# Chapter 2 INSTALLATION AND WIRING

This chapter describes the important points in installing and wiring inverters.

#### Contents

2.1	Instal	llation	·· 2-1
2.2	Wirin	g	·· 2-4
2.2	2.1	Basic connection diagrams	·· 2-4
2.2	2.2	Removal and attachment of the front cover and wiring guide	
2.2	2.3	Wiring precautions ······	
2.2	2.4	Precautions for long wiring (between inverter and motor)	·· 2-9
2.2	2.5	Main circuit terminals ·····	2-11
[ ]	1]	Screw specifications and recommended wire size (main circuit terminals)	
[2	2]	Terminal layout diagrams (main circuit terminals) ······	
[ (	3]	Recommended wire size (main circuit terminals)	
[4	4]	Terminal function description (main circuit terminals)	
2.2	2.6	Control circuit terminals (common to all models) ······	2-27
[ ]	1]	Screw specifications and recommended wire size (control circuit terminals)	
[2	2]	Terminal layout diagram (control circuit terminals)	
[:	3]	Control circuit wiring precautions ······	
[4	4]	Description of terminal functions (control circuit terminals)	
2.2		Switching switches ·····	
2.3	Moun	nting and Removing the Keypad	2-43

# 2.1 Installation

#### (1) Installation environment

Please install FRENIC-MEGA in locations which meet the requirements specified in Chapter 1 "1.3.1 Operating environment".

### (2) Installation surface

Please install the inverter on noncombustibles such as metal. Also, do not mount it upside down or horizontally.

# **WARNING**

Install on noncombustibles such as metal.

Failure to observe this could result in fire.

#### (3) Surrounding space

Secure the surrounding space shown in Fig. 2.1-1 and Table 2.1-1. If enclosing the product in a cabinet and so on, be sure to provide adequate ventilation to the cabinet, as the ambient temperature may rise. Do not contain it in small enclosures with low heat dissipation capacity.

#### Installation of multiple inverters

If installing two or more units inside the same equipment or cabinet, they must be installed side by side as a rule. If vertical installation is unavoidable, install partitions to prevent heat dissipation from inverters below affecting those above.

With FRN0115G2S $\Box$ -2G / FRN0060G2 $\Box$ -4G or lower, only in the case of an ambient temperature of 40 °C (104°F) or below is it possible to install inverters and converters closely together horizontally.

	<b>0</b> 1	,,		
Type of I	nverter			
FRNDDD G2S-2G	FRNDDDD G2D-4G	A	В	С
0003 to 0008	0002 to 0004	50 (1.97)		0
0011 to 0115	0006 to 0060	10 (0.39)	100 (3.9)	(0)
0146 to 0432	0075 to 0520	50		100 (3.9)
_	0650 to 1386	(1.97)	150 (5.9)	150 (5.9)

Table 2.1-1 Surrounding space (mm (inch))

C: Space in front of inverter unit



Fig. 2.1-1 Installation direction

#### Installation with external cooling

The external cooling installation reduces the generated heat inside the panel by dissipating approximately 70% of the total heat generated (total heat loss) by mounting the cooling fins protruding outside the equipment or cabinet. The external cooling unit body has a protective construction of IP55.

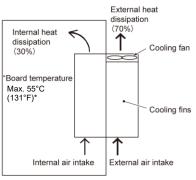
Installation with external cooling is possible for inverters FRN0115G2S-2G / FRN0060G2 -4G or lower with the addition of an external cooling attachment (option), and for FRN0146G2S-2G / FRN0075G2 -4G or higher by moving the mounting base.

(Refer to Chapter 11 "11.16 External Cooling Fan Attachments" for details on external cooling attachments.)



Take measures to prevent foreign material such as lint, wastepaper, wood shavings, dust, or metal scraps getting into the inverter, or adhering to the cooling fan.

Failure to observe this could result in fire or an accident.



Current derating is necessary in the +50 to +55°C (122 to 131°F) range.

Fig. 2.1-2 External cooling installation method

If installing a FRN0146G2S-2G / FRN0075G2 -4G or higher inverter with external cooling, change the mounting position of the upper and lower mounting bases using the following procedure. (See Fig. 2. 1-3 below.) The screw types and number of screws used will differ depending on the inverter type. Please check the following table.

Table 2.1-2 Screw type,	screw quantity	and tightening torque	
Table 2.1-2 0010W type,	Sciew quantity,	and lighterning lorque	

Inverter type	Mounting base securing screw	Case mounting screw	Tightening torque N·m (lb-in)
FRN0146G2S-2G/FRN0180G2S-2G FRN0075G2□-4G to FRN0150G2□-4G	M6x20 (top 5, bottom 3)	M6x20 (2 for top only)	5.8 (51.3)
FRN0215G2S-2G/FRN0288G2S-2G FRN0180G2□-4G	M6x20 (3 each for top and bottom)	M6x12 (3 for top only)	5.8 (51.3)
FRN0346G2S-2G FRN0216G2□-4G/FRN0260G2□-4G	M5x12 (7 each for top and bottom)	M5x12 (7 for top only)	3.5 (31.0)
FRN0325G2 -4G/FRN0377G2 -4G	M5x16 (7 each for top and bottom)	M5x16 (7 for top only)	3.5 (31.0)
FRN0432G2S-2G FRN0432G2□-4G/FRN0520G2□-4G	M5x16 (8 each for top and bottom)	M5x16 (8 for top only)	3.5 (31.0)
FRN0650G2□-4G/FRN0740G2□-4G FRN0960G2□-4G/FRN1040G2□-4G	M5x16 (2 each for top and bottom) M6x20 (6 each for top and bottom)	M5x16 (2 each for top and bottom) M6x20 (6 each for top and bottom)	3.5 (31.0) 5.8 (51.3)
FRN1170G2□-4G/FRN1386G2□-4G	M8x20 (8 each for top and bottom)	M8x20 (8 each for top and bottom)	13.5 (119.5)

1) Remove all of the mounting base securing screws and case mounting screws from the top of the inverter unit.

2) Secure the mounting base to the screw holes for the case mounting screws with the mounting base securing screws. There will be screws remaining after changing the mounting base position.

Mounting base fixation screw

Mounting base (upper side)

 Change the mounting base position at the bottom also using steps 1) and 2). (Inverters type of FRN0520G2□-4G or lower have no case mounting screws on the bottom.)

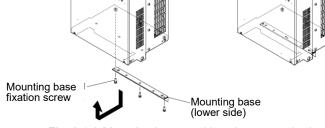


Fig. 2.1-3 Mounting base position change method



Use the specified screws for changing the mounting base.

Case attachment

screw

Failure to observe this could result in fire or an accident.

## 2.2 Wiring

### 2.2.1 Basic connection diagrams

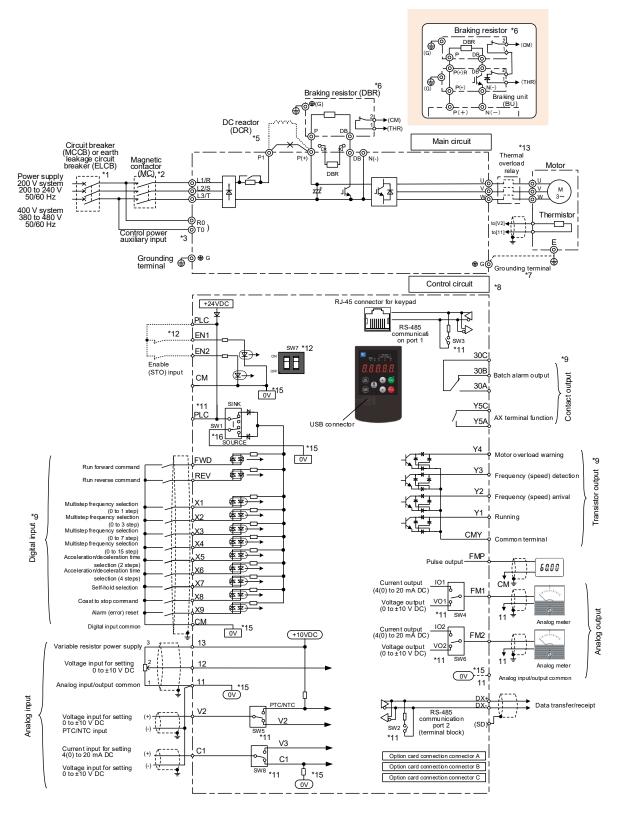


Fig. 2.2-1 Basic connection diagram

- (\*1) Install the molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELCB) (with overcurrent protection function) recommended for each inverter on the inverter input side (primary side) to protect wiring. Do not use a circuit breaker that exceeds the recommended rated current.
- (\*2) An MCCB or ELCB is also used if isolating the inverter from the power supply, and therefore the magnetic contactor (MC) recommended for each inverter should be installed if required. Please note that if installing a coil such as an MC or solenoid near the inverter, connect a surge absorber in parallel.
- (\*3) If wishing to retain the integrated alarm signal issued if the protective function is triggered even when the inverter main power supply is cut off, or to constantly display the keypad, connect these terminals to the power supply. (on FRN0008G2S-2G or higher / FRN0004G2□-4G or higher) The inverter can be run even without inputting the power supply to these terminals.
- (\*5) Remove the shorting bar between the inverter main circuit terminals P1 and P(+) before connecting the DC reactor (DCR) (option). Be sure to connect the DC reactor in the case of FRN0288G2S-2G / FRN0150G2□-4G HND specification and FRN0346G2S-2G or higher / FRN0180G2□-4G or higher inverters. Use a DC reactor (DCR) when the capacity of the power supply transformer is 500 kVA or more and is 10 times or more the inverter rated capacity, or when there are "thyristor-driven" loads.
- (\*6) FRN0288G2S-2G or lower / FRN0180G2□-4G or lower inverters are equipped with a built-in braking transistor, allowing direct connection of braking resistors between P(+) and DB.
   If connecting a braking resistor (DB) (option) to FRN0346G2S-2G or higher / FRN0216G2□-4G or higher inverters, a braking unit (BU) (option) is necessary. A built-in braking resistor is connected between terminals P(+) and DB on FRN0046G2S-2G or lower / FRN023G2□-4G or lower inverters. If connecting a braking resistor (DB), be sure to disconnect the built-in braking resistor.
- (\*7) This terminal is used for grounding the motor. Connect if required.
- (\*8) Use twisted wire or shielded wire for control signal lines. Shielded wires are generally grounded, however, if subject to significant induction noise from outside, it may be possible to suppress the effect of the noise by connecting wires to [CM]. Isolate control signal lines from the main circuit wiring as best as possible, and do not run inside the same duct (a distance of 10 cm or greater is recommended.) If lines intersect, ensure that they do so almost perpendicularly to the main circuit wiring.
- (\*9) Each of the functions described for terminals [FWD] and [REV], terminals [X1] to [X9] (digital input), terminals [Y1] to [Y4] (transistor output), terminal [Y5A/C], and terminal [30A/B/C] (contact output) indicate functions assigned by factory default.
- (\*11) These are the switches on control PCBs, and are used to specify settings for inverter operation. Refer to the User's Manual, "2.2.7 Switching switches" for details.
- (\*12) Safety function terminals [EN1] and [EN2] are disabled with SW7 (2-pole switch) on the control PCB by factory default. If using this terminal function, be sure to change the respective SW7 switches to the OFF position and connect.
- (\*13) Install a thermal relay if necessary. Make the circuit breakers (MCCB) or the magnetic contactors (MC) trip by the thermal relay auxiliary contacts (manual recovery).
- (\*15)  $\bigcirc$  and  $\bigcirc$  are isolated and insulated.
- (\*16) The factory default setting for SW1 of FRN-G2E-4G is "SOURCE".

Carry out wiring work in the following order (The descriptions assume that the inverter has already been installed).

#### 2.2.2 Removal and attachment of the front cover and wiring guide

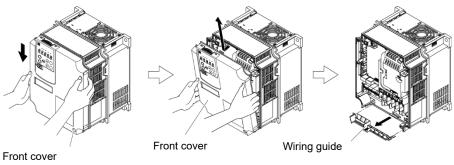
# 

If using the RS-485 communication cable for such purposes as remotely operating the keypad, always remove the RS-485 communication cable from the RJ-45 connector before removing the front cover.

Failure to observe this could result in fire or an accident.

#### (1) FRN0115G2S-2G / FRN0060G2 -4G or lower inverters

- 1) Loosen the screws of the front cover. Hold both sides of the front cover with the hands, slide the cover downward, and pull. Then remove it to the upward direction.
- 2) Push the wiring guide upward and pull. Let the wiring guide slide and remove it.
- 3) After routing the wires, attach the wiring guide and the front cover reversing the steps above.



attachment screw

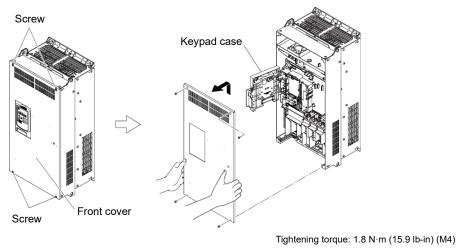
Fig. 2.2-2 Removal of front cover and wiring guide (for FRN0059G2S-2G)

#### (2) FRN0146G2S-2G / FRN0075G2 -4G or higher inverters

- 1) Loosen the screws of the front cover. Hold both sides of the front cover by hand, and slide the cover upward to remove.
- 2) After carrying out wiring work, align the top of the front cover with the hole on the cover, and reattach using the opposite procedure to that in Fig. 2.2-3.



Open the keypad case to expose the control PCB.



nıng torque: 1.8 N·m (15.9 lb-ın) (M4) 3.5 N·m (26.6 lb-in) (M5)

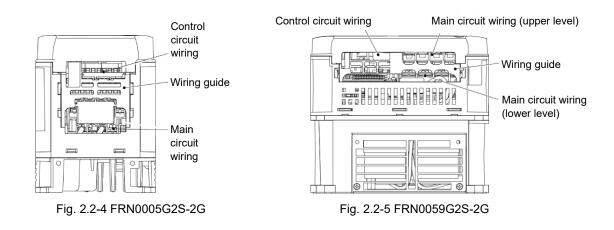
Fig. 2.2-3 Front cover removal (FRN146G2S-2G)

2.2 Wiring

## 2.2.3 Wiring precautions

Pay attention to the following items when carrying out wiring.

- (1) Confirm that the supply voltage is within the input voltage range described on the rating plate.
- Always connect the power lines to the inverter main power input terminals L1/R, L2/S, and L3/T (three-phase).
   (The inverter will be damaged when power is applied if the power lines are connected to the wrong terminals.)
- (3) Be sure to connect a ground wire in order to prevent accidents such as electric shock or fire, and to reduce noise.
- (4) For the lines connecting to the main circuit terminals, use crimped terminals with insulating sleeves or use crimped terminals in conjunction with insulating sleeves for high connection reliability.
- (5) Separate the routing of the lines connected to the main circuit input side terminals (primary side) and the output side terminals (secondary side) and the lines connected to the control circuit terminals. The control circuit terminal lines should be routed as far as possible from the main circuit routing. Malfunction may occur due to noise.
- (6) To prevent direct contact with the main circuit live sections (such as the main circuit terminal block), route the control circuit wiring inside the inverter as bundles using cable ties.
- (7) After removing a main circuit terminal screw, always restore the terminal screw in position and tighten even if lines are not connected.
- (8) The wiring guide is used to separately route the main circuit wiring and the control circuit wiring. The main circuit wiring and the control circuit wiring can be separated. Exercise caution for the order of wiring.



#### Handling the wiring guide

When wiring the main circuit on FRN0059G2S-2G to FRN0115G2S-2G / FRN0031G2 -4G to FRN0060G2 -4G inverters, the wiring space may become insufficient when routing the main circuit wires, depending on the wire material used. In these cases, the relevant cut-off sections (see figure below) can be removed using a pair of nippers to secure routing space. Be warned that removing the wiring guide to accommodate the enlarged main circuit wiring may result in non-conformance with IP20 requirements.

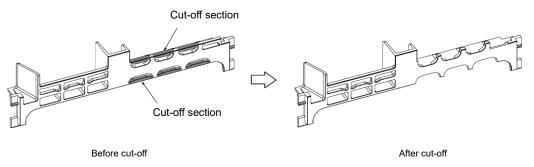


Fig. 2.2-6 Wiring guide (for FRN0075G2S-2G)

(9) Depending on the inverter capacity, straight routing of the main circuit wires from the main circuit terminal block may not be possible. In these cases, route the wires as shown in the figure below and securely attach the front cover.

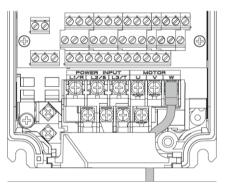


Fig. 2.2-7

(10) The L2/S input terminals on FRN1170G2□-4G and FRN1386G2□-4G inverters is located in the vertical direction when facing the unit. When connecting wires to these terminals, do so using the bolts, washers, and nuts provided as shown below.

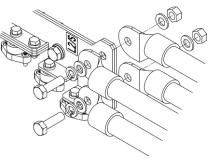


Fig. 2.2-8

INSTALLATION AND WIRING

Chap 2

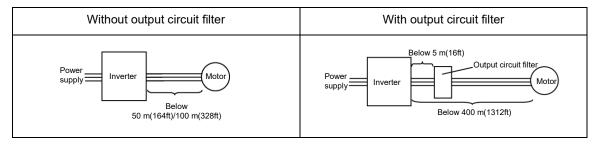
### 2.2.4 Precautions for long wiring (between inverter and motor)

- (1) When multiple motors are connected to one inverter, the wiring length is the total of all wire lengths.
- (2) Precautions for high-frequency leakage current

Precautions shall be taken for high frequency leakage current when the wiring length from the inverter to the motor is long, in this case the high frequency current may flow through the stray capacitance between the wires with various phases. The effect may cause the inverter to become overheated, or trip due to overcurrent. Leakage current may increase and the accuracy of the displayed current may not be ensured. Depending on the conditions, excessive leakage current may damage the inverter. To avoid the above problems when directly connecting an inverter to a motor, keep the wiring length to 50 m (164 ft) or less for FRN0018G2S-2G / FRN009G2 -4G inverters or lower, and to 100 m (328 ft) or less for FRN0032G2S-2G / FRN0018G2 -4G inverters or higher.

If using with longer wire lengths than those above, use with a carrier frequency of 5 kHz or less, and if using a 400V series inverter, use an output circuit filter (OFL- $\Box\Box$ -4A) (option).

When multiple motors are operated in parallel connection configuration (group operation), and especially when shielded cables are used for the connections, the ground to ground stray capacitance will be large. In this case, use with a carrier frequency of 5 kHz or less, and if using a 400V series inverter, use an output circuit filter (OFL- $\Box$   $\Box$ -4A) (option).



When the output circuit filter is used, the total wiring length should be below 400 m (1312ft) in case of using V/f control.

For motors with encoders, the wiring length between the inverter and motor should be below 100 m (328ft). The restriction comes from the encoder specifications. For distances beyond 100 m (328ft), insulation converters should be used. Please contact Fuji Electric when operating with wiring lengths beyond the upper limit.

- (3) Precautions on the surge voltage when driving the inverter (especially for 400 V series motor) When motors are driven by inverters using the PWM method, the surge voltage generated by the switching of the inverter elements is added to the output voltage and is applied onto the motor terminals. Especially when the motor wiring length is long, the surge voltage can cause insulation degradation in the motor. Please perform one of the countermeasures shown below.
  - · Use motor with insulation enhancement (Fuji's standard motors have insulation enhancements)
  - · Connect a surge suppression unit on the motor side (SSU50/100TA-NS).
  - · Connect an output circuit filter (OFL-□□-4A) to the inverter output side (secondary side).
  - · Reduce the wiring length from the inverter to the motor to less than 10 to 20 meters (33 to 66 ft).
- (4) When an output circuit filter (OFL-□□-4A) is inserted in the inverter, or when the wiring length is long, the voltage applied to the motor will decrease due to the voltage drop caused by the filter or wiring. In these cases, current oscillation and lack of torque may occur due to insufficient voltage.

# **WARNING**

 Connect to the power supply via a molded case circuit breaker or earth leakage circuit breaker (with overcurrent protection function) for each inverter.
 Use the recommended molded case circuit breaker or earth leakage circuit breaker, and do not use circuit

Use the recommended molded case circuit breaker or earth leakage circuit breaker, and do not use circuit breakers that exceed the recommended rated current.

- Be sure to use the specified wire size.
- Tighten terminals with the prescribed tightening torque.
- If there are multiple inverter and motor combinations, do not use multi-core cables for the purpose of bundling and storing wiring for multiple combinations.
- Do not install a surge suppressor to the inverter output side (secondary side).

#### Failure to observe this could result in fire.

- Ground the inverter in compliance with the national or local electric code.
- Be sure to ground the inverter ground terminal [�G] grounding wire.

#### Failure to observe this could result in electric shock or fire.

- Wiring work should be carried out by qualified professionals.
- · Carry out wiring work after ensuring that the power has been turned OFF.

#### Failure to observe this could result in electric shock.

• Always carry out wiring after installing the unit.

#### Failure to observe this could result in electric shock or injury.

- Ensure that the number of phases and rated voltage of the product input power supply matches that for the connected power supply.
- Do not connect the power lines to the inverter output terminals (U, V, W).

Failure to observe this could result in fire or an accident.

### 2.2.5 Main circuit terminals

### [1] Screw specifications and recommended wire size (main circuit terminals)

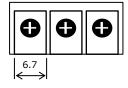
The specifications for the screws used in the main circuit wiring and the wire sizes are shown below. Exercise caution as the terminal position varies depending on inverter capacity. In the diagram in "[2] Terminal layout diagrams (main circuit terminals)", the two ground terminals [ $\bigoplus G$ ] are not differentiated for the input side (primary side) and the output side (secondary side).

Also, use crimped terminals with insulating sleeves compatible for main circuit or terminals with insulating tubes. The recommended wire sizes are shown depending on cabinet temperature and wire type.

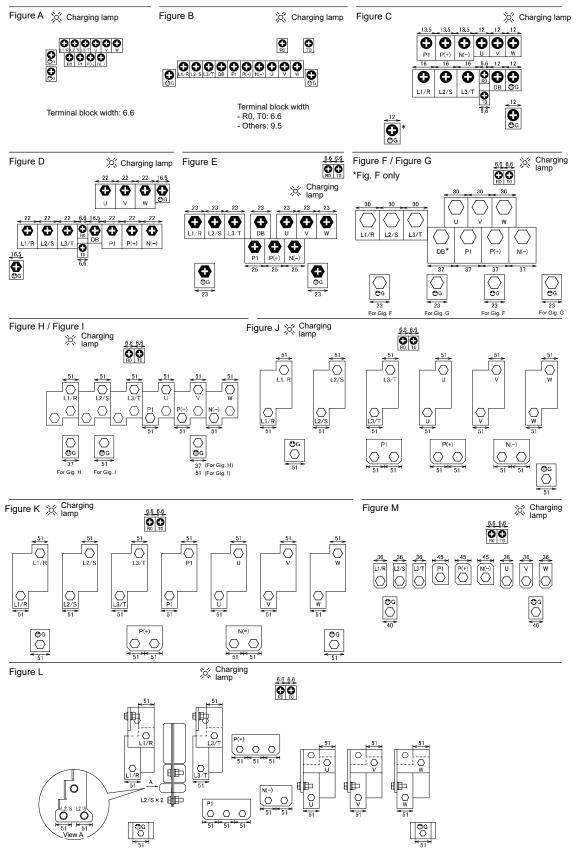
Inver	ter type				Screw speci	fication		
Three-phase	Three-phase	Ref.	Main	circuit	Grour	nding	ir	wer auxiliary iput ), T0]
200 V	400 V		Screw size (driver size)	Tightening torque N∙m (lb-in)	Screw size (driver size)	Tightening torque N·m (lb-in)	Screw size	Tightening torque N·m (lb-in)
FRN0003G2S-2G	FRN0002G2□-4G	Fig. A	M3.5	1.2 (10.6)	M3.5	1.2 (10.6)		
FRN0005G2S-2G	FRN0003G2□-4G	rig. A	1013.5	1.2 (10.0)	1013.5	1.2 (10.0)	-	-
FRN0008G2S-2G	FRN0004G2□-4G							
FRN0011G2S-2G	FRN0006G2□-4G	Fig. B	M4	1.8 (15.9)	M4	1.8 (15.9)		
FRN0018G2S-2G	FRN0009G2□-4G							
FRN0032G2S-2G	FRN0018G2□-4G							
FRN0046G2S-2G	FRN0023G2□-4G	Fig. C	M5	3.5 (26.6)	M5	3.5 (26.6)		
FRN0059G2S-2G	FRN0031G2□-4G							
FRN0075G2S-2G	FRN0038G2□-4G							
FRN0088G2S-2G	FRN0045G2□-4G	Fig. D	M6	5.8 (51.3)	M6	5.8 (51.3)		
FRN0115G2S-2G	FRN0060G2□-4G		(No.3)		(No.3)			
	FRN0075G2□-4G	RN0075G2□-4G						
	FRN0091G2□-4G							
FRN0146G2S-2G	FRN0112G2□-4G	Fig. E	M8	13.5 (119.5)				
	FRN0150G2□-4G							
FRN0180G2S-2G					M8	13.5 (119.5)		
FRN0215G2S-2G	FRN0180G2□-4G	Fig. F				(119.5)	M3.5	1.2 (10.6)
FRN0288G2S-2G			M10	27 (239.0)				
-	FRN0216G2□-4G	Fig. C						
-	FRN0260G2□-4G	Fig. G						
FRN0346G2S-2G	-	Fig. M						
-	FRN0325G2□-4G							
-	FRN0377G2□-4G	Fig. H						
	FRN0432G2□-4G							
FRN0432G2S-2G	FRN0520G2□-4G	Fig. I						
-	FRN0650G2□-4G		M12	48 (424.9)	M10	27 (239.0)		
- FRN0740 - FRN0960 - FRN1040	FRN0740G2□-4G	Fig. J						
	FRN0960G2□-4G							
	FRN1040G2□-4G	Fig. K						
	FRN1170G2 -4G	Fig. 1						
-	FRN1386G2□-4G	Fig. L						

Table 2.2-1 Screw specifications

### [2] Terminal layout diagrams (main circuit terminals)



The dimensions for each terminal indicate the "dimensions between walls" as shown in the diagram on the left.



# \Lambda WARNING 🗥

The following terminals will have high voltage when power is ON.

Main circuit: L1/R, L2/S, L3/T, P1, P(+), N(-), DB, U, V, W, R0, T0, AUX-contact (30A, 30B, 30C, Y5A, Y5C) Insulation level

- Main circuit casing
  - Main circuit control circuit
  - Contact output control circuit
- : Reinforced insulation (overvoltage category III, pollution degree 2) : Reinforced insulation (overvoltage category II, pollution degree 2)

: Basic insulation (overvoltage category III, pollution degree 2)

Failure to observe this could result in electric shock.

#### [3] Recommended wire size (main circuit terminals)

The following wires are recommended unless special requirements exist.

If using in an ambient temperature of 50 to 55 °C (122 to 131 °F), select wires by referring to the 55 °C field in Appendix F "Allowable Current of Insulated Wires" in "APPENDICES".

#### 600 V polyvinyl chloride insulated wire (IV wire)

This wire is used in circuits except the inverter control circuit. The wire is difficult to twist and is not recommended for the inverter control circuit. The maximum permissible temperature for the insulated wire is 60 °C (140 °F).

600 V heat-resistant polyvinyl chloride wire (HIV wire)

In comparison to the IV wire, this wire is smaller, more flexible, and the maximum permissible temperature for the insulated wire is 75 °C (167 °F) (higher), making it suitable for both the inverter main circuit and control circuit. However, the wiring distance should be short and the wire must be twisted for use in the inverter control circuit.

#### 600 V cross-linked polyethylene insulated wire (FSLC wire)

This wire is used mainly in the main circuit and the grounding circuits. The size is even smaller than the IV wire or the HIV wire and also more flexible. Due to these features, the wire is used to reduce the area occupied by wiring and to improve work efficiency in high temperature areas. The maximum permissible temperature for the insulated wire is 90 °C (194 °F). As a reference, Furukawa Electric Co., Ltd. produces Boardlex which satisfies these requirements.

#### Shielded-twisted wire for internal wiring of electronic/electrical equipment

This product is used in inverter control circuits. Use this wire with high shielding effect when risk of exposure to or effect of radiated noise and induced noise exists. Always use this wire when the wiring distance is long, even within the cabinet. Furukawa Electric's BEAMEX S shielded cables XEBV or XEWV satisfy these requirements.

Table 2.2-2 Recommended wire sizes (common terminals)

Common terminals	Recommended wire size (mm <sup>2</sup> ) [AWG]	Remarks
Control power auxiliary input terminals R0, T0	2.0 [14]	-

HHD specification: High, Heavy Duty applications

#### Panel internal temperature of 50 °C (122 °F) or lower

Table 2.2-3 Wire size (main power supply input and inverter output)

														•	ation: Hi		•		lications
										Recomr	nended	wire siz	e (mm <sup>2</sup>	)		•			
	-	Inverte	er type		Main	power	i vlaque	nput [L1						·	ter outp	ut IU. V	. W1		
μE	able (kW)			With	DC re	eactor ([	DCR)	Withc	ut DC r	eactor (	DCR)	F	IHD spe	cificatio	n .	Н	ND spe	cificatio	on
Power system	Stand pplic	HHD specification	HND specification		ermissi erature 1) 75 °C	(Note	Curren t value (A)		ermissib rature (N 75 °C	Note 1)	Curren t value (A)		ermissit rature (I 75 °C		Curren t value (A)	temp	ermissil erature 1) 75 °C	(Note	Curre nt value (A)
	0.4	FRN0003G2S-2G	-	2.0	2.0	2.0	1.6	2.0	2.0	2.0	3.1	2.0	2.0	2.0	3.0	00 0	75 0	90 0	(74)
	0.75	FRN0005G2S-2G		2.0	2.0	2.0	3.2	2.0	2.0	2.0	5.3	2.0	2.0	2.0	5.0				
	1.5	FRN0008G2S-2G		2.0	2.0	2.0	6.1	2.0	2.0	2.0	9.5	2.0	2.0	2.0	8.0				
	2.2	FRN0011G2S-2G		2.0	2.0	2.0	8.9	2.0	2.0	2.0	13.2	2.0	2.0	2.0	11.0		-		
	3.7	FRN0018G2S-2G	-	2.0	2.0	2.0	15.0	5.5	2.0	2.0	22.2	3.5	2.0	2.0	18.0	-	-	-	-
	5.5	FRN0032G2S-2G	-	5.5	2.0	2.0	21.1	8.0	3.5	3.5	31.5	5.5	3.5	2.0	27.0		-		-
	7.5		FRN0032G2S-2G		3.5	2.0	28.8	14	5.5	5.5	42.7	14	5.5	3.5	37.0	8.0	3.5	3.5	31.8
	11		FRN0046G2S-2G	14	5.5	5.5	42.2	22 *5	14	8.0	60.7	14	8.0	5.5	49.0	14.0	8.0	5.5	46.2
	15	FRN0075G2S-2G	FRN0059G2S-2G	22	14	8.0	57.6	38 *1	14	14	80.0	22	14	8.0	63.0	22.0	14.0	8.0	59.4
se	18.5	FRN0088G2S-2G	FRN0075G2S-2G	38 *1	14	14	71.0	60 *2	22	14	97.0	38 *1	14	14	76.0	38 *1	14.0	14.0	74.8
 ha	22	FRN0115G2S-2G	FRN0088G2S-2G	38 *1	22	14	84.4	60 *2	38 *1	22	112.0	38 *1	22	14	90.0	38 *1	22.0	14.0	88.0
Three-phase 200 V	30	-	FRN0115G2S-2G	60 *2	38 *1	22	114	100 *6	60 *2	38 *1	151	60	38	22	119	60 *2	38 *1	22.0	115.0
ЧЦ.	30	FRN0146G2S-2G	-	60	38	22	114	100	60	38	151	60	38	22	119	-	-	-	-
	07	-	FRN0146G2S-2G	100	38	38	138	150	60	38	185	-	-	-	-	100	38	38	146
	37	FRN0180G2S-2G	-	100	38	38	138	150	60	38	185	100	38	38	146	-	-	-	-
	45	FRN0215G2S-2G	FRN0180G2S-2G	100	60	38	167	150	100	60	225	150	60	38	180	150	60	38	180
	55	FRN0288G2S-2G	FRN0215G2S-2G	150	100	60	203	200	100	100	270	150	100	60	215	150	100	60	215
	75	-	FRN0288G2S-2G	250	150	100	282	-	-	-	-	-	-	-	-	250	150	100	288
	75	FRN0346G2S-2G		250	150	100	282	-	-	-	-	250	150	100	288	-	-	-	-
	90	-	FRN0346G2S-2G	325	150	100	334	-	-	-	-	-	-	-	-	325	150	150	346
	30	FRN0432G2S-2G	-	325	150	100	334	-	-	-	-	325	150	150	346	-	-	-	-
	110	-	FRN0432G2S-2G	400	200	150	410	-	-	-	-	-	-	-	-	500	250	150	432

(Note 1) "IV wire" is used for permissible temperature of 60 °C (140 °F), "600 V HIV insulated wire" is used for 75 °C (167 °F), and "600 V cross-linked polyethylene insulated wire" is used for 90 °C (194 °F). These values are for aerial wiring.

- \*1) For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.
- \*2) For compatible crimped terminals, please use model 60-6 by JST Mfg. Co., Ltd. or equivalent.
- \*3) Not applicable
- \*4) Not applicable
- \*5) For compatible crimped terminals, please use model 22-S5 by JST Mfg. Co., Ltd. or equivalent.
- \*6) For compatible crimped terminals, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.
- \*7) Not applicable

Table 2.2-3 Wire size (main power supply input and inverter output) (cont.)

HHD specification: High, Heavy Duty applications HND specification: High, Normal Duty applications

_														·	ation: Hi	gii, No	iiiiai Di	aty upp	loations
											nended	wire siz	e (mm²)	)					
	_ e €	Inverte	er type		Main	power	supply i	nput [L1	/R, L2/\$	S, L3/T]				Inver	ter outp	ut [U, V	/, W]		
en (er	abl (kV			With	n DC re	actor (I	DCR)	Withc	out DC r	eactor (	DCR)	F	IHD spe	cificatio	on	H	IND spe	ecificati	on
Pov	Standard applicable motor (kW)				ermissil		Curren	Pe	ermissib	le	Curren	P	ermissib	le	Curren		ermissil		Curren
	s a p	HHD specification	HND specification	tempe	erature 1)	(Note	t value		rature (l	Note 1)	t value	tempe	rature (I	Note 1)	t value	temp	erature 1)	(INOTE	t value
		-	-	60 °C		90 °C	(A)	60 °C	75 °C	90 °C	(A)	60 °C	75 °C	90 °C	(A)	60 °C	75 °C	90 °C	(A)
-	0.4	FRN0002G20-4G		2.0	2.0	2.0	0.85	2.0	2.0	2.0	1.7	2.0	2.0	2.0	1.5	00 0	15 0	30 0	
	0.75	FRN0003G20-4G		2.0	2.0	2.0	1.6	2.0	2.0	2.0	3.1	2.0	2.0	2.0	2.5	-			
	1.5	FRN0004G20-4G		2.0	2.0	2.0	3.0	2.0	2.0	2.0	5.9	2.0	2.0	2.0	4.0	-			
	2.2	FRN0006G20-4G	-	2.0	2.0	2.0	4.5	2.0	2.0	2.0	8.2	2.0	2.0	2.0	5.5	-		-	
	3.7	FRN0009G20-4G		2.0	2.0	2.0	7.5	2.0	2.0	2.0	13.0	2.0	2.0	2.0	9.0	-			
	5.5	FRN0018G20-4G		2.0	2.0	2.0	10.6	3.5	2.0	2.0	17.3	2.0	2.0	2.0	13.5	-			
	7.5		FRN0018G2 -4G	2.0	2.0	2.0	14.4	5.5	2.0	2.0	23.2	3.5	2.0	2.0	18.5	3.5	2.0	2.0	16.5
	11	FRN0031G20-4G	FRN0023G2-4G	8.0	2.0	2.0	21.1	8.0	3.5	3.5	33.0	5.5	3.5	2.0	24.5	5.5	2.0	2.0	23.0
	15	FRN0038G20-4G	FRN0031G20-4G	8 *3	3.5	2.0	28.8	14	5.5	5.5	43.8	8 *3	3.5	3.5	32.0	8 *3	3.5	2.0	30.5
	18.5	FRN0045G20-4G	FRN0038G20-4G	14	5.5	3.5	35.5	22	8 *3	5.5	52.3	14	5.5	3.5	39.0	14.0	5.5	3.5	37.0
	22	FRN0060G20-4G	FRN0045G20-4G	14	5.5	5.5	42.2	22	14	8 *3	60.6	14	8 *3	5.5	45.0	14.0	8 *3	5.5	45.0
		-	FRN0060G20-4G	22	14	8 *3	57.0	38 *1	14	14	77.9	22	14	8.0	60.0	22	14	8 *3	60.0
	30	FRN0075G20-4G	-	22	14	8	57.0	38	14	14	77.9	22	14	8	60.0	22	14	8.0	60.0
	37	FRN0091G20-4G	FRN0075G2 -4G	38	14	8	68.5	60	22	14	94.3	38	14	14	75.0	38	14	14	75.0
	45	FRN0112G20-4G	FRN0091G20-4G	38	22	14	83.2	60	38	22	114	38	22	14	91.0	38	22	14	91.0
ŝ	55		FRN0112G20-4G	60	22	22	102	100	38	38	140	60	38	22	112	60	38	22	112
< h		-	FRN0150G20-4G		38	38	138	-	-	-	-	-	-	-	-	100	60	38	150
400 400	75	FRN0180G20-4G	-	100	38	38	138	-	-	-	-	100	60	38	150	-	-	-	-
Three-phase 400 V	90	FRN0216G20-4G	FRN0180G20-4G	100	60	38	164	-	-	-	-	150	60	38	180	150	60	38	180
	110	FRN0260G2 -4G	FRN0216G2 -4G	150	100	60	201	-	-	-	-	150	100	60	216	150	100	60	216
		-	FRN0260G2 -4G		100	60	238	-	-	-	-	-	-	-	-	200	100	100	260
	132	FRN0325G2 -4G	-	200	100	60	238	-	-	-	-	200	100	100	260	-	-	-	-
	160	FRN0377G2 -4G	FRN0325G2 -4G	250	150	100	286	-	-	-	-	325	150	100	325	325	150	100	325
	200	FRN0432G2 -4G	FRN0377G2 -4G	325	150	150	357	-	-	-	-	400	200	150	377	400	200	150	377
	220	FRN0520G2 -4G	FRN0432G2 -4G	400	200	150	390	-	-	-	-	500	250	150	432	500	250	150	432
	280	FRN0650G2 -4G	FRN0520G2 -4G	-	250	200	500	-	-	-	-	-	325	200	520	-	325	200	520
	315	FRN0740G2 -4G	-	-	325	250	559	-	-	-	-	-	325	250	585	-	-	-	-
	355	FRN0960G2 -4G	FRN0650G2 -4G	-	2x200	250	628	-	-	-	-	-	2x200	325	650	-	2x200	325	650
	400	FRN1040G2 -4G	FRN0740G2 -4G	-	2x200	325	705	-	-	-	-	-	2x250	325	740	-	2x250	325	740
	500	-	FRN0960G2 -4G	-	2x325	2x200	881	-	-	-	-	-	-	-	-	-	2x325	2x250	960
	500	FRN1170G2 -4G	-	-	2x325	2x200	881	-	-	-	-	-	2x325	2x250	960	-	-	-	-
	560	-	FRN1040G2 -4G	-	3x250	2x250	990	-	-	-	-	-	-	-	-	-	3x250	2x250	1040
	630	FRN1386G2 -4G	FRN1170G2 -4G	-	3x325	2x325	1115	-	-	-	-	-	3x325	2x325	1170	-	3x325	2x325	1170
	710	-	FRN1386G2 -4G	-	4x250	3x250		-	-	-	-	-	-	-	-	-	4x325	3x325	1386

(Note 1) "IV wire" is used for permissible temperature of 60 °C (140 °F), "600 V HIV insulated wire" is used for 75 °C (167 °F), and "600 V cross-linked polyethylene insulated wire" is used for 90 °C (194 °F). These values are for aerial wiring.

(Note 2)  $\Box$  is replaced by a letter of the alphabet indicating the inverter type.

□ □ S (basic type), E (type with built-in EMC filter)

- \*1) For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.
- \*2) Not applicable

\*3) For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

- \*4) Not applicable
- \*5) Not applicable
- \*6) Not applicable
- \*7) Not applicable

Chap 2

HHD specification: High, Heavy Duty applications

Table 2.2-3 Wire size (for DC reactor connection, for braking resistor connection, and for inverter grounding) (cont.)

													•		ligh, Nori			
									Reco	mmend	ed wire s	ize (mn	n²)					
	⊤ ®⊋	Inverte	er type	For D		tor conr	ection	F	or braki	ing resis	tor conne	ection [I	P(+), DE	3] (Note	2)		or inver roundi	
tem	(kV				[P1,	, P(+)]			HHD sp	ecificati	on	ł	HND sp	ecificat	ion	9	[ <b>\$</b> G]	
Power system	Standard applicable motor (kW)	HHD specification	HND specification		ermissit rature (		Current value		Permissible temperature (Note 1)		Current value	Permissible temperature (Note 1		Talao	Permissible temperature (No 1)			
				60 °C	75 °C	90 °C	(A)	60 °C	75 °C	90 °C	(A)	60 °C	75 °C	90 °C	(A)	60 °C	75 °C	90 °C
	0.4	FRN0003G2S-2G	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.2	-	-	-	-			
	0.75	FRN0005G2S-2G	-	2.0	2.0	2.0	4.0	2.0	2.0	2.0	1.6	-	-	-	-			
	1.5	FRN0008G2S-2G	-	2.0	2.0	2.0	7.5	2.0	2.0	2.0	3.6	-	-	-	-	2.0	2.0	2.0
	2.2	FRN0011G2S-2G	-	2.0	2.0	2.0	11.0	2.0	2.0	2.0	3.5	-	-	-	-			
	3.7	FRN0018G2S-2G	-	3.5	2.0	2.0	18.4	2.0	2.0	2.0	4.1	-	-	-	-			
	5.5	FRN0032G2S-2G	-	5.5	3.5	2.0	25.9	2.0	2.0	2.0	6.4	-	-	-	-	3.5	3.5	3.5
	7.5	FRN0046G2S-2G	FRN0032G2S-2G	14.0	5.5	3.5	35.3	2.0	2.0	2.0	6.1	2.0	2.0	2.0	6.4	5.5	5.5	5.5
	11	FRN0059G2S-2G	FRN0046G2S-2G	22 *5	8.0	5.5	51.7	2.0	2.0	2.0	9.1	2.0	2.0	2.0	6.1	5.5	5.5	5.5
	15	FRN0075G2S-2G	FRN0059G2S-2G	38 *1	14.0	14.0	70.6	2.0	2.0	2.0	11	2.0	2.0	2.0	9.1	8 *3	8 *3	8 *3
ase	18.5	FRN0088G2S-2G	FRN0075G2S-2G	38 *1	22.0	14.0	87.0	2.0	2.0	2.0	14	2.0	2.0	2.0	11.0	8 *3	8 *3	8 *3
ਸ਼ੁੱ>	22	FRN0115G2S-2G	FRN0088G2S-2G	60 *2	22.0	22.0	103	2.0	2.0	2.0	15	2.0	2.0	2.0	14.0	14	14	14
Three-phase 200 V	30	-	FRN0115G2S-2G	100 *6	38 *1	38 *1	140	-	-	-	-	2.0	2.0	2.0	15.0	14	14	14
Ŧ	30	FRN0146G2S-2G	-	100	38	38	140	3.5	2	2	19	-	-	-	-	14	14	14
	37	-	FRN0146G2S-2G	100	60	38	170	-	-	-	-	3.5	2	2	19	22	22	22
	31	FRN0180G2S-2G	-	100	60	38	170	5.5	3.5	2	25	-	-	-	-	22	22	22
	45	FRN0215G2S-2G	FRN0180G2S-2G	150	100	60	205	8	3.5	2	30	5.5	3.5	2	25	22	22	22
	55	FRN0288G2S-2G	FRN0215G2S-2G	200	100	60	249	14	5.5	3.5	37	8	3.5	2	30	22	22	22
	75	-	FRN0288G2S-2G	325	150	150	345	-	-	-	-	14	5.5	3.5	37	22	22	22
	75	FRN0346G2S-2G	-	325	150	150	346	14	8	5.5	48	-	-	-	-	22	22	22
	90	-	FRN0346G2S-2G	400	200	150	409	-	-	-	-	14	8	5.5	48	22	22	22
	90	FRN0432G2S-2G	-	400	200	150	410	22	14	8	61	-	-	-	-	22	22	22
	110	-	FRN0432G2S-2G	-	250	200	502	-	-	-	-	22	14	8	61	38	38	38

(Note 1) "IV wire" is used for permissible temperature of 60 °C (140 °F), "600 V HIV insulated wire" is used for 75 °C (167 °F), and "600 V cross-linked polyethylene insulated wire" is used for 90 °C (194 °F). These values are for aerial wiring.

(Note 2) A braking unit (BU) (option) is necessary for FRN0346G2S-2G and above.

\*1) For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

\*2) For compatible crimped terminals, please use model 60-6 by JST Mfg. Co., Ltd. or equivalent.

\*3) For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

\*4) Not applicable

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\*5) For compatible crimped terminals, please use model 22-S5 by JST Mfg. Co., Ltd. or equivalent.

\*6) For compatible crimped terminals, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

\*7) Not applicable

Table 2.2-3 Wire size (for DC reactor connection, for braking resistor connection, and for inverter grounding) (cont.)

HHD specification: High, Heavy Duty applications	
HND specification: High, Normal Duty applications	

									Reco	mmend	ed wire s	ize (mn	1 <sup>2</sup> )					
		Inverte	er type	For [	C reac	tor conn	ection	F	or braki	ng resis	tor conne	ection [F	P(+), DE	3] (Note	e 3)		or inver	
n e	lard (kW				[P1,	P(+)]			HHD sp	ecificatio	on	ŀ	HND sp	ecificat	ion	g	roundir [ <b>ੳ</b> G]	ng
Power system	Standard applicable motor (kW)	HHD specification	HND specification	tempe	ermissik rature (I		Current value (A)	P tempe	ermissit rature (l	ole	Current	tempe		Note 1)	(A)	tempe	ermissil erature 1)	e (Note
				60 °C	75 °C	90 °C	(~)	-		90 °C		60 °C	75 °C	90 °C	(7)	60 °C	75 °C	90 °C
	0.4	FRN0002G20-4G		2.0	2.0	2.0	1	2.0	2.0	2.0	0.8							1
	0.75	FRN0003G2 -4G	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.1	-	-	-	-			1
	1.5	FRN0004G2 -4G	-	2.0	2.0	2.0	3.7	2.0	2.0	2.0	1.8	-	-	-	-	2.0	2.0	2.0
	2.2	FRN0006G20-4G	-	2.0	2.0	2.0	5.6	2.0	2.0	2.0	1.8	-	-	-	-	2.0	2.0	2.0
	3.7	FRN0009G20-4G	-	2.0	2.0	2.0	9.2	2.0	2.0	2.0	2.1	-	-	-	-			1
	5.5	FRN0018G2 -4G	-	2.0	2.0	2.0	13.0	2.0	2.0	2.0	3.2	-	-	-	-			
	7.5	FRN0023G2 -4G	FRN0018G2 -4G	3.5	2.0	2.0	17.7	2.0	2.0	2.0	3.1	2.0	2.0	2.0	3.2	3.5	3.5	3.5
	11	FRN0031G2 -4G	FRN0023G2 <sub>-4G</sub>	5.5	3.5	2.0	25.9	2.0	2.0	2.0	4.5	2.0	2.0	2.0	3.1	3.5	3.5	3.5
	15	FRN0038G2 -4G	FRN0031G2 -4G	14.0	5.5	3.5	35.3	2.0	2.0	2.0	5.7	2.0	2.0	2.0	4.5	5.5	5.5	5.5
	18.5	FRN0045G2 -4G	FRN0038G2 <sub>-4G</sub>	14.0	5.5	5.5	43.5	2.0	2.0	2.0	7.2	2.0	2.0	2.0	5.7	5.5	5.5	5.5
	22	FRN0060G20-4G	FRN0045G2 <sub>-4G</sub>	22.0	8 *3	5.5	51.7	2.0	2.0	2.0	7.7	2.0	2.0	2.0	7.2	5.5	5.5	5.5
	30	-	FRN0060G2 -4G	38 *1	14	14	69.9	-	-	-	-	2.0	2.0	2.0	7.7	8 *3	8 *3	8 *3
	30	FRN0075G2 -4G	-	38	14	8	69.9	2	2	2	10	-	-	-	-	8	8	8
	37	FRN0091G2 -4G	FRN0075G2 -4G	38	22	14	83.9	2	2	2	12	2	2	2	10	8	8	8
	45	FRN0112G2 -4G	FRN0091G2 -4G	60	22	22	102	2	2	2	15	2	2	2	12	8	8	8
e Q	55	-	FRN0112G2 -4G	60	38	22	125	3.5	2	2	19	2	2	2	15	14	14	14
Three-phase 400 V	55	FRN0150G20-4G	-	60	38	22	125	3.5	2	2	19	2	2	2	15	14	14	14
ee-pha 400 V	75		FRN0150G2 -4G	100	60	38	169	-	-	-	-	3.5	2	2	19	14	14	14
hre 4	75	FRN0180G2 -4G		100	60	38	170	5.5	2	2	24	-	-	-	-	14	14	14
⊢	90	FRN0216G2 -4G	FRN0180G2 -4G	150	100	60	201	8	3.5	2	31	5.5	2	2	24	14	14	14
	110	FRN0260G2 -4G	FRN0216G2 -4G	200	100	60	246	8	5.5	3.5	34	8	3.5	2	31	22	22	22
	132	-	FRN0260G2 -4G	250	150	100	291	-	-	-	-	8	5.5	3.5	34	22	22	22
	132	FRN0325G2 -4G	-	250	150	100	292	14	5.5	3.5	41	-	-	-	-	22	22	22
	160	FRN0377G2 -4G	FRN0325G2 -4G	325	150	150	350	14	8	5.5	50	14	5.5	3.5	41	22	22	22
	200	FRN0432G2 -4G	FRN0377G2 -4G	500	250	150	437	22	14	8	62	14	8	5.5	50	38	38	38
	220	FRN0520G2 -4G	FRN0432G2 -4G	500	250	200	478	38	14	14	71	22	14	8	62	38	38	38
	280	FRN0650G2 -4G	FRN0520G2 -4G	-	2x200	250	612	60	22	14	94	38	14	14	71	38	38	38
	315	FRN0740G2 -4G	-	-	2x200	325	685	60	22	14	99	-	-	-	-	60	60	60
	355	FRN0960G2 -4G	FRN0650G2 -4G	-	2x250	2x200	769	60	38	22	117	60	22	14	100	60	60	60
	400	FRN1040G2 -4G	FRN0740G2 -4G	-	2x325	2x200	864	60	38	22	124	60	38	22	124	60	60	60
	500	-	FRN0960G2 -4G	-	3x325	2x325	1080	-	-	•	-	60	38	22	124	100	100	100
1	500	FRN1170G20-4G	-	-	3x325	2x325	1079	100	60	38	170	-	-	-	-	100	100	100
	560	-	FRN1040G2 -4G	-	3x325	2x325	1212	-	-	-	-	60	38	22	124	100	100	100
	630	FRN1386G2 -4G	FRN1170G2 -4G	-	4x325	3x325	1366	150	100	60	207	150	60	38	186	150	150	150
	710	-	FRN1386G2 -4G	-	5x325	3x325	1538	-	-	-	-	200	100	60	234	150	150	150

(Note 1) "IV wire" is used for permissible temperature of 60 °C (140 °F), "600 V HIV insulated wire" is used for 75 °C (167 °F), and "600 V cross-linked polyethylene insulated wire" is used for 90 °C (194 °F). These values are for aerial wiring.

(Note 2)  $\square$  is replaced by a letter of the alphabet indicating the inverter type.

S (basic type), E (type with built-in EMC filter)

(Note 3) A braking unit (BU) (option) is necessary for FRN0216G2 -4G and above.

\*1) For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

\*2) Not applicable

\*3) For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

- \*4) Not applicable
- \*5) Not applicable
- \*6) Not applicable
- \*7) Not applicable

HHD specification: High, Heavy Duty applications

#### Panel internal temperature of 40 °C (104 °F) or lower

Table 2.2-4 Wire size (main power supply input and inverter output)

														•			•		lications
<b>—</b>										Recom	nended	wire siz				91, 110	iniai Bi	aty app	
		Inverte	or type		Main	nowor	supply i	nnut [] 1			nenueu			/	ter outp	It III V	( \A/I		
<u> </u>	dard able (kW)	inverte	ытуре	\A/ith		actor (I	11.7	<u> </u>	out DC r					cificatio				ecificati	ion
we	r (k				ermissi	,	JCK)	vviuic		eacior (	DCK)		IND SPE	cincatio		-	ermissi		on
Power system	Standard applicable motor (kW)				erature	(Note	Curren t value		ermissib		Curren		ermissik rature (I		Curren		erature		Curren
		HHD specification	HND specification		1)		t value (A)				t value (A)			,	t value (A)		1)		t value (A)
				60 °C			. ,	60 °C	75 °C			60 °C	75 °C	90 °C		60 °C	75 °C	90 °C	(,,)
	0.4	FRN0003G2S-2G	-	2.0	2.0	2.0	1.6	2.0	2.0	2.0	3.1	2.0	2.0	2.0	3.0	-	-	-	-
	0.75	FRN0005G2S-2G	-	2.0	2.0	2.0	3.2	2.0	2.0	2.0	5.3	2.0	2.0	2.0	5.0	-	-	-	-
	1.5	FRN0008G2S-2G	-	2.0	2.0	2.0	6.1	2.0	2.0	2.0	9.5	2.0	2.0	2.0	8.0	-	-	-	-
	2.2	FRN0011G2S-2G	-	2.0	2.0	2.0	8.9	2.0	2.0	2.0	13.2	2.0	2.0	2.0	11.0	-	-	-	-
	3.7	FRN0018G2S-2G	-	2.0	2.0	2.0	15.0	3.5	2.0	2.0	22.2	2.0	2.0	2.0	18.0	-	-	-	-
	5.5	FRN0032G2S-2G	-	2.0	2.0	2.0	21.1	5.5	3.5	2.0	31.5	3.5	2.0	2.0	27.0	-	-	-	-
	7.5	FRN0046G2S-2G	FRN0032G2S-2G	3.5	2.0	2.0	28.8	8.0	5.5	3.5	42.7	5.5	3.5	3.5	37.0	5.5	3.5	2.0	31.8
	11	FRN0059G2S-2G	FRN0046G2S-2G	8.0	5.5	3.5	42.2	14.0	8.0	5.5	60.7	8.0	5.5	5.5	49.0	8.0	5.5	3.5	46.2
	15	FRN0075G2S-2G	FRN0059G2S-2G	14.0	8.0	5.5	57.6	22.0	14.0	14.0	80.0	14.0	8 *3	5.5	63.0	14.0	8.0	5.5	59.4
ase	18.5	FRN0088G2S-2G	FRN0075G2S-2G	14.0	14.0	8 *3	71.0	38 *1	22.0	14.0	97.0	22.0	14.0	8 *3	76.0	22.0	14.0	8 *3	74.8
ä>	22	FRN0115G2S-2G	FRN0088G2S-2G	22.0	14.0	14.0	84.4	38 *1	22.0	14.0	112.0	22.0	14.0	14.0	90.0	22.0	14.0	14.0	88.0
Three-phase 200 V	30	-	FRN0115G2S-2G	38 *1	22.0	22.0	114	60 *2	38 *1	38 *1	151	1	-	-	-	38 *1	22.0	22.0	115.0
Ę	30	FRN0146G2S-2G	-	38	22	22	114	60	38	38	151	38	22	22	119	-	-	-	-
	37	-	FRN0146G2S-2G	60	38	22	138	100	60	38	185	-	-	-	-	60	38	22	146
	37	FRN0180G2S-2G	-	60	38	22	138	100	60	38	185	60	38	22	146	-	-	-	-
	45	FRN0215G2S-2G	FRN0180G2S-2G	60	38	38	167	100	60	60	225	100	60	38	180	100	60	38	180
	55	FRN0288G2S-2G	FRN0215G2S-2G	100	60	38	203	150	100	60	270	100	60	60	215	100	60	60	215
	75	-	FRN0288G2S-2G	150	100	100	282	-	-	-	-	-	-	-	-	150	100	100	288
1	15	FRN0346G2S-2G	-	150	100	100	282	-	-	-	-	150	100	100	288	-	-	-	-
	90	-	FRN0346G2S-2G	200	150	100	334	-	-	-	-	-	-	-	-	200	150	100	346
	90	FRN0432G2S-2G	-	200	150	100	334	-	-	-	-	200	150	100	346	-	-	-	-
	110	-	FRN0432G2S-2G	250	150	150	410	-	-	-	-	-	-	-	-	250	200	150	432

(Note 1) "IV wire" is used for permissible temperature of 60 °C (140 °F), "600 V HIV insulated wire" is used for 75 °C (167 °F), and "600 V cross-linked polyethylene insulated wire" is used for 90 °C (194 °F). These values are for aerial wiring.

- \*1) For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.
- \*2) For compatible crimped terminals, please use model 60-6 by JST Mfg. Co., Ltd. or equivalent.
- \*3) For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.
- \*4) Not applicable
- \*5) Not applicable
- \*6) Not applicable
- \*7) Not applicable

Table 2.2-4 Wire size (main power supply input and inverter output) (cont.)

HHD specification: High, Heavy Duty applications HND specification: High, Normal Duty applications

-	1									_				poomo	ation: H	g.,	indi Bi	ity upp	louiono
											nended	wire siz	e (mm²)	)					
	רם קיים	Inverte	er type			•	supply i	1 <u> </u>							ter outp				
em	(kV			With	DC re	actor (I	DCR)	Withc	out DC r	eactor (	DCR)	H	HD spe	cificatio	n	Н	ND spe	ecificati	on
ov vst	Standard applicable motor (kW)			Permissible temperature (Note		Curren	Pe	ermissib	le	Curren	Р	ermissib	le	Curren		ermissil		Curren	
- 00	n ap	HHD specification	HND specification	tempe		(Note	t value	tempe	rature (1	Note 1)	t value	tempe	rature (I	Note 1)	t value	temp	erature 1)	(Note	t value
				60 °C	1) 75 °C	00.00	(A)	60 °C	75 °C	90 °C	(A)	60 °C	75 °C	90 °C	(A)	60 °C	75 °C	00.00	(A)
-	0.4	EBN000000 40					0.05				47				4.5	60 C	75 C	90 C	
	0.4	FRN0002G20-4G FRN0003G20-4G	-	2.0	2.0	2.0 2.0	0.85	2.0	2.0	2.0	1.7 3.1	2.0 2.0	2.0 2.0	2.0	1.5 2.5	-	-	-	-
		FRN0003G20-4G	-	-	2.0	2.0	3.0	2.0	2.0	2.0	5.9	2.0	2.0	2.0			-	-	-
	1.5	FRN0004G20-4G	-	2.0 2.0	2.0	2.0	3.0 4.5	2.0	2.0	2.0	5.9 8.2	2.0	2.0	2.0	4.0 5.5	-	-	-	-
	3.7	FRN0000620-4G	-	2.0	2.0	2.0	7.5	2.0	2.0	2.0	13.0	2.0	2.0	2.0	9.0		-	-	-
	-		-	2.0	2.0		10.6	-	-	-		2.0	-	2.0		-		-	-
	5.5	FRN0018G20-4G	ED1004000 40		-	2.0		2.0	2.0	2.0	17.3	-	2.0	-	13.5	-	-	-	-
	7.5 11		FRN0018G20-4G	2.0	2.0	2.0	14.4	3.5 5.5	2.0	2.0	23.2	2.0	2.0 2.0	2.0	18.5	2.0 3.5	2.0 2.0	2.0	16.5
	11	FRN0031G20-4G	FRN0023G20-4G FRN0031G20-4G	2.0	-	2.0	21.1	5.5 8.0	3.5		33.0	3.5 5.5	2.0	2.0	24.5 32.0	3.5 5.5		2.0 2.0	23.0 30.5
	-		FRN0031G20-4G FRN0038G20-4G	3.5 5.5	2.0	2.0	28.8 35.5	8.0 14.0	5.5 8 *3	3.5 5.5	43.8 52.3	5.5 5.5	3.5	2.0		5.5 5.5	3.5 3.5	2.0	30.5
	18.5	FRN0045G20-4G		5.5 8 *3	3.5 5.5	3.5 3.5	35.5 42.2		8*3 8*3					3.5 3.5	39.0	5.5 8 *3	3.5 5.5	3.5	
	22	FRN0060G20-4G						14.0 22		5.5	60.6 77.9	8 *3	5.5		45.0	8 · 3	5.5 8 *3		45.0
	30	-	FRN0060G20-4G	14 14	8 *3 8	5.5 5.5	57.0 57.0	22	14 14	14 8	77.9	-	- 8	-	-	14.0	8.3	5.5	60.0
	07	FRN0075G20-4G	-		8 14					-		14	8 14	5.5	60.0	-	-	-	-
	37 45	FRN0091G20-4G	FRN0075G20-4G FRN0091G20-4G	14 22	14	8 14	68.5 83.2	38 38	14 22	14 22	94.3 114	22 22	14	8 14	75.0 91.0	22 22	14 14	8 14	75.0 91.0
					22	14		- 30 60	38	22	114		22	14		38			
	55 75		FRN0112G2-4G	38	38	22	102	60	38	22	140	38 60	38	38	112	- 38 - 60	22 38	14 38	112
Three-phase 400 V	-		FRN0150G20-4G	60 60	38	38	138 164	-	-	-	-	100	- 30 60	38	150 180	100	- 30 60	38	150 180
ų Ž	90		FRN0180G20-4G				-	-	-	-	-								
ee- 40(	110		FRN0216G20-4G	100	60	38	201	-	-	-	-	100	60	60	216	100	60	60	216
Thr	132 160		FRN0260G20-4G	100	100	60	238 286	-	-	-	-	150	100	60	260 325	150 200	100 150	60 100	260 325
			FRN0325G2-4G	150	100	100		-	-	-	-	200	150	100					
	200	FRN0432G2-4G	FRN0377G2-4G	200	150 150	100 150	357 390	-	-	-	-	200 250	150 200	100 150	377	200 250	150	100	377
	220	FRN0520G20-4G	FRN0432G2-4G	250				-	-	-	-				432		200	150	432
	280	FRN0650G20-4G	FRN0520G2-4G	325	200	150	500	-	-	-	-	325	250	200	520	325	250	200	520
	315	FRN0740G2-4G	-	400	250	200	559	-	-	-	-	400	250	200	585	-	-	-	-
	355	FRIN0960G20-4G	FRN0650G2-4G	500	325	250	628	-	-	-	-	500	325	250	650	500	325	250	650
	400	FRN1040G2 -4G	FRN0740G2 -4G	-	2x15 0	250	705	-	-	-	-	-	2x200	325	740	-	2x20 0	325	740
	500	-	FRN0960G20-4G	-	2x25 0	2x20 0	881	-	-	-	-	-	-	-	-	-	2x25	2x20 0	960
				_	0 2x25	0 2x20		-	-	-	-	-				-	0	-	-
	500	FRN1170G20-4G	-		0	0	881						2x250	2x200	960				
	560	-	FRN1040G2-4G	-	2x25 0	2x20 0	990	-	-	-	-	-	-	-	-	-	2x32 5	2x25 0	1040
				-	2x32	2x25		-	-	-	-	-				-	3x25	2x25	
	630	FRN1386G2□-4G	FRN1170G20-4G		5	0	1115						3x250	2x250	1170		0	0	1170
	710	-	FRN1386G2□-4G	-	3x25 0	2x32 5	1256	-	-	-	-	-	-	-	-	-	3x32 5	2x32 5	1386

(Note 1) "IV wire" is used for permissible temperature of 60 °C (140 °F), "600 V HIV insulated wire" is used for 75 °C (167 °F), and "600 V cross-linked polyethylene insulated wire" is used for 90 °C (194 °F). These values are for aerial wiring.

(Note 2)  $\Box$  is replaced by a letter of the alphabet indicating the inverter type.

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\_\_\_ S (basic type), E (type with built-in EMC filter)

- \*1) Not applicable
- \*2) Not applicable

\*3) For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

- \*4) Not applicable
- \*5) Not applicable
- \*6) Not applicable
- \*7) Not applicable

Chap 2

Table 2.2-4 Wire size (for DC reactor connection, for braking resistor connection, and for inverter grounding) (cont.)

	HHD specification: High,	Heavy Duty	applications
F	HND specification: High, I	Normal Duty	applications

									Reco	mmend	ed wire s	ize (mn	1 <sup>2</sup> )					
_	₽ @ Ŷ	Inverte	er type	For D		tor conn	ection	F	or braki	ng resis	tor conne	ection [F	P(+), DE	B] (Note	e 2)		or inver roundir	
ver tem	cabl (kv				[P1,	P(+)]		HHD specification				ŀ	HND sp	ecificat	ion	,	[ <b>\$</b> G]	5
Power system	Standard applicable motor (kW)	HHD specification HND specification		temperature (Note 1) valu			Current value (A)	Permissible temperature (Note 1)			value	Current Perm value (A)			Current value (A)		ermissi erature 1)	
				60 °C	75 °C	90 °C	(~)	60 °C	75 °C	90 °C	(~)	60 °C	75 °C	90 °C	(~)	60 °C	75 °C	90 °C
	0.4	FRN0003G2S-2G	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.2	-	-	-	-			
	0.75	FRN0005G2S-2G	-	2.0	2.0	2.0	4.0	2.0	2.0	2.0	1.6	-	-	-	-			
	1.5	FRN0008G2S-2G	-	2.0	2.0	2.0	7.5	2.0	2.0	2.0	3.6	-	-	-	-	2.0	2.0	2.0
	2.2	FRN0011G2S-2G	-	2.0	2.0	2.0	11.0	2.0	2.0	2.0	3.5	-	-	-	-			
	3.7	FRN0018G2S-2G	-	2.0	2.0	2.0	18.4	2.0	2.0	2.0	4.1	-	1	-	-			
	5.5	FRN0032G2S-2G	-	3.5	2.0	2.0	25.9	2.0	2.0	2.0	6.4	-	-	-	-	3.5	3.5	3.5
	7.5	FRN0046G2S-2G	FRN0032G2S-2G	5.5	3.5	3.5	35.3	2.0	2.0	2.0	6.1	2.0	2.0	2.0	6.4	5.5	5.5	5.5
	11	FRN0059G2S-2G	FRN0046G2S-2G	14.0	5.5	5.5	51.7	2.0	2.0	2.0	9.1	2.0	2.0	2.0	6.1	5.5	5.5	5.5
ψ.	15	FRN0075G2S-2G	FRN0059G2S-2G	14.0	14.0	8 *3	70.6	2.0	2.0	2.0	11	2.0	2.0	2.0	9.1	8 *3	8 *3	8 *3
< has	18.5	FRN0088G2S-2G	FRN0075G2S-2G	22.0	14.0	14.0	87.0	2.0	2.0	2.0	14	2.0	2.0	2.0	11.0	8 *3	8 *3	8 *3
0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-	22	FRN0115G2S-2G	FRN0088G2S-2G	38 *1	22.0	14.0	103	2.0	2.0	2.0	15	2.0	2.0	2.0	14.0	14	14	14
Three-phase 200 V	30	-	FRN0115G2S-2G	60 *2	38 *1	22.0	140	-	-	-	-	2.0	2.0	2.0	15.0	14	14	14
F	30	FRN0146G2S-2G	-	60	38	22	140	2	2	2	19	-	-	-	-	14	14	14
	37	FRN0180G2S-2G	FRN0146G2S-2G	60	38	38	169	3.5	2	2	25	2	2	2	19	22	22	22
	45	FRN0215G2S-2G	FRN0180G2S-2G	100	60	38	205	3.5	3.5	2	30	3.5	2	2	25	22	22	22
	55	FRN0288G2S-2G	FRN0215G2S-2G	150	100	60	249	5.5	3.5	3.5	37	3.5	3.5	2	30	22	22	22
	75	-	FRN0288G2S-2G	200	150	100	345	-	-	-	-	5.5	3.5	3.5	37	22	22	22
	75	FRN0346G2S-2G	-	200	150	100	346	8	5.5	5.5	48	-	-	-	-	22	22	22
	90	-	FRN0346G2S-2G	250	150	150	409	-	-	-	-	8	5.5	5.5	48	22	22	22
	90	FRN0432G2S-2G	-	250	150	150	410	14	8	5.5	61	-	-	-	-	22	22	22
	110	-	FRN0432G2S-2G	325	200	150	502	-	-	-	-	14	8	5.5	61	38	38	38

(Note 1) "IV wire" is used for permissible temperature of 60 °C (140 °F), "600 V HIV insulated wire" is used for 75 °C (167 °F), and "600 V cross-linked polyethylene insulated wire" is used for 90 °C (194 °F). These values are for aerial wiring.

(Note 2) A braking unit (BU) (option) is necessary for FRN0346G2S-2G and above.

\*1) For compatible crimped terminals, please use model 38-6 by JST Mfg. Co., Ltd. or equivalent.

\*2) For compatible crimped terminals, please use model 60-6 by JST Mfg. Co., Ltd. or equivalent.

\*3) For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

- \*4) Not applicable
- \*5) Not applicable
- \*6) Not applicable
- \*7) Not applicable

Table 2.2-4 Wire size (for DC reactor connection, for braking resistor connection, and for inverter grounding) (cont.)

HHD specification: High, Heavy Duty applications
HND specification: High, Normal Duty applications

0.4 0.75 1.5 2.2 3.7 5.5 7.5 11 15 18.5 22 30 30 37 45 55 90 110 110 112	FRN0002G2_4G FRN0003G2_4G FRN0004G2_4G FRN0009G2_4G FRN0018G2_4G FRN0018G2_4G FRN0031G2_4G FRN003G2_4G FRN0045G2_4G FRN0060G2_4G FRN0075G2_4G FRN0075G2_4G	Pr type HND specification - - - FRN001620-4G FRN0031620-4G FRN003620-4G FRN0045620-4G FRN0045620-4G FRN0060620-4G FRN0075620-4G	P tempe 60 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 5.5 8 *3 14.0 14.0 14.0		Note 1) 90 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 3.5 5.5 8 *3	ection Current value (A) 1 2.0 3.7 5.6 9.2 13.0 17.7 25.9 35.3 43.5 51.7 69.9	l Pi		ecification ble Note 1) 90 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	Current value (A) 0.8 1.1 1.8 2.1 3.2 3.1 4.5 5.7 7.2	ŀ	HND sp ermissit rature (l	ecificati	ion Current Value (A) - - - 3.2 3.1 4.5	g Petempe 60 °C 2.0 3.5 3.5 5.5	or invert roundir [●G] ermissib erature 1) 75 °C 2.0 3.5 3.5 5.5	ng ble (Note
0.4 0.75 1.5 2.2 3.7 5.5 7.5 11 15 18.5 22 30 37 45 55 55 55 90 110 122	FRN0002G2_4G FRN0003G2_4G FRN0004G2_4G FRN0009G2_4G FRN0018G2_4G FRN0018G2_4G FRN0031G2_4G FRN003G2_4G FRN0045G2_4G FRN0060G2_4G FRN0075G2_4G FRN0075G2_4G	FRN0018G2□-4G FRN0023G2□-4G FRN0031G2□-4G FRN0036G2□-4G FRN0045G2□-4G FRN0045G2□-4G	tempe 60 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 5.5 8 *3 14.0 14.0 14.0	ermissiterature ( 75 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	ble           Note 1)           90 °C           2.0           2.0           2.0           2.0           2.0           2.0           2.0           2.0           3.5           5.5           8 *3	value (A) 1 2.0 3.7 5.6 9.2 13.0 17.7 25.9 35.3 43.5 51.7	Protection (Constraint) (Constr	ermissik rature (1 75 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	90 °C           2.0	Current value (A) 0.8 1.1 1.8 2.1 3.2 3.1 4.5 5.7 7.2	Petemper 60 °C - - - - 2.0 2.0 2.0		ble Note 1) 90 °C - - - - - 2.0 2.0 2.0	Current value (A) - - - - 3.2 3.1 4.5	Petempe 60 °C 2.0 3.5 3.5 5.5	[♥G] ermissib erature 1) 75 °C 2.0 3.5 3.5	ble (Note 90 °C 2.0 3.5 3.5
0.4 0.75 1.5 2.2 3.7 5.5 7.5 11 15 18.5 22 30 37 45 55 55 90 110 122	FRN0002G2_4G FRN0003G2_4G FRN0004G2_4G FRN0009G2_4G FRN0018G2_4G FRN0018G2_4G FRN0031G2_4G FRN003G2_4G FRN0045G2_4G FRN0060G2_4G FRN0075G2_4G FRN0075G2_4G	FRN0018G2□-4G FRN0023G2□-4G FRN0031G2□-4G FRN0036G2□-4G FRN0045G2□-4G FRN0045G2□-4G	tempe 60 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 5.5 8 *3 14.0 14.0 14.0	75 °C           2.0           2.0           2.0           2.0           2.0           2.0           2.0           2.0           2.0           2.0           2.0           2.0           5.5           5.5           14.0	Note 1) 90 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 3.5 5.5 8 *3	value (A) 1 2.0 3.7 5.6 9.2 13.0 17.7 25.9 35.3 43.5 51.7	tempe 60 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	rature (1 75 °C 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	90 °C           2.0	value (A) 0.8 1.1 1.8 2.1 3.2 3.1 4.5 5.7 7.2	tempel 60 °C - - - 2.0 2.0 2.0	rature ( 75 °C - - - 2.0 2.0 2.0	Note 1) 90 °C - - - - 2.0 2.0 2.0	value (A) - - - - - - 3.2 3.1 4.5	tempe 60 °C 2.0 3.5 3.5 5.5	2.0 3.5 3.5	(Note 90 °C 2.0 3.5 3.5
0.75 1.5 2.2 3.7 5.5 7.5 11 15 18.5 22 30 37 45 55 90 110 122	FRN0003G20-4G FRN0004G20-4G FRN0009G20-4G FRN0018G20-4G FRN0031G20-4G FRN0031G20-4G FRN003G20-4G FRN0045G20-4G FRN0045G20-4G FRN0075G20-4G FRN0075G20-4G	FRN001862_4G FRN002362_4G FRN003162_4G FRN003662_4G FRN004562_4G FRN006662_4G	2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 5.5 8 *3 14.0 14.0 14	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 5.5 5.5 14.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 3.5 5.5 8 *3	1 2.0 3.7 5.6 9.2 13.0 17.7 25.9 35.3 43.5 51.7	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	0.8 1.1 1.8 2.1 3.2 3.1 4.5 5.7 7.2	- - - 2.0 2.0 2.0	- - - 2.0 2.0 2.0	- - - 2.0 2.0 2.0	- - - - 3.2 3.1 4.5	2.0 3.5 3.5 5.5	2.0 3.5 3.5	2.0 3.5 3.5
0.75 1.5 2.2 3.7 5.5 7.5 11 15 18.5 22 30 37 45 55 90 110 122	FRN0003G20-4G FRN0004G20-4G FRN0009G20-4G FRN0018G20-4G FRN0031G20-4G FRN0031G20-4G FRN003G20-4G FRN0045G20-4G FRN0045G20-4G FRN0075G20-4G FRN0075G20-4G	FRN001862_4G FRN002362_4G FRN003162_4G FRN003662_4G FRN004562_4G FRN006662_4G	2.0 2.0 2.0 2.0 3.5 5.5 8*3 14.0 14.0 14	2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 5.5 5.5 14.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 3.5 3.5 5.5 8 *3	2.0 3.7 5.6 9.2 13.0 17.7 25.9 35.3 43.5 51.7	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	1.1 1.8 2.1 3.2 3.1 4.5 5.7 7.2	- 2.0 2.0 2.0	- - 2.0 2.0 2.0	- - 2.0 2.0 2.0	- - - 3.2 3.1 4.5	3.5 3.5 5.5	3.5 3.5	3.5 3.5
1.5 2.2 3.7 5.5 7.5 11 15 18.5 22 30 30 37 45 55 55 55 90 110 122	FRN0004G20-4G FRN0009G20-4G FRN0018G20-4G FRN0018G20-4G FRN0031G20-4G FRN0031G20-4G FRN0045G20-4G FRN0045G20-4G FRN0075G20-4G FRN0075G20-4G	FRN001862_4G FRN002362_4G FRN003162_4G FRN003662_4G FRN004562_4G FRN006662_4G	2.0 2.0 2.0 2.0 3.5 5.5 8 *3 14.0 14.0 14	2.0 2.0 2.0 2.0 2.0 2.0 3.5 5.5 5.5 14.0	2.0 2.0 2.0 2.0 2.0 3.5 3.5 5.5 8 *3	3.7 5.6 9.2 13.0 17.7 25.9 35.3 43.5 51.7	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	1.8           1.8           2.1           3.2           3.1           4.5           5.7           7.2	- 2.0 2.0 2.0	- - 2.0 2.0 2.0	- - 2.0 2.0 2.0	- - 3.2 3.1 4.5	3.5 3.5 5.5	3.5 3.5	3.5 3.5
2.2 3.7 5.5 7.5 11 15 18.5 22 30 37 45 55 55 90 110 122	FRN0006G2=4G FRN009G2=4G FRN003G2=4G FRN0031G2=4G FRN00362=4G FRN0045G2=4G FRN0045G2=4G FRN0075G2=4G FRN0075G2=4G	FRN001862_4G FRN002362_4G FRN003162_4G FRN003662_4G FRN004562_4G FRN006662_4G	2.0 2.0 2.0 3.5 5.5 8*3 14.0 14.0 14	2.0 2.0 2.0 2.0 3.5 5.5 5.5 14.0	2.0 2.0 2.0 2.0 3.5 3.5 5.5 8 *3	5.6 9.2 13.0 17.7 25.9 35.3 43.5 51.7	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0	1.8 2.1 3.2 3.1 4.5 5.7 7.2	- 2.0 2.0 2.0	- - 2.0 2.0 2.0	- - 2.0 2.0 2.0	- - 3.2 3.1 4.5	3.5 3.5 5.5	3.5 3.5	3.5 3.5
3.7 5.5 7.5 11 15 18.5 22 30 37 45 55 90 110 122	FRN0009G2=4G FRN0018G2=4G FRN0031G2=4G FRN0031G2=4G FRN0045G2=4G FRN0045G2=4G - FRN0075G2=4G FRN0075G2=4G	- FRN0018G2□-4G FRN0023G2□-4G FRN003G2□-4G FRN0045G2□-4G FRN006G2□-4G	2.0 2.0 3.5 5.5 8 *3 14.0 14.0 14	2.0 2.0 2.0 3.5 5.5 5.5 14.0	2.0 2.0 2.0 3.5 3.5 5.5 8 *3	9.2 13.0 17.7 25.9 35.3 43.5 51.7	2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0 2.0	2.1 3.2 3.1 4.5 5.7 7.2	- 2.0 2.0 2.0	- 2.0 2.0 2.0	- 2.0 2.0 2.0	- 3.2 3.1 4.5	3.5 3.5 5.5	3.5 3.5	3.5 3.5
5.5 7.5 11 15 18.5 22 30 400 400 40 90 110 122	FRN0018G2=4G FRN0023G2=4G FRN0031G2=4G FRN0045G2=4G FRN0045G2=4G FRN0060G2=4G FRN0075G2=4G FRN0091G2=4G	- FRN0018G2□-4G FRN0023G2□-4G FRN003G2□-4G FRN0045G2□-4G FRN006G2□-4G	2.0 2.0 3.5 5.5 8*3 14.0 14.0 14	2.0 2.0 3.5 5.5 5.5 14.0	2.0 2.0 3.5 3.5 5.5 8 *3	13.0 17.7 25.9 35.3 43.5 51.7	2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0 2.0	3.2 3.1 4.5 5.7 7.2	- 2.0 2.0 2.0	- 2.0 2.0 2.0	- 2.0 2.0 2.0	- 3.2 3.1 4.5	3.5 5.5	3.5	3.5
7.5 11 15 18.5 22 30 4000 45 55 90 110 122	FRN0023G2 -4G FRN0031G2 -4G FRN0038G2 -4G FRN0045G2 -4G FRN0060G2 -4G - FRN0075G2 -4G FRN0091G2 -4G	FRN0023G2-4G FRN0031G2-4G FRN0038G2-4G FRN0045G2-4G FRN0060G2-4G -	2.0 3.5 5.5 8 *3 14.0 14.0 14	2.0 2.0 3.5 5.5 5.5 14.0	2.0 2.0 3.5 3.5 5.5 8 *3	17.7 25.9 35.3 43.5 51.7	2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0	3.1 4.5 5.7 7.2	2.0 2.0	2.0 2.0	2.0 2.0	3.1 4.5	3.5 5.5	3.5	3.5
11 15 18.5 22 30 37 45 55 90 110 122	FRN0031G2□-4G FRN0038G2□-4G FRN0045G2□-4G FRN0060G2□-4G - FRN0075G2□-4G FRN0091G2□-4G	FRN0023G2-4G FRN0031G2-4G FRN0038G2-4G FRN0045G2-4G FRN0060G2-4G -	3.5 5.5 8 *3 14.0 14.0 14	2.0 3.5 5.5 5.5 14.0	2.0 3.5 3.5 5.5 8 *3	25.9 35.3 43.5 51.7	2.0 2.0 2.0	2.0 2.0 2.0	2.0 2.0 2.0	4.5 5.7 7.2	2.0 2.0	2.0 2.0	2.0 2.0	3.1 4.5	3.5 5.5	3.5	3.5
15 18.5 22 30 37 45 55 46 007 90 110 122	FRN0038G2-4G FRN0045G2-4G FRN006G2-4G - FRN0075G2-4G FRN0091G2-4G	FRN0031G24G FRN0038G24G FRN0045G24G FRN0060G24G	5.5 8 *3 14.0 14.0 14	3.5 5.5 5.5 14.0	3.5 3.5 5.5 8 *3	35.3 43.5 51.7	2.0 2.0	2.0 2.0	2.0 2.0	5.7 7.2	2.0	2.0	2.0	4.5	5.5		
18.5 22 30 37 45 6-004 90 110 132	FRN0045G24G FRN0060G24G - FRN0075G24G FRN0091G24G	FRN0038G2□-4G FRN0045G2□-4G FRN0060G2□-4G -	8 *3 14.0 14.0 14	5.5 5.5 14.0	3.5 5.5 8 *3	43.5 51.7	2.0	2.0	2.0	7.2						5.5	5.5
22 30 45 45 40 400 75 90 110 122	FRN0060G2□-4G - FRN0075G2□-4G FRN0091G2□-4G	FRN0045G2□-4G FRN0060G2□-4G -	14.0 14.0 14	5.5 14.0	5.5 8 *3	51.7		-	-		2.0	0.0	20				
30 37 45 90 400 90 110 122	- FRN0075G2-4G FRN0091G2-4G	FRN0060G2□-4G -	14.0 14	14.0	8 *3		2.0	2.0	~ ~			2.0	2.0	5.7	5.5	5.5	5.5
9 9 9 9 9 9 9 9 10 10 132	FRN0091G2 -4G	-	14			69.9			2.0	7.7	2.0	2.0	2.0	7.2	5.5	5.5	5.5
	FRN0091G2 -4G	- FRN0075G2□-4G		14			-	-	-	-	2.0	2.0	2.0	7.7	8 *3	8 *3	8 *3
45 55 75 90 110 132		FRN0075G2 -4G	22		8	69.9	2	2	2	10	-	-	-	-	8	8	8
Hree-D 400 < 400 90 110 132	EDNI044000 10		22	14	14	83.9	2	2	2	12	2	2	2	10	8	8	8
132	FRN0112G2 -4G	FRN0091G2 -4G	38	22	14	102	2	2	2	15	2	2	2	12	8	8	8
132	FRN0150G2 -4G	FRN0112G2 -4G	38	38	22	125	2	2	2	19	2	2	2	15	14	14	14
132	FRN0180G2 -4G	FRN0150G2 -4G	60	38	38	169	3.5	2	2	24	2	2	2	19	14	14	14
132	FRN0216G2 -4G	FRN0180G2 -4G	100	60	38	201	5.5	3.5	2	31	3.5	2	2	24	14	14	14
132	FRN0260G2 -4G	FRN0216G2 -4G	150	100	60	246	5.5	3.5	2	34	5.5	3.5	2	31	22	22	22
132	-	FRN0260G2 -4G	150	100	100	292	-	-	-	-	5.5	3.5	2	34	22	22	22
	FRN0325G2 -4G	-	150	100	100	292	8	5.5	3.5	41	-	-	-	-	22	22	22
160	FRN0377G2 -4G	FRN0325G2 -4G	200	150	100	350	14	5.5	5.5	50	8	5.5	3.5	41	22	22	22
200	FRN0432G2 -4G	FRN0377G2 -4G	250	200	150	437	14	8	5.5	62	14	5.5	5.5	50	38	38	38
220	FRN0520G2 -4G	FRN0432G2 -4G	325	200	150	478	14	14	8	71	14	8	5.5	62	38	38	38
280	FRN0650G2 -4G	FRN0520G2 -4G	500	325	250	612	38	14	14	94	14	14	8	71	38	38	38
315	FRN0740G2 -4G	-	500	325	250	685	38	22	14	99	-	-	-	-	60	60	60
355	FRN0960G20-4G	FRN0650G20-4G	-	2x200	325	769	38	22	22	117	38	22	14	100	60	60	60
400	FRN1040G2 -4G	FRN0740G2 -4G	-	2x250	2x200	864	38	22	22	124	38	22	22	124	60	60	60
500	-	FRN0960G2 -4G	-	2x325	2x250	1079	-	-	-	-	38	22	22	124	100	100	100
500	FRN1170G2 -4G	-	-	2x325	2x250	1080	60	38	38	170	-	-	-	-	100	100	100
560	-	FRN1040G20-4G	-	3x325	2x325	1212	-	-	-	-	38	22	22	124	100	100	100
630		FRN1170G2 -4G	-	3x325	2x325	1366	100	60	38	207	100	60	38	186	150	150	150
710	FRN1386G2 -4G			4x325	3x325	1538					100	60	60	234	150	150	150

(Note 1) "IV wire" is used for permissible temperature of 60 °C (140 °F), "600 V HIV insulated wire" is used for 75 °C (167 °F), and "600 V cross-linked polyethylene insulated wire" is used for 90 °C (194 °F). These values are for aerial wiring.

(Note 2)  $\Box$  is replaced by a letter of the alphabet indicating the inverter type.

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S (basic type), E (type with built-in EMC filter)

(Note 3) A braking unit (BU) (option) is necessary for FRN0216G2□-4G and above.

- \*1) Not applicable
- \*2) Not applicable

\*3) For compatible crimped terminals, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

- \*4) Not applicable
- \*5) Not applicable
- \*6) Not applicable
- \*7) Not applicable

Classifi cation	Terminal symbol	Terminal command	Detailed specifications
	L1/R, L2/S, L3/T	Main power supply input	Connect a three-phase power supply.
	U, V, W	Inverter output	Terminals to connect three-phase motors.
	P(+), P1	For DC reactor connection	Connect a DC reactor (DCR) (option). Be sure to connect if using motors with output of 75 kW or higher.
	P(+), N(-)	For direct current bus connection	Used for connection to direct current intermediate circuits of other inverters and PWM converters.
Main circuit	P(+), DB	For braking resistor connection	Connect braking resistor (DB) (option) terminal (+) and DB (wiring length: 5 meters (16.4 ft) or shorter).
Main	₿G	For inverter chassis (case) grounding	This is the grounding terminal for the inverter chassis (casing) and motor. Ground to the earth at one end, and connect to the motor grounding terminal at the other end. Two of these terminals have been provided.
	R0, T0	Control power auxiliary input	If wishing to retain the integrated alarm signal issued if the protective function is triggered even when the inverter main power supply is cut off, or to constantly display the keypad, connect this terminal to the power supply (FRN0008G2S-2G or higher / FRN0004G2 -4G or higher).

### [4] Terminal function description (main circuit terminals)

Wire in the following order.

- (1) Inverter grounding terminal (�G)
- (2) Inverter output terminals (U, V, W), motor grounding terminal (GG)
- (3) Direct current reactor connection terminals (P1, P(+))\*
- (4) Braking resistor connection terminals (P(+), DB)\*
- (5) Direct current bus connection terminals (P(+), N(-))\*
- (6) Main power supply input terminals (L1/R, L2/S, L3/T)
- (7) Control power auxiliary input terminals (R0, T0) \* (FRN0008G2S-2G / FRN0004G2S-4G or higher)
- \*: Connect if necessary.

Chap 2

#### (1) Inverter grounding terminal **G**

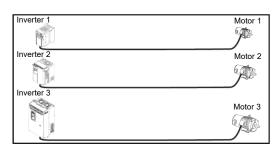
Be sure to ground grounding terminals to ensure safety, and as a noise countermeasure. In order to prevent accidents such as an electric shock or fire, users are obligated by the Electrical Equipment Technical Standards to carry out grounding work for the metal frames of electrical equipment.

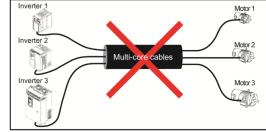
Ground the inverter in compliance with the national or local electric code.

#### (2) Inverter output terminals U, V, W, motor grounding terminal **G**

- 1) Connect the three-phase motor terminals U, V, and W while matching the phase sequence.
- 2) Connect the ground line of the outputs (U, V, W) to the ground terminal (GG).

Note If there are multiple inverter and motor combinations, do not use multi-core cables for the purpose of bundling and storing wiring for multiple combinations.





#### (3) Direct current reactor connection terminals P1, P(+)

Connect a DC reactor (DCR).

- 1) Remove the shorting bar from terminals P1 and P(+). (A shorting bar is not connected to FRN0346G2S-2G / FRN0180G2□-4G and higher)
- 2) Connect the DC reactor P1 and P(+) terminals.

Note

Keep the wiring length below 10 meters (32.8 ft).

- Do not remove the shorting bar if the direct current reactor is not used.
- Be sure to connect if using motors with output of 75 kW or higher.
- · Direct current reactors do not have to be connected when connecting PWM converters.

# WARNING

• Be sure to connect an optional DC reactor when the capacity of the power supply transformer exceeds 500 kVA, and is at least 10 times the inverter rated capacity.

Be sure to connect if using motors with output of 75 kW or higher.

Failure to observe this could result in fire.

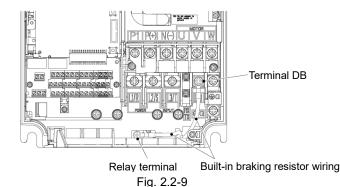
#### (4) Braking resistor connection terminals P(+), DB

Type of	Type of Inverter			Additional connected	Work procedure
FRNDDDDG2S-2G	FRNDDDDG2D-4G	transistor	braking resistor	devices (option)	
(Capacity kW)	(Capacity kW)		10313101		
0003 to 0046	0002 to 0023	Built-in	Built-in	Breaking resistor	Perform 1), 2), 3),
(0.4 to 7.5)	(0.4 to 7.5)	Built-III	Built-III	(higher capacity)	and 4).
0059 to 0288	0031 to 0180	Built-in	Not og uippod	Dreaking register	Perform 2), 3),
(11 to 55)	(11 to 75)	Duiit-in	Not equipped	Breaking resistor	and 4).

Table 2.2-5

If there is insufficient capacity with the built-in braking resistor in models FRN0046G2S-2G/FRN0023G2 -4G and lower (for frequent operation or high inertial load operation, etc.), it will be necessary to use an optional braking resistor (standard type or 10%ED type) to increase braking ability. If doing so, it will be necessary to remove the built-in braking resistor. Use the following procedure to remove the built-in braking resistor.

 On FRN0003G2S-2G / FRN0002G2□-4G to FRN0018G2S-2G / FRN0009G2□-4G inverters, disconnect the built-in braking resistor wiring connected to terminals P(+) and DB. On FRN0032G2S-2G / FRN0018G2□-4G and FRN0046G2S-2G / FRN0023G2□-4G inverters, disconnect the built-in braking resistor wiring connected to terminal DB and the internal relay terminal (see figure below). Insulate the ends of the disconnected wires with insulating tape, etc.



 Connect braking resistor terminals P(+) and DB. The internal relay terminal is not used on FRN0032G2S-2G / FRN0018G2□-4G and FRN0046G2S-2G / FRN0023G2□-4G inverters.

- 3) Mount the inverter main body and the braking resistor such that the wiring length will be less than 5 m (16ft) and route the two wires twisted or in contact with each other (parallel).
- 4) Change the DB resistor electronic thermal setting.

# **WARNING**

When connecting a DC braking resistor (DBR), never connect it to terminals other than terminals P(+) and DB.

Failure to observe this could result in fire.

### (5) Direct current bus connection terminals P(+), N(-)

#### Table 2.2-6

Type of	Inverter	Braking	Built-in	Additional connected			
FRNDDDDG2S-2G	FRNDDDG2D-4G	transistor	braking resistor	devices	Connected device, terminal		
(Capacity kW)	(Capacity kW)		16515101	(option)			
0346 to 0432	0216 to 1386	Not	Not	Braking unit	Between inverter and braking unit: P(+), N(-)		
(75 to 90)	(90 to 630)	equipped	equipped	Breaking resistor	Between braking unit and braking resistor: P(+), DB		

#### 1) Braking unit/braking resistor (option connection

A braking unit and braking resistor are necessary on FRN0346G2S-2G or higher (200V series) / FRN0216G2  $\Box$ -4G or higher (400V series) inverters.

Connect braking unit terminals P(+) and N(-) to inverter terminals P(+) and N(-). Wire so that the wiring length is no longer than 5 m (16 ft), and either twist or wire the two wires closely together (in parallel).

Connect braking resistor terminals P(+) and DB to braking unit terminals P(+) and DB. Wire so that the wiring length is no longer than 10 m (33 ft), and either twist or wire the two wires closely together (in parallel).

Refer to the braking unit instruction manual for details on other wiring, etc.

2) Connection of other devices

The direct current intermediate circuit of other inverters and PWM converters can be connected.

Note Contact Fuji Electric if using terminals P(+) and N(-) for DC bus bar connection.

#### (6) Main power supply input terminals L1/R, L2/S, and L3/T (three-phase input)

Connect a three-phase power supply.

- 1) To ensure safety, confirm that the molded case circuit breaker (MCCB) or magnetic contactor (MC) is OFF prior to wiring the main power supply.
- Connect the power lines (L1/R, L2/S, L3/T) via a molded case circuit breaker (MCCB) or earth leakage circuit breaker (ELCB)\*, and if necessary, via a magnetic contactor (MC). There is no need to align the power line and inverter phase sequence.

\* With overcurrent protection function



In the case of emergencies such as when the inverter protective function is activated, it is recommended that the inverter be disconnected from the power supply, and that an MC which allows manual disconnection of the power supply be installed to prevent magnification of failure or accident.

#### (7) Control power auxiliary input terminals R0, T0 (FRN0008G2S-2G / FRN0004G2 -4G or higher)

The inverter can be run even without inputting the power supply to the control power auxiliary input terminals. However, control power will also be lost by cutting off the inverter main power supply, and therefore all inverter output signals will stop, and the keypad will no longer display.

If wishing to retain the integrated alarm signal issued if the protective function is activated even when the inverter main power supply is cut off, or to constantly display the keypad, connect the control power auxiliary input terminals to the power supply. If the inverter is equipped with a magnetic contactor (MC) at the input side, wire from the magnetic contactor (MC) input side (primary side).

Terminal rating: 200 to 240 VAC, 50/60 Hz, maximum current 1.0 A (FRN0115G2S-2G or lower) 200 to 230 VAC, 50/60 Hz, maximum current 1.0 A (FRN0146G2S-2G or higher) 380 to 480 VAC, 50/60 Hz, maximum current 0.5 A (400V series))

Note When using the earth leakage breaker, connect terminals R0, T0 to the output side of the earth leakage breaker. When connections are made to the input side of the earth leakage breaker, the earth leakage breaker will malfunction because the inverter input is three-phase and the terminals R0, T0 are single phase. When connecting to terminals R0, T0 to the input side of the earth leakage breaker, make sure that the connection is done through an insulating transformer or, alternatively, through the auxiliary B contacts of the magnetic contactor as shown in the figure below.

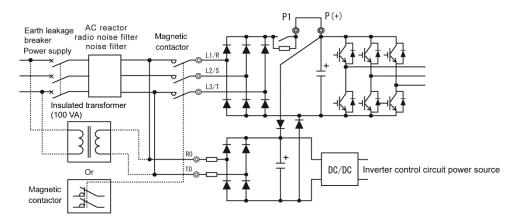


Fig. 2.2-10 Earth leakage circuit breaker connection

Note When connecting with the PWM converter, do not connect power source directly to the inverter's auxiliary power input terminals (R0, T0) for control circuit. Insert an insulating transformer or the auxiliary B contacts of a magnetic contactor on the power supply side.

Refer to the PWM converter instruction manual for PWM converter side connection examples.

There are cases where the power supply is connected directly to R0 and T0 on older models, and caution is therefore required particularly when replacing inverters.

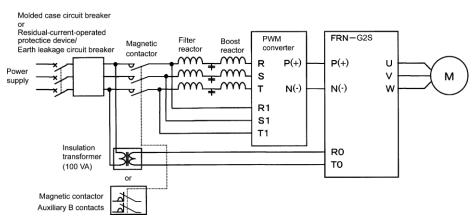


Fig. 2.2-11 Example of connection of R0, T0 terminals in combination with PWM converter

#### 2.2.6 Control circuit terminals (common to all models)

#### Screw specifications and recommended wire size (control circuit terminals) [1]

The specifications for the screws used in the control circuit wiring and the wire sizes are shown below.

The control circuit terminal block is common, regardless of the inverter capacity.

The control terminal block for the conventional model MEGA (GS1) is available as an option to allow round crimp terminals to be connected.

Refer to Chapter 11 "11.21 Control Terminal Block (G1S Compatible) OPC-G1-TB1" for details.

	Screv	v specification					Rod terminal *1	
Common terminal	Size	Tightening torque N∙m (Ib-in)	Permissible wire size mm <sup>2</sup> (AWG)	Recommended wire size mm <sup>2</sup> (AWG)	Driver (shape of tip)	Wire coating removal size ┣┏┲┲┲  ← ℓ	Terminal block opening dimension	
Control circuit terminal	M3	0.5 to 0.6 (4.43 to 5.31)	0.14 to 1.5 (26 to 16)	0.3 to 0.75 (22 to 18)	Minus (0.6 mm x 3.5 mm)	6 mm (0.24 in)	A1 *2 (2.75 x 1.95)	

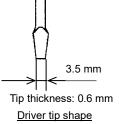
Table 2.2-7 Screw specifications and recommended wire sizes

\*1: Recommended rod terminal: Phoenix Contact Refer to Table 2.2-8 below for details.

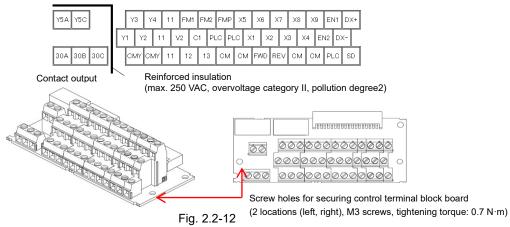
\*2: Defined according to IEC/EN 60947-1.

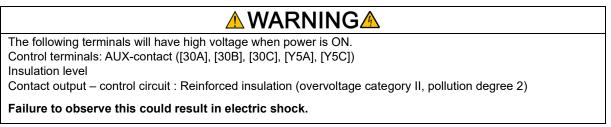
Table 2.2-8 Recommended rod terminals

Wire size	Туре					
wire size	With insulating collar	Without insulating collar				
0.34 mm <sup>2</sup> (AWG22)	AI 0.34-6 TQ	A 0.34-7				
0.5 mm <sup>2</sup> (AWG20)	AI 0.5-6 WH	A 0.5-6				
0.75 mm <sup>2</sup> (AWG18)	AI 0.75-6 GY	A 0.75-6				
1.25 mm <sup>2</sup> (AWG16)	AI 1.5-6-BK	A 1.5-7				



#### [2] Terminal layout diagram (control circuit terminals)





Chap 2

#### [3] Control circuit wiring precautions

#### ■ FRN0346GS-2G, FRN0432G2S-2G, FRN0325G2□-4G to FRN1386G2□-4G

- (1) Run the wiring along the plate on the left side of the inverter as shown in Fig. 2.2-13.
- (2) Secure the wiring to wire holders with cable ties (INSULOK, etc.)
  - Use cable ties with width of no greater than 3.8 mm (0.15 in), and thickness of no greater than 1.5 mm (0.06 in).

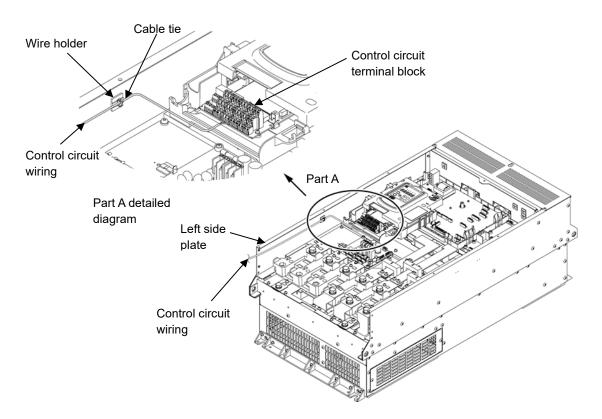


Fig. 2.2-13 Control circuit wiring route and securing locations

- The control circuit terminal lines should be routed as far as possible from the main circuit routing. Malfunction may occur due to noise.
  - To prevent direct contact with the main circuit live sections (such as the main circuit terminal block), route the control circuit wiring inside the inverter as bundles using cable ties.

# **WARNING**

Control signal lines generally do not have a reinforced insulation coating, and therefore if control signal lines come into contact with live parts of the main circuit, the insulation coating may be damaged for some reason. In such a case, there is a danger that high voltage from the main circuit will be applied to the control signal lines, and therefore care should be taken to ensure that they do not come into contact with live parts of the main circuit.

Failure to observe this could result in an accident or electric shock.

# 

Noise is produced by the inverter, motors, and wiring.

Take care to prevent the malfunction of peripheral sensors and devices.

Failure to observe this could result in an accident.

## [4] Description of terminal functions (control circuit terminals)

A description of control circuit terminal functions is shown in Table 2.2-9. The control circuit terminal connection method differs based on function code settings to suit the purpose for which the inverter is used. Wire appropriately to minimize the effect of noise from main circuit wiring.

#### Analog input terminals

Table 2.2-9 Description of control circuit terminal functions

Classification	Terminal symbol	Terminal command	Function description
	[13]	Power supply for variable resistor	The terminal is used for the power supply (+10 VDC) for the external frequency setter (variable resistor: 1 to 5 k $\Omega$ ). Connect variable resistors larger than 1/2 W.
Analog input	[12]	Analog setting voltage input	<ul> <li>(1) Frequency is set up according to the external analog voltage input command value.</li> <li>0 to ±10 VDC/0 to ±100(%) (inverse operation),</li> <li>+10 to 0 VDC/0 to 100(%) (inverse operation)</li> <li>(2) Other than frequency settings, this terminal can be assigned to PID commands, PID control feedback signals, frequency auxiliary settings, ratio settings, torque limit value settings, torque command values *1, *2/torque current command values *1, *2, speed limit values, and analog input monitors with analog input.</li> <li>(3) Hardware specifications <ul> <li>Input impedance: 22 (kΩ)</li> <li>Up to ±15 VDC can be input. However, input exceeding ±10 VDC will be recognized as ±10 VDC.</li> </ul> </li> <li>To input bipolar (0 to ±10 VDC) analog setting voltage at terminal [12], set function code C35 to "0".</li> </ul>

\*1 These are valid specifications and functions when performing speed sensorless vector control.

\*2 These are valid specifications and functions when performing vector control with speed sensor. A PG interface card (option) is required.

Table 2.2-9 Description of control circuit terminal functions (cont.)

Classification	Terminal symbol	Terminal command	Function description
	[C1]	Analog setting current input (C1 function)	<ol> <li>(1) Frequency is set up according to the external analog current input command value.         <ul> <li>4 to 20 mA DC/0 to 100(%), 0 to 20 mA DC/0 to 100(%) (normal operation)</li> <li>20 to 4 mA DC/0 to 100(%), 20 to 0 mA DC/0 to 100(%) (inverse operation)</li> </ul> </li> <li>(2) Other than frequency settings, this terminal can be assigned to PID commands, PID control feedback signals, frequency auxiliary settings, ratio settings, torque limit value settings, torque command values *1, *2/torque current command values *1, *2, speed limit values, and analog input monitors with analog input.</li> <li>(3) Hardware specifications         <ul> <li>Input impedance: 250 (Ω)</li> <li>Up to 30 mA DC can be input. However, input exceeding 20 mA DC will be recognized as 20 mA DC.</li> </ul> </li> </ol>
Analog input		Analog setting voltage input (V3 function)	<ul> <li>(1) Frequency is set up according to the external analog voltage input command value.</li> <li>0 to ±10 VDC/0 to ±100(%) (normal operation)</li> <li>10 to ±0 VDC/0 to ±100(%) (inverse operation)</li> <li>(2) Other than frequency settings, this terminal can be assigned to PID commands, PID control feedback signals, frequency auxiliary settings, ratio settings, torque limit value settings, torque command values *1, *2/torque current command values *1, *2, speed limit values, and analog input monitors with analog input.</li> <li>(3) Hardware specifications</li> <li>* Input impedance: 22 (kΩ)</li> <li>* Up to ±15 VDC can be input. However, input exceeding ±10 VDC will be recognized as ±10 VDC.</li> <li>* To input bipolar (0 to ±10 VDC) analog setting voltage at terminal [V3], set function code C78 to "0".</li> </ul>
	[V2]	Analog setting voltage input (V2 function)	<ol> <li>Frequency is set up according to the external analog voltage input command value.         <ul> <li>0 to ±10 VDC/0 to ±100(%) (normal operation)</li> <li>10 to ±0 VDC/0 to ±100(%) (inverse operation)</li> </ul> </li> <li>Other than frequency settings, this terminal can be assigned to PID commands, PID control feedback signals, frequency auxiliary settings, ratio settings, torque limit value settings, torque command values *1, *2/torque current command values *1, *2, speed limit values, and analog input monitors with analog input.</li> <li>Hardware specifications         <ul> <li>Input impedance: 22 (kΩ)</li> <li>Up to ±15 VDC can be input. However, input exceeding ±10 VDC will be recognized as ±10 VDC.</li> <li>To input bipolar (0 to ±10 VDC) analog setting voltage at terminal [V2], set function code C45 to "0".</li> </ul> </li> </ol>

\*1 These are valid specifications and functions when performing speed sensorless vector control.

\*2 These are valid specifications and functions when performing vector control with speed sensor. A PG interface card (option) is required.

Classification	Terminal symbol	Terminal command	Function description
	[V2]	PTC/NTC thermistor input (PTC/NTC function)	(1) PTC (Positive Temperature Coefficient)/NTC (Negative Temperature Coefficient) thermistors for motor protection can be connected. SW5 (see "2.2.7 Switching switches") on the PCB must be switched to the PTC/NTC side. The following diagram shows the internal circuit when SW5 (terminal [V2] changeover switch) is switched to the PTC/NTC side. Refer to "2.2.7 Switching switches" for details on SW5. When SW5 is switched to the PTC/NTC side, function code H26 also needs to be changed.          Image: the pt = 0.1 multiple state of the pt = 0.1 multiple state
ut	[11]	Analog common	The terminal is the common terminal for analog input signals (terminals [13], [12], [C1], [V2], [FM1], and [FM2]). The terminal is insulated from terminals [CM], [CMY].
Analog input	Note	<ul> <li>which are su external indibelow, shiel</li> <li>When insert Also, do not</li> <li>When extern due to the n to the output control signation.</li> <li>Do not apply circuit dama</li> </ul>	Shield lines Control circuit Analog signal generator> Capacitor O.022 µF block> [13] 50 V [12]
		resistor 1 to 5 kΩ	$ \downarrow $
		Fig. 2.2-1	5 Connection diagram for shielded wire Fig. 2.2-16 Example of noise countermeasures

#### Digital input terminals

Table 2.2-10 Description of o	control circuit terminal functions
-------------------------------	------------------------------------

Classification	Terminal symbol	Terminal command	Fun	ction o	descriptio	on			
	[X1]	Digital input 1	<ol> <li>Various signals (coast to stop comm be set with function codes E01 to E0 CODES" for details.</li> </ol>						
	[X2]	Digital input 2	(2) The input mode and SINK/SOURCE ( switches.)	can be	switche	d using SW1	. (See 2	.2.7 Swi	tching
	[X3]	Digital input 3	(3) The operating mode between each di switched to "ON when shorted (activ						
	[X4]	Digital input 4	(4) Digital input terminals [X6] and [X7] changing the function code	can be	e set up a	as a pulse tra	ain input	termina	l by
	[X5]	Digital input 5	Maximum wire length: 20 m Maximum input pulse 30 kHz: When connected to open co	ollector	· output r	oulse generat	tor		
	[X6]	Digital input 6	(A pull-up resistor and pull-down res train with terminals [X6] and [X7].	istor a	re requir	ed. Refer to	■Wher	n inputtir	ng pulse
	[X7]	Digital input 7	100 kHz: When connected to comple Refer to Chapter 5 "FUNCTION CO					ettings.	
	[X8]	Digital input 8	<digital circuit="" input="" specifications=""></digital>		Ite	m	Min	. N	1ax.
	[X9]	Digital	[PLC] +24VDC	Ope	erating	ON level	0 V		2 V
	[FWD]	input 9 Forward	SINK Photocoupler	vo	ltage INK)	OFF level	20 \		7 V
		rotation	SW1		erating	ON level	20 \	/ 2	7 V
		run/stop command input	- ([X1] to [X9], 5,4kΩ	(SC	ltage DURC E)	OFF level	0 V		2 V
Digital input	[REV]	Reverse rotation run/stop command input	Fig. 2.2-17 Digital input circuit	Ope ON (whe	, rating cu	rrent when voltage 0 V) ] input	2.5 m		mA 5 mA)
					nissible l ent wher	0	-	0.5	5 mA
						Table	2.2-11		
	[EN1] [EN2]	Enable input	<ol> <li>When terminals [EN1]-[PLC] or term transistors stop switching (safe torqu Be sure to operate terminals [EN1] a issued and the operation of the inve</li> <li>The input mode for terminals [EN1] a switched to sink.</li> <li>This function can be enabled and dir respective SW7 switches to the OFF</li> </ol>	ue off: and [El rter wil and [E sabled	STO). N2] simu II be disa N2] is fix with SV	ltaneously; o abled. aed to source	therwise	e an £r ode can	F alarm is not be
			<terminal [en1],="" [en2]="" circuit="" specificati<="" td=""><td>ons&gt;</td><td></td><td></td><td></td><td></td><td></td></terminal>	ons>					
						Item		Min.	Max.
			EN1SW7		Opera	-	level	20 V	27 V
					volta (SOUI	RCE) OFF	E level	0 V	2 V
			EN2 5.4kΩ	"▼	(when in	ng current wh nput voltage :	27 V)	2.5 mA	10 mA
						sible leakage when OFF		_	0.5 mA

l input	[PLC]	Programmable controller signal power supply	(1)	Connect the output signal power supply for the programmable controller. (Rated voltage +24 VDC (power supply voltage fluctuation range: 20 to +27 VDC), maximum 100 mA)
Digital			(2)	The terminal can also be used as the power supply for loads connected to transistor outputs. Refer to the "Transistor output" section for details.

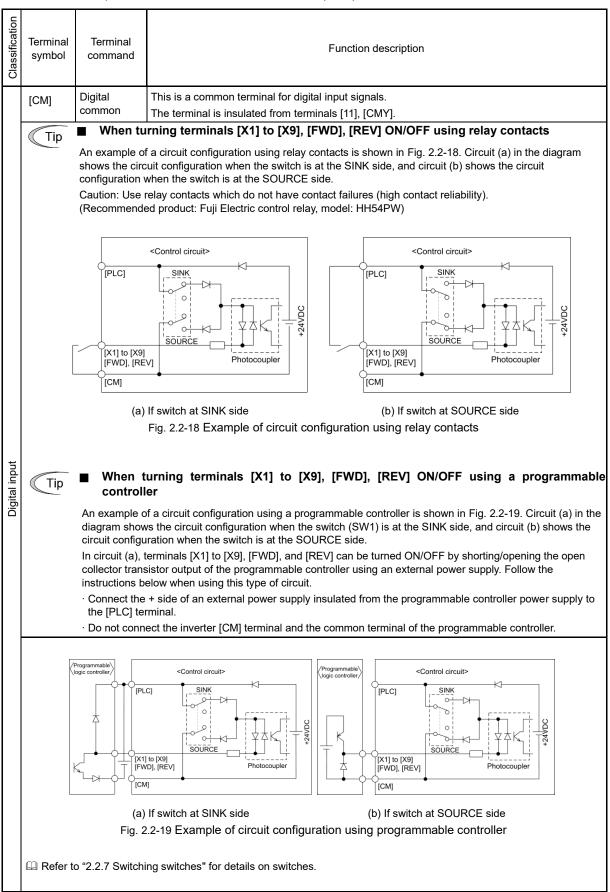


Table 2.2-10 Description of control circuit terminal functions (cont.)

Note

#### When inputting pulse train with terminals [X6] and [X7]

If connecting to an open collector output pulse generator, it may not be possible to correctly recognize input pulses due to the stray capacitance of the wiring. In response to this, if the changeover switch is set to the SINK side, connect a pull-up resistor between the open collector output signals (terminals [X6], [X7]) and the power supply (terminal [PLC]), and if the changeover switch is set to the SOURCE side, connect a pull-down resistor between the open collector output signals (terminals [X6], [X7]) and the four supply (terminal [PLC]), and if the changeover switch is set to the SOURCE side, connect a pull-down resistor between the open collector output signals (terminals [X6], [X7]) and the digital common (terminal [CM]). 1 k $\Omega$ , 2 W pull-up and pull-down resistors are recommended. The stray capacitance of wiring varies greatly depending on such factors as the wire type and method in which wiring is laid. It is therefore necessary to check whether it is possible to recognize pulse train input correctly.

#### Analog output, pulse output, transistor output, contact output terminals

Classification	Terminal symbol	Terminal command	Function o	description
Analog output	[FM1] [FM2]	Analog monitor (FMA function)	These terminals output analog DC voltage of 0 mA DC or 0 to 20 mA DC monitor signals. The using SW4 on the PCB and function code F29. following by setting function code F31 data. The [FM2] output form (VO2/IO2) can be switch F32. The signal content is selected from the fol • Output frequency • Output trequency • Output voltage • Output voltage • Output torque • Load factor • Power consumption • PID feedback value • Speed (PG feedback value) • DC intermediate circuit voltage • Universal AO • Motor output • Analog output test • PID command value • PID command value • PID output • Position error in master-follower operation * Allowable impedance for connection: Min. 5 k (up to two analog voltmeters (0 to 10 VDC, ing * Allowable impedance for connection: Max. 50 * Gain adjustable range: 0 to 300%	[FM1] output form (VO1/IO1) can be switched The signal content is selected from the ned using SW6 on the PCB and function code lowing by setting function code F61 data.
	[11]	Analog common	This is a common terminal for analog input/out The terminal is insulated from terminals [CM], [	-
Pulse output	[FMP]	Pulse monitor (FMP function)	This terminal outputs a pulse signal. The signa for the FM1/2 function by setting function code	l content is selected in the same way as that as F35 data. kΩ (up to two analog voltmeters (0 to 10 VDC, average voltage output.
	[CM]	Digital common	This is a common terminal for digital input signa from terminals [11], [CMY]. This is the same te	Fig. 2.2-21 als and terminal [FMP]. The terminal is insulated rrminal as terminal [CM] for digital input.

Table 2.2-12 Description of control circuit terminal functions (cont.)

Classification	Terminal symbol	Terminal command	Function de	scription		
	[Y1]	Transistor output 1	<ol> <li>Various signals (running signal, frequency rea up by function code E20 to E24 can be output</li> </ol>	0		
	[Y2]	Transistor output 2	for details. (2) The operating mode between transistor output			
	[Y3]	Transistor output 3	be switched to "ON when signal output (act OFF)".	ive ON)" or	"OFF when signal c	output (active
			<transistor circuit="" output="" specifications=""></transistor>			
				Table 2.2-	13	
Ŧ	[Y4]	Transistor output 4	Control circuit block> Photo coupler Current		Item	Maximum
utpu		output :		Operatin	ON level	Maximum 2 V 48 V
or ot				voltage	OFF level	48 V
Transistor output				Max. lo	ad current when ON	50 mA
Trar				Leakag	e current when OFF	0.1 mA
			Fig. 2.2-22 Transistor output circuit	•	e of a circuit configur to a programmable c ig. 2.2-23.	
			• Connect a surge absorbing diode to b connecting control relays.	oth ends of	the excitation coil wh	en
			<ul> <li>If a power supply is required for the ci used as the power supply terminal. In terminal [CM].</li> </ul>			
	[CMY]	Transistor output common	This is a common terminal for transistor output si The terminal is insulated from terminals [CM], [11	0		

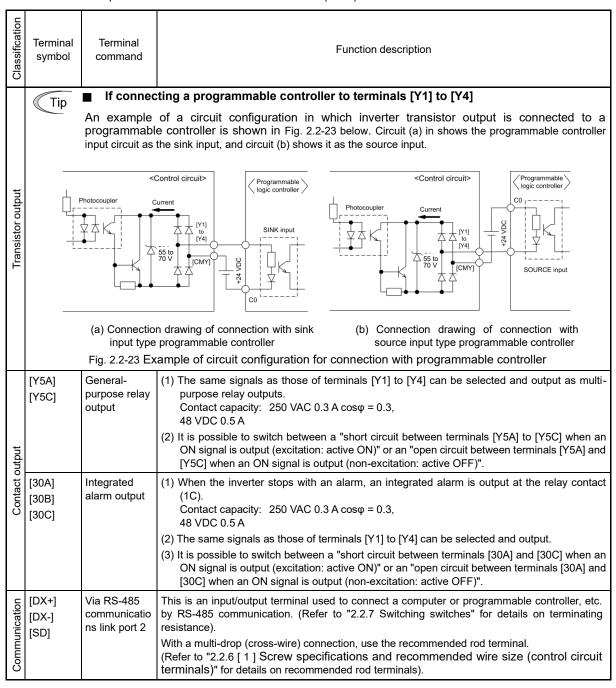


Table 2.2-12 Description of control circuit terminal functions (cont.)

### RS-485 communication connector

Table 2.2-14 Description of control circuit terminal functions

Classification	Terminal symbol	Terminal command	Function description
Communication	RJ-45 connector for keypad connectio n	RS-485 communicatio n port 1 (for keypad connection)	<ul> <li>(1) This is used as a connector for connecting the keypad. The keypad power is supplied from the inverter via an extension cable for remote operation. If using an extension cable, turn ON the SW3 terminating resistor.</li> <li>(2) This is used to connect a computer or programmable controller, etc. by RS-485 communication after disconnecting the keypad. (Refer to "2.2.7 Switching switches" for details on terminating resistance).</li> <li> TXD Image: the set of t</li></ul>
	USB connector	USB port (keypad)	This is a USB connector (miniB specification) for connecting to a computer. Function codes can be edited, transferred, and verified, an inverter test run can be performed, and all states can be monitored using the inverter support loader (FRENIC Loader)*. * Refer to Chapter 9 "9.2 FRENIC Loader Overview" for details.



• The control circuit terminal lines should be routed as far as possible from the main circuit routing. Malfunction may occur due to noise.

• To prevent direct contact with the main circuit live sections (such as the main circuit terminal block), route the control circuit wiring inside the inverter as bundles using cable ties.

### 2.2.7 Switching switches

# **WARNING**

Switch all switches after first waiting for at least 5 minutes for FRN0115G2S-2G / FRN0060G2 $\Box$ -4G or lower, or 10 minutes for FRN0146G2S-2G / FRN0075G2 $\Box$ -4G or higher after turning off the power, ensuring that the LED monitor and charge lamp are off, and using a device such as a tester to ensure that the DC intermediate circuit voltage across main circuit terminals P(+) - N(-) has dropped to a safe level (+25 VDC or less).

Failure to observe this could result in electric shock.

The I/O terminal specification can be changed, such as switching the analog output form, by operating the slide switches on the printed circuit board (see Fig. 2.2-25 Switch positions).

To change all slide switches remove the front cover to expose the control PCB. (With FRN0146G2S-2G / FRN0075G2□-4G or higher inverters, open the keypad case also.)

Refer to Chapter 2 "2.2.2 Removal and attachment of the front cover and wiring guide" for details on how to remove the front cover, and to open/close the keypad case.

A functional description of the slide switches is given in "Table 2.2-15" below.

Table 2.2-15 Functional description of slide switches

Switch symbol	Functi	on description		
SW1	<ul> <li><switch change="" dig.<="" li="" of="" setting="" sink="" source="" to=""> <li>This switch determines the type of input (to [X9], [FWD], and [REV].</li> <li>The switch is set to the SINK side by fact of it in this manual, this description will b SINK side.</li> <li>*1 The factory default setting for SW1 of FF</li> </switch></li></ul>	sink or source) ory default *1. e based on the	to use for digital input termin Unless there is no particular premise that the switch is se	mention
SW2	<terminating changeover="" for<br="" resistor="" switch="">port 2 (on terminal board))&gt; <ul> <li>Move the switch to the ON side when F located at either end of the communication</li> </ul></terminating>	RS-485 commu	,	
SW3	<terminating (for="" 1="" changeover="" connection))="" for="" keypad="" port="" resistor="" switch=""> • Move the switch to the ON side when F located at either end of the communication.</terminating>	RS-485 commu	,	
SW4	<terminal [fm1]="" cha<br="" current="" output="" voltage="">This switch changes the output type for change function code F29. Table 2.2-16</terminal>	•		ch, also
	Output type	SW4	F29 data	
	Voltage output (factory default)	VO1 side	0	
	Current output	IO1 side	1 (4 to 20 mA) 2 (0 to 20 mA)	

Chap 2 INSTALLATION AND WIRING

SW5	<terminal [v2]="" changeover="" function="" switch=""> The switch can be set to either analog setting voltage input or PTC/NTC therm terminal [V2] function. When operating this switch, also change function code</terminal>						
	Table 2.2-17	Switch, also ci		code 1120.			
		SW5	H26	data			
	Analog setting voltage input (factory default)	V2 side		0			
	PTC/NTC thermistor input	PTC/NTC side	1 or :	2 or 3			
SW6	<terminal [fm2]="" cha<="" current="" output="" td="" voltage=""><td>-</td><td></td><td>41</td></terminal>	-		41			
	This switch changes the output type for the change function code F32.	erminal [FM2]	. when opera	iting this switch,			
	Table 2.2-18						
	Output type	SW6	F32	data			
	Voltage output (factory default)	VO2 side	(	)			
	Current output	IO2 side	1 (4 to 2 (0 to	20 mA) 20 mA)			
SW7 (2-pole)	<functional [en1],="" [en2]="" changeover="" disable="" enable="" input="" safety="" switch="" terminal=""> This switch is used to enable or disable terminals [EN1] and [EN2]. If using functional input terminals [EN1] and [EN2], be sure to set this switch to the OFF side for both the right poles.</functional>						
	Table 2.2-19						
			SV	V7			
	Input type		SV EN1	V7 EN2			
		ry default)					
	Input type	ry default)	EN1	EN2			
SW8	Input type EN1/2 terminal input disable (factor	eover switch>	EN1 ON side OFF side	EN2 ON side OFF side			
SW8	Input type EN1/2 terminal input disable (factor EN1/2 terminal input enable <terminal [c1]="" change<br="" current="" input="" voltage="">The switch can be set to either analog setti the terminal [C1] function. Table 2.2-20</terminal>	eover switch>	EN1 ON side OFF side	EN2 ON side OFF side			
SW8	Input type EN1/2 terminal input disable (factor EN1/2 terminal input enable <terminal [c1]="" change<br="" current="" input="" voltage="">The switch can be set to either analog setti the terminal [C1] function.</terminal>	eover switch>	EN1 ON side OFF side ut or analog se	EN2 ON side OFF side			

The switch locations on the control PCB are shown below.

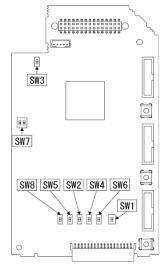


Fig. 2.2-25 Switch positions

	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
Variable range	SINK	OFF	OFF	VO1		VO2		
		ON ON	ON ON	IO1	PTC/NTC		↓ ↓ OFF	↓ V3
Factory default	SINK	OFF	OFF	VO1	V2	VO2		

\*1 The factory default setting for SW1 of FRN-G2E-4G is "SOURCE".

Note To change the switch settings, use a tool with fine tip (tweezers, etc.), and be careful not to touch any other electronic components. The switch will be at open state when the slider is in the middle, so be sure to push it fully in to the end.

# 2.3 Mounting and Removing the Keypad

The keypad can be removed from the inverter unit, and installed on the panel, or used for remote manual operation.

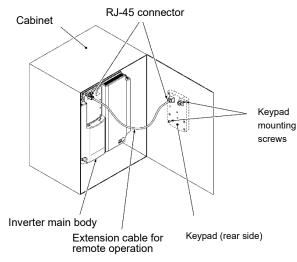


Fig. 2.3-1 If installing the keypad on the panel

The following parts are necessary if mounting the keypad on locations other than the inverter unit.

Table 2.3-1	

Part name	Туре	Remarks		
Extension cable for remote operation (Note 1)	CB-5S, CB-3S, CB-1S	Three lengths available (1 m, 3 m, 5 m) (3.3 ft, 9.8 ft, 16.4 ft)		
Keypad mounting screws	M3x□ (Note 2)	2 screws required (prepared by user)		

- (Note 1) When using a commercially available LAN cable, use a 10BASE-T/100BASE-TX straight cable (within 20 meters (65 ft)) which meets the ANSI/TIA/EIA-568A category 5 or higher standards of the US.
- (Note 2) When attaching to the cabinet, use a fixing screw of appropriate length to the cabinet thickness. (The keypad screw hole depth is 11 mm (0.43 in).)

#### Removing and mounting the keypad

Pull the keypad toward you to remove while pressing down on the hook indicated by the arrow. Use the opposite procedure to mount the keypad.

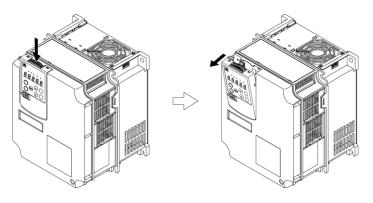


Fig. 2.3-2 Keypad removal