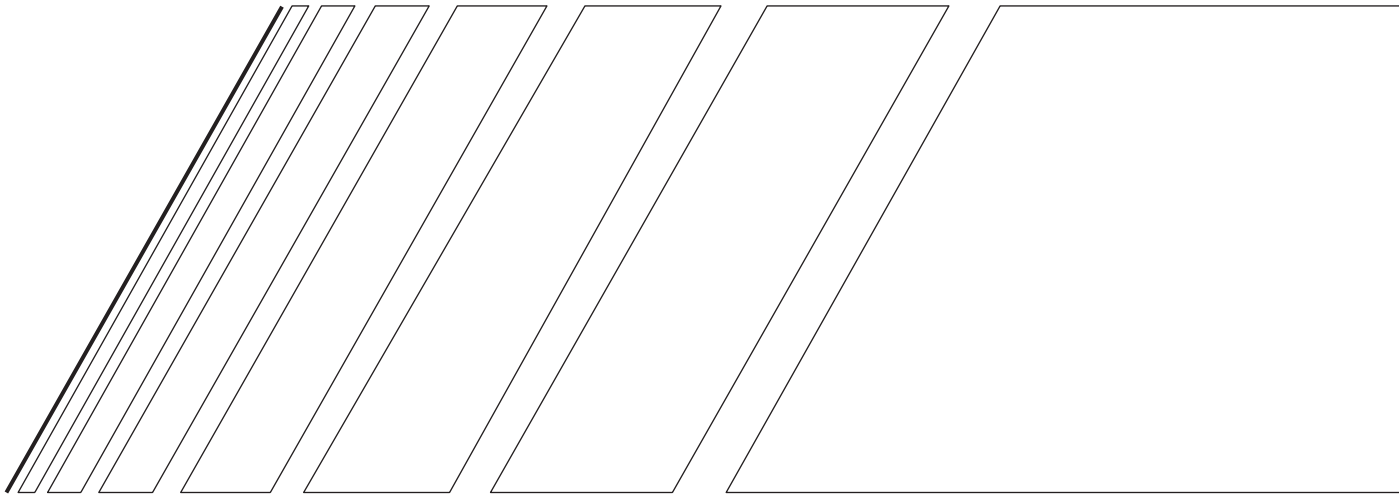
Cat. No. I547-E1-02

OMRON



USER'S MANUAL

EasySpeed

3G3JE

Compact Simplified Inverters

Preface

Thank you for choosing this 3G3JE-series Compact Simplified Inverter.
This User's Manual describes Inverter installation and wiring, the parameter settings required for operation, and troubleshooting and inspection procedures.

- This manual is to be delivered to the final end user of the product.
- After reading the manual, always keep it close at hand for reference when operating the Inverter.
- Every effort has been made to provide detailed specifications, information on functions, and interrelationships between them. Assume that anything not described in this manual cannot be performed.
- This manual is intended for the following personnel, who are assumed to have sufficient knowledge of electrical systems (i.e., an electrical engineer or the equivalent).
    - Personnel in charge of introducing control devices
    - Personnel designing the control system
    - Personnel installing and connecting control devices
    - Personnel managing the site where the Inverter is used
- Refer to the Communications Manual for information on communications commands for 3G3JE Inverters with communications.

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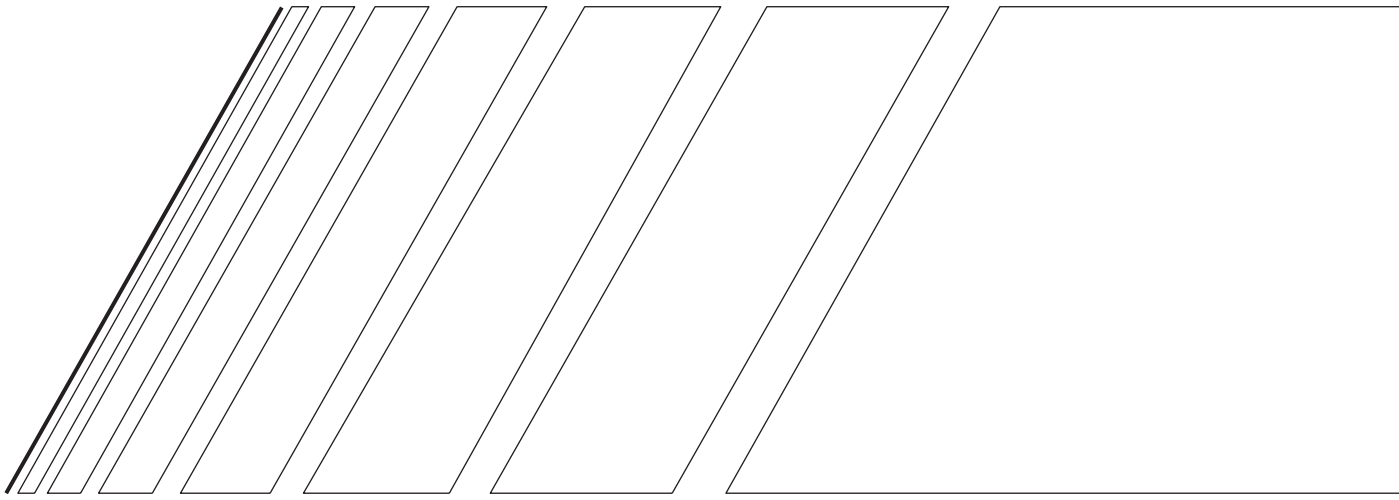

USER'S MANUAL

EasySpeed

3G3JE

Compact Simplified Inverters

Read and Understand this Manual

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

Warranty and Limitations of Liability

WARRANTY

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

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

LIMITATIONS OF LIABILITY

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

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

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

Application Considerations

SUITABILITY FOR USE

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

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

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

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

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

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

PROGRAMMABLE PRODUCTS

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

Disclaimers

CHANGE IN SPECIFICATIONS

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

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

DIMENSIONS AND WEIGHTS

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

PERFORMANCE DATA

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

ERRORS AND OMISSIONS

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

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Safety Precautions

● Indications and Meanings of Safety Information

The following precautions and signal words are used to provide information to ensure the safe use of the 3G3JE Inverter. The information provided here is vital to safety. Always observe the precautions provided.

Meanings of Signal Words

The following signal words are used in this manual.

⚠ **DANGER**	Indicates an imminently hazardous situation which, if not avoided, is likely to result in serious injury or may result in death. Additionally there may be severe property damage.

(There are no alert statements with “DANGER” contained in this manual.)

⚠ **WARNING**	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.

(There are no alert statements with “WARNING” contained in this manual.)

⚠ **CAUTION**	Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in property damage.

Meanings of Alert Symbols

The following alert symbols are used in this manual.

Symbol		Meaning
Caution		**General Caution** Indicates non-specific general cautions, warnings, and dangers.
		**Electrical Shock Caution** Indicates possibility of electric shock under specific conditions.
		**High Temperature Caution** Indicates possibility of burns due to high temperatures under specific conditions.
Prohibition		**Disassembly Prohibition** Indicates prohibitions when there is a possibility of injury, such as from electric shock, as the result of disassembly.
Mandatory Caution		**General Caution** Indicates non-specific general cautions, warnings, and dangers.

Alert Statements in this Manual

The following alert statements apply to the products in this manual. Each alert statement also appears at the locations needed in this manual to attract your attention.

⚠ Caution	
Be sure to use the specified Braking Resistor or Braking Resistor Unit. Not doing so may occasionally result in moderate burns due to heating of the Braking Resistor or Braking Resistor Unit. When using a Braking Resistor or Braking Resistor Unit, be sure to install a thermal relay to monitor the resistor temperature. Include a sequence to turn OFF the power supply to the Inverter if the Braking Resistor or Braking Resistor Unit overheats.	
Terminals B1 and B2 are for connecting an optional Braking Resistor or Braking Resistor Unit. Do not connect any device other than a Braking Resistor or Braking Resistor Unit to these terminals. Doing so may occasionally result in moderate fire, heating, or equipment damage.	
Do not open terminal covers while the power is being supplied or for at least one minute after the power has been turned OFF. Doing so may occasionally result in minor injury from electrical shock.	
Do not remove the fan cover except when replacing the fan. Before replacing the fan, first turn OFF the power and disconnect the wiring. Doing so may occasionally result in minor injury from electrical shock.	
Install external breakers (MCCB) suitable for the Inverter capacity on the power supply side of the Inverter and take other safety measures against short-circuiting in load wiring. Not doing so may occasionally result in property damage from short-circuiting in load wiring.	
Cover the Inverter or take other measures to prevent filings or lead clippings from entering the Inverter during installation and wiring. The Inverter contains high-voltage components and Inverter damage or property damage may occasionally occur if the high-voltage components are short-circuited.	

Precautions for Safe Use

■ Installation and Storage Environment

- Do not store, install, or operate the product in any of the following locations.
  - Locations subject to direct sunlight.
  - Locations subject to temperatures outside the range specified in the specifications.
  - Locations subject to humidity outside the range specified in the specifications.
  - Locations subject to condensation resulting from severe changes in temperature.
  - Locations subject to corrosive or flammable gases.
  - Locations subject to exposure to combustibles.
  - Locations subject to dust (especially iron dust) or salts.
  - Locations subject to exposure to water, oil, or chemicals.
  - Locations subject to shock or vibration.

■ Transporting, Installation, and Wiring

- Always use the original shipping box when transporting the Inverter.
- Do not apply excessive shock to the Inverter or drop the Inverter. The Inverter may malfunction or may be damaged.
- Do not connect an AC power supply voltage to the U, V, and W output terminals. Doing so will damage the Inverter.
- Do not connect any load other than a three-phase inductive motor to the U, V, and W output terminals.
- Do not connect an AC power supply voltage to the control I/O terminals. Doing so will damage the Inverter.
- Use 600-V polyvinyl chloride (PVC) cable with a wire size of 0.75 to 2 mm^2 to wire the main circuit terminals. Also, tighten the terminal screws on the terminal block to a torque of 0.8 to 1.0 N·m.
- Take appropriate and sufficient shielding countermeasures when installing systems in the following locations. Not doing so may result in malfunction or equipment damage.
  - Locations subject to static electricity or other forms of noise.
  - Locations subject to strong electromagnetic fields and magnetic fields.
  - Locations close to power lines.

■ Operation and Maintenance

- This Inverter can be set to operate from low speed to high speed. Operate the Inverter only after sufficiently confirming the allowable range for the motor installation being used.
- Take measures to assure safety before performing maintenance or inspection, or replacing components.

Precautions for Correct Use

■ Installation

- Mount the product vertically on a wall or on a DIN Track. Leave the prescribed space between this product and the control panel surface and other devices.

■ Main Circuit Power Supply

- Use a three-phase, 200 to 230 V, 50/60 Hz power supply.

■ Operation after Power Interruptions

- If continuing operation is selected for the momentary power interruption restart selection parameter (P09), the system may unexpectedly start operation after a momentary power interruption is reset. Exercise suitable caution.

■ Operation Command Selection

- If the operation command selection parameter (P10) is set to “PLC” to enable using the control circuit terminal inputs (STF and STR), the motor may start operation when the power supply is turned ON or an alarm is reset if the control circuit terminals are left ON. Exercise suitable caution. Also, if signals are checked during operation and a voltage is incorrectly applied to the control circuit terminals, the motor may start moving unexpectedly. Always check safety before performing signal checks.

■ Motor Overheating Protection (Electronic Thermal)

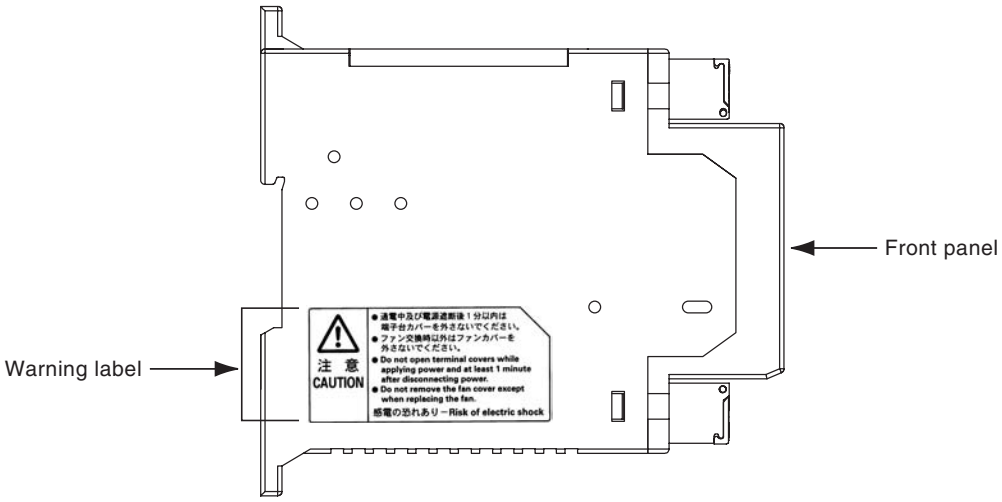
- The Inverter uses an electronic thermal to protect the motor from overheating. Set the rated current of the motor in the rated motor current parameter (P01). If more than one motor is operated with one Inverter, set the rated motor current parameter (P01) to 0.0 to disable motor overload detection, and install a thermal relay between the Inverter and each motor. Set the thermal relay to the nameplate current at 50 Hz and to 1.1 times the nameplate current at 60 Hz.

■ Disposing of the Inverter

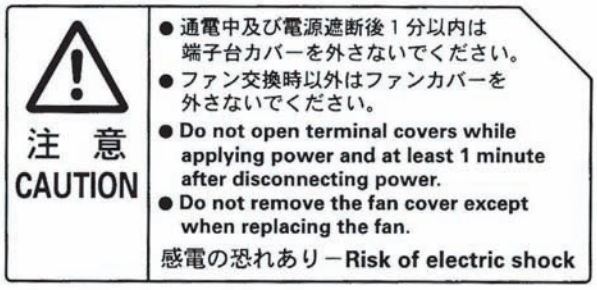
- Observe all applicable legal requirements when disposing of the Inverter.

■ Warning Label Position

• A warning label is pasted on the product as shown in the following illustration. Be sure to follow the instructions given there.



■ Contents of Warning

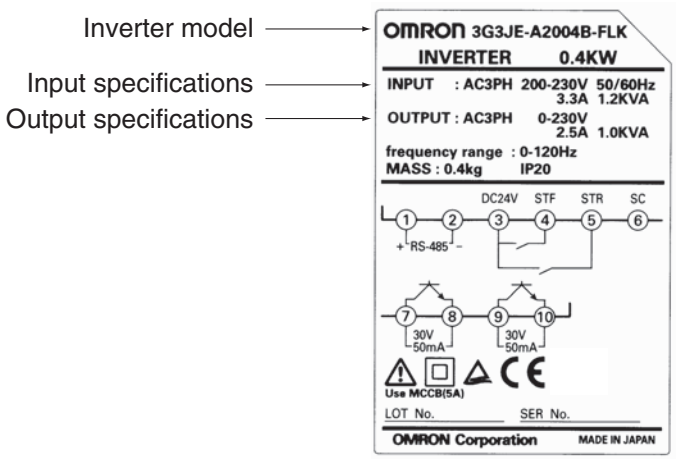


Checking Before Unpacking

■ Checking the Product

On delivery, always check that the delivered product is the 3G3JE 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

3G3JE–A2□□□–□ (1) (2) (3) (4)

Series name
3G3JE Series

(4) Communications
Blank: No communications function
FLK: CompoWay/F

(3) Control Circuit Terminals (Input Side)
Blank: PNP input
N: NPN input

(2) Braking Resistor Control
Blank: No Braking Resistor control.
B: Braking Resistor control provided.

(1) Maximum Applicable Motor Capacity
001: 0.1 kW
002: 0.2 kW
004: 0.4 kW

Voltage Class
2: Three-phase 200 V AC

Degree of Protection
A: Panel-mounting (IP10 or higher)/Closed wall-mounting

■ Checking the Accessories

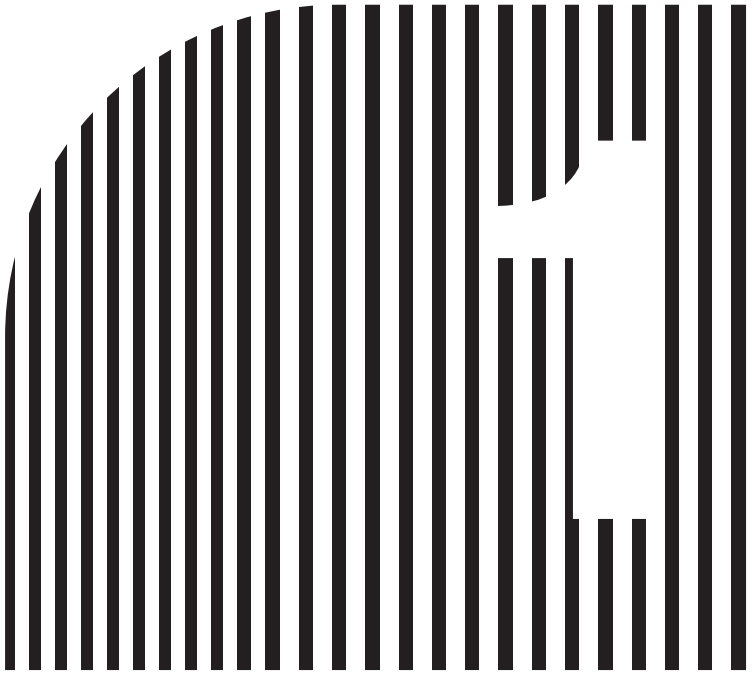
An Instruction Manual is the only accessory provided with the 3G3JE. Set screws and other necessary parts must be provided by the user.

About this Manual

This manual is divided into the chapters described in the following table. Understanding how information is organized will enable you to use the manual more efficiently.

Chapter	Contents
Chapter 1 Overview	Describes Inverter features and nomenclature.
Chapter 2 Design	Provides dimensions, installation methods, peripheral device design information, and peripheral device selection information.
Chapter 3 Operation	Describes initial setting methods, operation confirmation methods, and functions.
Chapter 4 Maintenance Operations	Describes Inverter maintenance. Provides troubleshooting information for when errors occur in the Inverter and periodic inspection and maintenance information.
Chapter 5 Specifications	Provides Inverter specifications, as well as the specifications and dimensions of peripheral devices.
Chapter 6 Parameter Tables	Provides tables of basic information on Inverter parameters in RUN Mode, Adjustment Mode, and Initial Settings Mode as a reference for users already familiar with Inverter operation. Use this chapter when adjusting the Inverter. Parameters are listed with the page numbers of further information for easy reference.
Chapter 7 Appendix	Provides information on selecting the Inverter and precautions on using the Inverter for a motor.

Table of Contents



Chapter 1

Overview

1-1 Functions

■ 3G3JE Models

- Rated power supply voltage: Three-phase 200 to 230 V AC
- Enclosure rating: IP20

(1) Models with PNP Input

Maximum applicable motor capacity		0.1 kW	0.2 kW	0.4 kW
No braking resistor control	Standard models 4 inputs and 2 outputs	3G3JE-A2001	3G3JE-A2002	3G3JE-A2004
	RS-485 communications models 2 inputs and 2 outputs	3G3JE-A2001-FLK	---	---
Braking resistor control	Standard models 4 inputs and 2 outputs	---	3G3JE-A2002B	3G3JE-A2004B
	RS-485 communications models 2 inputs and 2 outputs	---	3G3JE-A2002B-FLK	3G3JE-A2004B-FLK

(2) Models with NPN Input

Maximum applicable motor capacity		0.1 kW	0.2 kW	0.4 kW
No braking resistor control	Standard models 4 inputs and 2 outputs	3G3JE-A2001N	3G3JE-A2002N	3G3JE-A2004N
	RS-485 communications models 2 inputs and 2 outputs	3G3JE-A2001N-FLK	---	---
Braking resistor control	Standard models 4 inputs and 2 outputs	---	3G3JE-A2002BN	3G3JE-A2004BN
	RS-485 communications models 2 inputs and 2 outputs	---	3G3JE-A2002BN-FLK	3G3JE-A2004BN-FLK

■ Conformance with International Standards

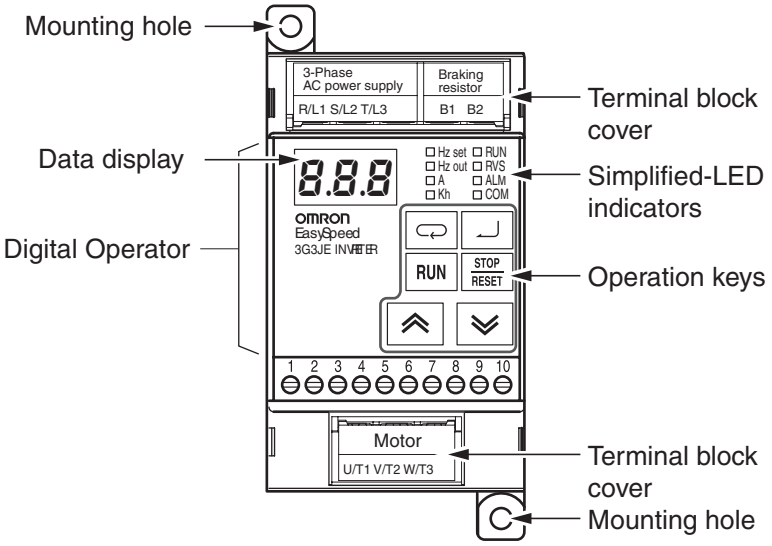
Classification		Applicable standard
EC Directives	EMC Directive	EN 61800-3
	Low-voltage Directive	EN 61800-5-1 (Pollution Degree 2/Overvoltage Category II)

■ Convenient Functions for Easy Operation

- Easy torque adjustment according to load torque characteristics.
- Replaceable cooling fan.
- Standard models include an interface for connecting to time-shared proportional pulse output, enabling direct connection to digital controllers or temperature controllers.
- Models with RS-485 communications support the CompoWay/F OMRON communications protocol.

1-2 Nomenclature

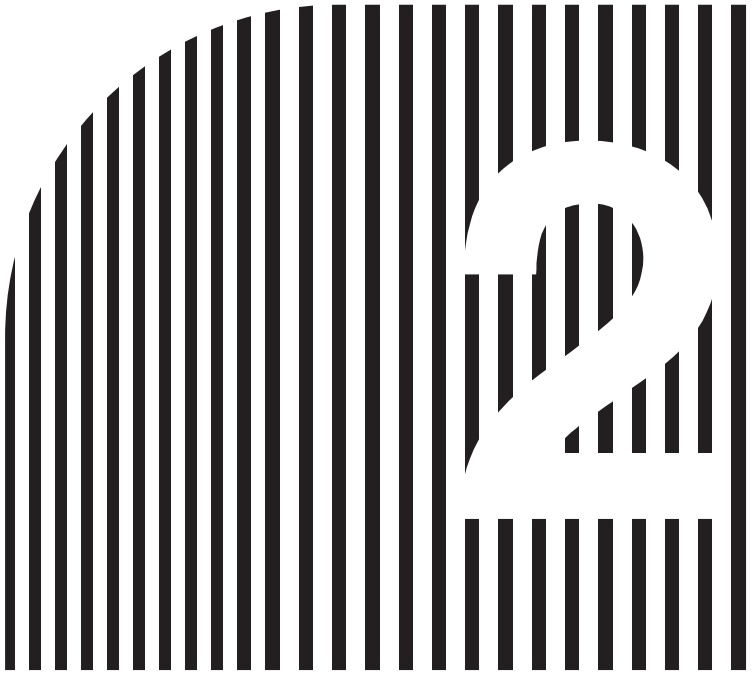
■ Part Names



■ Digital Operator Part Names

Name		Function
	Data display	Displays relevant data, such as the frequency reference, output frequency, output current, parameter set values, and accumulated operating time.
□ Hz set	Frequency reference	Lit when the data display shows the frequency reference.
□ Hz out	Output frequency	Lit when the data display shows the output frequency.
□ A	Output current	Lit when the data display shows the output current.
□ Kh	Accumulated operating time	Lit when the data display shows the accumulated operating time.
□ RUN	RUN indicator	Lit while the Inverter is operating.
□ RVS	Reverse operation indicator	Lit while the Inverter is operating in reverse.
□ ALM	Alarm indicator	Lit when a fault is detected or a protective function has been triggered. (Error information can be monitored in RUN mode.)
□ COM	Communications indicator	Lit while data is being sent or received. (Communications models only.)
	Mode Key	In RUN mode, switches the setting/monitoring indicators. When pressed for one second or longer, the mode changes from the RUN mode to the initial settings mode.
	Enter Key	Enters displayed items, set values, etc. When this key is pressed for one second or longer, the mode is changed from RUN mode to adjustment mode.
	RUN Key	Starts the Inverter if operation with the Digital Operator is selected.
	STOP/RESET Key	Stops the Inverter. This key also clears errors when errors are detected or a protection function operates. Operating with the Digital Operator must be selected to use the above key functions.
	Increment Key	These keys change the displayed set value. They also change the parameter set in the adjustment mode or initial settings mode.
	Decrement Key	

Note Refer to *Section 3 Operation* for information on moving between modes.



Chapter 2

Design

⚠ Caution	
Be sure to use the specified Braking Resistor or Braking Resistor Unit. Not doing so may occasionally result in moderate burns due to heating of the Braking Resistor or Braking Resistor Unit. When using a Braking Resistor or Braking Resistor Unit, be sure to install a thermal relay to monitor the resistor temperature. Include a sequence to turn OFF the power supply to the Inverter if the Braking Resistor or Braking Resistor Unit overheats.	
Terminals B1 and B2 are for connecting an optional Braking Resistor or Braking Resistor Unit. Do not connect any device other than a Braking Resistor or Braking Resistor Unit to these terminals. Doing so may occasionally result in moderate fire, heating, or equipment damage.	
Install external breakers (MCCB) suitable for the Inverter capacity on the power supply side of the Inverter and take other safety measures against short-circuiting in load wiring. Not doing so may occasionally result in property damage from short-circuiting in load wiring.	
Cover the Inverter or take other measures to prevent filings or lead clippings from entering the Inverter during installation and wiring. The Inverter contains high-voltage components and Inverter damage or property damage may occasionally occur if the high-voltage components are short-circuited.	

Precautions for Safe Use

■ Installation and Storage Environment

- Do not store, install, or operate the product in any of the following locations.
  - Locations subject to direct sunlight.
  - Locations subject to temperatures outside the range specified in the specifications.
  - Locations subject to humidity outside the range specified in the specifications.
  - Locations subject to condensation resulting from severe changes in temperature.
  - Locations subject to corrosive or flammable gases.
  - Locations subject to exposure to combustibles.
  - Locations subject to dust (especially iron dust) or salts.
  - Locations subject to exposure to water, oil, or chemicals.
  - Locations subject to shock or vibration.

■ Transporting, Installation, and Wiring

- Always use the original shipping box when transporting the Inverter.
- Do not apply excessive shock to the Inverter or drop the Inverter. The Inverter may malfunction or may be damaged.
- Do not connect an AC power supply voltage to the U, V, and W output terminals. Doing so will damage the Inverter.
- Do not connect any load other than a three-phase inductive motor to the U, V, and W output terminals.
- Do not connect an AC power supply voltage to the control I/O terminals. Doing so will damage the Inverter.
- Use 600-V polyvinyl chloride (PVC) cable with a wire size of 0.75 to 2 mm^2 to wire the main circuit terminals. Also, tighten the terminal screws on the terminal block to a torque of 0.8 to 1.0 N·m.
- Take appropriate and sufficient shielding countermeasures when installing systems in the following locations. Not doing so may result in malfunction or equipment damage.
  - Locations subject to static electricity or other forms of noise.
  - Locations subject to strong electromagnetic fields and magnetic fields.
  - Locations close to power lines.

Precautions for Correct Use

■ Installation

- Mount the product vertically on a wall or on a DIN Track. Leave the prescribed space between this product and the control panel surface and other devices.

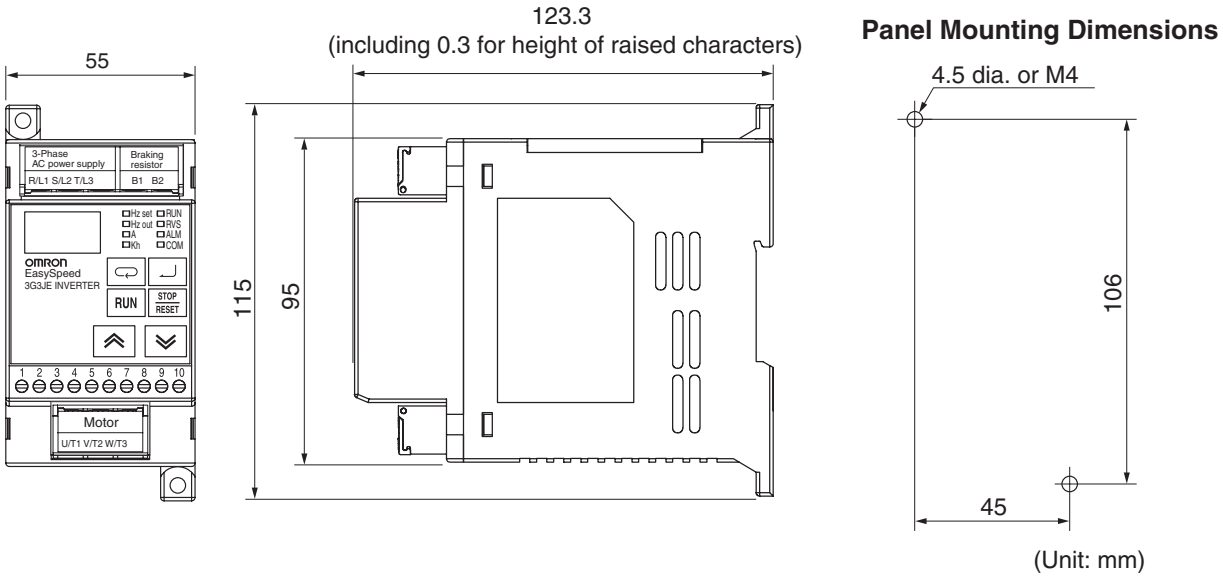
■ Main Circuit Power Supply

- Use a three-phase, 200 to 230 V, 50/60 Hz power supply.

2-1 Installation

2-1-1 Dimensions

● 3G3JE-A2001/-A2002/-A2004: Three-phase 200-V AC Input



Note All models are the same size.

2-1-2 Installation Conditions

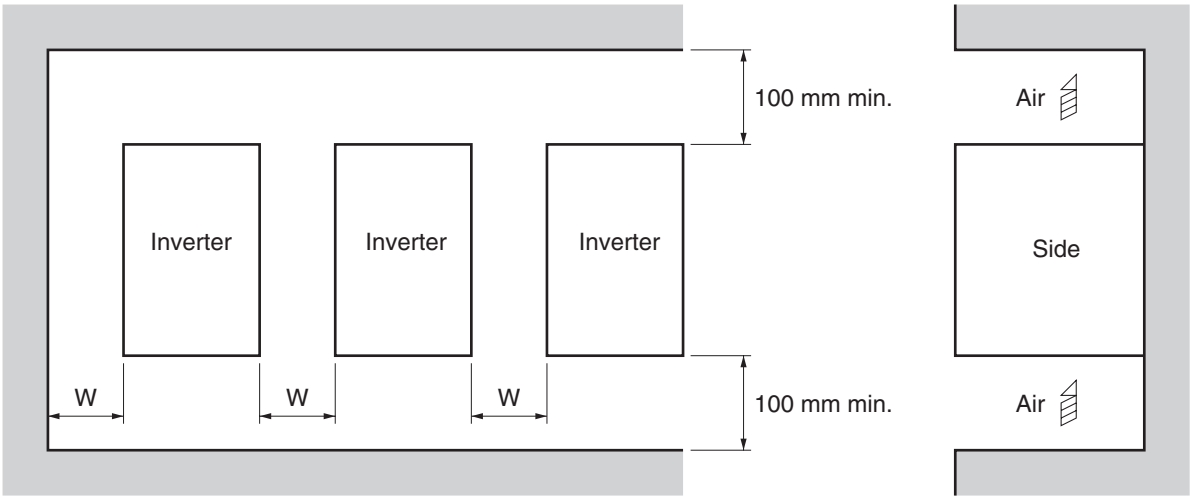
■ Installation Direction

- Screw the Inverter to a wall or mount it to DIN Track so that the characters on the nameplate read normally when facing the Inverter in a normal vertical position.

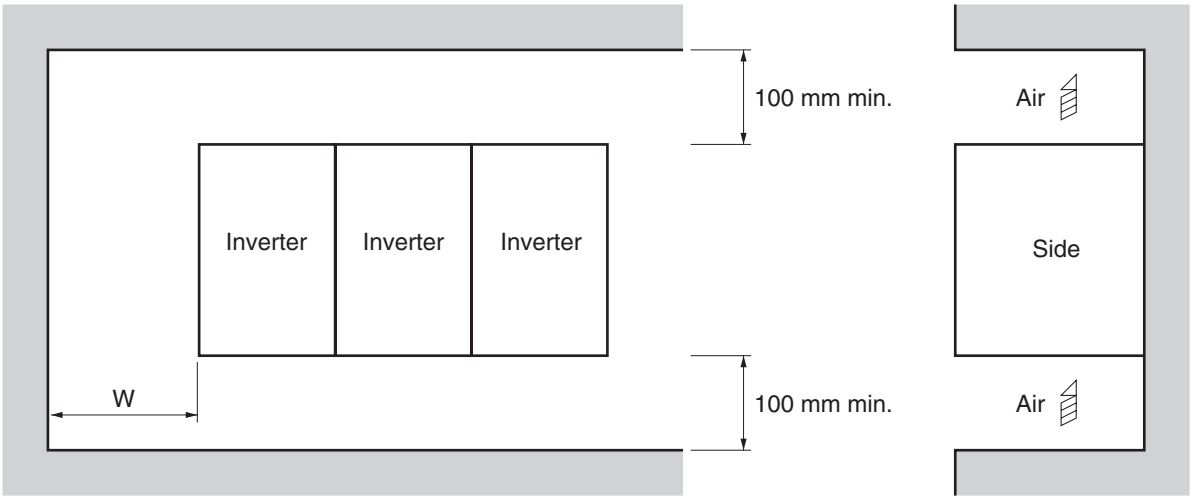
■ Clearances from Peripheral Devices

- When installing the Inverter, always provide the following clearances to allow normal heat dissipation from the Inverter. If using a line of 0.1-kW Inverters, leave ample space at the top of each one to allow airflow.

Inverter capacity	Model		W (clearance: –10 to 50°C)
0.1 kW	3G3JE-A2001	3G3JE-A2001N	10 mm
	3G3JE-A2001-FLK	3G3JE-A2001N-FLK	
0.2 kW	3G3JE-A2002	3G3JE-A2002N	10 mm
	3G3JE-A2002B	3G3JE-A2002BN	
	3G3JE-A2002B-FLK	3G3JE-A2002BN-FLK	
0.4 kW	3G3JE-A2004	3G3JE-A2004N	10 mm
	3G3JE-A2004B	3G3JE-A2004BN	
	3G3JE-A2004B-FLK	3G3JE-A2004BN-FLK	



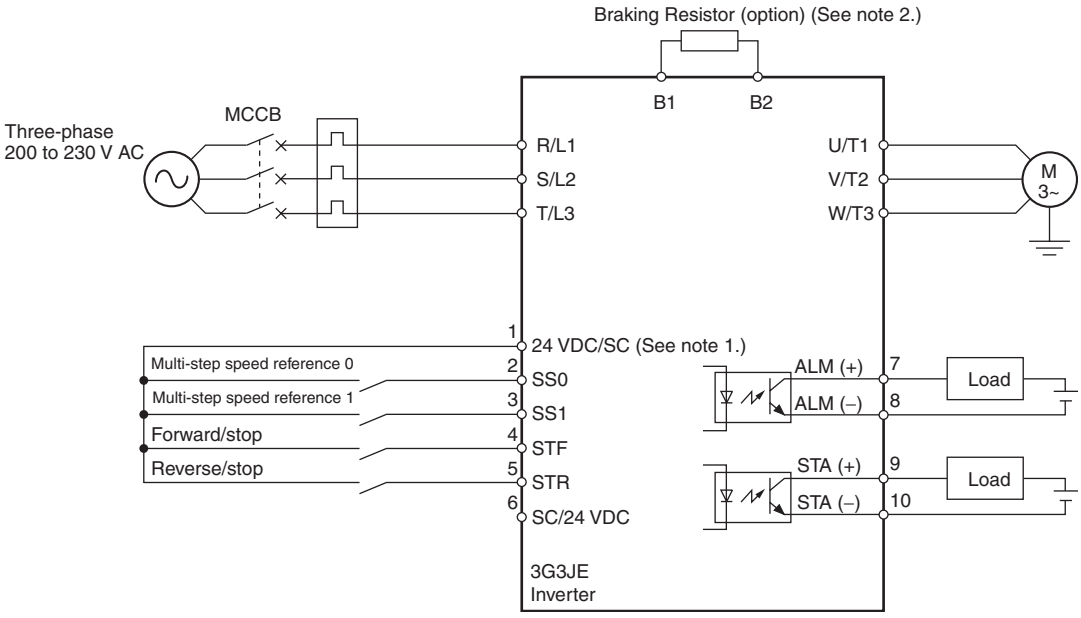
• Side-by-side mounting is possible as long as the ambient temperature is –10 to 45°C. (All models)



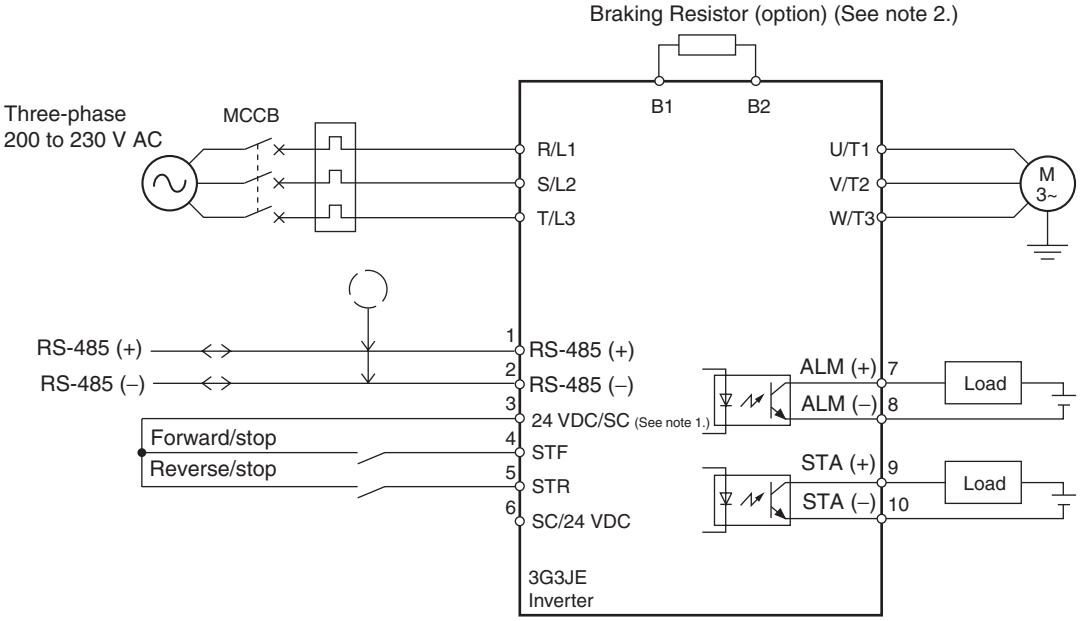
2-2 Wiring

2-2-1 Standard Connection Diagrams

■ Standard Models



■ Communications Models

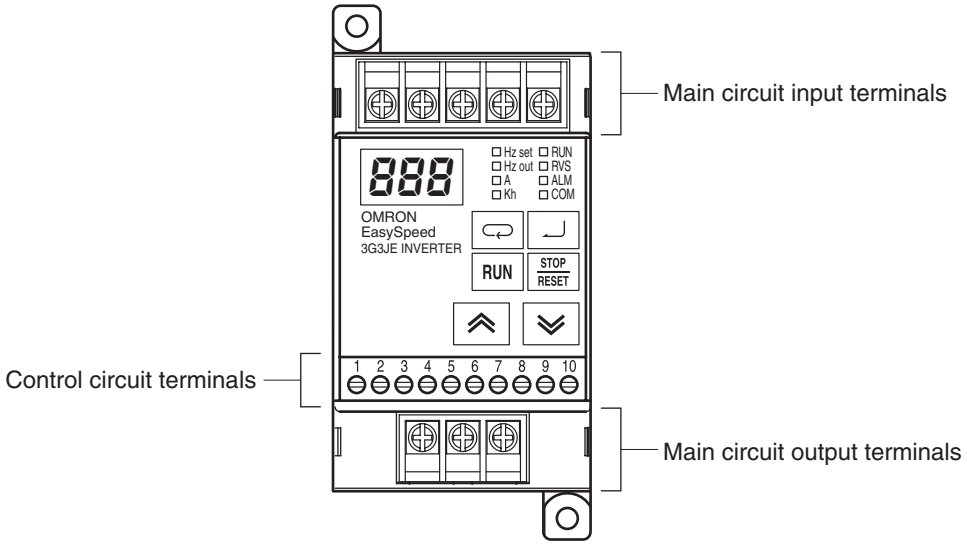


Note **1.** Refer to *2-2-4 Wiring Control Circuit Terminals* for information on wiring the control circuit terminals.

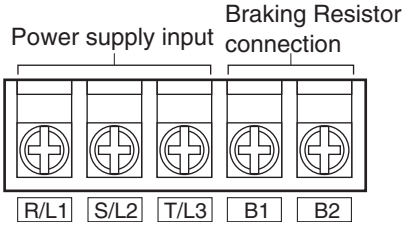
2. An optional Braking Resistor can be connected only to Inverters with braking resistor control.

2-2-2 Terminal Block

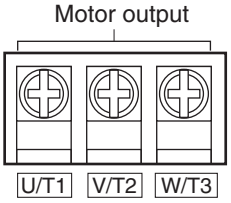
■ Terminal Arrangement



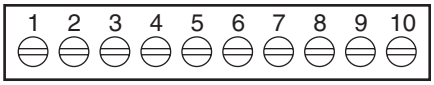
■ Arrangement of Main Circuit Input Terminals



■ Arrangement of Main Circuit Output Terminals



■ Control Circuit Terminals



■ Terminal Arrangement for Standard Models

Terminal	1	2	3	4	5	6	7	8	9	10
Models with PNP input	24 VDC	SS0	SS1	STF	STR	SC	ALM (+)	ALM (–)	STA (+)	STA (–)
Models with NPN input (□□□□N)	SC	SS0	SS1	STF	STR	24 VDC	ALM (+)	ALM (–)	STA (+)	STA (–)

■ Terminal Arrangement for Models with Communications

Terminal	1	2	3	4	5	6	7	8	9	10
Models with PNP input	RS-485 (+)	RS-485 (–)	24 VDC	STF	STR	SC	ALM (+)	ALM (–)	STA (+)	STA (–)
Models with NPN input (□□□□N)	RS-485 (+)	RS-485 (–)	SC	STF	STR	24 VDC	ALM (+)	ALM (–)	STA (+)	STA (–)

■ Main Circuit Terminals

Symbol	Name	Description
R/L1	Power supply inputs	Inputs for connecting three-phase 200 to 230-V AC power supply.
S/L2		
T/L3		
U/T1	Motor outputs	Three-phase power supply outputs for driving the motor.
V/T2		
W/T3		
B1	Between B1 and B2: Braking Resistor connection terminals	Connect between B1 and B2 to connect a Braking Resistor or a Braking Resistor Unit. (3G3JE-A2□□□B models with braking resistor control only)
B2		

■ Control Circuit Terminals for Standard Models

Symbol		Name	Function	Specifications
Input	24VDC	Internal 24-V power supply	The 24-VDC power supply input for Inverter control circuits. Do not use this power supply for any other purpose.	Photocoupler (24 V DC, 5 mA per input)
	SS0	Multi-step speed reference 0	Executes multi-step speed reference in combination with SS0 and SS1 when P11 (Frequency reference selection) is set to MSP (multi-step speed reference). (See note.)	
	SS1	Multi-step speed reference 1		
	STF	Forward/stop command	Executes forward operation.	
	STR	Reverse/stop command	Executes reverse operation.	
	SC	External power supply common	Common terminal for when internal 24-V power supply is not used.	
Output	ALM (+)	Alarm output	Turns ON when an alarm occurs.	Open collector (30 V DC, 50 mA max.)
	ALM (–)			
	STA (+)	Multi-function output	Turns ON when the operating status selected in P12 (Multi-function output selection) is reached.	
	STA (–)			

Note If P11 (Frequency reference selection) is set to T.C (Temperature controller time-shared proportional pulses), multi-step speed reference 0 (SS0) will be the temperature controller time-proportional pulse input and multi-step speed reference 1 (SS1) will be ignored.

■ Control Circuit Terminals for Communications Models

Symbol		Name	Function	Specifications
Input	RS-485 (+)	RS-485 communications terminals	Refer to the separate *Communications Manual* for communications specifications, wiring, communications commands, and other related information.	
	RS-485 (–)			
	24 VDC	Internal 24-V power supply	The 24-VDC power supply input for Inverter control circuits. Do not use this power supply for any other purpose.	Photocoupler (24 V DC, 5 mA per input)
	STF	Forward/stop command	Executes forward operation.	
	STR	Reverse/stop command	Executes reverse operation.	
	SC	External power supply common	Common terminal for when internal 24-V power supply is not used.	
Output	ALM (+)	Alarm output	Turns ON when an alarm occurs.	Open collector (30 V DC, 50 mA max.)
	ALM (–)			
	STA (+)	Multi-function output	Turns ON when the operating status selected in P12 (Multi-function output selection) is reached.	
	STA (–)			

● Relation between Control Circuit Terminals and Frequency Reference

Multi-step speed reference 0 (SS0) and multi-step speed reference 1 (SS1) can be used together to select one of the following frequency references.

Note Multi-step speed references are supported only for Standard Models.

Multi-step speed reference	SS0	SS1
Frequency reference 1 (SP1)	OFF	OFF
Frequency reference 2 (SP2)	ON	OFF
Frequency reference 3 (SP3)	OFF	ON
Frequency reference 4 (SP4)	ON	ON

● Relation between Control Circuit Terminals and Forward/Reverse Commands

The operation commands from control input are as follows:

Operation Command	STF	STR
Stop	OFF	OFF
Forward	ON	OFF
Reverse	OFF	ON
Stop	ON	ON

2-2-3 Main Circuit Terminal Wiring

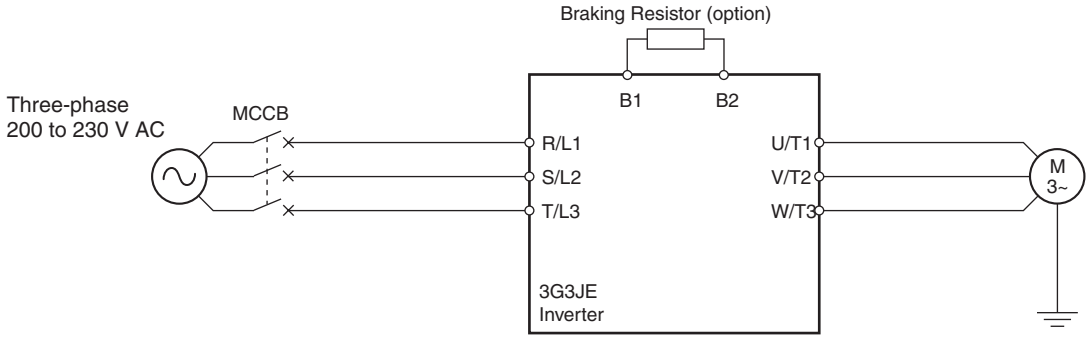
■ Main Circuit Terminal Connections

- Use insulated wiring with a rated voltage of 600 V and a temperature rating of 80°C min. for main circuit terminals.
- For terminal connections, use crimp terminals with insulating sleeves.
- When not connecting a Braking Resistor or a Braking Resistor Unit, screw crimp terminals with insulating sleeves to the Inverter's braking resistance connection terminals.
- Up to two power lines can be connected per terminal.
- If there is a possibility of voltage drops, increase the wire size according to the cable length.

● Wire Sizes, Terminal Screws, Screw Tightening Torque, and Molded-case Circuit Breaker (MCCB) Capacities

Model	Terminal symbol	Terminal screw	Screw tightening torque (N·m)	Wire size (mm^2)	Recommended wire size (mm^2)	MCCB capacity (A)
3G3JE-A2001	R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3	M3.5	0.8 to 1.0	0.75 to 2	2	3 to 5
3G3JE-A2002	R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3	M3.5	0.8 to 1.0	0.75 to 2	2	3 to 5
3G3JE-A2004	R/L1, S/L2, T/L3, B1, B2, U/T1, V/T2, W/T3	M3.5	0.8 to 1.0	0.75 to 2	2	5

■ Main Circuit Connection Diagram

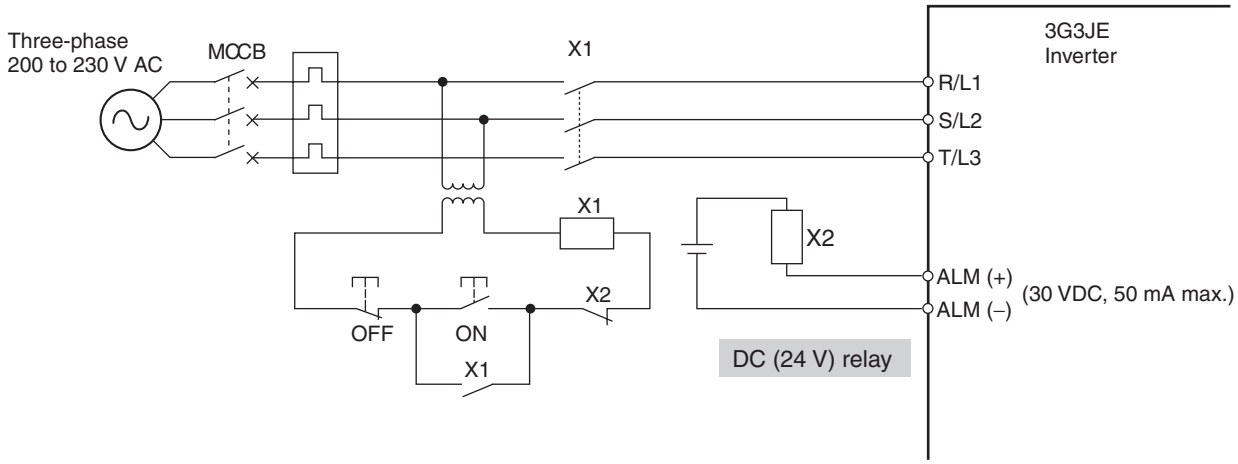


■ Wiring the Input Side of the Main Circuit

● Installing Molded-case Circuit Breakers

- Always install molded-case circuit breakers (MCCBs) in the power supply wiring to protect against short-circuit accidents.
- Always connect the power input terminals (R/L1, S/L2, and T/L3) and power supply via an MCCB suitable to the Inverter.
- Install one MCCB per Inverter.
- Choose an MCCB with the capacity indicated in the previous tables (*Wire Size, Terminal Screw, Tightening Torque, and Molded-case Circuit Breaker Capacities*).

- For the MCCB's time characteristics, be sure to consider the Inverter's overcurrent protection (one minute at 150% of the rated output current).
- A sequence that turns OFF the power supply using the alarm (ALM) output of the 3G3JE can be made as shown in the following diagram.



● Installing a Ground Fault Interrupter

- Inverter outputs use high-speed switching, so high-frequency leakage current is generated. (In general, a leakage current of approximately 100 mA will occur for each Inverter when the power cable is 1 m and approximately 5 mA for each additional meter of power cable.)
- Use a separate breaker for the power supply input section of the Inverter that removes high-frequency leakage currents and detects only leakage currents with frequencies hazardous to human beings. Use a breaker with a sensitivity amperage of at least 10 mA per Inverter.
- When using a general leakage breaker, choose a ground fault interrupter with a sensitivity amperage of 200 mA or more per Inverter and with an operating time of 0.1 s or more.

● Installing a Magnetic Contactor

- If the power supply of the main circuit is to be turned OFF because of the sequence, a magnetic contactor (MC) can be used. (When a magnetic contactor is installed on the primary side of the main circuit to forcibly stop a load, however, the regenerative braking will not work and the load will coast to a stop.)
- A load can be started and stopped by switching the magnetic contactor. Frequently switching the magnetic contactor, however, may cause the Inverter to break down. To maintain the service life of the Inverter's internal electrolytic capacitors, it is recommended that the MC be switched to start/stop operation no more than once every 30 minutes.
- When the Inverter is operated with the Digital Operator, automatic operation cannot be performed after recovery from a power interruption.

● Connecting Input Power Supply to the Terminal Block

Input power supply can be connected to any terminal on the terminal block because the phase sequence of input power supply is irrelevant to the phase sequence (R/L1, S/L2, and T/L3).

● Installing an AC Reactor

If the Inverter is connected to a large-capacity power transformer (660 kVA 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

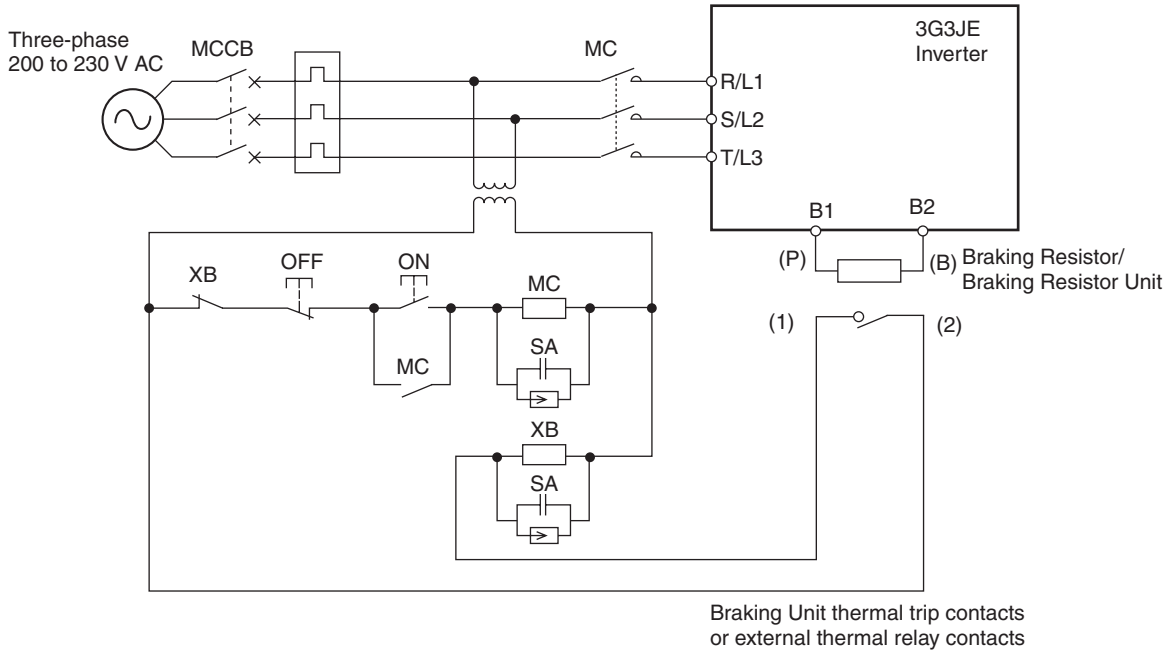
Always use a surge absorber or diode for the inductive loads near the Inverter. These inductive loads include magnetic contactors, electromagnetic relays, solenoid valves, solenoid, and magnetic brakes.

● Connecting a Braking Resistor or a Braking Resistor Unit

When driving a vertical axis or a load with a large inertia, regenerative energy is returned to the Inverter.

If main circuit overvoltage (E05) is generated during deceleration, the regenerative energy will exceed the Inverter's capacity. If this occurs, use a Braking Resistor or a Braking Resistor Unit.

- Connect the Braking Resistor as shown in the following diagram.
  - When using a Braking Resistor, be sure to install a thermal relay to monitor the resistor temperature.
  - Include a sequence to turn OFF the power supply to the Inverter if the Braking Resistor or Braking Resistor Unit overheats. Not doing so may result in fire.
    - Braking Resistor: Use thermal relay output for temperature monitoring.
    - Braking Resistor Unit: Use the Unit's fault contact output.



Braking Resistors and Braking Resistor Units for 200 V-class Inverters

Inverter	Braking Resistor (Usage rate: 3% ED)	Braking Resistor Unit (Usage rate: 10% ED)	Minimum connection resistance
3G3JE-A2002	3G3IV-PERF150WJ201 (200 Ω, 150 W)	3G3IV-PLKEB20P7 (200 Ω, 70 W)	200 Ω
3G3JE-A2004			

- Do not connect a resistance below the minimum. Doing so will damage the Inverter.
- The usage rate is expressed as the percentage of braking time in one cycle. For example, if the cycle time is 10 s and a Braking Resistor Unit with a usage rate of 10% ED is used, braking will be possible for up to 1 s.

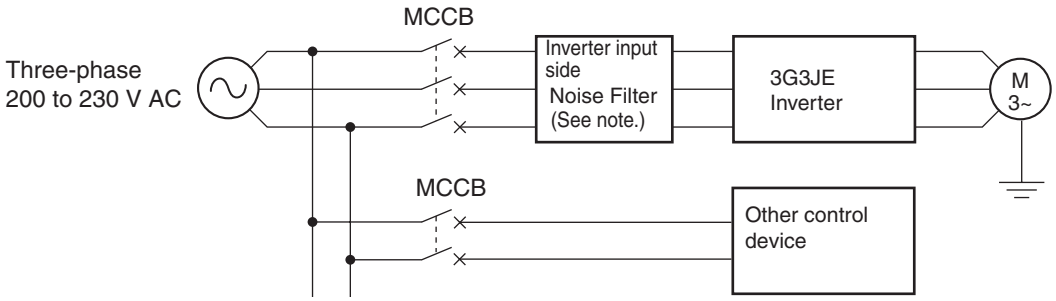
● Installing a Noise Filter on the Power Supply Side

- The Inverter's outputs utilize high-speed switching, so noise may be transmitted from the Inverter to the power line and adversely affect other devices in the vicinity.
- It is recommended that a Noise Filter be installed at the power supply to minimize the noise transmission. (Noise from the power line to the Inverter will also be reduced.)

Recommended Inverter Input-side Noise Filters

General purpose	For EMC compliance
3G3EV-PLNFD2103DY	3G3JV-PRS2010J

Note Noise filters not designed for Inverters are less effective and may not reduce noise.



■ Wiring the Output Side of the Main Circuit Terminals

● Connecting the Terminal Block to the Load

- Connect output terminals U/T1, V/T2, and W/T3 to motor lead wires U, V, and W.
- Check that the motor rotates forward with the forward command. Switch over any two of the output terminals (U/T1, V/T2, and W/T3) with each other and reconnect if the motor rotates in reverse with the forward command.

● Never Connect a Power Supply to Output Terminals

If voltage is applied to the output terminals, the internal circuit of the Inverter will be damaged. Never connect a power supply to output terminals U/T1, V/T2, or W/T3.

● Never Short or Ground Output Terminals

- Do not touch the output terminals with bare hands.
- If the output wires come into contact with the Inverter casing, an electrical shock or grounding will occur. This is extremely hazardous. Be careful not to short the output wires.

● Do Not Use a Phase Advancing Capacitor or Noise Filter

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

● Do Not Use an Electromagnetic Switch of Magnetic Contactor

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

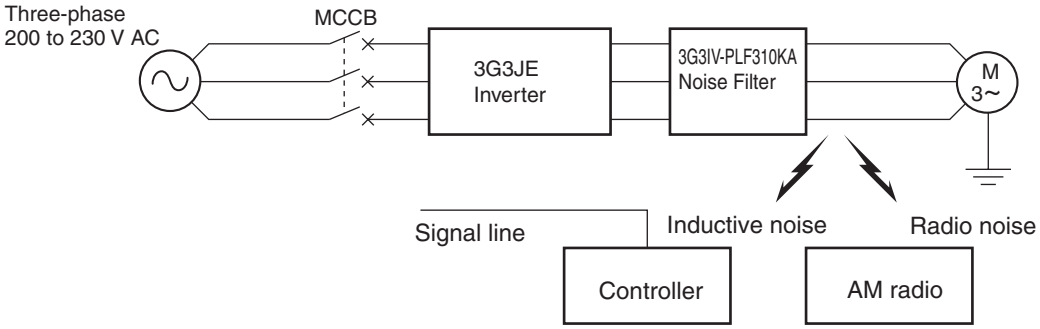
● Installing a Thermal Relay

The Inverter uses an electronic thermal to protect the motor from overheating. Take the following countermeasures if more than one motor is operated with one Inverter or a multi-polar motor is used.

- Install a thermal relay between the Inverter and each motor and set P01 (Rated motor current) to 0.0. (Motor overload detection (E03) will be disabled.)
- Make a sequence so that the magnetic contactor on the input side of the main circuit is turned OFF by the contacts 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.



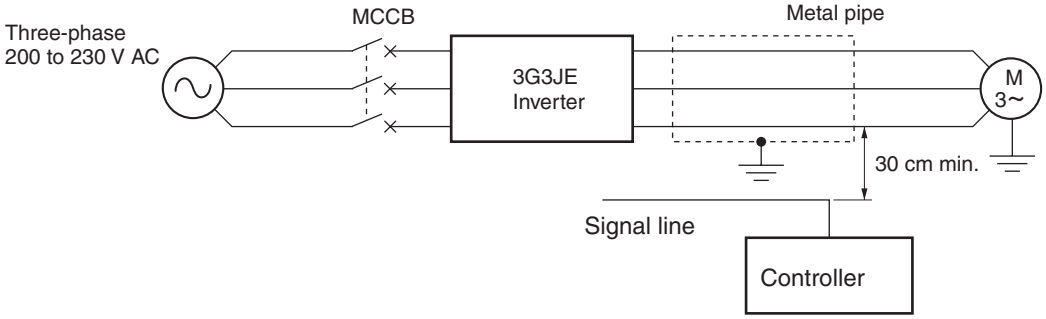
Inductive Noise: Electromagnetic induction generates noise on the signal line, causing the controller to malfunction.

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

● Countermeasures against Induction Noise

Use the following method to prevent induction noise from being generated on the output side.

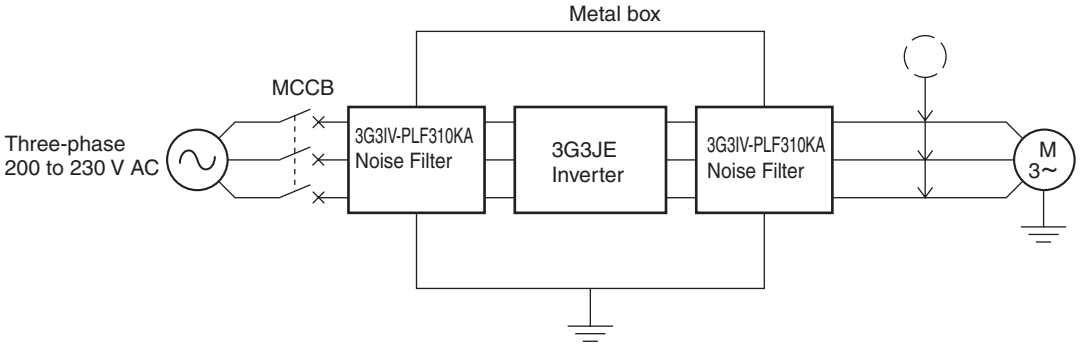
- Route cables through a grounded metal pipe. Keeping the metal pipe at least 30 cm away from the signal lines considerably reduces induction noise.



● Countermeasures against Radio Noise

Radio noise is generated from the Inverter as well as the input and output lines. Take the following countermeasures to reduce radio noise.

- Keep the cable between the Inverter and the motor as short as possible.
- Install noise filters on both input and output sides, and also install the Inverter in a totally enclosed steel box.



● Cable Length between Inverter and Motor

We recommend always keeping the wiring distance between the Inverter and motor to 50 m or less. As the cable length between the Inverter and the motor increases, the floating capacity between the Inverter outputs and the ground increases proportionally. The increase in floating capacity at the Inverter output causes the high-frequency leakage current to increase, and this may adversely affect peripheral devices and the current detector in the Inverter's output section.

If the cable must be longer than 50 meters, take the following countermeasures.

- Wire in metallic ducts.
- Use a separate cable for each phase.
- Reduce the carrier frequency selection (P14) (select 4 kHz).

● Single-phase Motors Cannot Be Used

The Inverter is not suited for the variable speed control of single-phase motors because they use either capacitor starting or split-phase starting methods to determine the rotation direction at startup. Do not use a single-phase motor.

Note If a capacitor start motor is used, the capacitor may be damaged by a sudden electric discharge caused by Inverter output. If a split-phase start motor is used, the starting coil may burn because the centrifugal switch does not operate.

2-2-4 Wiring Control Circuit Terminals

■ Control Circuit Terminal Connections

- Use insulated wiring with a temperature rating of 80°C min. for control circuit terminals.
- A control signal line must be 50 m maximum and separated from power lines.
- Shielded, twisted-pair cable must be used for RS-485 signal lines, and the lines must be no more than 500 m long.
- Do not solder the wires to the control circuit terminals. The wires may not contact well with the control circuit terminals if the wires are soldered.
- When solderless terminals are not used, the end of each wire for the control lines must be stripped for approximately 6 mm.
- Cover the shield with tape so that the shield will not come into contact with other signal wires or machines.
- To simplify wiring and improve reliability, it is recommended that solderless terminals be attached to control circuit lines.

● Applicable Wire Sizes, Terminal Screws, and Screw Tightening Torque

A maximum of two wires can be connected to each terminal.

1. When connecting one wire to each terminal, use the following wire size.

Terminal screw size	Tightening torque (N·m)	Wire	Wire size (mm^2)	Recommended wire size (mm^2)	Cable
M3	0.5 to 0.6	Solid wire	0.2 to 1.5 (AWG24 to AWG16)	0.75 (AWG18)	Polyethylene-insulated vinyl-sheath cable
		Stranded wire	0.2 to 1.5 (AWG24 to AWG16)		Shielded twisted-pair cable
			0.2 to 1.5 (AWG24 to AWG16)		

2. When connecting two wires to each terminal, use the following wire size.

Terminal screw size	Tightening torque (N·m)	Wire	Wire size (mm^2)	Recommended wire size (mm^2)	Cable
M3	0.5 to 0.6	Solid wire	0.2 to 0.75 (AWG24 to AWG18)	0.5 (AWG20)	Polyethylene-insulated vinyl-sheath cable
		Stranded wire	0.2 to 0.75 (AWG24 to AWG18)		Shielded twisted-pair cable
			0.2 to 0.75 (AWG24 to AWG18)		

● Solderless Terminal Size

To simplify wiring and improve reliability, it is recommended that solderless terminals be attached to control circuit lines. Use solderless terminals that match the size of the wire being used.
A maximum of two solderless terminals can be connected to each terminal.

1. When connecting one solderless terminal to each terminal, use the following size.

Terminal screw size	Tightening torque (N·m)	Wire	Solderless terminal size (mm^2)	Insulating sleeve	Recommended solderless terminal model (Mfd. by Phoenix Contact)
M3	0.5 to 0.6	Stranded wire	0.25 to 1.5	With/without	AI 0,25-6 BU AI 0,34-8 TQ AI 0,5-8 WH AI 0,75-8 GY AI 1-8 RD AI 1,5-8 BK

2. When connecting two solderless terminals to each terminal, use the following size.

Terminal screw size	Tightening torque (N·m)	Wire	Solderless terminal size (mm^2)	Insulating sleeve	Recommended solderless terminal model (Mfd. by Phoenix Contact)
M3	0.5 to 0.6	Stranded wire	0.25 to 0.5	Without	A 0,5-6

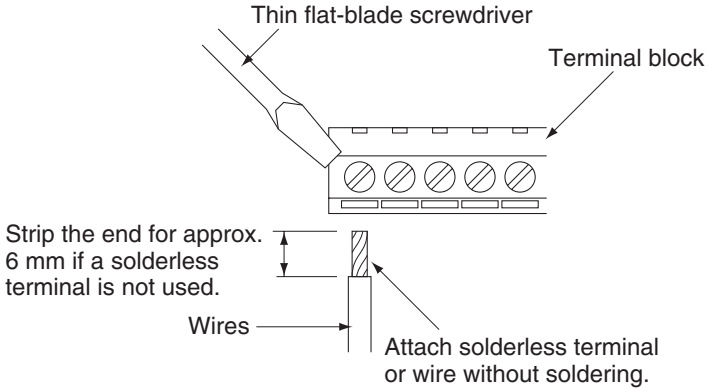
3. When connecting one 2-wire (twin) solderless terminal to each terminal, use the following size.

Terminal screw size	Tightening torque (N·m)	Wire	Solderless terminal size (mm^2)	Insulating sleeve	Recommended solderless terminal model (Mfd. by Phoenix Contact)
M3	0.5 to 0.6	Stranded wire	0.5 to 1	With	AI-TWIN 2x0,5-8 WH AI-TWIN 2x0,75-8 GY AI-TWIN 2x1-8 RD

● Wiring Method

Wire the control I/O terminals using the following procedure.

1. Loosen the terminal screws with a thin flat-blade screwdriver.
2. Insert the wires from underneath the terminal block.
3. Tighten the terminal screws to the torque specified in the previous table.

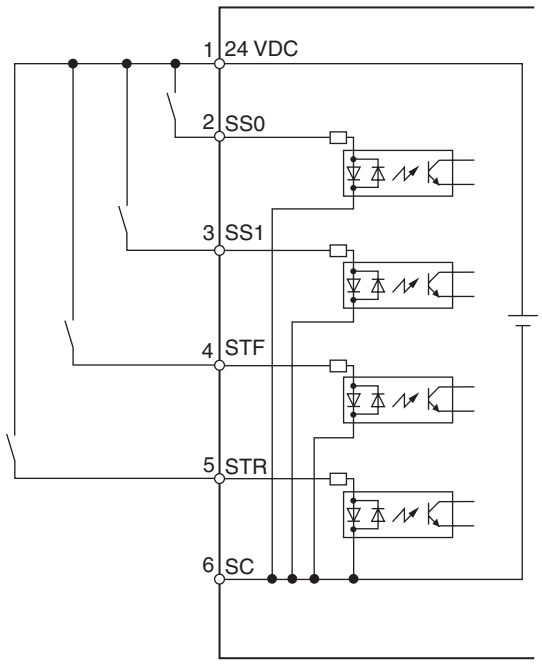


Note Applying a torque that is greater than the specified torque may damage the terminal block. If the tightening torque is insufficient, however, it may cause malfunction or short circuiting.

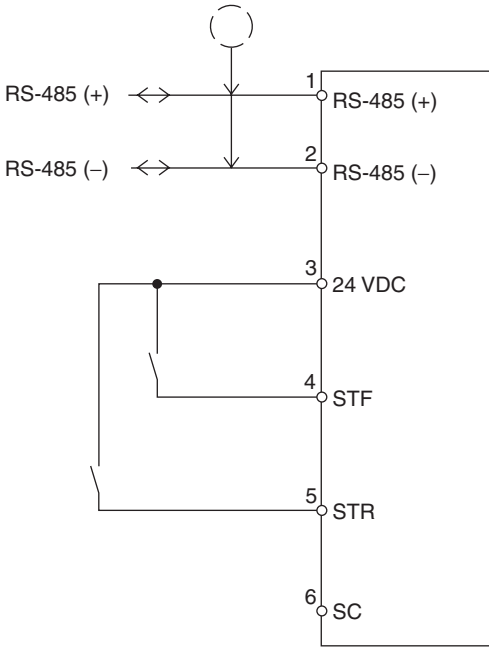
■ Control Circuit Input Terminal Connection Examples Using Internal 24-V Power Supply for Models with PNP Input

● Connecting to Relay Circuits

Standard Models

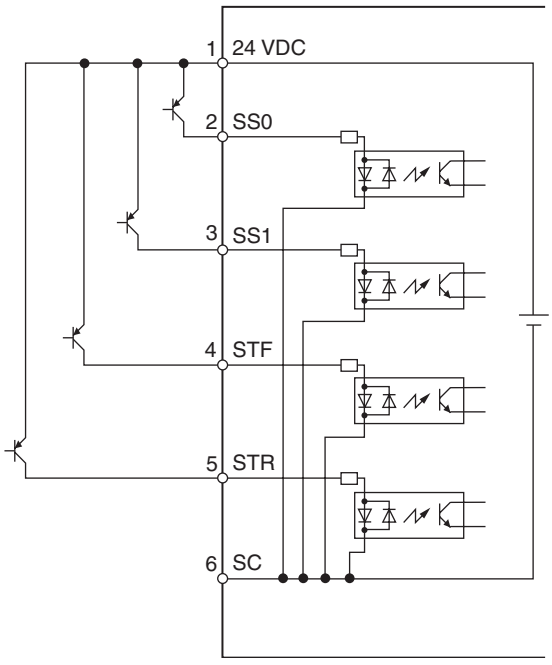


Communications Models

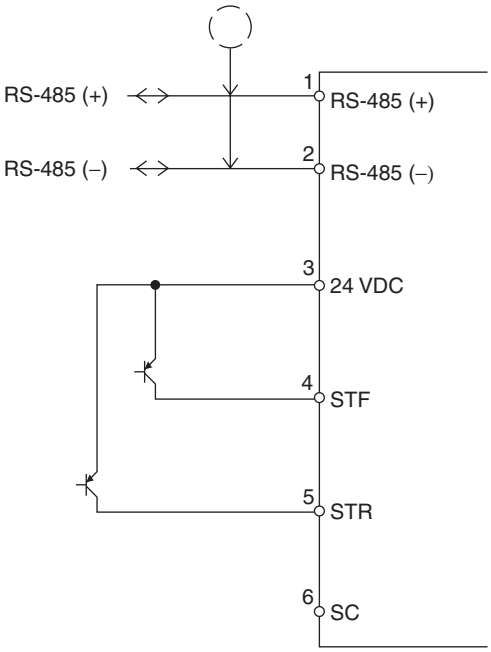


● Connecting to PNP Transistors

Standard Models



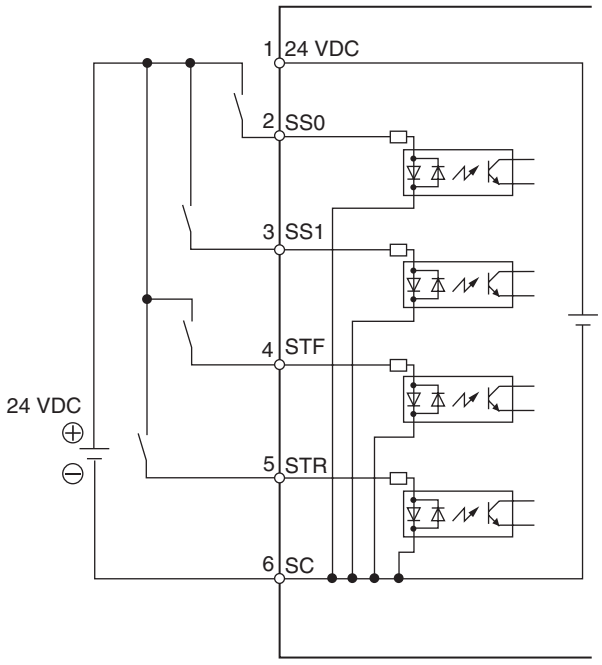
Communications Models



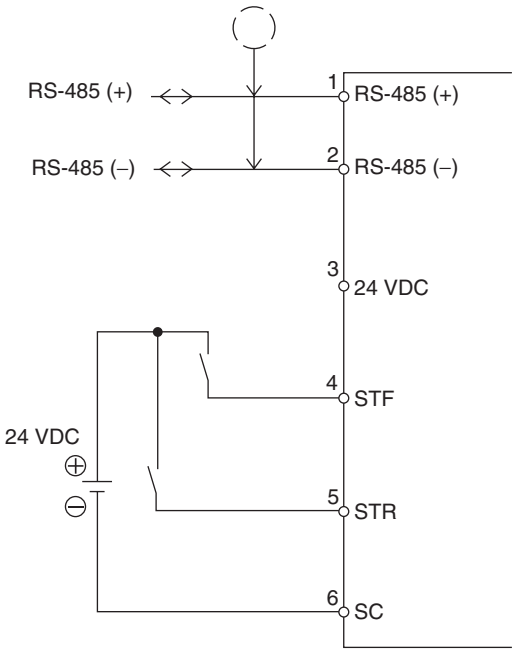
■ Control Circuit Input Terminal Connection Examples Using External 24-V Power Supply for Models with PNP Input

● Connecting to Relay Circuits

Standard Models

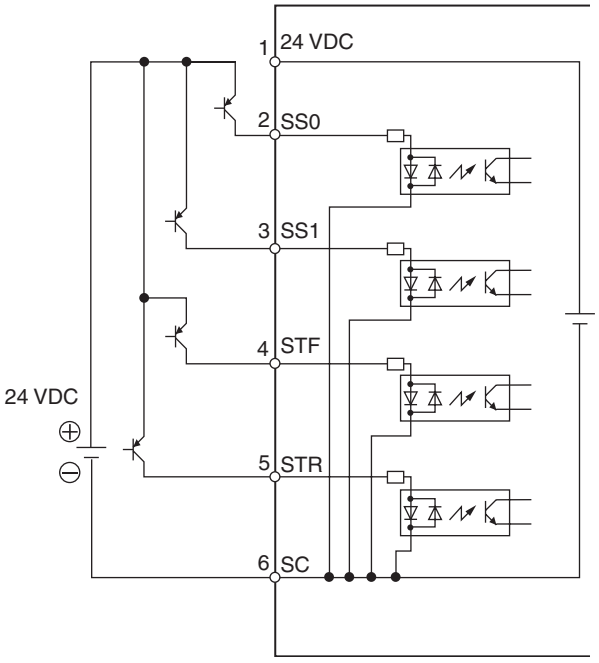


Communications Models

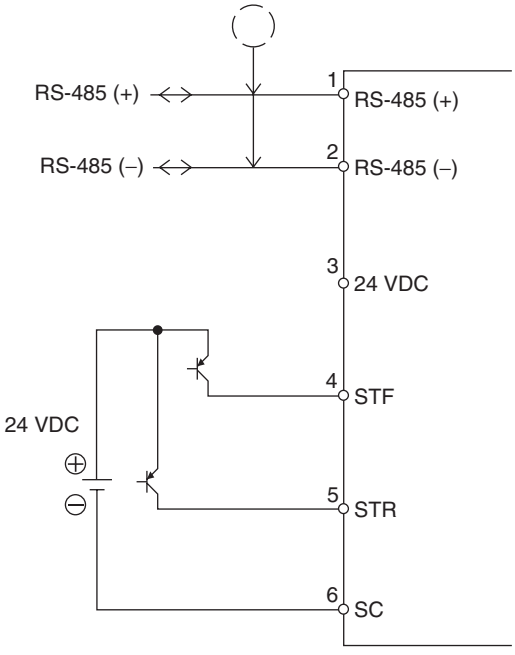


● Connecting to PNP Transistors

Standard Models

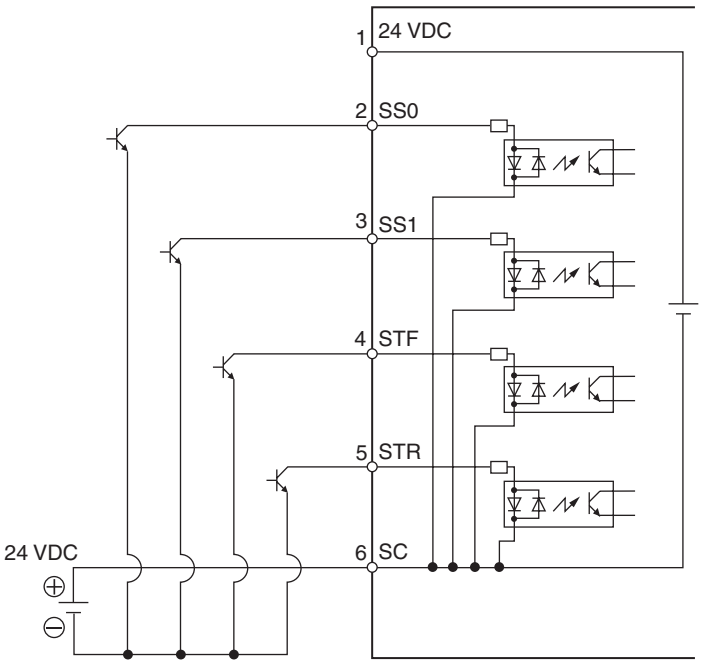


Communications Models

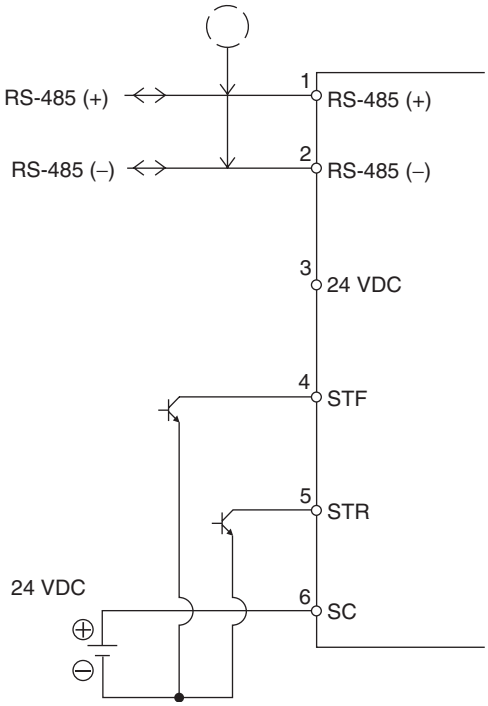


● Connecting to NPN Transistors

Standard Models



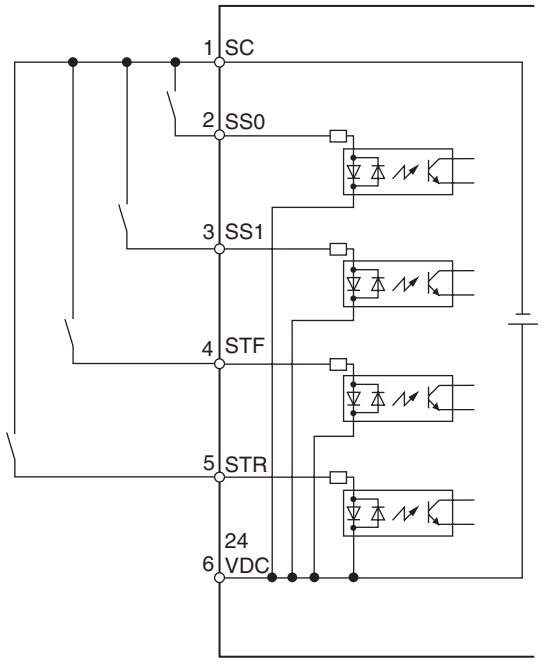
Communications Models



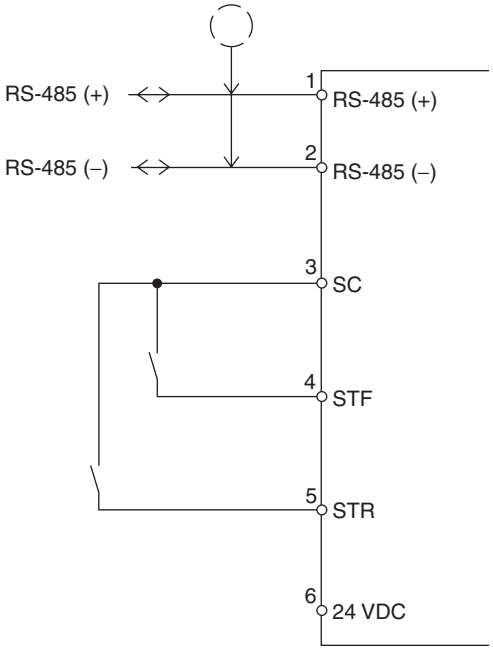
■ Control Circuit Input Terminal Connection Examples Using Internal 24-V Power Supply for Models with NPN Input

● Connecting to Relay Circuits

Standard Models

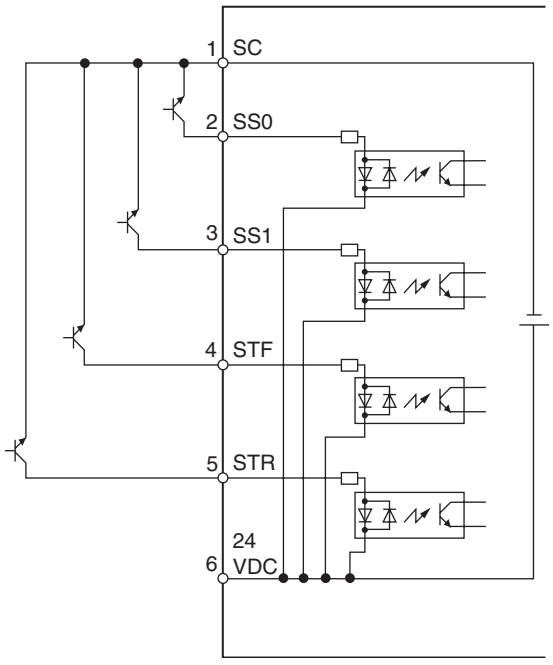


Communications Models

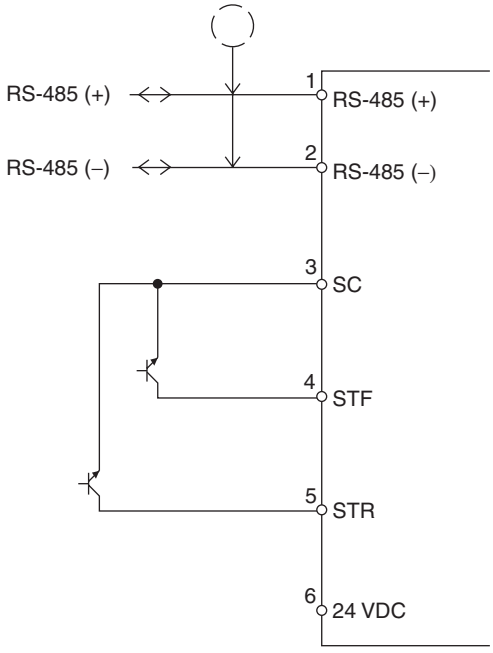


● Connecting to NPN Transistors

Standard Models



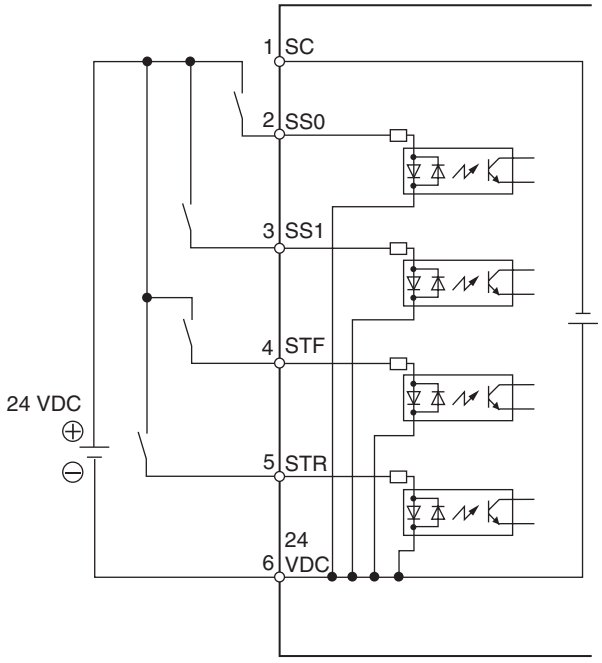
Communications Models



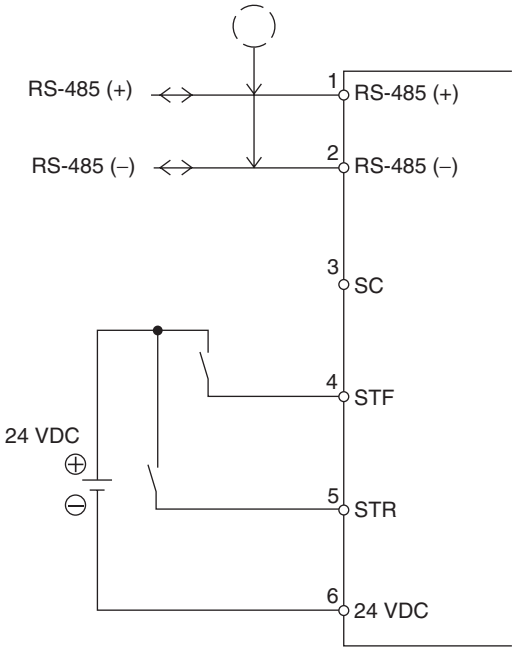
■ Control Circuit Input Terminal Connection Examples Using External 24-V Power Supply for Models with NPN Input

● Connecting to Relay Circuits

Standard Models

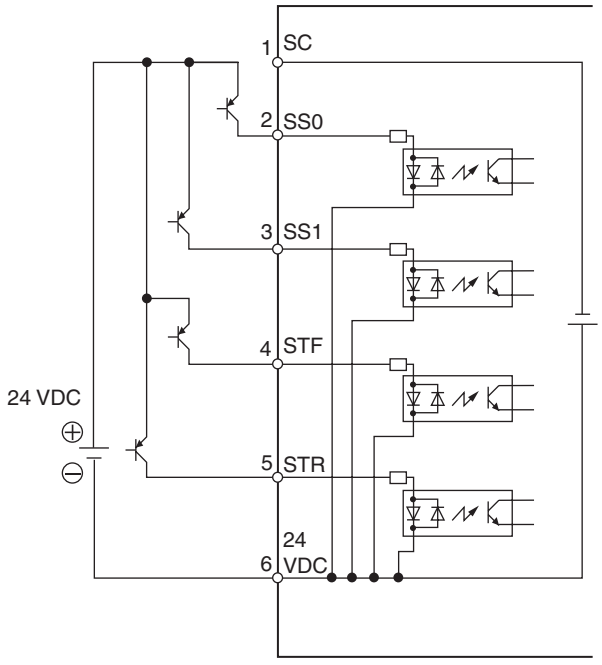


Communications Models

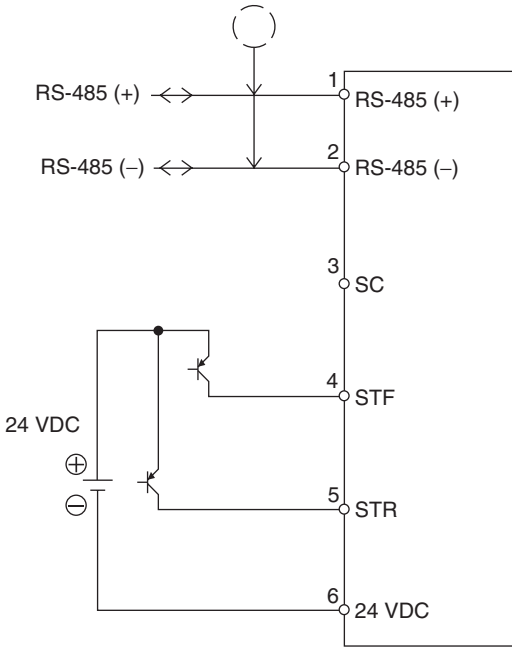


● Connecting to PNP Transistors

Standard Models

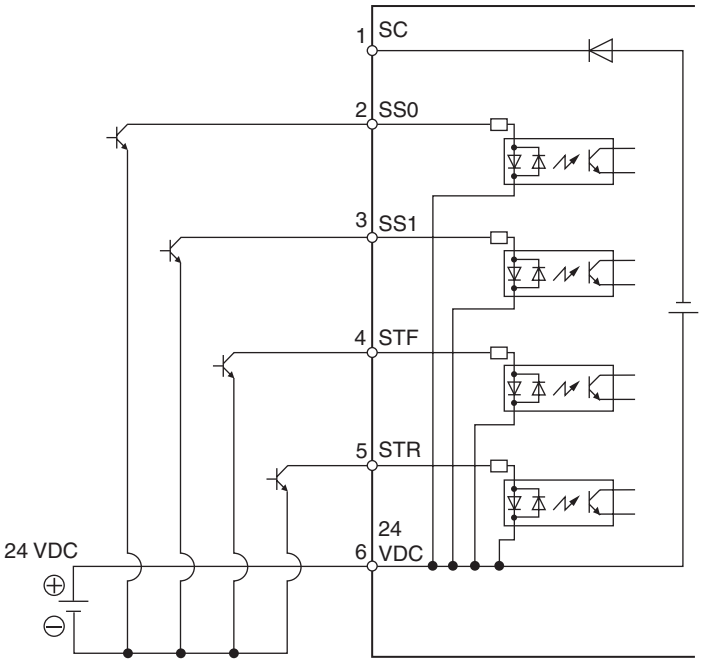


Communications Models

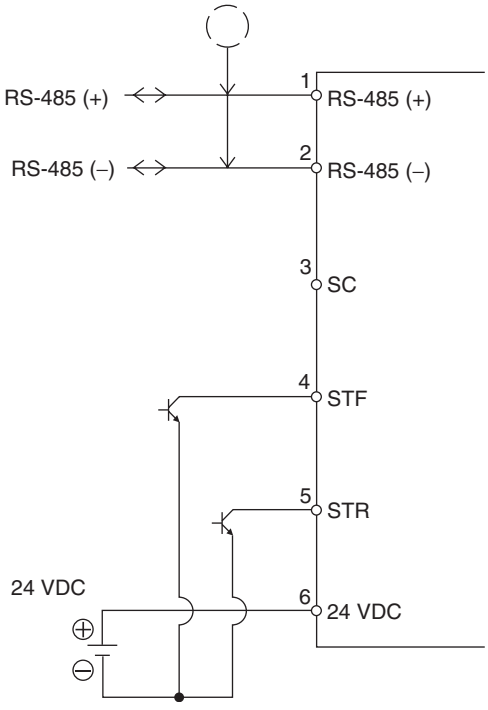


● Connecting to NPN Transistors

Standard Models

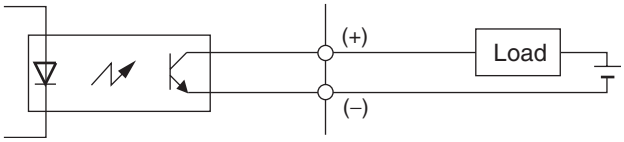


Communications Models

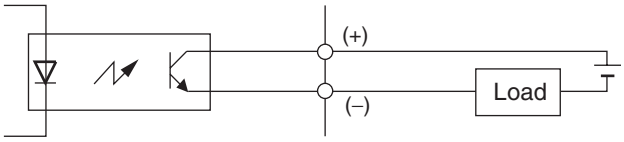


■ Control Circuit Output Terminal Connection Examples

● Connecting Sinking Outputs



● Connecting Sourcing Outputs



2-2-5 Connecting to a Digital Controller or Temperature Controller

The 3G3JE provides an interface for connecting to the time-shared proportional pulse output of a digital controller or temperature controller, so frequency references can be used when these devices are used.
This section describes how to connect the Inverter to a digital controller.

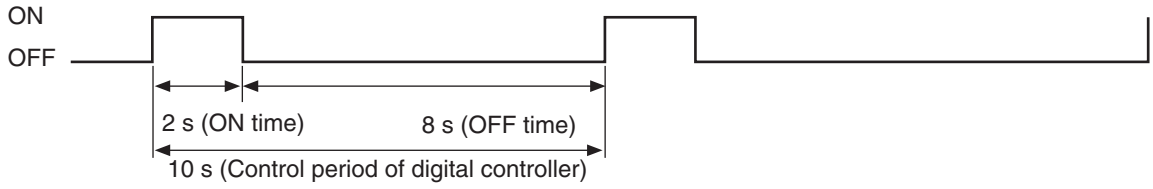
Note The frequency references for time-shared proportional pulse output and frequency reference selections cannot be used at the same time. If P11 (Frequency reference selection) is set to T.C (Temperature controller time-shared proportional pulses), multi-step speed reference 0 (SS0) will be the temperature controller time-proportional pulse input and multi-step speed reference 1 (SS1) will be ignored.

■ Overview of Operation

The frequency setting is determined based on the ratio of ON time to OFF time within the frequency reference upper and lower limit range.

- If the ON time is 0% and the OFF time is 100%, the frequency setting will be the frequency reference lower limit.
- If the ON time is 100% and the OFF time is 0%, the frequency setting will be the frequency reference upper limit.

For example, if time-shared proportional pulses are input when the frequency reference lower limit is 20 Hz, the upper limit is 60 Hz, the control period is 10 s, the ON time is 2 s, and the OFF time is 8 s, then the frequency setting will be 28 Hz.



Frequency setting = Frequency reference lower limit + (Frequency reference upper limit − Frequency reference lower limit) × (ON time/Control period)
= 20 Hz + (60 Hz − 20 Hz) × (2 s/10 s)
= 20 Hz + 40 Hz × 0.2
= 28 Hz

● Time Required to Switch Frequency Reference

The frequency of the time-proportional pulse input is calculated based on the ratio between the ON time and OFF time. At least one time-shared proportional pulse control cycle of the digital controller or temperature controller is required to switch the 3G3JE's frequency reference.

■ Digital Controller and Temperature Controller Output Specifications

The digital controller or temperature controller that is connected must have the following output specifications.

- Relay output models
- Voltage output models (12 V ±10% output or 24 V ±10% output)

Note When connecting to a digital controller or temperature controller with a voltage output, use a 3G3JE model with a PNP input. If a model with an NPN input is used, the power supply may be short-circuited depending on the insulation method between the controller's voltage output section and the power supply for other control input circuits.

■ Digital Controller and Temperature Controller Settings

- Set the control period as shown below for digital controllers and temperature controllers.
- If the control period is set shorter than the lower limit or longer than the upper limit, correct operation will not be possible.

Control period lower limit	3 s
Control period upper limit	10 s

■ 3G3JE Settings

- Set the frequency reference upper limit (P07) and frequency reference lower limit (P08).
- Operation will be at the frequency reference lower limit with the time-shared proportional pulse at 0%.
- Operation will be at the frequency reference upper limit with the time-shared proportional pulse at 100%.

Note If the frequency reference upper limit is greater than the maximum frequency, change the setting of the maximum output frequency (P06).

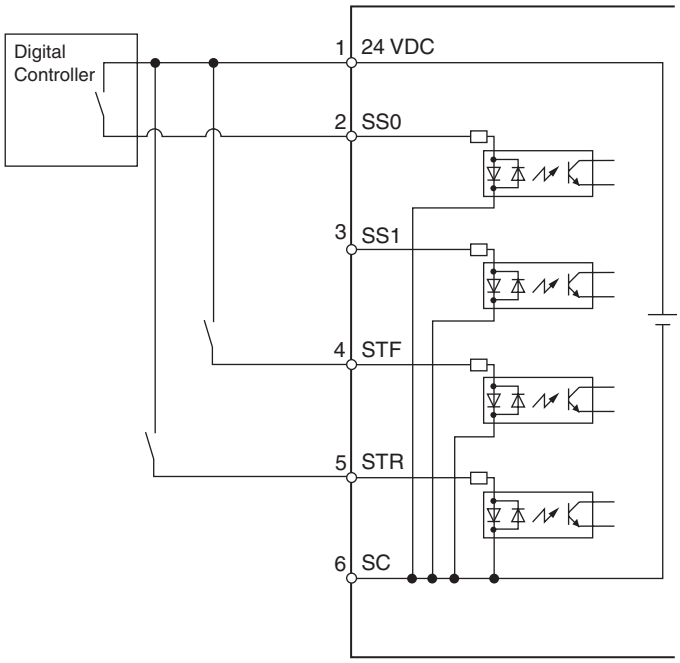
- Set the frequency reference selection (P11) is set to time-shared proportional pulses (T.C).

■ Connecting to a Digital Controller or a Temperature Controller with a Relay Output for Models with PNP Input

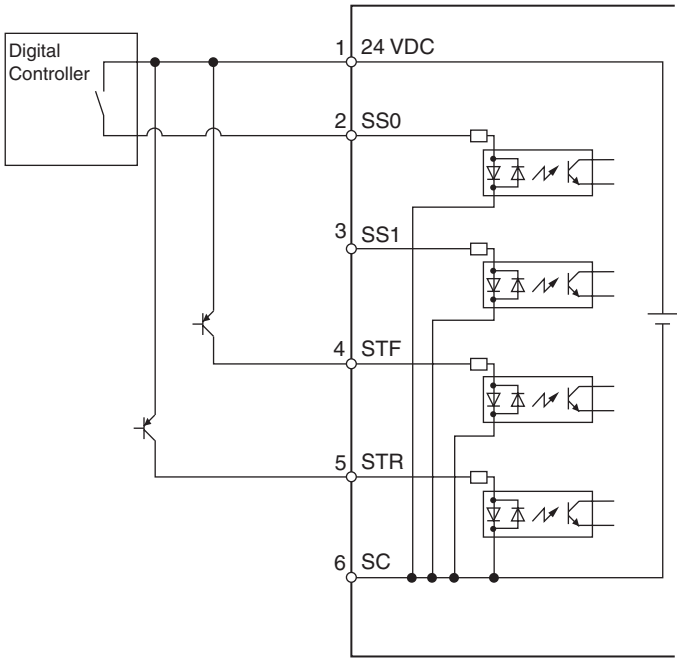
Connect the controller to multi-step speed reference 0 (SS0) terminal. The multi-step speed reference 1 (SS1) terminal input will be disabled.

● Control Circuit Input Terminal Connection Examples Using Internal 24-V Power Supply

Example 1

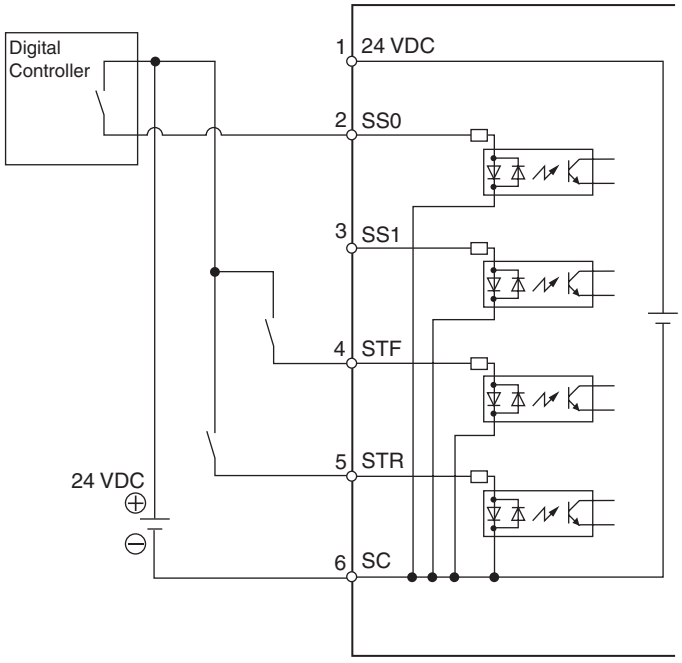


Example 2

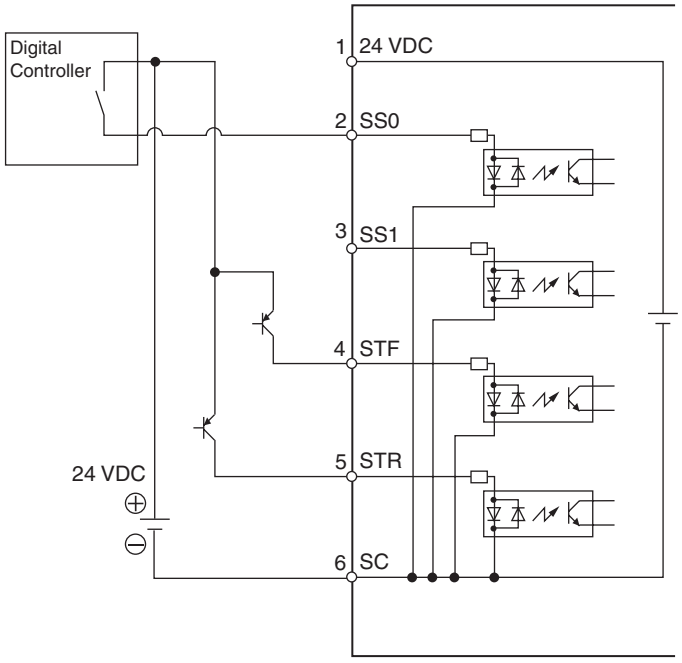


● Control Circuit Input Terminal Connection Examples Using External 24-V Power Supply

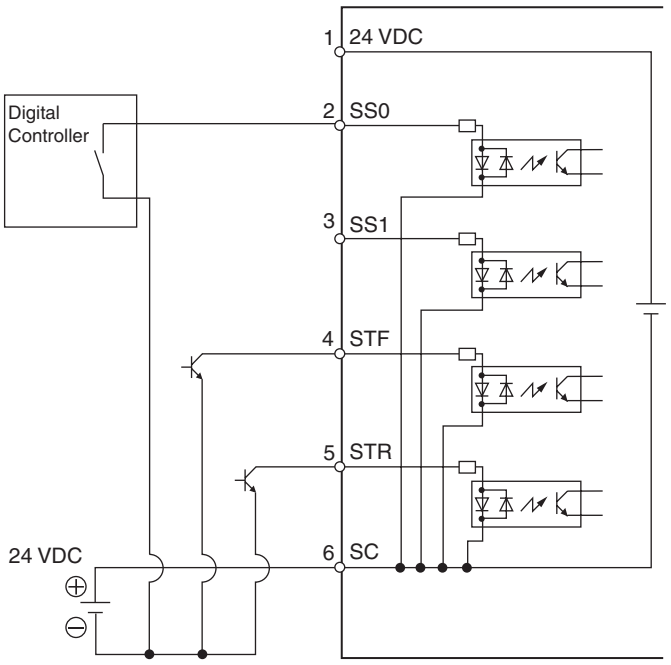
Example 1



Example 2



Example 3

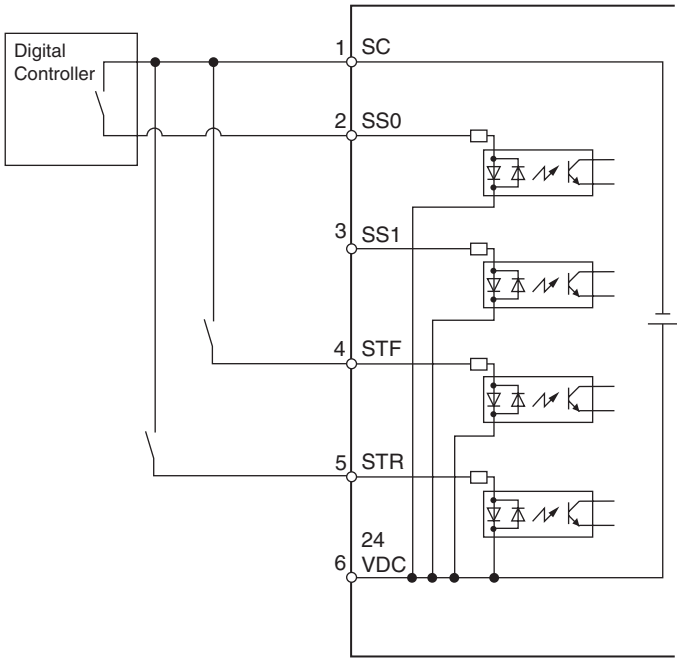


■ Connecting to a Digital Controller or a Temperature Controller with a Relay Output for Models with NPN Input

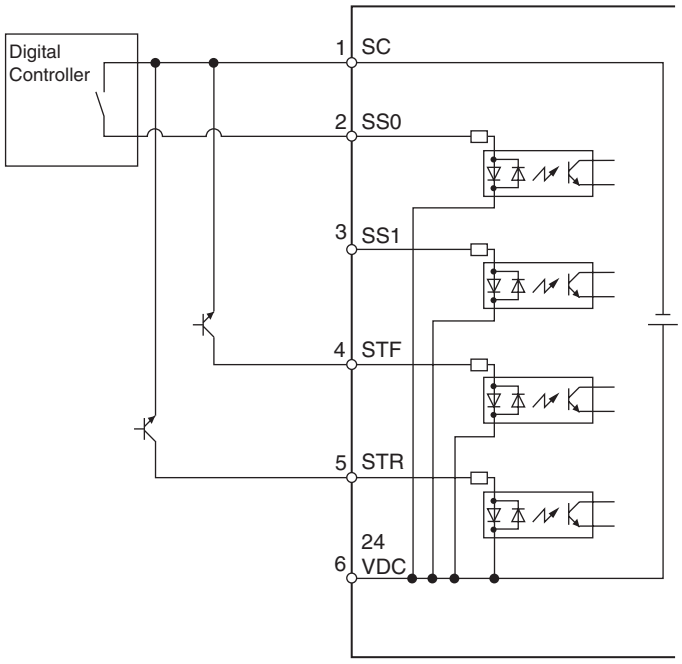
Connect the controller to multi-step speed reference 0 (SS0) terminal. The multi-step speed reference 1 (SS1) terminal input will be disabled.

● Control Circuit Input Terminal Connection Examples Using Internal 24-V Power Supply

Example 1

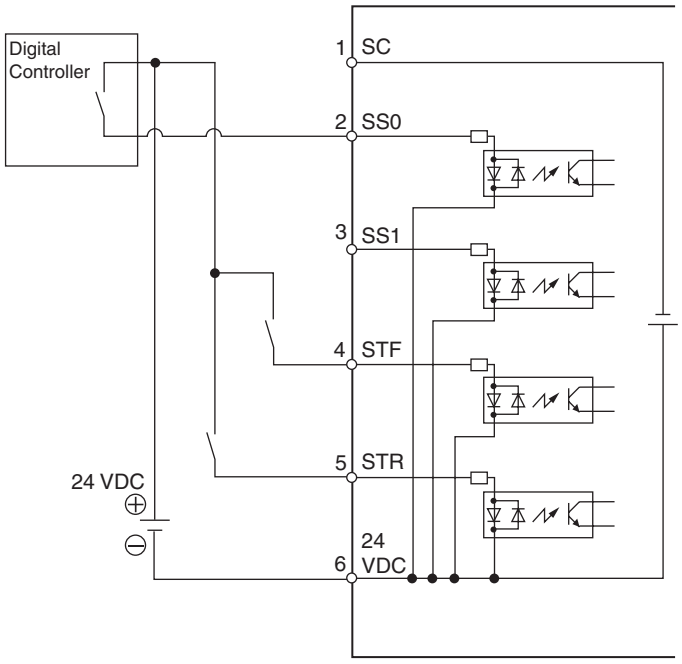


Example 2

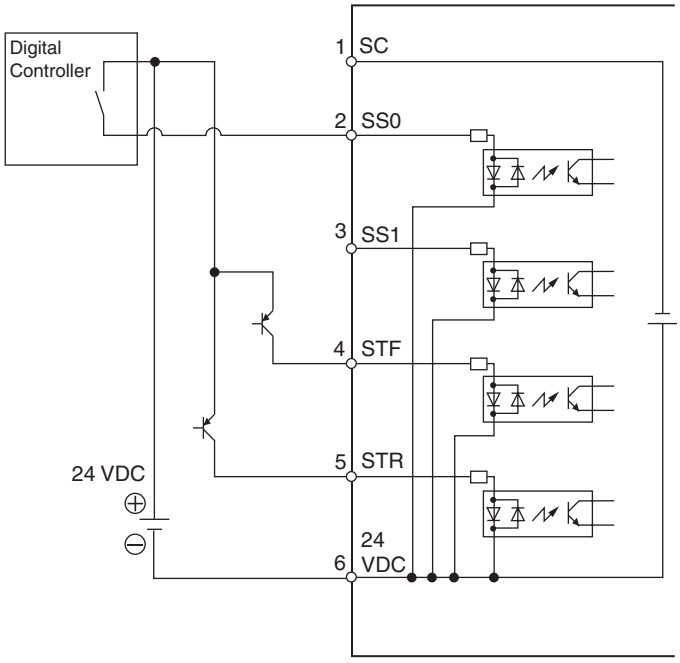


● Control Circuit Input Terminal Connection Examples Using External 24-V Power Supply

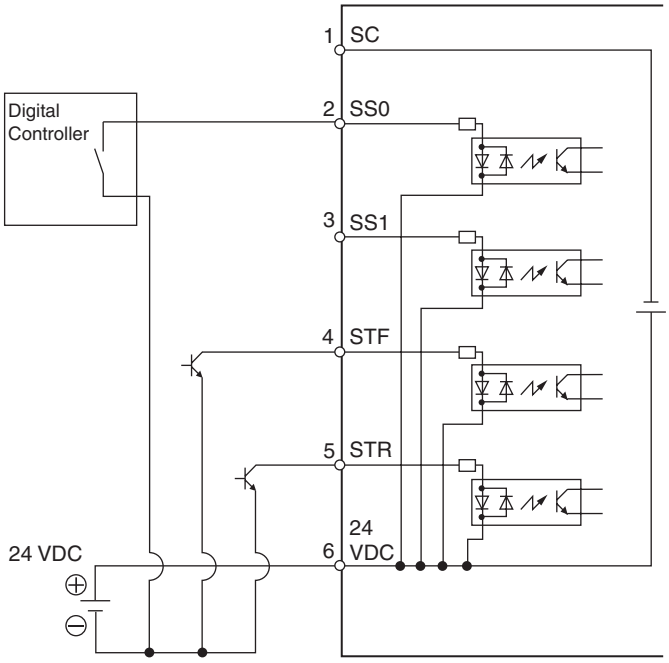
Example 1



Example 2



Example 3



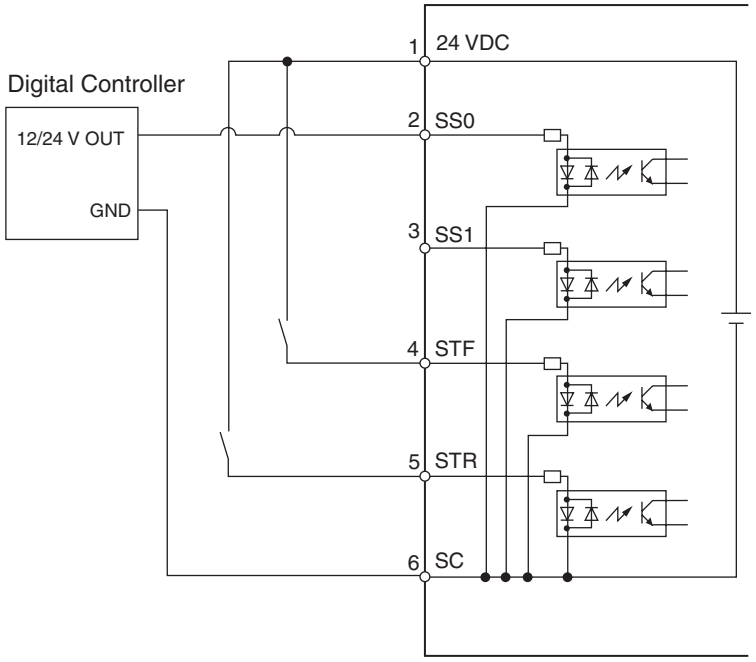
■ Connecting to a Digital Controller or a Temperature Controller with a Voltage Output for Models with PNP Input

Note When connecting to a digital controller or temperature controller with a voltage output, use a 3G3JE model with a PNP input. If a model with an NPN input is used, the power supply may be short-circuited depending on the insulation method between the controller's voltage output section and the power supply for other control input circuits.

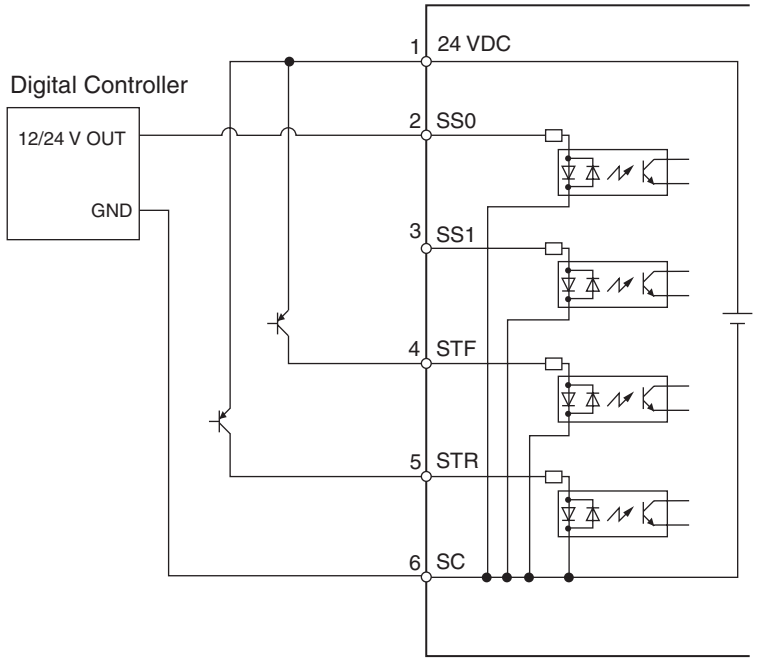
- Connect the controller between the multi-step speed reference 0 (SS0) terminal and the external power supply common terminal (SC).
- Connect the controller's positive (+) terminal to SS0, and the negative (–) terminal to SC. The multi-step speed reference 1 (SS1) terminal input will be disabled.

● Control Circuit Input Terminal Connection Examples Using Internal 24-V Power Supply

Example 1

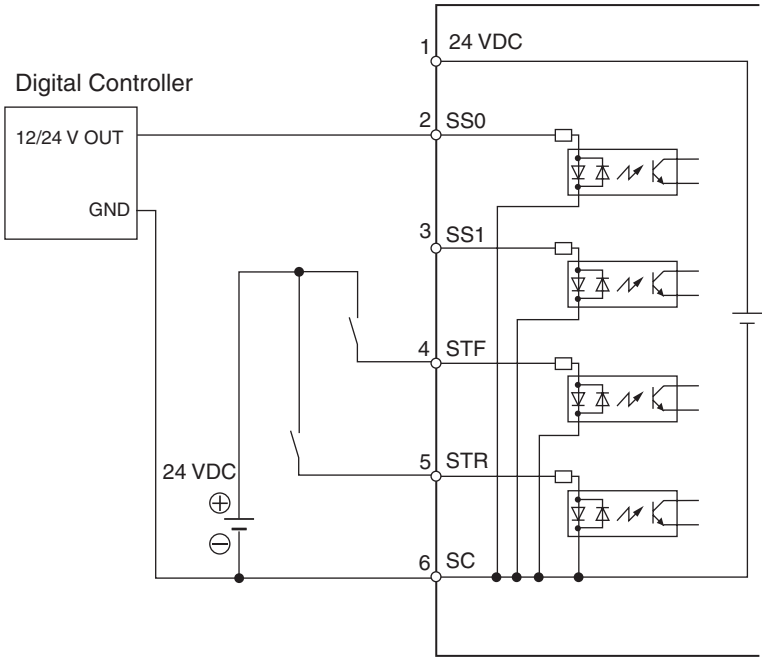


Example 2

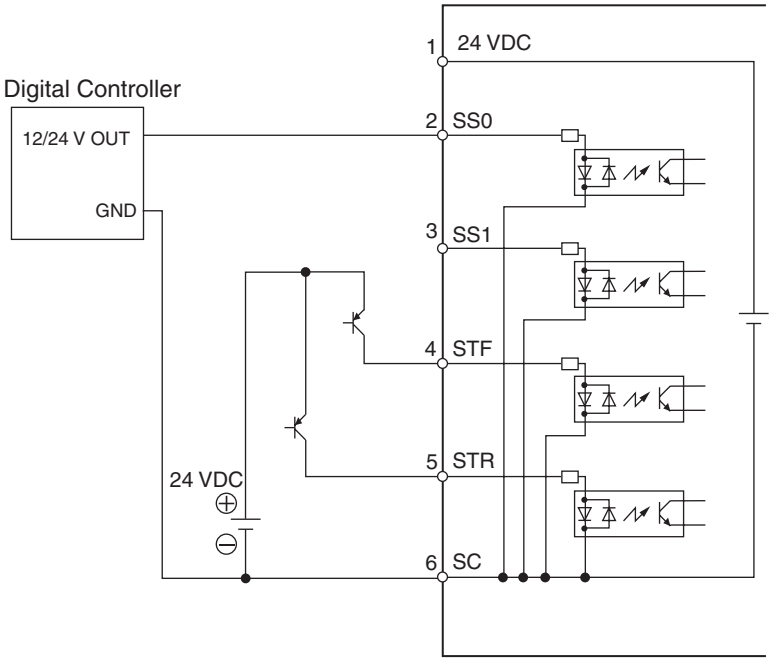


● Control Circuit Input Terminal Connection Examples Using External 24-V Power Supply

Example 1



Example 2



2-2-6 Harmonics Suppression in General-purpose Inverters (Input Current of 20 A Maximum)

When equipped with the AC Reactor specified in section 5-2-5, the 3G3JE meets the harmonic suppression guideline for general-purpose inverters (inverters with an input current of 20 A maximum) issued by the Japan Electronic Device Industrial Council (JEDIC).

2-2-7 Guideline to Reduce Harmonics Emissions in Appliances Receiving High Voltages or Special High Voltages

The 3G3JE meets the Guideline to Reduce Harmonics Emissions in Appliances Receiving High Voltages or Special High Voltages (JEITA).

■ Guideline Applicability

This guideline is applicable to the following appliances.

1. Appliances receiving power from a 6.6-kV network with a total capacity exceeding 50 kVA considering the harmonics emission rate for each type of installed device emitting harmonics (called the equivalent capacity)
2. Appliances receiving power from a 22-kV or 33-kV network with equivalent capacity exceeding 300 kVA
3. Appliances receiving power from a 66-kV or higher network with equivalent capacity exceeding 2,000 kVA

The limit for harmonic current, calculation methods for the equivalent capacity, and calculation methods for the harmonic current for appliances receiving 6.6 kV are described below.

● Limit of Harmonic Current

The allowable value for the harmonic current flowing to the network from special appliances is calculated for each harmonic number by multiplying the harmonic current limit per kilowatt of contracted power given in the following table by the contracted power (in kilowatts).

Limits to Harmonic Current per kW of Contracted Power

(Unit: mA/kW)

Received voltage (kV)	5th	7th	11th	13th	17th	19th	23rd	Higher than 23rd
6.6	3.5	2.5	1.6	1.3	1.0	0.90	0.76	0.70

● Calculating the Equivalent Capacity per Inverter

The equivalent capacity for an inverter is calculated as follows:
Equivalent capacity = Inverter's rated input capacity (Pi) x Coefficient

Here, the Inverter's rated input capacity (Pi) is calculated based on the rated capacity of the applicable motor, as shown in the following table.

Inverter's Rated Input Capacity

Motor capacity (kW)	Rated input capacity (Pi) (kVA)	
	200 V	400 V
0.4	0.57	
0.75	0.97	
1.5	1.95	

The coefficient is as shown in the following table for a three-phase general-purpose inverter.

3	Three-phase bridge (capacitor smoothing)	3-1	No reactor	K_{31} = 3.4	General-purpose inverters Servo amplifiers Elevators Refrigeration and air conditioning equipment Other general-purpose equipment
		3-2	Reactor on AC side	K_{32} = 1.8	
		3-3	Reactor on DC side	K_{33} = 1.8	
		3-4	Reactors on AC and DC side	K_{34} = 1.4	

■ Calculating the Harmonic Current per Inverter

Use the following formula: nth harmonic current [A] =
Fundamental frequency input current [A] x nth harmonic current ratio (%)/100

Here, the values in the following table are used for the fundamental frequency input current and converted for a received voltage of 6.6 kV.

Applicable motor [kW]		0.4	0.75	1.5
Fundamental frequency input current [A]	200 V	1.61	2.74	5.50
	400 V	0.81	1.37	2.75
Value converted for 6.6 kV [mA]		49	83	167

The following table is used to obtain the nth harmonic current ratio (%). Normally calculations are performed only for the 5th and 7th harmonics.

Three-phase Bridge (Capacitor Smoothing)

(Unit: %)

Harmonic number	5	7	11	13	17	19	23	25
No reactor	65	41	8.5	7.7	4.3	3.1	2.6	1.8
Reactor on AC side	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3
Reactor on DC side	30	13	8.4	5.0	4.7	3.2	3.0	2.2
Reactors on AC and DC side	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4

As described below, the result is multiplied by the maximum equipment operating rate to reduce the current.

The harmonic currents emitted by all devices at the rated operating status are totaled and then multiplied by the maximum equipment operating rate to calculate the harmonic emission current. The maximum equipment operating rate is the ratio of the total capacity of the devices emitting harmonic current to the maximum capacity of the equipment when operating. The maximum capacity of the equipment when operating is the average value over a 30-minute period.

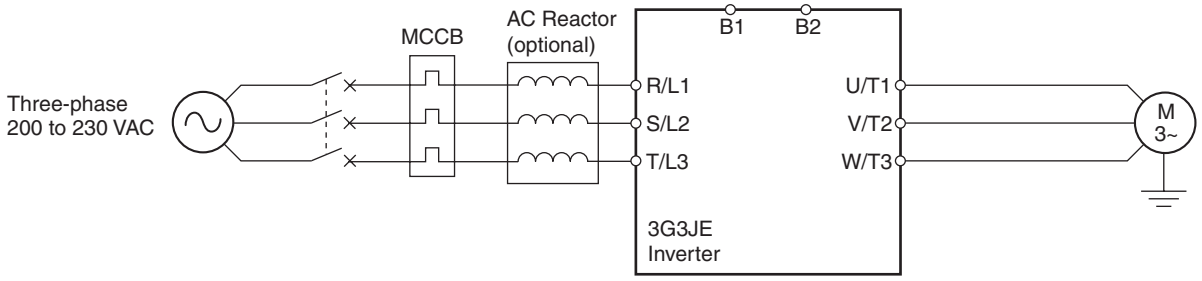
■ 3G3JE Harmonic Current Countermeasures

● AC Reactors

AC reactors are used to suppress harmonic current. Using an AC reactor will reduce the emission rate of harmonic current as shown in the following table to improve the power rate on the Inverter's input side. The AC reactor functions to suppress sudden currents.

● Effect of AC Reactor

Harmonic countermeasure	Harmonic current rate for harmonic numbers (%)							
	5th	7th	11th	13th	17th	19th	23rd	25th
None (only Inverter)	65	41	8.5	7.7	4.3	3.1	2.6	1.8
AC Reactor	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3



2-2-8 Conforming to EC Directives

■ Applicable Directives

- EMC Directive: EN 61800-3
- Low Voltage Directive: EN 61800-5-1

■ Concepts

● EMC Directive

OMRON products are designed for compliance with related EMC standards so that they can be more easily built into other devices or the overall machine. The 3G3JE has been checked for conformity to EN 61800-3 when the following installation and wiring methods are used. EMC-related performance of the OMRON products that comply with EC Directives will vary depending on the configuration, wiring, installation, and other conditions of the equipment or control panel on which the OMRON products are installed. The customer must, therefore, perform the final check to confirm that devices and the overall machine conform to EMC standards.

● Wiring the Power Supply

- Always connect the power input terminals (R/L1, S/L2, and T/L3) and power supply via a 3G3JV-PRS2010J Noise Filter (rated current: 10 A).
- Reduce the length of the ground wire as much as possible.
- Locate the Noise Filter as close as possible to the Inverter.

● Connecting a Motor to the Inverter

- When connecting a motor to the Inverter, be sure to use a cable with a braided shield.
- Reduce the length of the cable as short as possible.

■ Conforming to the Low Voltage Directive

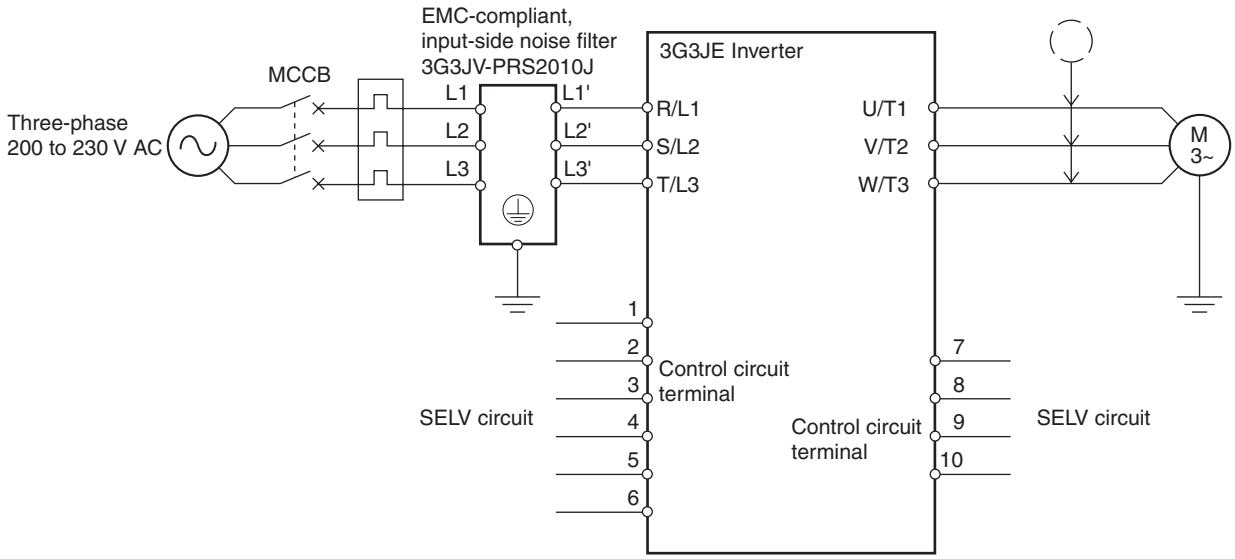
The 3G3JE conforms to EN 61800-5-1 when the following installation and wiring methods are used.

- The 3G3JE is an open-frame device. Always install it in a control panel.
- Always use reinforced or double insulated power supply/voltage (SELV) wiring for the control circuit terminals.
- The Low Voltage Directive requires that protection from short-circuiting in the power supply wiring be provided with a molded-case circuit breaker (MCCB). Always install an MCCB on the power supply side of the Inverter.
- Use one MCCB per Inverter.
- Use an MCCB with the rated current given in the following table.

Model number	Rated current	MCCB model examples
3G3JE-A2001	3 to 5 A	ABS33Fb ABS53Fb ABS33b ABS53b
3G3JE-A2002	3 to 5 A	
3G3JE-A2004	5 A	

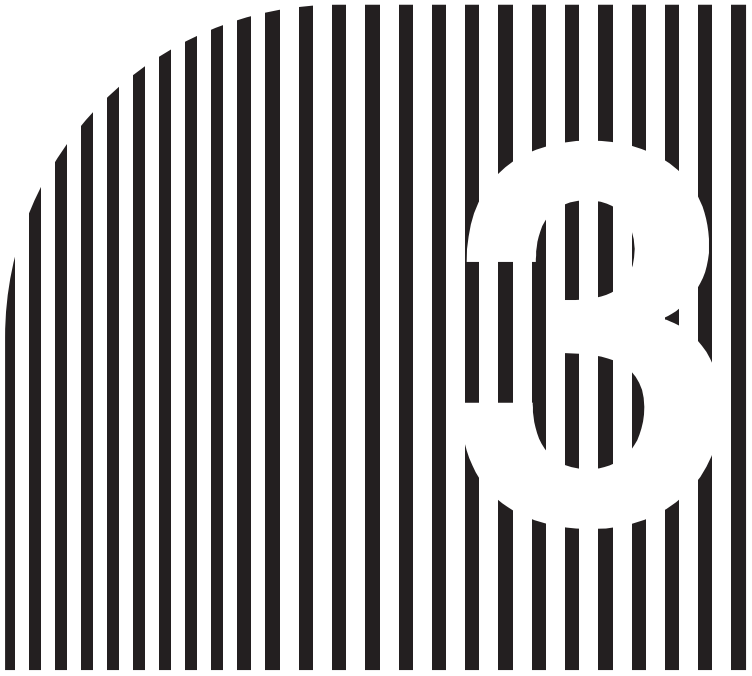
- Use crimp terminals with insulated sleeves for connection to the main circuit terminals.
- When not using a Braking Resistor or Braking Resistor Unit, connect crimp terminals with insulated sleeves to the braking resistor connection terminals (B1 and B2).

Standard Wiring Diagram for Conformance to EC Directives



● Precaution on Models with NPN Input (3G3JE-A2□□□N)

NPN circuits cannot be used for safety circuits. Therefore, models with an NPN input cannot be used for safety circuits specified in EN/IEC 60204-1.



Chapter 3

Operation

Precautions for Safe Use

■ Operation

• This Inverter can be set to operate from low speed to high speed. Operate the Inverter only after sufficiently confirming the allowable range for the motor installation being used.

Precautions for Correct Use

■ Operation after Power Interruptions

• If continuing operation is selected for the momentary power interruption restart selection (P09), the system may unexpectedly start operation after a momentary power interruption is reset. Exercise suitable caution.

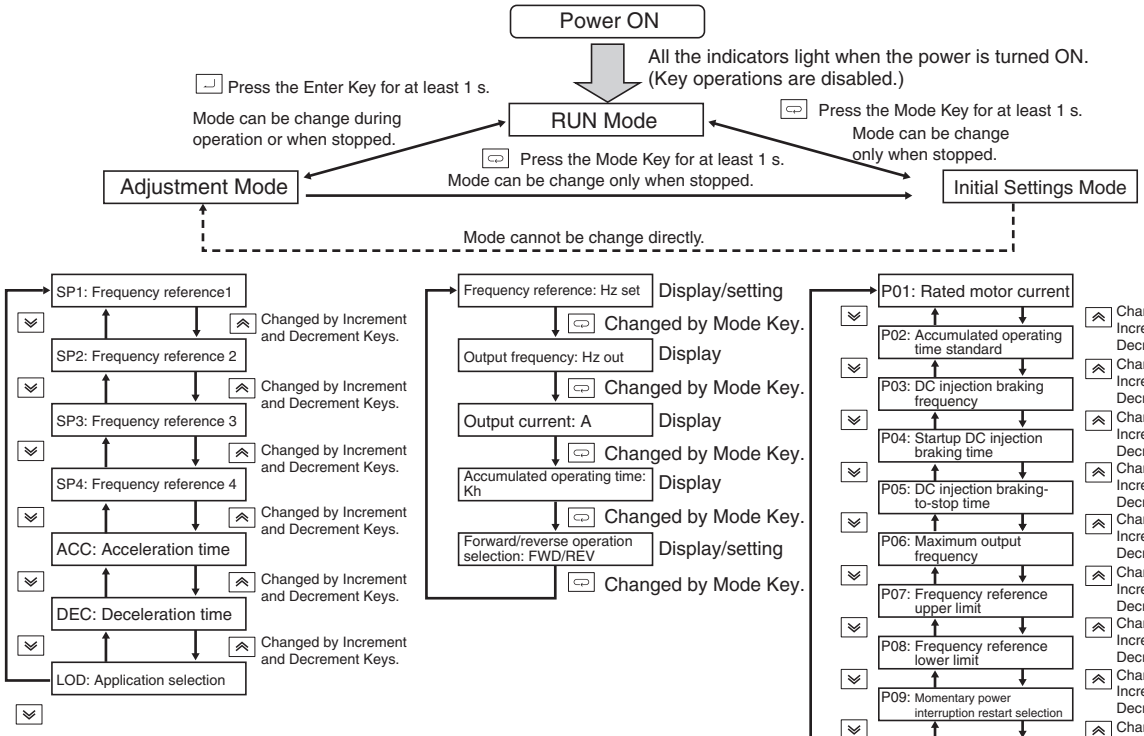
■ Operation Command Selection

• If the operation command selection parameter (P10) is set to “PLC” to enable using the control circuit terminal inputs (STF and STR), the motor may start operation when the power supply is turned ON or an alarm is reset if the control circuit terminals are left ON. Exercise suitable caution. Also, if signals are checked during operation and a voltage is incorrectly applied to the control circuit terminals, the motor may start moving unexpectedly. Always check safety before performing signal checks.

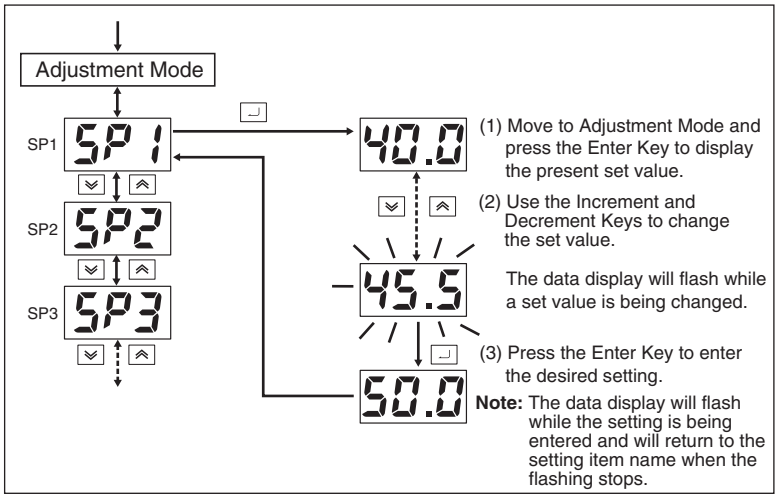
■ Motor Overheating Protection (Electronic Thermal)

• The Inverter uses an electronic thermal to protect the motor from overheating. Set the rated current of the motor in the rated motor current parameter (P01). If more than one motor is operated with one Inverter, set the rated motor current parameter (P01) to 0.0 to disable motor overload detection, and install a thermal relay between the Inverter and each motor. Set the thermal relay to 1.0 times the nameplate current at 50 Hz and to 1.1 times the nameplate current at 60 Hz.

3-1 Key Operation Flowchart



● Example: Changing the Set Value



Note 1: P11 can be set only on Standard Models.
2: P15 through P19 are displayed and can be set only for Communications Models.

3-2 Procedure for Test Run

1. Installation and Mounting

Install the Inverter according to the installation conditions. Refer to page 2-4.

- Make sure that the installation conditions are met.

2. Wiring and Connection

Connect to the power supply and peripheral devices. Refer to page 2-6.

- Select peripheral devices that meet the specifications and wire correctly.

3. Power ON

Carry out the following pre-connection checks before turning ON the power supply.
Refer to page 3-5.

4. Checking the Display Status

Check to be sure that there are no faults in the Inverter. Refer to page 3-5.

5. Initializing Parameters

Initialize the parameters. Refer to page 3-5.

6. Setting Parameters

Set the parameters required for a test run. Refer to page 3-6.

7. No-load Operation

Start the motor without a load using the RUN Key. Refer to page 3-7.

8. Actual Load Operation

Connect the mechanical system and use the Digital Operator for operation. Refer to page 3-8.

9. Operation

3-3 Performing a Test Run

This section describes performing a test run. Refer to *Chapter 2 Design* for information on Inverter installation and wiring.

■ Confirmation before Performing a Test Run

- Confirm that all installation conditions have been met.
- Confirm that peripheral devices that conform to all specifications have been used and that they are wired correctly.

1 Turning ON the Power

■ Checkpoints before Connecting the Power Supply

- Check that the power supply is of the correct voltage and that the power input terminals (R/L1, S/L2, and T/L3) are connected correctly.
- 3G3JE-A2□: Three-phase 200 to 230 V AC
- Make sure that the motor output terminals (U/T1, V/T2, and W/T3) are connected to the motor correctly.
- Make sure that the control circuit terminals and the control device are wired correctly. Make sure that all control terminals are turned OFF.
- Set the motor to no-load status (i.e., not connected to the mechanical system).

■ Connecting the Power Supply

- After conducting the above checks, connect the power supply.

2 Checking the Display Status

- The entire display and setting/monitoring indicators will light (except for the COM indicator) when the power supply is turned ON. The display and indicators will read as follows if the Inverter is normal.
  Data display: Shows the present frequency reference.
  Simplified-LED indicators: Only frequency reference indicator (Hz set) will be lit.
- If an error has occurred, the error parameter will be displayed on the data display.
  If that occurs, refer to *Chapter 4 Maintenance Operations* and take the required action.

3 Initializing Parameters

■ Using Parameter Initialization (P20)

- Initialize the parameters using the following procedure before performing a trial run. When the parameters are initialized, all values except for the accumulated operating time will be returned to their default settings.

• Parameter initialization is executed using P20 (parameter initialization) in the initial settings mode.

Key sequence	Indicator	Display example	Description
None	□ Hz set	10.0	The entire display and simplified-LED indicators will light (except for the COM indicator) when the power supply is turned ON. The present frequency reference will be displayed on the data display.
1s min.	None	P01	Press the Mode Key for at least 1 s to move to Initial Settings Mode.
	None	P20	Set P20 using the Increment and Decrement Keys.
	None	Rbt	Press the Enter Key. The set value will be entered.
	None	inL	Press the Increment and Decrement Keys and select inL. The data display will flash.
	None	P20	Press the Enter Key. The set values will be initialized to their default values except for the accumulated operating time. The data display will stop flashing and P20 will be displayed.
1 s min.	□ Hz set	10.0	Press the Mode Key for at least 1 s to return to the RUN mode.

4 Setting Parameters

■ Setting the Rated Motor Current (P01)

- Set the motor current parameter in P01 before the trial run to prevent the motor from burning due to overloading.
- Set the rated current indicated on the specifications nameplate of the motor that is to be used.
- This parameter is used for the electronic thermal function for detecting motor overload (E03). Setting it correctly protects the motor by preventing it from burning even if an overload occurs.
- Motor overload (E03) detection is disabled by setting the parameter to 0.0
- Refer to *3-6-1 Setting the Rated Motor Current* for details on the rated motor current (P01).

P01	**Rated motor current**			**Changes during operation**	No
Setting range	0.0 to 2.5 (A)	**Setting unit**	0.1 A	**Default setting**	See note.

Note The default setting for the rated motor current is the standard rated current of the maximum applicable motor.

Maximum applicable motor capacity	Default dated current setting [A]
0.1 kW	0.6
0.2 kW	1.0
0.4 kW	2.0

Key sequence	Indicator	Display example	Explanation
MODE 1 s min.	None	P01	Press the Mode Key for at least 1 s to move to Initial Settings Mode.
▲ ▼	None	P01	Use the Increment or Decrement Key to display P01.
ENTER	None	2.0	Press the Enter Key to display the value currently set in P01.
▲ ▼	None	1.8	Use the Increment or Decrement Key to set the rated motor current for the motor that is to be used. The display will flash while the value is being set.
ENTER	None	P01	Press the Enter Key to enter the set value. The data display will stop flashing and P01 will be displayed.

5 No-load Operation

■ No-load Motor Operation

Before performing operation with the mechanical system actually connected, operate the motor with no load (i.e., not connected to the mechanical system) using the Digital Operator keys.

- Check that no faults have occur in the Inverter during operation.
- Check that the directions of rotations match. If operation is in the wrong direction, reverse any two of the motor output wires.
- The Increment and Decrement Keys can be used to change the frequency when the □ Hz set indicator is lit.
- Refer to *3-4-3 Changing the Frequency Reference* for information on changing the frequency reference.

Key sequence	Indicator	Display example	Explanation
MODE	□ Hz set	10.0	Go to RUN mode and press the Mode Key to light the □ Hz set indicator. The present frequency reference will be displayed on the data display.
▲ ▼	□ Hz set	12.3	Set the frequency using the Increment and Decrement Keys.(It is recommended that the test run be first conducted at low frequency.)
RUN	□ Hz set □ RUN	12.3	Press the RUN Key. The □ RUN Indicator will be lit.
▲ ▼	□ Hz set □ RUN	20.0	The frequency can be changed using the Increment and Decrement Keys.

■ Stopping the Motor

• When finished operating the motor in the no-load state, press the STOP/RESET Key. The motor will stop.

Key sequence	Indicator	Display example	Explanation
STOP / RESET	□ RUN Goes out.	20.0	Press the STOP/RESET Key to stop the motor. The □ RUN indicator will go out and the motor will stop.

6 Actual Load Operation

After checking the operation with the motor in no-load status, connect the mechanical system and operate with an actual load using the Digital Panel keys.

• Confirm that the motor has stopped completely before connecting the mechanical system.

• Be sure to tighten all the screws when connecting the motor axis to the mechanical system.

• If an error occurs during operation, immediately press the STOP/RESET Key on the Digital Operator.

• First set the frequency reference to a low speed of one tenth the normal operating speed. (Set the frequency reference somewhat lower than the actual operating speed.)

■ Checking the Operating Status

• Check that the operating direction is correct and that the machine is operating smoothly at slow speed before increasing the frequency reference.

• After changing the frequency reference or the rotation direction, check that there is no vibration or abnormal sound from the motor. Check the monitor display to confirm that the output current is not becoming excessive.

• Refer to *3-4-4 Selecting Forward or Reverse Operation* for information on forward/reverse operation selection. If parameter initialization (P20) is performed, reverse operation will be prohibited (P13). To change the direction of rotation for actual load operation, enable reverse operation (P13). Refer to *3-6-9 Selecting Reverse Rotation Prohibition* for information on the reverse rotation prohibit selection (P13).

3-4 RUN Mode

3-4-1 Run/Stop Command

Set P01 in the initial settings mode to the rated current given on the motor's nameplate before operation. Setting the rated current correctly will protect the motor from burning due to an overload. For details on the procedure, refer to *3-6-1 Setting the Rated Motor Current*.

■ Operating and Stopping

- Press the RUN KEY to operate the motor.
- Press the STOP/RESET KEY to stop the motor.
- The □ RUN indicator will light during operation.
- In RUN mode, operation can always be started or stopped regardless of whatever item is currently being displayed.

Key sequence	Indicator	Display example	Explanation
	□ Hz set		Go to RUN mode and press the Mode Key to light the □ Hz set indicator. The present frequency reference will be displayed on the data display.
	□ RUN		Press the RUN Key to start the motor. The □ RUN indicator will light.
	□ RUN Goes out.		Press the STOP/RESET Key to stop the motor. The □ RUN indicator will go out.

3-4-2 Selecting the Item to be Displayed

■ Changing the Display Item

- The Mode Key can be pressed to change the display item in the order shown below.
- The display item can be change during operation or when operation is stopped.

Display	Key sequence	Indicator	Display example	Explanation
Frequency reference		☐ Hz set		The entire display and simplified-LED indicators will light (except for the COM indicator) when the power supply is turned ON. The present frequency reference will be displayed on the data display.
Output frequency		☐ Hz out		When the Mode Key is pressed while the ☐ Hz set indicator is lit, the output frequency will be displayed. At the same time the ☐ Hz out indicator will light.
Output current		☐ A		When the Mode Key is pressed while the ☐ Hz out indicator is lit, the present output current will be displayed. At the same time the ☐ A indicator will light.
Accumulated operating time		☐ Kh		When the Mode Key is pressed while the ☐ A indicator is lit, the present accumulated operating time will be displayed. At the same time the ☐ Kh indicator light will light.
Forward/ reverse operation selection		None (See note.) (☐ RVS)		When the Mode Key is pressed while the ☐ Kh indicator is lit, the present direction of rotation will be displayed. No indicator will light.

Note The ☐ RVS indicator will not light when forward operation is set and  will be displayed on the data display. If reverse operation is set, the ☐ RVS indicator will light and will be displayed on the data display.

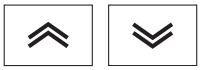
3-4-3 Changing the Frequency Reference

■ Range for Changing the Frequency Reference

- The frequency reference is set in increments of 0.1 Hz for less than 100 Hz and in increments of 1 Hz at 100 Hz or higher. The setting range for the frequency reference is between the frequency reference upper limit (P07) and the frequency reference lower limit (P08) set in the initial settings mode. (Set the frequency reference upper limit and frequency reference lower limit in initial settings mode.)

■ Setting the Frequency Reference

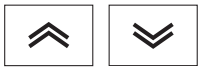
- The frequency reference can be set during operation or while operation is stopped.

Key sequence	Indicator	Display example	Explanation
	☐ Hz set		The entire display and simplified-LED indicators will light (except for the COM indicator) when the power supply is turned ON. The present frequency reference will be displayed on the data display. (If ☐ Hz set does not light, press the Mode Key to light it.)
	☐ Hz set		Set the frequency reference using the Increment and Decrement Keys.
None	☐ Hz set		The set value will be entered when the Increment and Decrement Keys are released and acceleration or deceleration will start.

3-4-4 Selecting Forward or Reverse Operation

- The rotation direction can be changed during operation or while operation is stopped.
- If parameter initialization (P20) is performed, reverse operation will be prohibited (P13). To change the direction of rotation for actual load operation, enable reverse operation (P13). Refer to *3-6-9 Selecting Reverse Rotation Prohibition* for information on the reverse rotation prohibit selection (P13).

■ Selecting the Rotation Direction

Key sequence	Indicator	Display example	Explanation
None	☐ Hz set		The entire display and simplified-LED indicators will light (except for the COM indicator) when the power supply is turned ON. The present frequency reference will be displayed on the data display.
	None		Press the Mode Key. The forward/reverse operation setting will be displayed. (The present rotation direction will be displayed on the data display.)
	None (See note.) (☐ RVS)		Set the direction of rotation using the Increment and Decrement Keys. (Press the Increment Key during forward operation to switch to reverse operation. Press the Decrement Key during reverse operation to switch to forward operation.)

Note The ☐ RVS indicator will not light when forward operation is set and  will be displayed on the data display. If reverse operation is set, the ☐ RVS indicator will light and  will be displayed on the data display.

3-5 Adjustment Mode

- Switching from RUN mode to adjustment mode is possible at any time by pressing the Enter Key for 1 second or longer.
- Switching from adjustment mode back to RUN mode is possible by pressing the Enter Key for 1 second or longer when any of the following adjustment items is being displayed: SP1 to SP4, ACC, DEC, or LOD. If a set value is being displayed, press the Enter Key to display the setting item name.

3-5-1 Setting Frequency References 1 to 4

- Four frequency references can be remembered internally in the Inverter.
- The frequency references 1 to 4 are set in increments of 0.1 Hz for less than 100 Hz and in increments of 1 Hz for 100 Hz or greater.
- Frequency references 1 to 4 are enabled when P11 (frequency reference selection) is set to MSP (multi-step speed reference).

SP1	**Frequency reference 1**			**Changes during operation**	Yes
Setting range	0.0 to 120 (Hz)	**Setting unit**	0.1 Hz	**Default setting**	10.0

SP2	**Frequency reference 2**			**Changes during operation**	Yes
Setting range	0.0 to 120 (Hz)	**Setting unit**	0.1 Hz	**Default setting**	0.0

SP3	**Frequency reference 3**			**Changes during operation**	Yes
Setting range	0.0 to 120 (Hz)	**Setting unit**	0.1 Hz	**Default setting**	0.0

SP4	**Frequency reference 4**			**Changes during operation**	Yes
Setting range	0.0 to 120 (Hz)	**Setting unit**	0.1 Hz	**Default setting**	0.0

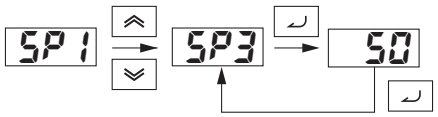
■ Relation between Control Circuit Terminals and Frequency Reference

Multi-step speed reference 0 (SS0) and multi-step speed reference 1 (SS1) can be used together to select one of the following frequency references.

Note Multi-step speed references are supported only for Standard Models.

Multi-step speed reference	SS0	SS1
Frequency reference 1 (SP1)	OFF	OFF
Frequency reference 2 (SP2)	ON	OFF
Frequency reference 3 (SP3)	OFF	ON
Frequency reference 4 (SP4)	ON	ON

■ Setting Frequency References 1 to 4



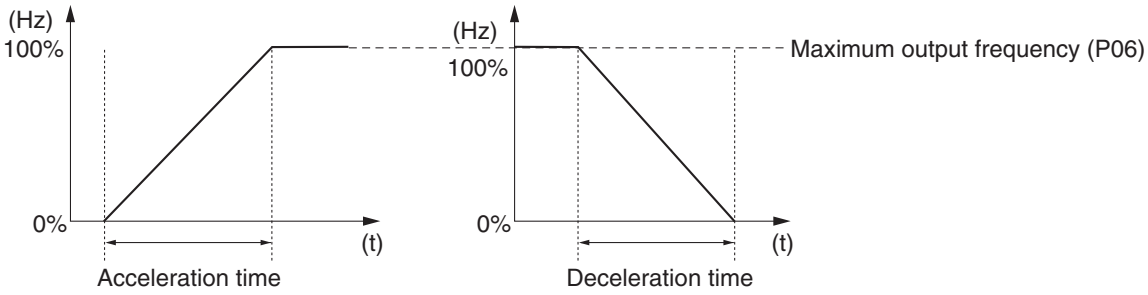
Key sequence	Indicator	Display example	Explanation
None	☐ Hz set	6.0	The entire display and simplified-LED indicators will light (except for the COM indicator) when the power supply is turned ON. The present frequency reference will be displayed on the data display.
Enter 1 s min.	None	SP1	Pressing the Enter Key for 1 s or longer changes the mode to the adjustment mode. SP1 will be displayed on the data display.
Increment Decrement	None	SP3	Select the item to be displayed using the Increment and Decrement Keys.
Enter	None	28.3	When the Enter Key is pressed, the present set value for the selected item will be displayed.
Increment Decrement	None	32.0	Set the frequency reference using the Increment and Decrement Keys. The data display will flash.
Enter	None	SP3	When the Enter Key is pressed, the set value will be entered. When the data display stops flashing, operation will be returned to the set item selection.
Enter 1 s min.	☐ Hz set	None	Press the Enter Key for at least 1 s to return to the RUN mode.

3-5-2 Setting Acceleration and Deceleration Times

- The acceleration time and the deceleration time are set separately.
- The acceleration time is the time required to accelerate from 0% to 100% of the maximum output frequency (P06), and the deceleration time is the time required to decelerate from 100% to 0% of the maximum output frequency.
- The setting unit for the acceleration and deceleration times is 0.1 s for less than 100 s, and 1 s for 100 s or more.
- If the load inertia is high, the acceleration and deceleration times must be increased. For details, refer to *7-1 Selecting the Inverter* at the end of this manual.
- The acceleration/deceleration time between 0 and the frequency reference is calculated with the following formula.

  Acceleration/deceleration time = (Acceleration/deceleration time setting) × (Frequency reference) ÷ (Maximum output frequency setting)

Note When accelerating from a stopped condition, the starting DC breaking time must be added.



ACC	**Acceleration time**			**Changes during operation**	No
Setting range	0.1 to 999 (s)	**Setting unit**	0.1 s	**Default setting**	10.0

DEC	**Deceleration time**			**Changes during operation**	No
Setting range	0.1 to 999 (s)	**Setting unit**	0.1 s	**Default setting**	10.0

■ Setting the Acceleration Time

Key sequence	Indicator	Display example	Explanation
None	□ Hz set	6.0	The entire display and simplified-LED indicators will light (except for the COM indicator) when the power supply is turned ON. The present frequency reference will be displayed on the data display.
[↵] 1 s min.	None	SP 1	Pressing the Enter Key for 1 s or longer changes the mode to the adjustment mode. SP 1 will be displayed on the data display.
[∧] [∨]	None	ACC	Use the Increment and Decrement Keys to display ACC on the data display.
[↵]	None	10.0	When the Enter Key is pressed, the present set value will be displayed.
[∧] [∨]	None	20.5	Set the acceleration time using the Increment and Decrement Keys. The data display will flash.
[↵]	None	ACC	Pressing the Enter Key will enter the set value. When the data displays stops flashing, the adjustment item name will again appear on the data display.

■ Setting the Deceleration Time

Key sequence	Indicator	Display example	Explanation
None	□ Hz set	6.0	The entire display and simplified-LED indicators will light (except for the COM indicator) when the power supply is turned ON. The present frequency reference will be displayed on the data display.
[↵] 1 s min.	None	SP 1	Pressing the Enter Key for 1 s or longer changes the mode to the adjustment mode. SP 1 will be displayed on the data display.

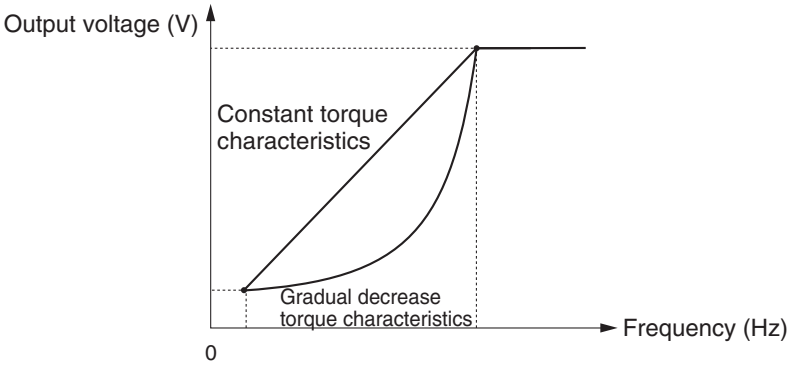
Key sequence	Indicator	Display example	Explanation
▲ ▼	None	dEC	Use the Increment and Decrement Keys to display dEC on the data display.
↵	None	10.0	When the Enter Key is pressed, the present set value will be displayed.
▲ ▼	None	20.5	Set the deceleration time using the Increment and Decrement Keys. The data display will flash.
↵	None	dEC	Pressing the Enter Key will enter the set value. When the data displays stops flashing, the adjustment item name will again appear on the data display.

3-5-3 Selecting the Application (Setting V/f Patterns)

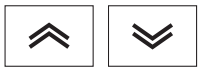
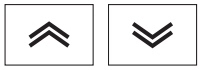
- Set the V/f pattern so that the motor output torque is adjusted to the required load torque.
- With the 3G3JE, either of the two patterns below can be selected as the pattern for V/f characteristics.
- The 3G3JE has an automatic torque boost function. The suitable torque characteristics can be obtained by simply selecting the load application.

LOD	**Application selection**	**Changes during operation**	No
Selected item	CNV/FAN	**Default setting**	CNV

Selected item	Characteristics and application	Description
CNV (CnU)	Constant torque characteristics (for conveyers)	Select for applications such as conveyers, where the load torque is uniform regardless of the rotation speed and the load moment of inertia is high.
FAN (FAn)	Gradual decrease torque characteristics (for fan)	Select for applications such as fans and pumps, where the load torque is lower when the rotation speed is slower.



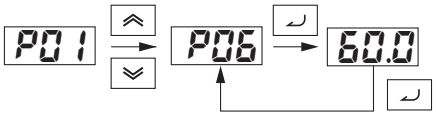
■ Setting the Application Selection

Key sequence	Indicator	Display example	Explanation
None	□ Hz set		The entire display and simplified-LED indicators will light (except for the COM indicator) when the power supply is turned ON. The present frequency reference will be displayed on the data display.
 1 s min.	None		Pressing the Enter Key for 1 s or longer changes the mode to the adjustment mode. *SP1* will be displayed on the data display.
	None		Use the Increment and Decrement Keys to display *Lod* on the data display.
	None		When the Enter Key is pressed, the present set value will be displayed.
	None		Press the Increment and Decrement Keys to select the application to match the usage. The data display will flash.
	None		Pressing the Enter Key will enter the set value. When the data displays stops flashing, the adjustment item name will again appear on the data display.

3-6 Initial Settings Mode

- It is always possible to change from the RUN mode or adjustment mode to the initial settings mode by pressing the Mode Key for at least one second while the motor is stopped.
- It is possible to change from the initial settings mode to the RUN mode by pressing the Mode Key for at least one second while an initial settings mode parameter name (P01 to P21) is displayed. Display the initial settings mode parameter name by pressing the Enter Key while the set value is displayed.
- Any set values that are changed will become valid when the RUN mode is entered.
- If the power is turned OFF while a setting has being changed but before RUN mode is entered, the change will be lost when power is turned back ON.

■ Example Settings in Initial Settings Mode



Key sequence	Indicator	Display example	Explanation
None	□ Hz set	6.0	The entire display and simplified-LED indicators will light (except for the COM indicator) when the power supply is turned ON. The present frequency reference will be displayed on the data display.
1 s min.	None	P01	Pressing the Mode Key for 1 s or longer changes the mode to the initial settings mode. P01 will be displayed on the data display.
	None	P06	Select the item to be displayed using the Increment and Decrement Keys.
	None	60.0	When the Enter Key is pressed, the present set value for the selected item will be displayed.
	None	58.3	Use the Increment and Decrement Keys to make the setting. The data display will flash.
	None	P06	Pressing the Enter Key will enter the set value. When the data displays stops flashing, the adjustment item name will again appear on the data display.
1 s min.	□ Hz set	6.0	Press the Mode Key for at least 1 s to return to the RUN mode.

3-6-1 Setting the Rated Motor Current

- Set P01 to the rated current given on the motor's nameplate before operation. Setting the rated current correctly will protect the motor from burning due to an overload. Read the information in *Motor Overheating Protection (Electronic Thermal)* under *Precautions for Correct Use* on page 3-2.

• Motor overload (E03) detection is disabled by setting the parameter to 0.0.

P01	**Rated motor current**			**Changes during operation**	No
Setting range	0.0 to 2.5 (A)	**Setting unit**	0.1 A	**Default setting**	See note.

Note The default setting for this parameter is the common rated current of the maximum applicable motor.

Maximum applicable motor capacity	Default dated current setting [A]
0.1 kW	0.6
0.2 kW	1.0
0.4 kW	2.0

3-6-2 DC Injection Braking Function

The DC injection braking function applies a DC voltage to the induction motor for braking control.

• Startup DC Injection Braking Time
This braking is used for stopping and starting a motor rotating by inertia with no regenerative processing.

• DC Injection Braking-to-stop Time
Adjust the stop DC injection braking time if the motor rotating does not decelerate to a stop in normal operation due to inertia. Increasing the DC injection braking time or DC injection braking frequency reduces the time required to stop the motor.

P03	**DC injection braking frequency**			**Changes during operation**	No
Setting range	0.0 to 5.0 (Hz)	**Setting unit**	0.1 Hz	**Default setting**	3.0

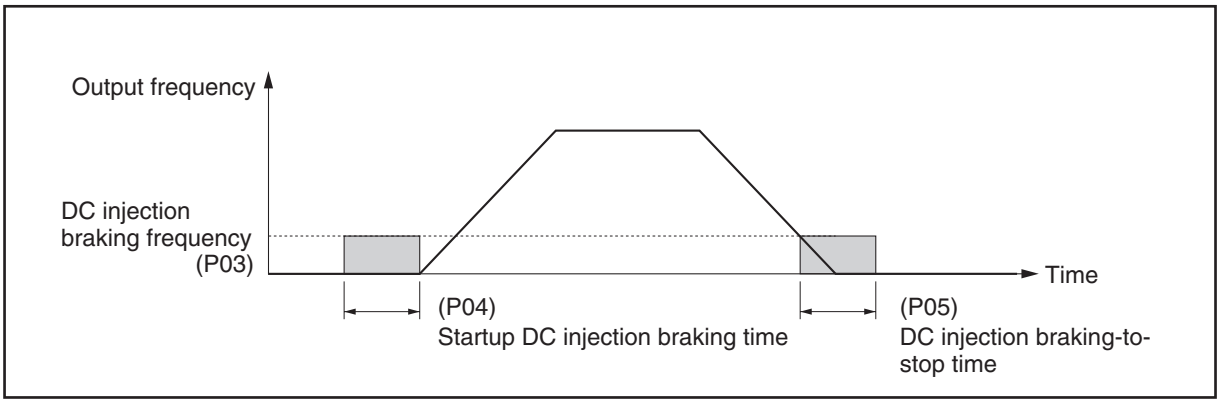
P04	**Startup DC injection braking time**			**Changes during operation**	No
Setting range	0.0 to 10.0 (s)	**Setting unit**	0.1 s	**Default setting**	0.0

P05	**DC injection braking-to-stop time**			**Changes during operation**	No
Setting range	0.0 to 10.0 (s)	**Setting unit**	0.1 s	**Default setting**	0.5

• When starting, acceleration will start after the startup DC injection braking time (P04) has elapsed.

• After decelerating to the DC injection braking frequency (P03) when stopping, DC injection braking will be applied for the DC injection braking-to-stop time (P05).

DC Braking Operation



3-6-3 Maximum Output Frequency

- This parameter functions as a frequency limiter.
- Acceleration and deceleration times are defined as the times required to reach the maximum output frequency (P06) from 0 Hz and to reach 0 Hz from the maximum output frequency (P06).

Note The setting unit for the frequency reference upper and lower limits is 0.1 Hz for less than 100 Hz, and 1 Hz for 100 Hz or higher.

P06	**Maximum output frequency**			**Changes during operation**	No
Setting range	50.0 to 120 (Hz)	**Setting unit**	0.1 Hz (See note.)	**Default setting**	60.0

3-6-4 Setting Frequency Reference Upper and Lower Limits

- Upper and lower limits are set for the frequency reference input from the Digital Operation, frequency references 1 to 4, time-proportional pulse inputs, or communications.
- If the frequency reference lower limit (P08) is higher than the frequency reference upper limit (P07), operation will be at the frequency lower limit.
- If the frequency reference upper limit (P07) or frequency reference lower limit (P08) is set higher than the maximum output frequency (P06), the maximum output frequency will be used for the frequency reference upper limit or frequency reference lower limit. (The settings will be automatically replaced when RUN mode is entered.)

Note The setting unit for the frequency reference upper and lower limits is 0.1 Hz for less than 100 Hz, and 1 Hz for 100 Hz or greater.

P07	**Frequency reference upper limit**			**Changes during operation**	No
Setting range	0.1 to 120 (Hz)	**Setting unit**	0.1 Hz (See note.)	**Default setting**	60.0

P08	**Frequency reference lower limit**			**Changes during operation**	No
Setting range	0.1 to 120 (Hz)	**Setting unit**	0.1 Hz (See note.)	**Default setting**	0.0

3-6-5 Selecting the Processing after Recovery from a Momentary Interruption

- Use this parameter to select the processing to be performed when a momentary power interruption occurs.
- When setting 1 or 2 is selected, an alarm is output when low voltage is detected in the main circuit, and the alarm is automatically cancelled when the normal voltage resumes.
- If the power interruption is longer that the time for which Inverter operation can be performed, the operation after recovery from the power interruption will be the same as the startup operation.

P09	**Momentary power interruption restart selection**	**Changes during operation**	No
Setting range	0 to 2	**Default setting**	0

Set value	Description
0 (0)	Inverter stops operating. (If the interruption lasts for 15 ms or longer, main circuit low voltage will be detected and an error will occur.)
1 (1)	Inverter continues operating if power interruption is 0.5 s or less. (If a power interruption occurs when 1 is set for 0.5 s, the main circuit low voltage is detected and outputs are stopped while waiting for power to be restored. If power is restored within 0.5 s, operation resumes.)
2 (2)	Inverter always continues operating. (If a power interruption occurs when 2 is set, outputs are stopped while waiting for power to be restored. When power is restored, outputs are resumed.)

3-6-6 Selecting Operation Commands

- This parameter selects the input method for specifying Inverter starting, stopping, and direction of rotation.
- There are two methods that can be selected for operation commands. Select the best method for the application.

P10	**Operation command selection**	**Changes during operation**	No
Selected item	Key/PLC	**Default setting**	Key

Selected item	Description
Key (KEY)	Operation commands are performed using the Digital Operator keys.
PLC (PLC)	Operation commands are performed using the STF and STR control inputs.

3-6-7 Frequency Reference Selection

- This parameter selects the method for inputting frequency references for the Inverter.
- There are three methods for inputting frequency references. Select the method according to the application.

Note 3G3JE Communications Models (RS-485) do not have external inputs to select the frequency, so this parameter is not displayed.

P11	**Frequency reference selection**	**Changes during operation**	No
Selected item	Key/MSP/T.C	**Default setting**	Key

Description of Selections

Selected item	Description
Key (KEY)	Frequency reference set using Digital Operator keys.
MSP (n5P)	Frequency reference according to multi-step speed reference 0 (SS0) and multi-step speed reference 1 (SS1).
T.C (t.C)	Frequency reference using temperature controller time-shared proportional pulses via multi-step speed reference 0 (SS0).

3-6-8 Selecting the Function for the Multi-function Output

This parameter is used to select the function of the multi-function output.

P12	**Multi-function output selection**	**Changes during operation**	No
Setting range	0 to 3	**Default setting**	0

Description of Set Values

Set value	Function name	Description
0 (0)	Not allocated	---
1 (1)	Zero speed	Output turned ON when the output frequency is 0 Hz or operation is stopped.
2 (2)	Frequency matching	Output turned ON when the output frequency and the frequency reference are the same.
3 (3)	Reverse operation	Output turned ON when the direction of rotation is set for reverse operation.

3-6-9 Selecting Reverse Rotation Prohibition

- This parameter is used to specify whether to enable or disable a reverse rotation command sent to the Inverter.
- The parameter must be set to prohibit reverse operation when the Inverter is applied to applications in which reverse rotation of the Inverter would cause problems.

P13	**Reverse rotation prohibit selection**	**Changes during operation**	No
Selected item	F.R/FWD	**Default setting**	FWD

Selected item	Description
F.R (F.r)	Allow reverse operation
FWD (FWd)	Prohibit reverse operation (reverse operation disabled)

3-6-10 Setting the Carrier Frequency

- With the 3G3JE, it is possible to switch between two carrier frequencies.
- Change the carrier frequency in the following cases.
  Reduce the carrier frequency to 4 kHz if there are fluctuations in the speed or torque at low speeds or if the wiring distance between the Inverter and motor is excessively long.

Wiring distance	Carrier frequency (guideline)
50 m or less	4 kHz or 7 kHz
Longer than 50 m	4 kHz

P14	**Carrier frequency selection**	**Changes during operation**	No
Setting range	4/7 (kHz)	**Default setting**	4k

Set value	Description
4 (4k)	4 kHz
7 (7k)	7 kHz

3-6-11 Initializing Parameters

- The parameters can be initialized to their default values.
- Parameters are initialize when P20 is set to “ini” and then the Enter Key is pressed.
- The frequency reference will also be initialized to the default value.
- The motor accumulated operating time will not be initialized.

P20	**Parameter initialization**	**Changes during operation**	No
Setting range	ini/abt	**Default setting**	abt

Set value	Description
ini (ini)	Initialize
abt (Abt)	Abort

3-6-12 Motor Accumulated Operating Time

• The 3G3JE keeps track of the motor's accumulated operating time. An alarm is output when the motor's total operating time reaches the accumulated operating time standard. This function can be useful in managing the equipment's maintenance periods.

● Accumulated Operating Time Standard

This parameter sets the accumulated operating time standard for outputting the accumulated operating time alarm (E09).

P02	**Accumulated operating time standard**			**Changes during operation**	No
Setting range	0.0 to 99.9	**Setting unit**	0.1 Kh	**Default setting**	20.0

Note 1 Kh=1000 hours

● Accumulated Operating Time Clear

• This parameter is used to reset the accumulated operating time to zero when equipment maintenance is performed or when the motor is replaced. The time is cleared when the parameter is set to “ini”.

• To clear the accumulated operating time alarm, either or both of the following two methods must be used.

1. Increase the accumulated operating time standard to a value greater than the present set value. This method does not reset the accumulated operating time, so the alarm will be output again when the motor's operating time reaches the new accumulated operating time standard.
2. Reset the accumulated operating time. The alarm will again be output at the point where the motor's operating time reaches the accumulated operating time standard from the point where it was cleared.

P21	**Accumulated operating time clear**	**Changes during operation**	No
Setting range	ini/abt	**Default setting**	abt

Set value	Description
ini (ini)	Resets the accumulated operating time to 0.0.
abt (Abt)	Abort

3-6-13 Setting Communications

■ Communications Settings

This section describes how to set the parameters (P15 to P19) for Communications Models (RS-485). There are five parameters that can be set: Communications unit number, baud rate, data length, stop bits, and parity.

Note For details on communications specifications, wiring, and communications commands, refer to the *Communications Manual*.

● Setting the Communications Unit Number

Sets the Communications unit number.

P15	**Communications unit number**	**Changes during operation**	No
Setting range	0 to 99	**Default setting**	1

● Setting the Communications Baud Rate

Sets the communications baud rate.

P16	**Communications baud rate**	**Changes during operation**	No
Setting range	2.4/4.8/9.6/19.2 (kbps)	**Default setting**	9.6

Selected item	Description
24 (24)	2.4 kbps
48 (48)	4.8 kbps
96 (96)	9.6 kbps
192 (192)	19.2 kbps

● Setting the Communications Data Length

Sets the communications data length.

P17	**Communications data length**	**Changes during operation**	No
Setting range	7/8 (bits)	**Default setting**	7

Selected item	Description
7 (7)	7 bits
8 (8)	8 bits

● Setting the Communications Stop Bits

Sets the number of communications stop bits.

P18	**Communications stop bits**	**Changes during operation**	No
Setting range	1/2 (bits)	**Default setting**	2

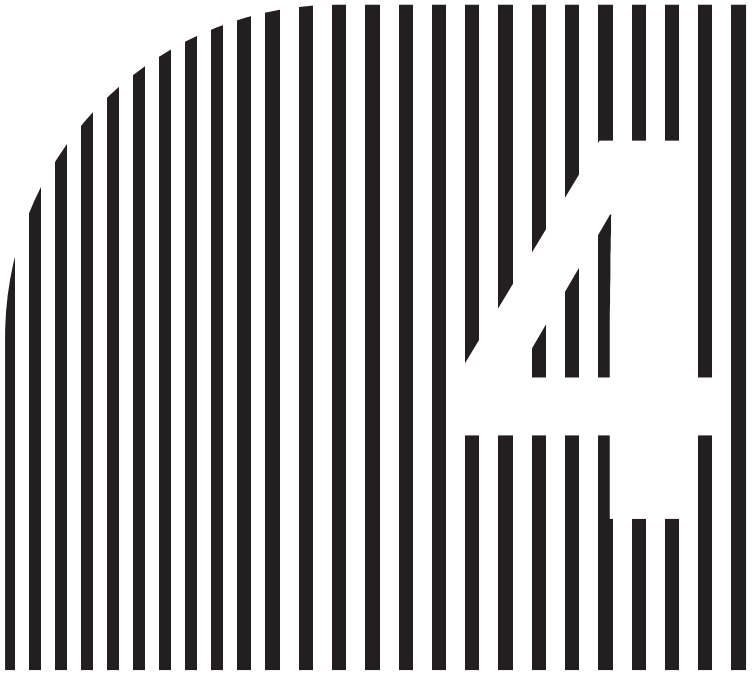
Selected item	Description
1 (1)	1 bit
2 (2)	2 bits

● Setting the Communications Parity

Sets the communications parity.

P19	**Communications parity**	**Changes during operation**	No
Selected item	None/even/odd	**Default setting**	Even

Selected item	Description
non (non)	None
evn (Evn)	Even
odd (odd)	Odd



Chapter 4

Maintenance Operations

⚠ Caution	
Do not touch the Inverter terminals while the power is being supplied or for at least one minute after the power has been turned OFF. Doing so may occasionally result in minor injury from electrical shock.	
Do not remove the fan cover except when replacing the fan. Before replacing the fan, first turn OFF the power and disconnect the wiring. Doing so may occasionally result in minor injury from electrical shock.	

Precautions for Safe Use

■ Operation and Maintenance

- Take measures to assure safety before performing maintenance or inspection, or replacing components.

Precautions for Correct Use

■ Operation Command Selection

- If the operation command selection parameter (P10) is set to “PLC” to enable using the control circuit terminal inputs (STF and STR), the motor may start operation when the power supply is turned ON or an alarm is reset if the control circuit terminals are left ON. Exercise suitable caution. Also, if signals are checked during operation and a voltage is incorrectly applied to the control circuit terminals, the motor may start moving unexpectedly. Always check safety before performing signal checks.

■ Disposing of the Inverter

- Observe all applicable legal requirements when disposing of the Inverter.

4-1 Protective and Diagnostic Functions

This section describes the fault information output for Inverter protection, motor burning protection, and Inverter internal circuit protection. If a fault occurs, refer to *Fault Displays and Corrective Measures* on page 4-4 and take suitable corrective measures.

■ Inverter Faults

- If a fault occurs, the Inverter will display a fault message on the Digital Operator.
- The fault contact output will operate and the Inverter output will be turned OFF, causing the motor to coast to a stop.

Note The stopping method can be selected for some faults.

- Inverter output will not be interrupted for an accumulated operating time fault.

■ Clearing Faults

Faults can be cleared using any of the following methods.

- Turn the power supply OFF and back ON again.
- If the PLC has been selected for the operation command selection (P10), turn STF ON and then OFF again.
- If key operations have been selected for the operation command selection (P10), press the STOP/RESET Key on the Digital Operator.
- Execute the STOP/RESET operation command with a communications command. (This can be done with Communications Models only.)

■ Fault Displays and Corrective Measures

Fault display	Fault name and meaning	Probable cause	Correction
E02	**Overcurrent** The momentary overcurrent (250% of rated output current) was exceeded. The overload rated current (150% of rated output current for 1 min) was detected.	A short-circuit or ground fault has occurred at the Inverter output.	Check and correct the motor power cable.
		A fault has occurred in the machine.	Correct the machine fault.
		The motor capacity is too large for the Inverter.	Reduce the motor capacity to the maximum permissible motor capacity or less.
		The Inverter capacity is insufficient.	Increase the Inverter capacity.
		The magnetic contactor on the output side of the Inverter has been opened and closed.	Rearrange the sequence so that the magnetic contactor will not open or close while the Inverter is outputting a current.
		The acceleration/deceleration time is too short.	Increase the acceleration/deceleration time.
		The output circuit of the Inverter is damaged.	Replace the Inverter.
		The load is too large.	Reduce the load.
E03	**Motor overload** The electronic thermal relay actuated the motor overload protective function.	The load is too large.	• Reduce the load. • Increase the motor capacity.
		The acceleration/deceleration time is too short.	Increase the acceleration/deceleration time.
		The value in P01 for rated motor current is incorrect.	Check the motor nameplate and set P01 to the rated current.
		The Inverter is driving more than one motor.	Disable the motor overload detection function and install a thermal relay for each of the motors. The motor overload detection function is disabled by setting P01 to 0.0.
E04	**Overvoltage** The main circuit DC voltage reached the overvoltage detection level (410 V DC min.) during Inverter operation.	The deceleration time is too short.	Increase the deceleration time.
		The power supply voltage is too high.	Decrease the voltage to within specifications.
		There is excessive regenerative energy due to overshooting at the time of acceleration.	Suppress the overshooting as much as possible.

Fault display	Fault name and meaning	Probable cause	Correction
E05	**Main circuit undervoltage** The main circuit DC voltage reached the undervoltage detection level (200 V DC) during Inverter operation.	Power supply to the Inverter has phase loss or the power cable is disconnected.	Check the wiring and check for loose screws and disconnected wires and correct any problems.
		Incorrect power supply voltage	Make sure that the power supply voltage is within specifications
		Momentary power interruption has occurred.	• Use the momentary power interruption restart (Set P09 to 1 or 2.) • Improve the power supply
		The internal circuitry of the Inverter is damaged.	Replace the Inverter.
E06	**Radiation fin overheated** The temperature of the radiation fins of the Inverter has exceeded the specified temperature.	The ambient temperature is too high.	Ventilate the Inverter or install a cooling unit.
		The installation space is insufficient.	Increase the space around the Inverter.
		The load is too large.	• Reduce the load. • Increase the Inverter capacity.
		The acceleration/deceleration time is too short.	Increase the acceleration/deceleration time.
		The ventilation is obstructed.	Change the location of the Inverter to meet the installation conditions.
		The cooling fan of the Inverter does not work. (The cooling fan's service life has expired, or the fan is broken.)	Replace the cooling fan. (Applies to Inverters with fans.)
E07	**Cooling fan fault** The cooling fan has been locked (stopped) or the rotation speed is down by 30% or more. Note: The motor output will stop if it's locked or the speed is down by 50% or more. A fault will be output if the speed is down 30% or more.	The cooling fan wiring has a fault.	Turn OFF the Inverter, remove the Inverter, and check and repair the wiring.
		The cooling fan is not in good condition.	Check and remove the foreign material or dust on the fan.
		The cooling fan is faulty or beyond its service life.	Replace the fan.
E08	**Braking IGBT fault** The brake IGBT is malfunctioning.	The IGBT is damaged.	Turn OFF the Inverter power immediately, and replace the Inverter.
E09	**Accumulated time alarm**	The Inverter's accumulated time has reached the accumulated operating time standard (P02) that was set.	To cancel the alarm, set the accumulated operating time clear parameter (P21) to *ini*, or increase the existing accumulated operating time standard (P02).

Fault display	Fault name and meaning	Probable cause	Correction
E01	**Memory fault** A fault was detected in the Inverter's internal memory.	Internal circuit fault	If the fault persists even after the power has been turned OFF and back ON, then replace the Inverter.
E5E	**EEPROM write error**	A power interruption occurred during an overload.	Turn the Inverter power OFF and back ON. (The immediately preceding accumulated operating time is not added.)
Not lit	**Power supply fault, power supply undervoltage, control power supply fault, or hardware error**	No power supply is provided.	Check and correct the power supply wire and voltage.
		Terminal screws are loosened.	Check and tighten the terminal screws.
		The Inverter is damaged.	Replace the Inverter.

4-2 Troubleshooting

Due to parameter setting errors, faulty wiring, and so on, the Inverter and motor may not operate correctly. If that should occur, use this section as a reference and take the appropriate measures. Refer to *4-1 Protective and Diagnostic Functions*, if a fault is displayed.

Parameters cannot be set.

Problem	Probable cause	Correction
The display does not change when a key is pressed.	Initial settings mode cannot be entered during operation.	Turn OFF the Inverter and then make the settings.
Nothing is displayed on the Digital Operator.	Cannot be determined.	If the fault persists even after the power has been turned OFF and back ON, then replace the Inverter.There is an internal circuit fault.

The motor does not operate.

Problem	Probable cause	Correction
The motor does not operate with input through the control circuit terminals	PLC is not selected in the operation command selection (P10).	If “Key” (Digital Operator keys) is selected for the operation command selection (P10), operations cannot be specified from the control circuit terminals. Select PLC in the operation command selection (P10).
	The wiring of the control circuit terminals of the Inverter is incorrect.	The Inverter cannot check the input signal if the input line of the control circuit terminals is incorrectly wired. Refer to 2-2-4 Wiring Control Circuit Terminals and check that the terminals are wired according to the correct wiring method.
The motor stops during acceleration/deceleration or when a load is connected.	The load may be too big.	The 3G3JE has a stall prevention function and automatic torque boost function, but the motor responsiveness limit may be exceeded if acceleration is too rapid or if the load is too big. Lengthen the acceleration time or reduce the load. Also consider increasing the motor capacity.
The motor operates at a frequency lower than the frequency reference.	The load may be too big.	The overcurrent protection may operate when the output current exceeds 150% of the Inverter’s rated current, lowering the output frequency. Reduce the load.

- The stall prevention function has operated during acceleration. The acceleration time is automatically increased to make tripping less likely to occur due to overcurrent during acceleration.
- The stall prevention function has operated during deceleration. The deceleration time is automatically increased to make tripping less likely to occur due to overvoltages during deceleration.

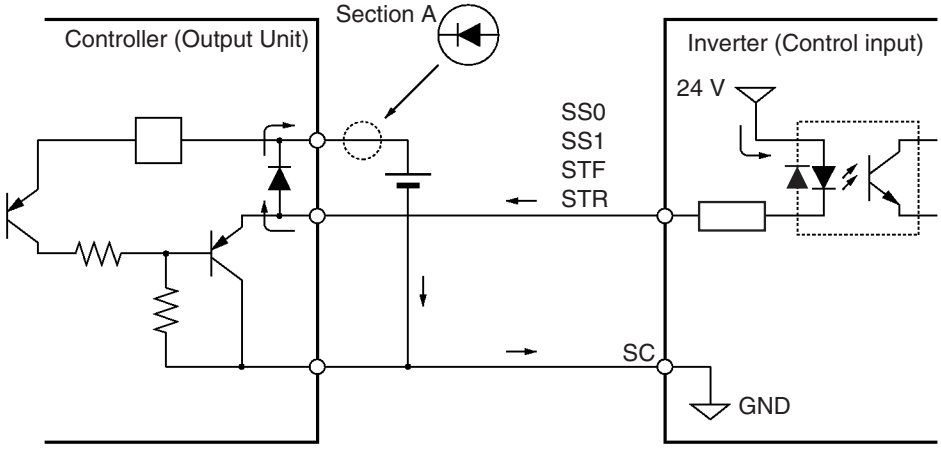
■ The Inverter does not operate or the motor operates only briefly when the Controller power supply is turned OFF.

● Faulty Sequence

The motor will not operate if both the Forward/Stop Command (STF) and the Reverse/Stop Command (STR) are input at the same time. Correct the sequence.

● Malfunction due to Unwanted Current Path (when Using an Internal Power Supply for a Model with an NPN Input)

The Inverter input may remain ON if there is an unwanted current path in the controller output. With the wiring shown below, the Inverter input will operate due to the current path indicated by the arrow if the controller output power supply is less than 24 VDC or the power supply is OFF. If this occurs, insert a diode as indicated in the diagram at section A.



The motor only rotates in one direction.

Problem	Probable cause	Correction
Reverse rotation prohibition is selected.	If P13 (reverse rotation prohibit selection) is set to FWD (prohibit reverse operation), the Inverter will not accept reverse-rotation commands.	To use both forward and reverse rotation, set P13 to “F.R.”

The motor is rotating in the wrong direction.

Problem	Probable cause	Correction
The output wiring of the motor is faulty.	The U/T1, V/T2, and W/T3 terminals of the Inverter are not properly connected to the U, V and W terminals of the motor.	When the U/T1, V/T2, and W/T3 terminals of the Inverter are properly connected to the U, V and W terminals of the motor, the motor will operate in a forward direction when a forward rotation command is executed. The forward direction depends on the manufacturer and the motor type. Therefore, be sure to check the specifications.Switching two wires among the U/T1, V/T2, and W/T3 will reverse the direction of rotation.

The motor is burning out.

Problem	Probable cause	Correction
The load is too big.	If the load of the motor is too big and the motor is used with the effective torque exceeding the rated torque of the motor, the motor will burn out.	Reduce the load amount by either reducing the load or lengthening the acceleration/deceleration time. Also consider increasing the motor capacity. Note: For example, the rated torque of the motor and capacity may be limited to eight hours of use if the inscription on the motor states that the motor is rated for eight hours. If the 8-hour rated torque is used for normal operation, it may cause the motor to burn out.
The ambient temperature is too high	The rating of the motor is determined within a particular ambient operating temperature range. The motor will burn out if it runs continuously at the rated torque in an environment in which the maximum ambient operating temperature is exceeded.	Lower the ambient temperature of the motor to within the acceptable ambient operating temperature range.
The withstand voltage between the phases of the motor is insufficient.	When the motor is connected to the output of the Inverter, a surge will be generated between the switching of the Inverter and the coil of the motor. Normally, the maximum surge voltage is approximately three times the input power supply voltage of the Inverter (i.e., approximately 600 V for 200-V Inverters).	Therefore, the dielectric strength of the motor to be used must be higher than the maximum surge voltage.

Controller or AM radio receives noise when Inverter is started.

Problem	Probable cause	Correction
Noise derives from Inverter switching.	Take the measures to prevent noise. Noise can be reduced to some extent.	Lower the carrier frequency of the Inverter in P14 to 4 kHz.
		Install an Input Noise Filter on the power input area of the Inverter.
		Install an Output Noise Filter on the output area of the Inverter.
		Enclose the Inverter with a metal shield and ground the shield.

The ground fault interrupter is actuated when Inverter is started.

Problem	Probable cause	Correction
Leakage current flows through the Inverter.	The Inverter performs internal switching. Therefore, a leakage current flows through the Inverter. This leakage current may actuate the ground fault interrupter, shutting the power OFF. Note: In addition, remember that a leakage current increases in proportion to the cable length. (Normally, approximately 5 mA of leakage current is generated for each meter of cable.)	Use a ground fault interrupter with a high leakage-current detection value (sensitivity amperage of 200 mA or more, operating time of 0.1 s or more) or one with high-frequency countermeasures for Inverter use. Reducing the carrier frequency value in P14 is also effective.

There is mechanical vibration.

Problem	Probable cause	Correction
The mechanical system is making unusual noise.	Resonance is occurring between the characteristic frequency of the mechanical system and the carrier frequency.	If the motor is running with no problems and the machinery system is vibrating with a high-pitched whine, it may indicate that there resonance is occurring between the characteristic frequency of the mechanical system and the carrier frequency. To prevent this type of resonance, adjust the carrier frequency value in P14.
	Resonance is occurring between the characteristic frequency of the mechanical system and the output frequency of the Inverter.	Install vibration-proof rubber on the motor base to prevent the resonance of the mechanical system.
The motor vibrates excessively and does not rotate normally.	Motor Phase Interruption. If one or two of the three phases of the motor are open, the motor will vibrate excessively and will not rotate.	Check that the motor is wired correctly without any disconnection. The same phenomenon will occur if the output transistor of the Inverter is open and damaged. Check the balance of the Inverter's output voltage as well.

The motor rotates even after Inverter output is stopped.

Problem	Probable cause	Correction
The motor rotates even after Inverter output is stopped.	If the motor continues operating at low speed, without completely stopping, even after a deceleration stop has been executed, it means that the DC injection braking is not decelerating enough.	Increase the parameter in P05 for DC injection braking-to-stop time or increase the deceleration time.

When the motor starts, an overcurrent fault (E02) is detected and the motor stalls.

Problem	Probable cause	Correction
When the motor starts, an overcurrent fault (E02) is detected and the motor stalls.	DC injection braking is insufficient at startup. This can also occur if the motor is already turning when the motor is started.	This can be prevented by slowing the rotation of the motor by DC injection braking before starting the motor. Increase the parameter in P04 for startup DC injection braking time.

4-3 Maintenance and Inspection

■ Daily Inspection

Check the following items with the Inverter in operation.

- The motor must not be vibrating or making unusual noises.
- There must be no abnormal heat generation.
- The output current value shown on the monitor display must not be higher than normal.
- The cooling fan must be operating normally. (This applies only to Inverter models that have a cooling fan.)

■ Periodic Inspection

Check the following items during periodic maintenance.

- The terminal screws of the Inverter must not be loose.
- There must be no conductive dust or oil mist on the terminal block or inside the Inverter.
- The mounting screws of the Inverter must not be loose.
- No dust must be accumulating on the vents of the Inverter.
- There must be no abnormalities in the outward appearance of the Inverter.
- The control panel cooling fan must be operating normally.

■ Periodic Maintenance of Parts

The Inverter is configured of many parts, and these parts must operate properly to make full use of the Inverter's functions. Among the electronic components, there are some that require maintenance depending on their usage conditions. To keep the Inverter operating normally over a long period of time, it is necessary to perform periodic inspections and replace parts according to their service life.

(Taken from the JEMA publication *Recommended Periodic Inspections of General-purpose Inverters*.)

Periodic inspection standards vary with the installation environment and usage conditions of the Inverter. To lengthen the maintenance period, it is recommended that you lower the ambient temperature, and minimize the time during which the power is ON. The maintenance period of the Inverter is described below. Keep this as reference.

Note For details regarding maintenance, consult your OMRON representative.

- Cooling fan: 5 years

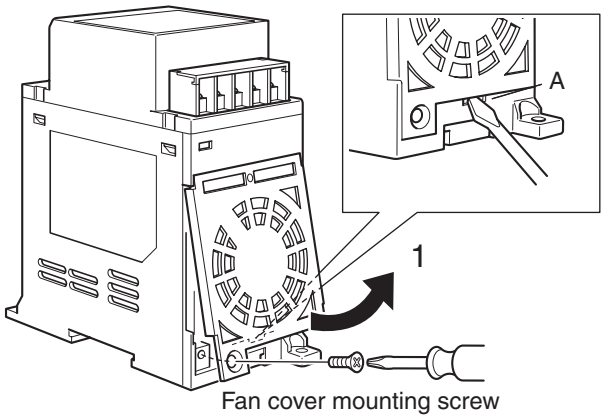
Usage Conditions (When mounted as described in the User's Manual)	
Ambient temperature	40°C
Load ratio	80%
Operating time per day	12 hours

■ Replacing the Cooling Fan

If a cooling fan fault (E07) is displayed, or if the cooling fan needs replacement, take the following steps to replace it.

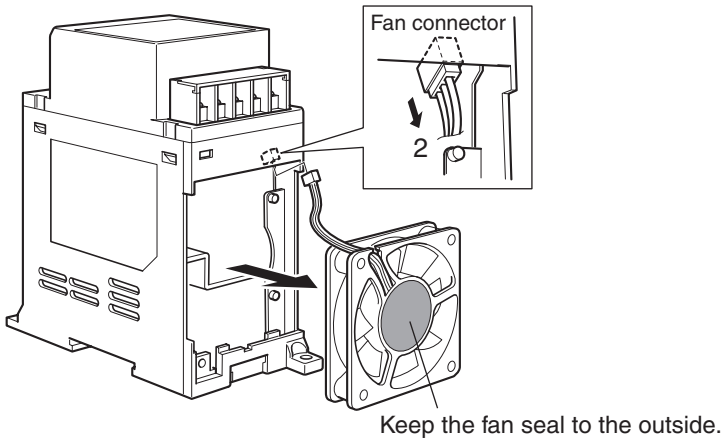
1. Remove the fan cover mounting screws.
2. Insert a flat-blade screwdriver into the slot (indicated by “A”), and pull off the fan cover in the direction indicated by “1.”

Fig. 1



3. Remove the fan and pull out the fan connector (in the direction indicated by “2”) from the socket on the board side in the case. Do not pull on the wires alone. Doing so may break the wires.

Fig. 2

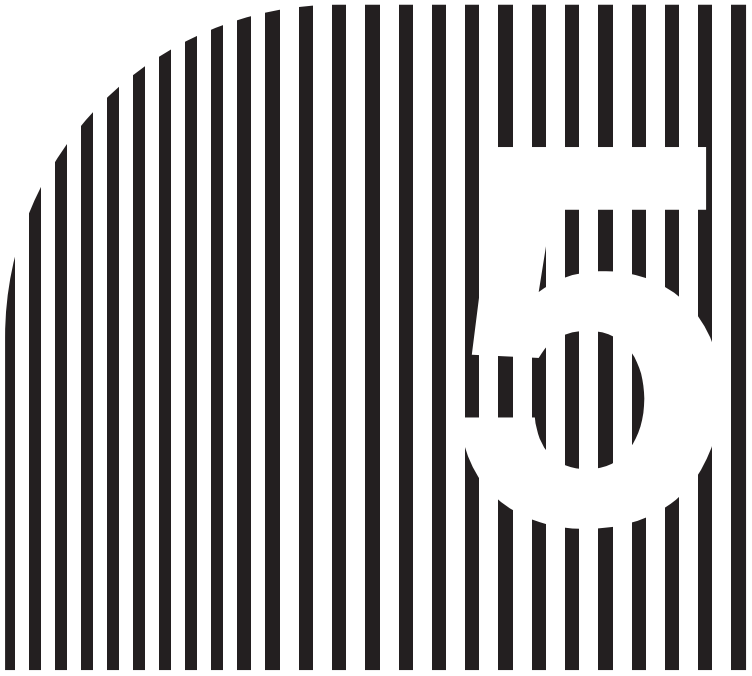


4. Insert the connector for the new fan into the socket on the board side in the case.
   Position the connector so that the connector latches are aligned.
5. Secure the fan in the case.
   Check that the wiring direction is as shown in Fig. 2, and mount the fan with the seal facing outwards.
6. Replace the fan cover and tighten the mounting screws.

   The cooling fan replacement is now complete.

● Replacement Cooling Fan Model (for 3G3JE)

For details on cooling fan models, refer to *5-2 Option Specifications*.



Chapter 5

Specifications

5-1 Inverter Specifications

■ 200 V-class Inverters

Item	Three-phase 200-V AC models (3G3JE)	A2001	A2002	A2004
Power supply	Rated supply voltage and frequency	Three-phase 200 to 230 V AC at 50/60 Hz		
	Allowable voltage fluctuation	−15 to 10%		
	Allowable frequency fluctuation	±5%		
	Required capacity at facility (kVA) (See note 1.)	0.4	0.7	1.2
Heat radiation (W) (See note 2.)		6.8	14.8	21.9
Approximate weight (kg)		0.3	0.4	
Cooling method		Self-cooling	Forced cooling	
Maximum motor capacity (kW)		0.1	0.2	0.4
Output specifications	Rated output capacity (kVA)	0.3	0.5	1.0
	Rated output current (A)	0.8	1.4	2.5
	Rated output voltage (V)	Three-phase 200 to 230 V AC		
	Maximum output frequency	120 Hz		
Short-circuit current rating for power output (Motor output) (A)		36	54	54
Short-circuit designation for auxiliary circuit (Braking resistor connection)		---	Non-short-circuit proof	
Control characteristics	Power supply harmonics countermeasures	AC reactor		
	Control method	Sine wave PWM (V/f control)		
	Carrier frequency	4 kHz/7 kHz (selectable)		
	Frequency control range	0.0 to 120 Hz		
	Frequency precision (temperature characteristics)	±0.3% of the frequency reference (−10 to 50°C)		
	Frequency setting resolution	Digital commands: 0.1 Hz (less than 100 Hz) 1 Hz (100 Hz or greater) Time-proportional pulse input: ±0.5% of the frequency reference		
	Overload capacity	150% of rated output current for 1 min		
	External frequency set signal	Time-proportional pulse input		
	Acceleration/deceleration times	0.1 to 999 s (independent acceleration and deceleration time settings)		
	Braking torque	Approx. 20% (with no Braking Resistor connected) Approx. 100% (with Braking Resistor connected)		
	Voltage/frequency characteristics	Constant torque characteristics or gradual decrease torque characteristics (with automatic torque boost)		

Item	Three-phase 200-V AC models (3G3JE)	A2001	A2002	A2004
Protective functions	Motor protection	Protection by electronic thermal		
	Instantaneous overcurrent protection	Stops at approx. 250% of rated output current.		
	Overcurrent protection	Stops in 1 min at approximately 150% of rated output current.		
	Overvoltage protection	Stops when main-circuit DC voltage is approximately 410 V min.		
	Undervoltage protection	Stops when main-circuit DC voltage is approximately 200 V max.		
	Momentary power interruption restart selection	Select between none (stops at 15 ms or longer), continue operation if power is restored within approx. 0.5 s, or continue operation regardless of length of interruption.		
	Radiation fin overheated	Temperature is detected by a thermistor.		
	Grounding protection	Protected by overcurrent protection.		
	Charge indicator	The data display will flash until the main circuit DC voltage is 60 V or less.		
Environment	Location	Inside a control panel (with no corrosive gas, dust, etc.)		
	Ambient operating temperature	−10°C to 50°C		
	Ambient operating humidity	5% to 85% (with no condensation)		
	Transport and storage temperature	−20°C to 60°C		
	Transport and storage humidity	5% to 85% (with no condensation)		
	Altitude	1,000 m max. (air pressure of 79.5 kPa min. during transport and storage)		
	Insulation resistance	5 MΩ min.		
	Vibration resistance	9.8 m/s^2 max.		
Degree of protection		IP20		

Note 1. The required capacity at the facility is the capacity for the Inverter's rated output. It depends on the impedance at the input power supply. (The input power supply's power factor fluctuates, so it can be improved by inserting an AC reactor.) There will also be variations in the ratio between the rated current of the motor that is used and the rated output current of the Inverter.

Note 2. The heat radiation is the electric power consumed in the Inverter at the Inverter's rated output. (It is calculated by subtracting the output power from the input power under rated operating conditions.)

5-2 Option Specifications

5-2-1 List of Options

■ Mounted Options

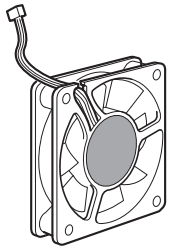
Product name	Model number	Description
Fan Unit	3G3JE-PFAN2004	Replacement for the existing cooling fan in the Inverter. Replace the cooling fan if it has reached the end of its service life or if a warning of cooling fan failure (E07) is indicated.

■ Separately Mounted Options

Product name	Model number	Description
Braking Resistor	3G3IV-PERF150WJ201	Uses a resistor to absorb the motor's regenerative energy to reduce deceleration time. (Usage rate: 3% ED)
Braking Resistor Unit	3G3IV-PLKEB20P7	Uses a resistor to absorb the motor's regenerative energy to reduce deceleration time. (Usage rate: 10% ED)
AC Reactor (0.1/0.2 kW) (Yaskawa Electric)	3G3IV-PUZBAB2A7.0MH	Connect an AC Reactor to the Inverter to suppress harmonic current generated from the Inverter, or if the power supply capacity is much greater than the Inverter capacity. The AC Reactor also improves the power factor of the Inverter.
AC Reactor (0.4 kW) (Yaskawa Electric)	3G3IV-PUZBAB2.5A4.2MH	
EMC-compliant Input Noise Filter (Rasmi)	3G3JV-PRS2010J	A noise filter on the input side meeting EC Directive EMC requirements.
Simple Input Noise Filter (Yaskawa Electric)	3G3EV-PLNFD2103DY	Connect this Filter to the power input side to suppress noise entering the Inverter from the power line and reduce noise leaking from the Inverter into the power line.
Output Noise Filter (Tokin)	3G3IV-PLF310KA	Connect this Filter to the motor output side of the Inverter to suppress the noise generated by the Inverter from being transmitted to the output side.

5-2-2 Fan Unit

■ 3G3JE-PFAN2004



This is the replacement fan for the cooling fan.

Replace the cooling fan if it has reached the end of its service life or if a warning of cooling fan failure (E07) is indicated.

■ Applicable Models

Inverter		Fan Unit
Three-phase 200 V AC	3G3JE-A2002/A2002B/A2002B-FLK/ A2004/A2004B/A2004B-FLK 3G3JE-A2002N/A2002BN/A2002BN-FLK/ A2004N/A2004BN/A2004BN-FLK	3G3JE-PFAN2004

■ Replacement Method

For details, refer to *Replacing the Cooling Fan* in *4-3 Maintenance and Inspection*.

5-2-3 Braking Resistor

■ 3G3IV-PERF150WJ201

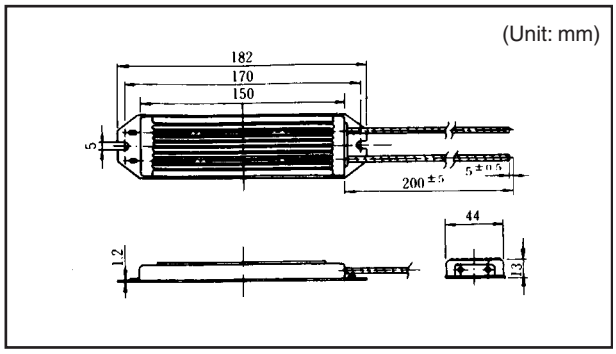
The Braking Resistor uses a resistor to absorb regenerative energy of the motor to reduce deceleration time. (Usage rate: 3% ED.)

Note "Usage rate: 3% ED" indicates that 3% of the operating time of one cycle can be used for braking (deceleration time).

■ Applicable Models

Inverter		Braking Resistor		
Voltage class	**Max. applicable motor capacity (kW)**	**Model**	**Resistor specifications**	**Number of parts**
200 V	0.2	3G3IV-PERF150WJ201	150 W, 200 Ω	1
	0.4			

■ External Dimensions



5-2-4 Braking Resistor Unit

■ 3G3IV-PLKEB20P7

The Braking Resistor Unit uses a resistor to absorb regenerative energy of the motor to reduce deceleration time. (Usage rate: 10% ED.)

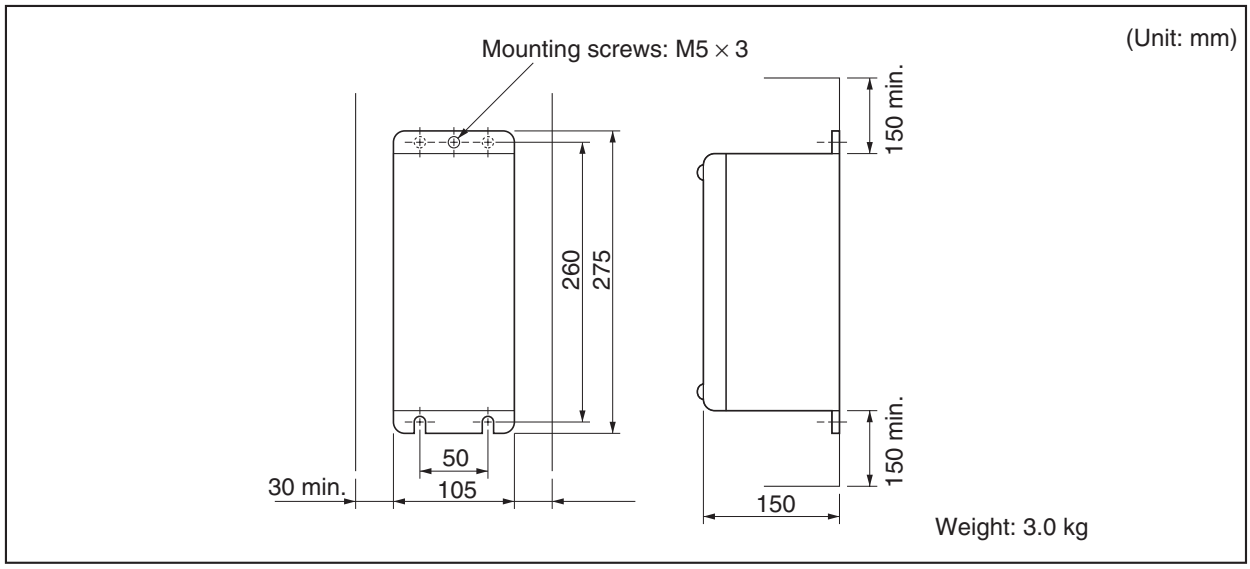
Note "Usage rate: 10% ED" indicates that 10% of the operating time of one cycle can be used for braking (deceleration time).

■ Applicable Models

Inverter		Braking Resistor Unit			
Voltage class	Max. applicable motor capacity (kW)	Model	Resistor specifications	Unit (See note.)	
				Number of parts	Max. number per Inverter
200 V	0.2	3G3IV-PLKEB20P7	70 W, 200 Ω	1	1
	0.4				

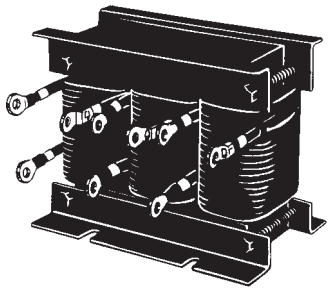
Note The "max. number per Inverter" indicates the maximum number of Braking Resister Units that can be connected per Inverter.

■ External Dimensions



5-2-5 AC Reactor

■ 3G3IV-PUZBAB□ (Yaskawa Electric)

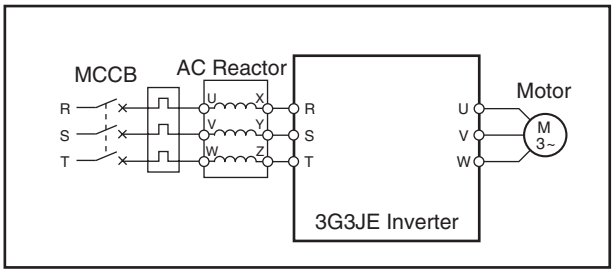


Connect an AC Reactor to the Inverter to suppress harmonic current generated from the Inverter, or if the power supply capacity is much greater than the Inverter capacity. The AC Reactor also improves the power factor of the Inverter. Select the AC Reactor model from the following table according to the motor capacity.

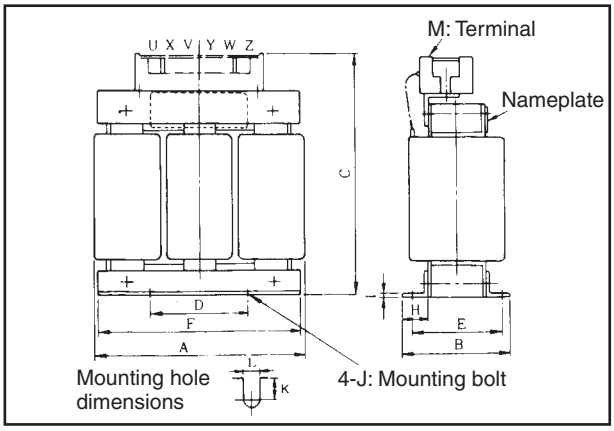
■ Applicable Models

Max. applicable motor capacity (kW)	Model 3G3IV-PUZBAB□	Current (A)	Induc-tance (mH)	Loss (W)	Weight (kg)	Dimensions (mm)										
						A	B	C	D	E	F	H	J	K	L	M
0.1 to 0.2	2A7.0MH	2	7.0	8	2.5	120	71	115	40	50	105	20	M6	10.5	7	M4
0.4	2.5A4.2MH	2.5	4.2	15	2.5	120	71	120	40	50	105	20	M6	10.5	7	M4

■ Connection Example



■ External Dimensions



5-2-6 EMC-compliant Input Noise Filter

■ 3G3JV-PRS2010J (Rasmi)

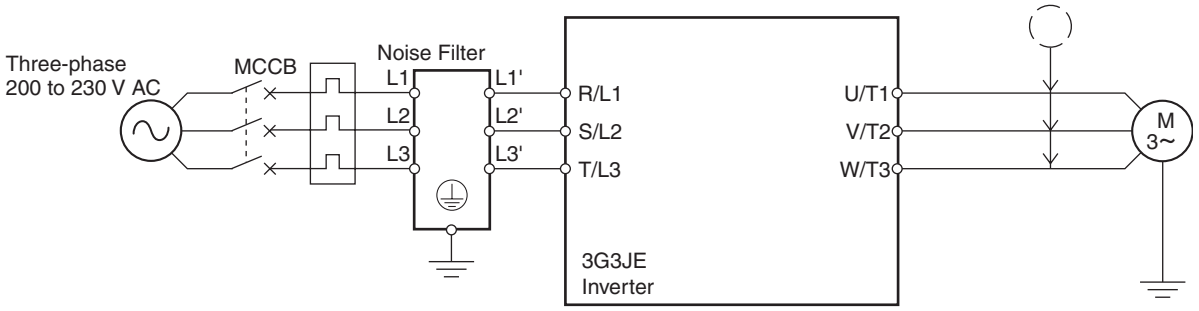
Be sure to select an optimum Noise Filter from the following so that the Inverter will satisfy EMC directive requirements of the EC Directives.

Connect the Noise Filter between the power supply and the input terminals (R/L1, S/L2, and T/L3) of the Inverter.

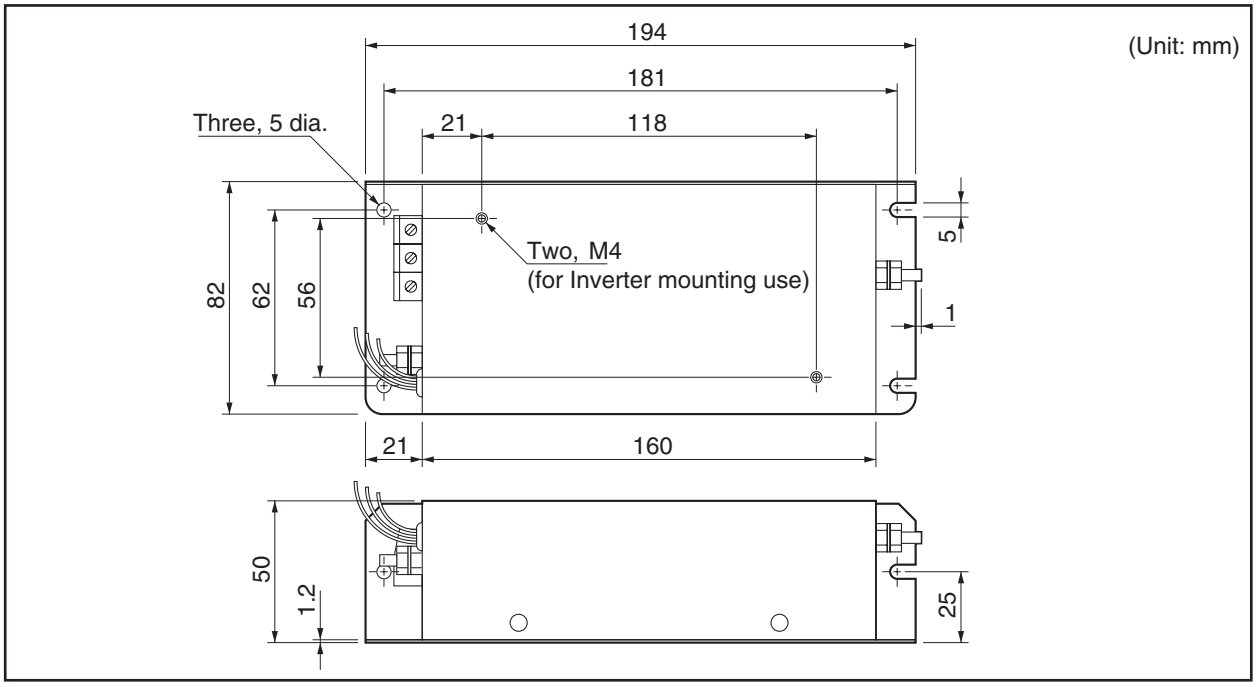
■ Applicable Models

Inverter		EMC-compatible Input Noise Filter		
Voltage	**Model**	**Model**	**Rated current (A)**	**Weight (kg)**
Three-phase 200 V AC	3G3JE-A2001/-A2001-FLK/ -A2002/-A2002B/-A2002B-FLK/ -A2004/-A2004B/-A2004B-FLK 3G3JE-A2001N/-A2001N-FLK/ -A2002N/-A2002BN/-A2002BN-FLK/ -A2004N/-A2004BN/-A2004BN-FLK	3G3JV-RPS2010J	10	0.8

■ Connection Example

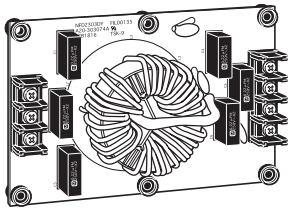


■ External Dimensions



5-2-7 Simple Input Noise Filter

■ 3G3EV-PLNFD2103DY (Yaskawa Electric)

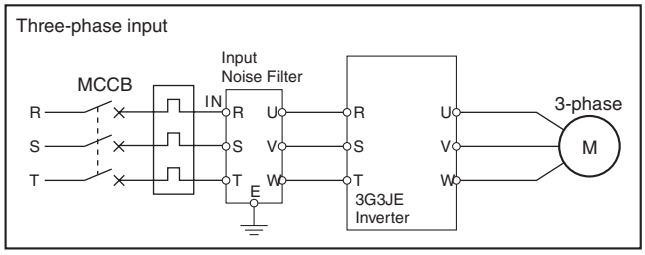


The Simple Input Noise Filter is connected to the power input side to eliminate the noise in the power line connected to the Inverter and suppress noise leaking from the Inverter to the power line.

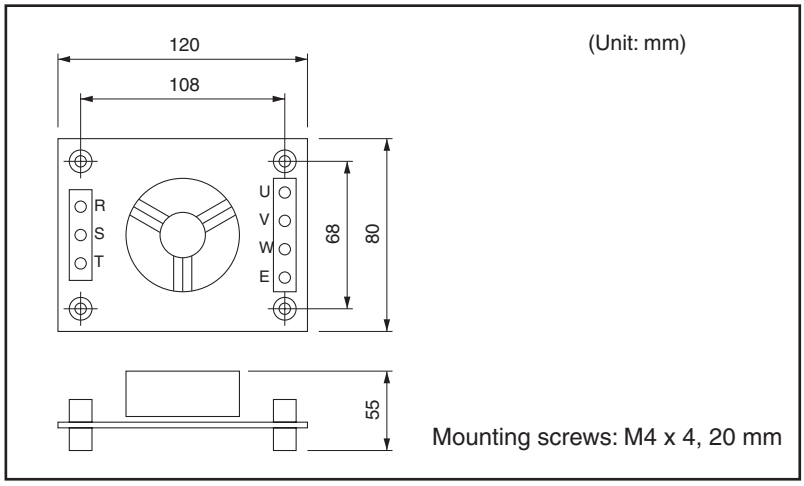
■ Applicable Models

Inverter		Simple Input Noise Filter		
Voltage	**Model**	**Model**	**Rated current (A)**	**Weight (kg)**
Three-phase 200 V AC	3G3JE-A2001/-A2001-FLK/ -A2002/-A2002B/-A2002B-FLK/ -A2004/-A2004B/-A2004B-FLK 3G3JE-A2001N/-A2001N-FLK/ -A2002N/-A2002BN/-A2002BN-FLK/ -A2004N/-A2004BN/-A2004BN-FLK	3G3EV-PLNFD2103DY	10	0.2

■ Connection Example

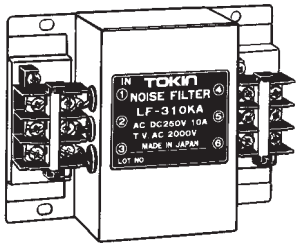


■ External Dimensions



5-2-8 Output Noise Filter

■ 3G3IV-PLF310KA (Tokin)

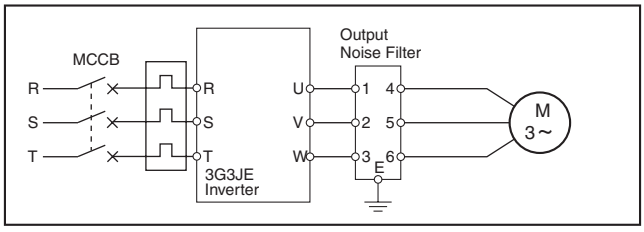


The Output Noise Filter suppresses the generated noise of the Inverter from being transmitted to the output line. Connect the Output Noise Filter to the output side of the Inverter.

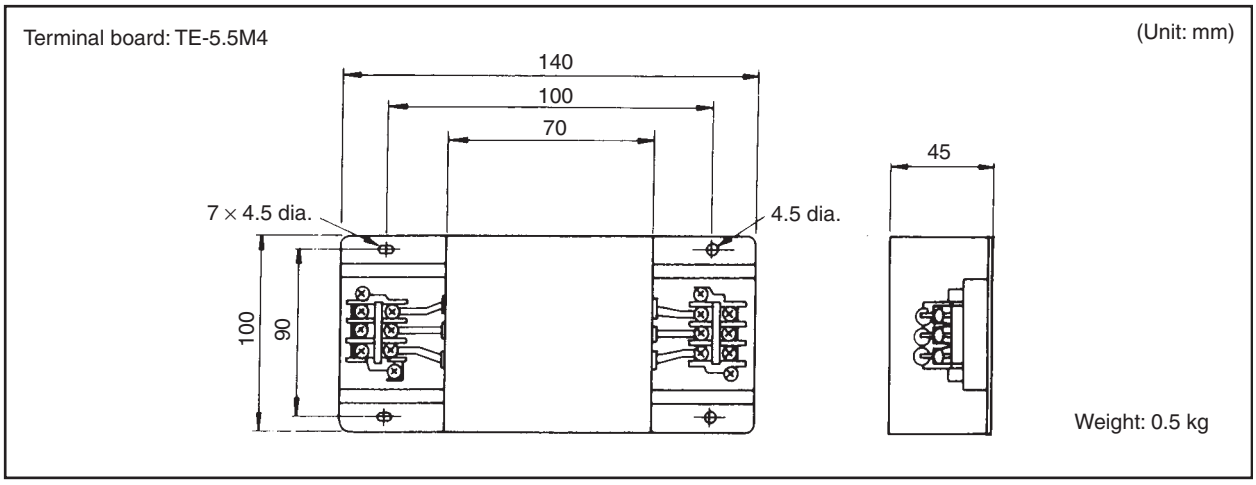
■ Applicable Models

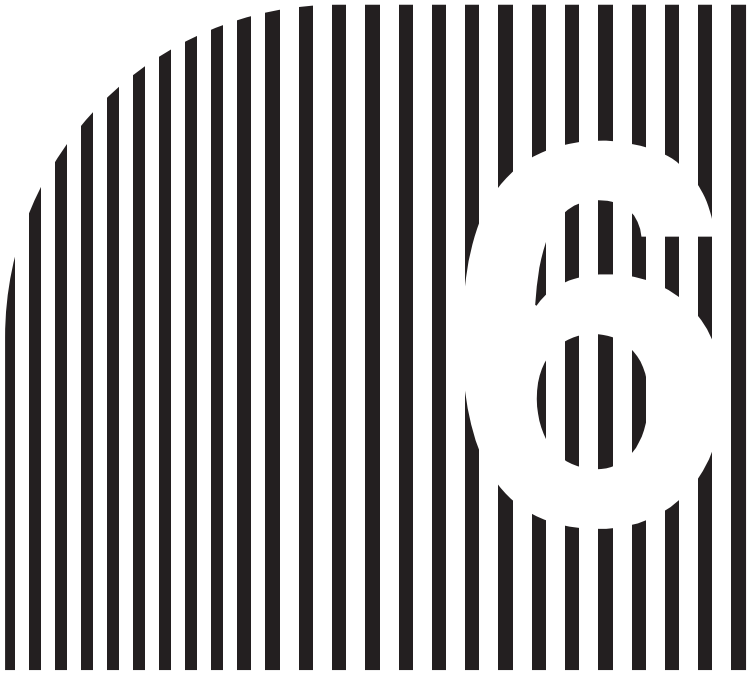
Inverter		Output Noise Filter	
Max. applicable motor capacity (kW)	**Inverter capacity (kVA)**	**Model**	**Rated current (A)**
0.1	0.3	3G3IV-PLF310KA	10
0.2	0.5		
0.4	1.0		

■ Connection Example



■ External Dimensions

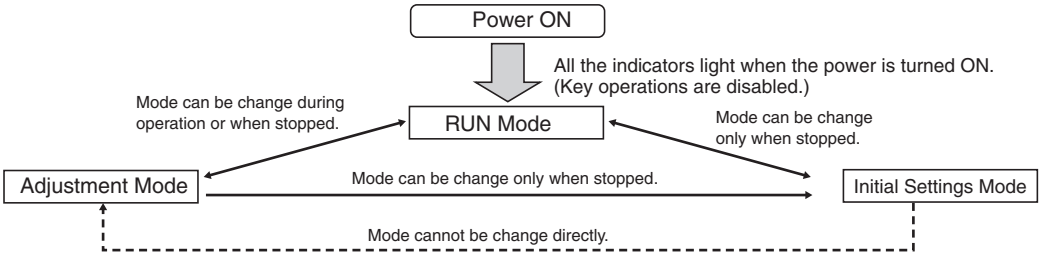




Chapter 6

Parameter Tables

■ Changing between Modes



■ Conditions for Setting and Monitoring in Each Mode

Mode	Setting/monitoring item	Motor operating			Motor stopped		
		Monitor set value	Change set value	Stop	Monitor set value	Change set value	Start
RUN mode	Frequency reference	Yes	Yes	Yes	Yes	Yes	Yes
	Output frequency	Yes	No	Yes	Yes	No	Yes
	Output current	Yes	No	Yes	Yes	No	Yes
	Accumulated operating time	Yes	No	Yes	Yes	No	Yes
	Forward/reverse operation selection	Yes	Yes	Yes	Yes	Yes	Yes
Adjustment mode	Frequency references 1 to 4	Yes	Yes	Yes	Yes	Yes	Yes
	Acceleration/deceleration time	Yes	No	Yes	Yes	Yes	Yes
	Application selection	Yes	No	Yes	Yes	Yes	Yes
Initial settings mode	P01 to P21	No	No	No	Yes	Yes	No

Note If the power is turned OFF while a setting is being changed, the change will be lost when power is turned back ON.

■ Indicator Operation

Name	Indicator	Description	Reference page
RUN indicator	☐ RUN	Lit while a RUN command is being applied.	1-4
Reverse operation indicator	☐ RVS	Lit while an RVS command is being applied.	1-4
Alarm indicator	☐ ALM	Lit when a fault occurs or when a protective function operates. (Faults can be monitored in RUN mode.)	1-4
Communications indicator	☐ COM	Lit during communications (sending or receiving) (Communications Models only).	1-4

■ RUN Mode

Name	Indicator	Data display	Setting range	Default setting	Unit	Reference
Frequency reference	☐ Hz set	The frequency reference is displayed.	0.0 to 120	10.0	Hz	3-10
Output frequency	☐ Hz out	The output frequency is displayed.	None	---	Hz	3-10
Output current	☐ A	The output current is displayed.	None	---	A	3-10
Accumulated operating time	☐ Kh	The accumulated operating time is displayed.	None	---	Kh	3-10
Forward/reverse operation selection	☐ RVS (Lit during reverse operation.)	The direction of rotation is displayed.	FWD (FWd) REV (rEv)	FWD	None	3-10

- The frequency reference can be set between the frequency reference upper limit (P07) and frequency reference lower limit (P08).
- Even if reverse operation is selected, forward operation will be returned to when the power is turned OFF and ON or initial settings mode is entered.

■ Adjustment Mode

Name	Data display	Description	Setting range	Default setting	Unit	Reference
Frequency reference 1	SP1	Used to set internal frequency references. **Note:** Enabled when "MSP" is selected for P11 (Frequency reference selection).	0.0 to 120	10.0	Hz	3-12
Frequency reference 2	SP2			0.0	Hz	3-12
Frequency reference 3	SP3			0.0	Hz	3-12
Frequency reference 4	SP4			0.0	Hz	3-12
Acceleration time	ACC	The acceleration time is the time required to accelerate from 0% to 100% of the maximum output frequency. (See note.)	0.1 to 999	10.0	s	3-13
Deceleration time	dEC	The deceleration time is the time required to decelerate from 100% to 0% of the maximum output frequency. (See note.)	0.1 to 999	10.0	s	3-13
Application selection	Lod	Sets the V/f pattern as the basic characteristic according to the application to be used. CNV: Conveyer applications FAN: Fan or pump applications	CNV (Cnv) FAN (FAn)	CNV	None	3-15

- Set values for SP1 to SP4, ACC, and DEC are changed in increments of 0.1 up to 99.9. From 100 and up they are changed in increments of 1.0.

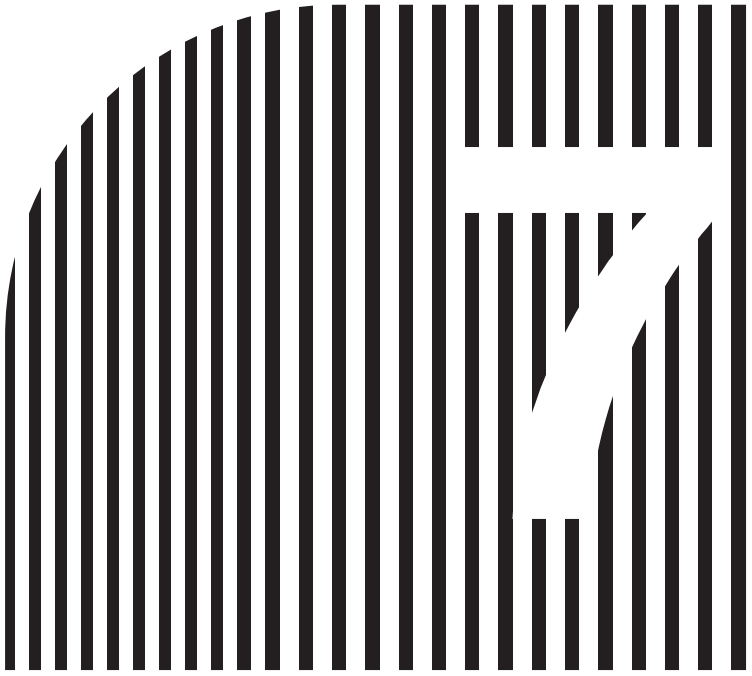
Note The time required to reach the frequency reference from 0 Hz, or to reach 0 Hz from the frequency reference, is as follows:
Acceleration (deceleration) time =
Acceleration (deceleration) time set value × Frequency reference value ÷ Maximum output frequency

■Initial Settings Mode

Display	Name	Description	Setting range (See note 1.)	Default setting	Unit	Reference
P01	Rated motor current	Used to set the motor's rated current as the standard current for motor overload (E03) detection. (Motor overload protection will be disabled if 0.0 A is set.) The normal rated current for a motor with the maximum capacity supported by the Inverter is set as the default.	0.0 to 2.5	0.1 kW: 0.6 0.2 kW: 1.0 0.4 kW: 2.0	A	3-17
P02	Accumulated operating time standard	Used to set the alarm output time for the accumulated operating time alarm (E09).	0.0 to 99.9	20.0	Kh	3-23
P03	DC injection braking frequency	Used to set functions for applying DC current to an inductive motor to brake the motor. When stopping, DC braking operates at the DC braking standard frequency and below.	0.0 to 5.0	3.0	Hz	3-18
P04	Startup DC injection braking time		0.0 to 10.0	0.0	s	3-18
P05	DC injection braking-to-stop time		0.0 to 10.0	0.5	s	3-18
P06	Maximum output frequency	Used to limit the frequency. Also used as a reference frequency for the acceleration time and deceleration time.	50.0 to 120	60.0	Hz	3-19
P07	Frequency reference upper limit	Used to set the upper limit for the frequency reference.	0.1 to 120	60.0	Hz	3-19
P08	Frequency reference lower limit	Used to set the lower limit for the frequency reference.	0.0 to 120	0.0	Hz	3-19
P09	Momentary power interruption restart selection	Used to select the processing for when main-circuit low voltage protection occurs. 0: Do not continue operation. 1: Continue operation if power interruption is 0.5 s or less. 2: Always continue operation.	0 (0) 1 (1) 2 (2)	0	None	3-20
P10	Operation command selection	Used to select the command method for starting and stopping the Inverter and the direction of rotation. Key: Use Digital Operator keys. PLC: Use the STF and STR control inputs.	Key (KEY) PLC (PLC)	Key	None	3-20
P11	Frequency reference selection	Used to select the method for inputting frequency references. Key: Use Digital Operator keys. MSP: Use frequency references using multi-step speed reference 0 (SS0) and multi-step speed reference 1 (SS1). T.C: Time-shared proportional pulses using multi-step speed reference 0 (SS0).	Key (KEY) MSP (MSP) T.C (t.C)	Key	None	3-21

Display	Name	Description	Setting range (See note 1.)	Default setting	Unit	Reference
P12	Multi-function output selection	Used to select the function of the multi-function output terminal. 0: Not allocated. 1: Zero speed (Output turned ON when the output frequency is 0 Hz or operation is stopped.) 2: Frequency matching (Output turned ON when the output frequency and the frequency reference are the same.) 3: Reverse operation (Output turned ON when the direction of rotation is set for reverse operation.)	0 (0) 1 (1) 2 (2) 3 (3)	0	None	3-21
P13	Reverse rotation prohibit selection	Used to select the operation for when a reverse rotation command is input. F.R: Forward or reverse rotation FWD: Forward rotation only (Reverse rotation prohibited.)	F.R (F.r) FWD (FWd)	FWD	None	3-22
P14	Carrier frequency selection	Used to set the carrier frequency. 4K: 4 kHz 7K: 7 kHz	4k (4K) 7k (7K)	4K	Hz	3-22
P15	Communications unit number	Used to set the communications unit number.	0 to 99	1	None	3-24
P16	Communications baud rate	Used to set the baud rate. 24: 2.4 kbps 48: 4.8 kbps 96: 9.6 kbps 192: 19.2 kbps	2.4 (24) 4.8 (48) 9.6 (96) 19.2 (192)	9.6	kbps	3-24
P17	Communications data length	Used to set the data length. 7: 7 bits 8: 8 bits	7 (7) 8 (8)	7	bit	3-24
P18	Communications stop bits	Used to set the number of stop bits. 1: 1 bit 2: 2 bits	1 (1) 2 (2)	2	bit	3-24
P19	Communications parity	Used to set the parity. non: None evn: Even odd: Odd	non (non) evn (Evn) odd (odd)	evn	None	3-25
P20	Parameter initialization	Initializes the parameter set values (except for the accumulated operating time) when “ini” is selected.	ini (ini) abt (Abt)	abt	None	3-22
P21	Accumulated operating time clear	Clears the accumulated operating time to zero when “ini” is selected.	ini (ini) abt (Abt)	abt	None	3-23

- Set values for P06, P07, and P08 are changed in increments of 0.1 up to 99.9. From 100 and up they are changed in increments of 1.0.
- P15 to P19 are not displayed for Standard Models. Refer to the *Communications Manual* for details.
- P11 is not displayed for Communications Models.



Chapter 7

Appendix

7-1 Selecting the Inverter

7-1-1 Selecting the Motor Capacity

Before selecting the Inverter, select the motor. To select the proper motor, calculate the load inertia according to the application, and calculate the motor's required capacity and torque.

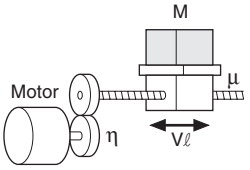
■ Simple Selection Method: Required Output Calculation

With this method, the motor is selected based on the output (kW) required for the motor's normal steady-state operation. More advanced calculations, such as the accelerating/decelerating operation, are omitted, so some extra capacity is added to the calculation result. This simple selection method can be used for applications such as fans and conveyor machinery, in which the motor operates continuously in a steady state.

Note The simple selection method cannot be used for the following kinds of applications. In these cases, used the detailed selection method.

- Applications requiring quick starts (acceleration)
- Applications with frequent starts and stops
- Applications with high inertia in the power transmission
- Applications with low efficiency in the power transmission

● Direct Drive Application: Normal Power P0 (kW)

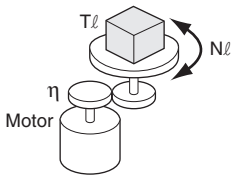


$$P_0\ (kW) = \frac{\mu \cdot Mg \cdot V\ell}{60 \cdot \eta} \times 10^{-3}$$

μ: Coefficient of friction
M: Weight of linear drive mechanism (kg)
g: Acceleration of gravity ($g \approx 9.8\ m/s^2$)
Vℓ: Velocity of linear drive mechanism (m/min)
η: Efficiency of transmission mechanism ($\eta \leq 1$)

Note This equation can be also be used for belt conveyors.

● Rotary Drive Application: Normal Power P0 (kW)



$$P0\ (kW) = \frac{2\pi \cdot T\ell \cdot N\ell}{60 \cdot \eta} \times 10^{-3}$$

Tℓ: Load torque (load axis, N·m)
Nℓ: Load axis speed (r/min)
η: Efficiency of transmission mechanism ($\eta \leq 1$)

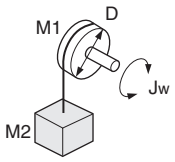
■ Detailed Selection Method: RMS Calculations

With this method, the motor is selected by calculating the effective torque and maximum torque required to achieve the application's operating pattern based on the output (kW) required for the motor's normal steady-state operation. This method can be used to select the motor appropriate for an operating pattern.

● Calculating the Load Inertia and Motor Axis Inertia

Calculate the moment of inertia at the motor axis by calculating the moment of inertia of all of the parts including the power transmission system.

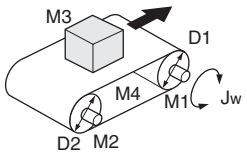
Winder Example



$$Jw\ (kg \cdot m^2) = J1 + J2 = \left(\frac{M1 \cdot D^2}{8} + \frac{M2 \cdot D^2}{4}\right) \times 10^{-6}$$

Jw: Axial inertia ($kg \cdot m^2$)
J1: Cylindrical inertia (axial, $kg \cdot m^2$)
J2: Workpiece inertia (axial, $kg \cdot m^2$)
M1: Cylinder weight (kg)
M2: Workpiece weight (kg)
D: Cylinder diameter (mm)

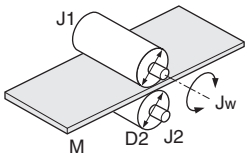
Conveyor Example



$$Jw\ (kg \cdot m^2) = J1 + J2 + J3 + J4 = \left(\frac{M1 \cdot D^2}{8} + \frac{M2 \cdot D^2}{4} \cdot \frac{D1^2}{D2^2} + \frac{M3 \cdot D1^2}{4} + \frac{M4 \cdot D1^2}{4} \right) \times 10^{-6}$$

Jw: Axial inertia (at cylinder, 1 axis, $kg \cdot m^2$)
J1: Cylinder 1 inertia (at cylinder, 1 axis, $kg \cdot m^2$)
J2: Cylinder 2 inertia (at cylinder, 1 axis, $kg \cdot m^2$)
J3: Workpiece inertia (at cylinder, 1 axis, $kg \cdot m^2$)
J4: Belt inertia (at cylinder, 1 axis, $kg \cdot m^2$)
M1: Cylinder 1 weight (kg)
M2: Cylinder 2 weight (kg)
M3: Workpiece weight (kg)
M4: Belt weight (kg)
D1: Cylinder 1 diameter (mm)
D2: Cylinder 2 diameter (mm)

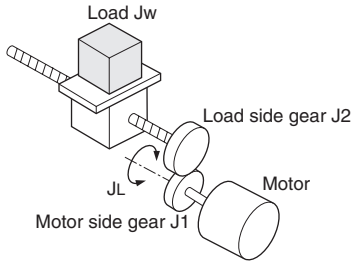
Roller Example



$$Jw\ (kg \cdot m^2) = J1 + \left(\frac{D1^2}{D2^2} \right) J2 + \frac{M \cdot D1^2}{4} \times 10^{-6}$$

Jw: Axial inertia (roller, 1 axis, $kg \cdot m^2$)
J1: Roller 1 inertia (roller, 1 axis, $kg \cdot m^2$)
J2: Roller 2 inertia (roller, 2 axis, $kg \cdot m^2$)
M: Workpiece weight (kg)
D1: Roller 1 diameter (mm)
D2: Roller 2 diameter (mm)

Motor Axis Inertia Conversion Example



J_L (kg·m^2)
$= J1 + G^2 (J2 + Jw)$

J_L: Motor axis inertia (kg·m^2)

Jw: Load inertia (load side gear axis, kg·m^2)

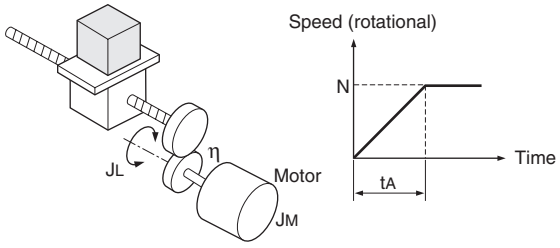
J1: Motor side gear inertia (kg·m^2)

J2: Load side gear inertia (kg·m^2)
Z1: Number of motor-side gear teeth
Z2: Number of load-side gear teeth
G: Gear ratio (reduction ratio) = Z1/Z2

● Calculating the Motor Axis Torque and Effective Torque

The torque required for acceleration is calculated from the load inertia at the motor axis, the motor's rotor inertia, and the acceleration rate. In addition, the load torque is calculated from external forces applied to the load (gravity and tension) and friction. These results are combined to calculate the required torque from the motor.

Calculating the Acceleration Torque (TA)



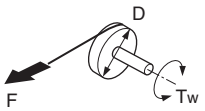
$$T_A\ (N{\cdot}m) = \frac{2\pi{\cdot}N}{60{\cdot}tA}\left(JM + \frac{JL}{\eta}\right)$$

T_A: Acceleration torque (N·m)

J_L: Motor axis load inertia (kg·m^2)

J_M: Motor rotor inertia (kg·m^2)
η: Efficiency of transmission mechanism ($\eta \leq 1$)
t_A: Acceleration time (s)
N: Motor revolutions (r/min)

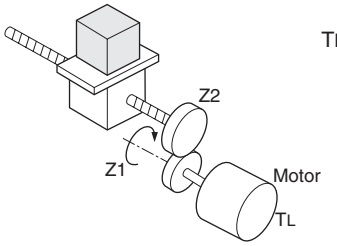
Calculating the Motor Axis Load Torque (TL)



$$Tw\ (N{\cdot}m) = F{\cdot}\frac{D}{2} \times 10^{-3}$$

Tw: Load torque (load axis, N·m)
F: External force (N)
D: Cylinder diameter (mm)

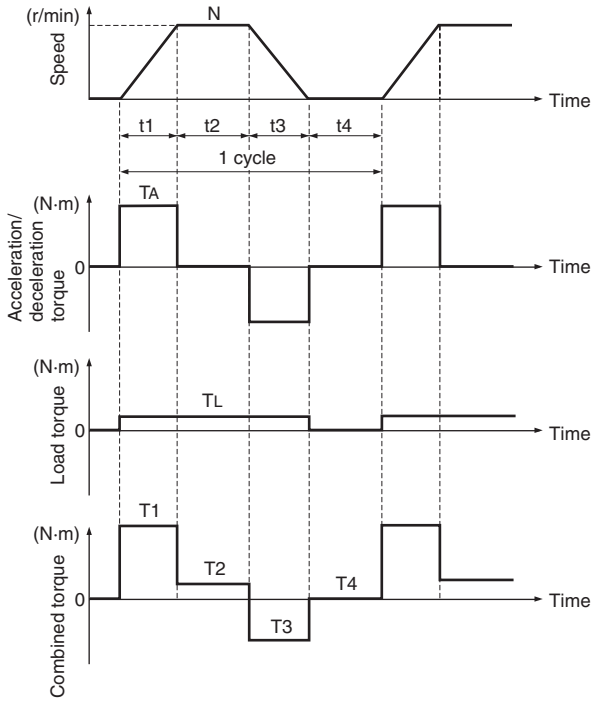
(Generally speaking, the force of friction is F = μMg (N).
μ: Coefficient of friction
M: Weight of drive mechanism (kg)
g: Acceleration of gravity (g ≈ 9.8 m/s^2)



$$TL\ (N{\cdot}m) = TW{\cdot}\frac{G}{\eta}$$

TL: Motor axis load torque (N·m)
Tw: Load torque (load axis, N·m)
Z1: Number of motor-side gear teeth
Z2: Number of load-side gear teeth
G: Gear ratio (reduction ratio) = Z1/Z2

Calculating the Combined Torque and Effective Torque



• Effective torque T_{RMS} (N·m)

$$= \sqrt{\frac{\Sigma (Ti^2 \cdot ti)}{\Sigma ti}}$$

$$= \sqrt{\frac{T1^2 \cdot t1 + T2^2 \cdot t2 + T3^2 \cdot t3 + T4^2 \cdot t4}{t1 + t2 + t3 + t4}}$$

• Maximum torque T_{MAX} (N·m) = T1 = TA + T_L

● Selecting the Motor

Select the motor capacity by putting the results of the calculations above into the following equations.

Calculate the motor capacities from the following two equations and use the larger of the two results as the motor capacity. Furthermore, when selecting the motor, add at least 20% to the motor capacity result to allow for calculation error and errors due to model changes.

Motor Capacity Equivalent to Effective Torque

$$\text{Motor capacity (kW)} = \frac{2\pi \cdot T_{RMS} \cdot N}{60} \times 10^{-3}$$

N: Max. speed (r/min)

Motor Capacity Required to Output the Maximum Torque

$$\text{Motor capacity (kW)} = \frac{2\pi \cdot T_{MAX} \cdot N}{60 \times 1.5} \times 10^{-3}$$

N: Max. speed (r/min)

Note The motor's maximum torque is calculated as 150% of the rated torque.

■ Selecting the Inverter Capacity

After selecting the motor, select an Inverter that can start the selected motor. Basically, select an Inverter with a maximum applicable motor capacity equal to the capacity of the selected motor. After selecting the Inverter, verify that it meets the following requirements.

- Motor steady-state current ≤ Inverter's rated output current
- Continuous maximum torque output time in the application ≤ 1 minute

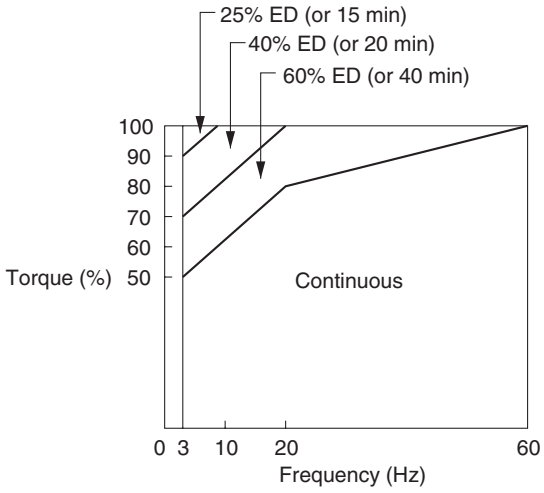
7-2 Precautions on Using the Inverter for a Motor

■ Using Inverter for Existing Standard Motor

When a standard motor is operated with the Inverter, a power loss is lightly higher than when operated with a commercial power supply. In addition, cooling effects also decline the low-speed range, resulting in an increase in the motor temperature. Therefore, motor torque must be reduced in the low speed range.

The following figure shows allowable load characteristics of a standard motor.

Allowable Load Characteristics of Standard Motor



● High-speed Operation

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

● Torque Characteristics

The motor may require more acceleration torque when the motor is operated with the Inverter than when operated with a commercial power supply. Check the load torque characteristics of the machine to be used with the motor to set a proper V/f pattern.

● Vibration

The 3G3JE Series employs high carrier PWM control to reduce motor vibration. When the motor is operated with the Inverter, motor vibration is almost the same as when operated with a commercial power supply.

Motor vibration may, however, become greater in the following cases.

- Resonance with the natural frequency of the mechanical system
  Take special care when a machine that has been operated at a constant speed is to be operated in variable speed mode.
  If resonance occurs, install vibration-proof rubber on the motor base.
- Residual imbalance in the 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. Motor noise, however, 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 input current of pole-changing motors differs from that of standard motors. Select, therefore, an appropriate Inverter according to the maximum input current of the motor to be used.

Before changing the number of poles, always make sure that the motor has stopped.

Otherwise, the overvoltage protective or overcurrent protective mechanism will be actuated, resulting in an error.

● Submersible Motor

The rated input current of submersible motors is higher than that of standard motors. Therefore, always select an Inverter by checking its rated output current.

When the distance between the motor and Inverter is long, use a cable thick enough to connect the motor and Inverter to prevent motor torque reduction.

● Explosion-proof Motor

When an explosion-proof motor or increased safety-type motor is to be used, it must be subject to an explosion-proof test in conjunction with the Inverter.

● Gear Motor

The speed range for continuous operation differs according to the lubrication method and motor manufacturer. In particular, the continuous operation of an oil-lubricated motor in the low speed range may result in seizing. If the motor is to be operated at a speed higher than 60 Hz, consult with the manufacturer.

● Synchronous Motor

A synchronous motor is not suitable for Inverter control.

If a group of synchronous motors is individually turned on and off, synchronism may be lost.

● Single-phase Motor

Do not use the Inverter for a single-phase motor.

The motor must be replaced with a 3-phase motor.

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

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

■ Motor Burnout Caused by Insufficient Dielectric Strength of Each Phase of Motor

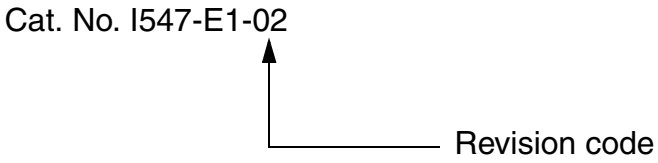
When using the Inverter to control a motor, surge occurs among the phases of the motor when the Inverter's output voltage is switched (PWM).

If the dielectric strength of each phase of the motor is insufficient, the motor may burn out.

Use a motor with a dielectric strength among the phases of the motor that is higher than the maximum surge voltage (i.e., three times the maximum power supply voltage).

Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.



The following table outlines the changes made to the manual during each revision.

Revision code	Date	Revised content
01	June 2006	Original production
02	September 2006	**Pages XII, 1-2, and 2-8:** Made additions related to models with NPN/PNP input. **Page 2-5:** Made additions to table. **Page 2-6:** Added note with references to it in graphic. **Pages 2-18, 2-19, 2-26, and 2-28:** Added “Models with PNP (NPN) Input” to the header tiles. **Pages 2-18, 2-19, 2-20, 2-26 to 2-28, 2-32 to 33:** Removed diodes from wiring diagrams. **Pages 2-20 to 2-22:** Added control circuit input terminal connection examples. **Pages 2-25 and 2-31:** Added note. **Pages 2-28 to 2-30:** Added information on connection to a Digital Controller or a Temperature Controller. **Page 2-36:** Added precaution on models with NPN input. **Page 4-8:** Added troubleshooting information on Inverter. **Page 5-5:** Added models to top table.

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