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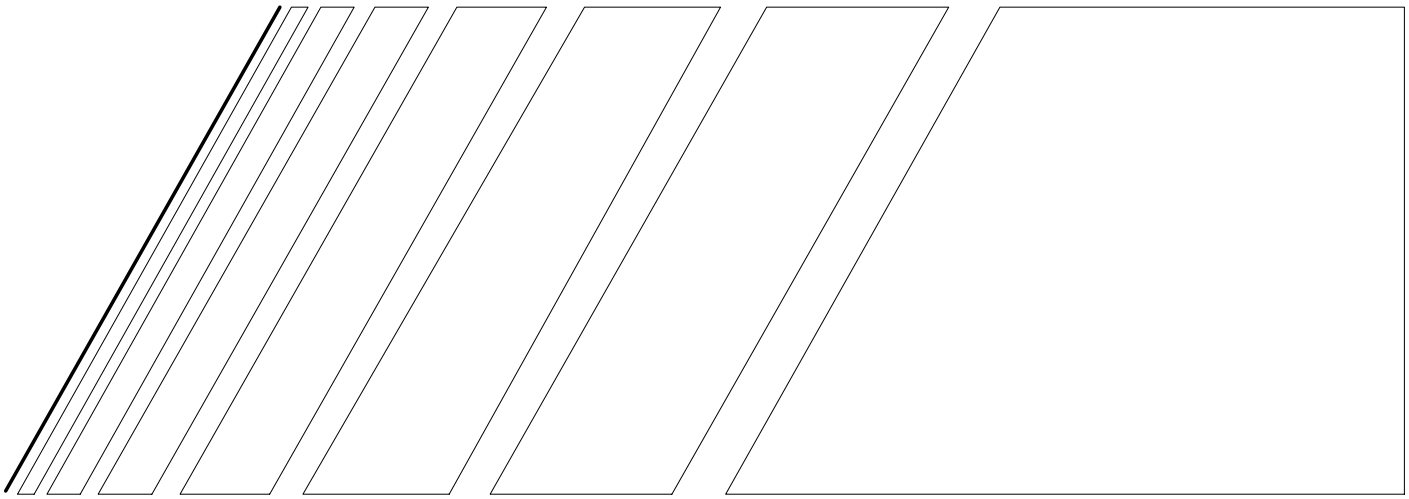

USER'S MANUAL

SYSDRIVE 3G3EV SERIES

(SYSMAC BUS Model)

Compact Low-noise Inverter

Thank you for choosing this SYSDRIVE 3G3EV-series product. Proper use and handling of the product will ensure proper product performance, will lengthen product life, and may prevent possible accidents.
Please read this manual thoroughly and handle and operate the product with care.

NOTICE

1. This manual describes the functions of the product and relations with other products. You should assume that anything not described in this manual is not possible.
2. Although care has been given in documenting the product, please contact your OMRON representative if you have any suggestions on improving this manual.
3. The product contains potentially dangerous parts under the cover. Do not attempt to open the cover under any circumstances. Doing so may result in injury or death and may damage the product. Never attempt to repair or disassemble the product.
4. We recommend that you add the following precautions to any instruction manuals you prepare for the system into which the product is being installed.
   - Precautions on the dangers of high-voltage equipment.
   - Precautions on touching the terminals of the product even after power has been turned off. (These terminals are live even with the power turned off.)
5. Specifications and functions may be changed without notice in order to improve product performance.

Items to Check Before Unpacking

Check the following items before removing the product from the package:

- Has the correct product been delivered (i.e., the correct model number and specifications)?
- Has the product been damaged in shipping?
- Are any screws or bolts loose?

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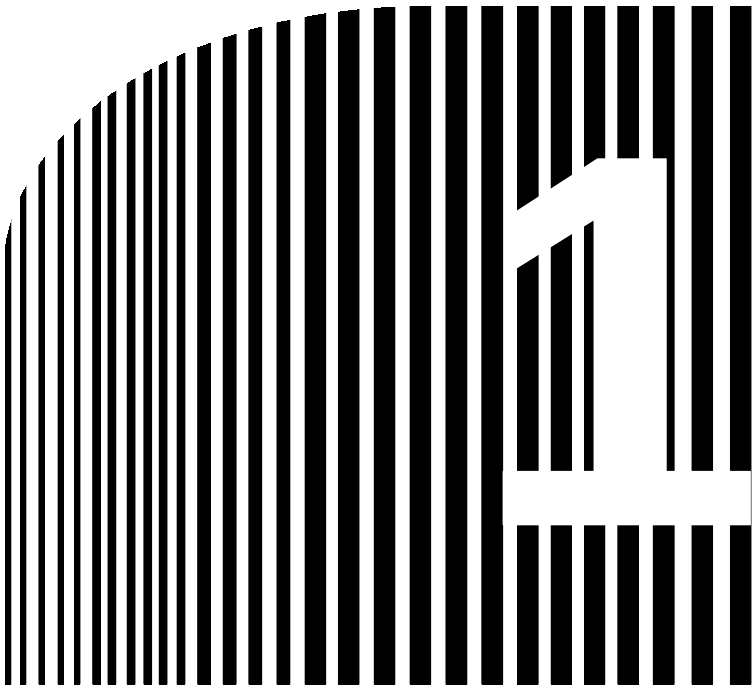
Table of Contents



Chapter 1

• Getting Started

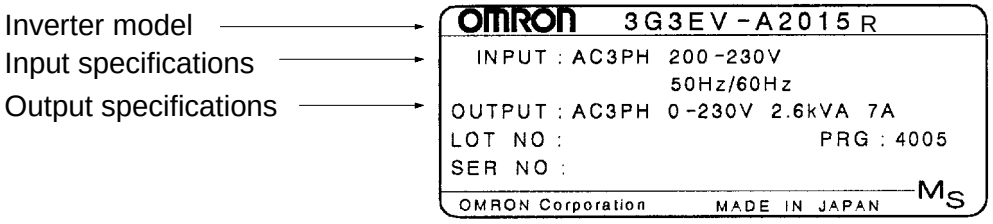
1-1 Items to be Checked when Unpacking

■ Checking the Product

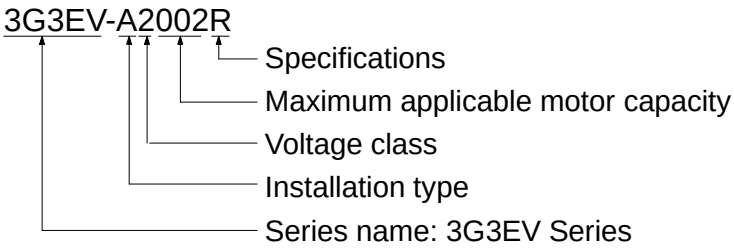
On delivery, always check that the delivered product is the SYSDRIVE 3G3EV Inverter that you ordered.

Should you find any problems with the product, immediately contact your nearest local sales representative.

● Checking the Nameplate



● Checking the Model



Specifications

Blank	Standard model
R	SYSMAC BUS model

Voltage Class

2	Three-phase 200 VAC input
B	Single/Three-phase 200 VAC input

Maximum Applicable Motor Capacity

001	0.1 kW
002	0.2 kW
004	0.4 kW
007	0.75 kW
015	1.5 kW

Installation Type

A	Panel mounting
P	Option

● Checking for Damage

Check the overall appearance and check for damage or scratches resulting from transportation.

■ Checking Accessories

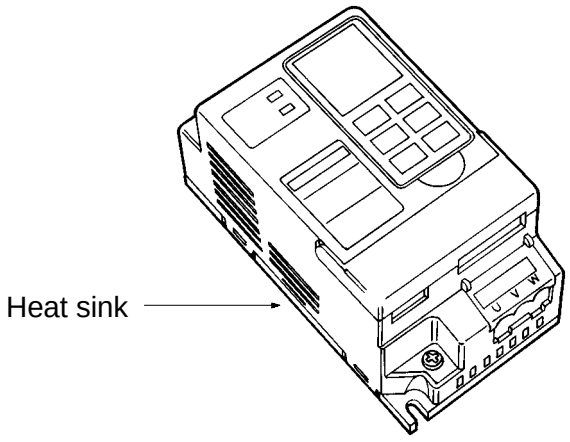
Note that this manual is the only accessory provided with the 3G3EV (SYSMAC BUS Model). Set screws and other necessary parts must be prepared by customers.

1-2 Precautions

To ensure safe operation of the 3G3EV, note the following items:

■ Always Hold the Heat Sink During Removal.

When moving the 3G3EV, always hold the heat sink (aluminum portion on the rear of the Unit).



■ Watch Out for Residual Voltage On Charged Portions

After the power is turned off, residual voltage remains in the capacitor inside the Inverter. Therefore, touching terminals immediately after turning the power off may cause an electrical shock.

If an inspection or some other task is to be performed, always wait at least one minute from the time all indicators on the front panel go off.

(Note that this warning is applicable whenever you perform any task after turning the main circuit off.)

■ Do Not Remove the Digital Operator When the Main Circuit is Still On.

Always turn the main circuit off before removing the digital operator.

Removing the digital operator with the main circuit ON may cause an electrical shock and damage the equipment.

■ Do Not Modify Wiring or Check Signals When the Main Circuit is On.

Always turn the main circuit off before modifying wiring or checking signals.

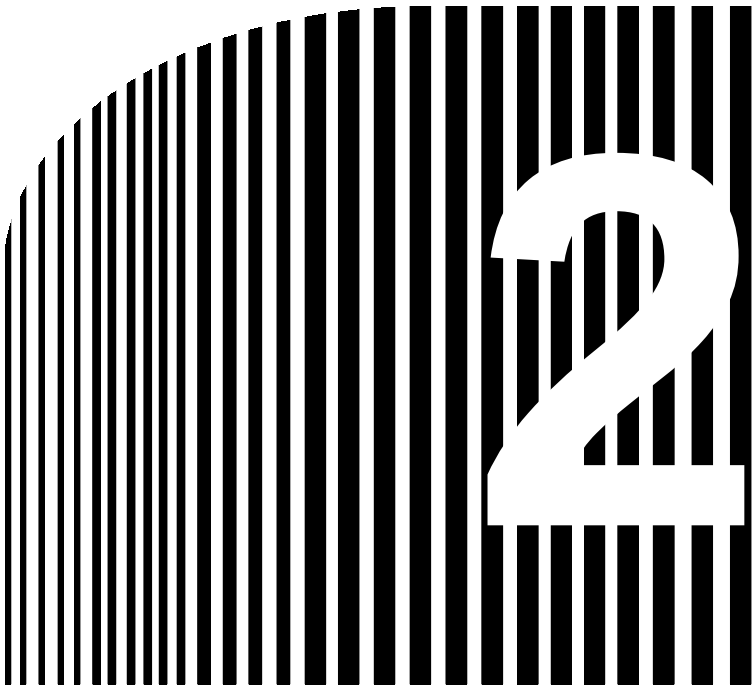
Touching terminals while the main circuit is on may cause an electrical shock and damage the equipment.

■ Do Not Conduct a Dielectric Strength Test.

Because the 3G3EV Inverter is an electronic control unit using semiconductor, never conduct a dielectric strength test or an insulation resistance test for the control circuit.

■ Modify Constant Settings Correctly.

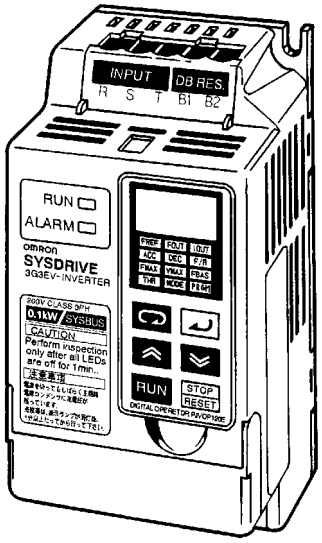
Always modify the constant settings according to the procedures described in this manual.



Chapter 2

Overview

2-1 Features



■ Easy to Use

● Basic Constants Displayed On Indicators

Constants for basic operations such as frequency setting and acceleration/deceleration time setting are displayed on dedicated indicators. Therefore, constant numbers can be confirmed easily.

■ Easy to Install

● Very Small and Lightweight

The 3G3EV Inverter is approximately half the size of our Low-noise General-purpose Inverters in terms of volume and weight percentage. This improves space efficiency and operating efficiency (including easier removal).

● Optional DIN Track

An optional DIN track is available. This DIN track enables the user to mount the 3G3EV Inverter on the DIN track with a one-touch operation.

■ Easy to Wire

● Using Two-conductor Cables to Minimize Wiring

Two-conductor cables (VCTF) enable the Inverter to be connected a higher-level PC.

● Easy Wiring without Having to Open the Front Cover

This Inverter can be wired just by opening the terminal block cover.

● Separate Input and Output Terminal Blocks

Power input terminals are located in the upper section, while motor output terminals are in the lower section. In this way, the input and output terminal blocks are separated according to the contactors, so incorrect wiring can be prevented.

● Soldering No Longer Necessary

No connector means no soldering.

■ Easy to Operate

● Bitwise Communication Making Programming Easier

No special communication program is required. Allocated input and output areas can be used to control the Inverter in a way similar to ordinary I/O Units.

● Switching the Operation Mode by Simple Key Operation

For example, after a test run is performed using the Digital Operator, it can be easily switched to a production run in communication mode by simple key operation.

● Checking a Test Run with Various Monitors

Output frequency, output current, and the direction of motor rotation appear in the display section of the Digital Operator, so the mechanical system can be easily monitored during a test run.

■ Low Noise

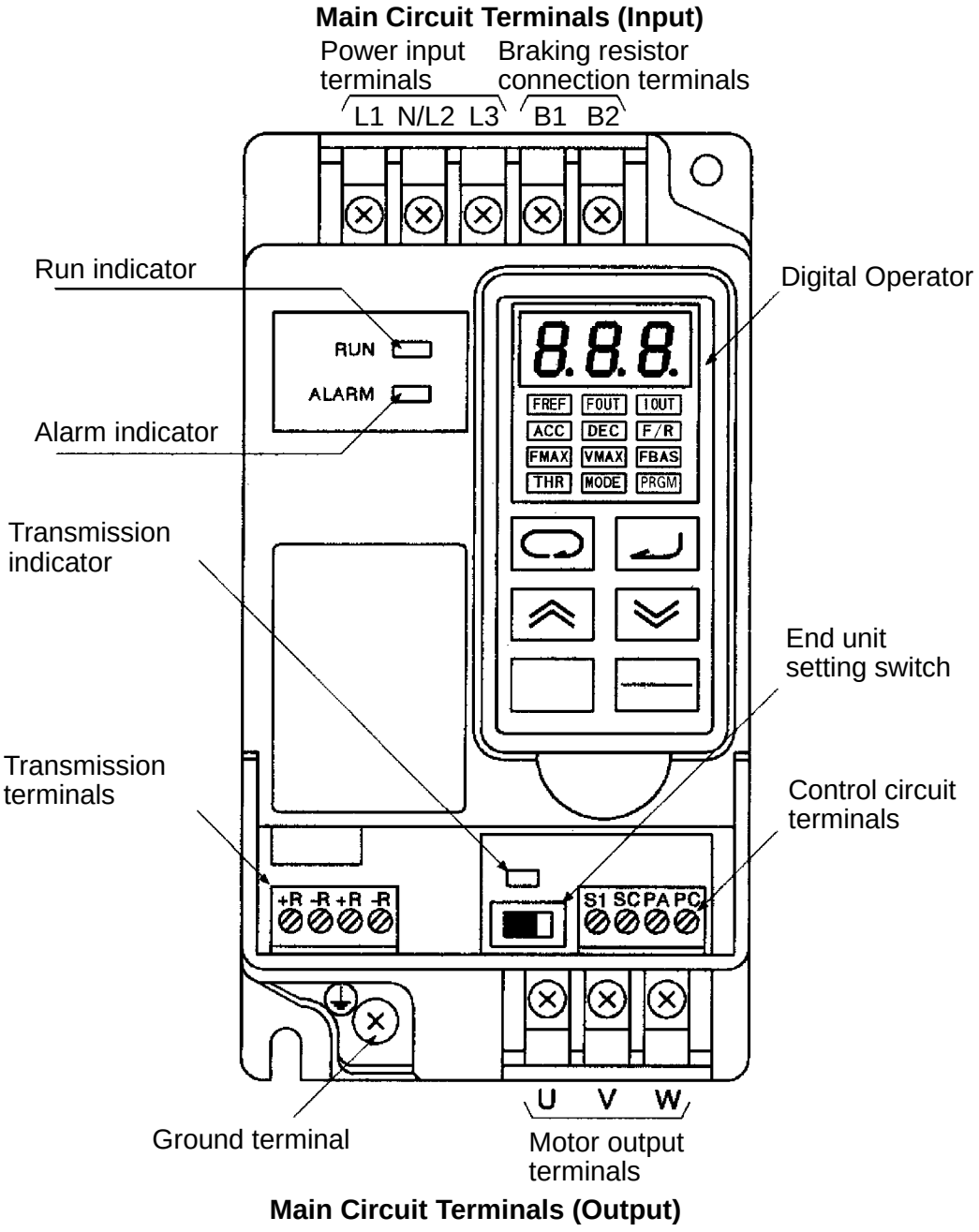
An insulated gate bipolar transistor (IGBT) power element has been adopted to eliminate metallic noise.

■ High-torque Operation Even in Low Speed Range

A torque rate of 150% can be achieved even in a low speed range where output frequency is only 3 Hz. Thus, acceleration time can be reduced.

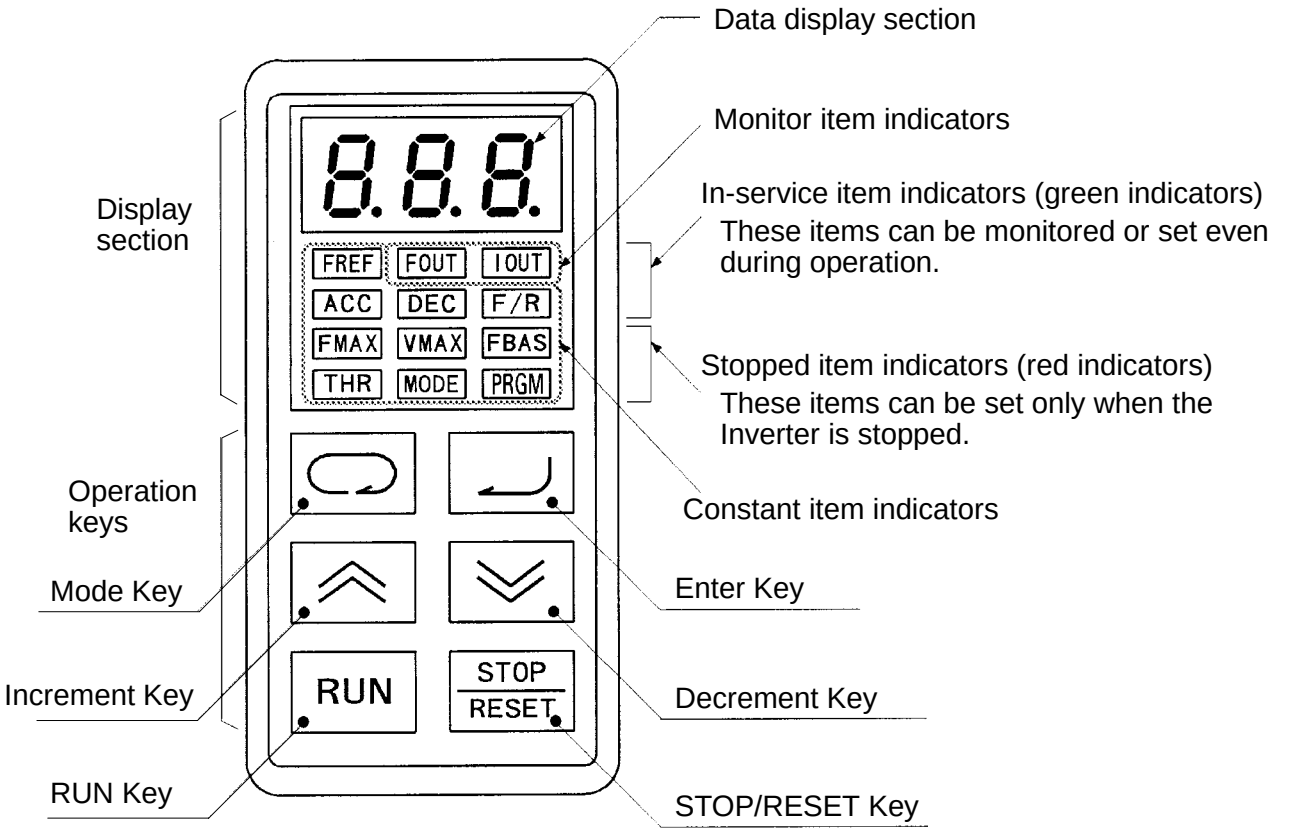
2-2 Component Names

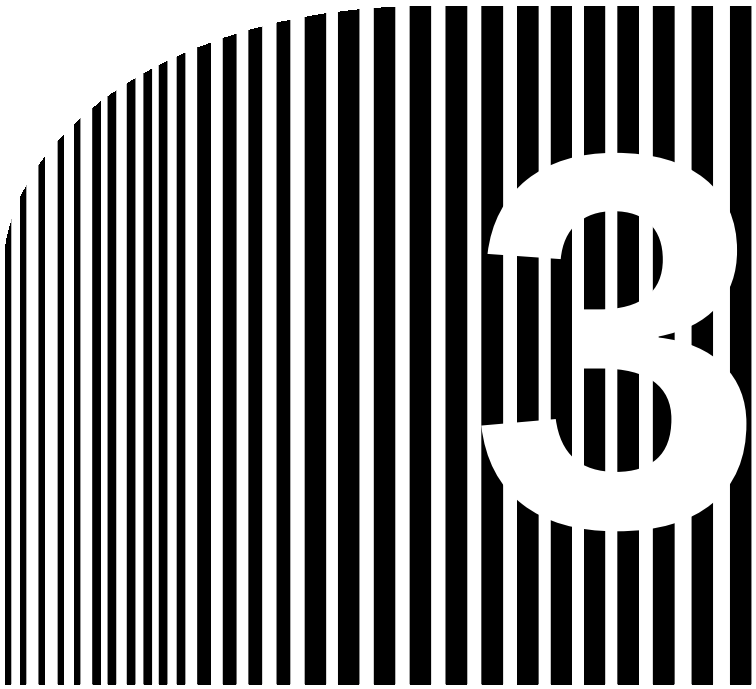
■ Main Unit



Note This diagram shows the Inverter with all terminal block covers removed.

■ Digital Operator





Chapter 3

Design

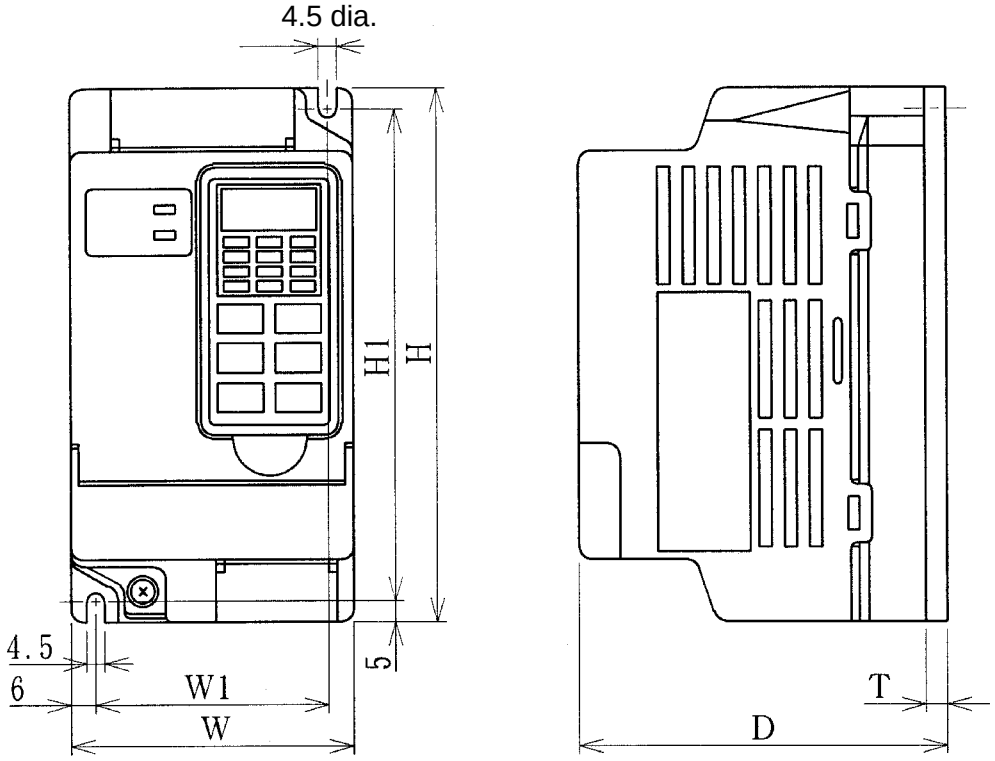
3-1 Installation

3-1-1 Outside/Mounting Dimensions

Note All dimensions are in millimeters.

■ 3G3EV-A2001R to 3G3EV-A2004R (0.1 to 0.4 kW): Three-phase 200-VAC Input

■ 3G3EV-AB001R to 3G3EV-AB002R (0.1 to 0.2 kW): Single/Three-phase 200-VAC Input



Note 1. For the 3G3EV-A2001R, 3G3EV-A2002R, and 3G3EV-AB001R, a U-shaped notch (4.5 mm wide) is provided instead of the upper mounting hole (4.5 mm in diameter).

Note 2. Install the Inverter with two M4 bolts.

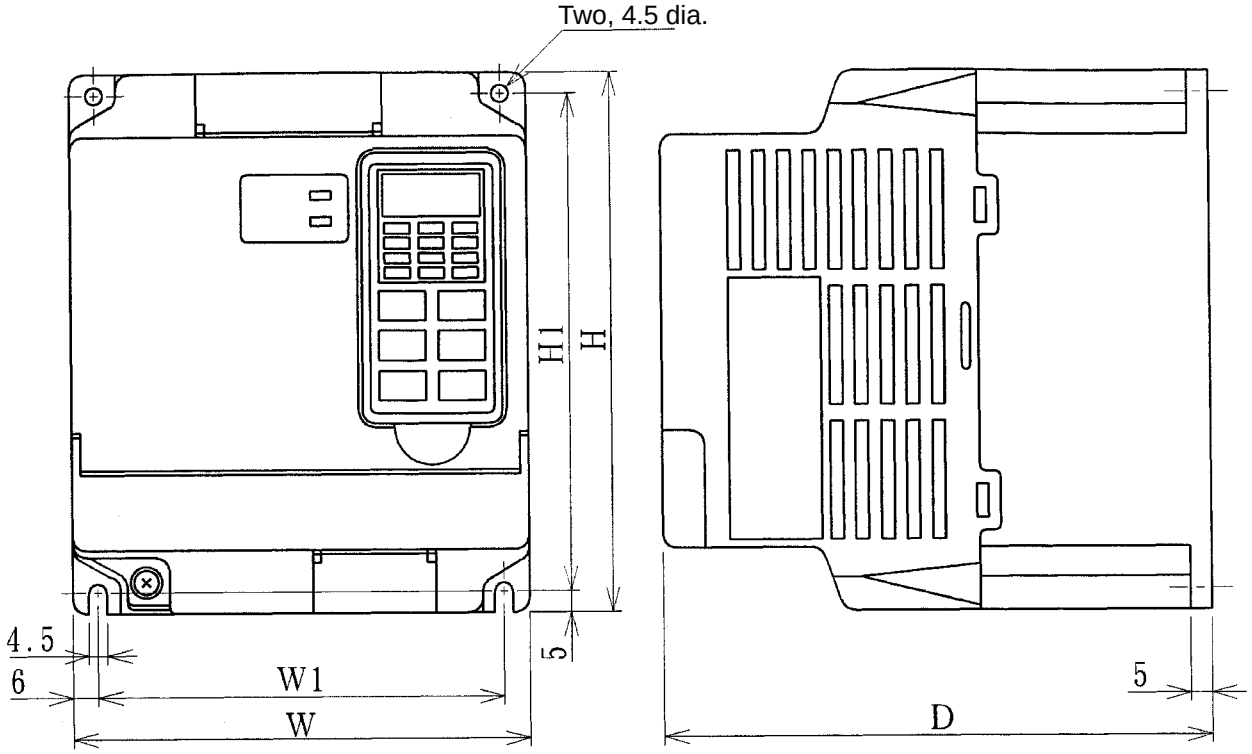
● Three-phase 200-VAC Input Model

3G3EV model	Output	W	H	D	W1	H1	T	Weight (kg)
A2001R	0.1 kW	68	128	75	56	118	3	Approx. 0.5
A2002R	0.2 kW			88			3	Approx. 0.6
A2004R	0.4 kW			110			5	Approx. 0.9

● Single/Three-phase 200-VAC Input Model

3G3EV model	Output	W	H	D	W1	H1	T	Weight (kg)
AB001R	0.1 kW	68	128	75	56	118	3	Approx. 0.6
AB002R	0.2 kW			108			5	Approx. 0.9

■ 3G3EV-A2007R to 3G3EV-A2015R (0.75 to 1.5 kW): Three-phase 200-VAC Input 3G3EV-AB004R to 3G3EV-AB007R (0.4 to 0.75 kW): Single/Three-phase 200-VAC Input



Note Install the Inverter with four M4 bolts.

● Three-phase 200-VAC Input Model

3G3EV model	Output	W	H	D	W1	H1	Weight (kg)
A2007R	0.75 kW	108	128	130	96	118	Approx. 1.3
A2015R	1.5 kW			155			Approx. 1.5

● Single/Three-phase 200-VAC Input Model

3G3EV model	Output	W	H	D	W1	H1	Weight (kg)
AB004R	0.4 kW	108	128	130	96	118	Approx. 1.3
AB007R	0.75 kW						Approx. 1.3

3-1-2 Installation Conditions

■ Installation Site

- Install the Inverter under the following conditions:

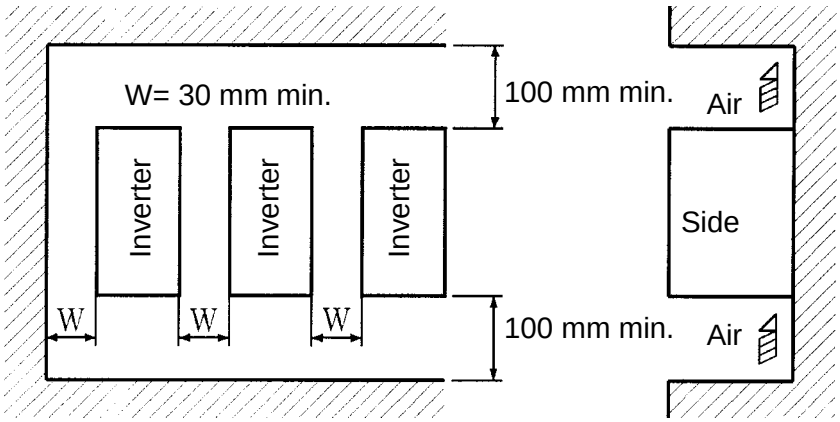
  Ambient temperature for operation: −10°C to 50°C
  Humidity: 90% RH or less (non-condensing)
- Install the Inverter in a clean location free from oil mist and dust. Alternatively, install it in a totally enclosed panel that is completely shielded from suspended dust.
- When installing or operating the Inverter, always take special care so that metal powder, oil, water, or other foreign matter do not get in the Inverter.
- Do not install the Inverter on inflammables such as wood.

■ Direction of Installation

- Install the Inverter on a vertical surface so that the characters on the nameplate are oriented upward.

■ Installation Space

- When installing the Inverter, always provide the following installation space to allow normal heat dissipation from the Inverter:



■ Ambient Temperature Control

- To enhance operation reliability, the Inverter should be installed in an environment free from extreme temperature rises.
- 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 50°C.
- The surface temperature of the Inverter may reach 30°C higher than the ambient temperature. Therefore, keep all thermally susceptible devices and wires away from the Inverter.

■ Protecting the Inverter from Foreign Matter during Installation

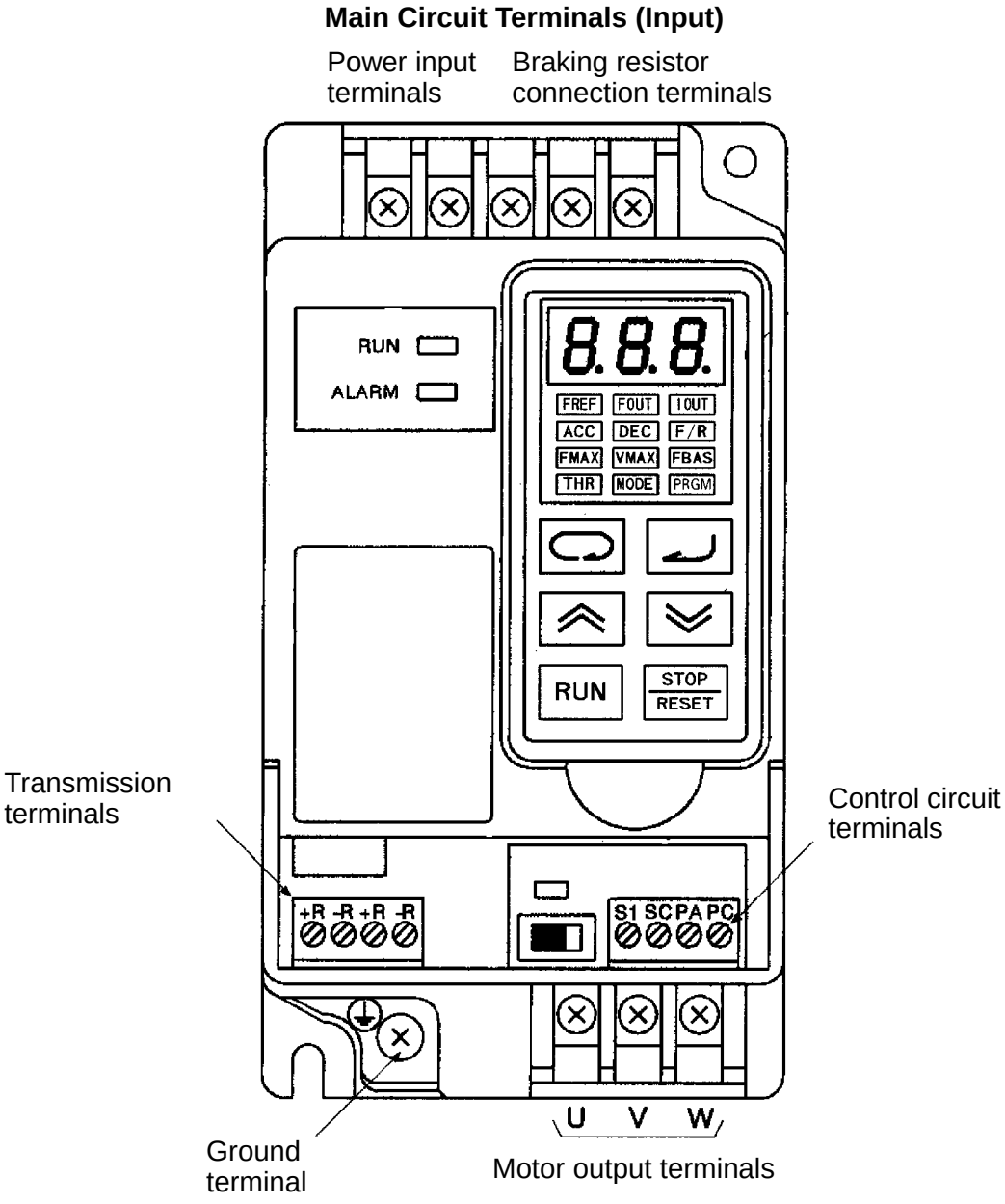
- Place a cover over the Inverter to shield it from metal powder produced by drilling during installation.

  (Upon completion of installation, always remove the cover from the Inverter. Otherwise, ventilation will be affected, causing the invert to overheat.)

3-2 Wiring

3-2-1 Terminal Blocks

■ Name of Each Terminal Block



Note This diagram shows an Inverter with all terminal block covers removed.

■ Main Circuit Terminals

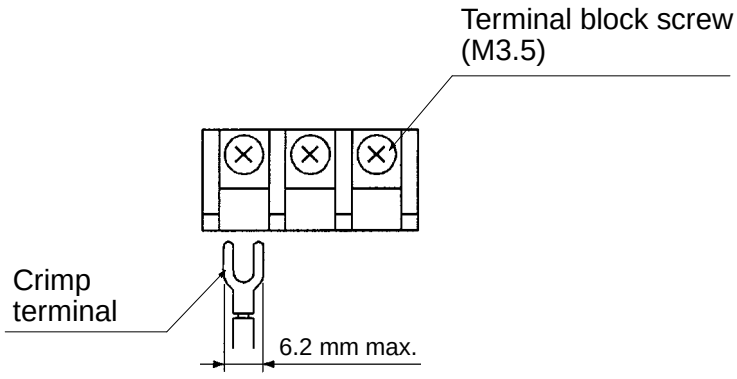
● Input Terminals (Top Section)

Terminal symbol	Name and description
L1 N/L2 L3	**Power input terminals** Three-phase, 200 to 230 VAC, 50/60 Hz input terminals. If a 3G3EV-AB□□□R is to be used in single-phase input mode, single-phase 200 to 240 VAC power with a frequency of 50/60 Hz must be input between terminals R and S.
B1 B2	**Braking resistor connection terminals (see note)** Terminals for connecting an optional braking resistor

Note Before shipping, a resin plate is attached to each braking resistor connection terminal to prevent incorrect wiring.
When connecting a braking resistor, always remove the resin plates with a pair of long-nose pliers.

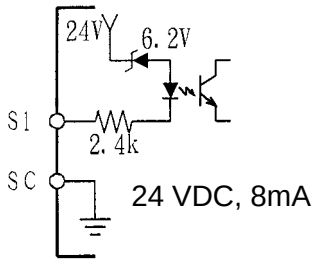
● Output Terminals (Bottom Section)

Terminal symbol	Name and description
U V W	**Motor output terminals** Three-phase power output terminals for operating the motor. (Never connect an AC power supply to these terminals.)
⏚	**Ground terminal** Always use a ground terminal with a ground resistance of 100 Ω or less.



■ Control Circuit Terminals

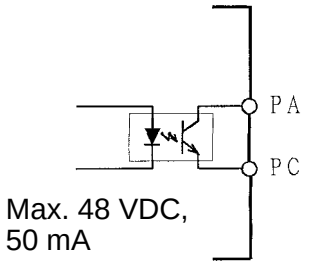
● Input Terminals

Terminal symbol	Name and description	Interface
S1	**Multi-function input (see notes 1 and 2)**	
SC	**Multi-function input common** Input common for S1	

Note 1. Constant no. 06 (n06) is used to set this function. This constant is factory-set to "fault reset."

Note 2. Multi-function input 1 is allocated to both the control circuit terminal and input channel. When either of them is turned on, multi-function input 1 becomes valid. Therefore, if multi-function input 1 is to be used as "external fault (contact b)," bit 4 of channel n + 1 on the communication side must be set to 0. If this bit is set to 1, an abnormal stop cannot be performed using external terminals.

● Output Terminals

Terminal symbol	Name and description	Interface
PA	**Multi-function output 1 (see note)**	
PB	**Multi-function output common**	

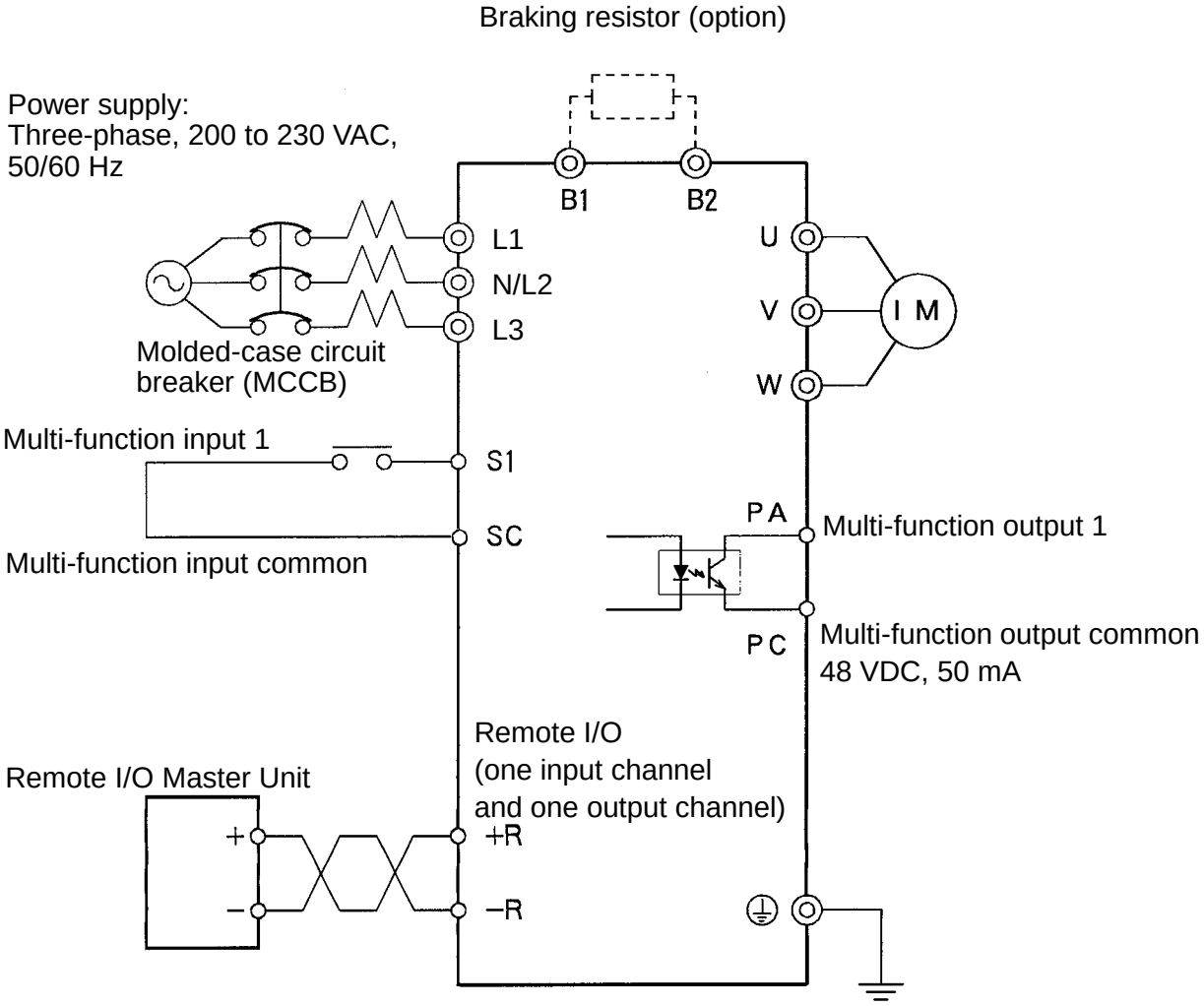
Note Constant no. 09 (n09) is used to set the function. This constant is factory-set to "operation in progress."

■ Transmission Terminals

Terminal symbol	Name and description
+R	**Data send-receive terminals**
−R	Terminals used to connect two-conductor cables for SYSMAC BUS.

Note +R and +R, and −R and −R are internally shorted.

■ Standard Connection Diagram



Note 1. If a 3G3EV-AB□□□R is used in single-phase input mode, 200 to 240 VAC power with a frequency of 50/60 Hz must be input between terminals R and S.

Note 2. Use cabtire cables (VCTF 0.75 x 2C) to connect to the Remote I/O Master Unit.

3-2-2 Wiring Around the Main Circuit

System reliability and noise resistance are affected by the wiring method used. Therefore, always follow the instructions given below when connecting the Inverter to peripheral devices and other parts.

■ Wire Size and Molded-Case Circuit Breaker to be Used

For the main circuit and ground, always use 600-V polyvinyl chloride (PVC) cables.

If the cable is long and may cause voltage drops, increase the wire size according to the cable length.

Model	Terminal symbol	Terminal screw	Wire size (mm^2)	Molded-case circuit breaker capacity (A)
3G3EV-A2001R 3G3EV-AB001R	R S T B1 B2 U V W ⏚	M3.5	0.75 to 2	5
3G3EV-A2002R 3G3EV-AB002R	R S T B1 B2 U V W ⏚	M3.5	0.75 to 2	5
3G3EV-A2004R 3G3EV-AB004R	R S T B1 B2 U V W ⏚	M3.5	0.75 to 2	5
3G3EV-A2007R 3G3EV-AB007R	R S T B1 B2 U V W ⏚	M3.5	0.75 to 2	10
3G3EV-A2015R	R S T B1 B2 U V W ⏚	M3.5	0.75 to 2	10

Determining the Wire Size

Determine the wire size for the main circuit so that line voltage drop is within 2% of the rated voltage.

Line voltage drop V_D is calculated as follows:

V_D (V) = $\sqrt{3}$ x wire resistance (Ω/km) x wire length (m) x amperage (A) x 10^{-3}

■ Wiring on the Input Side of Main Circuit

● 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.

● Installing a Ground Fault Interrupter

If a ground fault interrupter is to be connected to the wire on the primary side (R, S, and T) of the main circuit, use either of the following interrupters to prevent malfunctions:

- Ground fault interrupter with a sensitivity amperage of 200 mA or more and with an operating time of 0.1 second or more
- Ground fault interrupter with high-frequency countermeasures (for Inverter)

● Installing a Magnetic Contactor

This Inverter can be used without a magnetic contactor (MC) on the power supply side.

If the power supply for the main circuit is to be shut off because of the sequence, a magnetic contactor can be used instead of a molded-case circuit breaker.

However, when a magnetic contactor is installed on the primary side of the main circuit to forcibly stop a load, note that regenerative braking does not work and the load coasts to a stop.

- A load can be started and stopped by opening and closing the magnetic contactor on the primary side. Note, however, that frequently opening and closing the magnetic contactor may cause the Inverter to break down.
- When the Inverter is operated with a Digital Operator, automatic operation cannot be performed after recovery from a power interruption.
- If a braking resistor unit is to be used, program the sequence so that the magnetic contactor is turned off by the contact of the unit's thermal relay.

● Connecting Input Power Supply to the Terminal Block

Because the phase sequence of input power supply is irrelevant to the phase sequence (R, S, T) of the terminal block, input power supply can be connected to any terminal on the terminal block.

● Installing an AC Reactor

If the Inverter is connected to a large-capacity power transformer (600 kW or more) or the phase advance 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. This also improves the power factor on the power supply side.

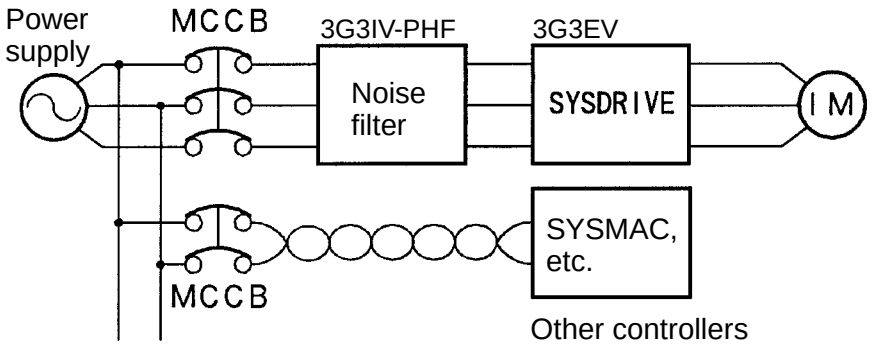
● Installing a Surge Absorber

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

● Installing a Noise Filter on the Power Supply Side

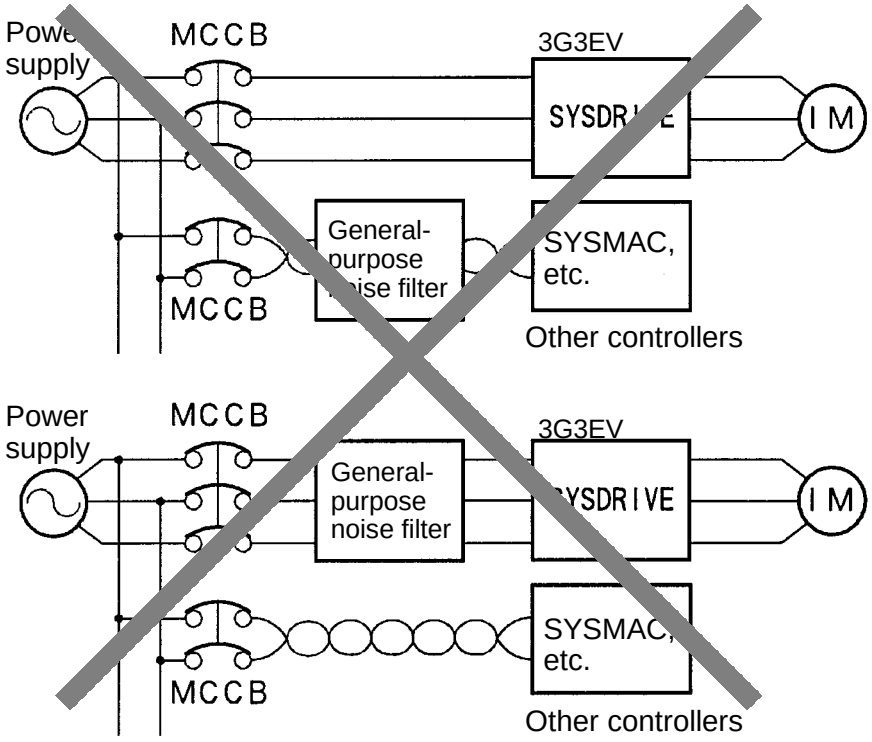
Install a noise filter to eliminate noise transmitted between the power line and the Inverter.

Wiring Example 1



Note Use a special-purpose noise filter for Inverters.

Wiring Example 2



Note Do not use a general-purpose noise filter.

■ Wiring on the Output Side of Main Circuit

● Connecting the Terminal Block to the Load

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

● Never Connect Power Supply to Output Terminals

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

● Never Short or Ground the Output Terminals

Caution 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. Also, be careful not to short the output wires.

● Do Not Use a Phase Advance Capacitor or Noise Filter

Never connect a phase advance capacitor or LC/RC noise filter to the output circuit. Doing so may result in damage to the Inverter or cause other parts to burn.

● Do Not Use an Electromagnetic Switch

Do not connect an electromagnetic switch or magnetic contactor to the output circuit. If a load is connected to the Inverter during operation, an inrush current will actuate the overcurrent protective circuit in the Inverter.

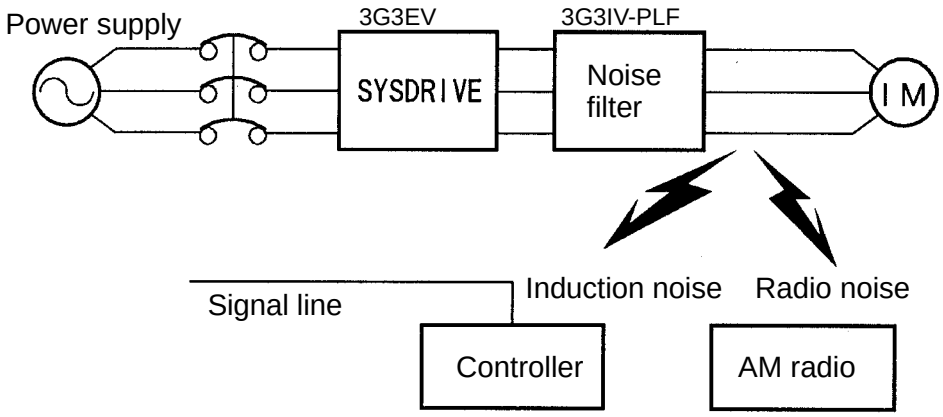
● Installing a Thermal Relay

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 multipolar motor is used, always install a thermal relay (THR) between the Inverter and the motor and set to “0.0” (no thermal protection) for constant No. 31 (“THR” indicator).

In this case, program the sequence so that the magnetic contactor on the input side of the main circuit is turned off by the contact of the thermal relay.

● Installing a Noise Filter on the Output Side

Connect a noise filter to the output side of the Inverter to reduce radio noise and induction noise.

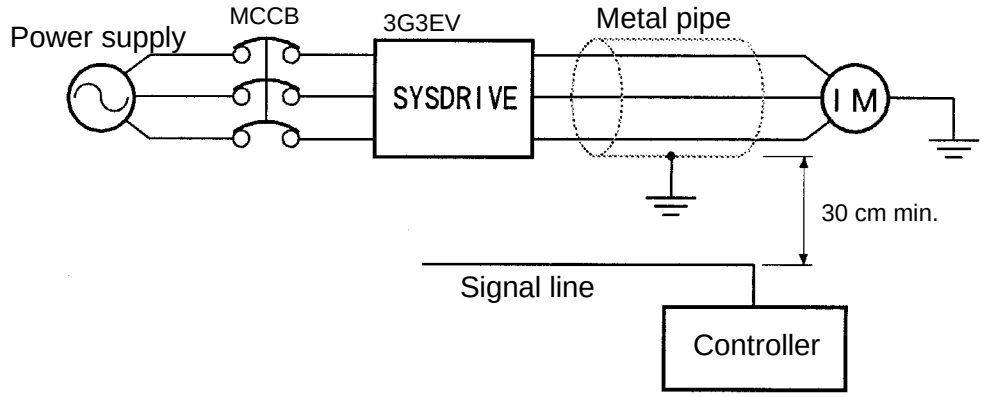


Induction Noise: Electromagnetic induction generates noise on the signal line, causing the controller to malfunction.

Radio Noise: Electromagnetic waves from the Inverter and cables cause the broadcasting radio receiver to make noise.

● How to Prevent Induction Noise

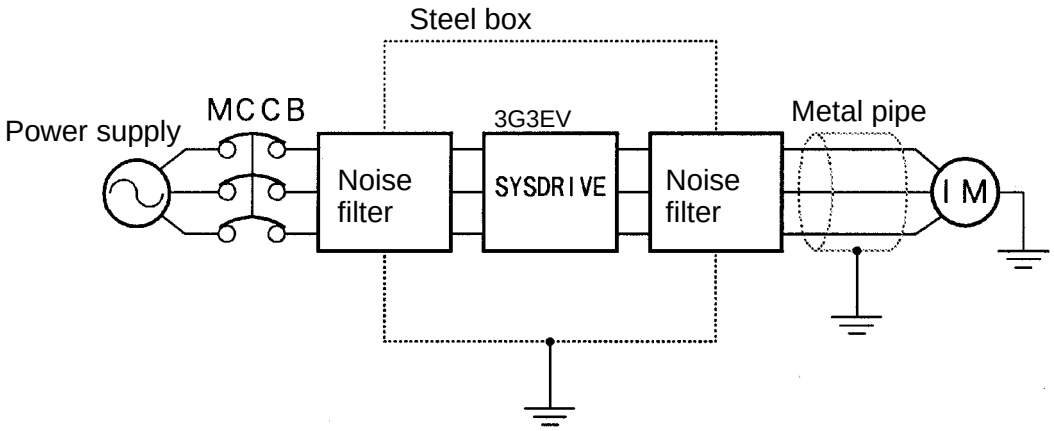
As described above, a noise filter can be used to prevent induction noise from being generated on the output side. Alternatively, cables can be routed through a grounded metal pipe to prevent induction noise. Keeping the metal pipe at least 30 cm away from the signal line considerably reduces induction noise.



● How to Prevent Radio Noise

Radio noise is generated from the Inverter as well as 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.



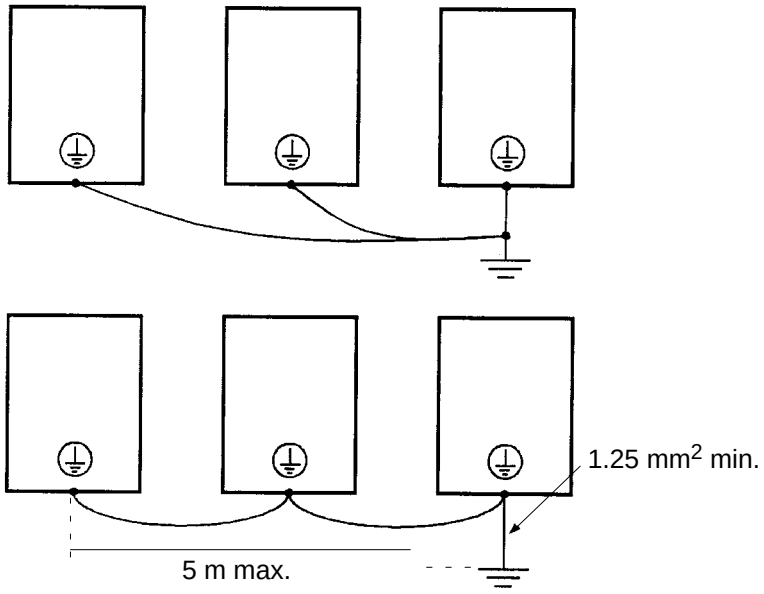
● Cable Length between Inverter and Motor

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 n37) as shown in the table below.

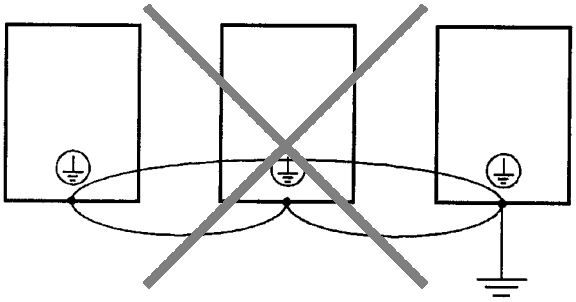
Cable length between Inverter and motor	50 m max.	100 m max.
Carrier frequency (n37)	10 kHz max. (1, 2, 3, 4)	5 kHz max. (1, 2)

■ Ground Wiring

- Always use a ground terminal with a ground resistance of 100 Ω or less.
- Do not share the ground wire with other devices such as a welder or power tool.
- Always use a ground wire that complies with technical standards on electrical equipment. Route the ground wire so that the total length is as short as possible.
- When using more than one Inverter, be careful not to loop the ground wire.



Note Minimize the total length (5 m or less) between the ground electrode and the ground terminal, and also use a thick wire (1.25 m^2 or more). 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.



3-2-3 Wiring Control Circuit Terminals

The control signal line must be 50 m or less and must be separated from the power line.

■ Wiring Sequence Input/Output Terminals

Wire the multi-function input1 terminals (S1 and SC) and the multi-function output 1 terminals (PA and PC) as described below.

● Wires to be Used

Wire type	Wire size	Wire to be used
Single wire	0.5 to 1.25 mm^2	Polyethylene-shielded cable
Stranded wire	0.5 to 0.75 mm^2	

● Wiring Method

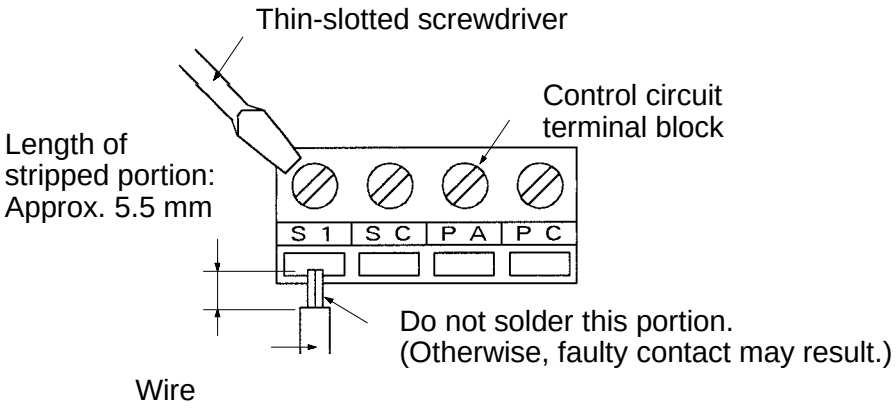
- Wire each terminal as follows:

a) Loosen the terminal screw with a thin-slotted screwdriver.

b) Insert the wire from underneath the terminal block.

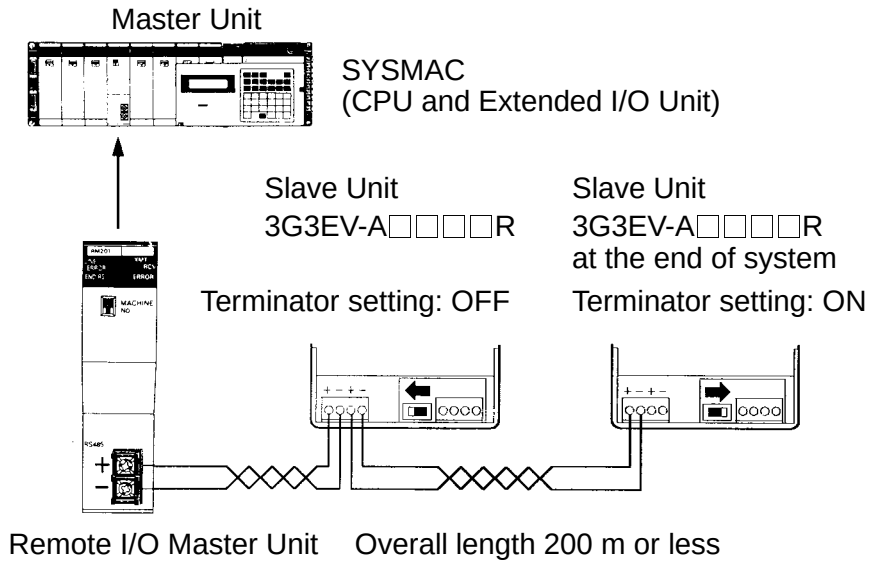
c) Tighten the terminal screw firmly.

- Always separate the control signal line from the main circuit cables and other power cables.



3-2-4 Wiring Transmission Terminals

Wire the transmission terminals (+R and −R) as described below.



■ Wires to be Used

Cabtire cable (VCTF 0.75 mm^2 x 2C)

■ Wiring Method

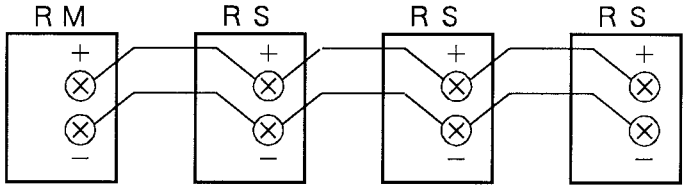
- The wiring method is the same as for sequence input/output terminals, described previously.
- Always separate the transmission cables from the main circuit cables and other power cables.
- Always connect the positive terminal to the positive terminal and the negative terminal to the negative terminal.
- Wire the Remote I/O Master Unit (RM201) on the SYSMAC side first, then continue wiring in order. Set the last Slave Unit (device) as a terminator.
- The overall cable length must be 200 m or less.
- Always separate the transmission line from the main circuit cables and other power cables. In particular, the transmission line must not be parallel to or close to the output cables from the Inverter.

■ Example of Connecting Remote I/O Slave Units

Connect the Remote I/O Master Unit (C500-RM201 or C200H-RM201) to Remote I/O Slave Units (devices) as described below.

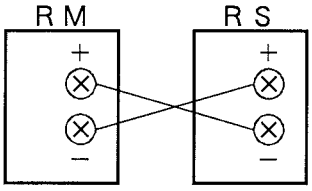
RM: Master Unit
RS: Slave Unit (device)

○



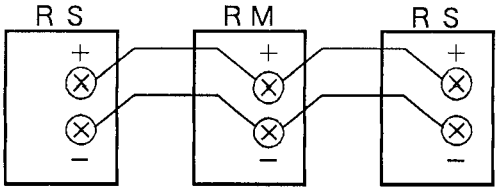
Connect the Remote I/O Master Unit first, then continue wiring in order.

×



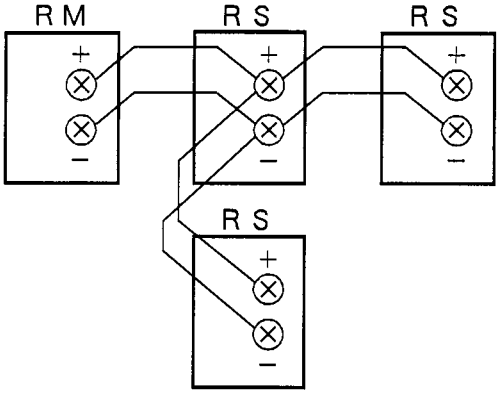
Do not connect a positive terminal to a negative terminal.

×



The Remote I/O Master Unit cannot be directly connected to more than one Remote I/O Slave Unit.

×



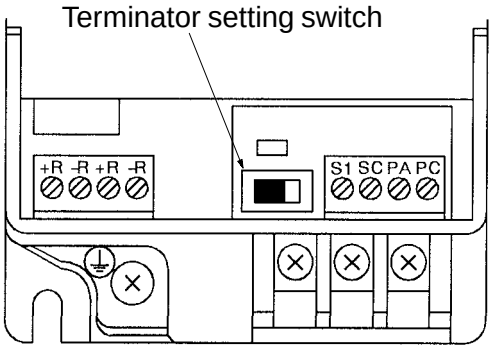
Wiring cannot be branched from a Remote I/O Slave Unit.

3-2-5 Setting the Terminator

The Remote I/O Unit at the end of the system must be set as the terminator. Otherwise, all Remote I/O Units cannot operate. This section describes how to set the 3G3EV-A□□□□R as a terminator.

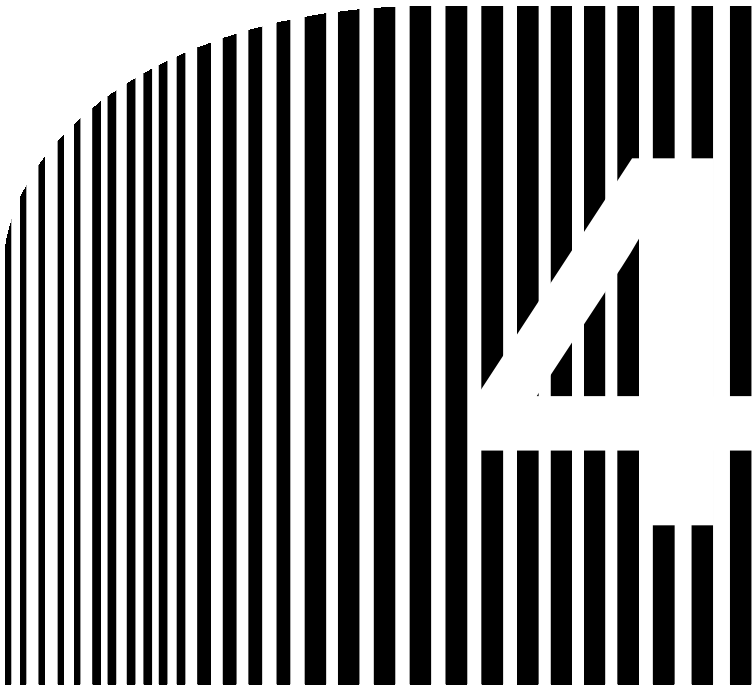
■ Setting the Terminator

- Open the terminal block cover in the lower part of the Inverter. The terminator setting switch is located on the left side of the control circuit terminals.
- Sliding the switch to the right sets the Inverter as the terminator.



■ Notes on Setting the Terminator

- The last Slave Unit under each Remote I/O Master Unit must be set as the terminator.
- Always set a terminator even when only one unit is to be connected.
- If no terminator is set, the Remote I/O System fails to operate, and the PC also fails to start operation even when the Master Unit enters run mode. In this case, the “END RS” indicator (terminator checking) remains lit. The Programming Console also displays a message indicating that CPU is on hold.



Chapter 4

Preparing for Operation

4-1 Preparation Procedure

1. Installation:

   Install the Inverter according to installation conditions.

   Check that all the installation conditions are met.

2. Wiring:

   Connect the Inverter to power supply and peripheral devices.

   Select peripheral devices that meet the specifications, and wire them correctly. Set and end unit as necessary.

3. Testing the Inverter Only

   • Turning the Power On:

   Check the necessary items, then turn the power on.

   Always check that the power voltage is correct and the power input terminals (R, S, and T) are wired correctly.

   • Power voltage

   Three-phase, 200 to 230 VAC, 50/60 Hz

   When a 3G3EV-AB□□□ is used in single-phase input mode, the power voltage must be as follows: single-phase, 200 to 240 VAC, 50/60 Hz (use terminals R and S)

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

   Check that the control circuit terminals and controller are connected correctly.

   • Checking Display Status:

   Check the Inverter for errors.

   If everything is normal, the indicators below become as follows when the power is turned on:

   • RUN indicator: Flashing

   • ALARM indicator: Not lit

   • Setting Constants:

   Use the Digital Operator to set constants required for operation.

   Set each constant as described in this manual. Set these constants in the following order:

   a) n01 and n02 (initializing constants)

   b) n24 to n26 (V/f pattern)

c) n31 (electronic thermal reference current)

d) n11 (reference frequency)

• Test Run:

Check motor operation.

Use the Digital Operator to check motor operation. Perform a no-load test run and an actual loading test run to check the direction of motor rotation, speed, and output current.

4. Setting the SYSMAC PC

Turn the Inverters, peripheral devices, and PC off, then turn them on. Turn on the power in the following order:

a) SYSDRIVE and other Remote I/O Slave Units,

b) CPU for the Remote I/O Master Unit. Create an I/O table on the SYSMAC side. For C1000H(F) or C2000(H), set the base no.

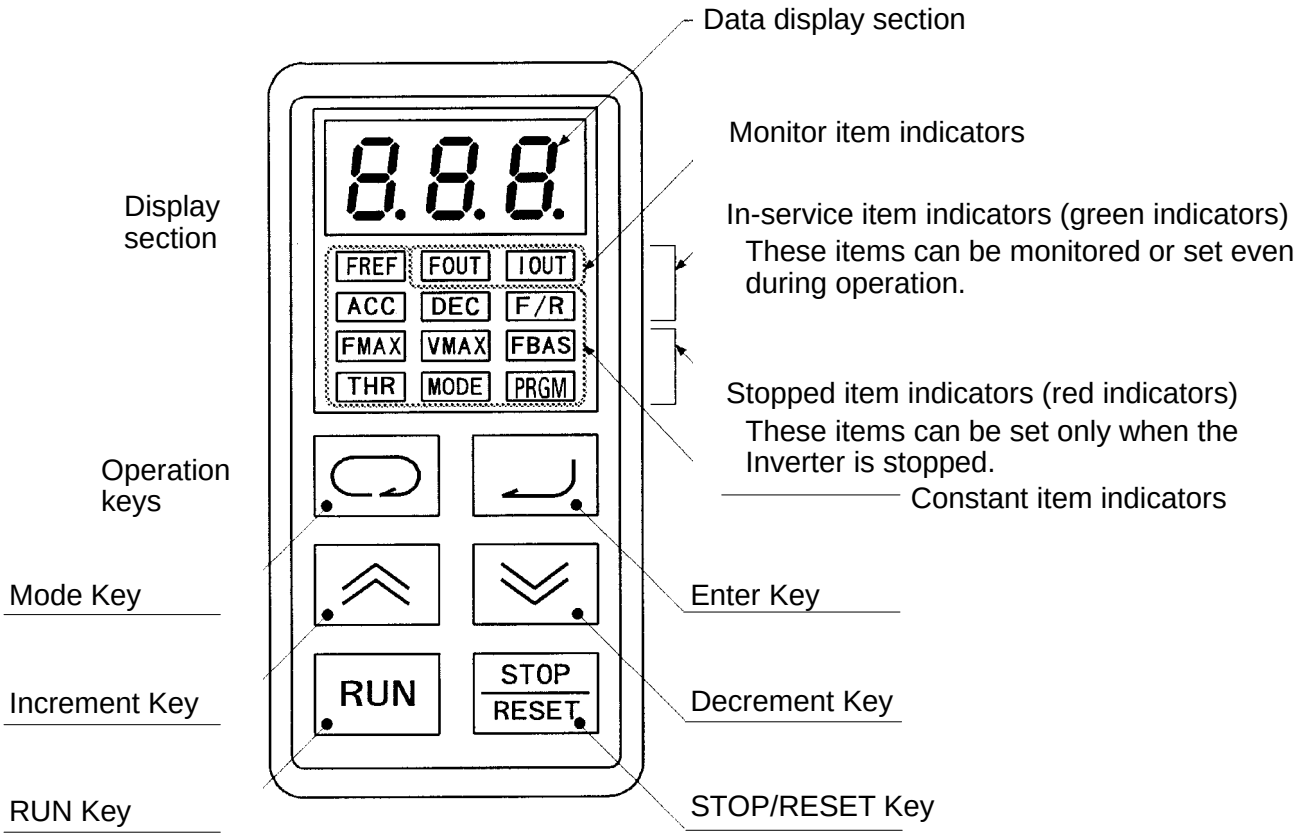
5. Production Run:

The Inverter is ready to run. If any error has occurred, refer to *Section 5 Operation*.

4-2 Using the Digital Operator

4-2-1 Name and Function of Each Component

■ Name of Each Component



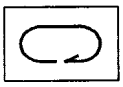
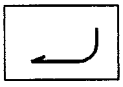
■ Function of Each Component

● Display Sections

Data display section	Reference frequency values, output frequency values, output current values, constant settings, and error codes are displayed.
Monitor item indicators	FOUT When this indicator is lit, an output frequency value (Hz) is displayed in the data display section. IOUT When this indicator is lit, an output current value (effective current: A) is displayed in the data display section.
Constant item indicators	The value set in the constant corresponding to the lit indicator is displayed in the data display section. A new value can be set.

Note In-service item indicators (green indicators):
These items can be monitored or the constant for each item can be set even during operation.
Stopped item indicators (red indicators):
Constants for these items can be set only when the Inverter is stopped.
In this display, the direction of motor rotation is displayed during operation.

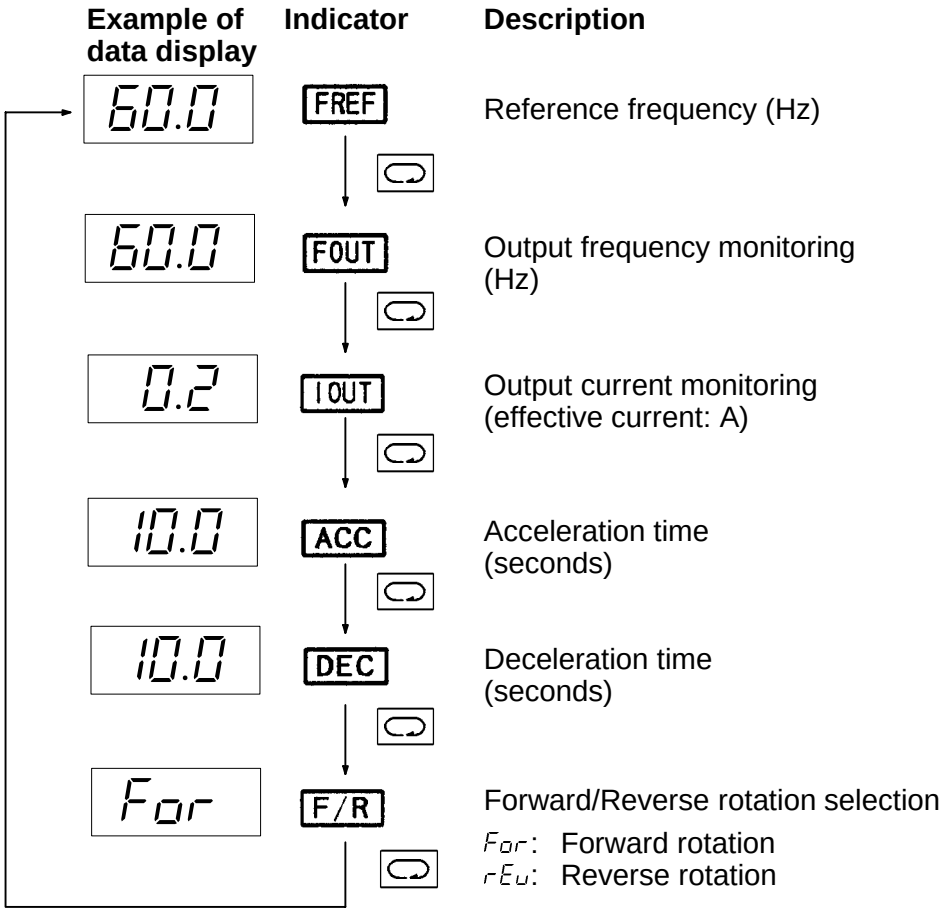
● Operation Keys

	Mode Key	Press this key to switch between monitor item indicators and constant item indicators.
	Enter Key	Press this key to register the value set in a constant.
	Increment Key	Press this key to increase a constant no. or the value of a constant.
	Decrement Key	Press this key to decrease a constant no. or the value of a constant.
RUN	RUN Key	Press this key to start the Inverter. (This key is valid only when Digital Operator run mode is selected and all indicators in the stopped item indicators are not lit.)
STOP / RESET	STOP/RESET Key	Press this key to stop the Inverter. (This key is valid only when Digital Operator run mode is selected.) Also, press this key to reset the Inverter when an error has occurred.

4-2-2 Outline of Operation

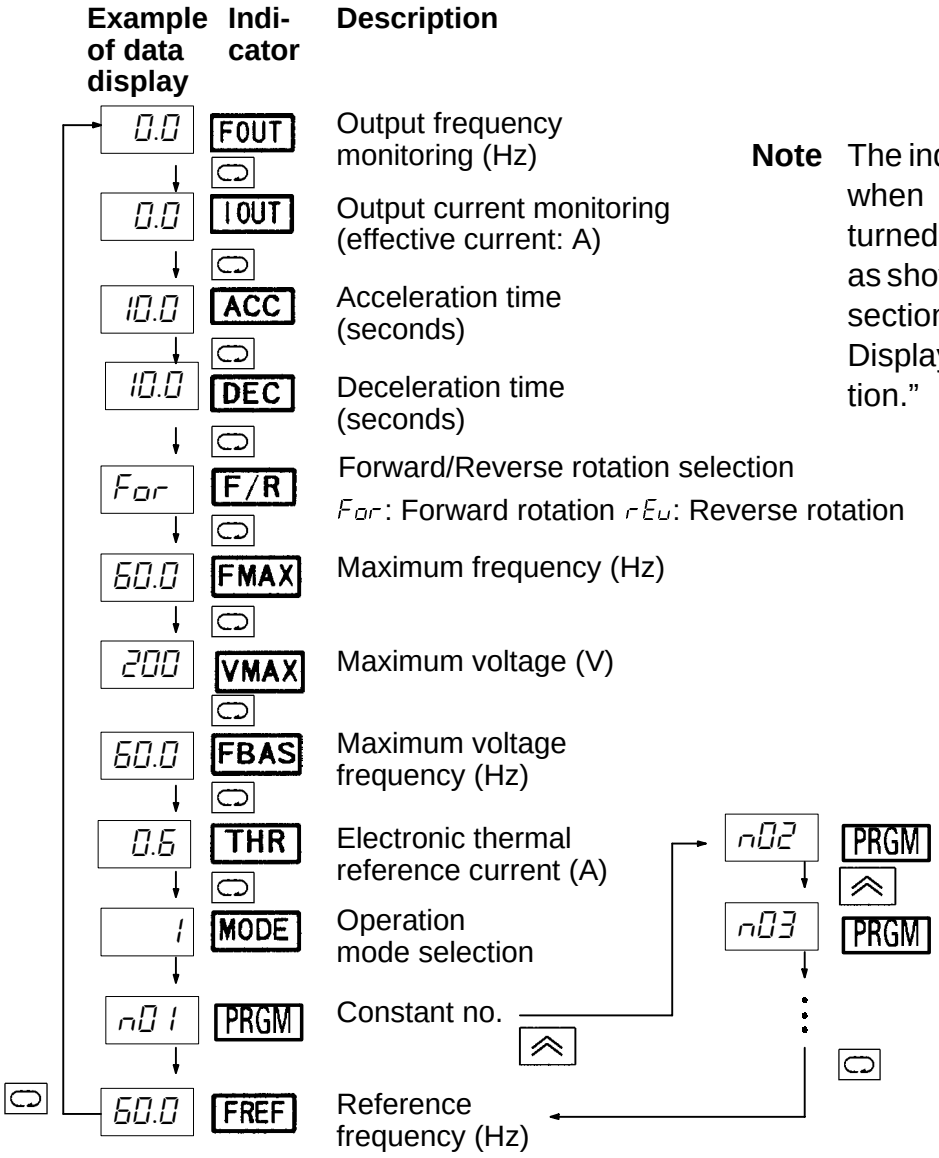
■ Switching Data Display during Operation

Press the Mode Key to switch data display.
During operation, only the items in the in-service item indicators section can be monitored and the constants for these items can be set.
If the power is turned off when the FOUT or IOUT indicator is lit, the same indicator lights up next time the power is turned on. Otherwise, the FREF indicator always lights up.



■ Switching Data Display when Inverter is Stopped

Press the Mode Key to switch data display.
When the Inverter is stopped, all items can be monitored and the constant for each item can be set.

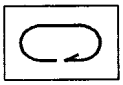
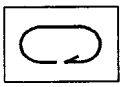
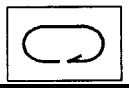


Note The indicators displayed when the power is turned on are the same as shown in the previous section “Switching Data Display during Operation.”

■ Monitor Display

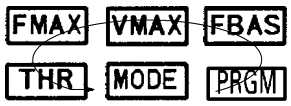
The 3G3EV allows the user to monitor the reference frequency, output frequency, output current, and the direction of rotation.

● Operation Method

Key operation	Indicator	Example of data display	Description
	FREF	60.0	Press the Mode Key until the FREF indicator lights up. The reference frequency (Hz) is displayed.
	FOUT	60.0	Press the Mode Key. The output frequency (Hz) is displayed.
	IOUT	0.2	Press the Mode Key. The output current value (effective current: A) is displayed.

Note 1. The direction of rotation can be always monitored during operation. The indicators in the lower two rows of the display section flash indicating the direction of rotation. The indicator flashing speed varies according to the speed of rotation.

Indicator flashing sequence during forward rotation



The indicators flash counterclockwise when the motor rotates in the forward direction.

Note 2. The constant item indicators section has the F/R indicator, but this indicator is used to indicate a command when the Inverter is operated with the Digital Operator.

4-2-3 Setting Constants

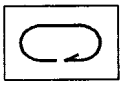
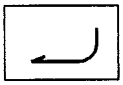
The 3G3EV (Standard Model) allows the user to set 18 different constants. The constants for basic operations are allocated to dedicated indicators, so the user need not refer to the constant nos. The constants allocated to dedicated indicators can be also set by lighting the PRGM indicator. Note that the operation methods using dedicated indicators and the PRGM indicator are different.

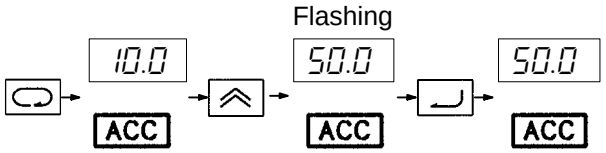
■ Setting Constants

● Setting Constants Using a Dedicated Indicator

Example:

Changing acceleration time from 10 seconds to 50 seconds.

Key operation	Indicator	Example of data display	Explanation
	ACC	10.0	Press the Mode Key until the ACC indicator lights up.
	ACC	Flashing 10.1	Press the Increment Key. The data display section flashes (indicating that the data is yet to be registered).
	ACC	Flashing 50.0	Press the Increment Key until “50.0” appears in the data display section. Holding down the key changes data quickly.
	ACC	50.0	Press the Enter Key to complete the setting procedure.

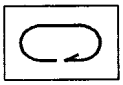
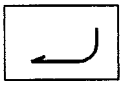
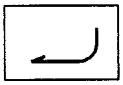


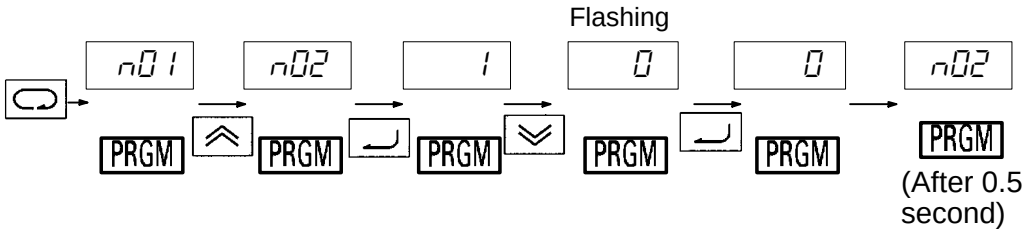
Note If the new data is not to be registered, press the Mode Key instead of the Enter Key. The new data becomes invalid and the next item is displayed.

● Setting Constants Using the PRGM Indicator

Example:

Changing the value of constant no. 02 (operation mode selection) to “0.”

Key operation	Indicator	Example of data display	Explanation
	PRGM	n01	Press the Mode Key until the PRGM indicator lights up.
	PRGM	n02	Press the Increment Key. “n02” appears in the data display section.
	PRGM	1	Press the Enter Key. The value of constant no. 02 is displayed.
	PRGM	Flashing 0	Change the value to “2” by pressing the Decrement Key. The data display section flashes (indicating that the value is yet to be registered).
	PRGM	0	Press the Enter Key. The data display section stops flashing.
	PRGM	n02	After approximately 0.5 second, the data display section returns to the constant no. display (“n02”).



Note 1. If the new data is not to be registered, press the Mode Key instead of the Enter Key. The new data becomes invalid and the constant no. display (“n02”) is returned.

Note 2. Holding down the Increment Key or Decrement Key changes data quickly.

■ List of Constants

Constant no.	Dedicated indicator	Description	Setting range	Factory setting
n01		Constant write-inhibit selection/constant initialization	0, 1, 8	1
n02	MODE	Operation mode selection	0, 1	1
n03		Stop mode selection	0, 1	0

Constant no.	Dedicated indicator	Description	Setting range	Factory setting
n04	F/R	Forward/Reverse rotation selection	For, rEv	For
n06		Multi-function input selection 1	0 to 14	1
n07		Multi-function input selection 2	1 to 14	2
n08		Multi-function input selection 3	1 to 15	4
n09		Multi-function output selection 1	0 to 11	1
n10		Multi-function output selection 2	0 to 11	2
n11	FREF	Frequency reference 1	0.0 to 400	6.0 (Hz)
n12	FREF	Frequency reference 2	0.0 to 400	0.0 (Hz)
n13	FREF	Frequency reference 3	0.0 to 400	0.0 (Hz)
n14	FREF	Frequency reference 4	0.0 to 400	0.0 (Hz)
n15	FREF	Frequency reference 5	0.0 to 400	0.0 (Hz)
n16	FREF	Frequency reference 6	0.0 to 400	0.0 (Hz)
n17	FREF	Frequency reference 7	0.0 to 400	0.0 (Hz)
n18	FREF	Frequency reference 8	0.0 to 400	40.0 (Hz)
n20	ACC	Acceleration time 1	0.0 to 999	10.0 (seconds)
n21	DEC	Deceleration time 1	0.0 to 999	10.0 (seconds)
n22	ACC	Acceleration time 2	0.0 to 999	10.0 (seconds)
n23	DEC	Deceleration time 2	0.0 to 999	10.0 (seconds)
n24	FMAX	Maximum frequency	50.0 to 400	60.0 (Hz)
n25	VMAX	Maximum voltage	1 to 255	200 (V)
n26	FBAS	Maximum voltage frequency	1.6 to 400	60.0 (Hz)
n31	THR	Electronic thermal reference current	0.0 or more (see note 1)	See note 1
n33		Stall prevention during deceleration	0, 1	0
n36		Operation after recovery from power interruption	0, 1, 2	0
n37		Carrier frequency	1, 2, 3, 4	4
n50		Over-torque detection function selection	0 to 4	0

Constant no.	Dedicated indicator	Description	Setting range	Factory setting
n51		Over-torque detection level	30 to 200	160 (%)
n52		Over-torque detection time	0.1 to 10.0	0.1 (seconds)
n53		Frequency detection level	0.0 to 400	0.0 (Hz)
n67		Unit no. (see note 4)	0 to 15	0
n68		Error history	(Display only)	

Note 1. The setting range and factory setting for n31 (electronic thermal reference current) depend on the Inverter model. For details, refer to *page 4-19*.
Normally, set the rated motor amperage in n31.

Note 2. Displaying the constant no. corresponding to an indicator in the "Dedicated indicator" column lights the indicator.

Note 3. Constant no. 02 (n02) and subsequent constants can be set only when constant no. 01 (n01) is set to 1.

Note 4. After setting the Unit no. in n67, turn the power off (make sure that all LEDs go off), then turn the power on. This makes the setting valid.

■ Details of Each Constant

n01	**Constant Write-Inhibit Selection/Constant Initialization**		
Setting range	0, 1, 8	**Factory setting**	1

One of the following four values can be selected:

Value	Description
0	Only n01 can be set.
1	Constants n01 to n68 can be displayed and set.
8	All constants are returned to factory settings.

Note If other constants are to be set, always set "1" in n01.

n02	MODE **Operation Mode Selection**		
Setting range	0, 1	**Factory setting**	1

This constant is used to specify whether the Inverter is to be operated with a Digital Operator or via communication.

Value	Run command	Frequency reference
0	Digital Operator	Digital Operator
1	Communication	Digital Operator

Note The above setting operation can be performed when constant no. 02 is selected. This operation is also possible when the dedicated indicator ("MODE") is lit.

n03	**Stop Mode Selection**		
Setting range	0, 1	**Factory setting**	0

This constant is used to select the stop mode to be invoked when the STOP/RESET key is pressed or when bit 0 of Unit n + 1 (run command) is set to 0.

Value	Description
0	Deceleration stop
1	Free running

n04	F/R **Forward/Reverse Rotation Selection**		
Setting range	For , rEv	**Factory setting**	For (forward rotation)

Value	Description
For	Forward rotation
rEv	Reverse rotation

Note 1. While the Inverter is being operated with the Digital Operator, the direction of motor rotation can be changed by lighting the F/R indicator with the Mode Key first, pressing the Increment or Decrement Key to change the setting, then pressing the Enter Key.

Note 2. The direction (forward/reverse) of motor rotation depends on the motor model used. Refer to the instruction manual for the motor.

n06	**Multi-Function Input Selection 1**		
Setting range	0 to 14	**Factory setting**	1 (fault reset)

n07	**Multi-Function Input Selection 2**		
Setting range	1 to 14	**Factory setting**	2 (external fault: contact a)

n08	**Multi-Function Input Selection 3**		
Setting range	1 to 15	**Factory setting**	4 (multi-step speed command 1)

One of the following values can be selected for n06 to n08:

Value	Description
0	Override (for n06 only) see note 2
1	Fault reset (fault reset when ON)
2	External fault (contact a: external fault when ON)
3	External fault (contact b: external fault when OFF)
4	Multi-step speed command 1
5	Multi-step speed command 2
6	Multi-step speed command 3 (also serves as an acceleration/deceleration time changeover command)
8	Acceleration/Deceleration time changeover command (acceleration/deceleration time 2 when ON)
9	External base block command (base block when ON)
10	External base block command (base block when OFF)
11	Search command from maximum frequency
12	Search command from preset frequency
13	Acceleration/Deceleration-inhibit command (inhibits acceleration/deceleration and maintains output frequency when ON)
14	Local/Remote changeover (local when ON) see note 4
15	Up/Down command (for n08 only) see note 3

Note 1. The same value cannot be allocated to more than one constant (multi-function input selection).

Note 2. If “0” (override) is set in n06, the n07 and n08 settings become invalid.

Note 3. If “15” is set in n08, the n07 setting becomes invalid, and multi-function input 2 and multi-function input 3 are set to the up and down commands, respectively.

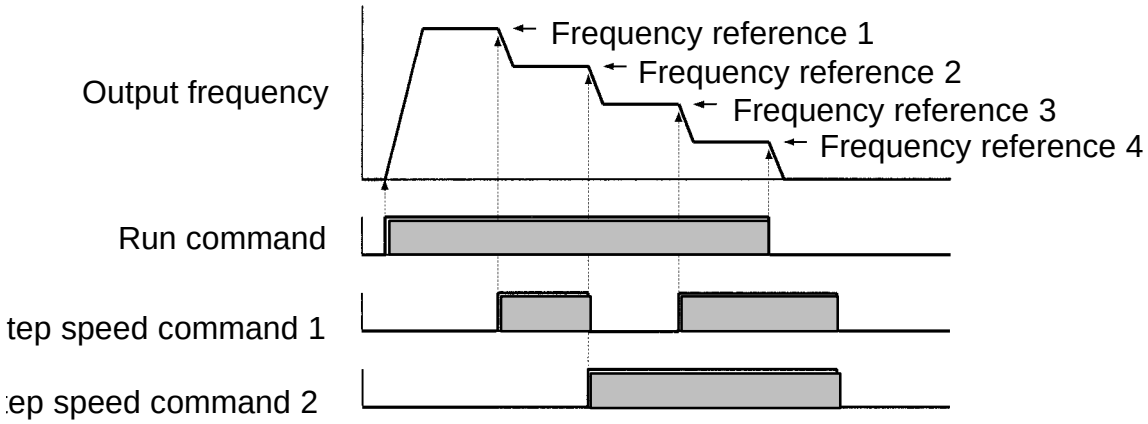
Note 4. To select value 14 (local/remote changeover), always set “1” in n02.

Note 5. If “4,” “5,” and “6” are set in n06, n07, and n08, respectively, eight-step speed operation can be performed.

(Number of frequency references selected) =
1 + (multi-step speed command 1) + (multi-step speed command 2) x 2 + (multi-step speed command 3) x 4

The bit of multi-step speed command n is set to 1 (when ON) or 0 (when OFF).

Example of Multi-step Speed Operation



n09	**Multi-Function Output Selection 1**		
Setting range	0 to 11	**Factory setting**	1 (operation in progress)

n10	**Multi-function output selection 2**		
Setting range	0 to 11	**Factory setting**	2 (frequency matching)

One of the following values can be specified for each constant (multi-function output selection):

Value	Description
0	Fault occurrence (fault occurrence when ON)
1	Operation in progress (frequency reference is being output)
2	Frequency matching (see note)
3	Idling
4	Frequency detection (output frequency ò frequency detection level set in n53)
5	Frequency detection (output frequency ó frequency detection level set in n53)
6	Over-torque being monitored
7	Base block in progress
8	Undervoltage(UV) being monitored
9	Speed search in progress
10	Run mode (local when ON, remote when OFF)
11	Normal (abnormal when OFF)

Note The contact is turned on when the difference between the reference frequency and the output frequency falls within 2 Hz. It is turned off when the difference exceeds ±4 Hz.

n11	FREF **Frequency Reference 1**		
Setting range	0.0 to 400 (Hz)	**Factory setting**	6.0 (Hz)

n12 to n17	FREF **Frequency References 2 to 7**		
Setting range	0.0 to 400 (Hz)	**Factory setting**	0.0 (Hz)

n18	FREF **Frequency Reference 8**		
Setting range	0.0 to 400 (Hz)	**Factory setting**	6.0 (Hz)

- These constants are used to set reference frequency values.
- The unit of setting is as follows:
  0.0 to 99.9 (Hz): 0.1 (Hz)
  100 to 400 (Hz): 1 (Hz)
- The reference frequency value can be changed even during operation. To change the reference frequency value, light the FREF indicator with the Mode Key first, press the Increment or Decrement Key to change the value, then press the Enter Key.
- To change the n12 to n18 settings during operation, select the desired reference frequency with the multi-step speed command, then perform the above operation.

- To use n11 (frequency reference 1) and n12 (frequency reference 2), set "4" (multi-step speed command 1) in one of n06 to n08 (multi-function input selection 1 to 3).
- To use n11 to n14 (frequency references 1 to 4), set "4" (multi-step speed command 1) and "5" (multi-step speed command 2) in two of n06 to n08 (multi-function input selection 1 to 3).
- To use n11 to n18 (frequency references 1 to 8), set "4" (multi-step speed command 1), "5" (multi-step speed command 2), and "6" (multi-step speed command 3) in n06 to n08 (multi-function input selection 1 to 3).
- When "0" (override) is set in n06, n18 (frequency reference 8) is set to the basic frequency (100% frequency reference).

n20	ACC **Acceleration Time 1**		
Setting range	0.0 to 999 (seconds)	**Factory setting**	10.0 (seconds)

n21	DEC **Deceleration time 1**		
Setting range	0.0 to 999 (seconds)	**Factory setting**	10.0 (seconds)

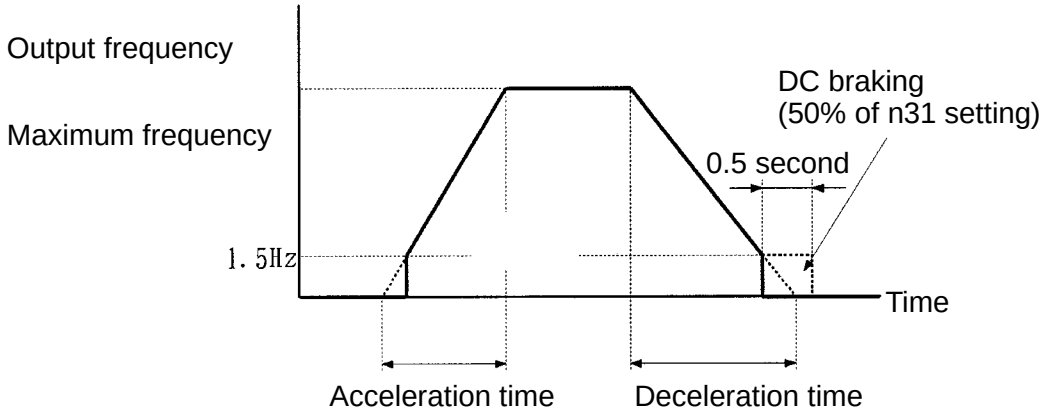
n22	ACC **Acceleration Time 2**		
Setting range	0.0 to 999 (seconds)	**Factory setting**	10.0 (seconds)

n23	DEC **Deceleration Time 2**		
Setting range	0.0 to 999 (seconds)	**Factory setting**	10.0 (seconds)

- These constants are used to set acceleration time (required to increase the output frequency from the stopped state to the maximum frequency) and deceleration time (required to decrease the output frequency from the maximum frequency to the stopped state).
  (Set the maximum frequency in n24.)
- The unit of setting is as follows:
  0.0 to 99.9 (seconds): 0.1 (second)
  100 to 999 (seconds): 1 (second)
- Acceleration and deceleration times can be changed even during operation. If, for example, acceleration time is to changed, light the ACC indicator with the Mode Key first, press the Increment or Decrement Key to change the value, then press the Enter Key. Deceleration time can be also changed in the same way. (Light the DEC indicator before changing the deceleration time.)

- To use n22 and n23, set “8” (acceleration/deceleration time changeover command) in one of n06 to n08 (multi-function input selection 1 to 3).

Explanation of n20 and n23 Settings



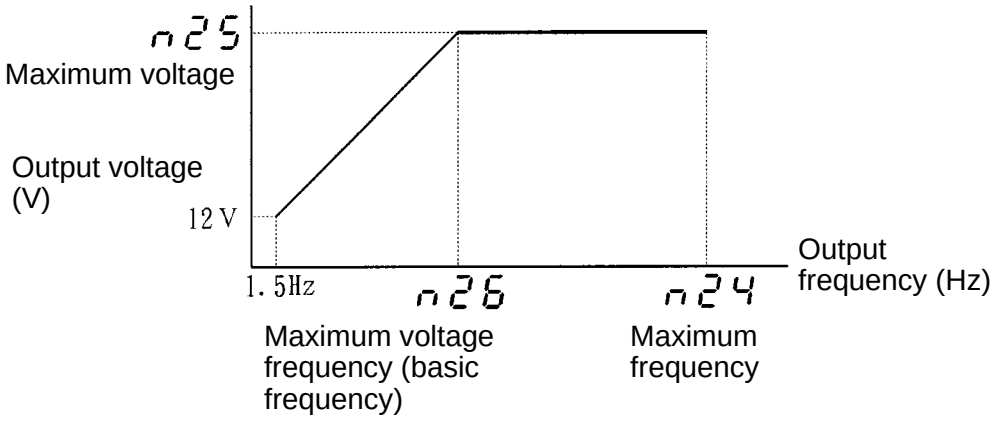
n24	FMAX Maximum Frequency		
Setting range	50.0 to 400 (Hz)	**Factory setting**	60.0 (Hz)
Unit of setting	50.0 to 99.9 (Hz) : 0.1 (Hz) 100 to 400 (Hz) : 1 (Hz)		

n25	VMAX Maximum Voltage		
Setting range	1 to 255 (V)	**Factory setting**	200 (V)
Unit of setting	1 (V)		

n26	FBAS Maximum Voltage Frequency (Basic Frequency)		
Setting range	1.6 to 400 (Hz)	**Factory setting**	60.0 (Hz)
Unit of setting	1.6 to 99.9 (Hz) : 0.1 (Hz) 100 to 400 (Hz) : 1 (Hz)		

- These three constants are used to set a V/f pattern.
- Check the motor specifications and set each constant as follows:
  n24: Maximum frequency or rated frequency
  n25: Rated voltage
  n26: Rated frequency
- The value set in n24 (maximum frequency) must be equal to or greater than the value set in n26 (maximum voltage frequency). Otherwise, an error will result.

Explanation of n24, n25, and n26 Settings



n31	THR Electronic Thermal Reference Current		
Setting range	0.0 to (see note 1) (A)	**Factory setting**	See note 2
Unit of setting	0.1 (A)		

- This constant is used to set an electronic thermal reference value to protect the motor from overheating.
  Set the rated motor amperage in this constant.
- If 0.0 is set in this constant, “no thermal protection” is assumed, so motor overload will not be detected.
- The setting range and factory setting for this constant are as follows:

3E3EV-	Maximum applicable motor capacity	Setting range (upper limit) (see note 1)	Factory setting (see note 2)
A2001R/AB001R	0.1 kW	0.9 (A)	0.6 (A)
A2002R/AB002R	0.2 kW	1.8 (A)	1.1 (A)
A2004R/AB004R	0.4 kW	3.6 (A)	1.9 (A)
A2007R/AB007R	0.75 kW	6.0 (A)	3.3 (A)
A2015R	1.5 kW	8.4 (A)	6.2 (A)

n33	Stall Prevention during Deceleration		
Setting range	0, 1	**Factory setting**	0

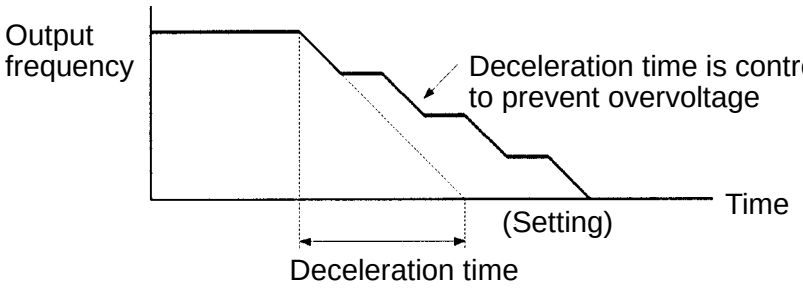
This constant is used to select the action to prevent overvoltage during deceleration.

Value	Description
0	Stall prevention during deceleration
1	No stall prevention during deceleration

Note 1. If a braking resistor is to be connected, always set “1” (no stall prevention during deceleration) in this constant.

Note 2. If “0” (stall prevention during deceleration) is set in this constant, deceleration time will be automatically lengthened to prevent overvoltage.

Explanation of Stall Prevention during Deceleration



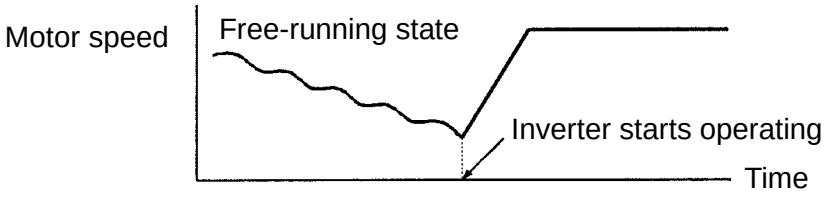
n36	**Operation after Recovery from Power Interruption**		
Setting range	0, 1, 2	**Factory setting**	0

This constant is used to select the processing to be performed after recovery from an instantaneous power interruption.

Value	Description
0	Discontinues operation.
1	Continues operation only if power interruption is within 0.5 second.
2	Continues operation unconditionally (with no error output).

Note If “1” or “2” is selected to continue operation, the Inverter automatically searches the motor speed (even when the motor is in a free-running state) and continues smooth operation. This function is called the speed search function.

Explanation of Speed Search Function



n37	**Carrier Frequency**		
Setting range	1, 2, 3, 4	**Factory setting**	4 (10 kHz)

This constant is used to set a pulse-width-modulated (PWM) carrier frequency.

Value	Carrier frequency
1	2.5 (kHz)
2	5 (kHz)
3	7.5 (kHz)
4	10 (kHz)

Note As the cable between the Inverter and the motor becomes longer, a high-frequency leakage current from the cable increases, causing the Inverter output current to increase as well. This may also affect peripheral devices. To prevent this, adjust the carrier frequency according to the following standards:

- Cable length of 50 meters or less: 10 kHz or less
- Cable length of 50 to 100 meters: 5 kHz or less

n50	**Over-torque Detection Function Selection**		
Setting range	0 to 4	**Factory setting**	0

n51	**Over-torque Detection Level**		
Setting range	30 to 200 (%)	**Factory setting**	160 (%)
Unit of setting	1 (%)		

n52	**Over-torque Detection Time**		
Setting range	0.1 to 10 (seconds)	**Factory setting**	0.1 (seconds)
Unit of setting	0.1 (seconds)		

- When excessive load is applied to the equipment, the Inverter detects any increase in output current and displays the fault according to the n09 and n10 settings (multi-function output selection).
- n50 is used to specify whether over-torque is to be monitored and specify the action to be taken when over-torque is detected.

n50 setting	Description
0	Inverter does not monitor over-torque.
1	Inverter monitors over-torque only when speed is matched. It continues operation (issues warning) even after over-torque is detected.
2	Inverter monitors over-torque only when speed is matched. It discontinues operation (through protection function) when over-torque is detected.
3	Inverter always monitors over-torque during operation. It continues operation (issues warning) even after over-torque is detected.
4	Inverter always monitors over-torque during operation. It discontinues operation (through protection function) when over-torque is detected.

- n51 is used to set the over-torque detection level. Specify this value in terms of the percentage of the rated output current.
- n52 is used to set the over-torque detection time (in seconds).

n53	**Frequency Detection Level**		
Setting range	0.4 to 400 (Hz)	**Factory setting**	0.0 (Hz)
Unit of setting	0.0 to 99.9 (Hz) : 0.1(Hz) 100 to 400 (Hz) : 1 (Hz)		

- When the output frequency drops below or exceeds the value set in n53, the Inverter displays the fault according to the n09 and n10 settings (multi-function output selection).
- To use the frequency detection function, always set “4” (output frequency ò frequency detection level set in n53) or “5” (output frequency ó frequency detection level set in n53) in n09 or n10 (multi-function output selection).

n67	**Unit no.**		
Setting range	0 to 15	**Factory setting**	0

- This constant is used to set a Unit no. for the Inverter.
- Note that the Unit no. does not overlap with that of another slave unit.
- After setting the Unit no. in n67, turn the power off (make sure that all LEDs go off), then turn the power on. This makes the setting valid.

n68	**Error History**
This constant can only be displayed. It cannot be set.	

- Information about the last error is recorded in this constant.
- Recorded are Inverter errors and other errors that actuate a protective mechanism. Warning (automatically recovered error) is not recorded.
- If no error has occurred, the indicator is not lit.
- All error codes are listed below.

Error code	Description	Error category
oC	Overcurrent (OC)	Errors that actuate protective mechanism
ou	Main circuit overvoltage (OV)	
Uu1	Main circuit undervoltage (UV1)	
Uu2	Control power supply fault (UV2)	
oH	Radiation fin overheated (OH)	
oL1	Motor overload (OL1)	
oL2	Inverter overload (OL2)	
oL3	Over-torque (OL3)	

Error code	Description	Error category
EF1	n50 is used to specify whether over-torque is to be monitored and specify the action to be taken when over-torque is detected.	
F00	Initial memory error	Inverter errors
F01	ROM error	
F04	Constant error	
F06	Option error	

4-3 I/O Word Allocation

The 3G3EV SYSMAC BUS occupies two of the I/O points for a SYSMAC PC. Set the word address in constant no. 67 (n67) as a remote address. Note that the word address occupied by the 3G3EV SYSMAC BUS does not overlap with that of another Remote I/O Slave Unit.

4-3-1 Word Numbers

This section shows the correspondence between the remote address (set in n67) and the I/O word for each SYSMAC model used as a Master Unit.

- **C220H and C200HS**

n67	Word no.	
	n	n+1
0	200	201
1	202	203
2	204	205
3	206	207
4	208	209
5	210	211
6	212	213
7	214	215
8	216	217
9	218	219
10	220	221
11	222	223
12	224	225
13	226	227
14	228	229
15	230	231

- **C120(F) and C500(F)**

n67	Word no.	
	n	n+1
0	0	1
1	2	3
2	4	5
3	6	7
4	8	9
5	10	11
6	12	13
7	14	15
8	16	17
9	18	19
10	20	21
11	22	23
12	24	25
13	26	27
14	28	29
15	30	31

● C1000H(F) and C2000(H)

n67	Word no.							
	Base no. 0		Base no. 1		Base no. 2		Base no. 3	
	n	n+1	n	n+1	n	n+1	n	n+1
0	0	1	32	33	64	65	96	97
1	2	3	34	35	66	67	98	99
2	4	5	36	37	68	69	100	101
3	6	7	38	39	70	71	102	103
4	8	9	40	41	72	73	104	105
5	10	11	42	43	74	75	106	107
6	12	13	44	45	76	77	108	109
7	14	15	46	47	78	79	110	111
8	16	17	48	49	80	81	112	113
9	18	19	50	51	82	83	114	115
10	20	21	52	53	84	85	116	117
11	22	23	54	55	86	87	118	119
12	24	25	56	57	88	89	120	121
13	26	27	58	59	90	91	122	124
14	28	29	60	61	92	93	124	125
15	30	31	62	63	94	95	126	127

● CV500, CV1000, and CVM1

- For the SYSMAC BUS remote I/O relay area, 32 words are allocated to each RM address (RM0 to RM7) starting with word 2300, by default.

RM address	RM0	RM1	RM2	RM3	RM4	RM5	RM6	RM7
Allocated words	2300 to 2331	2332 to 2363	2364 to 2395	2396 to 2427	2428 to 2459	2460 to 2491	2492 to 2523	2524 to 2555

- RM addresses are automatically assigned in the order in which Remote I/O Master Units were installed (or Rack numbers were set). This happens when an I/O table is created or edited.

- The CV500 are assigned RM0 to RM3 (words 2300 to 2427).

n67	Word no.							
	RM0		RM1		RM2		RM3	
	n	n+1	n	n+1	n	n+1	n	n+1
0	2300	2301	2332	2333	2364	2365	2396	2397
1	2302	2303	2334	2335	2366	2367	2398	2399
2	2304	2305	2336	2337	2368	2369	2400	2401
3	2306	2307	2338	2339	2370	2371	2402	2403
4	2308	2309	2340	2341	2372	2373	2404	2405
5	2310	2311	2342	2343	2374	2375	2406	2407
6	2312	2313	2344	2345	2376	2377	2408	2409
7	2314	2315	2346	2347	2378	2379	2410	2411
8	2316	2317	2348	2349	2380	2381	2412	2413
9	2318	2319	2350	2351	2382	2383	2414	2415
10	2320	2321	2352	2353	2384	2385	2416	2417
11	2322	2323	2354	2355	2386	2387	2418	2419
12	2324	2325	2356	2357	2388	2389	2420	2421
13	2326	2327	2358	2359	2390	2391	2422	2423
14	2328	2329	2360	2361	2392	2393	2424	2425
15	2330	2331	2362	2363	2394	2395	2426	2427

n67	Word no.							
	RM4		RM5		RM6		RM7	
	n	n+1	n	n+1	n	n+1	n	n+1
0	2428	2429	2460	2461	2492	2493	2524	2525
1	2430	2431	2462	2463	2494	2495	2526	2527
2	2432	2433	2464	2465	2496	2497	2528	2529
3	2434	2435	2466	2467	2498	2499	2530	2531
4	2436	2437	2468	2469	2500	2501	2532	2533
5	2438	2439	2470	2471	2502	2503	2534	2535
6	2440	2441	2472	2473	2504	2505	2536	2537
7	2442	2443	2474	2475	2506	2507	2538	2539
8	2444	2445	2476	2477	2508	2509	2540	2541
9	2446	2447	2478	2479	2510	2511	2542	2543
10	2448	2449	2480	2481	2512	2513	2544	2545
11	2450	2451	2482	2483	2514	2515	2546	2547
12	2452	2453	2484	2485	2516	2517	2548	2549
13	2454	2455	2486	2487	2518	2519	2550	2551
14	2456	2457	2488	2489	2520	2521	2552	2553
15	2458	2459	2490	2491	2522	2523	2554	2555

4-3-2 Contents of Transmission Data

Each word either inputs or outputs transmission data. Word n is an output word for an Inverter and word (n + 1) is an input word.

■ Transmission Data Output (from Inverter to PC)

Word n

Bit	Name	Description
0	Error code	(See *Error Code Table*.)
1		
2		
3		
4	Multi-function output 1	This function is set in n09 (outputs the same signal as control output PA).

Bit	Name	Description
5	Multi-function output 2	This function is set in n10.
6	Status output	0: Inoperable 1: Operable
7	Error status	0: Abnormal 1: Normal

● Error Code Table

Error type		Bit				Error code (hexadecimal)
		3	2	1	0	
(No error)		0	0	0	0	0
OC	Overcurrent	0	0	0	1	1
OV	Main circuit overvoltage	0	0	1	0	2
OL2	Inverter overload	0	0	1	1	3
OH	Radiation fin overheated	0	1	0	0	4
EF1 to 3	External fault	1	0	0	0	8
F00 to 06	Inverter fault	1	0	0	1	9
OL1	Motor overload	1	0	1	0	A
OL3	Over-torque	1	0	1	1	B
UV1	Main circuit undervoltage	1	1	0	0	C
UV2	Control power supply fault	1	1	0	1	D

■ Transmission Data Input (from PC to Inverter)

Word n+1

Bit	Name	Description
0	Run command	0: Stop 1: Run (fixed function)
1	Reverse rotation command	0: Forward 1: Reverse (fixed function)
2	(Unused)	(Input will be ignored)
3	Fault reset	1: Fault reset
4	Multi-function input 1	This function is set in n06.
5	Multi-function input 2	This function is set in n07.
6	Multi-function input 3	This function is set in n08.
7	Auxiliary input	Available when 0 is set in n06

● Setting Override Data

- If 0 is set in n06 (multi-function input selection 1), bits 4 to 7 are used to set override data.
- Output frequency can be set in terms of the percentage of the value set in n18 (frequency reference 8).

Bit				Override value (percentage of n18 setting)
7	6	5	4	
0	0	0	0	0 (%)
0	0	0	1	10 (%)
0	0	1	0	20 (%)
0	0	1	1	30 (%)
0	1	0	0	40 (%)
0	1	0	1	50 (%)
0	1	1	0	60 (%)
0	1	1	1	70 (%)

Bit				Override value (percentage of n18 setting)
7	6	5	4	
1	0	0	0	80 (%)
1	0	0	1	90(%)
1	0	1	0	100 (%)
1	0	1	1	110 (%)
1	1	0	0	120 (%)
1	1	0	1	130 (%)
1	1	1	0	140 (%)
1	1	1	1	150 (%)

● Up/Down command

- If 15 is set in n08 (multi-function input selection 3), bits 5 and 6 are used as the up and down commands, respectively.
- When the signal is ON, the output frequency is increased or decreased.

Bit	Name	Description
5	Up command	Increases the output frequency when ON
6	Down command	Decreases the output frequency when ON

- When these bits are simultaneously turned on, the output frequency remains unchanged.

4-4 Test Run

After wiring is complete, perform a test run of the Inverter as follows. First, start the motor through the Digital Operator without connecting the motor to the mechanical system. Next, connect the motor to the mechanical system and perform a test run. Finally, operate the controller to make sure that the sequence of operations is correct.

4-4-1 Checking Wiring

- Check that terminals R, S, and T receive power supply.
  Three-phase input: 200 to 230 VAC, 50/60 Hz
  Single-phase input: 200 to 240 VAC, 50/60 Hz (terminal R and S)
  (Single-phase input is only applicable to 3G3EV-AB□□□R.)
- Check that terminals U, V, and W are correctly connected to the motor power cables.
- Set an end unit as necessary.
- Do not connect the mechanical system to the motor. (The motor must be in no-load status.)

4-4-2 Turning Power On and Checking Indicator Display

- Check that the ALARM indicator is not lit.
- Check that the RUN indicator is flashing.

4-4-3 Initializing Constants

PRGM n01

- Set “8” in constant no. 01 to initialize constants.
- Set “0” in constant no. 02 to operate the Inverter with the Digital Operator.

4-4-4 Setting a V/f Pattern

FMAX VMAX FBAS

- Set the maximum frequency (“FMAX” or constant no. 24), maximum voltage (“VMAX” or constant no. 25), and maximum voltage frequency (“FBAS” or constant no. 26) according to the operating conditions.

4-4-5 Setting Rated Motor Amperage

THR

- Set the rated motor amperage in constant no. 31 (electronic thermal reference current) or with the “THR” indicator lit.

4-4-6 Setting the Reference Frequency

FREF

- Set the frequency corresponding to the motor speed in constant no. 11 (frequency reference 1) or with the “FREF” indicator lit.

4-4-7 Operating the Inverter with the Digital Operator

- Press the RUN Key to rotate the motor in the forward direction. (If the PRGM indicator is lit in the constant item indicators section, press the Mode Key once to light the FREF indicator. If a red indicator in the stopped item indicators section is lit, the run command cannot be accepted.)
- Check that the motor rotates smoothly without making noise.
- Check that the direction of rotation is correct.

4-4-8 Checking Output Frequency and Amperage FOUT IOUT

- Light the FOUT indicator (output frequency monitor) and make sure that the displayed value matches the reference frequency.
- Light the IOUT indicator (output current monitor) and check for overcurrent.

4-4-9 Checking Operation during Reverse Rotation F/R

- Rotate the motor in the reverse direction and check the same items as above.

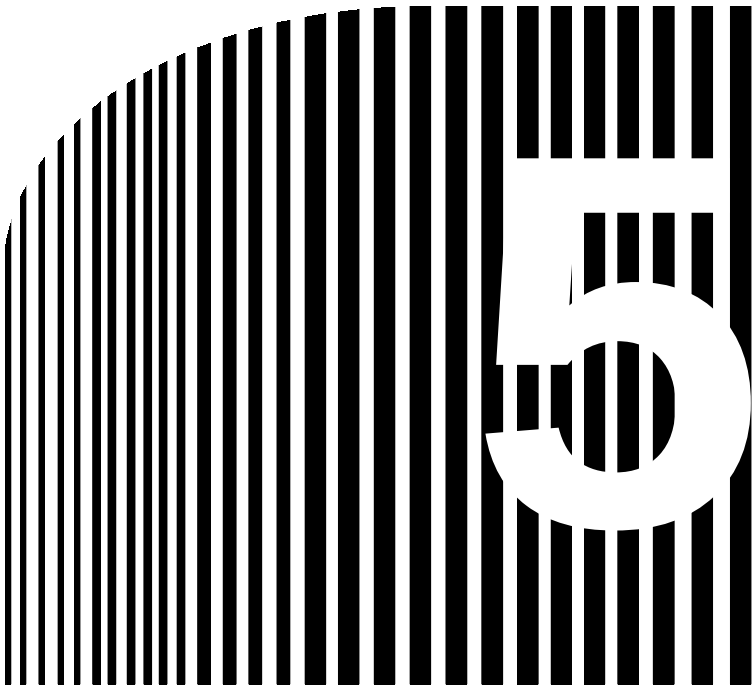
4-4-10 Checking Operation with Mechanical System Connected

- Press the STOP/RESET Key to stop the motor.
- Connect the mechanical system to the motor and check the same items as above.

4-4-11 Checking Operation Performed by Controller MODE

- Light the MODE indicator and set the actual operation mode.
- Set the remote address in constant no. 67. (After setting the address, turn the power off, then on.)
- Operate the Inverter with the controller, check for noise resulting from mechanical resonance, and check that the sequence of operations is correct.

Note For the SYSMAC BUS system, turn all the slave units on, then turn the master unit on. For details, refer to the user's manual for the SYSMAC C series Remote I/O Unit.



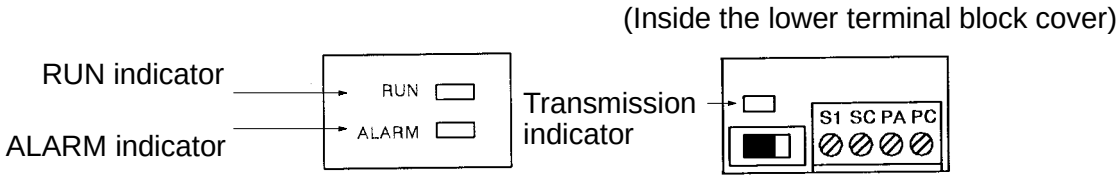
Chapter 5

· Operation ·

5-1 Protective and Diagnostic Functions

The 3G3EV has excellent protective and diagnostic functions. The RUN, ALARM, and transmission indicators on the front panel indicate the current Inverter status, and the data display section also displays information about an error that has occurred. These functions therefore enable the user to take the appropriate actions to correct most errors.

■ Indicator Status Display



• RUN and ALARM Indicators

The RUN and ALARM indicators indicate Inverter status.

Indicator		Inverter status
RUN	**ALARM**	
Flashes	Not lit	Normal: Ready to run
Lit	Not lit	Normal: Normal operation in progress
Lit	Flashes	Warning
Not lit	Lit	Protection function or Inverter fault (details are shown in the data display section)

• Transmission Indicator

The transmission indicator indicates the SYSMAC BUS transmission status.

Transmission indicator	SYSMAC BUS transmission status
Flashes	Normal transmission
Lit	Transmission error or waiting for transmission
Not lit	Watchdog timer monitoring error

■ List of Error Codes

Inverter status	Indicator		Data display	Description
	RUN	ALARM		
Normal	Flashes	Not lit	---	Ready to run
	Lit	Not lit	---	Normal operation in progress
Warning	Lit	Flashes	Uu	Main circuit undervoltage (UV)
			ou	Main circuit overvoltage (OV)
			oH	Radiation fin overheated (OH)
			STP	Digital Operator stopped (STP)
			oL3	Over-torque (OL3)
			SEr	Sequence error
Protective mechanism actuated	Not lit	Lit	oC	Overcurrent (OC)
			ou	Main circuit overvoltage (OV)
			Uu1	Main circuit undervoltage (UV1)
			Uu2	Control power supply fault (UV2)
			oH	Radiation fin overheated (OH)
			oL1	Motor overload (OL1)
			oL2	Inverter overload (OL2)
			oL3	Over-torque (OL3)
			EF1	External fault (EF1) (see note)
Inverter error	Not lit	Lit	F00	Initial memory error
			F01	ROM error
			F04	Constant error
			F06	Option error
	Not lit	Not lit	(Not lit)	Control circuit error

Note When an external fault is input from multi-function inputs 2 and 3, “EF2” and “EF3” are displayed respectively.

■ Data Display and Action to be Taken when Warning Status Arises

The ALARM indicator flashes when warning status arises. The data display section also flashes.

When warning status arises, no error code is output.

Eliminating the cause recovers the system automatically.

Data display	Description	Action
Uu flashing	**Main circuit undervoltage (UV)** The DC voltage of the main circuit dropped below the low-voltage detection level when the Inverter was stopped.	• Check the power voltage. • Check the power input line for disconnection. • Check the terminal block screws for looseness.
ou flashing	**Main circuit overvoltage (OV)** The DC voltage of the main circuit exceeded the overvoltage detection level when the Inverter was stopped.	• Check the power voltage.
oH flashing	**Radiation fin overheated (OH)** The radiation fin overheated when the Inverter was stopped.	• Check the ambient temperature. • Install a cooling fan or air conditioner.
STP flashing	**Digital Operator stopped (STP)** The STOP/RESET Key on the Digital Operator was pressed while the Inverter was being operated via communication. The Inverter stops the motor according to the n03 setting.	• Set the run command (bit 0 of channel n +1) to OFF (0).
oL3 flashing	**Over-torque (OL3)** A current exceeding the value set in n51 flowed for more than the time set in n52.	• Check if the n51 and n52 settings are appropriate. • Check the machine use status, and eliminate the cause of the problem.
SEr flashing	**Sequence error (SEr)** A local/remote changeover command was input during operation.	• Check the sequence (PC program).

■ Data Display and Action to be Taken when Protective Mechanism is Actuated

The ALARM indicator lights up when the protective mechanism is actuated. In this event, Inverter output is shut off, and the motor coasts to a stop.

Check the cause of the error, take the necessary action, and perform fault reset or turn the power off, then on.

Data display	Description	Cause and action
oC	**Overcurrent (OC)** The Inverter output current instantaneously exceeded 250% of the rated amperage.	• The output side of the Inverter is shorted or grounded. • Load inertia is excessive. • The acceleration and deceleration time settings are too short. • A special motor is used. • The motor was started during free running. • The magnetic contactor on the output side of the Inverter was opened and closed. ⇩ • Determine the cause of the error, take the necessary action, and reset the system.
ou	**Main circuit overvoltage (OV)** Because regenerative energy from the motor was excessive, the DC voltage of the main circuit exceeded approximately 410 V.	• The deceleration time setting is too short. ⇩ • Increase the deceleration time. • Connect a braking resistor (or braking resistor unit).
Uu1	**Main circuit undervoltage (UV1)** The DC voltage of the main circuit dropped below the specified level. 3G3EV-A2□□□R: Approximately 200 V or less 3G3EV-AB□□□R: Approximately 160 V or less	• The input power voltage dropped. • Open-phase occurred. • An instantaneous power interruption occurred. ⇩ • Check the power voltage. • Check the power input line for disconnection. • Check the terminal block screws for looseness.
Uu2	**Control power supply fault (UV2)** A voltage fault occurred in control power supply.	• Turn the power off, then on. • If this problem persists, replace the Unit.

Data display	Description	Cause and action
oH	**Radiation fin overheated (OH)** The radiation fin overheated because of ambient temperature rise or Inverter temperature rise due to overload.	• Load is excessive. ⇨ Reduce the load. • The V/f characteristics are inappropriate. ⇨ Reset constant Nos. 24 to 26. • The acceleration/deceleration time or cycle time is too short. ⇨ Increase the acceleration/deceleration time or cycle time. • The ambient temperature is too high. ⇨ Install a cooling fan or air conditioner.
oL1	**Motor overload (OL1)** The electronic thermal relay actuated the motor overload protection function.	• Review the load size, V/f characteristics, acceleration/deceleration time, and cycle time. • Set the rated motor amperage in constant No. 31 (electronic thermal reference current).
oL2	**Inverter overload (OL2)** The electronic thermal relay actuated the Inverter overload protection function.	• Review the load size, V/f characteristics, acceleration/deceleration time, and cycle time. • Review the Inverter capacity.
oL3	**Over-torque (OL3)** A current exceeding the value set in n51 flowed for more than the time set in n52.	• Check if the n51 and n52 settings are appropriate. • Check the machine use status, and eliminate the cause of the problem.
EF1	**External fault (EF1)** The Inverter received abnormal input from external circuits.	• Review the external circuits. • Review the external sequence. • Check the signal line of multi-function contact input for disconnection.

■ Data Display and Action to be Taken when Inverter Error Occurs

The first character of an error code is always “F” when an Inverter error occurs. (However, all indicators are not lit when a control circuit error occurs.)

If an Inverter error occurs, turn the power off, then on. If the problem persists, replace the Unit.

Data display	Description	Action
F00	**Initial memory error**	• Turn the power off, then on. • If the problem persists, replace the Unit.
F01	**ROM error**	
F04	**Constant error**	• Write down all the constant settings, initialize the constants, and reset the constants. • Turn the power off, then on. • If the problem persists, replace the Unit.
F06	**Option error** The Digital Operator has an error or faulty contact.	• Turn the power off, then reinstall the Digital Operator. • If the problem persists, replace the Unit.
(Not lit)	**Control circuit error** An error occurred in the control power supply or hardware.	• Check the power cables. • Replace the Unit.

5-2 Troubleshooting

If the Inverter or motor does not operate properly when the system is started, constant settings or wiring may be incorrect. In this case, take the appropriate action as described below. (If an error code is displayed, refer to *5-1 Protective and Diagnostic Functions*.)

5-2-1 Constants Fail to Set

■ Err is Displayed in the Data Display Section.

- If an attempt is made to set a value outside the allowable range, Err is displayed in the data display section. The value is canceled and the data display section redisplays the original value. For example, this error occurs when:
  - An attempt is made to set a reference frequency value higher than the maximum frequency value.
  - An attempt is made to set a maximum voltage frequency (basic frequency) value higher than the maximum frequency value.

Check the setting range, then set the constant correctly.

■ The Display Does Not Change when the Increment or Decrement Key is Pressed.

- Value “0” is set in n01 (constant write-inhibit selection)

  Set “1” in n01.

- The Digital Operator is not connected properly.

  Turn the power off. After all indicators on the front panel go off, remove the Digital Operator, then reinstall it.

5-2-2 Master Unit Displays a Message Indicating that CPU is on Hold

- If the END RS indicator on the Master Unit is lit, no end unit or more than one terminator has been set. Set only the last Slave Unit (device) as a terminator. After the terminator is set correctly, turn the power off, then on.
- Wiring is incorrect or broken.

  Check the SYSMAC BUS two-conductor cables for incorrect wiring or for breakage. After wiring is corrected, turn the power off, then on.

- Unit Numbers are Duplicated

  Check if the unit number overlaps with that of another remote I/O slave unit. After correcting the unit number, turn the power off, then on.

5-2-3 Master Unit Displays a Remote I/O Error

- The two-conductor cable broke during operation. Turn the power off, replace the cable, then turn the power on.

5-2-4 Master Unit Displays a Remote I/O Collation Error

- I/O allocation has not been performed. Perform I/O allocation on the SYSMAC side.

5-2-5 Motor Fails to Operate

■ The Motor Does Not Operate when the RUN Key on the Digital Operator is Pressed.

- Operation mode was not selected correctly.

  Perform one of the following steps to enable the RUN Key on the Digital Operator.

  - Set “0” in n02.
  - If “1” is set in n02, set the local/remote changeover signal to ON. The local/remote changeover signal can be switched using n08 (multi-function input selection 3).

- The reference frequency is too low.

  When the reference frequency is less than 1.5 Hz, the Inverter cannot operate. Change the reference frequency to 1.5 Hz or more.

■ The Motor Does not Operate when a Run Command is Input.

- Operation mode is selected incorrectly.

  If “0” is set in n02, the motor does not operate even when a run command is input.

  Set “1” in n02. If the local/remote changeover signal is set using n08 (multi-function input selection 3), set the signal to OFF.

- The reference frequency is too low.

  When the reference frequency is less than 1.5 Hz, the Inverter does not operate. Change the reference frequency to 1.5 Hz or more.

■ The Motor Stops during Acceleration or when a Load is Connected.

- Load is too high.

  The 3G3EV has a stall prevention function and full automatic torque boost function. However, if acceleration or load is too high, the motor response limit will be exceeded.

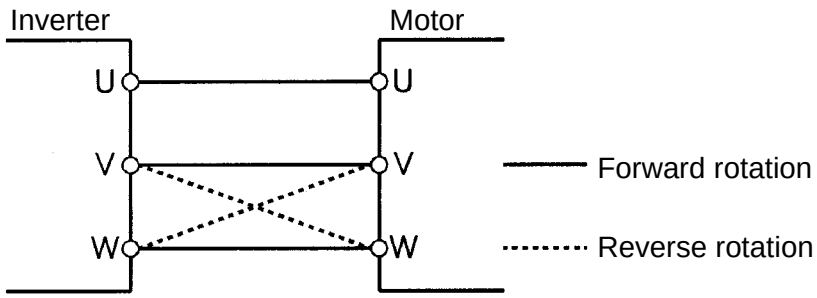
To prevent this, increase acceleration time or reduce load. Motor capacity should be also increased.

5-2-6 Motor Rotates in the Wrong Direction

- The motor output line is connected incorrectly.

  If terminals U, V, and W on the Inverter are correctly connected to terminals U, V, and W on the motor, the motor rotates in the forward direction when a forward rotation command is input. Since the forward direction of rotation depends on the motor manufacturer and model, check the motor specifications.

  To reverse the direction of rotation, switch the wires of two phases of U, V, and W as shown below.



5-2-7 Motor Deceleration is Too Slow

■ Deceleration Time is Too Long Even if a Braking Resistor is Connected.

- Value 0 (stall prevention during deceleration) is set in n33.

  When a braking resistor is connected, always set “1” (no stall prevention during deceleration) in n33. If “0” is set, the braking resistor will not be used.

- The deceleration time set in n21 (deceleration time 1) or n23 (deceleration time 2) is too long.

  Check the deceleration time setting.

- Motor torque is insufficient.

  If the constant settings are normal and overvoltage does not occur, motor capacity is insufficient.

  Motor capacity should be increased.

5-2-8 Vertical-axis Load Drops when Brakes are Applied

- Sequence is incorrect.

  The Inverter remains in DC braking status (50% of the n31 setting) for 0.5 second after deceleration is complete. Modify the sequence so that brakes are applied when the Inverter enters DC braking status.

- Brakes are inappropriate.

  Always use control brakes, not holding brakes.

5-2-9 Motor Burns

- The dielectric strength of the motor is insufficient.

  Surge arises when the motor (inductive load) is connected to the output side of the Inverter. Normally, the maximum surge voltage is approximately three times the power voltage. Therefore, the dielectric strength of the motor to be used must be higher than the maximum surge voltage.

5-2-10 Controller Receives Noise when Inverter is Started

- Noise derives from Inverter switching.

  Take the following actions to prevent noise:

  - Reduce the carrier frequency of the Inverter.

    The number of internal switching times is reduced, so noise can be reduced to some extent.

  - Improve the frame ground.

    A current generated by internal switching normally leaks into the frame ground. Therefore, connect the ground terminal with a sufficiently thick and short wire of 100 Ω or less.

  - Install an input noise filter.

    Install an input noise filter (3G3IV-PHF) on the power input side of the Inverter.

  - Install an output noise filter.

    Install an output noise filter (3G3IV-PLF) on the output side of the Inverter.

  - Provide a separate power supply for the sensor.

    If the sensor malfunctions, provide a dedicated power supply for the sensor and install a noise filter on the power supply. For the signal line, use a shielded cable.

5-2-11 AM Radio Receives Noise when Inverter is Started

- Noise derives from Inverter switching.

Take the following actions to prevent noise:

- Reduce the carrier frequency of the Inverter.

  The number of internal switching times is reduced, so noise can be reduced to some extent.

- Install an input noise filter.

  Install an input noise filter (3G3IV-PHF) on the power input side of the Inverter.

- Install an output noise filter.

  Install an output noise filter (3G3IV-PLF) on the output side of the Inverter.

- Use metal box and piping.

  Metal can block off radio waves. Therefore, enclose the Inverter with a metal (steel) box to prevent radio waves from being emitted from the Inverter.

5-2-12 Ground Fault Interrupter is Actuated when Inverter is Started

- Leakage current flows through the Inverter.

Because switching is performed inside the Inverter, a leakage current flows through the Inverter. This leakage current may actuate the ground fault interrupter, shutting the power off.

Use a ground fault interrupter with a high leakage-current detection value (sensitivity amperage of 200 mA or more, operating time of 0.1 second or more) or the one with high-frequency countermeasures (for Inverter).

Reducing the carrier frequency value is also relatively effective.

Note also that a leakage current increases in proportion to the cable length. Normally, an approximately 5 mA leakage current is generated per meter (cable length).

5-2-13 Mechanical System Makes Noise

- The carrier frequency and the natural frequency of the mechanical system resonates.

Take the following actions:

- Adjust the carrier frequency.

  Adjusting the carrier frequency (n37) may prevent resonance from occurring.

- Install vibration-proof rubber.

  Install vibration-proof rubber on the motor base.

5-3 Maintenance and Inspection

■ Daily Inspection

While the system is operating, check the following items:

- Check the motor for noise.
- Check for abnormal heating.
- Check if the ambient temperature is too high.
- Check if the output current monitor display indicates a higher value than usual.

■ Regular Maintenance

Check the items below during regular maintenance.

Before starting inspection, always turn the power off, then wait at least one minute after all indicators on the front panel go off. Touching terminals immediately after turning the power off may cause an electrical shock.

- Check the terminal block screws for looseness.
- Check if electrically conductive dust or oil mist adheres to the terminal block.
- Check the Inverter set screws for looseness.
- Check if dust or dirt builds up on the heat sink (aluminum portion on the rear of the Unit).
- Check if dust builds up in the air vents.
- Check if the appearance is normal.
- Check if the cooling fan for the control panel operates normally. (Check for noise or abnormal vibration, and also check if the total hours of operation has exceeded the value shown in the specifications.)

■ Regular Parts Maintenance

An Inverter consists of many different parts. It can provide its full performance only when these parts operate normally. Some electronic parts require maintenance depending on the service conditions. To allow the Inverter to operate normally over an extended period of time, always perform regular inspection and parts replacement according to the service life of each part.

Regular inspection intervals vary according to the Inverter installation environment and service conditions.

The maintenance interval for this Inverter is shown below. Use this information as a guide to regular maintenance.

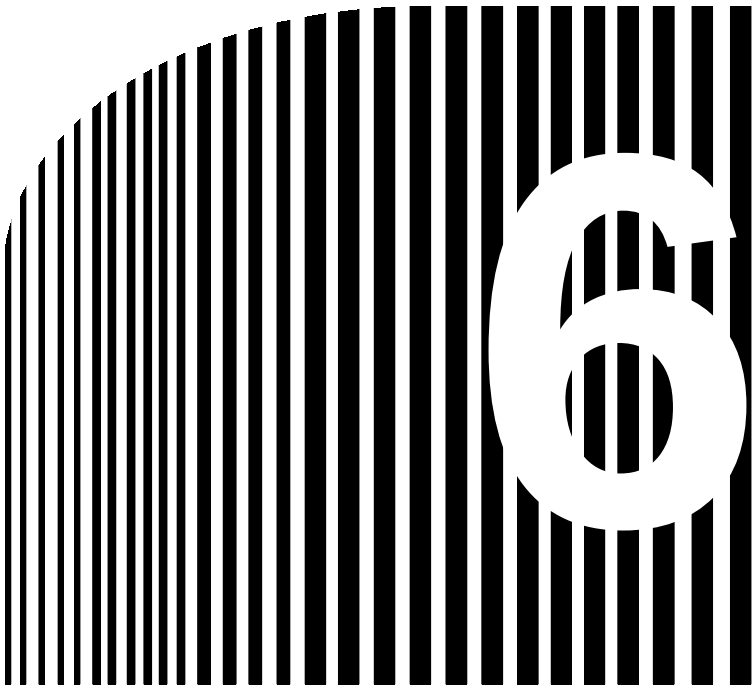
The standard interval for regular maintenance is as follows:

Electrolytic capacitor: Approximately 5 years (8 hours of operation per day)

As for service conditions, it is assumed that the ambient temperature of the Inverter is 40°C, and the Inverter is used under rated operating conditions (rated torque) and is installed as specified in the User's Manual.

To extend maintenance intervals, ambient temperatures should be lowered, and power-on time should be minimized.

Note For the maintenance method, contact your nearest local sales representative.



Chapter 6

Specifications

6-1 Specifications of Main Unit

■ Rating

3G3EV model		Three-phase input	A2001R	A2002R	A2004R	A2007R	A2015R
		Single/Three-phase input	AB001R	AB002R	AB004R	AB007R	---
Maximum applicable motor capacity (kW)			0.1	0.2	0.4	0.75	1.5
Rated output	Rated output capacity (kVA)		0.3	0.6	1.1	1.9	2.6
	Rated output current (A)		0.8	1.5	3.0	5.0	7.0
	Rated output voltage (V)		Three-phase 200 to 230 V (depending on input voltage)				
	Maximum frequency (Hz)		400 Hz (set in constant No. 24)				
Power supply	Rated voltage and frequency		3G3EV-A2□□□R (three-phase input): Three-phase, 200 to 230 VAC, 50/60 Hz 3G3EV-AB□□□R (three-phase input): Three-phase, 200 to 230 VAC, 50/60 Hz 3G3EV-AB□□□R (single-phase input): Single-phase, 200 to 240 VAC, 50/60 Hz				
	Allowable voltage fluctuation		−15% to +10%				
	Allowable frequency fluctuation		±5%				
Cooling method			Self-cooling				

■ General Specifications

Installation type	Panel mounting
Installation site	Indoor (free from corrosive gases and dust)
Ambient temperature for operation	−10° to 50°C
Humidity	90% or less (no-condensing)
Ambient temperature for storage	−20° to 60°C
Altitude	1,000 m max.
Vibration resistance	Less than 20 Hz: 1G {9.8 m/s^2} or less 20 to 50 Hz: 0.2G {1.96 m/s^2} or less
Cable length between Inverter and motor	100 m max.

■ Control Characteristics

Control method	Sine-wave PWM method (automatic torque boost)
Frequency control range	1.5 to 400 Hz
Frequency accuracy (temperature fluctuation)	±0.01% (–10°C to 50°C)
Frequency setting resolution	0.1 Hz (less than 100 Hz), 1 Hz (100 Hz or more)
Frequency output resolution	0.1 Hz (operation resolution)
Overload resistance	1 minute or less when 150% of rated output current is received
Acceleration/Deceleration time	0.0 to 999 seconds (acceleration and deceleration times are set separately)
Braking torque (continuous regenerative braking)	Approximately 20% **Note** 125% to 220% when braking resistor is externally installed.
Voltage/Frequency characteristics	Simple V/f pattern setting

■ Protection Functions

Motor protection	Electronic thermal protection
Instantaneous overcurrent protection	When 250% of the rated output amperage is exceeded
Overload protection	When 150% of the rated output amperage is exceeded for one minute
Overvoltage protection	Stops the system when DC voltage of the main circuit exceeds approximately 410 V
Voltage drop protection	3G3EV-A2□□□R: Stops the system when voltage drops below approximately 200 V 3G3EV-AB□□□R: Stops the system when voltage drops below approximately 160 V
Protection from instantaneous power interruption	Stops the system when a power interruption lasts for 15 ms or more. Operation can be continued by setting constant No. 36 as follows: • Operation is continued if a power interruption only lasts for approximately 0.5 second or less. • Operation is continued unconditionally.
Radiation fin overheat protection	Detects a fin temperature of 110 ±10°C
Ground protection	Overcurrent level protection

■ Operation Specifications

Control input	One photocoupler input terminal (24 VDC, 8 mA) • Multi-function input [S1]
Control output	One photocoupler input terminal (48 VDC, 50mA) • Multi-function output [PA]

■ Communication Specifications

Communication method	Two-conductor, half duplex
Synchronization method	Start-stop synchronization
Transmission path	Two-conductor cable (VCTF 0.75 x 2C recommended)
Interface	RS-485
Transmission speed	187.5 kbps
Transmission distance	200 m (total length)
Number of I/O points	2 points (input: 1 point, output: 1 point)

■ Response Time in SYSMAC BUS System

T_{on} : Input ON response time

T_c : Cycle time

T_{rm} : Communication cycle time = $\Sigma (T_{rt} + T_{tt})$

T_{rt} : Transmission time per Remote I/O Slave Unit
= 1.4ms + (0.2ms x n)

n : Total number of I/O points in the Slave Unit

T_{tt} : Transmission time per Inverter = 4ms

T_{min} : Minimum response time for Inverter output = 5ms

T_{max} : Maximum response time for Inverter output = 25ms

N : Number of SYSMAC BUS Master Units installed

- C1000H, C2000H, and C2000

  Minimum response time = $T_{on} + 2T_c + T_{rm} + T_{min}$

  Maximum response time = $T_{on} + 3T_c + 2T_{rm} + 0.5(T_{rt} + T_{tt}) + T_{max}$

- C500(F) and C120(F)

  Minimum response time = $T_{on} + T_c + T_{rm} + T_{min}$

  Maximum response time = $T_{on} + 2T_c + 2T_{rm} + 0.5(T_{rt} + T_{tt}) + T_{max}$

- C200H and C200HS

  (When remote transmission time is less than scanning time)

  Minimum response time = $T_{on} + 2T_c + T_{min}$

  Maximum response time = $T_{on} + 6T_c + T_{max}$

- CV500, CV1000, and CVM1 (asynchronous operation)

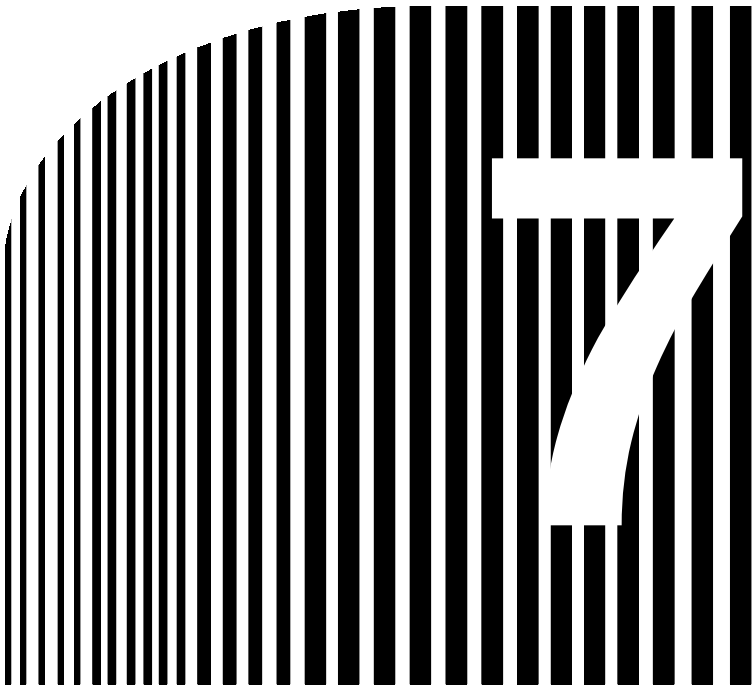
  Minimum response time = $T_{on} + 5N + T_{rm} + T_{min}$

  Maximum response time = $T_{on} + T_c + 5N + 2T_{rm} + 0.5(T_{rt} + T_{tt}) + T_{max}$

- CV500, CV1000, and CVM1 (synchronous operation)

  Minimum response time = $T_{on} + T_c + T_{rt} + T_{tt} + T_{min}$

  Maximum response time = $T_{on} + 2T_c + 2T_{rm} + T_{rt} + T_{tt} + T_{max}$



Chapter 7

· Supplementary Information ·

7-1 Notes on Using Inverter for Motor

■ Using Inverter for Existing Standard Motor

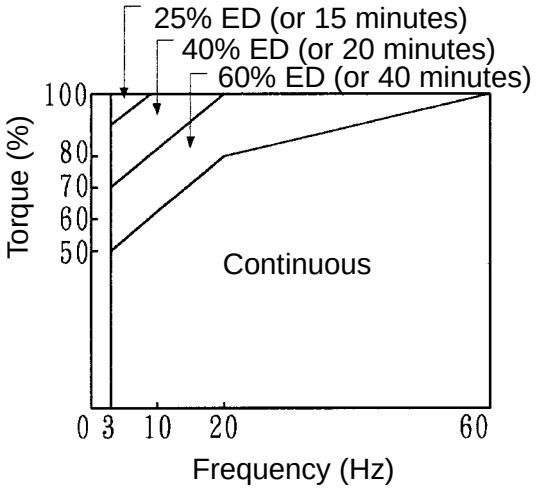
When a standard motor is operated with this Inverter, a power loss is slightly higher than when operated with a commercial power supply.

In addition, cooling effects also decline in the low-speed range, resulting in an increase in the motor temperature. Therefore, motor torque should be reduced in the low speed range.

The figure on the right-hand side shows allowable load characteristics of a standard motor.

If 100% torque is continuously required in the low-speed range, use a special motor for use with Inverters.

Allowable Load Characteristics of Standard Motor



● High-speed Operation

When using the motor at a high speed (60 Hz or more), note that problems may arise in dynamic balance, bearing durability, and so on.

● Torque Characteristics

When the motor is operated with the Inverter, torque characteristics differ from when operated with a commercial power supply. Check the load torque characteristics of the machine to be used with the motor.

● Vibration

The 3G3EV series employs high carrier PWM control to reduce motor vibration. When the motor is operated with this Inverter, motor vibration is almost the same as when operated with a commercial power supply.

However, motor vibration may become greater in the following cases:

- Resonance with the natural frequency of 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.

- Imbalanced rotor

  Take special care when the motor is operated at a high speed (60 Hz or more).

● Noise

Noise is almost the same as when the motor is operated with a commercial power supply. However, motor noise becomes louder when the motor is operated at a speed higher than the rated speed (60 Hz).

■ Using Inverter for Special Motors

● Pole-changing Motor

The rated amperage of pole-changing motors differs from that of standard motors. Select, therefore, an appropriate Inverter according to the maximum amperage of the motor to be used. Before changing the number of poles, always make sure that the motor has stopped. Otherwise, the overvoltage protection or overcurrent protection mechanism will be actuated, resulting in an error.

● Submersible Motor

The rated amperage of submersible motors is higher than that of standard motors. Therefore, always select an Inverter by checking its rated amperage. When the distance between the motor and the Inverter is long, use a cable thick enough to prevent motor torque reduction.

● Explosion-proof Motor

When an explosion-proof motor or increased safety type 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. However, since the Inverter itself is 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

This 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

This motor is not suitable for Inverter control. It should be replaced with a three-phase motor.

■ Power Transmission Mechanism (Speed Reducers, Belts, Chains, and so on)

If an oil-lubricated gearbox or speed reducer is used in the power transmission mechanism, note that oil lubrication will be affected when the motor operates only in the low speed range. Note also that the power transmission mechanism will make noise and experience problems with service life and durability if the motor is operated at a speed higher than 60 Hz.

7-2 List of Product Models

■ Inverter

Specifications		Model	
Standard models	Three-phase 200 VAC input	0.1 kW 0.2 kW 0.4 kW 0.75 kW 1.5 kW	3G3EV-A2001 3G3EV-A2002 3G3EV-A2004 3G3EV-A2007 3G3EV-A2015
	Single/Three-phase 200 VAC input	0.1 kW 0.2 kW 0.4 kW 0.75 kW	3G3EV-AB001 3G3EV-AB002 3G3EV-AB004 3G3EV-AB007
SYSMAC BUS models	Three-phase 200 VAC input	0.1 kW 0.2 kW 0.4 kW 0.75 kW 1.5 kW	3G3EV-A2001R 3G3EV-A2002R 3G3EV-A2004R 3G3EV-A2007R 3G3EV-A2015R
	Single/Three-phase 200 VAC input	0.1 kW 0.2 kW 0.4 kW 0.75 kW	3G3EV-AB001R 3G3EV-AB002R 3G3EV-AB004R 3G3EV-AB007R

■ Braking Resistor (Duty Cycle 3% ED)

Specifications		Model
0.75 kW or less	200 Ω 150 W	3G3IV-PERF150WJ201
1.5 kW	100 Ω 150 W	3G3IV-PERF150WJ101

■ Braking Resistor Unit (Duty Cycle 10% ED)

Specifications		Model
0.75 kW or less	200 Ω 70 W	3G3IV-PLKEB20P7
1.5 kW	100 Ω 260 W	3G3IV-PLKEB21P5

■ AC Reactor (for Three-Phase)

Specifications		Model
0.1 to 0.4 kW	2.5 A 4.2 mH	3G3IV-PUZBAB2.5A4.2MH
0.75 kW	5 A 2.1 mH	3G3IV-PUZBAB5A2.1MH
1.5 kW	10 A 1.1 mH	3G3IV-PUZBAB10A1.1MH

■ Input Noise Filter (for Three-Phase)

Specifications		Model
0.1 to 0.4 kW	5 A	3G3IV-PHF3005AZ
0.75 kW	10A	3G3IV-PHF3010AZ
1.5 kW	15 A	3G3IV-PHF3015AZ

■ Output Noise Filter

Specifications		Model
0.1 to 1.5 kW	10 A	3G3IV-PLF310KA

■ Variable Resistor Unit

Specifications		Model
3G3EV	2 kΩ 0.5 W	3G3EV-PETX3200

■ DIN Track

Specifications	Model
3G3EV-A2001□ to 3G3EV-A2004□ 3G3EV-AB001□ and 3G3EV-AB002□	3G3EV-PSPAT3
3G3EV-A2007□ to 3G3EV-A2015□ 3G3EV-AB004□ and 3G3EV-AB007□	3G3EV-PSPAT4

List of Constants Used with 3G3EV SYSMAC BUS Model

Constant no.	Indicators	Description	Setting range			Setting
n01		Constant write-inhibit selection /constant initialization	0: Only n01 can be set. 1: All constants can be set. 8: Constant settings are initialized.			
n02	MODE	Mode operation selection		Run command	Frequency reference	
			0	Digital Operator	Digital Operator	
			1	Communication	Digital Operator	
n03		Stop mode selection	0: Deceleration stop 1: Free running			
n04	F/R	Forward /Reverse rotation selection	For: forward rotation rEv: reverse rotation			
n06		Multi-function input selection 1	0: Override 1: Fault reset 2: External fault (external fault when ON) 3: External fault (external fault when OFF) 4: Multi-step speed command 1 5: Multi-step speed command 2 6: Multi-step speed command 3 8: Acceleration/deceleration time changeover command 9: External base block command (base block when ON) 10: External base block command (base block when OFF) 11: Search command from maximum frequency 12: Search command from preset frequency 13: Acceleration/deceleration-inhibit command 14: Local/remote changeover command			
n07		Multi-function input selection 2	1 to 14: Same as for n06 [2] Invalid when n06 = “0” or n08 = “15”			

Constant no.	Indi-cators	Description	Setting range	Setting
n08		Multi-function input selection 3	1 to 14: Same as for n06 [4] 15: Up/down command Invalid when n06 = "0"	
n09		Multi-function output selection 1	0: Fault occurrence 1: Operation in progress 2: Frequency matching 3: Idling 4: Frequency detection (output frequency ≧ frequency detection level set in n53) 5: Frequency detection (output frequency ≦ frequency detection level set in n53) 6: Over-torque being monitored 7: Base block in progress 8: Undervoltage (UV) being monitored 9: Speed search 10: Run mode 11: Normal	
n10		Multi-function output selection 2	0 to 11: Same as for n09 [2]	
n11	FREF	Frequency reference 1	0.0 to 400 (Hz) [6.0]	
n12	FREF	Frequency reference 2	0.0 to 400 (Hz) [0.0]	
n13	FREF	Frequency reference 3	0.0 to 400 (Hz) [0.0]	
n14	FREF	Frequency reference 4	0.0 to 400 (Hz) [0.0]	
n15	FREF	Frequency reference 5	0.0 to 400 (Hz) [0.0]	
n16	FREF	Frequency reference 6	0.0 to 400 (Hz) [0.0]	
n17	FREF	Frequency reference 7	0.0 to 400 (Hz) [0.0]	
n18	FREF	Frequency reference 8	0.0 to 400 (Hz) [40.0]	
n20	ACC	Acceleration time 1	0.0 to 999 (seconds) [10.0]	
n21	DEC	Deceleration time 1	0.0 to 999 (seconds) [10.0]	

Constant no.	Indi-cators	Description	Setting range	Setting
n22	ACC	Acceleration time 2	0.0 to 999 (seconds) [10.0]	
n23	DEC	Deceleration time 2	0.0 to 999 (seconds) [10.0]	
n24	FMAX	Maximum frequency	50.0 to 400 (Hz) [60.0]	
n25	VMAX	Maximum voltage	1 to 255 (V) [200]	
n26	FBAS	Maximum voltage frequency (basic frequency)	1.6 to 400 (Hz) [60.0]	
n31	THR	Electronic thermal reference current	0.0 to 120% of rated Inverter amperage Specify the rated motor amperage.	
n33		Stall prevention during deceleration	0: Stall prevention 1: No stall prevention	
n36		Operation after recovery from power interruption	0: Discontinues operation. 1: Continues operation only if the power interruption is within 0.5 second. 2: Continues operation unconditionally.	
n37		Carrier frequency	1: 2.5 (kHz) 2: 5 (kHz) 3: 7.5 (kHz) 4: 10 (kHz)	

Constant no.	Indi-cators	Description	Setting range	Setting
n50		Over-torque detection function selection	0: Inverter does not monitor over-torque. 1: Inverter monitors over-torque only when speed is matched. It continues operation even when over-torque is detected. 2: Inverter monitors over-torque only when speed is matched. It discontinues operation when over-torque is detected. 3: Inverter always monitors over-torque during operation. It continues operation even when over-torque is detected. 4: Inverter always monitors over-torque during operation. It discontinues operation when over-torque is detected.	
n51		Over-torque detection level	30 to 200 (%) [160]	
n52		Over-torque detection time	0.1 to 10.0 (seconds) [0.1]	
n53		Frequency detection level	0.0 to 400 (Hz) [0.0]	
n67		Unit no.	0 to 15 (Unit no. setting) [0]	

Note Values in shaded sections or values in brackets represent factory settings.