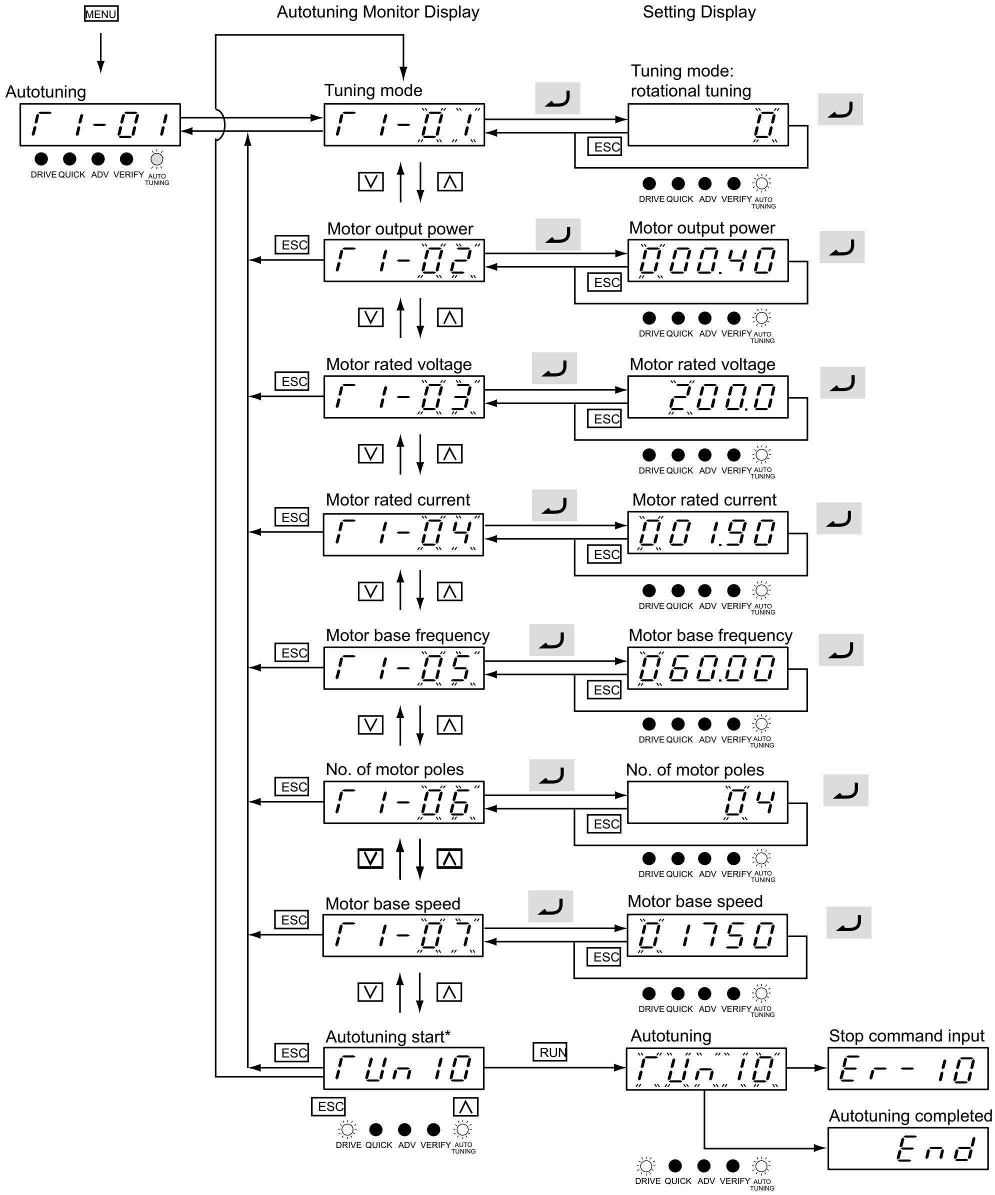
■ Example of Operation

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.



* TUn10 will be displayed during rotational autotuning and TUn11 will be displayed during stationary autotuning. The DRIVE indicator will light when autotuning starts.

Fig 3.8 Operation in Autotuning Mode (Example for the 3G3IV-PJVOP161)

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.

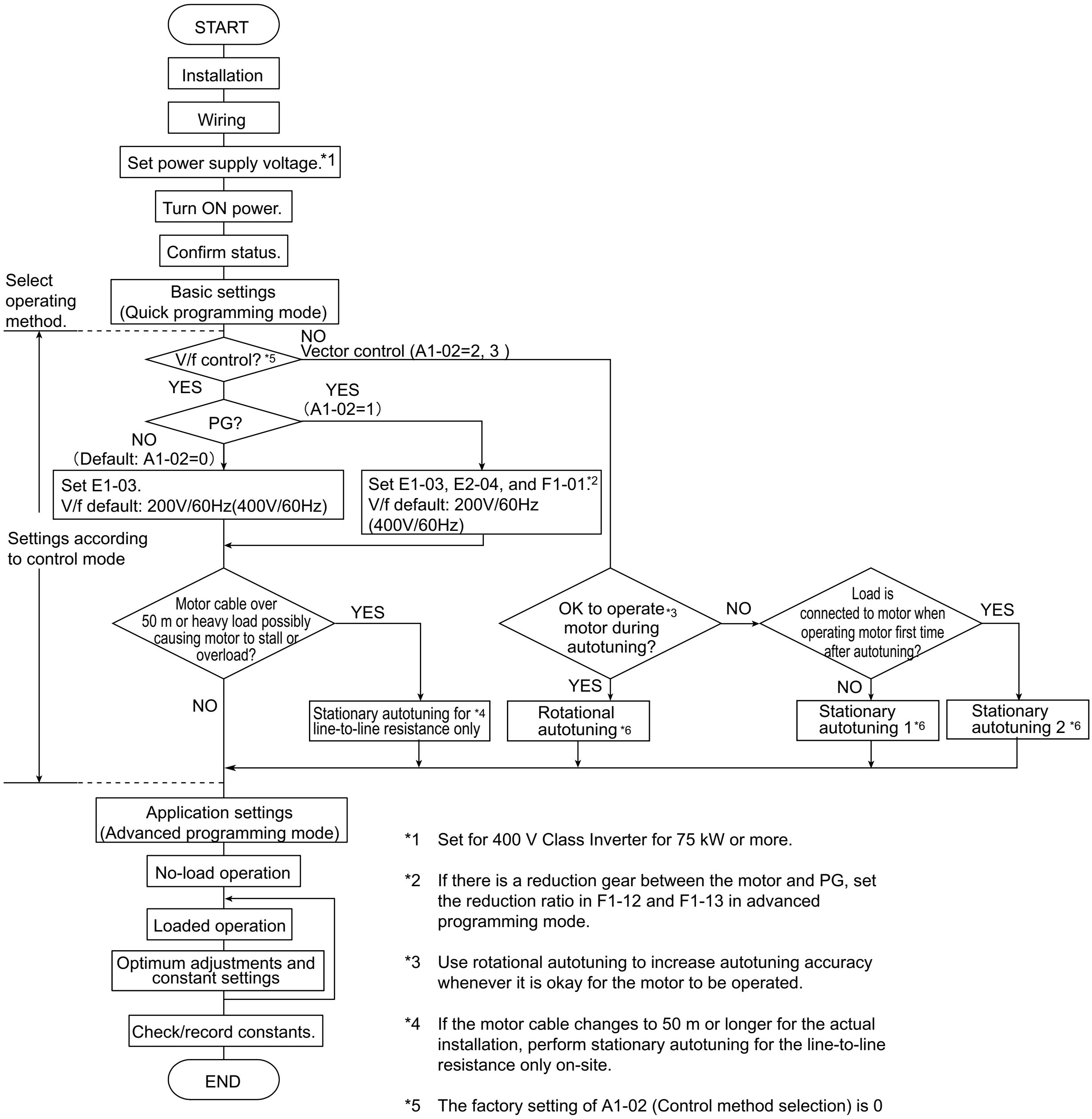
⚠ **Caution** Provide a separate holding brake when necessary. Not doing so may result in injury.

⚠ **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.



*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.

*5 The factory setting of A1-02 (Control method selection) is 0 (V/f control).

*6 If the maximum output frequency is different from the base frequency, set the maximum output frequency (E1-04) to the value of the base frequency after autotuning.

Fig 4.1 Trial Operation Flowchart

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 0 (CT: low carrier, fixed torque).
However, only 1(VT) can be set for 200 V Class 110 kW as well as 400 V Class 220 kW and 300 kW Inverters with any SPEC.

◆ 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.

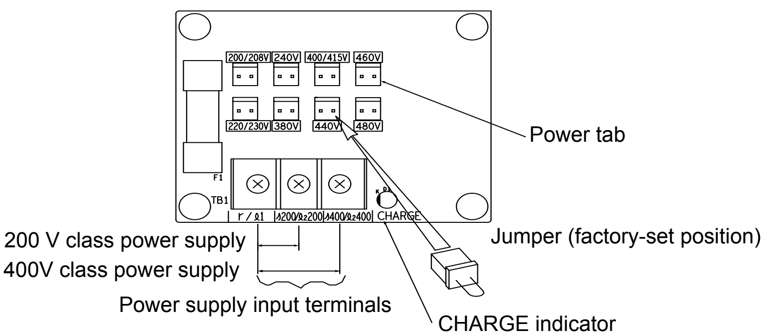


Fig 4.2 Large-capacity Inverter Connections

◆ Power ON

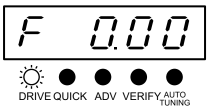
Confirm all of the following items before turning ON the power supply.

- 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
  For an Inverter of 200 V, 37 kW or more, use one of the following power supplies for the cooling fan.
  3-phase 200/208/220 VAC 50 Hz or 3-phase 200/208/220/230 VAC 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:

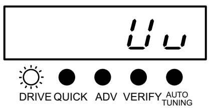
Display for normal operation



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



The display will differ depending on the type of fault.
A low voltage alarm is shown at left.

◆ 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 2: Open-loop vector control 3: Flux vector control	0 to 3	0	5-8
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 board 4: Pulse train input	0 to 4	1	5-10 6-6 6-81 6-100
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 board	0 to 3	1	5-10 6-14 6-81 6-100
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 s *1	10.0 s	5-21 6-23
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 s *1	10.0 s	5-21 6-23
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	0*2	5-26 6-2
E1-01	Input voltage setting	Set the Inverter's nominal input voltage in volts. This setting is used as a reference value in protection functions.	155 to 255 V (200 V Class) 310 to 510 V (400 V Class)	200 V (200 V Class) 400 V (400 V Class)	5-33 6-155
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	5-34 6-62 6-152

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	5-57 6-62

* 1. 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/deceleration times becomes 0.00 to 600.00 seconds.

* 2. Only 1(VT) can be set for 200 V Class 110 kW as well as 400 V Class 220 kW and 300 kW Inverters.

IMPORTANT

When C6-01 is set to 0 (CT), non-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	Select stopping method when Stop Command is sent. 0: Deceleration to stop 1: Coast to stop 2: DC braking stop 3: Coast to stop with timer	0 to 3 *1	0	5-10 6-16
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, 1 (C6-01=0) 0 to F (C6-01=1)	0, 1 (C6-01=0) 6*2 (C6-01=1)	5-26 6-2
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.	0.00 to 300.00 *3*4	d1-01 to d1-04: 0.00 Hz d1-17: 6.00 Hz	5-27 6-9
H4-02 and H4-05	FM and AM terminal output gain	Set the voltage level gain for the multi-function analog output 1 (H4-02) and 2 (H4-05). Set the number of multiples of 10 V to be output as the 100% output for the monitor item.	0.00 to 2.50	H4-02: 1.00 H4-05: 0.50	5-53
L3-04	Stall prevention selection during deceleration	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 the 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 *5	1	5-61 6-30

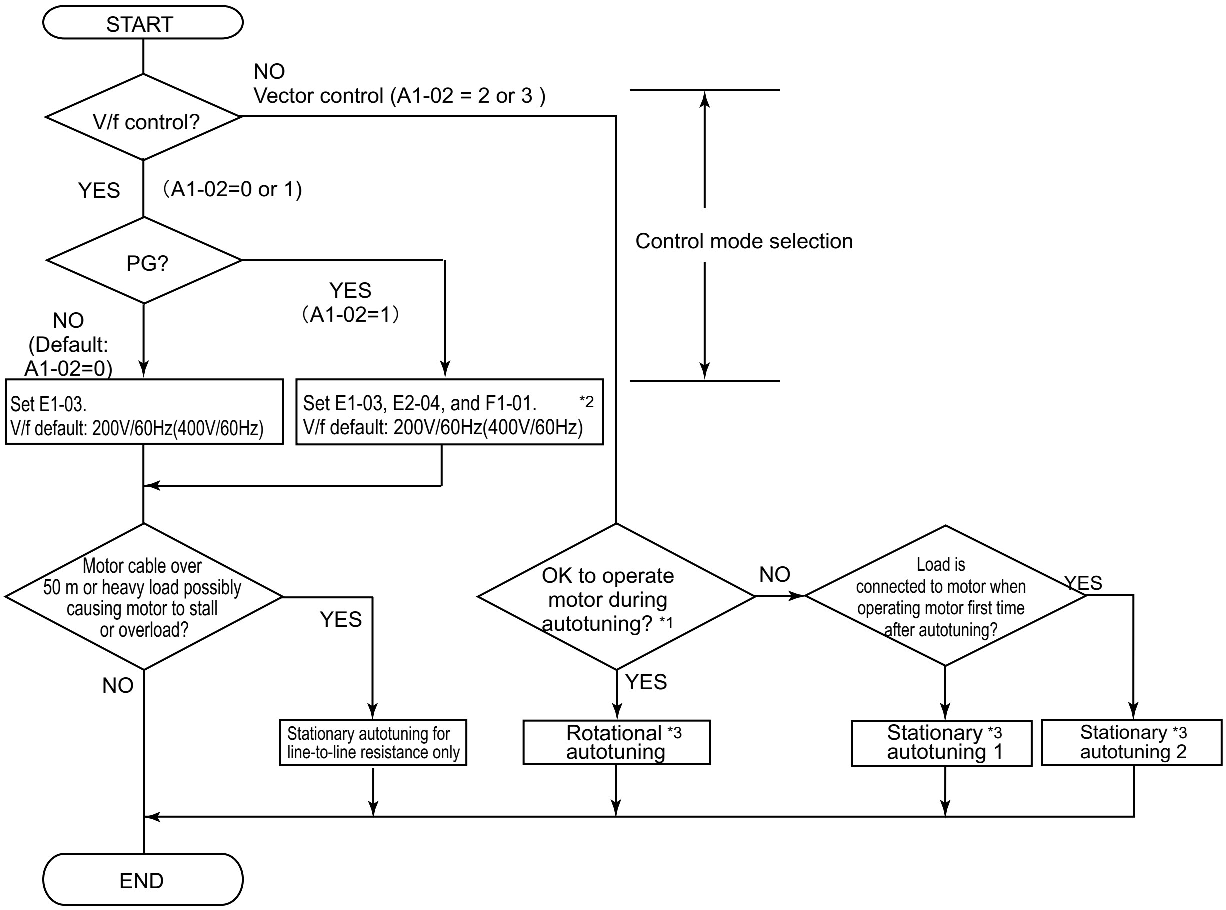
* 1. 0 or 1 for flux vector control.
* 2. The factory setting depends on the capacity of the Inverter.
* 3. The upper limit of the setting range depends on the upper limit set in E1-04.
* 4. When C6-01 = 1, the upper limit is 400.00.
* 5. When using flux vector control, 0 to 2.

◆ 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 flowchart.



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.
* 3. If the maximum output frequency is different from the base frequency, set the maximum output frequency (E1-04) to the value of the base frequency after autotuning.

Fig 4.3 Settings According to the Control Method

■ Setting the Control Method

Any of the following four control methods can be set.

Control Method	Parameter Setting	Basic Control	Main Applications
V/f control	A1-02 = 0 (factory setting)	Voltage/frequency ratio fixed control	Variable speed control, particularly control of multiple motors with one Inverter and replacing existing Inverters
V/f control with PG	A1-02 = 1	Voltage/frequency ratio fixed control with speed compensation using a PG	Applications requiring high-precision speed control using a PG on the machine side
Open-loop vector control	A1-02 = 2	Current vector control without a PG	Variable speed control, applications requiring speed and torque accuracy using vector control without a PG
Flux vector control	A1-02 = 3	Flux vector control	Very high-performance control with a PG (simple servo drives, high-precision speed control, torque control, and torque limiting)

Note With vector control, the motor and Inverter must be connected 1:1. The motor capacity for which stable control is possible is 50% to 100% of the capacity of the Inverter.

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 Parameter). 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.

Flux Vector Control (A1-02 = 3)

Perform autotuning. If the motor can be operated, perform rotational autotuning. If the motor cannot be operated, perform stationary autotuning 1 or 2. Refer to the following section on *Autotuning* for details on autotuning.

◆ Autotuning

Use the following procedure to perform autotuning if using the vector control method or the cable length is long, etc. Motor parameters will be set automatically.

If the control method was changed after autotuning, be sure to perform autotuning again.

One of the following four autotuning modes can be set.

- Rotational autotuning
- Stationary autotuning 1
- Stationary autotuning for line-to-line resistance only
- Stationary autotuning 2

■ 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 parameters, whereas servo system autotuning adjusts parameters according to the detected size of the load.
- When speed or torque 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 1 or 2 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, when high precision is required, 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 parameters 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 autotuning 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 1	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.
Stationary autotuning 2	Do not function.	Maintain same status as when autotuning is started.

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

■ Setting the Autotuning Mode

Rotational Autotuning (T1-01 = 0)

Rotational autotuning is used for open-loop vector control and flux 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 stop the motor for approximately 1 minute and then set the required motor parameters automatically while operating the motor for approximately 1 minute.

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 1 (T1-01 = 1)

Stationary autotuning1 is used for open-loop vector control and flux 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 parameters will be set automatically. The remaining motor parameters E2-02 (motor rated slip) and E2-03 (motor no-load current) will be set automatically the first time operation is started in drive mode. To perform an operation immediately after stationary autotuning1, use the following procedure under the recommended conditions.

1. Check the values of E2-02 and E2-03 in verify mode or advanced programming mode.
2. Run the motor once in drive mode under the following conditions.
   - The Inverter and the motor are connected.
   - The motor shaft is not locked with a mechanical brake or other stopping mechanism (or function).
   - A motor-load ratio of 30% or less is maintained.
   - A speed of 30% or more of the base frequency set at E1-06 (default = highest frequency) is maintained at a constant speed for one second or more.
3. After stopping the motor, check the values of E2-02 and E2-03 again in verify mode or advanced programming mode. If the values of E2-02 and E2-03 differ from the ones before the first operation was carried out, the settings have been successfully completed. Next, check if the values are suitable or not.

If the values of E2-02 and E2-03 differed greatly from the reference data of the motor in the test report or the instruction manual, hunting, motor vibrations, insufficient motor torque, or an overcurrent may occur because the motor is operated although the aforementioned conditions have not been fulfilled after stationary autotuning1. For elevators, failure to observe this caution may result in the cage falling or injury. If so, perform stationary autotuning1 again and run the motor using the aforementioned procedure under the recommended conditions or perform stationary autotuning 2 or rotational autotuning.

Usually the standard setting for E2-02 is 1 Hz to 3 Hz, and that for E2-03 is 30% to 65% of the rated current for a general-purpose motor. Generally, the larger the motor capacity is, the smaller the rated slip and the ratio of the no-load current to the rated current become. Use the data given in *Factory Settings that Change with the Inverter Capacity (o2-04)* of *Chapter 5 User Parameters* as a reference.

IMPORTANT

1. Power will be supplied to the motor when stationary autotuning 1 is performed even though the motor will not turn. Do not touch the motor until autotuning has been completed.
2. When performing stationary autotuning 1 connected to a conveyor or other machine, ensure that the holding brake is not activated during 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 (50 m or longer) or the cable length has changed since installation or when the motor and Inverter have different capacities.

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.

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.

Stationary Autotuning 2 (T1-01 = 4)

Stationary autotuning 2 is used for open-loop vector control and flux vector control. Set T1-04 to 4, and Motor no-load current (T1-09) will be added as a setting item. Input the data from the nameplate. Be sure to input the value or motor no-load current (motor exciting current) from motor examination results to T1-09. After autotuning, the value of T1-09 will be written in E1-03. When not setting T1-09, the value of Yaskawa standard motor's no-load current will be written in E1-03.

IMPORTANT

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

■ Precautions for Rotational and Stationary Autotuning

Lower the base voltage based on *Fig 4.4* to prevent saturation of the Inverter's output voltage when the rated voltage of the motor is higher than the voltage of the power supply to the Inverter. Use the following procedure to perform autotuning.

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 having completed autotuning, set E1-05 (Motor maximum frequency) to the base frequency shown on the motor nameplate.

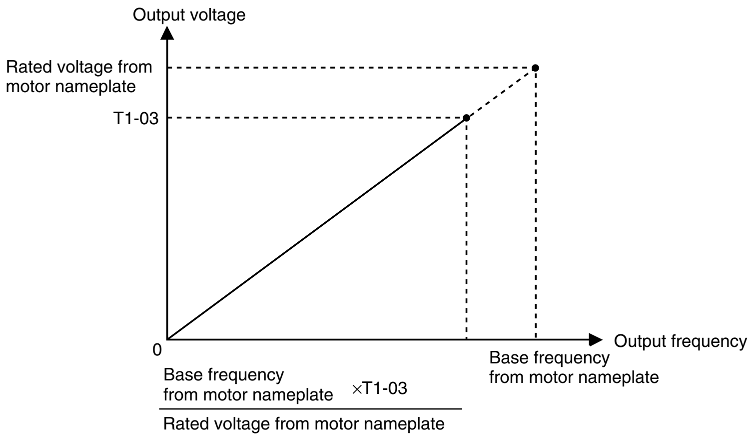


Fig 4.4 Motor Base Frequency and Inverter Input Voltage Setting

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 × 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.

■ Precautions after Using Rotational and Stationary Autotuning

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

In stationary autotuning1, when the motor is first operated in the drive mode after tuning, the remaining motor parameters E2-02 (Motor rated slip) and E2-03 (Motor no-load current) are set automatically. To perform an operation immediately after stationary autotuning 1, use the following procedure under the recommended conditions.

1. Check the values of E2-02 and E2-03 in verify mode or advanced programming mode.
2. Run the motor once in drive mode under the following conditions.
   - The Inverter and the motor are connected.
   - The motor shaft is not locked with a mechanical brake or other stopping mechanism (or function).
   - A motor-load ratio of 30% or less is maintained.
   - A speed of 30% or more of the base frequency set at E1-06 (default = highest frequency) is maintained at a constant speed for one second or more.
3. After stopping the motor, check the values of E2-02 and E2-03 again in verify mode or advanced programming mode. If the values of E2-02 and E2-03 differ from the ones before the first operation was carried out, the settings have been successfully completed. Next, check if the values are suitable or not.

If the values of E2-02 and E2-03 differed greatly from the reference data of the motor in the test report or the instruction manual, hunting, motor vibrations, insufficient motor torque, or an overcurrent may occur because the motor is operated although the aforementioned conditions have not been fulfilled after stationary autotuning 1. For elevators, failure to observe this caution may result in the cage falling or injury. If so, perform stationary autotuning 1 again and run the motor using the aforementioned procedure under the recommended conditions or perform stationary autotuning 2 or rotational autotuning.

Usually the standard setting for E2-02 is 1Hz to 3Hz, and that for E2-03 is 30% to 65% of the rated current for a general-purpose motor. Generally, the larger the motor capacity is, the smaller the rated slip and the ratio of the no-load current to the rated current become. Use the data given in *Factory Settings that Change with the Inverter Capacity (o2-04)* of *Chapter 5 User Parameters* as a reference.

■ Parameter Settings for Autotuning

The following parameters must be set before autotuning.

Table 4.4 Parameter Settings before Autotuning

Parameter Number	Name	Display	Setting Range	Factory Setting	Data Displays during Autotuning			
					V/f	V/f with PG	Open Loop Vector	Flux Vector
T1-00	Motor 1/2 selection*1	When switching to motor 2 is selected, set the motor for which autotuning is to be performed. (This parameter is ignored if motor 2 is not selected.) 1: Motor 1 2: Motor 2	1 or 2	1	Yes	Yes	Yes	Yes
T1-01	Autotuning mode selection	Set the autotuning mode. 0: Rotational autotuning 1: Stationary autotuning 1 2: Stationary autotuning for line-to-line resistance only 4: Stationary autotuning 2	0 to 2, 4 *8	2 *2	Yes (only for 2)	Yes (only for 2)	Yes	Yes
T1-02	Motor output power	Set the output power of the motor in kilowatts.*3 *5	0. 00 to 650.00 kW	0.40 kW *6	Yes	Yes	Yes	Yes
T1-03	Motor rated voltage	Set the rated voltage of the motor in volts.*3 *4	0.0 to 255.0 V (200 V Class) 0.0 to 510.0 V (400 V Class)	200.0 V (200 V Class) 400.0 V (400 V Class)	-	-	Yes	Yes
T1-04	Motor rated current	Set the rated current of the motor in amps.*3 *5	0.32 to 6.40 A *9	1.90 A *6	Yes	Yes	Yes	Yes
T1-05	Motor base frequency	Set the base frequency of the motor in hertz.*3 *4	0.0 to 300.0 Hz *10	60.0 Hz	-	-	Yes	Yes
T1-06	Number of motor poles	Set the number of motor poles.	2 to 48 poles	4 poles	-	-	Yes	Yes
T1-07	Motor base speed	Set the base speed of the motor in min^{-1}.*3	0 to 24000	1750 min^{-1}	-	-	Yes	Yes
T1-08	Number of PG pulses when turning	Set the number of pulses for the PG (pulse generator or encoder). Set the number of pulses per motor revolution without a multiplication factor.	0 to 60000	600	-	Yes	-	Yes
T1-09	Motor no-load current	Set the current value recorded in the motor's test results for a motor without a load. Displayed only when Stationary autotuning 2 is selected (T1-01 = 4).	0.00 to 1.89 *7	1.20A *6	No	No	No	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 H1-06 set to 16).
* 2. The factory setting will change when the control method is changed. The V/f control factory setting is given.
* 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 nameplate 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% of Inverter rating.
* 6. The factory setting depends on the Inverter capacity. The values for a 200 V Class Inverter for 0.4 kW are given.

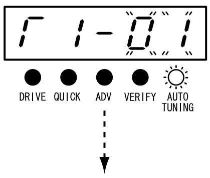
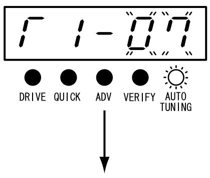
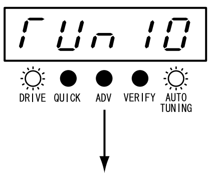
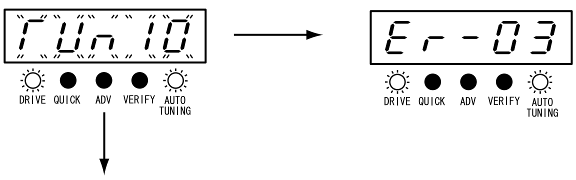
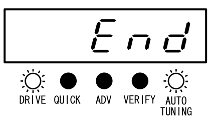
4

* 7. The setting range depends on the Inverter capacity. The value for a 200 V Class Inverter for 0.4 kW is given.
* 8. 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.
* 9. 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.
* 10.When C6-01=1, the upper limit is 400.00.

■ 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 	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) 	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 	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 	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 7-16.
Autotuning completed 	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) × (No. of motor poles)/120 (Hz) × (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 parameters after performing autotuning.

■ 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 4-20 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.

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	Recom-mended 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.
Flux vector control (A1-02 = 3)	ASR proportional gain 1 (C5-01) and ASR proportional gain 2 (C5-03)	• Torque and speed response • Controlling hunting and vibration	20.00	10.00 to 50.00	• Increase the setting (by increments of 5) if torque or speed response is slow. • Reduce the setting if hunting or vibration occurs.
	ASR integral time 1 (high-speed) (C5-02) and ASR integral time 2 (low-speed) (C5-04)	• Torque and speed response • Controlling hunting and vibration	0.500 s	0.300 to 1.000 s	• Reduce the setting if torque or speed response is slow. • Increase the setting if hunting or vibration occurs.
	ASR switching frequency (C5-07)	Switching the ASR proportional gain and integral time according to the output frequency	0.0 Hz	0.0 to max. output frequency	Set the output frequency at which to change the ASR proportional gain and integral time when the same values cannot be used for both high-speed and low-speed operation.
	ASR primary delay time (C5-06)	• Controlling hunting and vibration	0.004 s	0.004 to 0.020 s	• Reduce the setting (by increments of 0.01) if torque or speed response is show. • Increase the setting if machine rigidity is low and the system vibrates easily.
	Carrier frequency selection (C6-02)	• Reducing motor magnetic noise • Controlling hunting and vibration at low speeds (3 Hz or less)	Depends on the capacity	2.0 kHz 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.

* 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 set-

ting.) 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.
Droop function (b7-01 to b7-02)	Used to soften the torque or to balance the load between two motors. Can be used when the control method (A1-02) is set to 3.
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, L3-11, L3-12)	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, L7-06, L7-07)	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.
Feed forward control (N5-01 to N5-04)	Used to increase response for acceleration/deceleration or to reduce over-shooting when there is low machine rigidity and the gain of the speed controller (ASR) cannot be increased. The inertia ratio between the load and motor and the acceleration time of the motor running alone must be set.

5

Chapter 5
User Parameters

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

User Parameter Descriptions

This section describes the contents of the user parameter tables.

◆ Description of User Parameter Tables

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register	Page
						V/f	V/f with PG	Open Loop Vector	Flux Vector		
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 board 4: Pulse train input	0 to 4	1	No	Q	Q	Q	Q	180H	6-6

- Parameter Number: The number of the user parameter.
- Name: The name of the user parameter.
- Description: Details on the function or settings of the user parameter.
- Setting Range: The setting range for the user 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 5-85 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 user 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 Operation Display Functions and Levels

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

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 moni-tored or set.

Verify Mode
Parameters changed from the default settings can be moni-tored or set.

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

No.	Function	Display	Page
U1	Status Monitor Parameters	Monitor	5-77
U2	Fault Trace	Fault Trace	5-82
U3	Fault History	Fault History	5-84
A1	Initialize Mode	Initialization	5-8
A2	User-specified Setting Mode	User Parameters	5-9
b1	Operation Mode Selections	Sequence	5-10
b2	DC Injection Braking	DC Braking	5-12
b3	Speed Search	Speed Search	5-13
b4	Timer Function	Delay Timers	5-15
b5	PID Control	PID Control	5-15
b6	Dwell Functions	Reference Hold	5-18
b7	Droop Control	Droop Control	5-18
b8	Energy Saving	Energy Saving	5-19
b9	Zero-Servo	Zero Servo	5-20
C1	Acceleration/Deceleration	Accel/Decel	5-21
C2	S-curve Acceleration/Deceleration	S-Curve Acc/Dcc	5-22
C3	Motor Slip Compensation	Motor-Slip Comp	5-23
C4	Torque Compensation	Torque Comp	5-24
C5	Speed Control (ASR)	ASR Tuning	5-25
C6	Carrier Frequency	Carrier Freq	5-26
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
d5	Torque Control	Torque Control	5-30
d6	Field Weakening	Field-weakening	5-32
E1	V/f Pattern	V/f Pattern	5-33
E2	Motor Setup	Motor Setup	5-34
E3	Motor 2 V/f Pattern	V/f Pattern 2	5-36
E4	Motor 2 Setup	Motor Setup 2	5-37
F1	PG Option Setup	PG Option Setup	5-38
F2	Analog Reference Board	AI-14 Setup	5-41
F3	Digital Reference Board	DI-08, 16 Setup	5-41
F4	Analog Monitor Boards	A0-08, 12 Setup	5-42
F5	Not Used	D0-02, 08 Setup	5-43
F6	Communications Option Boards	CP-916 Setup	5-44
H1	Multi-function Contact Inputs	Digital Inputs	5-45
H2	Multi-function Contact Outputs	Digital Outputs	5-48
H3	Analog Inputs	Analog Inputs	5-50
H4	Multi-function Analog Outputs	Analog Outputs	5-53
H5	RS-422A/485 Communications	Serial Com Setup	5-54
H6	Pulse Train	Pulse I/O Setup	5-55
L1	Motor Overload	Motor Overload	5-57
L2	Power Loss Ridethrough	PwrLoss Ridethru	5-59
L3	Stall Prevention	Stall Prevention	5-60
L4	Reference Detection	Ref Detection	5-62
L5	Fault Restart	Fault Restart	5-63
L6	Torque Detection	Torque Detection	5-64
L7	Torque Limits	Torque Limit	5-65
L8	Hardware Protection	Hdwe Protection	5-66
N1	Hunting Prevention Function	Hunting Prev	5-68
N2	Speed Feedback Protection Control	AFR	5-69
N3	High-slip Braking	High Slip	5-70
N5	Feed Forward	Feedforward Cont	5-71
o1	Monitor Select	Monitor Select	5-72
o2	Multi-function Selections	Key Selections	5-73
o3	Copy Function	COPY Function	5-75
T	Motor Autotuning	Auto-Tuning	5-75

◆ User Parameters Settable in Quick Programming Mode

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
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 2: Open loop vector 3: Flux vector This parameter is not initialized by the initialize operation.	0 to 3	0	No	Q	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 board 4: Pulse train input	0 to 4	1	No	Q	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 board	0 to 3	1	No	Q	Q	Q	Q	181H
b1-03	Stopping method selection Stopping Method	Used to set the stopping method used 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 *1	0	No	Q	Q	Q	Q	182H
C1-01	Acceleration time 1 Accel Time 1	Sets the acceleration time to accelerate from 0 to the maximum output frequency, in 1-second units.	0.0 to 6000.0 *2	10.0 s	Yes	Q	Q	Q	Q	200H
C1-02	Deceleration time 1 Decel Time 1	Sets the deceleration time to decelerate from the maximum output frequency to 0, in 1-second units.	0.0 to 6000.0 *2	10.0 s	Yes	Q	Q	Q	Q	201H
C6-01	CT/VT selection Heavy/Normal Duty	0: CT (low carrier, parameter torque, 150% per minute) 1: VT (high carrier, variable torque, 120% per minute)	0 or 1	0*3	No	Q	Q	Q	Q	223H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
C6-02	Carrier frequency selection CarrierFreq Sel	Select carrier wave fixed pattern. 0: Low-noise PWM 1: 2.0 kHz 2: 5.0 kHz 3: 8.0 kHz 4: 10.0 kHz 5: 12.5 kHz 6: 15.0 kHz F: Enables detailed settings using parameters C6-03 to C6-05	0,1 (C6-01=0) 0 to F (C6-01=1)	1 (C6-01=0) 6*4 (C6-01=1)	No	Q	Q	Q	Q	224H
d1-01	Frequency reference 1 Reference 1	Sets the frequency reference in the units used in o1-03.	0.00 to 300.00 *5 *6	0.00 Hz	Yes	Q	Q	Q	Q	280H
d1-02	Frequency reference 2 Reference 2	The frequency reference when multi-step speed reference 1 is ON for a multi-function input.		0.00 Hz	Yes	Q	Q	Q	Q	281H
d1-03	Frequency reference 3 Reference 3	The frequency reference when multi-step speed reference 2 is ON for a multi-function input.		0.00 Hz	Yes	Q	Q	Q	Q	282H
d1-04	Frequency reference 4 Reference 4	The frequency reference when multi-step speed references 1 and 2 are ON for multi-function inputs.		0.00 Hz	Yes	Q	Q	Q	Q	283H
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	Q	292H
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 *7	200 V *7	No	Q	Q	Q	Q	300H
E1-03	V/f pattern selection 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	No	302H

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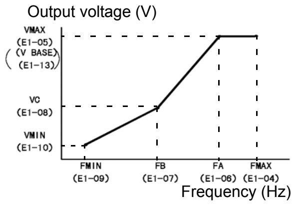
Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
E1-04	Max. output frequency	Max Frequency	 To set V/f characteristics in a straight 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)	40.0 to 300.0 *6	60.0 Hz *8	No	Q	Q	Q	Q	303H
E1-05	Max. voltage	Max Voltage		0.0 to 255.0*7	200.0 V *7*8	No	Q	Q	Q	Q	304H
E1-06	Base frequency	Base Frequency		0.0 to 300.0 *6	60.0 Hz *8	No	Q	Q	Q	Q	305H
E1-09	Min. output frequency	Min Frequency		0.0 to 300.0 *6	1.5 Hz *8	No	Q	Q	Q	A	308H
E1-13	Base voltage	Base Voltage	Set only to fine-adjust V/f for the output range. Normally, this setting is not required.	0.0 to 255.0 *7	0.0 V *9	No	A	A	Q	Q	30CH
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, torque limits and torque control. This parameter is automatically set during autotuning.	0.32 to 6.40 *10	1.90 A *4	No	Q	Q	Q	Q	30EH
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	Q	311H
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 kW *4	No	Q	Q	Q	Q	318H
F1-01	PG parameter	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	No	No	Q	No	Q	380H
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. A meter calibration function is available. *12	0.00 to 2.50	1.00	Yes	Q	Q	Q	Q	41EH

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
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. A meter calibration function is available. *12	0.00 to 2.50	0.50	Yes	Q	Q	Q	Q	421H
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	Q	480H
L3-04	Stall prevention 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 *11	1	No	Q	Q	Q	Q	492H

* 1. 0 or 1 for flux vector control.
* 2. 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/deceleration times becomes 0.00 to 600.00 seconds.
* 3. Only 1(VT) can be set for 200 V Class 110 kW as well as 400 V Class 220 kW and 300 kW Inverters.
* 4. The factory settings depend on the capacity of the Inverter. The values for a 200 V Class Inverter of 0.4 kW are given.
* 5. The upper limit of the setting range depends on the upper limit set in E1-04.
* 6. When C6-01 = 1, the upper limit is 400.00 (d1 parameters)/400.0(E1 parameters).
* 7. These are values for a 200 V Class Inverter. Values for a 400 V Class Inverter are double.
* 8. The factory setting will change when the control method is changed. The V/f control factory settings are given.
* 9. E1-13 is set to the same value as E1-05 by autotuning.
* 10.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. For the motor no-load current, set E2-03 to a value less than that of E2-01.
* 11.When using flux vector control, 0 to 2.
* 12.The CH1 output can be adjusted when the H4-02 or H4-03 setting is displayed in Quick, Advanced, or Verify mode while the motor is stopped. The CH2 output can be adjusted when the H4-05 or H4-06 setting is displayed in quick, Advance, or Verify mode while the motor is stopped. For analog output, the value equivalent to 100% of output value of monitored item is multiplied by the gain setting and the set bias is added.

5

User 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

User parameters for the environment modes are shown in the following table.

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
A1-00	Language selection for Digital Operator display	Select Language	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 initialized by the initialize operation.	0 to 6	1	Yes	A	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 user 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	A	101H	6-189
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 2: Open loop vector 3: Flux vector This parameter is not initialized by the initialize operation.	0 to 3	0	No	Q	Q	Q	Q	102H	4-7 4-9 4-20

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
A1-03	Initialize Init Parameters	Used to initialize the parameters using the specified method. 0: No initializing 1110: Initializes using the User parameters 2220: Initializes using a two-wire sequence. (Initializes to the factory setting.) 3330: Initializes using a three-wire sequence.	0 to 3330	0	No	A	A	A	A	103H	6-14 6-15 6-184
A1-04	Password Enter 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	A	104H	6-190
A1-05	Password setting Select Password	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 password will be displayed.	0 to 9999	0	No	A	A	A	A	105H	6-190

■User-set Parameters: A2

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
A2-01 to A2-32	User setting parameters User Param 1 to 32	Used to set the parameter numbers that can be set/read. Maximum 32. Effective when the Parameter 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.	b1-01 to o3-02	-	No	A	A	A	A	106H to 125H	6-191

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◆ 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, DROOP functions, energy saving functions, and zero-servo.

■Operation Mode Selections: b1

User parameters for operation mode selection are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
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 board 4: Pulse train input	0 to 4	1	No	Q	Q	Q	Q	180H	4-7 6-6 6-81 6-100
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 board	0 to 3	1	No	Q	Q	Q	Q	181H	4-7 6-14 6-81 6-100
b1-03	Stopping method selection Stopping Method	Used to set the stopping method used 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	Q	182H	4-8 6-16
b1-04	Prohibition of reverse operation Reverse Oper	0: Reverse enabled 1: Reverse disabled	0 or 1	0	No	A	A	A	A	183H	6-67

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
b1-05	Operation selection for setting E1-09 or less Zero-Speed Oper	Used to set the method of operation when the frequency reference input is less than the minimum output frequency (E1-09). 0: Run at frequency reference (E1-09 not effective). 1: STOP (Frequencies below E1-09 in the coast to stop state.) 2: Run at min. frequency. (E1-09) 3: Run at zero-speed (Frequencies below E1-09 are zero)	0 to 3	0	No	No	No	No	A	184H	6-16
b1-06	Read sequence input twice Cntl Input Scans	Used to set the responsiveness 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	A	185H	-
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	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)). 2: Cannot operate. (Cannot be in programming mode during operation.)	0 to 2	0	No	A	A	A	A	187H	-

* 0 or 1 for flux vector control.

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■DC Injection Braking: b2

User parameters for injection braking are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	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 is used to set the starting frequency for the DC injection braking. In flux vector control, b2-01 is used to set the starting frequency for the zero-speed control.	0.0 to 10.0	0.5 Hz	No	A	A	A	A	189H	6-17 6-179
b2-02	DC injection braking current DCInj Current	Sets the DC injection braking current as a percentage of the Inverter rated current. The DC injection braking current in flux control is affected by any change to the setting of E2-03.	0 to 100	50%	No	A	A	A	No	18AH	6-17 6-20
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	A	18BH	6-17 6-20
b2-04	DC injection braking time at stop DCInj Time@Stop	Used to set the time to perform DC injection braking at stop (zero-speed control in flux vector control) in units of 1 second. 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	A	18CH	6-17
b2-08	Magnetic flux compensation volume Field Comp	Sets the magnetic flux compensation as a percentage of the no-load current.	0 to 1000	0%	No	No	No	A	A	190H	-

■Speed Search: b3

User parameters for the speed search are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
b3-01	Speed search selection (current detection or speed calculation) 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*1	No	A	A	A	No	191H	6-70
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	150% *1 *2	No	A	No	A	No	192H	6-70
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	No	193H	6-70

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
b3-05	Speed search wait time (current detection or speed calculation) Search Delay	Sets the magnetic contactor operating delay time when there is a magnetic 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	A	195H	6-71
b3-10	Sets the magnetic flux compensation as a percentage of the no-load current. Srch Detect Comp	Operation restarts at a speed obtained by multiplying the speed from the speed search by the compensation gain (excitation search only.) Increase this setting if overvoltages occur when a speed search is performed after a long baseblock, for example, in searches at startup.	1.00 to 1.20	1.10	No	A	No	A	No	19AH	6-71
b3-14	Rotation direction search selection Bidir Search Sel	0: Disabled (operates with specified rotation direction) 1: Enabled (operates with rotation direction found by search)	0 or 1	1	No	A	A	A	No	19EH	6-71
b3-17	Speed search retrial current level Srch Restart Lvl	Sets the current level to retry a speed search as a percentage, taking the Inverter rated current as 100%.	0 to 200	150% *2	No	A	No	A	No	1F0H	6-71
b3-18	Speed search retrial detection time Srch Restart Time	Sets the time for detection in a speed search retrial in units of seconds.	0.00 to 1.00	0.01 s	No	A	No	A	No	1F1H	6-71
b3-19	Number of speed search retrials Num of Srch Restr	Sets the number of times that a speed search can be retried.	0 to 10	0	No	A	No	A	No	1F2H	6-71

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

* 2. C6-01 = 1:120%, C6-01 = 0:150%

■Timer Function: b4

User parameters for timer functions are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
b4-01	Timer function ON-delay time Delay-ON Timer	Sets 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-☐☐ or H2-☐☐.	0.0 to 300.0	0.0 s	No	A	A	A	A	1A3H	6-140
b4-02	Timer function OFF-delay time Delay-OFF Timer	Sets the timer function output OFF-delay time (dead band) for the timer function input, in 1-second units. Enabled when a timer function is set in H1-☐☐ or H2-☐☐.	0.0 to 300.0	0.0 s	No	A	A	A	A	1A4H	6-140

■PID Control: b5

User parameters for PID control are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
b5-01	PID control method 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	A	1A5H	6-142
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	A	1A6H	6-142
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	A	1A7H	6-142
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	A	1A8H	6-142
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	A	1A9H	6-142

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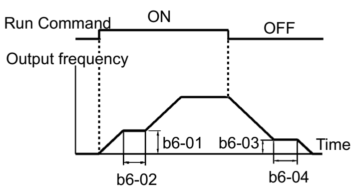
Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
b5-06	PID limit PID Limit	Sets the limit after PID-control as a percentage of the maximum output frequency.	0.0 to 100.0	100.0%	Yes	A	A	A	A	1AAH	6-142
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	A	1ABH	6-142
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	A	1ACH	6-142
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	A	1ADH	6-142
b5-10	PID output gain Output Gain	Sets output gain.	0.0 to 25.0	1.0	No	A	A	A	A	1AEH	6-142
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	A	1AFH	6-143
b5-12	Selection of PID feedback command 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	A	1B0H	6-143
b5-13	PID feedback command 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	A	1B1H	6-143

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
b5-14	PID feedback command loss detection time Fb los Det Time	Sets the PID feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	A	A	A	A	1B2H	6-143
b5-15	PID sleep function operation level PID Sleep Level	Set the PID sleep function start level as a frequency.	0.0 to 300.0 *	0.0 Hz	No	A	A	A	A	1B3H	6-143
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	A	1B4H	6-143
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 6000.0	0.0 s	No	A	A	A	A	1B5H	6-143

* When C6-01 = 1, the upper limit is 400.0.

■Dwell Functions: b6

User parameters for dwell functions are shown in the following table.

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
b6-01	Dwell frequency at start	Dwell Ref @Start	 The dwell function is used to output frequency temporarily when driving a motor with a heavy load.	0.0 to 300.0 *	0.0 Hz	No	A	A	A	A	1B6H	6-27
b6-02	Dwell time at start	Dwell Time@ Start		0.0 to 10.0	0.0 s	No	A	A	A	A	1B7H	6-27
b6-03	Dwell frequency at stop	Dwell Ref @Stop		0.0 to 300.0 *	0.0 Hz	No	A	A	A	A	1B8H	6-27
b6-04	Dwell time at stop	Dwell Time @Stop		0.0 to 10.0	0.0 s	No	A	A	A	A	1B9H	6-27

* When C6-01 = 1, the upper limit is 400.0.

■Droop Control: b7

User parameters for droop functions are shown in the following table.

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
b7-01	Droop control gain	Droop Quantity	Sets the slip as a percentage of maximum frequency when the maximum output frequency is specified and the rated torque occurs. Droop-control is not performed when the setting is 0.0.	0.0 to 100.0	0.0	Yes	No	No	No	A	1CAH	6-178
b7-02	Droop control delay time	Droop Delay Time	Droop control responsiveness parameter When hunting or oscillation occurs, increase the value.	0.03 to 2.00	0.05 s	Yes	No	No	No	A	1CBH	6-178

■Energy Saving: b8

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

Param-eter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vec-tor	Regis-ter	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	A	1CCH	6-150
b8-02	Energy-saving gain / Energy Save Gain	Set the energy-saving gain with the vector control method.	0.0 to 10.0	0.7 *1	Yes	No	No	A	A	1CDH	6-150
b8-03	Energy-saving filter time constant / Energy Save F.T	Set the energy-saving filter time constant with the vector control method.	0.00 to 10.00	0.50 s *2	Yes	No	No	A	A	1CEH	6-150
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.	0.00 to 655.00	288.20 *3 *4	No	A	A	No	No	1CFH	6-150
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	No	1D0H	6-150
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	No	1D1H	6-150

* 1. The factory setting is 1.0 when using flux vector control.
* 2. The factory setting is 2.00 s when Inverter capacity is 55 kW min.
The factory setting will change when the control method is changed. The open-loop vector factory setting is given.
* 3. By setting E2-11 (Motor rated output) the appropriate value will be set.
* 4. The factory setting depends on the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

■Zero-Servo: b9

User parameters for zero-servo functions are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
b9-01	Zero-servo gain Zero Servo Gain	Adjust the strength of the zero-servo lock. Enabled when the “zero-servo command” is set for the multi-function input. When the zero-servo command has been input and the frequency reference drop below excitation level (b2-01), a position control loop is created and the motor stops. Increasing the zero-servo gain in turn increases the strength of the lock. Increasing it by too much will cause oscillation.	0 to 100	5	No	No	No	No	A	1DAH	6-179
b9-02	Zero-servo completion width Zero Servo Count	Sets the output width of the zero-servo completion signal. Enabled when the “zero-servo completion (end)” is set for a multi-function input. The zero-servo completion signal is ON when the current position is within the range (the zero-servo start position± zero-servo completion width.) Set the allowable position displacement from the zero-servo start position to 4 times the pulse rate of the PG (pulse generator, encoder) in use.	0 to 16383	10	No	No	No	No	A	1DBH	6-180

◆ Autotuning Parameters: C

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

■Acceleration/Deceleration: C1

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
C1-01	Acceleration time 1 Accel Time 1	Sets the acceleration time to accelerate from 0 to the maximum output frequency, in 1-second units.	0.0 to 6000.0 *1	10.0 s	Yes	Q	Q	Q	Q	200H	4-7 6-23
C1-02	Deceleration time 1 Decel Time 1	Sets the deceleration time to decelerate from the maximum output frequency to 0, in 1-second units.			Yes	Q	Q	Q	Q	201H	4-7 6-23
C1-03	Acceleration 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	A	202H	6-23
C1-04	Deceleration 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	A	203H	6-23
C1-05	Acceleration 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	A	204H	6-23
C1-06	Deceleration 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	A	205H	6-23
C1-07	Acceleration 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	A	206H	6-23
C1-08	Deceleration 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	A	207H	6-23
C1-09	Emergency stop time Fast Stop Time	The deceleration time when the multi-function input “Emergency (fast) stop” is set to ON. This function can be used as a stopping method when a fault has been detected.			No	A	A	A	A	208H	6-22

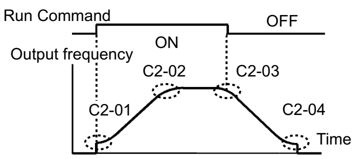
Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
C1-10	Accel/decel time setting unit	Acc/Dec Units	0: 0.01-second units 1: 0.1-second units	0 or 1	1	No	A	A	A	A	209H	6-24 6-25
C1-11	Accel/decel time switching frequency	Acc/Dec SW Freq	Sets the frequency for automatic acceleration/deceleration 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 priority.	0.0 to 300.0 *2	0.0 Hz	No	A	A	A	A	20AH	6-24

* 1. The setting range for acceleration/deceleration times will depend on the setting for C1-10. When C1-10 is set to 0, the setting range for acceleration/deceleration times become 0.00 to 600.00 seconds.

* 2. When C6-01=1, the upper limit is 400.0.

■S-curve Acceleration/Deceleration: C2

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

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
C2-01	S-curve characteristic time at acceleration start	SCrv Acc @ Start	All sections of the S-curve characteristic time are set in seconds units. 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	A	20BH	6-24
C2-02	S-curve characteristic time at acceleration end	SCrv Acc @ End		0.00 to 2.50	0.20 s	No	A	A	A	A	20CH	6-24
C2-03	S-curve characteristic time at deceleration start	SCrv Dec @ Start		0.00 to 2.50	0.20 s	No	A	A	A	A	20DH	6-24
C2-04	S-curve characteristic time at deceleration end	SCrv Dec @ End		0.00 to 2.50	0.00 s	No	A	A	A	A	20EH	6-24

■Motor Slip Compensation: C3

User parameters for slip compensation are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
C3-01	Slip compensation gain Slip Comp Gain	Used to improve speed accuracy when operating with a load. Usually setting is not necessary. 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. Used as the applicable control gain when using flux vector control.	0.0 to 2.5	0.0*	Yes	A	No	A	A	20FH	4-20 6-43
C3-02	Slip compensation primary delay time Slip Comp Time	Slip compensation primary delay time is set in ms units. Usually setting is not necessary. Adjust this parameter at the following times. • Reduce the setting when slip compensation responsive is slow. • When speed is not stabilized, increase the setting.	0 to 10000	2000 ms *	No	A	No	A	No	210H	4-20 6-43
C3-03	Slip compensation limit Slip Comp Limit	Sets the slip compensation limit as a percentage of motor rated slip.	0 to 250	200%	No	A	No	A	No	211H	6-43
C3-04	Slip compensation selection during regeneration Slip Comp Regen	0: Disabled. 1: Enabled. When the slip compensation during regeneration function has been activated, as regeneration capacity increases momentarily, it may be necessary to use a braking option (braking resistor, Braking Resistor Unit or Braking Unit.)	0 or 1	0	No	A	No	A	No	212H	6-43
C3-05	Output voltage limit operation selection V/F Slip Cmp Sel	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	A	213H	6-44

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

■Torque Compensation: C4

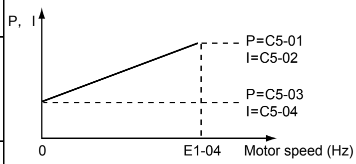
User parameters for are torque compensation shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	Control Methods V/f with PG	Control Methods Open Loop Vector	Control Methods Flux Vector	Register	Page
C4-01	Torque compensation gain Torq Comp Gain	Sets torque compensation gain as a ratio. Usually setting is not necessary. Adjust in the following circumstances: • When the cable is long; increase the set value. • When the motor capacity is smaller than the Inverter capacity (Max. applicable motor capacity), increase the set values. • When the motor is oscillating, 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 compensation 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	No	215H	4-20 6-46
C4-02	Torque compensation primary delay time constant Torq Comp Time	The torque compensation delay time is set in ms units. Usually setting is not necessary. Adjust in the following circumstances: • When the motor is oscillating, increase the set values. • When the responsiveness of the motor is low, decrease the set values.	0 to 10000	200 ms *	No	A	A	A	No	216H	4-20 6-46
C4-03	Forward starting torque F TorqCmp@ start	Sets the forward starting torque as a percentage of the motor rated torque.	0.0 to 200.0	0.0%	No	No	No	A	No	217H	-
C4-04	Reverse starting torque R TorqCmp@ start	Sets the reverse starting torque as a percentage of the motor rated torque.	-200.0 to 0.0	0.0%	No	No	No	A	No	218H	-
C4-05	Starting torque time constant TorqCmp Delay T	Sets the delay time in ms for starting torque. The filter is disabled if the time is set to 0 to 4 ms.	0 to 200	10 ms	No	No	No	A	No	219H	-

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

■Speed Control (ASR): C5

User parameters for speed control are shown in the following table.

Param-eter Num-ber	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods				Regis-ter	Page
						V/f	V/f with PG	Open Loop Vec-tor	Flux Vec-tor		
C5-01	ASR pro-portional (P) gain 1 ASR P Gain 1	Sets the proportional gain of the speed loop (ASR.)	1.00 to 300.00 *1	20.00 *2	Yes	No	A	No	A	21BH	4-21 6-170
C5-02	ASR inte-gral (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	0.500 s *2	Yes	No	A	No	A	21CH	4-21 6-170
C5-03	ASR pro-portional (P) gain 2 ASR P Gain 2	Usually setting is not necessary. Set to change the rotational speed gain.	1.00 to 300.00 *1	20.00 *2	Yes	No	A	No	A	21DH	4-21 6-171
C5-04	ASR inte-gral (I) time 2 ASR I Time 2		0.000 to 10.000	0.500 s *2	Yes	No	A	No	A	21EH	4-21 6-171
C5-05	ASR limit ASR Limit	Sets the upper limit for the com-pensation 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	No	21FH	6-171
C5-06	ASR pri-mary delay time ASR Delay Time	Sets the filter time constant for out-putting torque references from the speed control loop (ASR). It is set in 1-second units. Usually setting is not necessary.	0.000 to 0.500	0.004 s	No	No	No	No	A	220H	4-21 6-171
C5-07	ASR switching frequency ASR Gain SW Freq	Sets the frequency for switching between Proportion Gain 1, 2 and Integral Time 1, 2 in Hz units. The multi-function input "ASR switching proportional gain" has the priority.	0.0 to 300.0 *3	0.0 Hz	No	No	No	No	A	221H	4-21 6-171
C5-08	ASR inte-gral (I) limit ASR I Limit	Sets the upper limit for the integral (I) amount for the speed control loop (ASR) to a percentage of the rated load.	0 to 400	400%	No	No	No	No	A	222H	6-171

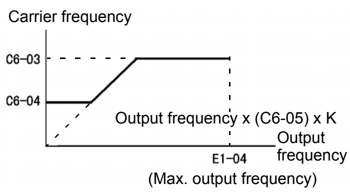
* 1. When using V/f with PG control, 0.00 to 300.00. The flux vector setting ranges are given.

* 2. When the control method changes, the factory setting is changed. The flux vector control factory settings are given. Refer to *Factory Settings that Change with the Control Method (A1-02)*.

* 3. When C6-01 = 1, the upper limit is 400.0.

■Carrier Frequency: C6

User parameters for the carrier frequency are shown in the following table.

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
C6-01	CT/VT selection	Heavy/ Normal Duty	0: CT (low carrier, parameter torque, 150% per minute) 1: VT (high carrier, variable torque, 120% per minute)	0 or 1	0*1	No	Q	Q	Q	Q	223H	4-7 6-2
C6-02	Carrier frequency selection	Carrier-Freq Sel	Select carrier wave fixed pattern. 0: Low-noise PWM 1: 2.0 kHz 2: 5.0 kHz 3: 8.0 kHz 4: 10.0 kHz 5: 12.5 kHz 6: 15.0 kHz F: Enables detailed settings using parameters C6-03 to C6-05	0,1 (C6-01=0) 0 to F (C6-01=1)	1 (C6-01=0) 6*2 (C6-01=1)	No	Q	Q	Q	Q	224H	4-8 4-20 4-21 6-2
C6-03 *3	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.	2.0 to 2.5	2.0 kHz	No	A	A	A	A	225H	6-2
C6-04 *3	Carrier frequency lower limit	Carrier-Freq Min		0.4 to 2.5	2.0 kHz	No	A	A	No	A	226H	6-2
C6-05 *3	Carrier frequency proportional gain	Carrier-Freq Gain	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	00 to 99	00	No	A	A	No	A	227H	6-2

* 1. Only 1(VT) can be set for 200 V Class 110 kW as well as 400 V Class 220 kW and 300 kW Inverters.
* 2. The factory settings depend on the capacity of the Inverter. The values for a 200 V Class Inverter of 0.4 kW are given.
* 3. This parameter can be monitored or set only when 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

User parameters for frequency references are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
d1-01	Frequency reference 1 / Reference 1	Sets the frequency reference in the units used in o1-03.	0.00 to 300.00 *1 *2	0.00 Hz	Yes	Q	Q	Q	Q	280H	4-8 6-9
d1-02	Frequency reference 2 / Reference 2	The frequency reference when multi-step speed reference 1 is ON for a multi-function input.		0.00 Hz	Yes	Q	Q	Q	Q	281H	4-8 6-9
d1-03	Frequency reference 3 / Reference 3	The frequency reference when multi-step speed reference 2 is ON for a multi-function input.		0.00 Hz	Yes	Q	Q	Q	Q	282H	4-8 6-9
d1-04	Frequency reference 4 / Reference 4	The frequency reference when multi-step speed references 1 and 2 are ON for multi-function inputs.		0.00 Hz	Yes	Q	Q	Q	Q	283H	4-8 6-9
d1-05	Frequency reference 5 / Reference 5	The frequency when multi-step speed reference 3 is ON for a multi-function input.		0.00 Hz	Yes	A	A	A	A	284H	6-9
d1-06	Frequency reference 6 / Reference 6	The frequency reference when multi-step speed references 1 and 3 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	A	285H	6-9
d1-07	Frequency reference 7 / Reference 7	The frequency reference when multi-step speed references 2 and 3 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	A	286H	6-9
d1-08	Frequency reference 8 / Reference 8	The frequency reference when multi-step speed references 1, 2, and 3 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	A	287H	6-9
d1-09	Frequency reference 9 / Reference 9	The frequency reference when multi-step speed reference 4 is ON for a multi-function input.		0.00 Hz	Yes	A	A	A	A	288H	-
d1-10	Frequency reference 10 / Reference 10	The frequency reference when multi-step speed references 1 and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	A	28BH	-

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
d1-11	Frequency reference 11 / Reference 11	The frequency reference when multi-step speed references 2 and 4 are ON for a multi-function inputs.	0.00 to 300.00 *1 *2	0.00 Hz	Yes	A	A	A	A	28CH	-
d1-12	Frequency reference 12 / Reference 12	The frequency reference when multi-step speed references 1, 2, and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	A	28DH	-
d1-13	Frequency reference 13 / Reference 13	The frequency reference when multi-step speed references 3 and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	A	28EH	-
d1-14	Frequency reference 14 / Reference 14	The frequency reference when multi-step speed references 1, 3, and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	A	28FH	-
d1-15	Frequency reference 15 / Reference 15	The frequency reference when multi-step speed references 2, 3, and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	A	A	A	290H	-
d1-16	Frequency reference 16 / Reference 16	The frequency reference when multi-step speed references 1, 2, 3, and 4 are ON for multi-function inputs.		0.00 Hz	Yes	A	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	Q	292H	4-8 6-10 6-90

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

* 1. The upper limit of the setting range depends on the upper limit set in E1-04.

* 2. When C6-01 = 1, the upper limit is 400.00.

■Reference Limits: d2

User parameters for frequency reference limits are shown in the following table.

Param-eter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vec-tor	Regis-ter	Page
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	A	289H	6-41 6-84
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	A	28AH	6-41 6-84
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	A	293H	6-41 6-84

■Jump Frequencies: d3

User parameters for jump frequencies are shown in the following table.

Param-eter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vec-tor	Regis-ter	Page
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 300.0 *	0.0 Hz	No	A	A	A	A	294H	6-37
d3-02	Jump frequency 2 Jump Freq 2			0.0 Hz	No	A	A	A	A	295H	6-37
d3-03	Jump frequency 3 Jump Freq 3			0.0 Hz	No	A	A	A	A	296H	6-37
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	A	297H	6-37

* When C6-01 = 1, the upper limit is 400.0.

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■Reference Frequency Hold: d4

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
d4-01	Frequency reference hold function selection MOP Ref Memory	Sets 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 previous 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	A	298H	6-83
d4-02	+ - Speed limits Trim Control Lvl	Set the frequency to be add to or subtracted from the analog frequency reference as a percent, 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	A	299H	6-87

■Torque Control: d5

User parameters for the torque control are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
d5-01	Torque control selection Torq Control Sel	0: Speed control (C5-01 to C5-07) 1: Torque control This function is only available in flux vector control method. To use the function for switching between speed and torque control, set to 0 and set the multi-function input to “speed/torque control change.”	0 or 1	0	No	No	No	No	A	29AH	6-162

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
d5-02	Torque reference delay time Torq Ref Filter	Set the torque reference delay time in ms units. This function can be used to adjust the noise of the torque control signal or the responsiveness with the host controller. When oscillation occurs during torque control, increase the set value.	0 to 1000	0 ms	No	No	No	No	A	29BH	6-162
d5-03	Speed limit selection Speed Limit Sel	Set the speed limit command method for the torque control method. 1: The analog input limit from a frequency reference (see b1-01) 2: Limited by d5-04 parameter setting values.	1 or 2	1	No	No	No	No	A	29CH	6-162
d5-04	Speed limit Speed Lmt Value	Set the speed limit during torque control as a percentage of the maximum output frequency. This function is enabled when d5-03 is set to 2. Directions are as follows. +: Run Command direction -: Run Command opposite direction	-120 to +120	0%	No	No	No	No	A	29DH	6-162
d5-05	Speed limit bias Speed Lmt Bias	Set the speed limit bias as a percentage of the maximum output frequency. Bias is given to the specified speed limit. It can be used to adjust the margin for the speed limit.	0 to 120	10%	No	No	No	No	A	29EH	6-162
d5-06	Speed/torque control switching timer Ref Hold Time	Set the delay time from inputting the multi-function input “speed/torque control change” (from On to OFF or OFF to ON) until the control is actually changed, in ms units. This function is enabled when the multi-function input “speed/torque control change” is set. In the speed/torque control switching timer, the analog inputs hold the values of when the “speed/torque control change” changes. Always be sure to allow time for this process to finish completely.	0 to 1000	0 ms	No	No	No	No	A	29FH	6-163

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■Field Weakening: d6

User parameters for the field weakening command are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
d6-01	Field weakening level Field-Weak Lvl	Set the Inverter output voltage when the field weakening 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	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 command is valid only at frequencies above this setting and only when the speed is in agreement with the current speed reference.	0.0 to 300.0 *	0.0 Hz	No	A	A	No	No	2A1H	-
d6-03	Field forcing function selection Field Force Sel	Set the field forcing function. 0: Disabled 1: Enabled	0 or 1	0	No	No	No	A	A	2A2H	-
d6-06	Field forcing limit Field Force Limit	Set the excitation current reference's upper limit for field forcing. Set the limit as a percentage, taking the motor's no-load current as 100%. Enabled for operation other than DC excitation. Usually, there is no need to change this setting	100 to 400	400%	No	No	No	A	A	2A5H	-

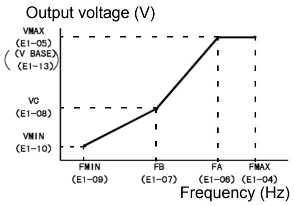
* When C6-01 = 1, the upper limit is 400.0.

◆ Motor Constant Parameters: E

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

■V/f Pattern: E1

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
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	Q	300H	4-7 6-155
E1-03	V/f pattern selection 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	No	302H	6-155
E1-04	Max. output frequency Max 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)	40.0 to 300.0 *5	60.0 Hz *2	No	Q	Q	Q	Q	303H	6-155
E1-05	Max. voltage Max Voltage		0.0 to 255.0 *1	200.0 V *1*2	No	Q	Q	Q	Q	304H	6-155
E1-06	Base frequency Base Frequency		0.0 to 300.0 *5	60.0 Hz *2	No	Q	Q	Q	Q	305H	6-155
E1-07	Mid. output frequency Mid Frequency A		0.0 to 300.0 *5	3.0 Hz *2	No	A	A	A	No	306H	6-155
E1-08	Mid. output frequency voltage Mid Voltage A		0.0 to 255 *1	15.0 V *1 *2	No	A	A	A	No	307H	4-20 4-21 6-155
E1-09	Min. output frequency Min Frequency		0.0 to 300.0 *5	1.5 Hz *2	No	Q	Q	Q	A	308H	6-155
E1-10	Min. output frequency voltage Min Voltage		0.0 to 255.0 *1	9.0 V *1 *2	No	A	A	A	No	309H	4-20 4-21 6-155

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
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 300.0 *5	0.0 Hz *3	No	A	A	A	A	30AH	6-156
E1-12	Mid. output frequency voltage 2 Mid Voltage B		0.0 to 255.0 *1	0.0 V *3	No	A	A	A	A	30BH	6-156
E1-13	Base voltage Base Voltage		0.0 to 255.0 *1	0.0 V *4	No	A	A	Q	Q	30CH	6-156

* 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. The 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 = 1, the upper limit is 400.0.

■Motor Setup: E2

User parameters for motor 1 are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
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, torque limits and torque control. This parameter is automatically set during autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q	Q	Q	Q	30EH	4-7 6-62 6-152
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	A	30FH	6-151 6-152
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	A	310H	6-152
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	Q	311H	6-152

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
E2-05	Motor line-to-line resistance Term Resistance	Sets the motor phase-to-phase resistance in Ω units. This parameter is automatically set during autotuning.	0.000 to 65.000	9.842 Ω *1	No	A	A	A	A	312H	6-152
E2-06	Motor leak inductance Leak Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of the motor rated voltage. This parameter is automatically set during autotuning.	0.0 to 40.0	18.2% *1	No	No	No	A	A	313H	6-152
E2-07	Motor iron saturation coefficient 1 Saturation Comp1	Sets the motor iron saturation coefficient at 50% of magnetic flux. This parameter is automatically set during autotuning.	0.00 to 0.50	0.50	No	No	No	A	A	314H	6-152
E2-08	Motor iron saturation coefficient 2 Saturation Comp2	Sets the motor iron saturation coefficient at 75% of magnetic flux. This parameter is automatically set during autotuning.	0.50 to 0.75 *4	0.75	No	No	No	A	A	315H	6-152
E2-09	Motor mechanical loss Mechanical Loss	Sets motor mechanical loss as a percentage of motor rated output (W). Usually setting is not necessary. Adjust in the following circumstances: • When torque loss is large due to motor bearing. • When the torque loss in the pump or fan is large. The set mechanical loss will compensate for torque.	0.0 to 10.0	0.0	No	No	No	No	A	316H	6-153
E2-10	Motor iron loss for torque compensation Tcomp Iron Loss	Sets motor iron loss in W units.	0 to 65535	14 W *1	No	A	A	No	No	317H	6-153
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 kW *1	No	Q	Q	Q	Q	318H	6-151

* 1. The factory settings depend on the Inverter capacity. The values for a 200 V Class Inverter of 0.4 kW are 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. For the motor no-load current, set E2-03 to a value less than that of E2-01.

* 3. The setting range depends on the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

* 4. The lower limit of E2-08 is the setting value of E2-07.

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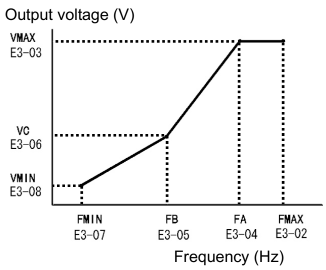
■ Motor 2 V/f Pattern: E3

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

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	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 3: Flux vector control	0 to 3	0	No	A	A	A	A	319H	-
E3-02	Motor 2 max. output frequency (FMAX) Max 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)	40.0 to 300.0 *3	60.0 Hz	No	A	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	A	31BH	-
E3-04	Motor 2 max. voltage frequency (FA) Base Frequency		0.0 to 300.0 *3	60.0 Hz	No	A	A	A	A	31CH	-
E3-05	Motor 2 mid. output frequency 1 (FB) Mid Frequency		0.0 to 300.0 *3	3.0 Hz *2	No	A	A	A	No	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	No	31EH	-
E3-07	Motor 2 min. output frequency (FMIN) Min Frequency		0.0 to 300.0 *3	1.5 Hz *2	No	A	A	A	A	31FH	-
E3-08	Motor 2 min. output frequency voltage (VMIN) Min Voltage		0.0 to 255.0 *1	9.0 V *1	No	A	A	A	No	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. The V/f control factory settings are given.
* 3. When C6-01 = 1, the upper limit is 400.0.

■Motor 2 Setup: E4

User parameters for motor 2 are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
E4-01	Motor 2 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, torque limits and torque control. This parameter is automatically set during autotuning.	0.32 to 6.40 *2	1.90 A *1	No	A	A	A	A	321H	6-62
E4-02	Motor 2 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	A	322H	-
E4-03	Motor 2 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	A	323H	-
E4-04	Motor 2 number of poles (number of poles) / Number of Poles	Sets the number of motor poles. This parameter is automatically set during autotuning.	2 to 48	4 poles	No	No	A	No	A	324H	-
E4-05	Motor 2 line-to-line resistance / Term Resistance	Sets the motor phase-to-phase resistance in Ω units. This parameter is automatically set during autotuning.	0.000 to 65.000	9.842 Ω *1	No	A	A	A	A	325H	-
E4-06	Motor 2 leak inductance / Leak Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of the motor rated voltage. This parameter is automatically set during autotuning.	0.0 to 40.0	18.2% *1	No	No	No	A	A	326H	-
E4-07	Motor 2 rated capacity / 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 kW *1	No	A	A	A	A	327H	-

* 1. The factory settings depend on the Inverter capacity. The values for a 200 V Class Inverter of 0.4 kW are 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. If a multi-function input is set for motor 2 (H1-☐☐ = 16), the setting range 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 boards

■PG Option Setup: F1

User parameters for the PG Speed Control Board are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
F1-01	PG parameter 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	No	No	Q	No	Q	380H	6-192
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	A	381H	6-192
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 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	A	382H	6-192

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	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	A	383H	6-193
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	A	384H	6-193
F1-06	PG division rate (PG pulse monitor) PG Output Ratio	Sets the division ratio for the PG speed control board pulse output. Division ratio = (1+ n) /m (n=0 or 1 m=1 to 32) F1-06 = □ □□ (n, m) This parameter is only effective when a 3G3FV-PPGB2 is used. The possible division ratio settings are: 1/32 ≤ F1-06 ≤ 1.	1 to 132	1	No	No	A	No	A	385H	6-193
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 parameter speeds.) 1: Enabled (The integral function is used at all times.)	0 or 1	0	No	No	A	No	No	386H	6-193

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Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register	Page
						V/f	V/f with PG	Open Loop Vector	Flux Vector		
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	A	387H	6-194
F1-09	Overspeed detection delay time PG Over-spd Time		0.0 to 2.0	0.0 s *	No	No	A	No	A	388H	6-194
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	A	389H	6-194
F1-11	Excessive speed deviation detection delay time PG Deviate Time		0.0 to 10.0	0.5 s	No	No	A	No	A	38AH	6-194
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	No	38BH	6-194
F1-13	Number of PG gear teeth 2 PG# Gear Teeth2			0	No	No	A	No	No	38CH	6-194
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	A	38DH	6-194

* The factory setting will change when the control method is changed. The flux vector control factory setting is given.

■Analog Reference Board: F2

User parameters for the Analog Reference Board are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
F2-01	Bi-polar or uni-polar input selection AI-14 Input Sel	Sets the functions for channel 1 to 3 which are effective when the 3G3IV-PAI14B Analog Reference Board is used. 0: 3-channel individual (Channel 1: terminal A1, Channel 2: terminal A2, Channel 3: terminal A3) 1: 3-channel addition (Addition values are the frequency reference) When set to 0, select 1 for b1-01. In this case the multi-function input “Option/ Inverter selection” cannot be used.	0 or 1	0	No	A	A	A	A	38FH	6-197

■Digital Reference Board: F3

User parameters for the Digital Reference Board are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
F3-01	Digital input option DI Input	Sets the Digital Reference Board input method. 0: BCD 1% unit 1: BCD 0.1% unit 2: BCD 0.01% unit 3: BCD 1 Hz unit 4: BCD 0.1 Hz unit 5: BCD 0.01 Hz unit 6: BCD special setting (5-digit input) 7: Binary input 6 is only effective when the 3G3IV-PDI16H2 is used. When o1-03 is set to 2 or higher, the input will be BCD, and the units will change to the o1-03 setting.	0 to 7	0	No	A	A	A	A	390H	6-198

■Analog Monitor Boards: F4

User parameters for the Analog Monitor Board are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
F4-01	Channel 1 monitor selection AO Ch1 Select	Effective when the Analog Monitor Board is used. Monitor selection: Set the number of the monitor item to be output. (U1-□□) The monitor items that can be set depends on the control method. Gain: Set the multiple of 10 V for outputting monitor items. 4, 10 to 14, 25, 28, 31, 34, 35, 39, 40, 42 cannot be set. 29 to 31 are not used. When the AO-12 Analog Monitor Board 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 Monitor Board is used, only outputs of 0 to +10 V are possible. A meter calibration function is available.*	1 to 99	2	No	A	A	A	A	391H	6-95
F4-02	Channel 1 gain AO Ch1 Gain		0.00 to 2.50	1.00	Yes	A	A	A	A	392H	6-95
F4-03	Channel 2 monitor selection AO Ch2 Select		1 to 99	3	No	A	A	A	A	393H	6-95
F4-04	Channel 2 gain AO Ch2 Gain		0.00 to 2.50	0.50	Yes	A	A	A	A	394H	6-95
F4-05	Channel 1 output monitor bias AO Ch1 Bias	Sets the channel 1 item bias to 100%/10 V when the Analog Monitor Board is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	A	395H	6-96
F4-06	Channel 2 output monitor bias AO Ch2 Bias	Sets the channel 2 item bias to 100%/10 V when the Analog Monitor Board is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	A	396H	6-96
F4-07	Analog output signal level for channel 1 AO Opt Level Ch1	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A	A	A	A	397H	6-96
F4-08	Analog output signal level for channel 2 AO Opt Level Ch2	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A	A	A	A	398H	6-96

* The CH1 output can be adjusted when the F4-02 or F4-05 setting is displayed in Quick, Advanced, or Verify mode while the motor is stopped.
The CH2 output can be adjusted when the F4-04 or F4-06 setting is displayed in Quick, Advanced, or Verify mode while the motor is stopped.
For analog output, the value equivalent to 100% of output value of monitored item is multiplied by the gain setting and the set bias is added.

■Not Used: F5

User parameters for the Digital Output Board are shown in the following table.

Parameter Number	Name / 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	Page
F5-01	Not used DO Ch1 Select	Do not set.	-	0	No	A	A	A	399H	-
F5-02	Not used DO Ch2 Select		-	1	No	A	A	A	39AH	-
F5-03	Not used DO Ch3 Select		-	2	No	A	A	A	39BH	-
F5-04	Not used DO Ch4 Select		-	4	No	A	A	A	39CH	-
F5-05	Not used DO Ch5 Select		-	6	No	A	A	A	39DH	-
F5-06	Not used DO Ch6 Select		-	37	No	A	A	A	39EH	-
F5-07	Not used DO Ch7 Select		-	0F	No	A	A	A	39FH	-
F5-08	Not used DO Ch8 Select		-	0F	No	A	A	A	3A0H	-
F5-09	Not used DO-08 Selection		-	0	No	A	A	A	3A1H	-

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■Communications Option Boards: F6

User parameters for a Communications Option Board are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
F6-01	Operation selection after communications error Comm Bus Flt Sel	Set the stopping method for communications errors. 0: Deceleration 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	1	No	A	A	A	A	3A2H	-
F6-02	Input level of external fault from Communications Option Board EF0 Detection	0: Always detect 1: Detect during operation	0 or 1	0	No	A	A	A	A	3A3H	-
F6-03	Stopping method for external fault from Communications Option Board EF0 Fault Action	0: Deceleration 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	1	No	A	A	A	A	3A4H	-
F6-04	Not used Trace Sample Tim	-	-	0	No	A	A	A	A	3A5H	-
F6-06	Torque reference/torque limit selection from optical option Torq Ref/Lmt Sel	0: Torque reference/torque limit from transmission disabled. 1: Torque reference/torque limit from transmission enabled.	0 or 1	0	No	No	No	No	A	3A7H	-
F6-08	Not used SI-T WDT Err Sel	Do not set.	-	1	No	A	A	A	A	3B6H	-
F6-09	Not used SI-T BUS DET Ctr	Do not set.	-	2	No	A	A	A	A	3B7H	-

◆ Terminal Function Parameters: H

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

■Multi-function Contact Inputs: H1

User parameters for multi-function contact inputs are shown in the following tables.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
H1-01	Terminal S3 function selection / Terminal S3 Sel	Multi-function contact input 1	0 to 78	24	No	A	A	A	A	400H	-
H1-02	Terminal S4 function selection / Terminal S4 Sel	Multi-function contact input 2	0 to 768	14	No	A	A	A	A	401H	-
H1-03	Terminal S5 function selection / Terminal S5 Sel	Multi-function contact input 3	0 to 78	3 (0)*	No	A	A	A	A	402H	-
H1-04	Terminal S6 function selection / Terminal S6 Sel	Multi-function contact input 4	0 to 78	4 (3)*	No	A	A	A	A	403H	-
H1-05	Terminal S7 function selection / Terminal S7 Sel	Multi-function contact input 5	0 to 78	6 (4)*	No	A	A	A	A	404H	-
H1-06	Terminal S8 function selection / Terminal S8 Sel	Multi-function contact input 6	0 to 78	8 (6) *	No	A	A	A	A	4-5H	-

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

Multi-function Contact Input Functions

Set-ting Value	Function	Control Methods				Page
		V/f	V/f with PG	Open Loop Vec-tor	Flux Vec-tor	
0	3-wire sequence (Forward/Reverse Run Command)	Yes	Yes	Yes	Yes	6-15
1	Local/Remote selection (ON: Local, OFF: Remote)	Yes	Yes	Yes	Yes	6-81
2	Option/Inverter selection (ON: Option board)	Yes	Yes	Yes	Yes	6-89 6-197
3	Multi-step speed reference 1 When H3-09 is set to 2, this function is combined with the master/auxiliary speed switch.	Yes	Yes	Yes	Yes	6-9
4	Multi-step speed reference 2	Yes	Yes	Yes	Yes	6-9
5	Multi-step speed reference 3	Yes	Yes	Yes	Yes	6-9
6	Jog frequency command (higher priority than multi-step speed reference)	Yes	Yes	Yes	Yes	6-9
7	Accel/decel time 1	Yes	Yes	Yes	Yes	6-25
8	External baseblock NO (NO contact: Baseblock at ON)	Yes	Yes	Yes	Yes	6-82
9	External baseblock NC (NC contact: Baseblock at OFF)	Yes	Yes	Yes	Yes	6-82
A	Acceleration/deceleration ramp hold (ON: Acceleration/deceleration stopped, frequency on hold)	Yes	Yes	Yes	Yes	6-83
B	OH2 alarm signal input (ON: OH2 will be displayed)	Yes	Yes	Yes	Yes	-
C	Multi-function analog input selection (ON: Enable)	Yes	Yes	Yes	Yes	-
D	No V/f control with PG (ON: Speed feedback control disabled,) (normal V/f control)	No	Yes	No	No	6-171
E	Speed control integral reset (ON: Integral control disabled)	No	Yes	No	Yes	6-171
F	Not used (Set when a terminal is not used)	-	-	-	-	-
10	Up command (Always set with the down command)	Yes	Yes	Yes	Yes	6-84
11	Down command (Always set with the up command)	Yes	Yes	Yes	Yes	6-84
12	FJOG command (ON: Forward run at jog frequency d1-17)	Yes	Yes	Yes	Yes	6-90
13	RJOG command (ON: Reverse run at jog frequency d1-17)	Yes	Yes	Yes	Yes	6-90
14	Fault reset (Reset when turned ON)	Yes	Yes	Yes	Yes	7-2
15	Emergency stop. (Normally open condition: Deceleration to stop in deceleration time set in C1-09 when ON.)	Yes	Yes	Yes	Yes	6-22
16	Motor switch command (Motor 2 selection)	Yes	Yes	Yes	Yes	-
17	Emergency stop (Normally closed condition: Deceleration to stop in deceleration time set in C1-09 when OFF)	Yes	Yes	Yes	Yes	6-22
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	Yes	6-140 7-19
19	PID control disable (ON: PID control disabled)	Yes	Yes	Yes	Yes	6-145
1A	Accel/Decel time 2	Yes	Yes	Yes	Yes	6-25
1B	Parameters write enable (ON: All parameters can be written-in. OFF: All parameters other than frequency monitor are write protected.)	Yes	Yes	Yes	Yes	6-189
1C	Trim control increase (ON: d4-02 frequency is added to analog frequency reference.)	Yes	Yes	Yes	Yes	6-87
1D	Trim control decrease (ON: d4-02 frequency is subtracted from analog frequency reference.)	Yes	Yes	Yes	Yes	6-87

Setting Value	Function	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Page
1E	Analog frequency reference sample/hold	Yes	Yes	Yes	Yes	6-88
20 to 2F	External fault (Desired settings possible) Input mode: NO contact/NC contact, Detection mode: Normal/during operation	Yes	Yes	Yes	Yes	6-91
30	PID control integral reset (reset when reset command is input or when stopped during PID control)	Yes	Yes	Yes	Yes	6-145
31	PID control integral hold (ON: Hold)	Yes	Yes	Yes	Yes	6-145
32	Multi-step speed reference 4	Yes	Yes	Yes	Yes	-
34	PID soft starter ON/OFF	Yes	Yes	Yes	Yes	6-145
35	PID input characteristics switch	Yes	Yes	Yes	Yes	6-145
60	DC injection braking command (ON: Performs DC injection braking)	Yes	Yes	Yes	Yes	6-21
61	External search command 1 (ON: Speed search from maximum output frequency)	Yes	No	Yes	No	6-72
62	External search command 2 (ON: Speed search from set frequency)	Yes	No	Yes	No	6-72
63	Field weakening command (ON: Field weakening control set for d6-01 and d6-02)	Yes	Yes	No	No	-
64	External speed search command 3 (NC contact)	Yes	Yes	Yes	Yes	-
65	KEB (deceleration at momentary power loss) command (NC contact)	Yes	Yes	Yes	Yes	-
66	KEB (deceleration at momentary power loss) command (NO contact)	Yes	Yes	Yes	Yes	-
67	Communications test mode (“Pass” is displayed when the communication test is passed.)	Yes	Yes	Yes	Yes	6-115
68	High-slip braking (HSB)	Yes	Yes	No	No	-
71	Speed/torque control change (ON: Torque control)	No	No	No	Yes	6-164 6-169
72	Zero-servo command (ON: Zero-servo)	No	No	No	Yes	6-179
77	Speed control (ASR) proportional gain switch (ON: C5-03)	No	No	No	Yes	6-171
78	Polarity reversing command for external torque reference	No	No	No	Yes	6-164

■ Multi-function Contact Outputs: H2

User parameters for multi-function outputs are shown in the following tables.

Param-eter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods				Regis-ter	Page
						V/f	V/f with PG	Open Loop Vector	Flux Vec-tor		
H2-01	Terminal M1-M2 function selection (contact) Term M1-M2 Sel	Multi-function contact out-put	0 to 3D	0	No	A	A	A	A	40BH	-
H2-02	Terminal P1 function selection (open col-lector) Term P1 Sel	Multi-function contact out-put 1	0 to 3D	1	No	A	A	A	A	40CH	-
H2-03	Terminal P2 function selection (open col-lector) Term P2 Sel	Multi-function contact out-put 2	0 to 3D	2	No	A	A	A	A	40DH	-

Multi-function Contact Output Functions

Set-ting Value	Function	Control Methods				Page
		V/f	V/f with PG	Open Loop Vec-tor	Flux Vec-tor	
0	During run (ON: Run Command is ON or voltage is being output)	Yes	Yes	Yes	Yes	6-92
1	Zero-speed	Yes	Yes	Yes	Yes	6-92
2	Frequency agree 1 (L4-02 used.)	Yes	Yes	Yes	Yes	6-56
3	Desired frequency agree 1 (ON: Output frequency = ±L4-01, L4-02 used and during frequency agree)	Yes	Yes	Yes	Yes	6-56
4	Frequency (FOUT) detection 1 (ON: +L4-01 ≥ output frequency ≥ -L4-01, L4-02 used)	Yes	Yes	Yes	Yes	6-56
5	Frequency (FOUT) detection 2 (ON: Output frequency ≥ +L4-01 or output frequency ≤ -L4-01, L4-02 used)	Yes	Yes	Yes	Yes	6-56
6	Inverter operation ready READY: After initialization, no faults	Yes	Yes	Yes	Yes	-
7	During DC bus undervoltage (UV) detection	Yes	Yes	Yes	Yes	-
8	During baseblock (ON: during baseblock)	Yes	Yes	Yes	Yes	-
9	Frequency reference selection (ON: Frequency reference from Operator)	Yes	Yes	Yes	Yes	-
A	Run Command selection status (ON: Run Command from Operator)	Yes	Yes	Yes	Yes	-
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque/under-torque detection at ON)	Yes	Yes	Yes	Yes	6-59
C	Loss of frequency reference (Effective when 1 is set for L4-05)	Yes	Yes	Yes	Yes	6-76
D	Braking resistor fault (ON: Resistor overheat or braking transistor fault)	Yes	Yes	Yes	Yes	6-79

Setting Value	Function	Control Methods				Page
		V/f	V/f with PG	Open Loop Vector	Flux Vector	
E	Fault (ON: Digital Operator communications error or fault other than CPF00 and CPF01 has occurred.)	Yes	Yes	Yes	Yes	-
F	Not used. (Set when the terminals are not used.)	-	-	-	-	-
10	Minor fault (ON: Alarm displayed)	Yes	Yes	Yes	Yes	-
11	Fault reset command active	Yes	Yes	Yes	Yes	-
12	Timer function output	Yes	Yes	Yes	Yes	6-140
13	Frequency agree 2 (L4-04 used)	Yes	Yes	Yes	Yes	6-56
14	Desired frequency agree 2 (ON: Output frequency = L4-03, L4-04 used, and during frequency agree)	Yes	Yes	Yes	Yes	6-56
15	Frequency detection 3 (ON: Output frequency ≤ L4-03, L4-04 used)	Yes	Yes	Yes	Yes	6-56
16	Frequency detection 4 (ON: Output frequency ≥ L4-03, L4-04 used)	Yes	Yes	Yes	Yes	6-56
17	Overtorque/undertorque detection 1 NC (NC Contact: Torque detection at OFF)	Yes	Yes	Yes	Yes	6-59
18	Overtorque/undertorque detection 2 NO (NO Contact: Torque detection at ON)	Yes	Yes	Yes	Yes	6-59
19	Overtorque/undertorque detection 2 NC (NC Contact: Torque detection at OFF)	Yes	Yes	Yes	Yes	6-59
1A	During reverse run (ON: During reverse run)	Yes	Yes	Yes	Yes	-
1B	During baseblock 2 (OFF: During baseblock)	Yes	Yes	Yes	Yes	-
1C	Motor selection (Motor 2 selected)	Yes	Yes	Yes	Yes	-
1D	During regeneration (ON: During regeneration)	No	No	No	Yes	-
1E	Restart enabled (ON: Restart enabled)	Yes	Yes	Yes	Yes	6-77
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)	Yes	Yes	Yes	Yes	6-63 6-93
20	Inverter overheat (OH) pre-alarm (ON: Temperature exceeds L8-02 setting)	Yes	Yes	Yes	Yes	6-93
30	During torque limit (current limit) (ON: During torque limit)	No	No	Yes	Yes	-
31	During speed limit (ON: During speed limit)	No	No	No	Yes	6-93
32	Speed control circuit operating for torque control (except when stopped). The external torque reference will be limited if torque control is selected (internal torque reference < external torque reference). Output when the motor is rotating at the speed limit.	No	No	No	Yes	6-164
33	Zero-servo end (ON: Zero-servo function completed)	No	No	No	Yes	6-93 6-180
36	Frequency (FOUT) detection 5	Yes	Yes	Yes	Yes	6-55
37	During run 2 (ON: Frequency output, OFF: Base block, DC injection braking, initial excitation, operation stop)	Yes	Yes	Yes	Yes	6-93
3D	Inverter's Cooling Fan Fault detected	Yes	Yes	Yes	Yes	6-78

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■Analog Inputs: H3

User parameters for analog inputs are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
H3-01	Signal level selection (terminal A1) Term A1 Lvl Sel	0: 0 to 10 V 1: –10 to 10 V	0 or 1	0	No	A	A	A	A	410H	6-33
H3-02	Gain (terminal A1) Terminal A1 Gain	Sets the frequency when 10 V is input, as a percentage of the maximum output frequency.	0.0 to 1000.0	100.0%	Yes	A	A	A	A	411H	6-33
H3-03	Bias (terminal 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	A	412H	6-33
H3-04	Signal level selection (terminal A3) Term A3 Signal	0: 0 to 10 V 1:–10 to 10 V	0 or 1	0	No	A	A	A	A	413H	6-33 6-163
H3-05	Multi-function analog input (terminal A3) function selection Terminal A3 Sel	Select from the functions listed in the following table. Refer to the next page.	0 to 1F	1F	No	A	A	A	A	414H	6-33 6-163
H3-06	Gain (terminal A3) Terminal A3 Gain	Sets the input gain (level) when 10V is input. Set according to the 100% value selected from H3-05.	0.0 to 1000.0	100.0%	Yes	A	A	A	A	415H	6-33 6-163
H3-07	Bias (terminal A3) Terminal A3 Bias	Sets the input gain (level) when 0V is input. Set according to the 100% value selected from H3-05.	-100.0 to +100.0	0.0%	Yes	A	A	A	A	416H	6-33 6-163
H3-08	Signal level selection (terminal A2) Term A2 Signal	0: 0 to +10V, with lower limit 1: –10 to 10 V, without lower limit 2: 4 to 20 mA. Switch current and voltage input using the switch on the control panel.	0 to 2	2	No	A	A	A	A	417H	6-34 6-163

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
H3-09	Multi-function analog input (terminal A2) function 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	A	418H	6-34 6-164
H3-10	Gain (terminal A2) Terminal A2 Gain	Sets the input gain (level) when 10 V (20 mA) is input. Set according to the 100% value for the function set for H3-09.	0.0 to 1000.0	100.0%	Yes	A	A	A	A	419H	6-34 6-164
H3-11	Bias (terminal A2) Terminal A2 Bias	Sets the input gain (level) when 0 V (4 mA) is input. Set according to the 100% value for the function set for H3-09.	-100.0 to +100.0	0.0%	Yes	A	A	A	A	41AH	6-34 6-164
H3-12	Analog input filter time constant Filter Avg Time	Sets primary delay filter time constant in seconds for the analog input terminal. Effective for noise control etc.	0.00 to 2.00	0.03 s	No	A	A	A	A	41BH	6-34
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 and H3-05 is not set to 0 or 2.	0 or 1	0	No	A	A	A	A	41CH	-

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H3-05 and H3-09 Settings

Setting Value	Function	Contents (100%)	Control Methods				Page
			V/f	V/f with PG	Open Loop Vector	Flux Vector	
0	Add to terminal A1	Maximum output frequency	Yes	Yes	Yes	Yes	6-36 6-164
1	Frequency gain	Frequency reference (voltage) command value	Yes	Yes	Yes	Yes	6-35
2	Auxiliary frequency reference 1 (2nd step analog)	Maximum output frequency	Yes	Yes	Yes	Yes	6-10
3	Auxiliary frequency reference 2 (3rd step analog)	Maximum output frequency	Yes	Yes	Yes	Yes	6-10
4	Voltage bias	200V (200V-class), 400V (400V-class)	Yes	Yes	No	No	-
5	Accel/decel change (reduction coefficient)	Set acceleration and deceleration times (C1-01 to C1-08)	Yes	Yes	Yes	Yes	6-26
6	DC injection braking current	Inverter rated output current	Yes	Yes	Yes	No	6-21
7	Overtorque/undertorque detection level	Motor rated torque for vector control Inverter rated output current for V/f control	Yes	Yes	Yes	Yes	6-61
8	Stall prevention level during run	Inverter rated output current	Yes	Yes	No	No	6-55
9	Frequency reference lower limit level	Maximum output frequency	Yes	Yes	Yes	Yes	6-42
A	Jump frequency	Maximum output frequency	Yes	Yes	Yes	Yes	6-38
B	PID feedback	Maximum output frequency	Yes	Yes	Yes	Yes	6-145
C	PID target value	Maximum output frequency	Yes	Yes	Yes	Yes	6-145
D	Frequency bias 2	Maximum output frequency	Yes	Yes	Yes	Yes	6-36
E	Motor temperature input	10 V = 100%	Yes	Yes	Yes	Yes	6-66
10	Positive torque limit	Motor's rated torque	No	No	Yes	Yes	6-51
11	Negative torque limit	Motor's rated torque	No	No	Yes	Yes	6-51
12	Regenerative torque limit	Motor's rated torque	No	No	Yes	Yes	6-51
13	Torque reference/torque limit at speed control	Motor’s rated torque	No	No	No	Yes	6-164
14	Torque compensation	Motor’s rated torque	No	No	Yes	Yes	6-164
15	Positive/negative torque limit	Motor's rated torque	No	No	Yes	Yes	6-51
1F	Analog input not used.	-	Yes	Yes	Yes	Yes	6-10
16 to 1E	Not used	-	-	-	-	-	-

■Multi-function Analog Outputs: H4

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

Param-eter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vec-tor	Regis-ter	Page
H4-01	Monitor selection (terminal FM) Terminal FM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal FM. The monitor items that can be set depends on the control method. 4, 10 to 14, 25, 28 to 31, 34, 35, 39 to 43 cannot be set.	1 to 99	2	No	A	A	A	A	41DH	6-94
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. A meter calibration function is available. *	0.00 to 2.50	1.00	Yes	Q	Q	Q	Q	41EH	4-8 6-94
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. A meter calibration function is available. *	-10.0 to +10.0	0.0%	Yes	A	A	A	A	41FH	6-94
H4-04	Monitor selection (terminal AM) Terminal AM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal AM. The monitor items that can be set depends on the control method. 4, 10 to 14, 25, 28 to 31, 34, 35, 39 to 43 cannot be set.	1 to 99	3	No	A	A	A	A	420H	6-94
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. A meter calibration function is available.*	0.00 to 2.50	0.50	Yes	Q	Q	Q	Q	421H	4-8 6-95

5

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
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. A meter calibration function is available.*	-10.0 to +10.0	0.0%	Yes	A	A	A	A	422H	6-95
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: –10 to 10 V output	0 or 1	0	No	A	A	A	A	423H	6-95
H4-08	Analog output 2 signal level selection AO Level Select2	Sets the signal output level for multi-function output 2 (terminal AM) 0: 0 to +10 V output 1: –10 to 10 V output	0 or 1	0	No	A	A	A	A	424H	-

* The CH1 output can be adjusted when the H4-02 or H4-03 setting is displayed in Quick, Advanced, or Verify mode while the motor is stopped. The CH2 output can be adjusted when the H4-05 or H4-06 setting is displayed in Quick, Advanced, or Verify mode while the motor is stopped. For analog output, the value equivalent to 100% of output value of monitored item is multiplied by the gain setting and the set bias is added.

■RS-422A/485 Communications: H5

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
H5-01	Slave address Serial Comm Adr	Set the Inverter's slave address.	0 to 20 *	1FH	No	A	A	A	A	425H	6-100
H5-02	Communication speed selection Serial Baud Rate	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	A	426H	6-100
H5-03	Communication parity selection Serial Com Sel	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	A	427H	6-100

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
H5-04	Stopping method after communication error Serial Fault Sel	Set the stopping method for communications errors. 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	A	428H	6-101
H5-05	Communication error detection selection Serial Flt Dtct	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	A	429H	6-101
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	A	42AH	6-101
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	A	42BH	6-101

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

■Pulse Train I/O: H6

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vector	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	A	42CH	6-6 6-39 6-144
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	A	42DH	6-6 6-39
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	A	42EH	6-39

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Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
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	A	42FH	6-39
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	A	430H	6-39
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	A	431H	6-98
H6-07	Pulse train monitor scaling Pulse Moni Scale	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	A	432H	6-98

◆ 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

User parameters for motor overloads are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
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	Q	480H	4-8 6-62
L1-02	Motor protection time constant MOL Time Const	Sets the electric thermal detection time in seconds units. 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	1.0 min	No	A	A	A	A	481H	6-62

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Param-eter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods				Regis-ter	Page
						V/f	V/f with PG	Open Loop Vector	Flux Vec-tor		
L1-03	Alarm operation selection during motor overheating Mtr OH Alarm Sel	Set Multi-function input terminalA3 (H3-05) or A2 (H3-09) to E and select the operation when the input motor temperature (thermistor) input exceeds the alarm detection level [1.17 V (±5%)]. 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	A	482H	6-65
L1-04	Motor overheating operation selection Mtr OH Fault Sel	Set Multi-function input terminal A3 (H3-05) or A2 (H3-09) to E and select the operation when the motor temperature (thermistor) input exceeds the operation detection level [2.34V (±5%)]. 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	A	483H	6-65
L1-05	Motor temperature input filter time constant Mtr Temp Filter	Set Multi-function input terminal A3 (H3-05) or A2 (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	A	484H	6-65

■Power Loss Ridethrough: L2

User parameters for power loss ridethroughs are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
L2-01	Momentary power loss detection PwrL Selection	0: Disabled [main circuit undervoltage (UV1) detection] 1: Enabled [Restarted when the power returns within the time for L2-02. When L2-02 is exceeded, main circuit undervoltage (UV1) is detected.] 2: Enabled while CPU is operating. [Restarts when power returns during control operations. Does not detect main circuit undervoltage. (UV1)]	0 to 2	0	No	A	A	A	A	485H	6-68
L2-02	Momentary power loss ridethru time PwrL Ridethru t	Ridethrough time, when Momentary Power Loss Selection (L2-01) is set to 1, in units of seconds.	0 to 25.5	0.1 s *1	No	A	A	A	A	486H	6-68
L2-03	Min. baseblock time PwrL Baseblock 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. When an overcurrent or overvoltage occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.2 s *1	No	A	A	A	A	487H	6-68 6-72
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 *1	No	A	A	A	A	488H	6-69 6-72
L2-05	Undervoltage detection level PUV Det 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	A	489H	6-69

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L2-06	KEB deceleration time KEB Frequency	Sets in seconds the time required to decelerate from the speed where the deceleration at momentary power loss command (KEB) is input to zero-speed.	0.0 to 200.0	0.0 s	No	A	A	A	A	48AH	-
L2-07	Momentary recovery time UV RETURN TIME	Set in seconds the time to accelerate to the set speed after recovery from a momentary power loss.	0.0 to 25.5	0.0 s *3	No	A	A	A	A	48BH	-
L2-08	Frequency reduction gain at KEB start KEB Decel Time	Sets as a percent the about to reduce the output frequency at the beginning of deceleration at momentary power loss (KEB). Reduction = slip frequency before KEB operation × L2-08 × 2	0 to 300	100%	No	A	A	A	A	48CH	-

* 1. The factory settings depend on the Inverter capacity. The values for a 200 V Class Inverter of 0.4 kW are given.
* 2. These are values for a 200 V Class Inverter. Values for a 400 V Class Inverter are 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

User parameters for the stall prevention function are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L3-01	Stall prevention selection during accel StallP Accel Sel	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	No	48FH	6-28
L3-02	Stall prevention level during accel StallP Accel Lvl	Effective when L3-01 is set to 1 or 2. Set as a percentage of Inverter rated current. Usually setting is not necessary. The factory setting reduces the set values when the motor stalls.	0 to 200	150% *1	No	A	A	A	No	490H	6-28

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L3-03	Stall prevention limit during accel StallP CHP Lvl	Sets the lower limit for stall prevention during acceleration, as a percentage of the Inverter rated current, when operation is in the frequency range above E1-06. Usually setting is not necessary.	0 to 100	50%	No	A	A	A	No	491H	6-28
L3-04	Stall prevention 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 *2	1	No	Q	Q	Q	Q	492H	4-8 6-30
L3-05	Stall prevention selection during running 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	No	493H	6-54
L3-06	Stall prevention level during running StallP Run Level	Effective when L3-05 is 1 or 2. Set as a percentage of the Inverter rated output current. Usually setting is not necessary. The factory setting reduces the set values when the motor stalls.	30 to 200	150% *1	No	A	A	No	No	494H	6-54

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L3-11	Overvoltage inhibit selection OV Inhibit Sel	0: Disabled 1: Enabled Used to enable or disable the function for inhibiting main circuit overvoltages by reducing the regenerative torque limit according to the main circuit overvoltage level. If this function is enabled, when the main circuit voltage rises, operation will be performed with the regenerative torque less than the set value.	0 or 1	0	No	No	No	A	A	4C7H	6-32 7-2
L3-12	Overvoltage inhibit voltage level OV Inhbt VoltLvl	Sets the main circuit voltage level for which the regenerative torque limit is restricted to 0. Usually, there is no need to change this setting. If main circuit overvoltages occur even with the overvoltage inhibit function enabled, reduce this setting.	350 to 390 *3	380V *3	No	No	No	A	A	4C8H	6-32

* 1. C6-01 = 1:120%, C6-01 = 0:150%

* 2. When using flux vector control, 0 to 2.

* 3. These are values for a 200 V Class Inverter. Values for a 400 V Class Inverter are double.

■Reference Detection: L4

User parameters for the reference detection function are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L4-01	Speed agreement detection level Spd Agree Level	Effective when “Desired frequency (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 300.0 *1	0.0 Hz	No	A	A	A	A	499H	6-55
L4-02	Speed agreement detection width Spd Agree Width	Effective when “Frequency (speed) agree 1,” “Desired frequency (speed) agree 1,” or “Frequency (FOUT) detection 1,” Frequency (FOUT) detection 2 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	A	49AH	6-55

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L4-03	Speed agreement detection level (+/-) Spd Agree Lvl+-	Effective when "Desired frequency (speed) agree 2," "Frequency (FOUT) detection 3," or "Frequency (FOUT) detection 4" is set for a multi-function output. Frequency that should be detected is set in Hz units.	-300.0 to +300.0 *2	0.0 Hz	No	A	A	A	A	49BH	6-56
L4-04	Speed agreement detection width (+/-) Spd Agree Width+-	Effective when "Frequency (speed) agree 2," "Desired frequency (speed) agree 2," Frequency (FOUT) detection 3 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	A	49CH	6-56
L4-05	Operation when frequency reference is missing Ref Loss Sel	0: Stop (Operation follows the frequency reference.) 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	A	49DH	6-76

* 1. When C6-01 = 1, the upper limit is 400.0.
* 2. When C6-01 = 1, -400.0 to +400.0.

■Fault Restart: L5

User parameters for restarting faults are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vector	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	A	49EH	6-77
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	A	49FH	6-77

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■Torque Detection: L6

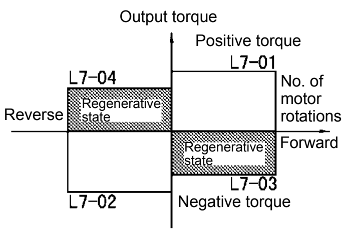
User parameters for the torque detection function are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L6-01	Torque detection selection 1 Torq Det 1 Sel	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	A	4A1H	6-58
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	A	4A2H	6-59
L6-03	Torque detection time 1 Torq Det 1 Time	Sets the overtorque/undertorque detection time in 1-second units.	0.0 to 10.0	0.1 s	No	A	A	A	A	4A3H	6-59

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L6-04	Torque detection selection 2 Torq Det 2 Sel	Output of torque detection 1 is enabled by setting B or 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	A	4A4H	6-59
L6-05	Torque detection level 2 Torq Det 2 Lvl		0 to 300	150%	No	A	A	A	A	4A5H	6-59
L6-06	Torque detection time 2 Torq Det 2 Time		0.0 to 10.0	0.1 s	No	A	A	A	A	4A6H	6-59

■Torque Limits: L7

User parameters for torque limits are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	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	A	4A7H	6-50
L7-02	Reverse drive torque limit Torq Limit Rev		0 to 300	200%	No	No	No	A	A	4A8H	6-50
L7-03	Forward regenerative torque limit Torq Lmt Fwd Rgn		0 to 300	200%	No	No	No	A	A	4A9H	6-50
L7-04	Reverse regenerative torque limit Torq Lmt Rev Rgn		0 to 300	200%	No	No	No	A	A	4AAH	6-50

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Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L7-06	Integral time setting for torque limit Torq Limit Time	Set the integral time for the torque limit. When integral control is set for the torque limit, reduce this setting to increase the change in frequency for the torque limit.	5 to 10000	200 ms	No	No	No	A	No	4ACH	6-50
L7-07	Control method selection for torque limit during acceleration and deceleration Torque Limit Sel	Select the control method for the torque limit during acceleration and deceleration. 0: Proportional control (integral control during parameter speed) 1: Integral control Usually, this parameter does not need to be set. For applications in which the torque limit will be reached during acceleration and deceleration, torque control can be given priority by selecting integral control. When the torque is limited, the acceleration and deceleration times may increase or the motor speed may not agree with the speed reference value.	0 or 1	0	No	No	No	A	No	4C9H	6-51

■Hardware Protection: L8

User parameters for hardware protection functions are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L8-01	Protect selection for internal DB resistor (Type ERF) DB Resistor Prot	0: Disabled (no overheating protection) 1: Enabled (overheating protection)	0 or 1	0	No	A	A	A	A	4ADH	6-79
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 *1	No	A	A	A	A	4AEH	6-80

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L8-03	Operation selection after overheat 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 setting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A	A	A	A	4AFH	6-80
L8-05	Input open-phase protection 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.) This fault is detected if a load is greater than approximately 80% of the maximum motor capacity.	0 or 1	0	No	A	A	A	A	4B1H	-
L8-07	Output open-phase protection selection Ph Loss Out Sel	0: Disabled 1: Enabled (Detects one output open-phase.) 2: Enabled (Detects more than one output open-phases) Output open-phase is detected at less than 5% of Inverter rated current. When applied motor capacity is small for Inverter capacity, output open-phase may be detected inadvertently or open-phase may not be detected. In this case, set to 0.	0 to 2	0	No	A	A	A	A	4B3H	-
L8-09	Ground protection selection Ground Fault Sel	0: Disabled 1: Enabled	0 or 1	1	No	A	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	A	4B6H	-
L8-11	Cooling fan control delay time Fan Delay Time	Set the time in seconds to delay turning OFF the cooling fan after the cooling fan OFF command is received.	0 to 300	60 s	No	A	A	A	A	4B7H	-

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Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
L8-12	Ambient temperature Ambient Temp	Set the ambient temperature. If set to 60 °C, the Inverter overload protection function (OL2) will start 20% earlier.	45 to 60	45 °C	No	A	A	A	A	4B8H	-
L8-15	OL2 characteristics selection at low speeds OL2 Sel @ L-Spd	0: OL2 characteristics at low speeds disabled. 1: OL2 characteristics at low speeds enabled.	0 or 1	1	No	A	A	A	A	4BBH	-
L8-18	Soft CLA selection Soft CLA Sel	0: Disable (gain = 0) 1: Enable	0 or 1	1 *2	No	A	A	A	A	4BE H	-
L8-32	OH1 detection of Inverter’ s cooling fan OH1 Detect Sel	0: Disabled (FAN minor fault detection) 1: Enabled (OH1 major fault detection)	0,1	1	No	A	A	A	A	4E2H	6-78

* 1. The factory setting depends on the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.
* 2. When the control method is changed, the factory setting will change. The V/f control factory setting is given.

◆ N: Special Adjustments

The following settings are made with the special adjustments parameters (N parameters): Hunting prevention, speed feedback detection control, high-slip braking, and feed forward control.

■Hunting Prevention Function: N1

User parameters for hunting prevention are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
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	No	580H	6-48

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	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	No	581H	4-20 6-48

■Speed Feedback Protection Control Functions: N2

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
N2-01	Speed feedback 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	No	584H	4-20 6-49
N2-02	Speed feedback 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	No	585H	6-49
N2-03	Speed feedback 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	No	586H	6-49

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■High-slip Braking: N3

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

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register	Page
						V/f	V/f with PG	Open Loop Vector	Flux Vector		
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	No	No	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	No	No	589H	-
N3-03	High-slip braking stop dwell time HSB DwelTim@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.	0.0 to 10.0	1.0 s	No	A	A	No	No	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	No	No	58BH	-

■Feed Forward: N5

User parameters for the feed forward control are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
N5-01	Feed forward control selection Feed forward	Select the feed forward control. 0: Disabled 1: Enabled	0 or 1	0	No	No	No	No	A	5B0H	4-22 6-176
N5-02	Motor acceleration time Motor Accel Time	Set the time required to accelerate the motor at the rated torque (T_{100}) to the rated speed (Nr). J: $GD^2/4$, P: Motor rated output $ta = \frac{2\pi \cdot J\ [kgm^2] \cdot Nr\ [min^{-1}]}{60 \cdot T_{100}\ [N \cdot m]}\ [s]$ However, $T_{100} = \frac{60}{2\pi} \cdot \frac{P\ [kW]}{Nr\ [min^{-1}]} \times 10^3\ [N \cdot m]$	0.001 to 10.000	0.178 s *	No	No	No	No	A	5B1H	4-22 6-176
N5-03	Feed forward proportional gain Feed forward Gain	Set the proportional gain for feed forward control. Speed reference response will increase as the setting of N5-03 is increased.	0.00 to 100.00	1.0	No	No	No	No	A	5B2H	4-22 6-176
N5-04	Response frequency for speed command Spd Response F	Sets the response frequency to a speed command in units of 0.01 Hz. Used when the machine rigidity is high and the N5-03 is correctly adjusted. Usually, setting is not required.	0.00 to 50.00	40.00 Hz	No	No	No	No	A	5B3H	4-22 6-176

* The factory setting depends on the Inverter capacity. The value for a 200 V Class Inverter for 0.4 kW is given.

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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

User parameters for Digital Operator Displays are shown in the following table.

Parameter Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register	Page
	Display					V/f	V/f with PG	Open Loop Vector	Flux Vector		
o1-01	Monitor selection User Monitor Sel	Set the number of the monitor item to be displayed in the earliest 4 monitor items. (U1-□□) The output monitor voltage (factory setting) can be changed.	4 to 99	6	Yes	A	A	A	A	500H	-
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	A	501H	6-182
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: min^{-1} 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	A	502H	6-182 6-198

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
o1-04	Setting unit for frequency parameters related to V/f characteristics	Display Units	Set the setting unit for frequency reference-related parameters. 0: Hz 1: min^{-1}	0 or 1	0	No	No	No	No	A	503H	6-182
o1-05	LCD brightness adjustment	LCD Contrast	Set a smaller value to lighten the LCD and a larger value to darken the LCD (standard: 3).	0 to 5	3	Yes	A	A	A	A	504H	-

* If changing the frequency unit, check the value of the frequency reference before and after the setting is changed to make sure that the value of the frequency reference is not larger than required.

■Multi-function Selections: o2

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

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	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	A	505H	6-183
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	A	506H	6-183
o2-03	User 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	A	507H	4-19 6-183
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*	No	A	A	A	A	508H	-

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
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	A	509H	6-183
o2-06	Operation selection when digital operator is disconnected / Oper Detection	Sets the operation when the Digital Operator is disconnected. 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	A	50AH	-
o2-07	Cumulative operation time setting / Elapsed Time Set	Sets the cumulative operation time in hour units. Operation time is calculated from the set values.	0 to 65535	0 hr	No	A	A	A	A	50BH	6-183
o2-08	Cumulative operation time selection / 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	No	A	A	A	A	50CH	-
o2-10	Fan operation time setting / Fan ON Time Set	Set the initial value of the fan operation time using time units. The operation time accumulates from the set value.	0 to 65535	0 hr	No	A	A	A	A	50EH	6-183
o2-12	Fault trace/ fault history clear function / FLT Trace Init	0: Disabled (U2 and U3 parameters are on hold.) 1: Enabled (Initializes U2 and U3 parameters.)	0 or 1	0	No	A	A	A	A	510H	-
o2-14	Output power monitor clear selection / kWh Monitor lnit	0: Holds output power monitor. 1: Initializes output power monitor. (Returns to 0.)	0 or 1	0	No	A	A	A	A	512H	5-80

* The factory setting depends on the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

■ Copy Function: o3

User parameters for the copy function are shown in the following table.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
o3-01	Copy function selection Copy Func Select	0: Normal operation 1: READ (Inverter to Operator) 2: COPY (Operator to Inverter) 3: Verify (compare)	0 to 3	0	No	A	A	A	A	515H	6-185
o3-02	Read permitted selection Copy Allowable	0: Read prohibited 1: Read permitted	0 or 1	0	No	A	A	A	A	516H	6-185

◆ T: Motor Autotuning

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register	Page
T1-00	Motor 1/2 selection Select Motor	Set the location where the autotuned motor parameters are to be stored. 1: E1 to E2 (motor 1) 2: E3 to E4 (motor 2)	1 or 2	1	No	Yes	Yes	Yes	Yes	700H	4-15
T1-01	Autotuning mode selection Tuning Mode Sel	Set the autotuning mode. 0: Rotational autotuning 1: Stationary autotuning 1 2: Stationary autotuning for line-to-line resistance only 4: Stationary autotuning 2	0 to 2, 4 *1	2 *7	No	Yes	Yes	Yes	Yes	701H	4-12 4-15
T1-02	Motor output power Mtr Rated Power	Set the output power of the motor in kilowatts.	0.00 to 650.00	0.40 kW *4	No	Yes	Yes	Yes	Yes	702H	4-15
T1-03	Motor rated voltage Rated Voltage	Set the rated voltage of the motor in volts.	0.0 to 255.0 *2	200.0 V *2	No	No	No	Yes	Yes	703H	4-15
T1-04	Motor rated current Rated Current	Set the rated current of the motor in amps.	0.32 to 6.40 *3	1.90 A *4	No	Yes	Yes	Yes	Yes	704H	4-15
T1-05	Motor base frequency Rated Frequency	Set the base frequency of the motor in hertz.	0.0 to 300.0 *5	60.0 Hz	No	No	No	Yes	Yes	705H	4-15

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register	Page
T1-06	Number of motor poles / Number of Poles	Set the number of motor poles.	2 to 48 poles	4 poles	No	No	No	Yes	Yes	706H	4-15
T1-07	Motor base speed / Rated Speed	Set the base speed of the motor in min^{-1}.	0 to 24000	1750 min^{-1}	No	No	No	Yes	Yes	707H	4-15
T1-08	Number of PG pulses when turning / PG Pulses/ Rev	Set the number of pulses per revolution for the PG being used (pulse generator or encoder) without any multiplication factor.	0 to 60000	600	No	No	No	No	Yes	708H	4-15
T1-09	Motor no-load current / No-Load Current	Set the current value recorded in the motor's test results for a motor without a load. Displayed only when Stationary autotuning 2 is selected (T1-01 = 4).	0.00 to 1.89 *6	1.20A *4	No	No	No	Yes	Yes	709H	4-15

* 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 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.
* 4. The factory setting depends on the Inverter capacity. The values for a 200 V Class Inverter for 0.4 kW are given.
* 5. When C6-01 = 1, the upper limit is 400.00.
* 6. The setting range depends on the Inverter capacity. The value for a 200 V Class Inverter for 0.4 kW is given.
* 7. When the control method is changed, the factory setting will change. The V/f control factory setting is given.

◆ 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.

Parameter Number	Name / Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
U1-01	Frequency reference / Frequency Ref	Monitors/sets the frequency reference value.*	10 V: Max. frequency (−10 to 10 V possible)	0.01 Hz	A	A	A	A	40H
U1-02	Output frequency / Output Freq	Monitors the output frequency.*	10 V: Max. frequency (−10 to 10 V possible)	0.01 Hz	A	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) When read in communications, the Inverter rated output current is 8192	0.01 A	A	A	A	A	42H
U1-04	Control method / Control Method	Checks the current control method.	(Cannot be output.)	-	A	A	A	A	43H
U1-05	Motor speed / Motor Speed	Monitors the detected motor speed.*	10 V: Max. frequency (−10 to 10 V possible)	0.01 Hz	No	A	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	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	A	46H
U1-08	Output power / Output kWatts	Monitors the output power (internally detected value).	10 V: Inverter capacity (max. applicable motor capacity) (−10 to 10 V possible)	0.1 kW	A	A	A	A	47H
U1-09	Torque reference / Torque Reference	Monitor in internal torque reference value for vector control.	10 V: Motor rated torque (−10 to 10 V possible)	0.1%	No	No	A	A	48H

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

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Parameter Number	Name / 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	Control Methods: Flux Vector	Register
U1-10	Input terminal status Input Term Sts	Shows input ON/OFF status U1-10=C11111111 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. 1: Multi input 6 (S8) is ON.	(Cannot be output.)	-	A	A	A	A	49H
U1-11	Output terminal status Output Term Sts	Shows output ON/OFF status. U1-11=o1....111 1: Multi-function contact output (M1-M2) is ON. 1: Multi-funtion contact output 1 (P1) is ON. 1: Multi-funtion contact output 2 (P2) is ON. Not used (always 0). 1: Error output (MA/AB-MC) is ON.	(Cannot be output.)	-	A	A	A	A	4AH
U1-12	Operation status Int Ctl Sts 1	Inverter operating status. U1-12= 11111111 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	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	A	4CH
U1-14	Software No. (flash memory) FLASH ID	(Manufacturer's ID number)	(Cannot be output.)	-	A	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) (−10 to 10 V possible)	0.1%	A	A	A	A	4EH

Parameter Number	Name / Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
U1-16	Terminal A2 input current (voltage) Term A2 Level	Monitors the input current of the multi-function analog input. An input of 20 mA corresponds to 100%.	20 mA: 100% (4 to 20 mA) (0 to 10 V, –10 to 10 V possible)	0.1%	A	A	A	A	4FH
U1-17	Terminal A3 input voltage Term A3 Level	Monitors the input voltage of the multi-function analog input. An input of 10 V corresponds to 100%.	10 V: 100% (10 V) (–10 to 10 V possible)	0.1%	A	A	A	A	050H
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) (–10 to 10 V output)	0.1%	A	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) (–10 to 10 V output)	0.1%	No	No	A	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 (–10 to 10 V possible)	0.01 Hz	A	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 (–10 to 10 V possible)	0.01 %	No	A	No	A	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) (–10 to 10 V possible)	0.01 %	No	A	No	A	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 (–10 to 10 V possible)	0.01 %	A	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) (–10 to 10 V possible)	0.1 V	No	No	A	A	59H

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Parameter Number	Name	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	Control Methods: Flux Vector	Register
U1-27	Output voltage reference (Vd)	Voltage Ref (Vd)	Monitors the Inverter internal voltage reference for motor excitation current control.	10 V: 200 VAC (400 VAC) (−10 to 10 V possible)	0.1 V	No	No	A	A	5AH
U1-28	Software No. (CPU)	CPU ID	(Manufacturer's CPU software No.)	(Cannot be output.)	-	A	A	A	A	5BH
U1-29	Output power lower 4 digits	kWh Lower 4 dig	Monitors the Inverter's output power. The display is split into upper digits and lower digits in the following way. □□□□□ □□□.□ kWH U1-30 U1-29 Example: If the output power is 12345678.9 kWh, the display will be as follows: U1-29: 678.9 kWH U1-30: 12345 MWH Range: 0.0 to 32767999.9	(Cannot be output.)	kWH	A	A	A	A	05CH
U1-30	Output power upper 5 digits	kWh Upper 5 dig			MWH	A	A	A	A	05DH
U1-31	LED check	-	Lights all LEDs on the Digital Operator JVOP-161.	(Cannot be output.)	-	A	A	A	A	3CH
U1-32	ACR output of q axis	ACR (q) Output	Monitors the current control output value for the motor secondary current.	10 V: 100% (−10 to 10 V possible)	0.1 %	No	No	A	A	5FH
U1-33	ACR output of d axis	ACR (d) Output	Monitors the current control output value for the motor excitation current.	10 V: 100% (−10 to 10 V possible)	0.1 %	No	No	A	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	A	61H
U1-35	Zero-servo movement pulses	Zero Servo Pulse	Shows the number of PG pulses times 4 for the movement range when stopped at zero.	(Cannot be output.)	1	No	No	No	A	62H
U1-36	PID input volume	PID Input	PID feedback volume Given as maximum frequency/100%	10 V: Max. frequency (−10 to 10 V possible)	0.01 %	A	A	A	A	63H
U1-37	PID output volume	PID Output	PID control output Given as maximum frequency/100%	10 V: Max. frequency (−10 to 10 V possible)	0.01 %	A	A	A	A	64H

Parameter Number	Name	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	Control Methods: Flux Vector	Register
U1-38	PID target value	PID Setpoint	PID target value Given as maximum frequency/100%	10 V: Max. frequency	0.01 %	A	A	A	A	65H
U1-39	RS-422A/485 communications error code	Transmit Err	Shows RS-422A/485 errors. U1-39= 00000000 1: CRC error 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	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.		1 hr	A	A	A	A	68H
U1-44	ASR output without filter	ASR Out w/o Fil	Monitors the output from the speed control loop (i.e., the primary filter input value). 100% is displayed for rated secondary current of the motor.	10 V: Rated secondary current of motor (-10 V to 10 V)	0.01 %	No	No	No	A	6BH
U1-45	Feed forward control output	FF Cont Output	Monitors the output from feed forward control. 100% is displayed for rated secondary current of the motor.	10 V: Rated secondary current of motor (-10 V to 10 V)	0.01 %	No	No	No	A	6CH

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■ Fault Trace: U2

User parameters for error tracing are shown in the following table.

Parameter Number	Name / Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
U2-01	Current fault / Current Fault	The contents of the current fault.	(Cannot be output.)	-	A	A	A	A	80H
U2-02	Previous fault / Last Fault	The contents of the error that occurred just prior to the current fault.	(Cannot be output.)	-	A	A	A	A	81H
U2-03	Reference frequency at fault / Frequency Ref	The reference frequency when the previous fault occurred.	(Cannot be output.)	0.01 Hz	A	A	A	A	82H
U2-04	Output frequency at fault / Output Freq	The output frequency when the previous fault occurred.	(Cannot be output.)	0.01 Hz	A	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	A	84H
U2-06	Motor speed at fault / Motor Speed	The motor speed when the previous fault occurred.	(Cannot be output.)	0.01 Hz	No	A	A	A	85H
U2-07	Output voltage reference at fault / Output Voltage	The output reference voltage when the previous fault occurred.	(Cannot be output.)	0.1 V	A	A	A	A	86H
U2-08	DC bus voltage at fault / DC Bus Voltage	The main current DC voltage when the previous fault occurred.	(Cannot be output.)	1 V	A	A	A	A	87H
U2-09	Output power at fault / Output kWatts	The output power when the previous fault occurred.	(Cannot be output.)	0.1 kW	A	A	A	A	88H
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	A	89H

Parameter Number	Name / Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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.	(Cannot be output.)	-	A	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.	(Cannot be output.)	-	A	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.	(Cannot be output.)	-	A	A	A	A	8CH
U2-14	Cumulative operation time at fault Elapsed time	The operating time when the previous fault occurred.	(Cannot be output.)	1 hr	A	A	A	A	8DH

Note 1. The following faults are not included in the fault trace: CPF00, 01, 02, 03, UV1, and UV2.
2. If the PUF fault is already indicated in U2-xx or U3-xx, even if the PUF fault is detected again, the fault trace is not updated.

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◆ Fault History: U3

User parameters for the error log are shown in the following table.

Parameter Number	Name / Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
U3-01	Most recent fault / Last Fault	The error contents of 1st previous fault.	(Cannot be output.)	-	A	A	A	A	90H
U3-02	Second most recent fault / Fault Message 2	The error contents of 2nd previous fault.		-	A	A	A	A	91H
U3-03	Third most recent fault / Fault Message 3	The error contents of 3rd previous fault.		-	A	A	A	A	92H
U3-04	Fourth most recent fault / Fault Message 4	The error contents of 4th previous fault.		-	A	A	A	A	93H
U3-05	Cumulative operation time at fault / Elapsed Time 1	The total operating time when the 1st previous fault occurred.		1 hr	A	A	A	A	94H
U3-06	Accumulated time of second fault / Elapsed Time 2	The total operating time when the 2nd previous fault occurred.		1 hr	A	A	A	A	95H
U3-07	Accumulated time of third fault / Elapsed Time 3	The total operating time when the 3rd previous fault occurred.		1 hr	A	A	A	A	96H
U3-08	Accumulated time of fourth fault / Elapsed Time 4	The total operating time when the 4th previous fault occurred.		1 hr	A	A	A	A	97H

Note 1. The following errors are not recorded in the error log: CPF00, 01, 02, 03, UV1, and UV2.
2. If the PUF fault is already indicated in U2-xx or U3-xx, even if the PUF fault is detected again, the fault trace is not updated.

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

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

Param-eter Number	Name	Setting Range	Unit	Factory Setting			
				V/f Con-trol A1-02=0	V/F with PG A1-02=1	Open Loop Vector A1-02=2	Flux Vector A1-02=3
b3-01	Speed search selection	0 to 3	1	2	3	2	-
b3-02	Speed search operating current	0 to 200	1%	150*5	-	100	-
b8-02	Energy-saving gain	0.0 to 10.0	0.1	-	-	0.7	1.0
b8-03	Energy-saving filter time constant	0.00 to 10.00	0.01 s	-	-	0.50*1	0.01*1
C3-01	Slip compensation gain	0.0 to 2.5	0.1	0.0	-	1.0	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*6	200*6	20	-
C5-01	ASR proportional (P) gain 1	0 to 300.00	0.01	-	0.20	-	20.00
C5-02	ASR integral (I) time 1	0.000 to 10.000	0.001 s	-	0.200	-	0.500
C5-03	ASR proportional (P) gain 2	0.00 to 300.00	0.01	-	0.02	-	20.00
C5-04	ASR integral (I) time 2	0.000 to 10.000	0.001 s	-	0.050	-	0.500
E1-04 E3-02	Max. output frequency (FMAX)	40.0 to 300.0 *4	0.1 Hz	60.0 *2	60.0 *2	60.0	60.0
E1-05 E3-03	Max. voltage (VMAX) *3	0.0 to 255.0 (0.0 to 510.0)	0.1 V	200.0 *2	200.0 *2	200.0	200.0
E1-06 E3-04	Base frequency (FA)	0.0 to 300.0*4	0.1 Hz	60.0 *2	60.0 *2	60.0	60.0
E1-07 E3-05	Mid. output frequency (FB)	0.0 to 300.0*4	0.1 Hz	3.0 *2	3.0 *2	3.0	0.0
E1-08 E3-06	Mid. output frequency voltage (VC)*3	0.0 to 255.0 (0.0 to 510.0)	0.1 V	15.0 *2	15.0 *2	11.0	0.0
E1-09 E3-07	Min. output frequency (FMIN)	0.0 to 300.0*4	0.1 Hz	1.5 *2	1.5 *2	0.5	0.0
E1-10 E3-08	Min. output frequency voltage (VMIN)*3	0.0 to 255.0 (0.0 to 510.0)	0.1 V	9.0 *2	9.0 *2	2.0	0.0
F1-09	Overspeed detection delay time	0.0 to 2.0	0.1 s	-	1.0	-	0.0
L8-18	Soft CLA selection	0, 1	1	1	1	1	0

* 1. For Inverters with a capacity of 55 kW or more, the factory setting is 2.00 for open-loop vector control and 0.05 for flux vector control.
* 2. Settings vary as shown in the following tables depending on the Inverter capacity and E1-03.
* 3. The settings shown are for 200 V Class Inverters. The values will double for 400 V Class Inverters.
* 4. When C6-01 = 1, the upper limit is 400.0.
* 5. C6-01 = 1:120%, C6-01 = 0:150%
* 6. 1000 ms for Inverters of 200 V Class 30 to 110 kW and 400 V Class 55 to 300 kW.

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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	Flux 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	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	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	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	0.0
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	0.0
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	0.0
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	0.0

* 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	Flux 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	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	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	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	0.0
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	0.0
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	0.0
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	0.0

* 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	Flux 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	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	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	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	0.0
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	0.0
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	0.0
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	0.0

* 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 user 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
C6-01	CT/VT selection	-	0	0	0	0	0	0	0	0	0
C6-02	Carrier frequency selection (when VT is selected) *1 *4	-	6 *2	6 *2	6 *2	6*2	6*2	6 *2	6 *2	6 *2	6 *2
-	Carrier frequency selection upper limit (when VT is selected)*1	-	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
L2-08	Frequency reduction gain at KEB start	°C	95	95	95	95	95	95	95	95	95
L8-02	Overheat pre-alarm level	°C	95	95	95	100	95	95	95	95	90
N5-02	Motor acceleration time	s	0.178	0.142	0.166	0.145	0.154	0.168	0.175	0.265	0.244

Param-eter 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 coeffi-cient	-	57.87	51.79	46.27	38.16	35.78	31.35	23.10	20.65	18.12
C6-01	CT/VT selection	-	0	0	0	0	0	0	0	0	1
C6-02	Carrier frequency selec-tion (when VT is selected) *1 *3	-	6 *2	6*2	4 *2	3 *2	3 *2	3 *2	2 *2	2 *2	1 *2
-	Carrier frequency selec-tion upper limit (when VT is selected)*1	-	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 resis-tance	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	1.0	1.0	1.0	1.0	1.0
L2-08	Frequency reduction gain at KEB start	°C	95	95	95	95	95	95	95	95	95
L8-02	Overheat pre-alarm level	°C	100	90	90	95	100	105	110	100	110
N5-02	Motor acceleration time	s	0.317	0.355	0.323	0.320	0.387	0.317	0.533	0.592	0.646

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.

* 1. The factory settings when VT is selected are given.
When CT is selected, the factory settings are as follows for Inverters of any capacity:
Carrier frequency selection: 1 (2.0 kHz)
Carrier frequency selection upper limit: 2.5 kHz

* 2. The setting of C6-02 changes the carrier frequency selection as follows:
0: Low-noise PWM, 1: 2.0 kHz, 2: 5.0 kHz, 3: 8.0 kHz, 4: 10.0 kHz, 5: 12.5 kHz, 6: 15.0 kHz

* 3. When setting the carrier frequency of 200 V Class Inverters of 30 kW or more to a value larger than the factory setting, reduce the value of the Inverter rated output current.

■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
C6-01	CT/VT selection	-	0	0	0	0	0	0	0	0	0	0
C6-02	Carrier frequency selection (when VT is selected)*1 *3	-	6 *2	6*2	6 *2	6 *2	6 *2	6*2	6 *2	6 *2	6 *2	6 *2
-	Carrier frequency selection upper limit (when VT is selected)*1	-	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
N5-02	Motor acceleration time	s	0.178	0.142	0.166	0.145	0.154	0.154	0.168	0.175	0.265	0.244

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Param-eter 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 coeffi-cient	-	115.74	103.58	92.54	76.32	71.56	67.20	46.20	38.91	36.23	32.79
C6-01	CT/VT selection	-	0	0	0	0	0	0	0	0	0	0
C6-02	Carrier frequency selec-tion (when VT is selected)*1 *3	-	6 *2	6 *2	4 *2	4 *2	4 *2	4 *2	3 *2	3 *2	3 *2	2 *2
-	Carrier frequency selec-tion upper limit (when VT is selected)*1	-	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 resis-tance	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	110
N5-02	Motor acceleration time	s	0.317	0.355	0.323	0.320	0.387	0.317	0.533	0.592	0.646	0.673

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
C6-01	CT/VT selection	-	0	0	1	1
C6-02	Carrier frequency selection (when VT is selected)*1 *3	-	2 *2	2 *2	1 *2	1 *2
-	Carrier frequency selection upper limit (when VT is selected)*1	-	4	2	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	108	95	100	108
N5-02	Motor acceleration time	s	0.777	0.864	0.910	1.392

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.

* 1. The factory settings when VT is selected are given.
When CT is selected, the factory settings are as follows for Inverters of any capacity:
Carrier frequency selection: 1 (2.0 kHz)
Carrier frequency selection upper limit: 2.5 kHz

* 2. The setting of C6-02 changes the carrier frequency selection as follows:
0: Low-noise PWM, 1: 2.0 kHz, 2: 5.0 kHz, 3: 8.0 kHz, 4: 10.0 kHz, 5: 12.5 kHz, 6: 15.0 kHz

* 3. When setting the carrier frequency of 400 V Class Inverters of 30 kW or more to a value larger than the factory setting, reduce the value of the Inverter rated output current.

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Chapter 6

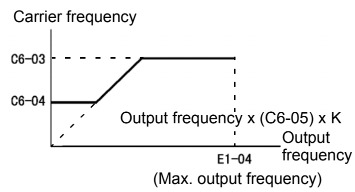
Parameter Settings by Function

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.

■Related Parameters

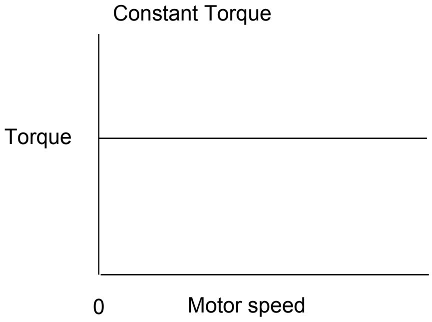
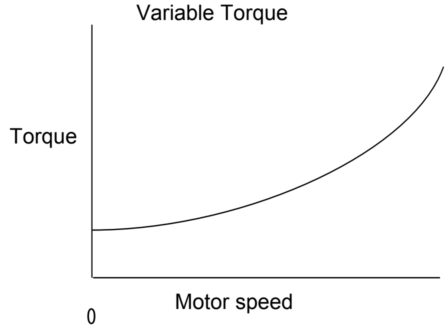
Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
C6-01	CT/VT selection Heavy/ Normal Duty	0: CT (low carrier, parameter torque, 150% per minute) 1: VT (high carrier, variable torque, 120% per minute)	0 or 1	0*1	No	Q	Q	Q	Q	223H
C6-02	Carrier frequency selection Carrier-Freq Sel	Select carrier wave fixed pattern. 0: Low-noise PWM 1: 2.0 kHz 2: 5.0 kHz 3: 8.0 kHz 4: 10.0 kHz 5: 12.5 kHz 6: 15.0 kHz F: Enables detailed settings using parameters C6-03 to C6-05	0,1 (C6-01=0) 0 to F (C6-01=1)	1 (C6-01=0) 6*2 (C6-01=1)	No	Q	Q	Q	Q	224H
C6-03 *2	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.	2.0 to 2.5	2.0 kHz	No	A	A	A	A	225H
C6-04 *2	Carrier frequency lower limit Carrier-Freq Min	 	0.4 to 2.5	2.0 kHz	No	A	A	No	A	226H
C6-05 *2	Carrier frequency proportional gain Carrier-Freq Gain	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	00 to 99	00	No	A	A	No	A	227H

* 1. Only 1(VT) can be set for 200 V Class 110 kW as well as 400 V Class 220 kW and 300 kW Inverters.

* 2. This parameter can be monitored or set only when F is set for C6-02.

■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 constant 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: Electromagnetic noise is present.	High carrier: Electromagnetic 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 2.0 kHz	0: Low carrier low noise 1: Carrier 2.0 kHz 2: Carrier 5.0 kHz 3: Carrier 8.0 kHz 4: Carrier 10.0 kHz 5: Carrier 12.5 kHz 6: Carrier 15.0 kHz F: User-set*
E1-04 and E3-02 (Max. Output Frequency)	300 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 kW, or 400 V Class Inverters for 30 to 55 kW: 4 (10 kHz)
200 V Class Inverters for 37 to 55 kW, or 400 V Class Inverters for 75 to 110 kW: 3 (8 kHz)
200 V Class Inverters for 75 to 90 kW, or 400 V Class Inverters for 132 to 185 kW: 2 (5 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 300 Hz, if C6-01 is set to 0, an OPE02 (Invalid parameter setting range) error will occur.

Carrier Frequency

When selecting the carrier frequency, observe the following precautions items.

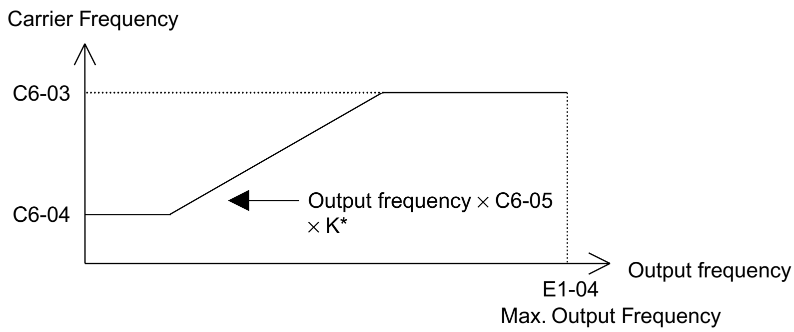
- When using a device with C6-01 set to 1 (VT), adjust the carrier frequency according to the cases shown below.
  If the wiring distance between Inverter and motor is long: Set the carrier frequency low. (Use the following values as guidelines.

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 5-87.

- 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).



*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=1

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% constant 1 min, OL2 (Inverter overload) will be detected. The Inverter overload current reduction level is shown below.

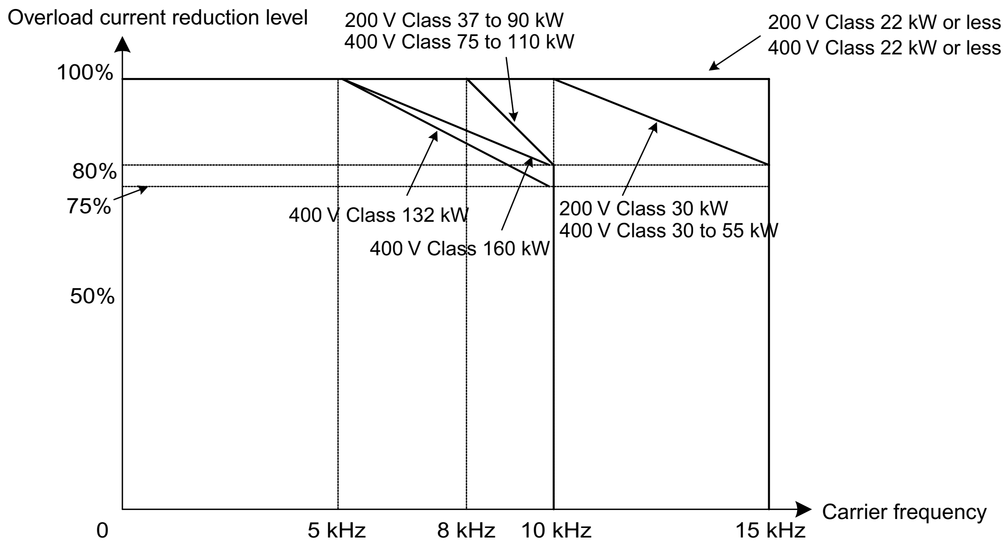


Fig 6.2 Overload Current Reduction Level

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

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
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 board 4: Pulse train input	0 to 4	1	No	Q	Q	Q	Q	180H
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	A	42CH
H6-02	Pulse train input scaling Pulse Input Scaling	Set the number of pulses in hertz, taking the reference to be 100%.	1000 to 32000	1440 Hz	Yes	A	A	A	A	42DH

■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 Digital Operator and Modes*.

Fig 6.3 Frequency Setting Display

■Inputting the Frequency Reference Using Control Circuit Terminal (Analog Setting)

When b1-01 is set to 1, you can input the frequency reference from control circuit terminal A1 (voltage input), control circuit terminal A2 (voltage or current input) or control circuit terminal A3 (voltage input).

Inputting Master Speed Frequency Reference Only (Voltage Input)

When inputting a voltage for the master speed frequency reference, input the voltage to control circuit terminal A1.

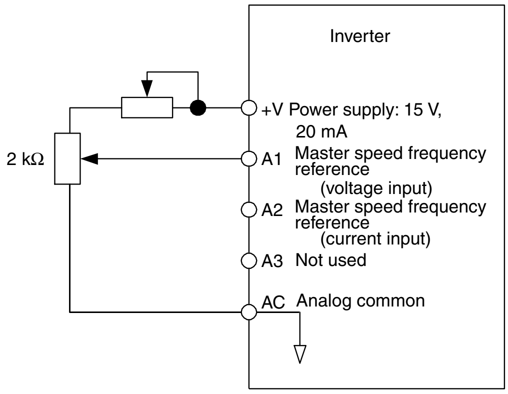


Fig 6.4 Voltage Input for Master Speed Frequency Reference

Inputting Master Speed Frequency Reference Only (Current Input)

When inputting a current for the master speed frequency reference, input the current to control circuit terminal A2, input 0 V to terminal A1, set H3-08 (Multi-function analog input terminal A2 signal level selection) to 2 (current input), and set H3-09 (Multi-function analog input terminal A2 function selection) to 0 (add to terminal A1).

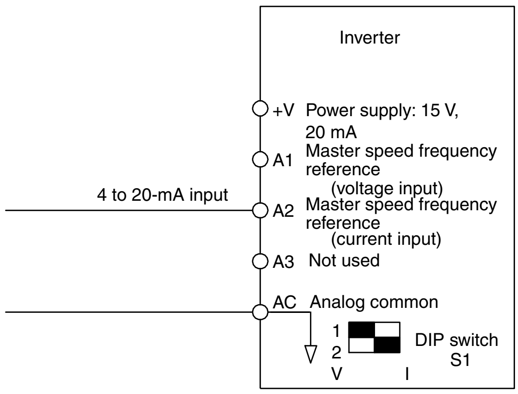


Fig 6.5 Current Input for Master Speed Frequency Reference

IMPORTANT

Turn ON pin 2 of DIP switch S1 (toward I), the voltage/current switch, when inputting a current to terminal A2. Turn OFF pin 2 of DIP switch S1 (toward V), the voltage/current switch, when inputting a voltage to terminal A2. Set H3-08 to the correct setting for the type of input signal being used.

Switch between 2 Step Speeds: Master/Auxiliary Speeds

When switching between the master and auxiliary speeds, input the master speed frequency reference to control circuit terminal A1 and the auxiliary speed frequency reference to control circuit terminal A2 or A3. The master speed frequency reference input to terminal A1 will be used for the Inverter frequency reference when the master speed reference 1 allocated to multi-function input terminal (factory setting: S5) is OFF, and the auxiliary speed frequency reference input to terminal A2 or A3 will be used for the Inverter frequency reference when the multi-speed reference 1 allocated to multi-function input terminal is ON.

When using terminal A2 as the input terminal of auxiliary speed frequency reference, set H3-09 (Multi-function analog input terminal A2 function selection) to 2 [Auxiliary speed reference frequency 1 (2nd speed analog)].

When using terminal A3 as the input terminal of auxiliary speed frequency reference, set H3-05 (Multi-function analog input terminal A3 function selection) to 2 [Auxiliary speed frequency reference 1 (2ndspeed analog)].

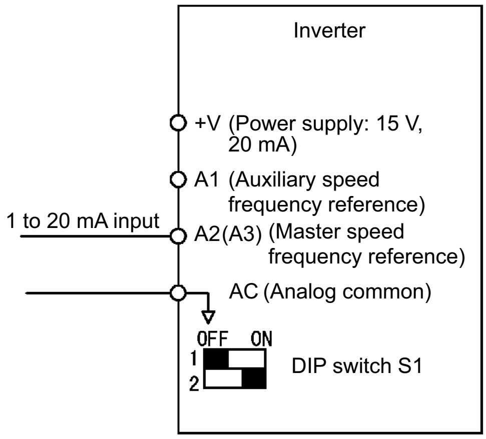


Fig 6.6 Switching between Master and Auxiliary Frequencies

Precautions on Setting DIP Switches and Parameters

- When inputting voltage signals to terminal A2, set the pin 2 of the current/voltage switching DIP switch S1-2 to OFF side (factory setting: ON).
- When inputting current signals to terminal A2, set the pin 2 of the current/voltage switching DIP switch S1-2 to ON side (factory setting: ON).
- When setting terminal A2 as the master speed frequency input terminal and terminal A1 as the auxiliary speed frequency input terminal, set the H3-09 (Multi-function analog input terminal A2 function selection) to 2 and H3-05 (Multi-function analog input terminal A3 function selection) to a number other than 0 and H3-05 (Multi-function analog input terminal A3 function selection) to a number other than 0 and 2.
  And then, set H3-13 (Terminal A1/A2 switching) to 1.
- H3-09 and H3-05 cannot be set to 2 at the same time.

■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 (Pulse Train 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

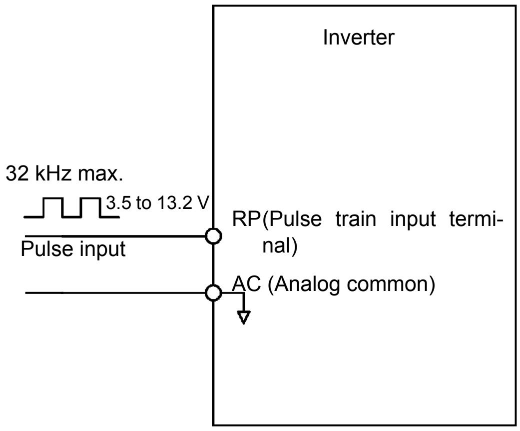


Fig 6.7 Frequency Reference Using Pulse Train Input

◆ Using Multi-Step Speed Operation

With SYSDRIVE 3G3RV 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.

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■Related Parameters

To switch frequency references, set multi-step speed references 1 to 3 and the jog reference selection in the multi-function contact inputs (any of the terminals S3 to S8). Setting examples are shown below. The unused terminals need not be set.

Multi-function Contact Inputs (H1-01 to H1-06)

Terminal	Parameter Number	Set Value	Details
S5	H1-03	3	Multi-step speed reference 1 [Also used for master speed/auxiliary speed switching when multi-function analog input H3-09 or H3-05 is set to 2 (auxiliary frequency reference).]
S6	H1-04	4	Multi-step speed reference 2 [Also used for auxiliary frequency reference 2 when multi-function analog input H3-09 or H3-05 is set to 3 (auxiliary frequency reference 2).]
S7	H1-05	5	Multi-step speed reference 3
S8	H1-06	6	Jog frequency selection (given priority over multi-step speed reference)

Combination of Multi-Function References and Multi-Function Contact Inputs. In the Above Setting Example

You can change the selected frequency reference by combining the ON/OFF status of S5 to S8 (multi-function contact input terminals) to set multi-step speed references 1 to 3 and the jog frequency selection. The following table shows the possible combinations.

Speed	TerminalS5	TerminalS6	TerminalS7	TerminalS8	Selected Frequency
	Multi-step Speed Reference 1	Multi-step Speed Reference 2	Multi-step Speed Reference 3	Jog Frequency Selection	
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 1
3	OFF	ON	OFF	OFF	Frequency reference 3 d1-03, auxiliary frequency 2
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 S8's jog frequency selection is given priority over multi-step speed references.

Setting Precautions

Refer to the following to set step 1 to step 3 to analog inputs.

- **Step 1**
  When setting terminal A1's analog input to step 1, set b1-01 to 1, and when setting d1-01 (Frequency Reference 1) to step 1, set b1-01 to 0.
- **Step 2**
  When setting terminal A2's (or A3's) analog input to step 2, set H3-09 (H3-05 when A3 is used) to 2 (auxiliary frequency reference 1). When setting d1-02 (Frequency Reference 2) to step 2, do not set H3-09 (H3-05 when A3 is used) to 2.
- **Step 3**
  When setting terminal A3's (or A2's) analog input to step 3, set H3-05 (H3-09 when A2 is used) to 3 (auxiliary frequency reference 2). When setting d1-03(Frequency Reference 3) to step 3, do not set H3-05 (H3-09 when A2 is used) to 3.

■Connection Example and Time Chart

The following diagram shows a time chart and control circuit terminal connection example during a 9-step operation.

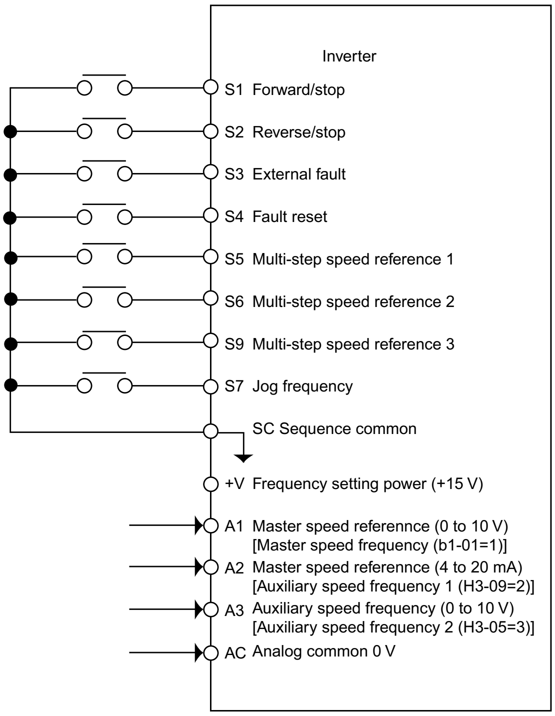


Fig 6.8 Control Circuit Terminal During 9-step Operation

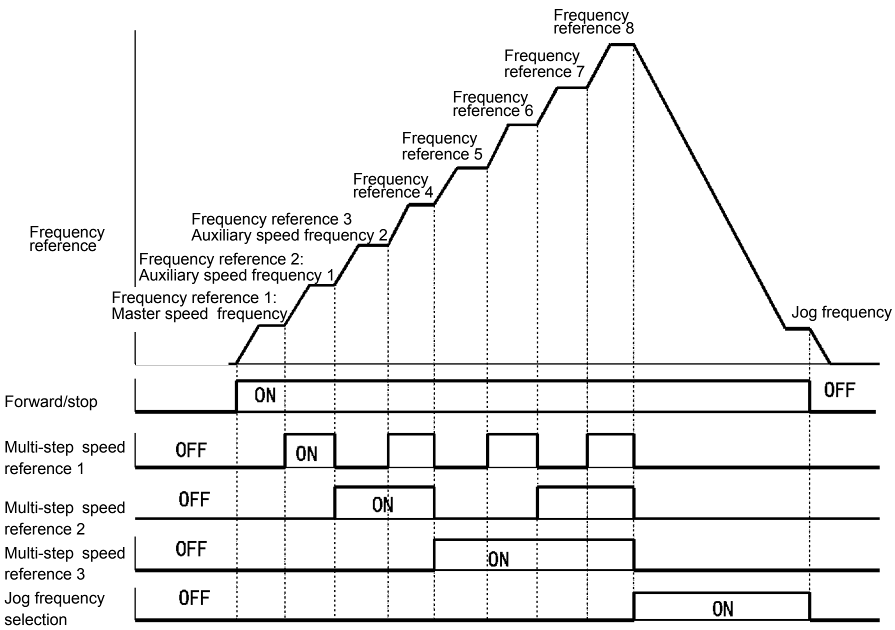
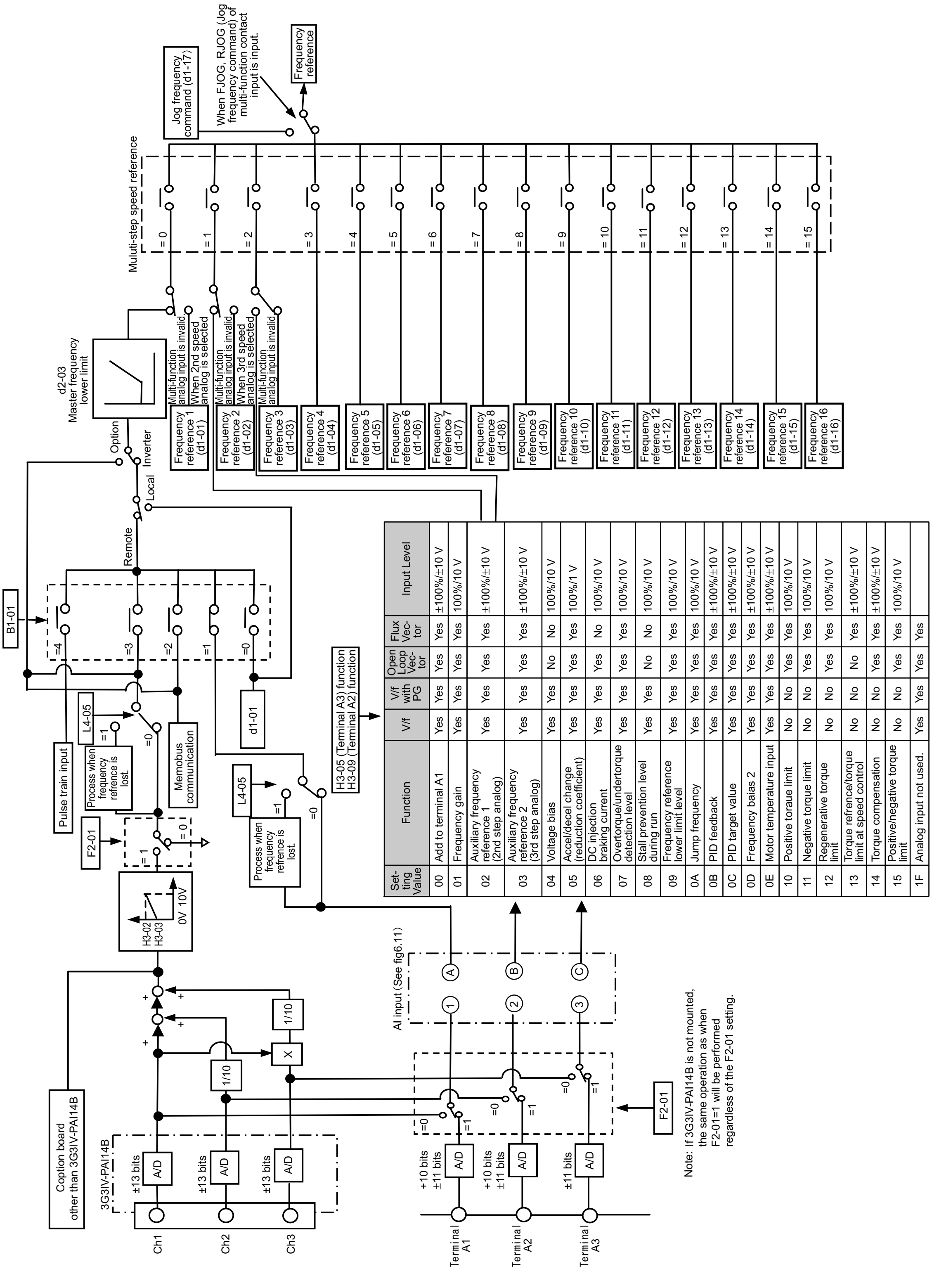


Fig 6.9 Multi-step speed reference/Jog Frequency Selection Time Chart

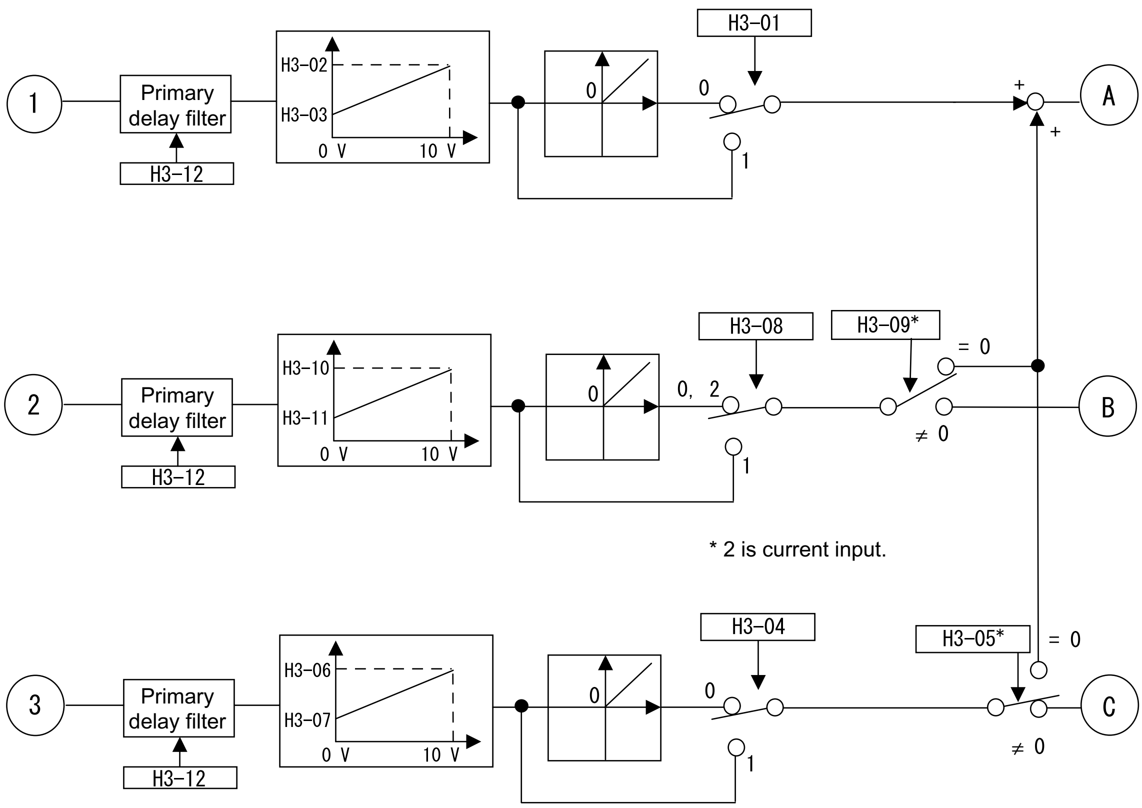
◆ 3G3RV-V1 Function Block

The following diagram shows the function block diagram of 3G3RV-V1.



Setting Value	Function	V/f	V/f with PG	Open Loop Vector	Flux Vector	Input Level
00	Add to terminal A1	Yes	Yes	Yes	Yes	±100%/±10 V
01	Frequency gain	Yes	Yes	Yes	Yes	100%/10 V
02	Auxiliary frequency reference 1 (2nd step analog)	Yes	Yes	Yes	Yes	±100%/±10 V
03	Auxiliary frequency reference 2 (3rd step analog)	Yes	Yes	Yes	Yes	±100%/±10 V
04	Voltage bias	Yes	Yes	No	No	100%/10 V
05	Accel/decel change (reduction coefficient)	Yes	Yes	Yes	Yes	100%/1 V
06	DC injection braking current	Yes	Yes	Yes	No	100%/10 V
07	Overtorque/undertorque detection level	Yes	Yes	Yes	Yes	100%/10 V
08	Stall prevention level during run	Yes	Yes	No	No	100%/10 V
09	Frequency reference lower limit level	Yes	Yes	Yes	Yes	100%/10 V
0A	Jump frequency	Yes	Yes	Yes	Yes	100%/10 V
0B	PID feedback	Yes	Yes	Yes	Yes	±100%/±10 V
0C	PID target value	Yes	Yes	Yes	Yes	±100%/±10 V
0D	Frequency baias 2	Yes	Yes	Yes	Yes	±100%/±10 V
0E	Motor temperature input	Yes	Yes	Yes	Yes	±100%/±10 V
10	Positive toraue limit	No	No	Yes	Yes	100%/10 V
11	Negative torque limit	No	No	Yes	Yes	100%/10 V
12	Regenerative torque limit	No	No	Yes	Yes	100%/10 V
13	Torque refrence/torque limit at speed control	No	No	No	Yes	±100%/±10 V
14	Torque compensation	No	No	Yes	Yes	±100%/±10 V
15	Positive/negative torque limit	No	No	Yes	Yes	100%/10 V
1F	Analog input not used.	Yes	Yes	Yes	Yes	

Fig 6.10 3G3RV-V1 Function Block



* The same value can not be set in H3-05 and H3-09.

Fig 6.11 AI Input Detailed Diagram

6

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
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 board	0 to 3	1	No	Q	Q	Q	Q	181H

■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 Digital Operator and Modes*.

■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.

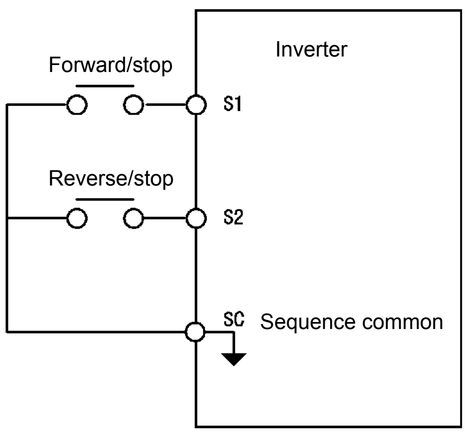


Fig 6.12 2-wire Sequence Wiring Example

Performing Operations Using a 3-wire Sequence

When any parameter from H1-01 to H1-6 (multi-function contact input terminals S3 to S8) is set to 0, terminals S1 and S2 are used for a 3-wire sequence, and the multi-function input terminal that has been set functions as a Forward/Reverse Run Command terminal.

When the Inverter is initialized for 3-wire sequence control with A1-03, multi-function input 3 (terminal S5) becomes the input terminal for the Forward/Reverse Run Command.

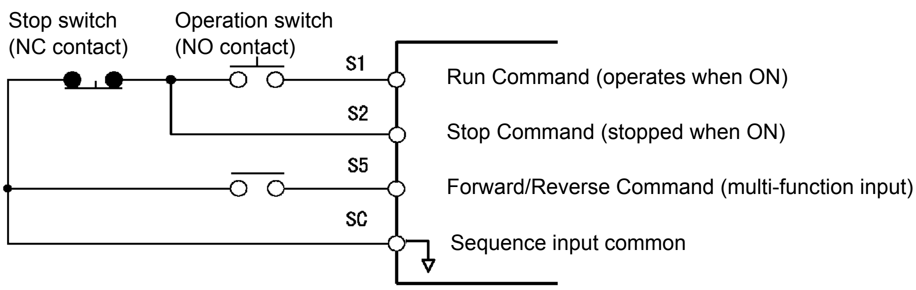


Fig 6.13 3-wire Sequence Wiring Example

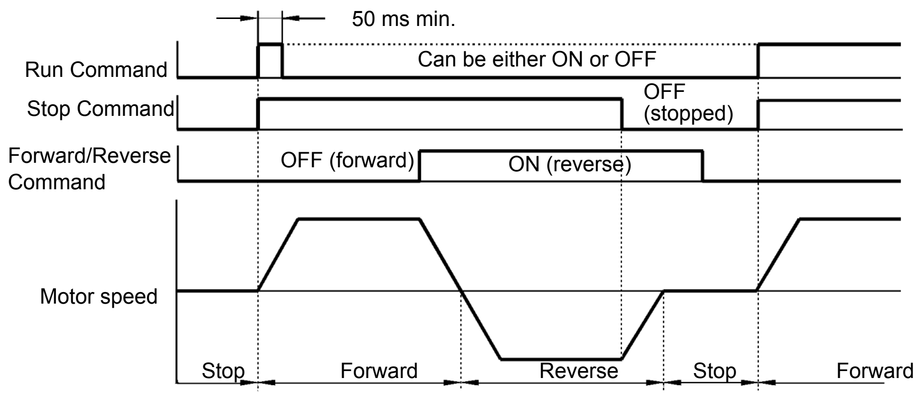


Fig 6.14 Three-wire Sequence Time Chart

INFO

1. 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.
2. When the 3-wire sequence is set, do not make the wiring for the control circuit unless the multi-function input terminal parameter is set. Failure to observe this warning may result in injury.

6

Stopping Methods

This section explains methods of stopping the Inverter.

◆ Selecting the Stopping Method when a Stop Command is Sent

There are four methods of stopping the Inverter when a Stop Command is sent:

- Deceleration to stop
- Coast to stop
- DC braking stop
- Coast to stop with timer

Set parameter b1-03 to select the Inverter stopping method. A DC braking stop and coasting to a stop with a timer cannot be set for flux vector control.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
b1-03	Stopping method selection / Stopping Method	Used to set the stopping method used 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	Q	182H
b1-05	Operation selection for setting E1-09 or less / Zero speed Oper	Used to set the method of operation when the frequency reference input is less than the minimum output frequency (E1-09). 0: Run at frequency reference (E1-09 not effective). 1: STOP (Frequencies below E1-09 in the coast to stop state.) 2: Run at min. frequency. (E1-09) 3: Run at zero-speed (Frequencies below E1-09 are zero)	0 to 3	0	No	No	No	No	A	184H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
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 is used to set the starting frequency for the DC injection braking. In flux vector control, b2-01 is used to set the starting frequency for the zero-speed control.	0.0 to 10.0	0.5 Hz	No	A	A	A	A	189H
b2-02	DC injection braking current DCInj Current	Sets the DC injection braking current as a percentage of the Inverter rated current. The DC injection braking current in flux control is affected by any change to the setting of E2-03.	0 to 100	50%	No	A	A	A	No	18AH
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	A	18BH
b2-04	DC injection braking time at stop DCInj Time@Stop	Used to set the time to perform DC injection braking at stop (zero-speed control in flux vector control) in units of 1 second. 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	A	18CH

* 0 or 1 for flux vector control.

6

■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 6-23 *Setting Acceleration and Deceleration Times*.

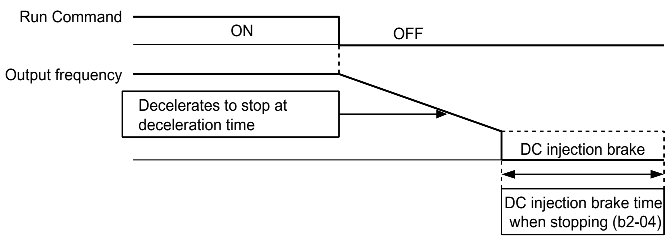


Fig 6.15 Deceleration to Stop

The operation after starting or stopping depends on the setting of b1-05 when flux vector control is selected (A1-02 = 3).

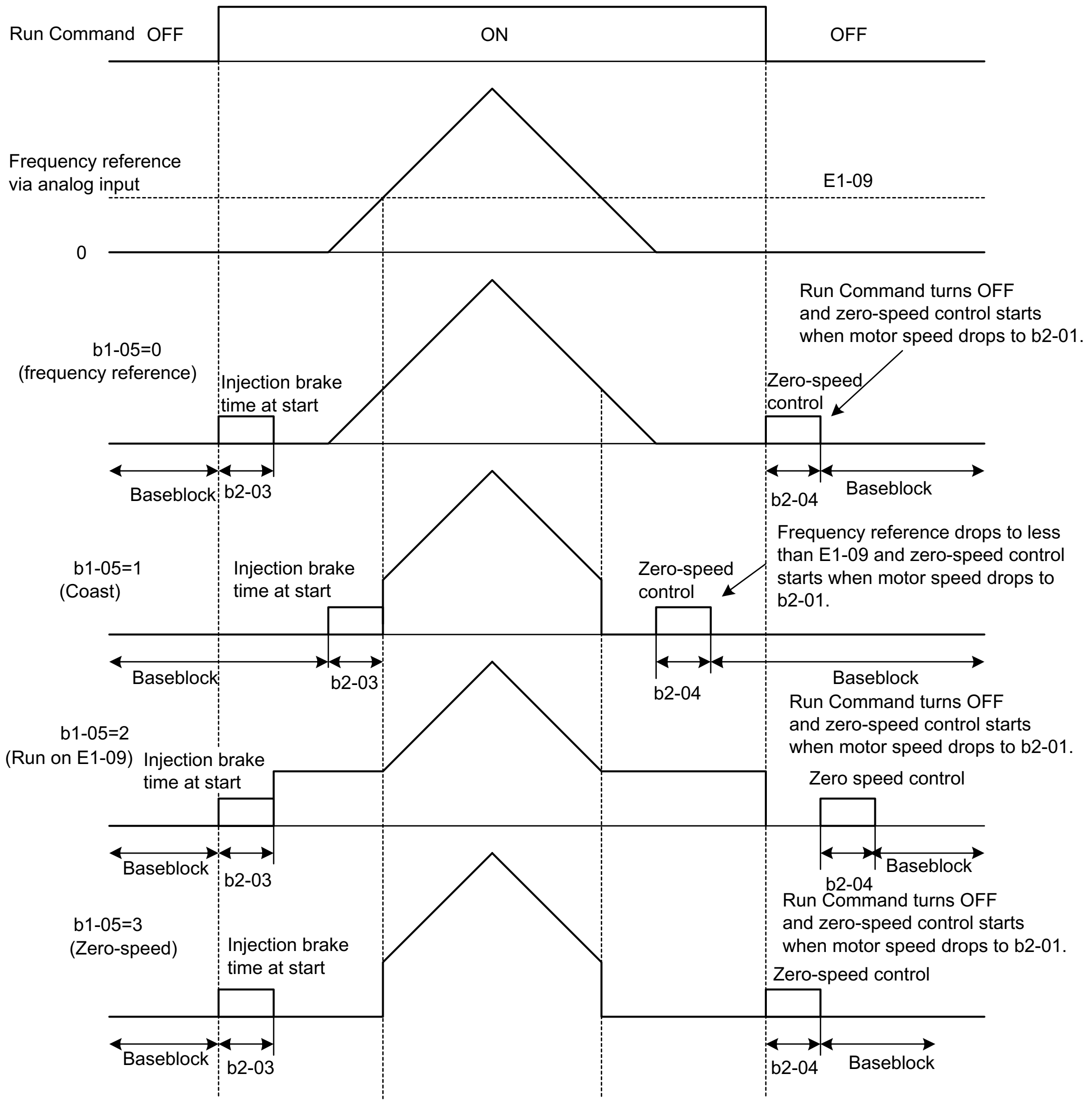


Fig 6.16 Deceleration to Stop (for Flux Vector Control)

Setting Precautions

- When using flux vector control, the zero-speed control starts when motor speed drops to b2-01 during deceleration. Also, the setting b2-01 < E1-09 is possible.
- The current level during injection brake time at start is the value of E2-03 (motor no-load current). Accordingly, b2-02 is invalid in flux vector control.

■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.

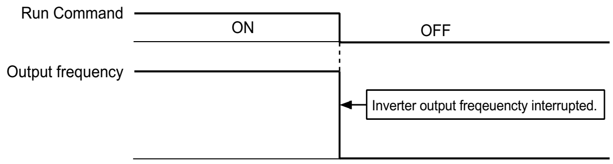


Fig 6.17 Coast to Stop

INFO

After the Stop Command is input, Run Commands are ignored until the Minimum Baseblock Time (L2-03) has elapsed.

■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.

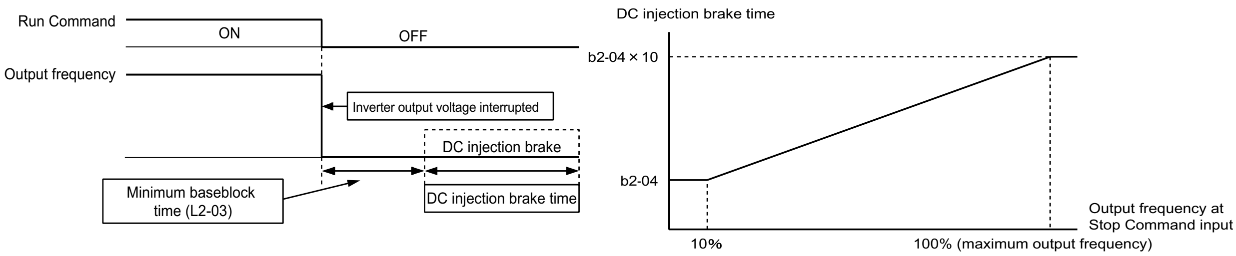


Fig 6.18 DC Injection Braking (DB) Stop

INFO

Lengthen the Minimum Baseblock Time (L2-03) when an overcurrent (OC) occurs during stopping.

6

■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.

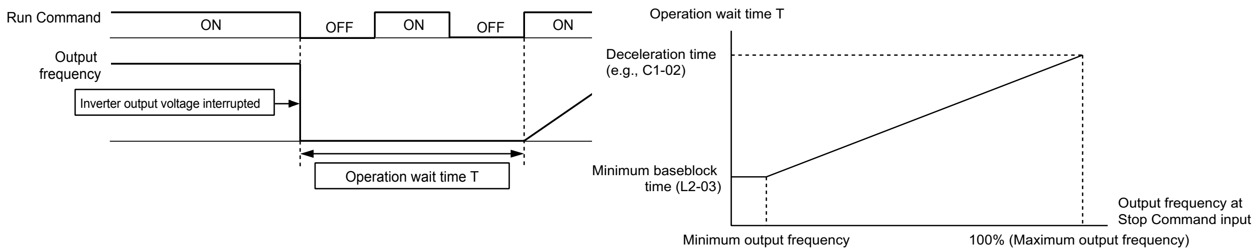


Fig 6.19 Coast to Stop with Timer

◆ Using the DC Injection Brake

Set parameter b2-03 to apply the DC injection braking current 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. DC injection braking is used at startup for flux vector control with the current set in E2-03 (Motor no-load current).

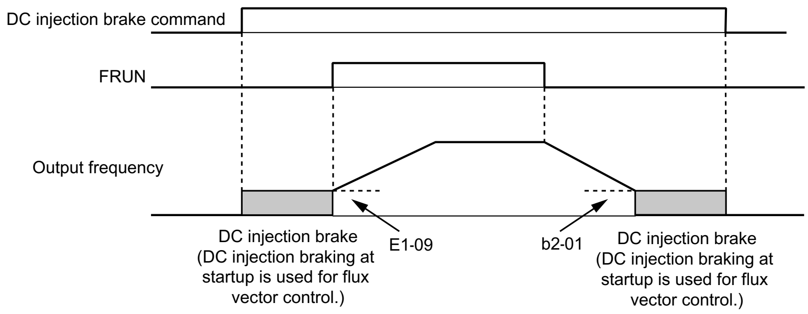
■Related Parameters

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
b2-02	DC injection braking current DCInj Current	Sets the DC injection braking current as a percentage of the Inverter rated current. The DC injection braking current in flux control is affected by any change to the setting of E2-03.	0 to 100	50%	No	A	A	A	No	18AH
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	A	18BH

■Inputting the DC Injection Brake Command from Control Circuit Terminals

If you set a multi-function contact input terminal (H1-□□) to 60 (DC injection brake command), you can apply the DC injection brake to the motor by turning ON the terminal for which the DC injection brake command has been set when the Inverter is being stopped. DC injection braking is used at startup for flux vector control.

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 6.20 DC Injection Brake Time Chart

■Changing the DC Injection Brake Current Using an Analog Input

If you set H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05(Multi-function Analog Input Terminal A3 Function Selection) to 6 (DC injection brake current), you can change the DC injection brake current level using the analog input.

At 10 V input (voltage) or 20 mA input (current), 100% of the Inverter rated current will be applied.

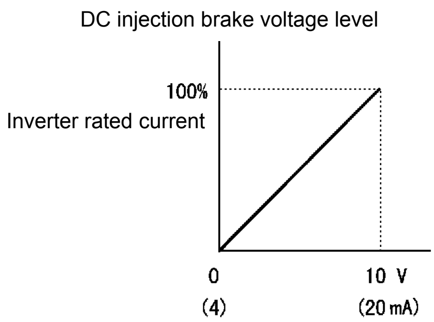


Fig 6.21 DC Injection Brake Current Using an Analog Input

◆ Using an Emergency Stop

Set a multi-function input terminal (H1-□□) to 15 or 17 (emergency stop) to decelerate to a stop at the deceleration time set in C1-09. If inputting the emergency stop with an NO contact, set the multi-function input terminal (H1-□□) to 15, and if inputting the emergency stop with an NC contact, set the multi-function input terminal (H1-□□) to 17.

After the emergency Stop Command has been input, operation cannot be restarted until the Inverter has stopped. To cancel the emergency stop, turn OFF the Run Command and emergency Stop Command.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
C1-09	Emergency stop time / Fast Stop Time	The deceleration time when the multi-function input "Emergency (fast) stop" is set to ON. This function can be used as a stopping method when a fault has been detected.	0.0 to 6000.0 *	10.0 s	No	A	A	A	A	208H

* 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/deceleration times becomes 0.00 to 600.00 seconds.

Acceleration and Deceleration Characteristics

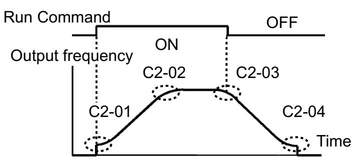
This section explains the acceleration and deceleration characteristics of the Inverter.

◆ 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 / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
C1-01	Acceleration time 1 Accel Time 1	Sets the acceleration time to accelerate from 0 to the maximum output frequency, in 1-second units.	0.0 to 6000.0*1	10.0 s	Yes	Q	Q	Q	Q	200H
C1-02	Deceleration time 1 Decel Time 1	Sets the deceleration time to decelerate from the maximum output frequency to 0, in 1-second units.			Yes	Q	Q	Q	Q	201H
C1-03	Acceleration 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	A	202H
C1-04	Deceleration 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	A	203H
C1-05	Acceleration 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	A	204H
C1-06	Deceleration 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	A	205H
C1-07	Acceleration 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	A	206H
C1-08	Deceleration 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	A	207H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
C1-10	Accel/ decel time setting unit Acc/Dec Units	0: 0.01-second units 1: 0.1-second units	0 or 1	1	No	A	A	A	A	209H
C1-11	Accel/ decel time switching frequency Acc/Dec SW Freq	Sets the frequency for automatic acceleration/deceleration 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 priority.	0.0 to 300.0 *2	0.0 Hz	No	A	A	A	A	20AH
C2-01	S-curve characteristic time at acceleration start SCrv Acc @ Start		0.00 to 2.50	0.20 s	No	A	A	A	A	20BH
C2-02	S-curve characteristic time at acceleration end SCrv Acc @ End	All sections of the S-curve characteristic time are set in seconds units. 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	A	20CH
C2-03	S-curve characteristic time at deceleration start SCrv Dec @ Start		0.00 to 2.50	0.20 s	No	A	A	A	A	20DH
C2-04	S-curve characteristic time at deceleration end SCrv Dec @ End		0.00 to 2.50	0.00 s	No	A	A	A	A	20EH

* 1. The setting range for acceleration/deceleration times will depend on the setting for C1-10. When C1-10 is set to 0, the setting range for acceleration/deceleration times become 0.00 to 600.00 seconds.

* 2. When C6-01=1, the upper limit is 400.0.

■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 6000.0 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.

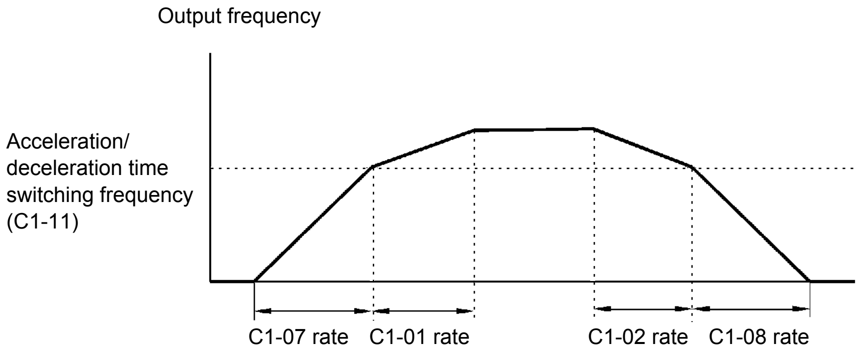
Acceleration/Deceleration Time Selection 1 Terminal	Acceleration/Deceleration Time Selection 2 Terminal	Acceleration Time	Deceleration Time
OFF	OFF	C1-01	C1-02
ON	OFF	C1-03	C1-04
OFF	ON	C1-05	C1-06
ON	ON	C1-07	C1-08

■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.



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 6.22 Acceleration/deceleration Time Switching Frequency

6

■Adjusting Acceleration and Deceleration Time Using an Analog Input

If you set H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) to 5 (acceleration/deceleration time gain), you can adjust the acceleration/deceleration time using terminal A2's or A3'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

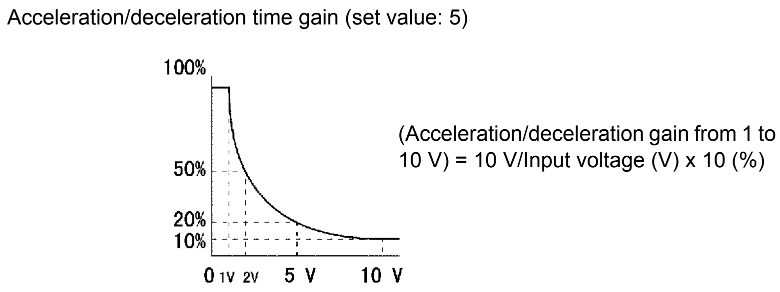


Fig 6.23 Acceleration/Deceleration Time Gain Using an Analog Input

■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.

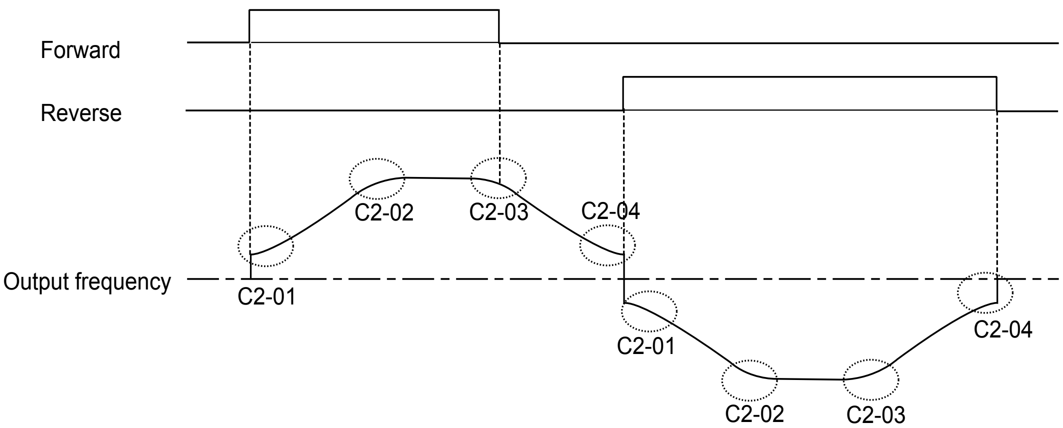
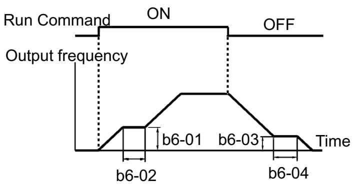


Fig 6.24 S-curve Characteristic during Operation Switching

◆ 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, you can prevent the motor from stalling. When using the dwell function, you must select a deceleration stop. Set b1-03 (Stopping Method Selection) to 0.

■Related Parameters

Parameter Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
	Display					V/f	V/f with PG	Open Loop Vector	Flux Vector	
b6-01	Dwell frequency at start Dwell Ref @Start	 The dwell function is used to output frequency temporarily when driving a motor with a heavy load.	0.0 to 300.0 *	0.0 Hz	No	A	A	A	A	1B6H
b6-02	Dwell time at start Dwell Time@ Start		0.0 to 10.0	0.0 s	No	A	A	A	A	1B7H
b6-03	Dwell frequency at stop Dwell Ref @Stop		0.0 to 300.0 *	0.0 Hz	No	A	A	A	A	1B8H
b6-04	Dwell time at stop Dwell Time @Stop		0.0 to 10.0	0.0 s	No	A	A	A	A	1B9H

* When C6-01=1, the upper limit is 400.0.

6

◆ 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
L3-01	Stall prevention selection during accel StallP Accel Sel	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	No	48FH
L3-02	Stall prevention level during accel StallP Accel Lvl	Effective when L3-01 is set to 1 or 2. Set as a percentage of Inverter rated current. Usually setting is not necessary. The factory setting reduces the set values when the motor stalls.	0 to 200	150% *	No	A	A	A	No	490H
L3-03	Stall prevention limit during accel StallP CHP Lvl	Sets the lower limit for stall prevention during acceleration, as a percentage of the Inverter rated current, when operation is in the frequency range above E1-06. Usually setting is not necessary.	0 to 100	50%	No	A	A	A	No	491H

* C6-01=1: 120%, C6-01=0: 150%

■Time Chart

The following figure shows the frequency characteristics when L3-01 is set to 1.

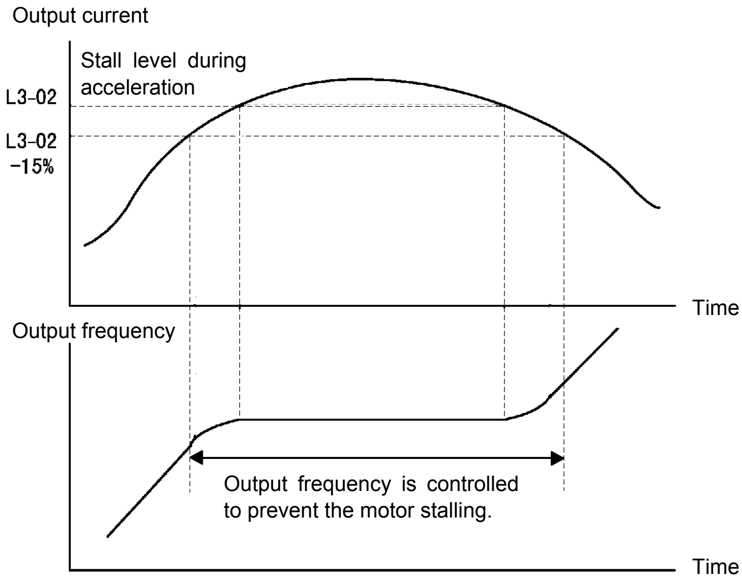


Fig 6.25 Time Chart for Stall Prevention During Acceleration

■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%.

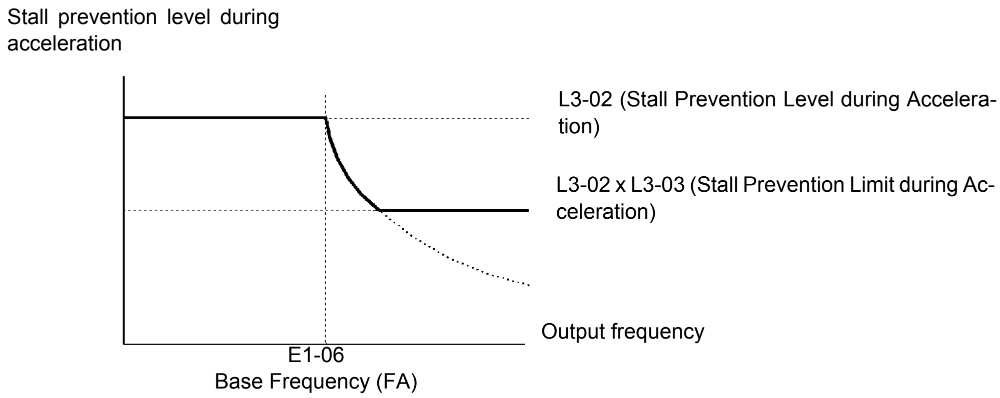


Fig 6.26 Stall Prevention Level and Limit During Acceleration

◆ 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
L3-04	Stall prevention 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	Q	492H

* When using flux vector control, 0 to 2.

■Setting Example

An example of stall prevention during deceleration when L3-04 is set to 1 as shown below.

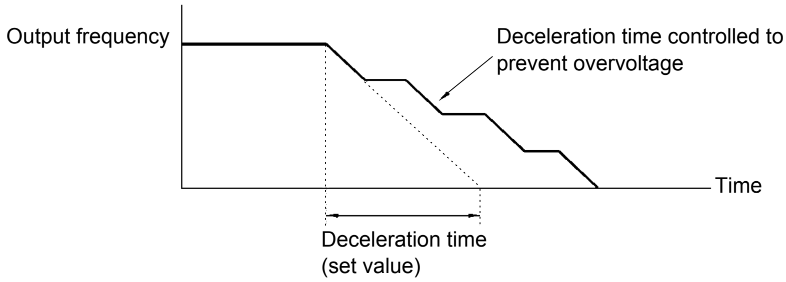


Fig 6.27 Stall Prevention During Deceleration Operation

■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.
- The setting of L3-04 is ignored for flux vector control.

◆ Preventing Overvoltage by Automatically Reducing the Regenerative Torque Limit (Overvoltage Inhibit Function)

The overvoltage inhibit function is a function that, by reducing the regenerative torque limit to a value less than its set value according to the main circuit voltage level, suppresses voltage rises with regenerative torque. Using this function means that if, for example, the main circuit voltage rises during deceleration, the regenerative torque limit will be reduced and so the deceleration rate will be reduced automatically, suppressing rises in the main circuit voltage.

This function is effective for suppressing overvoltages that occur during stabilization after an overshoot following sudden acceleration. This function differs from the stall prevention during deceleration function in this respect.

This function is enabled during vector control.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
L3-11	Overvoltage inhibit selection OV Inhibit Sel	0: Disabled 1: Enabled Used to enable or disable the function for inhibiting main circuit overvoltages by reducing the regenerative torque limit according to the main circuit overvoltage level. If this function is enabled, when the main circuit voltage rises, operation will be performed with the regenerative torque less than the set value.	0 or 1	0	No	No	No	A	A	4C7H
L3-12	Overvoltage inhibit voltage level OV Inhbt VoltLvl	Sets the main circuit voltage level for which the regenerative torque limit is restricted to 0. Usually, there is no need to change this setting. If main circuit overvoltages occur even with the overvoltage inhibit function enabled, reduce this setting.	350 to 390 *	380V *	No	No	No	A	A	4C8H

* These are values for a 200 V Class Inverter. Values for a 400 V Class Inverter are double.

■Setting Precautions

When this function is enabled, if the main circuit voltage rises, the regenerative torque limit will decrease to a value less than its set value and so the motor will not rotate at the speed specified by the speed reference. Therefore, in applications where it is necessary to rotate the motor at the speed specified by the speed reference, disable this function and use a converter, a dynamic braking resistor, or a power regenerative unit to suppress rises in the main circuit voltage.

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
H3-01	Signal level selection (terminal A1) Term A1 Lvl Sel	0: 0 to 10 V 1: –10 to 10 V	0 or 1	0	No	A	A	A	A	410H
H3-02	Gain (terminal A1) Terminal A1 Gain	Sets the frequency when 10 V is input, as a percentage of the maximum output frequency.	0.0 to 1000.0	100.0%	Yes	A	A	A	A	411H
H3-03	Bias (terminal 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	A	412H
H3-04	Signal level selection (terminal A3) Term A3 Signal	0: 0 to 10 V 1:–10 to 10 V	0 or 1	0	No	A	A	A	A	413H
H3-05	Multi-function analog input (terminal A3) function selection Terminal A3 Sel	Select from the functions listed in the following table. Refer to the next page.	0 to 1F	1F	No	A	A	A	A	414H
H3-06	Gain (terminal A3) Terminal A3 Gain	Sets the input gain (level) when 10V is input. Set according to the 100% value selected from H3-05.	0.0 to 1000.0	100.0%	Yes	A	A	A	A	415H
H3-07	Bias (terminal A3) Terminal A3 Bias	Sets the input gain (level) when 0V is input. Set according to the 100% value selected from H3-05.	-100.0 to +100.0	0.0%	Yes	A	A	A	A	416H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
H3-08	Signal level selection (terminal A2) Term A2 Signal	0: 0 to +10V, with lower limit 1: −10 to 10 V, without lower limit 2: 4 to 20 mA. Switch current and voltage input using the switch on the control panel.	0 to 2	2	No	A	A	A	A	417H
H3-09	Multi-function analog input (terminal A2) function 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	A	418H
H3-10	Gain (terminal A2) Terminal A2 Gain	Sets the input gain (level) when 10 V (20 mA) is input. Set according to the 100% value for the function set for H3-09.	0.0 to 1000.0	100.0%	Yes	A	A	A	A	419H
H3-11	Bias (terminal A2) Terminal A2 Bias	Sets the input gain (level) when 0 V (4 mA) is input. Set according to the 100% value for the function set for H3-09.	-100.0 to +100.0	0.0%	Yes	A	A	A	A	41AH
H3-12	Analog input filter time parameter Filter Avg Time	Sets primary delay filter time parameter in seconds for the analog input terminal. Effective for noise control etc.	0.00 to 2.00	0.03 s	No	A	A	A	A	41BH

■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.

Adjustment can be made using H3-06 and H3-07 when multi-function analog input terminal A3 is used as a frequency reference terminal.

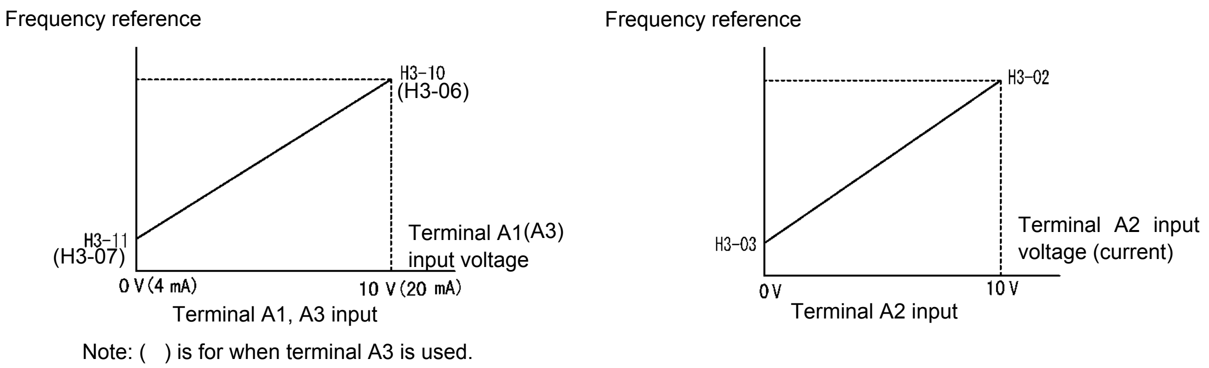


Fig 6.28 Terminals A1 and A2 Inputs

■Adjusting Frequency Gain Using an Analog Input

When H3-09 or H3-05 is set to 1 (frequency gain), you can adjust the frequency gain using the analog input terminal A2 or A3.

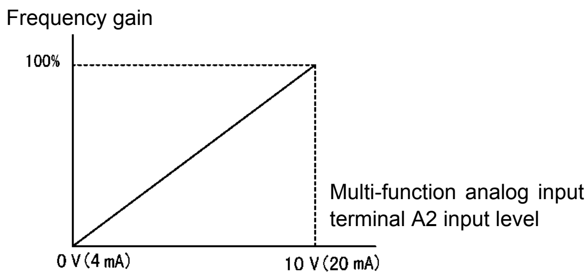
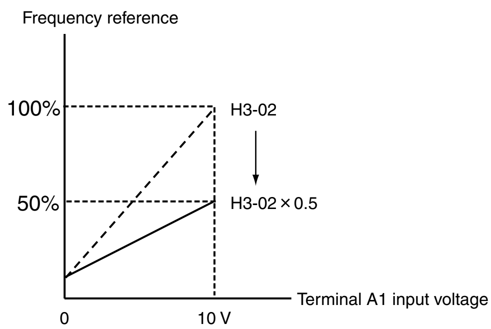


Fig 6.29 Frequency Gain Adjustment (Terminal A2 Input)

The frequency gain for terminal A1 is the product 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%.



■Adjusting Frequency Bias Using an Analog Input

When parameter H3-09 or H3-05 is set to 0 (add to terminal A1), the frequency equivalent to the terminal A2 or A3 input voltage is added to A1 as a bias.

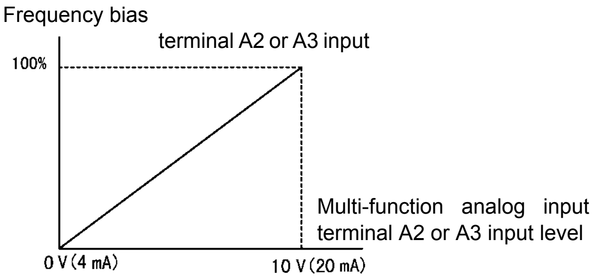
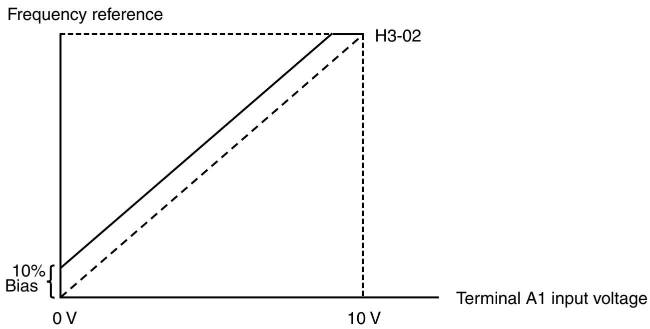


Fig 6.30 Frequency Bias Adjustment (Terminal A2 or A3 or A3 Input)

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%.



When parameter H3-09 or H3-05 is set to D (frequency bias 2), the frequency equivalent to the terminal A2 or A3 input voltage is added to A1 as a bias.

◆ 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
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 300.0 *	0.0 Hz	No	A	A	A	A	294H
d3-02	Jump frequency 2 / Jump Freq 2			0.0 Hz	No	A	A	A	A	295H
d3-03	Jump frequency 3 / Jump Freq 3			0.0 Hz	No	A	A	A	A	296H
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	A	297H

* When C6-01=1, the upper limit is 400.0.

The relationship between the output frequency and the jump frequency reference is as follows:

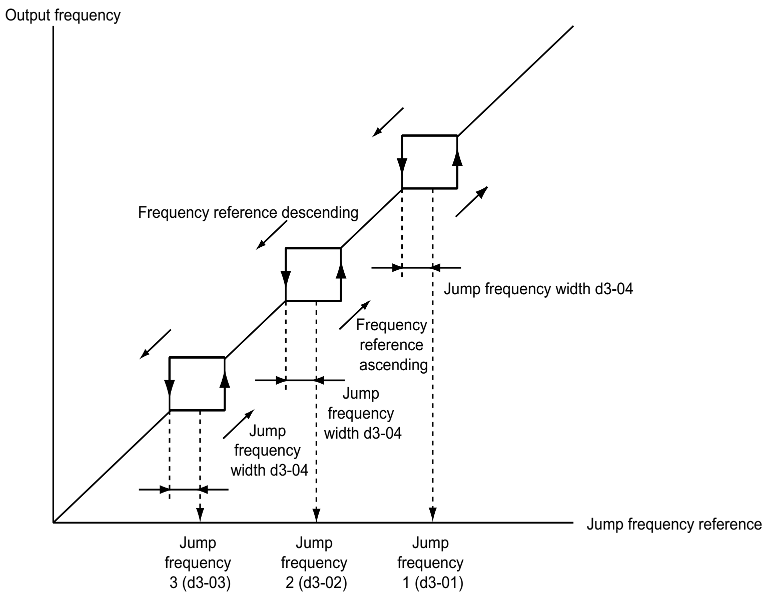


Fig 6.31 Jump Frequency

6

■Setting Jump Frequency Reference Using an Analog Input

When parameter H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) is set to A (jump frequency), you can change the jump frequency using the terminal A2 or A3 input level.

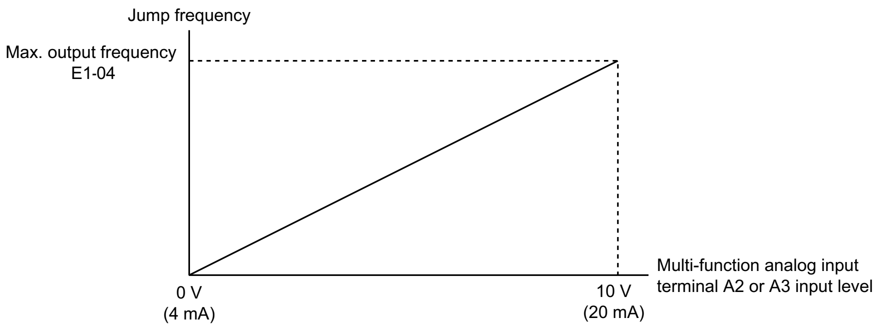


Fig 6.32   Jump Frequency Setting Using an Analog Input

■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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	42CH
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	A	42DH
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	A	42EH
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	A	42FH
H6-05	Pulse train input filter time Pulse In Filter	Set the pulse train input primary delay filter time parameter in seconds.	0.00 to 2.00	0.10 s	Yes	A	A	A	A	430H

The following diagram shows the method for adjusting the frequency reference using pulse inputs.

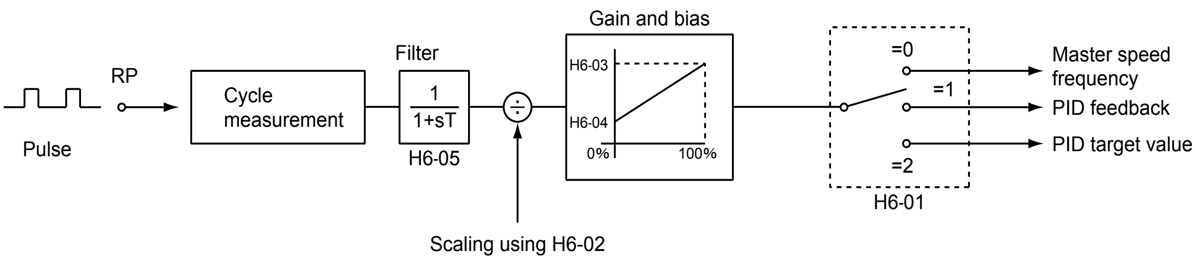


Fig 6.33 Frequency Reference Adjustments Using Pulse Train Inputs

■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.

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	289H

◆ 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	28AH
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	A	293H

6

■Adjusting Frequency Lower Limit Using an Analog Input

If you set parameter H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) to 9 (output frequency lower level), you can adjust the frequency lower level using the terminal A2 or A3 input level.

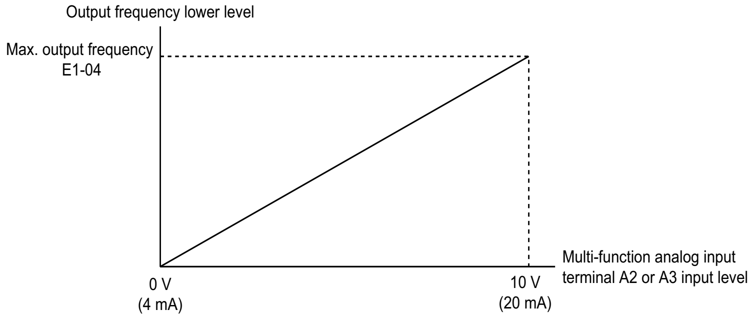


Fig 6.34 Output Frequency Lower Level for Multi-function Analog Input

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.

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
C3-01	Slip compensation gain Slip Comp Gain	Used to improve speed accuracy when operating with a load. Usually setting is not necessary. 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. Used as the applicable control gain when using flux vector control.	0.0 to 2.5	0.0*	Yes	A	No	A	A	20FH
C3-02	Slip compensation primary delay time Slip Comp Time	Slip compensation primary delay time is set in ms units. Usually setting is not necessary. Adjust this parameter at the following times. • Reduce the setting when slip compensation responsive is slow. • When speed is not stabilized, increase the setting.	0 to 10000	2000 ms *	No	A	No	A	No	210H
C3-03	Slip compensation limit Slip Comp Limit	Sets the slip compensation limit as a percentage of motor rated slip.	0 to 250	200%	No	A	No	A	No	211H
C3-04	Slip compensation selection during regeneration Slip Comp Regen	0: Disabled. 1: Enabled. When the slip compensation during regeneration function has been activated, as regeneration capacity increases momentarily, it may be necessary to use a braking option (braking resistor, Braking Resistor Unit or Braking Unit.)	0 or 1	0	No	A	No	A	No	212H

6

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
C3-05	Output voltage limit operation selection V/F Slip Cmp Sel	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	A	213H

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

■Adjusting Slip Compensation Gain

You can switch the C3-01 parameter settings as shown below by changing the control method.

- V/f control: 0.0
- Open-loop vector control: 1.0
- Flux 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.
   You can calculate the motor rated slip 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 (min^{-1}.) × 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.

For flux vector control, the slip compensation gain is used as the motor temperature compensation gain. When the motor temperate increases, the motor's internal constant increases, resulting in an increase in slip. If C3-01 is set, the amount of slip is adjusted as the temperature rises. Set C3-01 if the amount of torque varies with the temperature when using torque control or a torque limit. The larger the value of C3-01, the larger the compensation.

■Adjusting Slip Compensation Primary Delay Time Constant

Set the slip compensation primary delay time constant in ms.

You can switch the factory settings as follows by changing the control method.

- V/f control: 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

The upper limit for the slip compensation amount can be set in C3-03 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.

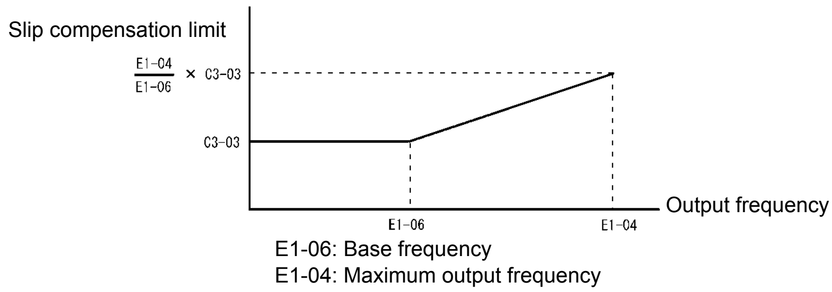


Fig 6.35 Slip Compensation Limit

■Selecting Slip Compensation Function During Regeneration

Whether to enable or disable the slip compensation function during regeneration can be set in C3-04.

If the slip compensation function operates during regeneration, you might have to use the braking option (braking resistor, Braking Resistor Unit, and Braking Unit) 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, set C3-05 to 1 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
C4-01	Torque compensation gain Torq Comp Gain	Sets torque compensation gain as a ratio. Usually setting is not necessary. Adjust in the following circumstances: • When the cable is long; increase the set value. • When the motor capacity is smaller than the Inverter capacity (Max. applicable motor capacity), increase the set values. • When the motor is oscillating, 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 compensation 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	No	215H
C4-02	Torque compensation primary delay time constant Torq Comp Time	The torque compensation delay time is set in ms units. Usually setting is not necessary. Adjust in the following circumstances: • When the motor is oscillating, increase the set values. • When the responsiveness of the motor is low, decrease the set values.	0 to 10000	200 ms *	No	A	A	A	No	216H

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

■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.

Adjust the torque compensation gain using V/f control 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.

■Adjusting the Torque Compensation Primary Delay Time Parameter

Set the torque compensation function primary delay in ms.

You can switch the factory settings as follows by changing the control method settings:

- V/f control: 200 ms
- V/f control with PG: 200 ms
- Open-loop vector control: 20 ms

Normally, there is no need to make this setting. Adjust the parameter as shown below.

- 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 and V/f with PG.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	No	580H
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	No	581H

◆ Stabilizing Speed (Speed Feedback Detection Function)

The speed feedback detection control (AFR) function measures the stability of the speed when a load is suddenly applied, by calculating the amount of fluctuation of the torque current feedback value, and compensating the output frequency with the amount of fluctuation.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
N2-01	Speed feedback 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	No	584H
N2-02	Speed feedback 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	No	585H
N2-03	Speed feedback 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	No	586H

Machine Protection

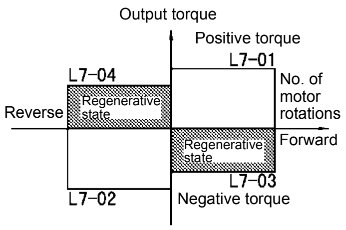
This section explains functions for protecting the machine.

◆ Limiting Motor Torque (Torque Limit Function)

The motor torque limit function is enabled with flux vector control and open-loop vector control.

In the open-loop vector control and flux vector control, the user-set value is applied to the torque limit by calculating internally the torque output by the motor. Enable this function if you do not want a torque above a specified amount to be applied to the load, or if you do not want a regeneration value above a specified amount to occur.

■Related Parameters

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	4A7H
L7-02	Reverse drive torque limit	Torq Limit Rev		0 to 300	200%	No	No	No	A	A	4A8H
L7-03	Forward regenerative torque limit	Torq Lmt Fwd Rgn		0 to 300	200%	No	No	No	A	A	4A9H
L7-04	Reverse regenerative torque limit	Torq Lmt Rev Rgn		0 to 300	200%	No	No	No	A	A	4AAH
L7-06	Integral time setting for torque limit	Torq Limit Time	Set the integral time for the torque limit. When integral control is set for the torque limit, reduce this setting to increase the change in frequency for the torque limit.	5 to 10000	200 ms	No	No	No	A	No	4ACH

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
L7-07	Control method selection for torque limit during acceleration and deceleration Torque Limit Sel	Select the control method for the torque limit during acceleration and deceleration. 0: Proportional control (integral control during parameter speed) 1: Integral control Usually, this parameter does not need to be set. For applications in which the torque limit will be reached during acceleration and deceleration, torque control can be given priority by selecting integral control. When the torque is limited, the acceleration and deceleration times may increase or the motor speed may not agree with the speed reference value.	0 or 1	0	No	No	No	A	No	4C9H

Multi-function Analog Input (H3-05, H3-09)

Setting Value	Function	Contents (100%)	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector
10	Positive torque limit	Motor's rated torque	No	No	Yes	Yes
11	Negative torque limit	Motor's rated torque	No	No	Yes	Yes
12	Regenerative torque limit	Motor's rated torque	No	No	Yes	Yes
15	Positive/negative torque limit	Motor's rated torque	No	No	Yes	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 terminals A2 and A3.

The analog input terminal signal level is factory-set as follows:

Multi-function analog input terminal A2: 4 to 20 mA If 20 mA is input, the torque is limited when the torque is 100% of the motor rated torque.
Multi-function analog input terminal A3: 0 to 10 If 10 V is input, the torque is limited when the torque is 100% of the motor rated torque.
The following diagram shows the relationship between the torque limits.

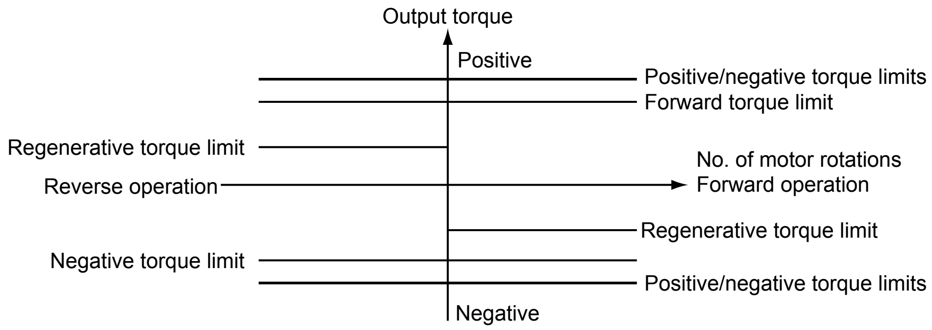


Fig 6.36 Torque Limit by Analog Input

■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.

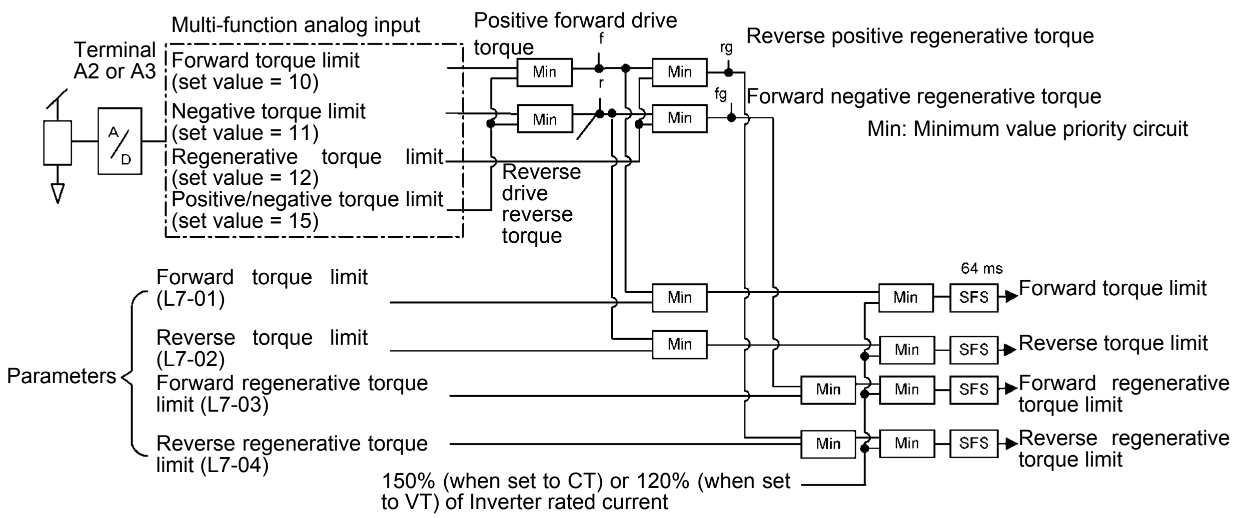


Fig 6.37 Torque Limit Using Parameters and an Analog Input

■Selecting the Control Method for Torque Limit during Acceleration and Deceleration

L7-07 is used to select the control method for the torque limit during acceleration and deceleration. The selections are proportional control and integral control. For applications, in which the torque limit will be reached during acceleration and deceleration, torque control can be given priority by selecting integral control. To increase the change in frequency for the torque limit when integral control is selected, decrease the value set for L7-06 (Integral Time Setting for Torque Limit).

■Setting Precautions

- When the torque limit function is operating, control and compensation of the motor speed is disabled because torque control is given priority. Therefore, the acceleration and deceleration times may increase or the number of motor rotations may decrease.
- 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 and for multi-function analog input terminal A3 using H3-06.
- 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.
- When the torque is limited while L7-07 is set to 1 (integral control), the acceleration and deceleration times may increase or the motor speed may not agree with the speed reference value.

◆ 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 Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vec-tor	Regis-ter
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	No	493H
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 output current. Usually setting is not neces-sary. The factory setting reduces the set values when the motor stalls.	30 to 200	150% *	No	A	A	No	No	494H

* C6-01= 1: 120%, C6-01= 0: 150%

◆ Changing Stall Prevention Level during Operation Using an Analog Input

If you set H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) to 8 (stall prevention level during run), you can change the stall level during operation by setting H3-10 [Gain (Terminal A2)] and H3-11 [Bias (Terminal A2)] or H3-06 [Gain (Terminal A3)] and H3-07 [Bias (Terminal A3)].

The stall prevention level during operation enabled is the multi-function analog input terminal A2 or A3 input level or the set value in parameter L3-06, whichever is the smaller.

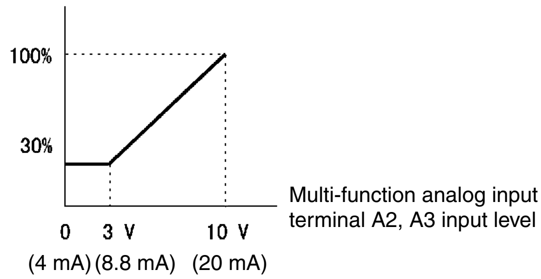


Fig 6.38 Stall Prevention Level during Operation Using an Analog Input

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.

◆ Using Frequency Detection

Set these parameters when outputting one of the frequency agree or frequency detection signals from a multi-function output. When using flux vector control, the motor speed is detected.

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
L4-01	Speed agreement detection level Spd Agree Level	Effective when “Desired frequency (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 300.0 *1	0.0 Hz	No	A	A	A	A	499H
L4-02	Speed agreement detection width Spd Agree Width	Effective when “Frequency (speed) agree 1,” “Desired frequency (speed) agree 1,” or “Frequency (FOUT) detection 1,” Frequency (FOUT) detection 2 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	A	49AH

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
L4-03	Speed agreement detection level (+/-) Spd Agree Lvl+-	Effective when “Desired frequency (speed) agree 2,” “Frequency (FOUT) detection 3,” or “Frequency (FOUT) detection 4" is set for a multi-function output. Frequency that should be detected is set in Hz units.	-300.0 to +300.0 *2	0.0 Hz	No	A	A	A	A	49BH
L4-04	Speed agreement detection width (+/-) Spd Agree Width+-	Effective when “Frequency (speed) agree 2,” “Desired frequency (speed) agree 2,” Frequency (FOUT) detection 3 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	A	49CH

* 1. When C6-01 = 1, the upper limit is 400.0.

* 2. When C6-01 = 1, -400.0 to +400.0

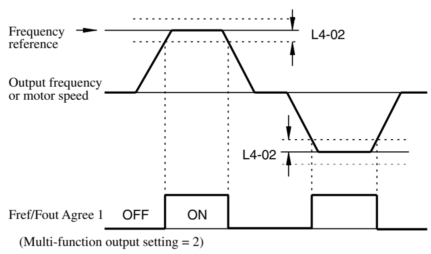
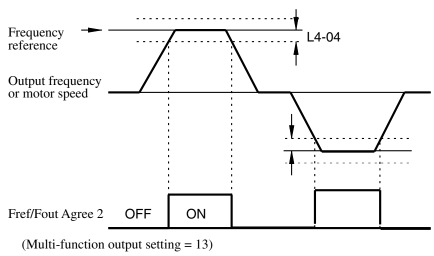
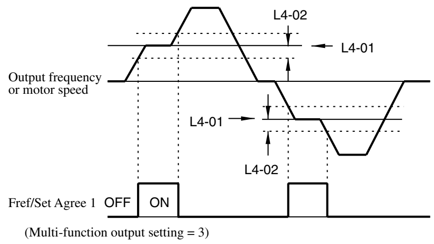
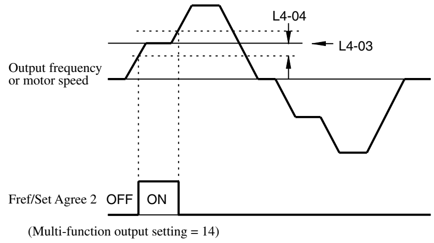
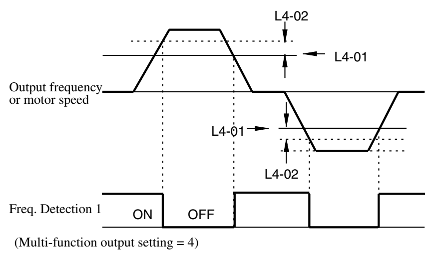
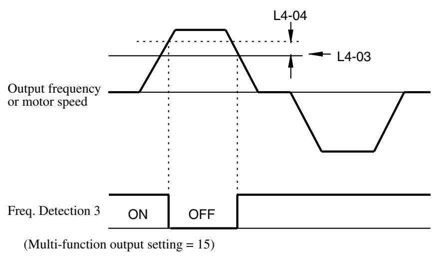
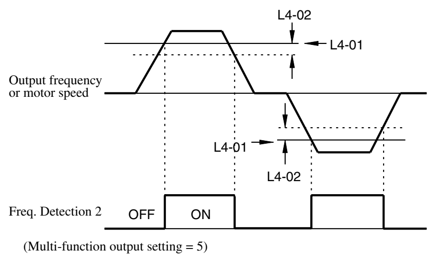
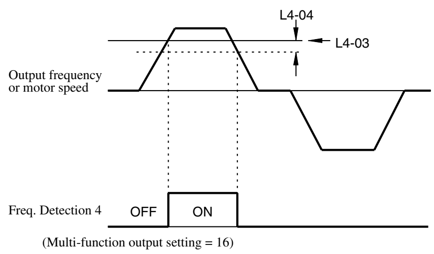
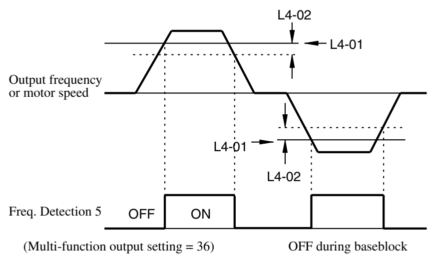
■Parameters and Output Signals

User Parameter Number	Name	Function
L4-01	Speed agree detection level	Fref/Set Agree 1 Frequency Detection 1 Frequency Detection 2 Frequency Detection 5
L4-02	Speed agree detection width	Fref/Fout Agree 1 Fref/Set Agree 1 Frequency Detection 1 Frequency Detection 2 Frequency Detection 5
L4-03	Speed agree detection level (+/-)	Fref/Set Agree 2 Frequency Detection 3 Frequency Detection 4
L4-04	Speed agree detection width (+/-)	Fref/Fout Agree 2 Fref/Set Agree 2 Frequency Detection 3 Frequency Detection 4

Set the corresponding setting in the multi-function output (H2-01 to H2-03) to output the desired Fref/Fout Agree signal, Fref/Set Agree signal, or Frequency Detection signal.

Function	Setting
Fref/Fout Agree 1	2
Fref/Set Agree 1	3
Frequency Detection 1	4
Frequency Detection 2	5
Fref/Fout Agree 2	13
Fref/Set Agree 2	14
Frequency Detection 3	15
Frequency Detection 4	16
Frequency Detection 5	36

Timing Chart for Frequency Detection Operation

<table>
<tr><th>Related parameter</th><th>L4-01: Speed Agree Level
L4-02: Speed Agree Width</th><th>L4-03: Speed Agree Level +/–
L4-04: Speed Agree Width +/–</th></tr>
<tr><td rowspan="2">Fref/Fout Agree</td><td>Fref/Fout Agree 1</td><td>Fref/Fout Agree 2</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td rowspan="2">Fref/Set Agree</td><td>Fref/Set Agree 1
(ON at the following conditions during frequency agree)</td><td>Fref/Set Agree 2
(ON at the following conditions during frequency agree)</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td rowspan="6">Fre-quency Detection</td><td>Frequency (FOUT) Detection 1
(L4-01 > | Output frequency |)</td><td>Frequency (FOUT) Detection 3
(L4-03 > Output frequency)</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Frequency (FOUT) Detection 2
(L4-01 < | Output frequency |)</td><td>Frequency (FOUT) Detection 4
(L4-01 < Output frequency)</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Frequency (FOUT) Detection 5
(L4-01 < | Output frequency |)</td><td></td></tr>
<tr><td>
</td><td></td></tr>
</table>

6

◆ Detecting Motor Torque

If an excessive load is placed on the machinery (overtorque) or the load is suddenly lightened (undertorque), you can output an alarm signal to multi-function output terminal M1-M2, P1-PC, or 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 (multi-function output terminals M1-M2, P1-PC, and P2-PC function selection).

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
L6-01	Torque detection selection 1 Torq Det 1 Sel	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	A	4A1H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	4A2H
L6-03	Torque detection time 1 / Torq Det 1 Time	Sets the overtorque/undertorque detection time in 1-second units.	0.0 to 10.0	0.1 s	No	A	A	A	A	4A3H
L6-04	Torque detection selection 2 / Torq Det 2 Sel	Output of torque detection 1 is enabled by setting B or 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	A	4A4H
L6-05	Torque detection level 2 / Torq Det 2 Lvl		0 to 300	150%	No	A	A	A	A	4A5H
L6-06	Torque detection time 2 / Torq Det 2 Time		0.0 to 10.0	0.1 s	No	A	A	A	A	4A6H

Multi-function Output (H2-01 to H2-03)

Setting Value	Function	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vector
B	Overtorque/undertorque detection 1 NO (NO contact: Overtorque/undertorque detection at ON)	Yes	Yes	Yes	Yes
17	Overtorque/undertorque detection 1 NC (NC Contact: Overtorque/undertorque detection at OFF)	Yes	Yes	Yes	Yes
18	Overtorque/undertorque detection 2 NO (NO Contact: Overtorque/undertorque detection at ON)	Yes	Yes	Yes	Yes
19	Overtorque/undertorque detection 2 NC (NC Contact: Overtorque/undertorque detection at OFF)	Yes	Yes	Yes	Yes

■L6-01 and L6-04 Set Values and LED Indications

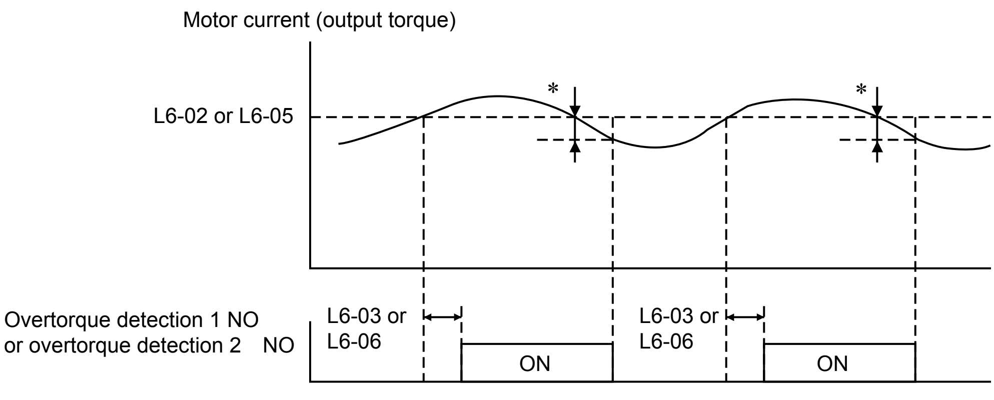
The relationship between alarms displayed by the Digital Operator when overtorque or undertorque is detected, and the set values in L6-01 and L6-04, is shown in the following table.

Set Value	Function	LED Indications	
		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

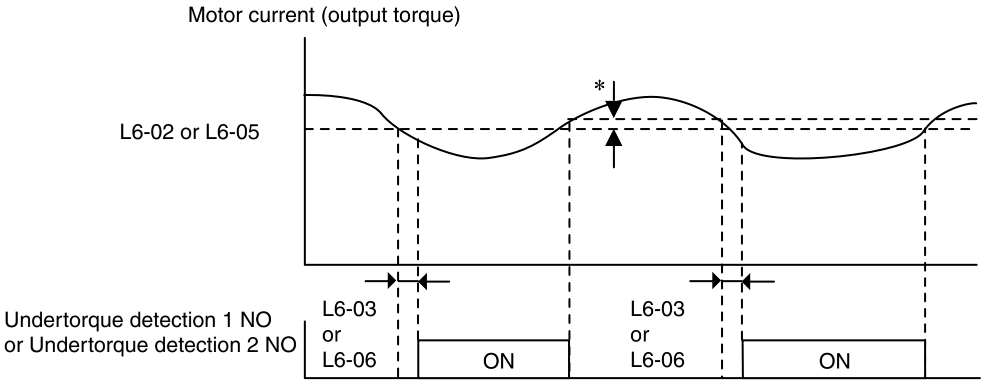
The following diagram shows the time chart for overtorque and undertorque detection.

- Overtorque Detection



* Overtorque detection disabled band is approximately 10% of the Inverter rated output current (or motor rated torque).

• Undertorque Detection



* 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) or H3-05 (Multi-function Analog Input Terminal A3 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.

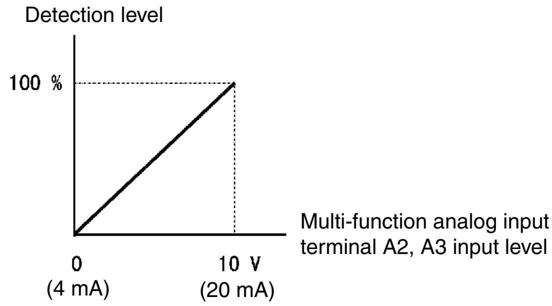


Fig 6.39 Overtorque/Undertorque Detection Level Using an Analog Input

Multi-Function Analog Input (H3-05, H3-09)

Setting Value	Function	Contents (100%)	Control Methods			
			V/f	V/f with PG	Open Loop Vector	Flux Vector
7	Overtorque/undertorque detection level	Motor rated torque for vector control Inverter rated output current for V/f control	Yes	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

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
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, torque limits and torque control. This parameter is automatically set during autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q	Q	Q	Q	30EH
E4-01	Motor 2 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, torque limits and torque control. This parameter is automatically set during autotuning.	0.32 to 6.40 *2	1.90 A *1	No	A	A	A	A	321H
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	Q	480H
L1-02	Motor protection time constant MOL Time Const	Sets the electric thermal detection time in seconds units. 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	1.0 min	No	A	A	A	A	481H

* 1. The factory settings depend on the Inverter capacity. The values for a 200 V Class Inverter of 0.4 kW are 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. For the motor no-load current, set E2-03 to a value less than that of E2-01.

Multi-Function Outputs (H2-01 to H2-03)

Setting Value	Function	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector
1F	Motor overload (OL1, including OH3) pre-alarm (ON: 90% or more of the detection level)	Yes	Yes	Yes	Yes

■Setting Motor Rated Current

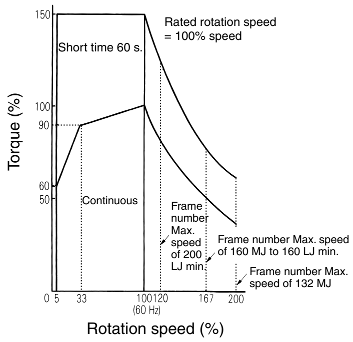
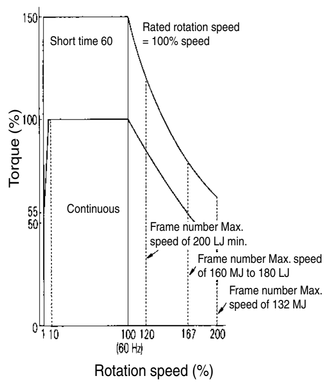
Set the rated current value on the motor nameplate in parameters E2-01 (for motor 1) and E4-01 (for motor 2). This set value is the electronic thermal base current.

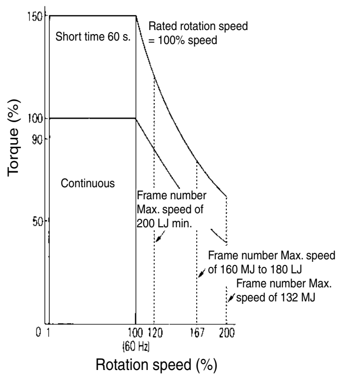
■Setting Motor Overload Protection Characteristics

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.

L1-01 Set Value	Motor Type	Tolerance Load Characteristics	Cooling Ability	Electronic Thermal Operation (at 100% Motor Load)
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)

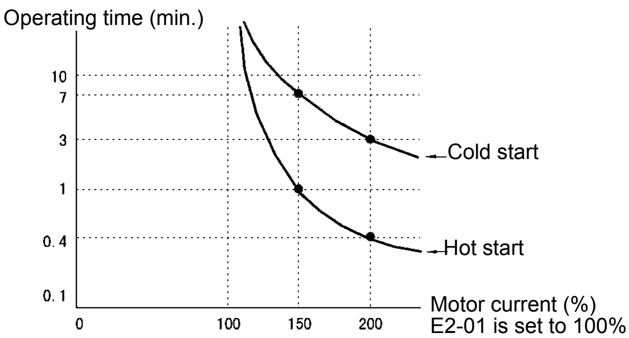


Fig 6.40 Motor Protection Operation Time

■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, 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.

◆ 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
L1-03	Alarm operation selection during motor overheating Mtr OH Alarm Sel	Set Multi-function input terminalA3 (H3-05) or A2 (H3-09) to E and select the operation when the input motor temperature (thermistor) input exceeds the alarm detection level [1.17 V (±5%)]. 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	A	482H
L1-04	Motor overheating operation selection Mtr OH Fault Sel	Set Multi-function input terminal A3 (H3-05) or A2 (H3-09) to E and select the operation when the motor temperature (thermistor) input exceeds the operation detection level [2.34V (±5%)]. 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	A	483H
L1-05	Motor temperature input filter time constant Mtr Temp Filter	Set Multi-function input terminal A3 (H3-05) or A2 (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	A	484H

6

■PTC Thermistor Characteristics

The following diagram shows the characteristics of the PTC thermistor temperature to the resistance value.

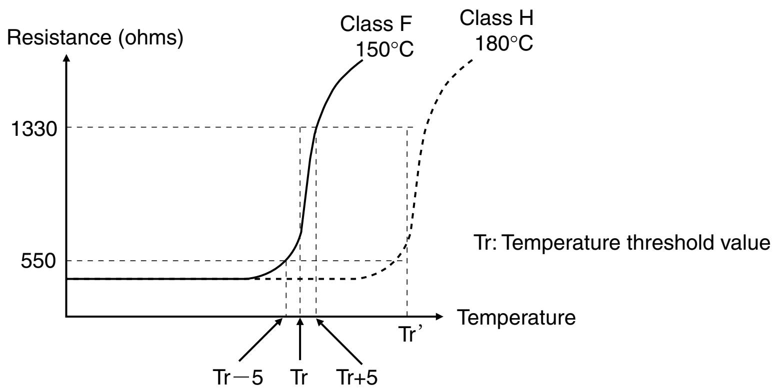


Fig 6.41 PTC Thermistor Temperature-Resistance Value Characteristics

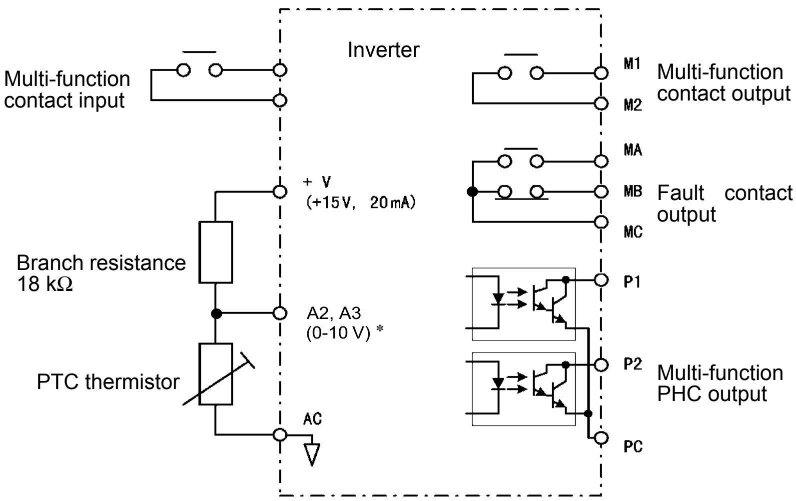
■Operation during Motor Overheating

Set the operation if the motor overheats in parameters L1-03 and L1-04. Set the motor temperature input filter time constant 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) or H3-05 (Multi-function Analog Input Terminal A3 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. Set H3-08〔Signal level selection (terminal A2)〕(H3-04 when A3 is used) to 0 (0 to + 10 V).



* When using terminal A2, set DIP switch S1-2 to OFF (0 to 10 V).

Fig 6.42 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
b1-04	Prohibition of reverse operation Reverse Oper	0: Reverse enabled 1: Reverse disabled	0 or 1	0	No	A	A	A	A	183H

6

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
L2-01	Momentary power loss detection PwrL Selection	0: Disabled [main circuit undervoltage (UV1) detection] 1: Enabled [Restarted when the power returns within the time for L2-02. When L2-02 is exceeded, main circuit undervoltage (UV1) is detected.] 2: Enabled while CPU is operating. [Restarts when power returns during control operations. Does not detect main circuit undervoltage. (UV1)]	0 to 2	0	No	A	A	A	A	485H
L2-02	Momentary power loss ridethru time PwrL Ridethru t	Ridethrough time, when Momentary Power Loss Selection (L2-01) is set to 1, in units of seconds.	0 to 25.5	0.1 s *1	No	A	A	A	A	486H
L2-03	Min. baseblock time PwrL Baseblock 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. When an overcurrent or overvoltage occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.2 s *1	No	A	A	A	A	487H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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 *1	No	A	A	A	A	488H
L2-05	Undervoltage detection level PUV Det 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	A	489H

* 1. The factory settings depend on the Inverter capacity. The values for a 200 V Class Inverter of 0.4 kW are given.
* 2. These are values for a 200 V Class Inverter. Values for a 400 V Class Inverter are double.

■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 the fan that is rotating using inertia.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
b3-01	Speed search selection (current detection or speed calculation) 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*1	No	A	A	A	No	191H
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	150% *1 *3	No	A	No	A	No	192H
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	No	193H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
b3-05	Speed search wait time (current detection or speed calculation) Search Delay	Sets the magnetic contactor operating delay time when there is a magnetic 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	A	195H
b3-10	Sets the magnetic flux compensation as a percentage of the no-load current. Srch Detect Comp	Operation restarts at a speed obtained by multiplying the speed from the speed search by the compensation gain (excitation search only.) Increase this setting if overvoltages occur when a speed search is performed after a long baseblock, for example, in searches at startup.	1.00 to 1.20	1.10	No	A	No	A	No	19AH
b3-14	Rotation direction search selection Bidir Search Sel	0: Disabled (operates with specified rotation direction) 1: Enabled (operates with rotation direction found by search)	0 or 1	1	No	A	A	A	No	19EH
b3-17	Speed search retrial current level Srch Restart Lvl	Sets the current level to retry a speed search as a percentage, taking the Inverter rated current as 100%.	0 to 200	150% *3	No	A	No	A	No	1F0H
b3-18	Speed search retrial detection time Srch Restart Time	Sets the time for detection in a speed search retrial in units of seconds.	0.00 to 1.00	0.01 s	No	A	No	A	No	1F1H
b3-19	Number of speed search retrials Num of Srch Restr	Sets the number of times that a speed search can be retried.	0 to 10	0	No	A	No	A	No	1F2H

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Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
L2-03	Min. baseblock time PwrL Baseblock 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. When an overcurrent or overvoltage occurs when starting a speed search or DC injection braking, increase the set values.	0.1 to 5.0	0.2 s *2	No	A	A	A	A	487H
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	A	488H

* 1. The factory setting will change when the control method is changed. The V/f control factory settings are given.
* 2. The factory settings depend upon the Inverter capacity. The values for a 200 V Class Inverter of 0.4 kW are given.
* 3. C6-01 = 1:120%, C6-01 = 0:150%

Multi-function Contact Inputs (H1-01 to H1-06)

Setting Value	Function	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux 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	No
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	No

■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 vector control, always perform rotational or stationary autotuning (not stationary autotuning for line-to-line resistance only) 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 line-to-line resistance only again.

IMPORTANT

The motor will not operate when stationary autotuning or stationary autotuning for line-to-line resistance only 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.

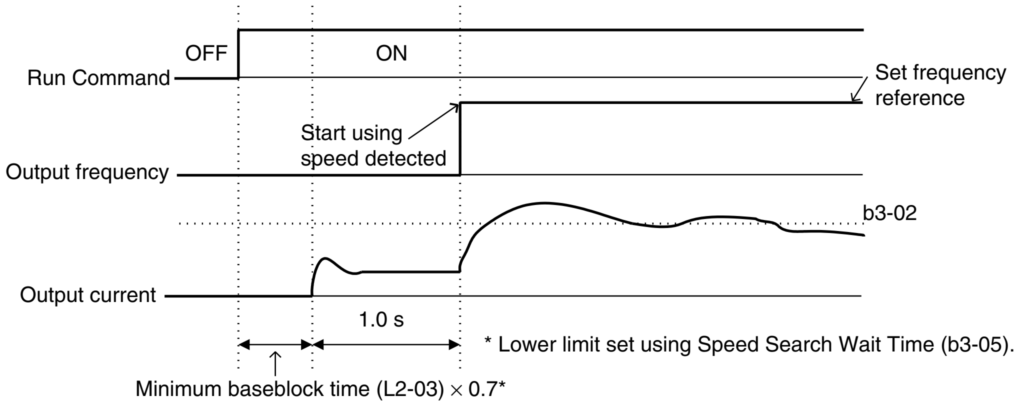
Search Name	Estimated Speed	Current Detection
Search Method	Estimates the motor speed when the search starts, and accelerates and decelerates from the estimated speed to the set frequency. You can also search including direction of motor rotation.	Starts speed search from the frequency when the temporary 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.



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 6.43 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)

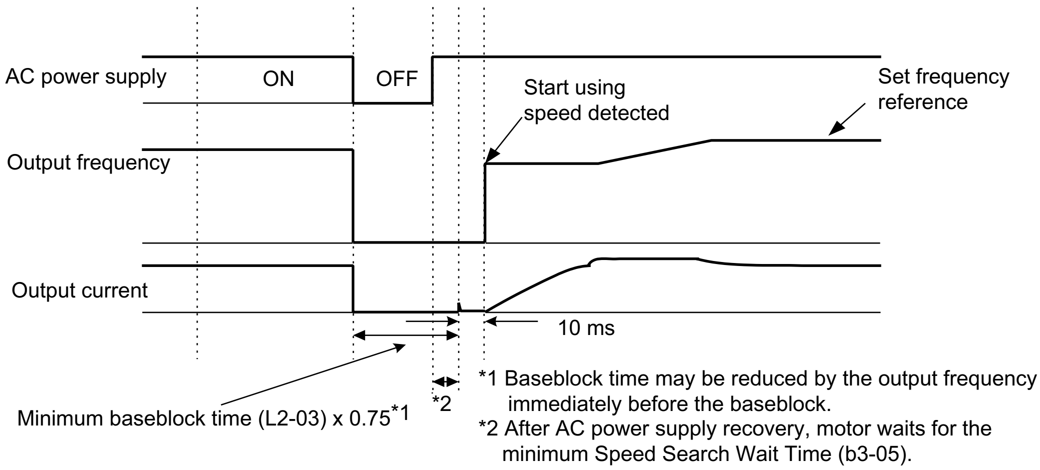


Fig 6.44 Speed Search after Baseblock (When Estimated Speed: Loss Time Is Set in L2-03)

- Loss Time Longer Than the Minimum Baseblock Time (L2-03)

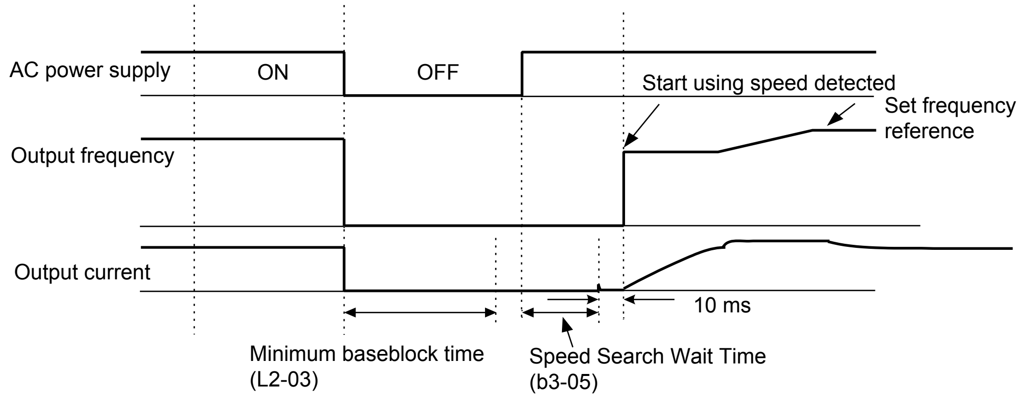


Fig 6.45 Speed Search After Baseblock (Estimated Speed: Loss Time > L2-03)

■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.

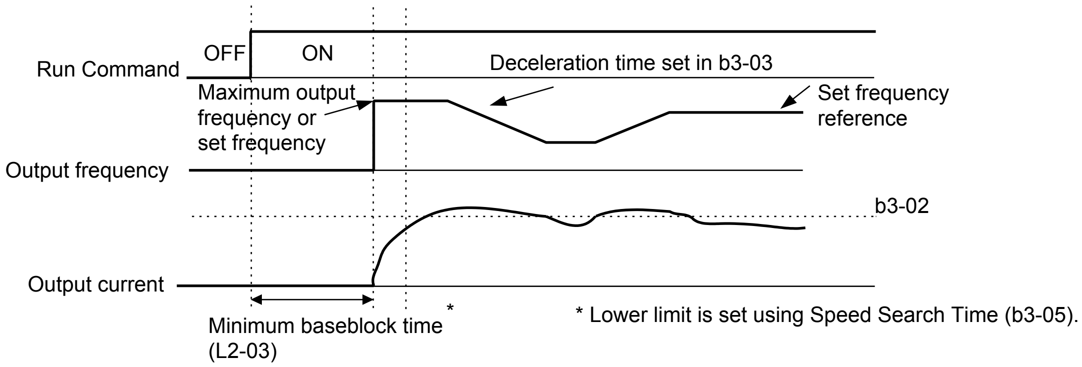


Fig 6.46 Speed Search at Startup (Using Current Detection)

Speed Search after Short Baseblock (during Power Loss Recovery, etc.)

- Loss Time Shorter Than Minimum Baseblock Time

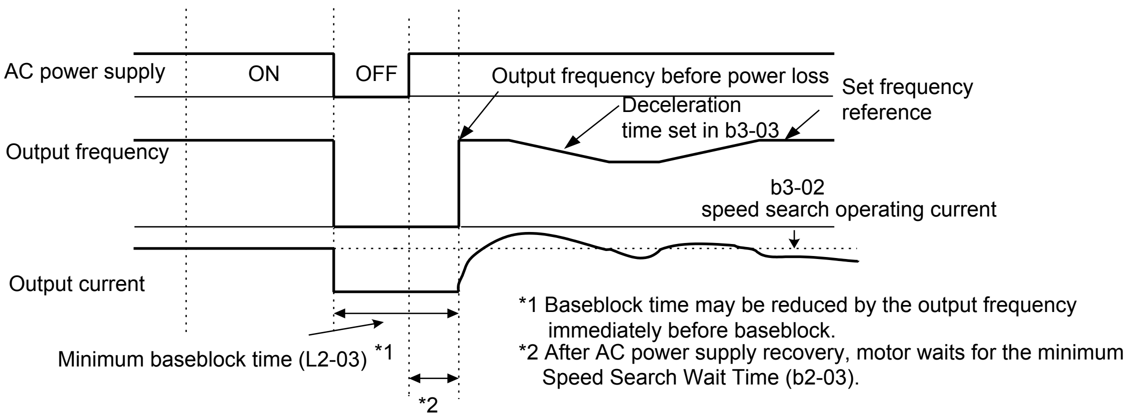


Fig 6.47 Speed Search After Baseblock (Current Detection: Loss Time < L2-03)

* Loss Time Longer Than Minimum Baseblock Time

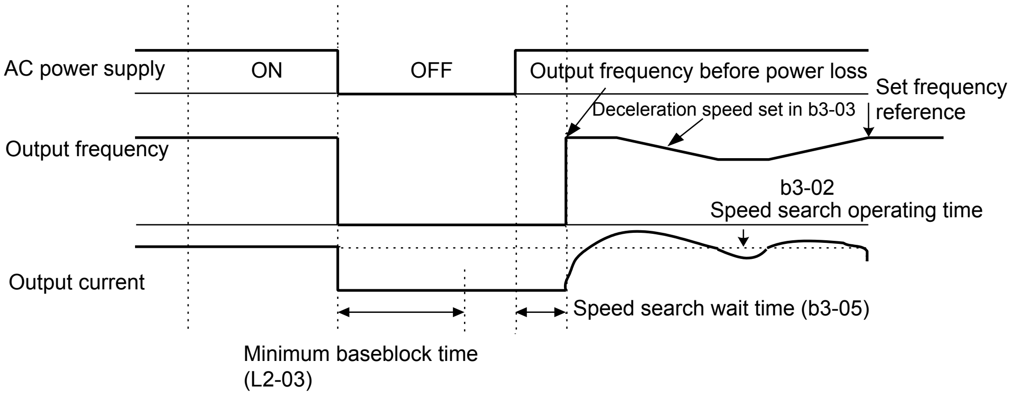


Fig 6.48 Speed Search After Baseblock (Current Detection: Loss Time > L2-03)

◆ 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, and P2-PC function selection) to C (frequency reference lost).

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
L4-05	Operation when frequency reference is missing Ref Loss Sel	0: Stop (Operation follows the frequency reference.) 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	A	49DH

◆ Restarting Operation After Transient Fault (Auto Restart Function)

If an Inverter fault occurs during operation, the Inverter will perform self-diagnosis. If no fault is detected, the Inverter will automatically restart. This is called the auto restart function.

Set the number of auto restarts in parameter L5-01. A fault reset is attempted every 5 ms after a fault occurs and minimum baseblock time has passed. The number of auto restarts is counted when the Inverter attempts a fault reset and restarts operation. The protection function will operate if a fault continues to occur after auto restarting the number of times set in L5-01.

The auto restart function can be applied to the following faults. If a 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 error)
- 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 contact output terminals M1-M2, P1-PC, and P2-PC function selection) to 1E (auto restart).

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	49EH
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	A	49FH

6

■ 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 fault has been verified, and an fault 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.

◆ Operation Selection After Cooling Fan Fault

Use the parameter setting to select the operation of the motor after a cooling fan fault occurs. This function can be used for times when a motor should not be stopped quickly (with an emergency stop.)

■Related Parameters

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	 V/f with PG	 Open Loop Vector	 Flux Vector	Register
L8-32	OH1 detection of Inverter’ s cooling fan OH1 Detect Sel	0: Disabled (FAN minor fault detection) 1: Enabled (OH1 major fault detection)	0,1	1	No	A	A	A	A	4E2H

The following table describes the operation of the motor and the display of the Digital Operator in accordance with the settings of the L8-32 if a cooling fan fault occurred.

Setting Value	Fault	Digital Operator	Motor Operation	Multi-function Contact Output
0	Cooling Fin Overheating	OH1 (lit)	Coast to a stop	Fault
	Inverter’s Cooling Fan Fault	FAN (blink)	Continue operation*	Minor fault
1	Cooling Fin Overheating	OH (lit)	Coast to a stop	Fault
	Inverter’s Cooling Fan Fault	OH1 (lit)	Coast to a stop	Fault

* If L8-32 is set to 0, the motor will continue running even if a cooling fan fault occurred. However, the Inverter rated output current and the overload capacity will be reduced. The rated output current will be reduced to 80% if the normal rated output current is 100%, and the overload capacity will be reduced to the values as follows.
When CT is selected: 100% per every 3 minutes, 150% per every 15 seconds
When VT is selected: 100% per every 30 seconds, 120% per every 10 seconds

IMPORTANT

If L8-32 is set to 0, be sure to set H2-01 to H2-03 multi-function contact outputs to 10 (minor fault) or to 3D (Inverter’s cooling fan fault.) If a cooling fan fault occurs, stop the Inverter immediately and replace the cooling fan. If the Inverter continues to run while a cooling fan fault occurs, the Inverter’s cooling ability will be affected and the Inverter’s internal temperature will increase and shorten the Inverter’s life.
During a cooling fan fault, the cooling fan stops for about 3 seconds every minute (interval operation.)

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 (Model: ERF-150WJ ☐☐).

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

Parameter Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
	Display					V/f	V/f with PG	Open Loop Vector	Flux Vector	
L8-01	Protect selection for internal DB resistor (Type ERF) DB Resistor Prot	0: Disabled (no overheating protection) 1: Enabled (overheating protection)	0 or 1	0	No	A	A	A	A	4ADH

Multi-function Contact Outputs (H2-01 to H2-03)

Setting Value	Function	Control Methods			
		V/f	V/f with PG	Open Loop Vector	Flux Vector
D	Braking resistor fault (ON: Resistor overheat or braking transistor fault)	Yes	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 1°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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	4AEH
L8-03	Operation selection after overheat 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 setting 0 to 2 and a minor fault will be given in setting 3.	0 to 3	3	No	A	A	A	A	4AFH

* The factory setting depends on the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

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 S8).

◆ 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 H1-06 (multi-function contact input terminal S3 to S8 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
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 board 4: Pulse train input	0 to 4	1	No	Q	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 board	0 to 3	1	No	Q	Q	Q	Q	181H

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 H1-06 (multi-function contact input terminal S3 to S8 function selection) to perform baseblock commands using the terminal's ON/OFF operation, and prohibit Inverter output using the baseblock commands. At this time, the motor will be coasting and “BB” will blink on the Digital Operator.

Clear the baseblock command to restart the operating using speed search from frequency references from the previous baseblock command input.

Multi-function Contact Inputs (H1-01 to H1-06)

Setting Value	Function	Control Methods			
		V/f	V/f with PG	Open Loop Vector	Flux Vector
8	External baseblock NO (NO contact: Baseblock at ON)	Yes	Yes	Yes	Yes
9	External baseblock NC (NC contact: Baseblock at OFF)	Yes	Yes	Yes	Yes

■Time Chart

The time chart when using baseblock commands is shown below.

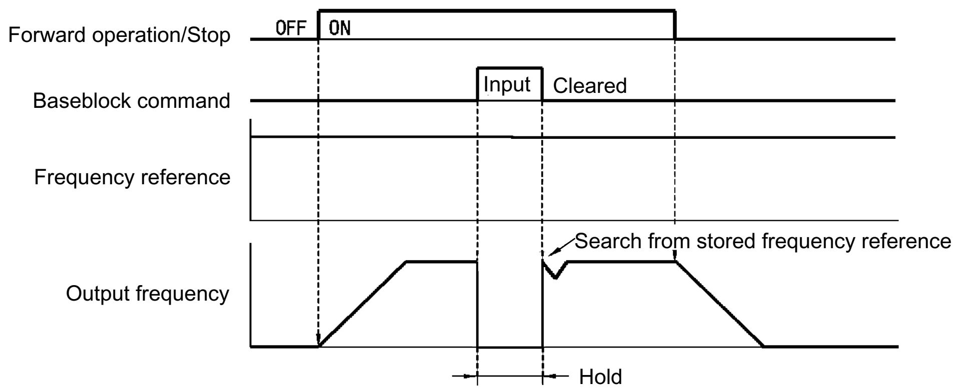


Fig 6.49 Baseblock Commands

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.

◆ 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 H1-06 (multi-function contact input terminal S3 to S8 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
d4-01	Frequency reference hold function selection MOP Ref Memory	Sets 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 previous 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	A	298H

■Time Chart

The time chart when using Acceleration/Deceleration Ramp Hold commands is given below.

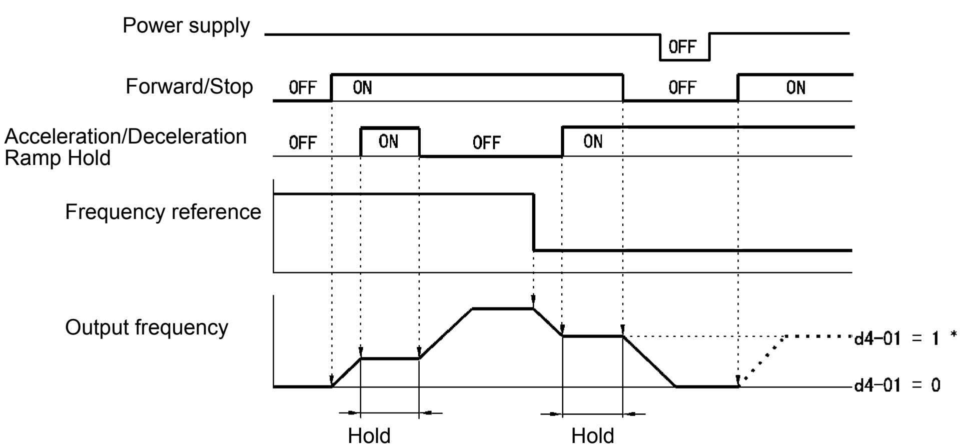


Fig 6.50 Acceleration/Deceleration Ramp Hold

■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 S8.

To use this function, set one of the parameters H1-01 to H1-06 (multi-function contact input terminal S3 to S8 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

Parameter Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
	Display					V/f	V/f with PG	Open Loop Vector	Flux Vector	
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	A	289H
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	A	28AH
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	A	293H

■Precautions

When setting and using UP and DOWN commands, observe the following precautions.

Setting Precautions

If multi-function input terminals S3 to S8 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.

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 OFF.

■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

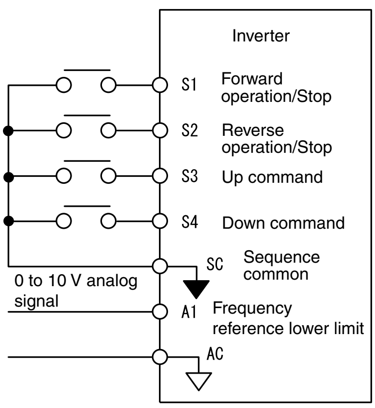
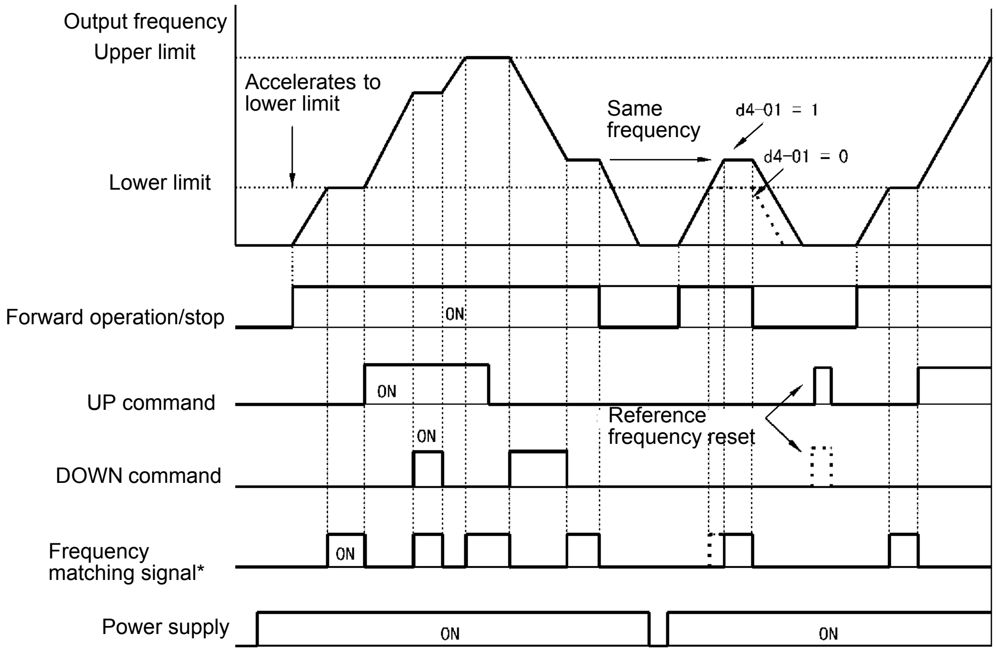


Fig 6.51 Connection Example when UP/DOWN Commands Are Allocated



* The frequency matching signal turns ON when the motor is not accelerating/ decelerating while the Run Command is ON.

Fig 6.52 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 H1-06 (multi-function contact terminal inputs S3 to S8 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
d4-02	+ – Speed limits Trim Control Lvl	Set the frequency to be add to or subtracted from the analog frequency reference as a percent, 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	A	299H

■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 Reference + d4-02	Set Frequency Reference – d4-02	Set Frequency Command	
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 analog frequency reference value – d4-02 < 0, the frequency reference is set to 0.
- The value of the auxiliary speed-frequency reference is incremented or decremented by the value of 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 S8, operation error OPE03 (invalid multi-function input selected) will occur.

◆ Hold Analog Frequency Using User-set Timing

When one of H1-01 to H1-06 (multi-function contact input terminal S3 to S8 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.

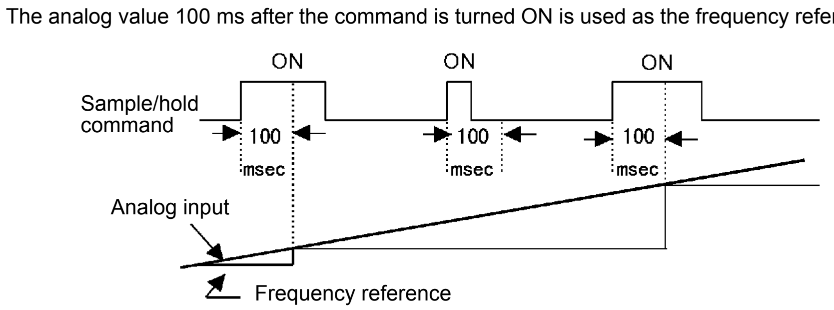


Fig 6.53 Sample/Hold Analog Frequency

■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.

◆ Switching Operations between a Communications Option Board and Control Circuit Terminals

You can switch reference input between the Communications Option Board and the control circuit terminals. Set one of the parameters H1-01 to H1-06 (multi-function contact input terminal S3 to S8 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 Board 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 H1-06 (multi-function contact input terminal S3 to S8 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 Board (Frequency reference and Run Command are enabled from Communications Option Board.)

◆ 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 H1-06 (multi-function contact input terminal S3 to S8 function selection) to 12 (FJOG command) or 13 (RJOG command).

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
d1-17	Jog frequency reference / Jog Reference	The frequency reference when the jog frequency reference selection, FJOG command, or RJOG command is ON.	0.00 to 300.00 *1 *2	6.00 Hz	Yes	Q	Q	Q	Q	292H

* 1. The upper limit of the setting range depends on the upper limit set in E1-04.
* 2. When C6-01 = 1, the upper limit is 400.00.

Multi-Function Contact Inputs (H1-01 to H1-06)

Setting Value	Function	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector
12	FJOG command (ON: Forward run at jog frequency d1-17)	Yes	Yes	Yes	Yes
13	RJOG command (ON: Reverse run at jog frequency d1-17)	Yes	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 Fault Function)

The external fault 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 fault [input terminal Sx]). The x in EFx shows the terminal number of the terminal that input the external fault signal. For example, if an external fault signal is input to terminal S3, EF3 will be displayed.

To use the external fault function, set one of the values 20 to 2F in one of the parameters H1-01 to H1-06 (multi-function contact input terminal S3 to S8 function selection).

Select the value to be set in H1-01 to H1-06 from a combination of any of the following three conditions.

- Signal input level from peripheral devices
- External fault detection method
- Operation during external fault 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

Note 1. Set the input level to detect errors using either signal ON or signal OFF. (NO contact: External fault when ON; NC contact: External fault 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.

6

Output Terminal Functions

The output terminal function, which sets the output methods by switching the settings of H2-01 to H2-03 (Multi-function contact output terminals M1-M2, P1-PC, and P2-PC), is described here.

During Run (Setting: 0)

OFF	The Run Command is OFF and there is not output voltage.
ON	The Run Command is ON or a voltage is being output.

During Run 2 (Setting: 37)

OFF	The Inverter is not outputting a frequency. (Baseblock, DC injection braking, initial excitation, or stopped)
ON	The Inverter is outputting a frequency.

- These outputs can be used to indicate the Inverter's operating status.

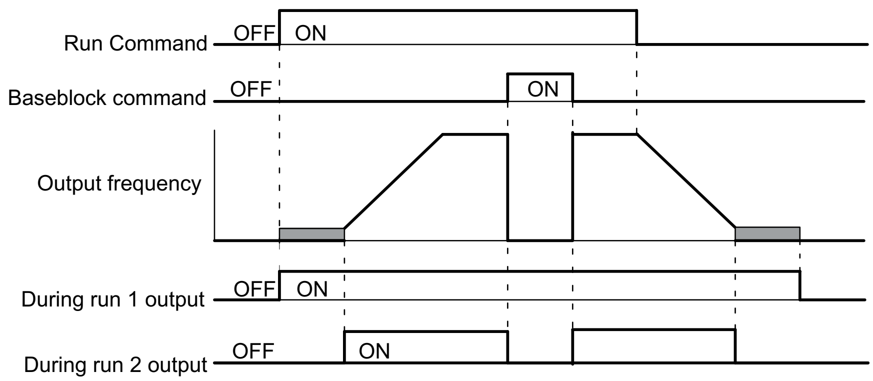


Fig 6.54 Timing Chart for “During RUN” Output

Zero-speed (Setting: 1)

OFF	The output frequency is greater than the minimum output frequency (E1-09). [With flux vector control, is greater than the zero-speed level (b2-01).]
ON	The output frequency is less than the minimum output frequency (E1-09). [With flux vector control, is less than the zero-speed level (b2-01).]

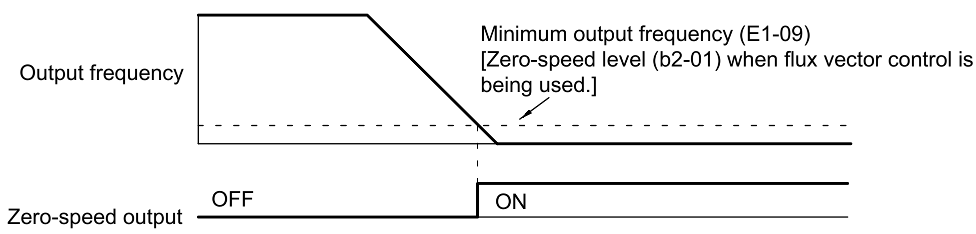


Fig 6.55 Timing Chart for Zero-speed

Motor Overload (OL1) Pre-alarm (Setting: 1F)

OFF	The motor protection function's electronic thermal value is less than 90% of the detection level.
ON	The motor protection function's electronic thermal value is greater than 90% of the detection level.

- This output function is valid when the motor overload protection function is enabled (L1-01 =1).
- This output can be used to warn of overheating before the protection function itself operates.

Inverter Overheat (OH) Pre-alarm (Setting: 20)

OFF	The cooling fin temperature is less than the "OH Pre-Alarm Level" set in L8-02.
ON	The cooling fin temperature exceeds the "OH Pre-Alarm Level" set in L8-02.

- This output function indicates that the temperature of the cooling fins reaches the temperature set in L8-02 (the Inverter overheating alarm detection level).

Speed reference limit (Setting: 31)

OFF	Other than ON condition
ON	Enables the speed reference limit in the following conditions (During flux vector control method): 1. Frequency reference ≥ Frequency reference upper limit (d2-01) Frequency reference ≤ Frequency reference lower limit (d2-02) Frequency reference ≥ Output frequency lower limit of the multi-function analog input (Setting: 9) 2. The frequency reference is less than the Min. output frequency (E1-09), and b1-05 is set to 1, 2, or 3.

Zero-servo End (Setting: 33)

OFF	The zero-servo command isn't being input or zero-servo position control hasn't been completed.
ON	The position has been brought within the zero-servo completion width (b9-02) after the zero-servo command was input.

- This output function indicates that zero-servo position control has been completed.
- The output is turned ON after the zero-servo command is input and the difference between the zero-servo operation starting position and the current position is within the zero-servo completion width (b9-02).

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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
H4-01	Monitor selection (terminal FM) Terminal FM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal FM. The monitor items that can be set depends on the control method. 4, 10 to 14, 25, 28 to 31, 34, 35, 39 to 43 cannot be set.	1 to 99	2	No	A	A	A	A	41DH
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. A meter calibration function is available.	0.00 to 2.50	1.00	Yes	Q	Q	Q	Q	41EH
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. A meter calibration function is available.	-10.0 to +10.0	0.0%	Yes	A	A	A	A	41FH
H4-04	Monitor selection (terminal AM) Terminal AM Sel	Sets the number of the monitor item to be output (U1-□□) from terminal AM. The monitor items that can be set depends on the control method. 4, 10 to 14, 25, 28 to 31, 34, 35, 39 to 43 cannot be set.	1 to 99	3	No	A	A	A	A	420H

Parameter Number	Name		Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
	Name	Display					V/f	V/f with PG	Open Loop Vector	Flux Vector	
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. A meter calibration function is available.	0.00 to 2.50	0.50	Yes	Q	Q	Q	Q	421H
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. A meter calibration function is available.	-10.0 to +10.0	0.0%	Yes	A	A	A	A	422H
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: –10 to 10 V output	0 or 1	0	No	A	A	A	A	423H
F4-01	Channel 1 monitor selection	AO Ch1 Select	Effective when the Analog Monitor Board is used. Monitor selection: Set the number of the monitor item to be output. (U1-□□) The monitor items that can be set depends on the control method. Gain: Set the multiple of 10 V for outputting monitor items. 4, 10 to 14, 25, 28, 31, 34, 35, 39, 40, 42 cannot be set. 29 to 31 are not used. When the AO-12 Analog Monitor Board 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 Monitor Board is used, only outputs of 0 to +10 V are possible. A meter calibration function is available.	1 to 99	2	No	A	A	A	A	391H
F4-02	Channel 1 gain	AO Ch1 Gain		0.00 to 2.50	1.00	Yes	A	A	A	A	392H
F4-03	Channel 2 monitor selection	AO Ch2 Select		1 to 99	3	No	A	A	A	A	393H
F4-04	Channel 2 gain	AO Ch2 Gain		0.00 to 2.50	0.50	Yes	A	A	A	A	394H

6

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
F4-05	Channel 1 output monitor bias AO Ch1 Bias	Sets the channel 1 item bias to 100%/10 V when the Analog Monitor Board is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	A	395H
F4-06	Channel 2 output monitor bias AO Ch2 Bias	Sets the channel 2 item bias to 100%/10 V when the Analog Monitor Board is used.	-10.0 to 10.0	0.0%	Yes	A	A	A	A	396H
F4-07	Analog output signal level for channel 1 AO Opt Level Ch1	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A	A	A	A	397H
F4-08	Analog output signal level for channel 2 AO Opt Level Ch2	0: 0 to 10 V 1: -10 to +10 V	0 or 1	0	No	A	A	A	A	398H

■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 User 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 boards 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 boards AO-08 and AO-12 using the gain and bias in F4-02, F4-04, F4-05, and F4-06.

Adjusting the Meter

The output voltage for terminals FM-AC and AM-AC and output channels 1 and 2 of the AO option board can be adjusted while the Inverter is stopped. For example, just pressing the Enter Key and displaying the data setting display for H4-02 or H4-03 will cause the following voltage to be output by the FM-AC terminals.

10 V/100% monitor output × output gain (H4-02) + output bias (H4-03)

Just pressing the Enter Key and displaying the data setting display for F4-02 or F4-05 will cause the following voltage to be output to channel 1 of the AO option board.

10 V/100% monitor output × output gain (F4-02) + output bias (F4-05)

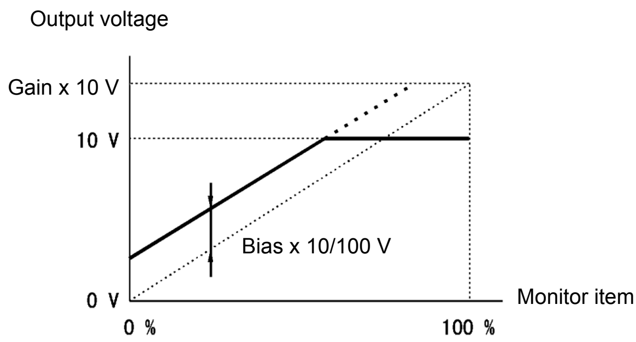


Fig 6.56 Monitor Output Adjustment

■Switching Analog Monitor Signal Levels

Monitor items corresponding to –10 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 –10 to 10 V, refer to *Chapter 5 User Parameters*.

INFO

You can select the signal levels separately for multi-function analog output terminals and analog output option terminals.

6

◆ Using Pulse Train Monitor Contents

This section explains pulse monitor parameters.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	431H
H6-07	Pulse train monitor scaling Pulse Moni Scale	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	A	432H

■Selecting Pulse Monitor Items

Output digital operator monitor items (U1-□□ [status monitor]) from pulse monitor terminal MP-AC. Refer to *Chapter 5 User 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-AC. Set the pulse frequency output when 100% frequency is output to H6-07.

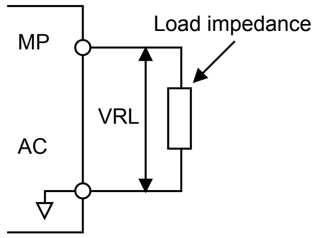
Set H6-06 to 2, and H6-07 to 0, to output the frequency synchronous with the Inverter's U-phase output.

■Application Precautions

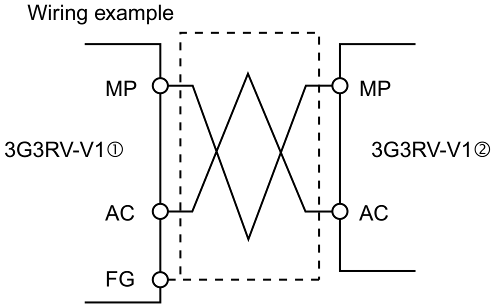
When using a pulse monitor parameter, connect a peripheral device according to the following load conditions. If the load conditions are different, there is a risk of characteristic insufficiency or damage to the machinery.

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.



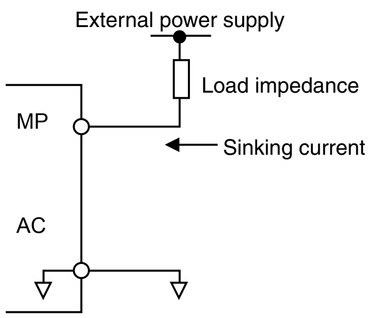
When using two 3G3RV-V1 Inverters and using the speed output of one 3G3RV-V1 as the speed reference of another 3G3RV-V1.



Set parameter H6-06 of 3G3RV-V1① to 2. The output frequency of 3G3RV-V1① will be sent to the MP as pulse.
Set parameter H6-01 of 3G3RV-V1② to 0 and parameter b1-01 of 3G3RV-V1② to 4. And parameters described in page 6-33 are used.

Using a Sinking Input

External Power Supply (V)	12 VDC±10%, 15 VDC±10%
Sink Current (mA)	16 mA Max



Communications Functions

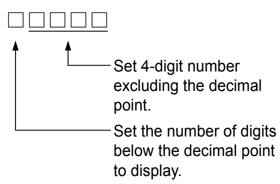
This section explains the individual communications functions.

◆ 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

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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 board 4: Pulse train input	0 to 4	1	No	Q	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 board	0 to 3	1	No	Q	Q	Q	Q	181H
H5-01	Slave address / Serial Comm Adr	Set the Inverter's slave address.	0 to 20 *	1FH	No	A	A	A	A	425H
H5-02	Communication speed selection / Serial Baud Rate	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	A	426H
H5-03	Communication parity selection / Serial Com Sel	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	A	427H

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
H5-04	Stopping method after communication error	Serial Fault Sel	Set the stopping method for communications errors. 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	A	428H
H5-05	Communication error detection selection	Serial Flt Dtct	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	A	429H
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	A	42AH
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	A	42BH
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: min^{-1} units (Sets the motor poles.) 40 to 39999: User desired display Set the desired values for setting and display for the max. output frequency.  Example: When the max. output frequency value is 200.0, set 12000	0 to 39999	0	No	A	A	A	A	502H

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Parameter Number	Name / 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	Control Methods: Flux Vector	Register
U1-39	RS-422A/485 communications error code Transmit Err	Shows RS-422A/485 errors. U1-39= □□□□□□□□ 1: CRC error 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	A	66H

* 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.

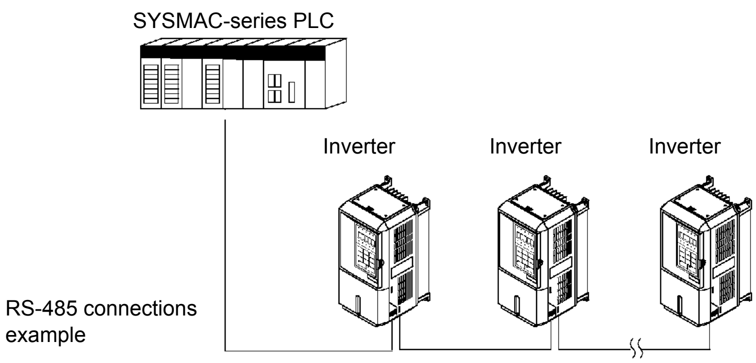


Fig 6.57 Example of Connections between PLC and Inverter

■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	31 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.

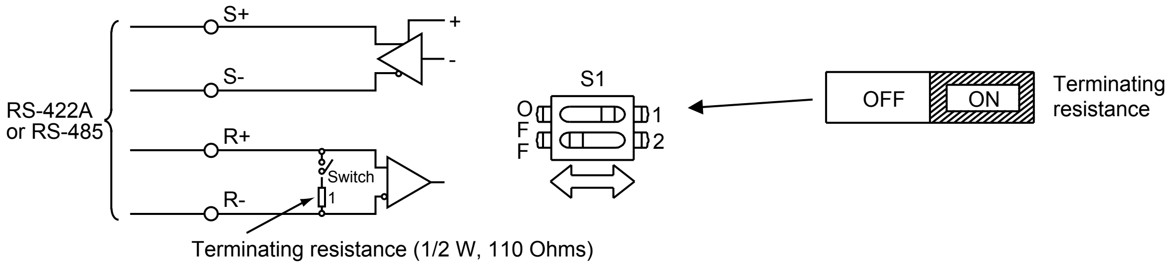
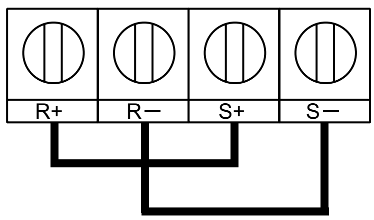


Fig 6.58 Communications Connection Terminal

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.

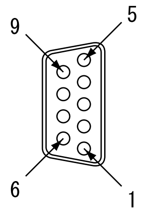


■Connection Example to a PLC

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-V1, CJ1W-SCU41-V1, and C200HW-COM06-V1 Serial Communications Boards/Units is shown below.



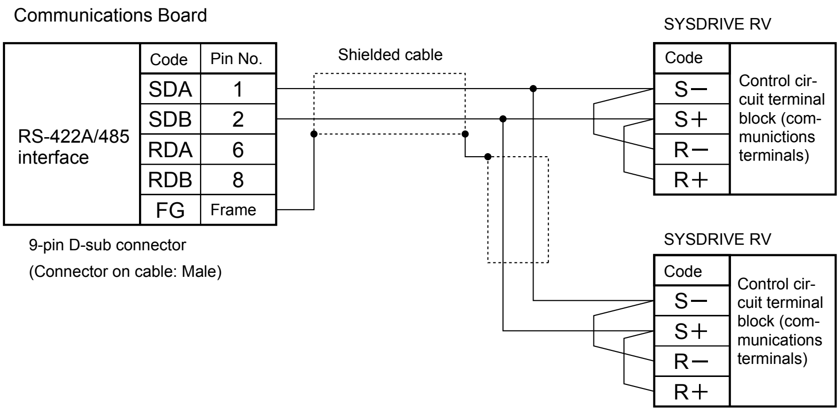
Pin No.	Code	Signal name	I/O
1	SDA	Send data (-)	Output
2	SDB	Send data (+)	Output
3	NC	-	-
4	NC	-	-
5	NC	-	-

Pin No.	Code	Signal name	I/O
6	RDA	Receive data (-)	Input
7	NC	-	-
8	RBD	Receive data (+)	Input
9	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 6.59 RS-485 Wiring

• RS-422A (4-wire)

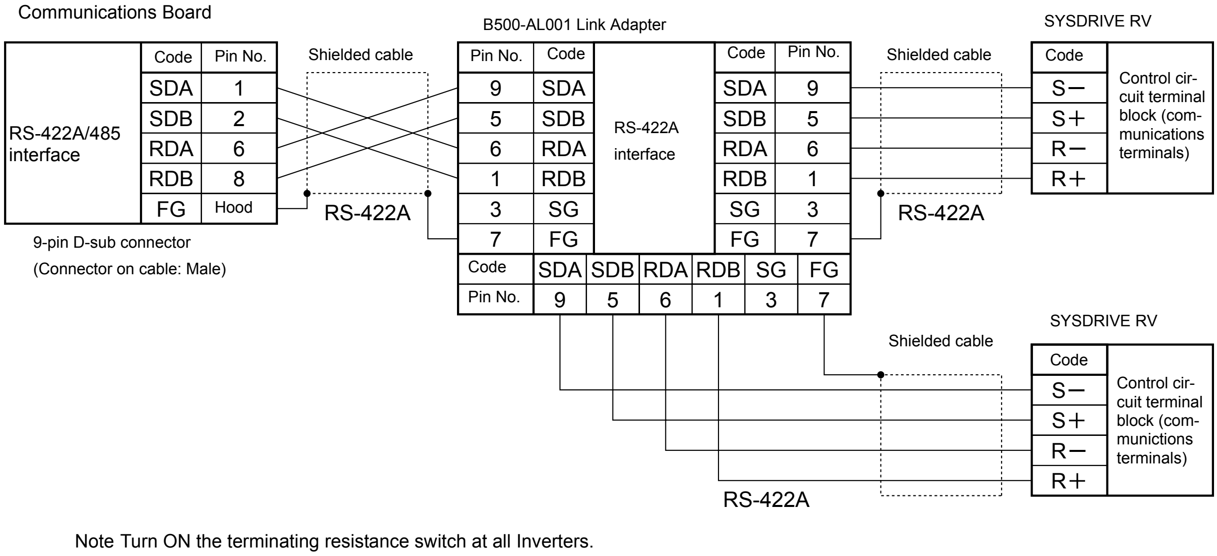


Fig 6.60 RS-422A Wiring

■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.

Message data (Request message or response =

Slave address (1 byte)	Function code (1 byte)	Communications data	Error check (2 bytes)

The space between messages must support the following.

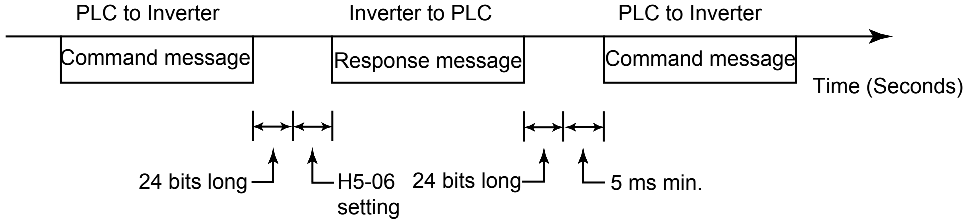


Fig 6.61 Message Spacing

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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.

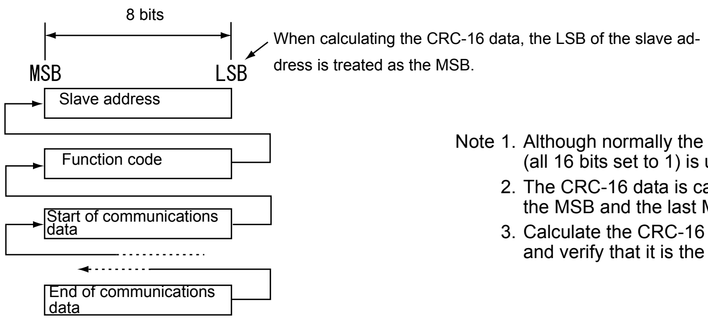
Function Code (Hexadecimal)	Function	Command Message		Response Message	
		Min. (Bytes)	Max. (Bytes)	Min. (Bytes)	Max. (Bytes)
03H	Read storage register contents	8	8	7	37
08H	Loopback test	8	8	8	8
10H	Write multiple storage registers	11	41	8	8

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 6.62

■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 Message)

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.

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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.

INFO

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	Not used	
0001H	Frequency reference	
	Bit 0	Forward Run/Stop command 1: Forward run 0: Stop
	Bit 1	Reverse Run/Stop command 1: Reverse run 0: Stop
	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
	Bit B	Multi-function input command 8
	Bits C 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	

6

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	Broadcast data S8 1: Enabled 0: Disabled

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)

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 (Unit: 1/0.1 A)	
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	
	Bit 7	Multi-function input terminal S8 1: ON 0: OFF	
	Bits 8 to F	Not used	
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	1: 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

Register No.	Contents	
002CH	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
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	Multi-function input S8
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).

6

■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.

■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.

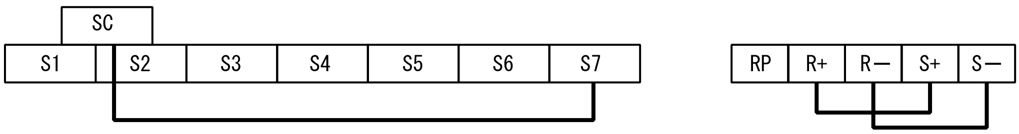

Fig 6.63 Details of Communications Terminals

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 User 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 User 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 6.64

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 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 6.1 Applicable Programmable Controllers

Series	CPU Unit models
SYSMAC CS	CS1H-CPU67H/66H/65H/64H/63H CS1G-CPU45H/44H/43H/42H
SYSMAC CJ	CJ1H-CPU67H/66H/65H CJ1G-CPU45H/44H/43H/42H CJ1G-CPU45P/44P/43P/42P CJ1M-CPU13/12/11/23/22/21
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 6.2 Applicable Serial Communications Boards

Series	Serial Communications Board/Unit	Mounting method	Specifications
SYSMAC CS	CS1W-SCB41-V1	As an Inner Board of the CPU Unit	• One RS-232C port • One RS-422A/485 port • Protocol macro function
SYSMAC CJ	CJ1W-SCU41-V1	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 6.3 Peripheral Devices

<table>
<tr><th>Name</th><th>Model</th><th colspan="2">Specification</th></tr>
<tr><td rowspan="9">CX-Protocol</td><td rowspan="9">WS02-PSTC1-E</td><td colspan="2">The following peripheral devices support the protocol macro function of the entire SYSMAC series.</td></tr>
<tr><td colspan="2">Personal computer environment</td></tr>
<tr><td>Personal computer</td><td>IBM PC/AT or compatible computer</td></tr>
<tr><td>CPU</td><td>Minimum requirement: Pentium 90 MHz
Recommended: Pentium 166 MHz or faster</td></tr>
<tr><td>OS</td><td>Microsoft Windows 95 or Windows 98</td></tr>
<tr><td>Memory</td><td>Minimum: 16 MB
Recommended: 24 MB min.</td></tr>
<tr><td>Hard disk</td><td>Minimum: Available space of 24 MB
Recommended: Available space of 50 MB</td></tr>
<tr><td>Monitor</td><td>SVGA or better</td></tr>
<tr><td>Drive</td><td>FDD: 1 or more
CD-ROM drive: 1 or more</td></tr>
<tr><td rowspan="9">Protocol Support Tool</td><td rowspan="9">WS01-PSTF1-E</td><td colspan="2">The following peripheral devices support the protocol macro function of the SYSMAC C200HX/HG/HE series.</td></tr>
<tr><td colspan="2">Personal computer environment</td></tr>
<tr><td>Personal computer</td><td>IBM PC/AT or compatible computer</td></tr>
<tr><td>CPU</td><td>Minimum requirement: Pentium 90 MHz
Recommended: Pentium 166 MHz or faster</td></tr>
<tr><td>OS</td><td>Microsoft Windows 95 or Windows 98</td></tr>
<tr><td>Memory</td><td>Minimum: 16 MB
Recommended: 24 MB min.</td></tr>
<tr><td>Hard disk</td><td>Minimum: Available space of 24 MB
Recommended: Available space of 50 MB</td></tr>
<tr><td>Monitor</td><td>SVGA or better</td></tr>
<tr><td>Drive</td><td>FDD: 1 or more
CD-ROM drive: 1 or more</td></tr>
</table>

■Manuals for Related Equipment and the Support Tool

The following manuals provide details on equipment and the Protocol Support Tool.

Table 6.4 List of manuals

Name, series, model	Cat. No.
SYSMAC CS series, CPU Unit	W339 Operation 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

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Table 6.4 List of manuals (Continued)

Name, series, model	Cat. No.
Serial Communications Board, CS1W-SCB21/41-V1 Serial Communications Unit, CS1W-SCU21-V1 Serial Communications Unit, CJ1W-SCU21/SCU41-V1	W336 Users Manual
Serial Communications Board, C200HW-COM01 C200HW-COM02-V1 to C200HW-COM06-EV1	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 System Settings

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)

<table>
<tr><th colspan="4">DM Area</th><th rowspan="3">Bit</th><th rowspan="3">Setting</th><th rowspan="3">Value</th></tr>
<tr><th colspan="2">CS1W-SCB41-V1</th><th colspan="2">CJ1W-SCU41-V1</th></tr>
<tr><th>Port 1</th><th>Port 2</th><th>Port 1</th><th>Port 2</th></tr>
<tr><td rowspan="9">D32000</td><td rowspan="9">D32010</td><td rowspan="9">m</td><td rowspan="9">m+10</td><td>15</td><td>Port setting -- 0: Default, 1*: Desired setting</td><td rowspan="9">860E</td></tr>
<tr><td>14 to 12</td><td>Reserved</td></tr>
<tr><td>11 to 08</td><td>Serial communications mode
(6 Hex*: Protocol macro)</td></tr>
<tr><td>07 to 05</td><td>Reserved</td></tr>
<tr><td>04</td><td>Start bit -- 0*: 1 bit, 1: 1 bit (fixed at 1 bit regardless of the setting)</td></tr>
<tr><td>03</td><td>Data length -- 0: 7 bits, 1*: 8 bits</td></tr>
<tr><td>02</td><td>Stop bit -- 0: 2 bits, 1*: 1 bit</td></tr>
<tr><td>01</td><td>Parity -- 0: With, 1*: Without</td></tr>
<tr><td>00</td><td>Parity -- 0*: Even, 1: Odd</td></tr>
<tr><td rowspan="2">D32001</td><td rowspan="2">D32011</td><td rowspan="2">m+1</td><td rowspan="2">m+11</td><td>15 to 04</td><td>Reserved</td><td rowspan="2">0006</td></tr>
<tr><td>03 to 00</td><td>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</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td></td><td></td><td>-</td></tr>
<tr><td rowspan="2">D32008</td><td rowspan="2">D32018</td><td rowspan="2">m+8</td><td rowspan="2">m+18</td><td>15</td><td>Transmission method -- 0: Half-duplex, 1*: Full-duplex</td><td rowspan="2">8000</td></tr>
<tr><td>14 to 00</td><td>Reserved</td></tr>
<tr><td>D32009</td><td>D32019</td><td>m+9</td><td>m+19</td><td>15 to 00</td><td>Max. number of bytes in send/receive data -- 00C8* to 03E8 Hex</td><td>00C8</td></tr>
</table>

* 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

<table>
<tr><th colspan="2">Communications Board</th><th rowspan="2">Bit</th><th rowspan="2">Setting</th><th rowspan="2">Value</th></tr>
<tr><th>Port 1
Port A</th><th>Port 2
Port B</th></tr>
<tr><td rowspan="3">DM6555</td><td rowspan="3">DM6550</td><td>00 to 03</td><td>Standard format setting
0 Hex: Standard setting (default)
1 Hex*: Settings in bits 00 to 15 of DM6656 and DM 6551 are used.</td><td rowspan="3">6001</td></tr>
<tr><td>04 to 11</td><td>00: Default</td></tr>
<tr><td>12 to 15</td><td>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</td></tr>
<tr><td rowspan="3">DM6556</td><td rowspan="3">DM6551</td><td>00 to 07</td><td>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</td><td rowspan="3">0803</td></tr>
<tr><td rowspan="2">08 to 15</td><td>Frame format</td></tr>
<tr><td><table>
<tr><th></th><th>Start bits</th><th>Data</th><th>Stop bits</th><th>Parity</th></tr>
<tr><td>00 Hex:</td><td>1</td><td>7</td><td>1</td><td>Even (default)</td></tr>
<tr><td>01 Hex:</td><td>1</td><td>7</td><td>1</td><td>Odd</td></tr>
<tr><td>02 Hex:</td><td>1</td><td>7</td><td>1</td><td>None</td></tr>
<tr><td>03 Hex:</td><td>1</td><td>7</td><td>2</td><td>Even</td></tr>
<tr><td>04 Hex:</td><td>1</td><td>7</td><td>2</td><td>Odd</td></tr>
<tr><td>05 Hex:</td><td>1</td><td>7</td><td>2</td><td>None</td></tr>
<tr><td>06 Hex:</td><td>1</td><td>8</td><td>1</td><td>Even</td></tr>
<tr><td>07 Hex:</td><td>1</td><td>8</td><td>1</td><td>Odd</td></tr>
<tr><td>08 Hex*:</td><td>1</td><td>8</td><td>1</td><td>None</td></tr>
<tr><td>09 Hex:</td><td>1</td><td>8</td><td>2</td><td>Even</td></tr>
<tr><td>10 Hex:</td><td>1</td><td>8</td><td>2</td><td>Odd</td></tr>
<tr><td>11 Hex:</td><td>1</td><td>8</td><td>2</td><td>None</td></tr>
</table></td></tr>
</table>

* 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.

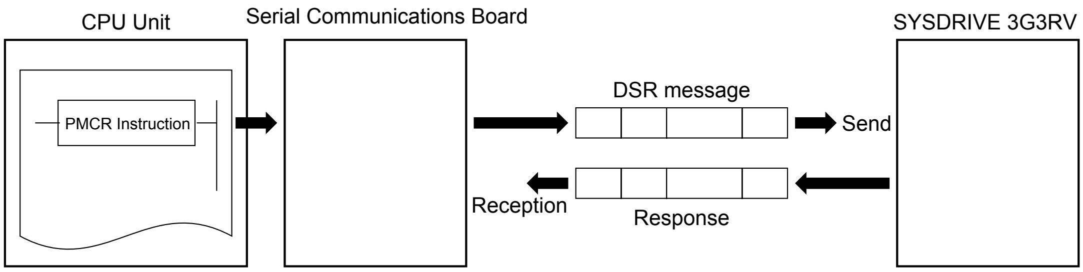


Fig 6.65 Creating a Message

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.

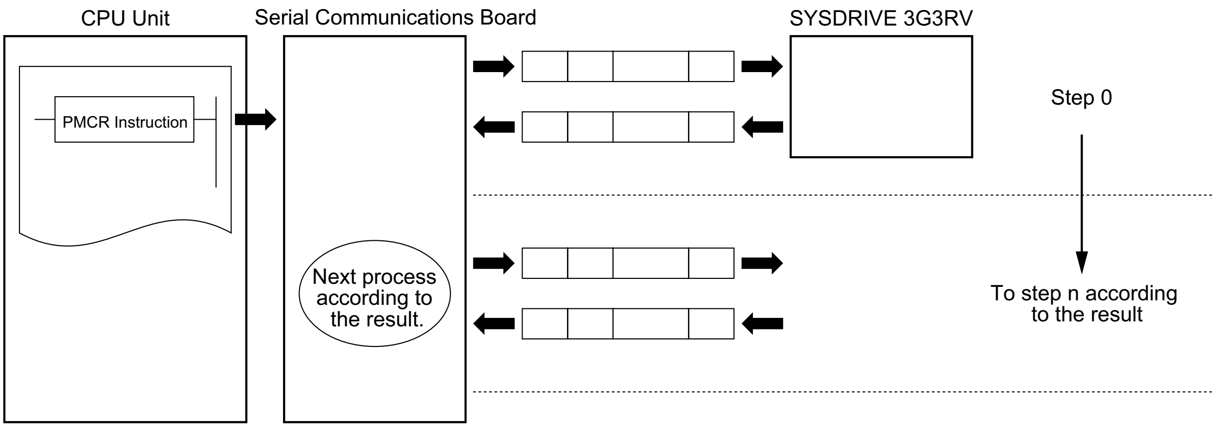


Fig 6.66 Sending and Receiving Messages

■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 *126* 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 *126* 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 communications 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 communications with the 3G3RV.

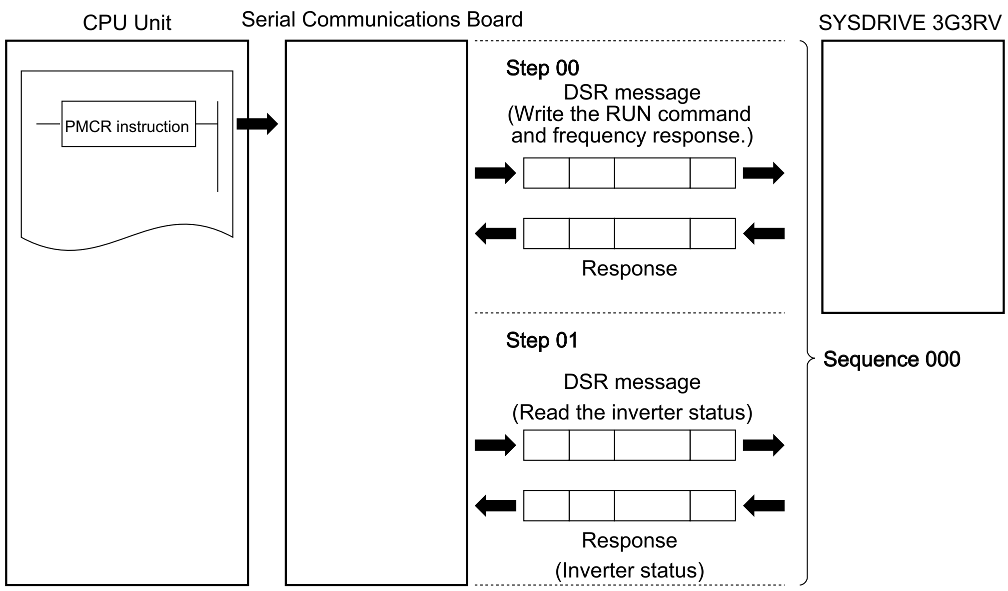


Fig 6.67

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 operation 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.

■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.

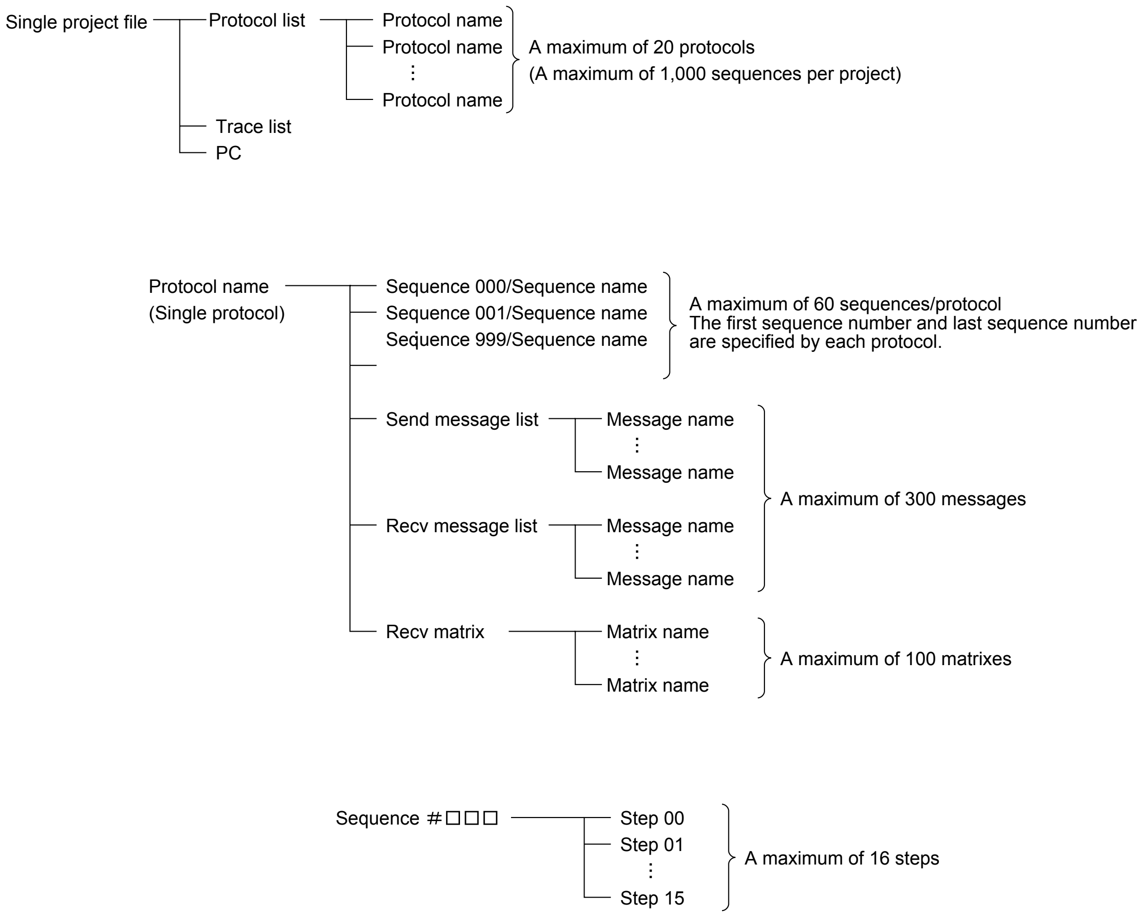


Fig 6.68 Project File Configuration

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 description 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.

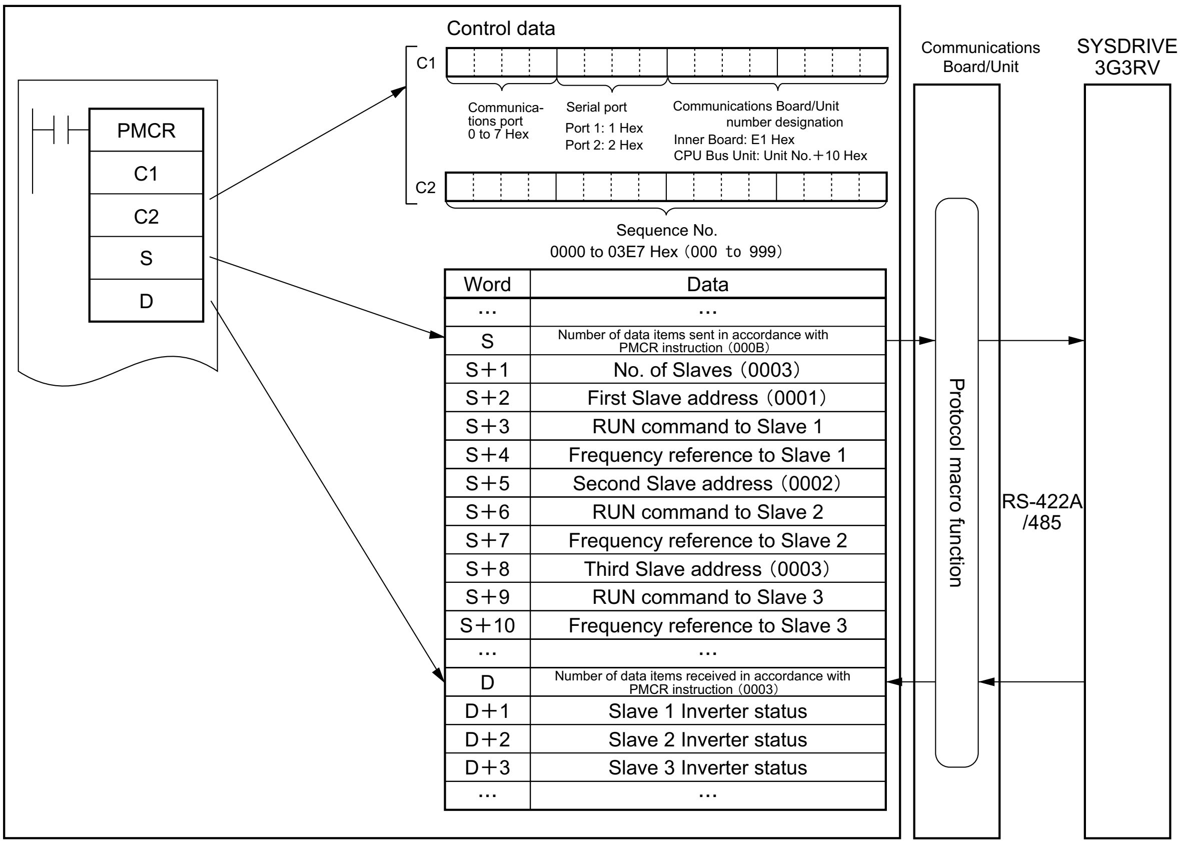
Checking the Register Numbers

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

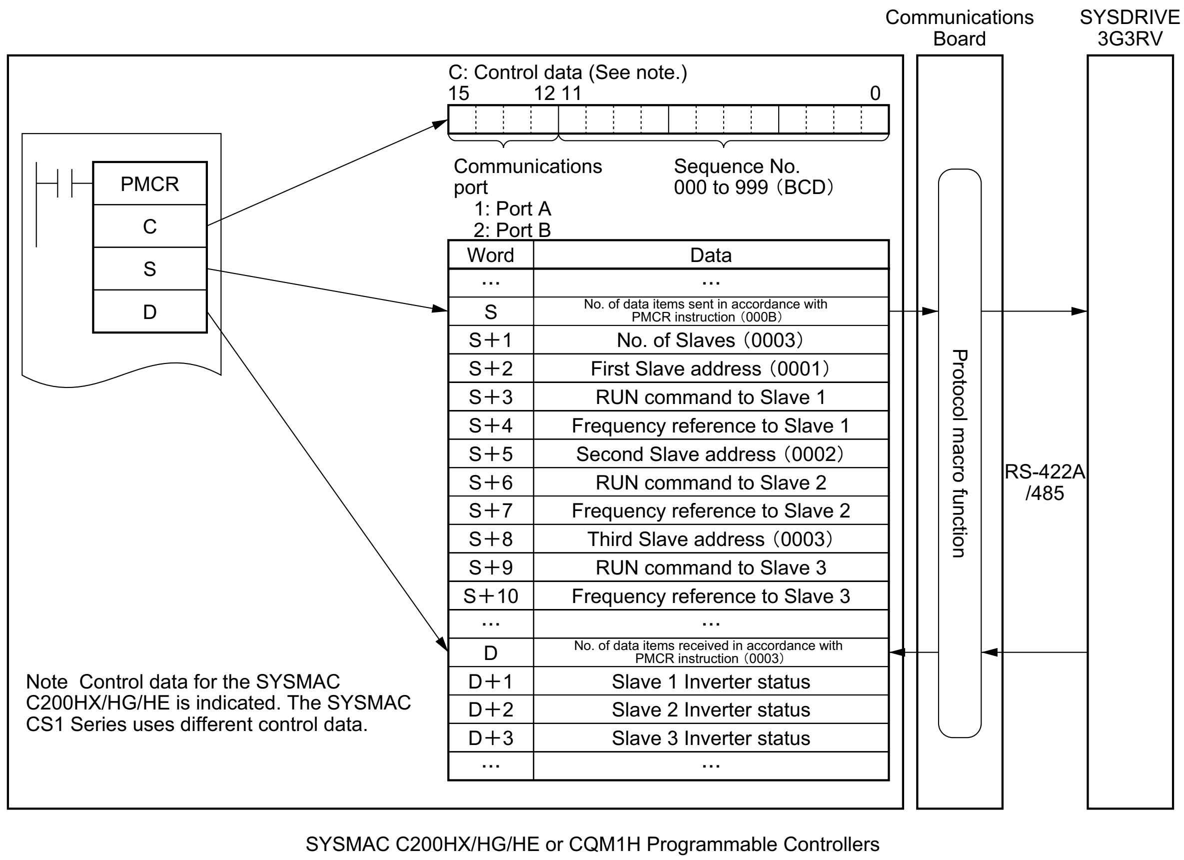


Fig 6.69 Memory Allocations

■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 connected 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**.

6

■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.

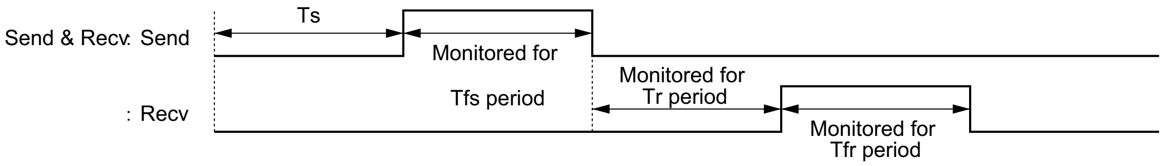
Response

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 6.70

■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	Com-mand	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.

6

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>	Data
→□	Input send			~CRC-16(65535)(2Byte BIN)	(0)(1Byte BIN)	~(R(3N+2),1)	⟨a⟩+[10]+[00]+[01]+[00]+[02]+⟨l⟩+(R(3N+3),4)+⟨c⟩
→□	Status			~CRC-16(65535)(2Byte BIN)		~(R(3N+2),1)	⟨a⟩+[03]+[00]+[2C]+[00]+[01]+⟨c⟩
→□							

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>

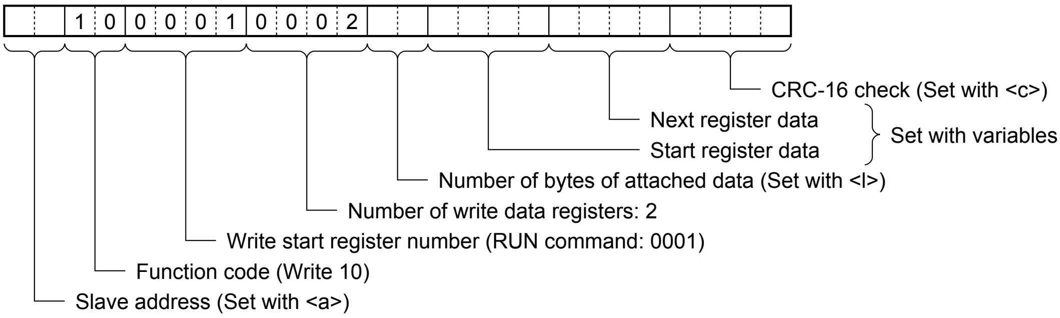
Set the addresses of the Slaves.

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 → 〈a〉+[10]+[00]+[01]+[00]+[02]+〈l〉+(R(3N+3), 4)+〈c〉

〈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.

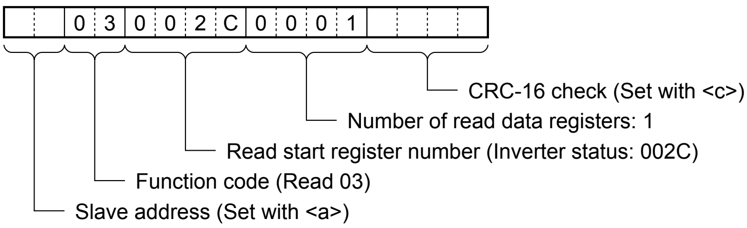
Set Edit Length to 0N + 4 so that it will be set to four bytes.

〈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 6.71 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.



Set data → 〈a〉+[03]+[00]+[2C]+[00]+[01]+〈c〉

Set the address data, constant data, and check code data.

Fig 6.72 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>

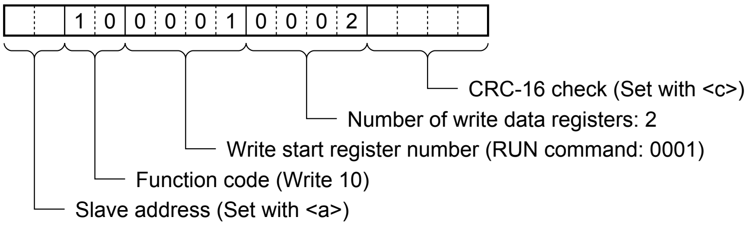
Set the addresses of the Slaves.

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 → 〈a〉＋[10]＋[00]＋[01]＋[00]＋[02]＋〈c〉

〈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.

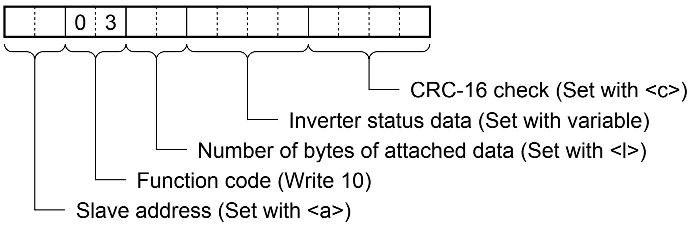
Use Set Constant and set the constants in Hex.

〈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 6.73 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 → 〈a〉＋[03]＋〈l〉＋(W(1N＋1), 2)＋〈c〉

〈a〉, [03], 〈c〉

The address data, constant data, and check code data are the same as the above.

〈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 (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 () 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.

Set Edit Length to 0N + 2 so that it will be set to two bytes.

Fig 6.74 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

6

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 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.

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

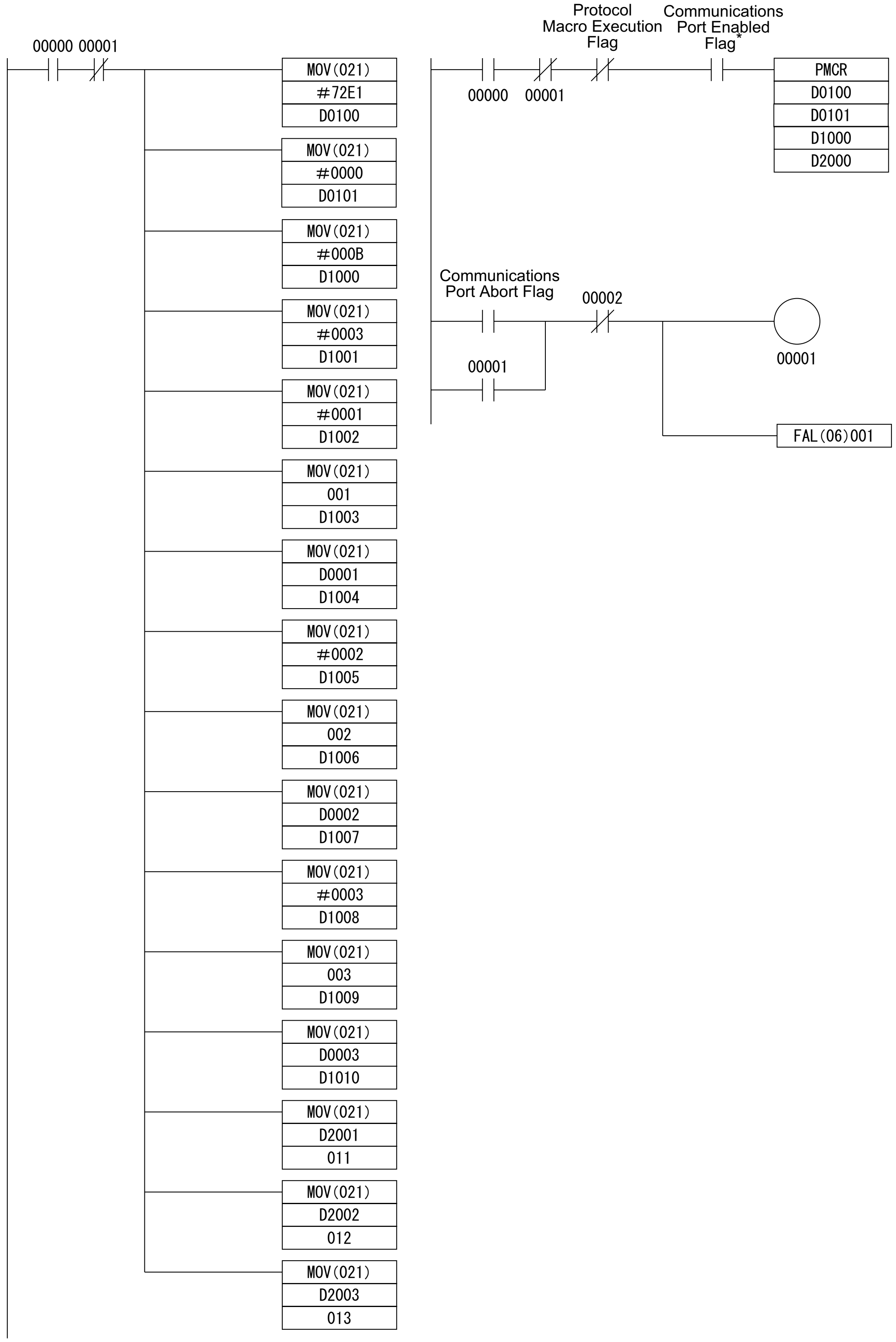


Fig 6.75 Ladder Program

■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.

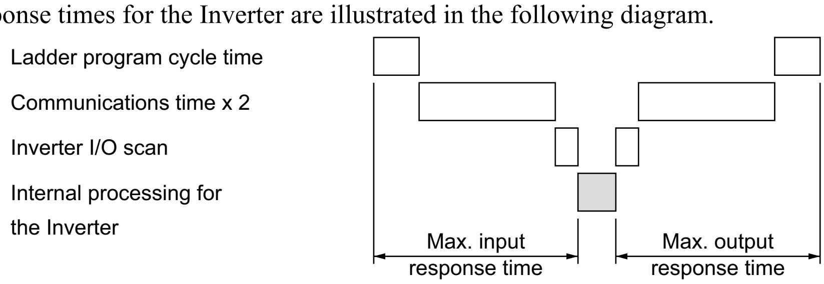


Fig 6.76 I/O Response Time

Individual Functions

This section explains the individual functions used in special applications.

◆ Using the Timer Function

Multi-function contact input terminals S3 to S8 can be designated as timer function input terminals, and multi-function output terminals M1-M2, 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 H1-06 (multi-function contact input terminal S3 to S8) to 18 (timer function input).
- Set H2-01 to H2-03 (multi-function output terminals M1-M2, P1-PC, and P2-PC function selection) to 12 (timer function output).

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
b4-01	Timer function ON-delay time / Delay-ON Timer	Sets 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-□□ or H2-□□.	0.0 to 300.0	0.0 s	No	A	A	A	A	1A3H
b4-02	Timer function OFF-delay time / Delay-OFF Timer	Sets the timer function output OFF-delay time (dead band) for the timer function input, in 1-second units. Enabled when a timer function is set in H1-□□ or H2-□□.	0.0 to 300.0	0.0 s	No	A	A	A	A	1A4H

■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.

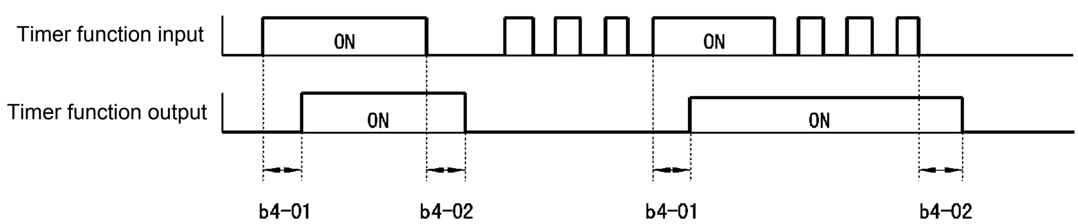


Fig 6.77 Timer Function Operation Example

◆ 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.

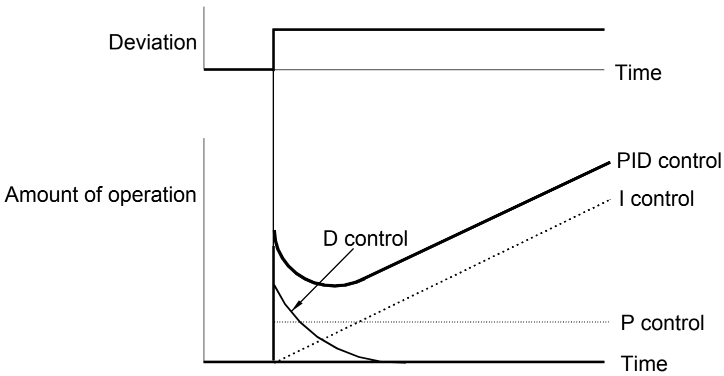


Fig 6.78 PID Control Operation

■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

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
b5-01	PID control method 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	A	1A5H
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	A	1A6H
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	A	1A7H
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	A	1A8H
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	A	1A9H
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	A	1AAH
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	A	1ABH
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	A	1ACH
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	A	1ADH
b5-10	PID output gain Output Gain	Sets output gain.	0.0 to 25.0	1.0	No	A	A	A	A	1AEH

Param-eter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	V/f	V/f with PG	Open Loop Vector	Flux Vec-tor	Regis-ter
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	A	1AFH
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	A	1B0H
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	A	1B1H
b5-14	PID feed-back com-mand loss detection time Fb los Det Time	Sets the PID feedback loss detection level in s units.	0.0 to 25.5	1.0 s	No	A	A	A	A	1B2H
b5-15	PID sleep function operation level PID Sleep Level	Set the PID sleep function start level as a frequency.	0.0 to 300.0 *	0.0 Hz	No	A	A	A	A	1B3H
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	A	1B4H
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 6000.0	0.0 s	No	A	A	A	A	1B5H

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Param-eter Number	Name	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods				Regis-ter
	Display					V/f	V/f with PG	Open Loop Vector	Flux Vec-tor	
H6-01	Pulse train input func-tion selec-tion Pulse Input Sel	0: Frequency reference 1: PID feedback value 2: PID target value	0 to 2	0	No	A	A	A	A	42CH

* When C6-01=1, the upper limit is 400.0.

Monitor Functions

Param-eter Number	Name	Description	Output Signal Level Dur-ing Multi-Function Analog Output	Min. Unit	Control Methods				Regis-ter
	Display				V/f	V/f with PG	Open Loop Vec-tor	Flux Vec-tor	
U1-24	PID feed-back value PID Feed-back	Monitors the feedback value when PID control is used. The input for the max. fre-quency corresponds to 100%.	10 V: Max. frequency (−10 to 10 V possible)	0.01 %	A	A	A	A	57H
U1-36	PID input volume PID Input	PID feedback volume Given as maximum fre-quency/100%	10 V: Max. frequency (−10 to 10 V possible)	0.01 %	A	A	A	A	63H
U1-37	PID output volume PID Output	PID control output Given as maximum fre-quency/100%	10 V: Max. frequency (−10 to 10 V possible)	0.01 %	A	A	A	A	64H
U1-38	PID target value PID Set-point	PID target value Given as maximum fre-quency/100%	10 V: Max. frequency	0.01 %	A	A	A	A	65H

Multi-Function Contact Inputs (H1-01 to H1-06)

Setting Value	Function	Control Methods			
		V/f	V/f with PG	Open Loop Vec-tor	Flux Vec-tor
19	PID control disable (ON: PID control disabled)	Yes	Yes	Yes	Yes
30	PID control integral reset (reset when reset command is input or when stopped during PID control)	Yes	Yes	Yes	Yes
31	PID control integral hold (ON: Hold)	Yes	Yes	Yes	Yes
34	PID soft starter ON/OFF	Yes	Yes	Yes	Yes
35	PID input characteristics switch	Yes	Yes	Yes	Yes

Multi-Function Analog Input (H3-05, H3-09)

Setting Value	Function	Contents (100%)	Control Methods			
			V/f	V/f with PG	Open Loop Vector	Flux Vector
B	PID feedback	Maximum output frequency	Yes	Yes	Yes	Yes
C	PID target value	Maximum output frequency	Yes	Yes	Yes	Yes

■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, or A3 Input	Set H3-05 or H3-09 to C (PID target value). Also, be sure to set H6-01 (pulse train input function selection) to 1 (PID feedback value). The negative inputs cannot be used for target values.
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) or H3-05 (Multi-function Analog Input Terminal A3 Function 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.

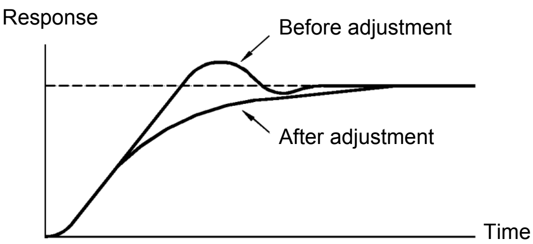
1. Set b5-01 (PID Control Method Selection) to 1 or 2 (PID control enabled).
2. Increase b5-02 (Proportional Gain (P)) to within a range that does not vibrate.
3. Reduce b5-03 (Integral (I) time) to within a range that does not vibrate.
4. Increase b5-05 (Derivative (D) time) to within a range that does not vibrate.

■PID Fine Adjustment Methods

This section explains the fine adjustment of PID after setting the PID control parameters.

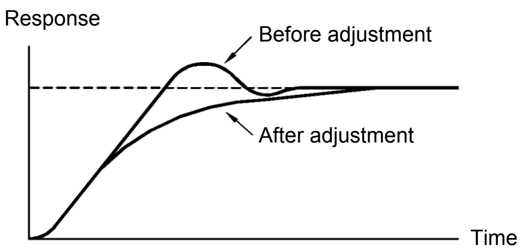
Suppressing Overshoot

If overshoot occurs, reduce derivative time (D), and increase integral time (I).



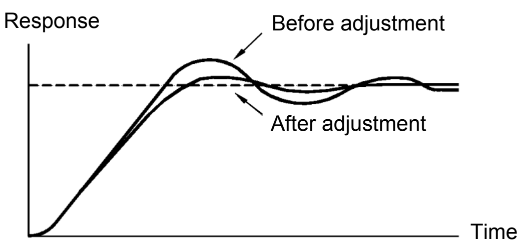
Set a Rapidly Stabilizing Control Condition

To rapidly stabilize the control even if overshoot occurs, reduce integral time (I), and lengthen derivative time (D).



Suppressing Long-cycle Vibration

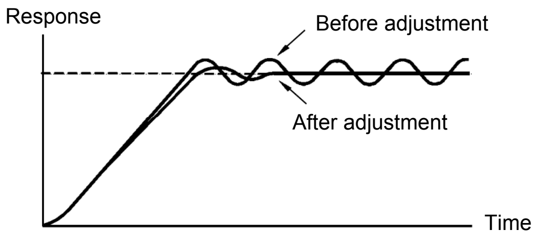
If vibration occurs with a longer cycle than the integral time (I) set value, the integral operation is too strong. Lengthen the integral time (I) to suppress the vibration.



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. If the load changes rapidly, the machine may be damaged or the motor may stall because of unpredictable response from the Inverter. In this case, reduce the set value.
- 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 parameter 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 PID control output is negative, you can use parameter b5-11 to invert the Inverter. When b1-04 (Prohibition of Reverse Operation) is set to 1 (enabled), however, PID output limit is 0.
- 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 (parameter C1) 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 parameter C1 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.

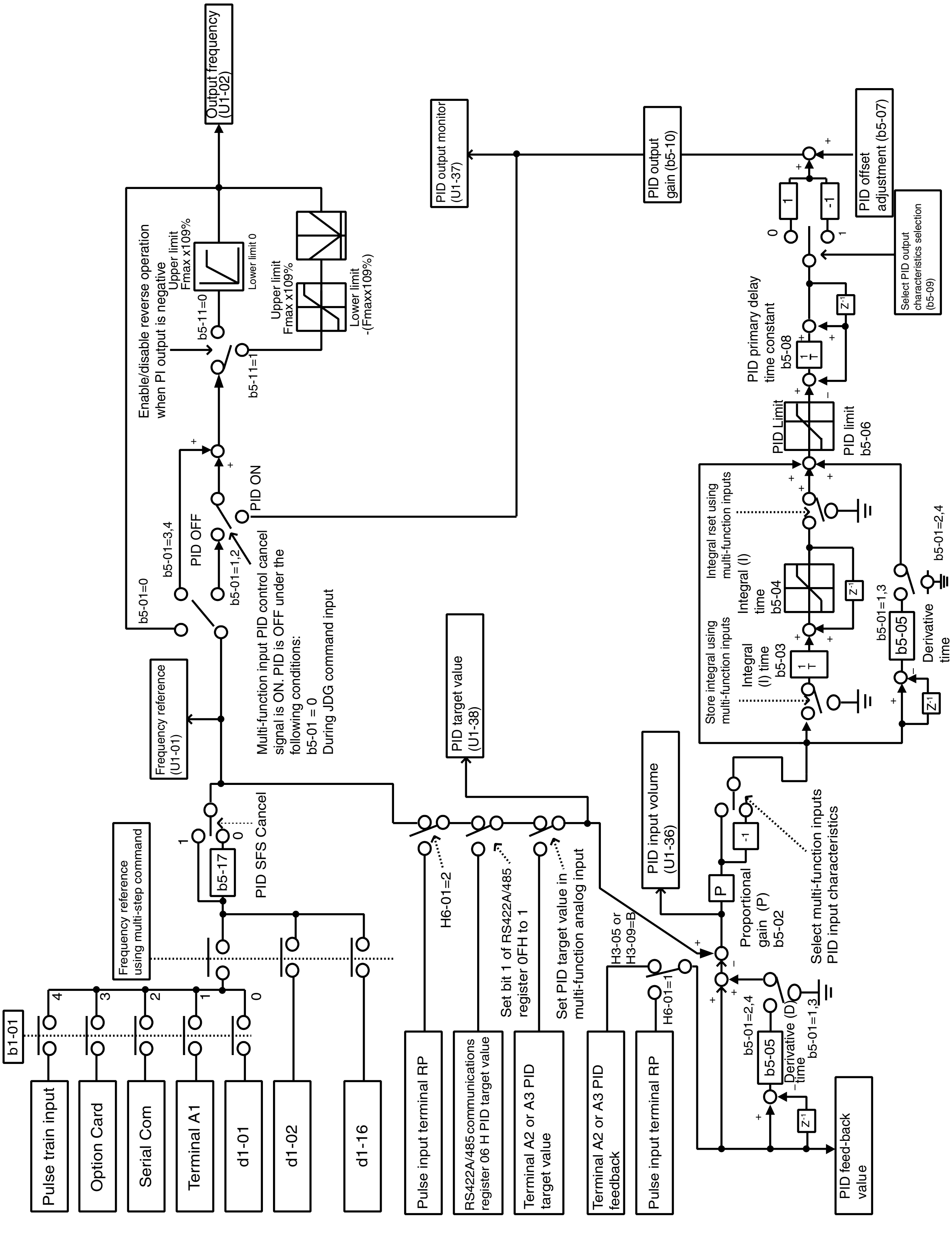


Fig 6.79 PID Control Block

■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.

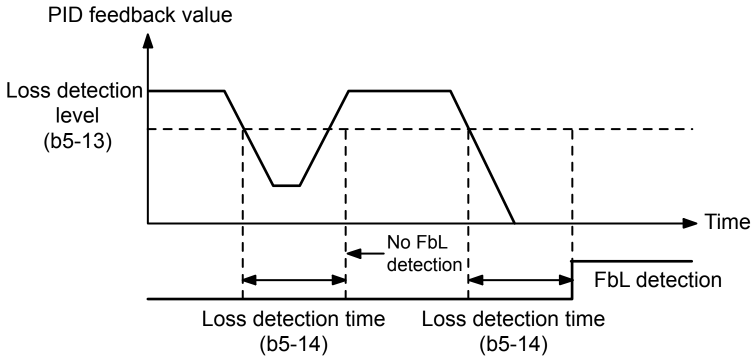


Fig 6.80 PID Feedback Loss Detection Time Chart

■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.

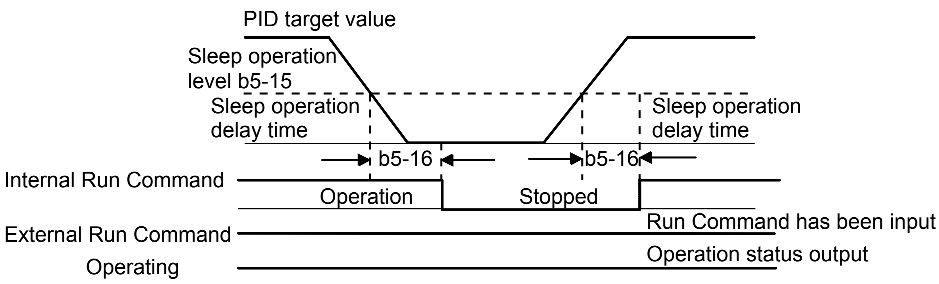


Fig 6.81 PID Sleep Time Chart

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◆ 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 vector control. The parameters to be adjusted are different for each. In V/f control, adjust b8-04 to b8-06, and in vector control, adjust b8-02 and b8-03.

■Related Parameters

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	1CCH
b8-02	Energy-saving gain Energy Save Gain	Set the energy-saving gain with the vector control method.	0.0 to 10.0	0.7 *1	Yes	No	No	A	A	1CDH
b8-03	Energy-saving filter time constant Energy Save F.T	Set the energy-saving filter time constant with the vector control method.	0.00 to 10.00	0.50 s *2	Yes	No	No	A	A	1CEH
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.	0.00 to 655.00	288.20 *3 *4	No	A	A	No	No	1CFH
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	No	1D0H
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	No	1D1H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	30FH
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 kW *1	No	Q	Q	Q	Q	318H

* 1. The factory setting is 1.0 when using flux vector control.

* 2. The factory setting is 2.00 s when Inverter capacity is 55 kW min.
The factory setting will change when the control method is changed. The open-loop vector factory setting is given.

* 3. By setting E2-11 (Motor rated output) the appropriate value will be set.

* 4. The factory setting depends on the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.

■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 constant 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.

Vector Control

In vector control method, 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 Parameters

In vector control method, the motor parameters are set automatically using autotuning. If autotuning does not complete normally, set them manually.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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, torque limits and torque control. This parameter is automatically set during autotuning.	0.32 to 6.40 *2	1.90 A *1	No	Q	Q	Q	Q	30EH
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	A	30FH
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	A	310H
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	Q	311H
E2-05	Motor line-to-line resistance / Term Resistance	Sets the motor phase-to-phase resistance in Ω units. This parameter is automatically set during autotuning.	0.000 to 65.000	9.842 Ω *1	No	A	A	A	A	312H
E2-06	Motor leak inductance / Leak Inductance	Sets the voltage drop due to motor leakage inductance as a percentage of the motor rated voltage. This parameter is automatically set during autotuning.	0.0 to 40.0	18.2% *1	No	No	No	A	A	313H
E2-07	Motor iron saturation coefficient 1 / Saturation Comp1	Sets the motor iron saturation coefficient at 50% of magnetic flux. This parameter is automatically set during autotuning.	0.00 to 0.50	0.50	No	No	No	A	A	314H
E2-08	Motor iron saturation coefficient 2 / Saturation Comp2	Sets the motor iron saturation coefficient at 75% of magnetic flux. This parameter is automatically set during autotuning.	0.50 to 0.75 *4	0.75	No	No	No	A	A	315H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
E2-09	Motor mechanical loss Mechanical Loss	Sets motor mechanical loss as a percentage of motor rated output (W). Usually setting is not necessary. Adjust in the following circumstances: • When torque loss is large due to motor bearing. • When the torque loss in the pump or fan is large. The set mechanical loss will compensate for torque.	0.0 to 10.0	0.0	No	No	No	No	A	316H
E2-10	Motor iron loss for torque compensation Tcomp Iron Loss	Sets motor iron loss in W units.	0 to 65535	14 W *1	No	A	A	No	No	317H
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 kW *1	No	Q	Q	Q	Q	318H

* 1. The factory settings depend on the Inverter capacity. The values for a 200 V Class Inverter of 0.4 kW are 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. For the motor no-load current, set E2-03 to a value less than that of E2-01.
* 3. The setting range depends on the Inverter capacity. The value for a 200 V Class Inverter of 0.4 kW is given.
* 4. The lower limit of E2-08 is the setting value of E2-07.

■Manual Motor Parameter Setting Methods

The motor parameters settings methods are given below. Make (enter) settings referring to the motor test report.

Motor Rated Voltage 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 (min^{-1}) 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 or flux vector control method 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 report] × 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 and are set automatically using rotational autotuning.

Motor Mechanical Loss

E2-09 is displayed only when the flux vector control method is selected. Adjust mechanical loss in the following cases. (There is normally no reason to make this adjustment.) The mechanical loss setting is used to compensate the torque.

- There is excessive torque loss from the motor bearings.
- There is excessive torque loss from a fan, pump, etc.

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.

Motor Rated Output

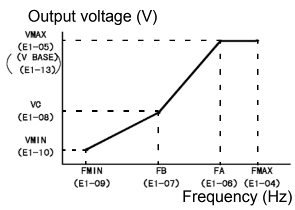
Set the rated output value of the motor indicated on the motor nameplate to E2-11.

This parameter is automatically set during autotuning.

◆ 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

Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
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	Q	300H
E1-03	V/f pattern selection 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	No	302H
E1-04	Max. output frequency Max 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)	40.0 to 300.0 *5	60.0 Hz *2	No	Q	Q	Q	Q	303H
E1-05	Max. voltage Max Voltage		0.0 to 255.0 *1	200.0 V *1*2	No	Q	Q	Q	Q	304H
E1-06	Base frequency Base Frequency		0.0 to 300.0 *5	60.0 Hz *2	No	Q	Q	Q	Q	305H
E1-07	Mid. output frequency Mid Frequency A		0.0 to 300.0 *5	3.0 Hz *2	No	A	A	A	No	306H
E1-08	Mid. output frequency voltage Mid Voltage A		0.0 to 255 *1	15.0 V *1 *2	No	A	A	A	No	307H
E1-09	Min. output frequency Min Frequency		0.0 to 300.0 *5	1.5 Hz *2	No	Q	Q	Q	A	308H
E1-10	Min. output frequency voltage Min Voltage		0.0 to 255.0 *1	9.0 V *1 *2	No	A	A	A	No	309H

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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 Vector	Flux Vec-tor	Regis-ter
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 300.0 *5	0.0 Hz *3	No	A	A	A	A	30AH
E1-12	Mid. output frequency voltage 2 Mid Voltage B		0.0 to 255.0 *1	0.0 V *3	No	A	A	A	A	30BH
E1-13	Base voltage Base Voltage		0.0 to 255.0 *1	0.0 V *4	No	A	A	Q	Q	30CH

* 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. The 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=1, the upper limit is 400.0.

■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.

The overvoltage detection level (OV) and the braking transistor operation level (BTR) vary depending on the input voltage as shown in the following table.

Inverter Class	E1-01 Setting	OV Detection Level	BTR Operation Level*
200 V Class	All values	Approx. 410 V	Approx. 394 V
400 V Class	400 V or more	Approx. 820 V	Approx. 788 V
	Less than 400 V	Approx. 720 V	Approx. 682 V

* These are values of operation levels for braking transistors built in Inverters of 0.4 to 18.5 kW.

If selecting a fixed V/f pattern (E1-03 = 0 to E) in V/f control the values of the max. voltage (E1-05), the mid. Output frequency voltage (E1-08), and the min. output frequency voltage (E1-10) will change if the value for the input voltage setting (E1-01) is changed.

■Setting V/f Pattern

Set the V/f pattern in E1-03 when using V/f control (with or without a PG). 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.

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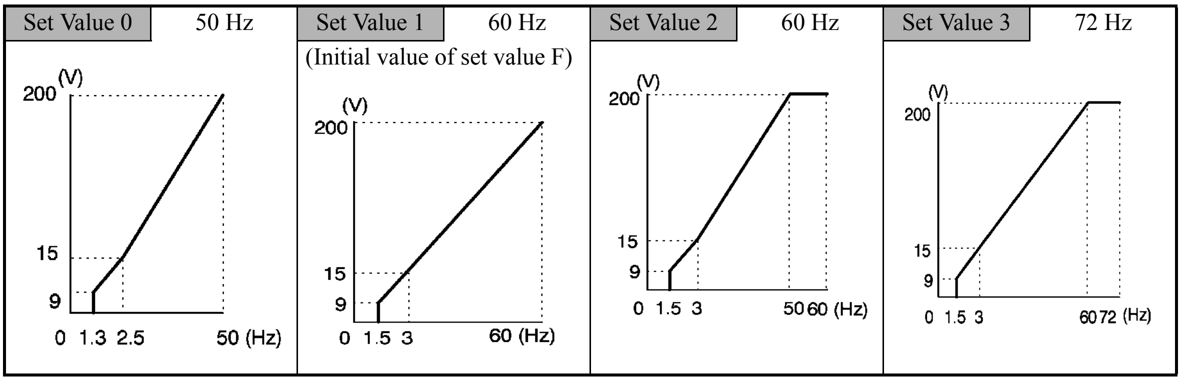
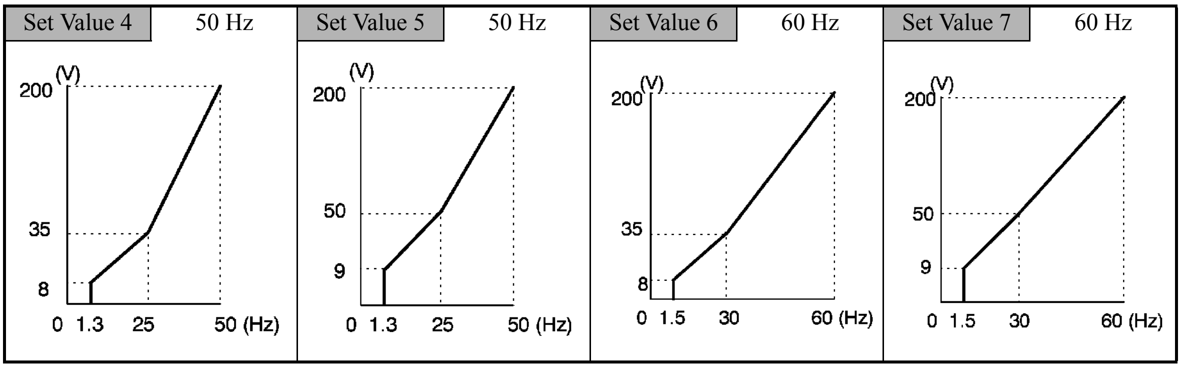
0.4 to 1.5 kW V/f Pattern

The diagrams show characteristics for a 200-V Class motor. For a 400-V Class motor, multiply all voltages by 2.

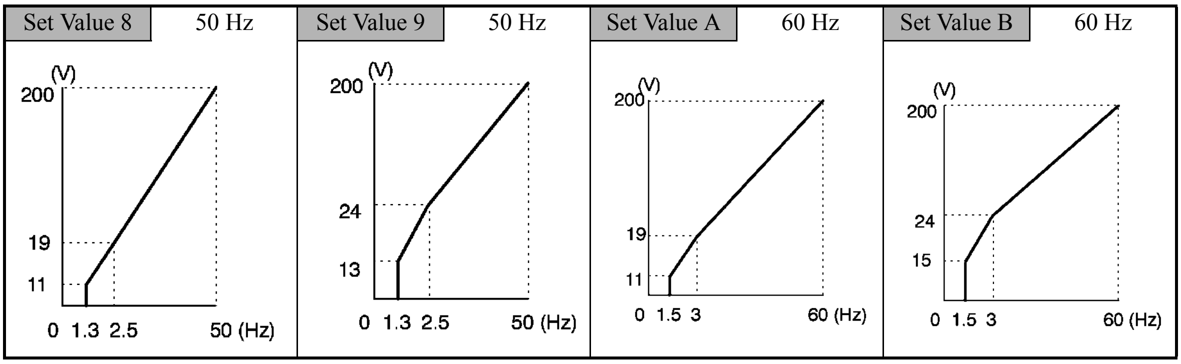
- Constant Torque Characteristics (Set Value: 0 to 3)



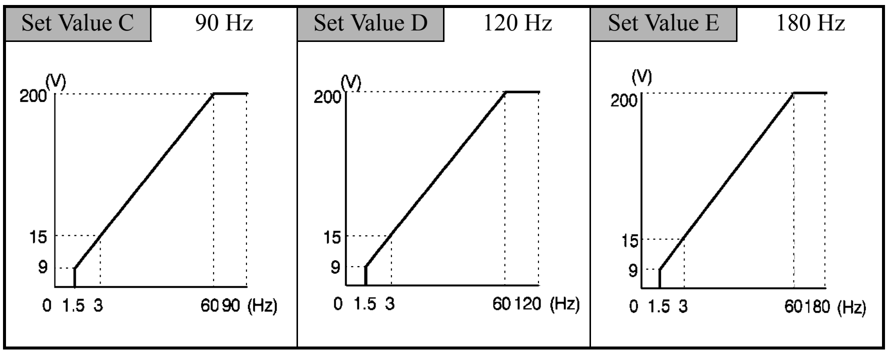
- Decrement Torque Characteristics (Set Value: 4 to 7)



- High startup torque (Set value 8: to B)



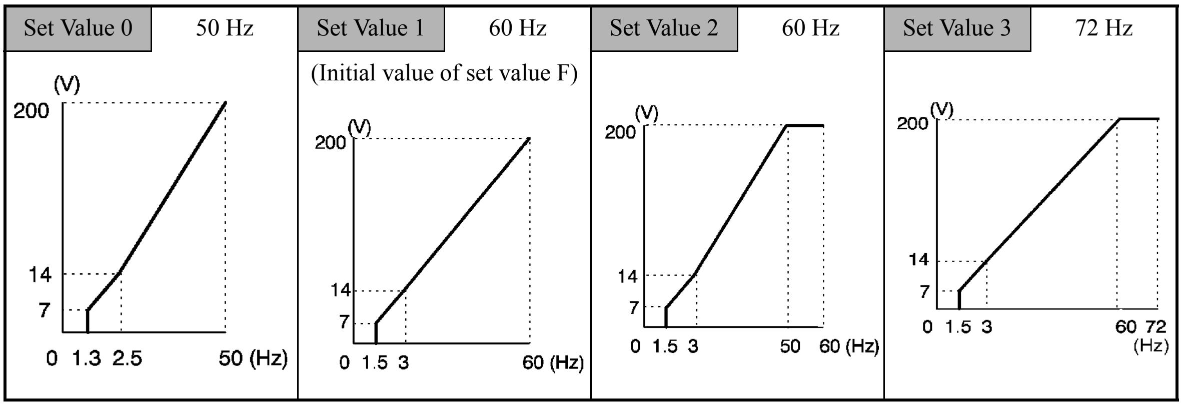
- Fixed Output Operation (Set Value: C to E)



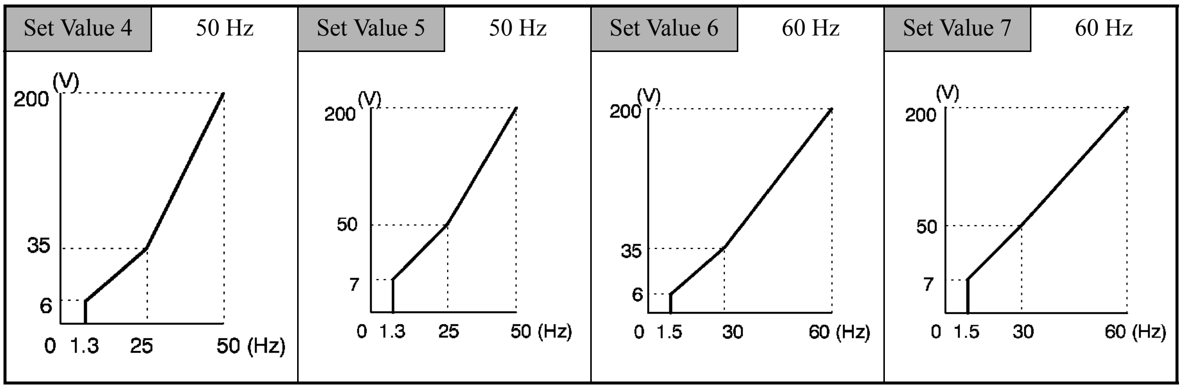
2.2 to 45 kW V/f Pattern

The diagrams show characteristics for a 200-V Class motor. For a 400-V Class motor, multiply all voltages by 2.

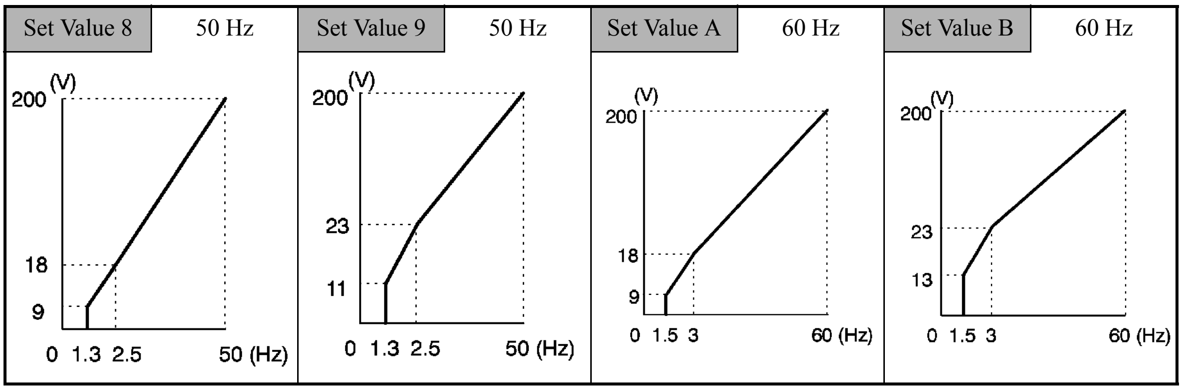
- Constant Torque Characteristics (Set Value: 0 to 3)



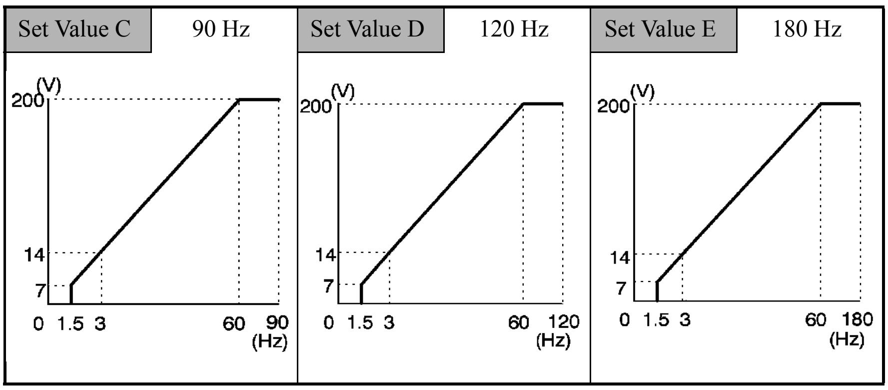
- Decrement Torque Characteristics (Set Value: 4 to 7)



- High Startup Torque (Set Value: 8 to B)



- Fixed Output Operation (Set Value: C to E)



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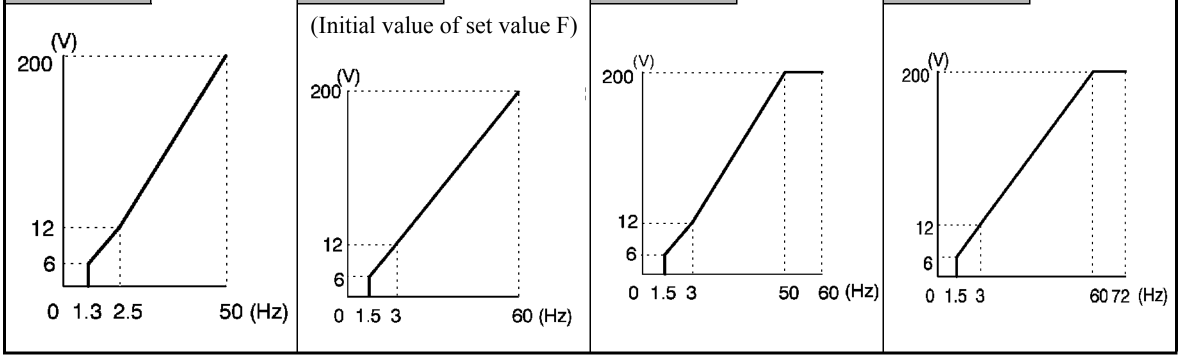
55 to 300 kW V/f Pattern

The diagrams show characteristics for a 200-V Class motor. For a 400-V Class motor, multiply all voltages by 2.

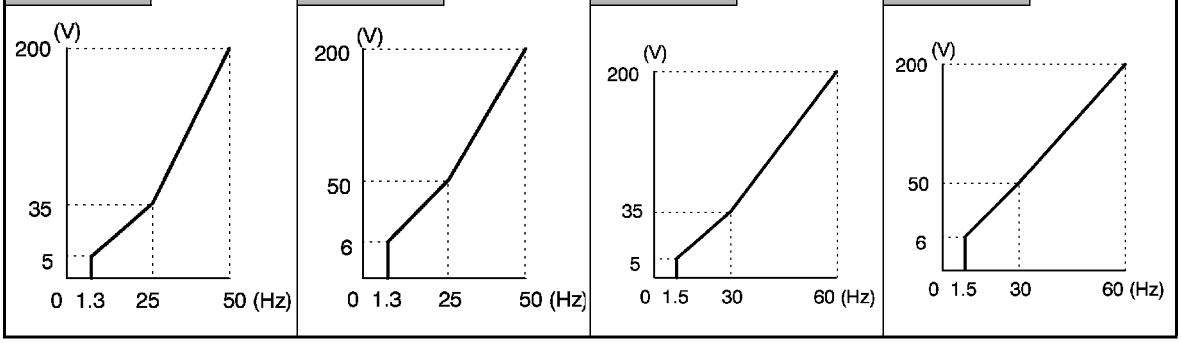
- Constant Torque Characteristics (Set Value: 0 to 3)

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)					



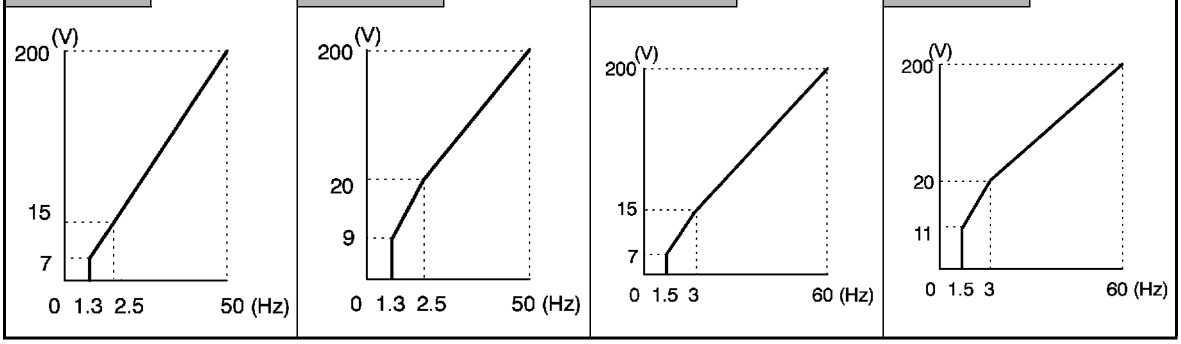
- Decrement Torque Characteristics (Set Value: 4 to 7)

Set Value 4	50 Hz	Set Value 5	50 Hz	Set Value 6	60 Hz	Set Value 7	60 Hz



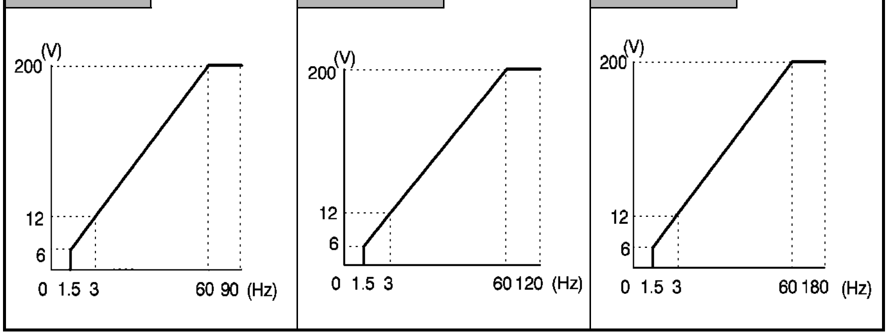
- High Startup Torque (Set Value: 8 to B)

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



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.

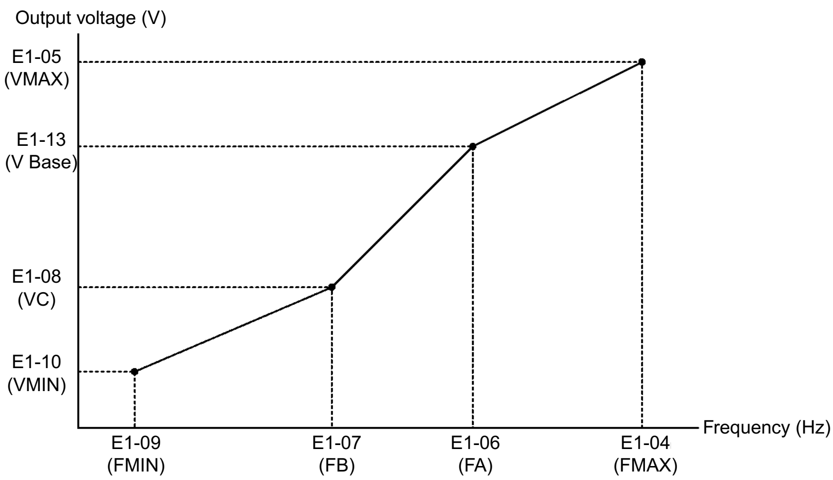


Fig 6.82 User-Set V/f Pattern

■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)

◆ Torque Control

With flux vector control, the motor's output torque can be controlled by a torque reference from an analog input. Set d5-01 to 1 to control torque.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
d5-01	Torque control selection Torq Control Sel	0: Speed control (C5-01 to C5-07) 1: Torque control This function is only available in flux vector control method. To use the function for switching between speed and torque control, set to 0 and set the multi-function input to “speed/torque control change.”	0 or 1	0	No	No	No	No	A	29AH
d5-02	Torque reference delay time Torq Ref Filter	Set the torque reference delay time in ms units. This function can be used to adjust the noise of the torque control signal or the responsiveness with the host controller. When oscillation occurs during torque control, increase the set value.	0 to 1000	0 ms	No	No	No	No	A	29BH
d5-03	Speed limit selection Speed Limit Sel	Set the speed limit command method for the torque control method. 1: The analog input limit from a frequency reference (see b1-01) 2: Limited by d5-04 parameter setting values.	1 or 2	1	No	No	No	No	A	29CH
d5-04	Speed limit Speed Lmt Value	Set the speed limit during torque control as a percentage of the maximum output frequency. This function is enabled when d5-03 is set to 2. Directions are as follows. +: Run Command direction –: Run Command opposite direction	−120 to +120	0%	No	No	No	No	A	29DH
d5-05	Speed limit bias Speed Lmt Bias	Set the speed limit bias as a percentage of the maximum output frequency. Bias is given to the specified speed limit. It can be used to adjust the margin for the speed limit.	0 to 120	10%	No	No	No	No	A	29EH

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
d5-06	Speed/ torque control switching timer Ref Hold Time	Set the delay time from inputting the multi-function input “speed/torque control change” (from On to OFF or OFF to ON) until the control is actually changed, in ms units. This function is enabled when the multi-function input “speed/torque control change” is set. In the speed/ torque control switching timer, the analog inputs hold the values of when the “speed/torque control change” changes. Always be sure to allow time for this process to finish completely.	0 to 1000	0 ms	No	No	No	No	A	29FH
H3-04	Signal level selection (terminal A3) Term A3 Signal	0: –10 to 10 V 1:–10 to 10 V	0 or 1	0	No	A	A	A	A	413H
H3-05	Multi-function analog input (terminal A3) function selection Terminal A3 Sel	Select from the functions listed in the following table. Refer to the next page.	0 to 1F	1F	No	A	A	A	A	414H
H3-06	Gain (terminal A3) Terminal A3 Gain	Sets the input gain (level) when 10V is input. Set according to the 100% value selected from H3-05.	0.0 to 1000.0	100.0%	Yes	A	A	A	A	415H
H3-07	Bias (terminal A3) Terminal A3 Bias	Sets the input gain (level) when 0V is input. Set according to the 100% value selected from H3-05.	-100.0 to +100.0	0.0%	Yes	A	A	A	A	416H
H3-08	Signal level selection (terminal A2) Term A2 Signal	0: 0 to +10V, with lower limit 1: –10 to 10 V, without lower limit 2: 4 to 20 mA. Switch current and voltage input using the switch on the control panel.	0 to 2	2	No	A	A	A	A	417H

6

Param-eter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vec-tor	Regis-ter
H3-09	Multi-function analog input (terminal A2) function 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	A	418H
H3-10	Gain (terminal A2) Terminal A2 Gain	Sets the input gain (level) when 10 V (20 mA) is input. Set according to the 100% value for the function set for H3-09.	0.0 to 1000.0	100.0%	Yes	A	A	A	A	419H
H3-11	Bias (terminal A2) Terminal A2 Bias	Sets the input gain (level) when 0 V (4 mA) is input. Set according to the 100% value for the function set for H3-09.	-100.0 to +100.0	0.0%	Yes	A	A	A	A	41AH

Multi-function Contact Input Functions (H1-01 to H1-06)

Setting Value	Function	Control Methods: V/f	V/f with PG	Open Loop Vec-tor	Flux Vec-tor
71	Speed/torque control change (ON: Torque control)	No	No	No	Yes
78	Polarity Reverse Command for external torque reference	No	No	No	Yes

Multi-function Contact Output Functions (H2-01 to H2-03)

Setting Value	Function	Control Methods: V/f	V/f with PG	Open Loop Vec-tor	Flux Vec-tor
32	Speed control circuit operating for torque control (except when stopped). The external torque reference will be limited if torque control is selected. Output when the motor is rotating at the speed limit.	No	No	No	Yes

Multi-function Analog Inputs (H3-05, H3-09)

Setting Value	Function	Control Methods: V/f	V/f with PG	Open Loop Vec-tor	Flux Vec-tor
0	Add to terminal A1	Yes	Yes	Yes	Yes
13	Torque reference/torque limit at speed control	No	No	No	Yes
14	Torque compensation	No	No	No	Yes

Monitor Function

Parameter Number	Name / Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
U1-09	Torque reference / Torque Reference	Monitor in internal torque reference value for vector control.	10 V: Motor rated torque (−10 to 10 V possible)	0.1%	No	No	A	A	48H

■Inputting Torque References and Torque Reference Directions

The torque reference can be changed according to an analog input by setting H3-09 (Multi-function analog input terminal A2 selection) or H3-05 (Multi-function analog input terminal A3 selection) to 13 (torque reference) or 14 (torque compensation). The torque reference input methods are listed in the following table.

Torque Reference Input Method	Reference Location	Selection Method	Remarks
Voltage input (−10 to 10 V)	Between A3 and AC	H3-04 = 1 H3-05 = 13	Set H3-04 to 0 for a 0 to 10-V torque reference. To switch the torque reference between positive and negative torque, set a multi-function analog input to 78.
	Between A2 and AC (Turn OFF pin 2 of SW1.)	H3-08 = 1 H3-09 = 13	Set H3-08 to 0 for a 0 to 10-V torque reference. To switch the torque reference between positive and negative torque, set a multi-function analog input to 78. The input can be used for torque compensation by setting H3-09 to 14.
Current input (4 to 20 mA)	Between A2 and AC (Turn ON pin 2 of SW1.)	H3-08 = 2 H3-09 = 13	To switch the torque reference between positive and negative torque, set a multi-function analog input to 78. The input can be used for torque compensation by setting H3-09 to 14.
Option board (3G3IV-DAI14B) (−10 to 10 V)	Between TC2 and TC4	F2-01 = 0 H3-08 = 1 H3-09 = 13	The input can be used for torque compensation by setting H3-05 to 14.

The direction of the torque output from the motor will be determined by the sign of the analog signal input. It does not depend on the direction of the Run Command. The direction of torque will be as follows:

- Positive analog reference: Torque reference for forward motor rotation (counterclockwise as viewed from the motor output axis).
- Negative analog reference: Torque reference for reverse motor rotation (clockwise as viewed from the motor output axis).

Application Precautions

If the analog signal input level is 0 to 10 V or 4 to 20 mA, a forward torque reference will not be applied. To apply reverse torque, use an input level of -10 V to 10 V or switch the direction using a multi-function input set to 78 (polarity Reverse Command for external torque reference).

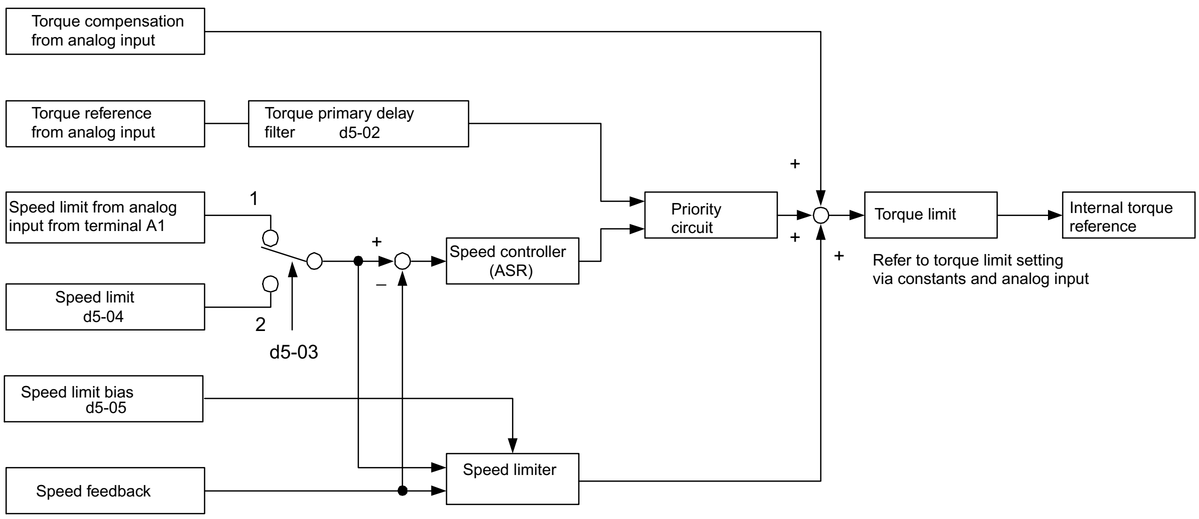


Fig 6.83 Torque Control Block Diagram

■Speed Limiter and Priority Circuit (Speed Limit Function)

If the external torque reference and load are not balanced during torque control, the motor will accelerate in either the forward or reverse direction. The speed limit function is used to limit the speed to a specified value and it consists of the speed limiter circuit and priority circuit.

When the motor speed exceeds the speed limit value during torque control, the speed limiter circuit generates the suppression torque proportional to the speed above the limit value and adds to the torque reference. The priority circuit switches the internal torque reference to ASR output so that the motor speed does not exceed the speed limit value.

Application Precautions

There are two ways to set a speed limit: using an input from an analog input terminal and setting a speed limit in d5-04. The inputs methods for a speed limit are listed in the following table.

Speed Limit Input Method	Location of Reference	Parameter Settings	Remarks
Voltage input (−10 to 10 V)	Set in d5-04	d5-03 = 2	-
	Between A1 and AC	b1-01 = 1 H3-01 = 1	Set H3-01 to 0 if the speed limit is always to be positive.
	Between A2 and AC	b1-01 = 0 H3-08 = 1 H3-09 = 1	The value will be added to the value input on A1 to determine the speed limit. Set H3-03 to 0 if the speed limit input on A2 is always to be positive. Turn OFF (V side) pin 2 of DIP switch S1 on the terminal board.
Current input (4 to 20 mA)	Between A2 and AC	b1-01 = 0 H3-08 = 2 H3-09 = 1	The value will be added to the value input on A1 to determine the speed limit. Turn ON (I side) pin 2 of DIP switch S1 on the terminal board.
Option board (3G3IV-PAI14B) (−10 to 10 V)	Between TC1 and TC4	b1-01 = 3 F2-01 = 0	If H3-09 is set to 0, the sum of the input between TC2 and TC4 will be added the input between TC1 and TC4 to determine the speed limit.

IMPORTANT

The direction in which speed is controlled is determined by the sign of the speed limit signal and the direction of the Run Command.

- Positive voltage applied: The speed in the forward direction will be limited for forward operation.
- Negative voltage applied: The speed in the reverse direction will be limited for reverse operation.

If the direction of motor rotation and the command direction are not the same, speed will be limited to 0 as long as b5-05 is set to 0.

■Torque Limit Operation Examples

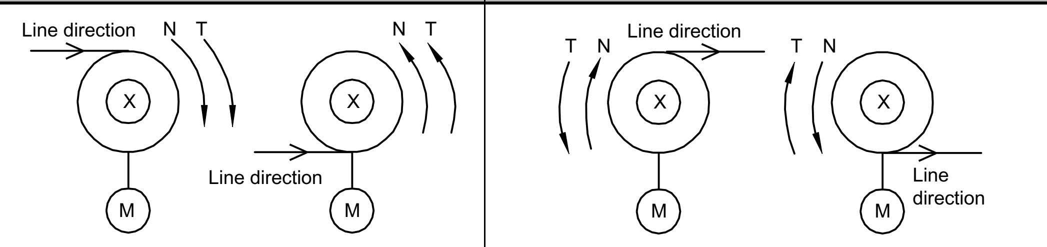
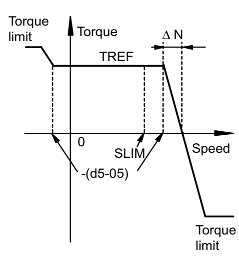
Operation examples will be described separately for winding operation, in which the speed and motor torque are in the same directions, and rewinding operation, in which the speed and motor torque are in opposite directions.

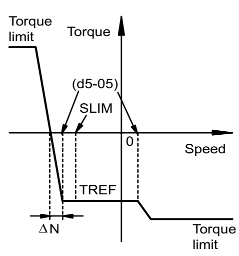
Winding Operation

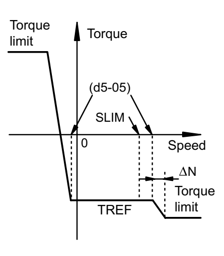
In a winding operation, the line (speed) and torque generated by the motor are in the same direction. For the winding operation, both the speed limit and the torque reference input are positive. The motor will accelerate when the torque reference input is larger than the load and will decelerate when it is smaller than the load. If the motor turns faster than the speed limit, a negative compensation value is output from the speed limiter circuit. When the speed then drops below the speed limit, a positive compensation value is output. The torque compensation is proportional to the ASR proportional gain. When the sum of the torque reference and the torque compensation output by the speed limiter is the same as the actual load, the motor will stop accelerating and run at a constant speed.

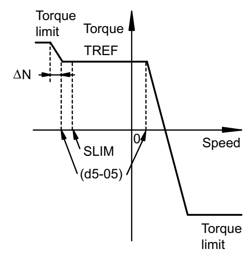
Rewinding Operation

In a rewinding operation, the line (speed) and torque generated by the motor are in the opposite directions. (In this example, we'll assume that the line speed is positive and the torque reference input is negative.) For the rewinding operation, the speed limit is positive and the torque reference input is negative. If the motor turns faster than the speed limit, a negative compensation value is output from the speed limiter circuit. If the motor is rotating in reverse, a negative compensation value is output. If the speed is 0 or is below the speed limit, a 0 compensation value is output. In this way, the output from the speed limiter is used to maintain the motor speed between 0 and the speed limit. When the sum of the torque reference and the torque compensation output by the speed limiter is the same as the actual load, the motor will stop accelerating and run at a constant speed.

<table>
<tr><th></th><th colspan="2">Winding Operation</th><th colspan="2">Rewinding Operation</th></tr>
<tr><td>Configuration</td><td colspan="4">
</td></tr>
<tr><td>Normal Rotation Direction</td><td>Forward</td><td>Reverse</td><td>Forward</td><td>Reverse</td></tr>
<tr><td>Torque Reference Polarity (TREF)</td><td>+</td><td>−</td><td>−</td><td>+</td></tr>
<tr><td>Speed Limit Polarity (SLIM)</td><td>+</td><td>−</td><td>+</td><td>−</td></tr>
<tr><td>Generated Torque</td>
<td>

$\Delta N(\%) = \frac{TREF(\%)}{C5\text{-}01}$</td>
<td>

$\Delta N(\%) = \frac{TREF(\%)}{C5\text{-}01}$</td>
<td>

The lower value of ΔN(%) = $\frac{TREF(\%)}{C5\text{-}01}$ or d5-05(%)</td>
<td>

The lower value of ΔN(%) = $\frac{TREF(\%)}{C5\text{-}01}$ or d5-05(%)</td></tr>
</table>

■Torque Reference Adjustment

Consider the following information when adjusting the torque.

Torque Reference Delay Time: d5-02

The time constant of the primary filter in the torque reference section can be adjusted. This parameter is used to eliminate noise in the torque reference signal and adjust the responsiveness to the host controller. Increase the setting if oscillation occurs during torque control.

Setting the Torque Compensation

Set multi-function analog input A2 or A3 to torque compensation (setting 14). When the amount of torque loss for mechanical loss or other factor at the load is input to one of these terminals, it is added to the torque reference to compensate for the loss. The direction of torque will be as follows:

- Positive voltage (current): Torque compensation reference for forward motor rotation (counterclockwise as viewed from the motor output axis).
- Negative voltage: Torque compensation reference for reverse motor rotation (clockwise as viewed from the motor output axis).

Since the polarity of the voltage input determines the direction, only forward torque compensation can be input when the 0 to 10 V or 4 to 20 mA signal level has been selected. If you want to input reverse torque compensation, be sure to select the –10 to 10 V signal level.

■Speed/Torque Control Switching Function

It is possible to switch between speed control and torque control when one of the multi-function inputs (H1-01 to H1-06) is set to 71 (Speed/Torque Control Change). Speed control is performed when the input is OFF and torque control is performed when the input is ON. Set d5-01 to switch speed/torque control.

■Setting the Speed/Torque Control Switching Timer

The delay between a change in the speed/control switching function input (ON to OFF or OFF to ON) and the corresponding change in the control method can be set in d5-06. During the timer delay, the value of the 3 analog inputs will retain the values they had when the ON/OFF status of speed/torque control switching signal was changed. Use this delay to complete any changes required in external signals.

Application Precautions

- The frequency reference (during speed control) is set in b1-01. The speed limit during torque control is set in d5-03.
- If the torque reference has been assigned to a multi-function analog input, terminal A2, or terminal A3, the input function changes when the control method is switched between torque control and speed control.
  During speed control: The analog input terminal is used as the torque limit input.
  During torque control: The analog input terminal is used as the torque reference input.
- When the Run Command turns OFF, the control method when stopped will be for speed control. Even from the torque control method, the system will automatically change to speed control and decelerate to a stop when the Run Command turns OFF.
- When A1-02 (control method selection) is set to 3 (flux vector control), the speed/torque change command (a setting of 71) can be set for a multi-function input (H1-01 to H1-06) to switch between speed and torque control during operation. An example is shown below.

Terminal No.	User Parameter No.	Factory Setting	Setting	Function
S8	H1-06	8	71	Speed/torque control change
A1	b1-01	1	1	Frequency reference selection (terminals A1, A2)
	d5-03	1	1	Speed limit (terminals A1, A2)
A3	H3-05	0	13	Torque reference/torque limit

A timing chart for switching between speed and torque control is shown in the following figure.

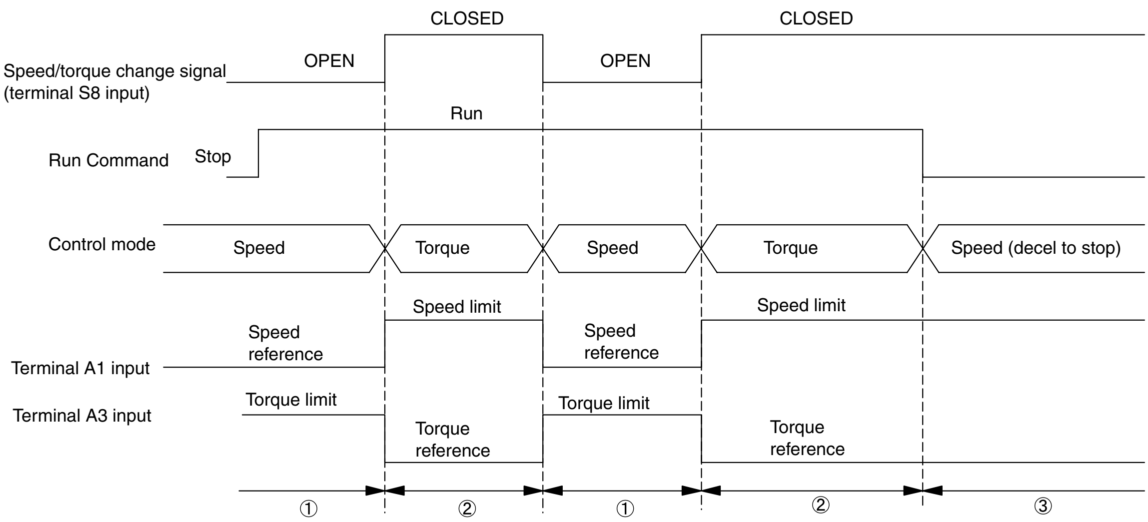


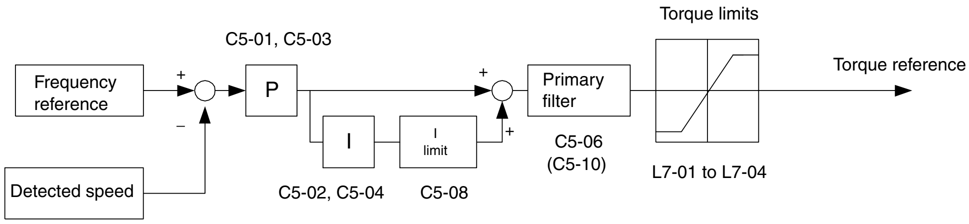
Fig 6.84 Speed/Torque Control Switching Time Chart.

◆ Speed Control (ASR) Structure

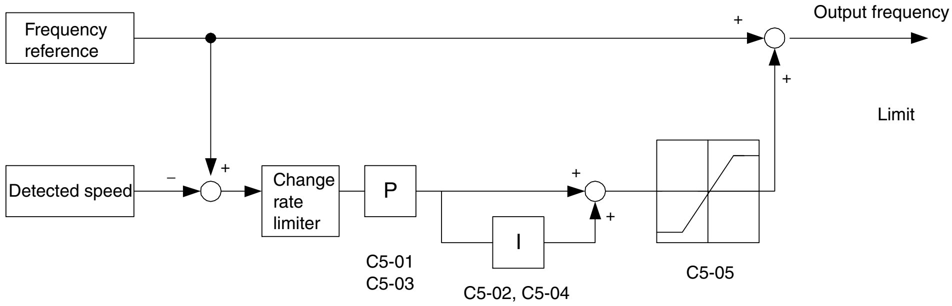
Speed control (ASR) during flux vector control adjusts the torque reference so that the deviation between the speed reference and the estimated speed (PG feedback) is 0.

Speed control (ASR) during V/f control with a PG adjusts the output frequency so that the deviation between the speed reference and the estimated speed (PG feedback) is 0.

The following block diagram shows the structure of the speed control for open-loop vector or V/f control with a PG.



Speed Control Block Diagram for Open-loop Vector Control

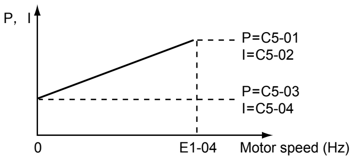


Speed Control Block Diagram for V/f Control with a PG

Fig 6.85 Speed Control Block Diagrams

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
C5-01	ASR proportional (P) gain 1 / ASR P Gain 1	Sets the proportional gain of the speed loop (ASR.)	1.00 to 300.00 *1	20.00 *2	Yes	No	A	No	A	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	0.500 s *2	Yes	No	A	No	A	21CH

Parameter Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
	Display					V/f	V/f with PG	Open Loop Vector	Flux Vector	
C5-03	ASR proportional (P) gain 2 ASR P Gain 2	Usually setting is not necessary. Set to change the rotational speed gain. 	1.00 to 300.00 *1	20.00 *2	Yes	No	A	No	A	21DH
C5-04	ASR integral (I) time 2 ASR I Time 2		0.000 to 10.000	0.500 s *2	Yes	No	A	No	A	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	No	21FH
C5-06	ASR primary delay time ASR Delay Time	Sets the filter time constant for outputting torque references from the speed control loop (ASR). It is set in 1-second units. Usually setting is not necessary.	0.000 to 0.500	0.004 s	No	No	No	No	A	220H
C5-07	ASR switching frequency ASR Gain SW Freq	Sets the frequency for switching between Proportion Gain 1, 2 and Integral Time 1, 2 in Hz units. The multi-function input "ASR switching proportional gain" has the priority.	0.0 to 300.0 *3	0.0 Hz	No	No	No	No	A	221H
C5-08	ASR integral (I) limit ASR I Limit	Sets the upper limit for the integral (I) amount for the speed control loop (ASR) to a percentage of the rated load.	0 to 400	400%	No	No	No	No	A	222H

* 1. When using V/f with PG control, 0.00 to 300.00. The flux vector setting ranges are given.
* 2. When the control method changes, the factory setting is changed. The flux vector control factory settings are given. Refer to *Factory Settings that Change with the Control Method (A1-02)*.
* 3. When C6-01=1, the upper limit is 400.0.

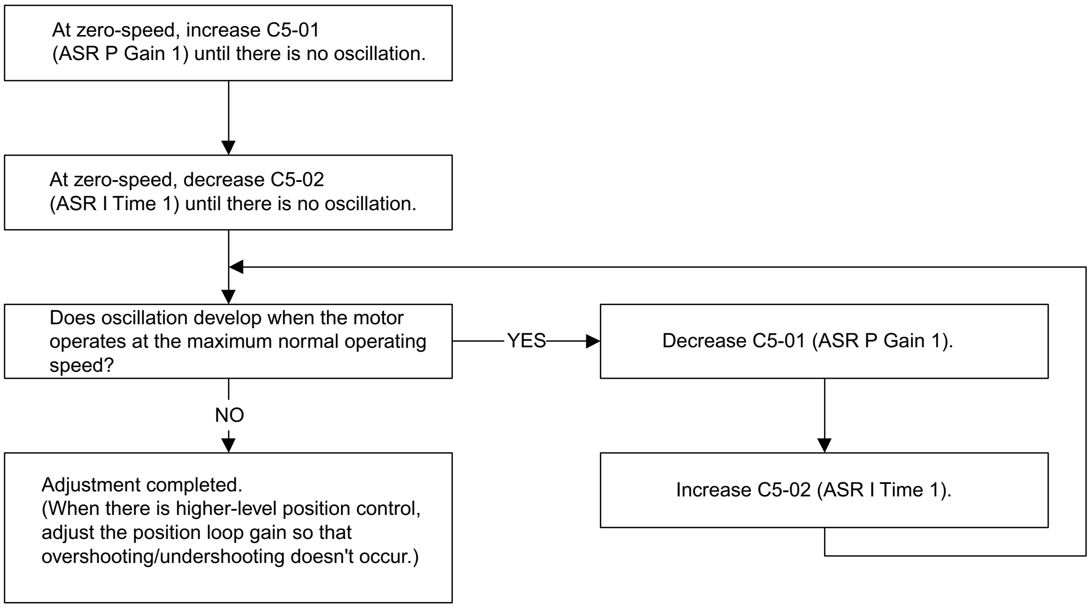
Multi-function Contact Input Functions (H1-01 to H1-06)

Setting Value	Function	Control Methods			
		V/f	V/f with PG	Open Loop Vector	Flux Vector
D	Speed control disable setting for V/f control with PG OFF: Use speed control V/f control with PG ON: Do not use speed control for V/f control with PG	No	Yes	No	No
E	Speed control integral reset Enables switching between PI and P control for the speed control loop.	No	No	No	Yes
77	Speed control (ASR) proportional gain switch (switching between C5-01 and C5-03) OFF: Use proportional gain in C5-01 ON: Use proportional gain in C5-03	No	No	No	Yes

6

■Speed Control (ASR) Gain Adjustment for Flux Vector Control

Use the following procedure to adjust C5-01 and C5-03 with the mechanical system and actual load connected.



Fine Adjustments

When you want even finer gain adjustment, adjust the gain while observing the speed waveform. Parameter settings like those shown in the following table will be necessary to monitor the speed waveform.

Parameter No.	Name	Setting	Explanation
H4-01	Multi-function analog output 1 terminal FM monitor selection	2	Settings that allow multi-function analog output 1 to be used to monitor the output frequency.
H4-02	Multi-function analog output 1 terminal FM output gain	1.00	
H4-03	Multi-function analog output 1 terminal FM bias	0.0	
H4-04	Multi-function analog output 2 terminal AM monitor selection	5	Settings that allow multi-function analog output 2 to be used to monitor the motor speed.
H4-05	Multi-function analog output 2 terminal AM output gain	1.00	
H4-06	Multi-function analog output 2 terminal AM bias selection	0.00	
H4-07	Multi-function analog output 1 terminal signal level selection	1	Settings that allow a −10 to 10 V signal range to be monitored.
H4-08	Multi-function analog output 2 terminal signal level selection	1	

The multi-function analog outputs have the following functions with these parameter settings.

- Multi-function analog output 1 (terminal FM): Outputs Inverter's output frequency (−10 to 10 V).
- Multi-function analog output 2 (terminal AM): Outputs actual motor speed (−10 to 10 V).

Terminal AC is the multi-function analog output common.
We recommend monitoring both the output frequency and the motor speed to monitor the response delay or deviations from the reference value, as shown in the following diagram.

Adjusting ASR Proportional Gain 1 (C5-01)

This gain setting adjusts the responsiveness of the speed control (ASR). The responsiveness is increased when this setting is increased. Usually this setting is higher for larger loads. Oscillation will occur if this setting is increased too much.

The following diagram shows the type of changes that can occur in the response when the ASR proportional gain is changed.

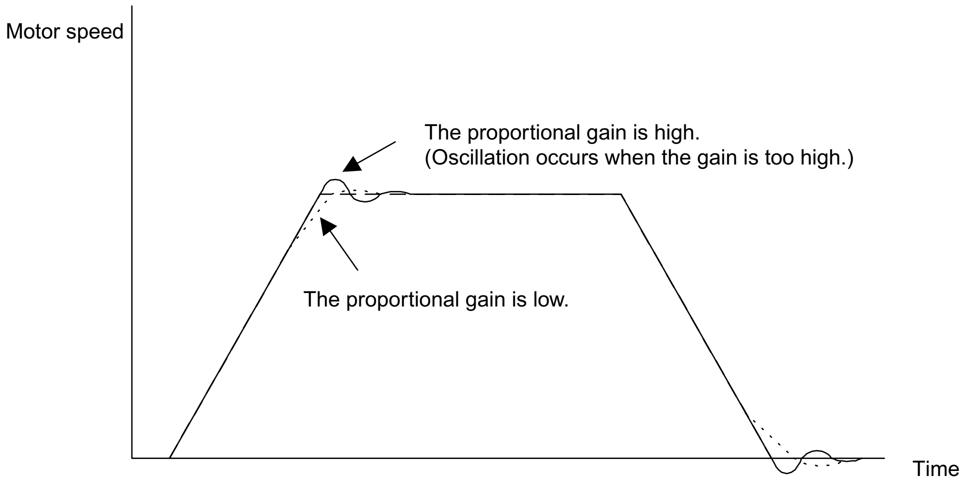


Fig 6.86 Responsiveness for Proportional Gain

Adjusting ASR Integral Time 1 (C5-02)

This parameter sets the speed control (ASR) integral time.

Lengthening the integral time lowers the responsiveness, and weakens the resistance to external influences. Oscillation will occur if this setting is too short. The following diagram shows the type of changes that can occur in the response when the ASR integral time is changed.

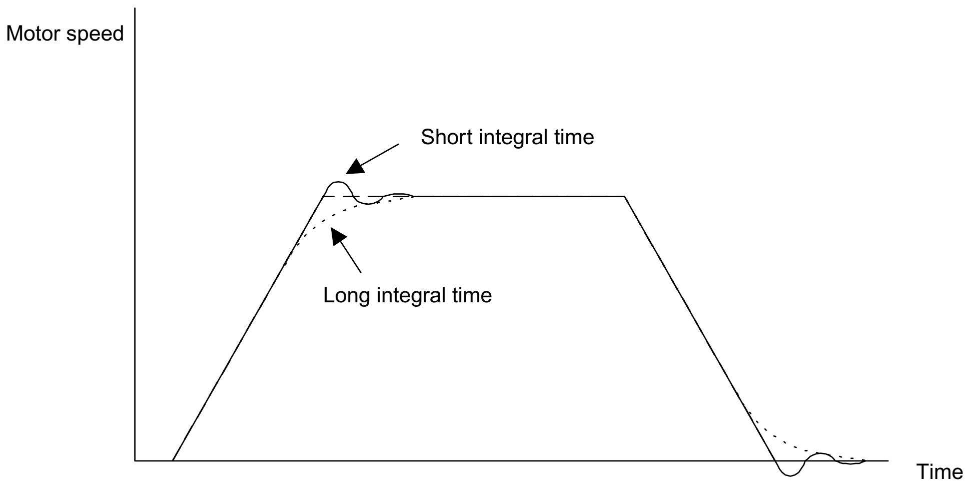


Fig 6.87 Responsiveness for Integral Time

Different Gain Settings for Low-speed and High-speed

Switch between low-speed and high-speed gain when oscillation occurs because of resonance with the mechanical system at low speed or high speed. The proportional gain P and integral time I can be switched according to the motor speed, as shown below.

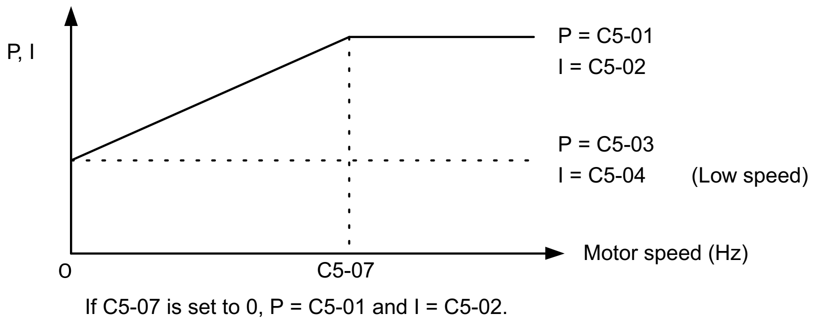


Fig 6.88 Low-speed and High-speed Gain Settings

Setting the Gain Switching Frequency (C5-07)

Set the switching frequency to about 80% of the motor operating frequency or the frequency at which oscillation occurs.

Low-speed Gain Adjustments (C5-03, C5-04)

Connect the actual load and adjust these parameters at zero-speed. Increase C5-03 (ASR proportional gain 2) until there is no oscillation. Decrease C5-04 (ASR integral time 2) until there is no oscillation.

High-speed Gain Adjustments (C5-01, C5-02)

Adjust these parameters at normal operating speed. Increase C5-01 (ASR proportional gain 1) until there is no oscillation. Decrease C5-02 (ASR integral time 1) until there is no oscillation. Refer to *Fine Adjustments* on page 6-172 for details on making fine adjustments of high-speed operation.

ASR Proportional Gain Switch Setting

When one of the multi-function inputs (H1-01 to H1-06) is set to 77, the input can be used to switch between C5-01 (proportional gain 1) and C5-03 (proportional gain 2). Proportional gain 2 is used when the multi-function input is ON. This input has higher priority than the ASR switching frequency set in C5-07.

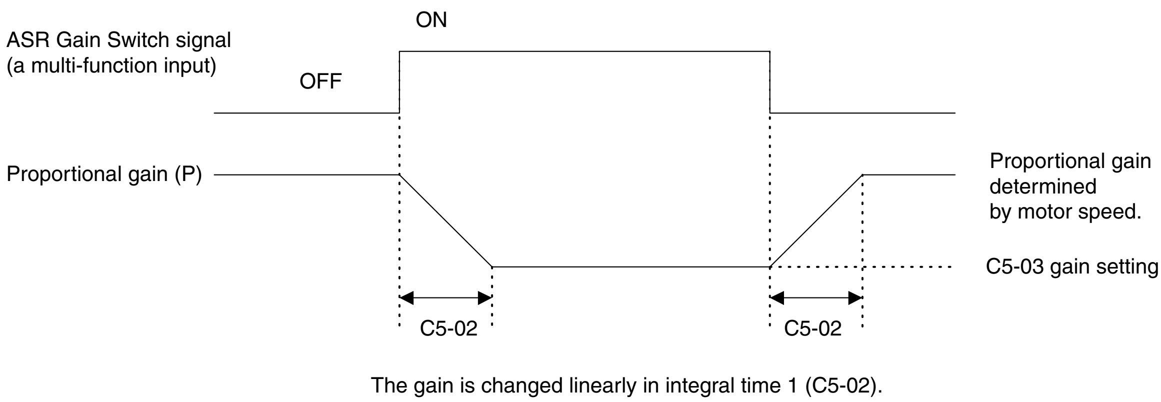


Fig 6.89 ASR Proportional Gain Switch

■Gain Adjustment for Speed Control during V/f Control with PG

When using V/f control with PG, set the proportional gain (P) and the integral time (I) at E1-09 (minimum output frequency) and E1-04 (maximum output frequency). *Fig 6.90 Speed Control Gain Integral Time Adjustment for V/f Control with PG* shows how the proportional gain and integral time change in linear fashion based on the speed.

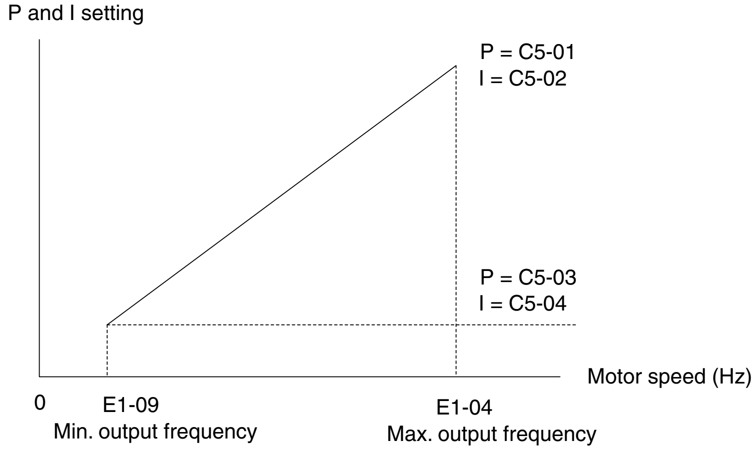


Fig 6.90 Speed Control Gain Integral Time Adjustment for V/f Control with PG

Gain Adjustments at Minimum Output Frequency

Operate the motor at the minimum output frequency. Increase C5-03 (ASR proportional gain 2) to a level where there is no oscillation. Decrease C5-04 (ASR integral time 2) to a level where there is no oscillation.
Monitor the Inverter's output current and verify that it is less than 50% of the Inverter rated current. If the output current exceeds 50% of the Inverter's rated current, decrease C5-03 and increase C5-04.

Gain Adjustments at Maximum Output Frequency

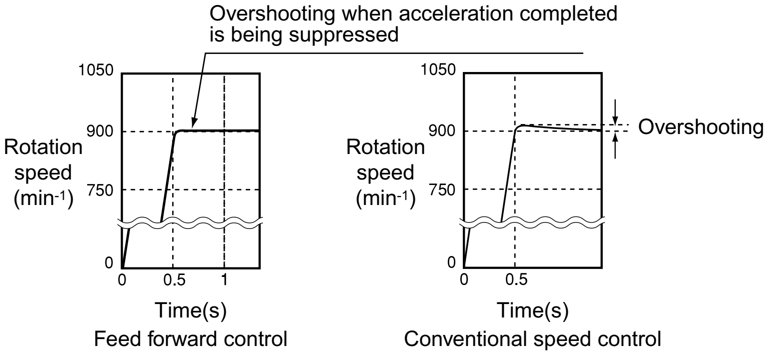
Operate the motor at the maximum output frequency. Increase C5-01 (ASR proportional gain 1) to a level where there is no oscillation. Decrease C5-02 (ASR integral time 1) to a level where there is no oscillation.

Fine Adjustments

When you want even finer gain adjustment, adjust the gain while observing the speed waveform. The adjustment method is the same as that for vector control.
Enable integral operation during acceleration and deceleration (by setting F1-07 to 1) when you want the motor speed to closely follow the frequency reference during acceleration and deceleration. Reduce the setting of C5-01 if overshooting occurs during acceleration, and reduce the setting of C5-03 and increase the setting of C5-04 if undershooting occurs when stopping. If overshooting and undershooting cannot be eliminated by adjusting only the gain, reduce the value of C5-05 speed control and reduce the limit of the frequency reference compensation value.

◆ Increasing the Speed Reference Response (Feed Forward Control)

Use feed forward control to increase the responsiveness to speed references. This function is effective for machines for which the ASR gain cannot be increased to a large value because doing so would result in vibrations. There is also the additional effect of making the system less prone to overshoot.
This function is valid only in flux vector control.



Overshooting control effect

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
N5-01	Feed forward control selection Feed forward	Select the feed forward control. 0: Disabled 1: Enabled	0 or 1	0	No	No	No	No	A	5B0H
N5-02	Motor acceleration time Motor Accel Time	Set the time required to accelerate the motor at the rated torque (T_{100}) to the rated speed (Nr). J: $GD^2/4$, P: Motor rated output $ta = \frac{2\pi \cdot J\,[kgm^2] \cdot Nr\,[min^{-1}]}{60 \cdot T_{100}\,[N \cdot m]}\,[s]$ However, $T_{100} = \frac{60}{2\pi} \cdot \frac{P\,[kW]}{Nr\,[min^{-1}]} \times 10^3\,[N \cdot m]$	0.001 to 10.000	0.178 s *	No	No	No	No	A	5B1H
N5-03	Feed forward proportional gain Feed forward Gain	Set the proportional gain for feed forward control. Speed reference response will increase as the setting of N5-03 is increased.	0.00 to 100.00	1.0	No	No	No	No	A	5B2H
N5-04	Response frequency for speed command Spd Response F	Sets the response frequency to a speed command in units of 0.01 Hz. Used when the machine rigidity is high and the N5-03 is correctly adjusted. Usually, setting is not required.	0.00 to 50.00	40.00 Hz	No	No	No	No	A	5B3H

* The factory setting depends on the Inverter capacity. The value for a 200 V Class Inverter for 0.4 kW is given.

■Feed Forward Control Structure

- The following block diagram shows the speed controller (ASR) and the feed forward control structure.

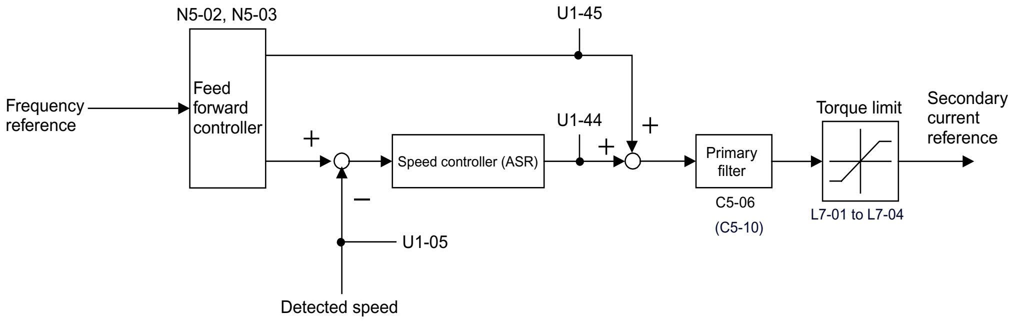


Fig 6.91 Structure of Speed Controller (ASR) and Feed Forward Control

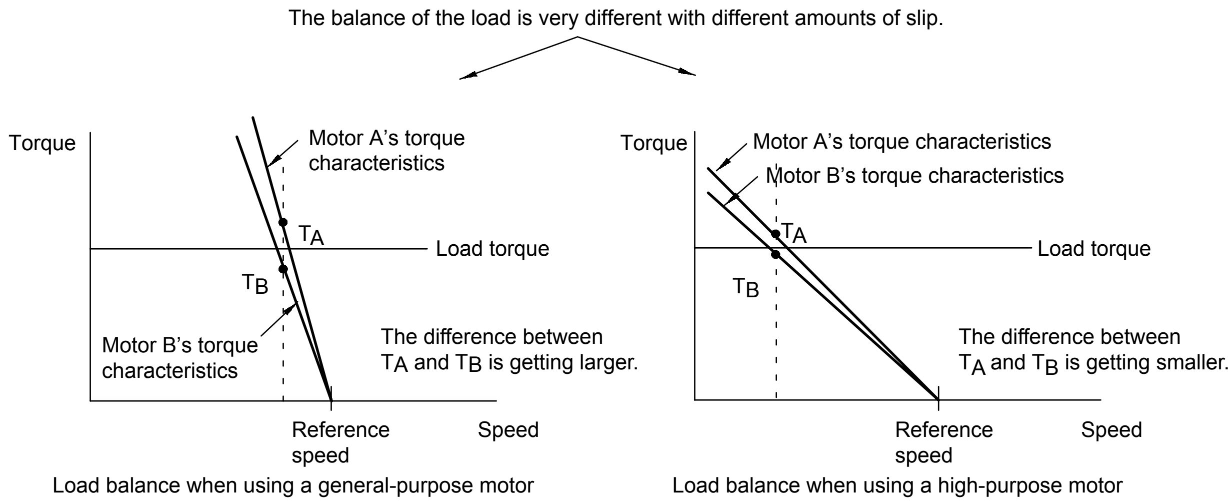
■Setting Precautions

- When N5-02 (Motor acceleration time) is not properly set, the acceleration time may not increase. The factory setting of N5-02 depends on the Inverter capacity. When the Inverter capacity is different from the motor capacity, calculate an appropriate acceleration time using the equation given in N5-02 of *Chapter 5 User Parameters* or set the time that corresponds to the motor capacity referring to *Factory Settings that Change with the Control Method (A1-02)* (Page 5-85)
- When setting the feed forward proportional gain (N5-03), take the inertia of the motor to be equivalent to 1. If the speed reference response is slow, increase the feed forward proportional gain (N5-03). If overshoot occurs with the actual speed, or if a negative torque reference is output when acceleration is completed, reduce the feed forward proportional gain (N5-03).
- When using the droop control function (i.e., if b7-01 is not set to 0.0), disable feed forward control (i.e., set N5-01 to 0).

6

◆ Droop Control Function

Droop control is a function that allows the user to set the amount of motor slip.
When a single load is operated with two motors (such as in a crane conveyor), a high-resistance motor is normally used. This is to use torque characteristics that exhibit proportion movements due to changes in the secondary resistor to maintain torque balance with the load and overall speed balance with the load.
If droop control is used, a high-resistance motor characteristics can be set for a general-purpose motor.



■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
b7-01	Droop control gain Droop Quantity	Sets the slip as a percentage of maximum frequency when the maximum output frequency is specified and the rated torque occurs. Droop-control is not performed when the setting is 0.0.	0.0 to 100.0	0.0	Yes	No	No	No	A	1CAH
b7-02	Droop control delay time Droop Delay Time	Droop control responsiveness parameter When hunting or oscillation occurs, increase the value.	0.03 to 2.00	0.05 s	Yes	No	No	No	A	1CBH

■Setting Precautions

- Droop control is disabled if b7-01 is set to 0.0.
- Set b7-01 to the amount of slip as the percentage of slip when the maximum output frequency is input and the rated torque is generated.
- Parameter b7-02 is used to adjust the responsiveness of droop control. Increase this setting if oscillation or hunting occur.
- Disable the feed forward control (N5-01 = 0) when using the droop control function.

■Setting the Droop Control Gain

Set the droop control gain as the speed reduction at a 100% motor torque, as a percentage of the maximum output frequency.

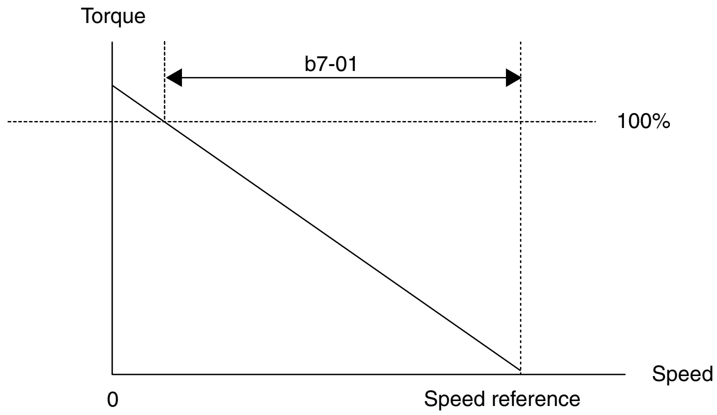


Fig 6.92 Droop Control Gain

◆ Zero-servo Function

The zero-servo function holds the motor when the motor is stopped in what is call a zero-servo status. This function can be used to stop the motor even with an external force acts on the motor or the analog reference input is offset.

The zero-servo function is enabled when one of the multi-function inputs (H1-01 to H1-06) is set to 72 (zero-servo command). If the zero-servo command is ON when the frequency (speed) reference falls below the zero-speed level, a zero-servo status is implemented.

■Related Parameters

Param-eter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Opera-tion	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vec-tor	Regis-ter
b2-01	Zero-speed level (DC injection braking starting fre-quency) 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 is used to set the starting frequency for the DC injection braking. In flux vector control, b2-01 is used to set the starting fre-quency for the zero-speed control.	0.0 to 10.0	0.5 Hz	No	A	A	A	A	189H
b9-01	Zero-servo gain Zero Servo Gain	Adjust the strength of the zero-servo lock. Enabled when the “zero-servo command” is set for the multi-function input. When the zero-servo com-mand has been input and the frequency reference drop below excitation level (b2-01), a position control loop is created and the motor stops. Increasing the zero-servo gain in turn increases the strength of the lock. Increasing it by too much will cause oscillation.	0 to 100	5	No	No	No	No	A	1DAH

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
b9-02	Zero-servo completion width Zero Servo Count	Sets the output width of the zero-servo completion signal. Enabled when the "zero-servo completion (end)" is set for a multi-function input. The zero-servo completion signal is ON when the current position is within the range (the zero-servo start position± zero-servo completion width.) Set the allowable position displacement from the zero-servo start position to 4 times the pulse rate of the PG (pulse generator, encoder) in use.	0 to 16383	10	No	No	No	No	A	1DBH

Multi-function Contact Input Functions (H1-01 to H1-06)

Setting Value	Function	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector
72	Zero-servo command (ON: Zero-servo)	No	No	No	Yes

Multi-function Contact Output Functions (H2-01 to H2-03)

Setting Value	Function	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector
33	Zero-servo end ON: Current position is within zero-servo start position ± the zero-servo end width.	No	No	No	Yes

To output the zero-servo status externally, assign the Zero-Servo End signal (setting 33) to one of the multi-function outputs (H2-01 to H2-03).

Monitor Function

Parameter Number	Name / Display	Description	Output Signal Level During Multi-Function Analog Output	Min. Unit	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
U1-35	Zero-servo movement pulses Zero Servo Pulse	Shows the number of PG pulses times 4 for the movement range when stopped at zero.	(Cannot be output.)	1	No	No	No	A	62H

■Time Chart

A time chart for the zero-servo function is given in *Fig 6.93 Time Chart for Zero-Servo*.

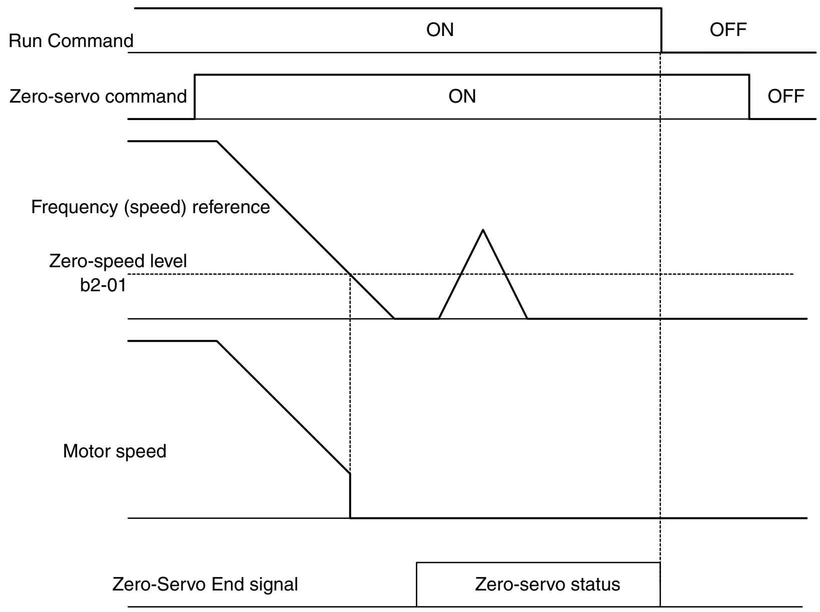


Fig 6.93 Time Chart for Zero-Servo

■Application Precautions

- Be sure to leave the Run Command input ON. If the Run Command is turned OFF, the output will be interrupted and the zero-servo function will become ineffective.
- The holding force of the zero-servo is adjusted in b9-01. The holding force will increase if the value of the setting is increased, but oscillation and hunting will occur if the setting is too large. Adjust b9-01 after adjusting the speed control gain.
- The zero-servo detection width is set as the allowable position offset from the zero-servo start position. Set 4 times the number of pulses from the PG.
- The Zero-Servo End signal will go OFF when the zero-servo command is turned OFF.

IMPORTANT

Do not lock the servo for extended periods of time at 100% when using the zero-servo function. Inverter errors may result. Extended periods of servo lock can be achieved by ensuring that the current during the servolock is 50% or less or by increasing the Inverter capacity.

6

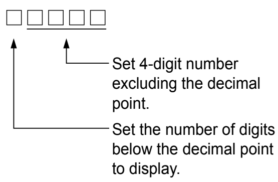
Digital Operator Functions

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

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
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	A	501H
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: min^{-1} units (Sets the motor poles.) 40 to 39999: User desired display Set the desired values for setting and display for the max. output frequency.  Example: When the max. output frequency value is 200.0, set 12000	0 to 39999	0	No	A	A	A	A	502H
o1-04	Setting unit for frequency parameters related to V/f characteristics Display Units	Set the setting unit for frequency reference-related parameters. 0: Hz 1: min^{-1}	0 or 1	0	No	No	No	No	A	503H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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	A	505H
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	A	506H
o2-03	User 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	A	507H
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	A	509H
o2-07	Cumulative operation time setting Elapsed Time Set	Sets the cumulative operation time in hour units. Operation time is calculated from the set values.	0 to 65535	0 hr	No	A	A	A	A	50BH
o2-10	Fan operation time setting Fan ON Time Set	Set the initial value of the fan operation time using time units. The operation time accumulates from the set value.	0 to 65535	0 hr	No	A	A	A	A	50EH

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

6

■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 User 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).

◆ 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

Parameter Number	Name LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
						V/f	V/f with PG	Open Loop Vector	Flux Vector	
o3-01	Copy function selection Copy Func Select	0: Normal operation 1: READ (Inverter to Operator) 2: COPY (Operator to Inverter) 3: Verify (compare)	0 to 3	0	No	A	A	A	A	515H
o3-02	Read permitted selection Copy Allowable	0: Read prohibited 1: Read permitted	0 or 1	0	No	A	A	A	A	516H

■COPY Function Selection

The available COPY functions (o3-01 “Copy function selection”) differ depending on the version of Inverter as shown in the table below.

READ Source	Inverter model without “-V1” (PRG:101□)	Inverter model without “-V1” (PRG:101□)	Inverter model with “-V1” (PRG:103□)	Inverter model with “-V1” (PRG:103□)
COPY Destination	Inverter model without “-V1” (PRG:101□)	Inverter model with “-V1” (PRG:103□)	Inverter model without “-V1” (PRG:101□)	Inverter model with “-V1” (PRG:103□)
READ (Inverter → Operator)	Available	Available	Available	Available
READ (Inverter → Operator)	Available	Available*	N/A	Available
VERIFY	Available	N/A	N/A	Available

* The initial values of user parameters that have been stored using the parameter o2-03 cannot be copied.

■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 03-02 (Read permitted selection) to 1 (read permitted).

Table 6.5 READ Function Procedure

Step No.	Digital Operator Display	Explanation
1	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the Menu Key, and select advanced programming mode.
2	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the DATA/ENTER Key, and select the parameters monitor display.
3	o3-01 DRIVE QUICK ADV VERIFY A.TUNE	Display o3-01 (Copy Function Selection) using the Increment Key and Decrement Key.
4	00 DRIVE QUICK ADV VERIFY A.TUNE	Press the DATA/ENTER Key, and select the parameters setting display.
5	01 DRIVE QUICK ADV VERIFY A.TUNE	Change the set value to 1 using the Increment Key.
6	rEd DRIVE QUICK ADV VERIFY A.TUNE	Set the changed data using the DATA/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 6.6 COPY Function Procedure

Step No.	Digital Operator Display	Explanation
1	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the MENU Key, and select advanced programming mode.
2	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the DATA/ENTER Key, and select the parameters monitor display.
3	o3-01 DRIVE QUICK ADV VERIFY A.TUNE	Display o3-01 (Copy Function Selection) using the Increment Key and Decrement Key.
4	00 DRIVE QUICK ADV VERIFY A.TUNE	Press the DATA/ENTER Key, and select the parameters setting display.
5	02 DRIVE QUICK ADV VERIFY A.TUNE	Change the set value to 2 using the Increment Key.
6	CPY DRIVE QUICK ADV VERIFY A.TUNE	Set the changed data using the DATA/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.
vAE	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 6.7 VERIFY Function Procedure

Step No.	Digital Operator Display	Explanation
1	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the MENU Key. and select advanced programming mode.
2	A1-00 DRIVE QUICK ADV VERIFY A.TUNE	Press the DATA/ENTER Key, and select the parameters monitor display.
3	o3-01 DRIVE QUICK ADV VERIFY A.TUNE	Display o3-01 (Copy Function Selection) using the Increment Key and Decrement Key.
4	00 DRIVE QUICK ADV VERIFY A.TUNE	Press the DATA/ENTER Key, and select the function setting display.
5	03 DRIVE QUICK ADV VERIFY A.TUNE	Change the set value to 3 using the Increment Key.
6	vFY DRIVE QUICK ADV VERIFY A.TUNE	Set the changed data using the DATA/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
vYE	Verify error (Settings in the Digital Operator and the Inverter do not match).
CPE	Inverter product code and Inverter software number are different.

■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
- Use the copy function off-line or with a communications option board removed.
- A CPF03 fault (EEPROM error) can occur if the power is shut down while the Inverter parameters are being copied. Do not shut down the power while copying the parameters.

◆ 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 H1-06 (multi-function contact input terminal S3 to S8 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.

Parameter Number	Name Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
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 user 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	A	101H

◆ 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

Parameter Number	Name	Description	Setting Range	Factory Setting	Change during Operation	Control Methods				Register
	Display					V/f	V/f with PG	Open Loop Vector	Flux Vector	
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 user 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	A	101H
A1-04	Password Enter 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	A	104H
A1-05	Password setting Select Password	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 password will be displayed.	0 to 9999	0	No	A	A	A	A	105H

■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 parameters) 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

Parameter Number	Name / LCD Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
A2-01 to A2-32	User setting parameters / User Param 1 to 32	Used to set the parameter numbers that can be set/read. Maximum 32. Effective when the Parameter 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.	b1-01 to o3-02	-	No	A	A	A	A	106H to 125H

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Options

This section explains the Inverter option functions.

◆ Performing Speed Control with PG

This section explains functions with V/f control with PG and flux vector control.

■Related Parameters

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	V/f with PG	Open Loop Vector	Flux Vector	Register
F1-01	PG parameter 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	No	No	Q	No	Q	380H
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	A	381H
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 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	A	382H

Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
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	A	383H
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	A	384H
F1-06	PG division rate (PG pulse monitor) PG Output Ratio	Sets the division ratio for the PG speed control board pulse output. Division ratio = (1+ n) /m (n=0 or 1 m=1 to 32) F1-06 = □ □□ (n, m) This parameter is only effective when a 3G3FV-PPGB2 is used. The possible division ratio settings are: 1/32 ≤ F1-06 ≤ 1.	1 to 132	1	No	No	A	No	A	385H
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 parameter speeds.) 1: Enabled (The integral function is used at all times.)	0 or 1	0	No	No	A	No	No	386H

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Parameter Number	Name / Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
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	A	387H
F1-09	Overspeed detection delay time PG Over-spd Time		0.0 to 2.0	0.0 s *	No	No	A	No	A	388H
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	A	389H
F1-11	Excessive speed deviation detection delay time PG Deviate Time		0.0 to 10.0	0.5 s	No	No	A	No	A	38AH
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	No	38BH
F1-13	Number of PG gear teeth 2 PG# Gear Teeth2			0	No	No	A	No	No	38CH
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	A	38DH

* The factory setting will change when the control method is changed. The flux vector control factory setting is given.

■Using PG Speed Control Board

There are four types of PG Speed Control Board 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.

There are two types of PG Speed Control Boards that can be used for flux vector control.

- 3G3FV-PPGB2: A/B phase pulse inputs, complementary outputs
- 3G3FV-PPGX2: A/B/Z phase pulse inputs, line driver outputs

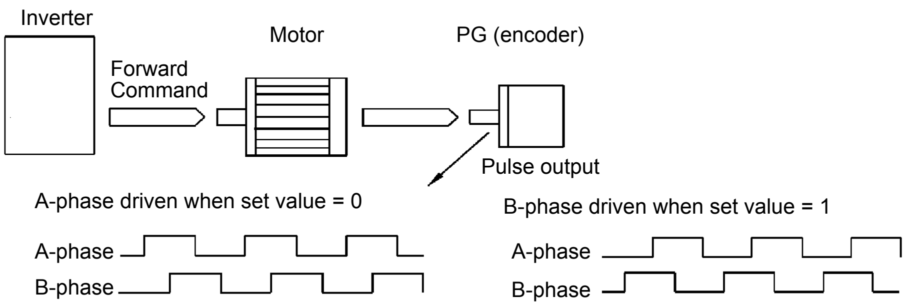
For the connection diagram, refer to page 2-38 to 2-37.

■Setting Number of PG Pulses

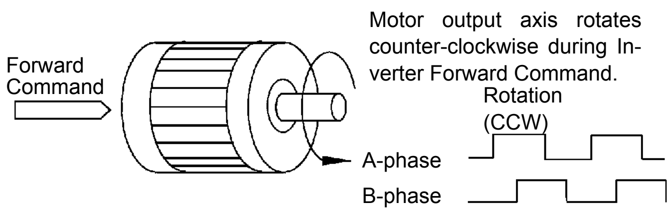
Set the number of PG (Pulse Generator/Encoder) pulses in pulses/rotation. Set the number of A-phase or B-phase pulses per 1 motor rotation in F1-01.

■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: Samtack (KK))



Yaskawa standard PG used is A-phase driven (CCW) when motor rotation is forward.

Fig 6.94 PG Rotation Direction Setting

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.

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■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 speed of motor rotations within the Inverter is calculated using the following formula.

Speed of motor rotations (min^{-1}.) = No. of input pulses from PC × 60 / F1-01 × 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 when using V/f with PG control.

To match the motor speed as closely as possible to the frequency reference even during acceleration and deceleration, set F1-07 to 1.

IMPORTANT

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.

■Setting PG Pulse Monitor Output Dividing Ratio

This function is enabled only when using PG speed control board 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 = $\underbrace{\square}_{n}\ \underbrace{\square\square}_{m}$

The dividing ratio can be set within the following range: 1/32 ≤ 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

Select the stopping method when PG cable disconnected is detected and the PG open circuit (PGO) detection time.

When the Inverter is operating with the frequency reference set to 1% minimum (except when operating on direct current), if the speed feedback from PG is greater than the time setting in F1-14, PGO is detected.

■Detecting Motor Overspeed

An error is detected when the number of motor rotations exceeds the regulated limit. An overspeed (OS) is detected when a 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.

◆ Using an Analog Reference Board

3G3IV-PAI14B provides 3 channels of bi-polar inputs with 13-bit A/D conversion accuracy (and a + sign bit). The function of each channel is determined by the setting of F2-01.

3G3IV-PAI14U provides 2 channels of bi-polar inputs with 14-bit A/D conversion accuracy. Channel 1 is a voltage input and channel 2 is a current input. The sum of channels 1 and 2 is a frequency input. F2-01 does not need to be set for the 3G3IV-PAI14U.

■Related Parameters

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 Vector	Control Methods: Flux Vec-tor	Regis-ter
F2-01	Bi-polar or uni-polar input selec-tion A1-14 Input Sel	Sets the functions for chan-nel 1 to 3 which are effective when the 3G3IV-PAI14B Analog Reference Board is used. 0: 3-channel individual (Channel 1: terminal A1, Channel 2: terminal A2, Channel 3: terminal A3) 1: 3-channel addition (Addi-tion values are the fre-quency reference) When set to 0, select 1 for b1-01. In this case the multi-function input “Option/ Inverter selection” cannot be used.	0 or 1	0	No	A	A	A	A	38FH

■Setting Precautions

Always set b1-01 (Reference selection) to 1 (control circuit terminal) when using the 3G3IV-PAI14B for three channels of independent inputs. When this is done, H1-01 to H1-06 (multi-function contact inputs) cannot be set to 2 (Option/Inverter selection).

◆ Using a Digital Reference Board

When using a 3G3IV-PDI08 or 3G3IV-PDI16H2 Digital Reference Board, set b1-01 (Reference selection) to 3 (Option Board).

The 3G3IV-PDI16H2 can be used to set a frequency using a 16-bit digital reference. The 3G3IV-PDI08 can be used to set a frequency using a 8-bit digital reference.

■Related Parameters

Parameter Number	Name	Display	Description	Setting Range	Factory Setting	Change during Operation	Control Methods: V/f	Control Methods: V/f with PG	Control Methods: Open Loop Vector	Control Methods: Flux Vector	Register
F3-01	Digital input option	DI Input	Sets the Digital Reference Board input method. 0: BCD 1% unit 1: BCD 0.1% unit 2: BCD 0.01% unit 3: BCD 1 Hz unit 4: BCD 0.1 Hz unit 5: BCD 0.01 Hz unit 6: BCD special setting (5-digit input) 7: Binary input 6 is only effective when the 3G3IV-PDI16H2 is used. When o1-03 is set to 2 or higher, the input will be BCD, and the units will change to the o1-03 setting.	0 to 7	0	No	A	A	A	A	390H
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: min^{-1} 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	A	502H

■Selecting Input Terminal Functions for the 3G3IV-PDI16H2 Digital Reference Board

The frequency reference from the 3G3IV-PDI16H2 Board is determined by the setting of F3-01 and the 12/16-bit switch on the option board. The possible settings are listed in the following table.

Terminal	Pin No.	12-bit Binary with Sign F3-01 = 7 S1: 12 bit	16-bit Binary with Sign F3-01 = 7 S1: 16 bit	3-digit BCD with Sign F3-01 = 0 to 5 S1: 12 bit		4-digit BCD with Sign F3-01 = 0 to 5 S1: 16 bit		5-digit BCD without Sign F3-01 = 6 S1: 16 bit	
TC1	1	Bit 1 (2^0)	Bit 1 (2^0)	1	BDC digit 1 (0 to 9)	1	BDC digit 1 (0 to 9)	2	BDC digit 1 (0, 2, 4, 8)
	2	Bit 1 (2^1)	Bit 1 (2^1)	2		2		4	
	3	Bit 1 (2^2)	Bit 1 (2^2)	4		4		8	
	4	Bit 1 (2^3)	Bit 1 (2^3)	8		8		1	BDC digit 2 (0 to 9)
	5	Bit 1 (2^4)	Bit 1 (2^4)	1	BDC digit 2 (0 to 9)	1	BDC digit 2 (0 to 9)	2	
	6	Bit 1 (2^5)	Bit 1 (2^5)	2		2		4	
	7	Bit 1 (2^6)	Bit 1 (2^6)	4		4		8	
	8	Bit 1 (2^7)	Bit 1 (2^7)	8		8		1	BDC digit 3 (0 to 9)
	9	Bit 1 (2^8)	Bit 1 (2^8)	1	BDC digit 3 (0 to 9)	1	BDC digit 3 (0 to 9)	2	
	10	Bit 1 (2^9)	Bit 1 (2^9)	2		2		4	
TC2	1	Bit 1 (2^{10})	Bit 1 (2^{10})	4		4		8	
	2	Bit 1 (2^{11})	Bit 1 (2^{11})	8		8		1	BDC digit 4 (0 to 9)
	3	-	Bit 1 (2^{12})		-	1	BDC digit 4 (0 to 9)	2	
	4	-	Bit 1 (2^{13})		-	2		4	
	5	-	Bit 1 (2^{14})		-	4		8	
	6	-	Bit 1 (2^{15})		-	8		1	BDC digit 5 (0 to 3)
	7	Sign signal (0: Forward, 1: Reverse)						2	
	8	SET (read) signal (1: Read)							
	9	Input signal common (0 V)							
TC3		Shield wire connection terminal							

■Application Precautions

- The maximum frequency (100% speed) reference will be used when the binary input is set (setting: 6 or 7) and all bits are 1.
- Setting F3-01 to 6 is valid only when the 3G3IV-PDI16H2 is used. Using this setting, a frequency from 0.00 to 399.8 Hz can be set in BCD. The sign bit is used as a data bit, so only positive (plus) data can be set. Also, the digit starts from 0, so the minimum setting is 0.02 Hz.

6

■Selecting the Input Terminal Function for a 3G3IV-PDI08 Digital Reference Board

The frequency reference from a 3G3IV-PDI08 Board is determined by the setting of F3-01, as shown in the following table.

Terminal	Pin No.	8-bit Binary with Sign	2-digit BCD with Sign	
		F3-01 = 7	F3-01 = 0 to 5	
TC	1	Bit 1 (2^0)	1	BDC digit 1 (0 to 9)
	2	Bit 1 (2^1)	2	
	3	Bit 1 (2^2)	4	
	4	Bit 1 (2^3)	8	
	5	Bit 1 (2^4)	1	BDC digit 2 (0 to 15)
	6	Bit 1 (2^5)	2	
	7	Bit 1 (2^6)	4	
	8	Bit 1 (2^7)	8	
	9	Sign signal		
	10	SET (read) signal		
	11	Reference common signal (0 V)		

■Application Precautions

The 3G3IV-PDI08 will not function if F3-01 is set to 6.

■Selecting the Digital Reference

The range of the digital references is determined by the combination of the settings of o1-03 and F3-01. The information monitored in U1-01 (Frequency reference) will also change.

3G3IV-PDI16H2 Reference Ranges

When using the 3G3IV-PDI16H2, the following ranges can be set depending on the settings of the parameters.

o1-03	F3-01	Switch S1	Reference Input Mode	Reference Setting Range	U1-01 Monitor Unit	
					o1-03 = 0	o1-03 = 1
0 or 1	0	12 bits	3-digit BCD with sign, 1%	-110 to 110%	0.01 Hz	0.01%
		16 bits	4-digit BCD with sign, 1%	-110 to 110%		
	1	12 bits	3-digit BCD with sign, 0.1%	-110.0 to 110.0%		
		16 bits	4-digit BCD with sign, 0.1%	-110.0 to 110.0%		
	2	12 bits	3-digit BCD with sign, 0.01%	-15.99 to 15.99%		
		16 bits	4-digit BCD with sign, 0.01%	-110.0 to 110.0%		
	3	12 bits	3-digit BCD with sign, 1 Hz	-400 to 400 Hz		
		16 bits	4-digit BCD with sign, 1 Hz	-400 to 400 Hz		
	4	12 bits	3-digit BCD with sign, 0.1 Hz	-159.9 to 159.9 Hz		
		16 bits	4-digit BCD with sign, 0.1 Hz	-400.0 to 400.0 Hz		
	5	12 bits	3-digit BCD with sign, 0.01 Hz	-15.99 to 15.99 Hz		
		16 bits	4-digit BCD with sign, 0.01 Hz	-159.99 to 159.99 Hz		
	6	16 bits	5-digit BCD without sign, 0.01 Hz	000.00 to 399.98 Hz		
	7	12 bits	12-bit binary with sign, 100%/4095	-4095 to 4095		
		16 bits	16-bit binary with sign, 100%/30000	-33000 to 33000		
2 to 39	-	12 bits	3-digit BCD with sign, 1 rpm	-1599 to 1599 rpm	1 rpm	
		16 bits	4-digit BCD with sign, 1 rpm	-15999 to 15999 rpm	1 rpm	
x0040 to x9999 (x = 0 to 3)	-	12 bits	3-digit BCD with sign, 100%/(1- to 4-digit setting of o1-03)	-1599 to 1599	5th digit of o1-03 setting: X = 0, unit: 1 X = 1, unit: 0.1 X = 2, unit: 0.01 X = 3, unit: 0.001	
	-	16 bits	4-digit BCD with sign, 100%/(1- to 4-digit setting of o1-03)	-9999 to 9999 (when o1-03 = 9999)		
x1000 (x = 1 to 3)	-	16 bits	4-digit BCD with sign, 100%/10000	-1000 to 1000		

6

3G3IV-PDI08 Reference Ranges

When using the 3G3IV-PDI08, the following ranges can be set depending on the settings of the parameters.

F3-01	Reference Input Mode	Reference Setting Range	U1-01 Monitor Unit	
			o1-03 = 0	o1-03 = 1
0	2-digit BCD with sign, 1%	-110 to 110%	0.01 Hz	0.01%
1	2-digit BCD with sign, 0.1%	-15.9 to 15.9%		
2	2-digit BCD with sign, 0.01%	-1.59 to 1.59%		
3	2-digit BCD with sign, 1 Hz	-159 to 159 Hz		
4	2-digit BCD with sign, 0.1 Hz	-15.9 to 15.9 Hz		
5	2-digit BCD with sign, 0.01 Hz	-1.59 to 1.59 Hz		
6	-			
7	8-bit binary with sign, 100%/255	-255 to 255		

Using Inverters for Elevating Machines

This section describes precautions to be observed when using the 3G3RV-V1 for elevating machines such as elevators and cranes.

◆ Brake ON/OFF Sequence

■Brake ON/OFF Sequence

For the holding brake's ON/OFF sequence, use the following Inverter output signals according to the set control method.

Control Method	Brake ON/OFF Signal		Brake ON/OFF Level Adjustment	
	Signal Name	Parameter *1	Signal Name	Parameter
V/f (A1-02 = 0, factory setting) V/f with PG (A1-02 = 1) Open-loop vector (A1-02 = 2)	Frequency detection 2	H2-01 = 05 *4	• Speed agree detection level • Speed agree detection width	• L4-01 = 1.0 to 3.0 Hz *2 • L4-02 = 0.1 to 0.5 Hz *3
	Frequency detection 5	H2-01 = 36 *4		
Flux vector (A1-02 = 3)	During run 2	H2-01 = 37	Zero-speed level (OFF timing only)	b2-01 = 0.1 to 0.5 Hz

* 1. This example shows multi-function output terminals M1-M2 used for the holding brake ON/OFF signal. Do not set H2-01 to 0 (During run).

* 2. This is the standard setting range for open-loop vector control. For V/f control, set to approximately the motor rated slip frequency +0.5 Hz. If the set value is too low, the motor torque is insufficient and the load may slip when the brake is applied. Be sure to set L4-01 to a value larger than that of E1-09 (Min. output frequency) and larger than that of L4-02 shown in Figure 6.95. If the set value is too large, the motor may not run smoothly when it starts running.

* 3. The hysteresis in frequency detection 2 can be adjusted (from 0.1 to 0.5 Hz) by L4-02 (speed agree detection width). Change the setting to approximately 0.1 Hz if there are drops while stopping.

* 4. When using frequency detection 2, set L4-01 before H2-01. If H2-01 is set before L4-01, the holding brake will engage while stopping. Use frequency detection 5 in which a holding brake signal is OFF when the Inverter is baseblocked.

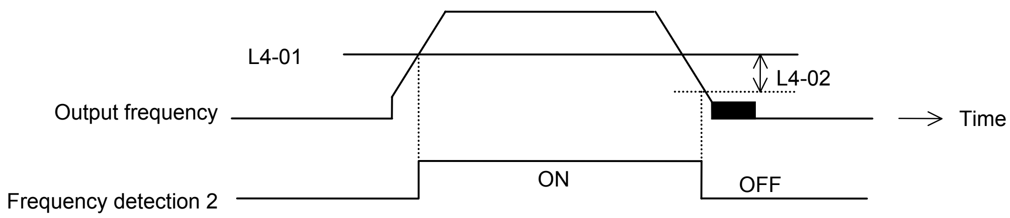
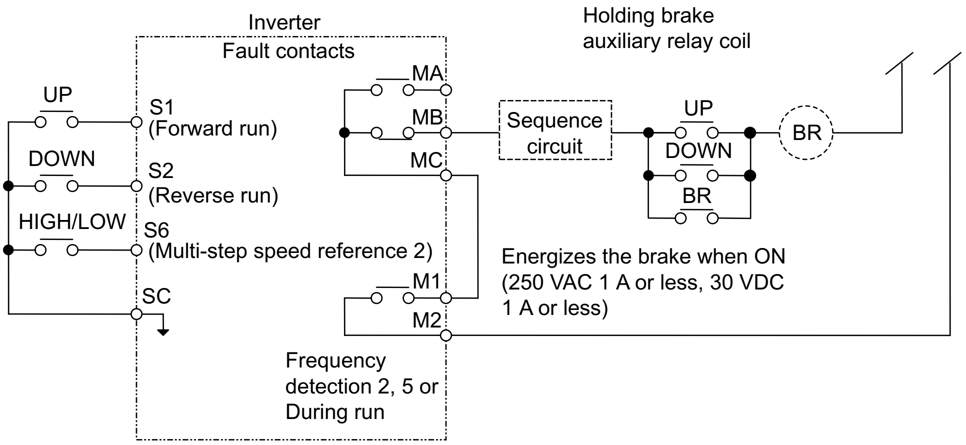


Fig 6.95

■Sequence Circuit Configuration

The brake ON/OFF sequence circuit configuration is shown below.

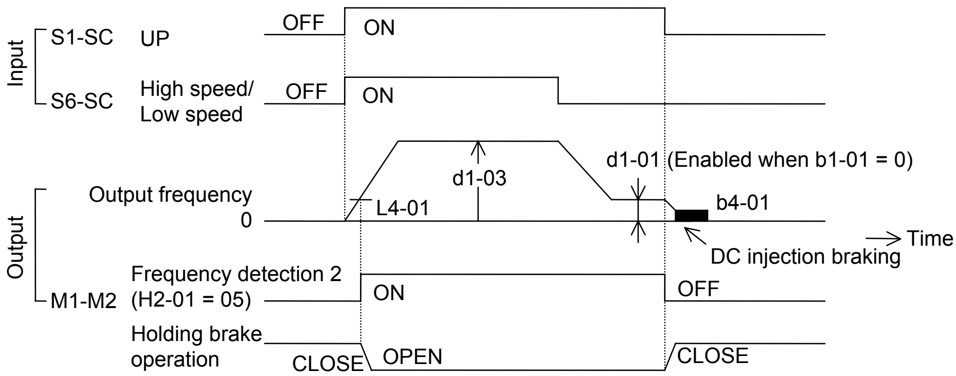


Note Design the sequence so that the holding brake contact is open when the sequence operation conditions are satisfied and the contact between M1 and M2 is closed (ON).
Make sure that the holding brake contact is closed when the emergency stop signal or Inverter fault contact output signal is ON.
Also, make sure that the holding brake is released when an up/down command is issued (ON.)

Fig 6.96 Brake ON/OFF Sequence Circuit Configuration

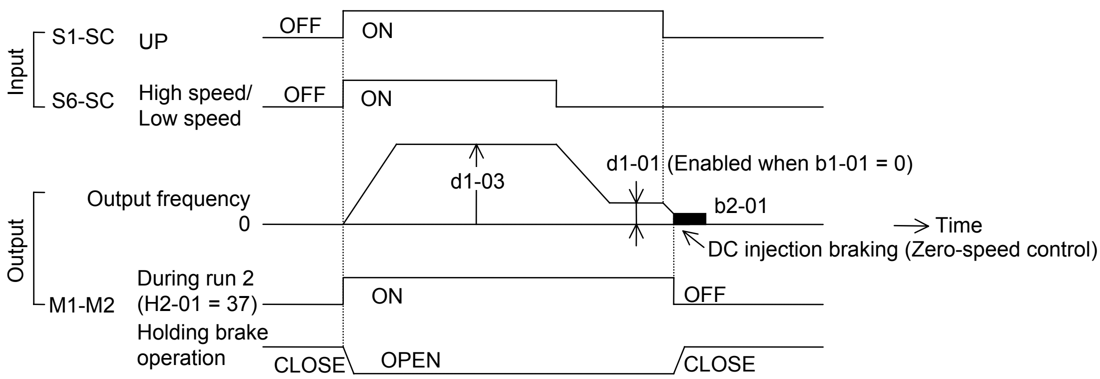
■Time Chart

The brake ON/OFF sequence time charts are shown in Figs. 6.97 and 6.98.



Note For variable speed operation by an analog signal, set to b1-01 = 1.

Fig 6.97 Brake ON/OFF Sequence Time Chart (V/f, V/f with PG, open-loop vector)



Note For variable speed operation by an analog signal, set to b1-01 = 1.

Fig 6.98 Brake ON/OFF Sequence Time Chart (Flux Vector)

◆ Stall Prevention during Deceleration

If connecting a braking resistor to discharge regenerative energy, be sure to set Stall prevention selection during decel (L3-04) to 0 (Disabled).

IMPORTANT

If Stall prevention selection during decel (L3-04) is set to 1, 2, or 3, the motor may not stop within the specified decelerating time.
Stall prevention selection during accel (L3-01) and Stall prevention selection during running (L3-05) should be set to their initial values 1 (Enabled) to enable these functions.

◆ Autotuning

Always perform autotuning with the motor before operating using vector control. Be sure to disconnect the motor from the load before conducting autotuning. Conducting autotuning while the motor is connected to an elevating machine system is dangerous because it automatically runs the motor for approximately one minute.

IMPORTANT

1. When the motor cannot be disconnected from the load, perform stationary autotuning 1 (T1-01 = 1) or stationary autotuning 2 (T1-01 = 4). Stationary autotuning will apply current to the motor in its stopped condition and automatically measure the motor data. In the initial running period after stationary autotuning 1 (T1-01 = 1) (20% speed min., fixed speed for 1 s min.), the motor data measured by autotuning will automatically be corrected.
2. To improve low-speed torque characteristics using V/f control, conduct stationary autotuning for line to line resistance only (T1-01 = 2).
3. When conducting autotuning on wound motor or other special types of motors, obtain a test report for the motor in advance and confirm that the E2 motor parameters after autotuning do not vary greatly from those of the test report.

◆ Braking Resistor Overheating Protection

When using a braking resistor other than the Braking Resistor Unit, provide a sequence with a thermal overload relay or similar means to turn off the power input to the Inverter when it detects resistor overheating. See the Connection Diagram on page 2-4 for this sequence circuit.

◆ Momentary Power Loss Restart

Do not use the momentary power loss restart and fault restart functions in applications for elevating machines. Make sure that L2-01=0 and L5-01=0. If these functions are used, the motor coasts to a stop with the brake contact open when a momentary power loss or fault occurs during operation, possibly resulting in serious accidents.

◆ Torque Limit

The torque limit values (L7-01 to L7-04) are the motor's rated torque. When there is a possibility of insufficient torque at start-up or other time, increase the Inverter capacity and set the torque limit value to between 200% and 300% (factory setting is 200%).

◆ I/O Open-phase Protection and Overtorque Detection

To prevent the machine from falling when the motor is open-phase or a similar situation, enable L8-05 and L8-07 (Input and output open-phase protection selection) and L6-01 to L6-06 (Overtorque detection) (factory setting is Disabled).

Falling detection or a similar safety measure should also be provided on the machine side.

◆ External Baseblock Signal

If the external baseblock command (settings 8 and 9 of H1-01 to H1-06) is input while the motor is running, the motor will immediately coast to a stop. Do not input the external baseblock command while the motor is running unless necessary.

Make sure that the holding brake operates when using the external base block command for an emergency stop or interlock to start the Inverter.

If the external baseblock command is input and immediately reset, the Inverter does not output voltage during the value of L2-03 (Min. baseblock time), which factory setting is 0.5 to 2.0 seconds depending on the Inverter capacity. Do not use the external baseblock command in an application where the motor is frequently started and stopped.

◆ Acceleration/Deceleration Time

If the delay time for the holding brake's mechanical operation is not taken into consideration and the acceleration/deceleration time on the Inverter side is set to a time that is too short, and overcurrent or wear on the brakes may occur at staring or the load will slip at stopping because the holding brake does not operate on time. If so, use the dwell function at start described on page 6-209 or the dwell function at stop described on page 6-210 to tune the timing for the holding brake.

◆ Magnetic Contactor on the Inverter's Output-side

Do not install a magnetic contactor between the Inverter and the motor. If a magnetic contactor must be installed because of local electrical codes or regulations or to operate motors with an Inverter, excluding emergencies, open or close the magnetic contactor only when the holding brake is fully closed and the Inverter is in baseblock status with the baseblock signal ON.

If the magnetic contactor is opened or closed while the Inverter is controlling the motor or DC injection braking (Zero-speed control), surge voltage or a current from the motor by full-voltage starting may cause an Inverter fault.

When a magnetic contactor is installed between the Inverter and the motor, set L8-07 (Output open-phase protection selection) to 1 or 2 (Enabled).

◆ Control-related Adjustments

The 3G3RV-V1 is designed to provide sufficient performance for elevating machines. However, if problems related to controllability should occur, such as vibration or slipping, adjust the following parameters in accordance with the control method. Only parameters that frequently require adjustment are listed in this table.

Table 6.8 Control-related Adjustments

Control Method	Parameter Number	Name	Performance	Factory Setting	Recommended Setting	Adjustment Method
Open-loop vector control (A1-02 = 2)	N2-01	Speed feedback detection control (AFR) gain	• Increasing torque and speed response • Controlling hunting and vibration in middle-range speeds (10 to 40 Hz)	1.00	0.50 to 2.00	• Torque or speed response is insufficient: Reduce the setting • Hunting or vibration occurs: Increase the setting
	C4-02	Torque compensation primary delay time constant	• Increasing torque and speed response • Controlling hunting and vibration	20 ms	20 to 100 ms	• Torque or speed response is insufficient: Reduce the setting • Hunting or vibration occurs: Increase the setting
	C3-02	Slip compensation primary delay time	• Increasing speed response • Improving speed stability	200 ms	100 to 500 ms	• Speed response is slow: Reduce the setting • Speed is not stable: Increase the setting
	C3-01	Slip compensation gain	• Improving speed accuracy	1.0	0.5 to 1.5	• Speed is slow: Increase the setting • Speed is too fast: Reduce the setting
	C6-02	Carrier frequency selection	• Reducing motor magnetic noise • Controlling hunting and vibration at low speeds (10 Hz or lower)	*1	1 to F	• Motor magnetic noise is high: Increase the setting • Hunting or vibration occurs at low speeds: Reduce the setting
	E1-08	Mid. output frequency voltage (VC)	• Improving torque and speed response at low speeds • Controlling shock at startup	11.0 V*2	12.0 to 13.0 V*2	• Torque or speed response is insufficient: Increase the setting • Shock at startup is large: Reduce the setting
	E1-10	Min. output frequency voltage (VMIN)				

Table 6.8 Control-related Adjustments (Continued)

<table>
<tr><th>Control Method</th><th>Parameter Number</th><th>Name</th><th>Performance</th><th>Factory Setting</th><th>Recommended Setting</th><th>Adjustment Method</th></tr>
<tr><td rowspan="7">Flux vector control (A1-02 = 3)</td><td>C5-01</td><td>ASR proportional (P) gain 1</td><td rowspan="2">• Increasing torque and speed response
• Controlling hunting and vibration</td><td rowspan="2">20.00</td><td rowspan="2">10.00 to 50.00</td><td rowspan="2">• Torque or speed response is insufficient: Increase the setting
• Hunting or vibration occurs: Reduce the setting</td></tr>
<tr><td>C5-03</td><td>ASR proportional (P) gain 2</td></tr>
<tr><td>C5-02</td><td>ASR integral (I) time 1</td><td rowspan="2">• Increasing torque and speed response
• Controlling hunting and vibration</td><td rowspan="2">0.500 s</td><td rowspan="2">0.300 to 1.000 s</td><td rowspan="2">• Torque or speed response is insufficient: Reduce the setting
• Hunting or vibration occurs: Increase the setting</td></tr>
<tr><td>C5-04</td><td>ASR integral (I) time 2</td></tr>
<tr><td>C5-07</td><td>ASR switching frequency</td><td>Switching the ASR proportional gain and integral time according to the output frequency.</td><td>0.0 Hz (no switching)</td><td>0.0 to max. output frequency</td><td>Set the output frequency at which to change the ASR proportional gain and integral time when the same values cannot be used for both high-speed and low-speed operation.</td></tr>
<tr><td>C5-06</td><td>ASR primary delay time</td><td>• Controlling hunting and vibration</td><td>0.004 s</td><td>0.004 to 0.020</td><td>Machine rigidity is low and the system vibrates easily: Increase the setting</td></tr>
<tr></tr>
<tr><td rowspan="5">V/f control (A1-02 = 0 or 1)</td><td>N1-02</td><td>Hunting-prevention gain</td><td>• Controlling hunting and vibration in middle-range speeds (10 to 40 Hz)</td><td>1.00</td><td>0.50 to 2.00</td><td>• Torque is insufficient for heavy loads: Reduce the setting
• Hunting or vibration occurs for light loads: Increase the setting</td></tr>
<tr><td>C6-02</td><td>Carrier frequency selection</td><td>• Reducing motor magnetic noise
• Controlling hunting and vibration at low and medium speeds</td><td>*1</td><td>1 to F</td><td>• Motor magnetic noise is high: Increase the setting
• Hunting or vibration occurs at low to middle-range speeds: Reduce the setting</td></tr>
<tr><td>C4-01</td><td>Torque compensation gain</td><td>• Improving torque at low speeds (10 Hz or lower)
• Controlling hunting and vibration for light loads</td><td>1.00</td><td>0.50 to 1.50</td><td>• Torque is insufficient at low speeds: Increase the setting
• Hunting or vibration occurs for light loads: Reduce the setting</td></tr>
<tr><td>E1-08</td><td>Mid. output frequency voltage (VC)</td><td rowspan="2">• Improving torque at low speeds
• Controlling shock at startup</td><td rowspan="2">2.0 V*2</td><td rowspan="2">5.0 to 7.0 V*2</td><td rowspan="2">• Torque is insufficient at low speeds: Increase the setting
• Shock at startup is large: Reduce the setting</td></tr>
<tr><td>E1-10</td><td>Min. output frequency voltage (VMIN)</td></tr>
</table>

* 1. Varies depending on capacity.

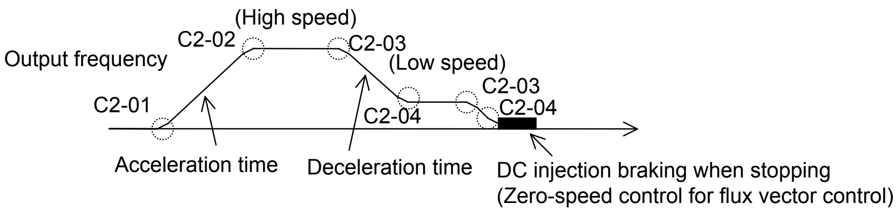
* 2. The setting is given for 200 V Class Inverters. Double the voltage for 400 V Class Inverters.

Note
1. Do not change C4-01 (Torque compensation gain) from its factory setting of 1.00 when using open-loop vector control.
2. If speeds are inaccurate during regeneration in open-loop vector control, enable Slip compensation selection during regeneration (C3-04 = 1). If speeds are inaccurate in the high-speed range, enable Output voltage limit operation selection (C3-05 = 1).
3. Do not use Slip compensation gain (C3-01) during V/f control (A1-02 = 0). (It is not used with the factory setting.)
4. Use the ASR parameters (C5-01 to C5-05) in their factory settings when using V/f control with PG (A1-02 = 1). Vibration may occur if these parameters are changed greatly from their factory settings.
5. The torque and speed response of high-resistance (high-slip) motors are insufficient. Use appropriate adjustments to improve them. On the contrary, low-resistance (low-slip) motors are easily subject to hunting and vibration. Here too, use appropriate adjustments to improve them.
6. The current during startup may increase when C4-02 (Torque compensation primary delay time constant) is increased. Check the current during startup while adjusting this parameter.

◆ Reducing Shock during Elevating Machine Start, Stop, Acceleration, and Deceleration

When the riding comfort during start, stop, acceleration, and deceleration is of high importance, as it is for elevators in which people ride, adjust the following parameters.

■S-curve Characteristics, Acceleration/Deceleration Times

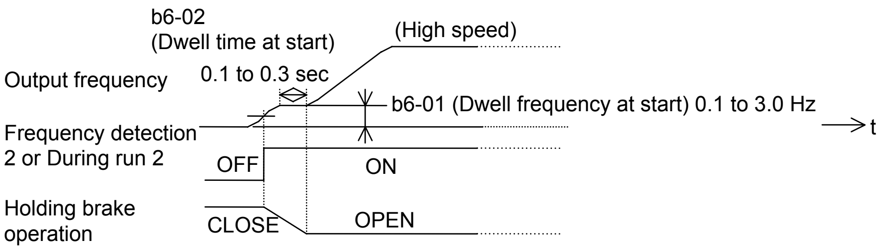


IMPORTANT

1. The factory setting for C2-04 (S-curve characteristic time at deceleration end) is 0.00 second, while the factory setting for all other S-curve characteristic times is 0.20 second. Make appropriate settings for the accel/decel times and S-curve characteristic times at each point. (S-curve characteristic time = Approximately 0.2 to 1.0 second)
2. The accel/decel rate can be automatically switched during acceleration and deceleration by using C1-11 (Accel/decel time switching frequency). (Factory setting: Disabled)
   Output frequency ≥ set frequency: C1-01, C1-02 accel/decel times
   Output frequency < set frequency: C1-07, C1-08 accel/decel times
3. If the output frequency during the S-curve characteristic time for deceleration falls below the value set for E1-09 (Min. output frequency), the S-curve characteristic will be cancelled, and the DC injection braking (Zero-speed control) will be applied.
4. Do not use the S-curve characteristic for applications where a short run time is desired, such as in cranes and hoists. (S-curve characteristic time = Approximately 0.0 to 0.2 second)

6

■Dwell Function at Start

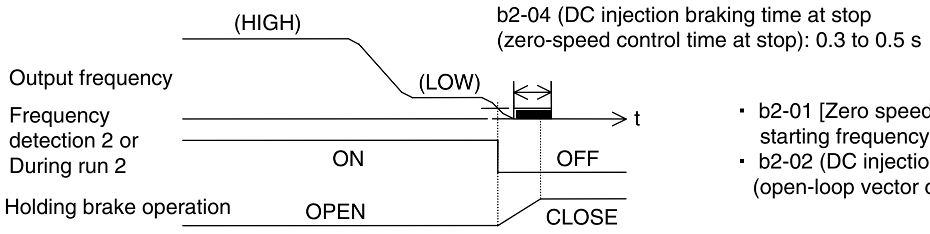


If the mechanical operation of the holding brake is slow, use the dwell function at start to prevent brake wear, and accelerate after the brake is completely open.

IMPORTANT

1. When using open-loop vector control and V/f control, set b6-01 (Dwell frequency at start) higher than frequency detection 2 (frequency when brakes open).
2. If the motor tends to have insufficient torque when started, use the DC injection braking function to allow sufficient motor current (torque) before starting.
   - b2-03 (DC injection braking time at start): 0.2 to 0.5 s
   - b2-02 (DC injection braking current): 50% to 80% (open-loop vector control, V/f control only)

■Stopping with DC Injection Braking and Zero-speed Control



- b2-01 [Zero speed level (DC injection braking starting frequency)]: 0.1 to 3.0 Hz
- b2-02 (DC injection braking current): 50% to 80% (open-loop vector control, V/f control only)

When the holding brake's mechanical operation is slow, use DC injection braking (zero-speed control for flux vector control) until the brakes are fully closed to prevent the brakes from slipping when stopping.

IMPORTANT

1. When the load cannot be maintained sufficiently using DC injection braking with open-loop vector control and V/f control, use the dwell functions at stop.
   - b6-03 (Dwell frequency at stop): Min. output frequency to 3.0 Hz.
     The value must be less than the frequency when frequency detection 2 is OFF (L4-01 – L4-02).
   - b6-04 (Dwell time at stop): 0.3 to 0.5 s
     [b2-04 (DC injection braking at stop): 0.0 s]
2. If the Inverter and motor must be isolated while stopping using a magnetic contactor, for example in an elevator, fully close the holding brakes and isolate the Inverter during baseblock (during baseblock signal: ON) as stipulated by law in the EU.
   During motor control or DC injection braking (zero-speed control), an Inverter error may occur due to surge voltage. When a magnetic contactor is used between the Inverter and motor, set L8-07 (Output open-phase protection) to 1 (enabled).

■Torque Compensation (Flux Vector Control Only)

When flux vector control is used, the torque compensation signals corresponding to the load can be input from the multi-function analog input terminals in advance to reduce shock, such as that caused by opening and closing holding brakes. The load size and motoring/regenerating status must be detected at the machine side in advance. Check that polarity is correct. Incorrect polarity will increase the shock.

Sequence Circuit Configuration

The following diagram shows the sequence circuit configuration for torque compensation.

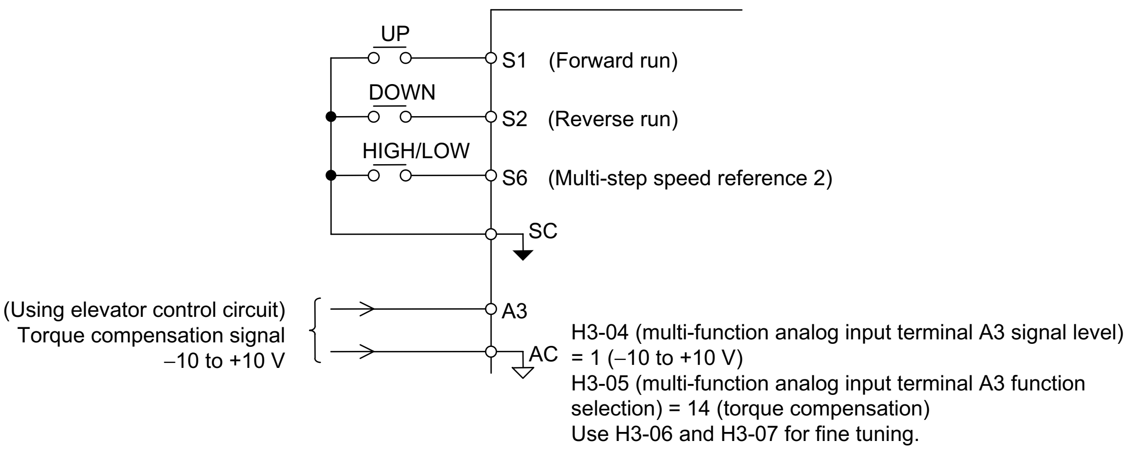


Fig 6.99 Torque Compensation Sequence Circuit Configuration

Time Chart

- Lifting

The analog signals corresponding to the load size are input as torque compensation signals from before the Inverter starts until operation stops. (Factory setting: 10 V/100% torque)
Positive polarity is input for motor loads and negative polarity is input for regenerative loads.
The following diagram shows the time chart for lifting.

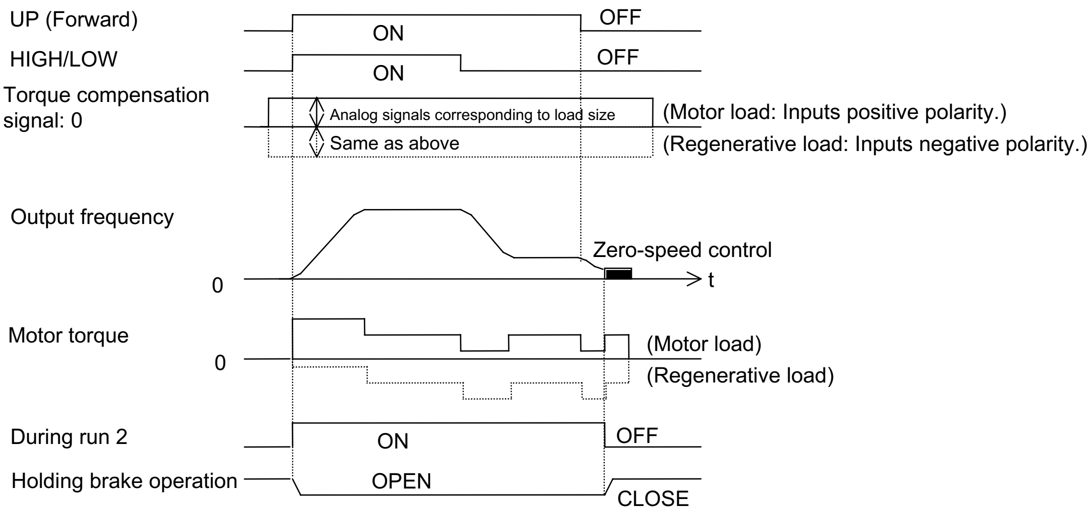


Fig 6.100 Torque Compensation Time Chart (Lifting)

- Lowering

In the same way as for lifting, when the torque decreases, the analog signals corresponding to the load size are input as torque compensation signals from before the Inverter starts until operation stops. (Factory setting: 10 V/100% torque)
Negative polarity is input for motor loads and positive polarity is input for regenerative loads.

The following diagram shows the time chart for lowering.

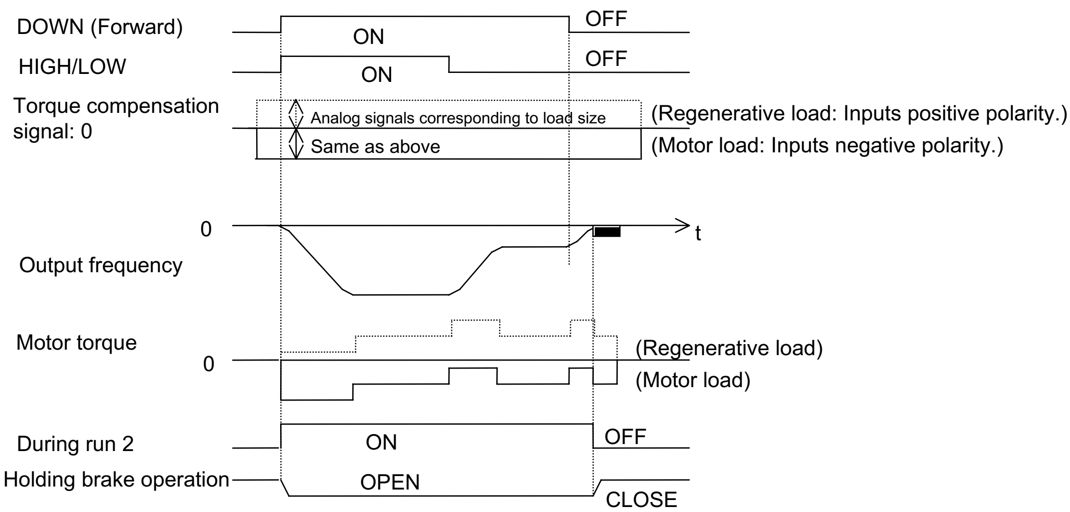


Fig 6.101 Torque Compensation Time Chart (Lowering)

IMPORTANT

1. For either increasing or decreasing torque, externally maintain the torque compensation signals during operation to prevent them from fluctuating. Fluctuation in compensation signals during operation may result in vibration.
2. If reverse run is used for lifting and forward run is used for lowering, the torque compensation signal polarity must be reversed.

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■Analog Input Filter Time Constant

If noise enters the analog frequency reference during operation using analog frequency reference (b1-01 = 1), and operation becomes rough, implement noise countermeasures and also set H3-12 (Analog input filter time parameter) to between 0.01 and 0.10 s.

◆ Confirming Startup Current and Reducing Carrier Frequency

When performing trial operation, check the motor current using the Digital Operator or a clamp ammeter with and without a mechanical load. An extremely high current will flow if the motor torque at start is insufficient, or if timing is not correct and the motor locks with the holding brake.

For applications with repetitive loads (cranes, elevators, presses, washing machines, etc.), if a current exceeding 125% of the rated current or more flows repeatedly, the IGBT in the Inverter will be subject to heat stress, resulting in a shortened life span. In this case, select CT instead of VT and reduce the load, lengthen the acceleration/deceleration time, or increase the frame size of the Inverter so that the peak current for repetitive operation will drop to less than 125% of the rated current. If performing a trial operation with repetitive loads, make sure that the peak current for repetitive operation is less than 125% of the rated current. If particularly low noise is not required, do not increase the Inverter's carrier frequency to reduce the influence of heat stress.

◆ Overvoltage Inhibit Function

Leave L3-11 (Overvoltage inhibit function selection) set to 0 (disabled: factory setting). This function is used to prevent overvoltage tripping when the braking resistor is not used with a regenerative load. When this function is enabled, the torque reference on the regenerative side is automatically inhibited in the Inverter during regeneration. Using this function in elevating machines is dangerous because the elevator may slip and fall.

Contact your Yaskawa representative for details on applications such as high-speed elevators (speed: 2 m/s or higher), direct-drive elevators, or Inverters designed for cranes.

7

Chapter 7
Troubleshooting

This chapter describes the fault displays and countermeasure for the Inverter and motor problems and countermeasures.

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.

Be sure to turn Run Command to OFF first, use one of the following methods to reset the fault before restarting the Inverter.

- Set a multi-function contact input (H1-01 to H1-06) to 14 (Fault Reset) and turn ON the fault 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
oC 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.*1
		A short-circuit between +V, −V, and AC terminals occurred.	Make sure that incorrect wiring has not been done.
GF Ground Fault	Ground Fault*2 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.*1
		A short-circuit between +V, −V, and AC terminals occurred.	Make sure that incorrect wiring has not been done.
PUF 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 (⊕3) ←→ U, V, W ⊖ ←→ U, V, W	Replace the Inverter after correcting the cause.

* 1. Before turning the power ON again, make sure that no short-circuit or ground fault occurs at the Inverter output.

* 2. The ground fault here is one which occurs in the motor wiring while the motor is running. A ground fault may not be detected in the following cases.
- A ground fault with low resistance which occurs in motor cables or terminals.
- A ground fault occurs when the power is turned ON.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
oU 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 (E1-01 ≥ 400 V) Approx. 720 V (E1-01 < 400 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 regenerative energy when an overshoot occurs after acceleration is completed is too large.	In vector control, enable (Set to 1) the overvoltage inhibit selection (L3-11).
		The power supply voltage is too high.	Decrease the voltage so it's within specifications.
Uv1 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.
Uv2 CTL PS Undervolt	Control Power Fault The control power supply voltage dropped.	The wiring of the control power circuit is incorrect.	• Fix the wiring. • Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.
Uv3 MC Answer-back	Inrush Prevention Circuit Fault Malfunction in the inrush prevention circuit. 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 if a load is greater than approximately 80% of the maximum motor capacity. This fault is detected when L8-05 is set to 1.	• 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 1 or 2.	• 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 rated output current.	Check the motor and Inverter capacity.

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Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
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 the overheat protection level. 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.)
		A short-circuit between +V, −V, and AC terminals occurred.	Make sure that incorrect wiring has not been done.
	Inverter's Cooling Fan Fault (11 kW or more) This fault is detected when L8-32 is set to 1.	The Inverter's cooling fan has stopped.	Replace the cooling fan. (Contact our sales representative.)
FAn (blinking) Cooling FAN Err	Inverter's Cooling Fan Fault An Inverter's cooling fan fault was detected, and the Inverter-overload protection was activated based on the internal electric thermal value. This fault is detected when L8-32 is set to 0.	The Inverter continued running with an overload after the cooling fan stopped.	Replace the cooling fan. (Contact our sales representative.)
oH3 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 A2 and A3.
			Check the setting of E2-01 (motor rated current).
oH4 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 A2and A3.
			Check the setting of E2-01 (motor rated current).
rH 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.
rr DynBrk Transistr	Internal Braking Transistor Fault The braking transistor is not operating properly.	• The braking transistor is damaged. • The Inverter's control circuits are faulty.	• Try turning the power supply off and on. • Replace the Inverter if the fault continues to occur.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
oL1 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) and Motor 2 Rated Current (E4-01) is incorrect.	Check the Motor Rated Current (E2-01) and Motor 2 Rated Current (E4-01).
		A short-circuit between +V, −V, and AC terminals occurred.	Make sure that incorrect wiring has not been done.
oL2 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.
		A short-circuit between +V, −V, and AC terminals occurred.	Make sure that incorrect wiring has not been done.
oL3 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.
oL4 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.
oL7 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 OV is the value of N3-04 or less.
UL3 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.
UL4 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.

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Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
oS 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 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.
		Brake is applied to the motor.	Check for open circuit when using brake (motor).
dEv 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.
		Brake is applied to the motor.	Check for open circuit when using brake (motor).
CF 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.	The settings for torque limit aren't appropriate.	Check the settings for torque limit.
		The settings of motor parameter aren't appropriate.	• Check the motor parameters. • Perform autotuning.
FbL 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).	The settings in b5-13 and b5-14 aren't appropriate.	Check the settings in b5-13 and b5-14.
		The wiring of the PID feedback circuit is incorrect.	Fix the wiring.
EF0 Opt External Flt	**External Fault input from Communications Option Board**	-	Check the Communications Option Board and communications signals.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
EF3 Ext Fault S3	External Fault (Input Terminal S3)	An "external fault" was input from a multi-function input terminal (S3 to S8).	• Reset external fault inputs to the multi-function inputs. • Remove the cause of the external fault.
EF4 Ext Fault S4	External Fault (Input Terminal S4)		
EF5 Ext Fault S5	External Fault (Input Terminal S5)		
EF6 Ext Fault S6	External Fault (Input Terminal S6)		
EF7 Ext Fault S7	External Fault (Input Terminal S7)		
EF8 Ext Fault S8	External Fault (Input Terminal S8)		
SvE Zero Servo Fault	Zero-Servo Fault The rotation position moved during zero-servo operation.	The torque limit is too small.	Increase the limit.
		The load torque is too large.	Reduce the load torque.
		-	Check for signal noise.
SEr Search Retry Err	Exceeded Allowable Number of Speed Search Retrials The speed search has been retried more than the number of times set in b3-19 (Number of speed search retrials).	The settings in b3-17 and b3-18 aren't appropriate.	Make sure that the settings in b3-17 and b3-18 are appropriate.
oPr Oper Disconnect	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 Digital Operator.
CE RS-422A/485 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 signals.
bUS Option Com Err	Option Communications Error A communications error was detected during a Run Command or while setting a frequency reference from a Communications Option Board.	-	Check the communications devices and communications signals.
E5 SI-WDT Err	SI-T Watchdog Error Consistency error of received control data	Synchronization error between master controller and Inverter for control data.	Check the communications timing such as communications cycle. Refer to *MECHATROLINK COMMUNICATIONS INTERFACE CARD INSTRUCTIONS (TOBPC73060008)* for details.

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Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
E-10 SI-F/G CPU down	SI-F/G Option Board CPU Failure SI-F/G Option Board operation failed.	Digital Operator connection is faulty.	Disconnect and then reconnect the Digital Operator.
		Inverter control circuit is faulty.	Replace the Inverter.
CPF00 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.
CPF01 CPF01	Digital Operator Communications Error 2 After communications were established, 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.
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.
		A short-circuit between +V, −V, and AC terminals occurred.	Make sure that incorrect wiring has not been done.
CPF05 External A/D Err	CPU External A/D Converter Error	-	Try turning the power supply off and on again.
		The control circuit is damaged.	Replace the Inverter.
		A short-circuit between +V, −V, and AC terminals occurred.	Make sure that incorrect wiring has not been done.
CPF06 Option error	Option Board Connection Error	The option board is not connected properly.	Turn off the power and insert the board again.
		The Inverter or option board is faulty.	Replace the option board 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.

Table 7.1 Fault Displays and Processing (Continued)

Display	Meaning	Probable Causes	Corrective Actions
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 Board A/D Converter Error	The option board is not connected properly.	Turn off the power and insert the board again.
		The option board's A/D converter is faulty.	Replace the Communications Option Board.
CPF21 Option CPU down	Communications Option Board Self Diagnostic Error	Communications Option Board fault.	Replace the option board.
CPF22 Option Type Err	Communications Option Board Model Code Error		
CPF23 Option DPRAM Err	Communications Option Board DPRAM Error	Communications Option Board fault.	Replace the option board.
		The copy function of the Digital Operator was used during communications.	• Use the copy function off-line. • Use the copy function with an option board removed.
		The option board is not connected properly.	Turn off the power and insert the board again.

◆ Alarm Detection

Alarms are detected as a type of Inverter protection function that do not operate the fault contact output. The system will automatically returned 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 magnetic 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. 410 V 400 V Class: Approx. 820 V	The power supply voltage is too high.	Decrease the voltage so it's within specifications.
oH (blinking) Heatsnk Overtemp	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 Yaskawa representative.)
		A short-circuit between +V, −V, and AC terminals occurred.	Make sure that incorrect wiring has not been done.
FAn Cooling FAN Err	Inverter's Cooling Fan Fault An Inverter's cooling fan fault was detected. This fault is detected when L8-32 is set to 0.	The Inverter's cooling fan has stopped.	Replace the cooling fan. (Contact our sales representative.)
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 S8).	-	Clear the multi-function input terminal's overheating alarm input.

Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
oH3 (blinking) Motor Overheat 1	Motor Overheating E was set for H3-05 or 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 A2 and A3.
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.
oS (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.

Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
EF0 (blinking) Opt External Flt	External Fault Detected for Communications Board Other Than SI-K2 Continuing operation was specified for EF0 (F6-03 = 3)and an external fault was input from the option board.	-	Remove the cause of the external fault.
EF3 (blinking) Ext Fault S3	External Fault (Input Terminal S3)	An external fault was input from a multi-function input terminal (S3 to S8).	• 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)		
EF8 (blinking) Ext Fault S8	External Fault (Input Terminal S8)		
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).	The settings in b5-13 and b5-14 aren't appropriate.	Check the settings in b5-13 and b5-14.
		The wiring of the PID feedback circuit is incorrect.	Fix the wiring.
CE (blinking) RS-422A/485 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.

Table 7.2 Alarm Displays and Processing (Continued)

Display	Meaning	Probable causes	Corrective Actions
bUS (blink-ing) Option Com Err	Option Board Communications Error A communications error occurred in a mode where the Run Command or a frequency reference is set from a Communications Option Board.	-	Check the communications devices and signals.
CALL (blink-ing) ComCall	Communications on Standby Control data was not normally received when power was turned ON.	-	Check the communications devices and signals.
CrST (blink-ing) Ext Run Active	Reset during Run Command Input Error The reset signal was input during Run Command input from an external terminal or other source.	-	Check that a Run Command is not being input from an external terminal or other source.
E5 (blink-ing) SI-T WDT Err	Option Board Communications Error	-	-
AEr (blink-ing) SI-T Address Err	Option Board Communications Error	-	-
CYC (blink-ing) SI-T Cycle Err	Option Board Communications Error	-	-
bb (blink-ing) Base Block	Receiving External Baseblock Command External baseblock was input from external terminal again while it was input.	-	-

* Refer to *MECHATROLINK COMMUNICATIONS INTERFACE CARD INSTRUCTIONS (TOBPC73060008)* for details.

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◆ 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 Yaskawa representative.)
oPE02 Limit	Parameter Setting Range Error	The parameter setting is outside of the valid setting range. Press the ENTER Key on the Digital Operator to display OPE fault parameter (U1-34).
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. • The up/down commands (10 and 11) were selected while PID Control Method Selection (b5-01) was enabled. • 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. • Deceleration at momentary power loss (KEB) command (65 or 66) and High-slip braking (HSB) (68) were selected at the same time.
oPE05 Sequence Select	Option Board Selection Error	The option board was selected as the frequency reference source by setting b1-01 to 3, but an option board isn't connected (C option).
oPE06 PG Opt Missing	Control Method Selection Error	1 (V/f with PG) or 3 (Flux vector) was selected in A1-02, but a PG Speed Control Board 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 or H3-05 = B and H6-01 = 1 • H3-09 or H3-05 = 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). H3-13 (Terminal A1/A2 switching) is set to 1 and H3-09 is set to other than 2 or H3-05 is set to 0 or 2. The same value is set to H3-05 and H3-09.
oPE08 Ctrl Func Error	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. Press the ENTER Key on the Digital Operator to display OPE fault parameter (U1-34).

Table 7.3 Operation Error Displays and Incorrect Settings (Continued)

Display	Meaning	Incorrect settings
oPE09 PID Select Error	PID Control Selection Error	The following settings have been made at the same time. • b5-01 (PID Control Method 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.
oPE10 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)
oPE11 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.
Err 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.

Note: If the settings for the parameters of an Inverter with a different version of software are copied, an OPE error can occur. Contact your Yaskawa representative if wanting to copy the settings with a different software version.

◆ 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
Er-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.
Er-02 Minor Fault	Alarm	A minor fault occurred during autotuning (xxx).	• Check the input data. • Check wiring and the machine. • Check the load.
Er-03 STOP Key	STOP key input	The STOP Key was pressed to cancel autotuning.	
Er-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 user parameter.	• Check the input data. • Check the motor wiring. • If the motor is connected to the machine, disconnect it.
Er-05 No-load current	No-load current error		
Er-08 Rated Slip	Rated slip error		
Er-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.
Er-10 PG Direction	Motor Direction Error	There is a faulty connection between the Inverter and PC (A or B phase) or the Inverter and Motor (U, V, or W).	• Check the PG wiring. • Check the motor wiring. • Check the PG rotation direction and F1-05 (PG rotation).
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.	Check the current detection circuit, motor wiring, current detector, and installation methods.
		The detected current sign was the opposite of what it should be.	
		There is a phase fault for U, V, or W.	

Table 7.4 Errors During Autotuning (Continued)

Display	Meaning	Probable causes	Corrective Actions
Er-13 Leak Inductance	Leakage inductance error	Autotuning was not completed in the specified time.	Check the motor wiring.
PGo PG Open	PG Disconnection Detected	PG pulses were input when the Inverter was outputting a frequency.	Fix the broken/disconnected wiring.
End1 V/f Over Setting	V/f settings excessive* (detected only for rotational autotuning)	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)	The results of autotuning has exceeded the setting range for a user 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).
End4 Rated Slip	Adjusted slip value fell below lower limit	As a result of stationary autotuning 1, the slip value has fallen to 0.2 Hz or below.	• Check the input data. • If rotational autotuning is possible, perform it. If impossible, perform stationary autotuning 2.

* Displayed after autotuning has been completed. For parameters in which no error is detected, the settings are reset to the values determined by autotuning.

◆ 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.

Table 7.5 Errors during Copy Function

Function	Display	Meaning	Probable causes	Corrective Actions
Read	PrE 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.
	iFE READ DATA ERROR	Illegal read data	The read data length does not agree. The write data is incorrect.	Repeat the read. Check the Digital Operator cable. Replace the Digital Operator.
	rdE 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.

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Table 7.5 Errors during Copy Function (Continued)

Func-tion	Display	Meaning	Probable causes	Corrective Actions
Copy	CPE 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.
	vAE 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.
	CrE 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.
	CYE 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.
	CSE 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.
Verify	vYE VERIFY ERROR	Verify error	The Digital Operator and Inverter settings do not agree.	Retry the copy and verify again.
	CPE 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.

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 Inverter 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 input.

This occurs when "parameter write enable" (set value: 1B) is set for a multi-function input terminal (H1-01 to H1-06). 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/Select Key and the Menu Key simultaneously while in the A1-04 display. Then reset the password. (Input the reset password in parameter A1-04.)

■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.

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 and the DRIVE indicator on the Digital Operator (JVOP-161) does not light up, the Inverter 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 H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) 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 and the DRIVE indicator on the Digital Operator does not light up, the Inverter 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 DATA/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, set the multi-function input terminal (H1-01 through H1-06, terminals S3 to S8) to 0, and input the proper signals.

When using a 2-wire sequence, set the multi-function input terminal (H1-01 through H1-06, terminals S3 to S8) 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 or 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 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 does not accelerate.

If the torque limit settings (L7-01 to L7-04) or the torque reference input (torque control) are too small, the motor may not be able to accelerate. Check the settings and input values.

■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.

◆ 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 T1(U), T2(V), and T3(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 or H3-05 = 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 parameters 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 terminal A2 or A3.

When 0 (Add to terminal A1) is set for parameter H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection), a frequency corresponding to the terminal A2 or A3 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 Method

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.

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 H3-09 (Multi-function Analog Input Terminal A2 Function Selection) or H3-05 (Multi-function Analog Input Terminal A3 Function Selection) is set to 10, 11, 12 or 15 (positive and negative torque limit), 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 rating 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 parameters 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.

◆ 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 parameters 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 flux vector control.

The gain adjustment is insufficient. Adjust the various gains for speed control (ASR). If the oscillation points overlap with those of the machine and cannot be eliminated, increase the primary delay time constant for speed control (ASR) in C5-06 and then readjust the gains.

If autotuning is not performed, proper performance cannot be achieved for vector control. Perform autotuning or set the motor parameters according to calculations.

■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 6-146.)

■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 parameters through calculations. Alternatively, change the Control Method Selection (A1-02) to V/f control.

◆ If the Torque Generated for the Motor is Insufficient (Insufficient Power)

If autotuning has not been performed, or the control method has been changed since last performing autotuning, perform autotuning. If the problem occurs after performing stationary autotuning, perform rotational autotuning.

◆ 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 OV is Detected When the Fan is Started, or Fan Stalls

Generation of OV (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.

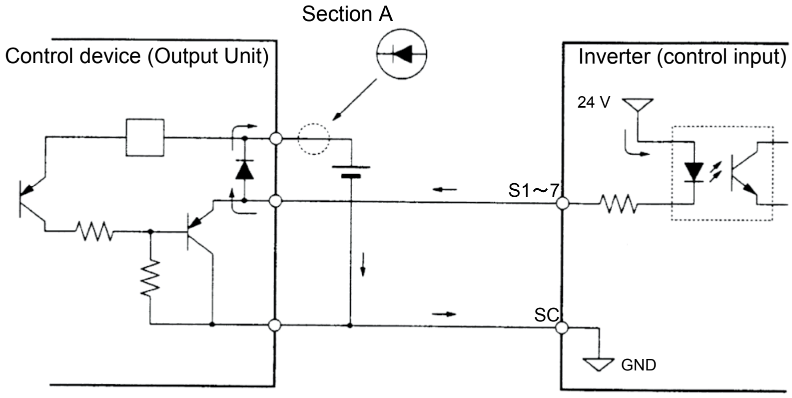
When the EF is detected and the Inverter will not operate, use one of the following measures.

■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.



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. Turn OFF the main circuit power supply, wait for the time indicated on the front cover, and make sure the CHARGE indicator light has gone out, and then perform maintenance and inspection. Be sure not to touch terminals right after the power has been turned off. Doing so can result in electric shock.

Table 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.
Heatsinks	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 x 10^4 to 58.8 x 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 x 10^4 to 58.8 x 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 x 10^4 to 58.8 x 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 the Inverter's installation environment and usage conditions. The Inverter's maintenance periods are noted below. Keep them as reference.

Refer to *Cooling Fan Replacement Outline* (Page 8-5) for replacing a cooling fan and *Circulation Fan Replacement Outline* (Page 8-15) for replacing a circulation fan. To replace other parts, contact your Yaskawa representative for details on preventive maintenance for Inverters.

Table 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

◆ Types and Number of Cooling Fans Used in the Drive

Cooling fans used for the Drive has two types; Heatsink cooling fan and heatsink circulation fan. Heatsink cooling fan blows air to the Drive cooling fin. Heatsink circulation fan stirs up the air inside the Drive unit.

Table 8.3 shows the number of cooling fans used in the Drive.

When replacing the fan, use the specified type of the fan. If the inapplicable fans are used, performance of the Drive will not be fully obtained.

Table 8.3 Number of Cooling Fans to be Used

Maximum Motor Capacity (kW)	200 V Class		400 V Class	
	Heatsink Cooling Fan	Heatsink Circulation Fan	Heatsink Cooling Fan	Heatsink Circulation Fan
0.4	-	-	-	-
0.75	-	-	-	-
1.5	-	-	-	-
2.2	-	-	1	-
3.7	1	-	1	-
5.5	1	-	1	-
7.5	2	-	2	-
11	2	1	2	1
15	2	-	2	-
18.5	2	1	2	1
22	2	-	2	-
30	2	-	2	-
37	2	1	2	-
45	2	1	2	-
55	2	1	2	-

Table 8.3 Number of Cooling Fans to be Used (Continued)

Maximum Motor Capacity (kW)	200 V Class		400 V Class	
	Heatsink Cooling Fan	Heatsink Circulation Fan	Heatsink Cooling Fan	Heatsink Circulation Fan
75	2	1	2	1
90	2	1	2	1
110	2	1	2	1
132	-		2	1
160			2	1
185			4	2
220			4	2
300			5	2

◆ 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 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.

Mounting the Cooling Fan

1. Attach the fan cover to the cooling fan. Be sure that the airflow 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.

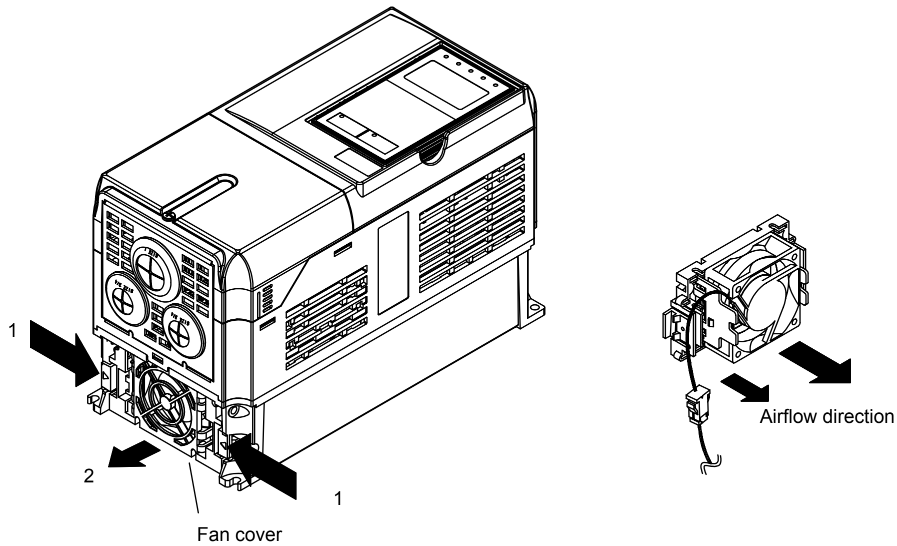


Fig 8.1 Cooling Fan Replacement (200 V Class Inverters of 5.5 kW)

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■ 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.

200 V Class Inverters of 22 kW, 30kW and 400 V Class Inverters of 22 kW to 55 kW

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 control board bracket to which the boards are mounted. Remove all cables connected to the control board. The cables connected to the control circuit terminals can be removed at the same time by removing them together with the control circuit terminal board. This procedure is not required for 400 V Class Inverters of 37 kW, 45 kW, and 55 kW. (Refer to page 8-20.)
3. Remove the cooling fan power cable connector (CN26 and CN27) from the gate drive board 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 and replace it with a new one.

Mounting the Cooling Fan

After attaching a new cooling fan, reverse the above procedure to attach all of the components. Refer to the next page for attaching the fan cover.
When attaching the cooling fan to the mounting bracket, be sure that the airflow faces the top of the Inverter.

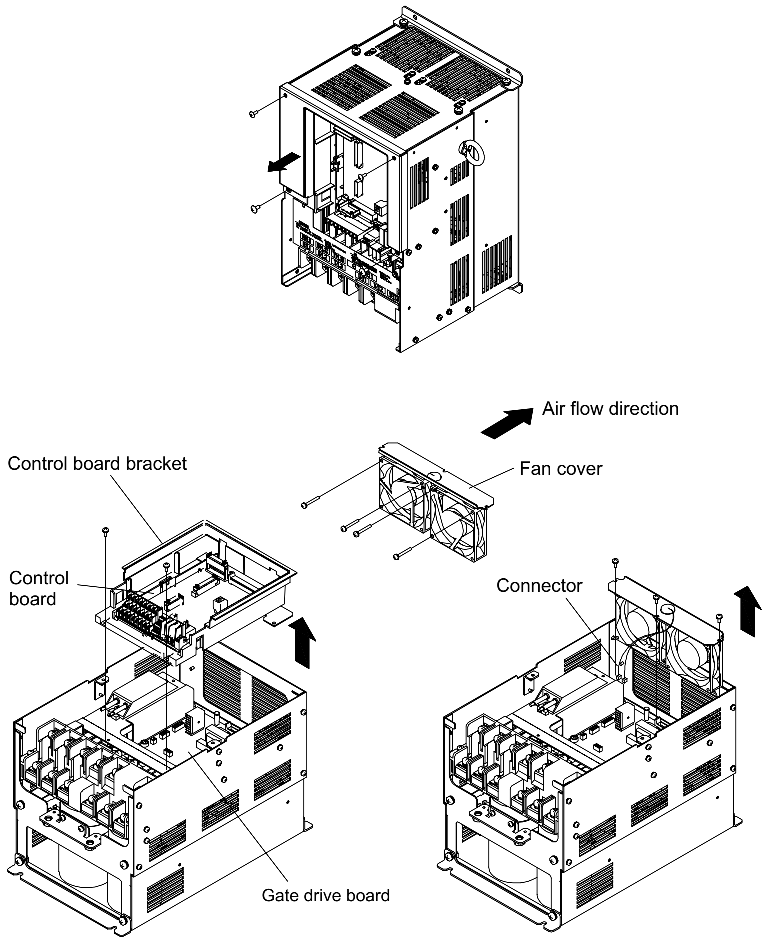


Fig 8.2 Cooling Fan Replacement (200 V Class Inverters of 22 kW)

Attaching the Fan Cover

1. Tilt the fan cover toward the bottom of the Inverter as shown in Fig 8.3 and insert it to the mounting hole until it meets with A.

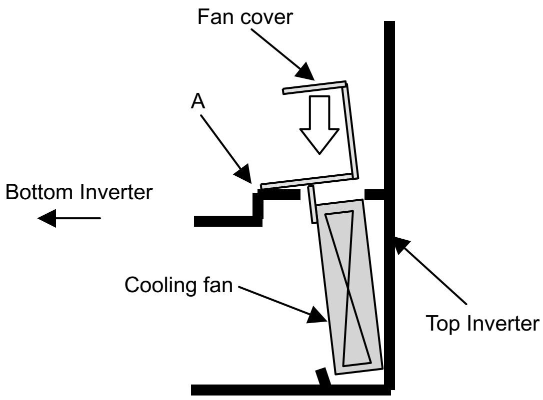


Fig 8.3

2. Push the fan cover toward the top of the Inverter.

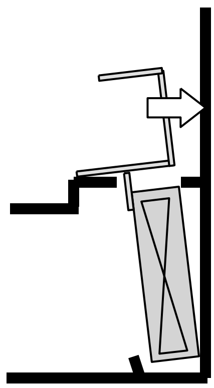


Fig 8.4

3. Make sure that there is no gap between the fan cover and A. Then screw it in place with the three screws.

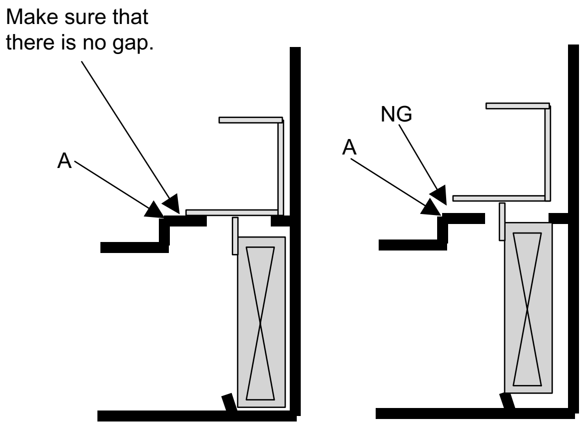


Fig 8.5

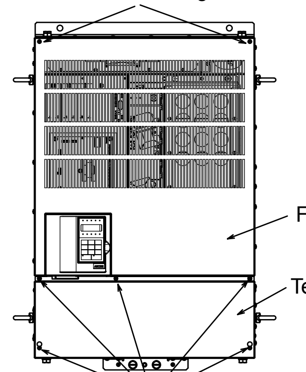
200 V Class Inverters of 55 kW, 75 kW and 400 V Class Inverters of 75 kW, 90 kW

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Pull the cooling fan power cable connector that extends from the fan cover cable hole out of the cooling fan power relay board.
3. Only for 400 V Class Inverters of 75 kW and 90 kW, loosen the resistor unit mounting screws and slide the resistor unit to remove it. Take care as the resistor unit is hot.
4. Remove the fan cover screws and pull out the fan cover from the Inverter.
5. Remove the cooling fan from the fan cover and replace it with a new one.

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 airflow faces the top of the Inverter.



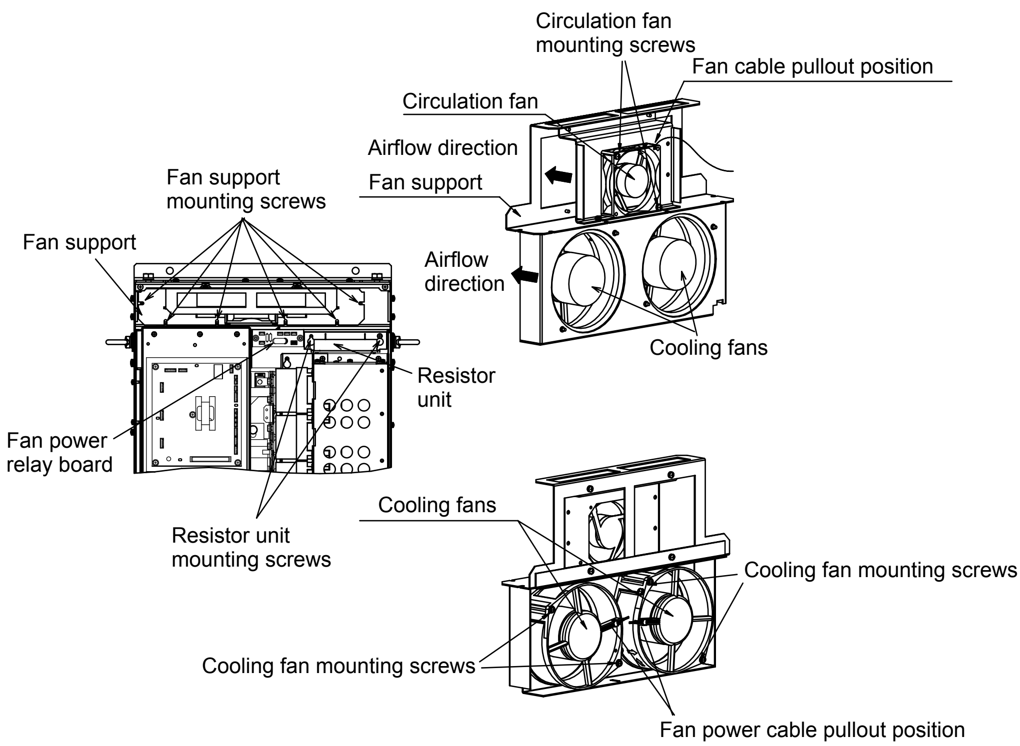


Fig 8.6 Cooling Fan Replacement (400 V Class Inverters of 75 kW and 90 kW)

200 V Class Inverters of 37 kW and 45 kW

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 panel to which the control board, the gate drive board, and the cooling fan power relay board are mounted. Remove any cables that are connected to the control board, the gate drive board, and the cooling fan power relay board. The cable that is connected to the control circuit terminals can be removed together with the control circuit terminal board. (Refer to page 8-20.)
3. Remove the fan cover screws and pull out the fan cover from the Inverter.
4. Remove the cooling fan from the fan cover and replace it with a new one.

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 airflow faces the top of the Inverter.

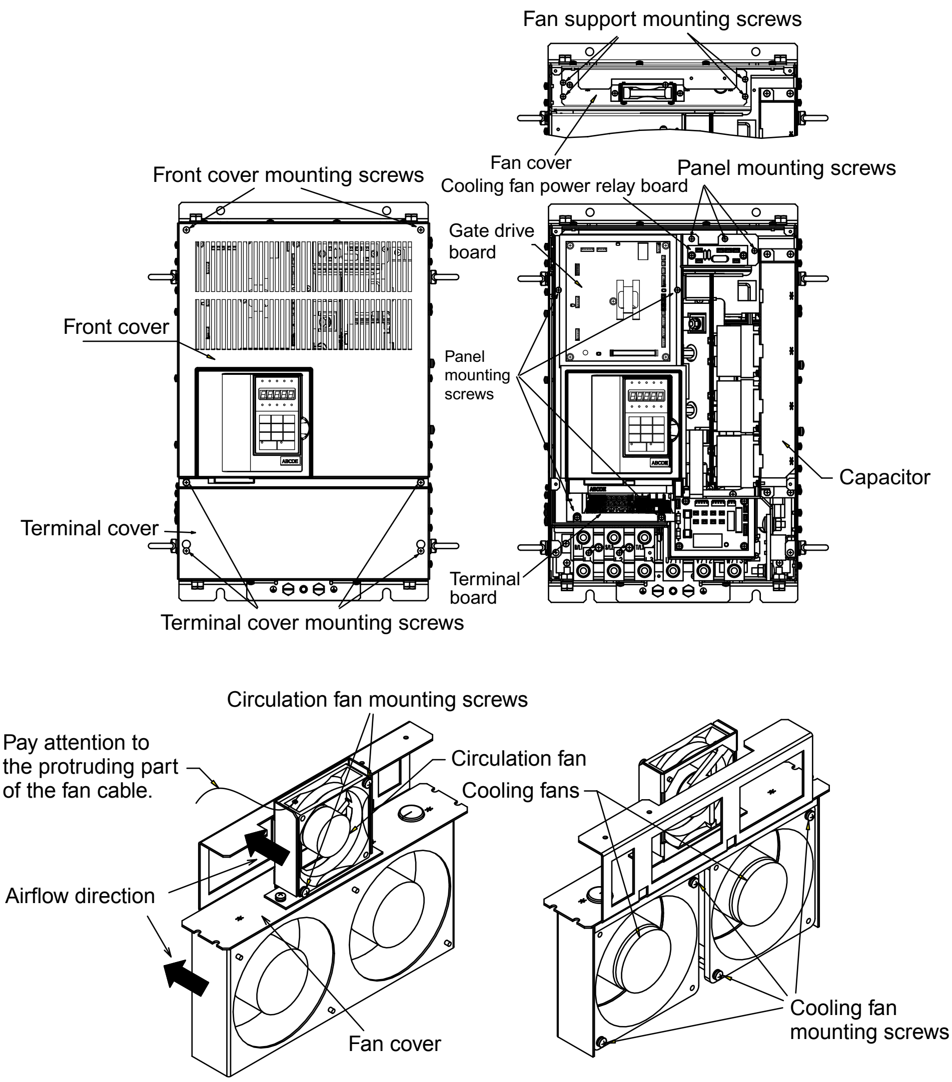


Fig 8.7 Cooling Fan Replacement (200 V Class Inverters of 37 kW and 45 kW)

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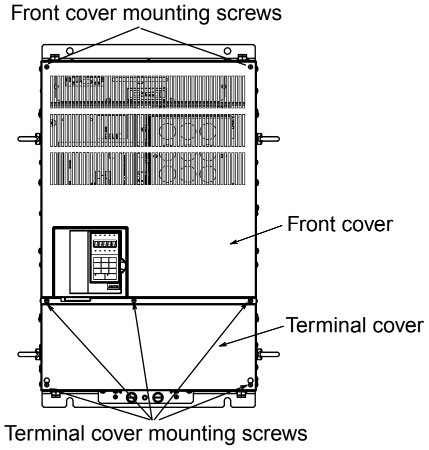
200 V Class Inverters of 90 kW

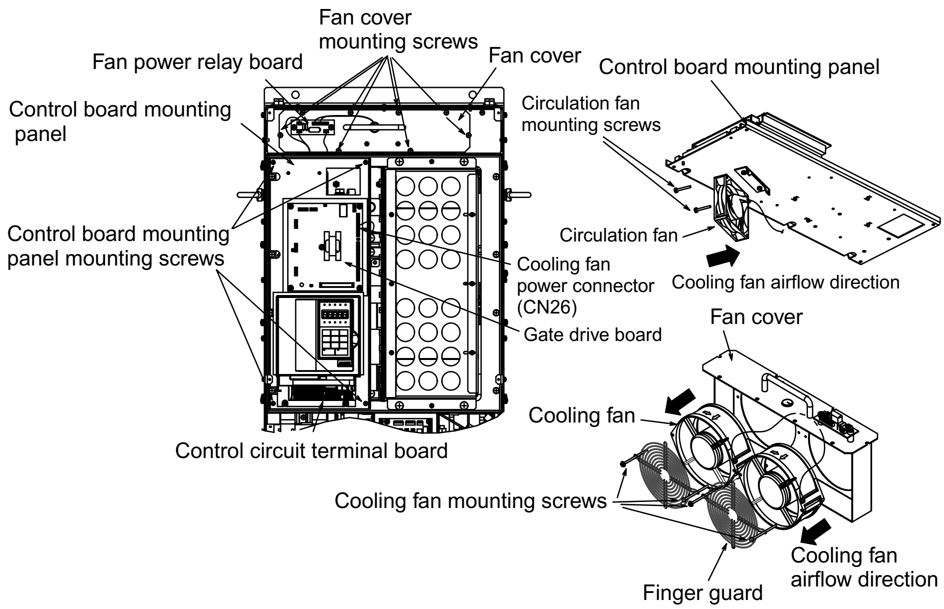
Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove the panel to which the control board, the gate drive board, and the cooling fan power relay board are mounted. Remove any cables that are connected to the control board, the gate drive board, and the cooling fan power relay board. The cable that is connected to the control circuit terminals can be removed together with the control circuit terminal board. (Refer to page 8-20.)
3. Remove the fan cover screws and pull out the fan cover from the Inverter.
4. Remove the cooling fan from the fan cover and replace it with a new one.

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 airflow faces the top of the Inverter.





Note: A finger guard is not provided on Inverter with slits.

Fig 8.8 Cooling Fan Replacement (200 V Class Inverters of 90 kW)

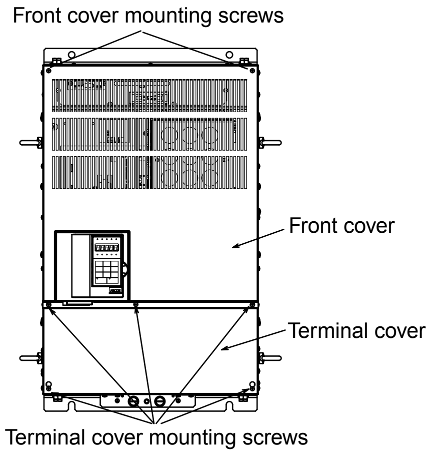
400 V Class Inverters of 110 kW and 132 kW

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove any cables that are connected to the cooling fan power relay board. The cable that is connected to the control circuit terminals can be removed together with the control circuit terminal board. (Refer to page 8-20.)
3. Remove the fan cover screws and pull out the fan cover from the Inverter.
4. Remove the cooling fan from the fan cover and replace it with a new one.

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 airflow faces the top of the Inverter.



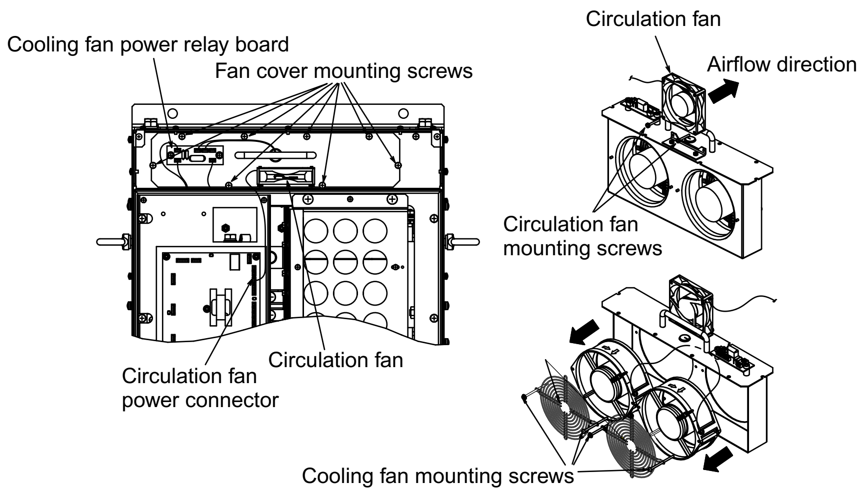


Fig 8.9 Cooling Fan Replacement (400 V Class Inverters of 110 kW)

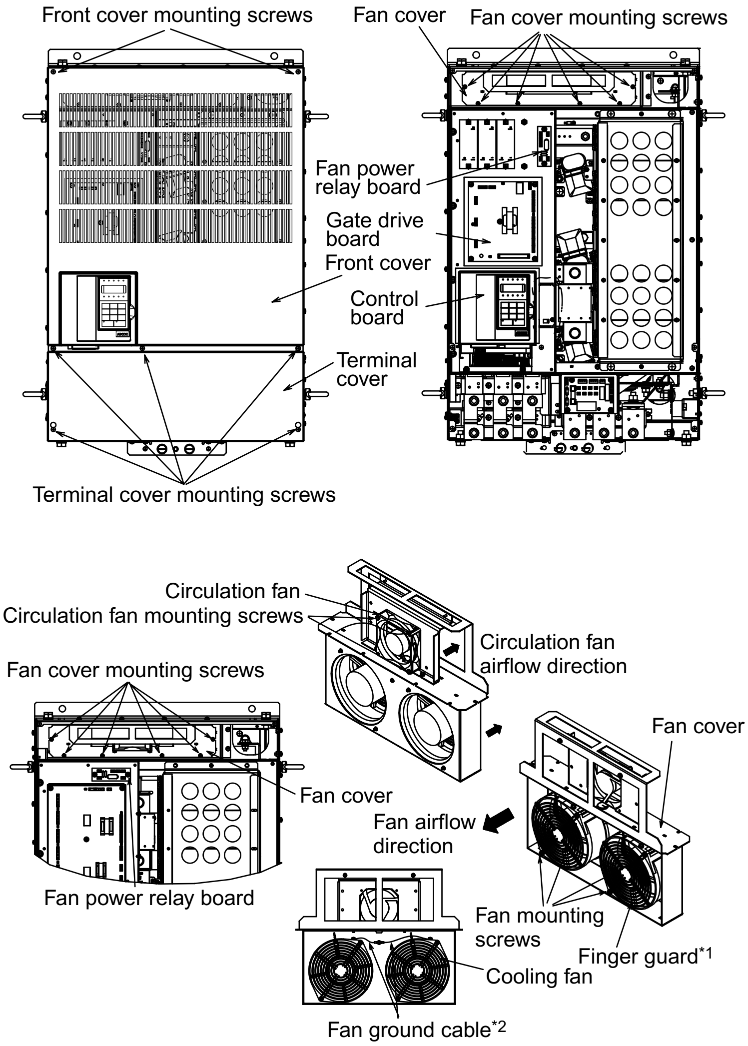
200 V Class Inverters of 110 kW and 400 V Class Inverters of 160 kW

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove any cables that are connected to the cooling fan power relay board. The cable that is connected to the control circuit terminals can be removed together with the control circuit terminal board. (Refer to page 8-20.)
3. Remove the fan cover screws and pull out the fan cover from the Inverter.
4. Remove the cooling fan from the fan cover and replace it with a new one.

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 airflow faces the top of the Inverter.



* 1. There is no finger guard mounted to the fan for some capacities. (There is a guard on the Inverter side.)
* 2. There is no fan ground cable for the capacities without a finger guard.

Fig 8.10 Cooling Fan Replacement (200 V Class Inverters of 110 kW)

400 V Class Inverters of 185 kW and 220 kW

Removing the Cooling Fan

1. Remove the terminal cover and top and bottom front covers from the front of the Inverter.
2. Remove any cables that are connected to the cooling fan power relay board.
3. Remove the fan cover screws and pull out the fan covers from the Inverter.
4. Remove the cooling fan from the fan cover and replace it with a new one.

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 airflow faces the top of the Inverter.
Make sure that the fan cable and the fan ground cable are not tangled or pinched.

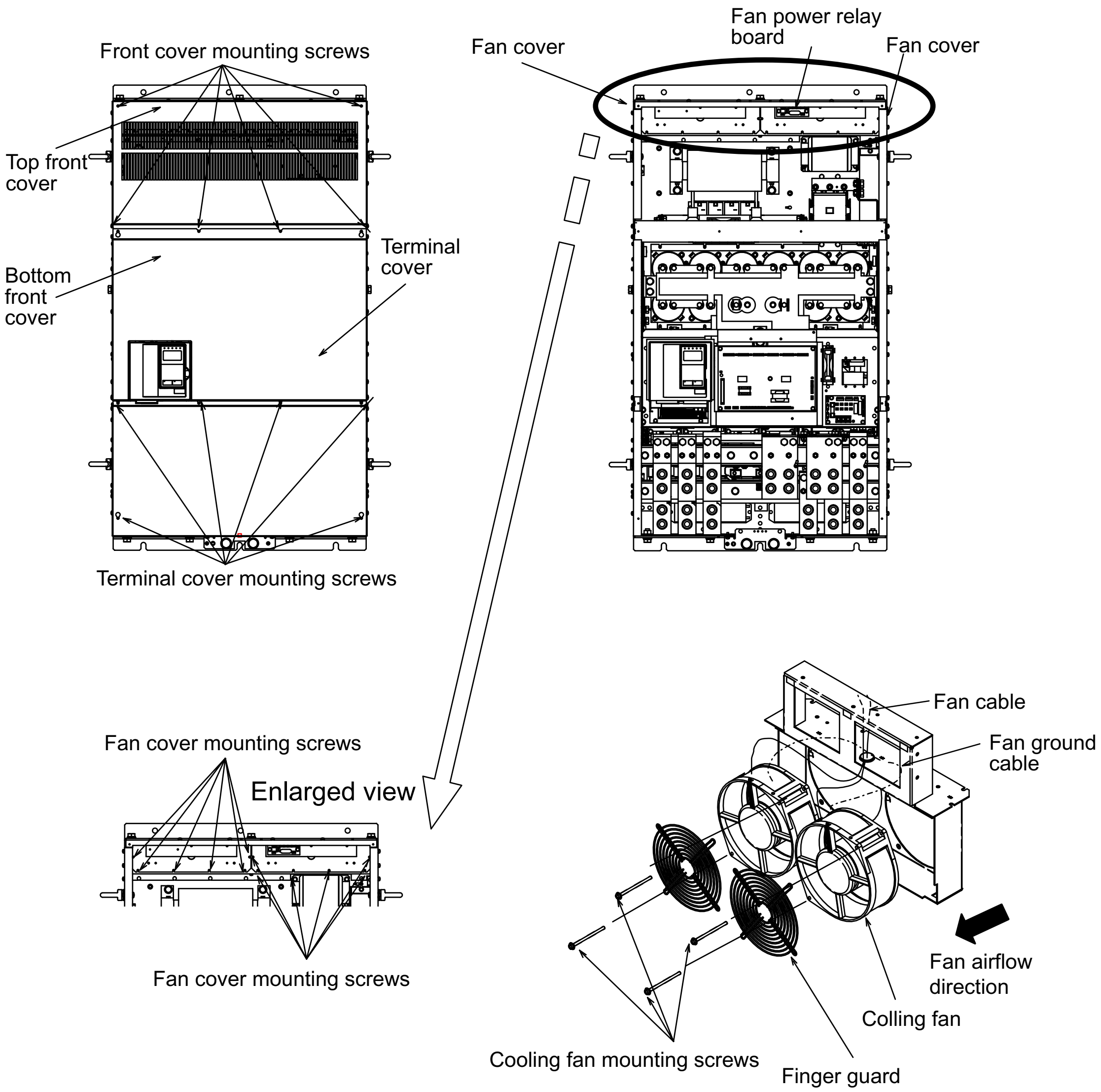


Fig 8.11 Cooling Fan Replacement (400 V Class Inverters of 185 kW and 220 kW)

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400 V Class Inverters of 300 kW

Removing the Cooling Fan

1. Remove the terminal cover, Inverter cover, Digital Operator, and front cover from the front of the Inverter.
2. Remove any cables that are connected to the cooling fan power relay board. The cable that is connected to the terminal board can be removed together with the terminal board.
3. Remove the fan unit screws and pull out the fan units from the Inverter.
4. Replace the fan units with new ones.
   And, remove the screws for the fan power relay board and attach this board to the new unit.

Mounting the Cooling Fan

After attaching a new cooling fan unit, reverse the above procedure to attach all of the components.

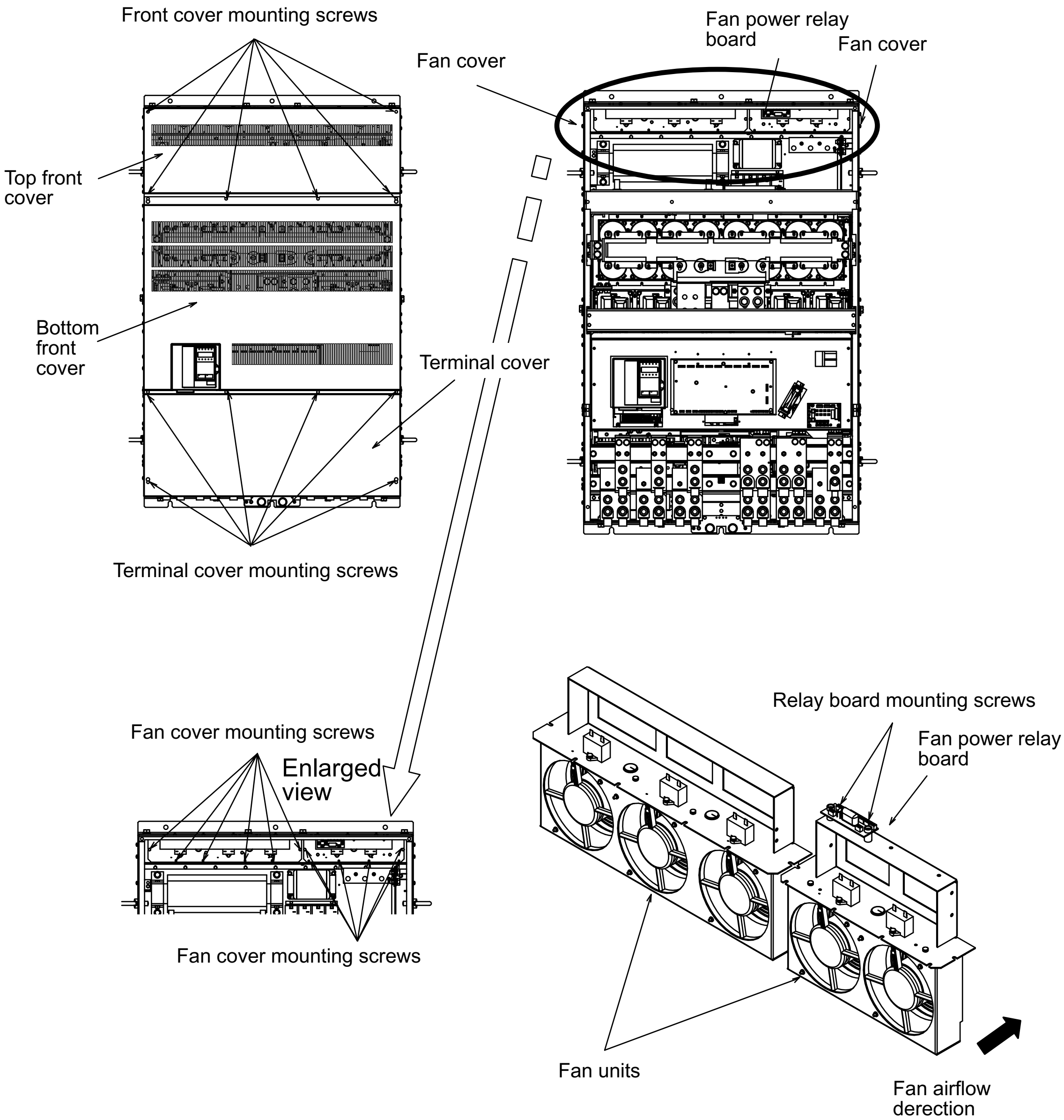


Fig 8.12 Cooling Fan Replacement (400 V Class Inverters of 300 kW)

◆ Circulation Fan Replacement Outline

With some capacities, there is a small fan installed inside the Inverter for the purpose of increasing circulation in areas where heat has built up. These fans have built-in fan sensors that output an alarm when the rotation rate of the fan drops to indicate that replacement is necessary.

■ 200 V and 400 V Class Inverters of 11 kW

The circulation fan is installed behind the control circuit terminal board inside the Inverter.

The circulation fan can be replaced by removing the control circuit terminal board.

Removing the Circulation Fan

1. Remove the Digital Operator, the terminal cover, and the front cover.
2. Remove the control circuit terminal board. Remove the cables connected to the terminals if necessary.
3. While pushing the two tabs (A) in direction 1, pull the fan out in direction 2.
4. Remove the relay connector connected to the fan.

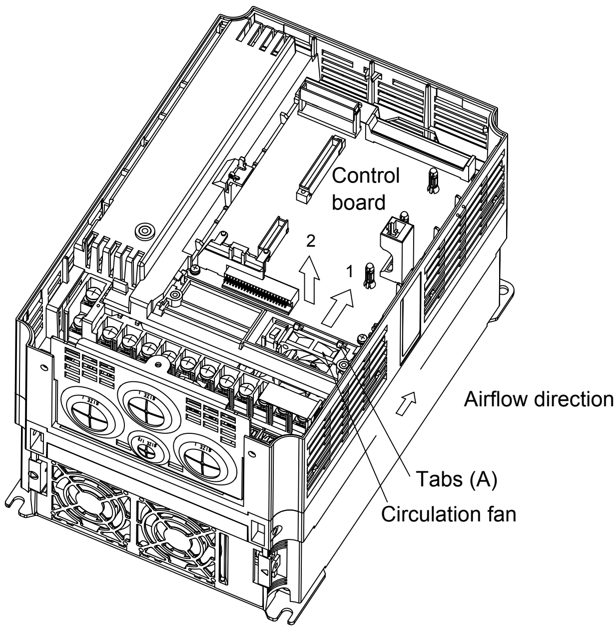
Mounting the Circulation Fan

Reverse the above procedure to mount the fan.

Be sure to mount the fan so that the air flows towards the top of the Inverter (direction indicated by the arrow).

Mount the fan securely using the tabs (A).

Confirm that there are no cables in contact with the fan’s rotating parts.



Inverter with Control Circuit Terminal Board Removed

Fig 8.13 Circulation Fan Replacement (200 V and 400 V Class Inverters of 11 kW)

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■ 200 V and 400 V Class Inverters of 18.5 kW

The circulation fan is installed at the top-left corner of the Inverter interior.

Removing the Circulation Fan

1. Remove the Digital Operator, the terminal cover, and the front cover.
2. While pushing the relay connector tab (A) in direction 1, pull the relay connector out in direction 2.
3. While pushing the fan tabs (B) in direction 3, pull the fan out in direction 2.
4. Remove the relay connector connected to the fan.

Mounting the Circulation Fan

Reverse the above procedure to mount the fan.

Be sure to mount the fan so that the air flows towards the bottom of the Inverter (direction indicated by the arrow).

Mount the fan securely using the fan tabs (B).

Confirm that there are no cables in contact with the fan's rotating parts.

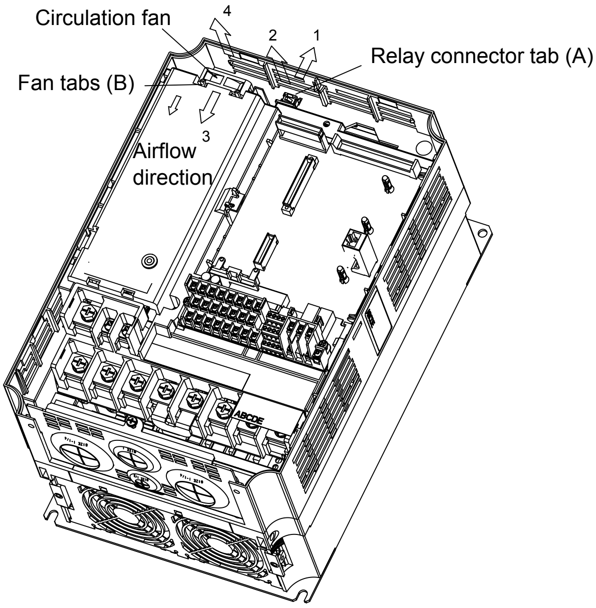


Fig 8.14   Circulation Fan Replacement (200 V and 400 V Class Inverters of 18.5 kW)

■ 200 V Class Inverters of 37 kW or More and 400 V Class Inverters of 75 to 160 kW

The circulation fan is installed in front of the fan cover inside the Inverter. Remove the circulation fan using the procedure for replacing the cooling fan and replace it with the new fan. (The installation position for 200 V Class Inverters of 75 kW is different.)

200 V Class Inverters of 90 kW

The circulation fan is installed behind the control board mounting panel. Do not subject the fan to shock during replacement.

Removing the Circulation Fan

1. Remove the terminal cover, the Inverter cover, the Digital Operator, and the control board cover.
2. Pull out the cables connected to the control circuit terminal board, the gate drive board, and the cooling fan power relay board.
3. Remove the control board mounting panel.
4. Replace the circulation fan installed behind the control board mounting panel.

Mounting the Circulation Fan

Reverse the above procedure to mount the fan.

Be sure to mount the fan so that the air flows in the direction indicated by the arrow in the corresponding diagram.

Confirm that there are no cables in contact with the fan’s rotating parts.

Refer to *Fig 8.8 Cooling Fan Replacement (200 V Class Inverters of 90 kW)* for details.

400 V Class Inverters of 185 kW and 220 kW

Two circulation fans are installed as described in the following sections.

Removing the Circulation Fan

1. Remove the terminal cover and top and bottom front covers.
2. Unscrew the frame fixing screws and take off the frame.
3. Remove the relay connector connected to the fan.
4. Remove the fan cover mounting screws and pull the fan cover out.
5. Remove the fan from the fan cover and replace it with a new one.

Mounting the Circulation Fan

Reverse the above procedure to mount the fan.

Be sure to mount the fan so that the air flows in the direction indicated by the arrow in the corresponding diagram.

Confirm that there are no cables in contact with the fan's rotating parts.

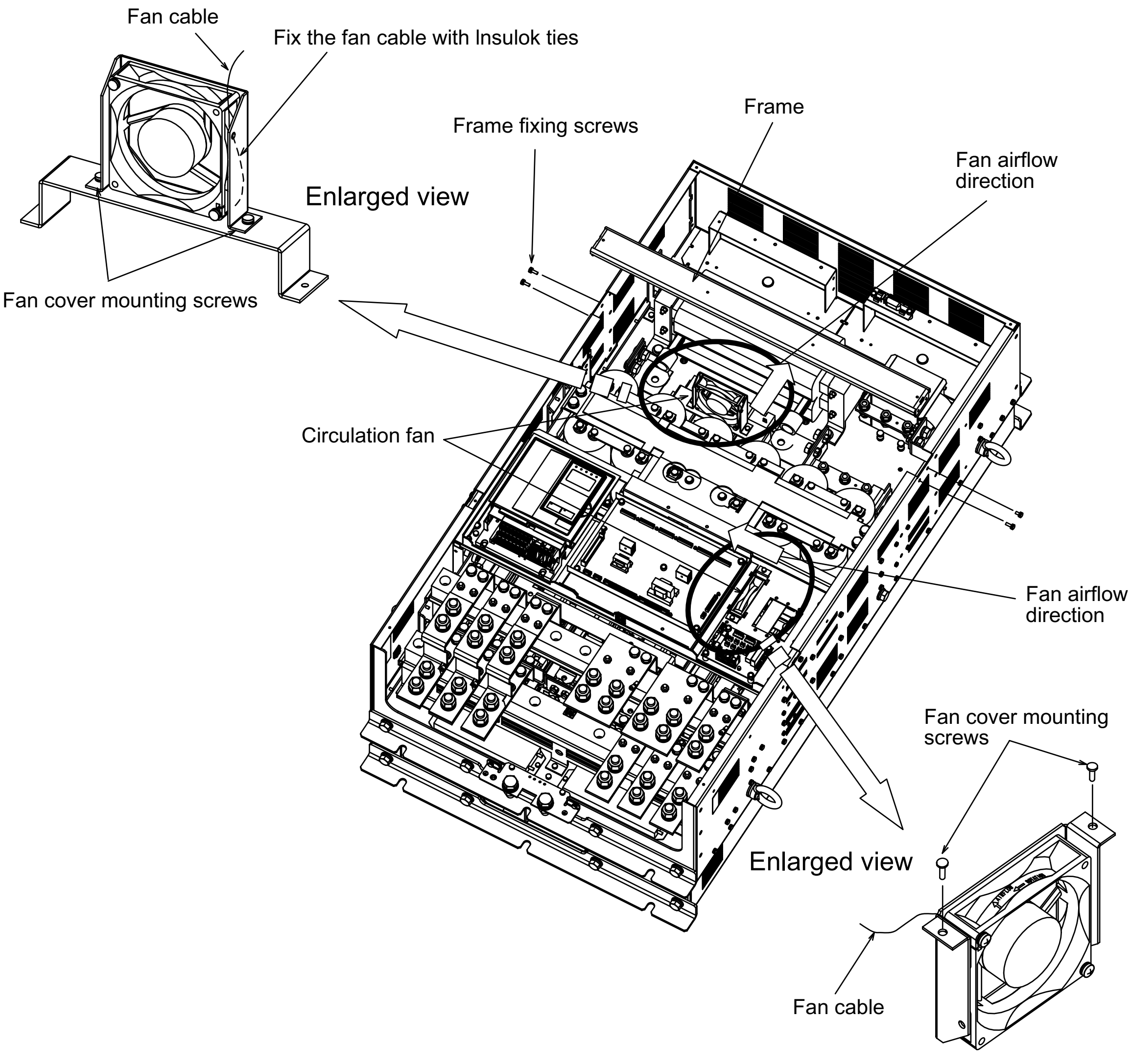


Fig 8.15 Circulation Fan Replacement (400 V Class Inverters of 185 kW and 220 kW)

400 V Class Inverters of 300 kW

Two circulation fans are installed as described in the following sections.

Removing the Circulation Fan

1. Remove the terminal cover and top and bottom front covers.
2. Unscrew the frame fixing screws and takeoff the frame.
3. Remove the relay connector connected to the fan.
4. Remove the fan cover mounting screws and pull the fan cover out.
5. Remove the fan from the fan cover and replace it with a new one.

Mounting the Circulation Fan

Reverse the above procedure to mount the fan.

Be sure to mount the fan so that the air flows in the direction indicated by the arrow in the corresponding diagram.

Confirm that there are no cables in contact with the fan's rotating parts.

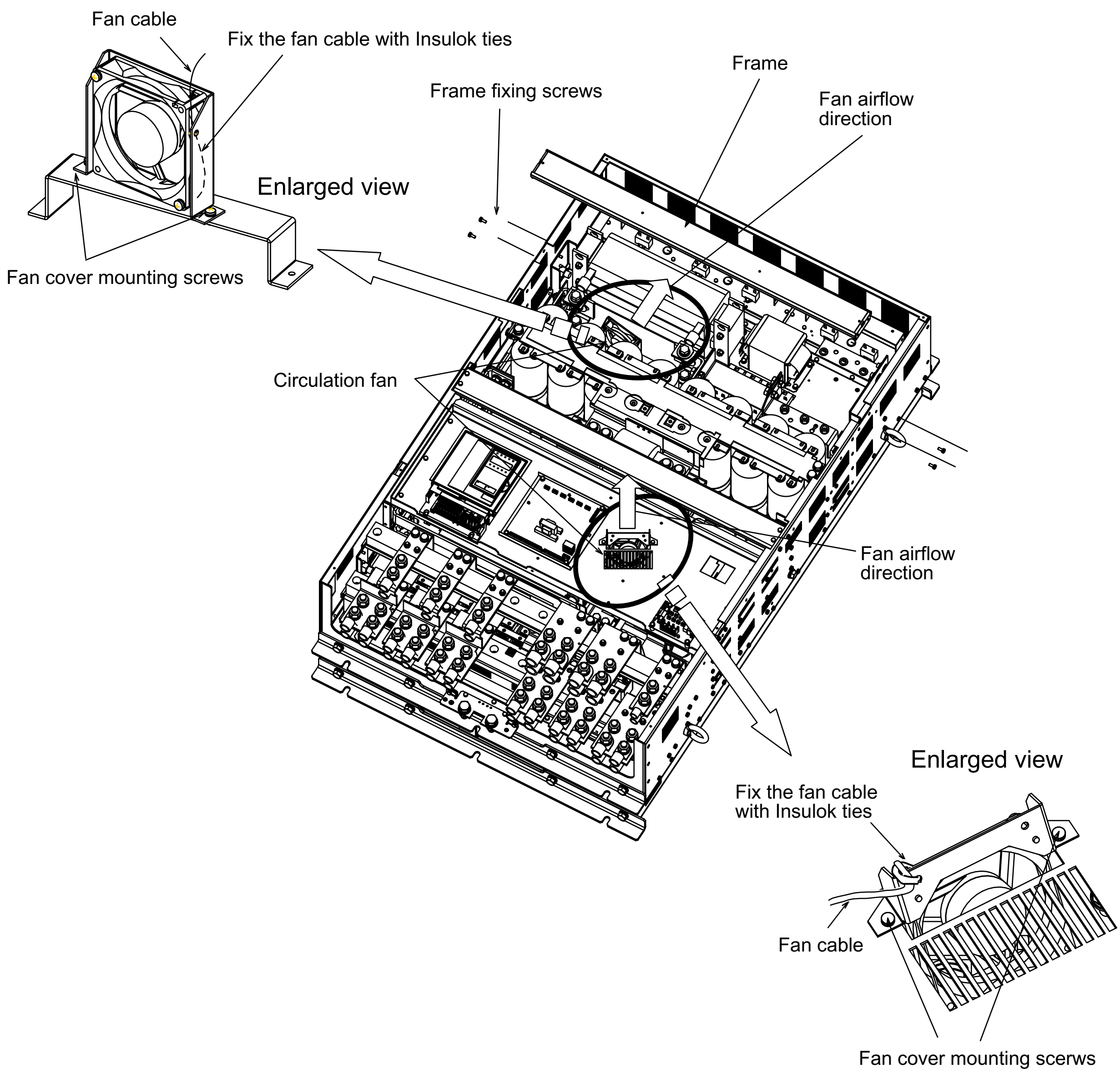


Fig 8.16 Circulation Fan Replacement (400 V Class Inverters of 300 kW)

◆ Removing and Mounting the Control Circuit Terminal Board

The control circuit terminal board 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 board.

■ Removing the Control Circuit Terminal Board

1. Remove the Digital Operator and front cover.
2. Remove the connecting line connectors connected to FE and NC on the control circuit terminal board.
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 board out sideways (in direction 2) with the screws sticking out from the board.

■ Mounting the Control Circuit Terminal Board

Reverse the removal procedure to mount the terminal board.

Confirm that the control circuit terminal board and the control board properly meet at connector CN5 before pressing in on the board.

The connector pins may be bent if the board is forced into place, possibly preventing correct Inverter operation.

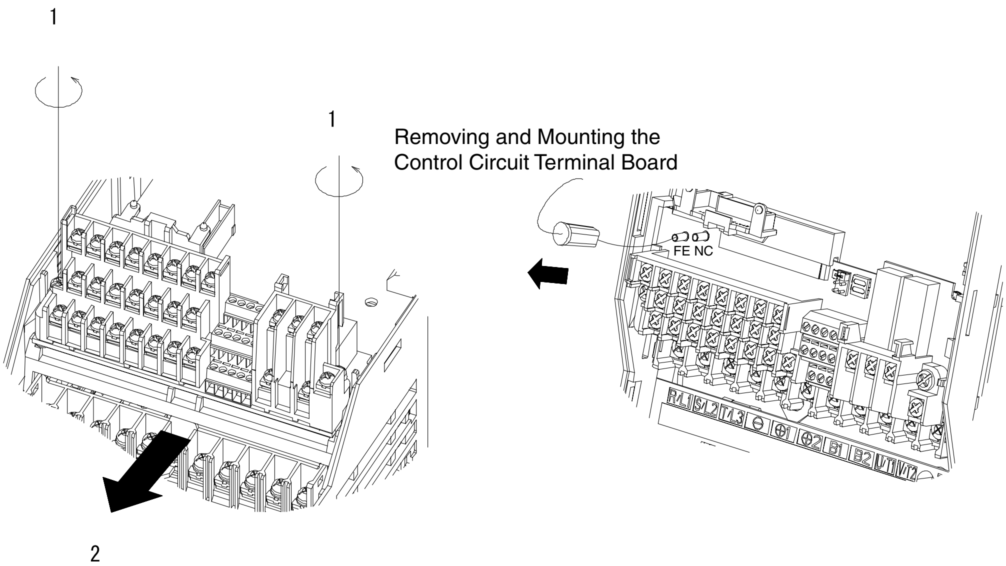


Fig 8.17   Removing the Control Circuit Terminal Board

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-☐-V1		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
Rated input current (A)		3.8	4.9	8.4	11.5	18	24	37	52	68	84	94	120	160	198	237	317	381	457
Output specifi-cations	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): 300 Hz VT (high carrier, variable torque applications): 400 Hz																	VT: 400 Hz
Power supply specifi-cations	Rated voltage (V) Rated fre-quency (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 volt-age fluctuation	-15% to +10%																	
	Allowable fre-quency fluctua-tion	±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	2857	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 sup-ply 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-☐-V1		A4004	A4007	A4015	A4022	A4037	A4055	A4075	A4110	A4150	A4185
Max. applicable motor output (kW)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5
Rated input current (A)		2.2	2.5	4.4	6.4	9.0	15	20	29	37	47
Output specifications	Rated output capacity (kVA)	1.4	1.6	2.8	4	5.8	9.5	13	18	24	30
	Rated output current (A)	1.8	2.1	3.7	5.3	7.6	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): 300 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	12	15	22	28	36
Power consumption (W)		53	58	84	115	148	209	307	410	498	634
Approx. weight (kg)		3.0	3.0	3.0	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-☐-V1		B4220	B4300	B4370	B4450	B4550	B4750	B4900	B411K	B413K	B416K	B418K	B422K	B430K
Max. applicable motor output (kW)		22	30	37	45	55	75	90	110	132	160	185	220	300
Rated input current (A)		50	66	83	100	120	165	198	238	286	334	407	557	743
Output specifications	Rated output capacity (kVA)	34	46	57	69	85	110	140	160	200	230	280	390	510
	Rated output current (A)	45	60	75	91	112	150	180	216	260	304	370	506	675
	Max. output voltage (V)	3-phase, 380 to 480 VAC (Depends on input voltage.)												
	Max. output frequency (Hz)	CT (low carrier, fixed torque applications): 300 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	309	423	565
Power consumption (W)		725	995	1144	1316	1698	1974	2285	2950	3390	3938	4609	5277	8158
Approx. weight (kg)		21	21	36	36	36	88	89	102	120	160	260	280	405
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.

9

◆ Common Specifications

The following specifications apply to both 200 V and 400 V Class Inverters.

Table 9.3 Common Specifications

	Model Number 3G3RV-☐-V1	Specification
Control characteristics	Control method	Sine wave PWM Flux vector control, Open-loop vector control, V/f control, V/f with PG control (switched by parameter setting)
	Torque characteristics	CT selected (low carrier, constant torque applications): 150% /0.5 Hz (Open-loop vector control) VT selected (high carrier, variable torque applications): 120%/0.5 Hz (Open-loop vector control) CT selected (low carrier, constant torque applications): 150%/0 min^{-1} (Flux vector control) VT selected (high carrier, variable torque applications): 120%/0 min^{-1} (Flux vector control)
	Speed control range	1:100 (Open-loop vector control), 1:1000 (Flux vector control) *1
	Speed control accuracy *4	±0.2% (25°C ± 10°C, Open-loop vector control), ±0.02% (25°C ± 10°C, Flux vector control) *1
	Speed control response	5 Hz (Open-loop vector control), 40 Hz (Flux vector control) *1
	Torque limits	Provided for vector control only (4 quadrant steps can be changed by parameter settings.)
	Torque accuracy *4	±5%
	Frequency control range	0.01 to 300 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) 0.03 Hz/60 Hz (±11 bit)
	Output frequency resolution	0.001 Hz
	Overload capacity and maximum current*2	CT selected (low carrier, constant torque applications): 150% of rated output current per minute*3, *6 VT selected (high carrier, variable torque applications): 120% of rated output current per minute *6
	Frequency setting signal	-10 to +10V, 0 to 10 V, 4 to 20 mA, pulse train
	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 *5, braking transformer built into 200 V and 400 V Class Inverters for 18.5 kW or less.)
	Main control functions	Restarting for momentary power loss, speed searches, overtorque detection, torque limits, 17-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, Communications (RS-485/422, 19.2 kbps maximum), fault reset, Droop control, function copying, torque control, speed/torque control switching, etc.
Protective functions	Motor protection	Protection by electronic thermal overload relay.
	Instantaneous overcurrent protection	Stops at approx. 200% of rated output current.
	Fuse blown protection	Stops for fuse blown.
	Overload protection	CT selected (low carrier, constant torque applications): 150% of rated output current per minute*3 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 applox. 410 V. 400 Class Inverter: Stops when main-circuit DC voltage is above applox. 820 V.
	Undervoltage protection	200 Class Inverter: Stops when main-circuit DC voltage is below applox. 190 V. 400 Class Inverter: Stops when main-circuit DC voltage is below applox. 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.
	Stall prevention	Stall prevention during acceleration, deceleration, or running.
	Grounding protection*7	Protection by electronic circuits. (Overcurrent level)
	Charge indicator	Lit when the main circuit DC voltage is approx. 50 V or more.
Environment	Ambient operating temperature	-10°C to 40°C (Enclosed 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)
	Application site	Indoor (no corrosive gas, dust, etc.)
	Altitude	1000 m max.
	Vibration	10 to 20 Hz: 9.8 m/s^2 20 to 50 Hz: 2.0 m/s^2
	Protective structure	Enclose, wall-mounting (NEMA1 (Type 1): Equivalent to IP20) or Mounted in a panel (equivalent to IP00) Mounted in a panel (equivalent to IP00)

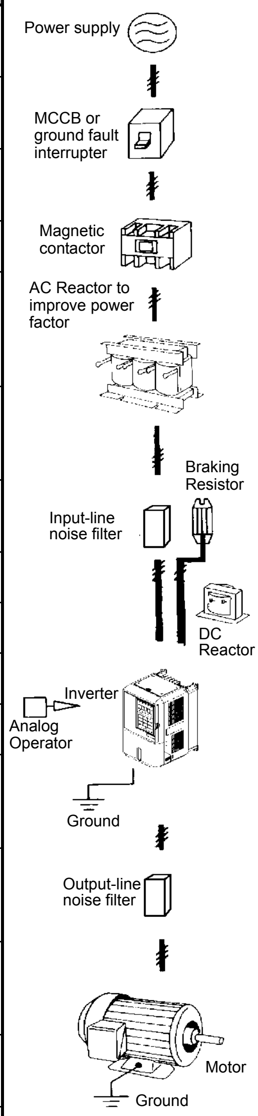
* 1. Rotational autotuning must be performed to ensure obtaining the specifications given for flux or open-loop vector control.
* 2. Increase the Inverter capacity if loads exceeding these current values are expected.
* 3. Only VT can be set for 200 V Class 110 kW as well as 400 V Class 220 kW and 300 kW Inverters.
* 4. The speed control accuracy depends on the installation condition and types of motor used. Contact your Yaskawa representative for details.
* 5. When connecting a Braking Resistor or Braking Resistor Unit, set L3-04 (Stall prevention selection during deceleration) to 0 (disabled). Stopping may not be possible in the specified deceleration time if this function is not disabled.
* 6. Derating is required for applications that use repetitive loads. (Refer to page 10-6 for details.)
* 7. The ground fault here is one which occurs in the motor wiring while the motor is running. A ground fault may not be detected in the following cases.
  - A ground fault with low resistance which occurs in motor cables or terminals.
  - A ground fault occurs when the power is turned ON.

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	J7L 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.
	Input Noise Filter for EMC Directives	3G3RV-PFS□	Used to conform to the EC Directive on electromagnetic compatibility (EMC).
	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□	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-PP00□	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	K3MA-J	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)

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.

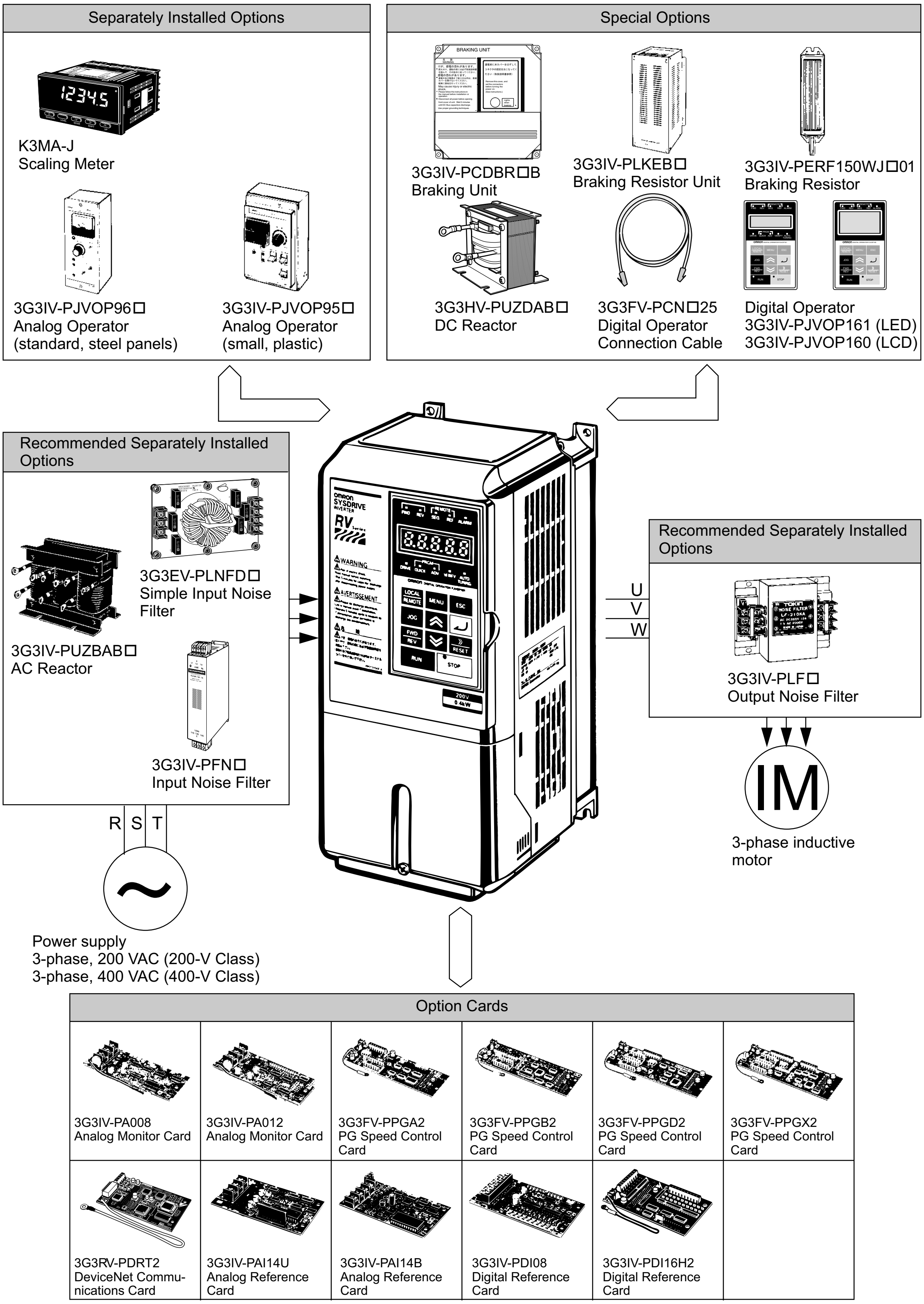


Fig 9.1 Options and Peripheral Devices

Table 9.5 Options and Peripheral Devices

Type	Name	Model number	Application
Special Mounted Options	Fan Unit	3G3RV-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	K3MA-J	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 18.5 kW or less.
	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.
	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 22 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
	Analog Reference Card	3G3IV-PAI14U	Enables high-precision, high-resolution setting of analog speed references. • Input signal ranges: 0 to 10 V (20 kΩ), 1 channel 4 to 20 mA (250 Ω), 1 channel • Input resolution: 14-bit (1/16384)
		3G3IV-PAI14B	Enables high-precision, high-resolution setting of analog speed references. • Input signal ranges: −10 to 10 V (20 kΩ) 4 to 20 mA (500 Ω), 3 channels • Input resolution: 13-bit + sign (1/8192)
	Digital Reference Card	3G3IV-PDI08	Enables 8-bit digital setting of speed references. • Input signal: 8-bit binary 2-digit BCD + sign signal + set signal • Input voltage: +24 V (isolated) • Input current: 8 mA
		3G3IV-PDI16H2	Enables 16-bit digital setting of speed references. • Input signal: 16-bit binary 4-digit BCD + sign signal + set signal • Input voltage: +24 V (isolated) • Input current: 8 mA With 16-bit/12-bit switch.
Option Cards	Analog Monitor Cards	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	3G3RV-PDRT2	Used for DeviceNet communications with a Programmable Controller or other DeviceNet master device.
Recommended Separately Installed Options*	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)	3G3RV-PLF□	Controls noise generated by the Inverter so it does not enter the power supply. Connected to the motor output side.

* Recommended Options can be ordered from OMRON using the above model numbers.

◆ 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.

<table>
<tr><th colspan="3">Inverter</th><th colspan="2">Replacement External Cooling Fan</th><th colspan="2">Replacement Internal Cooling Fan</th></tr>
<tr><th>Voltage Class</th><th>Max. Applicable Motor Capacity (kW)</th><th>Model No.</th><th>Model No.</th><th>Qty Used</th><th>Model No.</th><th>Qty Used</th></tr>
<tr><td rowspan="18">3-phase, 200 VAC</td><td>0.4</td><td>3G3RV-A2004-V1</td><td rowspan="4">No Fan</td><td rowspan="4">-</td><td rowspan="7">No Fan</td><td rowspan="7">-</td></tr>
<tr><td>0.75</td><td>3G3RV-A2007-V1</td></tr>
<tr><td>1.5</td><td>3G3RV-A2015-V1</td></tr>
<tr><td>2.2</td><td>3G3RV-A2022-V1</td></tr>
<tr><td>3.7</td><td>3G3RV-A2037-V1</td><td rowspan="2">3G3RV-PFAN001</td><td rowspan="2">1</td></tr>
<tr><td>5.5</td><td>3G3RV-A2055-V1</td></tr>
<tr><td>7.5</td><td>3G3RV-A2075-V1</td><td rowspan="2">3G3RV-PFAN002</td><td rowspan="2">2</td></tr>
<tr><td>11</td><td>3G3RV-A2110-V1</td><td>3G3RV-PFAN003</td><td>1</td></tr>
<tr><td>15</td><td>3G3RV-A2150-V1</td><td rowspan="2">3G3RV-PFAN004</td><td rowspan="2">2</td><td>No Fan</td><td>-</td></tr>
<tr><td>18.5</td><td>3G3RV-A2185-V1</td><td>3G3RV-PFAN003</td><td>1</td></tr>
<tr><td>22</td><td>3G3RV-B2220-V1</td><td rowspan="2">3G3RV-PFAN005</td><td rowspan="2">2</td><td rowspan="2">No Fan</td><td rowspan="2">-</td></tr>
<tr><td>30</td><td>3G3RV-B2300-V1</td></tr>
<tr><td>37</td><td>3G3RV-B2370-V1</td><td rowspan="2">3G3RV-PFAN006</td><td rowspan="2">2</td><td rowspan="2">3G3RV-PFAN007</td><td rowspan="2">1</td></tr>
<tr><td>45</td><td>3G3RV-B2450-V1</td></tr>
<tr><td>55</td><td>3G3RV-B2550-V1</td><td>3G3RV-PFAN008</td><td>2</td><td rowspan="4">3G3RV-PFAN009</td><td rowspan="4">1</td></tr>
<tr><td>75</td><td>3G3RV-B2750-V1</td><td>3G3RV-PFAN011</td><td>2</td></tr>
<tr><td>90</td><td>3G3RV-B2900-V1</td><td>3G3RV-PFAN018</td><td>2</td></tr>
<tr><td>110</td><td>3G3RV-B211K-V1</td><td>3G3RV-PFAN013</td><td>2</td></tr>
<tr><td rowspan="26">3-phase, 400 VAC</td><td>0.4</td><td>3G3RV-A4004-V1</td><td rowspan="3">No Fan</td><td rowspan="3">-</td><td rowspan="6">No Fan</td><td rowspan="6">-</td></tr>
<tr><td>0.75</td><td>3G3RV-A4007-V1</td></tr>
<tr><td>1.5</td><td>3G3RV-A4015-V1</td></tr>
<tr><td>2.2</td><td>3G3RV-A4022-V1</td><td rowspan="3">3G3RV-PFAN001</td><td rowspan="3">1</td></tr>
<tr><td>3.7</td><td>3G3RV-A4037-V1</td></tr>
<tr><td>5.5</td><td>3G3RV-A4055-V1</td></tr>
<tr><td>7.5</td><td>3G3RV-A4075-V1</td><td rowspan="2">3G3RV-PFAN002</td><td rowspan="2">2</td><td>3G3RV-PFAN003</td><td>1</td></tr>
<tr><td>11</td><td>3G3RV-A4110-V1</td><td>No Fan</td><td>-</td></tr>
<tr><td>15</td><td>3G3RV-A4150-V1</td><td rowspan="2">3G3RV-PFAN004</td><td rowspan="2">2</td><td>3G3RV-PFAN003</td><td>1</td></tr>
<tr><td>18.5</td><td>3G3RV-A4185-V1</td><td rowspan="6">No Fan</td><td rowspan="6">-</td></tr>
<tr><td>22</td><td>3G3RV-B4220-V1</td><td rowspan="2">3G3RV-PFAN005</td><td rowspan="2">2</td></tr>
<tr><td>30</td><td>3G3RV-B4300-V1</td></tr>
<tr><td>37</td><td>3G3RV-B4370-V1</td><td rowspan="3">3G3RV-PFAN010</td><td rowspan="3">2</td></tr>
<tr><td>45</td><td>3G3RV-B4450-V1</td></tr>
<tr><td>55</td><td>3G3RV-B4550-V1</td></tr>
<tr><td>75</td><td>3G3RV-B4750-V1</td><td rowspan="2">3G3RV-PFAN008</td><td rowspan="2">2</td><td rowspan="6">3G3RV-PFAN009</td><td rowspan="6">1</td></tr>
<tr><td>90</td><td>3G3RV-B4900-V1</td></tr>
<tr><td>110</td><td>3G3RV-B411K-V1</td><td rowspan="2">3G3RV-PFAN019</td><td rowspan="2">2</td></tr>
<tr><td>132</td><td>3G3RV-B413K-V1</td></tr>
<tr><td>160</td><td>3G3RV-B416K-V1</td><td>3G3RV-PFAN013</td><td>2</td></tr>
<tr><td rowspan="2">185</td><td rowspan="2">3G3RV-B418K-V1</td><td>3G3RV-PFAN014</td><td>2</td></tr>
<tr><td>3G3RV-PFAN019</td><td>2</td><td>3G3RV-PFAN017</td><td>1</td></tr>
<tr><td rowspan="2">220</td><td rowspan="2">3G3RV-B422K-V1</td><td>3G3RV-PFAN014</td><td>2</td><td>3G3RV-PFAN009</td><td>1</td></tr>
<tr><td>3G3RV-PFAN019</td><td>2</td><td>3G3RV-PFAN017</td><td>1</td></tr>
<tr><td rowspan="2">300</td><td rowspan="2">3G3RV-B430K-V1</td><td rowspan="2">3G3RV-PFAN022</td><td rowspan="2">1</td><td>3G3RV-PFAN009</td><td>1</td></tr>
<tr><td>3G3RV-PFAN015</td><td>1</td></tr>
</table>

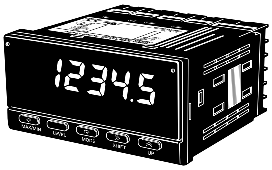
Refer to *Chapter 8 Maintenance and Inspection* for the Fan Unit replacement procedure.

◆ 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.



K3MA-J

Standard Models and Application

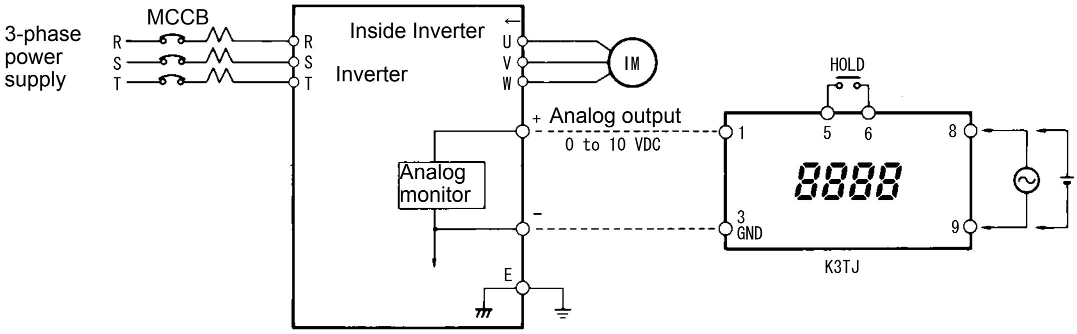
Input type	Output	Supply Voltage	
		100 to 240 VAC (50/60 Hz)	24 VAC (50/60 Hz), 24 VDC
DC voltage/ current	None	K3MA-J: 100 to 240 VAC	K3MA-J: 24 VDC/VAC
	2 relay contact outputs, SPST-NO	K3MA-J-A2:100-240 VAC	K3MA-J-A2: 24 VDC/VAC

Standard Specifications

Input signal	DC voltage/current (0 to 20 mA, 4 to 20 mA, 0 to 5 V, 1 to 5 V, ±5 V, ±10 V)
Measurement method	Double integral method
Input impedance	Current input: 45 Ω max., Voltage input: 1 MΩ min.
Sampling period	250 ms
Display refresh period	Sampling period (sampling times multiplied by number of measurements for averaging if average processing is selected.)
Max. displayed digits	5 digits (–19999 to 99999)
Display	7-segment digital display
Polarity display	"–" is displayed automatically with a negative input signal.
Zero display	Leading zeros are suppressed.
Scaling function	Programmable with front-panel key inputs (The display range depends on the maximum number of display digits). The decimal point position can be set as desired.
Hold function	Max. hold (maximum value), Min. hold (minimum value)
Hysteresis setting	Programmable with front-panel key inputs (0001 to 9999).
Other functions	Forced-zero (with front-panel key) Zero-limit Scaling teach function Display color change (green (red), green, red (green), red) OUT type change (upper limit, lower limit, upper/lower limit) Average processing (simple average)
Output	Relays: DPST-NO
Delay in comparative outputs	750 ms max.
Degree of protection	Front panel: NEMA4X for indoor use (equivalent to IP66) Rear case: IEC standard IP20 Terminals: IEC standard IP00 + finger protection (VDE0106/100)
Memory protection	Non-volatile memory (EEPROM) (possible to rewrite 100,000 times)

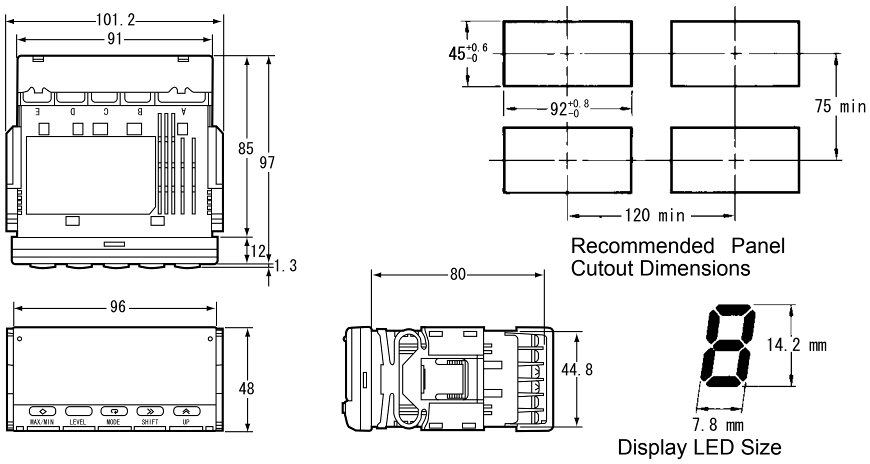
Wiring Example

A wiring example for a Scaling Meter is shown below.



Dimensions

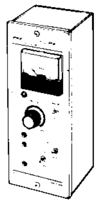
The dimensions of a Scaling Meter are given below.



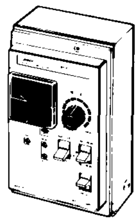
Weight: 200 g

■ 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)

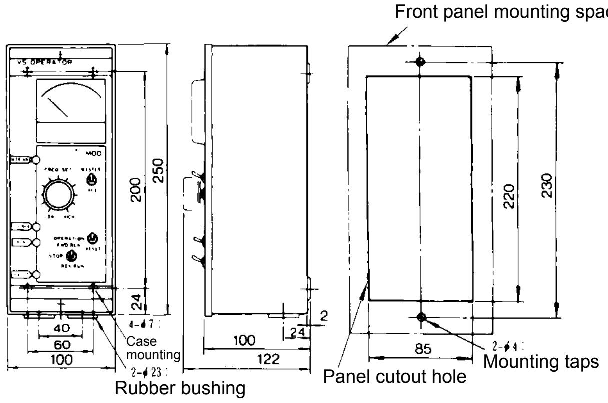
Models and Application

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

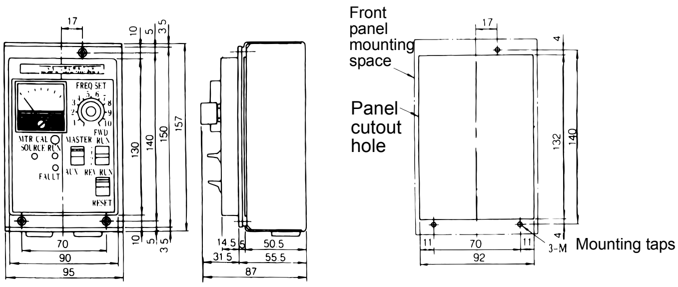
The dimensions of an Analog Operator are given below.



Weight: 1.8 kg

Panel Cutout

Standard Analog Operator with Steel Panels



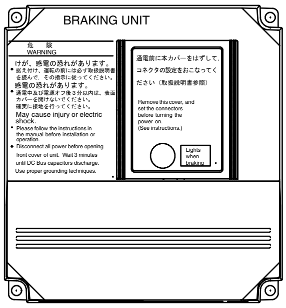
Weight: 0.8 kg

Panel Cutout

Small Plastic Analog Operator

■ 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-PCDBR2022B	1	6.4
	30	3G3IV-PCDBR2015B	2	9.6
	37	3G3IV-PCDBR2015B	2	9.6
	45	3G3IV-PCDBR2022B	2	6.4
	55	3G3IV-PCDBR2022B	2	6.4
	75	3G3IV-PCDBR2110B	1	1.6
	90	3G3IV-PCDBR2110B	1	1.6
	110	3G3IV-PCDBR2110B	1	1.6
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-PCDBR4030B	1	19.2
	30	3G3IV-PCDBR4030B	1	19.2
	37	3G3IV-PCDBR4045B	1	12.8
	45	3G3IV-PCDBR4045B	1	12.8
	55	3G3IV-PCDBR4030B	2	19.2
	75	3G3IV-PCDBR4045B	2	12.8
	90	3G3IV-PCDBR4220B	1	3.2
	110	3G3IV-PCDBR4220B	1	3.2
	132	3G3IV-PCDBR4220B	1	3.2
	160	3G3IV-PCDBR4220B	1	3.2
	180	3G3IV-PCDBR4220B	1	3.2
	220	3G3IV-PCDBR4220B	1	3.2
	300	3G3IV-PCDBR4220B	2	3.2

* 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.

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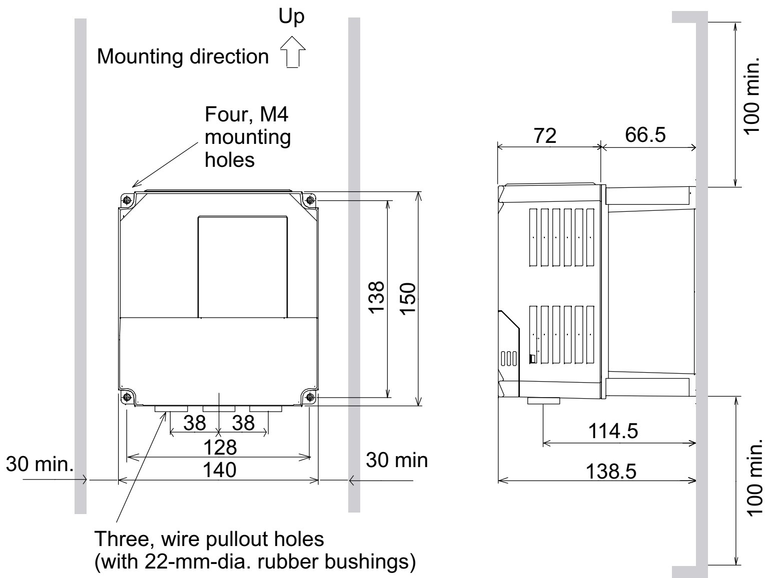
Dimensions

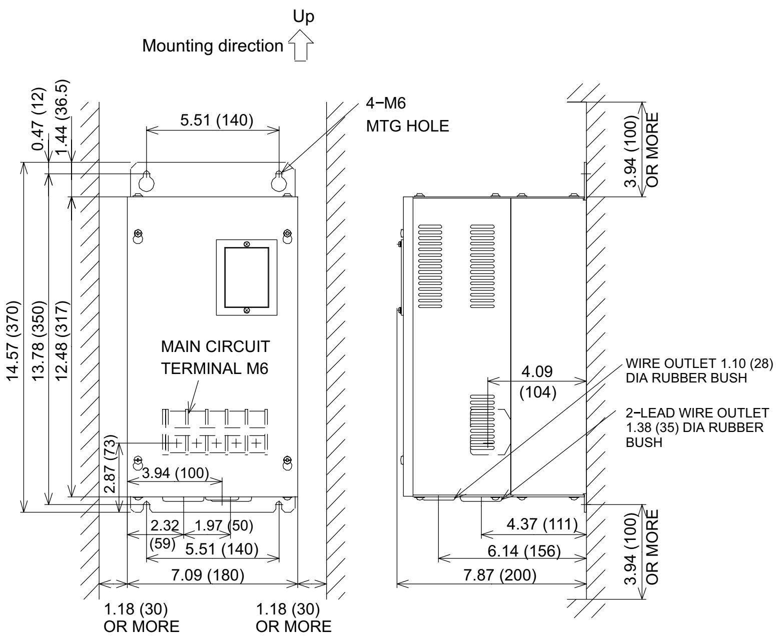
The dimensions of a Braking Unit are given below.

3G3IV-PCDBR2015B/PCDBR2022B

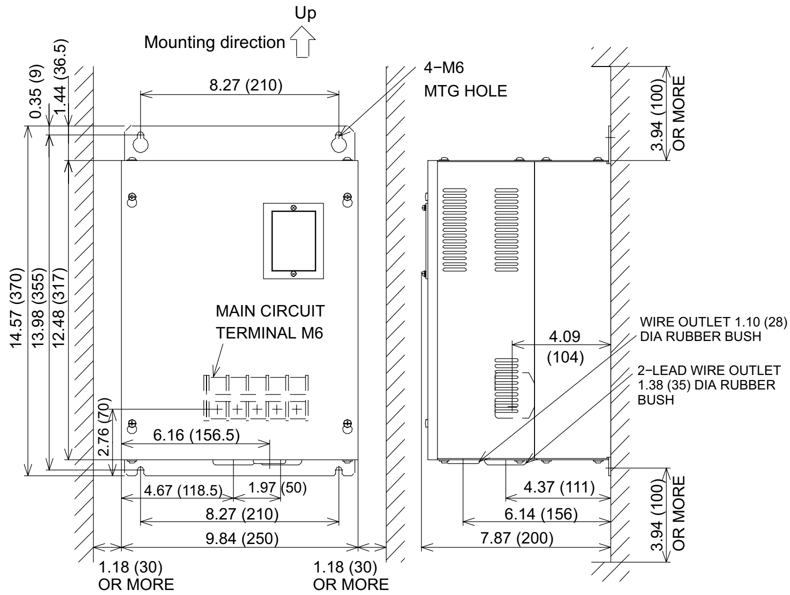
3G3IV-PCDBR4030B/PCDBR4045B



3G3IV-PCDBR2110B



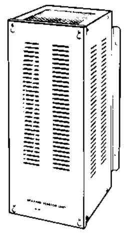
3G3IV-PCDBR4220B



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

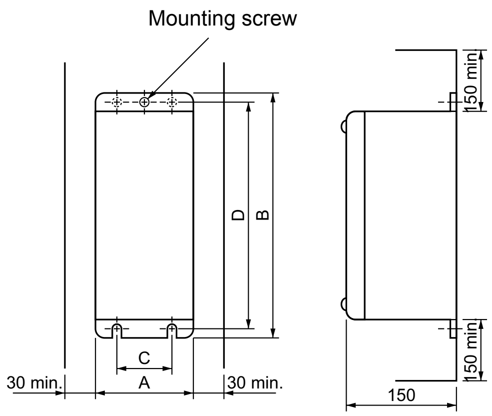
The standard models of Braking Resistor Units are listed below.

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, 70 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-PLKEB4030	9600 W, 13.6 Ω	3	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
	180	3G3IV-PLKEB4045	9600 W, 13.6 Ω	4	120
	220	3G3IV-PLKEB4037	9600 W, 16 Ω	5	110
	300	3G3IV-PLKEB4045	9600 W, 13.6 Ω	6	110

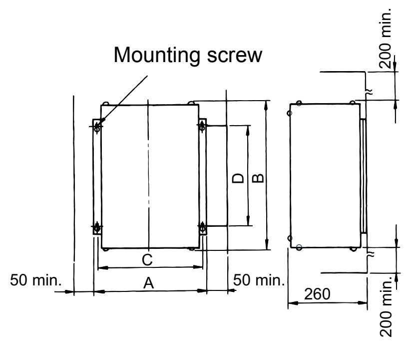
Dimensions

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	350	412	330	325	M6 × 4	16
	4015	2	350	412	330	325	M6 × 4	18
	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



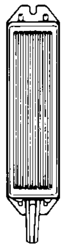
Dimensions Diagram 1



Dimensions Diagram 2

■ 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

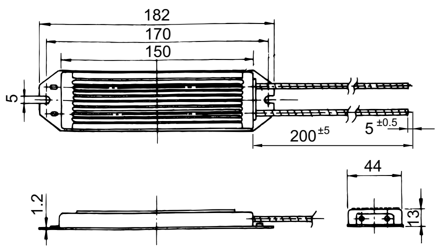
The standard models of Braking Resistors are listed below.

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, 200 Ω	1	110*

* Application rate: 2%ED

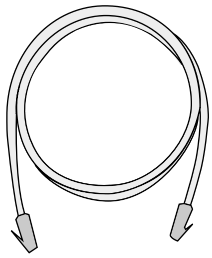
Dimensions

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.



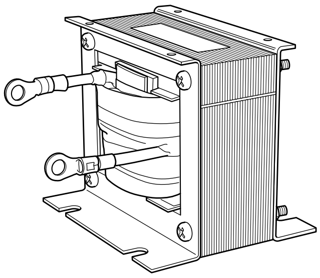
3G3IV-PCN□26

Models and Application

Model No.	Specifications
3G3IV-PCN126	Cable length: 1 m
3G3IV-PCN326	Cable length: 3 m

■ 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

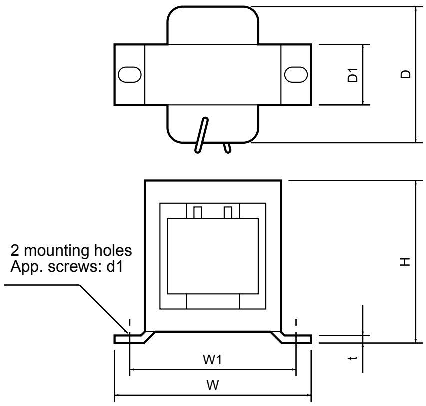
The standard models of DC Reactors are listed below.

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

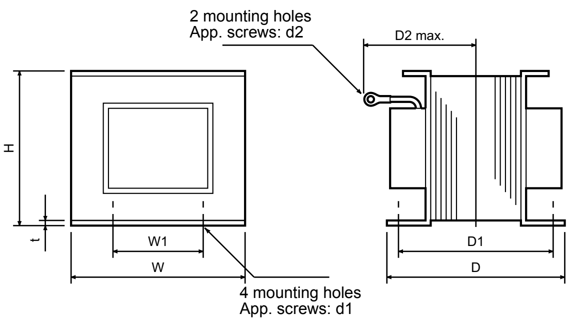
Dimensions

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

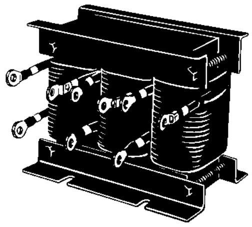


Dimensions Diagram 2

9

■ 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

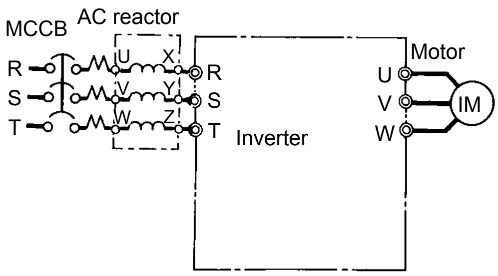
The standard models of AC Reactors are listed in the following table.

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
	75	3G3IV-PUZBAB360A0.026MH	360	0.026	145
	90	3G3IV-PUZBAB500A0.02MH	500	0.02	200
	110	3G3IV-PUZBAB500A0.02MH	500	0.02	200
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

Inverter		AC Reactor			
Voltage Class	Max. Applicable Motor Capacity (kW)	Model No.	Current (A)	Inductance (mH)	Loss (W)
400-V Class	75	3G3IV-PUZBAB200A0.11MH	200	0.11	135
	90	3G3IV-PUZBAB250A0.09MH	250	0.09	135
	110	3G3IV-PUZBAB250A0.09MH	250	0.09	135
	130	3G3IV-PUZBAB330A0.06MH	330	0.06	200
	160	3G3IV-PUZBAB330A0.06MH	330	0.06	200
	180	3G3IV-PUZBAB490A0.04MH	490	0.04	340
	220	3G3IV-PUZBAB490A0.04MH	490	0.04	340
	300	3G3IV-PUZBAB660A0.03MH	660	0.03	310

Wiring Example

A wiring example for an AC Reactor is shown below.

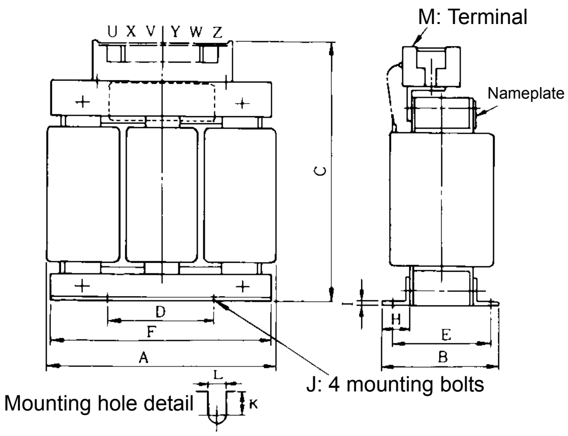


Dimensions

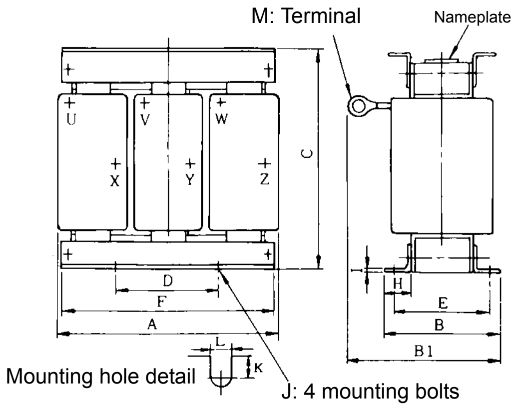
The dimensions of a DC Reactor are given below.

Model 3G3IV -PUZBAB□	Dimensions 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
360A0.026MH		270	162	241	230±5	150	130	260	40	M8	16	10	M12	32
500A0.02MH	3	330	162	286	315±5	150	130	320	40	M10	16	10	M12	55
500A0.02MH		330	162	286	315±5	150	130	320	40	M10	16	10	M12	55
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

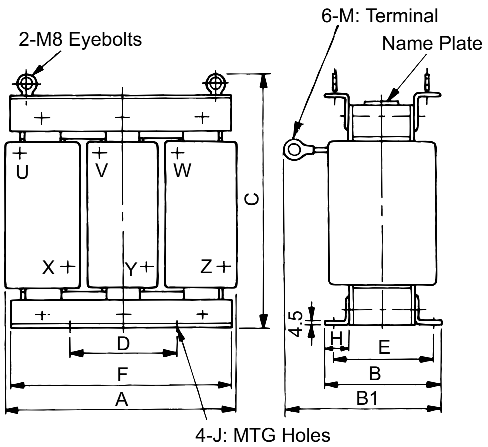
Model 3G3IV -PUZBAB□	Dimen-sions Diagram	Dimensions (mm)												Weight (kg)
		A	B	B1	C	D	E	F	H	J	K	L	M	
200A0.11MH	2	270	162	231	230±5	150	130	260	40	M8	16	10	M10	32
250A0.09MH		270	162	231	230±5	150	130	260	40	M8	16	10	M10	32
330A0.06MH		320	165	253	230±5	150	130	320	40	M10	17.5	12	M12	55
490A0.04MH	3	330	176	293	315±5	150	150	320	40	M10	13	12	M12	60
660A0.03MH	4	330	216	353	315±5	150	185	320	40	M10	15.5	18	M16	80



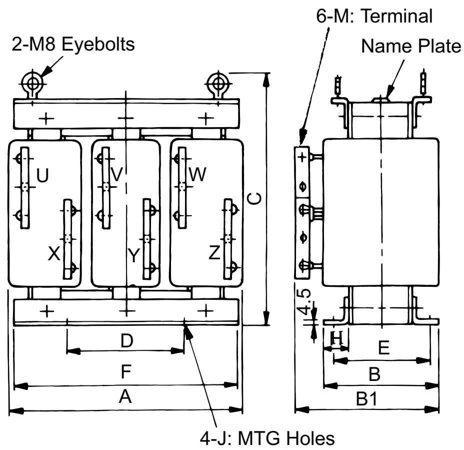
Dimensions Diagram 1



Dimensions Diagram 2



Dimensions Diagram 3



Dimensions Diagram 4

■ 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.

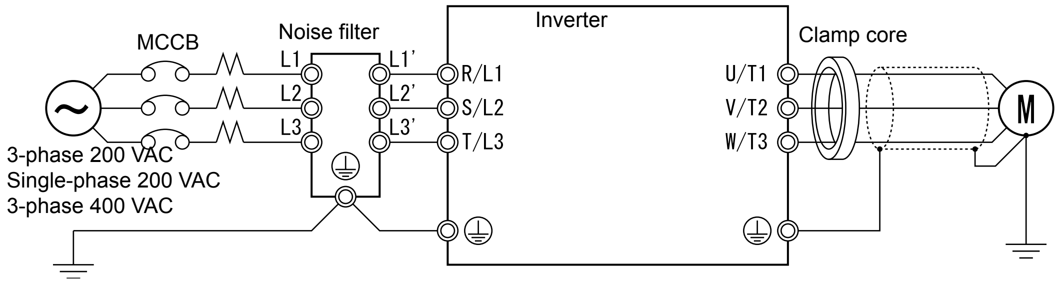
Models and Application

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				
	75	410	3G3RV-PFS5972-410-99	10	9
	90				
	110	600	3G3RV-PFS5972-600-99	11	10
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				
	75	170	3G3RV-PFS5972-170-40	6	6
	90	250	3G3RV-PFN3359-250-28	7.0	8
	110				
	132	410	3G3RV-PFS5972-410-99	10	9
	160				
	185				
	220	600	3G3RV-PFS5972-600-99	11	10
	300	800	3G3RV-PFS5972-800-99	31.5	11

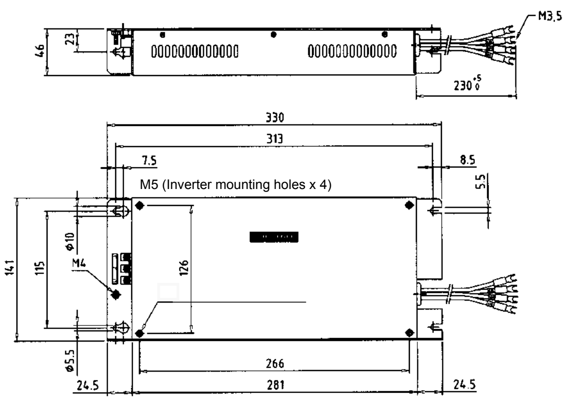
Wiring Example

A wiring example for an Input Noise Filter for EMC Directives is shown below.

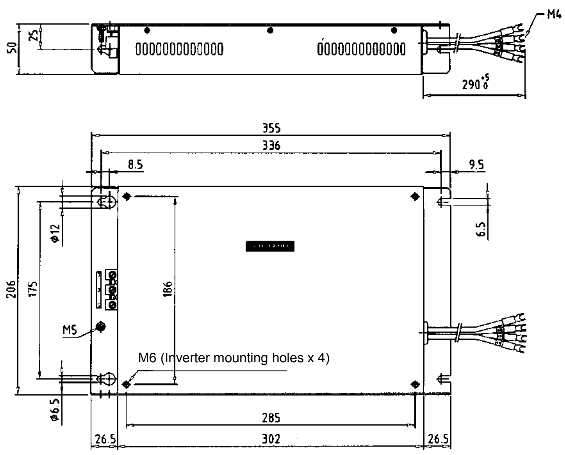


Dimensions

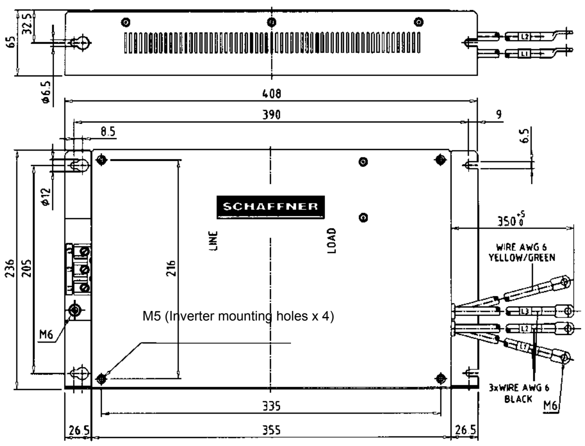
The dimensions of an Input Noise Filter for EMC Directives are given below.



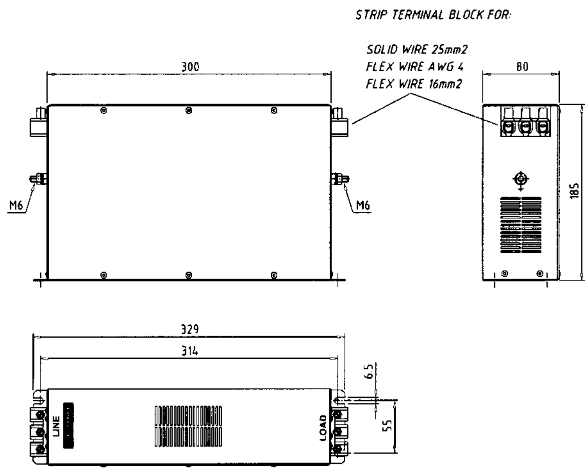
Dimensions Diagram 1



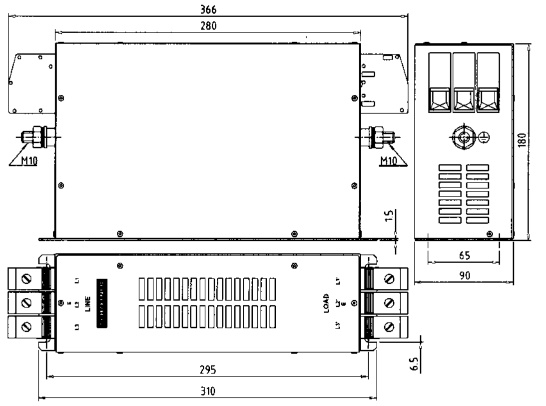
Dimensions Diagram 2



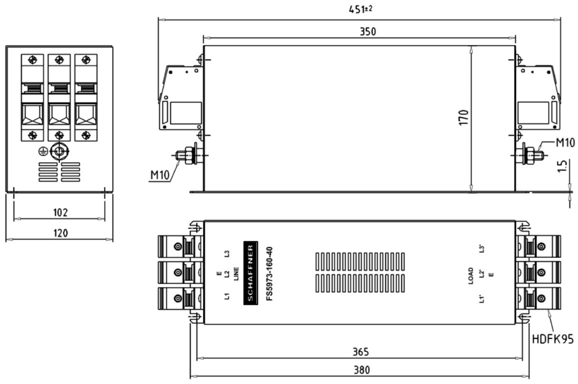
Dimensions Diagram 3



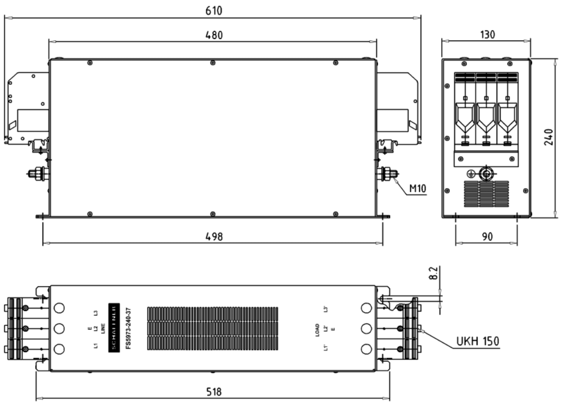
Dimensions Diagram 4



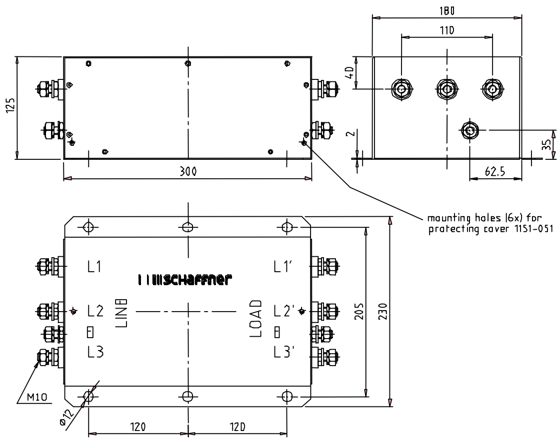
Dimensions Diagram 5



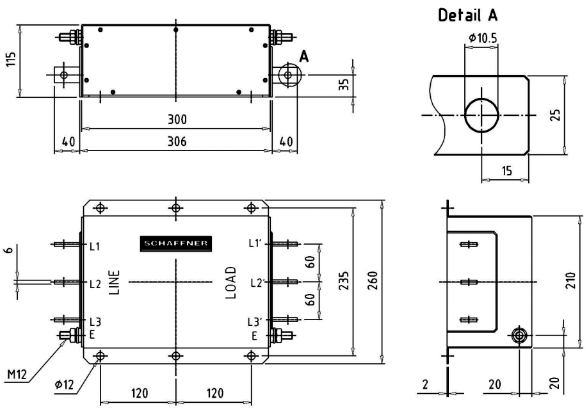
Dimensions Diagram 6



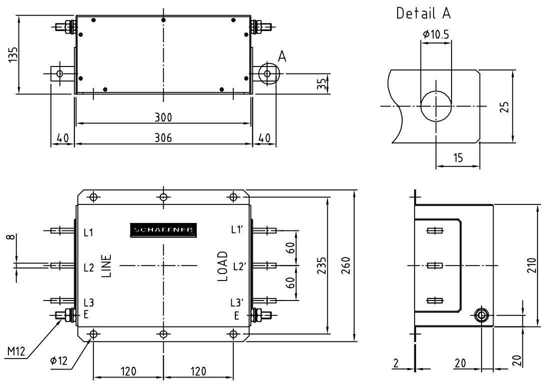
Dimensions Diagram 7



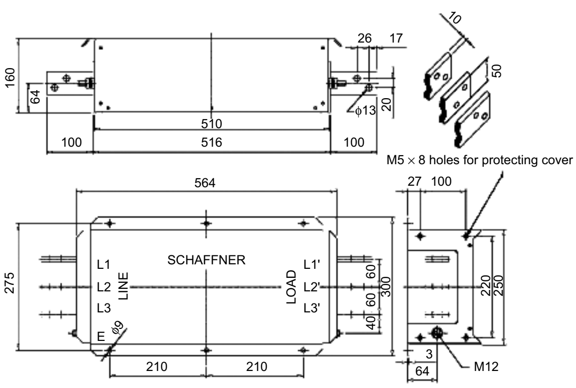
Dimensions Diagram 8



Dimensions Diagram 9



Dimensions Diagram 10

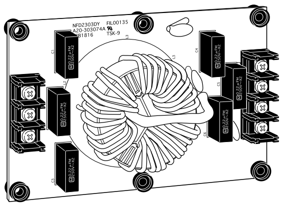


Dimensions Diagram 11

9

■ 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）

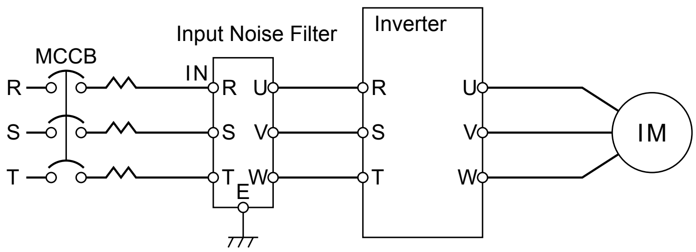
Models and Application

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

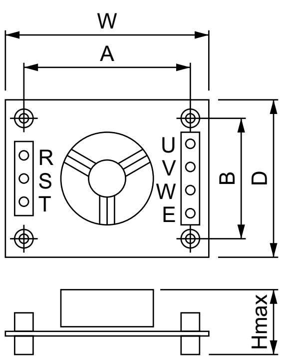
A wiring example for a Simple Input Noise Filter is shown below.



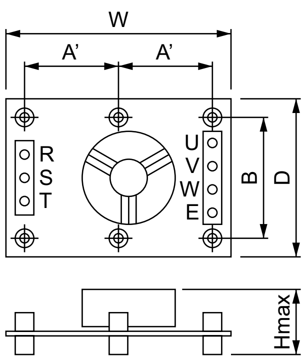
Dimensions

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	1	120	80	55	108	-	68	M4 × 4 20 mm	0.2
PLNFD2153DY		120	80	55	108	-	68	M4 × 4 20 mm	0.2
PLNFD2203DY		170	90	70	158	-	78	M4 × 4 20 mm	0.4
PLNFD2303DY	2	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		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



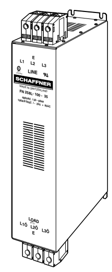
Dimensions Diagram 1



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-PFN359P40099	1	400
	90	3G3IV-PFN359P50099	1	500
	110	3G3IV-PFN359P60099	1	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-PFN359P40099	1	400
	160	3G3IV-PFN359P40099	1	400
	185	3G3IV-PFN359P50099	1	500
	220	3G3IV-PFN359P60099	1	600
	300	3G3IV-PFN359P90099	1	900

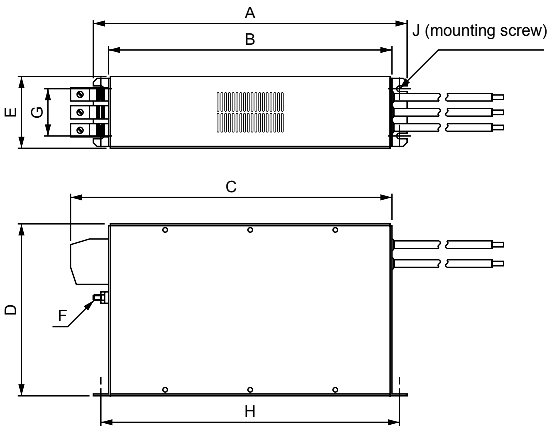
Wiring Example

Wiring for an Input Noise Filter is the same as that for a Simple Input Noise Filter.

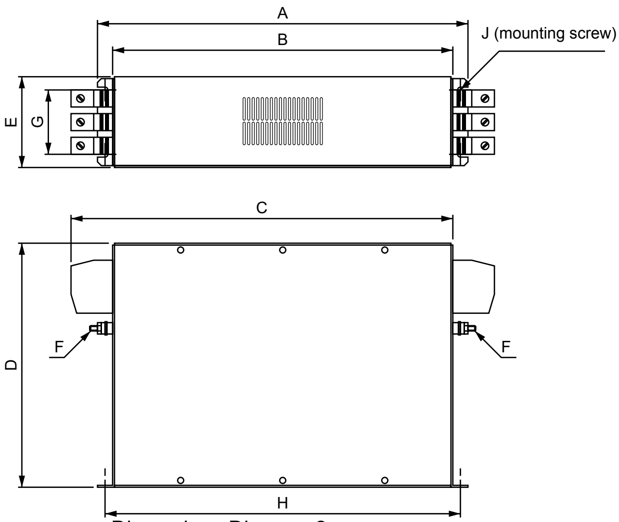
Dimensions

The dimensions of an Input Noise Filter are given below.

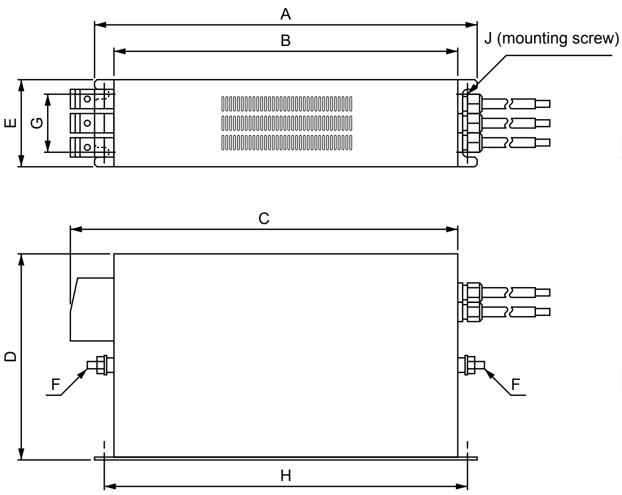
Model 3G3IV-	Dimensions Diagram	Dimensions (mm)									Weight (kg)
		A	B	C	D	E	F	G	H	J	
PFN258L4207	1	329	300	325	185	70	M6	45	314	4-M5	2.8
PFN258L5507		329	300	353	185	80	M6	55	314	4-M5	3.1
PFN258L7534	2	329	300	377	220	80	M6	55	314	4-M5	3.9
PFN258L10035		379	350	436	220	90	M10	65	364	4-M5	5.5
PFN258L13035		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
PFN359P40099		-	-	-	-	-	-	-	-	-	18.5
PFN359P50099		-	-	-	-	-	-	-	-	-	19.5
PFN359P60099		-	-	-	-	-	-	-	-	-	20.5
PFN359P90099		-	-	-	-	-	-	-	-	-	33



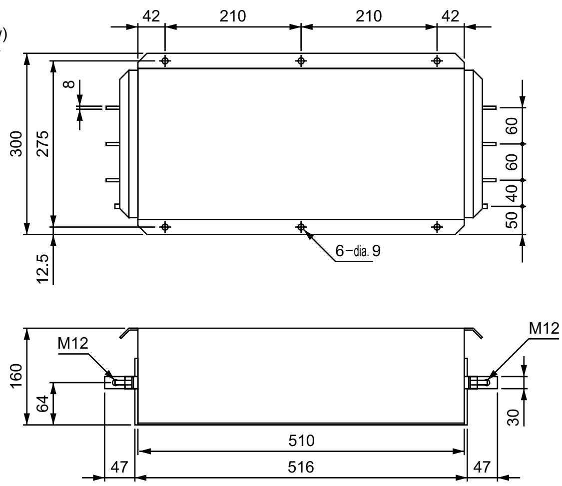
Dimensions Diagram 1



Dimensions Diagram 2



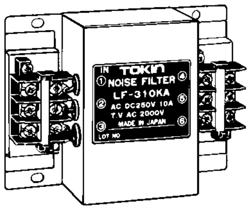
Dimensions Diagram 3



Dimensions Diagram 4

■ 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-PLF3110KB	1	110
	30	44	3G3IV-PLF375KB	2	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
	185	280	3G3IV-PLF3110KB	4	440
	220	390	3G3IV-PLF3110KB	5	550
	300	510	3G3IV-PLF3110KB	7	770

* Connect the Filters in parallel when connecting more than one Filter, and use a relay terminal block to balance the current.

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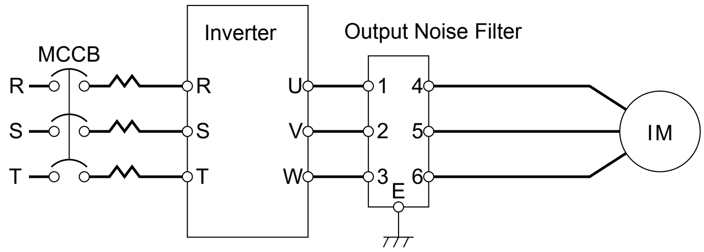
Wiring Example

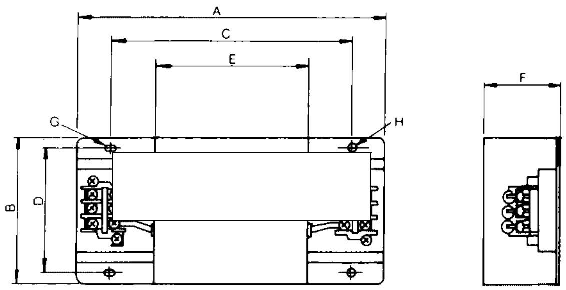
A wiring example for an Output Noise Filter is shown below.



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



10

Appendix

This chapter provides precautions for the Inverter, motor, and peripheral devices and also provides lists of parameters.

SYSDRIVE 3G3RV Control Methods

Details of the SYSDRIVE 3G3RV Inverter control methods and their features are provided in this section.

◆ Control Methods and Features

3G3RV-Series Inverters support the following four control methods, allowing the selection of a control method to suit the required purpose. *Table 10.1* provides an overview of the control methods and their features.

Table 10.1 Overview and Features of Control Methods

<table>
<tr><th colspan="3">Control Method</th><th>V/f Control</th><th>V/f Control with PG</th><th>Open-loop Vector Control</th><th>Flux Vector Control</th></tr>
<tr><td colspan="3">Parameter Setting</td><td>A1-02 = 0
(factory setting)</td><td>A1-02 = 1</td><td>A1-02 = 2</td><td>A1-02 = 3</td></tr>
<tr><td colspan="3">Basic Control</td><td>Voltage/frequency fixed ratio control</td><td>Voltage/frequency fixed ratio control with speed compensation using a PG</td><td>Current vector control without a PG</td><td>Current vector control with a PG</td></tr>
<tr><td colspan="3">Main Applications</td><td>Variable speed control, particularly for control of multiple motors with a single Inverter and for replacing existing Inverters</td><td>Applications requiring high-precision speed control using a PG on the machine side</td><td>Variable speed control, applications requiring high performance without a PG on the motor side, and for replacing open-loop vector control of the previous VS-616G5.</td><td>Very high-performance control with a PG on the motor side (simple servodrives, high-precision speed control, torque control, and torque limiting)</td></tr>
<tr><td colspan="3">PG Speed Control Board (Option)</td><td>Not required.</td><td>Required (PG-A2 or PG-D2).</td><td>Not required.</td><td>Required (PG-B2 or PG-X2).</td></tr>
<tr><td rowspan="7">Basic Performance</td><td colspan="2">Speed Control Range*1</td><td>1:40</td><td>1:40</td><td>1:100</td><td>1:1000</td></tr>
<tr><td colspan="2">Speed Control Accuracy*2</td><td>±2 to 3%</td><td>±0.03%</td><td>±0.2%</td><td>±0.02%</td></tr>
<tr><td colspan="2">Speed Response*3</td><td>Approx. 1 Hz</td><td>Approx. 1 Hz</td><td>5 Hz</td><td>40 Hz</td></tr>
<tr><td rowspan="2">Maximum Output Frequency</td><td>CT</td><td>300 Hz</td><td>300 Hz</td><td>300 Hz</td><td>300 Hz</td></tr>
<tr><td>VT</td><td>400 Hz</td><td>400 Hz</td><td>400 Hz</td><td>400 Hz</td></tr>
<tr><td rowspan="2">Starting Torque*4</td><td>CT</td><td>150%/3 Hz</td><td>150%/3 Hz</td><td>150%/0.5 Hz</td><td>150%/0 min^{-1}</td></tr>
<tr><td>VT</td><td>120%/3 Hz</td><td>120%/3 Hz</td><td>120%/0.5 Hz</td><td>120%/0 min^{-1}</td></tr>
</table>

Table 10.1 Overview and Features of Control Methods (Continued)

Control Method		V/f Control	V/f Control with PG	Open-loop Vector Control	Flux Vector Control
Application Functions	Autotuning	Line-to-line resistance (Normally not required.)	Line-to-line resistance (Normally not required.)	Rotational autotuning, stationary autotuning 1, 2, stationary autotuning for line-to-line resistance only	Rotational autotuning, stationary autotuning 1, 2, stationary autotuning for line-to-line resistance only
	Torque Limiting*5	No	No	Yes (except during acceleration/deceleration, below minimum frequency, or during reverse rotation)	Yes
	Torque Control*6	No	No	No	Yes
	Droop Control*7	No	No	No	Yes (except for 0 min^{-1} and during reverse rotation)
	Zero-servo Control*8	No	No	No	Yes
	Speed Estimation (Detection) Instantaneous Speed Search*9	Yes (speed and rotation direction estimation)	Yes (speed detection and rotation direction estimation)	Yes (speed and rotation direction estimation)	Yes (speed and rotation direction detection)
	Automatic Energy-saving Control*10	Yes	Yes	Yes	Yes
	High-slip Braking*11	Yes	Yes	No	No
	Feed Forward Control*12	No	No	No	Yes

* 1. The variable speed control range. (For continuous operation, the motor's temperature rise must be considered.)
* 2. The speed deviation in relation to the maximum speed with a rated load and when the load is stable. (For open-loop vector control, the motor temperature must be 25 °C ± 10 °C.)
* 3. The speed response guidelines indicating the extent of the motor's actual speed gain in proportion to the speed reference, which changes in a sinusoidal wave form, within a range where motor torque does not become saturated.
* 4. A guideline for the motor torque that can be generated when started at a low speed and its output frequency (rotations) at that time.
* 5. This function limits the maximum motor torque to protect the machine and the load.
* 6. This function directly controls the amount of torque being generated at the motor and its rotation direction, e.g., to control force.
* 7. This function controls the amount of motor slip that occurs to prevent mechanical shock, when replacing a torque motor, etc.
* 8. This function performs simple positioning control (servo lock), without using an external positioning control device.
* 9. This function instantaneously estimates (or detects) the speed and rotation direction of a coasting motor, and quickly starts it without subjecting it to shock.
* 10.This function automatically adjusts the voltage applied to the motor to optimize the motor's efficiency with light loads.
* 11.This function improves the deceleration time without using a braking resistor by making the motor winding absorb regenerative power. As a standard, this function is effective with a motor running on 160 kW or less with a high-inertia load.
* 12.This function enables proportional gain in relation to changes in the speed reference, even for low rigidity (corresponds to the servo's model gain control).

■ Application Function Precautions

Observe the following precautions when using the application functions.

- Perform rotational autotuning during trial operation whenever it is possible to separate the motor and machine. To achieve the characteristics of vector control described in *Table 10.1*, the control must be adjusted within a range that the machine will not vibrate after rotational autotuning has been performed.
- With vector control, the motor and Inverter must be connected 1:1. Vector control is not possible when multiple motors are connected to a single Inverter. Select an Inverter capacity so the rated motor current is 50% to 100% of the rated Inverter current.
- For estimated speed searching, the motor and Inverter must be connected 1:1. The speed search must be performed at a frequency of 130 Hz or less and with a motor with the same number of frames as or one frame less than the Inverter capacity.
- During high-slip braking, motor loss increases, so use a high-slip braking frequency of 5% ED or less, and a braking time of 90 seconds or less. Once high-slip braking has started, the motor cannot be restarted until it has stopped.
- Feed forward control is a function that improves the proportional gain of the motor speed in relation to the change in the speed reference. Adjust the response to interference loads using the speed controller (ASR) parameters.
- The torque limit function will not operate during acceleration or deceleration (during soft start transition) when using a control method such as open-loop vector control. Even if the motor speed drops due to torque limiting while set to a fixed speed, the speed will not fall below the minimum frequency and the motor will not slip into reverse rotation.

◆ Control Methods and Applications

Application examples for the Inverter control methods are provided here.

■ V/f Control (A1-02 = 0)

V/f control is suitable for applications where multiple motors are operated with a single Inverter, such as with multi-motor drives.

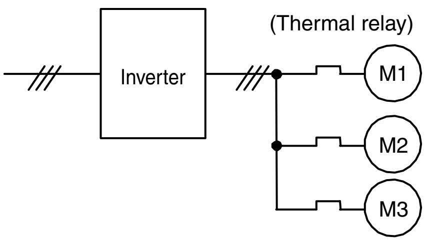


Fig 10.1

■ V/f Control with PG (A1-02 = 1)

V/f control with a PG enables precise control of machine line speed. Speed control using the speed feedback of the machine shaft is possible in this mode.

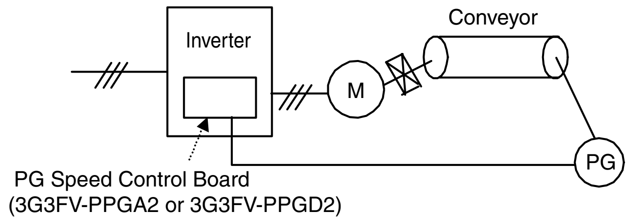


Fig 10.2

■ Open-Loop Vector Control (A1-02 = 2)

Open-loop vector control enables the use of high-performance drives without a speed detector. PG wiring is not required.

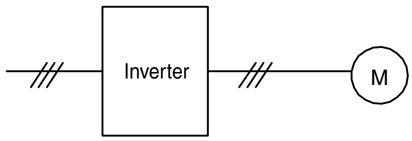


Fig 10.3

■ Flux Vector Control (A1-02 = 3)

Flux vector control is suitable for applications using high-precision drives with PG feedback. High-precision positioning, zero-speed control, and torque control are possible with this mode.

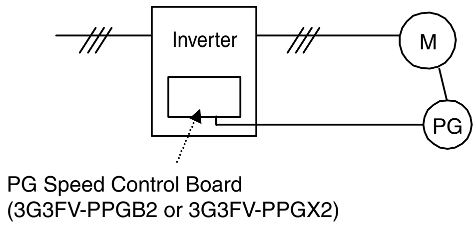


Fig 10.4

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.

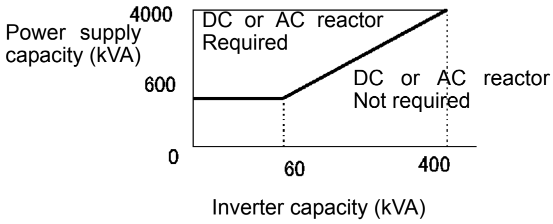


Fig 10.5

■ 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.

■ Applications with Repetitive Loads

Applications with repetitive loads (cranes, elevators, presses, washing machines, etc.) using Inverters require derating for the repetitive load [reducing carrier frequency and current (changing accel/decel timing, increasing the frame size of the Inverter)]. Contact your Yaskawa representative for details.

■ 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.

◆ 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).

◆ 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 overcurrent 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.

Conformance to UL Standard

To comply with UL standard, follow the appropriate installation instructions.

■ Installation Site

Install the Inverter in a pollution degree 2 environment or equivalent.

■ Specification of Closed-Loop Connector

The closed-loop connectors must be installed on conductors before installing to terminal blocks.
Use UL Listed closed-loop connectors shown below.

Table 10.2 JST Closed-Loop Connector Model

Inverter Model 3G3RV-☐	JST Kit P/N	
	Input	Output
A2110-V1	14-5	14-5
A2150-V1	38-6	22-6
A2185-V1	38-8	38-8
B2220-V1	60-8	38-8
B2300-V1	60-8	60-8
B2370-V1	100-10	100-10
B2450-V1	150-10	150-10
B2550-V1	60-10 (2perPh)	60-10 (2perPh)
B2750-V1	100-10 (2perPh)	80-10 (2perPh)
B2900-V1	150-12 (2perPh)	100-12 (2perPh)
B211K-V1	150-12 (2perPh)	150-12 (2perPh)
B4220-V1	22-6	14-6
B4300-V1	38-6	22-6
B4370-V1	38-8	38-8
B4450-V1	60-8	60-8
B4550-V1	70-8	70-8
B4750-V1	100-10	80-10
B4900-V1	60-10 (2perPh)	100-10
B411K-V1	70-10 (2perPh)	60-10 (2perPh)
B413K-V1	70-10 (2perPh)	70-10 (2perPh)
B416K-V1	80-12 (2perPh)	80-12 (2perPh)
B418K-V1	150-16 (2perPh)	150-16 (2perPh)
B422K-V1	325-16 (2perPh)	200-16 (2perPh)
B430K-V1	150-16 (4perPh)	150-16 (4perPh)

■ Control Circuit Terminal

A UL Listed, Class 2 power supply must be used for the control circuits. See below table.

Table 10.3 Power Supply for Control Circuits

Input/Output	Terminal	Power Supply
Open Collector Outputs	P1, P2, PC	Class 2 power supply
Digital Inputs	S1, S2, S3, S4, S5, S6, S7, S8, SC	LVLC power supply when using internal power supply. Class 2 power supply when using external power supply.
Analog Inputs	RP, +V, -V, A1, A2, A3, AC	

■ Interrupting Rating

3G3RV is suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes, 240 VAC maximum (200 V Class) and 480 VAC maximum (400 V Class).
Use a circuit breaker or fuses having an interrupting rating not less than 100,000 RMS symmetrical amperes, 600 VAC maximum.

■ Motor Overheat Protection

To protect the motor from overheating, set the E2-01 parameter in the Inverter to the same value as the level of the motor rated current.

Conformance to CE Markings

Points regarding conformance to CE markings are given below.

◆ CE Markings

CE markings indicate conformance to safety and environmental standards that apply to business transactions (including production, imports, and sales) in Europe. There are unified European standards for mechanical products (Machine Directive), electrical products (Low Voltage Directive), and electrical noise (EMC Directive). CE markings are required for business transactions in Europe (including production, imports, and sales).

The 3G3RV-Series Inverters bear CE markings indicating conformance to the Low Voltage Directive and the EMC Directive.

- Low Voltage Directive: 73/23/EEC
93/68/EEC
- EMC Directive: 89/336/EEC
92/31/EEC
93/68/EEC

Machinery and installations that incorporate the Inverter are also subject to CE markings. It is ultimately the responsibility of customers making products incorporating the Inverter to attach CE markings to the finished products. The customer must confirm that the finished products (machines or installations) conform to the European Standards.

◆ Requirements for Conformance to CE Markings

■ Low Voltage Directive

3G3RV-Series Inverters satisfy testing for conformance to the Low Voltage Directive under the conditions described in European Standard EN50178.

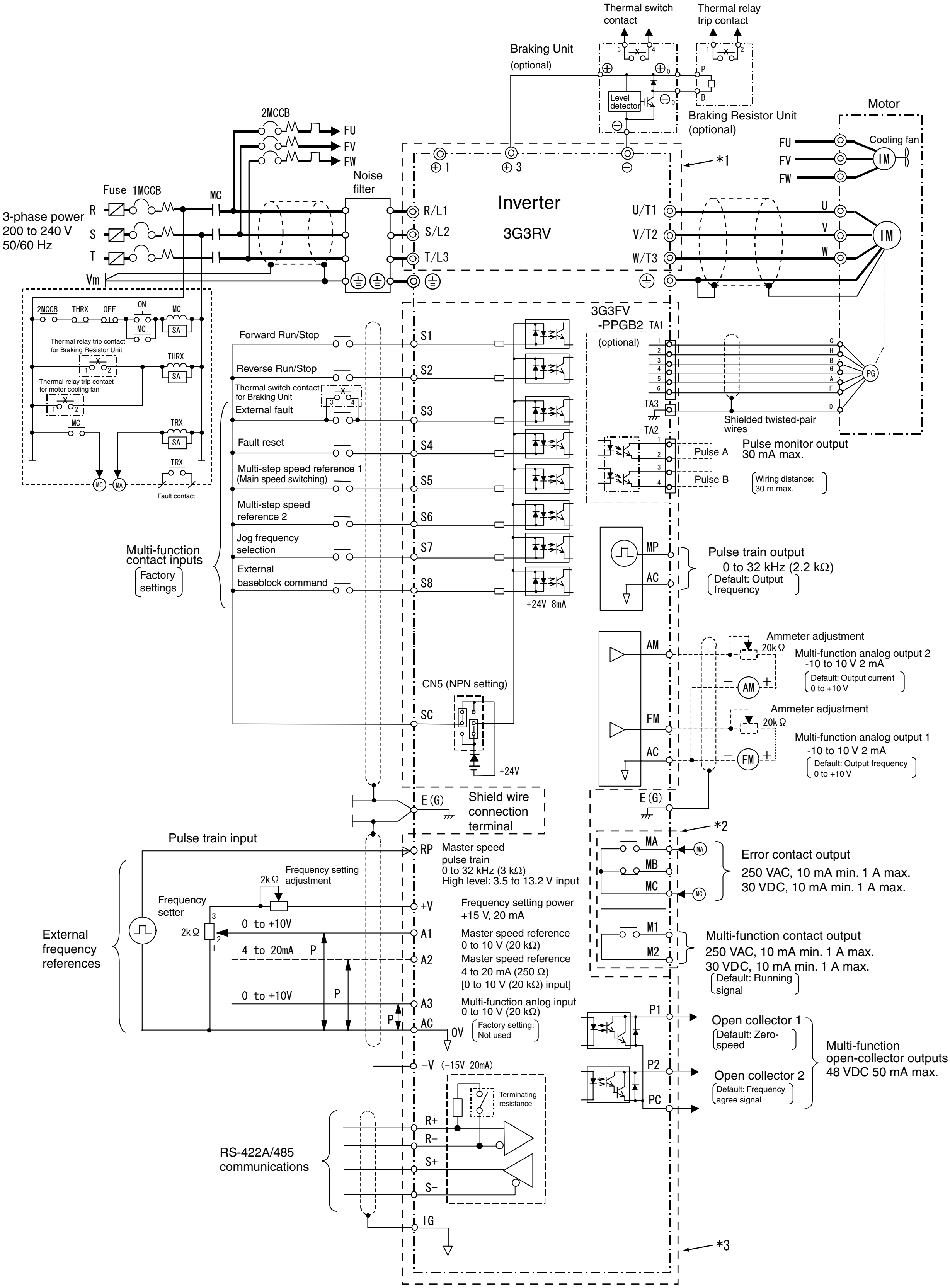
Requirements for Conformance to the Low Voltage Directive

3G3RV-Series Inverters must satisfy the following conditions in order to conform to the Low Voltage Directive.

- It must be used under conditions corresponding to overvoltage category 3 or less and pollution degree 2 or less as specified in IEC664.
- Input fuses:
  For details on selecting fuses, refer to *Table 10.4 Selection Requirements for Input Fuses with Examples*.
- With Inverters 3G3RV-B2220 to B211K and 3G3RV-B4220 to B430K, an enclosure preventing foreign matter from entering from the top or front sides is required (IP4X or higher: panel installation).

Wiring Example

This example shows wiring for conforming to undervoltage reference.



* 1. The main circuit is separated from the terminal cover for safety reasons.

* 2. The contact output circuit is separated from the main circuit and the control circuit by reinforced insulation. It can be connected to extra-low voltage circuits or circuits that are 250 VAC 1 A, 30 VDC 1 A or less.

* 3. The control circuit is an extra-low voltage circuit and separated from the main circuit and the contact output circuit by reinforced insulation. Always connect it to extra-low voltage circuits.

Fig 10.6

Input Fuses

In order to conform to the Low Voltage Directive, fuses must be provided for inputs. Use UL-compatible input fuses with ratings higher than the voltages and currents, and fusing I^2t specifications within the ranges shown in the table below.

Table 10.4 Selection Requirements for Input Fuses with Examples

Voltage Class	Inverter Model Number 3G3RV-□	Selection Requirements			Input Fuse (Examples)			
		Voltage (V)	Current (A)	Fusing I^2t (A^2sec)	Model Number	Manufacturer	Ratings	Fusing I^2t (A^2sec)
200 V Class	A2004-V1	240	10	12 to 25	A60Q12-2	FERRAZ	600 V 12 A	17
	A2007-V1	240	10	12 to 25	A60Q12-2	FERRAZ	600 V 12 A	17
	A2015-V1	240	15	23 to 55	CR2LS-20/UL	FUJI	250 V 20 A	27
	A2022-V1	240	20	34 to 98	CR2LS-30/UL	FUJI	250 V 30 A	60
	A2037-V1	240	30	82 to 220	CR2LS-50/UL	FUJI	250 V 50 A	200
	A2055-V1	240	40	220 to 610	CR2LS-75/UL	FUJI	250 V 75 A	276
	A2075-V1	240	60	290 to 1300	CR2LS-75/UL	FUJI	250 V 75 A	560
	A2110-V1	240	80	450 to 5000	CR2LS-100/UL	FUJI	250 V 100 A	810
	A2150-V1	240	100	1200 to 7200	CR2L-125/UL	FUJI	250 V 125 A	1570
	A2185-V1	240	130	1800 to 7200	CR2L-150/UL	FUJI	250 V 150 A	2260
	B2220-V1	240	150	870 to 16200	CR2L-150/UL	FUJI	250 V 150 A	2260
	B2300-V1	240	180	1500 to 23000	CR2L-200/UL	FUJI	250 V 200 A	4010
	B2370-V1	240	240	2100 to 19000	CR2L-260/UL	FUJI	250 V 260 A	7320
	B23450-V1	240	300	2700 to 55000	CR2L-300/UL	FUJI	250 V 300 A	9630
	B2550-V1	240	350	4000 to 55000	CR2L-350/UL	FUJI	250 V 350 A	16000
	B2750-V1	240	450	7100 to 64000	CR2L-450/UL	FUJI	250 V 450 A	31000
	B2900-V1	240	550	11000 to 64000	CR2L-600/UL	FUJI	250 V 600 A	40000
	B211K-V1	240	600	13000 to 83000	CR2L-600/UL	FUJI	250 V 600 A	52000

Table 10.4 Selection Requirements for Input Fuses with Examples (Continued)

Voltage Class	Inverter Model Number 3G3RV-☐	Selection Requirements			Input Fuse (Examples)			
		Voltage (V)	Current (A)	Fusing I^2t (A^2sec)	Model Number	Manufacturer	Ratings	Fusing I^2t (A^2sec)
400 V Class	A4004-V1	480	5	6 to 55	CR6L-20/UL	FUJI	600 V 20 A	26
	A4007-V1	480	5	6 to 55	CR6L-20/UL	FUJI	600 V 20 A	26
	A4015-V1	480	10	10 to 55	CR6L-20/UL	FUJI	600 V 20 A	26
	A4022-V1	480	10	18 to 55	CR6L-20/UL	FUJI	600 V 20 A	26
	A4037-V1	480	15	34 to 72	CR6L-30/UL	FUJI	600 V 30 A	59
	A4055-V1	480	25	100 to 570	CR6L-50/UL	FUJI	600 V 50 A	317
	A4075-V1	480	30	100 to 640	CR6L-50/UL	FUJI	600 V 50 A	317
	A4110-V1	480	50	150 to 1300	CR6L-50/UL	FUJI	600 V 50 A	317
	A4150-V1	480	60	400 to 1800	CR6L-75/UL	FUJI	600 V 75 A	564
	A4185-V1	480	70	700 to 4100	CR6L-100/UL	FUJI	600 V 100 A	1022
	B4220-V1	480	80	240 to 5800	CR6L-100/UL	FUJI	600 V 100 A	1022
	B4300-V1	480	100	500 to 5800	CR6L-100/UL	FUJI	600 V 100 A	1022
	B4370-V1	480	125	750 to 5800	CR6L-150/UL	FUJI	600 V 150 A	3070
	B4450-V1	480	150	920 to 13000	CR6L-150/UL	FUJI	600 V 150 A	3070
	B4550-V1	480	150	1500 to 13000	CR6L-200/UL	FUJI	600 V 200 A	5200
	B4750-V1	480	250	3000 to 55000	CR6L-300/UL	FUJI	600 V 300 A	17700
	B4900-V1	480	300	3800 to 55000	CR6L-300/UL	FUJI	600 V 300 A	17700
	B411K-V1	480	350	5400 to 23000	A70P350-4	FERRAZ	700 V 350 A	15000
	B413K-V1	480	400	7900 to 64000	A70P400-4	FERRAZ	700 V 400 A	19000
	B416K-V1	480	450	14000 to 250000	A70P450-4	FERRAZ	700 V 450 A	24000
	B418K-V1	480	600	20000 to 250000	A70P600-4	FERRAZ	700 V 600 A	43000
	B422K-V1	480	700	34000 to 400000	A70P700-4	FERRAZ	700 V 700 A	59000
	B430K-V1	480	900	52000 to 920000	A70P900-4	FERRAZ	700 V 900 A	97000

■ EMC Directive

3G3RV-Series Inverters satisfy testing for conformance to the EMC Directive under the conditions described in European Standard EN61800-3.

Installation Method

In order to ensure that the machinery or installation incorporating the Inverter conforms to the EMC Directive, perform installation according to the method below.

- Install a noise filter that conforms to European Standards on the input side. (Refer to *Chapter 9 ■ Input Noise Filters for EMC Directives*).
- Use a shielded line or metal piping for wiring between the Inverter and Motor. Make the wiring as short as possible.
- To suppress harmonics, install a DC reactor in 3G3RV-A2004-V1, A2007-V1, A4004-V1, and A4007-V1 models. (Refer to *Chapter 9 ■ AC Reactor*.)

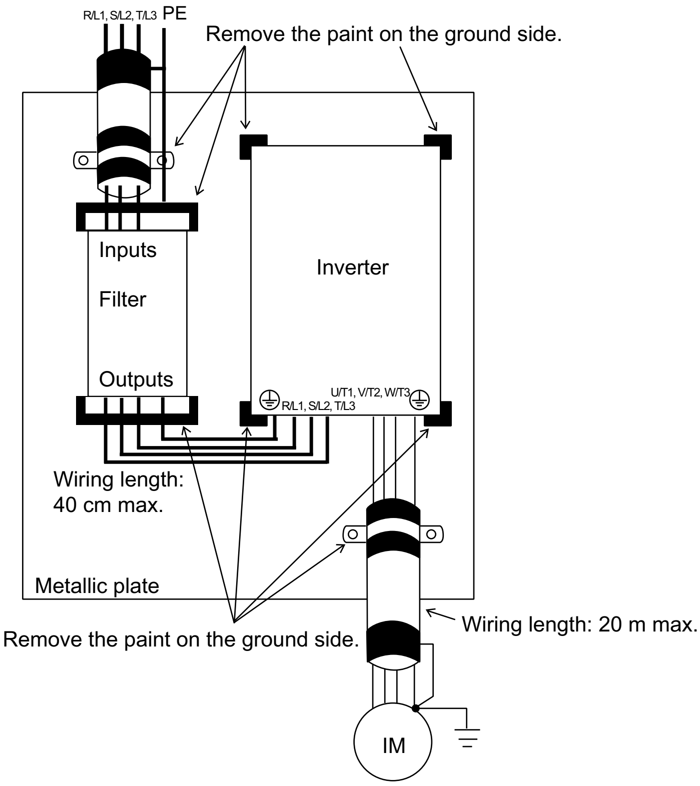


Fig 10.7 Installation Method for Filter and Inverter (3G3RV-A2004-V1 to A2185-V1, A4004-V1 to A185-V1)

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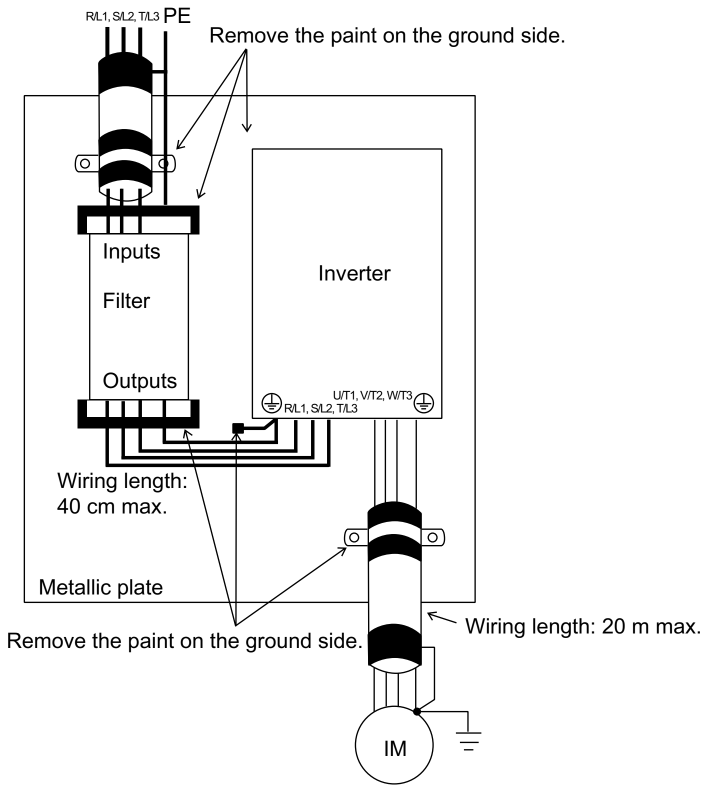


Fig 10.8 Installation Method for Filter and Inverter (3G3RV-B2220-V1 to B211K-V1, B4220-V1 to B430K-V1)

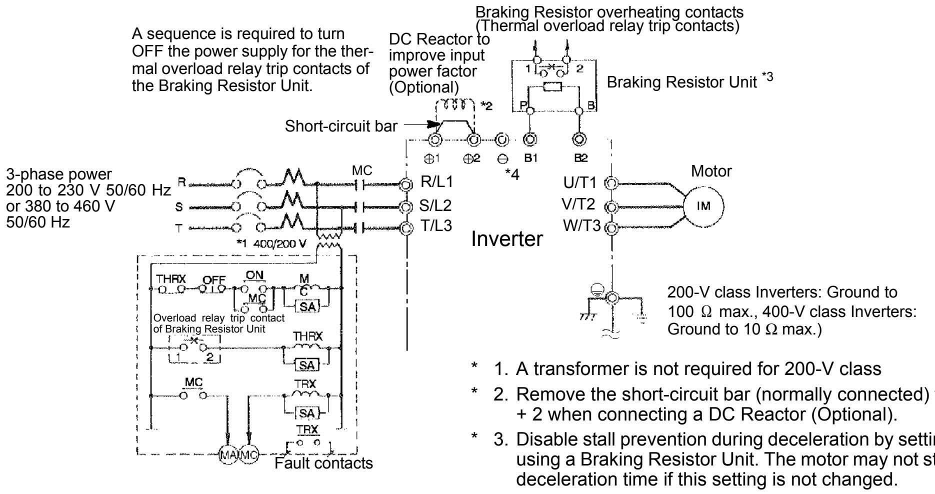
Wiring Examples

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)



* 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.

* 4. When connecting a separately-installed type Braking Unit (model 3G3IV-PCDBR☐) to Inverters with built-in braking transistor (200 V/400 V 18.5 kW or less), connect the B1 terminal of the Inverter to the + terminal of the Braking Unit and connect the – terminal of the Inverter to the – terminal of the Braking Unit. The B2 terminal is not used in this case.

Fig 10.9

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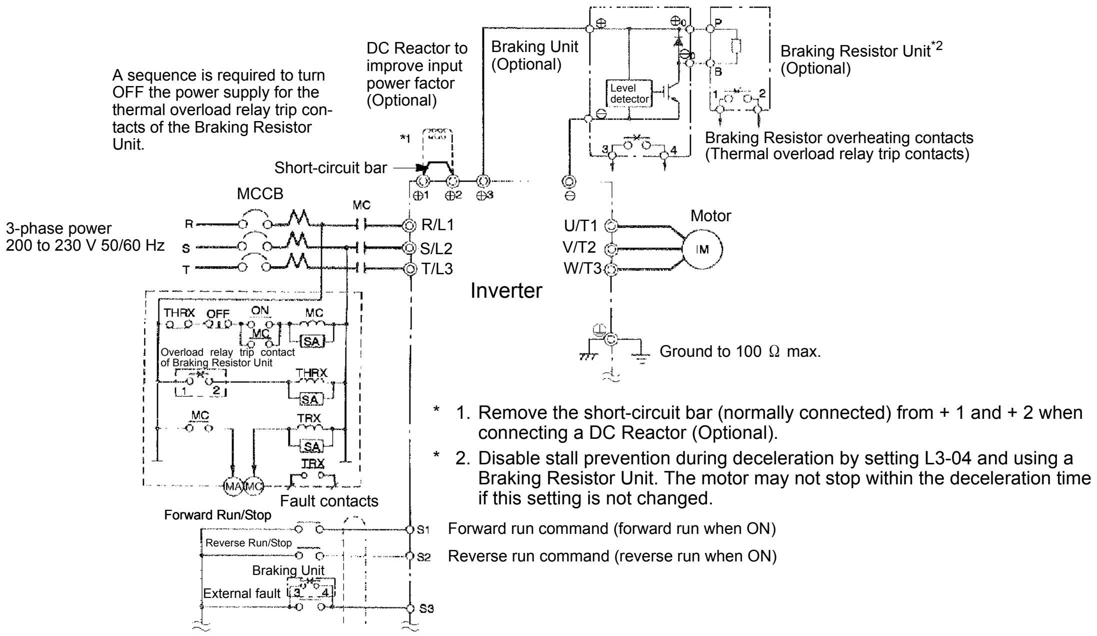
◆ Using a Braking Unit and Braking Resistor Unit

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)



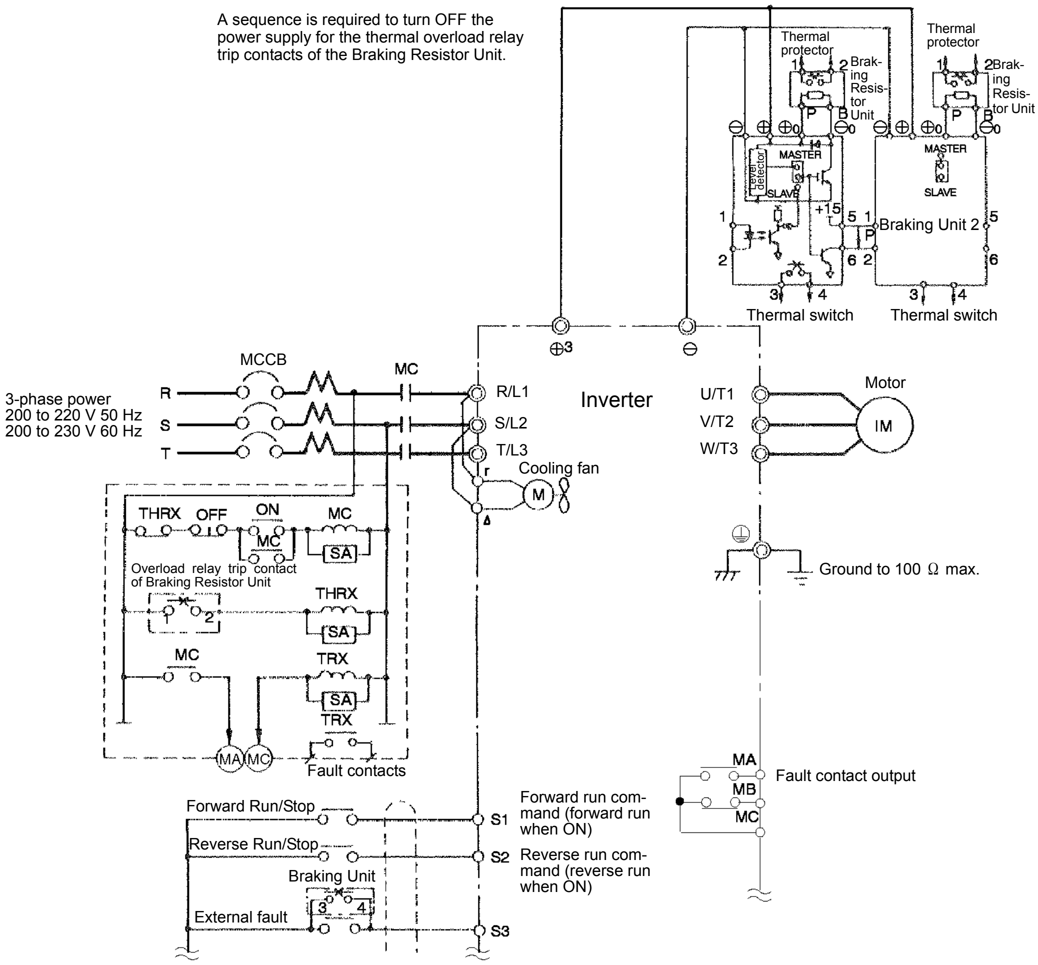
* 1. Remove the short-circuit bar (normally connected) from + 1 and + 2 when connecting a DC Reactor (Optional).

* 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 10.10

◆ Using Braking Units in Parallel

This example shows wiring for using two Braking Units in parallel.

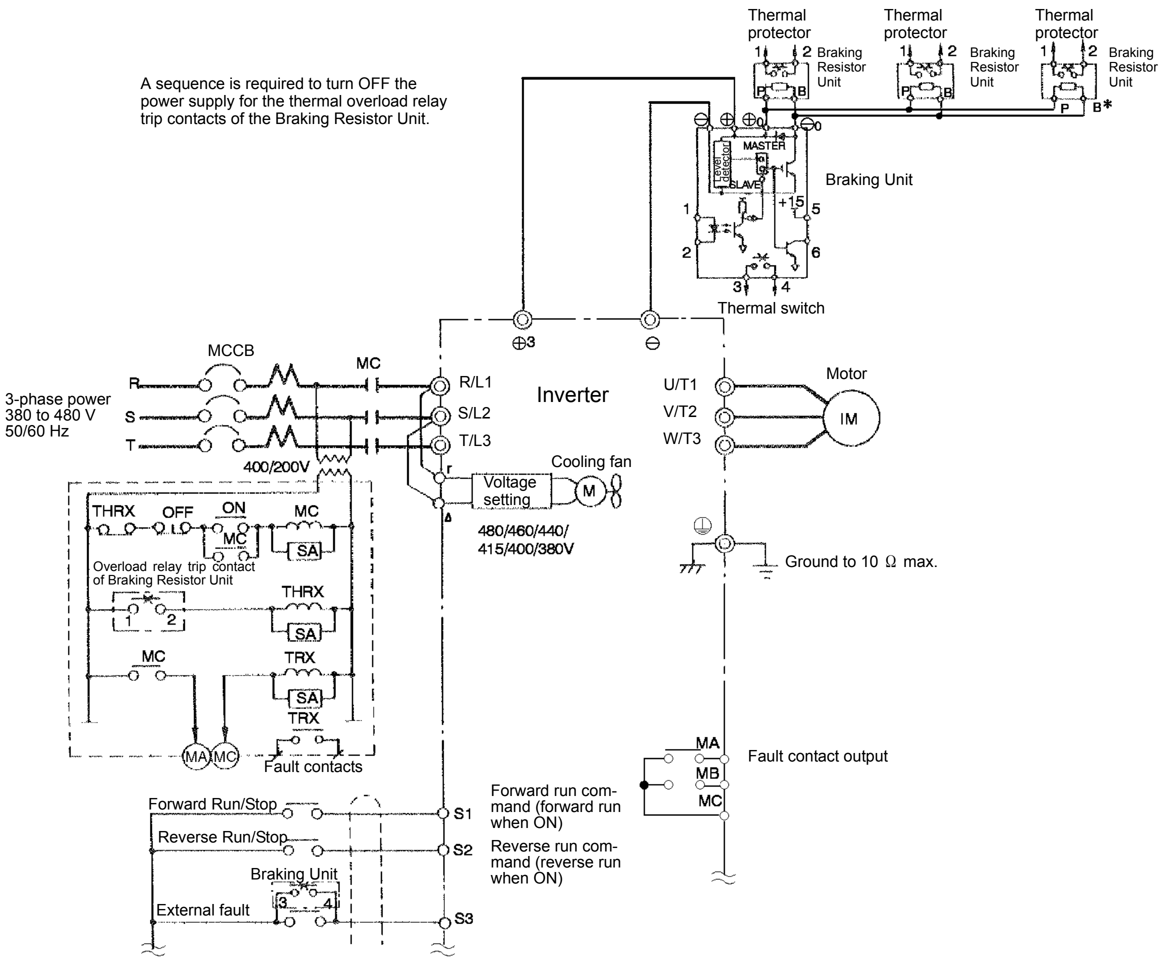


* Disable stall prevention during deceleration by setting L3-04 to Resistor Unit. The motor may not stop within the deceleration time if this setting is not changed.

Fig 10.11

◆ Using a Braking Unit and Three Braking Resistor Units in Parallel

This example shows wiring for using three Braking Resistor 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 10.12

◆ 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)

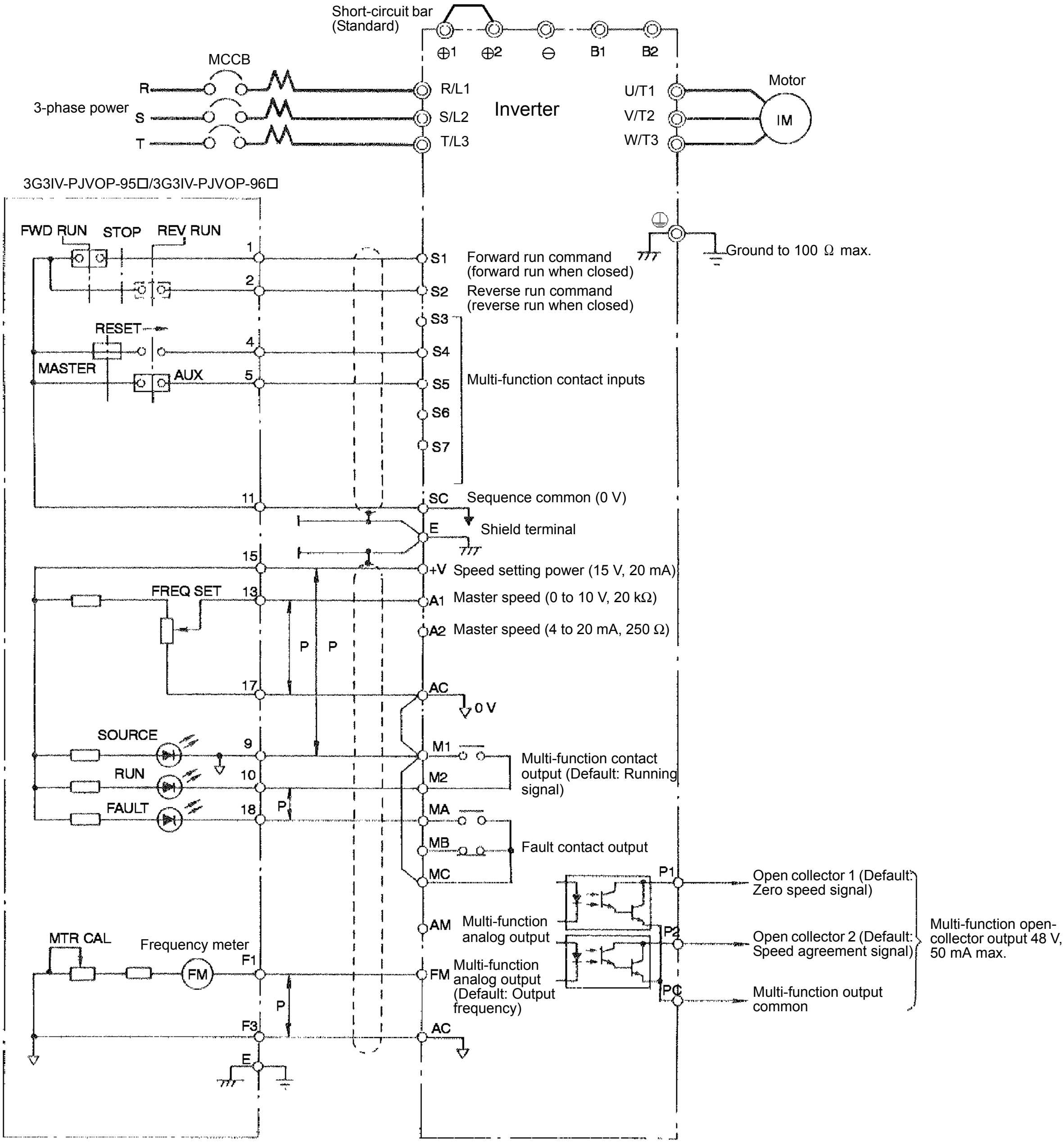


Fig 10.13

◆ 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.

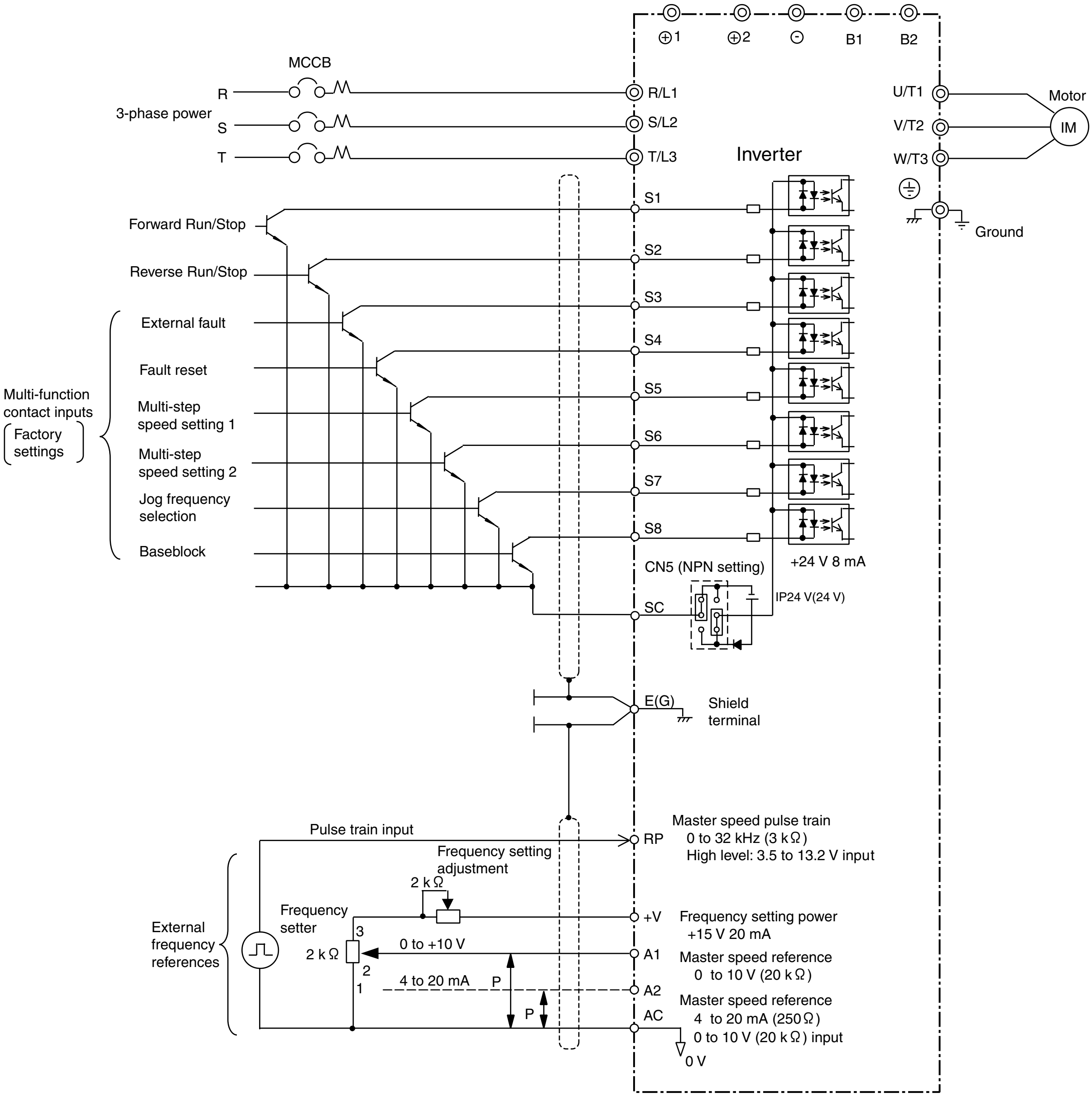


Fig 10.14

◆ 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.

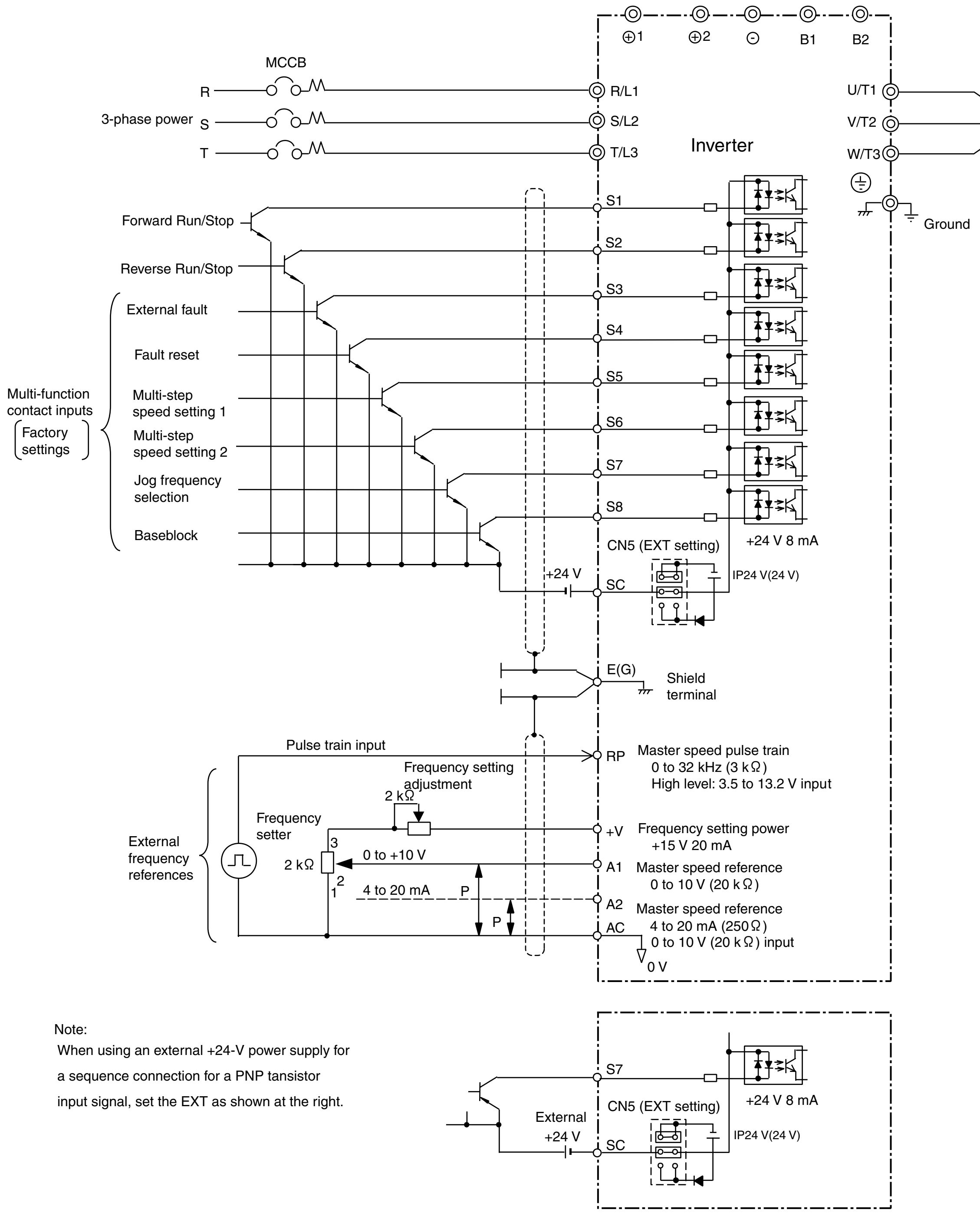


Fig 10.15

◆ 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).

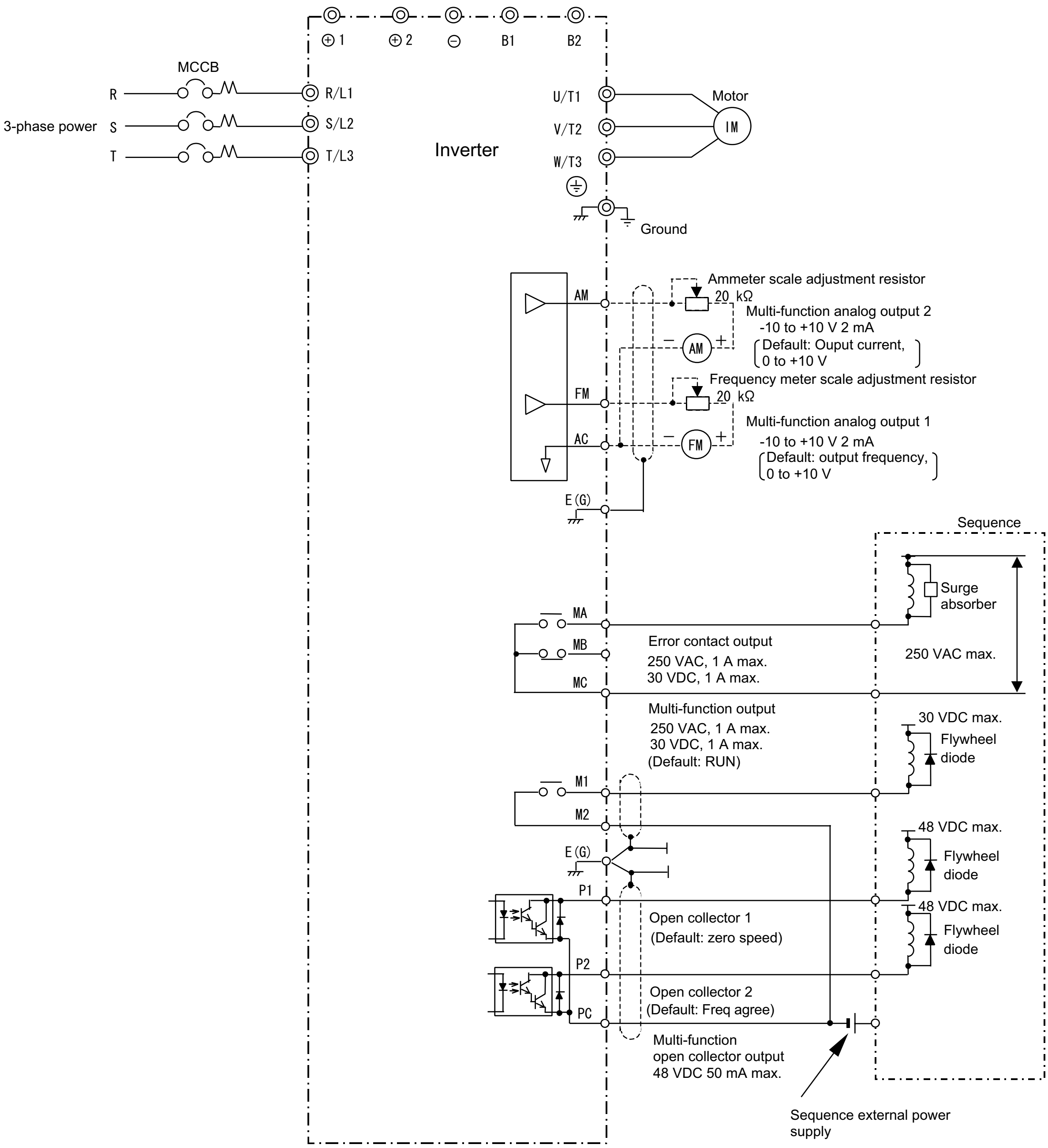


Fig 10.16

Parameters

Factory settings are given in the following table.

Table 10.5 User Parameters

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
A1-00	Language selection for Digital Operator display	1*1		b3-05	Speed search wait time	0.2	
A1-01	Parameter access level	2		b3-10	Sets the magnetic flux compensation as a percentage of the no-load current.	1.10	
A1-02	Control method selection	0*1		b3-14	Rotation direction search selection	1	
A1-03	Initialize	0		b3-17	Speed search retrial current level	150*14	
A1-04	Password	0		b3-18	Speed search retrial detection time	0.01	
A1-05	Password setting	0		b3-19	Number of speed search retrials	0	
A2-01 to A2-32	User setting parameters	-		b4-01	Timer function ON-delay time	0.0	
b1-01	Reference selection	1		b4-02	Timer function OFF-delay time	0.0	
b1-02	Operation method selection	1		b5-01	PID control method selection	0	
b1-03	Stopping method selection	0		b5-02	Proportional gain (P)	1.00	
b1-04	Prohibition of reverse operation	0		b5-03	Integral (I) time	1.0	
b1-05	Operation selection for setting E1-09 or less	0		b5-04	Integral (I) limit	100.0	
b1-06	Read sequence input twice	1		b5-05	Derivative (D) time	0.00	
b1-07	Operation selection after switching to remote mode	0		b5-06	PID limit	100.0	
b1-08	Run Command selection in programming modes	0		b5-07	PID offset adjustment	0.0	
b2-01	Zero-speed level (DC injection braking starting frequency)	0.5		b5-08	PID primary delay time constant	0.00	
b2-02	DC injection braking current	50		b5-09	PID output characteristics selection	0	
b2-03	DC injection braking time at start	0.00		b5-10	PID output gain	1.0	
b2-04	DC injection braking time at stop	0.50		b5-11	PID reverse output selection	0	
b2-08	Magnetic flux compensation volume	0		b5-12	Selection of PID feedback command loss detection	0	
b3-01	Speed search selection	2*2		b5-13	PID feedback command loss detection level	0	
b3-02	Speed search operating current	150 *2 *14		b5-14	PID feedback command loss detection time	1.0	
b3-03	Speed search deceleration time	2.0		b5-15	PID sleep function operation level	0.0	

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Table 10.5 User Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
b5-16	PID sleep operation delay time	0.0		C1-10	Accel/decel time setting unit	1	
b5-17	Acceleration/deceleration time for PID reference	0.0		C1-11	Accel/decel time switching frequency	0.0	
b6-01	Dwell frequency at start	0.0		C2-01	S-curve characteristic time at acceleration start	0.20	
b6-02	Dwell time at start	0.0		C2-02	S-curve characteristic time at acceleration end	0.20	
b6-03	Dwell frequency at stop	0.0		C2-03	S-curve characteristic time at deceleration start	0.20	
b6-04	Dwell time at stop	0.0		C2-04	S-curve characteristic time at deceleration end	0.00	
b7-01	Droop control gain	0.0		C3-01	Slip compensation gain	0.0*2	
b7-02	Droop control delay time	0.05		C3-02	Slip compensation primary delay time	2000*2 *3	
b8-01	Energy-saving mode selection	0		C3-03	Slip compensation limit	200	
b8-02	Energy-saving gain	0.7*3		C3-04	Slip compensation selection during regeneration	0	
b8-03	Energy-saving filter time constant	0.50*4		C3-05	Output voltage limit operation selection	0	
b8-04	Energy-saving coefficient	288.20 *5*6		C4-01	Torque compensation gain	1.00	
b8-05	Power detection filter time constant	20		C4-02	Torque compensation time constant	200*2	
b8-06	Search operation voltage limiter	0		C4-03	Forward starting torque	0.0	
b9-01	Zero-servo gain	5		C4-04	Reverse starting torque	0.0	
b9-02	Zero-servo completion width	10		C4-05	Starting torque time constant	10	
C1-01	Acceleration time 1	10.0		C5-01	ASR proportional (P) gain 1	20.00*7	
C1-02	Deceleration time 1	10.0		C5-02	ASR integral (I) time 1	0.500*7	
C1-03	Acceleration time 2	10.0		C5-03	ASR proportional (P) gain 2	20.00*7	
C1-04	Deceleration time 2	10.0		C5-04	ASR integral (I) time 2	0.500*7	
C1-05	Acceleration time 3	10.0		C5-05	ASR limit	5.0	
C1-06	Deceleration time 3	10.0		C5-06	ASR primary delay time	0.004	
C1-07	Acceleration time 4	10.0		C5-07	ASR switching frequency	0.0	
C1-08	Deceleration time 4	10.0		C5-08	ASR integral (I) limit	400	
C1-09	Emergency stop time	10.0		C6-01	CT/VT selection	0*8	

Table 10.5 User Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
C6-02	Carrier frequency selection	1 (C6-01 = 0) 6*6 (C6-01 = 1)		d2-03	Master speed reference lower limit	0.0	
				d3-01	Jump frequency 1	0.0	
				d3-02	Jump frequency 2	0.0	
C6-03*15	Carrier frequency upper limit	2.0		d3-03	Jump frequency 3	0.0	
C6-04*15	Carrier frequency lower limit	2.0		d3-04	Jump frequency width	1.0	
C6-05*15	Carrier frequency proportional gain	00		d4-01	Frequency reference hold function selection	0	
d1-01	Frequency reference 1	0.00		d4-02	+ - Speed limits	10	
d1-02	Frequency reference 2	0.00		d5-01	Torque control selection	0	
d1-03	Frequency reference 3	0.00		d5-02	Torque reference delay time	0	
d1-04	Frequency reference 4	0.00		d5-03	Speed limit selection	1	
d1-05	Frequency reference 5	0.00		d5-04	Speed limit	0	
d1-06	Frequency reference 6	0.00		d5-05	Speed limit bias	10	
d1-07	Frequency reference 7	0.00		d5-06	Speed/torque control switching timer	0	
d1-08	Frequency reference 8	0.00		d6-01	Field weakening level	80	
d1-09	Frequency reference 9	0.00		d6-02	Field frequency	0.0	
d1-10	Frequency reference 10	0.00		d6-03	Field forcing function selection	0	
d1-11	Frequency reference 11	0.00		d6-06	Field forcing limit	400	
d1-12	Frequency reference 12	0.00		E1-01	Input voltage setting	200*9	
d1-13	Frequency reference 13	0.00		E1-03	V/f pattern selection	F	
d1-14	Frequency reference 14	0.00		E1-04	Max. output frequency	60.0*2	
d1-15	Frequency reference 15	0.00		E1-05	Max. voltage	200.0 *2 *9	
d1-16	Frequency reference 16	0.00		E1-06	Base frequency	60.0*2	
d1-17	Jog frequency reference	6.00		E1-07	Mid. output frequency	3.0*2	
d2-01	Frequency reference upper limit	100.0		E1-08	Mid. output frequency voltage	15.0 *2*9	
d2-02	Frequency reference lower limit	0.0		E1-09	Min. output frequency	1.5*2	

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Table 10.5 User Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
E1-10	Min. output frequency voltage	9.0*2*9		E4-03	Motor 2 no-load current	1.20 *6	
E1-11	Mid. output frequency 2	0.0*10		E4-04	Motor 2 number of poles (number of poles)	4	
E1-12	Mid. output frequency voltage 2	0.0*10		E4-05	Motor 2 line-to-line resistance	9.842*6	
E1-13	Base voltage	0.0*11		E4-06	Motor 2 leak inductance	18.2*6	
E2-01	Motor rated current	1.90*6		E4-07	Motor 2 rated capacity	0.40*6	
E2-02	Motor rated slip	2.90*6		F1-01	PG parameter	600	
E2-03	Motor no-load current	1.20*6		F1-02	Operation selection at PG open circuit (PGO)	1	
E2-04	Number of motor poles	4		F1-03	Operation selection at overspeed (OS)	1	
E2-05	Motor line-to-line resistance	9.842*6		F1-04	Operation selection at deviation	3	
E2-06	Motor leak inductance	18.2*6		F1-05	PG rotation	0	
E2-07	Motor iron saturation coefficient 1	0.50		F1-06	PG division rate (PG pulse monitor)	1	
E2-08	Motor iron saturation coefficient 2	0.75		F1-07	Integral value during accel/decel enable/disable	0	
E2-09	Motor mechanical loss	0.0		F1-08	Overspeed detection level	115	
E2-10	Motor iron loss for torque compensation	14*6		F1-09	Overspeed detection delay time	0.0*7	
E2-11	Motor rated output	0.40*6		F1-10	Excessive speed deviation detection level	10	
E3-01	Motor 2 control method selection	0		F1-11	Excessive speed deviation detection delay time	0.5	
E3-02	Motor 2 max. output frequency (FMAX)	60.0		F1-12	Number of PG gear teeth 1	0	
E3-03	Motor 2 max. voltage (VMAX)	200.0*2		F1-13	Number of PG gear teeth 2	0	
E3-04	Motor 2 max. voltage frequency (FA)	60.0		F1-14	PG open-circuit detection time	2.0	
E3-05	Motor 2 mid. output frequency 1 (FB)	3.0 *2		F2-01	Bi-polar or uni-polar input selection	0	
E3-06	Motor 2 mid. output frequency voltage 1 (VC)	15.0 *9		F3-01	Digital input option	0	
E3-07	Motor 2 min. output frequency (FMIN)	1.5 *2		F4-01	Channel 1 monitor selection	2	
E3-08	Motor 2 min. output frequency voltage (VMIN)	9.0 *9		F4-02	Channel 1 gain	1.00	
E4-01	Motor 2 rated current	1.90 *6		F4-03	Channel 2 monitor selection	3	
E4-02	Motor 2 rated slip	2.90 *6		F4-04	Channel 2 gain	0.50	

Table 10.5 User Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
F4-05	Channel 1 output monitor bias	0.0		H1-06	Terminal S8 function selection	8 (6) *12	
F4-06	Channel 2 output monitor bias	0.0		H2-01	Terminal M1-M2 function selection (contact)	0	
F4-07	Analog output signal level for channel 1	0		H2-02	Terminal P1 function selection (open collector)	1	
F4-08	Analog output signal level for channel 2	0		H2-03	Terminal P2 function selection (open collector)	2	
F5-01	Channel 1 output selection	0		H3-01	Signal level selection (terminal A1)	0	
F5-02	Channel 2 output selection	1		H3-02	Gain (terminal A1)	100.0	
F5-03	Channel 3 output selection	2		H3-03	Bias (terminal A1)	0.0	
F5-04	Channel 4 output selection	4		H3-04	Signal level selection (terminal A3)	0	
F5-05	Channel 5 output selection	6		H3-05	Multi-function analog input (terminal A3) function selection	1F	
F5-06	Channel 6 output selection	37		H3-06	Gain (terminal A3)	100.0	
F5-07	Channel 7 output selection	0F		H3-07	Bias (terminal A3)	0.0	
F5-08	Channel 8 output selection	0F		H3-08	Signal level selection (terminal A2)	2	
F5-09	DO-08 output mode selection	0		H3-09	Multi-function analog input (terminal A2) function selection	0	
F6-01	Operation selection after communications error	1		H3-10	Gain (terminal A2)	100.0	
F6-02	Input level of external fault from Communications Option Board	0		H3-11	Bias (terminal A2)	0.0	
F6-03	Stopping method for external fault from Communications Option Board	1		H3-12	Analog input filter time constant	0.03	
F6-04	Trace sampling from Communications Option Board	0		H3-13	Terminal A1/A2 switching	0	
F6-06	Torque reference/torque limit selection from optical option	0		H4-01	Monitor selection (terminal FM)	2	
F6-08*17	Operation selection after SI-T WDT error	1		H4-02	Gain (terminal FM)	1.00	
F6-09*17	Number of SI-T BUS error detection	2		H4-03	Bias (terminal FM)	0.0	
H1-01	Terminal S3 function selection	24		H4-04	Monitor selection (terminal AM)	3	
H1-02	Terminal S4 function selection	14		H4-05	Gain (terminal AM)	0.50	
H1-03	Terminal S5 function selection	3 (0)*12		H4-06	Bias (terminal AM)	0.0	
H1-04	Terminal S6 function selection	4 (3)*12		H4-07	Analog output 1 signal level selection	0	
H1-05	Terminal S7 function selection	6 (4)*12		H4-08	Analog output 2 signal level selection	0	

Table 10.5 User Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
H5-01	Slave address	1F		L2-07	Momentary recovery time	0.0*13	
H5-02	Communication speed selection	3		L2-08	Frequency reduction gain at KEB start	100	
H5-03	Communication parity selection	0		L3-01	Stall prevention selection during accel	1	
H5-04	Stopping method after communication error	3		L3-02	Stall prevention level during accel	150*14	
H5-05	Communication error detection selection	1		L3-03	Stall prevention limit during accel	50	
H5-06	Send wait time	5		L3-04	Stall prevention selection during decel	1	
H5-07	RTS control ON/OFF	1		L3-05	Stall prevention selection during running	1	
H6-01	Pulse train input function selection	0		L3-06	Stall prevention level during running	150*14	
H6-02	Pulse train input scaling	1440		L3-11	Overvoltage inhibit selection	0	
H6-03	Pulse train input gain	100.0		L3-12	Overvoltage inhibit voltage level	380V*9	
H6-04	Pulse train input bias	0.0		L4-01	Speed agreement detection level	0.0	
H6-05	Pulse train input filter time	0.10		L4-02	Speed agreement detection width	2.0	
H6-06	Pulse train monitor selection	2		L4-03	Speed agreement detection level (+/-)	0.0	
H6-07	Pulse train monitor scaling	1440		L4-04	Speed agreement detection width (+/-)	2.0	
L1-01	Motor protection selection	1		L4-05	Operation when frequency reference is missing	0	
L1-02	Motor protection time constant	1.0		L5-01	Number of auto restart attempts	0	
L1-03	Alarm operation selection during motor overheating	3		L5-02	Auto restart operation selection	0	
L1-04	Motor overheating operation selection	1		L6-01	Torque detection selection 1	0	
L1-05	Motor temperature input filter time constant	0.20		L6-02	Torque detection level 1	150	
L2-01	Momentary power loss detection	0		L6-03	Torque detection time 1	0.1	
L2-02	Momentary power loss ridethru time	0.1*6		L6-04	Torque detection selection 2	0	
L2-03	Min. baseblock time	0.2*6		L6-05	Torque detection level 2	150	
L2-04	Voltage recovery time	0.3*6		L6-06	Torque detection time 2	0.1	
L2-05	Undervoltage detection level	190*9		L7-01	Forward drive torque limit	200	
L2-06	KEB deceleration time	0.0		L7-02	Reverse drive torque limit	200	

Table 10.5 User Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
L7-03	Forward regenerative torque limit	200		N5-01	Feed forward control selection	0	
L7-04	Reverse regenerative torque limit	200		N5-02	Motor acceleration time	0.178*6	
L7-06	Integral time setting for torque limit	200		N5-03	Feed forward proportional gain	1.0	
L7-07	Control method selection for torque limit during acceleration and deceleration	0		N5-04	Response frequency for speed command	40.00	
L8-01	Protect selection for internal DB resistor (Type ERF)	0		o1-01	Monitor selection	6	
L8-02	Overheat pre-alarm level	95*6		o1-02	Monitor selection after power up	1	
L8-03	Operation selection after overheat pre-alarm	3		o1-03	Frequency units of reference setting and monitor	0	
L8-05	Input open-phase protection selection	0		o1-04	Setting unit for frequency parameters related to V/f characteristics	0	
L8-07	Output open-phase protection selection	0		o1-05	LCD brightness adjustment	3	
L8-09	Ground protection selection	1		o2-01	LOCAL/REMOTE key enable/disable	1	
L8-10	Cooling fan control selection	0		o2-02	STOP key during control circuit terminal operation	1	
L8-11	Cooling fan control delay time	60		o2-03	User parameter initial value	0	
L8-12	Ambient temperature	45		o2-04	kVA selection	0*6	
L8-15	OL2 characteristics selection at low speeds	1		o2-05	Frequency reference setting method selection	0	
L8-18	Soft CLA selection	1*2		o2-06	Operation selection when digital operator is disconnected	0	
L8-32	OH1 detection of Inverter's cooling fan	1		o2-07	Cumulative operation time setting	0	
N1-01	Hunting-prevention function selection	1		o2-08	Cumulative operation time selection	0	
N1-02	Hunting-prevention gain	1.00		o2-10	Fan operation time setting	0	
N2-01	Speed feedback detection control (AFR) gain	1.00		o2-12	Fault trace/fault history clear function	0	
N2-02	Speed feedback detection control (AFR) time constant	50		o2-14	Output power monitor clear selection	0	
N2-03	Speed feedback detection control (AFR) time constant 2	750		o3-01	Copy function selection	0	
N3-01	High-slip braking deceleration frequency width	5		o3-02	Read permitted selection	0	
N3-02	High-slip braking current limit	150		T1-00	Motor 1/2 selection	1	
N3-03	High-slip braking stop dwell time	1.0		T1-01	Autotuning mode selection	2*2	
N3-04	High-slip braking OL time	40		T1-02	Motor output power	0.40*6	

Table 10.5 User Parameters (Continued)

No.	Name	Factory Setting	Setting	No.	Name	Factory Setting	Setting
T1-03	Motor rated voltage	200.0*9		T1-07	Motor base speed	1750	
T1-04	Motor rated current	1.90*6		T1-08	Number of PG pulses when turning	600	
T1-05	Motor base frequency	60.0		T1-09	Motor no-load current	1.20*6	
T1-06	Number of motor poles	4					

* 1. Not initialized. (Japanese standard specifications: A1-01 = 1, A1-02 = 2)
* 2. The factory setting will change when the control method is changed. The V/f control factory settings are given.
* 3. The factory setting is 1.0 when using flux vector control.
* 4. The factory setting is 2.00 s when Inverter capacity is 55 kW min.
The factory setting will change if the control method is changed. The open-loop vector factory setting is given.
* 5. By setting E2-11 (Motor rated output) the appropriate value will be set.
* 6. The factory setting depends on the Inverter capacity. The values for a 200 V Class Inverter for 0.4 kW are given.
* 7. The factory setting will change when the control method is changed. The flux vector control factory settings are given.
* 8. Only 1 (VT) can be set for 200 V Class 110 kW as well as 400 V Class 220 kW and 300 kW Inverters.
* 9. Setting for 200 V Class Inverters. For 400 V Class Inverters, double the value.
* 10.E1-11 and E1-12 are disregarded when set to 0.0.
* 11.E1-13 is set to the same value as E1-05 by autotuning.
* 12.The values in parentheses indicate factory settings when initialized in 3-wire sequence.
* 13.If the setting is 0, the axis will accelerate to the specified speed over the specified acceleration time (C1-01 to C1-08).
* 14.C6-01 = 1:120%, C6-01 = 0:150%
* 15.This parameter can be monitored or set only when F is set for C6-02.

Symbols

Numerics

A

B

C

D

E

F

G

H

R

S

T

U

V

W

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