Fuji Electric
Innovating Energy Technology

Instruction Manual

High Performance Inverter

FRENIC-Ace

⚠CAUTION

Thank you for purchasing our multifunction FRENIC-Ace series of inverters.

- This product is designed to drive a three-phase motor under variable speed control. Read through this instruction manual and become familiar with the handling procedure for correct use.
- Improper handling might result in incorrect operation, a short life, or even a failure of this product as well as the motor.
- Deliver this manual to the end user of this product. Keep this manual in a safe place until this product is discarded.
- For how to use an optional device, refer to the instruction manual prepared for that optional device.
- This manual provides only major functions of the FRENIC-Ace series. For details, refer to the FRENIC-Ace User's Manual.

Fuji Electric Co., Ltd. **INR-SI47-1733a-E**

The information contained herein is subject to change without prior notice for improvement.

The purpose of this manual is to provide accurate information in handling, setting up and operating of the FRENIC-Ace series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will Fuji Electric Co., Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.

Preface

Thank you for purchasing our multifunction FRENIC-Ace series of inverters. This product is designed to drive a three-phase induction motor under variable speed control.

This manual provides all the information on the FRENIC-Ace series of inverters including its operating procedure and selection of peripheral equipment. Before use, carefully read this manual for proper use. Improper handling might result in incorrect operation, a short life, or even a failure of this product as well as the motor.

The table below lists the other materials related to the use of the FRENIC-Ace. Read them in conjunction with this manual as necessary.

Name	Material No.	Description
Catalog	24A1-E-0042	Product scope, features, specifications, external drawings, and options of the product
FRENIC-Ace User's Manual	24A7-E-0043	Product details control block diagrams, specifications, and external dimensions
RS-485 Communication User's Manual	24A7-E-0021*	Overview of functions implemented by using FRENIC-Ace RS-485 communications facility, its communications specifications, Modbus RTU/Fuji general-purpose inverter protocol, function codes and related data formats

*Available soon

The materials are subject to change without notice. Be sure to obtain the latest editions for use.

CONTENTS

☐ Safety precautions

Read this manual thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection. Ensure you have sound knowledge of the device and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.

Safety precautions are classified into the following two categories in this manual.

⚠WARNING	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries.
⚠CAUTION	Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in minor or light bodily injuries and/or substantial property damage.

Failure to heed the information contained under the CAUTION title can also result in serious consequences. These safety precautions are of utmost importance and must be observed at all times.

Application

⚠WARNING

- The FRENIC-Ace is designed to drive a three-phase induction motor. Do not use it for single-phase motors or for other purposes.

  Fire or an accident could occur.

- The FRENIC-Ace may not be used for a life-support system or other purposes directly related to the human safety.
- Though the FRENIC-Ace is manufactured under strict quality control, install safety devices for applications where serious accidents or property damages are foreseen in relation to the failure of it.

  An accident could occur.

Installation

⚠WARNING

- Install the inverter on a base made of metal or other non-flammable material.

  Otherwise, a fire could occur.

- Do not place flammable object nearby.

  Doing so could cause fire.

- Inverters FRN0085E2S-4☐ or above, whose protective structure is IP00, involve a possibility that a human body may touch the live conductors of the main circuit terminal block. Inverters to which an optional DC reactor is connected also involve the same. Install such inverters in an inaccessible place.

  Otherwise, electric shock or injuries could occur.

⚠CAUTION

- Do not support the inverter by its front cover during transportation.

  Doing so could cause a drop of the inverter and injuries.

- Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the heat sink.
- When changing the positions of the top and bottom mounting bases, use only the specified screws.

  Otherwise, a fire or an accident might result.

- Do not install or operate an inverter that is damaged or lacking parts.

  Doing so could cause fire, an accident or injuries.

Wiring

⚠WARNING

- If no zero-phase current (earth leakage current) detective device such as a ground-fault relay is installed in the upstream power supply line in order to avoid the entire power supply system's shutdown undesirable to factory operation, install a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) individually to inverters to break the individual inverter power supply lines only.

  Otherwise, a fire could occur.

- When wiring the inverter to the power source, insert a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the path of each pair of power lines to inverters. Use the recommended devices within the recommended current capacity.
- Use wires in the specified size.
- Tighten terminals with specified torque.

  Otherwise, a fire could occur.

- When there is more than one combination of an inverter and motor, do not use a multicore cable for the purpose of handling their wirings together.
- Do not connect a surge killer to the inverter's output (secondary) circuit.

  Doing so could cause a fire.

- Be sure to connect an optional DC reactor (DCR) when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity.

  Otherwise, a fire could occur.

- Ground the inverter in compliance with the national or local electric code.
- Be sure to ground the inverter's grounding terminals ⏚G.

  Otherwise, an electric shock or a fire could occur.

- Qualified electricians should carry out wiring.
- Be sure to perform wiring after turning the power OFF.

  Otherwise, an electric shock could occur.

- Be sure to perform wiring after installing the inverter unit.

  Otherwise, an electric shock or injuries could occur.

- Ensure that the number of input phases and the rated voltage of the product match the number of phases and the voltage of the AC power supply to which the product is to be connected.

  Otherwise, a fire or an accident could occur.

- Do not connect the power supply wires to output terminals (U, V, and W).
- When connecting a DC braking resistor (DBR), never connect it to terminals other than terminals P(+) and DB.

  Doing so could cause fire or an accident.

- In general, sheaths of the control signal wires are not specifically designed to withstand a high voltage (i.e., reinforced insulation is not applied). Therefore, if a control signal wire comes into direct contact with a live conductor of the main circuit, the insulation of the sheath might break down, which would expose the signal wire to a high voltage of the main circuit. Make sure that the control signal wires will not come into contact with live conductors of the main circuit.

  Doing so could cause an accident or an electric shock.

⚠WARNING⚠

- Before changing the switches or touching the control circuit terminal symbol plate, **turn OFF the power and wait at least five minutes for inverters FRN0072E2S-4☐ or below, or at least ten minutes for inverters FRN0085E2S-4☐ or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  Otherwise, an electric shock could occur.

⚠CAUTION

- The inverter, motor and wiring generate electric noise. Be careful about malfunction of the nearby sensors and devices. To prevent them from malfunctioning, implement noise control measures.

  Otherwise an accident could occur.

Operation

⚠WARNING

- Be sure to mount the front cover before turning the power ON. Do not remove the cover when the inverter power is ON.
  Otherwise, an electric shock could occur.
- Do not operate switches with wet hands.
  Doing so could cause electric shock.
- If the auto-reset function has been selected, the inverter may automatically restart and drive the motor depending on the cause of tripping. Design the machinery or equipment so that human safety is ensured at the time of restarting.
  Otherwise, an accident could occur.
- If the stall prevention function (current limiter), automatic deceleration (anti-regenerative control), or overload prevention control has been selected, the inverter may operate with acceleration/deceleration or frequency different from the commanded ones. Design the machine so that safety is ensured even in such cases.
- The (STOP) key on the keypad is effective only when the keypad operation is enabled with function code F02 (= 0, 2 or 3). When the keypad operation is disabled, prepare an emergency stop switch separately for safe operations.
  Switching the run command source from keypad (local) to external equipment (remote) by turning ON the "Enable communications link" command ***LE*** disables the (STOP) key. To enable the (STOP) key for an emergency stop, select the STOP key priority with function code H96 (= 1 or 3).
- If any of the protective functions have been activated, first remove the cause. Then, after checking that the all run commands are set to OFF, release the alarm. If the alarm is released while any run commands are set to ON, the inverter may supply the power to the motor, running the motor.
  Otherwise, an accident could occur.
- If you enable the "Restart mode after momentary power failure" (Function code F14 = 3 to 5), then the inverter automatically restarts running the motor when the power is recovered.
  Design the machinery or equipment so that human safety is ensured after restarting.
- If the user configures the function codes wrongly without completely understanding this manual, the motor may rotate with a torque or at a speed not permitted for the machine.
- Starting auto-tuning involves motor rotation. Sufficiently check that motor rotation brings no danger beforehand.
  An accident or injuries could occur.
- Even if the inverter has interrupted power to the motor, if the voltage is applied to the main circuit input terminals L1/R, L2/S and L3/T, voltage may be output to inverter output terminals U, V, and W.
- Even if the motor is stopped due to DC braking or preliminary excitation, voltage is output to inverter output terminals U, V, and W.
  An electric shock may occur.
- The inverter can easily accept high-speed operation. When changing the speed setting, carefully check the specifications of motors or equipment beforehand.
  Otherwise, injuries could occur.

⚠CAUTION

- Do not touch the heat sink and braking resistor because they become very hot.
  Doing so could cause burns.
- The DC brake function of the inverter does not provide any holding mechanism.
  Injuries could occur.
- Ensure safety before modifying the function code settings.
  Run commands (e.g., "Run forward" ***FWD***), stop commands (e.g., "Coast to a stop" ***BX***), and frequency change commands can be assigned to digital input terminals. Depending upon the assignment states of those terminals, modifying the function code setting may cause a sudden motor start or an abrupt change in speed.
- When the inverter is controlled with the digital input signals, switching run or frequency command sources with the related terminal commands (e.g., ***SS1***, ***SS2***, ***SS4***, ***SS8***, ***Hz2/Hz1***, ***Hz/PID***, ***IVS***, and ***LE***) may cause a sudden motor start or an abrupt change in speed.
- Ensure safety before modifying customizable logic related function code settings (U codes and related function codes) or turning ON the "Cancel customizable logic" terminal command ***CLC***. Depending upon the settings, such modification or cancellation of the customizable logic may change the operation sequence to cause a sudden motor start or an unexpected motor operation.
  An accident or injuries could occur.

Maintenance and inspection, and parts replacement

⚠WARNING⚠

- Before proceeding to the maintenance/inspection jobs, **turn OFF the power and wait at least five minutes for inverters FRN0072E2S-4☐ or below, or at least ten minutes for inverters FRN0085E2S-4☐ or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  Otherwise, an electric shock could occur.

- Maintenance, inspection, and parts replacement should be made only by qualified persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.

  Otherwise, an electric shock or injuries could occur.

- Never modify the inverter.

  Doing so could cause an electric shock or injuries.

Disposal

⚠CAUTION

- Treat the inverter as an industrial waste when disposing of it.

  Otherwise injuries could occur.

GENERAL PRECAUTIONS

Drawings in this manual may be illustrated without covers or safety shields for explanation of detail parts. Restore the covers and shields in the original state and observe the description in the manual before starting operation.

Icons

The following icons are used throughout this manual.

This icon indicates information which, if not heeded, can result in the inverter not operating to full efficiency, as well as information concerning incorrect operations and settings which can result in accidents.

This icon indicates information that can prove handy when performing certain settings or operations.

This icon indicates a reference to more detailed information.

Chapter 1 BEFORE USE

1.1 Acceptance Inspection (Nameplates and Inverter Type)

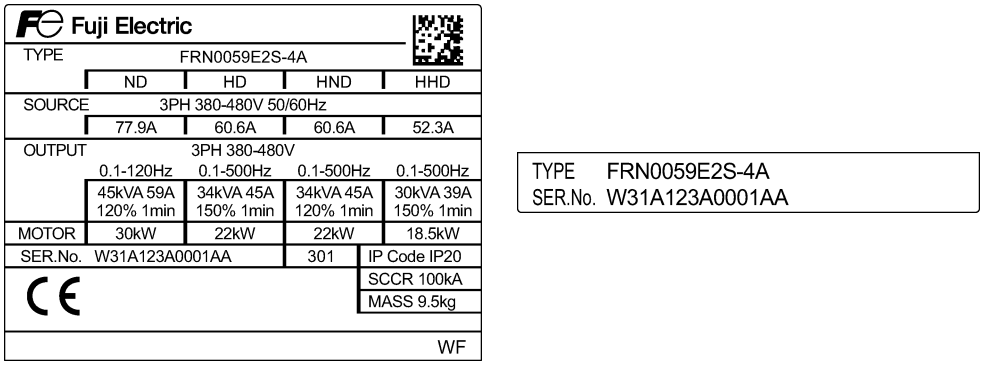
Unpack the package and check the following:

(1) An inverter and the following accessories are contained in the package.

Accessories
- DC reactor (for ND-mode inverters of FRN0139E2S-4□ or above, HD-/HND-mode inverters of FRN0168E2S-4□ or above, and HHD-mode inverters of FRN0203E2S-4□ or above) (Not bundled with the FRN****E2S-4C)
- Keypad rear cover (with three screws for securing the keypad)
- Instruction manual
- CD-ROM (containing the FRENIC-Ace User's Manual)

(2) The inverter has not been damaged during transportation—there should be no dents or parts missing.

(3) The inverter is the type you ordered. You can check the type and specifications on the main nameplate. (The main and sub nameplates are attached to the inverter as shown on Figure 1.2-1.)



(a) Main Nameplate (b) Sub Nameplate

Figure 1.1-1 Nameplates

TYPE: Type of inverter

FRN 0059 E2S - 4A

Code	Series name
FRN	FRENIC series

Code	Nominal applied motor current(A)			
	ND	HD	HND	HHD
0059	59.0	45.0	45.0	39.0
0072	72.0	60.0	60.0	45.0
0085	85.0	75.0	75.0	60.0
0105	105	91.0	91.0	75.0
0139	139	112	112	91.0
0168	168	150	150	112
0203	203	176	176	150

Code	Applicable area
E	For industrial/ High performance/ Multiple functionality

Code	Shipping destination/ Instruction manual language
C	China・Chinese
A	Asia・English
E	EU・English
T	Taiwan・English
K	Korea・English

Code	Power supply voltage
4	Three-phase 400V

Code	Enclosure
S	Basic type(IP20/IP00)

Code	Development code
2	2

Note In this manual, inverter types are denoted as "FRN_ _ _ _E2S-4□."

The FRENIC-Ace is available in four different drive modes--ND (Normal Duty), HD (Heavy Duty), HND (High, Normal Duty) and HHD (High, Heavy Duty). One of these modes should be selected to match the load property of your system. Specifications in each mode are printed on the main nameplate.

ND mode : Designed for general load applications.
Overload capability: 120% for 1 min.

HD mode : Designed for heavy duty load applications.
Overload capability: 150% for 1 min.

HND mode : Designed for general load applications.
Overload capability: 120% for 1 min.

HHD mode : Designed for heavy duty load applications.
Overload capability: 150% for 1 min. and 200% for 0.5 s.

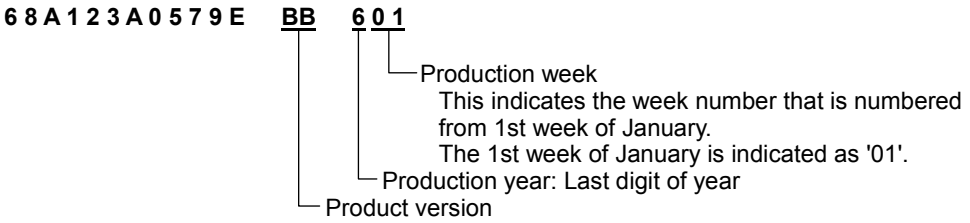
SOURCE : Number of input phases (three-phase: 3PH), input voltage, input frequency, input current

OUTPUT : Number of output phases, rated output voltage, output frequency range, rated output capacity, rated output current, and overload capability

SCCR : Short-circuit capacity

MASS : Mass of the inverter in kilogram

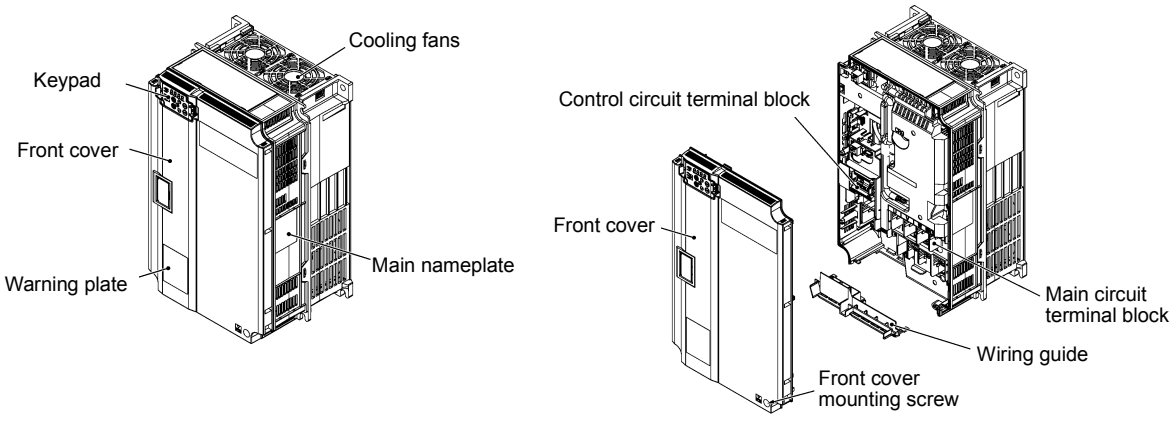
SER. No. : Product number



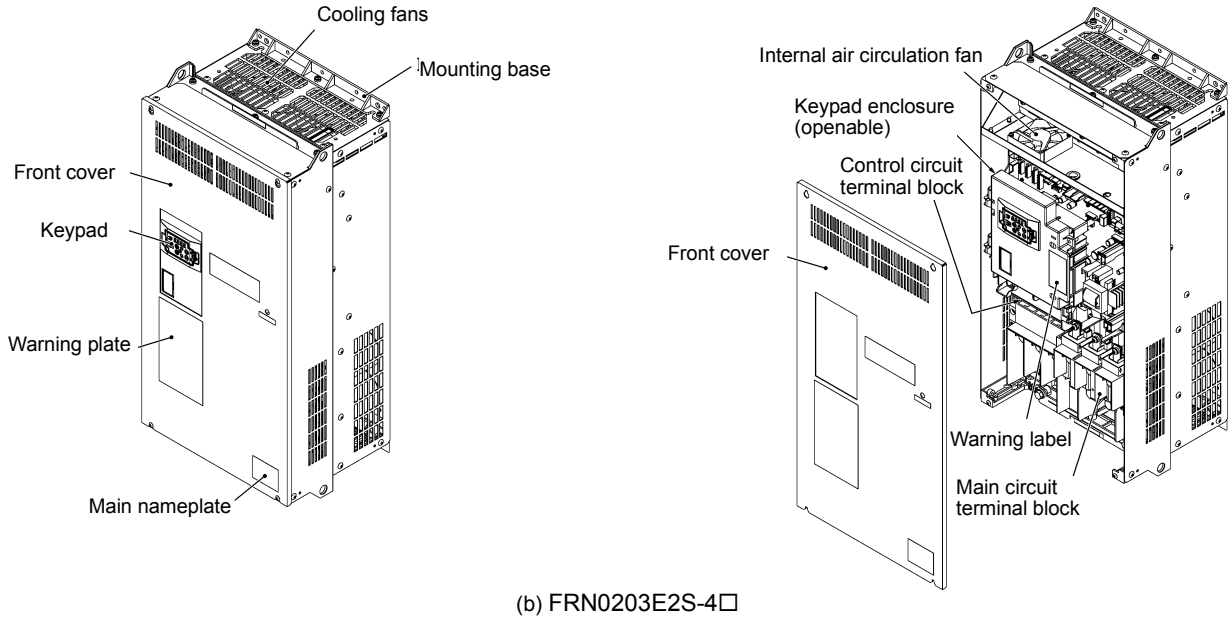
If you suspect the product is not working properly or if you have any questions about your product, contact your Fuji Electric representative.

1.2 External View and Terminal Blocks

(1) Outside and inside views



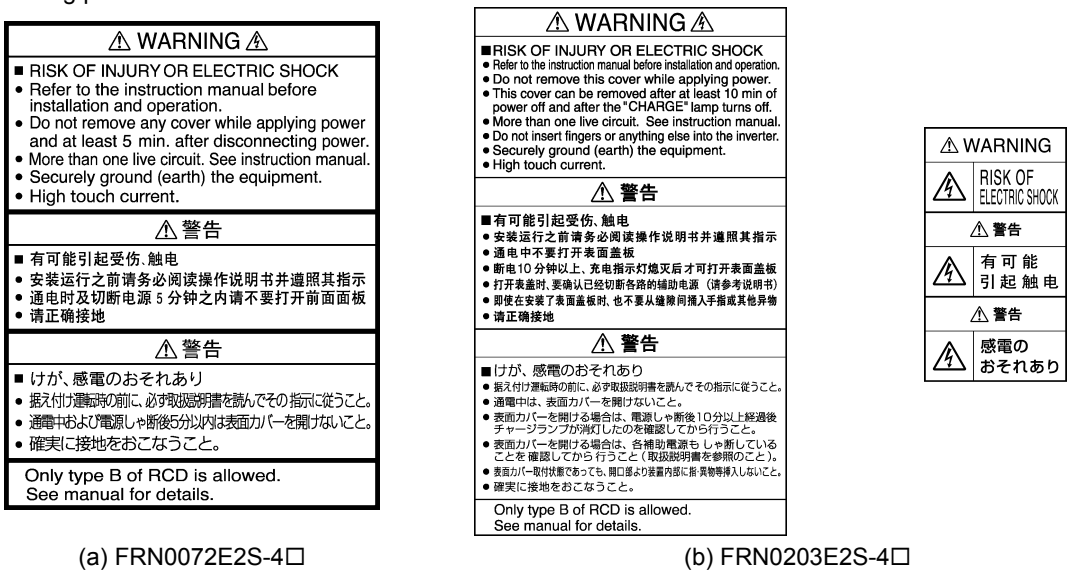
(a) FRN0072E2S-4☐



(b) FRN0203E2S-4☐

Figure 1.2-1 Outside and Inside Views of Inverters

(2) Warning plates and label



(a) FRN0072E2S-4☐ (b) FRN0203E2S-4☐

Figure 1.2-2 Warning Plates and Label

1.3 Precautions for Using Inverters

This section provides precautions in introducing inverters, e.g. precautions for installation environment, power supply lines, wiring, and connection to peripheral equipment. Be sure to observe those precautions.

1.3.1 Usage environment

Install the inverter in an environment that satisfies the requirements listed in Table 1.3-1.

Table 1.3-1 Usage Environment

Item	Specifications
Site location	Indoors
Ambient temperature	-10 to +50°C (14 to 122°F) **(Note 1)**
Relative humidity	5 to 95% RH (No condensation)
Atmosphere	The inverter must not be exposed to dust, direct sunlight, corrosive gases, flammable gases, oil mist, vapor or water drops. Pollution degree 2 (IEC60664-1) **(Note 2)** The atmosphere can contain a small amount of salt. (0.01 mg/cm^2 or less per year) The inverter must not be subjected to sudden changes in temperature that will cause condensation to form.
Altitude	1,000 m (3,300 ft) max. **(Note 3)**
Atmospheric pressure	86 to 106 kPa
Vibration	FRN0203E2S-4☐ or below 3 mm (Max. amplitude) 2 to less than 9 Hz 9.8 m/s^2 9 to less than 20 Hz 2 m/s^2 20 to less than 55 Hz 1 m/s^2 55 to less than 200 Hz

(Note 1) When inverters are mounted side-by-side without any clearance between them (FRN0072E2S-4☐ or below), the ambient temperature should be within the range from -10 to +40°C.

(Note 2) Do not install the inverter in an environment where it may be exposed to lint, cotton waste or moist dust or dirt which will clog the heat sink of the inverter. If the inverter is to be used in such an environment, install it in a dustproof panel of your system.

(Note 3) If you use the inverter in an altitude above 1,000 m (3,300 ft), you should apply an output current derating factor as listed in Table 1.3-2.

Table 1.3-2 Output Current Derating Factor in Relation to Altitude

Altitude	Output current derating factor
1,000 m or lower (3,300 ft or lower)	1.00
1,000 to 1500 m (3,300 to 4,900 ft)	0.97
1,500 to 2,000 m (4,900 to 6,600 ft)	0.95
2,000 to 2,500 m (6,600 to 8,200 ft)	0.91
2,500 to 3,000 m (8,200 to 9,800 ft)	0.88

Fuji Electric strongly recommends installing inverters in a panel for safety reasons, in particular, when installing the ones whose enclosure rating is IP00.

When installing the inverter in a place out of the specified environmental requirements, it is necessary to derate the inverter or consider the panel engineering design suitable for the special environment or the panel installation location. For details, refer to the Fuji Electric technical information "Engineering Design of Panels" or consult your Fuji Electric representative.

The special environments listed below require using the specially designed panel or considering the panel installation location.

Environments	Possible problems	Sample measures	Applications
Highly concentrated sulfidizing gas or other corrosive gases	Corrosive gases cause parts inside the inverter to corrode, resulting in an inverter malfunction.	Any of the following measures may be necessary. - Mount the inverter in a sealed panel with IP6X or air-purge mechanism. - Place the panel in a room free from influence of the gases.	Paper manufacturing, sewage disposal, sludge treatment, tire manufacturing, gypsum manufacturing, metal processing, and a particular process in textile factories.
A lot of conductive dust or foreign material (e.g., metal powders or shavings, carbon fibers, or carbon dust)	Entry of conductive dust into the inverter causes a short circuit.	Any of the following measures may be necessary. - Mount the inverter in a sealed panel. - Place the panel in a room free from influence of the conductive dust.	Wiredrawing machines, metal processing, extruding machines, printing presses, combustors, and industrial waste treatment.
A lot of fibrous or paper dust	Fibrous or paper dust accumulated on the heat sink lowers the cooing effect. Entry of dust into the inverter causes the electronic circuitry to malfunction.	Any of the following measures may be necessary. - Mount the inverter in a sealed panel that shuts out dust. - Ensure a maintenance space for periodical cleaning of the heat sink in panel engineering design. - Employ external cooling when mounting the inverter in a panel for easy maintenance and perform periodical maintenance.	Textile manufacturing and paper manufacturing.
High humidity or dew condensation	In an environment where a humidifier is used or where the air conditioner is not equipped with a dehumidifier, high humidity or dew condensation results, which causes a short-circuiting or malfunction of electronic circuitry inside the inverter.	- Put a heating module such as a space heater in the panel.	Outdoor installation. Film manufacturing line, pumps and food processing.
Vibration or shock exceeding the specified level	If a large vibration or shock exceeding the specified level is applied to the inverter, for example, due to a carrier running on seam joints of rails or blasting at a construction site, the inverter structure gets damaged.	- Insert shock-absorbing materials between the mounting base of the inverter and the panel for safe mounting.	Installation of an inverter panel on a carrier or self-propelled machine. Ventilating fan at a construction site or a press machine.
Fumigation for export packaging	Halogen compounds such as methyl bromide used in fumigation corrodes some parts inside the inverter.	- When exporting an inverter built in a panel or equipment, pack them in a previously fumigated wooden crate. - When packing an inverter alone for export, use a laminated veneer lumber (LVL).	Exporting.

1.3.2 Storage environment

The storage environment in which the inverter should be stored after purchase differs from the usage environment. Store the inverter in an environment that satisfies the requirements listed below.

[1] Temporary storage

Table 1.3-3 Storage and Transport Environments

Item	Specifications	
Storage temperature *1	During transport: -25 to +70°C (-13 to +158°F)	Places not subjected to abrupt temperature changes or condensation or freezing
	During storage: -25 to +65°C (-13 to +153°F)	
Relative humidity	5 to 95% RH *2	
Atmosphere	The inverter must not be exposed to dust, direct sunlight, corrosive or flammable gases, oil mist, vapor, water drops or vibration. The atmosphere must contain only a low level of salt. (0.01 mg/cm^2 or less per year)	
Atmospheric pressure	86 to 106 kPa (during storage)	
	70 to 106 kPa (during transportation)	

***1** Assuming comparatively short time storage, e.g., during transportation or the like.

***2** Even if the humidity is within the specified requirements, avoid such places where the inverter will be subjected to sudden changes in temperature that will cause condensation or freezing.

Precautions for temporary storage

(1) Do not leave the inverter directly on the floor.

(2) If the environment does not satisfy the specified requirements listed in Table1.3-3 , wrap the inverter in an airtight vinyl sheet or the like for storage.

(3) If the inverter is to be stored in a high-humidity environment, put a drying agent (such as silica gel) in the airtight package described in (2) above.

[2] Long-term storage

The long-term storage method of the inverter varies largely according to the environment of the storage site. General storage methods are described below.

(1) The storage site must satisfy the requirements specified for temporary storage.

However, for storage exceeding three months, the surrounding temperature range should be within the range from -10 to +30°C (14 to 86°F). This is to prevent electrolytic capacitors in the inverter from deterioration.

(2) The package must be airtight to protect the inverter from moisture. Add a drying agent inside the package to maintain the relative humidity inside the package within 70%.

(3) If the inverter has been installed to the equipment or panel at construction sites where it may be subjected to humidity, dust or dirt, then temporarily remove the inverter and store it in the environment specified in Table 1.3-3.

Precautions for storage over 1 year

If the inverter has not been powered on for a long time, the property of the electrolytic capacitors may deteriorate. Power the inverters on once a year and keep the inverters powering on for 30 to 60 minutes. Do not connect the inverters to the load circuit (secondary side) or run the inverter.

Chapter 2 INSTALLATION AND WIRRING

2.1 Installation

(1) Installation Environment

Please install FRENIC-Ace in locations which meet the conditions specified in “Chapter 1, 1.3.1 Usage environment”.

(2) Installation Surface

Please install the inverter on non-combustible matter such as metals. Also, do not mount it upside down or horizontally.

⚠WARNING

Install on non-combustible matter such as metals.

Risk of fire exists

(3) Surrounding Space

Secure the space shown in Figure 2.1-1 and Table 2.1-1. When enclosing FRENIC-Ace in cabinets, be sure to provide adequate board ventilation, as the surrounding temperature may rise. Do not contain it in small enclosures with low heat dissipation capacity.

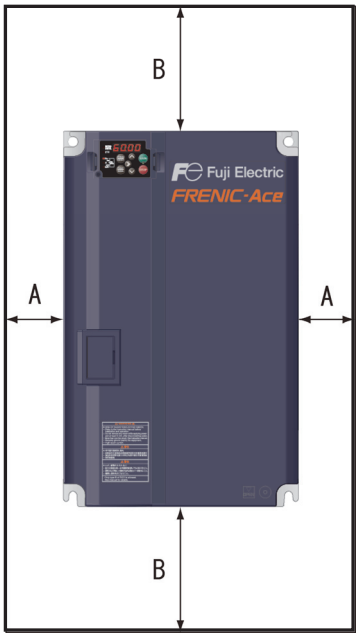


Figure 2.1-1 Installation Direction

■ Installation of Multiple Inverters

When installing 2 or more units in the same equipment or cabinet, generally mount them in horizontally parallel position. When the inverters are mounted vertically, attach partitioning boards to prevent the heat dissipated from the lower inverter to affect the upper inverter.

For types smaller than FRN0072E2S-4☐ and for ambient temperature below 40°C only, the units can be installed horizontally without any spacing in between. (30°C or lower for HND and HHD)

Table 2.1-1 Surrounding Space (mm)

Applicable Capacity	A	B	C
FRN0059/0072E2S-4☐	10	100	0*1
FRN0085 to 0203E2S-4☐	50		100

*1 A clearance of 50 mm is required to use RJ45 connector.

C: Space in front of the inverter unit

■ Installation with External Cooling

The external cooling form reduces internally generated heat by dissipating approximately 70% of the total heat generated (total heat loss) using the cooling fins protruding outside the equipment or cabinet.

Installation with external cooling is possible for types smaller than FRN0072E2S-4☐ by adding attachments (optional) for external cooling, and for types larger than FRN0085E2S-4☐ by moving the mounting bases.

(Refer to the User's Manual, Chapter 11, Section 11.15 for the outside drawing of the external cooling attachment (optional)).

⚠CAUTION

Prevent lint, wastepaper, wood shavings, dust, metal scrap, and other foreign material from entering the inverter or from attaching to the cooling fins.

Risk of fire and risk of accidents exist

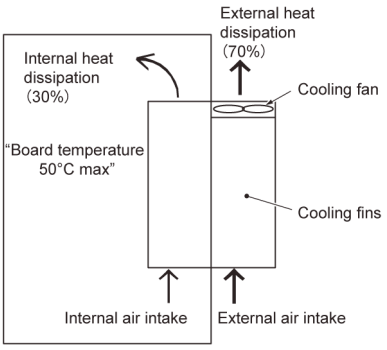


Figure 2.1-2 Installation with External Cooling

To install the FRN0085E2S-4□ inverter with external cooling, change the mounting position of the mounting bases following the procedure in Figure 2.1-3.

As the type and number of screws differ by inverter type, please review the following table.

For details of panel cutting size, refer to the User's Manual, Chapter 2, Section 2.3 "Attachment and Connection of Keypad."

Table 2.1-2 Type and Number of Screws, and Tightening Torque

Inverter type	Mounting base fixation screw	Case attachment screw	Tightening torque (N•m)
FRN0085E2S-4□ to FRN0168E2S-4□	M6×20 (5 screws on top, 3 screws on bottom)	M6×20 (2 screws on top only)	5.8
FRN0203E2S-4□	M6×20 (3 screws on top and bottom each)	M6×12 (3 screws on top only)	5.8

1) Remove all of the mounting base fixation screws and the case attachment screws on the top of the inverter.
2) Fix the mounting bases to the case attachment screw holes using the mounting base fixation screws. A few screws should remain after changing the position of the mounting bases.
3) Change the position of the mounting bases on the bottom side following the procedure in 1) and 2).

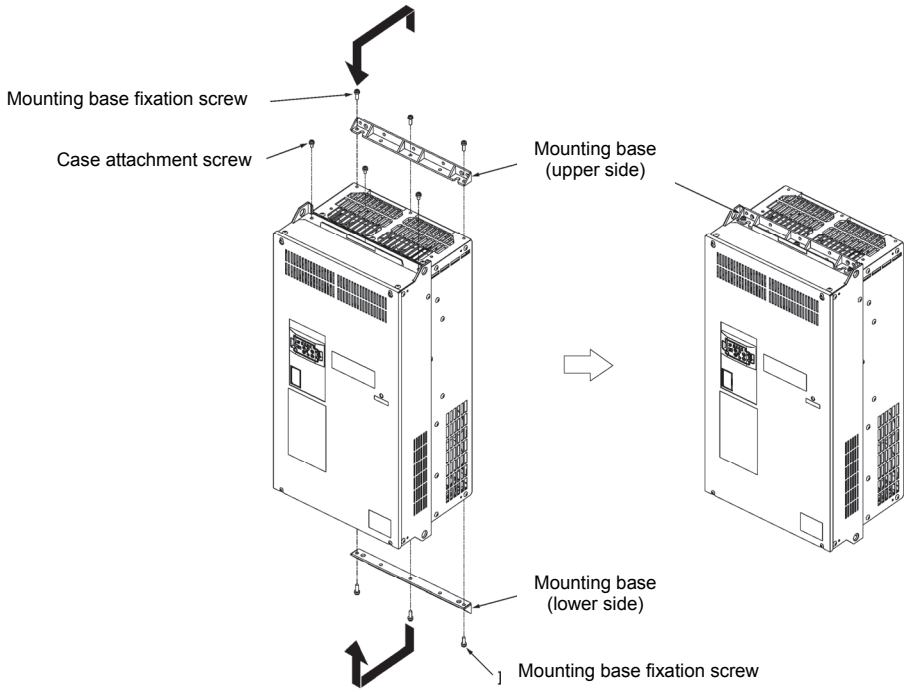


Figure 2.1-3 Method to Change the Mounting Base Positions

⚠CAUTION
Use the specified screws in changing the mounting bases. **Risk of fire and risk of accidents exist**

2.2 Wiring

2.2.1 Basic connection diagram

■ Standard terminal block board (with CAN) (Destinaion: -A, -E, -T and -K)

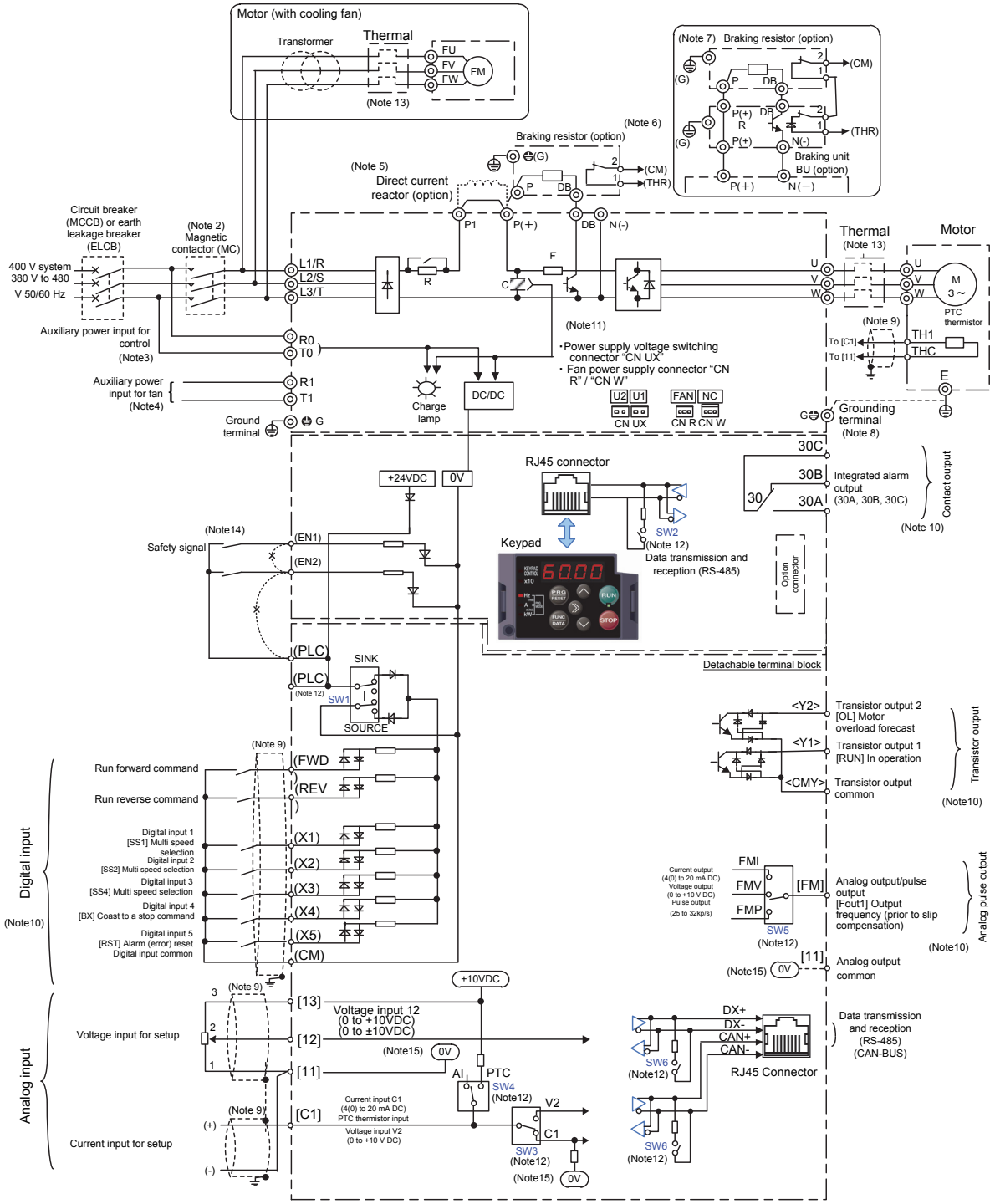


Figure 2.2-1 Standard Terminal Block Board (with CAN)

■ Standard terminal block board (without CAN, with FM2) (Destinaion: -C)

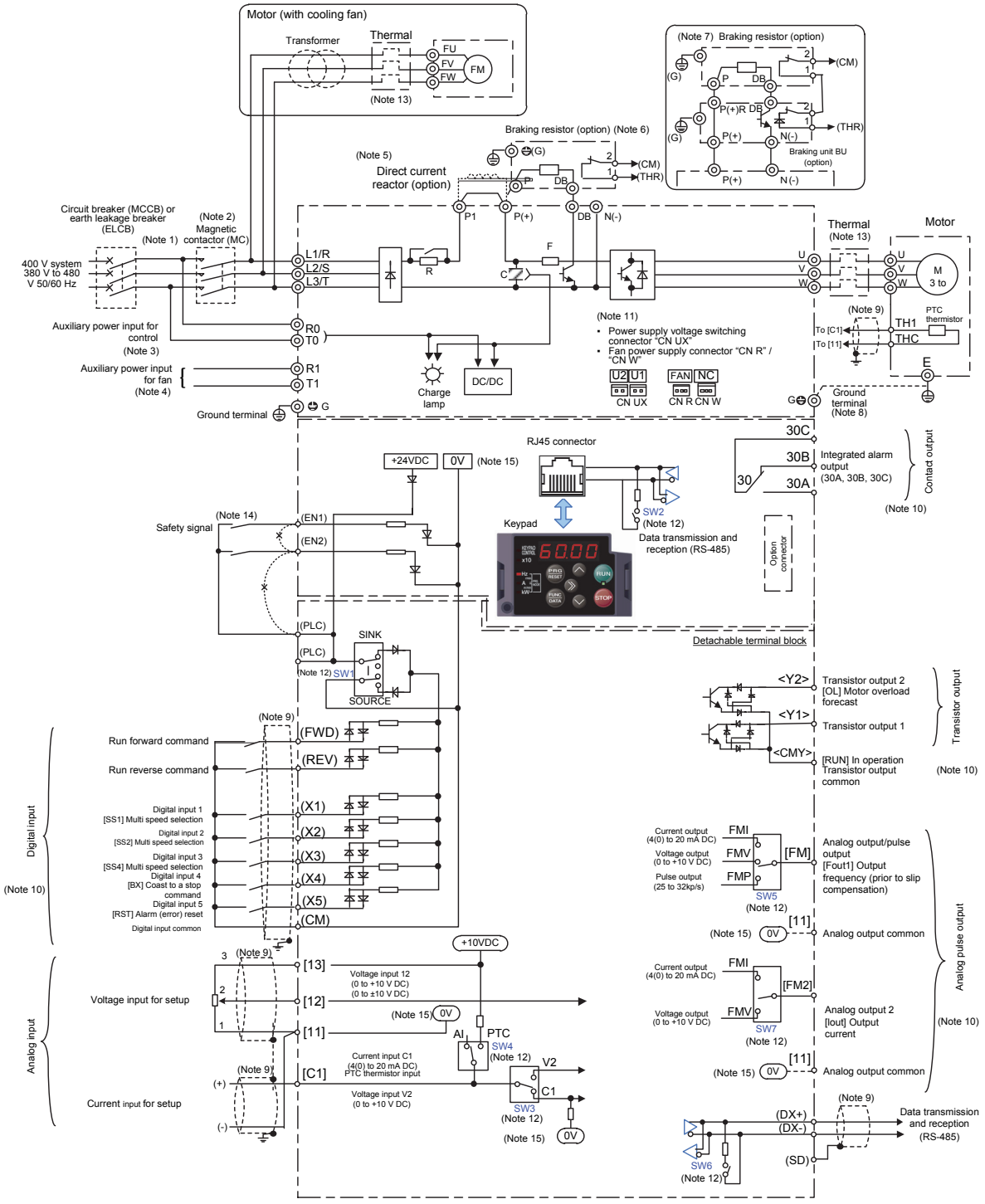


Figure 2.2-2 Standard Terminal Block Board (Without CAN, With FM2)

(Note 1) Install recommended circuit breakers (MCCB) or residual-current-operated protective device (RCD)/ earth leakage breakers (ELCB) (with overcurrent protective function) on the inputs of each inverter (primary side) for wiring protection. Do not use breakers which exceed the recommended rated current.

(Note 2) Install recommended magnetic contactors (MC) as necessary on each inverter as these will be used to disconnect the inverter from the power supply separately from the MCCB or RCD / the ELCB. Additionally, when installing coils such as MC or solenoid close to the inverter, connect surge absorbers in parallel.

(Note 3) When retaining the integrated alarm signal for the activation of the protective function at inverter main power supply shut off is desired, or when continuous display of the keypad is desired, connect this terminal to the power supply. The inverter can be operated without connecting power to this terminal.

(Note 4) The terminal does not need to be connected. Use this terminal when operating in combination with a high power factor regenerative PWM converter (RHC series). (For types larger than FRN0203E2S-4□)

(Note 5) Remove the shorting bar between the inverter main circuit terminals P1-P(+) before connecting the direct current reactor (DCR) (option).
ND mode: Types larger than FRN0139E2S-4□, HD/ HND mode: Types larger than FRN0168E2S-4□, HHD mode: Always connect for FRN0203E2S-4□.
Use the direct current reactor (option) when the power supply transformer capacity is above 500 kVA and the transformer capacity is over 10 times the rated capacity of the inverter, and when “thyristor load exists” in the same power system.

(Note 6) Types smaller than FRN0072E2S-4□ contain braking transistors, allowing direct connection of braking resistors between P(+)-DB.

(Note 7) When connecting braking resistors to types larger than FRN0085E2S-4□, always add the braking unit (option). Connect the braking unit (option) between P(+)-N(-). Auxiliary terminals [1] and [2] have polarity. Please connect as shown in the diagram.

(Note 8) This terminal is used for grounding the motor. Grounding the motor using this terminal is recommended in order to suppress inverter noise.

(Note 9) Use twisted lines or shielded lines for the control signal.
Generally, the shielded line requires grounding, but when the effect of externally induced noise is large, connecting to [CM] may suppress the effect of noise. Separate the line from the main circuit wiring and do not enclose in the same duct. (Separation distance of over 10 cm is recommended.) When crossing the main circuit wiring, make the intersection perpendicular.

(Note 10) The various functions listed for terminals[X1] to [X5](digital input), terminals [Y1] to [Y2](transistor output), and terminal [FM] (monitor output) show the functions assigned as factory default.

(Note 11) These are connectors for switching the main circuit. For details, refer to “2.2.7 Switching connector”.

(Note 12) The various switches on the control printed circuit board define the setting for the inverter operation. For details, refer to “2.2.8 Operating various switches”.

(Note 13) Make the circuit breakers (MCCB) or the magnetic contactors (MC) trip by the thermal relay auxiliary contacts (manual recovery).

(Note 14) Shorting bars are connected between the safety function terminals [EN1], [EN2], and [PLC] as factory default. Remove the shorting bars when using this function.

(Note 15) [0V] and (0V) are separated and insulated.

Route the wiring following the steps below. (The inverter is already installed in the descriptions.)

2.2.2 Removal and attachment of the front cover and wiring guide

⚠CAUTION
Always remove the RS-485 communication cable from the RJ-45 connector before removing the front cover. **Risk of fire and risk of accidents exist.**

(1) Types smaller than FRN0072E2S-4□

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 to the upward direction.
2) Push the wiring guide upward and pull. Let the guide slide and remove.
3) After routing the wires, attach the wiring guide and the front cover reversing the steps above.

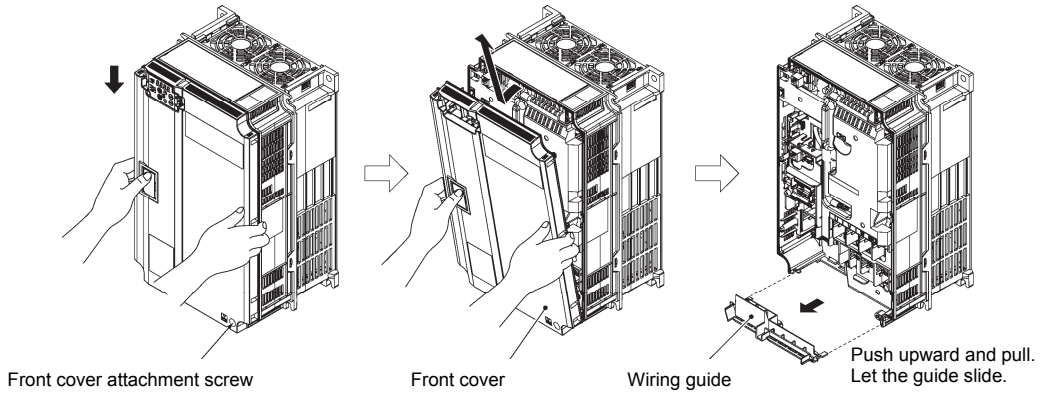
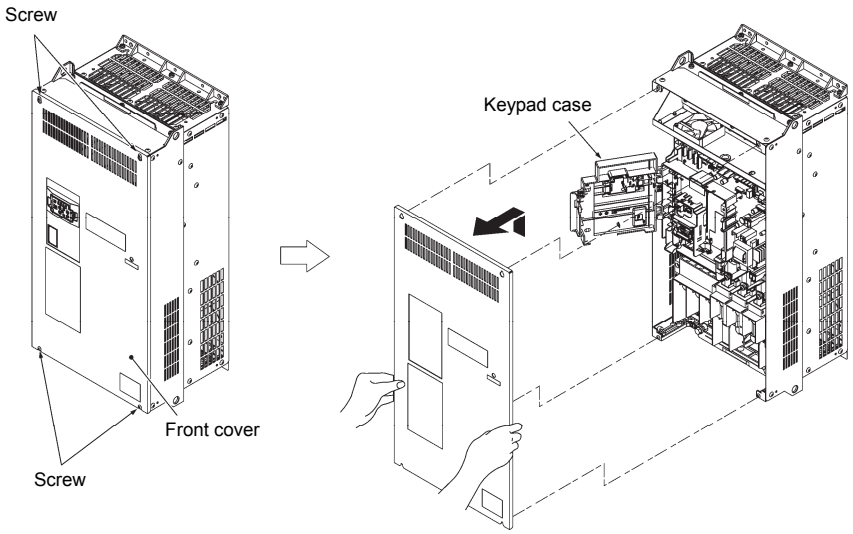


Figure 2.2-3 Removal of the Front Cover and the Wiring Guide (for FRN0072E2S-4□)

(2) Types larger than FRN0085E2S-4□

1) Loosen the screws of the front cover. Hold both sides of the front cover with the hands and slide upward to remove.
2) After routing the wires, align the front cover top edge to the screw holes and attach the cover reversing the steps in figure 2.2-4.

Tip Open the keypad case to view the control printed circuit board.



Tightening torque: 1.8 N·m (M4)
3.5 N·m (M5)

Figure 2.2-4 Removal of the front cover (for FRN0203E2S-4□)

2.2.3 Precautions for wiring

Exercise caution for the following when wiring.

(1) Confirm that the supply voltage is within the input voltage range described on the rating plate.

(2) Always connect the power lines to the inverter main power input terminals L1/R, L2/S, L3/T (3 phase). (The inverter will be damaged when power is applied while the power lines are connected to the wrong terminals.)

(3) Always route the ground line to prevent accidents such as electric shock and fire and to reduce noise.

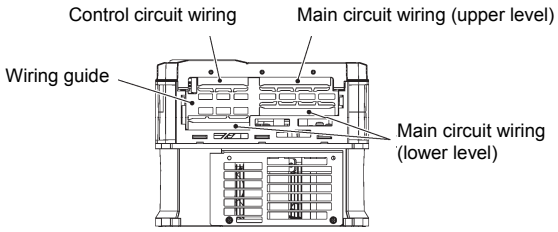
(4) For the lines connecting to the main circuit terminals, use crimped terminals with insulating sleeves or use crimped terminals in conjunction with insulating sleeves for high connection reliability.

(5) Separate the routing of the lines connected to the main circuit terminal input side (primary side) and the output side (secondary side) and the lines connected to the control circuit terminals.
The control circuit terminal lines should be routed as far from the main circuit routing as possible. 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 the main circuit terminal screw, always restore the terminal screw in position and tighten even if lines are not connected.

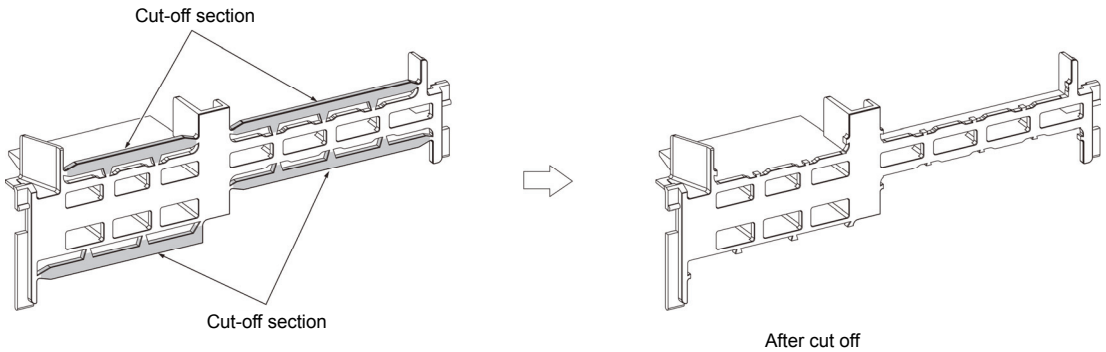
(8) The wiring guide is used to separately route the main circuit wiring and the control circuit wiring. In FRN0072/0085E2S-4□, the main circuit wiring (lower level), the main circuit wiring (upper level) and the control circuit wiring can be separated. Exercise caution for the order of wiring.



Case of FRN0072E2S-4□

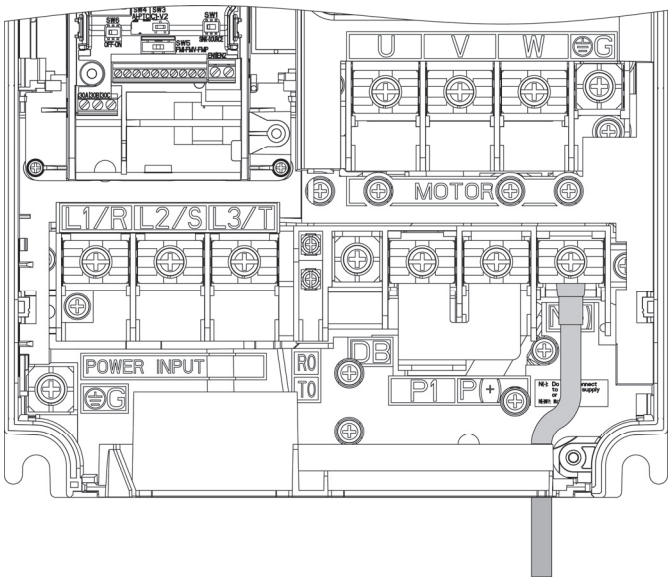
■ Handling the Wiring Guide

For inverter types smaller than FRN0072E2S-4□, 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 the 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 will result in non-conformance to IP20 standards.



Wiring Guide (FRN0072E2S-4□)

(8) 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.



2.2.4 Precautions for long wiring (between inverter and motor)

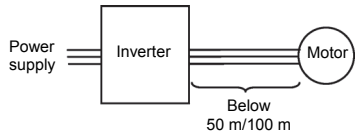
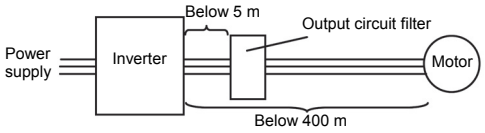
(1) When multiple motors are connected to one inverter, the wiring length is the total of all wire lengths.

(2) Precautions for high frequency leak current

When the wiring length from the inverter to the motor is long, 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. Leak current may increase and the accuracy of the displayed current may not be ensured. Depending on the conditions, excessive leak current may damage the inverter. When directly connecting the inverter and motor, the wiring length should be kept to below 100 meters.

To operate in excess of the above mentioned wiring length, reduce the carrier frequency or use an output circuit filter (OFL-□□□-□A).

When multiple motors are operated in parallel connection configuration (group operation), and especially when shielded cables are used in the connections, the stray capacitance to ground is large. Reduce the carrier frequency or use output circuit filters (OFL-□□□-□A).

Without output circuit filter	With output circuit filter
	

When the output circuit filter is attached, the total wiring length should be below 100 meters (below 400 meters under V/f control).
For motors with encoders, the wiring length between the inverter and motor should be below 100 m. The restriction comes from the encoder specification. For distances beyond 100 m, 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-□□□-□A) to the inverter output side (secondary side)
- Reduce the wiring length from the inverter to the motor. (Less than 10 to 20 meters)

(4) When output circuit filters are attached to 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⚠

- For each inverter, connect to the power supply via circuit breaker and earth leakage breaker (with overcurrent protective function). Use recommended circuit breakers and earth leakage breakers and do not use breakers which exceed the recommended rated current.
- Always use the specified sizes for the wires.
- Tighten terminals with the defined tightening torque.
- When multiple combinations of inverters and motors exist, do not use multi-core cables for the purpose of bundling the various wires.
- Do not install surge killers on the inverter output side (secondary side)
  Risk of fire exists.
- Ground the inverter in compliance with the national or local electric code.
- Always ground the ground line connected to the inverter grounding terminal [⏚G]
  Risk of electric shock and risk of fire exist.
- Qualified personnel should perform the wiring.
- Perform wiring after confirming that the power is shut off.
  Risk of electric shock exists.
- Perform wiring only after the equipment is installed at the location.
  Risk of electric shock and risk of injury exist.
- Confirm that the phase of the power input and the rated voltage for the product matches with the phase and voltage of the power supply to be connected.
- Do not connect power supply lines to the inverter output terminals (U, V, W).
  Risk of fire and risk of accidents exist.

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 by inverter capacity. In the diagram, the two ground terminals [⏚G]are not differentiated for the input side (primary side) and the output side (secondary side).

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

Table 2.2-1 Screw Specifications

Power System	Inverter type	See item [2]	Screw specifications							
			Main circuit		Grounding		Auxiliary power input for control [R0, T0]		Auxiliary power input for fan [R1, T1]	
			Screw size (driver size)	Tightening torque (N•m)	Screw size (driver size)	Tightening torque (N•m)	Screw size	Tightening torque (N•m)	Screw size	Tightening torque (N•m)
3 Phase 400 V	FRN0059E2S-4□	Fig. A	M6 (No. 3)	5.8	M6 (No.3)	5.8	M3.5	1.2	-	-
	FRN0072E2S-4□									
	FRN0085E2S-4□	Fig. B	M8	13.5	M8	13.5				
	FRN0105E2S-4□									
	FRN0139E2S-4□									
	FRN0168E2S-4□									
	FRN0203E2S-4□	Fig. C	M10	27					M3.5	1.2

⚠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, R1, T1

Insulation level

Main circuit - Casing : Basic insulation (overvoltage category III, degree of contamination 2)

Main circuit - Control circuit : Enhanced insulation (overvoltage category III, degree of contamination 2)

Risk of electric shock exists

The following wires are recommended unless special requirements exist.

■ 600 V vinyl insulation wire (IV wire)

The wire is used in circuits except the inverter control circuit. The wire is difficult to twist and is not recommended for inverter control circuit. The maximum allowable temperature for the insulated wire is 60°C.

■ 600 V type 2 vinyl insulation wire or 600 V polyethylene insulation wire (HIV wire)

In comparison to the IV wire, the wire is smaller, more flexible, and the maximum allowable temperature for the insulated wire is higher at 75°C, 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 insulation wire (FSLC wire)

The 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 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 allowable temperature for the insulated wire is 90°C. As a reference, Furukawa Electric Co., Ltd. produces Boardlex which satisfies the requirements.

■ Shielded-Twisted cables for internal wiring of electronic/electric instruments

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 board. Furukawa Electric's BEAMEX S shielded cables XEBV or XEWV satisfy the requirements.

Table 2.2-2 Recommended Wire Sizes (Common Terminals)

Common terminals	Recommended wire size (mm^2)	Remarks
Auxiliary power input terminal for control circuit R0, T0	2.0	-
Auxiliary power input terminal for fan R1, T1	2.0	FRN0203E2S-4□

1) Wire sizes conforming to low voltage directive in Europe

Table 2.2-3 Recommended Wire Sizes

ND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)						
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]		Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor	With DC reactor	Without DC reactor			
3 Phase 400 V	30	FRN0059E2S-4□	16	25	16	16	16	25	2.5
	37	FRN0072E2S-4□	25	35	16	16	25	25	2.5
	45	FRN0085E2S-4□	25	50	16	25	35	35	2.5
	55	FRN0105E2S-4□	35	70	16	35	50	50	2.5
	75	FRN0139E2S-4□	70	-	35	35	70	95	2.5
	90	FRN0168E2S-4□	95	-	50	50	95	120	4
	110	FRN0203E2S-4□	50×2	-	70	70	50×2	150	6

HD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)						
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]		Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor	With DC reactor	Without DC reactor			
3 Phase 400 V	22	FRN0059E2S-4□	10	16	10	16	10	16	2.5
	30	FRN0072E2S-4□	16	25	16	16	16	25	2.5
	37	FRN0085E2S-4□	25	35	16	16	25	25	2.5
	45	FRN0105E2S-4□	25	50	16	25	35	35	2.5
	55	FRN0139E2S-4□	35	70	16	35	50	50	2.5
	75	FRN0168E2S-4□	70	-	35	35	70	95	4
	90	FRN0203E2S-4□	95	-	50	50	95	120	6

The recommended wire sizes for the main circuit terminals assume using 70°C 600 V PVC wire at 40°C ambient temperature.

HND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)						
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]		Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor	With DC reactor	Without DC reactor			
3 Phase 400 V	22	FRN0059E2S-4□	10	16	10	16	10	16	2.5
	30	FRN0072E2S-4□	16	25	16	16	16	25	2.5
	37	FRN0085E2S-4□	25	35	16	16	25	25	2.5
	45	FRN0105E2S-4□	25	50	16	25	35	35	2.5
	55	FRN0139E2S-4□	35	70	16	35	50	50	2.5
	75	FRN0168E2S-4□	70	-	35	35	70	95	2.5
	90	FRN0203E2S-4□	95	-	50	50	95	120	4

HHD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)						
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]		Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor	With DC reactor	Without DC reactor			
3 Phase 400 V	18.5	FRN0059E2S-4□	6	16	10	16	10	10	2.5
	22	FRN0072E2S-4□	10	16	10	16	10	16	2.5
	30	FRN0085E2S-4□	16	25	16	16	16	25	2.5
	37	FRN0105E2S-4□	25	35	16	16	25	25	2.5
	45	FRN0139E2S-4□	25	50	16	25	35	35	2.5
	55	FRN0168E2S-4□	35	70	16	35	50	50	2.5
	75	FRN0203E2S-4□	70	-	35	35	70	95	4

The recommended wire sizes for the main circuit terminals assume using 70°C 600 V PVC wire at 40°C ambient temperature.

2) Wire sizes for board temperature: Below 40°C, wire type: 60°C wire

Table 2.2-4 Recommended Wire Sizes

ND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	30	FRN0059E2S-4□	14	22	8*1	14	14	2
	37	FRN0072E2S-4□	14	38	8*1	14	22	2
	45	FRN0085E2S-4□	22	38	8	22	38	2
	55	FRN0105E2S-4□	38	60	14	38	38	2
	75	FRN0139E2S-4□	60	-	14	60	60	2
	90	FRN0168E2S-4□	60	-	14	60	100*5	3.5
	110	FRN0203E2S-4□	100	-	22	100	150	5.5

HD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	8*1	14	5.5	8*1	14	2
	30	FRN0072E2S-4□	14	22	8*1	14	14	2
	37	FRN0085E2S-4□	14	38	8	22	22	2
	45	FRN0105E2S-4□	22	38	8	22	38	2
	55	FRN0139E2S-4□	38	60	14	38	38	2
	75	FRN0168E2S-4□	60	-	14	60	60	3.5
	90	FRN0203E2S-4□	60	-	14	60	100	5.5

HND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	8*1	14	5.5	8*1	14	2
	30	FRN0072E2S-4□	14	22	8*1	14	14	2
	37	FRN0085E2S-4□	14	38	8	22	22	2
	45	FRN0105E2S-4□	22	38	8	22	38	2
	55	FRN0139E2S-4□	38	60	14	38	38	2
	75	FRN0168E2S-4□	60	-	14	60	60	2
	90	FRN0203E2S-4□	60	-	14	60	100	3.5

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.
*5 For compatible crimped terminal, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

HHD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	18.5	FRN0059E2S-4□	5.5	14	5.5	5.5	8*1	2
	22	FRN0072E2S-4□	8*1	14	5.5	8*1	14	2
	30	FRN0085E2S-4□	14	22	8	14	14	2
	37	FRN0105E2S-4□	14	38	8	22	22	2
	45	FRN0139E2S-4□	22	38	8	22	38	2
	55	FRN0168E2S-4□	38	60	14	38	38	2
	75	FRN0203E2S-4□	60	-	14	60	60	3.5

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

3) Wire sizes for board temperature: Below 40°C, wire type: 75°C wire

Table 2.2-5 Recommended Wire Sizes

ND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	30	FRN0059E2S-4□	8*1	14	8*1	8*1	14	2
	37	FRN0072E2S-4□	14	14	8*1	14	14	2
	45	FRN0085E2S-4□	14	22	8	14	22	2
	55	FRN0105E2S-4□	22	38	14	22	38	2
	75	FRN0139E2S-4□	38	-	14	38	38	2
	90	FRN0168E2S-4□	38	-	14	38	60	2
	110	FRN0203E2S-4□	60	-	22	60	100	3.5

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

HD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	5.5	8 *1	5.5	5.5	5.5	2
	30	FRN0072E2S-4□	8 *1	14	8 *1	8 *1	14	2
	37	FRN0085E2S-4□	14	14	8	14	14	2
	45	FRN0105E2S-4□	14	22	8	14	22	2
	55	FRN0139E2S-4□	22	38	14	22	38	2
	75	FRN0168E2S-4□	38	-	14	38	38	2
	90	FRN0203E2S-4□	38	-	14	60	60	3.5

HND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	5.5	8 *1	5.5	5.5	5.5	2
	30	FRN0072E2S-4□	8 *1	14	8 *1	8 *1	14	2
	37	FRN0085E2S-4□	14	14	8	14	14	2
	45	FRN0105E2S-4□	14	22	8	14	22	2
	55	FRN0139E2S-4□	22	38	14	22	38	2
	75	FRN0168E2S-4□	38	-	14	38	38	2
	90	FRN0203E2S-4□	38	-	14	60	60	2

HHD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	18.5	FRN0059E2S-4□	3.5 *6	8 *1	5.5	3.5 *6	5.5	2
	22	FRN0072E2S-4□	5.5	8 *1	5.5	5.5	5.5	2
	30	FRN0085E2S-4□	8	14	8	8	14	2
	37	FRN0105E2S-4□	14	14	8	14	14	2
	45	FRN0139E2S-4□	14	22	8	14	22	2
	55	FRN0168E2S-4□	22	38	14	22	38	2
	75	FRN0203E2S-4□	38	-	14	38	38	2

The recommended wire sizes for the main circuit terminals assume using 75°C 600V HIV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.
*6 For compatible crimped terminal, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

4) Wire sizes for board temperature: Below 40°C, wire type: 90°C wire

Table 2.2-6 Recommended Wire Sizes

ND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	30	FRN0059E2S-4□	5.5	8 *1	8 *1	5.5	8 *1	2
	37	FRN0072E2S-4□	8 *1	14	8 *1	8 *1	14	2
	45	FRN0085E2S-4□	14	22	8	14	14	2
	55	FRN0105E2S-4□	14	22	14	14	22	2
	75	FRN0139E2S-4□	22	-	14	22	38	2
	90	FRN0168E2S-4□	38	-	14	38	38	2
	110	FRN0203E2S-4□	38	-	22	38	60	2

HD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	3.5 *6	5.5	5.5	3.5 *6	5.5	2
	30	FRN0072E2S-4□	5.5	8 *1	8 *1	5.5	8 *1	2
	37	FRN0085E2S-4□	8	14	8	8	14	2
	45	FRN0105E2S-4□	14	22	8	14	14	2
	55	FRN0139E2S-4□	14	22	14	14	22	2
	75	FRN0168E2S-4□	22	-	14	38	38	2
	90	FRN0203E2S-4□	38	-	14	38	38	2

HND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	3.5 *6	5.5	5.5	3.5 *6	5.5	2
	30	FRN0072E2S-4□	5.5	8 *1	8 *1	5.5	8 *1	2
	37	FRN0085E2S-4□	8	14	8	8	14	2
	45	FRN0105E2S-4□	14	22	8	14	14	2
	55	FRN0139E2S-4□	14	22	14	14	22	2
	75	FRN0168E2S-4□	22	-	14	38	38	2
	90	FRN0203E2S-4□	38	-	14	38	38	2

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.
*6 For compatible crimped terminal, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

HHD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	18.5	FRN0059E2S-4□	3.5*6	5.5	5.5	3.5*6	3.5*6	2
	22	FRN0072E2S-4□	3.5*6	5.5	5.5	3.5*6	5.5	2
	30	FRN0085E2S-4□	5.5	8	8	5.5	8	2
	37	FRN0105E2S-4□	8	14	8	8	14	2
	45	FRN0139E2S-4□	14	22	8	14	14	2
	55	FRN0168E2S-4□	14	22	14	14	22	2
	75	FRN0203E2S-4□	22	-	14	38	38	2

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.
*6 For compatible crimped terminal, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

5) Wire sizes for board temperature: Below 50°C, wire type: 60°C wire

Table 2.2-7 Recommended Wire Sizes

ND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [⏚G]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	30	FRN0059E2S-4□	14	22	8*1	14	22	2
	37	FRN0072E2S-4□	22	38	8*1	22	38	2
	45	FRN0085E2S-4□	38	38	8	38	38	2
	55	FRN0105E2S-4□	38	60	14	38	60	2
	75	FRN0139E2S-4□	60	-	14	60	100*5	3.5
	90	FRN0168E2S-4□	100*5	-	14	100*5	100*5	3.5
	110	FRN0203E2S-4□	100	-	22	100	150	5.5

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.
*5 For compatible crimped terminal, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

HD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [⏚G]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) *[P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	8 *1	14	5.5	14	14	2
	30	FRN0072E2S-4□	14	22	8 *1	14	22	2
	37	FRN0085E2S-4□	22	38	8	22	38	2
	45	FRN0105E2S-4□	38	38	8	38	38	2
	55	FRN0139E2S-4□	38	60	14	38	60	3.5
	75	FRN0168E2S-4□	60	-	14	60	100 *5	3.5
	90	FRN0203E2S-4□	100	-	14	100	100	5.5

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

HND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	14	22	5.5	14	22	2
	30	FRN0072E2S-4□	22	38	8 *1	22	38	2
	37	FRN0085E2S-4□	38	60	8	38	38	2
	45	FRN0105E2S-4□	38	60	8	38	60	2
	55	FRN0139E2S-4□	60	100 *5	14	60	100 *5	2
	75	FRN0168E2S-4□	100 *5	-	14	100 *5	100 *5	3.5
	90	FRN0203E2S-4□	100	-	14	150 *3	150	5.5

HHD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	18.5	FRN0059E2S-4□	14	22	5.5	14	14	2
	22	FRN0072E2S-4□	14	22	5.5	14	22	2
	30	FRN0085E2S-4□	22	38	8	22	38	2
	37	FRN0105E2S-4□	38	60	8	38	38	2
	45	FRN0139E2S-4□	38	60	8	38	60	2
	55	FRN0168E2S-4□	60	100 *5	14	60	100 *5	3.5
	75	FRN0203E2S-4□	100	-	14	100	100	5.5

The recommended wire sizes for the main circuit terminals assume using 60°C IV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.
*3 For compatible crimped terminal, please use model CB150-10 by JST Mfg. Co., Ltd. or equivalent.
*5 For compatible crimped terminal, please use model CB100-S8 by JST Mfg. Co., Ltd. or equivalent.

6) Wire sizes for board temperature: Below 50°C, wire type: 75°C wire

Table 2.2-8 Recommended Wire Sizes

ND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [⏚G]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	30	FRN0059E2S-4□	8*1	14	8*1	8*1	14	2
	37	FRN0072E2S-4□	8*1	14	8*1	14	14	2
	45	FRN0085E2S-4□	14	22	8	14	22	2
	55	FRN0105E2S-4□	22	38	14	22	22	2
	75	FRN0139E2S-4□	38	-	14	38	38	2
	90	FRN0168E2S-4□	38	-	14	38	60	2
	110	FRN0203E2S-4□	60	-	22	60	60	3.5

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

HD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [⏚G]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	5.5	8*1	5.5	5.5	5.5	2
	30	FRN0072E2S-4□	8*1	14	8*1	8*1	14	2
	37	FRN0085E2S-4□	8	14	8	14	14	2
	45	FRN0105E2S-4□	14	22	8	14	22	2
	55	FRN0139E2S-4□	22	38	14	22	22	2
	75	FRN0168E2S-4□	38	-	14	38	38	2
	90	FRN0203E2S-4□	38	-	14	38	60	3.5

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

HND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	5.5	14	5.5	8*1	8*1	2
	30	FRN0072E2S-4□	14	14	8*1	14	14	2
	37	FRN0085E2S-4□	14	22	8	14	22	2
	45	FRN0105E2S-4□	22	38	8	22	22	2
	55	FRN0139E2S-4□	22	38	14	38	38	2
	75	FRN0168E2S-4□	38	-	14	60	60	2
	90	FRN0203E2S-4□	60	-	14	60	100	2

HHD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	18.5	FRN0059E2S-4□	5.5	8*1	5.5	5.5	5.5	2
	22	FRN0072E2S-4□	5.5	14	5.5	8*1	8*1	2
	30	FRN0085E2S-4□	14	14	8	14	14	2
	37	FRN0105E2S-4□	14	22	8	14	22	2
	45	FRN0139E2S-4□	22	38	8	22	22	2
	55	FRN0168E2S-4□	22	38	14	38	38	2
	75	FRN0203E2S-4□	38	-	14	60	60	2

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.

7) Wire sizes for board temperature: Below 50°C, wire type: 90°C wire

Table 2.2-9 Recommended Wire Sizes

ND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [⏚G]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	30	FRN0059E2S-4□	5.5	8*1	8*1	5.5	5.5	2
	37	FRN0072E2S-4□	5.5	14	8*1	8*1	8*1	2
	45	FRN0085E2S-4□	8	14	8	8	14	2
	55	FRN0105E2S-4□	14	22	14	14	14	2
	75	FRN0139E2S-4□	22	-	14	22	38	2
	90	FRN0168E2S-4□	22	-	14	38	38	2
	110	FRN0203E2S-4□	38	-	22	38	60	2

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

HD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input (Note 1) [L1/R, L2/S, L3/T]		Ground terminal (Note 1) [⏚G]	Inverter output (Note 1) [U, V, W]	For DC reactor connection (Note 1) [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	3.5*6	5.5	5.5	3.5*6	3.5*6	2
	30	FRN0072E2S-4□	5.5	8*1	8*1	5.5	5.5	2
	37	FRN0085E2S-4□	5.5	14	8	8	8	2
	45	FRN0105E2S-4□	8	14	8	14	14	2
	55	FRN0139E2S-4□	14	22	14	14	14	2
	75	FRN0168E2S-4□	22	-	14	22	38	2
	90	FRN0203E2S-4□	22	-	14	38	38	2

Note 1) The rated current must be reduced for operation (Rated current x 80%). Recommended wire sizes assume these conditions.

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.
*6 For compatible crimped terminal, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

HND Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	22	FRN0059E2S-4□	5.5	8 *1	5.5	5.5	5.5	2
	30	FRN0072E2S-4□	8 *1	14	8 *1	8 *1	8 *1	2
	37	FRN0085E2S-4□	8	14	8	14	14	2
	45	FRN0105E2S-4□	14	22	8	14	22	2
	55	FRN0139E2S-4□	22	38	14	22	22	2
	75	FRN0168E2S-4□	38	-	14	38	38	2
	90	FRN0203E2S-4□	38	-	14	38	60	2

HHD Mode

Power System	Std Applicable Motor (kW)	Inverter type	Recommended wire size (mm^2)					
			Main power supply input [L1/R, L2/S, L3/T]		Ground terminal [⏚G]	Inverter output [U, V, W]	For DC reactor connection [P1, P(+)]	For braking resistor connection [P(+), DB]
			With DC reactor	Without DC reactor				
3 Phase 400 V	18.5	FRN0059E2S-4□	3.5 *6	5.5	5.5	3.5 *6	5.5	2
	22	FRN0072E2S-4□	5.5	8 *1	5.5	5.5	5.5	2
	30	FRN0085E2S-4□	8	14	8	8	8	2
	37	FRN0105E2S-4□	8	14	8	14	14	2
	45	FRN0139E2S-4□	14	22	8	14	22	2
	55	FRN0168E2S-4□	22	38	14	22	22	2
	75	FRN0203E2S-4□	38	-	14	38	38	2

The recommended wire sizes for the main circuit terminals assume using 75°C 600 V HIV wire.
*1 For compatible crimped terminal, please use model 8-L6 by JST Mfg. Co., Ltd. or equivalent.
*6 For compatible crimped terminal, please use model R5.5-6 by JST Mfg. Co., Ltd. or equivalent.

[2] Terminal layout diagram (main circuit terminal)

Figure A

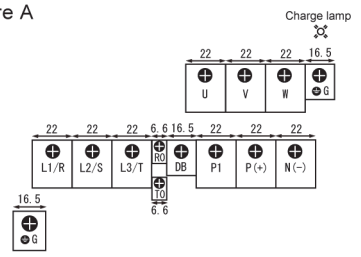


Figure B

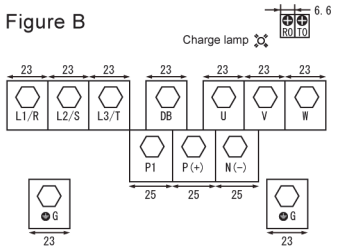
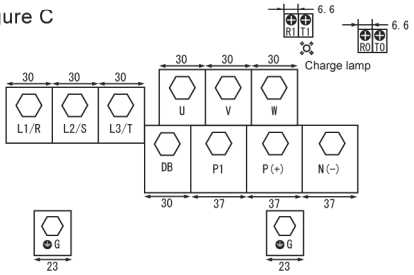


Figure C



[3] Description of terminal functions (main circuit terminal)

Classification	Terminal symbol	Terminal name	Specification
Main circuit	L1/R, L2/S, L3/T	Main power input	Terminals to connect 3 phase power source.
	U, V, W	Inverter output	Terminals to connect 3 phase motors.
	P (+), P1	For direct current reactor connection	Terminals to connect DC reactor (DCR) for power factor enhancement. ND mode: Types larger than FRN0139E2S-4□, HD/HND mode: Types larger than FRN0168E2S-4□, HHD mode: Always connect for FRN0203E2S-4□.
	P (+), N (-)	For direct current bus connection	Terminals to connect direct current intermediate circuit of other inverters and PWM converters.
	P (+), DB	For braking resistor connection	Terminals to connect P (+) terminal of braking resistor (option) and DB. (Wiring length: Below 5 meters) (Types smaller than FRN0072E2S-4□)
	⏚ G	For inverter chassis (case) grounding	Grounding terminal for inverter chassis (case).
	R0, T0	Auxiliary power input for brakes	When retaining the integrated alarm signal for the activation of the protective function at inverter main power supply shut off is desired, or when continuous display of the keypad is desired, connect this terminal to the power supply.
	R1, T1	Auxiliary power input for fan	Ordinarily, the terminal does not need to be connected. Connect these terminals to AC power supply when operating with direct current power input (such as in combination with PWM converters).

Follow the steps below when wiring.

(1)Inverter ground terminal (⏚G)

(2)Inverter output terminals (U, V, W), motor ground terminal (⏚G)

(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)

* Connect as necessary

(1) Main power source input terminals L1/R, L2/S, L3/T (3 phase input)

Connect the 3 phase power source.

1) For safety, confirm that the circuit breaker (MCCB) or the magnetic contactor (MC) is OFF prior to wiring the power lines.
2) Connect the power lines (L1/R, L2/S, L3/T) to MCCB or residual-current-operated protective device (RCD)/ the earth leakage breaker (ELCB)*, or connect via MC as necessary. The phase sequence of the power lines and the inverter do not need to be matched.

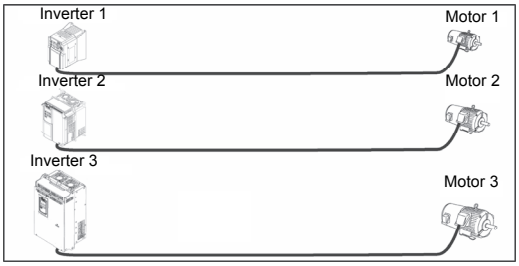
   * With overcurrent protection

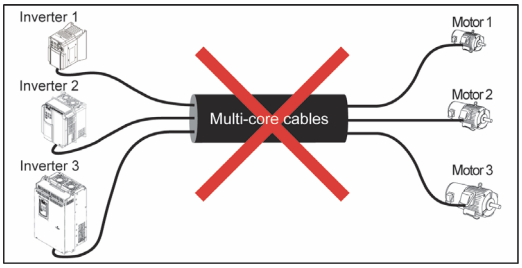
Tip In emergencies such as when the inverter protective function is activated, disconnecting the inverter from the power source to prevent magnification of failure or accident may be desired. Installation of an MC which allows manual disconnection of the power source is recommended.

(2) Inverter output terminals U, V, W, motor ground terminal ⏚G

1) Connect the 3 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 (⏚G).

Note When multiple combinations of inverters and motors exist, do not use multi-core cables for the purpose of bundling the various wires.





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

Connect the direct current reactor (DCR) for power factor enhancement.

1) Remove the shorting bar from terminals P1-P(+).
   (FRN0203E2S-4☐ will not have the shorting bar connected.)

2) Connect the P1, P(+) terminals for the direct current reactor (option).

Note
- ▪Keep the wiring length below 10 meters.
- ▪Do not remove the shorting bar if the direct current reactor is not used.
- ▪When the capacity of the motor to be used is above 75 kW, always connect the direct current reactor.
- ▪Direct current reactors do not have to be connected when connecting PWM converters.

⚠WARNING
Always connect the direct current reactor (option) when the power supply transformer capacity is above 500 kVA and is over 10 times the rated capacity of the inverter. **Risk of fire exists.**

(4) Braking resistor connection terminals P(+) DB (Types smaller than FRN0072E2S-4☐)

1) Connect terminals P(+), DB for the braking resistor (option).
2) Position the inverter main body and the braking resistor such that the wiring length will be less than 5 meters and route the two wires twisted or in contact with each other (parallel).

⚠WARNING
Do not connect to terminals other than P(+)-DB when connecting braking resistors. **Risk of fire exists.**

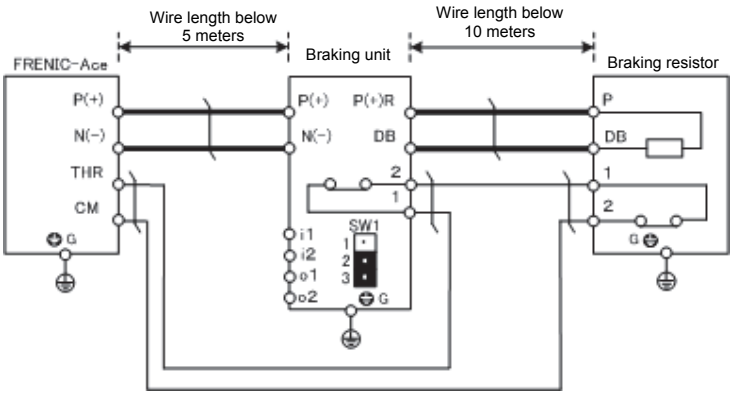
(5) Direct current bus terminals P(+), N(-)

1) Connecting the braking unit/braking resistor (option)

Inverter type	Braking transistor	Additional instruments for connection (option)	Instruments connected/connection terminals
Types larger than FRN0085E2S-4☐	Not equipped	Braking unit	Inverter (P(+), N(-)) - Braking unit (P(+), N(-))
		Braking resistor	Braking unit (P(+) R, DB) - Braking resistor (P, DB)

Braking units are necessary when using braking resistors for types larger than FRN0085E2S-4☐.

Connect terminals P(+), N(-) of the braking unit to the inverter terminals P(+), N(-). Position the equipment such that the wiring length is below 5 meters and route the two wires twisted or in contact with each other (parallel).
Connect the terminals P(+) R, DB of the braking unit to terminals P(+), DB of the braking resistor. Position the equipment such that the wiring length is below 10 meters and route the two wires twisted or in contact with each other (parallel).
For details such as other wirings, refer to the user's manual for the braking unit.



2) Connection of other instruments

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

(For connection with the PWM converter, refer to the User's Manual, Chapter 11, Section 11.9 "Power Regenerative PWM Converters, RHC Series").

(6) Inverter ground terminal ⏚G

The terminal is the ground terminal for the inverter chassis (case). Always connect to ground for safety and as a countermeasure for noise. To prevent accidents such as electric shock and fire, the electric facility technical standards require grounding construction for metallic frames in electric instruments.

Follow the steps below in connecting the ground terminal on the power supply side.

1) Ground the inverter in compliance with the national or local electric code.
2) The grounding wire should be thick, with large surface area, and as short as possible.

(7) Auxiliary power input terminals for control circuit R0, T0

The inverter can be operated without power input to the auxiliary power input terminals for control circuit. However, the various inverter output signals and the keypad display will be terminated when the inverter main power is shut off and the control power source is lost.

When retaining the integrated alarm signal for the activation of the protective function at inverter main power supply shut off is desired, or when continuous display of the keypad is desired, connect these terminals to the power supply. When the inverter input side has a magnetic contactor (MC), wire from the input side (primary side) of the magnetic contactor (MC).

Terminal rating: AC 380 to 480 V, 50/60 Hz, maximum current 0.5 A (400 V series)

Note When connecting 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 3 phase and the terminals R0, T0 are single phase. When connecting to terminals R0, T0 from the input side of the earth leakage breaker, make sure that the insulating transformer is positioned as in the figure below, or make sure to connect the auxiliary B contact of the magnetic contactor.

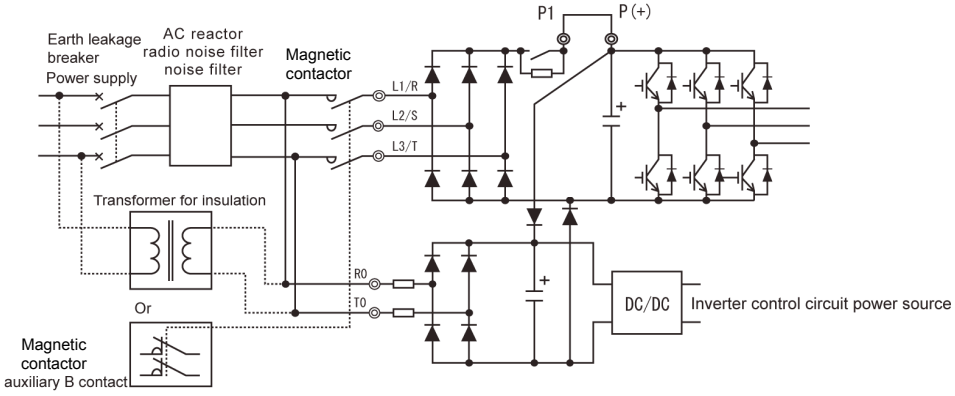


Figure 2.2-5 Connection of the Earth Leakage Breaker

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 contact of a magnetic contactor on the power supply side.
On connection examples for the PWM converter side, refer to the User's Manual, Chapter 11, Section 11.9 "Power Regenerative PWM Converters, RHC Series".

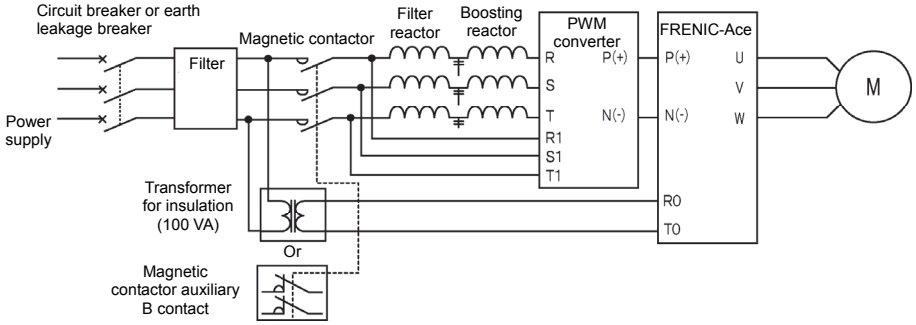


Figure 2.2-6 Example of Grounding in Combination with PWM Converter

(8) Auxiliary power input terminals for fan R1, T1

The terminals are equipped on FRN0203E2S-4□ but is not used ordinarily.

Connect AC power source when using direct current power supply input (such as in combination with PWM converters).

Also switch the fan power supply switching connectors “CN R”, “CN W”.

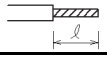
Terminal rating: AC 380 to 440 V/50 Hz, 380 to 480 V/60 Hz, maximum current 1.0 A (400 V series)

2.2.6 Control circuit terminals (common to all models)

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

The screw specifications and wire sizes to be used for control circuit wiring are shown below.
The control circuit terminal box differs by destination.

Table 2.2-10 Screw Specifications and Recommended Wire Sizes

Terminal symbol	Screw specification		Allowable wire sizes	Driver (shape of tip)	Removal size of wire cover 	Gauge size to insert wire
	Size	Tightening torque				
30A, 30B, 30C EN1, EN2	M3	0.5 to 0.6 N·m	0.14 to 1.5 mm^2 (AWG26 to 16)	Minus (0.6 mm×3.5 mm)	6 mm	A1*1
Others	M2	0.22 to 0.25 N·m	0.14 to 1 mm^2 (AWG26 to 18)	Minus (0.4 mm×2.5 mm)	5 mm	φ1.6

* Recommended rod terminal: Phoenix Contact Refer to Table 2.2-11 for details.

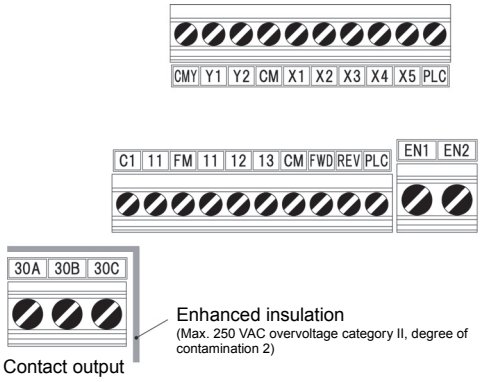
*1 Defined according to IEC/EN 60947-1.

Table 2.2-11 Recommended Rod Terminals

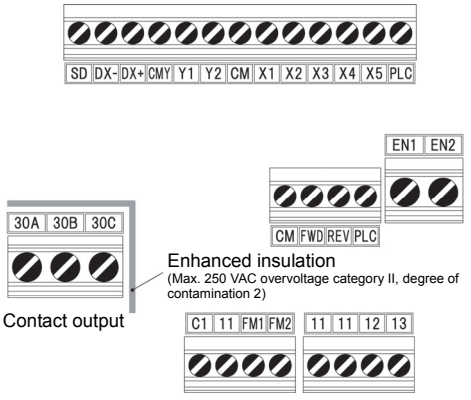
Screw size		Wire size	Type	
			With insulating collar	Without insulating collar
M3	M2	0.25 mm^2 (AWG24)	AI 0.25-6 BU	A 0.25-7
		0.34 mm^2 (AWG22)	AI 0.34-6 TQ	A 0.34-7
		0. 5 mm^2 (AWG20)	AI 0.5-6 WH	A 0.5-6
		0.75 mm^2 (AWG18)	AI 0.75-6 GY	A 0.75-6
		1 mm^2 (AWG18)	AI 1-6 RD	A 1-6
		1.5 mm^2 (AWG16)	AI 1.5-6 BK	A 1.5-7

Note) When sizes exceeding the recommended wire sizes are used, the front cover may be pushed outward depending on the number of wires, causing erroneous operation of the keypad.

[2] Terminal layout diagram (control circuit terminal)



Destination: -A ,-E,-T and -K



Destination: -C

⚠WARNING⚠

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

Control terminals: AUX-contact (30A, 30B, 30C, Y5A, Y5C)

Insulation level

Contact output – control circuit : Enhanced insulation (overvoltage category II, degree of contamination 2)

Risk of electric shock exists

[3] Description of terminal functions (control circuit terminal)

⚠WARNING⚠

Generally, the insulation for control signal lines are not enhanced. When the control signal lines come into direct contact with the main circuit live section, the insulation cover may be damaged. High voltage of the main circuit may be applied on the control signal lines, so exercise caution such that the main circuit live sections do not contact the control signal lines.

Risk of accidents and risk of electric shock exist.

⚠CAUTION

Noise is generated by the inverter, motor, and wiring.

Exercise caution to prevent malfunction of peripheral sensors and instruments.

Risk of accidents exists.

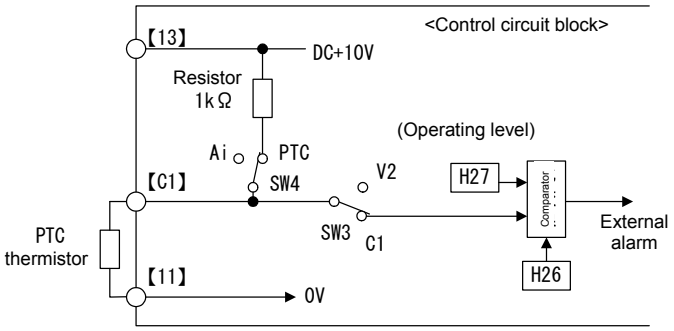
Table 2.2-12 shows the functional explanations for the control circuit terminals. The connection method differs for the control circuit terminals depending on the functional code setting matching the purpose of inverter operation.

Properly wire such that the impact of noise generated by the main circuit wiring is reduced.

Table 2.2-12 Functional Description of Control Circuit Terminals

Classification	Terminal symbol	Terminal name	Functional description
Analog input	[13]	Power source for variable resistor	The terminal is used for the power source (DC+10 V 10 mA Max) for the external speed setup device (variable resistor: 1 to 5 kΩ). Connect variable resistors larger than 1/2 W.
	[12]	Analog setup voltage input	(1) Frequency is set up according to the external analog voltage input command value. Normal operation • DC0 to +10 V/0 to 100(%) (DC0 to +5 V/0 to 100%) • DC0 to ±10 V/0 to ±100(%) (DC0 to ±5 V/0 to ±100%) Reverse operation • DC+10 to 0 to -10 V/-100% to 0 to 100(%) • DC-10 to 0 to +10 V/+100% to 0 to -100(%) (2) The terminal can be assigned to PID command, feedback signal of PID control, auxiliary frequency setup, ratio setup, torque limit setup, and analog input monitor aside from the frequency setup by analog input. (3) Hardware specification * Input impedance: 22 (kΩ) * Up to DC±15 V can be input. However, input exceeding DC±10 V will be recognized as DC±10 V.
	[C1]	Analog setup current input (C1 function)	(1) Frequency is set up according to the external analog current input command value. Normal operation • DC4 to 20 mA/0 to 100(%)/-100% to 0 to 100% • DC0 to 20 mA/0 to 100(%)/-100% to 0 to 100% Reverse operation • DC20 to 4 mA/0 to 100(%)/-100% to 0 to 100% • DC20 to 0 mA/0 to 100(%)/-100% to 0 to 100% (2) The terminal can be assigned to PID command, feedback signal of PID control, auxiliary frequency setup, ratio setup, torque limit setup, and analog input monitor aside from the frequency setup by analog input. (3) Hardware specification * Input impedance: 250 (Ω) * Up to DC 30 mA can be input. However, input exceeding DC 20 mA will be recognized as DC 20 mA.

Table 2.2-12 Functional Description of Control Circuit Terminals (continued)

Classification	Terminal symbol	Terminal name	Functional description
Analog input	[C1]	Analog setup voltage input (V2 function)	(1) Frequency is set up according to the external analog voltage input command value. SW3 (refer to "2.2.8 Operating various switches") must be switched on the printed circuit board. Normal operation • DC0 to +10 V/0 to 100(%) (DC0 to +5 V/0 to 100%) • DC0 to +10 V/-100 to 0 to 100(%) (DC0 to +5 V/-100 to 0 to 100%) Reverse operation • DC+10 to 0 V/0 to 100(%) (DC＋5 V to 0 V/0 to 100%) • DC+10 to 0 V/-100 to 0 to 100(%) (DC+5 to 0 V/-100 to 0 to 100%) (2) The terminal can be assigned to PID command, feedback signal of PID control, auxiliary frequency setup, ratio setup, torque limit setup, and analog input monitor aside from the frequency setup by analog input. (3) Hardware specification * Input impedance: 22(kΩ) * Up to DC±15 V can be input. However, input exceeding DC±10 V will be recognized as DC±10 V.
		PTC thermistor input (PTC function)	(1) PTC (Positive Temperature Coefficient) thermistor for motor protection can be connected. SW3 (C1/V2 Switch) and SW4 (PTC /AI Switch) (refer to "2.2.8 Operating various switches") must be switched on the printed circuit board. The following figure shows the internal circuit when SW3 and SW4 are set for PTC thermistor input. For details on SW3 and SW4, refer to "2.2.8 Operating various switches". When SW3 and SW4 are switched to the PTC side, function code H26 also needs to be changed.
			 Figure 2.2-7 Internal circuit when SW4 is switched to PTC side
		Analog input monitor (AI function)	(1) The analog input monitor can be used to monitor the status of peripheral instruments using communication by inputting the analog signals of various sensors such as temperature sensors. Data can be converted to physical property values such as temperature and pressure by using display factors and shown on the keypad display.
	[11]	Analog input common	The terminal is the common terminal for analog input signals (terminals [12], [13], [C1]). The terminal is insulated against terminals [CM], [CMY].

Note

- Use shielded lines and keep the wiring to the minimum as possible (below 20 meters) for control signals which are susceptible to external noise. Grounding the external layer of the shielded lines is generally recommended, but if external induction noise is large, connecting to terminal 11 may reduce the noise. The shielded line increases the blocking effect. Always ground one end as shown in figure 2.2-8.
- When creating contacts to analog input signal lines, use twin contacts for small signals. Also, do not insert contacts to terminal 11.
- When external analog signal generators are connected, the analog signal generator circuit may malfunction due to the noise created by the inverter. In these cases, connect ferrite core (toroidal shape or equivalent) to the output terminals of the analog signal generator or connect high frequency capacitors between the control signal lines, as shown in figure 2.2-9.

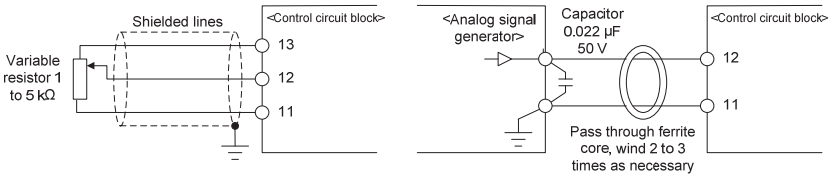
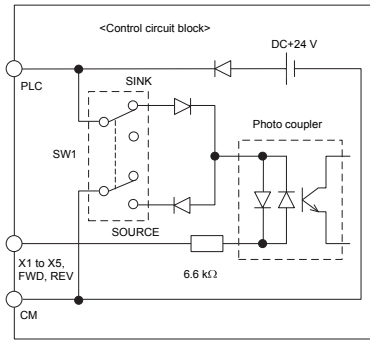


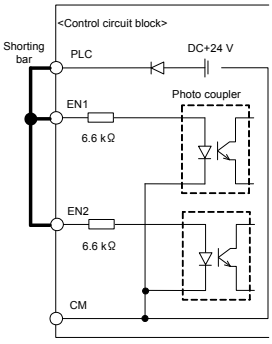
Figure 2.2-8 Connection Diagram for Shielded Lines, Figure 2.2-9 Example of Noise Countermeasure

Table 2.2-12 Functional Description of Control Circuit Terminals (continued)

<table>
<tr><th>Classification</th><th>Terminal symbol</th><th>Terminal name</th><th>Functional description</th></tr>
<tr><td rowspan="8">Digital input</td><td>[X1]</td><td>Digital input</td><td rowspan="8">(1) Various signals (coast to a stop command, external alarm, multi-speed selection, etc) set up by function codes E01 to E05, E98, E99 can be set up.
For details, refer to “Chapter 5 Function Codes”.
(2) Input mode, sink/source can be switched using SW1.
(Refer to “2.2.8 Operating various switches”)
(3) The operating mode between various digital input terminals and terminal CM can be switched to “ON when shorted (active ON)” or “OFF when shorted (active OFF)”. (SINK side)
(4) Digital input terminal [X5] can be set up as a pulse train input terminal by changing the function code
Maximum wiring length 20 meters
Maximum input pulse
30 kHz: When connected to open collector output pulse generator
100 kHz: When connected to complementary output pulse generator
For function code settings, refer to “Chapter 5 FUNCTION CODE”

<Digital input circuit specification>
 

<table><tr><th colspan="2">Item</th><th>Minimum</th><th>Maximum</th></tr><tr><td rowspan="2">Operating voltage (SINK)</td><td>ON level</td><td>0 V</td><td>2 V</td></tr><tr><td>OFF level</td><td>22 V</td><td>27 V</td></tr><tr><td rowspan="2">Operating voltage (SOURCE)</td><td>ON level</td><td>22 V</td><td>27 V</td></tr><tr><td>OFF level</td><td>0 V</td><td>2 V</td></tr><tr><td colspan="2">Operating current at ON (at input voltage 0 V) (for [X5] input terminal)</td><td>2.5 mA (9.7 mA)</td><td>5 mA (16 mA)</td></tr><tr><td colspan="2">Allowable leak current at OFF</td><td>-</td><td>0.5 mA</td></tr></table>
Figure 2.2-10 Digital Input Circuit</td></tr>
<tr><td>[X2]</td><td>Digital input 2</td></tr>
<tr><td>[X3]</td><td>Digital input 3</td></tr>
<tr><td>[X4]</td><td>Digital input 4</td></tr>
<tr><td>[X5]</td><td>Digital input 5/pulse train input</td></tr>
<tr><td>[FWD]</td><td>Run forward command</td></tr>
<tr><td>[REV]</td><td>Run reverse command</td></tr>
<tr><td>[EN1]
[EN2]</td><td>Enable input</td><td>(1) When terminals [EN1]-[PLC] or terminals [EN2]-[PLC] are OFF, the inverter output transistors stop functioning. (safe torque off: STO)
Be sure to operate terminals [EN1] and [EN2] simultaneously; otherwise an  alarm is issued and the operation of the inverter will be disabled.
To enable the Enable function, remove the short bar.
(2) The input mode for terminals [EN1] and [EN2] is fixed to source. The mode cannot be switched to sink.
(3) Short terminals [EN1]-[PLC] and [EN2] – [PLC] using shorting bars when the enable input function is not used. (Keep the shorting bar connected).

<EN terminal circuit spec>
 

<table><tr><th colspan="2">Item</th><th>Min</th><th>Max</th></tr><tr><td rowspan="2">Operating voltage (SOURCE)</td><td>ON level</td><td>22 V</td><td>27 V</td></tr><tr><td>OFF level</td><td>0 V</td><td>2 V</td></tr><tr><td colspan="2">Operating current at ON (at input voltage 24 V)</td><td>-</td><td>4.5 mA</td></tr><tr><td colspan="2">Allowable leak current at OFF</td><td>-</td><td>0.5 mA</td></tr></table></td></tr>
<tr><td>[PLC]</td><td>Programmable controller signal power source</td><td>(1) The terminal is used for connecting the output signal power source of the programmable controller (rated voltage DC +24 V (power supply voltage fluctuation range: DC +22 to +27 V) maximum 100 mA).
(2) The terminal can also be used for the power source for the load connected to the transistor output. For details, refer to the page on transistor output.</td></tr>
</table>

Table 2.2-12 Functional Description of Control Circuit Terminals (continued)

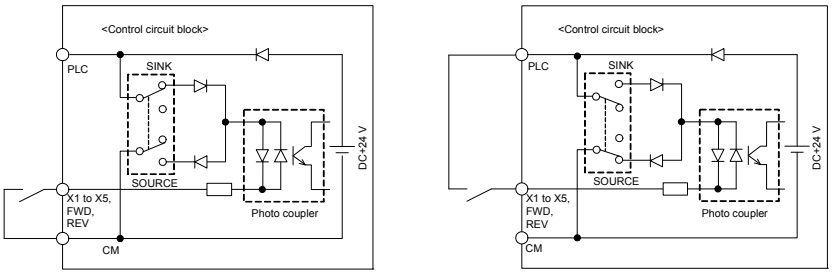
Classification	Terminal symbol	Terminal name	Functional description
Digital Input	[CM]	Digital common	This terminal is the common terminal for digital input signals. This terminal is insulated against terminals [11] and [CMY].

Tip

■ When turning terminals [FWD], [REV], [X1] to [X5] ON and OFF using relay contacts

Figure 2.2-11 shows an example of the circuit configuration using relay contact. Circuit (a) in Figure 2.2-11 shows the switch on the sink side and circuit (b) shows the switch on the source side.

Caution: Use a relay which will not have contact failures (high contact reliability).
(Recommended product: Fuji Electric's control relay type: HH54PW)



(a) Switch on sink side (b) Switch on source side

Figure 2.2-11 Circuit Configuration Example Using Relay Contact

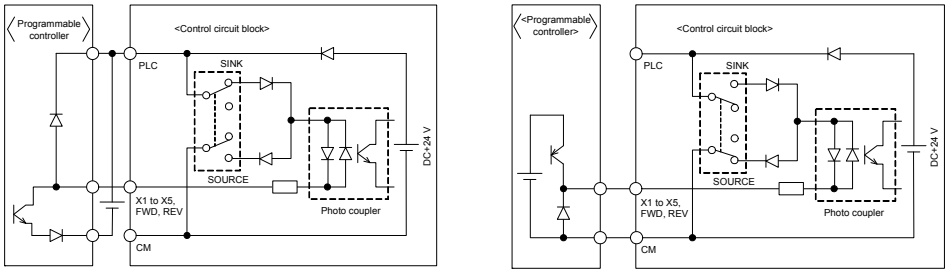
Tip

■ When turning terminals [FWD], [REV], [X1] to [X5] ON and OFF using the programmable controller

Figure 2.2-12 shows an example of the circuit configuration using programmable controller. Circuit (a) in Figure 2.2-12 shows the switch (SW1) on the sink side and circuit (b) shows the switch on the source side.

In circuit (a), terminals [FWD], [REV] , [X1] to [X5] can be turned ON/OFF by shorting/opening the open collector transistor output of the programmable controller using the external power supply. Follow the commands below when using this type of circuit.

- Connect the + side of the external power supply which is insulated from the programmable controller power supply to terminal [PLC].
- Do not connect the inverter's [CM] terminal and the common terminal of the programmable controller.

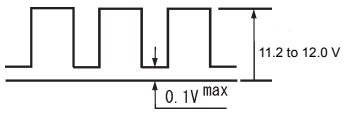


(a) Switch on the sink side (b) Switch on the source side

Figure 2.2-12 Circuit Configuration Example Using Programmable Controller

Refer to "2.2.8 Operating various switches" for more information on switches.

Table 2.2-12 Functional Description of Control Circuit Terminals (continued)

<table>
<tr><th>Classification</th><th>Terminal symbol</th><th>Terminal name</th><th>Functional description</th></tr>
<tr><td rowspan="4">Analog output/pulse output</td><td rowspan="3">[FM]</td><td>Analog monitor
FMV function
FMI function</td><td>The terminal outputs analog direct current voltage DC0 to 10 V or analog direct current/ DC4 to 20 mA monitor signal. The output form (FMV/FMI) can be switched using SW5 on the printed circuit board and function code F29. Refer to “Table 2.2-13 Functional Description of Various Switches”.
The signal content can be chosen in the function code F31 data setting among the following items.
・Output frequency (prior to slip compensation)
・Output frequency (after slip compensation)
・Output Current
・Output torque
・Load factor
・Power consumption
・Output voltage
・PID feedback value (PV)
・Direct current intermediate circuit voltage
・Universal AO
・Motor output
・Analog output test
・PID command value (SV)
・PID output (MV)
・Customized logic output 1 to 5
・Inverter cooling fin temperature
* Allowable impedance for connection: Min 5 kΩ (at DC to 10 V output) (up to 2 analog volt meters (DC0 to 10 V, input impedance 10 kΩ) can be connected.)
* Allowable impedance for connection: Max 500 Ω (at DC4 to 20 mA/DC0 to 20 mA) (in the case of output)
* Gain adjustable range: 0 to 300%</td></tr>
<tr><td>Pulse monitor
FMP function</td><td>The terminal outputs pulse signal. Signal content can be chosen as with the FMV function by function code F31 setting. The output form (FMP) can be switched using SW5 on the printed circuit board and function code F29. Refer to “Table 2.2-13 Functional Description of Various Switches”.
* Allowable impedance for connection: Min. 5 kΩ (at DC to 10 V output) (up to 2 analog volt meters (DC0 to 10 V, input impedance 10 kΩ) can be connected.)
* Pulse duty: Approximately 50%, pulse rate: 25 to 32000 p/s (at full scale)
• Pulse output waveform
 

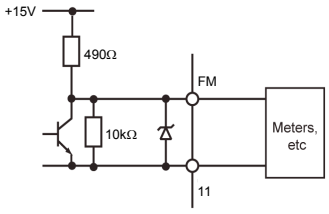
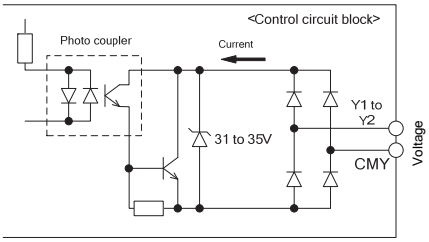
• FMP output circuit
 
</td></tr>
<tr><td>[FM2]</td><td>Analog monitor
FMV2 function
FMI2 function</td><td>The terminal outputs analog direct current voltage DC0 to 10 V or analog direct current DC4 to 20 mA monitor signal. The output form (FMV2/FMI2) can be switched using SW7 on the printed circuit board and function code F32. Refer to “Table 2.2-13 Functional Description of Various Switches”.
Signal content can be chosen as with the FMV function by function code F35 setting.
* Allowable impedance for connection: Min 5 kΩ (at DC to 10 V output)
(up to 2 analog volt meters (D0 to 10 V, input impedance 10 kΩ) can be connected.)
* Allowable impedance for connection: Max 500 Ω (at DC4 to 20 mA)
* Gain adjustable range: 0 to 300%
* This terminal is equipped only on FRN○○○E2S-4C.</td></tr>
<tr><td>[11]</td><td>Analog output common terminal</td><td>This terminal is the common terminal for analog input/pulse output signals. The terminal is insulated against terminals [CM] and [CMY]. Do not use them as common terminal for [FM], [FM2].</td></tr>
</table>

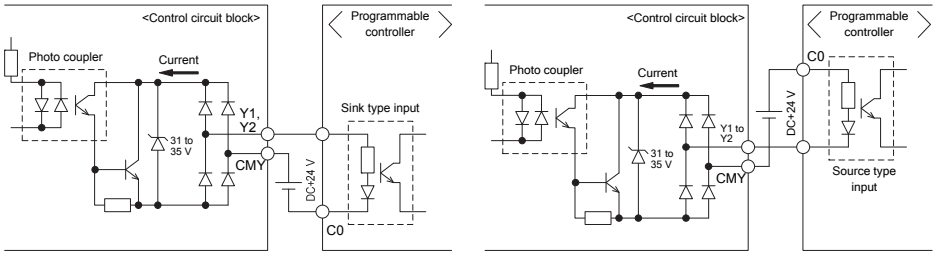
Table 2.2-12 Functional Description of Control Circuit Terminals (continued)

<table>
<tr><th>Classification</th><th>Terminal symbol</th><th>Terminal name</th><th>Functional description</th></tr>
<tr><td rowspan="3">Transistor output</td><td>[Y1]
[Y2]</td><td>Transistor output 1
Transistor output 2</td><td>(1) Various signals (running signal, frequency reached signal, overload forecast signal, etc) set up by function code E20, E21 can be output. For details, refer to “Chapter 5 Function Codes”.
(2) The operating mode between transistor output terminals [Y1], [Y2] and terminal CMY can be switched to “ON (active ON) at signal output” or “OFF (active OFF) at signal output”.

<Transistor output circuit specification>
 

<table>
<tr><th colspan="2">Item</th><th>Maximum</th></tr>
<tr><td rowspan="2">Operating voltage</td><td>ON level</td><td>3 V</td></tr>
<tr><td>OFF level</td><td>27 V</td></tr>
<tr><td colspan="2">Max load current at ON</td><td>50 mA</td></tr>
<tr><td colspan="2">Leak current at OFF</td><td>0.1 mA</td></tr>
</table>
Figure 2.2-13 Transistor Output Circuit

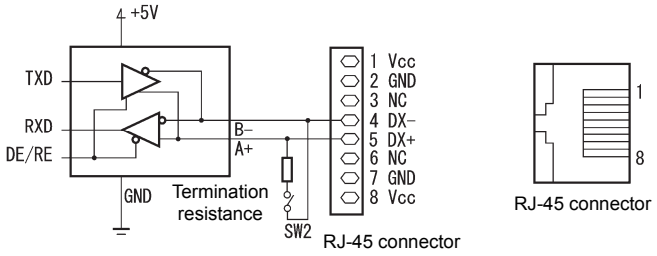
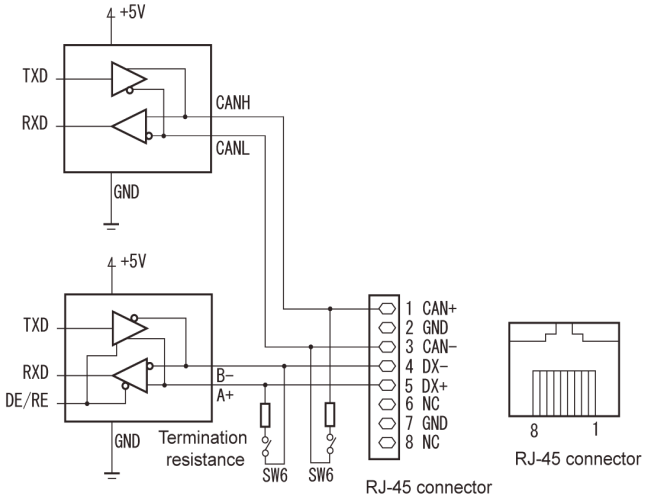
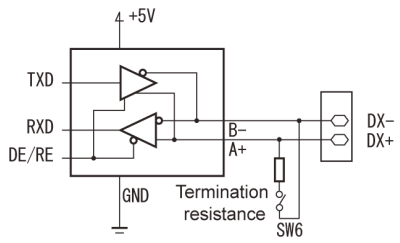
Note
• Connect surge absorbing diode on both ends of the excitation coil when connecting control relays.
• When a power source is needed for the circuit to be connected, terminal PLC can be used as a power source terminal (DC24 V (power supply voltage fluctuation range: DC22 to 27 V), maximum 50 mA). In this case, terminal [CMY] must be shorted to terminal [CM].</td></tr>
<tr><td>[CMY]</td><td>Transistor output common</td><td>This terminal is the common terminal for transistor output signals.
This terminal is insulated against terminals [CM] and [11].</td></tr>
<tr><td colspan="3">Tip
■ When connecting the programmable controller to terminals [Y1], [Y2].
The circuit configuration example for connecting the inverter transistor output to the programmable controller is shown in Figure 2.2-14. Circuit (a) in figure 2.2-14 shows the programmable controller input circuit as sink input and circuit (b) shows as the source input case.

(a) Connection diagram for sink input type programmable controller
(b) Connection diagram for source input type programmable controller

Figure 2.2-14 Example of Connection Circuit Configuration with Programmable Controller</td></tr>
<tr><td>Contact output</td><td>[30A/B/C]</td><td>Integrated alarm output</td><td>(1) When the inverter stops with an alarm, output is generated on the relay contact (1C). Contact capacitance: AC250 V 0.3 A cosϕ = 0.3, DC48 V 0.5 A
(2) Terminals can be switched to “Terminals [30A to 30C] shorted (excitation: active ON) at ON signal output” or “Terminals [30A to 30C] open (non-excitation: active OFF) at ON signal output”</td></tr>
</table>

Table 2.2-12 Functional Description of Control Circuit Terminals (continued)

Classification	Terminal symbol	Terminal name	Functional description
Communication	RJ-45 connector for keypad connection	RJ-45 connector for keypad connection RS-485 communication port 1	(1) The terminal is used as a connector to connect the keypad. The power to the keypad will be supplied from the inverter via the extended cable for remote operation. (2) The terminal is a connector to connect the computer, programmable controller, etc by RS-485 communication, after removing the keypad. (On termination resistance, refer to “2.2.8 Operating Various Switches”).  Figure 2.2-15 RJ-45 Connector Pin-layout • Pins 1, 2, 7, and 8 are assigned as power supply source for the keypad. When connecting this RJ-45 connector to other instruments, do not use these pins.
	RJ-45 connector for RS-485 /CANopen communica-tion	RS-485 communication port 2 CANopen communication port	(1) The terminal is a connector to connect the computer, programmable controller, etc by RS-485 communication. (On termination resistance, refer to “2.2.8 Operating Various Switches”). (2) The terminal is a connector to connect the computer, programmable controller, etc by CANopen communication. (On termination resistance, refer to “2.2.8 Operating Various Switches”).  Figure 2.2-16 RJ-45 Connector Pin-layout * The terminal is used on the models with the destination codes -A, -E, -T and -K.
	DX+ /DX- /SD]	RS-485 Communication Port 2 (terminal block)	The terminal is an I/O terminal to connect the computer, programmable controller, etc by RS-485 communication. (On termination resistance, refer to “2.2.8 Operating Various Switches”)  Figure 2.2-17 RS-485 Communication Port 2 Terminal Block Pin-layout * The terminal is used only on the models with the destination code -C..

2.2.7 Switching connector

■ Position of each connector

The individual switching connectors are positioned on the power supply printed circuit board as shown in the figure below.

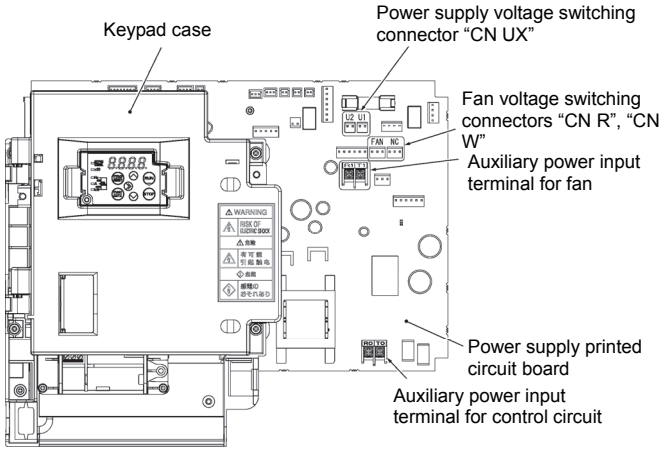


Figure 2.2-18 Switching Connector Positions

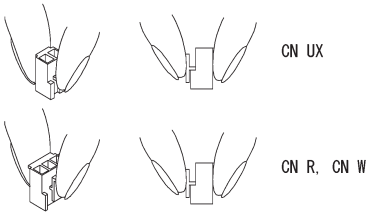


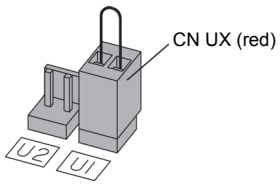
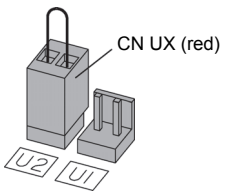
Figure 2.2-19 Attachment and Removal of the Switching Connector

Note When removing the individual connectors, pinch the upper portion of the connector with the fingers, unlock the fastener, and pull. When inserting the connector, push in until the fastener lock engages with the receiving end with a click.

■ Power supply switching connector “CN UX”（FRN0203E2S-4□）

The power supply switching connector “CN UX” is equipped on FRN0203E2S-4□. When the power supply connecting to the main power supply input terminals (L1/R, L2/S, L3/T) or the auxiliary power input terminals for the fan (R1, T1) meets the following requirements, move the connector CN UX to U2 side. Otherwise, leave it on the U1 side, which is the factory default.

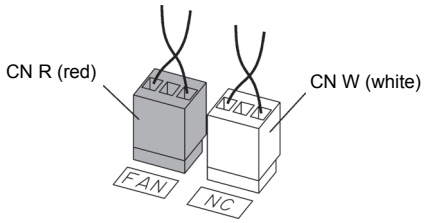
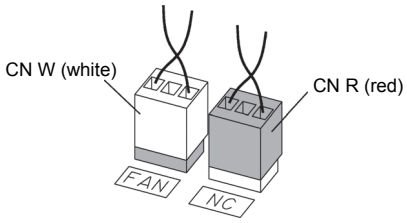
For details on the switching procedure, refer to “Figure 2.2-18 Switching Connector Positions” and “Figure 2.2-19 Attachment and Removal of the Switching Connector”.

Setting		
Applicable voltage	398 to 440 V/50 Hz, 430 to 480 V/60 Hz (Factory default)	380 to 398V/50 Hz, 380 to 430 V/60 Hz

■ Fan power source switching connector “CN R”, “CN W” (models larger than FRN0203E2S-4□)

FRENIC-Ace supports direct current power supply input with PWM converters in the standard specification. However, FRN0203E2S-4□ contains parts which are driven by AC power supply such as the AC fan, so AC power must also be supplied. When using DC power for the inverter, move connector “CN R” to NC side, move connector “CN W” to FAN side, and connect an AC power source to the auxiliary power input terminals for the fan (R1, T1).

For details on the switching procedure, refer to “Figure 2.2-18 Switching Connector Positions” and “Figure 2.2-19 Attachment and Removal of the Switching Connector”.

Setting		
Purpose	In the case terminals R1 and T1 are NOT used (Factory default)	In the case terminals R1 and T1 are used • DC bus input type • Combination with PWM converter

Note The fan power source switching connector “CN R” is on FAN and “CN W” is on NC when shipped from the factory. When direct current power supply input is not used, do not alter the setting.

Mistakes in the fan power source switching connector setting may prevent the cooling fan from operating, and alarms such as cooling fin overheat $\mathcal{OH}$ 1 and charging circuit error $\mathcal{PbF}$ may be generated.

2.2.8 Operating various switches

⚠WARNING ⚠

Operation of the various switches should be conducted **after more than 5 minutes has elapsed** since power is shut off **for types smaller than FRN0072E2S-4□** and **after more than 10 minutes has elapsed for types larger than FRN0085E2S-4□.** Confirm that the LED monitor and the charge lamp are turned off, and that the direct current intermediate circuit voltage between the main circuit terminals P(+)-N(-) is below the safe voltage (below DC+25 V) with the tester before operating the switches.

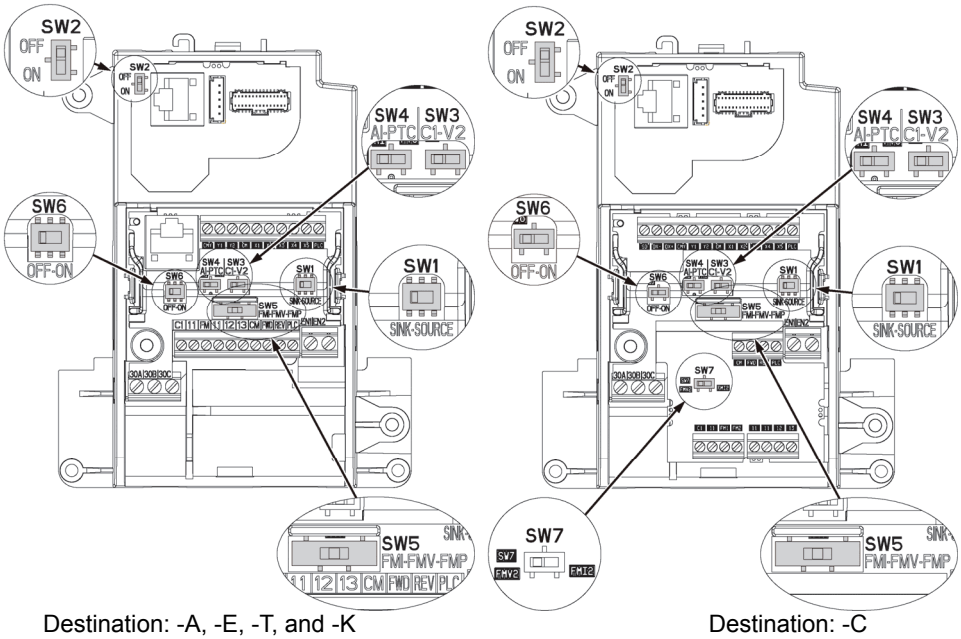
Risk of electric shock exists.

The I/O terminal specification can be changed, such as switching the analog output form, by operating the various slide switches on the printed circuit board (figure 2.2-20 Various Switch Positions on the Control Printed Circuit Board).

To operate the various slide switches, remove the front cover and make the control printed circuit board visible. (For types larger than FRN0085E2S-4□, also open the keypad case).

Refer to “2.2.2 Removal and attachment of the front cover and wiring guide” to remove the front cover and to open/close the keypad case.

The various switch positions on the control printed circuit board are shown below.



Destination: -A, -E, -T, and -K

Destination: -C

Figure 2.2-20 Various Switch Positions on the Control Printed Circuit Board

	SW1	SW2	SW3	SW4	SW5	SW6	SW7 -C only
Factory default Destination: -E	SOURCE	OFF	C1	AI	FMV	OFF	—
Factory default Destination: -A ,-C,-T, and -K	SINK	OFF	C1	AI	FMV	OFF	FMV2
—	SOURCE	ON	V2	PTC	FMI FMP	ON	FMI2

Note Use pointed devices (such as tweezers) to operate the switches. Avoid touching other electronic parts when moving the switches. The switch will be at open state when the slider is in the middle, so make sure to push the slider to the ends.

Functional description of the various switches is shown in Table 2.2-13 Functional Description of Various Switches.

Table 2.2-13 Functional Description of Various Switches

<table>
<tr><th>Switch symbol</th><th>Functional description</th></tr>
<tr><td>SW1</td><td><Switch to change sink/source setting of digital input terminals>
• This switch determines the type of input (sink or source) to use for digital input terminals [X1] to [X5], FWD, and REV.</td></tr>
<tr><td>SW2</td><td><Switch to change the RS-485 communication termination resistance (RS-485 communication port (on the control PCB))>
• Move to the ON side when RS-485 communication is used and this inverter is connected to the termination.</td></tr>
<tr><td>SW3
SW4</td><td><Switch to change terminal [C1] input setting to current/voltage/PTC thermistor>
This switch changes the input type for terminal [C1].
<table>
<tr><th>Input type</th><th>SW3</th><th>SW4</th><th>E59</th><th>H26</th></tr>
<tr><td>Current input (factory default)</td><td>C1 side</td><td>AI side</td><td>0</td><td>0</td></tr>
<tr><td>Voltage input</td><td>V2 side</td><td>AI side</td><td>1</td><td>0</td></tr>
<tr><td>PTC thermistor input</td><td>C1 side</td><td>PTC side</td><td>0</td><td>1</td></tr>
</table></td></tr>
<tr><td>SW5</td><td><Switch to change terminal [FM] output setting to current/voltage/pulse>
This switch changes the output type for terminal [FM]. When operating this switch, also change function code F29.
<table>
<tr><th>Output type</th><th>SW5</th><th>F29</th></tr>
<tr><td>Current output</td><td>FMI side</td><td>1 or 2</td></tr>
<tr><td>Voltage output (factory default)</td><td>FMV side</td><td>0</td></tr>
<tr><td>Pulse output</td><td>FMP side</td><td>3</td></tr>
</table></td></tr>
<tr><td>SW6</td><td><Switch to change the RS-485 communication termination resistance (RS-485 communication port (on the terminal board))>
* In the case of Destination: -A, -E, -T and -K
・ Used for the RS-485/CANopen communication. Move the switch to the ON position when the inverter is connected to the terminal. They cannot be used simultaneously.
* In the case of Destination: -C
・ Used for the RS-485 communication. Move the switch to the ON position when the inverter is connected to the termination.</td></tr>
<tr><td>SW7</td><td><Switch to change terminal [FM2] output setting to voltage/current> The terminal is used only on the model with the destination code -C.
This switch changes the output type for terminal [FM2]. When operating this switch, also change function code F32.
<table>
<tr><th>Output type</th><th>SW7</th><th>F32</th></tr>
<tr><td>Voltage output</td><td>FMV2 side</td><td>0</td></tr>
<tr><td>Current output</td><td>FMI2 side</td><td>3</td></tr>
</table></td></tr>
</table>

Note Exercise caution as expected operation may not result if the setting above is not conducted accurately.

Chapter 3 OPERATION USING THE KEYPAD

Refer to the FRENIC-Ace User's Manual, Chapter 3 for details of the keypad.

3.1 Names and Functions of Keypad Components

The keypad allows you to run and stop the motor, display various data, configure function code data, and monitor I/O signal states, maintenance information and alarm information.

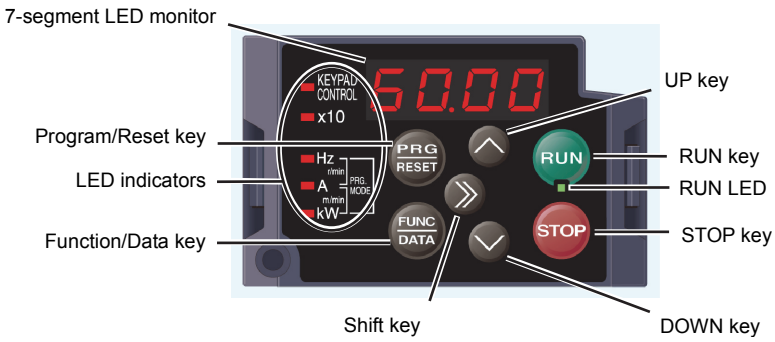


Table 3.1-1 Overview of Keypad Functions

Item	LED Monitor, Keys, and LED Indicators	Functions
LED Monitor	60.00	Four-digit, 7-segment LED monitor which displays the followings according to the operation modes. ■ In Running mode: Running status information (e.g., output frequency, current, and voltage) When a light alarm occurs, L-AL is displayed. ■ In Programming mode: Menus, function codes and their data ■ In Alarm mode: Alarm code, which identifies the alarm factor that has activated the protective function.
Operation Keys	PRG RESET	Program/Reset key which switches the operation modes of the inverter. ■ In Running mode: Pressing this key switches the inverter to Programming mode. ■ In Programming mode: Pressing this key switches the inverter to Running mode. ■ In Alarm mode: Pressing this key after removing the alarm factor resets the alarm and switches back to Running mode.
	FUNC DATA	Function/Data key which switches the operations you want to do in each mode as follows: ■ In Running mode: Pressing this key switches the information to be displayed concerning the status of the inverter (output frequency (Hz), output current (A), output voltage (V), etc.). When a light alarm is displayed, holding down this key resets the light alarm and switches back to Running mode. ■ In Programming mode: Pressing this key displays the function code or establishes the data entered with ∧ and ∨ keys. ■ In Alarm mode: Pressing this key displays the details of the problem indicated by the alarm code that has come up on the LED monitor.
	RUN	RUN key. Press this key to run the motor.
	STOP	STOP key. Press this key to stop the motor.
	∧ and ∨	UP and DOWN keys. Press these keys to select the setting items and change the function code data displayed on the LED monitor.
	»	Shift key. Press this key to shift the cursor to the right for entry of a numerical value.

Table 3.1-1 Overview of Keypad Functions (continued)

Item	LED Monitor, Keys, and LED Indicators	Functions
LED Indicators	RUN LED	Lights when running with a run command entered by the (RUN) key, by terminal command ***FWD*** or ***REV***, or through the communications link.
	KEYPAD CONTROL LED	Lights when the inverter is ready to run with a run command entered by the (RUN) key (F02 = 0, 2, or 3). In Programming and Alarm modes, however, pressing the (RUN) key cannot run the inverter even if this indicator lights.
	Unit LEDs (3 LEDs)	These three LED indicators identify the unit of numeral displayed on the LED monitor in Running mode by combination of lit and unlit states of them. Unit: Hz, A, kW, r/min and m/min Refer to User's Manual, Section 3.3.1 "Monitoring the running status" for details.
		While the inverter is in Programming mode, the LEDs of Hz and kW light. ■Hz □A ■kW
	x10 LED	Lights when the data to display exceeds 9999. When this LED lights, the "displayed value x 10" is the actual value. Example: If data is "12,345," the LED monitor displays 1234 and the x10 LED lights, meaning that "1,234 × 10 = 12,340."

■ LED monitor

In Running mode, the LED monitor displays running status information (output frequency, current or voltage); in Programming mode, it displays menus, function codes and their data; and in Alarm mode, it displays an alarm code which identifies the alarm factor that has activated the protective function.

If one of LED4 through LED1 is blinking, it means that the cursor is at this digit, allowing you to change it.

If the decimal point of LED1 is blinking, it means that the currently displayed data is a value of the PID command, not the frequency data usually displayed.

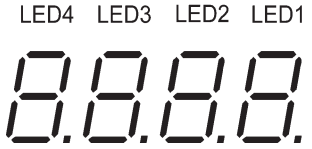


Figure 3.1-1 7-Segment LED Monitor

Table 3.1-2 Alphanumeric Characters on the LED Monitor

Character	7-segment	Character	7-segment	Character	7-segment	Character	7-segment
0	0	9	9	i	ı	r	r
1	1	A	A	J	J	S	5
2	2	b	b	K	K	T	t
3	3	C	C	L	L	u	u
4	4	d	d	M	n	V	U
5	5	E	E	n	n	W	W
6	6	F	F	o	o	X	X
7	7	G	G	P	P	y	y
8	8	H	H	q	q	Z	Z
Special characters and symbols (numbers with decimal point, minus and underscore)							
0. - 9.	0. - 9.	-	-	_	_		

3.2 Overview of Operation Modes

The FRENIC-Ace features the following three operation modes.

Table 3.2-1 Operation Modes

Operation mode	Description
Running mode	When powered ON, the inverter automatically enters this mode. This mode allows you to specify the reference frequency, PID command value and etc., and run/stop the motor with the (RUN) / (STOP) keys. It is also possible to monitor the running status in real time. If a light alarm occurs, the L-AL appears on the LED monitor.
Programming mode	This mode allows you to configure function code data and check a variety of information relating to the inverter status and maintenance.
Alarm mode	If an alarm condition arises, the inverter automatically enters Alarm mode in which you can view the corresponding alarm code* and its related information on the LED monitor. * Alarm code: Indicates the cause of the alarm condition. For details, first see Table 6.1 "Abnormal States Detectable ("Heavy Alarm" and "Light Alarm" Objects)" in Chapter 6, Section 6.1 "Protective Function," and then read the troubleshooting of each alarm.

Figure 3.2-1 shows the status transition of the inverter between these three operation modes.

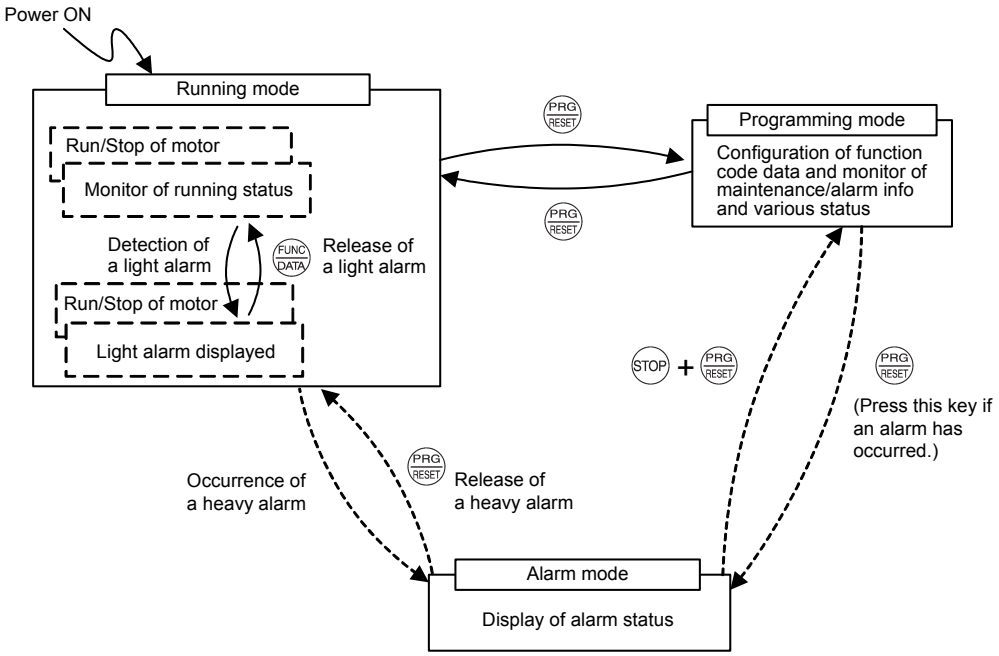


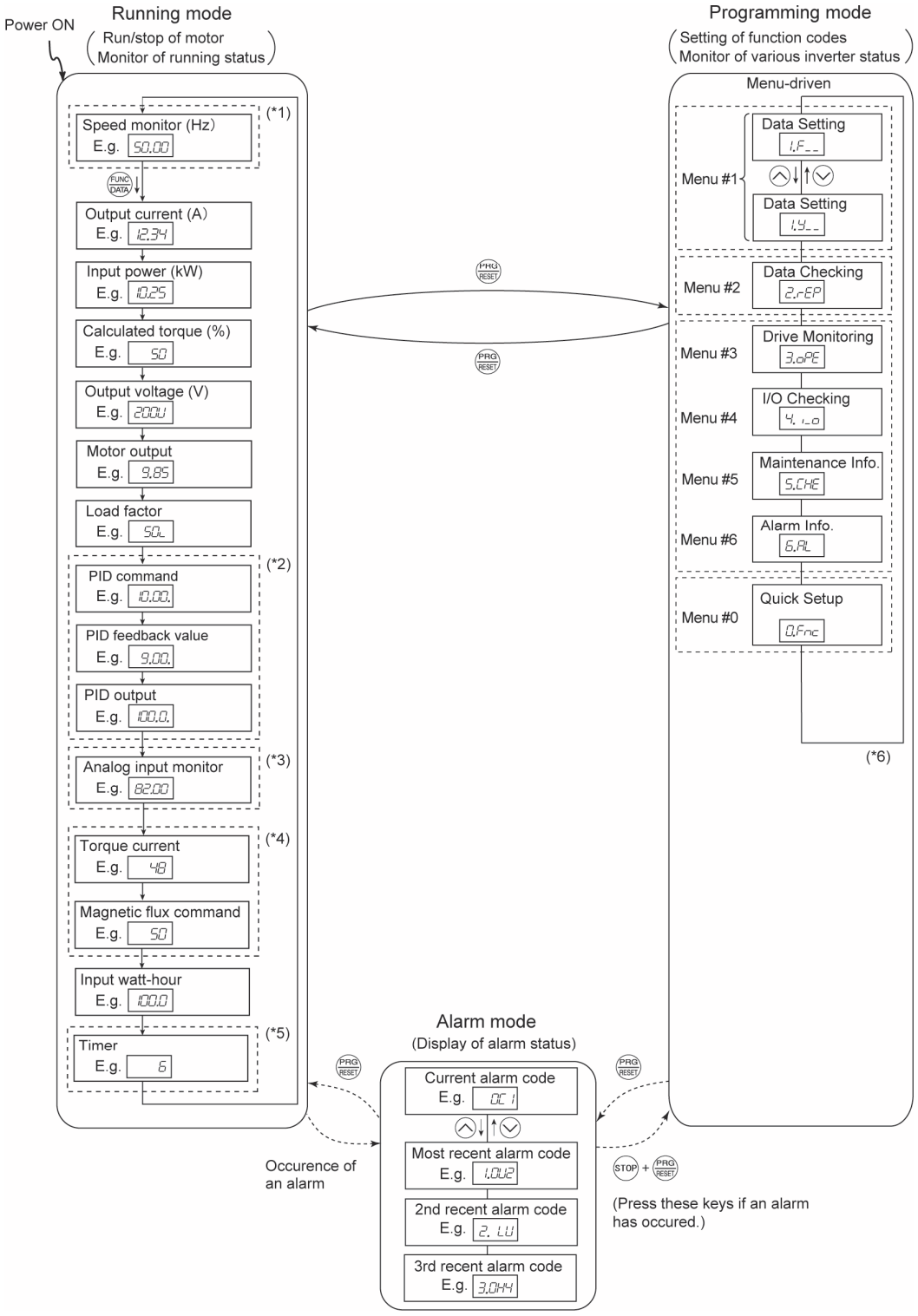
Figure 3.2-1 Status Transition between Operation Modes

Simultaneous keying

Simultaneous keying means pressing two keys at the same time. The simultaneous keying operation is expressed by a "+" letter between the keys throughout this manual.

For example, the expression "(STOP) + (PRG RESET) keys" stands for pressing the (PRG RESET) key with the (STOP) key held down.

Figure 3.2-2 illustrates the transition of the LED monitor screen during Running mode, the transition between menu items in Programming mode, and the transition between alarm codes at different occurrences in Alarm mode.



(*1) The speed monitor allows you to select the desired one from the speed monitor items by using function code E48.

(*2) Applicable only when PID control is active (J01 = 1, 2 or 3).

(*3) The analog input monitor can appear only when the analog input monitor function is assigned to one of the analog input terminals by one of function codes E61 to E63 (= 20).

(*4) 7 appears under the V/f control.

(*5) The Timer screen appears only when the timer operation is enabled with function code C21 (C21 = 1).

(*6) Applicable only when the full-menu mode is selected (E52 = 2).

Figure 3.2-2 Transition between Basic Screens in Individual Operation Mode

Chapter 4 TEST RUN PROCEDURE

4.1 Test Run Procedure Flowchart

Make a test run of the motor using the flowchart given below.

This chapter describes the test run procedure with motor 1 dedicated function codes that are marked with an asterisk (*). For motor 2, replace those asterisked function codes with motor 2 dedicated ones.

For the function codes dedicated to motor 2, see Chapter 5 "FUNCTION CODES."

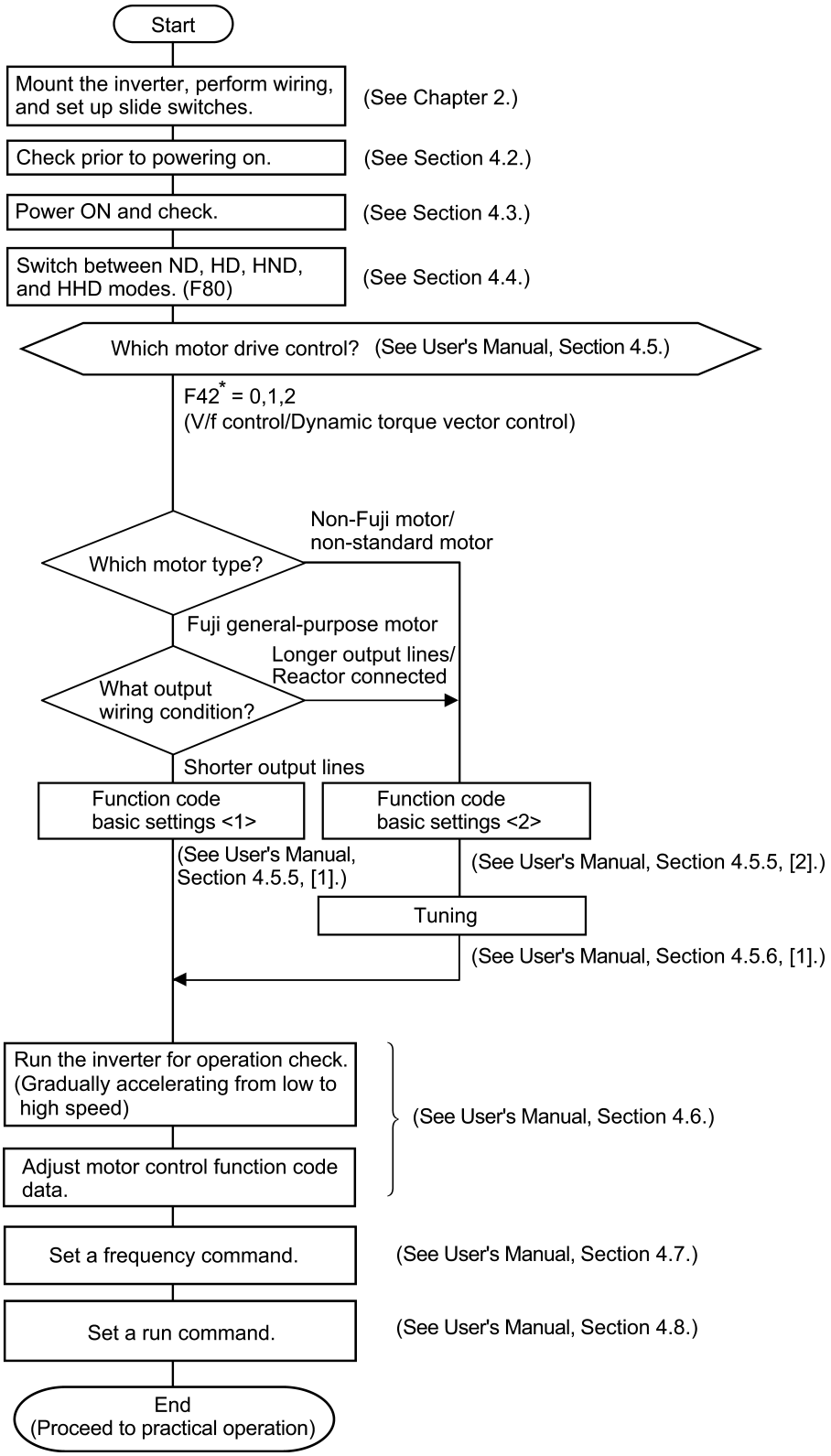


Figure 4.1-1 Test Run Procedure

4.2 Checking Prior to Powering On

Check the following before powering on the inverter.

(1) Check that the wiring is correct.
Especially check the wiring to the inverter input terminals L1/R, L2/S and L3/T and output terminals U, V, and W. Also check that the grounding wires are connected to the grounding terminals (⏚G) correctly. See Figure 4.2-1.

⚠WARNING

- Never connect power supply wires to the inverter output terminals U, V, and W. Doing so and turning the power ON breaks the inverter.
- Be sure to connect the grounding wires of the inverter and the motor to the ground electrodes.

Otherwise, an electric shock could occur.

(2) Check the control circuit terminals and main circuit terminals for short circuits or ground faults.

(3) Check for loose terminals, connectors and screws.

(4) Check that the motor is separated from mechanical equipment.

(5) Make sure that all switches of devices connected to the inverter are turned OFF. Powering on the inverter with any of those switches being ON may cause an unexpected motor operation.

(6) Check that safety measures are taken against runaway of the equipment, e.g., a defense to prevent people from access to the equipment.

(7) Check that a power factor correction DC reactor (DCR) is connected to the DC reactor terminals P1 and P(+). (ND-mode inverters of FRN0139E2S-4☐ or above, HD-/HND-mode ones of FRN0168E2S-4☐ or above, and HHD-mode ones of FRN0203E2S-4☐ or above are provided together with a DCR as standard. Be sure to connect the DCR to the inverter.)

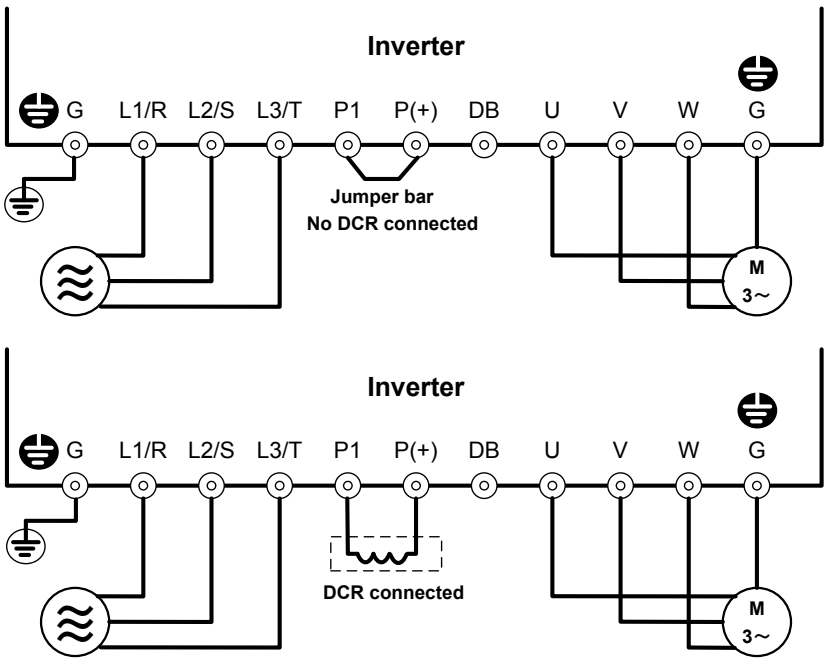


Figure 4.2-1 Connection of Main Circuit Terminals

4.3 Powering ON and Checking

⚠WARNING

- Be sure to mount the front cover before turning the power ON. Do not remove the cover when the inverter power is ON.
- Do not operate switches with wet hands.

Otherwise, an electric shock could occur.

Turn the power ON and check the following points. The following is a case when no function code data is changed from the factory defaults.

(1) Check that the LED monitor displays 0.00 (indicating that the reference frequency is 0 Hz) that is blinking. (See Figure 4.3-1.)

(2) Check that the built-in cooling fans rotate.

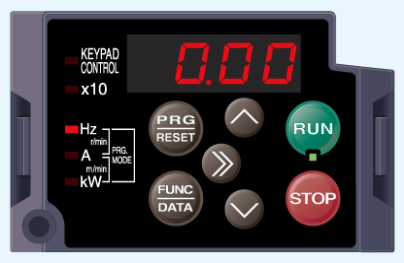


Figure 4.3-1 Display of the LED Monitor after Power-on

4.4 Switching the Applicable Motor Rank (ND, HD, HND and HHD Modes)

Changing the data of function code F80 switches the applicable motor rank to match load conditions. In HD, HND or HHD mode, the inverter drives a motor whose capacity is one or two ranks lower than the inverter's one.

F80 data	Drive mode	Application	Applicable motor	Overload capability	Maximum frequency	Operating temperature	Application samples
4	ND mode	General load	Motor whose capacity is the same as the inverter's one.	120% for 1 min.	120 Hz	40°C	Fan, pump, blower, compressor, etc.
3	HD mode	Heavy duty load	Motor whose capacity is one rank lower than the inverter's one.	150% for 1 min.	120 Hz	40°C	Wire drawing machine, winding machine, twisting machine, spinning frame, etc.
1	HND mode	General load	Motor whose capacity is one rank lower than the inverter's one.	120% for 1 min.	120 Hz	50°C	Fan, pump, blower, compressor, etc.
0	HHD mode	Heavy duty load	Motor whose capacity is two ranks lower than the inverter's one.	150% for 1 min. 200% for 0.5 s.	500 Hz	50°C	Wire drawing machine, winding machine, twisting machine, spinning frame, hoist, machine tool, etc.

The HD-/HND-/HHD-mode inverter brings out the continuous rated current level which enables the inverter to drive a motor with one or two ranks lower capacity, but its overload capability (%) against the continuous current level or the operating temperature increases. For details, see the User's Manual, Chapter 8 "BLOCK DIAGRAMS FOR CONTROL LOGIC."

The inverter is subject to restrictions on the function code data setting range and internal processing as listed below.

Function codes	Name	ND mode	HD mode	HND mode	HHD mode	Remarks
F21*	DC braking (Braking level)	Setting range: 0 to 60%	Setting range: 0 to 80%		Setting range: 0 to 100%	In the ND/HD/HND mode, a value out of the range, if specified, automatically changes to the maximum value allowable in the ND/HD/HND mode.
F26	Motor sound (Carrier frequency)	Setting range: 0.75～10kHz (FRN0059E2S-4□) 0.75～6kHz (FRN0072E2S-4□ ～ FRN0203E2S-4□)	Setting range: 0.75～16kHz (FRN0059E2S-4□) 0.75～10kHz (FRN0072E2S-4□～ FRN0168E2S-4□) 0.75～6kHz (FRN0203E2S-4□)		Setting range: 0.75～16kHz (FRN0059E2S-4□ ～ FRN0168E2S-4□) 0.75～10kHz (FRN0203E2S-4□)	
F44	Current limiter (Level)	Initial value: 130%	Initial value: 160%	Initial value: 130%	Initial value: 160%	Switching the drive mode with function code F80 automatically initializes the F44 data to the value specified at left.
F03*	Maximum frequency	Upper limit: 120 Hz	Setting range: 25 to 500 Hz Upper limit: 500 Hz			In the ND/HD/HND mode, if the maximum frequency exceeds 120 Hz, the actual output frequency is internally limited to 120 Hz.
—	Current indication and output	Based on the rated current level for ND mode	Based on the rated current level for HD mode	Based on the rated current level for HND mode	Based on the rated current level for HHD mode	—

Switching between the drive modes does not automatically change the motor rated capacity (P02*) to the one suitable for the rank-changed motor, so configure the P02* data to match the applied motor rating as required.

Chapter 5 FUNCTION CODES

5.1 Function Code Overview

Function code is used for selecting various functions of FRENIC-Ace. Function code comprises 3 digits or 4 digits of alphanumeric character. The first digit categorizes the group of function code alphabetically and the subsequent 2 or 3 digits identify each code within the group by number. Function code comprises 11 groups: Basic function (F code), Terminal function (E code), Control code (C code), Motor 1 parameter (P code), High-level function (H code) (H1 code), Motor 2 parameter (A code), Application function 1 (J code) (J1 code), Application function 2 (d code), Customizable logic (U code) (U1 code), Link function (y code), Keypad functions (k code), and Option function (o code) . The function of each function code is determined according to the data to be set. The following descriptions are for supplementary explanation of function code table. Refer to instruction manual of each option to find the details of the option function (o code).

5.2 Function Code Table

5.2.1 Supplementary note

■ Change, reflect, and save function code data during operation

Function code is categorized into those which data change is enabled during operation of the inverter and those which such change is disabled. The meaning of the code in the "Change during operation" column of the function code table is described in the following table.

Code	Change during operation	Reflect and save data
⊙	Allowed	At the point when data is changed by ▲/▼ key, the changed data is immediately reflected on the operation of inverter. However, at this stage, the changed value is not saved to the inverter. In order to save it to the inverter, press FUNC/DATA key. Without saving by FUNC/DATA key and leaving the state of when the change was made by the PRG/RESET key, the data before the change is reflected on the operation of inverter.
○	Allowed	Even if data is changed by the ▲/▼ key, the changed data will not be reflected on the operation of the inverter as is; by pressing the FUNC/DATA key, the changed value is reflected on the operation of the inverter and is also saved to the inverter.
x	Not allowed	-

■ Copying data

Function code data can be copied collectively by using the keypad (program mode menu number 7 " Data copy"). By using this function, it is possible to read out all function code data and write the same data to a different inverter.

However, if the specification of inverter at the copy source and copy destination is not identical, some function codes may not be copied due to security reason. According to necessity, configure the settings individually for the function code that is not to be copied. The code to categorize these codes is indicated in the "data copy" column in the function code table in the next page and after.

○: to be copied.

△1: When inverter capacity is different, copying will not be performed.

△2: When voltage group is different, copying will not be performed.

×: not to be copied.

■ Negative logic setting of data

Digital input terminal and transistor/contact output terminal can become a signal for which negative logic is specified by function code data setting. Negative logic is a function to reverse ON and OFF state of input or output, and switch Active ON (function enabled with ON: positive logic) and Active OFF (function enabled with OFF: negative logic). However, negative logic may not be enabled depending on the function of the signal.

Negative logic signal can be switched by setting the data with 1000 added to the function code data of the function to be set. For example, the following example shows when coast to a stop command "BX" is selected by function code E01.

Function code data	Action
7	"BX" is ON and coast to a stop (Active ON)
1007	"BX" is OFF and coast to a stop (Active OFF)

■ Details of function codes

For details of function codes, refer to the User's Manual, Chapter 5.

5.2.2 Function code table

The table of function code to be used in FRENIC-Ace is shown.

■ F code: Fundamental Functions (Basic function)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
F00	Data protection	0: No data protection, no digital setting protection 1: With data protection, no digital setting protection 2: No data protection, with digital setting protection 3: With data protection, with digital setting protection	○	○	0
F01	Frequency setting 1	0: Keypad key operation (△/▽key) 1: Analog voltage input (Terminal [12]) (from 0 to ±10 VDC) 2: Analog current input (Terminal [C1] (C1 function)) (4 to 20mA DC) 3: Analog voltage input (Terminal [12]) + Analog current input (Terminal [C1] (C1 function)) 5: Analog voltage input (Terminal [C1] (V2 function)) (0 to 10 VDC) 7: UP/DOWN control 8: Keypad key operation (△/▽key) (With balances bumpless) 10: Pattern operation 12: Pulse train input	x	○	0
F02	Operation	0: Keypad operation (rotation direction input: terminal block) 1: External signal (digital input) 2: Keypad operation (forward rotation) 3: Keypad operation (Reverse rotation)	x	○	2
F03	Maximum output frequency 1	25.0 to 500.0 Hz	x	○	CE:50.0, TJK:60.0 A: 200V class 60.0 A: 400V class 50.0
F04	Base frequency 1	25.0 to 500.0Hz	x	○	CEJKT:50.0, A: 200 V class 60.0 A: 400 V class 50.0
F05	Base frequency voltage 1	0: AVR disable (output voltage proportional to power voltage) 80 to 240 V: AVR operation (200V class) 160 to 500V: AVR operation (400V class)	x	△2:	TJK:200/400 A:220/415 C:200/380 E:230/400
F06	Maximum output voltage 1	80 to 240V: AVR operation (200V class) 160 to 500V: AVR operation (400V class)	x	△2:	
F07	Acceleration time1	0.00 to 6000 s * 0.00 is for acceleration and deceleration time cancel (when performing soft-start and stop externally)	○	○	20.0
F08	Deceleration time1		○	○	
F09	Torque boost 1	0.0 to 20.0% (% value against base frequency voltage 1)	○	○	*2
F10	Electronic thermal 1 (for motor protection) (Characteristics selection)	1: Enable (For a general-purpose motor with self-cooling fan) 2: Enable (For an inverter-driven motor (FV) with separately powered cooling fan)	○	○	1
F11	(Operation level)	0.00 (disable), current value of 1 to 135% of inverter rated current (Inverter rated current dependent on F80)	○	△1△2	*3
F12	(Thermal time constant)	0.5 to 75.0 min	○	○	*4
F14	Momentary power failure restart (Mode selection)	0: Immediately trip 1: Trip at auto-restarting 2: Trip after momentary deceleration is stopped 3: Continue to run (for heavy inertia load or general load) 4: Restart from frequency at power failure (for general load) 5: Restart from starting frequency	○	○	E:0 ACTJK:1
F15	Frequency Limiter (upper limit)	0.0 to 500.0Hz	○	○	70.0
F16	(Lower limit)	0.0 to 500.0Hz	○	○	0.0
F18	Bias (for frequency setting 1)	-100.00 to 100.00%	⊙	○	0.00
F20	DC braking 1 (Braking starting frequency)	0.0 to 60.0Hz	○	○	0.0
F21	(Operation level)	0 to 100% (HHD mode), 0 to 80% (HD/HND mode) 0 to 60% (ND mode)	○	○	0
F22	(Braking time)	0.00 (Disable): 0.01 to 30.00 s	○	○	0.00
F23	Starting Frequency 1	0.0 to 60.0Hz	○	○	0.5
F24	(Holding time)	0.00 to 10.00 s	○	○	0.00
F25	Stop Frequency	0.0 to 60.0 Hz	○	○	0.2

Factory default•••A (For Asia), C (for China), E (for Europe), T (For Taiwan), J (for Japan), K (for Korea)

indicates quick setup target function code.

*2 Standard value is set per capacitance. Refer to table A.

*3 Rated current of the motor is set. Refer to Table B (function code P03).

*4 Standard applicable electric motor is 5.0 min for 22 kw or lower and 10.0 min for 30 kW or higher.

Function code	Name	Data setting range	Under operation Change	Data Copy	Factory Default
F26	Motor sound (Carrier frequency)	0.75 to 6 kHz ND: FRN0072 to 0203E2□-4□ 0.75 to 10 kHz ND: FRN0059E2□-4□ HD: FRN0072 to 0203E2□-4□ HND: FRN0072 to 0203E2□-4□ HHD: FRN0203E2□-4□ 0.75 to16 kHz HD: FRN0059E2□4□ HND: FRN0059E2□-4□ HHD: FRN0059 to 0168E2□-4□	○	○	2
F27	(Tone)	0: Level 0 (Disable) 1: Level 1 2: Level 2 3: Level 3	○	○	0
F29	Terminal FM (Mode selection)	0: Voltage output (0 to +10 VDC) 1: Current output (4 to 20 mA DC) 2: Current output (0 to 20 mA DC) 3: Pulse output	○	○	0
F30	(Output gain)	0 to 300%	⊙	○	100
F31	(Function selection)	0: Output frequency 1 (before slip compensation) 1: Output frequency 2 (after slip compensation) 2: Output current 3: Output voltage 4: Output torque 5: Load factor 6: Consumed power 7: PID feedback value 9: DC intermediate circuit voltage 10: Universal AO 13: Motor output 14: Analog output test (+) 15: PID command (SV) 16: PID output (MV) 18: Inverter cooling fin temperature 111 to 115 Customizable logic output signal 1 to 5	○	○	0
F32	Terminal FM 2 (Mode selection)	0: Voltage output (0 to +10 VDC) 1: Current output (4 to 20 mA DC) 2: Current output (0 to 20 mA DC)	○	○	0
F33	Terminal FM (Pulse rate)	25 to 32000 p/s (number of pulse at 100%)	⊙	○	1440
F34	Terminal FM 2 *1 (Output gain)	0 to 300%	⊙	○	100
F35	(Function selection)	Same as F31 (only 0 to 18 supported)	○	○	2
F37	Load selection/ Auto torque boost/ Auto energy-saving operation 1	0: Variable torque load 1: Constant torque load 2: Auto torque boost 3: Auto energy-saving operation (variable torque load) 4: Auto energy-saving operation (constant torque load) 5: Auto energy-saving operation (auto torque boost)	x	○	1
F39	Stop frequency (Holding time)	0.00 to 10.00 s	○	○	0.00
F40	Torque limiter 1 (Drive)	0 to 300%; 999 (Disable)	○	○	999
F41	(Braking)	0 to 300%; 999 (Disable)	○	○	999
F42	Drive control selection 1	0: V/f control without slip compensation 1: Vector control without speed sensor (dynamic torque vector) 2: V/f control with slip compensation	x	○	0
F43	Current limiter (Mode selection)	0: Disable 1: At constant speed (Disable at acceleration and deceleration) 2: At acceleration and constant speed (Disable at deceleration)	○	○	2
F44	(Operation level)	20 to 200% (inverter rated current standard value)	○	○	J:160, ACEKT:130
F50	Electronic thermal (for braking resistor protection) (Discharging capacity)	1 to 9000 kWs OFF (Cancel)	○	△1△2	OFF
F51	(Allowable average loss)	0.001 to 99.99 kW	○	△1△2	0.001
F52	(Braking resistance value)	0.00: Resistance not required (FRENIC-Multi compatible operation) 0.01 to 999 Ω	○	△1△2	0.00
F80	ND/HD/HND/HHD switching	0: HHD mode 1: HND mode 3: HD mode 4: ND mode	x	○	J:0 ACEKT:4

Factory default•••A (For Asia), C (for China), E (for Europe), T (For Taiwan), J (for Japan), K (for Korea)
indicates quick setup target function code.
*1: F34 and F35 only exist for C model (for China).

■ E code: Extension Terminal Functions (Terminal function)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
E01	Terminal X1 (Function selection)	0 (1000): Select multi-frequency (0 to 1 steps) "SS1"	x	○	0
E02	Terminal X2	1(1001): Select multi-frequency (0 to 3 steps) "SS2"	x	○	1
E03	Terminal X3	2(1002): Select multi-frequency (0 to 7 steps) "SS4"	x	○	2
E04	Terminal X4	3(1003): Select multi-frequency (0 to 15 steps) "SS8"	x	○	7
E05	Terminal X5	4 (1004): Select acceleration/deceleration (2 steps) "RT1" 5 (1005): Select acceleration/deceleration (4 steps) "RT2" 6 (1006): Select self-hold "HLD" 7 (1007): Coast to a stop command "BX" 8 (1008): Alarm (Abnormal) reset "RST" 9 (1009): External alarm (9 = Active OFF/ 1009 = Active ON) "THR" 10 (1010): Jogging operation "JOG" 11 (1011): Frequency setting 2/ Frequency setting 1 "Hz2/ Hz1" 12 (1012): Motor selection 2 "M2" 13: DC braking command "DCBRK" 14 (1014): Torque limit 2/ Torque limit 1 "TL2/ TL1" 15: Commercial power switching (50 Hz) "SW50" 16: Commercial power switching (60 Hz) "SW60" 17 (1017): UP command "UP" 18 (1018): DOWN command "DOWN" 19 (1019): Editing approval command (Data change enabled) "WE-KP" 20 (1020): PID control cancel "Hz/PID" 21 (1021): Switch normal/ inverse operation "IVS" 22 (1022): Interlock "IL" 24 (1024): Select link operation (RS-485, BUS option) "LE" 25 (1025): Universal DI "U-DI" 26 (1026): Select starting mode "STM" 30 (1030): Force to stop (30 = Active OFF/1030 = Active ON) "STOP" 33 (1033): PID Integer/Differential reset "PID-RST" 34 (1034): PID integer hold "PID-HLD" 35 (1035): Select local (Keypad) command "LOC" 46 (1046): Overload stop enable "OLS" 48: Pulse rate input (Only for X5 terminal (E05)) "PIN" 49 (1049): Pulse train sign (Other than X5 terminal (E01 to E04)) "SIGN" 65(1065): Brake check "BRKE" 76 (1076): Select droop "DROOP" 80 (1080): Cancel customizable logic "CLC" 81 (1081): Clear all customizable logic timers "CLTC" 82 (1082): Anti-regenerative control cancel "AR-CCL" 100: No function assigned "NONE" 171 (1171): PID control multistage command 1 "PID-SS1" 172 (1172): PID control multistage command 2 "PID-SS2" * Inside the ( ) is the negative logic signal (OFF at short-circuit)	x	○	8
E 10	Acceleration time2	0.00 to 6000 s * 0.00 is for acceleration and deceleration time cancel (when performing soft-start and stop externally)	○	○	20.0
E 11	Deceleration time2		○	○	20.0
E 12	Acceleration time 3		○	○	20.0
E 13	Deceleration time 3		○	○	20.0
E 14	Acceleration time 4		○	○	20.0
E 15	Deceleration time 4		○	○	20.0
E16	Torque limiter 2 (Drive)	0 to 300%; 999 (Disable)	○	○	999
E17	(Braking)	0 to 300%; 999 (Disable)	○	○	999
E20	Terminal Y1 (Function selection)	0 (1000): During operation "RUN"	x	○	0
E21	Terminal Y2 (Function selection)	1 (1001): Frequency (speed) arrival "FAR"	x	○	7
E27	Terminal 30A/B/C (Ry output) (Function selection)	2 (1002): Frequency (speed) detected "FDT" 3 (1003): Undervoltage detected (inverter stopped) "LU" 4 (1004): Torque polarity detected "B/D" 5 (1005): Inverter output limiting "IOL" 6 (1006): Auto-restarting after momentary power failure "IPF" 7 (1007): Motor overload early warning signal "OL" 8 (1008) Keypad operation enabled "KP"	x	○	99

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
		10 (1010): Inverter ready to run "RDY" 15 (1015): AX terminal function "AX" 16 (1016): Shift pattern operation stage "TU" 17 (1017): Complete pattern operation cycle operation "TO" 18 (1018): Pattern operation stage 1 "STG1" 19 (1019): Pattern operation stage 2 "STG2" 20 (1020): Pattern operation stage 4 "STG4" 21 (1021): Speed arrival 2 “FAR2” 22 (1022): Inverter output limiting with delay "IOL2" 25 (1025): Cooling Fan ON/OFF control "FAN" 26 (1026): Retrying "TRY" 27 (1027): Universal DO "U-DO" 28 (1028): Cooling fin overheat early warning "OH" 30 (1030): Lifetime alarm "LIFE" 31 (1031): Frequency (speed) detected 2 "FDT2" 33 (1033): Command loss detected "REF OFF" 35 (1035): Inverter outputting "RUN 2" 36 (1036) Overload prevention controlling "OLP" 37 (1037): Current detected "ID" 38 (1038): Current detected 2 "ID2" 39 (1039): Current detected 3 "ID3" 41 (1041): Low current detected "IDL" 42 (1042): PID alarm output "PID-ALM" 43 (1043): Under PID control "PID-CTL" 44 (1044): Motor stopped due to slow flow rate under PID control "PID-STP" 45 (1045): Low torque detected "U-TL" 46 (1046): Torque detected 1 "TD1" 47 (1047): Torque detected 2 "TD2" 48 (1048): Motor 1 selected "SWM1" 49 (1049): Motor 2 selected "SWM2" 52 (1052): Running forward "FRUN" 53 (1053): Running reverse "RRUN" 54 (1054): During remote mode "RMT" 56 (1056): Thermistor detected "THM" 57 (1057): Brake signal "BRKS" 58 (1058): Frequency (speed) detected 3 "FDT3" 59 (1059): [C1] (C1 function) Terminal wire break detected "C1OFF" 72 (1072): Frequency (speed) arrival 3 "FAR3" 77 (1077): Low link bus voltage detection “U-EDC” 79 (1079): During decelerating at momentary power failure "IPF2" 84 (1084): Maintenance timer "MNT" 87 (1087): Frequency arrival AND frequency detected "FARFDT" 90 (1090): Alarm content 1 "AL1" 91 (1091): Alarm content 2 "AL2" 92 (1092): Alarm content 4 "AL4" 93 (1093): Alarm content 8 "AL8" 98 (1098): Light alarm "L-ALM" 99 (1099): Alarm output "ALM" 101 (1101): EN terminal detection circuit abnormal "DECF" 102 (1102): EN terminal OFF "ENOFF" 105 (1105): Braking transistor broken "DBAL" 111 (1111): Customizable logic output signal 1 "CLO1" 112 (1112): Customizable logic output signal 2 "CLO2" 113 (1113): Customizable logic output signal 3 "CLO3" 114 (1114): Customizable logic output signal 4 "CLO4" 115 (1115): Customizable logic output signal 5 "CLO5" * Inside the ( ) is the negative logic signal. (OFF at short-circuit)			
E29	Frequency arrival delay (FAR2)	0.01 to 10.00 s	○	○	0.10
E30	Frequency arrival detection width (Detection width)	0.0 to 10.0 Hz	○	○	2.5
E31	Frequency detection (Operation level)	0.0 to 500.0 Hz	○	○	CE: 50.0, JKT: 60.0 A: 200 V class 60.0 A: 400 V class 50.0
E32	(Hysteresis width)	0.0 to 500.0 Hz	○	○	1.0

Factory default•••A (For Asia), C (for China), E (for Europe), T (For Taiwan), J (for Japan), K (for Korea)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
E34	Overload Early Warning/Current detection (Operation level)	0.00 (Disable), 1 to 200% of inverter rated current (Inverter rated current dependent on F80)	○	△1△2	*3
E35	(Timer time)	0.01 to 600.00 s	○	○	10.00
E36	Frequency detection 2 (Operation level)	0.0 to 500.0 Hz	○	○	CE: 50.0, JKT: 60.0 A: 200 V class 60.0 A: 400 V class 50.0
E37	Current detection 2/ Low current detection (Operation level)	0.00 (Disable), 1 to 200% of inverter rated current (Inverter rated current dependent on F80)	○	△1△2	*3
E38	(Timer time)	0.01 to 600.00 s	○	○	10.00
E39	Coefficient for constant rate sending time	0.000 to 9.999	○	○	0.000
E42	LED Display Filter	0.0 to 5.0 s	○	○	0.5
E43	LED monitor (Item selection)	0: Speed monitor (Selectable with E48) 3: Output current 4: Output voltage 8: Calculated torque 9: Consumed power 10: PID command 12: PID feedback amount 13: Timer value 14: PID output 15: Load factor 16: Motor output 17: Analog signal input monitor 25: Input watt-hour	○	○	0
E44	(Display when stopped)	0: Display setting value 1: Display output value	○	○	0
E48	LED monitor detail (Speed monitor selection)	0: Output frequency 1 (before slip compensation) 1: Output frequency 2 (after slip compensation) 2: Reference frequency 3: Motor rotation speed 4: Load rotation speed 5: Line speed 6: Constant rate sending time 7: Speed (%)	○	○	0
E50	Coefficient for Speed Indication	0.01 to 200.00	○	○	30.00
E51	Display Coefficient for Input Watt-hour Data	0.000 (Cancel/Reset). 0.001 to 9999	○	○	0.010
E52	Keypad (Menu display mode)	0: Function code data setting mode (Menu 0, Menu1, and Menu 7) 1: Function code data check mode (Menu 2 and Menu 7) 2: Full-menu mode	○	○	0
E54	Frequency detection 3 (Operation level)	0.0 to 500.0Hz	○	○	CE: 50.0, JKT: 60.0 A: 200 V class 60.0 A: 400V class 50.0
E55	Current detection 3 (Operation level)	0.00 (Disable), 1 to 200% of inverter rated current (Inverter rated current dependent on F80)	○	△1△2	*3
E56	(Timer time)	0.01 to 600.00 s	○	○	10.00
E59	Terminal [C1] Function selection	0: Current input (C1 function) 1: Voltage input (V2 function)	○	○	0
E61	Terminal [12] (Extension function selection)	0: None 1: Auxiliary frequency setting 1 2: Auxiliary frequency setting 2 3: PID process command 1 5: PID feedback amount 6: Ratio setting 7: Analog torque limiter A 8: Analog torque limiter B 20: Analog signal input monitor	x	○	0
E62	Terminal [C1] (C1 function)		x	○	0
E63	Terminal [C1] (V2 function)		x	○	0
E64	Saving of Digital Reference Frequency	0: Auto saving (main power is turned off) 1: Save by turning key ON	○	○	0
E65	Reference loss detection (Continue to run frequency)	0: Stop deceleration, 20 to 120%, 999: Cancel	○	○	999
E76	Direct current intermediate voltage detection level	200 to 400 V (200 V class) 400 to 800 V (400 V class)	○	○	235 470
E78	Torque detection 1 (Operation level)	0 to 300%	○	○	100
E79	(Timer time)	0.01 to 600.00 s	○	○	10.00
E80	Torque detection 2/ Low torque detection (Operation level)	0 to 300%	○	○	20
E81	(Timer time)	0.01 to 600.00 s	○	○	20.00

Factory default•••A (For Asia), C (for China), E (for Europe), T (For Taiwan), J (for Japan), K (for Korea)
indicates quick setup target function code.
*3 Rated current of the motor is set. Refer to Table B (function code P03).

Function code	Name	Data setting range			Under operation Change	Data copy	Factory Default
E98	Terminal FWD (Function selection)	0 (1000):	Select multi-frequency (0 to 1 steps)	"SS1"	x	○	98
E99	Terminal REV	1 (1001):	Select multi-frequency (0 to 3 steps)	"SS2"	x	○	99
		2 (1002):	Select multi-frequency (0 to 7 steps)	"SS4"			
		3 (1003):	Select multi-frequency (0 to 15 steps)	"SS8"			
		4 (1004):	Select acceleration/deceleration (2 steps)	"RT1"			
		5 (1005):	Select acceleration/deceleration (4 steps)	"RT2"			
		6 (1006):	Select self-hold	"HLD"			
		7 (1007):	Free run command	"BX"			
		8 (1008):	Alarm (Abnormal) reset	"RST"			
		9 (1009):	External alarm (9 = Active OFF/1009 = Active ON)	"THR"			
		10 (1010):	Jogging operation	"JOG"			
		11 (1011):	Frequency setting 2/ Frequency setting 1	"Hz2/ Hz1"			
		12 (1012):	Motor selection 2	"M2"			
		13:	DC braking command	"DCBRK"			
		14 (1014):	Torque limit 2/ Torque limit 1	"TL2/ TL1"			
		15:	Commercial power switching (50 Hz)	"SW50"			
		16:	Commercial power switching (60 Hz)	"SW60"			
		17 (1017):	UP command	"UP"			
		18 (1018):	DOWN command	"DOWN"			
		19 (1019):	Editing approval command (Data change enabled)	"WE-KP"			
		20 (1020):	PID control cancel	"Hz/PID"			
		21 (1021):	Switch normal/ inverse operation	"IVS"			
		22 (1022):	Interlock	"IL"			
		24 (1024):	Select link operation (RS-485, BUS option)	"LE"			
		25 (1025):	Universal DI	"U-DI"			
		26 (1026):	Select starting mode	"STM"			
		30 (1030):	Force to stop (30 = Active OFF/1030 = Active ON)	"STOP"			
		33 (1033):	PID Integer/Differential reset	"PID-RST"			
		34 (1034):	PID integer hold	"PID-HLD"			
		35 (1035):	Select local (Keypad) command	"LOC"			
		46 (1046):	Overload stop enable	"OLS"			
		49 (1049):	Pulse train sign	"SIGN"			
		65 (1065):	Brake check	"BRAKE"			
		76 (1076):	Select droop	"DROOP"			
		80 (1080):	Cancel customizable logic	"CLC"			
		81 (1081):	Clear all customizable logic timers	"CLTC"			
		82 (1082):	Anti-regenerative control cancel	"AR-CCL"			
		98:	Run forward stop command	"FWD"			
		99:	Run reverse stop command	"REV"			
		100:	No function assigned	"NONE"			
		171 (1171):	PID control multistage command 1	"PID-SS1"			
		172 (1172):	PID control multistage command 2	"PID-SS2"			
		* Inside the ( ) is the negative logic signal. (OFF at short-circuit)					

■ C code: Control Functions of Frequency (Control function)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
C01	Jump frequency 1	0.0 to 500.0Hz	○	○	0.0
C02	2		○	○	0.0
C03	3		○	○	0.0
C04	(Width)	0.0 to 30.0Hz	○	○	3.0
C05	Multi-frequency 1	0.00 to 500.00Hz	○	○	0.00
C06	2		○	○	0.00
C07	3		○	○	0.00
C08	4		○	○	0.00
C09	5		○	○	0.00
C10	6		○	○	0.00
C11	7		○	○	0.00
C12	8		○	○	0.00
C13	9		○	○	0.00
C14	10		○	○	0.00
C15	11		○	○	0.00
C16	12		○	○	0.00
C17	13		○	○	0.00
C18	14		○	○	0.00
C19	15		○	○	0.00
C20	Jogging Frequency	0.00 to 500.00 Hz	○	○	0.00
C21	Pattern operation selection/ Timer operation (Select openmin)	0: 1 cycle operation 1: Repetition operation 2: Constant speed operation after 1 cycle operation 3: Timer operation	x	○	0
C22	(Stage 1)	Special setting: Press FUNC/DATA key three times. 1st: Set run time 0.0 to 6000 s and press FUNC/DATA key. 2nd: Set rotational direction F (forward) or r (reverse) and press FUNC/DATA key. 3rd: Set acceleration/deceleration time 1 to 4 and press FUNC/DATA key.	○	○	1st: 0.00 2nd: F 3rd: 1
C23	(Stage 2)		○	○	
C24	(Stage 3)		○	○	
C25	(Stage 4)		○	○	
C26	(Stage 5)		○	○	
C27	(Stage 6)		○	○	
C28	(Stage 7)		○	○	
C30	Frequency setting 2	0: Keypad ▲/▼ key operation 1: Analog voltage input (Terminal [12]) (from 0 to ±10 VDC) 2: Analog current input (Terminal [C1] (C1 function)) (4 to 20mA DC) 3: Analog voltage input (Terminal [12]) + Analog current input (Terminal [C1] (C1 function)) 5: Analog voltage input (Terminal [C1] (V2 function)) (0 to 10 VDC) 7: UP DOWN control 8: Keypad key operation (▲/▼key) (With balances bumpless) 10: Pattern operation 12: Pulse train input	x	○	2
C31	Analog input adjustment (Terminal [12]) (Offset)	-5.0 to 5.0%	⊙	○	0.0
C32	(Gain)	0.00 to 200.00%	⊙	○	100.0
C33	(Filter)	0.00 to 5.00 s	○	○	0.05
C34	(Gain base point)	0.00 to 100.00%	⊙	○	100.0
C35	(Polarity selection)	0: Bipolar 1: Single polarity	x	○	1
C36	Analog input adjustment (Terminal [C1] (C1 function)) (Offset)	-5.0 to 5.0%	⊙	○	0.0
C37	(Gain)	0.00 to 200.00%	⊙	○	100.0
C38	(Filter)	0.00 to 5.00 s	○	○	0.05
C39	(Gain base point)	0.00 to 100.00%	⊙	○	100.0
C40	Terminal [C1] (C1 function) Range selection	0: 4 to 20 mA Single polarity 1: 0 to 20 mA Single polarity 10: 4 to 20 mA Bipolar 11: 0 to 20 mA Bipolar	x	○	0
C41	Analog input adjustment (Terminal [C1] (V2 function)) (Offset)	-5.0 to 5.0%	⊙	○	0.0
C42	(Gain)	0.00 to 200.00%	⊙	○	100.0
C43	(Filter)	0.00 to 5.00 s	○	○	0.05
C44	(Gain base point)	0.00 to 100.00%	⊙	○	100.0
C45	(Polarity selection)	0: Bipolar 1: Single polarity	x	○	1
C50	Bias (for frequency setting 1) (Bias base point)	0.00 to 100.00%	⊙	○	0.00
C53	Selection of normal/inverse operation (Frequency setting 1)	0: Normal 1: Inverse	○	○	0

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
C55	Analog input adjustment (Terminal 12) (Bias)	-100.00 to 100.00%	○	○	0.00
C56	(Bias base point)	0.00 to 100.00 %	○	○	0.00
C58	(Display unit)	* Same as J105 (However ,Setting range is, 1 to 80)	○	○	2
C59	(Maximum scale)	-999.00 to 0.00 to 9990.00	○	○	100
C60	(Minimum scale)	-999.00 to 0.00 to 9990.00	○	○	0.00
C61	Analog input adjustment (Terminal [C1] (C1 function)) (Bias)	-100.00 to 100.00 %	○	○	0.00
C62	(Bias base point)	0.00 to 100.00 %	○	○	0.00
C64	(Display unit)	* Same as J105 (However ,Setting range is, 1 to 80)	○	○	2
C65	(Maximum scale)	-999.00 to 0.00 to 9990.00	○	○	100
C66	(Minimum scale)	-999.00 to 0.00 to 9990.00	○	○	0.00
C67	Analog input adjustment (Terminal [C1] (V2 function)) (Bias)	-100.00 to 100.00 %	○	○	0.00
C68	(Bias base point)	0.00 to 100.00 %	○	○	0.00
C70	(Display unit)	* Same as J105 (However ,Setting range is,1 to 80)	○	○	2
C71	(Maximum scale)	-999.00 to 0.00 to 9990.00	○	○	100
C72	(Minimum scale)	-999.00 to 0.00 to 9990.00	○	○	0.00
C89	Frequency compensation 1 by (Numerator)	-32768 to 32767 (Keypad display is 8000 to 7FFFH) (Interpreted as 1 when the value is set to 0)	○	○	0001
C90	Frequency compensation 2 by (Denominator)	-32768 to 32767 (Keypad display is 8000 to 7FFFH) (Interpreted as 1 when the value is set to 0)	○	○	0001

■ P code: Motor 1 Parameters (Motor 1 parameter)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
P01	Motor 1 (No. of poles)	2 to 22 poles	x	△1△2	4
P02	(Capacitance)	0.01 to 1000 kW (At P99 = 0 or 4) 0.01 to 1000 HP (At P99 = 1)	x	△1△2	*6
P03	(Rated current)	0.00 to 2000A	x	△1△2	*6
P04	(Auto-tuning)	0: Disable 1: Stop tuning (%R1, %X, Rated slip frequency) 2: Rotation tuning for V/f control (%R1, %X, Rated slip frequency, No-load current)	x	X	0
P05	(Online tuning)	0: Disable 1: Action	○	○	0
P06	(No-load current)	0.00 to 2000A	x	△1△2	*6
P07	(%R1)	0.00 to 50.00%	○	△1△2	*6
P08	(%X)	0.00 to 50.00%	○	△1△2	*6
P09	(Slip compensation gain for driving)	0.0 to 200.0%	⊙	○	100.0
P10	(Slip compensation response time)	0.01 to 10.00 s	○	△1△2	0.5
P11	(Slip compensation gain for braking)	0.0 to 200.0%	⊙	○	100.0
P12	(Rated slip frequency)	0.00 to 15.00Hz	x	△1△2	*6
P13	(Iron loss factor 1)	0.00 to 20.00%	○	△1△2	*6
P53	(%X correction factor 1)	0 to 300%	○	△1△2	100
P99	Motor 1 selection	0: Motor characteristics 0 (Fuji standard motors, 8-series) 1: Motor characteristics 1 (HP rating motors) 4: Other motors	x	△1△2	0

indicates quick setup target function code.

*6 Constant of motor is set per capacitance. Refer to table B.

■ H code: High Performance Functions (High level function)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
H03	Data initialization	0: Manual setting value 1: Initial value (factory default value) 2: Initialize motor 1 parameters 3: Initialize motor 2 parameters 11: Limited initialization (Initialization excluding communication function code) 12: Limited initialization (initialize customizable logic)	x	x	0
H04	Retry (Count)	0: Disable, 1 to 20: Number of retries	○	○	0
H05	(Interval)	0.5 to 20.0 s	○	○	5.0
H06	Cooling Fan ON/OFF Control	0: Disable (Alway Fan ON) 1: Enable (ON/OFF control effective)	○	○	0
H07	Curve acceleration/deceleration	0: Disable (Linear acceleration/deceleration) 1: S-curve acceleration/deceleration (Weak) 2: S-curve acceleration/deceleration (Arbitrary: According to H57 to H60) 3: Curve acceleration/deceleration	○	○	0
H08	Rotational Direction Limitation	0: Disable 1: Enable (Reverse rotation inhibited) 2: Enable (Forward rotation inhibited)	x	○	0
H09	Starting Mode (Auto search)	0: Disable 1: Enable (Only at restart after momentary power failure) 2: Enable (At normal start and at restart after momentary power failure)	x	○	0
H11	Deceleration Mode	0: Normal deceleration 1: Coast to a stop	○	○	0
H12	Instantaneous Overcurrent Limiting (Mode selection)	0: Disable 1: Enable	○	○	1
H13	Momentary power failure restart (Interval)	0.1 to 20.0 s	○	△1△2	*2
H14	(Frequency lowering rate)	0.00: Selected deceleration time, 0.01 to 100.00Hz/s, 999 (According to current limiter)	○	○	999
H15	(Continue to run level)	200 to 300V: (200 V class) 400 to 600V: (400V class)	○	△2:	235 470
H16	(Allowable momentary power failure time)	0.0 to 30.0s, 999 (Auto judge by inverter)	○	○	999
H26	Thermistor (for motor) (Mode selection)	0: Disable 1: PTC: ﾌﾘｯﾌﾟ trip and stop the inverter 2: PTC: Output the output signal "THM" and continue to run	○	○	0
H27	(Operation level)	0.00 to 5.00 V	○	○	1.60
H28	Droop control	-60.0 to 0.0Hz	○	○	0.0
H30	Link Function (Mode selection)	Frequency command / Run command 0: F01/C30 / F02 1: RS-485 communication (Port 1) / F02 2: F01/C30 / RS-485 Communication (Port 1) 3: RS-485 Communication (Port 1) / RS-485 Communication (Port 1) 4: RS-485 Communication (Port 2) / F02 5: RS-485 Communication (Port 2) / RS-485 Communication (Port 1) 6: F01/C30 / RS-485 Communication (Port 2) 7: RS-485 Communication (Port 1) / RS-485 Communication (Port 2) 8: RS-485 Communication (Port 2) / RS-485 Communication (Port 2)	○	○	0
H42	Capacitance of DC link bus capacitor	For adjustment at replacement (0000 to FFFF (in hexadecimal))	○	x	-
H43	Cumulative run time of cooling fan	For adjustment at replacement Displays the cumulative run time of cooling fan in units of ten hours.	○	x	-
H44	Startup Count for Motor 1	For adjustment at replacement (0000 to FFFF (in hexadecimal))	○	x	-
H45	Mock Alarm	0: Disable 1: Occurrence of mock Alarm	○	x	0
H46	Starting Mode (Auto search delay time 2)	0.1 to 20.0 s	○	△1△2	*6
H47	Initial capacitance of DC link bus capacitor	For adjustment at replacement (0000 to FFF (in hexadecimal))	○	x	-
H48	Printed circuit board capacitor cumulative run time	For adjustment at replacement Change in cumulative motor run time (Reset is enabled) (in units of ten hours)	○	x	-
H49	Starting Mode (Auto search delay time 1)	0.0 to 10.0 s	○	○	0.0
H50	Non-linear V/f1 (Frequency)	0.0 (Cancel), 0.1 to 500.0 Hz	x	○	0.0
H51	(Voltage)	0 to 240 V: AVR operation (200 V class) 0 to 500V: AVR operation (400V class)	x	△2:	0
H52	Non-linear V/f2 (Frequency)	0.0 (Cancel), 0.1 to 500.0 Hz	x	○	0.0
H53	(Voltage)	0 to 240V: AVR operation (200V class) 0 to 500V: AVR operation (400V class)	x	△2:	0
H54	Acceleration Time (Jogging operation)	0.00 to 6000 s	○	○	20.0
H55	Deceleration Time (Jogging operation)	0.00 to 6000 s	○	○	20.0
H56	Deceleration Time for Forced Stop	0.00 to 6000 s	○	○	20.0

Factory default•••A (For Asia), C (for China), E (for Europe),T (For Taiwan), J (for Japan), K (for Korea)
*2 Standard value is set per capacitance. Refer to table A.
*6 Rated current of motor is set per capacitance. Refer to table B.

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
H57	1st S-curve acceleration range (At the start)	0 to 100%	○	○	10
H58	2nd S-curve acceleration range (At the end)	0 to 100%	○	○	10
H59	1st S-curve deceleration range (At the start)	0 to 100%	○	○	10
H60	2nd S-curve deceleration range (At the end)	0 to 100%	○	○	10
H61	UP/DOWN control initial value setting	0: Initial value is 0.00 Hz 1: Initial value is set frequency with UP/DOWN command right before there is no more run command.	x	○	1
H63	Low limiter (Mode selection)	0: Lower limit is F16: Continuous to run with limitation by frequency limiter (lower limit) 1: Lower limit is F16: Stop deceleration at or below the frequency limiter (lower limit)	○	○	0
H64	(Minimum frequency during limiting operation)	0.0: F16: 0.1 to 60.0 Hz dependent on frequency limiter (lower limit)	○	○	1.6
H65	Non-linear V/f Pattern 3 (Frequency)	0.0 (Cancel), 0.1 to 500.0 Hz	x	○	0.0
H66	(Voltage)	0 to 240V: AVR operation (200V class) 0 to 500V: AVR operation (400V class)	x	△2:	0
H68	Slip Compensation 1 (Operating conditions selection)	0: Enable during acceleration/deceleration, enable at base frequency or higher 1: Disable during acceleration/deceleration, enable at base frequency or higher 2: Enable during acceleration/deceleration, disable at base frequency or higher 3: Disable during acceleration/deceleration, disable at base frequency or higher	x	○	0
H69	Anti-regenerative control (Mode selection)	0: Disable 2: Torque control (Force to stop after elapse of three times of deceleration time) 3: DC intermediate voltage control (Force to stop after elapse of three times of deceleration time) 4: Torque control (Disable force to stop processing) 5: DC intermediate voltage control (Disable force to stop processing)	○	○	0
H70	Overload prevention control	0.00: Comply with the selected deceleration time 0.01 to 100.00 Hz/s, 999 (Cancel)	○	○	999
H71	Deceleration characteristics	0: Disable 1: Enable	○	○	0
H72	Detected the main power shoutdown (Mode selection)	0: Disable 1: Enable	○	○	1
H76	Torque limiter (Braking) (Frequency increment limit for braking)	0.0 to 500.0Hz	○	○	5.0
H77	Life of main circuit capacitor (Time remaining before the end of life)	0 to 8760 (in units of ten hours)	○	x	-
H78	Maintenance Interval (M1)	0 (Disable): 1 to 9999 (in units of ten hours)	○	x	J:8760 ACEKT:6132
H79	Preset Startup Count for Maintenance (M1)	OFF (Disable): 0001 to FFFF (in hexadecimal)	○	x	OFF
H80	Output current fluctuation damping Gain for Motor 1	0.00 to 1.00	○	○	0.20
H81	Light Alarm Selection 1	0000 to FFFF (in hexadecimal)	○	○	0000
H82	Light Alarm Selection 2	0000 to FFFF (in hexadecimal)	○	○	0000
H89	Reserved for particular manufacturers	0.1	○	○	1
H90	Reserved for particular manufacturers	0.1	○	○	0
H91	PID feedback wire break	0.0 (Alarm disable): 0.1 to 60.0 s	○	○	0.0
H92	Continue to run (P)	0.000 to 10.000 times; 999	○	△1△2	999
H93	(I)	0.010 to 10.000 s; 999	○	△1△2	999
H94	Cumulative Motor Run Time 1	0 to 9999 Change in cumulative motor run time (Reset is enabled) (in units of 10 hours)	x	x	-
H95	DC Braking (Braking response mode)	0: Slow response 1: Quick response	○	○	1
H96	STOP Key Priority/ Start Check Function	0: STOP key priority disable/ Start check function disable 1: STOP key priority enable/ Start check function disable 2: STOP key priority disable/ Start check function enable 3: STOP key priority enable/ Start check function enable	○	○	0
H97	Clear Alarm Data	0: Disable 1: Alarm data clear (Automatically return to 0 after clearing data)	○	x	0
H98	Protection/Maintenance Function (Mode selection)	0 to 255 (Data is displayed in decimal, Meaning of each bit 0: Disable; 1 Enable) Bit 0: Lower the carrier frequency automatically (0: Disable; 1: Enable) Bit 1: Input phase loss protection (0: Disable; 1: Enable) Bit 2: Output phase loss protection (0: Disable; 1: Enable) Bit 3 Main circuit capacitor life judgment selection (0: Factory default referenced; 1 User measurement value standard) Bit 4: Judge the life of main circuit capacitor (0: Disable; 1: Enable) Bit 5: Detect DC fan lock (0: Enable; 1: Disable) Bit 6: Braking transistor error detection (22 kW or below) (0: Disable; 1: Enable)	○	○	FRN0059, 0072E2S-4□ : 83 FRN0085 to 0203E2S-4□ :19
H114	Anti-regenerative control (Operation level)	0.0 to 50.0%, 999: disabled	○	○	999
H180	Brake signal (Brake operation check time)	0.00 to 10.00 s	○	○	0.00
H195	DC braking (Braking time at the startup)	0.00 (Disable): 0.01 to 30.00 s	○	○	0.00

Factory default•••A (For Asia), C (for China), E (for Europe), T (For Taiwan), J (for Japan), K (for Korea)

■ A code: Motor 2 Parameters (Motor 2 parameter)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
A01	Maximum output frequency 2	25.0 to 500.0Hz	x	○	CE: 50.0, JKT: 60.0 A: 200 V class 60.0 A: 400V class 50.0
A02	Base frequency 2	25.0 to 500.0Hz	x	○	CEJKT:50.0, A: 200 V class 60.0 A: 400V class 50.0
A03	Base frequency voltage 2	0: AVR disable (output voltage proportional to power voltage) 80 to 240V: AVR operation (200V class) 160 to 500V: AVR operation (400V class)	x	△2:	TJK:200/400 A: 220/415, C: 200/380 E: 230/400,
A04	Maximum output voltage 2	80 to 240V: AVR operation (200V class) 160 to 500V: AVR operation (400V class)	x	△2:	
A05	Torque boost 2	0.0 to 20.0% (% value against base frequency voltage 2)	○	○	*2
A06	Electronic thermal 2 for motor protection (Characteristics selection)	1: Enable (For a general-purpose motor with self-cooling fan) 2: Enable (For an inverter-driven motor (FV) with separately powered cooling fan)	○	○	1
A07	(Operation level)	0.00 (disable), current value of 1 to 135% of inverter rated current	○	△1△2	*3
A08	(Thermal time constant)	0.5 to 75.0 min	○	○	*4
A09	DC braking 2 (Braking starting frequency)	0.0 to 60.0Hz	○	○	0.0
A10	(Operation level)	0 to 100% (HHD mode), 0 to 80% (HD/HND mode), 0 to 60% (ND mode)	○	○	0
A11	(Braking time)	0.00 (Disable): 0.01 to 30.00 s	○	○	0.00
A12	Starting Frequency 2	0.0 to 60.0Hz	○	○	0.5
A13	Select load/ Auto torque boost/ Auto energy-saving operation 2	0: Variable torque load 1: Constant torque load 2: Auto torque boost 3: Auto energy-saving operation (variable torque load) 4: Auto energy-saving operation (constant torque load) 5: Auto energy-saving operation (auto torque boost)	x	○	1
A14	Drive control selection 2	0: V/f control without slip compensation 1: Speed sensor-less vector control (Dynamic torque vector control) 2: V/f control with slip compensation	x	○	0
A15	Motor 2 (No. of poles)	2 to 22 poles	x	△1△2	4
A16	(Capacitance)	0.01 to 1000 kW (At P39 = 0 to 4) 0.01 to 1000 HP (At P39 = 1)	x	△1△2	*6
A17	(Rated current)	0.00 to 2000A	x	△1△2	*6
A18	(Auto-tuning)	0: Disable 1: Stop tuning (%R1, %X, Rated slip frequency) 2: Rotation tuning (%R1, %X, Rated slip frequency, No-load current, %X correction factor 1)	x	x	0
A19	(Online tuning)	0: Disable 1: Enable	○	○	0
A20	(No-load current)	0.00 to 2000A	x	△1△2	*6
A21	(%R1)	0.00 to 50.00%	○	△1△2	*6
A22	(%X)	0.00 to 50.00%	○	△1△2	*6
A23	(Slip compensation gain for driving)	0.0 to 200.0%	⊙	○	100.0
A24	(Slip compensation reponse time)	0.01 to 10.00 s	○	△1△2	0.50
A25	(Slip compensation gain for braking)	0.0 to 200.0%	⊙	○	100.0
A26	(Rated slip frequency)	0.00 to 15.00Hz	x	△1△2	*6
A27	(Iron loss factor 1)	0.00 to 20.00%	○	△1△2	*6
A39	Motor 2 Selection	0: Motor characteristics 0 (Fuji standard motors, 8-series) 1: Motor characteristics 1 (HP rating motors) 4: Other motors	x	△1△2	0
A40	Slip Compensation 2 (Operating conditions selection)	0: Enable during acceleration/deceleration, enable at base frequency or higher 1: Disable during acceleration/deceleration, enable at base frequency or higher 2: Enable during acceleration/deceleration, disable at base frequency or higher 3: Disable during acceleration/deceleration, disable at base frequency or higher	x	○	0
A41	Output Current Fluctuation Damping Gain for Motor 2	0.00 to 1.00	○	○	0.20
A51	Cumulative Motor Run Time 2	0 to 9999 Change in cumulative motor run time (Reset is enabled) (in units of 10 hours)	x	x	-
A52	Startup Counter for Motor 2	For adjustment at replacement (0000 to FFF (in hexadecimal))	○	x	-
A53	Motor 2 (%X correction factor 1)	0 to 300%	○	△1△2	100
A98	(Function selection)	0 to 255 (Data is displayed in decimal, Meaning of each bit 0: Disable; 1 Enable)	x	○	0

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
		bit0 : Current control (F43, F44) (0: Disable; 1: Enable) bit1 : Rotational direction control (H08) (0: Disable; 1: Enable) bit2 : Non-linear V/f (H50 to H53, H65, H66) (0: Disable; 1: Enable) bit3 : PID control (J01 to J62, H91) (0: Disable; 1: Enable) bit4 : Brake signal (0: Disable; 1: Enable) bit5 : Braking time at the Startup (H195)(0: Disable; 1: Enable) Bit6 to 7: Empty			

Factory default•••A (For Asia), C (for China), E (for Europe), T (For Taiwan), J (for Japan), K (for Korea)
*2 Standard value is set per capacitance. Refer to table A.
*3 Rated current of the motor is set. Refer to Table B (function code P03).
*4 Standard applicable electric motor is 5.0 min for 22 kw or lower and 10.0 min for 30 kW or higher.
*6 Rated current of motor is set per capacitance. Refer to table B.

■ J code: Application Functions 1 (Application function 1)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
J01	PID control (Mode selection)	0: Disable 1: For process (normal operation) 2: For process (inverse operation) 3: Speed control (Dancer)	x	○	0
J02	(Remote command)	0: Keypad key operation (△/▽key) 1: PID process command 1 (Analog input: Terminals 12, C1 and V2) 3: UP/DOWN 4: Communication	x	○	0
J03	P (Gain)	0.000 to 30.000 times	○	○	0.100
J04	I (Integral time)	0.0 to 3600.0 s	○	○	0.0
J05	D (Differential time)	0.00 to 600.00 s	○	○	0.00
J06	(Feedback filter)	0.0 to 900.0 s *1	○	○	0.5
J10	(Anti-reset windup)	0 to 200%	○	○	200
J11	(Select alarm output)	0: Absolute-value alarm 1: Absolute-value alarm (with Hold) 2: Absolute-value alarm (with Latch) 3: Absolute-value alarm (with Hold and Latch) 4: Deviation alarm 5: Deviation alarm (with Hold) 6: Deviation alarm (with Latch) 7: Deviation alarm (with Hold and Latch)	○	○	0
J12	(Upper limit warning (AH))	-100% to 100%	○	○	100
J13	(Lower limit warning (AL))	-100% to 100%	○	○	0
J15	(Stop frequency for slow flow rate)	0.0 (Disable): 1.0 to 500.0 Hz	○	○	0.0
J16	(Slow flow rate level stop latency)	0 to 60 s	○	○	30
J17	(Starting Frequency)	0.0 to 500.0Hz	○	○	0.0
J18	(PID output limiter Upper limit)	-150% to 150% ; 999 (Conform to F15)	○	○	999
J19	(PID output limiter Lower limit)	-150% to 150% ; 999 (Conform to F16)	○	○	999
J23	(Startup feedback difference at stop frequency for slow flow rate)	0.0 to 100.0%	○	○	0.0
J24	(Startup delay time at stop frequency for slow flow rate)	0 to 3600 s	○	○	0
J57	(Dancer reference position)	-100 to 0 to 100%	○	○	0
J58	(Dancer reference position detection width)	0: Cancel PID constant switch 1 to 100%: Manual setting value	○	○	0
J59	P (Gain) 2	0.000 to 30.000 times	○	○	0.100
J60	I (Integral time) 2	0.0 to 3600.0 s	○	○	0.0
J61	D (Differential time) 2	0.00 to 600.00 s	○	○	0.00
J62	(PID control block selection)	0 to 3 bit0: PID output characteristics 0=Plus (Addition); 1=Minus (Subtraction) bit1: Select output ratio compensation 0=Correction amount is ratio compensation (Ratio against primary speed) 1=Correction amount is speed command correction (Ratio against the maximum frequency)	x	○	0
J63	Overload stop (Detected value)	0: Torque, 1: Current	○	○	0
J64	(Detection level)	20 to 200%	○	○	100
J63	(Operation selection)	0: No operation 1: Stop after deceleration 2: Free run	○	○	0
J66	(Operation mode)	0: During constant speed running & deceleration 1: During constant speed running 2: All modes	○	○	0
J67	(Timer time)	0.00 to 600.00 s	○	○	0.00
J68	Brake Signal (Brake-OFF current)	0.00 to 300.00%	○	○	100.0
J69	(Brake-OFF frequency/speed)	0.0 to 25.0 Hz	○	○	1.0
J70	(Brake-OFF timer)	0.00 to 5.00 s	○	○	1.00
J71	(Brake-ON frequency/speed)	0.0 to 25.0 Hz	○	○	1.0
J72	(Brake-ON timer)	0.00 to 5.00 s	○	○	1.00

*1 Perform it at 0.1 or below if J01 = 3 (dancer control).

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
J105	PID control (Display unit)	0 to 80 0: based on unit/scale of PID control feedback value 1: No unit 2: % 4: r/min 7: kW [Flow rate] 20: m^3/s 21: m^3/min 22: m^3/h 23: L/s 24: L/min 25: L/h [Pressure] 40: Pa 41: kPa 42: MPa 43: mbar 44: bar 45: mmHg 46: psi PSI (Square inch per weight pound) 47: mWG 48: inWG [Temperature] 60: K 61: °C 62: °F [Concentration] 80: ppm	x	○	0
J106	(Maximum scale)	-999 to 0.00 to 9990	x	○	100
J107	(Minimum scale)		x	○	0.00
J136	(Multistage command 1)	-999 to 0.00 to 9990	○	○	0.00
J137	(Multistage command 2)		○	○	0.00
J138	(Multistage command 3)		○	○	0.00

■ d code: Application Functions 2 (Application function 2)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
d51	For manufacturer *9	0 to 500	x	○	20
d52	For manufacturer *9	0 to 500	x	○	20
d55	For manufacturer *9	0000 to 00FF (Display in hexadecimal)	x	○	0000
d61	Command pulse (Filter time constant)	0.000 to 5.000 s	○	○	0.005
d62	(Pulse correction factor 1)	1 to 9999	○	○	1
d63	(Pulse correction factor 2)	1 to 9999	○	○	1
d69	For manufacturer *9	30.0 to 100.0Hz	○	○	30.0
d91	For manufacturer *9	0.00 to 2.00, 999	○	○	999
d99	Extension function 1	0 to 31 Bit 0: For manufacturer *9 Bit 1: For manufacturer *9 Bit 2: For manufacturer *9 Bit 3: JOG operation from communication (0: Disable; 1: Enable) Bit 4: For manufacturer *9	○	○	0

*9 This is function code for manufacturer. Do not change the code.

■ U code: Application Functions 3 (Customizable logic)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
U00	Customizable logic (Mode selection)	0: Disable 1: Enable (Customizable logic operation) ECL alarm occurs when the value is changed from 1 to 0 during operation.	○	○	0
U01	Customizable logic: Step 1 (Block selection)	[Digital] 0: No function assigned 10 to 15: Through output + General-purpose timer 20 to 25: ANDing + General-purpose timer 30 to 35: ORing + General-purpose timer 40 to 45: XORing + General-purpose timer 50 to 55: Set priority flip-flop + General-purpose timer 60 to 65: Reset priority flip-flop + General-purpose timer 70, 72, 73: Rising edge detector + General-purpose timer 80, 82, 83: Falling edge detector + General-purpose timer 90, 92, 93: Rising & falling edges detector + General-purpose timer 100 to 105: Hold + General-purpose timer 110: Increment counter 120: Decrement counter 130: Timer with reset input General-purpose timer function (Least significant digit 0 to 5) _0: No timer _1: On-delay timer _2: Off-delay timer _3: Pulse (1 shot) _4: Retriggerable timer _5 Pulse train output [Analog] 2001: Addition 2002: Subtraction 2003: Multiplication 2004: Division 2005: Limiter 2006: Absolute value 2007: Negative addition 2008: Variable limiter 2009: Linear addition 2051 to 2056: Comparison 1 to 6 2071, 2072 Window comparison 1, 2 2101: Maximum selection 2102: Minimum selection 2103: Average 2151: Function code 2201: Scale reverse conversion 2202: Scale conversion 3001 to 3002: Conversion 1 to 2 [Digital, Analog] 4001: Hold 4002: Negative addition switch 4003, 4004: Selection 1, 2 4005: LPS(Low-pass filter) 4006: Change rate limit 5000: Selection 3 5001 to 5014: Selection 3-1 to 14 5100: Selection 4 5101 to 5114: Selection 4-1 to 14 6001: Read function code 6002: Write function code 6003 : Selection 5 6101 : PID dancer output gain frequency	x	○	0
U02	Customizable logic Step 1: (Input 1)	[Digital] 0 to 105: The same as E20. However, 27, 111 to 115 cannot be selected	x	○	100
U03	(Input 2)	2001 to 2100 (3001 to 3100): Output of Step 1 to 100 "SO01" to"SO100" 4001 (5001): X1 terminal input signal "X1" 4002 (5002): X2 terminal input signal "X2" 4003 (5003): X3 terminal input signal "X3" 4004 (5004): X4 terminal input signal "X4" 4005 (5005): X5 terminal input signal "X5" 4010 (5010): FWD terminal input signal "FWD" 4011 (5011): REV terminal input signal "REV" 6000 (7000): Final run command RUN "FL_RUN" 6001 (7001): Final run command FWD "FL_FWD" 6002 (7002): Final run command REV "FL_REV" 6003 (7003): Accelerating "DACC" 6004 (7004): Decelerating "DDEC" 6005 (7005): Under anti-regenerative control "REGA" 6006 (7006): Within dancer reference position "DR_REF" 6007 (7007): With/without alarm factor "ALM_ACT" * Inside the ( ) is the negative logic signal. (OFF at short-circuit)	x	○	100

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
		[Analog] 8000 to 8018 : The value with 8000 added to F31 9001: Analog 12 terminal input signal [12] 9002: Analog C1 terminal input signal [C1] (C1 function) 9003: Analog V2 terminal input signal [C1] (V2 function)			
U04	(Function 1)	-9990 to 0.00 to 9990	x	○	0.00
U05	(Function 2)		x	○	0.00

Customizable logic Step 1 to 14 function code is assigned as follows: Setting value is the same as U01 to U05.

	Step1	Step2	Step3	Step4	Step5	Step6	Step7	Step8	Step9	Step10
Logic circuit	U01	U06	U11	U16	U21	U26	U31	U36	U41	U46
Input 1	U02	U07	U12	U17	U22	U27	U32	U37	U42	U47
Input 2	U03	U08	U13	U18	U23	U28	U33	U38	U43	U48
Function 1	U04	U09	U14	U19	U24	U29	U34	U39	U44	U49
Function 2	U05	U10	U15	U20	U25	U30	U35	U40	U45	U50

	Step11	Step12	Step13	Step14
Logic circuit	U51	U56	U61	U66
Input 1	U52	U57	U62	U67
Input 2	U53	U58	U63	U68
Function 1	U54	U59	U64	U69
Function 2	U55	U60	U65	U70

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
U71	Customizable logic Output signal 1 (Output selection)	0: Disable 1 to 100: Output of Step 1 to 100 "S001" to "S0100"	x	○	0
U72	Output signal 2		x	○	0
U73	Output signal 3		x	○	0
U74	Output signal 4		x	○	0
U75	Output signal 5		x	○	0
U76	Output signal 6		x	○	0
U77	Output signal 7		x	○	0
U78	Output signal 8		x	○	0
U79	Output signal 9		x	○	0
U80	Output signal 10		x	○	0
U81	Customizable logic Output signal 1 (Function selection)	0 to 172 (1000 to 1172): Same as E01 8001 to 8018: The value with 8000 added to E61	x	○	100
U82	Output signal 2		x	○	100
U83	Output signal 3		x	○	100
U84	Output signal 4		x	○	100
U85	Output signal 5		x	○	100
U86	Output signal 6		x	○	100
U87	Output signal 7		x	○	100
U88	Output signal 8		x	○	100
U89	Output signal 9		x	○	100
U90	Output signal 10		x	○	100
U91	Customizable logic Timer monitor (Step selection)	0: Monitor disable 1 to 100: Step 1 to 100	x	x	0
U92	Customizable logic operation coefficient (Mantissa of KA1)	-9.999 to 9.999	x	○	0.000
U93	(Exponent part of KA1)	-5 to 5	x	○	0
U94	(Mantissa of KB1)	-9.999 to 9.999	x	○	0.000
U95	(Exponent part of KB1)	-5 to 5	x	○	0
U96	(Mantissa of KC1)	-9.999 to 9.999	x	○	0.000
U97	(Exponent part of KC1)	-5 to 5	x	○	0

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
U100	Task process cycle setting	0: Auto select from 2, 5, or 10 ms depending on the number of steps 2: 2 ms (Up to 10 step) 5: 5 ms (Up to 50 step) 10: 10 ms (Up to 100 step)	x	○	0
U101	Customizable logic Operating point of customizable logic reduction 1 (X1)	-999.00 to 0.00 to 9990.00	○	○	0.00
U102	Operating point of customizable logic reduction 1 (Y1)				
U103	Operating point of customizable logic reduction 2 (X2)				
U104	Operating point of customizable logic reduction 2 (Y2)				
U105	Operating point of customizable logic reduction 3 (X3)				
U106	Operating point of customizable logic reduction 3 (Y3)				
U107	Auto calculation of customizable logic reduction coefficient	0: Disable 1. Execute calculation (Reduction 1)	x	○	0
U121	Customizable logic (User parameter 1)	-999.00 to 0.00 to 9990.00	○	○	0.00
U122	(User parameter 2)		○	○	0.00
U123	(User parameter 3)		○	○	0.00
U124	(User parameter 4)		○	○	0.00
U125	(User parameter 5)		○	○	0.00
U126	(User parameter 6)		○	○	0.00
U127	(User parameter 7)		○	○	0.00
U128	(User parameter 8)		○	○	0.00
U129	(User parameter 9)		○	○	0.00
U130	(User parameter 10)		○	○	0.00
U131	(User parameter 11)		○	○	0.00
U132	(User parameter 12)		○	○	0.00
U133	(User parameter 13)		○	○	0.00
U134	(User parameter 14)		○	○	0.00
U135	(User parameter 15)		○	○	0.00
U136	(User parameter 16)		○	○	0.00
U137	(User parameter 17)		○	○	0.00
U138	(User parameter 18)		○	○	0.00
U139	(User parameter 19)		○	○	0.00
U140	(User parameter 20)		○	○	0.00
U171	Customizable logic (Memory area 1)	-999.00 to 0.00 to 9990.00	○	○	0.00
U172	(Memory area 2)		○	○	0.00
U173	(Memory area 3)		○	○	0.00
U190	Customizable logic Setting Step (Step number)	15 to 100	○	x	15
U191	Setting Step (Select circuit)	Same as U01	x	x	0
U192	Setting Step (Input 1)	Same as U02	x	x	100
U193	Setting Step (Input 2)	Same as U03	x	x	100
U194	Setting Step (Function 1)	Same as U04	x	x	0.00
U195	Setting Step (Function 2)	Same as U05	x	x	0.00
U198	Customizable logic ROM version (Monitor)	0 to 9999	-	-	-
U199	Customizable logic ROM version (For User setting)	0 to 9999	x	○	0

■ y code: LINK Functions (Link function)

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
y01	RS-485 setting 1 (Station address)	1 to 255	x	○	1
y02	(Mode selection upon occurrence of an error)	0: Immediate Er-8 trip 1: Er-8 trip after timer time operation 2: Retry communication during timer time operation and perform Er-8 trip if communication cannot be recovered. When communication is recovered, continue to run. 3: Continue to run	○	○	0
y03	(Timer time)	0.0 to 60.0 s	○	○	2.0
y04	(Transmission speed)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	○	○	3
y05	(Data length selection)	0: 8 bits 1: 7 bits	○	○	0
y06	(Parity bit selection)	0: None (Stop bit: 2 bits) 1: Even number parity (Stop bit: 1 bits) 2: Odd number parity (Stop bit: 1 bits) 3: None (Stop bit: 1 bits)	○	○	0
y07	(Stop bit selection)	0: 2 bits 1: 1 bit	○	○	0
y08	(Communication failure detection time)	0: No detection 1 to 60 s	○	○	0
y09	(Response interval time)	0.00 to 1.00 s	○	○	0.01
y10	(Protocol selection)	0: Modbus RTU protocol 1: SX protocol (Loader protocol) 2: Fuji general-purpose inverter protocol	○	○	1
y11	RS-485 setting 2 (Station address)	1 to 255	x	○	1
y12	(Mode selection upon occurrence of an error)	0: Immediate Er-P trip 1: Er-P trip after timer time operation 2: Retry communication during timer time operation and perform Er-P trip if communication cannot be recovered. When communication is recovered, continue to run. 3: Continue to run	○	○	0
y13	(Timer time)	0.0 to 60.0 s	○	○	2.0
y14	(Transmission speed)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	○	○	3
y15	(Data length selection)	0: 8 bits 1: 7 bits	○	○	0
y16	(Parity bit selection)	0: None (Stop bit: 2 bits) 1: Even number parity (Stop bit: 1 bits) 2: Odd number parity (Stop bit: 1 bits) 3: None (Stop bit: 1 bits)	○	○	0
y17	(Stop bit selection)	0: 2 bits 1: 1 bit	○	○	0
y18	(Communication failure detection time)	0: No detection 1 to 60 s	○	○	0
y19	(Response interval time)	0.00 to 1.00 s	○	○	0.01
y20	(Protocol selection)	0: Modbus RTU protocol 1: SX protocol (Loader protocol) 2: Fuji general-purpose inverter protocol	○	○	0
y21	Set embedded CAN (Station address)	1 to 127	x	○	1
y24	(Transmission speed)	0: 125kbps 1: 20kbit/s 2: 50kbit/s 3: 125kbit/s 4: 250kbit/s 5: 500kbit/s 6: 800kbit/s 7: 1Mbit/s	○	○	0
y25	(Assign write function code 1)	0000 to FFFF (in hexadecimal) Data mapped I/O (Write)	x	○	0000
y26	(Assign write function code 2)		x	○	0000
y27	(Assign write function code 3)		x	○	0000
y28	(Assign write function code 4)		x	○	0000
y29	(Assign write function code 5)		x	○	0000
y30	(Assign write function code 6)		x	○	0000
y31	(Assign write function code 7)		x	○	0000
y32	(Assign write function code 8)		x	○	0000

Function code	Name	Data setting range	Under operation Change	Data copy	Factory Default
y33	Set embedded CAN (Mode selection)	0: Disable 1: Enable	x	○	0
y34	(Mode selection in the event of transmission abnormal situation)	0 to 15 0: Upon occurrence of communication error, immediately perform Er-E trip. 1: After timer time operation from occurrence of communication error, immediately perform Er-E trip. 2: Upon occurrence of communication error, communication cannot be recovered by communication retry during timer time operation, immediately perform Er-E trip. 3: Even if communication error occurred, continue to run without Er-E occurrence. After communication is recovered, operate according to the communication command. 4 to 9: Same as 0. 10: After communication error occurred, stop deceleration and perform Er-E trip. 11: After timer time operation from occurrence of communication error, stop deceleration, and perform Er-E trip. 12: Upon occurrence of communication error, communication cannot be recovered by communication retry during timer time operation, stop deceleration. When communication is recovered, continue to run according to communication command. 13 to 15: Same as 3.	○	○	0
y35	(Transmission error timer time)	0.0 to 60.0	○	○	0.0
y95	Select data clear upon occurrence of communication abnormal situation	0: Upon alarm occurrence of communication abnormal state, no function code Sxx data clear (Existing mode compatible) 1: Upon alarm occurrence of communication abnormal state, function code S01, S05, S19 data clear 2: Upon alarm occurrence of communication abnormal state, bit clear for assigning operation command of function code S06 3: Above both 1 and 2 are clear operation * Target alarm is Er-8, Er-P, Er-4, Er-5, Er-E	○	○	0
y97	Communication data storing method selection	0: Store into nonvolatile memory (with restriction on the number of writes) 1: Write into temporary memory (no restriction on the number of writes) 2: All save from temporary memory to nonvolatile memory (After all save, return to Data 1)	○	○	0
y98	Bus link function (Mode selection)	Frequency command / Run command 0: Follow H30 / Follow H30 1: Command from bus link / Follow H30 2: Follow H30 / Command from bus link 3: Command from bus link / Command from bus link	○	○	0
y99	Link Function for Support (Mode selection)	Frequency command / Run command 0: Follow H30, y98 / Follow H30, y98 1: Command from FRENIC loader / Follow H30, y98 2: Follow H30, y98 / Command from FRENIC loader 3: Command from FRENIC loader / Command from FRENIC loader	○	x	0

■ K codes: Keypad functions for TP-A1

Function code	Name	Data setting range	Modification during operation	Data copy	Factory default
K01	Multifunction keypad TP-A1 (language selection)	0: Japanese 1: English 2: German 3: French 4: Spanish 5: Italian 6: Chinese 8: Russian 9: Greek 10: Turkish 11: Polish 12: Czech 13 Swedish 14: Portuguese 15 Dutch 16 Malay 17: Vietnamese 18: Thai 19: Indonesian 100: User-Customizable language	○	○	J: 0 C: 6 AEKT: 1
K02	(Backlight OFF time)	0: Always OFF 1 to 30 min	○	○	5
K03	(Backlight brightness adjustment)	0 (dark) - 10 (bright)	○	○	5
K04	(Contrast adjustment)	0 (low) - 10 (high)	○	○	5
K08	(LCD monitor status display)	0: Not displayed 1: Fully displayed	○	○	1
K15	(Sub-monitor display selection)	0: Operation guide display 1: Bar graph display	○	○	0
K16	(Sub-monitor 1 display selection)	13: Output current 14: Output voltage 18: Calculated torque 19: Input power 20: PID command value 22: PID feedback value 23: Timer value 24: PID output 25: Load factor 26: Motor output 27: Analog input monitor 35: Input watt-hour	○	○	13
K17	(Sub-monitor 2 display selection)		○	○	19
K20	(Bar graph 1 display selection)	1: Output frequency 1 (before slip compensation) 13: Output current 14: Output voltage 18: Calculated torque 19: Input power 25: Load factor 26: Motor output	○	○	1
K21	(Bar graph 2 display selection)		○	○	13
K22	(Bar graph 3 display selection)		○	○	19
K91	(< key shortcut selection)	0: disabled 11 to 99: respective mode	○	○	0
K92	(> key shortcut selection)		○	○	64

The keypad function K codes are used when the multi-function keypad (TP-A1) is connected. For details about the K codes, refer to the instruction manual for the keypad.

Table A Factory default value per applicable electric motor capacitance

Applicable electric motor capacitance [kW]	Torque boost 1 to 2 F09/ A05	Momentary power failure restart H13	Applicable electric motor capacitance [kW]	Torque boost 1 to 2 F09/ A05	Momentary power failure restart H13
0.4	7.1	0.5	55	0.0	1.5
0.75	6.5		75		
1.5	4.9		90		
2.2	4.5		110		
3.7	4.1		132		2.0
5.5	3.4		160		
7.5	2.7		200		2.5
11	2.1	1.0	220		
15	1.6		280		
18.5	1.3		315		4.0
22	1.1		355		
30	0.0		400		5.0
37			500		
45		1.5	630		

Table B Motor constant

[1] When Fuji standard motor 8-series, or other motors are selected by motor selection (Function code P99/ A39 = 0 or 4)

■ 3-phase 200V class

Motor capacity Setting range (kW) P02/A16	Applicable motor Capacitance (kW)	Rated current (A) P03/A17 *1	No-load current (A) P06/A20 *1	%R1 (%) P07/A21 *1	%X (%) P08/A22 *1	Rated slip frequency P12/A26	Iron loss factor 1 P13/A27	Starting Mode (Auto search delay time 2) H46
0.01 to 0.09	0.06	0.44	0.40	13.79	11.75	1.77	14.00	0.5
0.10 to 0.19	0.1	0.68	0.55	12.96	12.67	1.77	14.00	
0.20 to 0.39	0.2	1.30	1.06	12.95	12.92	2.33	12.60	
0.40 to 0.74	0.4	2.30	1.66	10.20	13.66	2.40	9.88	
0.75 to 1.49	0.75	3.60	2.30	8.67	10.76	2.33	7.40	
1.50 to 2.19	1.5	6.10	3.01	6.55	11.21	2.00	5.85	
2.20 to 3.69	2.2	9.20	4.85	6.48	10.97	1.80	5.91	0.6
3.70 to 5.49	3.7	15.00	7.67	5.79	11.25	1.93	5.24	0.8
5.50 to 7.49	5.5	22.50	11.00	5.28	14.31	1.40	4.75	1.0
7.50 to 10.99	7.5	29.00	12.50	4.50	14.68	1.57	4.03	1.2
11.00 to 14.99	11	42.00	17.70	3.78	15.09	1.07	3.92	1.3
15.00 to 18.49	15	55.00	20.00	3.25	16.37	1.13	3.32	2.0
18.50 to 21.99	18.5	67.00	21.40	2.92	16.58	0.87	3.34	
22.00 to 29.99	22	78.00	25.10	2.70	16.00	0.90	3.28	
30.00 to 36.99	30	107.0	38.90	2.64	14.96	0.80	3.10	2.3
37.00 to 44.99	37	130.0	41.50	2.76	16.41	0.80	2.30	2.5
45.00 to 54.99	45	156.0	47.50	2.53	16.16	0.80	2.18	
55.00 to 74.99	55	190.0	58.60	2.35	16.20	0.94	2.45	2.6
75.00 to 89.99	75	260.0	83.20	1.98	16.89	0.80	2.33	2.8
90.00 to 109.9	90	310.0	99.20	1.73	16.03	0.80	2.31	3.2
From 110.0	110	376.0	91.20	1.99	20.86	0.66	1.73	3.5

*1: F05: The value for the model, in which the base frequency voltage 1 is not 200V, becomes the optimal value, which is different from the above value.

Table B Motor constant (Cont.)

■ 3-phase 400V class

Motor capacity Setting range (kW) P02/A16	Applicable motor Capacitance (kW)	Rated current (A) P03/A17 *1	No-load current (A) P06/A20 *1	%R1 (%) P07/A21 *1	%X (%) P08/A22 *1	Rated slip frequency P12/A26	Iron loss factor 1 P13/A27	Starting Mode (Auto search delay time 2) H46
0.01 to 0.09	0.06	0.22	0.20	13.79	11.75	1.77	14.00	0.5
0.10 to 0.19	0.1	0.35	0.27	12.96	12.67	1.77	14.00	
0.20 to 0.39	0.2	0.65	0.53	12.95	12.92	2.33	12.60	
0.40 to 0.74	0.4	1.15	0.83	10.20	13.66	2.40	9.88	
0.75 to 1.49	0.75	1.80	1.15	8.67	10.76	2.33	7.40	
1.50 to 2.19	1.5	3.10	1.51	6.55	11.21	2.00	5.85	
2.20 to 3.69	2.2	4.60	2.43	6.48	10.97	1.80	5.91	0.6
3.70 to 5.49	3.7	7.50	3.84	5.79	11.25	1.93	5.24	0.8
5.50 to 7.49	5.5	11.50	5.50	5.28	14.31	1.40	4.75	1.0
7.50 to 10.99	7.5	14.50	6.25	4.50	14.68	1.57	4.03	1.2
11.00 to 14.99	11	21.00	8.85	3.78	15.09	1.07	3.92	1.3
15.00 to 18.49	15	27.50	10.00	3.25	16.37	1.13	3.32	2.0
18.50 to 21.99	18.5	34.00	10.70	2.92	16.58	0.87	3.34	
22.00 to 29.99	22	39.00	12.60	2.70	16.00	0.90	3.28	
30.00 to 36.99	30	54.00	19.50	2.64	14.96	0.80	3.10	2.3
37.00 to 44.99	37	65.00	20.80	2.76	16.41	0.80	2.30	2.5
45.00 to 54.99	45	78.00	23.80	2.53	16.16	0.80	2.18	
55.00 to 74.99	55	95.00	29.30	2.35	16.20	0.94	2.45	2.6
75.00 to 89.99	75	130.0	41.60	1.98	16.89	0.80	2.33	2.8
90.00 to 109.9	90	155.0	49.60	1.73	16.03	0.80	2.31	3.2
110.0 to 131.9	110	188.0	45.60	1.99	20.86	0.66	1.73	3.5
132.0 to 159.9	132	224.0	57.60	1.75	18.90	0.66	1.80	4.1
160.0 to 199.9	160	272.0	64.50	1.68	19.73	0.66	1.50	4.5
200.0 to 219.9	200	335.0	71.50	1.57	20.02	0.66	1.36	4.7
220.0 to 249.9	220	365.0	71.80	1.60	20.90	0.58	1.25	
250.0 to 279.9	250	415.0	87.90	1.39	18.88	0.54	1.33	5.0
280.0 to 314.9	280	462.0	93.70	1.36	19.18		1.27	5.5
315.0 to 354.9	315	520.0	120.0	0.84	16.68	0.45	1.81	5.6
355.0 to 399.9	355	580.0	132.0	0.83	16.40	0.43	1.77	
400.0 to 449.9	400	670.0	200.0	0.62	15.67	0.29	1.58	7.5
450.0 to 499.9	450	770.0	270.0	0.48	13.03	0.23	1.84	9.8
500.0 to 559.9	500	835.0		0.51	12.38	0.18	1.80	
560.0 to 629.9	560	940.0		0.57	13.94	0.20	1.61	
630.0 to 709.9	630	1050.0	355.0	0.46	11.77	0.17	1.29	10.5
From 710.0	710	1150.0	290.0	0.54	14.62	0.21	0.97	

*1: F05: The value for the model, in which the base frequency voltage 1 is not 400V, becomes the optimal value, which is different from the above value.

Table B Motor constant (Cont.)

[2] When HP display motor is selected by motor selection (Function code P99/A39 = 1)

■ 200V class

Motor capacity Setting range (kW) P02/A16	Applicable motor Capacitance (kW)	Rated current (A) P03/A17	No-load current (A) P06/A20	%R1 (%) P07/A21	%X (%) P08/A22	Rated slip frequency P12/A26	Iron loss factor 1 P13/A27	Starting Mode (Auto search delay time 2) H46
0.01 to 0.11	0.1	0.44	0.40	13.79	11.75	2.50	14.00	0.5
0.12 to 0.24	0.12	0.68	0.55	12.96	12.67	2.50	14.00	
0.25 to 0.49	0.25	1.40	1.12	11.02	13.84	2.50	12.60	
0.50 to 0.99	0.5	2.00	1.22	6.15	8.80	2.50	9.88	
1.00 to 1.99	1	3.00	1.54	3.96	8.86	2.50	7.40	
2.00 to 2.99	2	5.80	2.80	4.29	7.74	2.50	5.85	
3.00 to 4.99	3	7.90	3.57	3.15	20.81	1.17	5.91	0.6
5.00 to 7.49	5	12.6	4.78	3.34	23.57	1.50	5.24	0.8
7.50 to 9.99	7.5	18.6	6.23	2.65	28.91	1.17	4.75	1.0
10.00 to 14.99	10	25.3	8.75	2.43	30.78	1.17	4.03	1.2
15.00 to 19.99	15	37.3	12.7	2.07	29.13	1.00	3.92	1.3
20.00 to 24.99	20	49.1	9.20	2.09	29.53	1.00	3.32	2.0
25.00 to 29.99	25	60.0	16.70	1.75	31.49	1.00	3.34	
30.00 to 39.99	30	72.4	19.80	1.90	32.55	1.00	3.28	
40.00 to 49.99	40	91.0	13.60	1.82	25.32	0.47	3.10	2.3
50.00 to 59.99	50	115.0	18.70	1.92	24.87	0.58	2.30	2.5
37.00 to 44.99	60	137.0	20.80	1.29	26.99	0.35	2.18	
75.00 to 99.99	75	174.0	28.60	1.37	27.09	0.35	2.45	2.6
100.0 to 124.9	100	226.0	37.40	1.08	23.80	0.23	2.33	2.8
125.0 to 149.9	125	268.0	29.80	1.05	22.90	0.35	2.31	3.2
From 150.0	150	337.0	90.40	0.96	21.61	0.39	1.73	3.5

Table B Motor constant (Cont.)

■ 400V class

Motor capacity Setting range (kW) P02/A16	Applicable motor Capacitance (kW)	Rated current (A) P03/A17	No-load current (A) P06/A20	%R1 (%) P07/A21	%X (%) P08/A22	Rated slip frequency P12/A26	Iron loss factor 1 P13/A27	Starting Mode (Auto search delay time 2) H46
0.01 to 0.11	0.1	0.22	0.20	13.79	11.75	2.50	14.00	0.5
0.12 to 0.24	0.12	0.34	0.27	12.96	12.67	2.50	14.00	
0.25 to 0.49	0.25	0.70	0.56	11.02	13.84	2.50	12.60	
0.50 to 0.99	0.5	1.00	0.61	6.15	8.80	2.50	9.88	
1.00 to 1.99	1	1.50	0.77	3.96	8.86	2.50	7.40	
2.00 to 2.99	2	2.90	1.40	4.29	7.74	2.50	5.85	
3.00 to 4.99	3	4.00	1.79	3.15	20.81	1.17	5.91	0.6
5.00 to 7.49	5	6.30	2.39	3.34	23.57	1.50	5.24	0.8
7.50 to 9.99	7.5	9.30	3.12	2.65	28.91	1.17	4.75	1.0
10.00 to 14.99	10	12.7	4.37	2.43	30.78	1.17	4.03	1.2
15.00 to 19.99	15	18.7	6.36	2.07	29.13	1.00	3.92	1.3
20.00 to 24.99	20	24.6	4.60	2.09	29.53	1.00	3.32	2.0
25.00 to 29.99	25	30.0	8.33	1.75	31.49	1.00	3.34	
30.00 to 39.99	30	36.2	9.88	1.90	32.55	1.00	3.28	
40.00 to 49.99	40	45.5	6.80	1.82	25.32	0.47	3.10	2.3
50.00 to 59.99	50	57.5	9.33	1.92	24.87	0.58	2.30	2.5
60.00 to 74.99	60	68.7	10.4	1.29	26.99	0.35	2.18	
75.00 to 99.99	75	86.9	14.3	1.37	27.09	0.35	2.45	2.6
100.0 to 124.9	100	113.0	18.7	1.08	23.80	0.23	2.33	2.8
125.0 to 149.9	125	134.0	14.9	1.05	22.90	0.35	2.31	3.2
150.0 to 174.9	150	169.0	45.2	0.96	21.61	0.39	1.73	3.5
175.0 to 199.9	175	188.5	45.2	0.96	21.61	0.39	1.80	4.1
200.0 to 249.9	200	231.0	81.8	0.72	20.84	0.23	1.50	4.5
250.0 to 299.9	250	272.0	41.1	0.71	18.72	0.35	1.36	4.7
300.0 to 324.9	300	323.0	45.1	0.53	18.44	0.23	1.25	
325.0 to 349.9	325	342.9	45.1	0.53	18.44	0.23	1.33	5.0
350.0 to 399.9	350	375.0	68.3	0.99	19.24	0.46	1.27	5.5
400.0 to 449.9	400	429.0	80.7	1.11	18.92	0.46	1.81	5.6
450.0 to 499.9	450	481.0	85.5	0.95	19.01	0.48	1.77	
500.0 to 599.9	500	534.0	99.2	1.05	18.39	0.45	1.58	7.5
600.0 to 699.9	600	638.0	140.0	0.85	18.38	0.39	1.84	9.8
700.0 to 749.9	700						1.70	
750.0 to 799.9	750							
From 800.0	800							10.5

Chapter 6 TROUBLESHOOTING

6.1 Protective Function

FRENIC-Ace is provided with various protective functions shown in Table below to prevent system down or to shorten a downtime. The protective functions marked with an asterisk (*) in the table are disabled by factory default. Enable them according to your needs.
The protective functions include, for example, the "heavy alarm" detection function which, upon detection of an abnormal state, displays the alarm code on the LED monitor and causes the inverter to trip, the "light alarm" detection function which displays the alarm code but lets the inverter continue the current operation, and other warning signal output functions.
If any problem arises, understand the protective functions listed below and follow the procedures given in Sections 6.2 and onwards for troubleshooting.

Table 6.1 "Abnormal States Detectable ("Heavy Alarm" and "Light Alarm" Objects)

Protective function	Description	Relative function code
"Heavy alarm" detection	This function detects an abnormal state, displays the corresponding alarm code, and causes the inverter to trip. See Table 6.3-1 “Various failure detections (Heavy alarm objects)” for alarm codes. For details of each alarm code, see the corresponding item in the troubleshooting in Section 6.3. The inverter retains the last four alarm codes and their factors together with their running information applied when the alarm occurred, so it can display them.	H98
"Light alarm" detection*	This function detects an abnormal state categorized as a "light alarm," displays *l-al* and lets the inverter continue the current operation without tripping. Details of light alarms are selectable. Selectable details (codes) are codes shown in Table 6.3-1 "Various failure detections (light alarm objects)." See Section 6.4 for the confirming method and releasing method of the light alarms.	H81 H82
Stall prevention	When the output current exceeds the current limiter level (F44) during acceleration/ deceleration or constant speed running, this function decreases the output frequency to avoid an overcurrent trip.	F44
Overload prevention control*	Before the inverter trips due to a cooling fin overheat (*0h1*) or inverter overload (*0lu*), this function decreases the output frequency of the inverter to reduce the load.	H70
Anti-regenerative control*	If regenerative energy returned exceeds the inverter's braking capability, this function automatically increases the deceleration time or controls the output frequency to avoid an overvoltage trip.	H69
Deceleration characteristics* (Improvement of braking performance)	During deceleration, this function increases the motor energy loss and decreases the regenerative energy returned to avoid an overvoltage trip (*0u*).	H71
Reference loss detection*	This function detects a frequency reference loss (due to a broken wire, etc.), issues the alarm, and continues the inverter operation at the specified frequency.	E65
Automatic lowering of carrier frequency	Before the inverter trips due to an abnormal surrounding temperature or output current, this function automatically lowers the carrier frequency to avoid a trip.	H98
Motor overload early warning*	When the inverter output current has exceeded the specified level, this function issues the "Motor overload early warning" signal before the thermal overload protection function causes the inverter to trip for motor protection. (Only for the 1st motor)	E34 E35
Retry*	When the inverter has stopped because of a trip, this function allows the inverter to automatically reset and restart itself. (The number of retries and the latency between stop and reset can be specified.))	H04 H05
Forced stop*	Upon receipt of the "Force to stop" terminal command STOP, this function interrupts the run and other commands currently applied in order to forcedly decelerate the inverter to a stop.	H56
Surge protection	This function protects the inverter from a surge voltage invaded between main circuit power lines and the ground.	-
Momentary power failure protection*	• If a momentary power failure for 15 ms or longer occurs, a protective operation (inverter stop) is activated. • When momentary power failure restart is selected, the inverter is restarted responding to voltage restoration within a set-up time (momentary power failure permissible time).	F14

6.2 Before Proceeding with Troubleshooting

⚠WARNING

- If any of the protective functions has been activated, first remove the cause. Then, after checking that the all run commands are set to OFF, release the alarm. If the alarm is released while any run commands are set to ON, the inverter may supply the power to the motor, running the motor.
  Injury may occur.
- Even though the inverter has interrupted power to the motor, if the voltage is applied to the main circuit input terminals L1/R, L2/S and L3/T, voltage may be output to inverter output terminals U, V, and W.
- Turn OFF the power and wait for at least five minutes for inverters with a capacity of FRN0072E2S-4□ or below, or at least ten minutes for inverters with a capacity of FRN0085E2S-4□ or above. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC intermediate circuit voltage between the terminals P (+) and N (-) has dropped to the safe level (+25 VDC or below).
  Electric shock may occur.

Follow the procedure below to solve problems.

(1) Is wire connection correct?
See Chapter 2 "2.2.1 Basic Connection Diagram."

(2) Check whether an alarm code or the "light alarm" indication (L-AL) is displayed on the LED monitor.

- When an alarm code (excluding light alarms) is displayed — To User's Manual, Sect. 6.3
- If the “Light Alarm” Indication (L-AL) Appears on the LED Monitor — To User's Manual, Sect. 6.4
- When codes other than alarm codes and light alarm indication (L-AL) are displayed — To User's Manual, Sect. 6.5

Abnormal motor operation — To Section 6.5.1

- 6.5.1 [1] The motor does not rotate.
- 6.5.1 [2] The motor rotates, but the speed does not increase.
- 6.5.1 [3] The motor runs in the reverse direction to the command.
- 6.5.1 [4] Speed fluctuation or current oscillation (e.g., hunting) occurs during running at constant speed.
- 6.5.1 [5] Unpleasant noises are emitted from motor or noises fluctuate.
- 6.5.1 [6] The motor is not accelerated or decelerated according to setup acceleration or deceleration time.
- 6.5.1 [7] The motor does not restart even after the power recovers from a momentary power failure.
- 6.5.1 [8] Motor generates heat abnormally.
- 6.5.1 [9] The motor does not run as expected.
- 6.5.1 [10] Motor stalls during acceleration.

Problems with inverter settings — To Section 6.5.2

- 6.5.2 [1] Nothing appears on the LED monitor.
- 6.5.2 [2] The desired menu is not displayed.
- 6.5.2 [3] Display of under bars(_ _ _ _)
- 6.5.2 [4] Display of cenfer bars(- - - -)
- 6.5.2 [5] [ ] Display of parenthesis
- 6.5.2 [6] Data of fuction codes cannot be changed.
- 6.5.2 [7] Function code data are not changeable (change from link functions)

If any problems persist after the above recovery procedure, contact your Fuji Electric representative.

6.3 If an Alarm Code Appears on the LED Monitor

6.3.1 Alarm code list

When an alarm is detected, check an alarm code displayed on 7-segment LED of keypad.

When one alarm code has plural factors, alarm subcodes are provided to make it easy to identify causes. When a factor is one, the alarm subcode is displayed as "-" and described as "-."

* See the User's Manual (Chapter 3 “3.4.6 Reading alarm information”) for the check method of the alarm codes.

* With regard to alarm details having alarm subcodes name“for manufacturer”, inform us of the alarm subcodes, too, when contacting us or requesting an inverter repair.

Table 6.3-1 Various failure detections (Heavy failure objects)

Alarm code	Alarm code name	Heavy failure object	Light alarm selectable	Retry object	Alarm subcode*	Alarm subcode name
CoF	PID feedback wire break	○	○	-	-	-
dbA	Braking transistor broken	○	-	-	-	-
dbH	Braking resistor overheat (FRN0072E2S-4□ or below)	○	○	○	0	DB resistor overheat
					1	For manufacturer
ECF	EN circuit failure	○	-	-	10	ASIC alarm for functional safety
					3000	Erroneous detection of STO input
					Other than above	For manufacturer
ECL	Customized logic failure	○	-	-	-	-
EF	Ground fault (FRN0085E2S-4□ or above)	○	-	-	-	-
Er 1	Memory error	○	-	-	1 to 16	For manufacturer
Er2	Keypad communications error	○	-	-	1 to 2	For manufacturer
Er3	CPU error	○	-	-	1 to 9000	For manufacturer
Er4	Option communications error	○	○	-	1	For manufacturer
Er5	Option error (To be responded soon.)	○	○	-	0	Time-out
					1 to 10	For manufacturer
Er6	Operation error	○	-	-	1	STOP key priority/forced stop (STOP terminal)
					2	Start check function
					3	Start check function (when operation is permitted)
					4	Start check function (when reset is turned on)
					5	Start check function (when the power recovers in powering on)
					6	Start check function (TP connection)
					8 to 14	For manufacturer

Continuation of Table 6.3-1

Alarm code	Alarm code name	Heavy failure object	Light alarm selectable	Retry object	Alarm subcode*	Alarm subcode name
Er 7	Tuning error	○	-	-	7	Operation command OFF during motor tuning
					8	Forced stop during motor tuning
					9	BX command during motor tuning
					10	Hardware current limit during motor tuning
					11	Occurrence of low voltage (LV) during motor tuning
					12	Failure due to prevention of reverse rotation during motor tuning
					13	Over upper limit frequency during motor tuning
					14	Switching to commercial power during motor tuning
					15	Occurrence of alarm during motor tuning
					16	Change of run command source during motor tuning
					18	Over acceleration time during motor tuning
					24	EN terminal failure during motor tuning
					Other than above	For manufacturer
Er8	RS-485 communications error (Communication port 1)	○	○	-	-	-
Erd	Detection of step-out (To be responded soon.)	○	-	-	5001 to 5008	For manufacturer
ErE	Speed inconsistency/ excessive speed deviation (To be responded soon.)	○	○	-	1	Signs of speed command and speed detection are inconsistent.
					3	In the case of excessive speed deviation (|detected speed|>|speed command|)
					5	Detected speed remains 0Hz irrespective of speed command.
					7	In the case of excessive speed deviation (|detected speed|<|speed command|)
ErF	Data saving error during undervoltage	○	-	-	-	-
Ero	Positioning control error (To be responded soon.)	○	○	-	1 to 5	For manufacturer
ErP	RS-485 communications error (Communication port 2)	○	○	-	-	-
Err	Simulated failure	○	-	-	-	-
ErE	CAN communications failure	○	-	-	1 to 2	For manufacturer
FuS	DC fuse-blowing (The capacity is not determined yet.)	○	-	-	-	-

Continuation of Table 6.3-1

Alarm code	Alarm code name	Heavy failure object	Light alarm selectable	Retry object	Alarm subcode*	Alarm subcode name
Lin	Input phase loss	○	-	-	1-2	For manufacturer
LU	Undervoltage	○	-	-	1	Occurrence of low voltage during gate on (F14=0)
					2	Timer time and run command ON during low voltage (F14=0, 2)
					3	LV trip on power recovery from a momentary power failure (F14=1)
					4 to 5	For manufacturer
OC1	Instantaneous overcurrent	○	-	○	1 to 5001	For manufacturer
OC2						
OC3						
OH1	Cooling fin overheat	○	○	○	6	Detection of fan stop
					Other than above	For manufacturer
OH2	External alarm	○	○	-	-	-
OH3	Inverter internal overheat	○	○	○	0	Interior air overheat
					1	Charging resistor overheat
					Other than above	For manufacturer
OH4	Motor protection (PTC thermistor)	○	-	○	-	-
OL1	Motor 1 overload	○	○	○	-	-
OL2	Motor 2 overload	○	○	○	-	-
OLU	Inverter overload	○	-	○	1	IGBT protection
					2	Inverter overload
					10	For manufacturer
OPL	Output phase-failure detection	○	-	-	1 to 10	For manufacturer
OS	Overspeed protection	○	-	-	-	-
OU1	Overvoltage	○	-	○	1 to 12	For manufacturer
OU2						
OU3						
PbF	Charging circuit failure (FRN0203E2S-4□ or above)	○	-	-	1 to 2	For manufacturer
PG	PG wire break (To be responded soon.)	○	-	-	10 to 20	For manufacturer

NB) • If a control power supply voltage drops to such a level that the operation of the inverter control circuit cannot be maintained, all protective functions are automatically reset.

• By OFF → ON operation between (PRG/RESET) key or X terminal (assigned to RST) and CM of the keypad, the protection stop state can be released. In a state that an alarm factor is not removed, however, resetting operation fails to become effective.

• If two or more alarms are occurring, the resetting operation remains ineffective until all the alarm factors are removed.
(Alarm factors not removed can be checked from the keypad.)

• When assigned to light alarms, "30A/B/C" do not work.

Chapter 7 MAINTENANCE AND INSPECTION

Perform daily and periodic inspections to avoid trouble and keep reliable operation of the inverter for a long time. When performing inspections, follow the instructions given in this chapter.

⚠WARNING⚠

- Before proceeding to the maintenance/inspection jobs, **turn OFF the power and wait at least five minutes for inverters FRN0072E2S-4□ or below, or at least ten minutes for inverters FRN0085E2S-4□ or above**. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

  Electric shock may occur.
- Maintenance, inspection, and parts replacement should be made only by authorized persons.
- Take off the watch, rings and other metallic objects before starting work.
- Use insulated tools.
- Never modify the inverter.

  Electric shock or injuries could occur.

7.1 Inspection Interval

Table 7.1-1 lists the inspection intervals and check items, as a guide.

Table 7.1-1 List of Inspections

Inspection type	Inspection interval	Check items
Daily inspection	Every day	See Section 7.2.
Periodic inspection	Every year	See Section 7.3.
Decennial inspection *1	Every 10 years *2	Replacement of cooling fans *3 Replacement of DC link bus capacitors and close checks

*1 The decennial inspection (except replacement of cooling fans) should be performed only by the persons who have finished the Fuji Electric training course. Contact the sales agent where you purchased the product or your nearest Fuji Electric representative.

*2 Every 7 years for ND-mode inverters.

*3 For the standard replacement interval of cooling fans, refer to Section 7.4 "List of Periodic Replacement Parts."

Note The replacement intervals are based on the inverter's service life estimated at an ambient temperature of 40°C at 100% (HHD-mode inverters) or 80% (ND-/HD-/HND-mode inverters) of full load. In environments with an ambient temperature above 40°C or a large amount of dust or dirt, the replacement intervals may be shorter.

Standard replacement intervals mentioned above are only a guide for replacement, not a guaranteed service life. Refer to Section 7.4 "List of Periodic Replacement Parts."

7.2 Daily Inspection

Visually inspect the inverter for operation errors from the outside without removing the covers when the inverter is running or the power is ON.

Table 7.2-1 lists daily inspection items.

Table 7.2-1 Daily Inspection List

Check part	Check item	How to inspect	Evaluation criteria
Environment	1) Check the surrounding temperature, humidity, vibration and atmosphere (dust, gas, oil mist, or water drops). 2) Check that tools or other foreign materials or dangerous objects are not left around the equipment.	1) Check visually or measure using apparatus. 2) Visual inspection	1) The usage environment given in Chapter 1, Section 1.3.1 must be satisfied. 2) No foreign or dangerous objects are left.
External appearance and others	1) Check that the bolts securing the wires to the main circuit terminals and control circuit terminals are not loose before turning the power ON. 2) Check for traces of overheat, discoloration and other defects. 3) Check for abnormal noise, odor, or excessive vibration.	1) Retighten before turning the power ON. 2) Visual inspection 3) Auditory, visual, and olfactory inspection	1) No looseness. If loose, retighten the screws. 2), 3) No abnormalities
Cooling fans	Check for abnormal noise or excessive vibration when the cooling fans are in operation.	Auditory and visual inspections	No abnormalities
Keypad	Check for alarm indication.	Visual inspection	If any alarm is displayed, refer to Chapter 6.
Performance	Check that the inverter provides the expected performance (as defined in the standard specifications).	Check the monitor items shown on the keypad.	No abnormalities in the output speed, current and voltage and other running data.

7.3 Periodic Inspection

[1] Periodic inspection 1--Before the inverter is powered ON or after it stops running

Perform periodic inspections according to the items listed in Table 7.3-1. Before performing periodic inspection 1, shut down the power and then remove the front cover.

Even if the power has been shut down, it takes the time for the DC link bus capacitor to discharge. After the charging lamp is turned OFF, therefore, make sure that the DC link bus voltage has dropped to the safe level (+25 VDC or below) using a multimeter or a similar instrument.

Table 7.3-1 Periodic Inspection List 1

Check part		Check item	How to inspect	Evaluation criteria
Structure such as frame and cover		Check for: 1) Loose bolts (at clamp sections). 2) Deformation and breakage 3) Discoloration caused by overheat 4) Contamination and accumulation of dust or dirt	1) Retighten. 2), 3), 4) Visual inspection	1), 2), 3), 4) No abnormalities (If any section is stained, clean it with a soft cloth.)
Main circuit	Common	1) Check that bolts and screws are tight and not missing. 2) Check the devices and insulators for deformation, cracks, breakage and discoloration caused by overheat or deterioration. 3) Check for contamination or accumulation of dust or dirt.	1) Retighten. 2), 3) Visual inspection	1), 2), 3) No abnormalities (If any section is stained, clean it with a soft cloth.)
	Conductors and wires	1) Check conductors for discoloration and distortion caused by overheat. 2) Check the sheath of the wires for cracks and discoloration.	1), 2) Visual inspection	1), 2) No abnormalities
	Terminal blocks	Check that the terminal blocks are not damaged.	Visual inspection	No abnormalities
	DC link bus capacitor	1) Check for electrolyte leakage, discoloration, cracks and swelling of the casing. 2) Check that the safety valve does not protrude remarkably.	1), 2) Visual inspection	1), 2) No abnormalities
	Braking resistor	1) Check for abnormal odor or cracks in insulators caused by overheat. 2) Check for wire breakage.	1) Olfactory and visual inspection 2) Check the wires visually, or disconnect either one of the wires and measure the conductivity with a multimeter.	1) No abnormalities 2) Within ±10% of the resistance of the braking resistor
Control circuit	Printed circuit board	1) Check for loose screws and connectors. 2) Check for odor and discoloration. 3) Check for cracks, breakage, deformation and remarkable rust. 4) Check the capacitors for electrolyte leaks and deformation.	1) Retighten. 2) Olfactory and visual inspection 3), 4) Visual inspection * Judgment on service life using "Menu #5 Maintenance Information" in Section 3.4.5.	1), 2), 3), 4) No abnormalities
Cooling system	Cooling fan	1) Check for engagement or abnormal vibration. 2) Check for loose bolts. 3) Check for discoloration caused by overheat.	1) Turn by hand. (Be sure to turn the power OFF beforehand.) 2) Retighten. 3) Visual inspection * Judgment on service life using "Menu #5 Maintenance Information" in Section 3.4.5.	1) Smooth rotation 2), 3) No abnormalities
	Ventilation path	Check the heat sink, intake and exhaust ports for clogging and foreign materials.	Visual inspection	No clogging or accumulation of dust, dirt or foreign materials. Clean it, if any, with a vacuum cleaner.

[2] Periodic inspection 2--When the inverter is ON or it is running

Visually inspect the inverter for operation errors from the outside without removing the covers when the inverter is ON or it is running.

Perform periodic inspections according to the items listed in Table 7.3-2

Table 7.3-2 Periodic Inspection List 2

Check part		Check item	How to inspect	Evaluation criteria
Input voltage		Check that the input voltages of the main and control circuits are correct.	Measure the input voltages using a multimeter or the like.	The standard specifications must be satisfied.
Structure such as chassis and covers		Check for abnormal noise or excessive vibration when the inverter is running.	Visual and auditory inspections	No abnormalities
Main circuit	Transformers and reactors	Check for abnormal roaring noise or odor when the inverter is running.	Auditory, visual, and olfactory inspections	No abnormalities
	Magnetic contactors and relays	Check for chatters when the inverter is running.	Auditory inspection	No abnormalities
	DC link bus capacitor	Measure the capacitance if necessary.	Judgment on service life using "Menu #5 Maintenance Information (5.LIFE)" in Chapter 3, Section 3.4.5.	Capacitance ≥ Initial value x 0.85
Cooling fans		Check for abnormal noise or excessive vibration when the inverter is running.	Visual and auditory inspections	No abnormalities

Additional notes

(1) The inspection interval (every year) of check items given in Table 7.3-1 and Table 7.3-2 is merely a guide. Make the interval shorter depending on the usage environment.

(2) Store and organize the inspection results to utilize them as a guide for operation and maintenance of the equipment and service life estimation.

(3) At the time of an inspection, check the cumulative run times on the keypad to utilize them as a guide for replacement of parts. (Refer to the User's Manual, Section 7.4.1 "Judgment on service life.")

(4) The inverter has cooling fans inside to ventilate itself for discharging the heat generated by the power converter section. This will accumulate dust or dirt on the heat sink depending on the ambient environment.

In a dusty environment, the heat sink requires cleaning in a shorter interval than that specified in periodic inspection. Neglecting cleaning of the heat sink can rise its temperature, activating protective circuits to lead to an abrupt shutdown or causing the temperature rise of the surrounding electronic devices to adversely affect their service life.

7.4 List of Periodic Replacement Parts

Each part of the inverter has its own service life that will vary according to the environmental and operating conditions. It is recommended that the following parts be replaced at the specified intervals.

When the replacement is necessary, consult your Fuji Electric representative.

Table 7.4-1 Replacement Parts

Part name	Standard replacement intervals (See **Note** below.)
DC link bus capacitor	10 years (7 years in the ND mode)
Electrolytic capacitors on printed circuit boards	10 years (7 years in the ND mode)
Cooling fans	10 years (7 years in the ND mode)
Fuses	10 years (7 years in the ND mode)

Note These replacement intervals are based on the inverter's service life estimated at a surrounding temperature of 40°C at 100% (HHD-mode inverters) or 80% (ND-/HD-/HND-mode inverters) of full load. In environments with an ambient temperature above 40°C or a large amount of dust or dirt, the replacement intervals may be shorter.

Notes for periodic replacement of parts

(1) The replacement intervals listed above are a guide for almost preventing parts from failure if those parts are replaced with new ones at the intervals. They do not guarantee the completely fault-free operation.

(2) The table above does not apply to unused spare parts being kept in storage.

It applies only when they are stored under the temporary and long-term storage conditions given in Chapter 1, Section 1.3.2 "Storage environment" and energized approximately once a year.

(3) Cooling fans can be replaced by users. As for other parts, only the persons who have finished the Fuji Electric training course can replace them. For the purchase of spare cooling fans and the request for replacement of other parts, contact the sales agent where you purchased the product or your nearest Fuji Electric representative.

7.5 Measurement of Electrical Amounts in Main Circuit

Because the voltage and current of the power supply (input, primary circuit) of the main circuit of the inverter and those of the motor (output, secondary circuit) contain harmonic components, the readings may vary with the type of the meter. Use meters indicated in Table 7.5-1 when measuring with meters for commercial frequencies.

The power factor cannot be measured by a commercially available power-factor meter that measures the phase difference between the voltage and current. To obtain the power factor, measure the power, voltage and current on each of the input and output sides and use the following formula.

■ Three-phase input

$$\text{Power factor} = \frac{\text{Electric power (W)}}{\sqrt{3} \times \text{Voltage (V)} \times \text{Current (A)}} \times 100\ \%$$

Table 7.5-1 Meters for Measurement of Main Circuit

Item	Input (primary) side			Output (secondary) side			DC link bus voltage (P(+)-N(-))
Waveform	Voltage / Current			Voltage / Current			—
Name of meter	Ammeter AR, AS, AT	Voltmeter VR, VS, VT	Wattmeter WR, WT	Ammeter AU, AV, AW	Voltmeter VU, VV, VW	Wattmeter WU, WW	DC voltmeter V
Type of meter	Moving iron type	Rectifier or moving iron type	Digital AC power meter	Digital AC power meter	Digital AC power meter	Digital AC power meter	Moving coil type
Symbol of meter			—	—	—	—	

Note It is not recommended that meters other than a digital AC power meter be used for measuring the output voltage or output current since they may cause larger measurement errors or, in the worst case, they may be damaged.

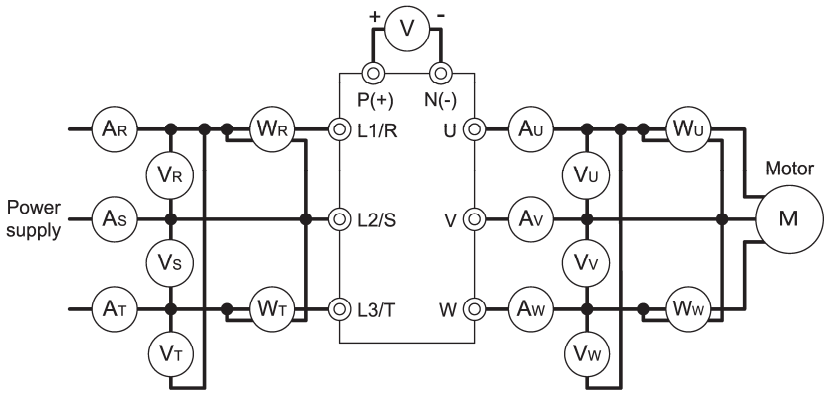


Figure 7.5-1 Connection of Meters

7.6 Insulation Test

Since the inverter has undergone an insulation test before shipment, avoid making a Megger test at the customer's site.

If a Megger test is unavoidable for the main circuit, observe the following instructions; otherwise, the inverter may be damaged.

A withstand voltage test may also damage the inverter if the test procedure is wrong. When the withstand voltage test is necessary, consult your Fuji Electric representative.

(1) Megger test of main circuit

1) Use a 500 VDC Megger and shut off the main power supply without fail before measurement.
2) If the test voltage leaks to the control circuit due to the wiring, disconnect all the wiring from the control circuit.
3) Connect the main circuit terminals with a common line as shown in Figure 7.6-1.
4) The Megger test must be limited to across the common line of the main circuit and the ground (⏚).
5) Value of 5 MΩ or more displayed on the Megger indicates a correct state. (The value is measured on an inverter alone.)

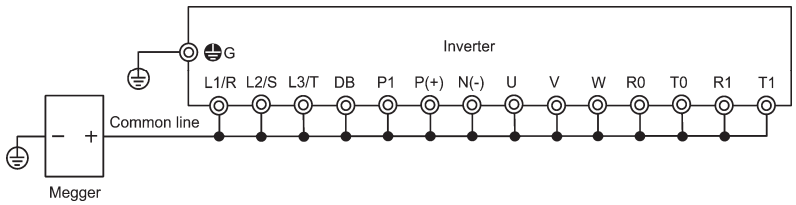


Figure 7.6-1 Main Circuit Terminal Connection for Megger Test

(2) Insulation test of control circuit

Do not make a Megger test or withstand voltage test for the control circuit. Use a high resistance range tester for the control circuit.

1) Disconnect all the external wiring from the control circuit terminals.
2) Perform a continuity test to the ground. One MΩ or a larger measurement indicates a correct state.

(3) Insulation test of external main circuit and sequence control circuit

Disconnect all the wiring connected to the inverter so that the test voltage is not applied to the inverter.

7.7 Inquiries about Product and Guarantee

7.7.1 When making an inquiry

Upon breakage of the product, uncertainties, failure or inquiries, inform your Fuji Electric representative of the following information.

1) Inverter type (Refer to Chapter 1, Section 1.1 "Acceptance Inspection (Nameplates and Inverter Type.")
2) SER No. (serial number of equipment) (Refer to Chapter 1, Section 1.1 "Acceptance Inspection (Nameplates and Inverter Type.")
3) Function codes and their data that you changed (Refer to Chapter 3, Section 3.4.2 "Checking changed function codes.")
4) ROM version (Refer to the maintenance item 5_ 14 in Chapter 3, Section 3.4.5 "Reading maintenance information.")
5) Date of purchase
6) Inquiries (for example, point and extent of breakage, uncertainties, failure phenomena, and other circumstances)

7.7.2 Product warranty

To all our customers who purchase Fuji Electric products included in this documentation:

Please take the following items into consideration when placing your order.

When requesting an estimate and placing your orders for the products included in these materials, please be aware that any items such as specifications which are not specifically mentioned in the contract, catalog, specifications or other materials will be as mentioned below.

In addition, the products included in these materials are limited in the use they are put to and the place where they can be used, etc., and may require periodic inspection. Please confirm these points with your sales representative or directly with this company.

Furthermore, regarding purchased products and delivered products, we request that you take adequate consideration of the necessity of rapid receiving inspections and of product management and maintenance even before receiving your products.

[1] Free of charge warranty period and warranty range

(1) Free of charge warranty period

1) The product warranty period is "1 year from the date of purchase" or 24 months from the manufacturing date imprinted on the name place, whichever date is earlier.
2) However, in cases where the use environment, conditions of use, use frequency and times used, etc., have an effect on product life, this warranty period may not apply.
3) Furthermore, the warranty period for parts restored by Fuji Electric's Service Department is "6 months from the date that repairs are completed."

(2) Warranty range

1) In the event that breakdown occurs during the product's warranty period which is the responsibility of Fuji Electric, Fuji Electric will replace or repair the part of the product that has broken down free of charge at the place where the product was purchased or where it was delivered. However, if the following cases are applicable, the terms of this warranty may not apply.

   ① The breakdown was caused by inappropriate conditions, environment, handling or use methods, etc. which are not specified in the catalog, operation manual, specifications or other relevant documents.

   ② The breakdown was caused by the product other than the purchased or delivered Fuji's product.

   ③ The breakdown was caused by the product other than Fuji's product, such as the customer's equipment or software design, etc.

   ④ Concerning the Fuji's programmable products, the breakdown was caused by a program other than a program supplied by this company, or the results from using such a program.

   ⑤ The breakdown was caused by disassembly, modifications or repairs affected by a party other than Fuji Electric.

   ⑥ The breakdown was caused by improper maintenance or replacement using consumables, etc. specified in the operation manual or catalog, etc.

   ⑦ The breakdown was caused by a science or technical problem that was not foreseen when making practical application of the product at the time it was purchased or delivered.

⑧ The product was not used in the manner the product was originally intended to be used.

⑨ The breakdown was caused by a reason which is not this company's responsibility, such as lightning or other disaster.

2) Furthermore, the warranty specified herein shall be limited to the purchased or delivered product alone.

3) The upper limit for the warranty range shall be as specified in item (1) above and any damages (damage to or loss of machinery or equipment, or lost profits from the same, etc.) consequent to or resulting from breakdown of the purchased or delivered product shall be excluded from coverage by this warranty.

(3) Trouble diagnosis

As a rule, the customer is requested to carry out a preliminary trouble diagnosis. However, at the customer's request, this company or its service network can perform the trouble diagnosis on a chargeable basis. In this case, the customer is asked to assume the burden for charges levied in accordance with this company's fee schedule.

[2] Exclusion of liability for loss of opportunity, etc.

Regardless of whether a breakdown occurs during or after the free of charge warranty period, this company shall not be liable for any loss of opportunity, loss of profits, or damages arising from special circumstances, secondary damages, accident compensation to another company, or damages to products other than this company's products, whether foreseen or not by this company, which this company is not be responsible for causing.

[3] Repair period after production stop, spare parts supply period (holding period)

Concerning models (products) which have gone out of production, this company will perform repairs for a period of 7 years after production stop, counting from the month and year when the production stop occurs. In addition, we will continue to supply the spare parts required for repairs for a period of 7 years, counting from the month and year when the production stop occurs. However, if it is estimated that the life cycle of certain electronic and other parts is short and it will be difficult to procure or produce those parts, there may be cases where it is difficult to provide repairs or supply spare parts even within this 7-year period. For details, please confirm at our company's business office or our service office.

[4] Transfer rights

In the case of standard products which do not include settings or adjustments in an application program, the products shall be transported to and transferred to the customer and this company shall not be responsible for local adjustments or trial operation.

[5] Service contents

The cost of purchased and delivered products does not include the cost of dispatching engineers or service costs. Depending on the request, these can be discussed separately.

[6] Applicable scope of service

Above contents shall be assumed to apply to transactions and use of the country where you purchased the products.

Consult the local supplier or Fuji for the detail separately.

Appendix H CONFORMITY WITH STANDARDS

H.1 Compliance with European Standards (CE)

The CE marking on Fuji products indicates that they comply with the essential requirements of the Electromagnetic Compatibility (EMC) Directive 2004/108/EC, Low Voltage Directive 2006/95/EC, and Machinery Directive 2006/42/EC which are issued by the Council of the European Communities.

Table H.1-2 1 Conformity with Standards

	Standards
EMC Directives	IEC/EN61800-3 : 2004/A1:2012 Immunity : Second environment (Industrial) Emission : Category C2 IEC/EN61326-3-1 : 2008
Low Voltage Directive	IEC/EN61800-5-1 : 2007

H.1.1 Compliance with EMC standards

The CE marking on inverters does not ensure that the entire equipment including our CE-marked products is compliant with the EMC Directive. Therefore, CE marking for the equipment shall be the responsibility of the equipment manufacturer. For this reason, Fuji's CE mark is indicated under the condition that the product shall be used within equipment meeting all requirements for the relevant Directives. Instrumentation of such equipment shall be the responsibility of the equipment manufacturer.

Generally, machinery or equipment includes not only our products but other devices as well. Manufacturers, therefore, shall design the whole system to be compliant with the relevant Directives.

■ List of EMC-compliant filters

To satisfy the requirements noted above, use inverters in combination with an external filter (option) dedicated to Fuji inverters. In either case, mount inverters in accordance with the installation procedure given below. To ensure the compliance, it is recommended that inverters be mounted in a metal panel.

Table H.1-2 2 EMC-compliant filter

Power supply voltage	Inverter type	Specification	Filter type
Three-phase 400V	FRN0059E2S-4□	ND	FS21312-78-07
		HD	FS5536-72-07 (EFL-22G11-4)
		HND	FS5536-72-07 (EFL-22G11-4)
		HHD	FS5536-72-07 (EFL-22G11-4)
	FRN0072E2S-4□	ND	-
		HD	FS21312-78-07
		HND	FS21312-78-07
		HHD	FS5536-72-07 (EFL-22G11-4)
	FRN0085E2S-4□	ND	FS5536-180-40
		HD	FS5536-100-35
		HND	FS5536-100-35
		HHD	FS5536-100-35
	FRN0105E2S-4□	ND	FS5536-180-40
		HD	FS5536-180-40
		HND	FS5536-180-40
		HHD	FS5536-100-35
	FRN0139E2S-4□	ND	FS5536-180-40
		HD	FS5536-180-40
		HND	FS5536-180-40
		HHD	FS5536-180-40
	FRN0168E2S-4□	ND	FS5536-180-40
		HD	FS5536-180-40
		HND	FS5536-180-40
		HHD	FS5536-180-40
	FRN0203E2S-4□	ND	FS5536-250-99-1
		HD	FS5536-180-40
		HND	FS5536-180-40
		HHD	FS5536-180-40

■ Recommended installation procedure

To make the machinery or equipment fully compliant with the EMC Directive, have certified technicians wire the motor and inverter in strict accordance with the procedure described below.

When an EMC-compliant filter (option) is externally used

1) Mount the inverter and the filter on a grounded panel or metal plate. Use shielded wires for the motor cable and route the cable as short as possible. Firmly clamp the shields to the metal plate to ground them. Further, connect the shielding layers electrically to the grounding terminal of the motor.
2) For connection to inverter's control terminals and for connection of the RS-485 communication signal cable, use shielded wires. As with the motor, clamp the shields firmly to a grounded panel.
3) If noise from the inverter exceeds the permissible level, enclose the inverter and its peripherals within a metal panel as shown in Figure H.1- 1

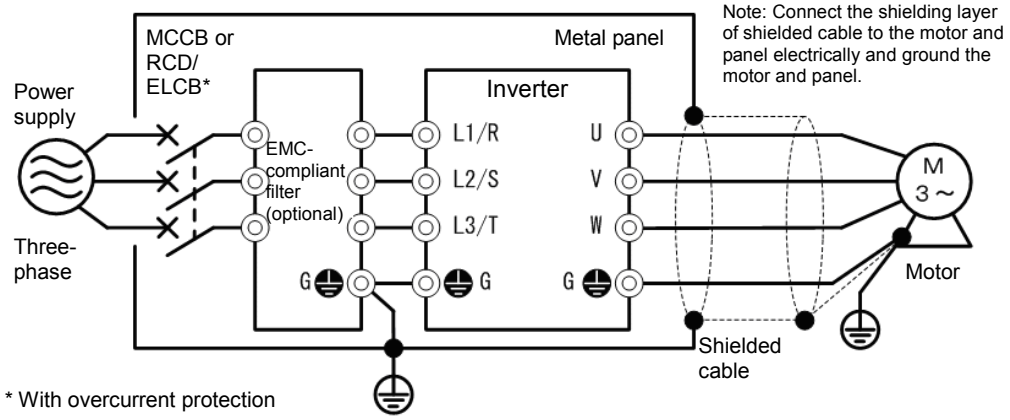


Figure H.1- 1 Mounting an EMC-compliant Filter (option) in a Metal Panel

H.1.2 Compliance with the low voltage directive in the EU

General-purpose inverters are regulated by the Low Voltage Directive in the EU. Fuji Electric states that all our inverters with CE marking are compliant with the Low Voltage Directive.

■ Note

If installed according to the guidelines given below, inverters marked with CE are considered as compliant with the Low Voltage Directive 2006/95/EC.

Compliance with European Standards

Adjustable speed electrical power drive systems.

Part 5-1: Safety requirements. Electrical, thermal and energy. IEC/EN61800-5-1 : 2007

⚠ ⚠WARNING

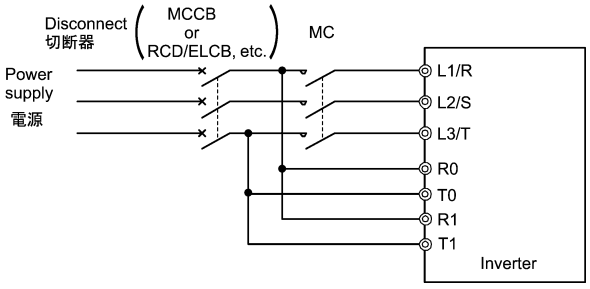
1. The ground terminal ⏚G should always be connected to the ground. Do not use only a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB)* as the sole method of electric shock protection. Be sure to use ground wires whose size is greater than power supply lines.

   *With overcurrent protection.

2. To prevent the risk of hazardous accidents that could be caused by damage of the inverter, install the specified fuses in the supply side (primary side) according to the following tables.

   • - Breaking capacity: Min. 10 kA - Rated voltage: Min. 500 V

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/MD/LD mode	Fuse rating (A)
Three-phase 400V	30	FRN0059E2S-4□	ND	160(IEC60269-4)
	22		HD	160(IEC60269-4)
	22		HND	160(IEC60269-4)
	18.5		HHD	160(IEC60269-4)
	37	FRN0072E2S-4□	ND	160(IEC60269-4)
	30		HD	160(IEC60269-4)
	30		HND	160(IEC60269-4)
	22		HHD	160(IEC60269-4)
	45	FRN0085E2S-4□	ND	250(IEC60269-4)
	37		HD	250(IEC60269-4)
	37		HND	250(IEC60269-4)
	30		HHD	250(IEC60269-4)
	55	FRN0105E2S-4□	ND	315(IEC60269-4)
	45		HD	315(IEC60269-4)
	45		HND	315(IEC60269-4)
	37		HHD	315(IEC60269-4)
	75	FRN0139E2S-4□	ND	315(IEC60269-4)
	55		HD	315(IEC60269-4)
	55		HND	315(IEC60269-4)
	45		HHD	315(IEC60269-4)
	90	FRN0168E2S-4□	ND	350(IEC60269-4)
	75		HD	350(IEC60269-4)
	75		HND	350(IEC60269-4)
	55		HHD	350(IEC60269-4)
	110	FRN0203E2S-4□	ND	350(IEC60269-4)
	90		HD	350(IEC60269-4)
	90		HND	350(IEC60269-4)
	75		HHD	350(IEC60269-4)



Conformity to the Low Voltage Directive in the EU (Continued)

⚠WARNING⚠

3. When used with the inverter, a molded case circuit breaker (MCCB), residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) or magnetic contactor (MC) should conform to the EN or IEC standards.
4. When you use a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) for protection from electric shock in direct or indirect contact power lines or nodes, be sure to install type B of RCD/ELCB on the input (primary) of the inverter.

Power supply voltage	Nominal applied motor (kW)	Inverter type	ND/HD/ HND mode	MCCB or RCD/ELCB *1 Rated current	
				W/DCR	W/o DCR
Three--phase 400 V	30	FRN0059E2S-4□	ND	75	125
	22		HD	50	100
	22		HND		
	18.5		HHD	40	75
	37	FRN0072E2S-4□	ND	100	125
	30		HD	75	
	30		HND		
	22		HHD	50	100
	45	FRN0085E2S-4□	ND	100	150
	37		HD		125
	37		HND		
	30		HHD	75	
	55	FRN0105E2S-4□	ND	125	200
	45		HD	100	150
	45		HND		
	37		HHD		125
	75	FRN0139E2S-4□	ND	175	—
	55		HD	125	200
	55		HND		
	45		HHD	100	150
	90	FRN0168E2S-4□	ND	200	—
	75		HD	175	
	75		HND		
	55		HHD	125	200
	110	FRN0203E2S-4□	ND	250	—
	90		HD	200	
	90		HND		
	75		HHD	175	

*1 The frame size and model of the MCCB or RCD/ELCB (with overcurrent protection) will vary, depending on the power transformer capacity. Refer to the related technical documentation for details.

5. The inverter should be used in an environment that does not exceed Pollution Degree 2 requirements. If the environment conforms to Pollution Degree 3 or 4, install the inverter in an enclosure of IP54 or higher.
6. Install the inverter, AC or DC reactor, input or output filter in an enclosure with minimum degree of protection of IP2X (Top surface of enclosure shall be minimum IP4X when it can be easily accessed), to prevent human body from touching directly to live parts of these equipment.
7. Do not connect any copper wire directly to grounding terminals. Use crimp terminals with tin or equivalent plating to connect them.
8. When you use an inverter at an altitude of more than 2000 m, you should apply basic insulation for the control circuits of the inverter. The inverter cannot be used at altitudes of more than 3000 m.
9. Use wires lsiterd in Chapter 2, 2.2.5 [1] Screw Specifications and Recommended Wire Size (Main Circuit Terminals).

High Performance Inverter

FRENIC-Ace

Instruction Manual

First Edition, January 2013

Fuji Electric Co., Ltd.

The purpose of this instruction manual is to provide accurate information in handling, setting up and operating of the FRENIC-Ace series of inverters. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will Fuji Electric Co., Ltd. be liable for any direct or indirect damages resulting from the application of the information in this manual.

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