Fuji Electric

Instruction Manual

High-performance, Vector Control Inverter (Stack Type)

FRENIC-VG

⚠CAUTION

Thank you for purchasing our high-performance, vector control FRENIC-VG series of inverters.

- This product is designed to drive a three-phase motor. Read through this instruction manual to become familiar with proper handling and 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 instructions on how to use options, refer to the instruction manuals for those optional devices.
- For the installation and selection of peripheral equipment exclusive to the stack type of inverters, refer to the FRENIC-VG User's Manual (Stack Type Edition).
- For the configuration of the inverter functions and operating procedure, refer to the FRENIC-VG User's Manual (Unit Type / Function Codes Edition).
- For details about PWM converters and diode rectifiers, refer to the FRENIC-VG User's Manual (Stack Type Edition).

Fuji Electric Co., Ltd. **INR-SI47-1721g-E**

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Preface

Thank you for purchasing our high-performance, vector control FRENIC-VG series of inverters. This product is designed to drive a three-phase motor.

Read through this instruction manual to become familiar with proper handling 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.

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

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■ Inquiries about Product and Guarantee

● 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.)
2) SER No. (serial number of equipment) (Refer to Chapter 1, Section 1.1.)
3) Function codes and their data that you changed (refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.3.)
4) ROM version (refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.6.)
5) Date of purchase
6) Inquiries (for example, point and extent of breakage, uncertainties, failure phenomena, and other circumstances)

● 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 18 months from the manufacturing week 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 modifications, repairs or disassembly made 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.

■ 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.

This product has been manufactured using standard industrial parts. Safety devices should be installed when the product is used for equipment which may result in a serious accident or loss in the event of failure. Responsibility for the application of this product lies with the device designer, or with the customer assembling the final product. Fuji Electric accepts no responsibility for methods used for integration into system designs using this product. In any case, do not integrate this product into products or designs solely for the purpose of providing a safety control function.

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

  Fire or an accident could occur.

- Use this product in combination with a Fuji authorized PWM converter or diode rectifier. The product connected with a commercial power cannot drive a three-phase motor by itself.

  Fire or an accident could occur.

- The FRENIC-VG may not be used for a life-support system or other purposes directly related to the human safety.
- Though the FRENIC-VG 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.

- The inverter whose protective structure is IP00 involves a possibility that a human body may touch the live conductors of the main circuit terminal block. Install the inverter 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 installing the inverter, use screws and bolts specified in the installation procedure and tighten them with the specified tightening torque.

  Otherwise, a fire or an accident might result.

- Do not install or run 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 the input line of the PWM converter or diode rectifier.
- When wiring a PWM converter or diode rectifier 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 those devices. 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.
- According to the input voltage series of the PWM converter or diode rectifier, ground the inverter in compliance with the national or local electric code.
- Be sure to connect the grounding terminals (⏚G) of the inverter and the PWM converter/diode rectifier to a protective ground conductor.

  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 could occur.
- Ensure that the number of input phases and the rated voltage of the PWM converter or diode rectifier match the number of phases and the voltage of the AC power supply to which the PWM converter or diode rectifier is to be connected.

  Otherwise, a fire or an accident could occur.
- Do not connect the PWM converter or diode rectifier to the inverter's output terminals (U, V, and W).

  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 slide switches on the control printed circuit board, **turn the power OFF, wait at least ten minutes,** and 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). Note that the diode rectifier has no LED monitor function.

  An electric shock could occur.

⚠CAUTION

- The PWM converter, 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 (torque limiter) has been selected, the inverter may operate with acceleration/deceleration or speed 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.
- 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 Instruction Manual and the FRENIC-VG User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine.
- Starting auto-tuning rotates the motor. Confirm sufficiently that there is no risk in rotating the motor 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 input power of the PWM converter or diode rectifier, voltage may be output to inverter's 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 because it becomes 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 function code settings.
  Run commands (e.g., "Run forward" ***FWD***), stop commands (e.g., "Coast to a stop" ***BX***), and speed change commands can be assigned to digital input terminals. Depending upon the input terminal operation, 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 speed command sources with the related terminal commands (e.g., ***SS1***, ***SS2***, ***SS4***, ***SS8***, ***N2/N1***, ***KP/PID***, ***IVS***, and ***LE***) may cause a sudden motor start or an abrupt change in speed.
  An accident or injuries could occur.

Maintenance and inspection, and parts replacement

⚠WARNING⚠

- Before changing the slide switches on the control printed circuit board in maintenance or inspection, **turn the power OFF, wait at least ten minutes,** and 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). Note that the diode rectifier has no LED monitor function.

  Otherwise, an electric shock could occur.

- Always carry out the daily and periodic inspections described in the instruction/user's manual. Use of the inverter for long periods of time without carrying out regular inspections could result in malfunction or damage, and an accident or fire could occur.
- It is recommended that periodic inspections be carried out every one to two years, however, they should be carried out more frequently depending on the usage conditions.
- It is recommended that parts for periodic replacement be replaced in accordance with the standard replacement frequency indicated in the user's manual. Use of the product for long periods of time without replacement could result in malfunction or damage, and an accident or fire could occur.
- Contact outputs [30A/B/C] and [Y5A/C] use relays, and may remain ON, OFF, or undetermined when their lifetime is reached. In the interests of safety, equip the inverter with an external protective function.
- If it continues using it in spite of having exhausted the battery, data may disappear.

  Otherwise, an accident or fire 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 FRENIC-VG as an industrial waste when disposing of it.

  Otherwise injuries could occur.

- The battery used in the inverter is a so-called primary battery. When disposing of it, comply with local codes and regulations.

Speed control mode

⚠CAUTION

- If the control parameters of the automatic speed regulator (ASR) are not appropriately configured under speed control, even turning the run command OFF may not decelerate the motor due to hunting caused by high gain setting. Accordingly, the inverter may not reach the stop conditions so that it may continue running.

  During deceleration, hunting may be caused by high response in low speed domain so that the detected speed deviates from the zero speed area before the zero speed control duration (F39) elapses. Accordingly, the inverter will not reach the stop conditions so that it enters the deceleration mode again and continues running.

  If any of the above problems occurs, adjust the ASR control parameters to appropriate values and use the speed mismatch alarm function in order to alarm-trip the inverter, switch the control parameters by speed, or judge the detection of a stop speed by commanded values when the actual speed deviates from the commanded one.

  An accident or injuries could occur.

Torque control mode

⚠CAUTION

- When the motor is rotated by load-side torque exceeding the torque command under torque control, turning the run command OFF may not bring the stop conditions so that the inverter may continue running.

  An accident or injuries could occur.

- To shut down the inverter output, switch from torque control to speed control and apply a decelerate-to-stop or coast-to-stop command.

General precautions

⚠CAUTION
Drawings in this manual are illustrated without the front cover or safety shields for explanation of detail parts. Do not turn the power ON when the inverter is as shown in drawings. Be sure to restore the covers and shields in the original state before running the inverter.

Icons

The following icons are used throughout this manual.

Note 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.

Tip 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 type of inverter)

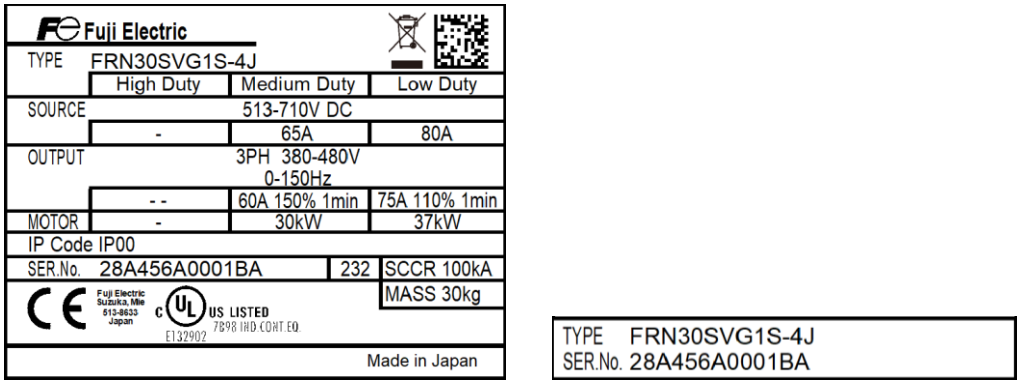
Unpack the package and check the following:

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

Accessories - Instruction manual (this document)
- CD-ROM (containing the FRENIC-VG User's Manual, FRENIC-VG Loader (free version), and FRENIC-VG Loader Instruction 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 and sub nameplates. (The main and sub nameplates are attached to the inverter as shown in Figures 1.2-1 through 1.2-4.)



(a) Main Nameplate (b) Sub Nameplate

Figure 1.1-1 Nameplates

TYPE: Type of inverter

FRN 30 SVG1S − 4□

Code	Series name
FRN	FRENIC series

Code	Nominal applied motor
30	30 kW
37	37 kW
45	45 kW
⋮	⋮
315	315 kW

Code	Structure
None	Unit type
S	Standard stack type
B	Phase-specific stack type

Code	Shipping destination/ Instruction manual language
J	Japan/Japanese
E	EU/English
C	China/Chinese

Code	Power supply voltage
4	Three-phase 400 V

Code	Enclosure
S	Basic type

Code	Development code
1	1 series

Code	Applicable area
VG	High performance, vector control

The FRENIC-VG is available in two drive modes depending upon the inverter capacity: Medium Duty (MD) and Low Duty (LD) modes. Specifications in each mode are printed on the main nameplate.

Medium Duty : MD mode designed for medium duty load applications.
Overload capability: 150% for 1 min. Continuous ratings = Inverter capacity

Low Duty : LD mode designed for light duty load applications.
Overload capability: 110% for 1 min. Continuous ratings = One rank higher capacity of inverters

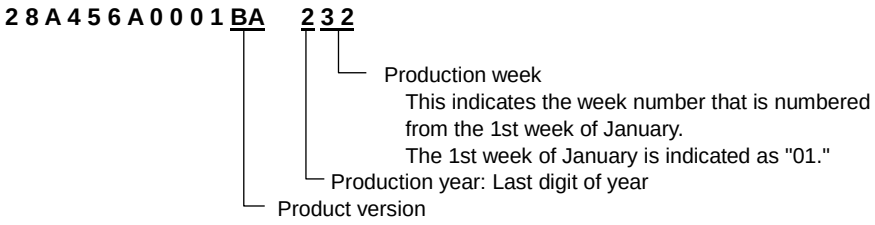
SOURCE : Input current

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



: Mark of conformity with European standards (Refer to Chapter 9.1 for details)

: Mark of conformity with UL Standards and CSA Standards (cUL-listed for Canada) (Refer to Chapter 9.3 for details)

: Mark of conformity with WEEE Directive

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 Appearance

(1) Outside and inside views

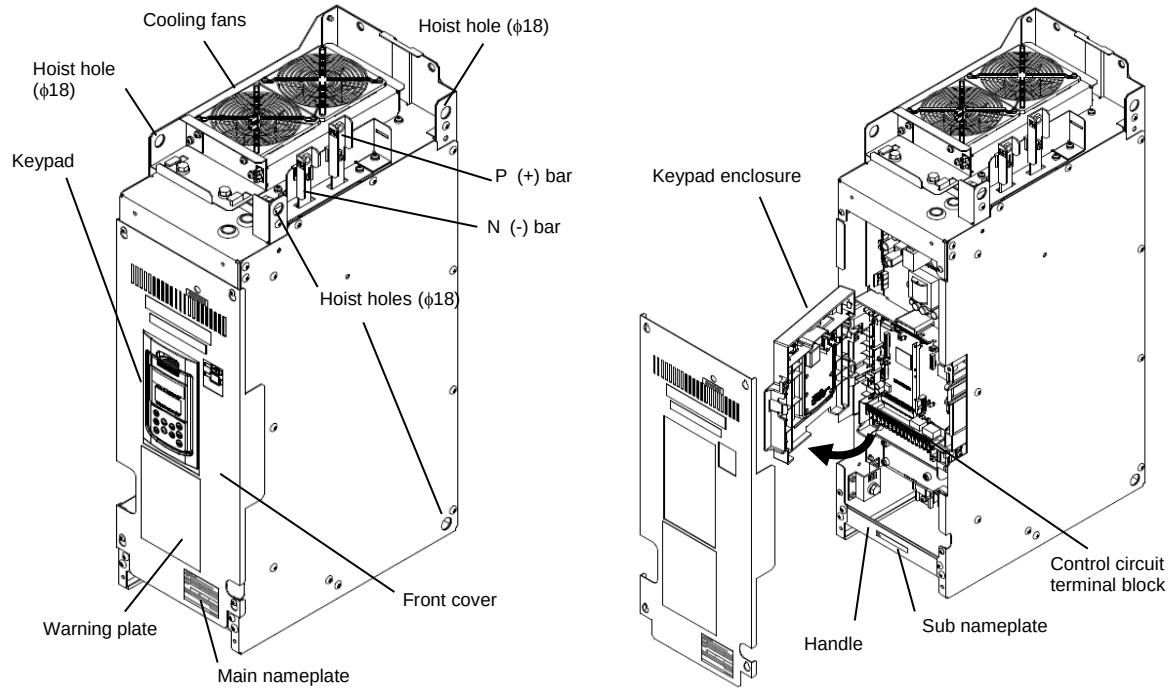


Figure 1.2-1 Rank 1 (30 to 45 kW)

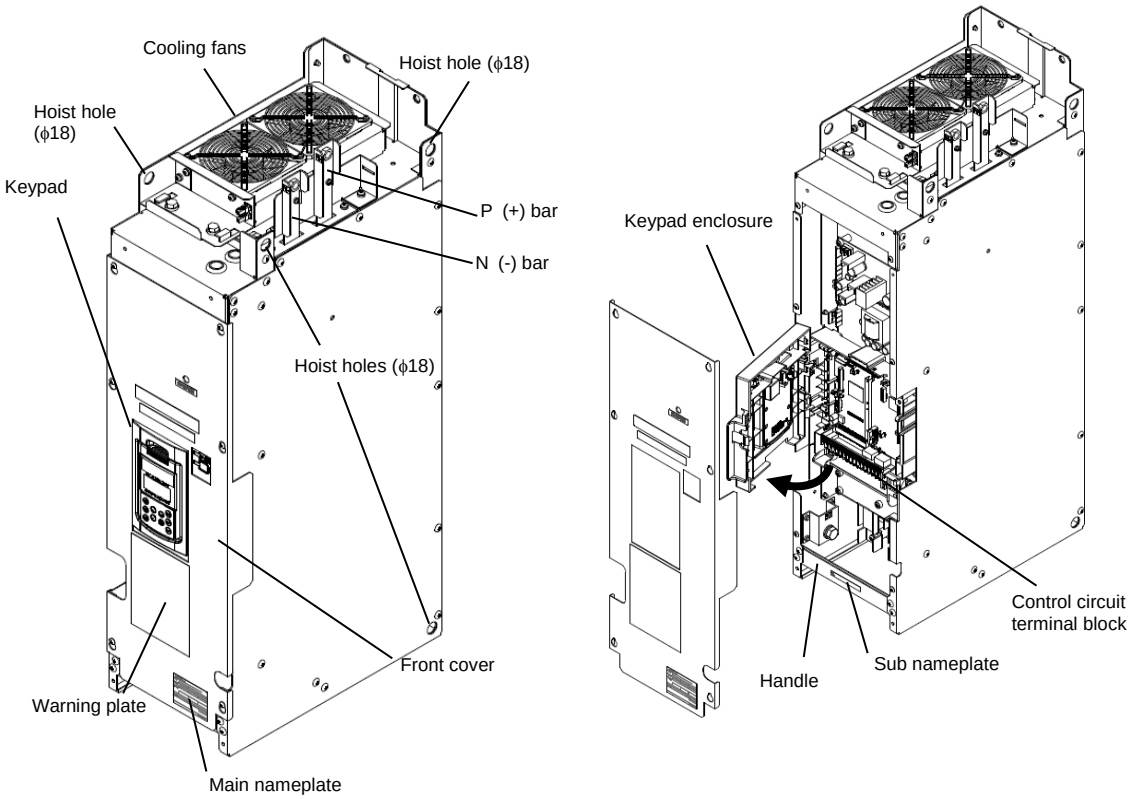


Figure 1.2-2 Rank 2 (55 to 110 kW)

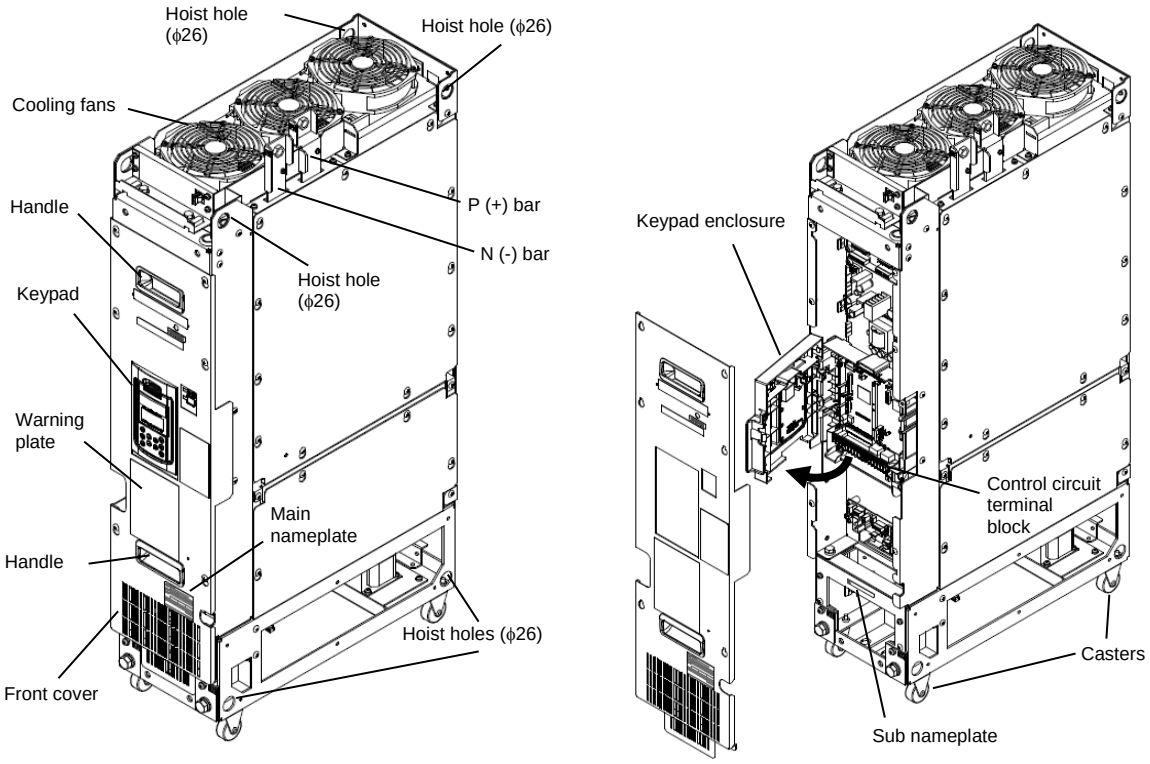


Figure 1.2-3 Rank 3 (132 to 200 kW)

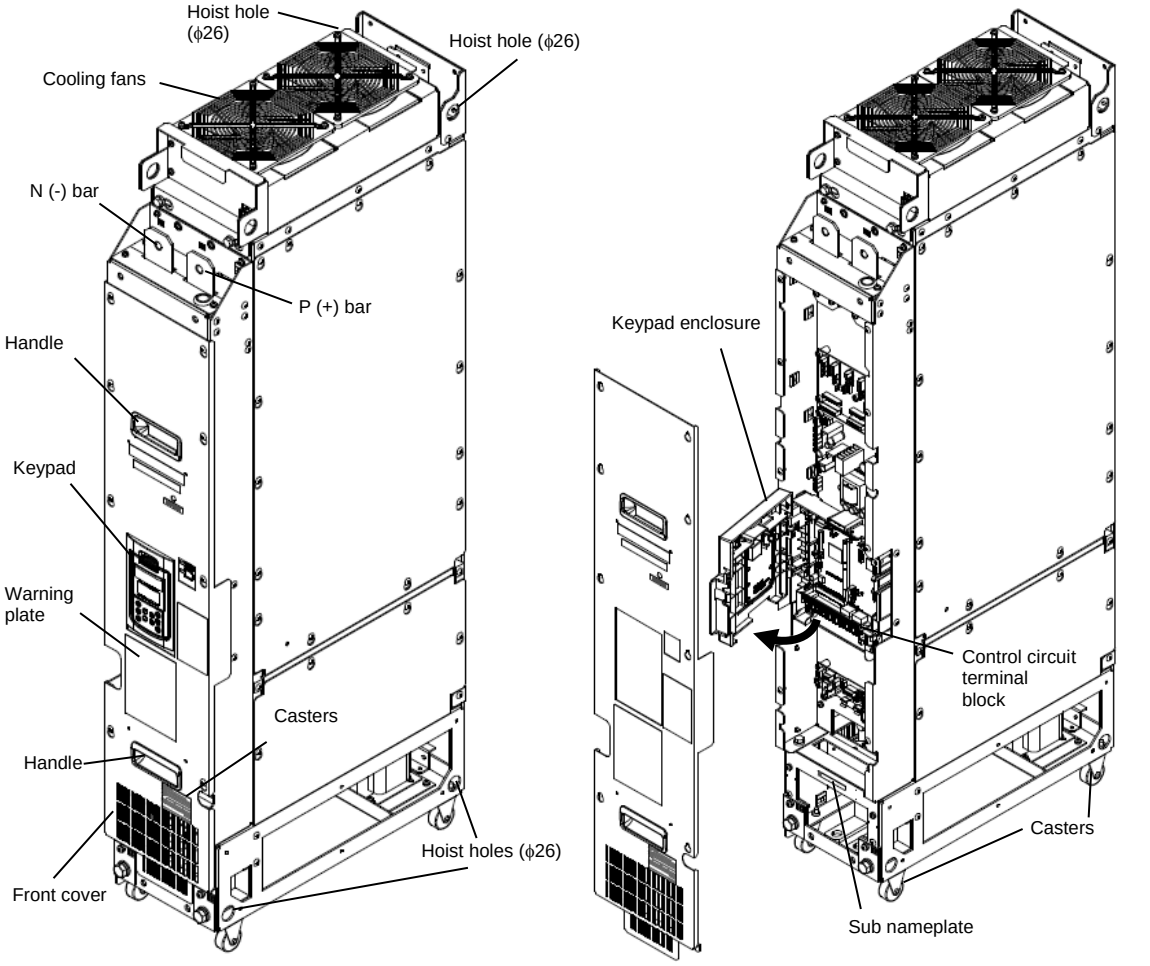
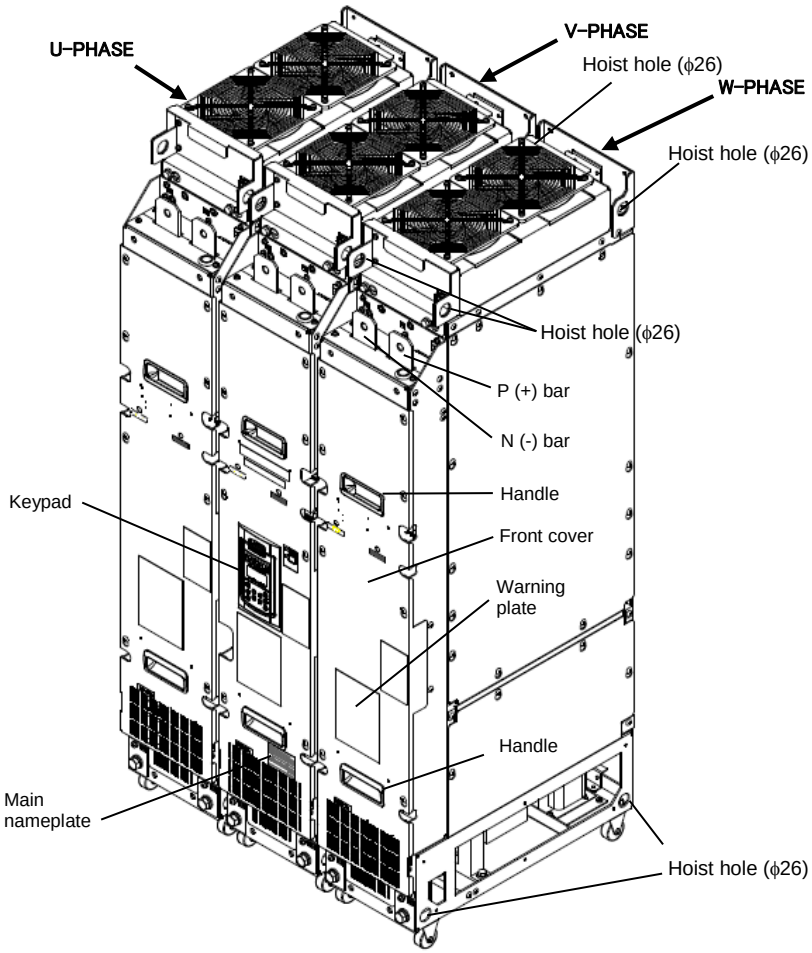


Figure 1.2-4 Rank 4 (220 to 315 kW)



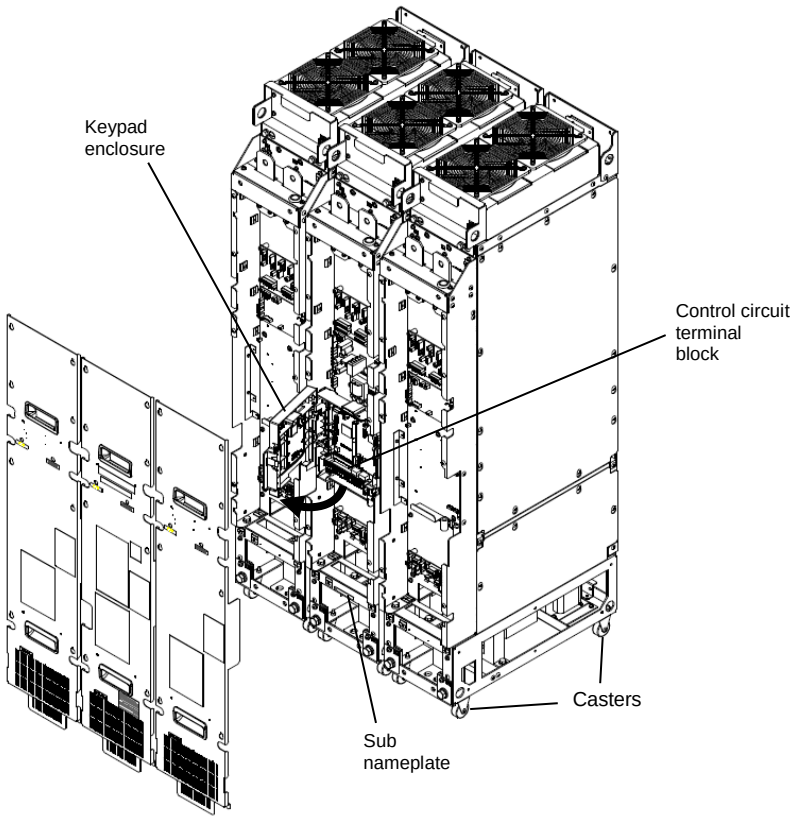


Figure 1.2-5 Rank 4 (630 to 800 kW)

(2) Warning plates and label

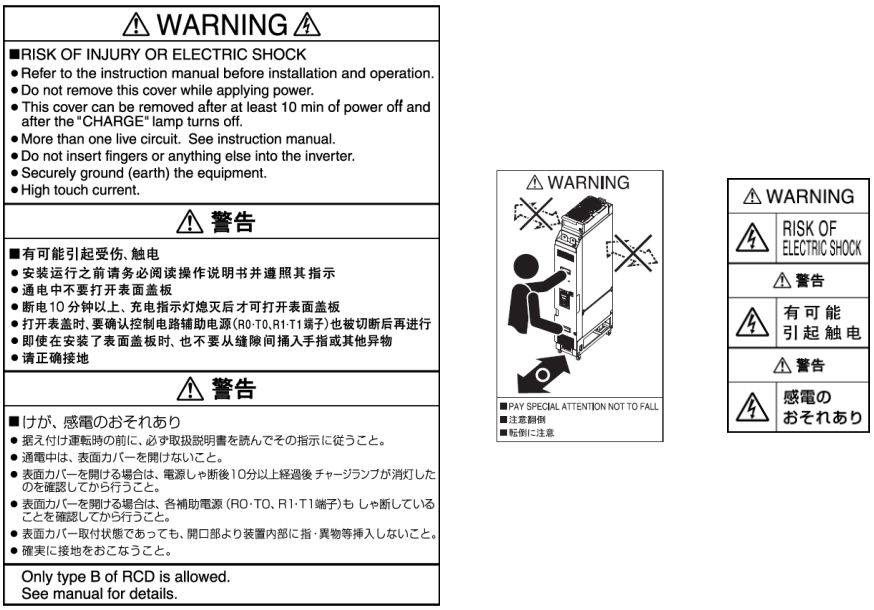


Figure 1.2-6 Warning Plates and Label

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 Installation environment

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

Table 1.3-1 Environmental Requirements

Item	Specifications	
Site location	Indoors	
Ambient temperature	-10 to +40°C	
Relative humidity	5 to 95% (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 1)** 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	Less than 1,000 m If the altitude is 1,000 to 3,000 m, output current derating is required. **(Note 2)** If the altitude is 2,001 to 3,000 m, the insulation level of the control circuits lowers from the reinforced insulation to the basic insulation.	
Vibration	Compliant to the standard IEC61800-2 Amplitude 0.3 mm: 2 to less than 9 Hz 1 m/s^2: 9 to 200 Hz	Compliant to the standard IEC61800-5-1 Amplitude 0.075 mm: 10 to less than 57 Hz 1 G: 57 to 150 Hz

(Note 1) 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 cabinet.

(Note 2) If you use the inverter in an altitude above 1000 m, 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
1000 m or lower	1.00
1000 to 1500 m	0.97
1500 to 2000 m	0.95
2000 to 2500 m	0.91
2500 to 3000 m	0.88

Fuji Electric strongly recommends installing inverters in a cabinet 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 cabinet engineering design suitable for the special environment or the cabinet 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 cabinet or considering the cabinet installation location.

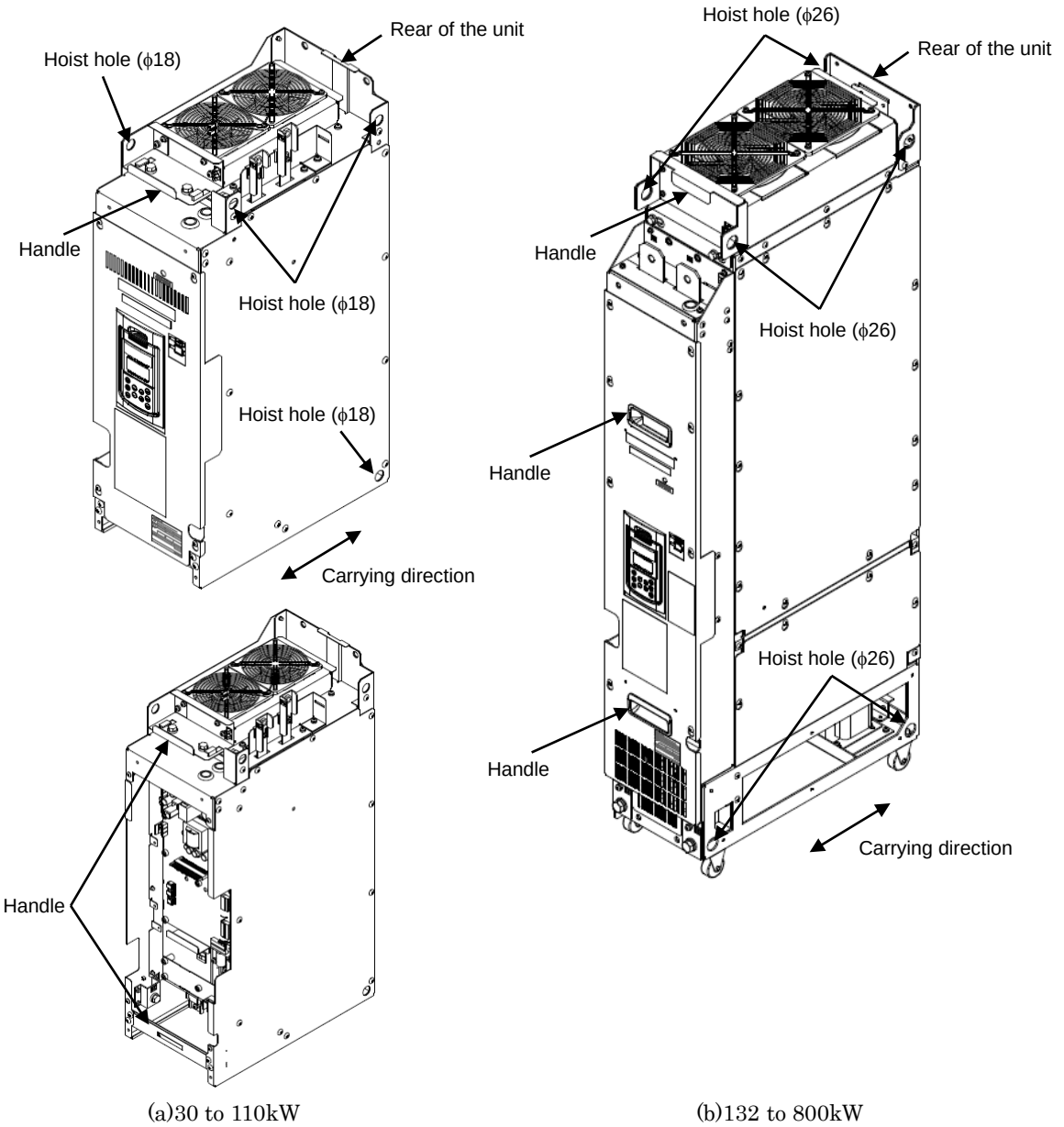
Environments	Possible problems	Sample measures	Applications
Highly concentrated sulfidizing gas or other corrosive gases	Corrosive gases cause parts inside the inverter to corrode, resulting in an inverter malfunction.	Any of the following measures may be necessary. - Mount the inverter in a sealed cabinet with IP6X or air-purge mechanism. - Place the cabinet 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 cabinet. - Place the cabinet 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 cabinet that shuts out dust. - Ensure a maintenance space for periodical cleaning of the heat sink in cabinet engineering design. - Employ external cooling when mounting the inverter in a cabinet 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 cabinet.	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.	- Put shock-absorbing materials on the mounting base of the inverter for safe mounting.	Installation of an inverter cabinet 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 cabinet 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 Transportation

⚠ CAUTION
Do not hold the covers or components during transportation. **The converter may fall or turn over, causing injuries.**

When carrying the product, be sure to hold the handles (provided on the front side) or the rear side of the unit. Holding the covers or components may fall or turn over the product. When carrying the product with casters, in particular, take extra care for avoiding turnover.

To use a hoist or crane for carrying the product, pass the hook or rope through hoist holes.



(a)30 to 110kW (b)132 to 800kW

Figure 1.3-1 Carrying direction and handle position

1.3.3 Storage environment

The storage environment in which the inverter should be stored after purchase differs from the installation 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	-25 to +70°C	Places not subjected to abrupt temperature changes or condensation or freezing
Relative humidity	5 to 95% *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 Table 1.3-3, 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 ambient temperature range should be within the range from -10 to 30°C. 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 cabinet 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 inverter to the load circuit (secondary side) or run the inverter.

1.3.4 Precautions for connection of peripheral equipment

[1] Fuses

Fuses have their own service life. It is recommended that they be replaced periodically. Secure them since improper setting could cause an unexpected accident at the time of fuse melting.

[2] Circuit breakers and disconnectors (Molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB))

The MCCB or RCD/ELCB cannot apply to the inverter DC common input side or output circuit because of their properties.

- The inverter output circuit has the inverter protective functions (for overcurrent, grounding fault, phase loss, etc.), so it does not require using circuit breakers or disconnectors. In particular, no ELCB can be used.

  When using an MCCB unavoidably for grounding fault protection, use such an MCCB that trips with the current larger than the inverter rated capacity. Confirm the protective coordination with the wire size. Also select the MCCB specifications suitable for the user specifications.
- Use a non-auto switch with the overcurrent trip function removed, as a disconnector.

[3] Magnetic contactors (MC)

For magnetic contactors to be installed at the DC common input side or output circuit, a sequence should be configured so that they open or close when the inverter is stopped (during inverter gate shutdown).

[4] Motor overload protection

The inverter has the electronic thermal overload protection function for motors. Use it when a single inverter drives a single motor.

In any of the following cases, the electronic thermal overload protection function cannot protect the motor, so use a thermistor (NTC/PTC) or thermal relay to protect the motor.

- In applications where start and stop are frequently repeated, great fluctuation of the load is frequently repeated, or the inverter drives in very low-speed domain continuously.
- Driving motors (whose electronic thermal overload characteristics are different) other than standard 3-phase motors

  Do not use a thermal relay at the inverter DC common power side. This is because the inverter DC common power is DC voltage containing high frequency components.

[5] Magnetic contactor (MC) in the inverter output (secondary) circuit

If installing magnetic contactors at the inverter output side (secondary side), ensure that magnetic contactor open and close operations are performed when the inverter is stopped in order to suppress magnetic contactor contact arcs. Do not equip magnetic contactors with main circuit surge suppression units (Fuji Electric SZ-ZM□, etc.)

Inverters will suffer damage if a commercial power supply is applied from the inverter's output side (secondary side). Employ an interlock to ensure that the magnetic contactor at the commercial power supply side does not turn ON at the same time as the magnetic contactor at the inverter output side.

1.3.5 Noise reduction

If noise generated from the inverter affects other devices, or that generated from peripheral equipment causes the inverter to malfunction, follow the basic measures outlined below.

(1) If noise generated from the inverter affects the other devices through power wires or grounding wires:
- Isolate the grounding terminals of the inverter from those of the other devices.
- Connect a noise filter to the inverter power wires.
- Isolate the power system of the other devices from that of the inverter with an insulated transformer.

(2) If induction or radio noise generated from the inverter affects other devices:
- Isolate the main circuit wires from the control circuit wires and other device wires.
- Put the main circuit wires through a metal conduit pipe, and connect the pipe to the ground near the inverter.
- Install the inverter into a metal cabinet and connect the whole cabinet to the ground.
- Connect a noise filter to the inverter's power wires.

(3) When implementing measures against noise generated from peripheral equipment:
- For inverter's control signal wires, use twisted or shielded-twisted wires. When using shielded-twisted wires, connect the shield of the shielded wires to the common terminals of the control circuit.
- Connect a surge absorber in parallel with magnetic contactor's coils or other solenoids (if any).

1.3.6 Leakage current

A high frequency current component generated by insulated gate bipolar transistors (IGBTs) switching on/off inside the inverter becomes leakage current through stray capacitance of inverter input and output wires or a motor. If any of the problems listed below occurs, take an appropriate measure against them.

Problem	Measures
An earth leakage circuit breaker* that is connected to the input (primary) side has tripped. *With overcurrent protection	1) Make the wires between the inverter and motor shorter. 2) Use an earth leakage circuit breaker with lower sensitivity than the one currently used. 3) Use an earth leakage circuit breaker that features measures against the high frequency current component (Fuji SG and EG series).
An external thermal relay was falsely activated.	1) Increase the current setting of the thermal relay. 2) Use the electronic thermal overload protection built in the inverter, instead of the external thermal relay.

1.3.7 Precautions in driving a permanent magnet synchronous motor (PMSM)

When using a PMSM, note the following.

- When using a PMSM other than the Fuji standard synchronous motor (GNF2), consult your Fuji Electric representative.
- A single inverter cannot drive two or more PMSMs.
- A PMSM cannot be driven by commercial power.

Chapter 2 MOUNTING AND WIRING THE INVERTER

2.1 Mounting the Inverter

(1) Installation environment

Mount the inverter at the place satisfying the requirements given in Chapter 1, Section 1.3.1 "Installation environment."

(2) Mounting base

Install the inverter on a base made of metal or other non-flammable material. Do not mount the inverter upside down or horizontally.

⚠WARNING
Install the inverter on a base made of metal or other non-flammable material. **Otherwise, a fire could occur.**

(3) Clearances

Mount the stack only in the direction shown in Figure 2.1-1 (in the reading direction of the nameplate). For the clearances, refer to Figure 2.1-1 and Table 2.1-1. When mounting two or more stacks side by side, observe also the clearances specified in Table 2.1-1.

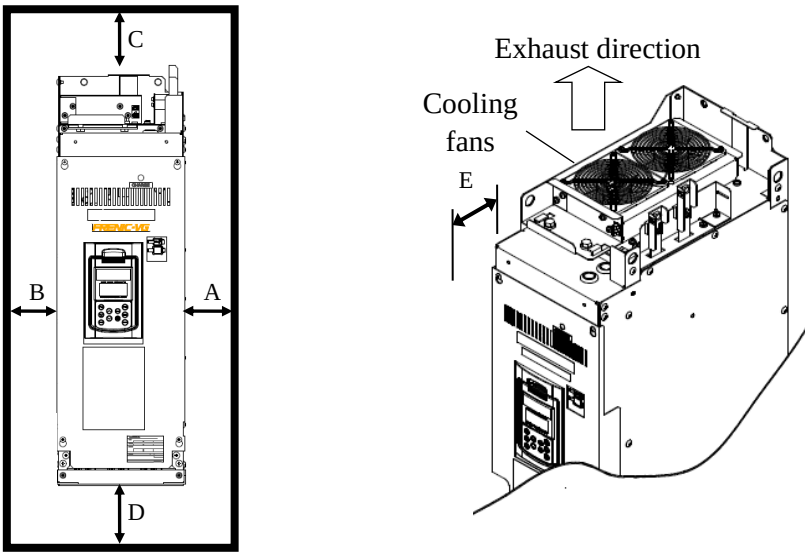


Figure 2.1-1 Mounting Direction and Required Clearances

Table 2.1-1 Clearances (mm)

		A	B	C	D	E
Between stacks	Rank 1	10	10	300	350	50
	Rank 2					
	Rank 3					20
	Rank 4					20
With other equipment		20	20	-	350 (100)	50

Rank 1: 30 to 45 kW stack size
Rank 2: 55 to 110 kW stack size
Rank 3: 132 to 200 kW stack size
Rank 4: 220 to 800 kW stack size

Note
- Stacks cannot be mounted, one above the other.
- Above the stack (i.e. above the exhaust fans) at location "C," only a fuse (authorized by Fuji) can be mounted. To mount general devices, select devices whose maximum allowable working temperature is 70°C and prevent them from interfering with the effect of the exhaust fans.
- Beneath the stack (i.e. beneath the intake vent) at location "D," do not block about 60% of the area in the 350 mm clearance. When mounting a device, ensure a 100 mm clearance.

F:10 to 135 [mm]

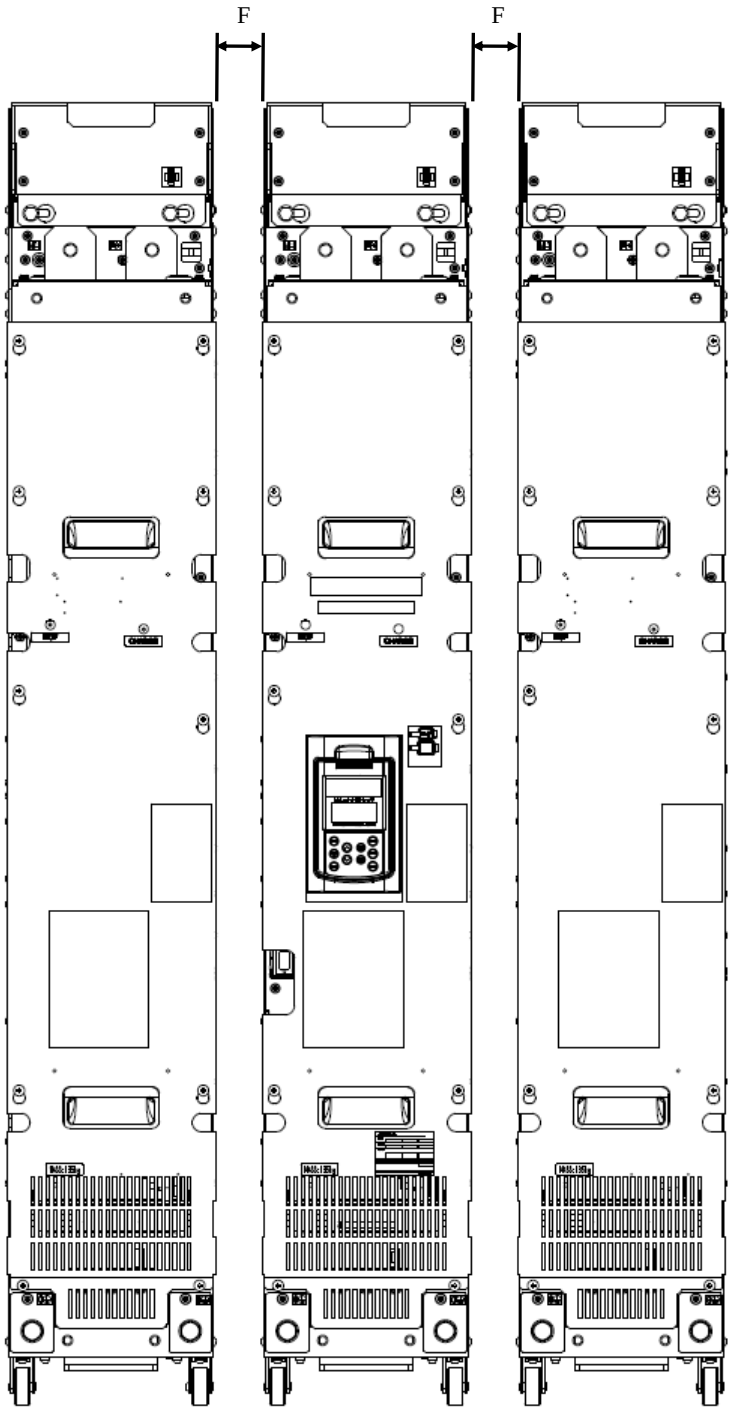


Figure 2.1-2 Clearances between stacks of Phase-specific stack type

(4) Mounting method

[1] Rank 1 (30 to 45 kW)

1) The holes for fixing of the upper part on the back side (2×φ10: The screw of M8 size,or stud bolt)

2) The tapped holes for fixing of the lower part on the front side (2×M5-12(~25): In case recommended thickness of the metal fitting is 2.3mm)

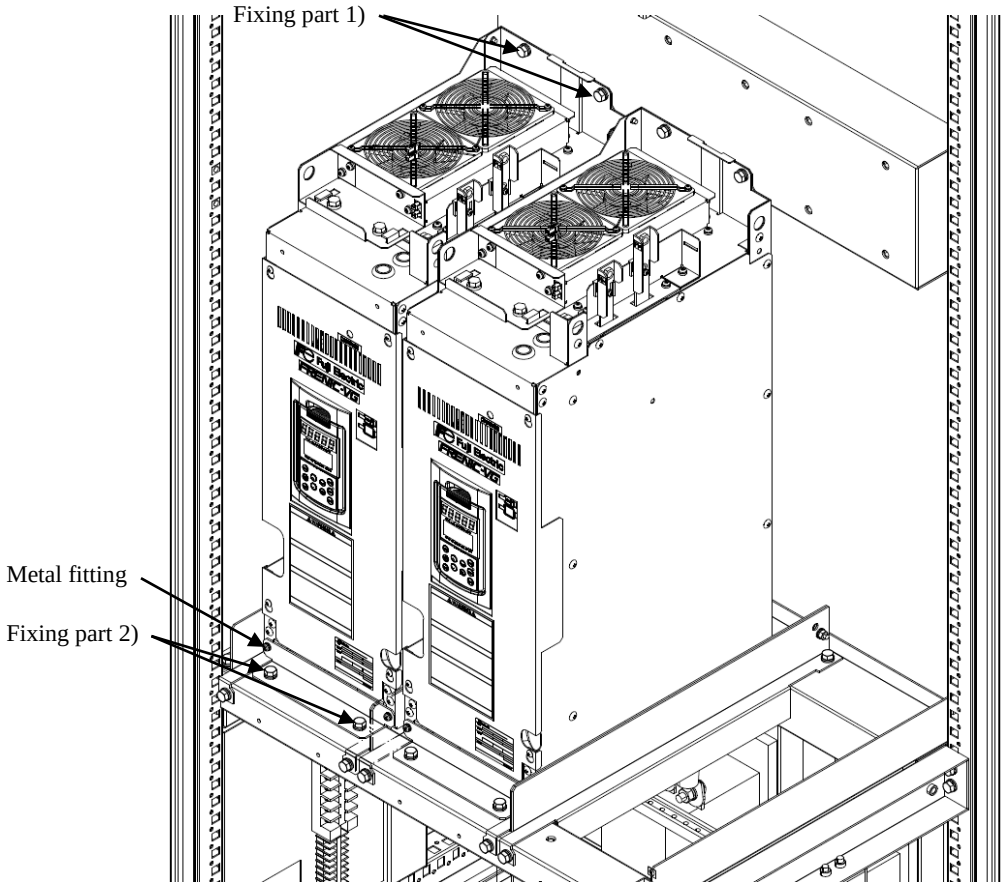


Figure 2.1-3 The stack mounting method of Rank 1 size (30 to 45 kW)

[2] Rank 2 (55 to 110 kW)

1) The holes for fixing of the upper part on the back side (2×φ10: The screw of M8 size,or stud bolt)
2) The tapped holes for fixing of the lower part on the front side (2×M5-12(~25): In case recommended thickness of the metal fitting is 2.3mm)

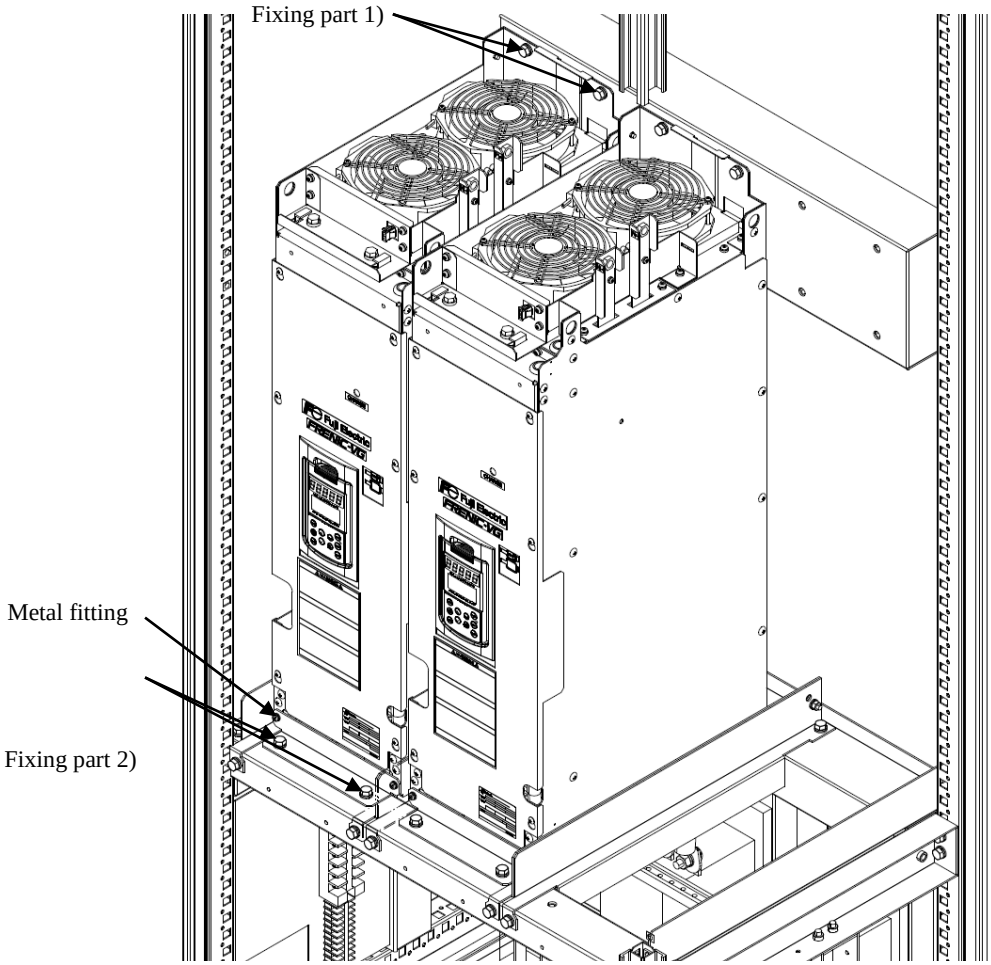


Figure 2.1-4 The stack mounting method of Rank 2 size (55 to 110 kW)

[3] Rank 3 (132 to 200 kW)

1) The fixation plate of the upper part on the back side
2) The fixation plate of the lower part on the back side
3) The tapped holes for fixing of the upper part on the front side (2×M8-25: In case recommended thickness of the metal fitting is 2.3mm)
4) The tapped holes for fixing of the lower part on the front side (2×M8-25: In case recommended thickness of the metal fitting is 2.3mm)

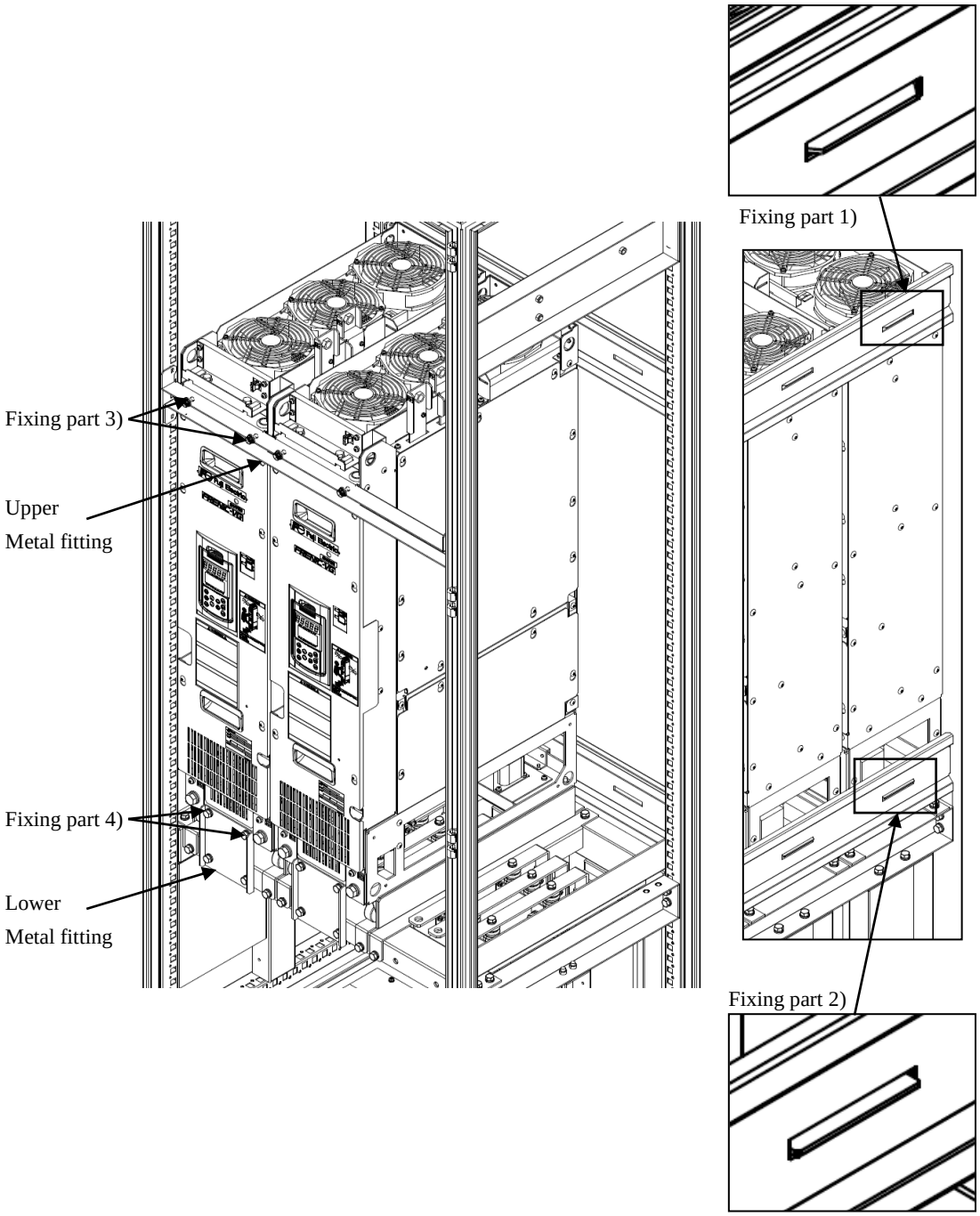


Figure 2.1-5 The stack mounting method of Rank 3 size (132 to 200 kW)

[4] Rank 4 (220 to 800 kW)

1) The fixation plate of the upper part on the back side
2) The fixation plate of the lower part on the back side
3) The tapped holes for fixing of the upper part on the front side (2×M8-25: In case recommended thickness of the metal fitting is 2.3mm)
4) The tapped holes for fixing of the lower part on the front side (2×M8-25: In case recommended thickness of the metal fitting is 2.3mm)

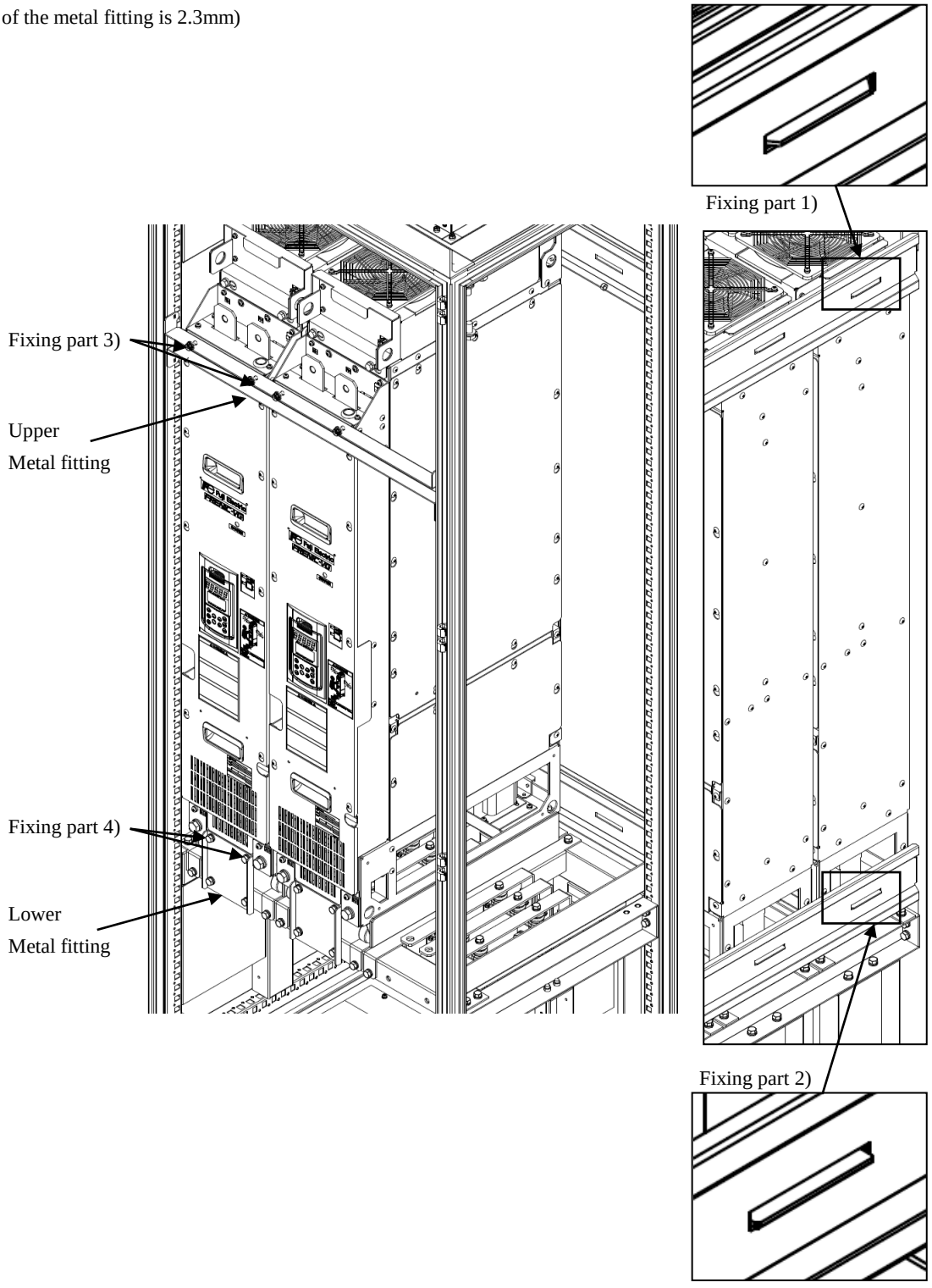


Figure 2.1-6 The stack mounting method of Rank 4 size (220 to 800 kW)

(5) Precautions for the inverter installation

⚠CAUTION
Please protect the upper part of the inverter with a curing sheet before installing in the control box and wiring work. If you protected with a curing sheet please remove it after construction. Please also protect the inverter in the same way as above when making additional work in the control box.

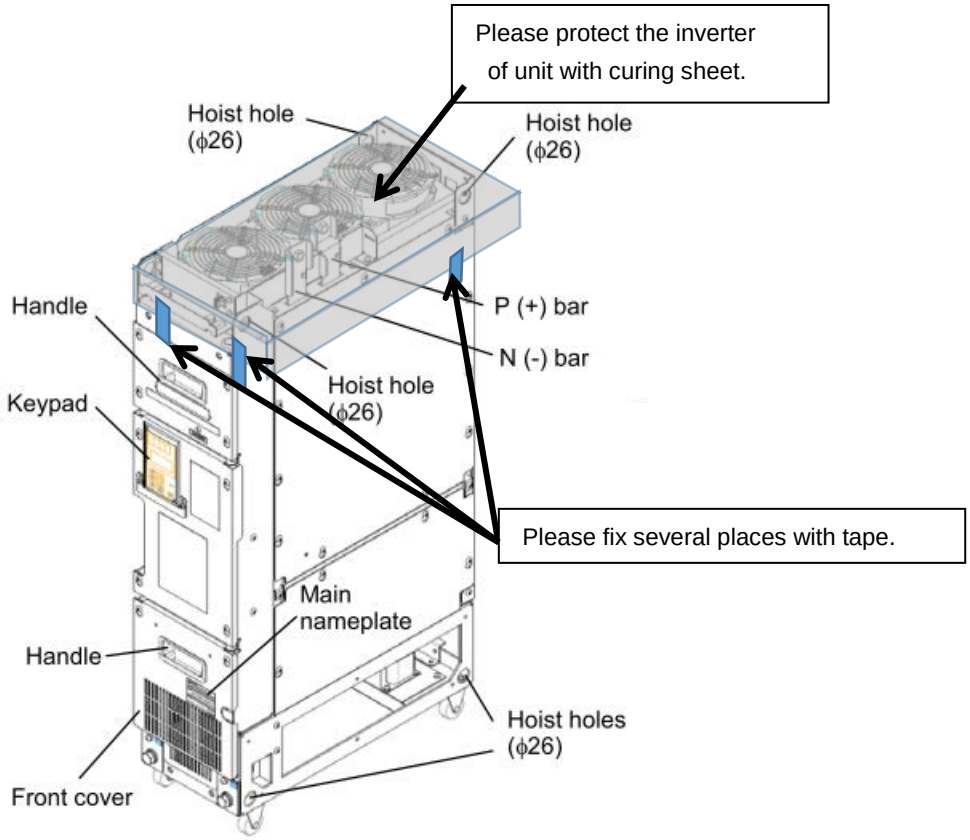
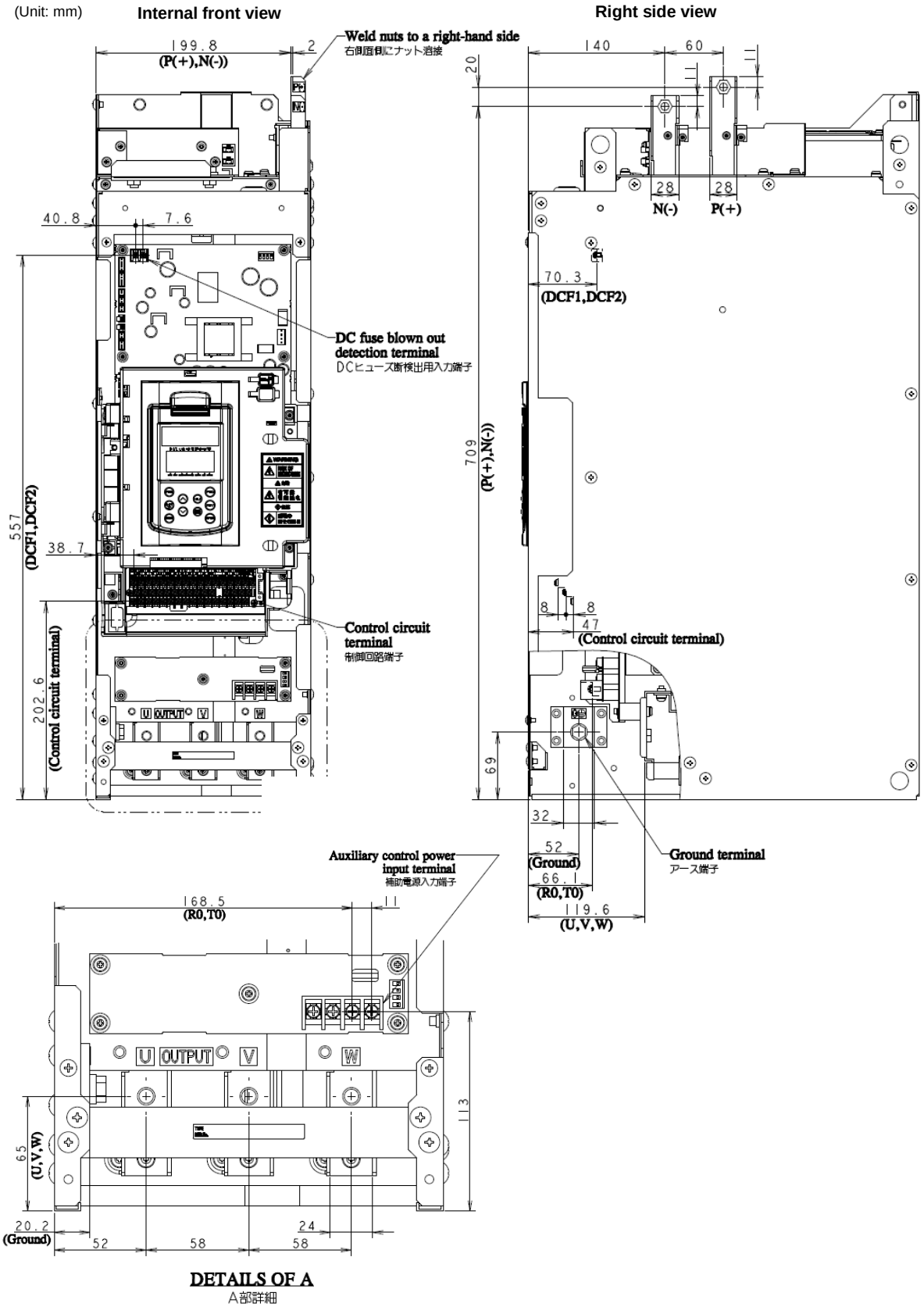


Figure 2.1-7 Example of protecting the inverter with curing sheet

2.1.1 Terminal Arrangement and Screw Sizes (Main circuit terminals)

[1] Rank 1 (30 to 45 kW)

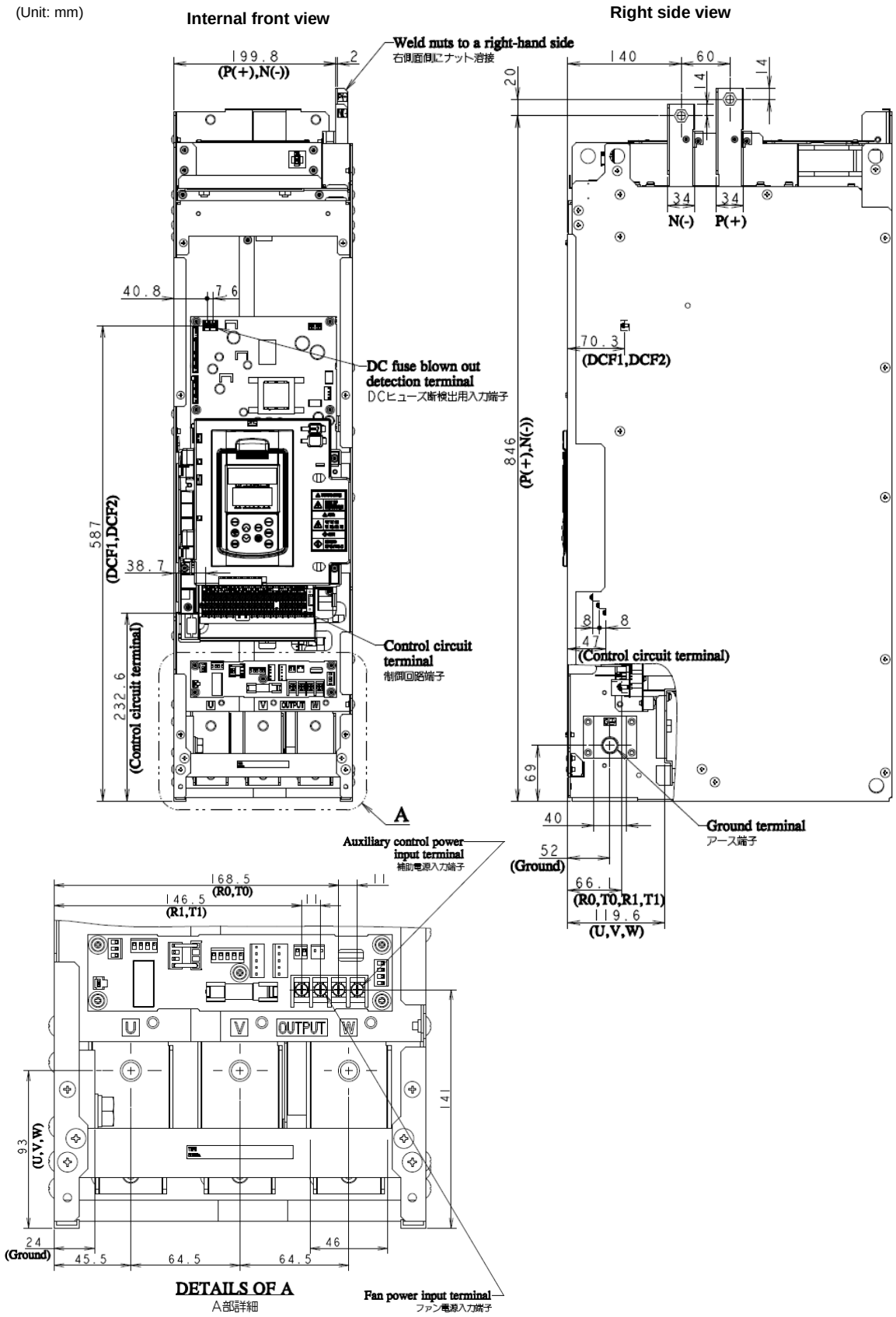


Terminal name	Symbol	Screw size	Tightening torque	Applicable crimp terminal size
Output terminal	U, V, W	M8	13.5 N•m	R60-8/MAX
DC input terminal	P(+), N(-)			
Grounding terminal	⏚G			

Figure 2.1-8 Rank 1 (30 to 45 kW)

[2] Rank 2 (55 to 110 kW)

(Unit: mm)

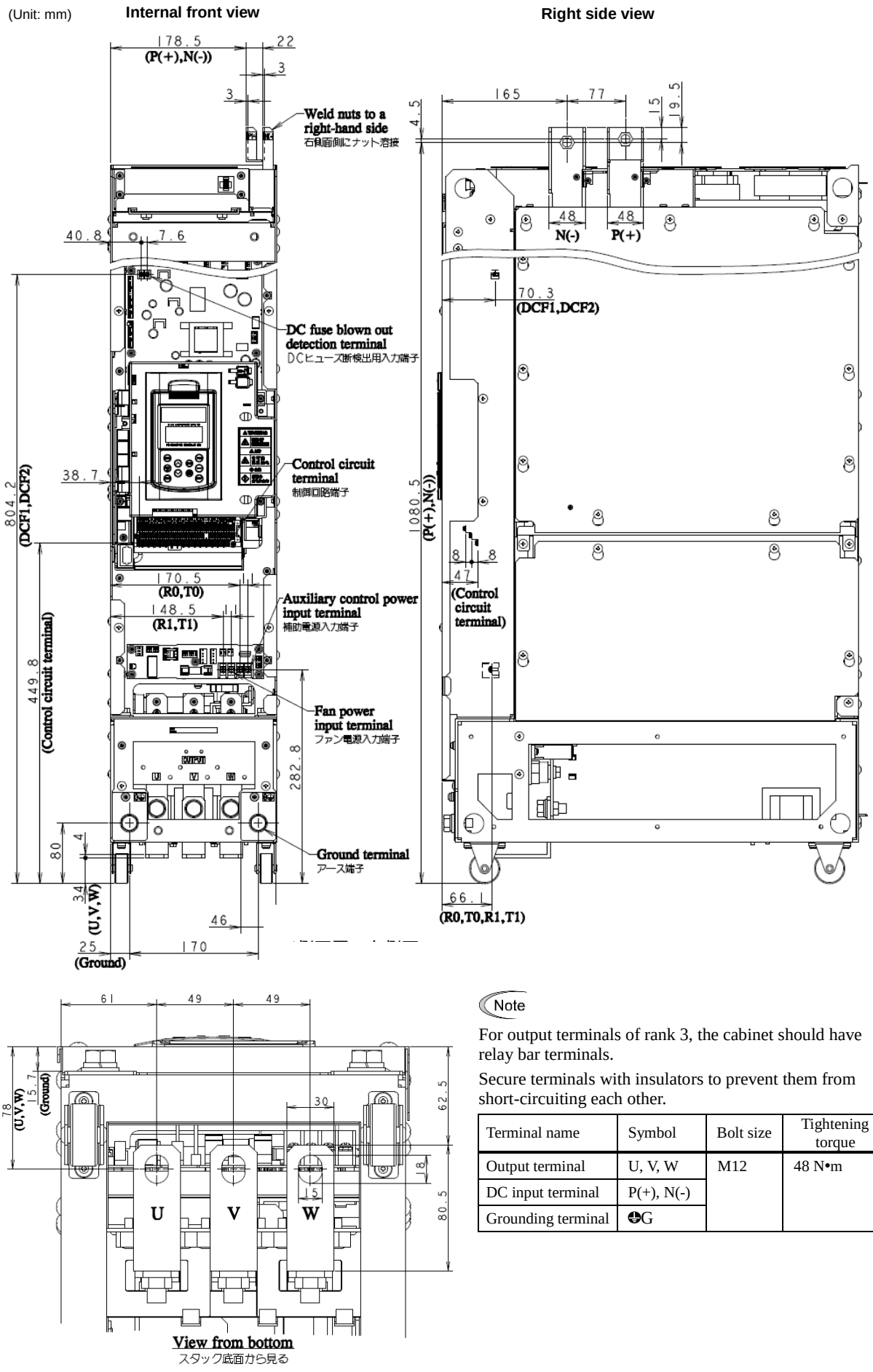


Terminal name	Symbol	Screw size	Tightening torque	Applicable crimp terminal size
Output terminal	U, V, W	M10	27 N•m	R150-10/MAX
DC input terminal	P(+), N(-)			
Grounding terminal	⏚G			

Figure 2.1-9 Rank 2 (55 to 110 kW)

[3] Rank 3 (132 to 200 kW)

(Unit: mm)



Note

For output terminals of rank 3, the cabinet should have relay bar terminals.

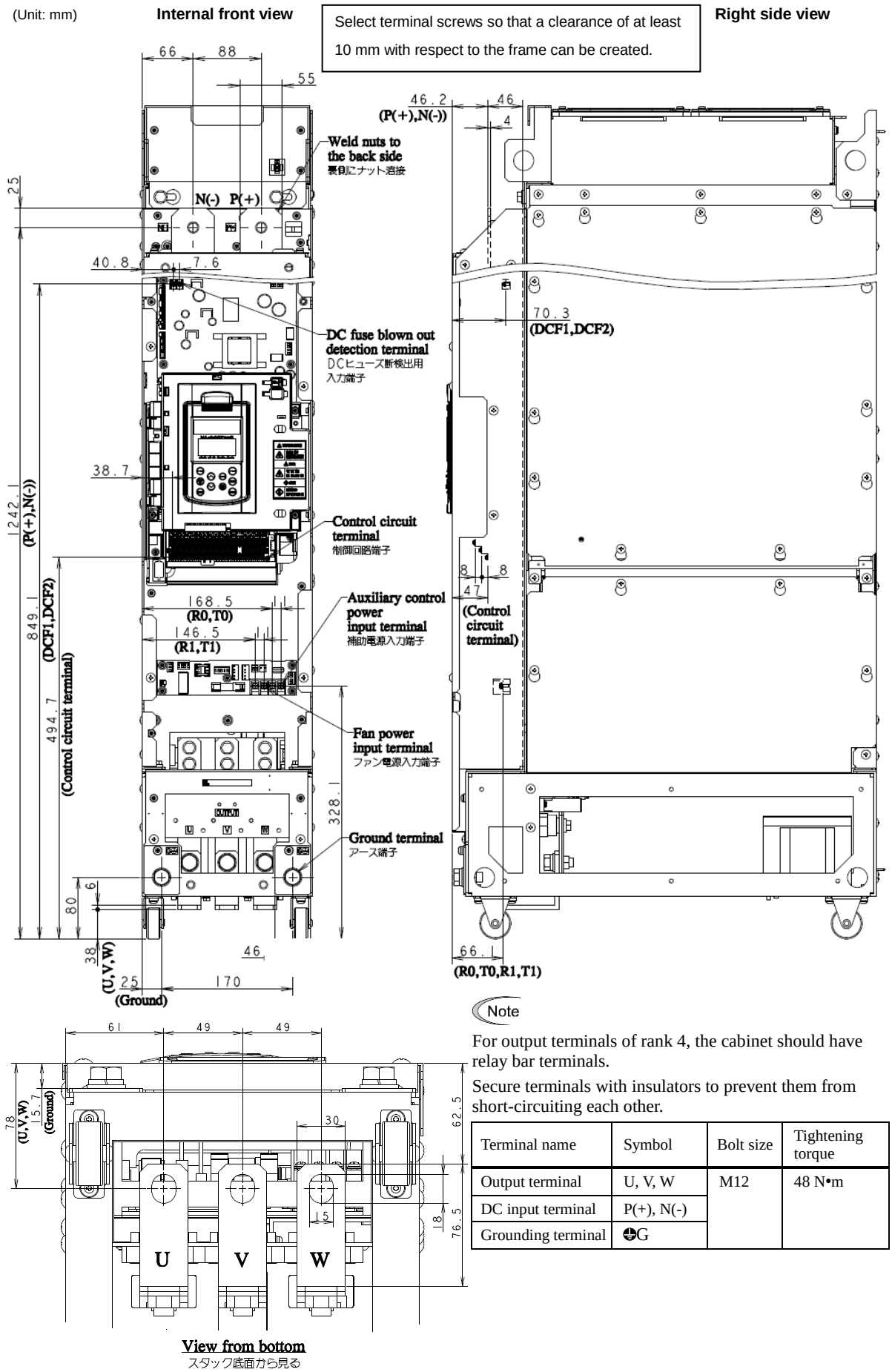
Secure terminals with insulators to prevent them from short-circuiting each other.

Terminal name	Symbol	Bolt size	Tightening torque
Output terminal	U, V, W	M12	48 N•m
DC input terminal	P(+), N(-)		
Grounding terminal	⏚G		

Figure 2.1-10 Rank 3 (132 to 220 kW)

[4] Rank 4 (220 to 315 kW)

(Unit: mm)



Note

For output terminals of rank 4, the cabinet should have relay bar terminals.

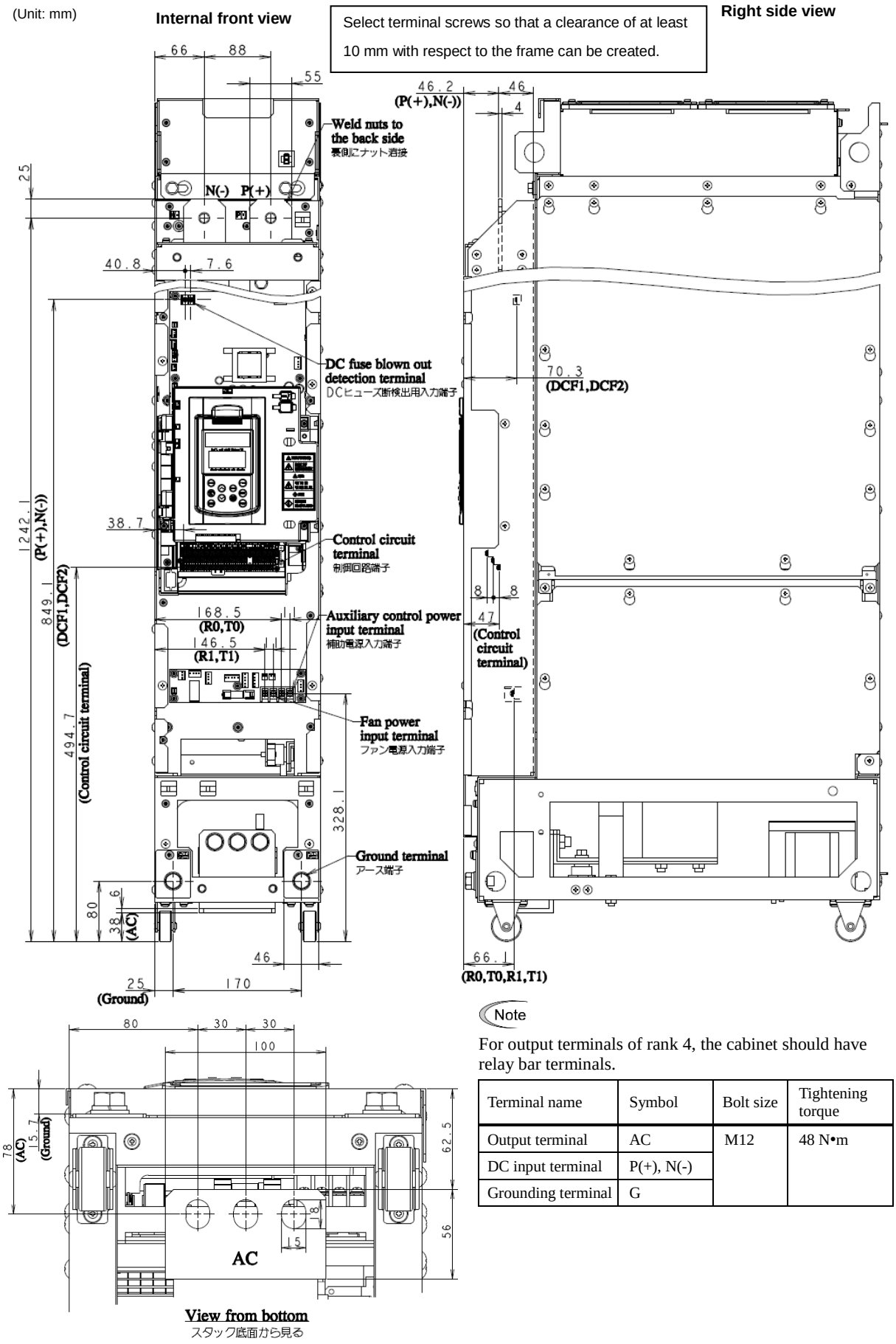
Secure terminals with insulators to prevent them from short-circuiting each other.

Terminal name	Symbol	Bolt size	Tightening torque
Output terminal	U, V, W	M12	48 N•m
DC input terminal	P(+), N(-)		
Grounding terminal	⏚G		

Figure 2.1-11 Rank 4 (220 to 315 kW)

[5] Rank 4 (630 to 800 kW)

(Unit: mm)



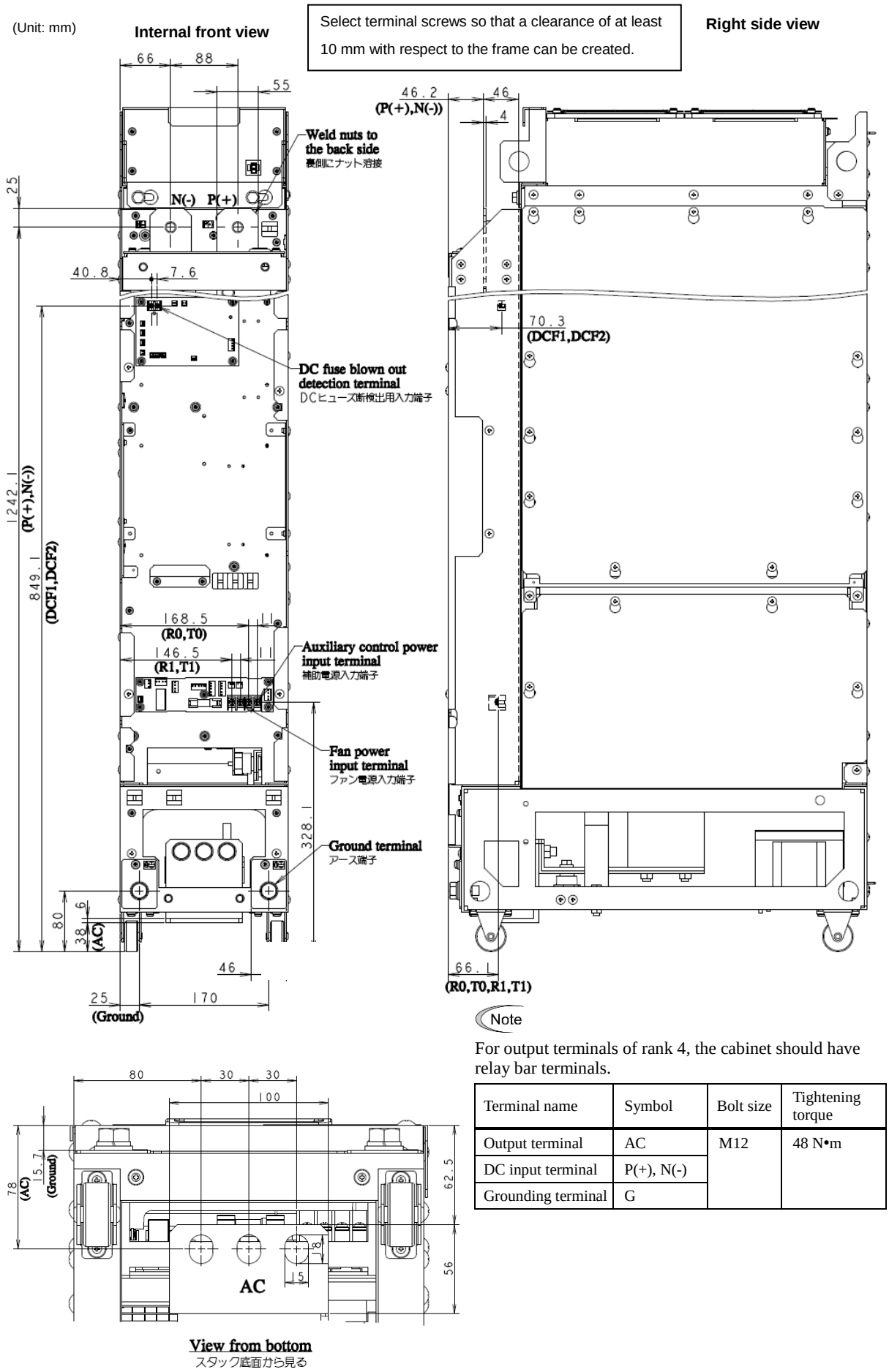
Note

For output terminals of rank 4, the cabinet should have relay bar terminals.

Terminal name	Symbol	Bolt size	Tightening torque
Output terminal	AC	M12	48 N•m
DC input terminal	P(+), N(-)		
Grounding terminal	G		

Figure 2.1-12 Rank 4 (630 to 800 kW) V-PHASE

(Unit: mm)



Note

For output terminals of rank 4, the cabinet should have relay bar terminals.

Terminal name	Symbol	Bolt size	Tightening torque
Output terminal	AC	M12	48 N•m
DC input terminal	P(+), N(-)		
Grounding terminal	G		

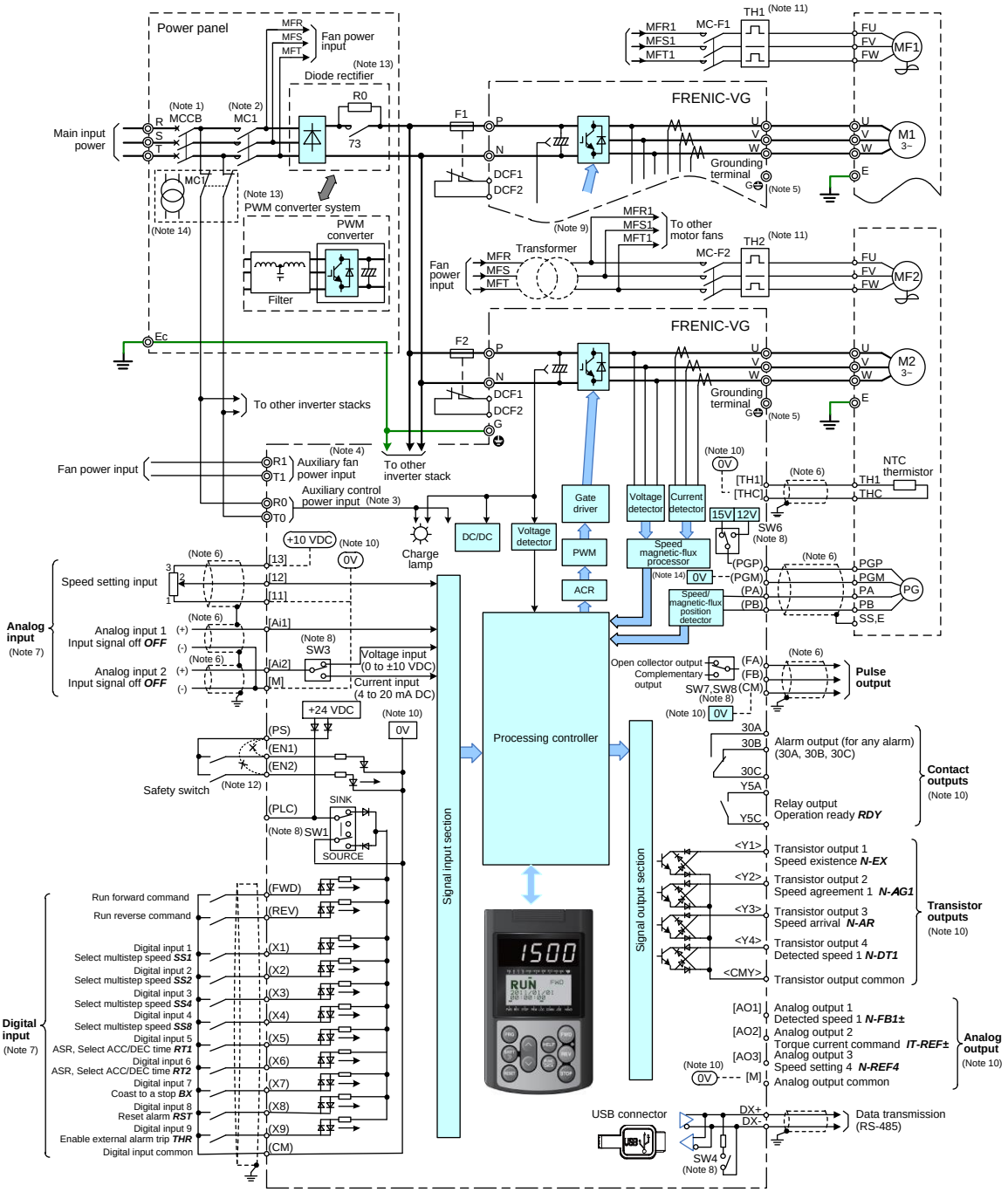
Figure 2.1-13 Rank 4 (630 to 800 kW) U/W-PHASE

2.2 Wiring

2.2.1 Connection diagram

[1] Standard stack

The connection example of the standard stack type is shown below.



(Note 1) In the primary circuit of the PWM converter or diode rectifier, install a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection function) for protection of wiring. Ensure that the circuit breaker capacity is equivalent to or lower than the recommended capacity.

(Note 2) Apart from the MCCB or RCD/ELCB, install a recommended magnetic contactor (MC) to separate the PWM converter or diode rectifier from the power supply as needed.
Connect a surge absorber in parallel when installing a coil such as an MC or solenoid near the inverter.

(Note 3) To retain an alarm output signal ALM issued on inverter's programmable output terminals by the protective function or to keep the keypad alive even if the main power has shut down, connect these terminals to the power supply lines. Without power supply to these terminals, the inverter can run.

(Note 4) These terminals are provided on inverters of 90 kW or above. Connect fan power wires to them.

(Note 5) A grounding terminal for a motor. It is recommended that the motor be grounded via this terminal for suppressing inverter noise.

(Note 6) For wiring enclosed with , use twisted or shielded wires.

In principle, the shielded sheath of wires should be connected to ground. If the inverter is significantly affected by external induction noise, however, connection to 0V ([M], [11], [THC]) or 0V ([CM]) may be effective to suppress the influence of noise.

Keep the control circuit wiring away from the main circuit wiring as far as possible (recommended: 10 cm or more). Never install them in the same wire duct. When crossing the control circuit wiring with the main circuit wiring, set them at right angles.

(Note 7) The connection diagram shows factory default functions assigned to digital input terminals [X1] to [X9], transistor output terminals [Y1] to [Y4], relay contact output terminals [Y5A/C], analog output terminals [AO1] to [AO3], and analog input terminals [Ai1] and [Ai2].

(Note 8) Slide switches on the control printed circuit board (control PCB).

(Note 9) The power voltage of the cooling fans differs depending upon the motors. Use a transformer as needed.

(Note 10) 0V ([M], [11], [THC]) and 0V ([CM]) are insulated inside the inverter unit.

(Note 11) Use the auxiliary contact (manual reset) of the thermal relay to trip the MCCB or MC.

(Note 12) Jumper bars are mounted between safety terminals [EN1]/[EN2] and [PS] by factory default. To use the safety function, remove the jumper bars before connection of safety devices.

(Note 13) Using a PWM converter or diode rectifier requires selecting recommended peripheral equipment. For details about the PWM converter or diode rectifier, refer to the FRENIC-VG User's Manual.

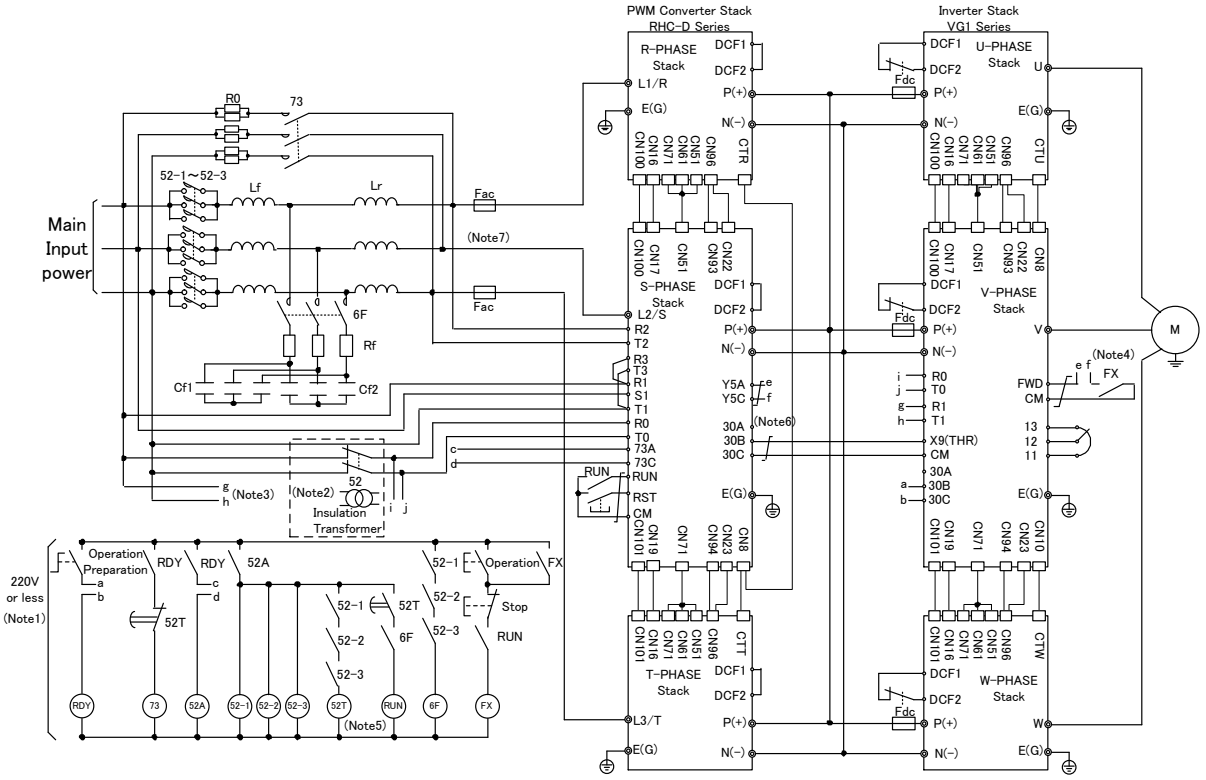
(Note 14) When using a PWM converter in combination with the inverter, be sure to connect the auxiliary power supply input terminals (R0 and T0) of the PWM converter and inverter to the main power supply through the “b” contact of the electromagnetic contactor (MC1) for the power supply. When using a diode rectifier in combination with the inverter, it is not necessary. Additionally, when connecting to a non-grounding power supply, install an insulation transformer. Refer to High power factor PWM converter instruction manual for more information.

[2] Phase specific stack

630 to 800kW Stack type inverter (Phase-specific stack) is consist of three set of Standard stacks of RANK 4 size.

In addition to the example of connection of the above-mentioned standard stack, you need connection between each stacks.

The example of connection is shown below.(This example of connection is in case of PWM Converter)



(Note 1) Connect a step-down transformer to lower the voltage of the sequence circuit to within 220V.

(Note 2) When using a PWM converter in combination with the inverter, be sure to connect the auxiliary power supply input terminals (R0 and T0) of the PWM converter and inverter to the main power supply through the “b” contact of the electromagnetic contactor (52) for the power supply. When using a diode rectifier in combination with the inverter, it is not necessary. Additionally, when connecting to a non-grounding power supply, install an insulation transformer. Refer to High power factor PWM converter instruction manual for more information.

(Note 3) The power of the AC fan of the inverter is supplied from the R1 and T1 terminals; connect to the main power supply without being intervened by the normally closed contact of 73 or 52.

(Note 4) Build the sequence so that the RUN signal is supplied to the inverter after the PWM converter becomes ready for operation.

(Note 5) Set the timer of 52T at 1sec.

(Note 6) Assign one of X1 to X9 terminals of the inverter to external alarm (THR).

(Note 7) Connect cables to theL1/R, L2/S, L3/T, R2, T2, S1 and T1 terminals in the correct phase order.

Follow the procedure below. (In the following description, the inverter has already been installed.)

2.2.2 Removing and mounting the front cover and the wiring guide

⚠CAUTION
Be sure to disconnect the USB cable from the USB connector before removing the front cover. **Otherwise, a fire or accident could occur.**

(1) To remove the front cover, loosen the screws (four or six) on the front cover.

The front cover fixing points have double circle holes that allow the front cover to be removed without removing the screws.

(2) For the front cover having no handles, hold the right and left ends of the front cover and slide the cover up and towards you.

For the front cover having handles, hold the handles and slide the cover up and towards you.

(3) Mount the front cover in the reverse order of removal.

(4) To show the control circuit terminals on the control printed circuit board, open the keypad enclosure (left-hand door).

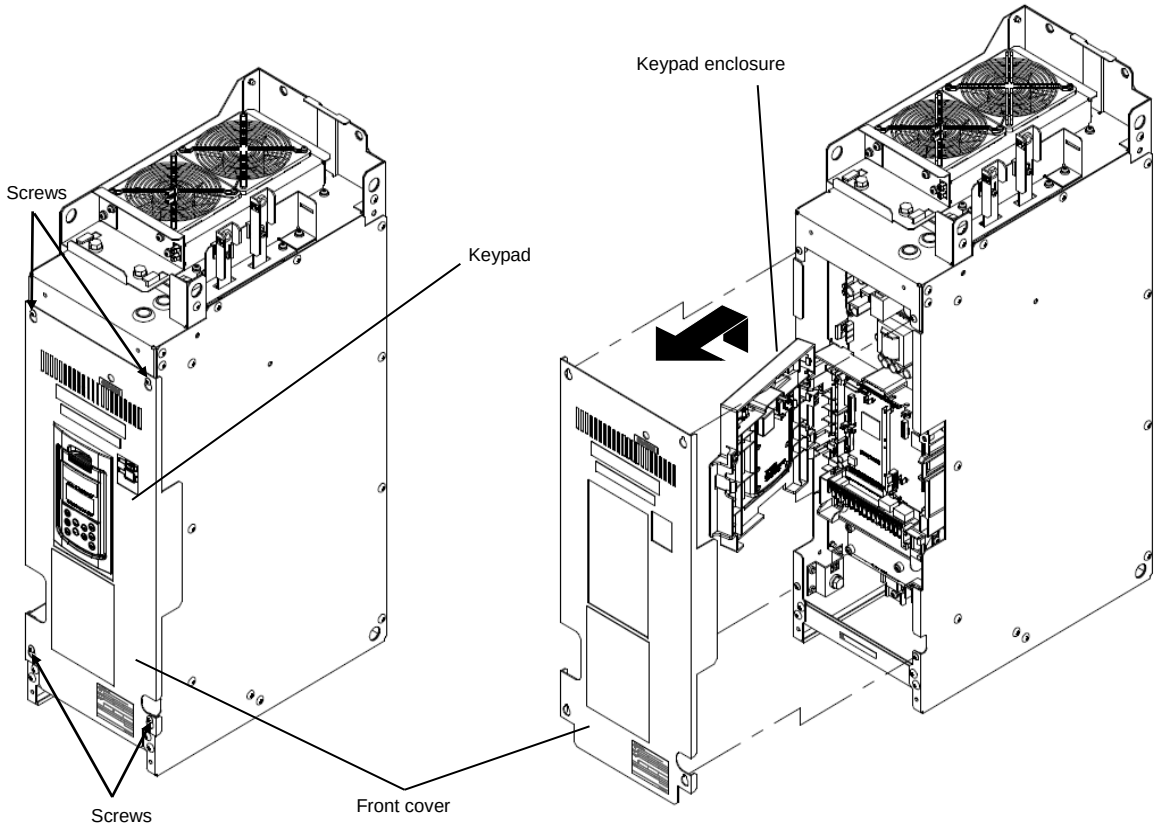


Figure 2.2-1 Removing the Front Cover

2.2.3 Precautions for long wiring (between the inverter and motor)

(1) If more than one motor is to be connected to a single inverter, the wiring length should be the sum of the length of the wires to the motors.

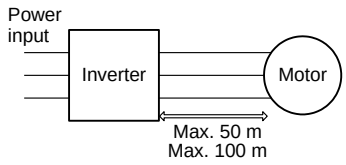
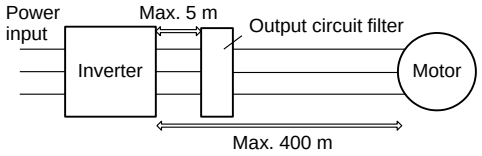
(2) Precautions for high frequency leakage currents

If the wiring distance between an inverter and a motor is long, high frequency currents flowing through stray capacitance across wires of phases may cause an inverter overheat, overcurrent trip, increase of leakage current, or it may not assure the accuracy in measuring leakage current. Depending on the operating condition, an excessive leakage current may damage the inverter.

To avoid the above problems when directly connecting an inverter to a motor, keep the wiring distance 50 m or less for inverters with a capacity of 3.7 kW or below, and 100 m or less for inverters with a higher capacity.

If the wiring distance longer than the specified above is required, insert an output circuit filter (OFL-□□□-□A) as shown below.

When a single inverter drives two or more motors connected in parallel (group drive), in particular, using shielded wires, the stray capacitance to the earth is large, so insert an output circuit filter (OFL-□□□-□A).

No output circuit filter installed	Output circuit filter installed
	

If using the motor with encoder, 100m below the wiring distance between the inverter and the motor. This is due to the limitation on the specifications of the encoder. If it exceeds 100m, the action is required, such as in the middle put the isolated converter.

If further longer secondary wiring is required, consult your Fuji Electric representative.

(3) Precautions for surge voltage in driving a motor by an inverter (especially for 400 V class motors)

If the motor is driven by a PWM-type inverter, surge voltage generated by switching the inverter component may be superimposed on the output voltage and may be applied to the motor terminals. Particularly if the wiring length is long, the surge voltage may deteriorate the insulation resistance of the motor. Implement the following measures.

- Use a motor with insulation that withstands the surge voltage.
- Connect a surge suppressor unit (SSU50/100TA-NS) at the motor terminal.
- Connect an output circuit filter (OFL-□□□-□A) to the output terminals (secondary circuits) of the inverter.
- Minimize the wiring length between the inverter and motor (10 to 20 m or less).

(4) When an output circuit filter is inserted in the secondary circuit or the wiring between the inverter and the motor is long, a voltage loss occurs due to reactance of the filter or wiring so that the insufficient voltage may cause output current oscillation or a lack of motor output torque.

⚠WARNING

- Be sure to 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.
- 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 fire could occur.
- Qualified electricians should carry out wiring.
- Be sure to perform wiring after shutting down the power.

  Otherwise, electric shock could occur.
- Be sure to perform wiring after installing the inverter unit.

  Otherwise, 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 source wires to inverter output terminals (U, V, and W).

  Doing so could cause fire or an accident.

2.2.4 Main circuit terminals

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

This section provides information on choices of wire sizes for main circuit such as DC input and motor output.

Depending upon the main circuit wiring, electric noise could be applied to the control circuit, causing malfunctions.

Refer to the FRENIC-VG User's Manual (Stack type), Chapter 7 "EMC Compatible Peripherals," Appendix 5 "Proficient Way to User Inverters (on Electric Noise), and Appendix 6 "Grounding As Noise Countermeasure and Ground Noise."

(1) Screw specifications

Table 2.2-1 Screw Specifications

Inverter type	Main DC input [P(+), N(-)]		Inverter output [U, V, W]		Grounding terminals [⏚G]		Auxiliary control power input terminals [R0, T0] Auxiliary fan power input terminals [R1, T1]		Input terminals for fuse blowout detection [DCF1, DCF2]	
FRN□VG1S-4E	Screw size	Tightening torque (N·m)	Screw size	Tightening torque (N·m)	Screw size	Tightening torque (N·m)	Screw size	Tightening torque (N·m)	Screw size	Tightening torque (N·m)
30S	M8	13.5	M8	13.5	M8	13.5	M4	1.2	M3	0.5
37S										
45S										
55S	M10	27	M10	27	M10	27				
75S										
90S										
110S										
132S	M12	48	M12	48	M12	48				
160S										
200S										
220S										
250S										
280S										
315S										
630B										
710B										
800B										

(2) Recommended wire sizes

Table 2.2-2 Recommended wire/copper bar sizes (Ambient temperature: 40°C)

<table>
<tr><th rowspan="2">Nominal applied motor (kW)</th><th colspan="2">FRN□VG1S-4E</th><th colspan="2">Main DC input [P(+), N(-)]</th><th colspan="2">Inverter output [U, V, W]</th><th rowspan="2">Grounding terminal [⏚G] (mm²)</th><th rowspan="2">Auxiliary control power input terminals [R0, T0] Auxiliary fan power input terminals [R1, T1] (mm²)</th><th rowspan="2">Input terminal for fuse blowout detection [DCF1, DCF2] (mm²)</th></tr>
<tr><th>MD</th><th>LD</th><th>Copper bar sizes (mm²)</th><th>Wire sizes (mm²)</th><th>Copper bar sizes (mm²)</th><th>Wire sizes (mm²)</th></tr>
<tr><td>30</td><td>30S</td><td>-</td><td rowspan="4">t3×25 (75)</td><td>8</td><td rowspan="8">-</td><td>8</td><td>5.5</td><td rowspan="20">2</td><td rowspan="20">1.25</td></tr>
<tr><td>37</td><td>37S</td><td>30S</td><td>14</td><td rowspan="2">14</td><td>8</td></tr>
<tr><td>45</td><td>45S</td><td>37S</td><td rowspan="3">22</td><td rowspan="3">14</td></tr>
<tr><td rowspan="2">55</td><td>-</td><td>45S</td><td rowspan="2">22</td></tr>
<tr><td>55S</td><td>-</td><td rowspan="6">t3×30 (90)</td></tr>
<tr><td>75</td><td>75S</td><td>55S</td><td>38</td><td>38</td><td rowspan="3">22</td></tr>
<tr><td rowspan="2">90</td><td>-</td><td>75S</td><td rowspan="2">60</td><td rowspan="2">60</td></tr>
<tr><td>90S</td><td>-</td></tr>
<tr><td>110</td><td>110S</td><td>90S</td><td rowspan="2">100</td><td rowspan="3">100</td><td rowspan="3">38</td></tr>
<tr><td rowspan="2">132</td><td>-</td><td>110S</td><td rowspan="4">t5×30 (150)</td></tr>
<tr><td>132S</td><td>-</td><td rowspan="3">t4×40 (160)</td></tr>
<tr><td>160</td><td>160S</td><td>132S</td><td>150</td></tr>
<tr><td>200</td><td>200S</td><td>160S</td><td rowspan="3">200</td><td rowspan="3">150</td><td rowspan="6">60</td></tr>
<tr><td rowspan="2">220</td><td>-</td><td>200S</td></tr>
<tr><td>220S</td><td>-</td><td rowspan="6">t8×50 (400)</td><td rowspan="6">t10×30 (300)</td></tr>
<tr><td>250</td><td>250S</td><td>220S</td><td>250</td><td>200</td></tr>
<tr><td>280</td><td>280S</td><td>250S</td><td rowspan="2">325</td><td rowspan="2">250</td></tr>
<tr><td>315</td><td>315S</td><td>280S</td></tr>
<tr><td>355</td><td>-</td><td>315S</td><td>200×2</td><td>325</td><td>100</td></tr>
<tr><td>630</td><td>630B</td><td>-</td><td rowspan="4">t8×50 (400)</td><td rowspan="4">-</td><td rowspan="4">t10×125 (1250)</td><td>250×3</td><td rowspan="3">150</td></tr>
<tr><td>710</td><td>710B</td><td>630B</td><td>250×4</td></tr>
<tr><td>800</td><td>800B</td><td>710B</td><td>325×4</td></tr>
<tr><td>1000</td><td>-</td><td>800B</td><td>325×5</td><td>150×2</td></tr>
</table>

(Note) *1 The recommended wire sizes listed above are for 600 V HIV insulated wires.
*2 The size of wire or copper bar of stack by phase is a part for 1 phase (1 stack).
*3 Do not connect electric wires directly to the inverter output terminals of FRN132-200SVG1S-4E, nor main DC input terminals of FRN132-315SVG1S-4E, FRN630-800BVG1S-4E.
If connecting electric wires directly to their terminals is required, consult your Fuji Electric representative.

(3) Rated current of Cu bus bars

"Table 2.2-3" shows the rated currents of bus bars. However, if the ambient temperature of the cabinet is lower than 40°C and in some other cases, the derating of the current must be considered.

[Precaution about the application of the current and capacity table of bus bars]

Select a bus bar based on a temperature of 70°C, which means a temperature rise of 30 K from an ambient temperature of 40°C. If ambient temperature drops below 40°C, the value of temperature rise increases. Consider a correction factor according to "Figure 2.2-2 Temperature correction factor." In addition, the reduction rate of the supplied current depends on the layout of bus bars. When supplying a large current, plan the current by making reference to Figure 2.2-3

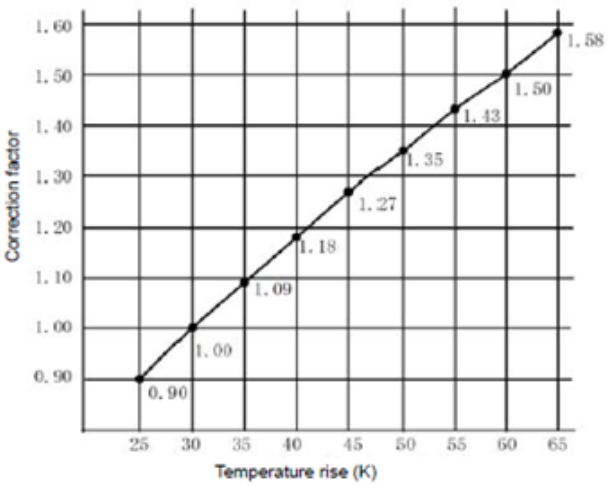


Figure 2.2-2 Temperature correction factor

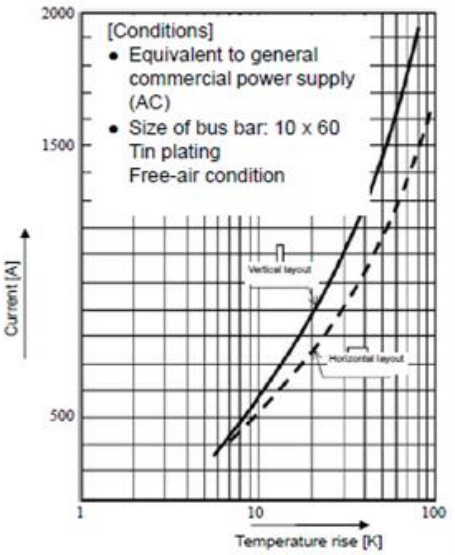


Figure 2.2-3 Derating in installation direction (reference)

Table 2.2-3 Rated currents of CU bus bars

Dimension [mm]		Cross section [mm^2]		Not parallel		2 parallel		3 parallel	
Thickness	Width		DC	AC (50/60 Hz)	DC	AC (50/60 Hz)	DC	AC (50/60 Hz)
3	15	45	180	180	–	–	–	–
	20	60	225	225				
	25	75	275	275				
	30	90	320	320				
4	25	100	325	325	–	–	–	–
	30	120	380	375				
	40	160	485	480				
5	25	125	370	365	–	–	–	–
	30	150	430	425				
	40	200	550	540				
	50	250	660	650				
	60	300	780	860				
	75	375	950	930	1920	1790		
6	25	150	410	410	–	–	–	–
	30	180	480	470				
	40	240	610	600				
	50	300	730	720				
	60	360	860	840				
	75	450	1050	1010	2090	1910		
	80	480	1110	1070	2190	2000		
	100	600	1350	1280	2620	2330	3670	3060
8	25	200	500	490	–	–	–	–
	30	240	570	560				
	40	320	720	700				
	50	400	860	840				
	60	480	1010	970				
	75	600	1220	1160	2390	2120		
	80	640	1290	1220	2510	2210		
	100	800	1580	1470	2990	2560	4230	3330
10	30	300	670	650	1450	1390	–	–
	40	400	830	800	1730	1600		
	50	500	990	950	2010	1810		
	60	600	1150	1090	2280	2010		
	75	750	1390	1290	2680	2290		
	80	800	1460	1360	2810	2380		
	100	1000	1780	1620	3310	2730	4750	3490
	125	1250	2150	1930	3930	3160	5570	3960
	150	1500	2550	2260	4550	3590	6410	4450
12	125	1500	2390	2100	4290	3300	6140	4120
	150	1800	2800	2430	4930	3700	7000	4590
15	100	1500	2110	1920	–	–	–	–
	150	2250	3160	2660	5510	3870	7900	4790
	175	2625	3550	2960	6080	4240	8660	5200
	200	3000	4070	3350	6850	4680	9680	5700

(Note) *1 The selection conditions applied to this table are ambient temperature: 40°C and temperature rise: 30K.

*2 The layout of bus bars is a vertical layout.

[2] Terminal functions (main circuit terminals)

Classification	Symbol	Name	Functions
Main circuit	U, V, W	Inverter outputs	Connect a three-phase motor. For the phase-specific stack, one terminal connects to one phase (one stack).
	P(+), N(-)	Main DC inputs	To be used for connection to the DC link bus. Connect to the diode rectifier or PWM converter output terminals P (+) and N (-).
	R0, T0	Auxiliary power inputs for control circuit	Connect the same AC power lines as the main power input of the diode rectifier or PWM converter for a backup of the control circuit power supply. Do not connect a power supply directly to these terminals. When the inverter is used in combination with the PWM converter, insert an insulation transformer or auxiliary B contact (normally-closed) of a power side magnetic contactor.
	R1, T1	Auxiliary power inputs for fans	Power terminals for AC cooling fans. For inverters of 90 kW (FRN90SVG1S-4) or above, connect an AC power supply to these terminals. To match the power specifications, set the fan power switching connectors U1 and U2. For details, refer to Section 2.2.7.
	DCF1, DCF2	Inputs for fuse blowout detection	Terminals for detecting a blowout of the DC fuse connected to the inverter main input power supply. When the circuit between terminals [DCF1] and [DCF2] is OFF, the inverter can detect the blowout of the DC fuse. To use the detection function, remove the short bar from these terminals to close the microswitch of the DC fuse. (24 VDC 12 mA typ.)
	⏚ G	Grounding for inverter	Grounding terminals of the inverter.

2.2.5 Control circuit terminals (common to all inverter types)

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

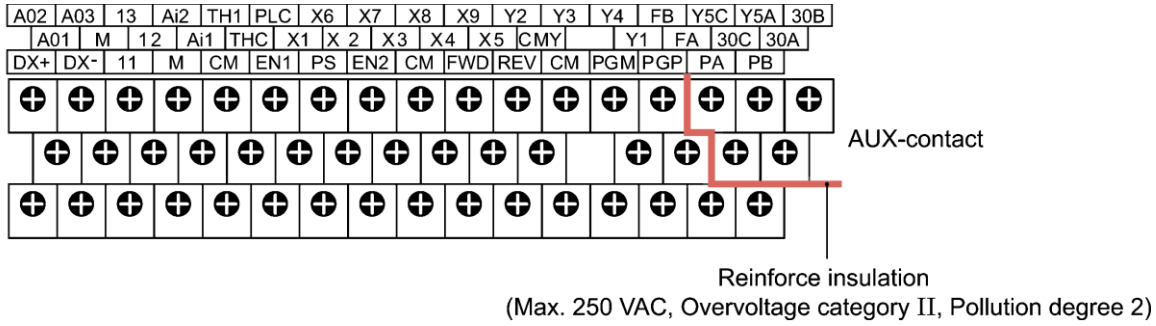
Table 2.2-4 lists the screw specifications and recommended wire size for wiring of the control circuit terminals. The control circuit terminals are common to all inverter types regardless of their capacities.

Table 2.2-4 Screw Specifications and Recommended Wire Size

Terminals common to all inverter types	Screw specifications		Recommended wire size (mm^2)
	Screw size	Tightening torque (N·m)	
Control circuit terminals	M3	0.7	1.25 *

* Using wires exceeding the recommended sizes may lift the front cover depending upon the number of wires used, resulting in a keypad connection failure and impeding keypad's normal operation.

[2] Terminal arrangement (control circuit terminals)



[3] Detailed functions of control circuit terminals

⚠WARNING

In general, the covers 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 cover 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.

Failure to observe these precautions could cause electric shock or an accident.

⚠CAUTION

Noise may be emitted from the inverter, motor and wires. Take appropriate measures to prevent the nearby sensors and devices from malfunctioning due to such noise.

It takes a maximum of 5 seconds to establish the input/output of the control circuit after the main power is turned ON. Take appropriate measures, such as external timers.

An accident could occur.

Table 2.2-5 lists the symbols, names and functions of the control circuit terminals. The wiring to the control circuit terminals differs depending upon the setting of the function codes, which reflects the use of the inverter. The states of the control circuit terminals can be checked with Menu #4 "I/O CHECK" using the keypad. For details, refer to Section 3.2.

Route wires properly to reduce the influence of noise. (Refer to the notes for analog input in Table 2.2-5.)

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals

Classification	Symbol	Name	Functions
Analog input	[13]	Power supply for potentiometer	Power supply for an external speed command potentiometer (Variable resistor: 1 to 5kΩ). The potentiometer of 1/2 W rating or more should be connected. Specifications 10 VDC/10 mA max.
	[12]	Analog setting voltage input	The speed is commanded according to the external voltage input. Specifications • 0 to ±10 VDC/0 to maximum speed Maximum input is ±15 VDC Note that the input voltage out of the range of ±10 VDC is regarded as ±10 VDC. • Input impedance: 10kΩ
	[Ai1] [Ai2]	Analog input 1 Analog input 2	(1) Analog input voltage from external equipment. Possible to assign various signal functions (Input signal off, Auxiliary speed setting 1, Torque limiter, etc.*) selected with Function codes E49 and E50 to these terminals. (2) Only for terminal [Ai2], the input is switchable between voltage and current with the SW3 configuration. (3) To use terminal [Ai2] for current input speed setting (***N-REFC***), turn SW3 to the I position, set F01 or C25 to "9" and set E50 to "26." After that, check that the current input is normal on the I/O check screen*. * For details, refer to the FRENIC-VG User's Manual (Unit Type / Function Codes Edition). Specifications • Voltage input: 0 to ±10 VDC, Input impedance: 10kΩ Maximum input voltage: ±15 VDC Note that the input voltage out of the range of ±10 VDC is regarded as ±10 VDC. • Current input (only on terminal [Ai2]): Input impedance: 250Ω Maximum input current: 30 mADC Note that the input current exceeding 20 mADC is regarded as 20 mADC.
	[11] [M]	Analog input common	Common for analog input signals ([12], [Ai1] and [Ai2]). Isolated from terminals [CM], [CMY] and [PGM].

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

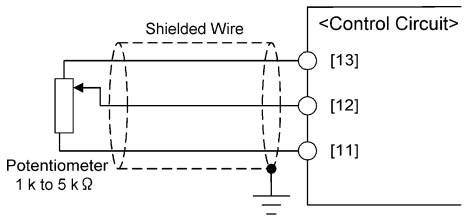
<table>
<tr><th>Classifi-cation</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="4">Digital input</td><td colspan="3">Note
- Since low level analog signals are handled, these signals are especially susceptible to the external noise effects. Route the wiring as short as possible (within 20 m) and use shielded wires. In principle, ground the shielded sheath of wires; if effects of external inductive noises are considerable, connection to terminal [11] may be effective. As shown in Figures 2.2-4 and 2.2-5, be sure to ground the single end of the shield to enhance the shield effect.
- Use a twin-contact relay for low level signals if the relay is used in the control circuit. Do not connect the relay's contact to terminal [11] or [M].
- When the inverter is connected to an external device outputting the analog signal, the external device may malfunction due to electric noise generated by the inverter. If this happens, according to the circumstances, connect a ferrite core (a toroidal core or equivalent) to the device outputting the analog signal or connect a capacitor having the good cut-off characteristics for high frequency between control signal wires as shown in Figures 2.2-4 and 2.2-5.
 

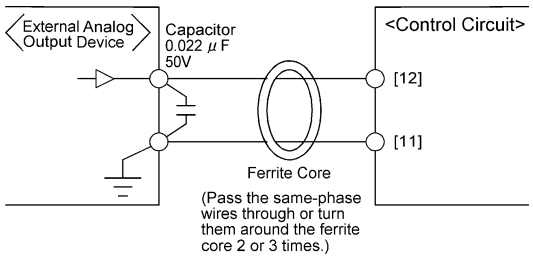
Figure 2.2-4 Connection of Shielded Wires
 

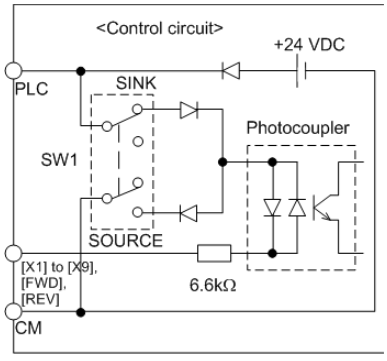
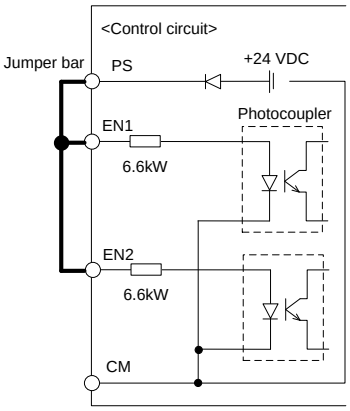
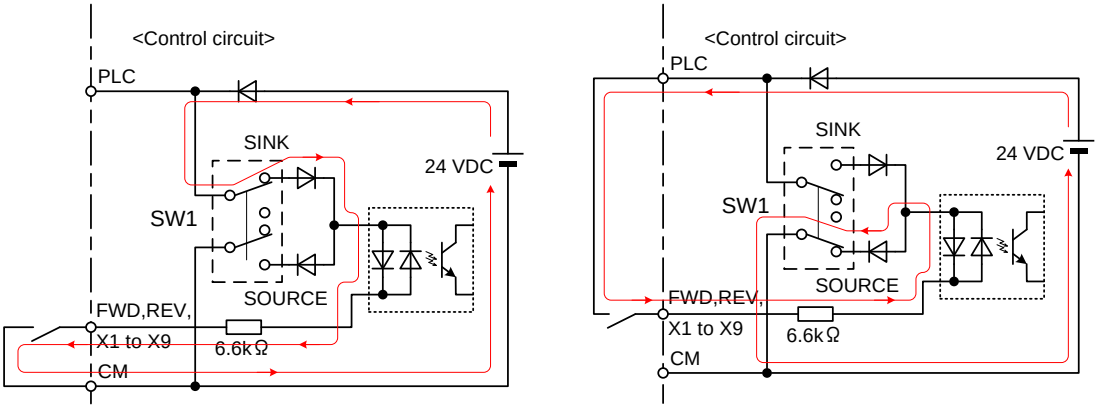
Figure 2.2-5 Example of Electric Noise Reduction</td></tr>
<tr><td>[FWD]</td><td>Run forward command</td><td>(1) When terminals [FWD] and [CM] are closed, the motor runs in the forward direction. When they are opened, the motor decelerates to a stop. (SINK)
When terminals [FWD] and [PLC] are closed, the motor runs in the forward direction. When they are opened, the motor decelerates to a stop. (SOURCE)
(2) Input mode, i.e. SINK/SOURCE, is changeable by using the slide switch SW1. Factory default: SINK (Refer to Section 2.2.6 "Setting up the slide switches.")</td></tr>
<tr><td>[REV]</td><td>Run reverse command</td><td>(1) When terminals [REV] and [CM] are closed, the motor runs in the forward direction. When they are opened, the motor decelerates to a stop. (SINK)
When terminals [REV] and [PLC] are closed, the motor runs in the forward direction. When they are opened, the motor decelerates to a stop. (SOURCE)
(2) Input mode, i.e. SINK/SOURCE, is changeable by using the slide switch SW1. Factory default: SINK (Refer to Section 2.2.6 "Setting up the slide switches.")</td></tr>
<tr><td>[X1]
[X2]
[X3]
[X4]
[X5]
[X6]
[X7]
[X8]
[X9]</td><td>Digital input 1
Digital input 2
Digital input 3
Digital input 4
Digital input 5
Digital input 6
Digital input 7
Digital input 8
Digital input 9</td><td>(1) Various signals such as "Coast to a stop," "Enable external alarm trip," and "Select multistep speed" can be assigned to these terminals by setting Function codes E01 to E09. *
(2) It is possible to switch the normal/negative logic output mode for these terminals with Function code E14. *
When short-circuited: ON (Active ON)
When short-circuited: OFF (Active OFF)
(3) Input mode, i.e. SINK/SOURCE, is changeable by using the slide switch SW1. Factory default: SINK (Refer to Section 2.2.6 "Setting up the slide switches.")
* For details, refer to the FRENIC-VG User's Manual(Unit Type / Function Codes Edition), Chapter 4, Section 4.3 "Details of Function Codes."
(Digital input circuit specifications)
 

Figure 2.2-6 Digital Input Circuit
<table><tr><th colspan="2">Item</th><th>Min.</th><th>Max.</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 (Input voltage is at 0 V)</td><td>–</td><td>4.5 mA</td></tr><tr><td colspan="2">Allowable leakage current at OFF</td><td>–</td><td>0.5 mA</td></tr></table></td></tr>
</table>

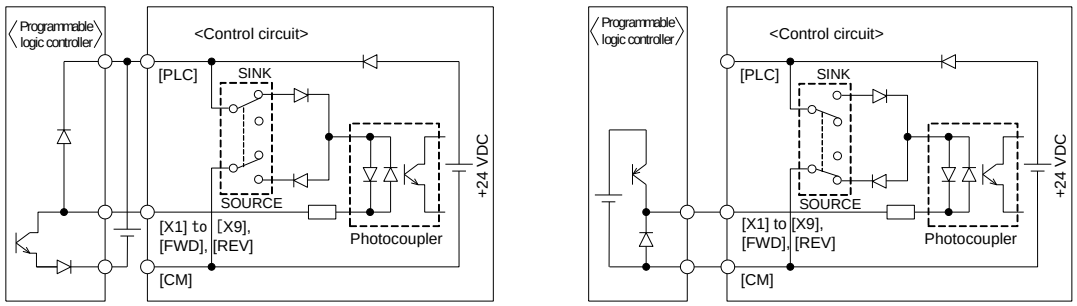
Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

<table>
<tr><th>Classifi-cation</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="4">Digital input</td><td>[EN1]
[EN2]</td><td>Enable inputs</td><td>(1) When [EN1]-[PS] or [EN2]-[PS] is opened (OFF), the inverter output transistor stops its operation. (Safe Torque Off, STO)
To enable the STO function, remove the jumper bars.
(2) The input mode of terminals [EN1] and [EN2] is fixed at SOURCE. It cannot be switched to SINK.
(3) When not using the Enable input function, short the circuit between [EN1]-[PS] and [EN2]-[PS] with jumper bars (that is, keep the short bars connected).
(Terminal EN circuit specification)
 

<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 (Input voltage is at 0 V)</td><td>–</td><td>4.5 mA</td></tr>
<tr><td colspan="2">Allowable leakage current at OFF</td><td>–</td><td>0.5 mA</td></tr>
</table></td></tr>
<tr><td>[PS]</td><td>[EN] terminal power</td><td>Power terminal for terminals [EN1] and [EN2].
This terminal outputs +24 VDC (Reference for terminal [CM]).</td></tr>
<tr><td>[PLC]</td><td>PLC signal power</td><td>(1) Connects to PLC output signal power supply.
Rated voltage: +24 VDC (Allowable range: +22 to +27 VDC), Maximum 100 mA DC
(2) This terminal also supplies a power to the load connected to the transistor output terminals. Refer to "Transistor output" described later in this table for more.</td></tr>
<tr><td>[CM]</td><td>Digital input common</td><td>Two common terminals for digital input signals
Electrically isolated from terminals [11], [M], and [CMY].</td></tr>
<tr><td colspan="3">Tip
■ Using a relay contact to turn [FWD], [REV], or [X1] to [X9] ON or OFF
Figure 2.2-7 shows two examples of a circuit configuration that uses a relay contact to turn control signal input [X1] to [X9], [FWD], or [REV] ON or OFF. In circuit (a), the slide switch is turned to SINK, whereas in circuit (b) it is turned to SOURCE.
Note: To configure this kind of circuit, use a highly reliable relay.
(Recommended product: Fuji control relay Model HH54PW.)
 

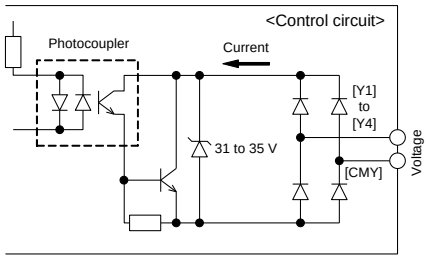
(a) With the switch turned to SINK (b) With the switch turned to SOURCE
Figure 2.2-7 Circuit Configuration Using a Relay Contact</td></tr>
</table>

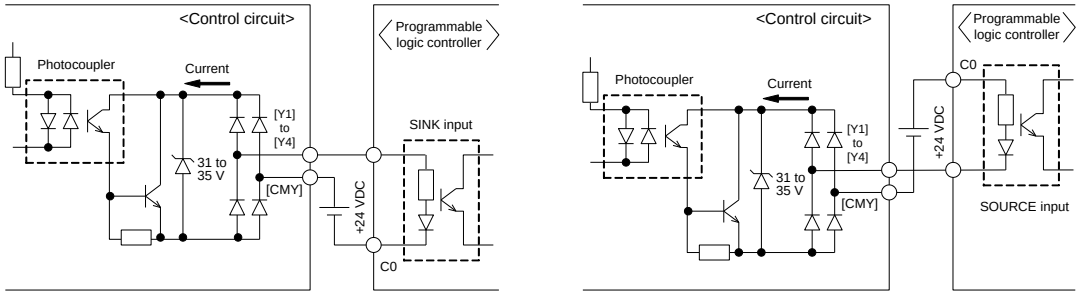
Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td>Digital input</td><td colspan="3">
Tip ■ Using a programmable logic controller (PLC) to turn [FWD], [REV], or [X1] to [X9] ON or OFF
Figure 2.2-8 shows two examples of a circuit configuration that uses a programmable logic controller (PLC) to turn control signal input [X1] to [X9], [FWD], or [REV] ON or OFF. In circuit (a), the slide switch is turned to SINK (factory default), whereas in circuit (b) it is turned to SOURCE.
In circuit (a) below, short-circuiting or opening the transistor's open collector circuit in the PLC using an external power supply turns ON or OFF control signal [FWD], [REV], or [X1] to [X9]. When using this type of circuit, observe the following:
- Connect the + node of the external power supply (which should be isolated from the PLC's power) to terminal [PLC] of the inverter.
- Do not connect terminal [CM] of the inverter to the common terminal of the PLC.


(a) With the switch turned to SINK (b) With the switch turned to SOURCE
Figure 2.2-8 Circuit Configuration Using a PLC
For details about the slide switch setting, refer to Section 2.2.6 "Setting up the slide switches."
</td></tr>
<tr><td rowspan="2">Analog output</td><td>[Ao1]
[Ao2]
[Ao3]</td><td>Analog output 1
Analog output 2
Analog output 3</td><td>Output of monitor signals with analog DC voltage.
Various signals such as "Detected speed," "Speed setting," and "Torque current command" can be assigned to these terminals by setting Function codes E69, E70, and E71.
For details, refer to the FRENIC-VG User's Manual(Unit Type / Function Codes Edition), Chapter 4, Section 4.3 "Details of Function Codes."
<u>Specifications</u>
• Output voltage: 0 to ±10 VDC, Connectable impedance: Min. 3kΩ
• Gain adjustment range: 0 to ±100 times</td></tr>
<tr><td>[M]</td><td>Analog common</td><td>Common for analog output signals ([Ao1], [Ao2] and [Ao3]).
Electrically isolated from terminals [CM], [CMY] and [PGM].</td></tr>
</table>

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="3">Transistor output</td><td>[Y1]
[Y2]
[Y3]
[Y4]</td><td>Transistor output 1
Transistor output 2
Transistor output 3
Transistor output 4</td><td>(1) Various signals such as "Inverter running," "Speed valid," and "Speed agreement" can be assigned to these terminals by setting Function codes E15 to E18. *
(2) It is possible to switch the normal/negative logic output mode for these terminals with Function code E28. *
When short-circuited: ON (Active ON)
When short-circuited: OFF (Active OFF)
*For details, refer to the FRENIC-VG User's Manual(Unit Type / Function Codes Edition), Chapter 4, Section 4.3 "Details of Function Codes."
(Transistor output circuit specification)
 

<table>
<tr><th colspan="2">Item</th><th>Max.</th></tr>
<tr><td rowspan="2">Operation voltage</td><td>ON level</td><td>2 V</td></tr>
<tr><td>OFF level</td><td>27 V</td></tr>
<tr><td colspan="2">Maximum current at ON</td><td>50 mA</td></tr>
<tr><td colspan="2">Leakage current at OFF</td><td>0.1 mA</td></tr>
</table>
Figure 2.2-9 Transistor Output Circuit
Note - When a transistor output drives a control relay, connect a surge-absorbing diode across relay's coil terminals.
- When any equipment or device connected to the transistor output needs to be supplied with DC power, feed the power (+24 VDC: allowable range: +22 to +27 VDC, 100 mA max.) through the [PLC] terminal. Short-circuit between the terminals [CMY] and [CM] in this case.</td></tr>
<tr><td>[CMY]</td><td>Transistor output common</td><td>Common terminal for transistor output signals
Electrically isolated from terminals [CM], [11], [M], and [PGM].</td></tr>
<tr><td colspan="3"></td><td>Tip ■ Connecting programmable logic controller (PLC) to terminal [Y1], [Y2], [Y3] or [Y4]
Figure 2.2-10 shows two examples of circuit connection between the transistor output of the inverter's control circuit and a PLC. In example (a), the input circuit of the PLC serves as a SINK for the control circuit output, whereas in example (b), it serves as a SOURCE for the output.
 

(a) PLC serving as SINK (b) PLC serving as SOURCE
Figure 2.2-10 Connecting PLC to Control Circuit</td></tr>
</table>

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

Classification	Symbol	Name	Functions
Relay output	[Y5A/C]	General purpose relay output	(1) As a general-purpose relay contact output, this selects and outputs the same various signals as those from terminals [Y1] to [Y4]. ***** Contact rating: 250 VAC 0.3 A, cos ϕ = 0.3, 48 VDC, 0.5 A (Resistance load) (2) It is possible to switch the normal/negative logic output mode for these terminals with Function code E28. ***** When ON signal is issued, [Y5A]-[Y5C] is short-circuited (Excited: "Active ON") When ON signal is issued, [Y5A]-[Y5C] is opened (Not excited: "Active OFF") ***** For details, refer to the FRENIC-VG User's Manual(Unit Type / Function Codes Edition), Chapter 4, Section 4.3 "Details of Function Codes."
	[30A/B/C]	Alarm relay output (for any error)	(1) Outputs a contact signal (relay contact, 1C) when the protective function stops the inverter. Contact rating: 250 VAC, 0.3 A, cos ϕ = 0.3, 48 VDC, 0.5 A (Resistance load) (2) It is possible to switch the normal/negative logic output mode for these terminals with Function code F36.***** When ON signal is issued, [30A]-[30C] is short-circuited (excited: "Active ON"). When ON signal is issued, [30A]-[30C] is opened (non-excited: "Active OFF"). * For details, refer to the FRENIC-VG User's Manual(Unit Type / Function Codes Edition), Chapter 4, Section 4.3 "Details of Function Codes."

Note

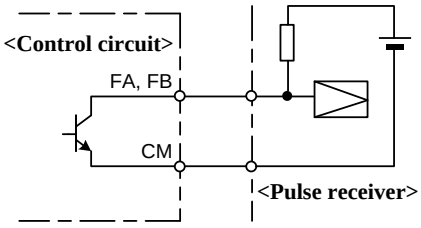
- Terminals [Y5A/C] and [30A/B/C] use mechanical contacts that cannot stand frequent ON/OFF switching. The service life of a relay is approximately 200,000 times if it is switched ON and OFF at one-second intervals in case of rated load operation. Frequent ON/OFF switching signals can be output from the transistor outputs terminals [Y1]-[Y4].

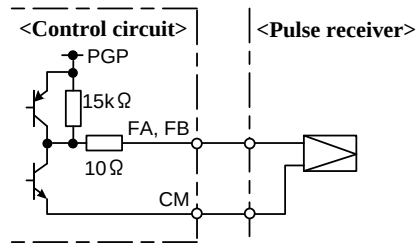
  Further, even if an AC power source, in the case of loads, such as direction of the contact current is fixed (such as load having a half-wave rectifier circuit, for example a timer, the power supply for the motor electromagnetic brake), contact life is shortened. In such a case, instead of directly connecting the load to the contact output terminal, the control relay (separately installed) that matches the load requirement is connected to the contact output terminal, and connected to the load via the relay.

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

Classification	Symbol	Name	Functions
Communication	[DX+]/ [DX-]	RS-485 communications port 2 (Terminal block)	Input/output terminals to transmit data through the RS-485 communications link between the inverter and a computer or other equipment such as a PLC. (For setting of the terminating resistor, refer to Section 2.2.6 "Setting up the slide switches.")
	USB connector	USB port	A USB port connector (mini B) that connects an inverter to a computer. Using FRENIC Loader VG (inverter support software*****) running on the computer supports editing the function codes, transferring them to the inverter, verifying them, test-running the inverter and monitoring the inverter running status. ***** FRENIC Loader VG (free version) is available as an install from the CD-ROM (that comes with the inverter as an accessory) or as a free download from our website at: http://www.fujielectric.com/products/inverter/download/ The free version supports editing, transferring and verifying of function codes and the traceback function.

Table 2.2-5 Symbols, Names and Functions of the Control Circuit Terminals (Continued)

<table>
<tr><th>Classifi-cation</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="6">Speed detection</td><td>[PA]
[PB]</td><td>Pulse generator 2-phase signal input</td><td>The PG interface uses a complementary output mode.
[PA]: Input terminal for A phase of the pulse generator
[PB]: Input terminal for B phase of the pulse generator
When 12V power supply is in use: H level ≥ 9V, L level ≤ 1.5V
When 15V power supply is in use: H level ≥ 12V, L level ≤ 1.5V
Input pulse frequency: 100 kHz or below, Duty: 50 ±10%
Wiring length: 100 m or less
(Note) False detection may occur due to noise. Make the wiring length as short as possible and take sufficient noise control measures.</td></tr>
<tr><td>[PGP]</td><td>Pulse generator power output</td><td>Power supply terminal for a pulse generator.
The output voltage is switchable between 12 V and 15 V with the slide switch.
Output: +12 VDC ±10%, Maximum current: 270 mA
Output: +15 VDC ±10%, Maximum current: 270 mA
Factory default: 15 V
(For the output voltage switch, refer to Section 2.2.6 "Setting up the slide switches.")</td></tr>
<tr><td>[PGM]</td><td>Common terminal</td><td>Common terminal for pulse generator power/signal.
Electrically isolated from terminals [11], [M] and [CMY].
Not electrically isolated from terminal [CM], but not equivalent voltage.</td></tr>
<tr><td>[FA]
[FB]</td><td>Pulse generator output</td><td>(1) This outputs pulse generator signals with frequency divided to 1/n (where, n is programmable with Function code E29).
(2) Switchable between open collector and complementary (equivalent to the voltage on terminal [PGP]) transistor outputs.
Factory default: Open collector
(For switching, refer to Section 2.2.6 "Setting up the slide switches.")
<u>Specifications</u>
Open collector
 

<table><tr><th colspan="2">Items</th><th>Max.</th></tr><tr><td rowspan="2">Operating voltage</td><td>ON level</td><td>2 V</td></tr><tr><td>OFF level</td><td>Indefinite (depending on the receiver side)</td></tr><tr><td colspan="2">Load current at ON</td><td>15 mA</td></tr><tr><td colspan="2">Rated voltage</td><td>27 V</td></tr></table>
Complementary
 

<table><tr><th colspan="2">Items</th><th>Min.</th><th>Max.</th></tr><tr><td rowspan="2">Operating voltage</td><td>High level</td><td>PGP-3V</td><td>-</td></tr><tr><td>Low level</td><td>-</td><td>2 V</td></tr><tr><td colspan="2">Load current at ON</td><td>-</td><td>20 mA</td></tr><tr><td colspan="2">Leakage current at OFF</td><td>-</td><td>0.5 mA</td></tr></table></td></tr>
<tr><td>[CM]</td><td>Pulse generator output common</td><td>Common terminal for [FA] and [FB].</td></tr>
<tr><td rowspan="2">Temperature detection</td><td>[TH1]</td><td>NTC/PTC thermistor connection</td><td>Monitors the motor temperature with NTC or PTC thermistor.
For a PTC thermistor, the motor overheat protection level can be specified with Function code E32.</td></tr>
<tr><td>[THC]</td><td>Common</td><td>Common terminal for NTC and PTC thermistors.
Electrically isolated from terminals [CM], [CMY], and [PGM]</td></tr>
</table>

[4] Wiring for the control circuit

The following three wiring routes are available for the control circuit.

(1) Wiring route for DC fuse blowout detection (Leading in from the top at the front side)

(2) Wiring route from the left-hand side of the front cover.

(3) Wiring route from the right-hand side of the front cover.

In wiring inside the stack, take care to bind control circuit wires with cable ties and secure them to the cable tie fixtures attached to the inside of the stack. Otherwise, the control circuit wires may come into contact with the electronic devices inside the stack, resulting in burnt wires.

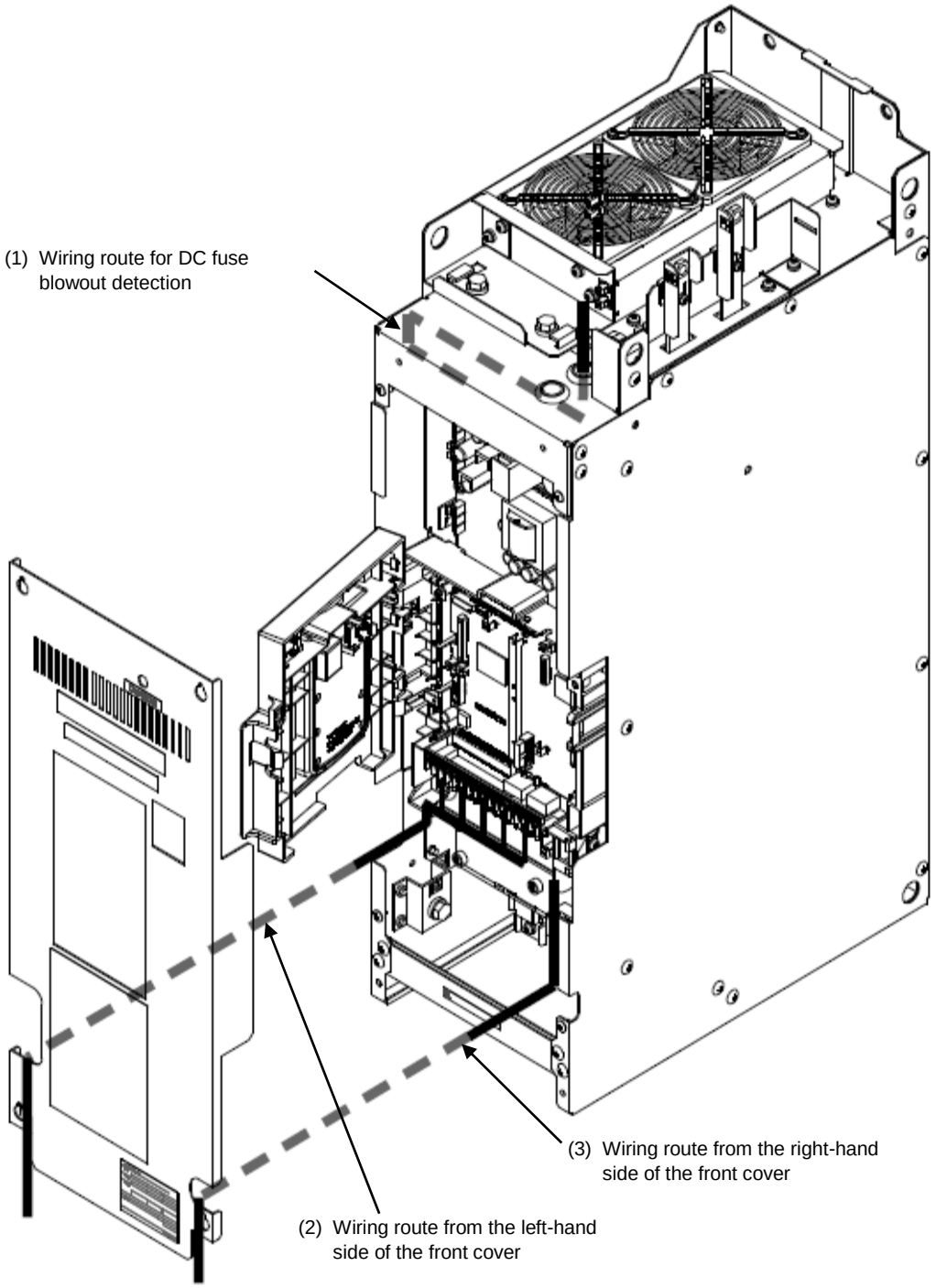


Figure 2.2-11 Control Circuit Wiring Route for Rank 1 (30 to 45 kW) (Example)

The wiring route for DC fuse blowout detection is shown in Figure 2.2-12.

On the printed circuit boards, aluminum electrolytic capacitors, high-voltage circuits, and heat sinks for cooling electronic devices are mounted. To prevent the wires from coming into contact with those components, be sure to secure the wires to the cable tie fixtures using cable ties. Otherwise, those components in contact with the wires may come off due to vibration.

In wiring, take care not to stretch the wires too tight.

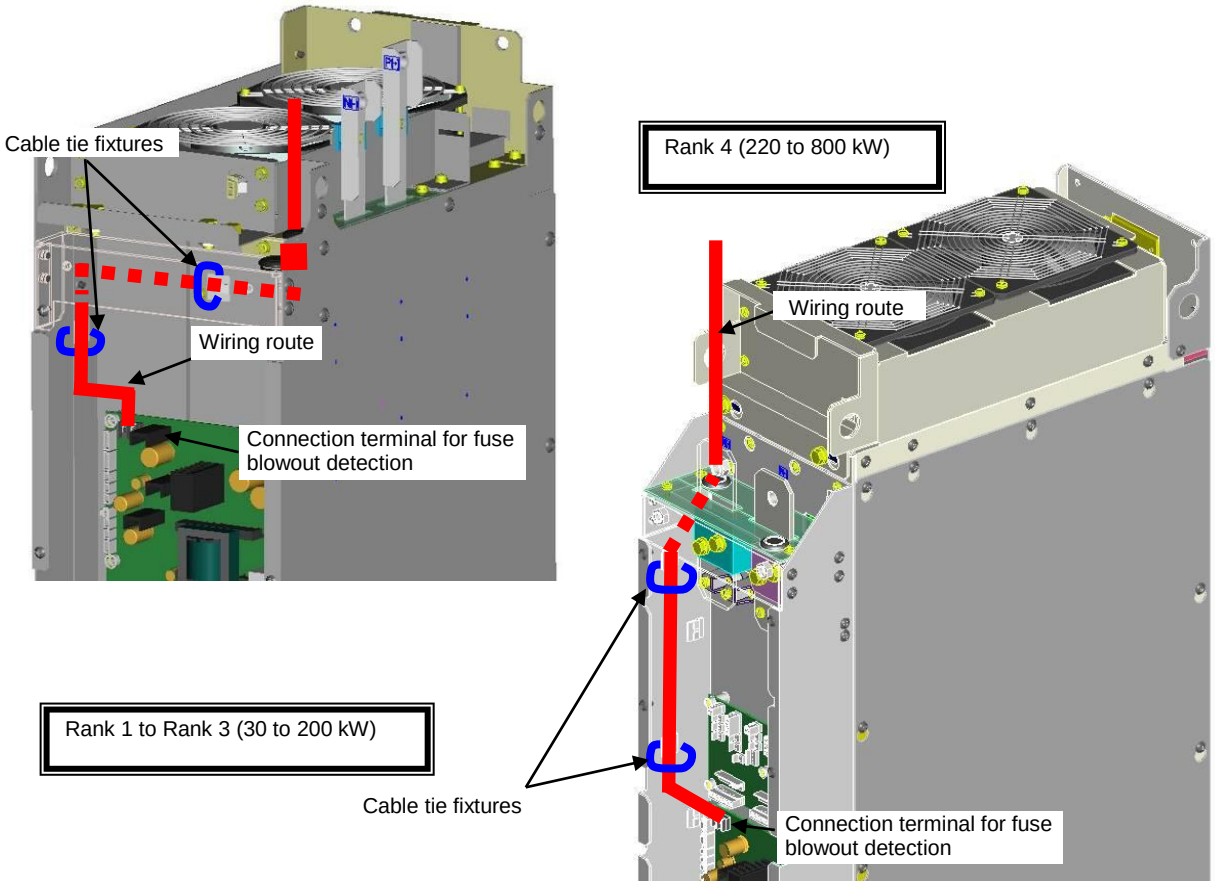


Figure 2.2-12 Wiring Route for DC Fuse Blowout Detection

2.2.6 Setting up the slide switches

⚠WARNING⚠

Before changing the slide switches on the control printed circuit board, **turn the power OFF, wait at least ten minutes**, and 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).

An electric shock could occur.

Switching the slide switches located on the control PCB (shown in Figure 2.2-13) allows you to customize the operation mode of the analog input terminals, digital I/O terminals, and communications ports.

To access the slide switches, remove the front cover so that you can see the control PCB.

For details on how to remove the front cover and how to open and close the keypad enclosure, refer to Section 2.2.2 "Removing and mounting the front cover and the wiring guide."

Figure 2.2-13 shows the location of slide switches on the control PCB.

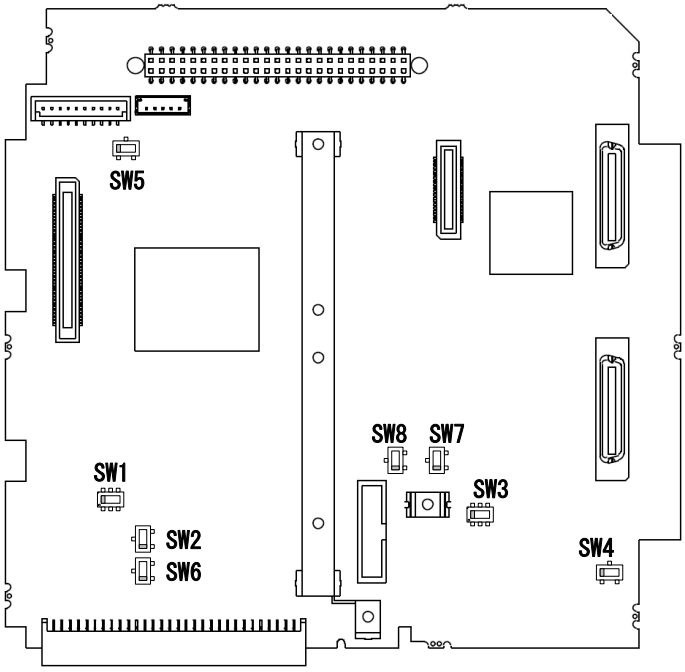


Figure 2.2-13 Location of the Slide Switches on the Control PCB

Switch Configuration and Factory Defaults

	SW1	SW2	SW3	SW4	SW5	SW6	SW7 SW8
Factory default	SINK		V	OFF		15V	1
---	SOURCE		I	ON		12V	2

Note To move a switch slider, use a tool with a narrow tip (e.g., a tip of tweezers). Be careful not to touch other electronic parts, etc. If the slider is in an ambiguous position, the circuit is unclear whether it is turned ON or OFF and the digital input remains in an undefined state. Be sure to place the slider so that it contacts either side of the switch.

SW2 and SW5 are reserved for particular manufacturers. Do not access them.

Table 2.2-6 lists function of each slide switch.

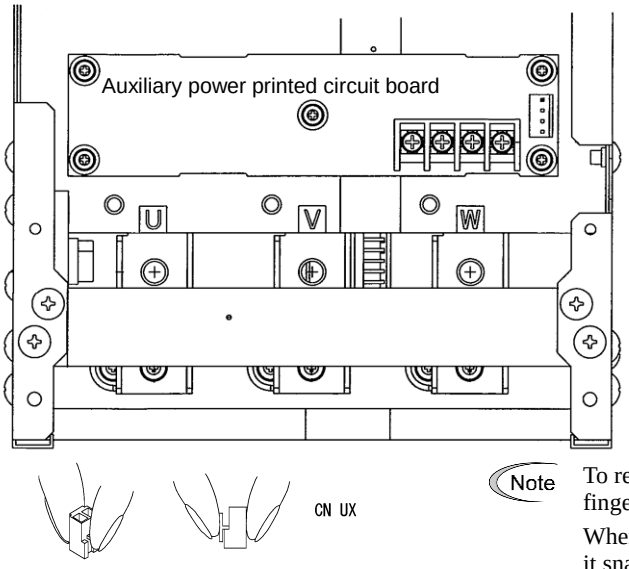
Table 2.2-6 Function of Each Slide Switch

<table>
<tr><th>Switch</th><th>Function</th></tr>
<tr><td>SW1</td><td>Switches the service mode of the digital input terminals between SINK and SOURCE.
▪ This switches the input mode of digital input terminals [X1] to [X9], [FWD] and [REV] to be used as the SINK or SOURCE mode.
▪ Factory default: SINK</td></tr>
<tr><td>SW2</td><td>Reserved for particular manufacturers.</td></tr>
<tr><td>SW3</td><td>Switches the input mode of the analog input terminal [Ai2] between voltage and current.
<table>
<tr><th>Input form</th><th>SW3</th></tr>
<tr><td>Voltage input (Factory default)</td><td>V position</td></tr>
<tr><td>Current input</td><td>I position</td></tr>
</table></td></tr>
<tr><td>SW4</td><td>Switches the terminating resistor of RS-485 communications port 2 on the terminal block ON and OFF. (RS-485 communications port 2, for connecting the keypad)
▪ If the inverter is connected to the RS-485 communications network as a terminating device, turn SW4 to ON.</td></tr>
<tr><td>SW5</td><td>Reserved for particular manufacturers.</td></tr>
<tr><td>SW6</td><td>Switches the output voltage of terminal [PGP] between 12 V and 15 V.
Select the voltage level that matches the power voltage of the pulse generator to be connected.
<table>
<tr><th>Output voltage</th><th>SW6</th></tr>
<tr><td>12 V</td><td>12 V</td></tr>
<tr><td>15 V (Factory default)</td><td>15 V</td></tr>
</table></td></tr>
<tr><td>SW7
SW8</td><td>Switch the output mode of terminals [FA] and [FB] between open collector output and complementary output.
<table>
<tr><th>Output form</th><th>SW7
(Terminal [FA])</th><th>SW8
(Terminal [FB])</th></tr>
<tr><td>Open collector output (Factory default)</td><td>1</td><td>1</td></tr>
<tr><td>Complementary output</td><td>2</td><td>2</td></tr>
</table></td></tr>
</table>

2.2.7 Fan power switching connector CN UX

Stack type of inverters of 90 kW or above has fan power switching connector CN UX on the auxiliary power printed circuit board located at the bottom of the stack. If a power supply to be connected to auxiliary fan power input terminals [R1] and [T1] matches the following specifications, move the connector from the U1 to U2 position. In any other cases, retain the connector in the U1 position (factory default).

Terminal rating: 380 to 440 VAC/50 Hz, 380 to 480 VAC/60 Hz, Maximum current 1.0 A
(For the phase-specific stack, three time the current value should apply.)



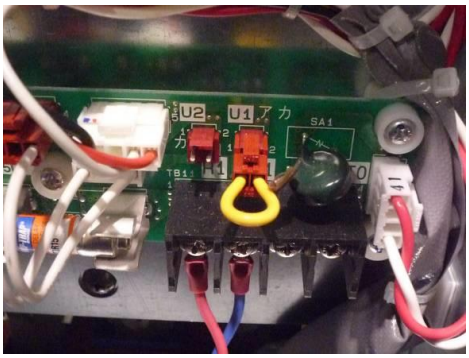


Figure 2.2-14 Inserting/Removing the connector

Note

To remove the connector, pinch its upper side between your fingers, unlock its fastener, and pull it up.

When mounting the connector, fit it over the connector until it snaps into place.

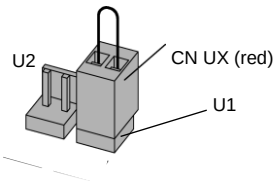
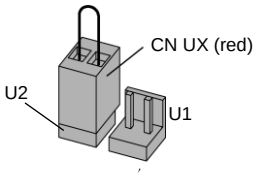
Connector configuration		
Power source voltage	398 to 440 V/50 Hz, 430 to 480 V/60 Hz (Factory default)	380 to 398 V/50 Hz, 380 to 430 V/60 Hz

Figure 2.2-15 Fan Power Switching Connector

2.2.8 Wiring between stacks of Phase-specific stack type

In case of Phase-specific stack type (FRN630-800BVG1S-4), you need to wire between each stacks after installation the inverters. Refer to Figure2.2-16～2.2-18.

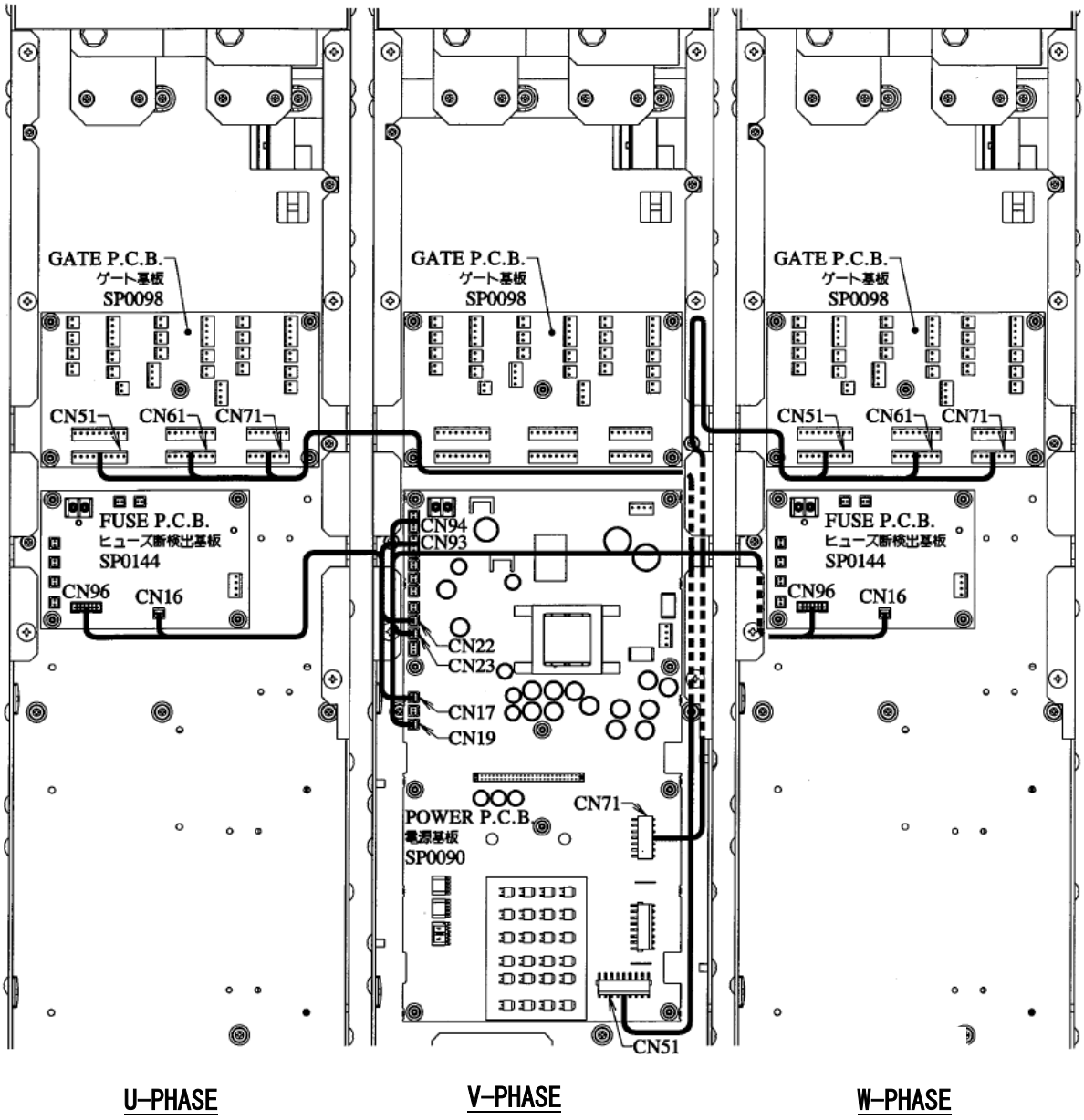


Figure2.2-16 Wiring between GATE P.C.B, FUSE P.C.B and POWER P.C.B of Phase-specific stack type

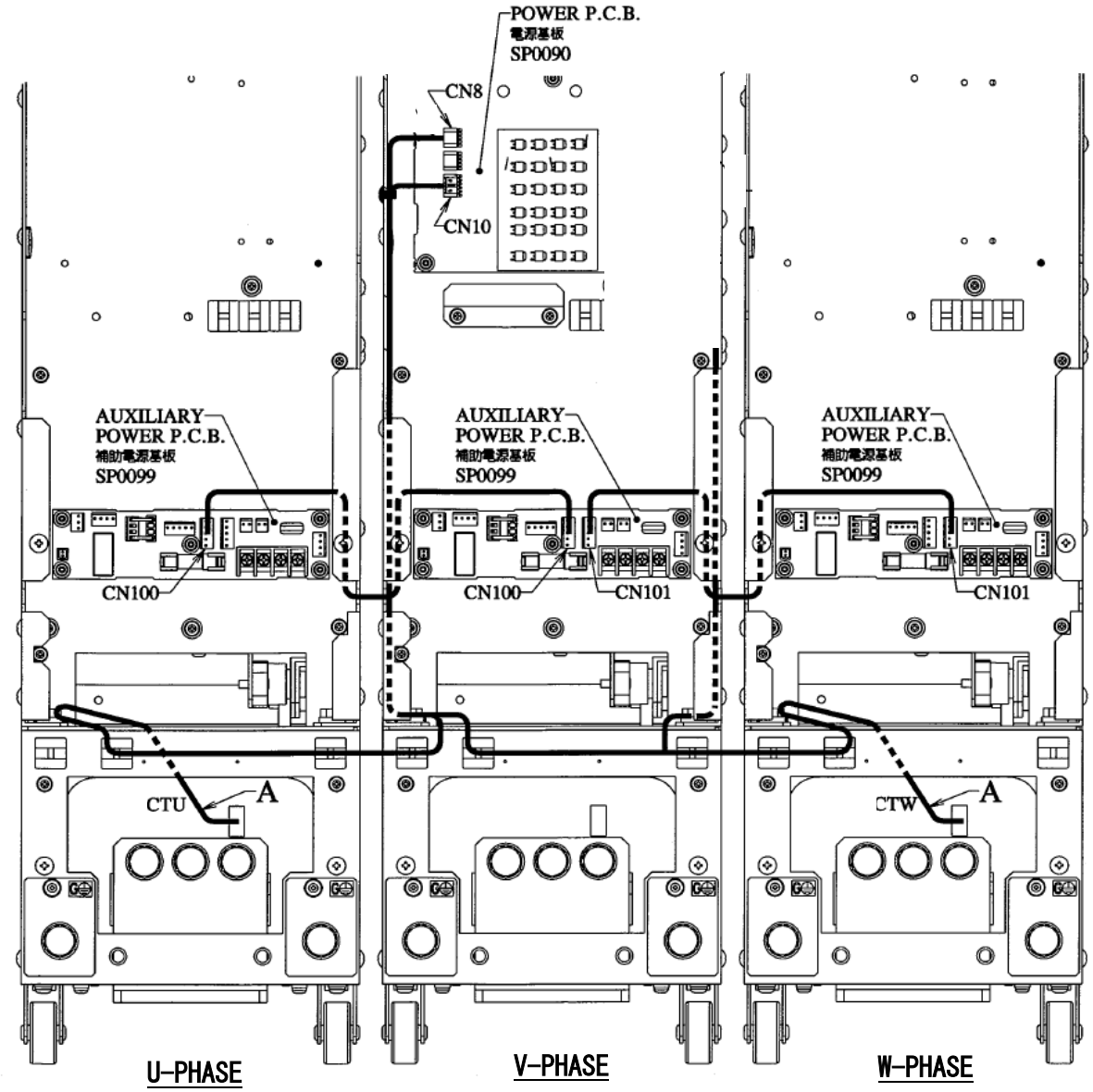


Figure2.2-17 Wiring between AUXILIARY POWER P.C.B ,CT(current detector) cable of Phase-specific stack type.

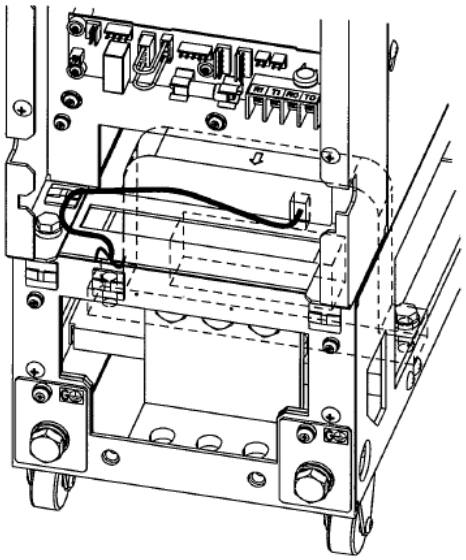


Figure2.2-18 Detail of A that is wiring route of CT cable of Phase-specific stack type.

2.3 Mounting and Connecting the Keypad

The keypad can be installed and used in one of the following ways:

- Mounting it directly on the inverter (default state when shipped)
- Mounting it on the cabinet door for remote operation (see Figure 2.3-1.)
- Using it in your hand at remote location

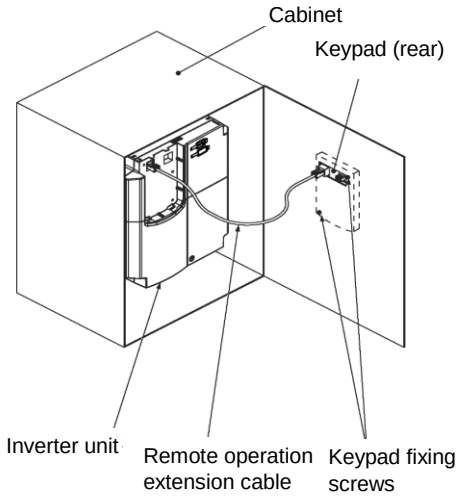


Figure 2.3-1 Mounting the Keypad in the Cabinet

2.3.1 Parts required for connection

To mount the keypad on a place other than an inverter, the parts listed below are needed.

Parts name	Model	Remarks
Extension cable (Note 1)	CB-5S, CB-3S and CB-1S	3 types available in length of 5 m, 3 m, and 1 m.
Fixing screw	M3 × □ (Note 2)	Two screws needed. (To be provided by the customer)

(Note 1) When using an off-the-shelf LAN cable, use a 10BASE-T/100BASE-TX straight type cable compliant with US ANSI/TIA/EIA-568A Category 5. (20 m or less)

Recommended LAN cable
Manufacturer: Sanwa Supply Inc.
Model: KB-10T5-01K (1 m)
KB-STP-01K: (1 m) (Shielded LAN cable to make the inverter compliant with the EMC Directive)

(Note 2) When mounting the keypad in a cabinet, use the screws with a length suitable for the cabinet thickness.

⚠CAUTION

- The RJ-45 connector on the inverter is exclusive to communication via a keypad. With the RJ-45 connector, neither RS-485 communication nor connection with FRENIC-VG Loader is possible.
- Do not connect the inverter to a LAN port of a computer, Ethernet hub, or telephone line. Doing so may damage the inverter or devices connected.

A fire or accident could occur.

2.3.2 Mounting procedure

After completion of wiring, mount the keypad using the following procedure. Make sure that the inverter power is shut down beforehand.

[1] Removing and mounting the keypad from/to the inverter

(1) Removing the keypad

While holding down the hook as directed by the arrow, pull the keypad towards you and off the inverter.

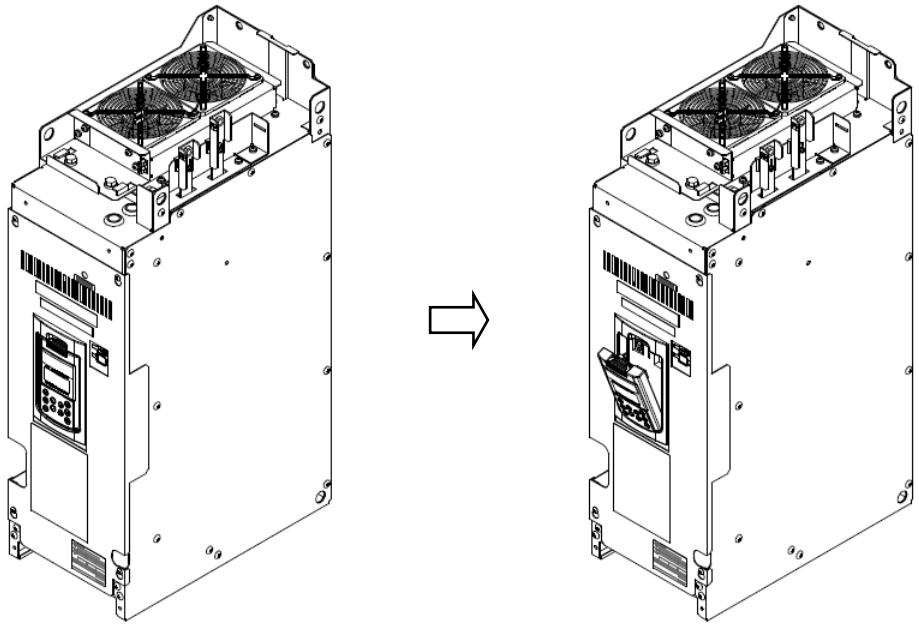


Figure 2.3-2 Removing the Keypad

(2) Mounting the keypad

Set the bottom of the keypad into the latches, push the keypad in the direction of the terminal block cover (arrow ①), and put the keypad in the original slot (arrow ②).

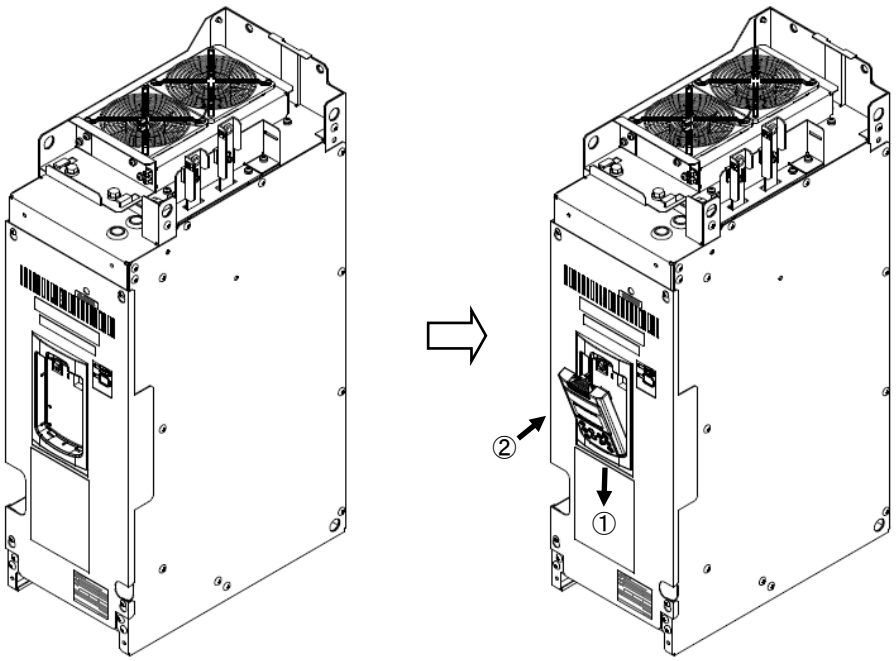


Figure 2.3-3 Mounting the Keypad

[2] Mounting the keypad to the cabinet door

(1) Make a cutout in the cabinet door (in which the keypad is to be mounted) as shown in [3] External dimensions of the keypad.

(2) Mount the keypad on the cabinet door as shown in Figure 2.3-4.
- With two screws (M3 x 12) (Thickness of the door: 2.3 mm)
- Tightening torque: 0.7 N•m

(3) Using a remote operation extension cable or a LAN cable, connect the keypad (RJ-45 connector) to the inverter (RJ-45 connector, modular jack) as shown in Figure 2.3-5.

Note Secure the cable using fasteners such as Insulock. Otherwise, the cable may get caught in the cabinet door and be damaged when the door is opened or closed.

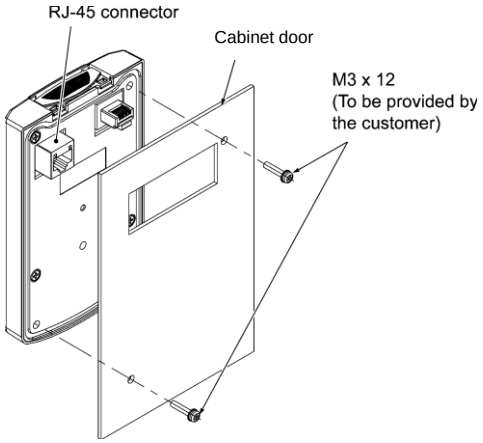


Figure 2.3-4 Mounting the Keypad

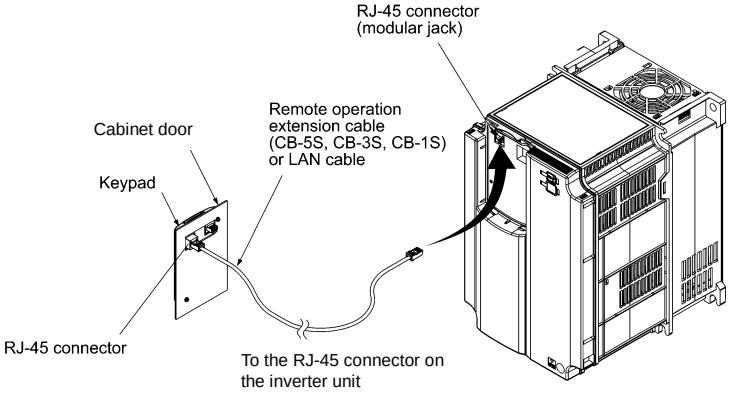
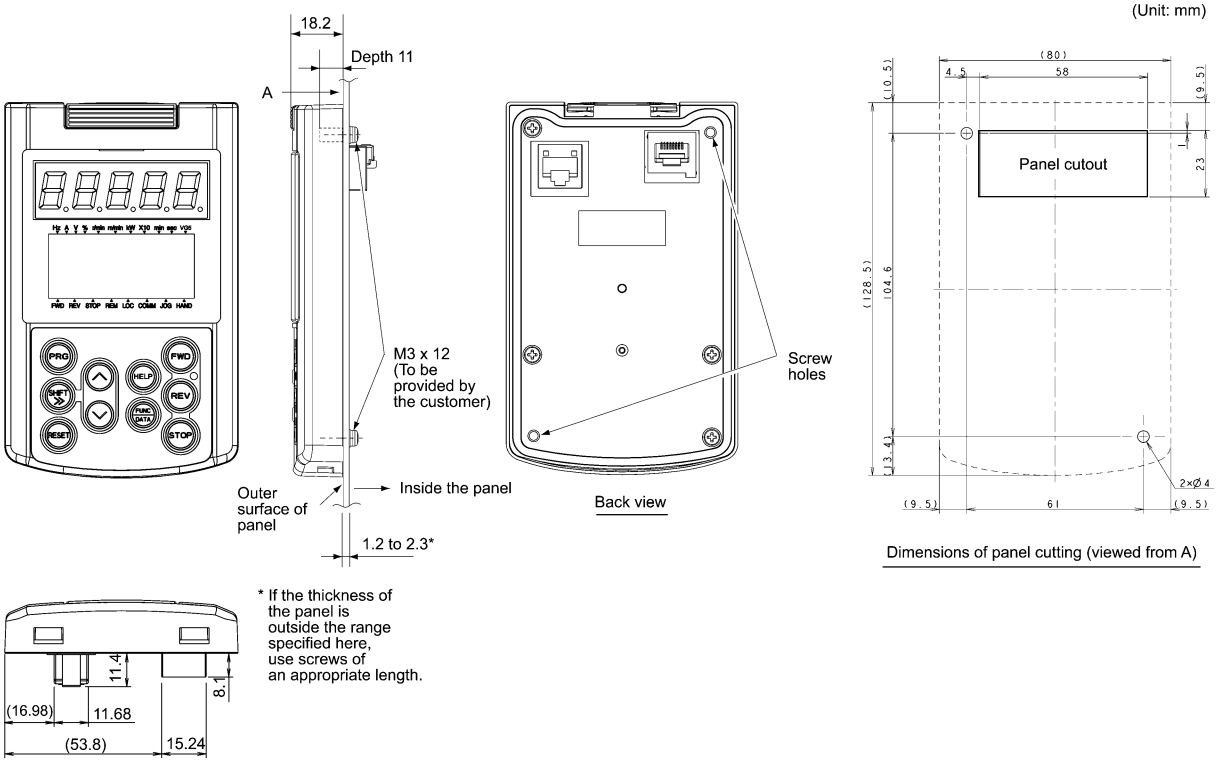


Figure 2.3-5 Connecting the Keypad to the Inverter

[3] External dimensions of the keypad

The dimensions of the keypad is shown below. Make a cutout in the cabinet door for mounting the keypad as instructed below.

(Unit: mm)



2.4 Connecting a USB Cable

At the right side of the keypad mounting place, a USB port (mini B connector) is provided. To connect a USB cable, open the USB port cover as shown below.

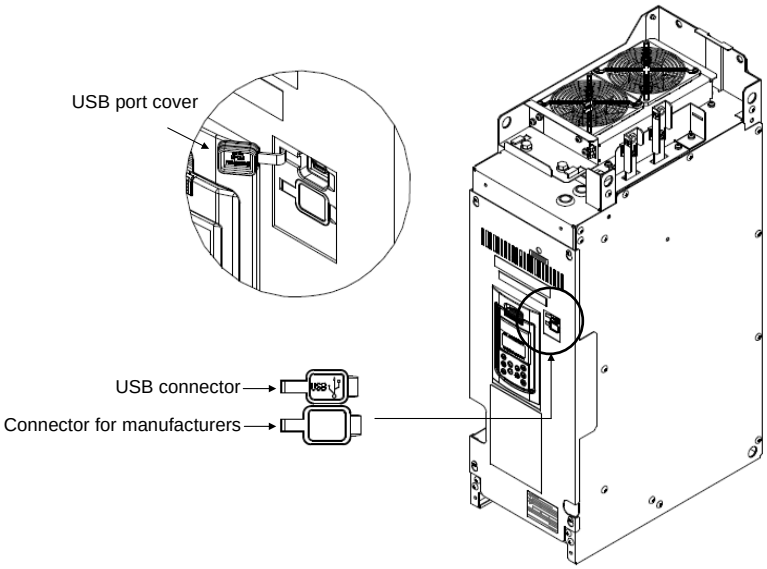


Figure 2.4-1 Connecting a USB Cable

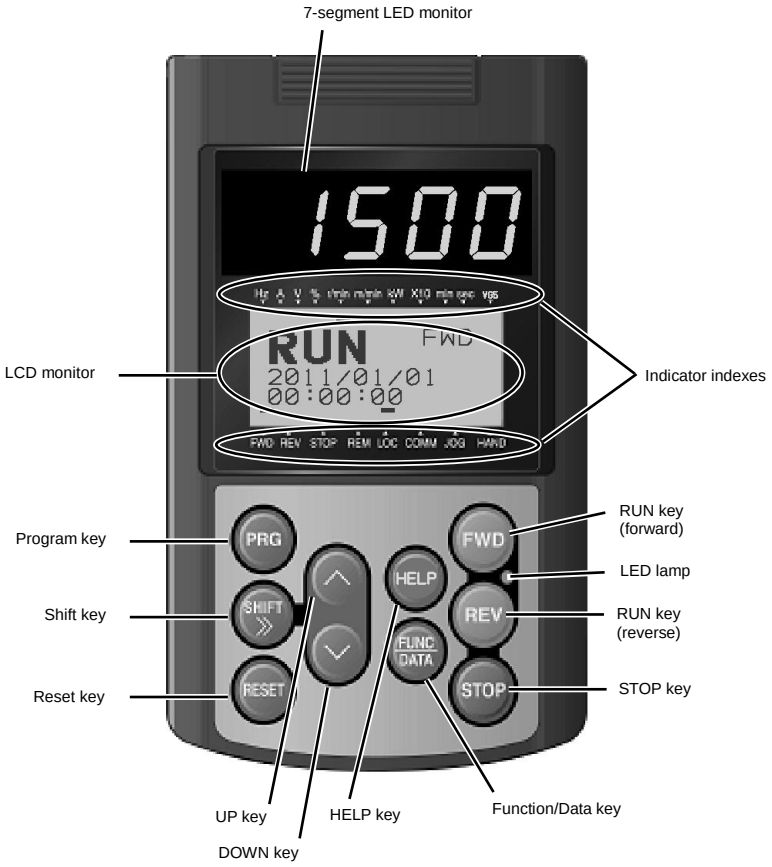
Connecting the inverter to a PC with a USB cable enables remote control from FRENIC-VG Loader. On the PC running FRENIC-VG Loader, it is possible to edit, check and manage the inverter's function code data and monitor the real-time data and the running/alarm status of the inverter.

⚠CAUTION
Connector located beneath the USB connector is provided for particular manufacturers. Do not access it. **Otherwise, a fire or accident could occur.**

Chapter 3 OPERATION USING THE KEYPAD

3.1 Names and Functions of Keypad Components

The keypad allows you to start and stop the motor, view various data including maintenance information and alarm information, configure function codes, monitor I/O signal status, copy data, and calculate the load factor.

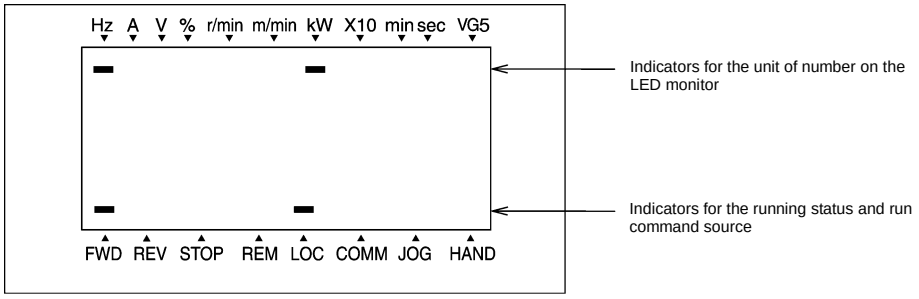


📖 For details, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4 "OPERATION USING THE KEYPAD".

Table 3.1-1 Overview of Keypad Functions

Item	Monitors and Keys	Functions
Monitors		Five-digit, 7-segment LED monitor which displays the following according to the operation modes: ■ In Running mode: Running status information (e.g., detected speed, speed command, and torque command) ■ In Programming mode: Same as above. ■ In Alarm mode: Alarm code, which identifies the cause of alarm when the protective function is activated.
		LCD monitor which displays the following according to the operation modes: ■ In Running mode: Running status information ■ In Programming mode: Menus, function codes and their data ■ In Alarm mode: Alarm information, which identifies the cause of an alarm when the protective function is activated.
	Indicator indexes	In Running mode, these indexes show the unit of the number displayed on the 7-segment LED monitor and the running status information on the LCD monitor. For details, see the next page.
Programming keys	PRG	Switches the operation modes of the inverter.
	SHIFT	Shifts the cursor to the right for entry of a numerical value.
	RESET	Pressing this key after removing the cause of an alarm switches the inverter to Running mode. This key is used to reset settings or screen transition.
	▲ / ▼	UP and DOWN keys, which are used to select the setting items or change function code data.
	FUNC DATA	Function/Data key, which switches the operation mode as follows: ■ In Running mode: Pressing this key switches the information to be displayed concerning the status of the inverter (detected speed, speed command, torque command, etc.). ■ In Programming mode: Pressing this key displays the function code and establishes the newly entered data. ■ 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.
	STOP + ▲	This simultaneous keying toggles between the ordinary running mode and jogging mode. The current mode appears on the corresponding indicator.
	STOP + RESET	This simultaneous keying toggles between the remote and local modes. The current mode appears on the corresponding indicator.
	SHIFT + ▲ / ▼	This simultaneous keying jumps the cursor to the preceding/following function code group (F to M) in selecting a function code.
Operation keys	FWD	Starts running the motor in the forward rotation.
	REV	Starts running the motor in the reverse rotation.
	STOP	Stops the motor.
	HELP	Switches the screen to the operation guide display prepared for each operation mode or to the menu function guide display.
LED lamp		Lights when the inverter is running.

Details of Indicator Indexes



Type	Item	Description (information, condition, status)
Unit of number on LED monitor	Hz	Output frequency
	A	Output current
	V	Output voltage
	%	Torque command, calculated torque, and load factor
	kW	Input power and motor output
	r/min	Preset and actual (detected) motor speeds
	m/min	Preset and actual line speeds
	X10	Data exceeding 99,999
	min	Not used.
	sec	Not used.
	VG5	Not used.
Running status	FWD	Running in forward rotation
	REV	Running in reverse rotation
	STOP	No output
Run command source	REM	Remote mode (Run command and speed command sources selected by F02 and F01) (In the remote mode, a run command entered via the communications link takes effect. This indicator goes off when H30 = 2 or 3.)
	LOC	Local mode (Run command and speed command sources from the keypad, independent of the setting of F02 and F01.)
	COMM	Via communications link
	JOG	Jogging mode
	HAND	Via keypad This indicator lights also: - in local mode or - in remote mode and when H30 = 0 and F02 = 0

3.2 Programming Mode

Programming mode allows you to set and check function code data and monitor maintenance information and input/output (I/O) signal status. The functions can be easily selected with a menu-driven system. Table 3.2-1 lists menus available in Programming mode.

Table 3.2-1 Menus Available in Programming Mode

Menu #	Menu	Used to:
0	Selecting language (LANGUAGE)	Change the display language on the LCD monitor.
1	Configuring function codes (DATA SET)	Display and change the data of the function code selected.
2	Checking function code data (DATA CHECK)	Display a function code and its data on the same screen. Also this menu is used to change the function code data or check whether the data has been changed from the factory default.
3	Monitoring the running status (OPR MNTR)	Display the running information required for maintenance or test running.
4	Checking I/O signal status (I/O CHECK)	Display external interface information.
5	Reading maintenance information (MAINTENANCE)	Display maintenance information including cumulative run time. Note that information on the capacitance of the DC link bus capacitor and input watt-hour is invalid in the stack type of inverters.
6	Measuring load factor (LOAD FCTR)	Measure the maximum output current, average output current, and average braking power.
7	Reading alarm information *1 (ALM INF)	Display recent four alarm codes. Also this menu is used to view the information on the running status at the time the alarm occurred.
8	Viewing causes of alarm (ALM CAUSE)	Display the cause of the alarm.
9	Reading communications information (COMM INFO)	(Available soon.)
10	Copying data (DATA COPY)	Read or write function code data, as well as verifying it.
11	Checking changed function codes (CHANGES)	Display only the function code data that has been changed from the factory default.
12	Setting the calendar clock (DATE/TIME)	Display/hide the date and time and adjust the display format and data.
13	Compatibility with conventional inverter models (FORMER INV)	Not supported.
14	Limiting function codes to be displayed (LIMITED FC)	• Select whether to display all function codes or limited ones (selected in Loader). • Cancel the directory structure of function codes.

*1 Alarm information will not be saved when only the auxiliary power input for the control circuit is turned on.

■ Configuring function code data

Figure 3.2-1 shows the LCD screen transition for Menu #0 "DATA SET."

A hierarchy exists among those screens that are shifted in the order of "Menu screen," "List of function code groups," and "List of function codes." On the modification screen of the target function code, you can modify or check its data.

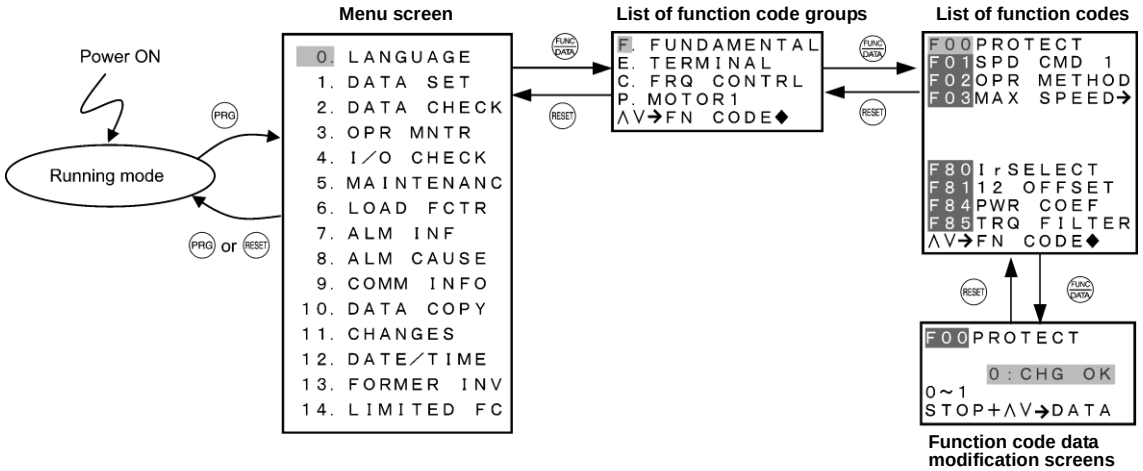
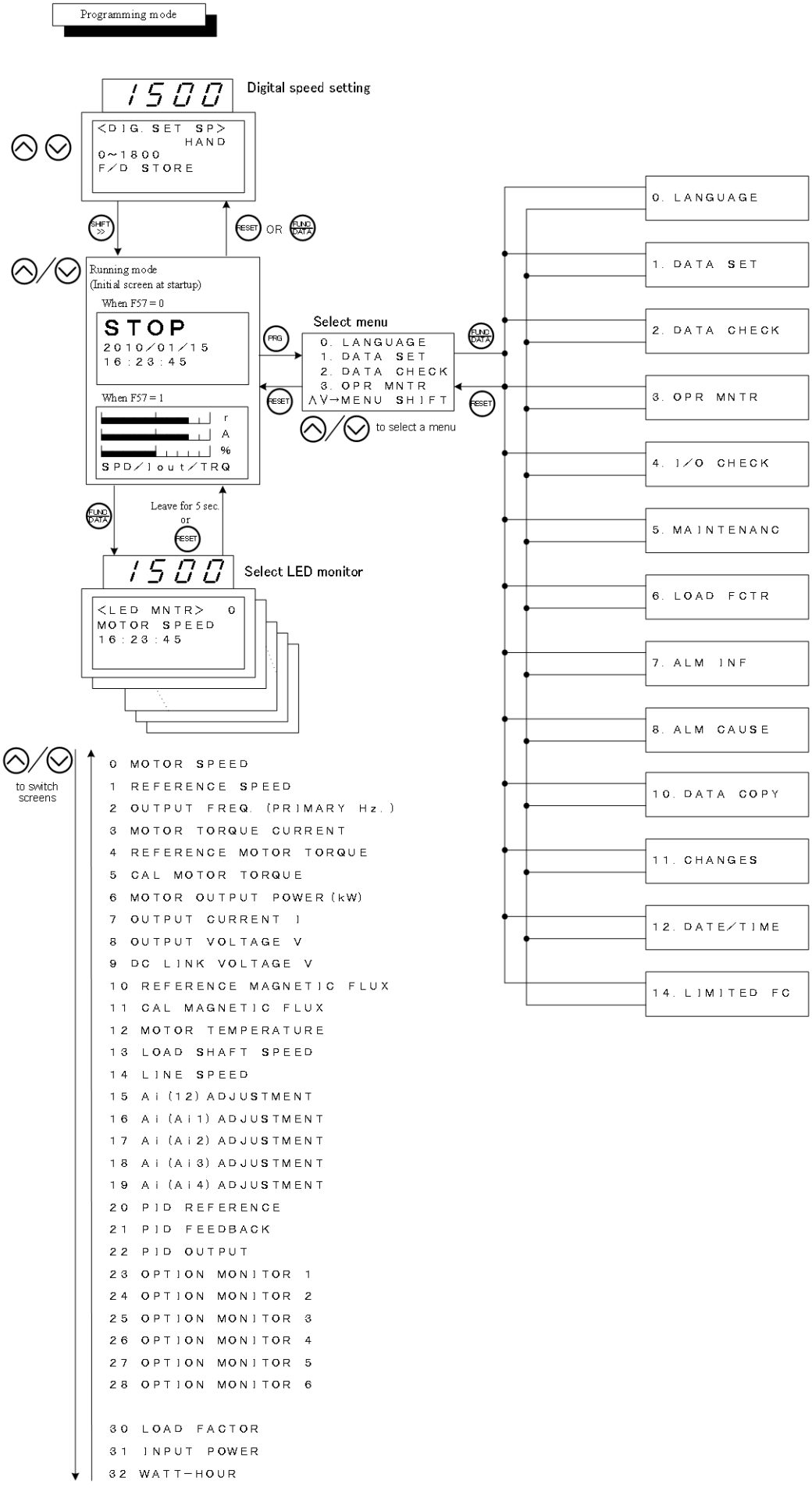


Figure 3.2-1 Configuration of Screens for "DATA SET"

The screen transition and hierarchy structure in Running and Programming modes are shown below.



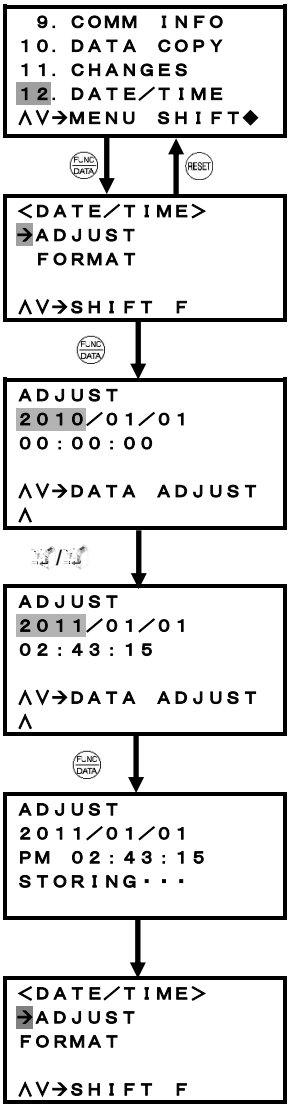
* If the screen system is password-protected, no menu can be selected until the password is canceled.

3.2.1 Setting the calendar clock -- Menu #12 "DATE/TIME"

Menu #12 "DATE/TIME" in Programming mode is used to select the format of the calendar clock to be displayed in the operation guide line in Running mode and set the date and time.

⚠CAUTION
After mounting a memory backup battery, set the date and time. When no memory backup battery is mounted, the calendar clock does not work correctly.

1) Setting the date and time



To display this menu screen, press the PRG key in Running mode to switch to Programming mode.

Move the cursor (flashing rectangle) at the left of the screen to "12. DATA/TIME" using the ∧ and ∨ keys. Then press the FUNC/DATA key.

Move the cursor (flashing rectangle) at the left of the screen to "ADJUST" using the ∧ and ∨ keys. Then press the FUNC/DATA key.

Use the SHIFT key to move the cursor to the desired item.

Change the date and time using the ∧ and ∨ keys.

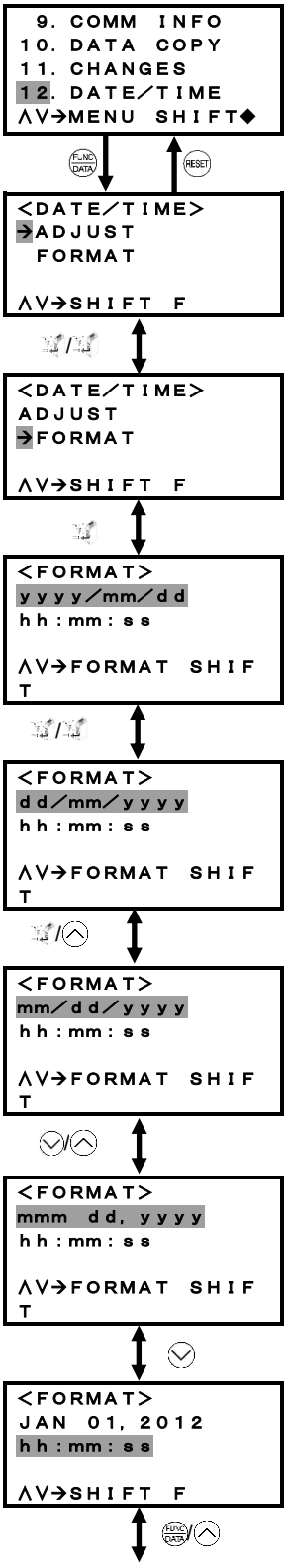
Press FUNC/DATA key to establish the date and time.

If the relationship between the changed year, month, day, and time is invalid, "CANNOT SET" appears when the FUNC/DATA key is pressed.

After a second, the screen automatically switches back to the submenu.

Tip The calendar clock can also be set with FRENIC-VG Loader. For details, refer to the FRENIC-VG Loader Instruction Manual.

2) Selecting the display format



To display this menu screen, press the PRG key in Running mode to switch to Programming mode.

Move the cursor (flashing rectangle) at the left of the screen to "12. DATA/TIME" using the ∧ and ∨ keys. Then press the FUNC DATA key.

Press FUNC DATA key to establish the desired menu.

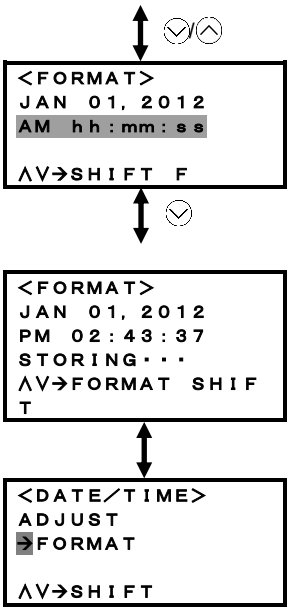
Move the cursor (flashing rectangle) at the left of the screen to "FORMAT" using the ∧ and ∨ keys. Then press the FUNC DATA key.

Change the date format data using the ∧ and ∨ keys.

<List of date formats>

yyyy/mm/dd	Year/Month/Date
dd/mm/yyyy	Date/Month/Year
mm/dd/yyyy	Month/Date/Year
mmm dd, yyyy	Month Date, Year
<OFF>	No display

Press FUNC DATA key to establish the newly specified date format.



Select the time format using the ∧ and ∨ keys.

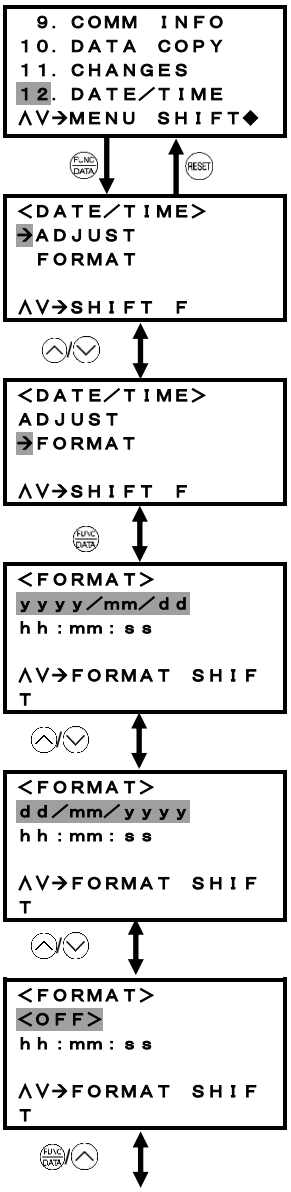
<List of time formats>

hh:mm:ss	0-24 hour: minutes: seconds
hh:mm:ss AM	0-12 hour: minutes: seconds AM/PM
AM hh:mm:ss	AM/PM 0-12 hour: minutes: seconds
<OFF>	No display

Press FUNC/DATA key to establish the newly specified time format.

After a second, the screen automatically switches back to the submenu.

3) Selecting the No display



To display this menu screen, press the PRG key in Running mode to switch to Programming mode.

Move the cursor (flashing rectangle) at the left of the screen to "12. DATA/TIME" using the ∧ and ∨ keys. Then press the FUNC/DATA key.

Press FUNC/DATA key to establish the desired menu.

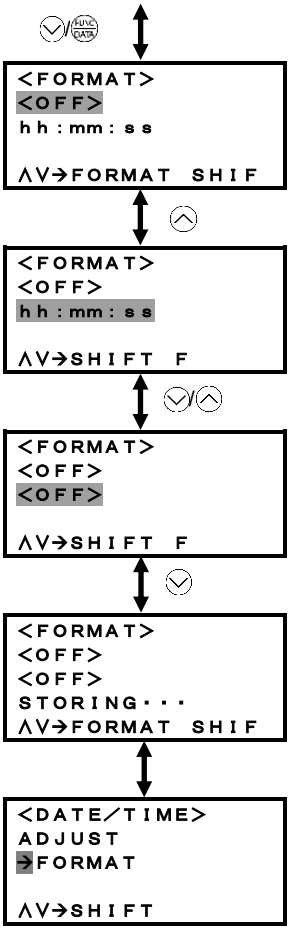
Move the cursor (flashing rectangle) at the left of the screen to "FORMAT" using the ∧ and ∨ keys. Then press the FUNC/DATA key.

Change the date format using the ∧ and ∨ keys.

<List of date formats>

yyyy/mm/dd	Year/Month/Date
dd/mm/yyyy	Date/Month/Year
mm/dd/yyyy	Month/Date/Year
mmm dd, yyyy	Month Date, Year
<OFF>	No display

Move the cursor (flashing rectangle) at the left of the screen to "<OFF>" using the ∧ and ∨ keys. Then press the FUNC/DATA key.



Press FUNC/DATA key to establish the newly specified date format.

Change the time format data using the ∧ and ∨ keys.

<List of time formats>

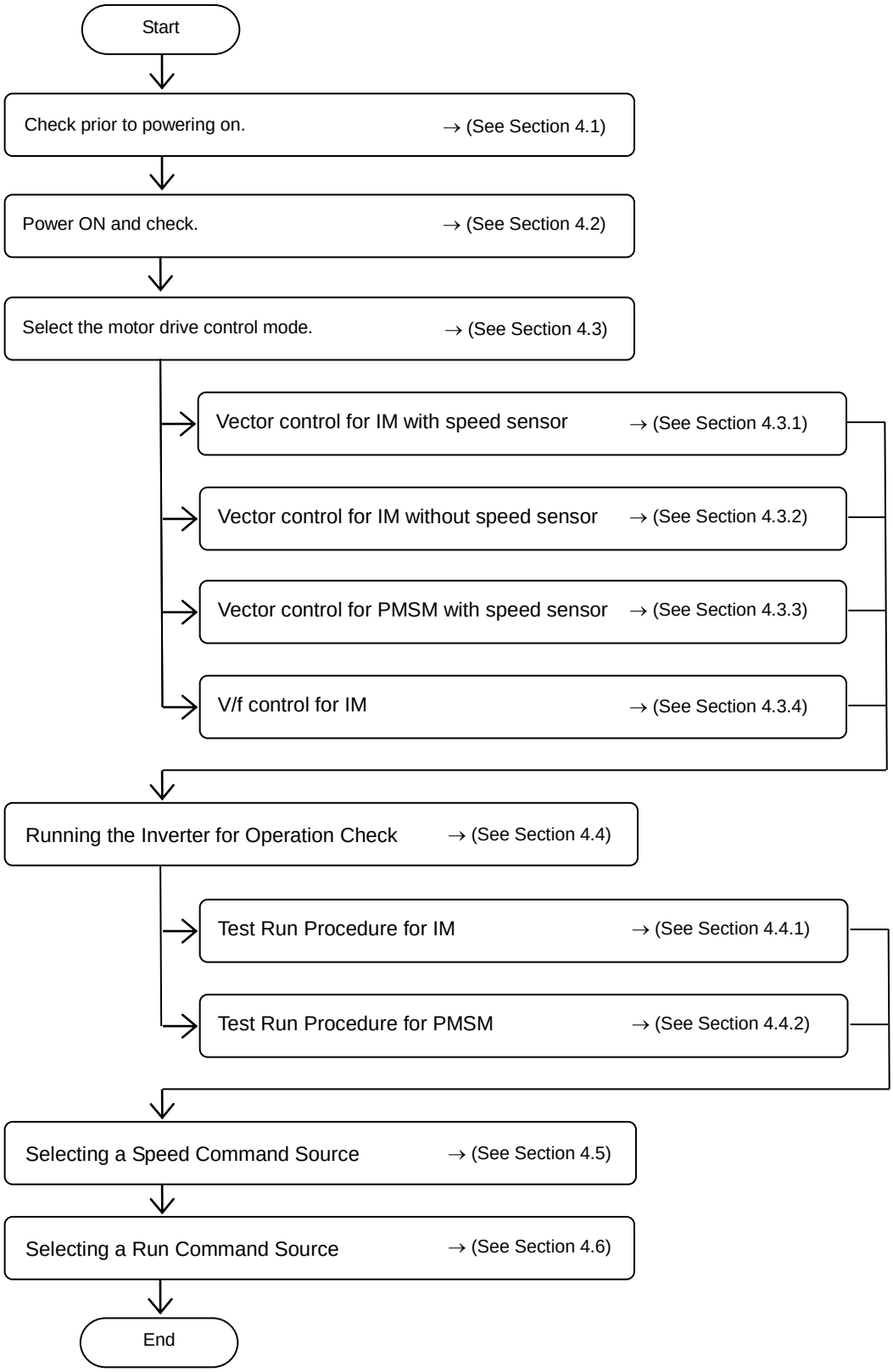
hh:mm:ss	0-24 hour: minutes: seconds
hh:mm:ss AM	0-12 hour: minutes: seconds AM/PM
AM hh:mm:ss	AM/PM 0-12 hour: minutes: seconds
<OFF>	No display

Move the cursor (flashing rectangle) at the left of the screen to "<OFF>" using the ∧ and ∨ keys. Then press the FUNC/DATA key.

After a second, the screen automatically switches back to the submenu.

Chapter 4 TEST RUN PROCEDURE

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



4.1 Checking Prior to Powering On

Check the following before powering on the inverter.

(1) Check the wiring to the main DC input terminals P(+) and N(-) and output terminals U, V, and W. Also check that the grounding wires are connected to the grounding terminals (⏚G) correctly. (See Figure 4.1-1.)

⚠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.

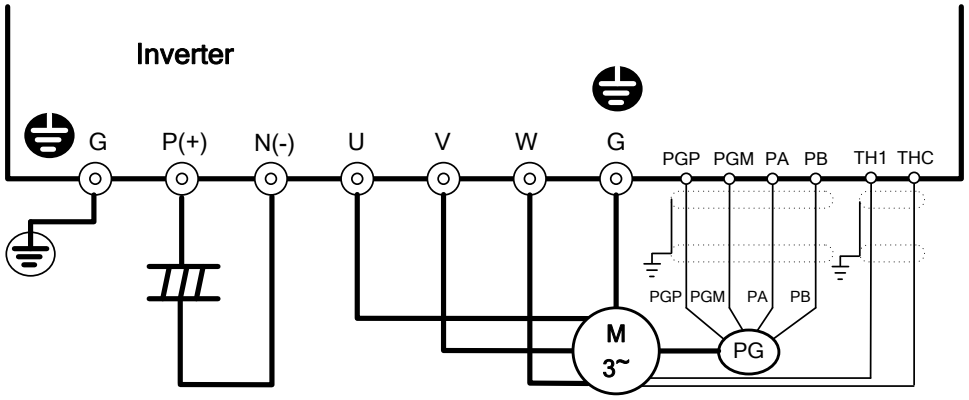
(6) Check that safety measures are taken against runaway of the equipment, e.g., a defense to prevent people from access to the equipment.

(7) Check that the PG (pulse generator) wiring is correct.

⚠CAUTION

Wrong wiring may break the PG..

If the inverter is powered on with wrong wiring, disconnect the PG signal wires from the inverter, keep only the PG powered on via the PGP and PGM, and then check that each signal is correctly output with an oscilloscope or recorder.



Note: In principle, the shielded sheath of wires should be connected to ground. If the inverter is significantly affected by external induction noise, however, connection to 0V may be effective to suppress the influence of noise.

Figure 4.1-1 Connection of Main Circuit Terminals (Vector dedicated motor connected)

4.2 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. After the initial display (LOAD) appears, 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 (indicating that the reference speed is 0 r/min) that is blinking. (See Figure 4.2-1.)
If the LED monitor displays any number except 0, press ⌃ / ⌄ key to set 0.

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

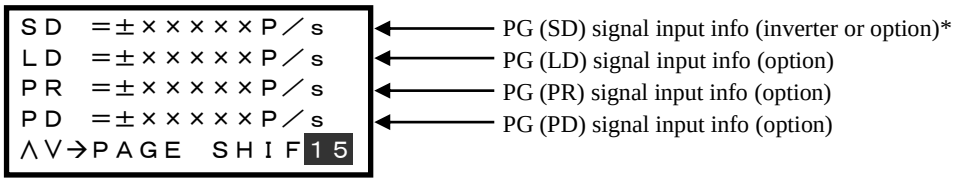
Figure 4.2-1 Display of the LED Monitor at Power-on

4.2.1 Checking the input state of PG (pulse generator) signals

Before proceeding to a test run of the inverter, rotate the motor shaft and check the digital input state of PG (pulse generator) signals on the screen shown below.

To call up the screen, switch the inverter operation mode from the Running mode to the Programming mode, select Menu #4 "I/O CHECK" on the menu screen, and select page 15 (shown below) using the ⌃/⌄ keys.

For details, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.5.



* When a PG (SD) option is mounted, the PG (SD) signal input info appears; when it is not, the inverter PG signal input info appears.

4.2.2 Mounting direction of a PG (pulse generator) and PG signals

The forward rotational direction of the dedicated motor (MVK type) is CCW when viewed from the motor output shaft as shown in Figure 4.2-2.

During rotation in the forward direction, the PG output pulse forms a forward rotation signal (B phase advanced by 90 degrees) shown in Figure 4.2-3, and during rotation in the reverse direction, a reverse rotation signal (A phase advanced by 90 degrees).

When mounting an external PG on motors other than the dedicated one, directly connect it to the motor, using a coupling, etc.

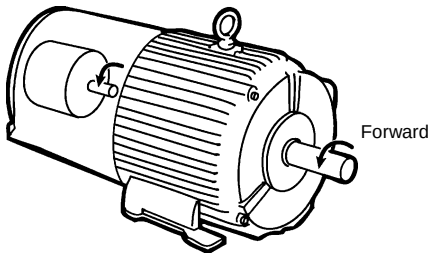


Figure 4.2-2 Forward Rotational Direction of Motor and PG

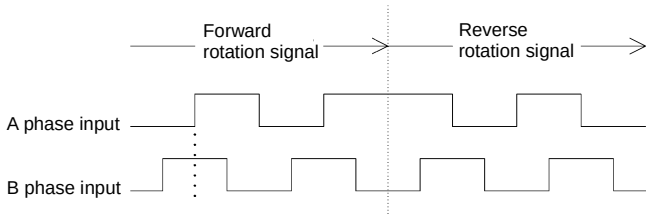


Figure 4.2-3 PG (Pulse Generator) Signal

4.3 Selecting a Desired Motor Drive Control

The FRENIC-VG supports the following motor drive controls.

Data for P01	M1 drive control	Speed feedback	Speed control	Refer to:
0	Vector control for IM with speed sensor	Yes	Speed control with automatic speed regulator (ASR)	Section 4.3.1
1	Vector control for IM without speed sensor	Estimated speed		Section 4.3.2
2	Simulation mode	Yes		FRENIC-VG User's Manual, Chapter 4, Section 4.3.4 "P codes"
3	Vector control for PMSM with speed sensor	Yes		Section 4.3.3
5	V/f control for IM	No	Frequency control	Section 4.3.4

4.3.1 Vector control for IM with speed sensor

Under vector control, the inverter detects the motor's rotational position and speed according to PG feedback signals and uses them for speed control. In addition, it decomposes the motor drive current into the exciting and torque current components, and controls each of components in vector.

The desired response can be obtained by adjusting the control constants (PI constants) with the speed regulator (PI controller).

This control enables the speed control with higher accuracy and quicker response than the vector control without speed sensor.

(A recommended motor for this control is a Fuji VG motor exclusively designed for vector control.)

Note Vector control regulating the motor current requires some voltage margin between the voltage that the inverter can output and the induced voltage of the motor. Usually a general-purpose motor is so designed that the voltage matches the commercial power. Under the control, therefore, it is necessary to suppress the motor terminal voltage to the lower level in order to secure the voltage margin required.

However, driving the motor with the motor terminal voltage suppressed to the lower level cannot generate the rated torque even if the rated current originally specified for the motor is applied. To ensure the rated torque, it may be necessary to review the rated current.

[1] For Fuji VG motor exclusively designed for vector control

Configure the function codes as listed below. The machinery design values (maximum speed and acceleration/deceleration time) should match your machinery ones.

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3 "Details of Function Codes".

Function code	Name	Function code data	Factory default
P01 A01 A101	M1 Drive Control M2 Drive Control M3 Drive Control	0: Vector control for IM with speed sensor	0: Vector control for IM with speed sensor
P02	M1 Selection	Motor to be applied	Motor to be applied
P28 A30 A130	M1 PG Pulse Resolution M2 PG Pulse Resolution M3 PG Pulse Resolution	1024	1024
P30 A31 A131	M1 Thermistor Type M2 Thermistor Type M3 Thermistor Type	1: NTC thermistor	1: NTC thermistor
F03	M1 Maximum Speed M2 Maximum Speed M3 Maximum Speed	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	1500 r/min
F07	Acceleration Time 1 **(Note)**		5.00 s
F08	Deceleration Time 1 **(Note)**		5.00 s

[2] For motors except Fuji VG motor

To use motors except a Fuji VG motor when their motor parameters to be set to function codes are unknown, perform auto-tuning to automatically configure them.

Configure the function codes as listed below according to the motor ratings and your machinery design values (maximum speed and acceleration/deceleration time). The motor ratings are printed on the motor's nameplate. For your machinery design values, ask system designers about them.

After configuring the function codes, perform motor parameter auto-tuning (H01 = 3 or 4).

For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3 "Details of Function Codes".

Function code	Name	Function code data	Factory default
P01 A01 A101	M1 Drive Control M2 Drive Control M3 Drive Control	0: Vector control for IM with speed sensor	0: Vector control for IM with speed sensor
P02	M1 Selection	37: Others (No modification is required for M2 or M3.)	Motor to be applied
P28 A30 A130	M1 Pulse Resolution M2 Pulse Resolution M3 Pulse Resolution	Match the specifications of the PG to be used.	1024
P30 A31 A131	M1 Thermistor Type M2 Thermistor Type M3 Thermistor Type	0: No thermistor	1: NTC thermistor
F04 A05 A105	M1 Rated Speed M2 Rated Speed M3 Rated Speed	Motor ratings (printed on the nameplate of the motor)	1500 r/min
F05	M1 Rated Voltage		Rated voltage of nominal applied motors
A04 A104	M2 Rated Voltage M3 Rated Voltage		80 V
P03	M1 Rated Capacity		Capacity of nominal applied motors
A02 A102	M2 Rated Capacity M3 Rated Capacity		0.00 kW
P04	M1 Rated Current		Rated current of nominal applied motors
A03 A103	M2 Rated Current M3 Rated Current		0.01 A
P05 A07 A107	M1 Poles M2 Poles M3 Poles		4 poles
F03 A06 A106	M1 Maximum Speed M2 Maximum Speed M3 Maximum Speed	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	1500 r/min
F07	Acceleration Time 1 **(Note)**		5.00 s
F08	Deceleration Time 1 **(Note)**		5.00 s

For the motor parameter auto-tuning procedure (H01 = 3 or 4), refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3.5 "H Codes (High Performance Functions)."

Function code	Name	Function code data	Factory default
H01	Tuning Selection	3: Auto tuning with motor stopped 4: Auto tuning with motor rotating	0: Disable

Note Performing motor parameter auto-tuning (H01 = 3 or 4) automatically changes the data of function codes P06 through P11 and P15 through P21 for M1, A08 through A13 and A17 through A23 for M2, and A108 through A113 and A117 through A123 for M3. Be careful with this data change.

After tuning, be sure to perform Save All (H02 = 1) to save the tuned data into the non-volatile memory of the inverter.

4.3.2 Vector control for IM without speed sensor

Under this control, the inverter estimates the motor speed based on the inverter's output voltage and current to use the estimated speed for speed control. In addition, it controls the motor current and motor torque with quick response and high accuracy under vector control. No PG (pulse generator) is required.

The desired response can be obtained by adjusting the control constants (PI constants) and using the speed regulator (PI controller).

Applying "vector control without speed sensor" requires auto-tuning regardless of the motor type. (Even driving a Fuji VG motor exclusively designed for vector control requires auto-tuning.)

Configure the function codes as listed below according to the motor ratings and your machinery design values (maximum speed and acceleration/deceleration time). The motor ratings are printed on the motor's nameplate. For your machinery design values, ask system designers about them.

[1] For Fuji VG motor exclusively designed for vector control

Configure the function codes as listed below and perform motor parameter auto-tuning (H01 = 2)

For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3 "Details of Function Codes".

Function code	Name	Function code data	Factory default
P01 A01 A101	M1 Drive Control M2 Drive Control M3 Drive Control	1: Vector control for IM without speed sensor	0: Vector control for IM with speed sensor
P02	M1 Selection	37: Others (No modification is required for M2 or M3.)	Motor to be applied
P30 A31 A131	M1 PG Pulse Resolution M2 PG Pulse Resolution M3 PG Pulse Resolution	1: NTC thermistor	1: NTC thermistor
F03 A06 A106	M1 Thermistor Type M2 Thermistor Type M3 Thermistor Type	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	1500 r/min
F07	M1 Maximum Speed M2 Maximum Speed M3 Maximum Speed		5.00 s
F08	Acceleration Time 1 **(Note)**		5.00 s

For the motor parameter auto-tuning procedure (H01 = 2), refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3.5 "H Codes (High Performance Functions)."

Function code	Name	Function code data	Factory default
H01	Tuning Selection	2: Auto-tuning (R1, Lσ)	0: Disable

Note Performing motor parameter auto-tuning (H01 = 2) automatically changes the data of function codes P06 and P07 for M1, A08 and A09 for M2, and A108 and A109 for M3. Be careful with this data change.

After tuning, be sure to perform Save All (H02 = 1) to save the tuned data into the non-volatile memory of the inverter.

[2] For motors except Fuji VG motor

Configure the function codes as listed below and perform motor parameter auto-tuning (H01 = 3 or 4)

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3 "Details of Function Codes".

Function code	Name	Function code data	Factory default
P01 A01 A101	M1 Drive Control M2 Drive Control M3 Drive Control	1: Vector control for IM without speed sensor	0: Vector control for IM with speed sensor
P02	M1 Selection	37: Others (No modification is required for M2 or M3.)	Motor to be applied
P30 A31 A131	M1 Thermistor Type M2 Thermistor Type M3 Thermistor Type	0: No thermistor	1: NTC thermistor
F04 A05 A105	M1 Rated Speed M2 Rated Speed M3 Rated Speed	Motor ratings (printed on the nameplate of the motor)	1500 r/min
F05	M1 Rated Voltage		Rated voltage of nominal applied motors
A04 A104	M2 Rated Voltage M3 Rated Voltage		80 V
P03	M1 Rated Capacity		Capacity of nominal applied motors
A02 A102	M2 Rated Capacity M3 Rated Capacity		0.00 kW
P04	M1 Rated Current		Rated current of nominal applied motors
A03 A103	M2 Rated Current M3 Rated Current		0.01 A
P05 A07 A107	M1 Poles M2 Poles M3 Poles		4 poles
F03 A06 A106	M1 Maximum Speed M2 Maximum Speed M3 Maximum Speed	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	1500 r/min
F07	Acceleration Time 1 **(Note)**		5.00 s
F08	Deceleration Time 1 **(Note)**		5.00 s

📖 For the motor parameter auto-tuning procedure (H01 = 3 or 4), refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3.5 "H Codes (High Performance Functions)."

Function code	Name	Function code data	Factory default
H01	Tuning Selection	3: Auto tuning with motor stopped 4: Auto tuning with motor rotating	0: Disable

Note Performing motor parameter auto-tuning (H01 = 3 or 4) automatically changes the data of function codes P06 through P11 and P15 through P21 for M1, A08 through A13 and A17 through A23 for M2, and A108 through A113 and A117 through A123 for M3. Be careful with this data change.

After tuning, be sure to perform Save All (H02 = 1) to save the tuned data into the non-volatile memory of the inverter.

4.3.3 Vector control for PMSM with speed sensor and magnetic pole position sensor

Under this control, the inverter detects the motor's rotational position, speed and magnetic pole position according to feedback signals sent from the speed sensor and magnetic pole position sensor for speed control. In addition, it decomposes the motor drive current into the exciting and torque current components, and controls each of components in vector.

The desired response can be obtained by adjusting the control constants (PI constants) with the speed regulator (PI controller).

(A recommended motor for this control is Fuji GNF2 series exclusively designed for vector control.)

[1] For Fuji GNF2 motor exclusively designed for vector control

Configure the function codes as listed below. The machinery design values (maximum speed and acceleration/deceleration time) should match your machinery ones. For details, contact your Fuji Electric representative.

For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3 "Details of Function Codes".

Function code	Name	Function code data	Factory default
P01 A01	M1 Drive Control M2 Drive Control	3: Vector control for PMSM with speed sensor and magnetic pole position sensor	0: Vector control for IM with speed sensor
A101	M3 Drive Control		5: V/f control for IM
P02	M1 Selection	37: Others (No modification is required for M2 or M3.)	Motor to be applied
o10 A60 A160	M1 Magnetic Pole Position Sensor Offset M2 Magnetic Pole Position Sensor Offset M3 Magnetic Pole Position Sensor Offset	0.0 to 359.9 (0.0° to 359.9° CCW) Use the function code to adjust the magnetic pole position. For detail, refer to page 78, "[3] Setting the magnetic pole position offset value."	0.0
o11 A61 A161	M1 Saliency Ratio (%Xq/%Xd) M2 Saliency Ratio (%Xq/%Xd) M3 Saliency Ratio (%Xq/%Xd)	1.000 to 3.000 Specify the saliency ratio of PMSM.	1.000
F03 A06 A106	M1 Maximum Speed M2 Maximum Speed M3 Maximum Speed	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	1500 r/min
F07	Acceleration time 1 **(Note)**		5.00 s
F08	Deceleration time 1 **(Note)**		5.00 s
* For detail on function code that need to be configured other than the above, refer to Table 4.3-1 " Function code table 1 of Synchronous motor (GNF2)" and Table 4.3-2 " Function code table 2 of Synchronous motor (GNF2)".			

Note Since vector control for a Fuji GNF2 motor with speed sensor uses motor parameters, the following conditions should be satisfied; otherwise, full control performance may not be obtained.

- A single motor should be connected per inverter.
- Motor parameters are properly configured.

Table 4.3-1 Function code table 1 of Synchronous motor (GNF2)

Motor Type	Motor Capacity	Rated Voltage	Rated Current	Num. of poles	Rated Speed	Maximum Speed	F03 (A06) (A106)	F04 (A05) (A105)	F05 (A04) (A104)	F40	F44	P01 (A01) (A101)	P02	P03 (A02) (A102)	P04 (A03) (A103)	P05 (A07) (A107)	P06 (A08) (A108)	P07 (A09) (A109)	P08 (A10) (A110)	P09 (A11) (A111)	P10 (A12) (A112)	P11 (A13) (A113)	P12 (A14) (A114)	P13 (A15) (A115)	P14 (A16) (A116)	P15 (A17) (A117)	P16 (A18) (A118)	P17 (A19) (A119)	P18 (A20) (A120)	P19 (A21) (A121)
GNF2114A	5.5	370	10	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	5.50	10.00	6	4.02	45.57	4.88	7.48	0.001	0.001	5.45	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2115A	7.5	370	15	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	7.50	15.00	6	4.93	52.97	7.15	9.97	0.001	0.001	5.33	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2117A	11	370	21	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	11.00	21.00	6	4.44	59.11	10.81	14.70	0.001	0.001	4.55	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2118A	15	370	29	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	15.00	29.00	6	4.10	45.80	13.09	20.90	0.001	0.001	4.67	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2136A	18.5	360	36	6	1500	2000	2000	1500	360	3	150	3	P-OTHER	18.50	36.00	6	3.03	52.56	19.11	23.93	0.001	0.001	4.32	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2137A	22	370	41	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	22.00	41.00	6	2.93	37.62	17.48	31.28	0.001	0.001	4.09	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2139A	30	360	57	6	1500	2000	2000	1500	360	3	150	3	P-OTHER	30.00	57.00	6	2.96	41.87	27.18	41.75	0.001	0.001	4.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2165A	37	370	70	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	37.00	70.0	6	2.75	51.88	40.20	45.39	0.001	0.001	2.97	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2167A	45	370	83	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	45.00	83.00	6	2.30	45.38	47.05	56.30	0.001	0.001	3.11	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2185A	55	370	100	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	55.00	100.0	6	2.47	47.65	61.33	62.46	0.001	0.001	3.27	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2187A	75	370	135	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	75.00	135.0	6	2.12	45.27	80.90	88.18	0.001	0.001	3.20	0.00	0.00	0.0	0.0	0.0	0.0	0.0
GNF2207A	90	370	158	6	1500	2000	2000	1500	370	3	150	3	P-OTHER	90.00	158.0	6	1.99	43.92	102.8	97.55	0.001	0.001	2.67	0.00	0.00	0.0	0.0	0.0	0.0	0.0

Table 4.3-2 Function code table 2 of Synchronous motor (GNF2)

Motor Type	Motor Capacity	Rated Voltage	P20 (A22) (A122)	P21 (A23) (A123)	P22 (A24) (A124)	P23 (A25) (A125)	P24 (A26) (A126)	P25 (A27) (A127)	P26 (A28) (A128)	P27 (A29) (A129)	P28 (A30) (A130)	P30 (A31) (A131)	P33 (A53) (A153)	P42 (A62) (A162)	P43 (A63) (A163)	P44 (A64) (A164)	P45 (A65) (A165)	P46 (A66) (A166)	P47 (A67) (A167)	P48 (A68) (A168)	P49 (A69) (A169)	P50 (A70) (A170)	P51 (A71) (A171)	H51 (H52) (H127)	H104	H160 (H170) (H180)	H161 (H171) (H181)	H162 (H172) (H182)	o09 (A59) (A159)	o11 (A61) (A161)
GNF2114A	5.5	370	0.001	328	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	100.0	25.0	0.90	0.85	-0.170	0.050	-3.00	-3.00	-0.150	0.018	1110	0	80	1.0	1	2.258
GNF2115A	7.5	370	0.001	328	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	100.0	36.3	1.00	0.88	-0.120	-0.120	0.00	-3.00	-0.200	0.021	1110	0	80	1.0	1	2.204
GNF2117A	11	370	0.001	320	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	100.0	52.5	1.00	1.15	-0.100	-0.250	-2.00	-3.00	-0.170	0.027	1110	0	80	1.0	1	2.009
GNF2118A	15	370	0.001	314	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	98.3	71.3	0.95	0.95	-0.100	-0.100	-0.50	-2.50	-0.200	0.036	1110	0	80	1.0	1	2.397
GNF2138A	18.5	380	0.001	322	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	380	95.0	100.0	88.8	0.95	0.95	-0.120	-0.200	-2.00	-3.00	-0.200	0.065	1110	0	80	1.0	1	2.242
GNF2137A	22	370	0.001	320	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	100.0	102.5	0.90	0.90	-0.200	-0.300	0.00	-3.00	-0.200	0.070	1110	0	80	1.0	1	2.548
GNF2139A	30	360	0.001	314	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	360	95.0	99.9	141.3	0.90	0.90	-0.150	-0.150	-1.00	-2.00	-0.200	0.090	1110	0	80	1.0	1	2.494
GNF2165A	37	370	0.001	304	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	100.0	175.0	1.02	1.00	-0.100	-0.100	-2.00	-3.00	-0.200	0.153	1110	0	80	1.0	1	2.595
GNF2167A	45	370	0.001	302	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	98.8	206.2	0.93	0.93	-0.170	-0.140	0.00	-2.00	-0.200	0.191	1110	0	80	1.0	1	2.776
GNF2185A	55	370	0.001	324	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	100.0	250.0	0.95	1.00	-0.100	-0.100	-3.00	-4.00	-0.200	0.350	1110	0	80	1.0	1	2.792
GNF2187A	75	370	0.001	321	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	98.1	337.5	0.97	0.95	-0.150	-0.150	0.00	-3.50	-0.200	0.467	1110	0	80	1.0	1	2.816
GNF2207A	90	370	0.001	338	1.100	1.000	1.000	0.000	2.0	1.0	1024	1	370	95.0	100.0	395.0	1.00	1.10	-0.050	-0.030	0.00	-3.00	-0.200	0.805	1110	0	80	1.0	1	2.929

4.3.4 V/f control for IM

Under this control, the inverter drives a motor with the voltage and frequency according to the V/f pattern specified by function codes.

[1] For Fuji VG motor exclusively designed for vector control

Configure the function codes as listed below. The machinery design values (maximum speed and acceleration/deceleration time) should match your machinery ones.

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3 "Details of Function Codes".

Function code	Name	Function code data	Factory default
P01 A01 A101	M1 Drive Control M2 Drive Control M3 Drive Control	5: V/f control for IM	0: Vector control for IM with speed sensor
P02	M1 Selection	Motor to be applied	Motor to be applied
P30 A31 A131	M1 Thermistor Type M2 Thermistor Type M3 Thermistor Type	1: NTC thermistor (Specify the thermistor as needed.)	1: NTC thermistor
F04 A05 A105	M1 Rated Speed M2 Rated Speed M3 Rated Speed	Motor ratings (printed on the nameplate of the motor)	1500 r/min
F05	M1 Rated Voltage		Rated voltage of nominal applied motors
A04 A104	M2 Rated Voltage M3 Rated Voltage		80 V
P33	M1 Maximum Output Voltage		200 V class series: 220 (V) 400 V class series: 440 (V)
A53 A153	M2 Maximum Output Voltage M3 Maximum Output Voltage		80 V
F03 A06 A106	M1 Maximum Speed M2 Maximum Speed M3 Maximum Speed	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	1500 r/min
F07	Acceleration time 1 **(Note)**		5.00 s
F08	Deceleration time 1 **(Note)**		5.00 s
P35 A55 A155	M1 Torque Boost M2 Torque Boost M3 Torque Boost	2.0 (For constant torque load) **(Note)** In applications requiring a starting torque, adjust the torque boost (P35, A55, A155) within the range from 2.0 to 20.0.)	0.0 (Auto torque boost)

[2] For motors except Fuji VG motor

Configure the function codes as listed below according to the motor ratings and your machinery design values (maximum speed and acceleration/deceleration time). The motor ratings are printed on the motor's nameplate. For your machinery design values, ask system designers about them.

In applications requiring a starting torque, adjust the torque boost (P35, A55, A155) within the range from 2.0 to 20.0, or perform motor parameter auto-tuning (H01 = 2) and then set the torque boost (P31, A55, A155) to 0.0 (auto torque boost).

In applications requiring a starting mode(Auto search), perform motor parameter auto-tuning (H01 = 3 or 4).

For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET". For details of the function code data, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3 "Details of Function Codes".

Function code	Name	Function code data	Factory default
P01 A01 A101	M1 Drive Control M2 Drive Control M3 Drive Control	5: V/f control for IM	0: Vector control for IM
P02	M1 Selection	37: Others (No modification is required for M2 or M3.)	Motor to be applied
P30 A31 A131	M1 Thermistor Type M2 Thermistor Type M3 Thermistor Type	0: No thermistor	1: NTC thermistor
F04 A05 A105	M1 Rated Speed M2 Rated Speed M3 Rated Speed	Motor ratings (printed on the nameplate of the motor)	1500 r/min
F05	M1 Rated Voltage		Rated voltage of nominal applied motors
A04 A104	M2 Rated Voltage M3 Rated Voltage		80 V
P33	M1 Maximum Output Voltage		200 V class series: 220 (V) 400 V class series: 440 (V)
A53 A153	M2 Maximum Output Voltage M3 Maximum Output Voltage		80 V
P03	M1 Rated Capacity		Capacity of nominal applied motors
A02 A102	M2 Rated Capacity M3 Rated Capacity		0.00 kW
P04	M1 Rated Current		Rated current of nominal applied motors
A03 A103	M2 Rated Current M3 Rated Current		0.01 A
P05 A07 A107	M1 Poles M2 Poles M3 Poles		4 poles
F03 A06 A106	M1 Maximum Speed M2 Maximum Speed M3 Maximum Speed	Machinery design values **(Note)** For a test-driving of the motor, increase values so that they are longer than your machinery design values. If the specified time is short, the inverter may not run the motor properly.	1500 r/min
F07	Acceleration time 1 **(Note)**		5.00 s
F08	Deceleration time 1 **(Note)**		5.00 s
P35 A55 A155	M1 Torque Boost M2 Torque Boost M3 Torque Boost	2.0 (For constant torque load)	0.0 (Auto torque boost)
P06	M1 %R1	To use the auto torque boost function (P35, A55, A155 = 0.0), be sure to perform motor parameter auto-tuning (H01 =2).	Depends on the rated capacity.
A08 A108	M2 %R1 M3 %R1		0.00%
P07	M1 %X		Depends on the rated capacity.
A09 A109	M2 %X M3 %X		0.00%
H09	Starting Mode(Auto search)	To use the auto search, be sure to perform motor parameter auto-tuning (H01 =3 or 4). Please disable the auto search function (H09=0) if auto-tuning is not performed.	2: Enable

For the motor parameter auto-tuning procedure (H01 = 2), refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3.5 "H Codes (High Performance Functions)."

Function code	Name	Function code data	Factory default
H01	Tuning Selection	2: Auto-tuning (R1, Lσ)	0: Disable

Note Performing motor parameter auto-tuning (H01 = 2) automatically changes the data of function codes P06 and P07 for M1, A08 and A09 for M2, and A108 and A109 for M3. Be careful with this data change.

After tuning, be sure to perform Save All (H02 = 1) to save the tuned data into the non-volatile memory of the inverter.

For the motor parameter auto-tuning procedure (H01 = 3 or 4), refer to the FRENIC-VG User's Manual Chapter 4, Section 4.3.5 "H Codes (High performance Functions)."

Function code	Name	Function code data	Factory default
H01	Tuning Selection	3: Auto tuning with motor stopped 4: Auto tuning with motor rotating	0: Disable

Note Performing motor parameter auto-tuning (H01 = 3 or 4) automatically changes the data of function codes P06 through P11 and P15 through P21 for M1, A08 through A13 and A17 through A23 for M2, and A108 through A113 and A117 through A123 for M3. Be careful with this data change.

After tuning, be sure to perform the full save function (H02 = 1) to save the tuned data into the inverter.

4.4 Running the Inverter for Operation Check

⚠WARNING

- If the user configures the function codes without completely understanding this Instruction Manual and the FRENIC-VG User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine.
- When making a test run with a permanent magnet synchronous motor (PMSM), be sure to observe the test run procedure given in Section 4.4.2. If wiring between the inverter and motor or PG wiring is wrong, or the magnetic pole position offset is improper, the motor may run out of control.

An accident or injuries may result.

After completion of preparations for a test run as described above, start running the inverter for motor operation check using the following procedure.

⚠CAUTION

If any abnormality is found in the inverter or motor, immediately stop operation and investigate the cause referring to Chapter 6, "TROUBLESHOOTING."

4.4.1 Test Run Procedure for Induction Motor (IM)

(1) Turn the power ON and check that the reference speed is 0 r/min and it is blinking on the LED monitor.

(2) Set a low reference speed such as 100 r/min, using ⌃ / ⌄ keys. (Check that the speed is blinking on the LED monitor.)

(3) To run the motor in the forward direction, press the FWD key; to run it in the reverse direction, press the REV key. (Check that the speed is lit on the LED monitor.)

(4) Press the STOP key to stop the motor.

< Check points during a test run >

- Check that the motor is running in the forward direction when it is driven with the FWD key.
- Check that the motor is running in the reverse direction when it is driven with the REV key.
- Check for smooth rotation without motor humming or excessive vibration.
- Check for smooth acceleration and deceleration.

When no abnormality is found, press the FWD or REV key again to start driving the motor, then increase the reference speed using ⌃ / ⌄ keys. Check the above points again.

4.4.2 Test Run Procedure for Permanent Magnet Synchronous Motor (PMSM)

[1] Before proceeding with a test run

This section provides a test run procedure for the configuration consisting of the FRENIC-VG, the interface card for PMPG drive (OPC-VG1-PMPG), and a PMSM using a UVW phase detection PG (including GNF2 motor).

For a test run using a PMSM, it is recommended that the motor be disconnected from the equipment for testing it by itself. If it is impossible to drive the motor by itself due to the equipment, however, make a test run under the conditions that cause no problems even if the motor runs continuously in the forward and reverse directions.

[2] Preparation for a test run

(1) Before turning the inverter power ON, make checking given in Section 4.1 "Checking Prior to Powering On."

(2) Check that wiring of the encoder (PG) is correct.

(For the connection diagram, refer to the User's Manual, Chapter 2, Section 2.7.1.2 "In combination with a dedicated PMSM (GNF2 type).")

⚠CAUTION
Wrong wiring may break the PG. If the inverter is powered on with wrong wiring, disconnect the PG signal wires from the inverter, keep only the PG powered on via the PGP and PGM, and then check that each signal is correctly output with an oscilloscope or recorder.

(3) Turn the power ON, make a note of the current configuration of all function codes, and then change the function code data as listed in Table 4.4-1.

(4) Check that the magnetic pole position offset (o10) is set to the previously specified value or manually adjusted value. Replacing the motor or encoder requires adjustment of the magnetic pole position offset again.

Table 4.4-1 Configuration for Test Run of PMSM

Function code	Name	Current configuration before test run (Values given below are factory defaults)		Configuration for test run	
F01	Speed Command N1	0	The current configuration of function codes differs depending upon the equipment specifications. Make a note of the current configuration and then change the function code data as shown at the right.	0	0: Enable the ⌃ and ⌄ keys on the keypad (Digital speed setting)
F02	Operation Method	0		0	0: Enable the FWD, REV and STOP keys on the keypad to run or stop the motor.
F03	Maximum Speed M1	1500 r/min		750 r/min	Set about half of the current value (before test run).
F40	Torque Limiter Mode 1	0 (Disable)		3	3: Torque current limit
F44	Torque Limiter Level 1	150%		10%	If motor power wires or encoder wires are wrongly connected, the motor may run out of control, breaking the equipment. To suppress abrupt acceleration at the time of runaway, decrease the torque limiter level.
E45	Speed Disagreement Alarm	00 (Disable)		01	Speed disagreement alarm: Enable Power supply phase loss detection: Disable

Note 1: If the moment of inertia of the coupled equipment is large, the motor may not run at a test run. If it happens, adjust the torque limiter level 1 properly.

Note 2: After a test run, revert the function code data to the previous values.

[3] Setting the magnetic pole position offset value

⚠CAUTION
Be sure to adjust the magnetic pole position offset value, using the adjustment procedure given below. - when the inverter runs for the first time after purchase - after replacement of a motor, PG or inverter Running the inverter with the magnetic pole position offset value (o10, A60, A160) not adjusted or with the position deviated greatly from the true value could run the motor in the opposite direction or out of control in the worst case. **An accident or injuries could occur.**

When driving a PMSM for the first time, be sure to set the magnetic pole position offset value to the inverter with the following function code(s) beforehand.

M1: Function code o10
M2: Function code A60
M3: Function code A160

Select the adjustment procedure from the following three depending on the situation.

(1) When the magnetic pole position offset value is printed on the label attached to the motor

GNF2 motors have a magnetic pole position label on the motor power line (U phase) on which the magnetic pole position offset value is printed. See Figure 4.4-1. Set the value to the function code (o10, A60, A160).

As shown in Figure 4.4-2, there are two types of magnetic pole position labels.

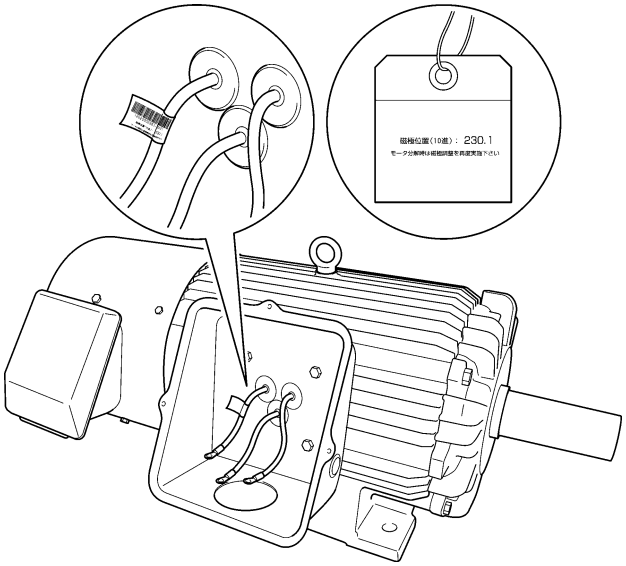


Figure 4.4-1 Magnetic Pole Position Offset Label Attaching Position Example

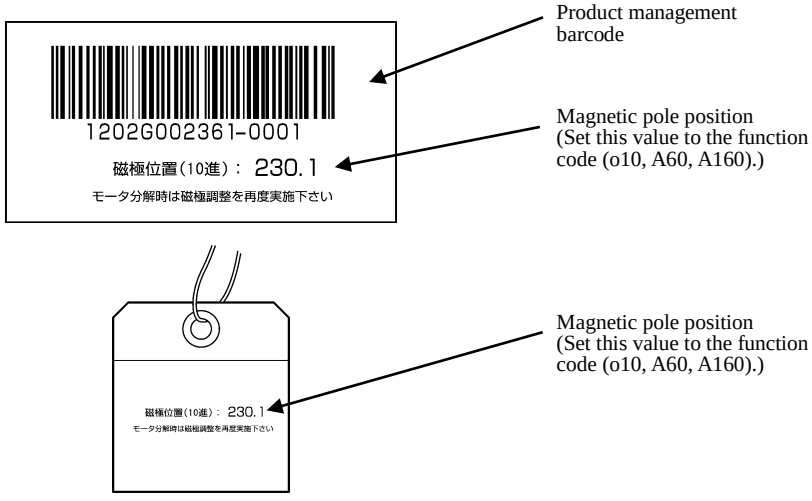


Figure 4.4-2 Magnetic Pole Position Offset Labels

Note Once a pulse generator (PG) is removed from the motor, it is necessary to adjust the magnetic pole position offset value.

(2) Automatic adjustment of the magnetic pole position offset value

When you mount a PG on the motor or replace the PG at the site for motors having no magnetic pole position offset label, perform automatic adjustment with the tuning function (H71 = 5).

Upon normal end of tuning, the magnetic pole position offset data is automatically saved into function code o10 (Magnetic pole position offset).

Requisites for tuning the magnetic pole position offset

1) Running the motor does not bring the machinery into dangerous situations.
2) There is no load fluctuation at the machinery and the motor rotation is stabilized.

If any of the above conditions is not satisfied, separate the motor from the machinery and perform the magnetic pole position offset tuning.

3) Automatic adjustment of the magnetic pole position offset value can apply only to the absolute UVW encoders (o09 = 1).

For encoders other than the absolute UVW ones, perform manual adjustment given in item (3) later.

Tuning procedure

1) Before starting tuning, configure the following function codes.
   P01 = 3 (Select PMSM)
   o09 = 1 (Select absolute UVW encoders)
   F02 = 0 (Select keypad for operation)
2) Set H71 to "5" (Select magnetic pole position offset tuning).
   (The H71 data can be changed by simultaneous keying of STOP + ⋀ / ⋁ keys.)
3) Press the FWD key to start tuning.
4) Upon completion of tuning, the data of H71 automatically reverts to "0."
5) The tuning result is saved into o10.

Note: When motor 2 (M2) or motor 3 (M3) is selected, use the following function codes in tuning as listed below

Motor 1 (M1)	Motor 2 (M2)	Motor 3 (M3)
P01	A01	A101
o09	A59	A159
o10	A60	A160

Function codes applied for adjustment

The following function codes are applied for adjustment in tuning. Usually, their factory default values should be retained.

- H161 (M1 pull-in current command)
- H171 (M2 pull-in current command)
- H181 (M3 pull-in current command)

Setting range: 10 to 200(%), Factory default: 80(%)
(Assuming the setting of P04 (M1 rated current) as 100%)

Note: If the motor sticks to the stop state, increasing the current value preset to the above function codes may resolve the problem.

- H162 (M1 pull-in frequency)
- H172 (M2 pull-in frequency)
- H182 (M3 pull-in frequency)

Setting range: 0.1 to 10.0 (Hz), Factory default: 1.0 (Hz)

Note: If the motor vibrates abnormally, decreasing the frequency value preset to the above function codes may resolve the problem.

📖 For the configuration procedure of the function codes, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Configuring function codes -- Menu #1 DATA Set." For function codes, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3 "Details of Function Codes."

Tuning Errors

If tuning fails, check the configuration of the function codes and wiring according to the instructions given below.

1) The "NOT EXECUTE" appears on the keypad.

   When M1 is selected, P02 ≠ 37 (OTHER).
   ⇒ Set P02 to "37."

   The JOG mode is selected. (The JOG indicator on the keypad is lit.)
   ⇒ Cancel the JOG mode by simultaneous keying of STOP + ⌃ keys.
   ⇒ Turn the digital input ***JOG*** OFF (if ON).

2) Alarm Er-5 occurs.

   P01 ≠ 3, o09 ≠ 1, or H160 ≠ 0.
   ⇒ Set P01 to "3," o09 to "1," or H160 to "0."

   Any of the digital inputs ***BX***, ***STOP1***, ***STOP2***, and ***STOP3*** is ON.
   Either one of the functional safety input terminals [EN1] and [EN2] is OFF.
   ⇒ Turn ***BX***, ***STOP1***, ***STOP2***, and ***STOP3*** OFF and turn [EN1] and [EN2] ON; otherwise, turning cannot start.

3) Alarm Er-7 occurs.

   A phase loss may have occurred in connection between the inverter and motor.
   ⇒ Correct the connection between the inverter and motor.

   Brake applies to the motor.
   ⇒ During tuning, be sure to enable the motor to rotate.

   The motor cannot rotate. The motor is vibrating abnormally.
   ⇒ For motor 1: Adjust the settings of H161 (M1 pull-in current command) and H162 (M1 pull-in frequency).
   ⇒ For motor 2: Adjust the settings of H171 (M2 pull-in current command) and H172 (M2 pull-in frequency).
   ⇒ For motor 3: Adjust the settings of H181 (M3 pull-in current command) and H182 (M3 pull-in frequency).

4) Alarm PG occurs.

   The PG wiring may be wrong.
   ⇒ Correct the PG wiring.

⚠ WARNING ⚠
Starting magnetic pole position offset tuning rotates the motor. Before starting tuning, be sure to check that running the motor does not cause any dangerous situation. **An accident or injuries could occur.**

(3) Manual adjustment of the magnetic pole position offset value

If magnetic pole position offset tuning cannot be used, adjust the offset value manually according to the instructions given below. This procedure enables you to check the current magnetic pole position offset value.

Configuring function code data beforehand

- E69 (Terminal [Ao1] function) = 26 (U phase voltage)
- E70 (Terminal [Ao2] function) = 39 (Magnetic pole position signal ***SMP***)
- E84 (Ao1-Ao5 filter setting) = 0.000 s (Cancel filter)

Adjustment procedure

Rotate the motor shaft by hand to check that the positional relationship between the waveforms on Ao1 and Ao2 is as shown below. If the waveforms are greatly misaligned, adjust the data of function code o10 to align the waveforms as shown below.

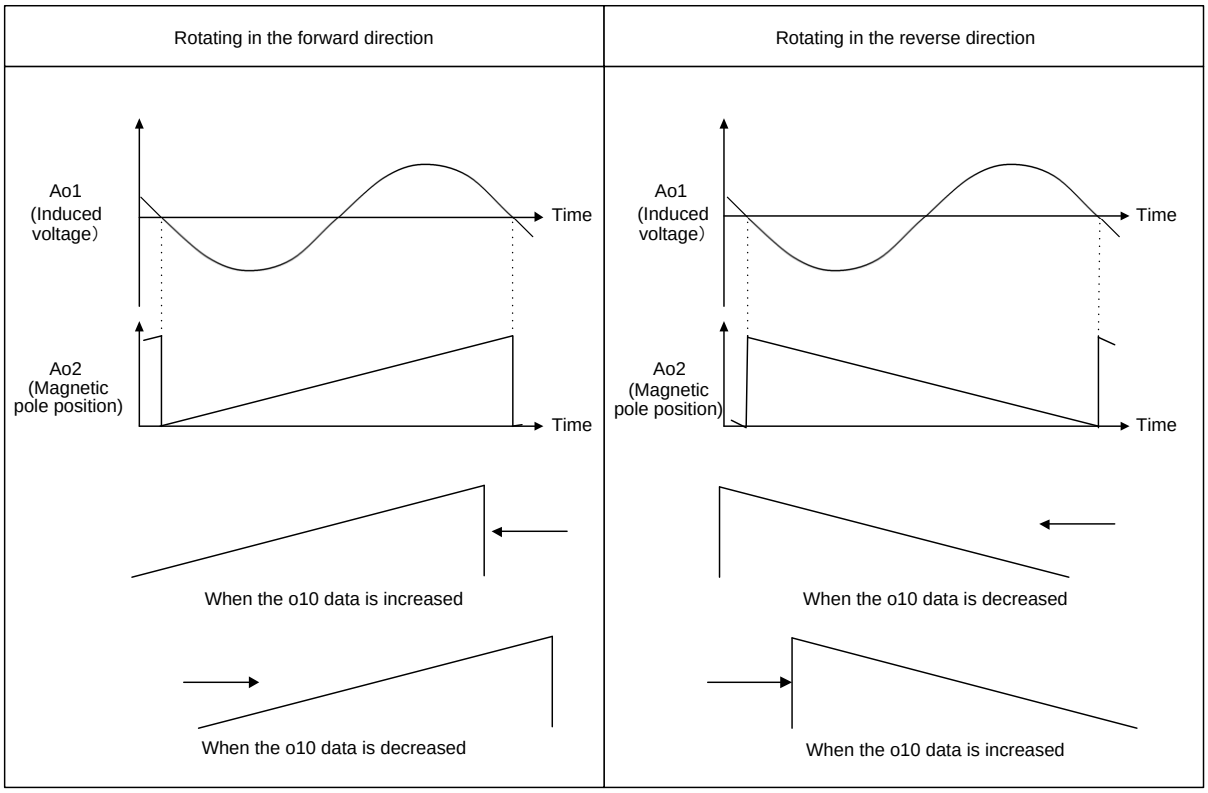


Figure 4.4-3 Adjustment of Magnetic Pole Position

Note If a PG alarm occurs during adjustment, the PG connection may be wrong. Check the PG wiring.

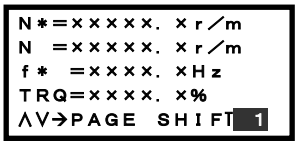
[4] Test run

(1) Turn the power ON and check that the reference speed is 0 r/min and it is blinking on the LED monitor.

(2) Set a low reference speed such as 100 r/min, using ∧ / ∨ keys. (Check that the speed is blinking on the LED monitor.)

(3) Set the maximum speed (F03) to 750 r/min.

(4) Shift the LCD monitor to Menu #3 "OPR MNTR" to show the speed (N∗, N).



(5) To run the motor in the forward direction, press the FWD key; to run it in the reverse direction, press the REV key.

Check that:

- The speed on the LED monitor comes ON instead of blinking
- The motor accelerates up to the specified speed.
- There is no abnormal discrepancy between the reference speed (N*) and the detected speed (N) shown on the LCD monitor.

(6) Press the STOP key to stop the motor.

(7) If no alarm occurs or no problem is found in motor running, increase the speed with the ∧ / ∨ keys.

(8) Turn the run command OFF.

< Check points during a test run >

・Check that the motor is running in the forward direction when it is driven with the FWD key.
・Check that the motor is running in the reverse direction when it is driven with the REV key.
・Check for smooth rotation without motor humming or excessive vibration.
・Check for smooth acceleration and deceleration.

When no abnormality is found, press the FWD or REV key again to start driving the motor, then increase the reference speed using ∧ / ∨ keys. Check the above points during a test run.

[5] Troubleshooting for motor abnormality

If any of the following abnormalities is found during a test run, follow the troubleshooting procedure in Table 4.4-2.

・Turning the inverter ON triggers a PG alarm.
・Entering a run command triggers a PG or Er-9 alarm.
・Entering a run command does not run the motor or increase the speed.

Table 4.4-2 Troubleshooting for Motor Abnormality

Possible Causes	What to Check and Suggested Measures
(1) Setting of torque limiter level 1 too small relative to the load.	Check the setting of the torque limiter level 1 (F44). ➔ Increase the F44 data in increments of 5%.
(2) Wrong wiring between the inverter and motor.	Check the wiring between the inverter and motor. ➔ Correct the wiring.
(3) Wrong PG wiring.	Check the wiring of the PG. ➔ Correct the wiring.
(4) PMSM magnetic pole position not matched.	Check the magnetic pole position. ➔ Adjust the magnetic pole position (o10, A60, A160), referring to "[3] Setting the magnetic pole position offset value."

4.5 Selecting a Speed Command Source

A speed command source is the keypad (△ / ▽ keys) by factory default. This section provides the speed command setting procedures using the speed command sources of the keypad, external potentiometer, and speed selection terminal commands.

4.5.1 Setting up a speed command from the keypad

Follow the procedure given below.

(1) Configure the function codes as listed below.

Function code	Name	Function code data	Factory default
F01	Speed Command Source N1	0: Keypad (△ / ▽ keys)	0

Note
- When the inverter is in Programming or Alarm mode, speed command setting with △ / ▽ keys is disabled. To enable it, switch to Running mode.
- If any of higher priority speed command sources (multistep speed commands and speed commands via communications link) is specified, the inverter may run at an unexpected speed.

(2) Press the △ / ▽ key to display the current speed command on the LED monitor. The least significant digit blinks.

(3) To change the speed command, press the △ / ▽ key again.
When you start specifying the speed command with the △ / ▽ key, the least significant digit on the display blinks; that it, the cursor lies in the least significant digit. Holding down the △ / ▽ key changes data in the least significant digit and generates a carry, while the cursor remains in the least significant digit.

(4) To save the new setting into the inverter's memory, press the FUNC/DATA key.

For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 DATA SET".

4.5.2 Setting up a speed command with an external potentiometer

Follow the procedure given below.

(1) Configure the function codes as listed below.

Function code	Name	Function code data	Factory default
F01	Speed Command Source N1	1: Analog voltage input to terminal [12] (0 to ±10 V)	0

(2) Connect an external potentiometer to terminals [11] through [13] of the inverter.

(3) Rotate the external potentiometer to apply voltage to terminal [12] for a speed command input.

For precautions in wiring, refer to Chapter 2 "MOUNTING AND WIRING THE INVERTER."

For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 DATA SET".

4.6 Selecting a Run Command Source

A run command source is the keypad (FWD / REV / STOP keys) by factory default.

4.6.1 Setting up a run command from the keypad

Follow the procedure given below.

(1) Configure the function codes as listed below.

Function code	Name	Function code data	Factory default
F02	Operation Method	0: Keypad (FWD / REV / STOP keys)	0: Keypad (FWD / REV / STOP keys)

(2) Press the FWD key to run the motor in the forward direction. Press the STOP key to stop it.

(3) Press the REV key to run the motor in the reverse direction. Press the STOP key to stop it.

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 "DATA SET".

4.6.2 Setting up a run command with digital input signals (terminals [FWD] and [REV])

Follow the procedure given below.

(1) Configure the function codes as listed below.

Function code	Name	Function code data	Factory default
F02	Operation Method	1: External digital input signal	0: Keypad (FWD / REV / STOP keys)

Note If terminal [FWD] and [REV] are ON, the F02 data cannot be changed. First turn those terminals OFF and then change the F02 data.

(2) Connect the run forward switch between terminals [FWD] and [CM] and the run reverse switch between [REV] and [CM].

Note Make sure that the SINK/SOURCE slide switch (SW1) is turned to the SINK position. If SW1 is in the SOURCE position, the inverter cannot run the motor.

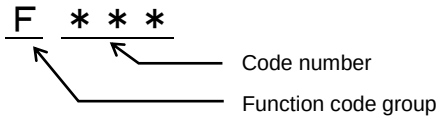
(3) Turn the run forward switch or run reverse switch ON (short-circuit) to run the motor in the forward or reverse direction, respectively.

📖 For precautions in wiring, refer to Chapter 2 "MOUNTING AND WIRING THE INVERTER."

📖 For details on how to modify the function code data, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.2 "Setting up function codes -- Menu #1 DATA SET".

Chapter 5 FUNCTION CODES

5.1 Function Code Groups and Function Codes



Function code group		Function codes	Remarks	
Fundamental functions	**F** codes	F00 to F85		
Extension terminal functions	**E** codes	E01 to E118		
			E51, E52	For the OPC-VG1-AIO option
			E55, E56	
			E59, E60	
			E63, E64	
			E67, E68	
			E72, E73	
			E77, E78	
			E82, E83	
			E103, E104	
			E107, E108	
Control functions	**C** codes	C01 to C73		
Motor **P**arameter functions M1	**P** codes	P01 to P51	For M1.	
High performance function	**H** codes	H01 to H228		
Alternative motor parameter functions M2/M3	**A** codes	A01 to A171	For M2 and M3.	
option functions	**o** codes	o05 to o197	o01 to o04	For the OPC-VG1-DIA, DIB option.
			o05	For the OPC-VG1-PG (PD) option.
			o06 to o08	For the OPC-VG1-PG (LD) option.
			o09 to o11	For the OPC-VG1-PMPG option.
			o12 to o19	For the OPC-VG1-PG (PR) option.
			o29 to o32	For communications options (e.g., OPC-VG1-TL, OPC-VG1-CCL).
			o33, o34, o50	For the high-speed serial communication terminal block OPC-VG1-TBSI.
			o122 to o197	For communications options.
Lift functions	**L** codes	L01 to L15		
User functions	**U** codes	U01 to U64	For the UPAC option.	
		U101 to U150	For manufacturers.	
Sa**F**ety functions	**SF** codes	SF00 to SF31	For functional safety. For details, refer to the Functional Safety card Instruction Manual.	
Serial communication functions	**S** codes	S01 to S17	Commands	Accessible in local mode (keypad), via the communications link (T-Link, RS-485, SIU system, SX-bus, and fieldbus), and via the UPAC.
Monitoring functions	**M** codes	M01 to M222	Data monitor	

📖 Function codes Tables are stated only "F to H" code. For details of the other function code data, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.2 "Function Codes Tables".

📖 For details of the function code data, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.3 "Details of Function Codes".

5.2 About the Contents of Column Headers in Function Code Tables

Column Headers		Description
Function codes		Function code group and code number * Shaded function codes denote that they have different functions between the unit type and stack type or they are invalid for the stack type even if they can be displayed and configured.
Communications address	485 No.	Address to be used to refer to or change function code data using a communications option. Available for all communications options except OPC-VG1-TL.
	Link No.	Address to be used to refer to or change function code data using a communications option (OPC-VG1-TL, OPC-VG1-SX, etc.). Blank link number fields mean that the corresponding function codes cannot be accessed via a field option.
Name		Name assigned to a function code.
Dir.		Number of subdirectories in the keypad directory structure. 0: Parent directory having no subdirectories 1: Subdirectory 2 or more: Parent directory having the specified number of subdirectories
Data setting range		Allowable data setting range and definition of each data.
Change when running		Indicates whether the function code data can be changed or not when the inverter is running. Y: Possible, N: Impossible
Default setting		Data preset by factory default. If data is changed from the factory default, it is displayed with an asterisk (*) on the keypad. Using function code H03 reverts changed function code data to the default values.
Data copying		Indicates whether or not the function code data can be copied when you copy the data stored in the keypad memory of a source inverter to other destination inverters.
Initialization		Indicates whether or not the function code data can be initialized to the default value by function code H03 (Data initialization). Y: Possible, N: Impossible
Format type		Indicates a format type to be used to refer to or change function code data via the communications link.
Drive control (Availability)		Indicates whether or not the function code is available to the individual drive controls. Y: Available, N: Not available Drive controls: VC w/ PG: Vector control for induction motor (IM) with speed sensor VC w/o PG: Vector control for induction motor (IM) without speed sensor V/f: V/f control for induction motor (IM) VC for PMSM: Vector control for permanent magnet synchronous motor (PMSM) with speed sensor

For details about the format type, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.2.4 "Data format list."

5.3 Function Code Tables

5.3.1 F codes (Fundamental Functions)

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
F00	0h	50h	Data protection	0	0 to 1 0: Data change allowed 1: Data protection Write-protects data from the keypad. H29 "Link write protect" defines the write-protect from links (T-link, 485, etc.).	×	0	×	○	40	○	○	○	○	
F01	1h	h	Speed setting N1	0	0 to 9 0: Keypad (⌃/⌄keys) 1: Analog 12 input (0 to ±10 V) 2: Analog 12 input (0 to +10 V) 3: UP/DOWN (initial value 0) 4: UP/DOWN (initial value: previous value) 5: UP/DOWN (initial value: creep speed 1, 2) 6: DIA card input 7: DIB card input 8: Ai (N-REFV) input 9: Ai2 (N-REFC) input Defines how to set a speed command.	×	0	○	○	41	○	○	○	○	
F02	2h	h	Operation method	0	0 to 1 0: Key operation (FWD , REV and STOP keys) (LOCAL mode) 1: External signal (FWD and REV terminals) (REMOTE mode) Defines how to input the operation method.	×	0	○	○	42	○	○	○	○	
F03	3h	51h	M1 Maximum speed	3	50 to 30000 r/min	×	1500	○	×	0	○	○	○	○	
F04	4h	52h	M1 Rated speed	1	50 to 30000 r/min	×	Depends on capacity	○	×	0	○	○	○	○	
F05	5h	53h	M1 Rated voltage	1	80 to 999 V	×	Depends on capacity	○	×	0	○	○	○	○	
F07	7h	54h	Acceleration time 1	0	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
F08	8h	55h	Deceleration time 1	0	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
F10	Ah	56h	M1 Electronic thermal (Operation selection)	3	0 to 2 0: No operation (when using exclusive motor for VG) 1: Operation (for general purpose motors: use in the case of self-cooling fan) 2: Operation (for inverter motors: use in the case of externally powered fan)	○	0	○	×	85	○	○	○	○	
F11	Bh	57h	M1 Electronic thermal (Detection level)	1	0.01 to 99.99 A 100.0 to 999.9 A 1000 to 2000 A	○	Depends on capacity	○	×	13	○	○	○	○	
F12	Ch	58h	M1 Electronic thermal (Thermal time constant)	1	0.5 to 75.0 min	○	Depends on capacity	○	×	2	○	○	○	○	
F14	Eh	h	Restart after momentary power failure (Operation selection)	0	0 to 5 0: No operation (No restart, immediate alarm ⟨⟨⟩⟩) 1: No operation (No restart, alarm on power return ⟨⟨⟩⟩) 2: No operation (No restart, alarm after slow down and stop ⟨⟨⟩⟩) 3: Operation (Restart, continue operation) 4: Operation (Restart, operate at speed when power was cut off) 5: Operation (Restart, operate at starting speed)	○	0	○	○	0	○	○	○	○	
F17	11h	h	Gain (for speed setting on terminal [12])	0	0.0 to 200.0% Ratio to analog speed setting value on control terminal [12]. Limited at ±110% of maximum speed.	○	100.0	○	○	2	○	○	○	○	
F18	12h	h	Bias (for speed setting on terminal [12])	0	-30000 to 30000 r/min Bias to analog speed setting value on control terminal [12]. Limited at ± maximum speed.	○	0	○	○	5	○	○	○	○	
F20	14h	59h	DC Braking (Braking starting speed)	3	0 to 3600 r/min	○	0	○	○	0	○	○	○	×	
F21	15h	5Ah	DC Braking (Braking level)	1	0 to 100%	○	0	○	○	16	○	○	○	×	
F22	16h	5Bh	DC Braking (Braking time)	1	0.0 to 30.0 s 0.0: No operation 0.1 to 30.0 s: Operation	○	0.0	○	○	2	○	○	○	×	
F23	17h	5Ch	Starting speed	0	0.0 to 150.0 r/min Restrict to over 0.1 Hz (for sensor-less, VF control) Starting speed can be set to secure the torque for starting.	×	0.0	○	○	2	○	○	○	○	
F24	18h	5Dh	Starting speed (Holding time)	0	0.00 to 10.00 s	×	0.00	○	○	3	○	○	○	○	
F26	1Ah	5Eh	Motor sound (Carrier frequency) * Function code invalid for setting change	0	2 to 15 kHz 2: 2 kHz 3: 3 kHz 4: 4 kHz 5: 5 kHz 6: 6 kHz 7: 7 kHz 8, 9: 8 kHz 10, 11: 10 kHz 12, 13, 14: 12 kHz 15: 15 kHz * Internal parameter of stack type is fixed at 2 kHz. (It will operate at 2 kHz even if set.)	×	2	○	○	10	○	○	○	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LEnS	VF	SM	
F36	24h	h	30RY Drive mode	0	0 to 1 0: Excitation operation on alarm 1: Normal excitation operation	×	0	○	○	43	○	○	○	○	
F37	25h	60h	Stop speed	3	0.0 to 150.0 r/min Restrict to over 0.1 Hz (for sensor-less, VF control)	×	10.0	○	○	2	○	○	○	○	
F38	26h	61h	Stop speed (Detection mode)	1	0 to 1 0: Detected speed value 1: Speed command value Only speed command value is valid, regardless of the setting value, under sensor-less vector control or V/F control.	×	0	○	○	90	○	×	×	○	
F39	27h	62h	Stop speed (Zero speed control holding time)	1	0.00 to 10.00 s Applies to when timing the application of the mechanical brake.	×	0.50	○	○	3	○	×	×	○	
F40	28h	63h	Torque limiter mode 1	12	0 to 3 0: Limit disable 1: Torque limit 2: Power limit 3: Torque current limit	×	0	○	○	44	○	○	○	○	
F41	29h	64h	Torque limiter mode 2	1	0 to 3 0: Same for 4 quadrants at level 1 1: Drive (Level 1) and brake (Level 2) 2: Upper limit (Level 1), lower limit (Level 2) 3: Switch between levels 1 and 2 for all the 4 quadrants Levels 1 and 2 are specified by the sources defined by F42 and F43, respectively.	×	0	○	○	45	○	○	○	○	
F42	2Ah	65h	Torque limiter value (Level 1) selection	1	0 to 5 0: Function code (F44) 1: Ai [TL-REF1] 2: DIA card 3: DIB card 4: Link enable 5: PID output	×	0	○	○	46	○	○	○	○	
F43	2Bh	66h	Torque limiter value (Level 2) selection	1	0 to 5 0: Function code (F45) 1: Ai [TL-REF2] 2: DIA card 3: DIB card 4: Link enable 5: PID output	×	0	○	○	47	○	○	○	○	
F44	2Ch	67h	Torque limiter value (Level 1)	1	-300 to 300%	○	150	○	○	5	○	○	○	○	
F45	2Dh	68h	Torque limiter value (Level 2)	1	-300 to 300%	○	10	○	○	5	○	○	○	○	
F46	2Eh	69h	Mechanical loss compensation value	1	-300.00 to 300.00%	○	0.00	○	○	7	○	○	×	○	
F47	2Fh	6Ah	Torque bias T1	1	-300.00 to 300.00% Torque biases T1 to T3 are switchable with DI.	○	0.00	○	○	7	○	○	×	○	
F48	30h	h	Torque bias T2	1	-300.00 to 300.00%	○	0.00	○	○	7	○	○	×	○	
F49	31h	h	Torque bias T3	1	-300.00 to 300.00%	○	0.00	○	○	7	○	○	×	○	
F50	32h	h	Torque bias startup timer	1	0.00 to 1.00 s Specifies the time required for generating 300% torque.	○	0.00	○	○	3	○	○	×	○	
F51	33h	FBh	Torque command monitor (Polarity selection)	1	0 to 1 0: Torque polarity 1: + on drive, - on brake Specifies the polarity of torque related data output (e.g., AO monitor, keypad LED monitor, and keypad LCD monitor).	○	0	○	○	48	○	○	○	○	
F52	34h	h	LED Monitor (Display coefficient A)	8	-999.00 to 999.00 Specifies the conversion coefficient for displaying the load shaft speed and line speed on the keypad LED monitor. Display value = Motor speed x (0.01 to 200.00) Data is valid only between 0.01 and 200.00, out of range data will be restricted.	○	1.00	○	○	12	○	○	○	○	
F53	35h	h	LED Monitor (Display coefficient B)	1	-999.00 to 999.00 Display coefficient A: Maximum value Display coefficient B: Minimum value Display coefficients A and B are used to set the conversion coefficients for determining the display values for the PID command value, PID feedback amount, and PID output (Process amount). Display value = (Command or feedback value) x (Display coefficient A - B) + B	○	1.00	○	○	12	○	○	○	○	
F54	36h	h	LED Monitor (Display filter)	1	0.0 to 5.0 s	○	0.2	○	○	2	○	○	○	○	
F55	37h	H	LED Monitor (Display selection)	1	00 to 32	○	0	○	○	49					
					00: Speed detection 1/Speed command (r/min) (F56 switches the display while motor is stopped)						○	○	×	○	
					01: Speed setup 4 (ASR input) (r/min)						○	○	○	○	
					02: Output frequency command value (slide in) (Hz)						○	○	○	○	
					03: Torque current command value (%)						○	○	×	○	
					04: Torque command value (%)						○	○	×	○	
					05: Torque calculated value (%)						○	○	○	○	
					06: Power consumption (Motor output) (switched by F60) (kW, HP)						○	○	○	○	
					07: Output current detected value (A)						○	○	○	○	
					08: Output voltage detected value (V)						○	○	○	○	
					09: DC link bus voltage detected value (V)						○	○	○	○	
					10: Magnetic flux command value (%)						○	○	×	×	
					11: Magnetic flux calculated value (%)						○	○	×	×	
					12: Motor temperature (°C) (when NTC thermistor is not used, "---" is displayed)						○	○	○	○	
					13: Load axis rotational speed detected value, command value (r/min) (Display with the motor stopped is switchable with F56.)						○	○	×	○	
					14: Line speed detected value, command value (m/min) (Display with the motor stopped is switchable with F56.)						○	○	○	○	
					15: Ai adjusted value (12) (%)						○	○	○	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LE S	VF	SM	
F55	37h	H	LED Monitor (Display selection)	1	16: Ai adjusted value (Ai1) (%)	○	0	○	○	49	○	○	○	○	
					17: Ai adjusted value (Ai2) (%)						○	○	○	○	
					18: Ai adjusted value (Ai3) (%)						○	○	○	○	
					19: Ai adjusted value (Ai4) (%)						○	○	○	○	
					The following data will be hidden depending upon the mode or options. 20: PID command value (%)						○	○	○	○	
					21: PID feedback value (%)						○	○	○	○	
					22: PID output value (%)						○	○	○	○	
					23: Option monitor 1 (HEX)						○	○	○	○	
					24: Option monitor 2 (HEX)						○	○	○	○	
					25: Option monitor 3 (DEC)						○	○	○	○	
					26: Option monitor 4 (DEC)						○	○	○	○	
					27: Option monitor 5 (DEC)						○	○	○	○	
					28: Option monitor 6 (DEC)						○	○	○	○	
					29: -						-	-	-	-	
					30: Load factor (%)						○	○	○	○	
					31: Input power (F60 switches units.) (kW/HP)						○	○	○	○	
					32: Input watt-hour (x 100 kWh)						○	○	○	○	
F56	38h	H	LED Monitor (Display when stopped)	1	0 to 1 0: Display command value 1: Display actual value The display with the motor stopped is switchable with F55. Relevant data are speed (0), load axis rotational speed (13), and line speed (14).	○	0	○	○	50	○	○	○	○	
F57	39h	h	LCD Monitor (Display selection)	1	0 to 1 0: Display operation guidance screen (Operating condition, Rotation direction) 1 Display bar graph of operation data (Speed detect 1, Current, Torque command value) Switches the running mode screen on the keypad.	○	0	○	○	51	○	○	○	○	
F58	3Ah	h	LCD Monitor (Language selection)	1	0 to 7 0: Japanese 1: English 2-5: - 6: Chinese 7: Korean	○	0	○	×	52	○	○	○	○	
F59	3Bh		LCD Monitor (Contrast adjustment)	1	0 (Low) to 10 (High)	○	5	○	○	0	○	○	○	○	
F60	3Ch		Output unit (HP/kW) setting	0	0 to 1 0: kW 1: HP Switches the display unit for the inverter output (power consumption) of the keypad LED and LCD monitors and the selection list (kW-HP) for P02 "Motor selection (M1)".	○	0	○	○	53	○	○	○	○	
F61	3Dh	6Bh	ASR1-P (Gain)	10	0.1 to 500.0 times	○	10.0	○	○	2	○	○	×	○	
F62	3Eh	6Ch	ASR1-I (Integral constant)	1	0.000 to 10.000 s P control when set to 0.000	○	0.200	○	○	4	○	○	×	○	
F63	3Fh	6Dh	ASR1-FF (Gain)	1	0.000 to 9.999 s	○	0.000	○	○	4	○	○	×	○	
F64	40h	6Eh	ASR1 Input filter	1	0.000 to 5.000 s	○	0.040	○	○	4	○	○	○	○	
F65	41h	6Fh	ASR1 Detection filter	1	0.000 to 0.100 s Specifies the first order delay filter time constant for the detected speed value.	○	0.005	○	○	4	○	○	×	○	
F66	42h	70h	ASR1 Output filter	1	0.000 to 0.100 s Specifies the first order delay filter time constant for the torque command.	×	0.002	○	○	4	○	○	×	○	
F67	43h	71h	S-curve acceleration 1 (Start)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
F68	44h	72h	S-curve acceleration 1 (End)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
F69	45h	73h	S-curve deceleration 1 (Start)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
F70	46h	74h	S-curve deceleration 1 (End)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
F72	48h	h	Pre-excitation operation selection	4	0 to 1 0: Operates when starting operation. Pre-excitation continues for the duration specified by F74. 1: Operates when starting and stopping operation. Pre-excitation continues for the duration specified by F74 or until the magnetic flux command reaches the level specified by E48, whichever is earlier.	×	0	○	○	230	○	○	×	×	
F73	49h	h	Magnetic flux level at light load	1	10 to 100%	○	100	○	○	16	○	×	×	×	
F74	4Ah	75h	Pre-excitation (Duration)	1	0.0 to 10.0 s When the operation command is turned ON (FWD, REV), the unit automatically enters the pre-excitation state for the time specified in this function code.	×	0.0	○	○	2	○	○	×	×	
F75	4Bh	76h	Pre-excitation (Initial level)	1	100 to 400%	×	100	○	○	0	○	○	×	×	
F76	4Ch	h	Speed limiter (Mode selection)	3	0 to 3 0: Limits to Normal: Level 1, Reverse: level 2. 1: Limits to Normal: Level 1, Reverse: level 1. 2: Limits to upper limit at level 1, lower limit at level 2. 3: Limits to Normal: Level 1, Reverse: level 2. Terminal [12] input added as a bias	×	0	○	○	91	○	○	○	○	
F77	4Dh	4Fh	Speed limiter (Level 1)	1	-110.0 to 110.0%	○	100.0	○	○	6	○	○	○	○	
F78	4Eh	FEh	Speed limiter (Level 2)	1	-110.0 to 110.0%	○	100.0	○	○	6	○	○	○	○	
F79	4Fh	77h	Motor selection (M1, M2, M3)	0	0 to 2 0: M1 selected Note that switching of contacts by X functions has priority over this function code setting. 1: M2 selected (X function disable) 2: M3 selected (X function disable) Select a motor to be used from M1, M2 and M3.	×	0	○	×	54	○	○	○	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LEV	VF	SM	
F80	50h	h	Current rating switching	0	0 to 3 **Stack type** 0,2,3 : MD (high duty overload current 150%-1min) 1 : LD (low duty overload current 110%-1min) * It switches the dual ratings (MD, LD) of inverter. As for keypad display, HD display is operated in accordance with MD spec. **Unit type** 0,2 : HD (high duty overload current 150%-1min/200%-3sec) 1 : LD (low duty overload current 120%-1min) 3 : MD (medium duty overload current 150%-1min) * It switches the triple ratings (HD, LD, MD) of inverter.	×	0	○	×	56	○	○	○	○	
F81	51h	h	Offset for speed setting on terminal [12]	3	-30000 to 30000 r/min Specifies the offset for analog speed setting value on control terminal [12].	○	0	○	○	5	○	○	○	○	
F82 (*1)	52h	h	Dead zone for speed setting on terminal [12]	1	0.0 to 150.0 r/min Limits the speed command value below specified value ± to 0 r/min for analog speed setting value on control terminal [12].	○	0.0	○	○	2	○	○	○	○	
F83	53h	h	Filter for speed setting on terminal [12]	1	0.000 to 5.000 s	○	0.005	○	○	4	○	○	○	○	
F84	54h	h	Display coefficient for input watt-hour data * Invalid for use in stack type	0	0.000 to 9999 Specifies a display coefficient for displaying the input watt-hour data (M116). M116 = F84 x M115 "Input watt-hour" (kWh) Specification of 0.000 clears the input watt-hour data.	○	0.010	○	○	101	○	○	○	○	
F85	55h	h	Display filter for calculated torque	0	0.000 to 1.000 s Specifies a display filter for calculated torque output for monitoring (keypad LED monitor and keypad LCD monitor).	○	0.100	○	○	4	○	○	○	○	

*Depending upon the inverter's capacity.

5.3.2 E codes (Extension Terminal Functions)

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
E01	101h	78h	X1 Function selection	13	00 to 79	×	0	○	○	57					
					00, 01, 02, 03: Multistep speed selection (1 to 15 speeds) [00: SS1, 01: SS2, 02: SS4, 03: SS8]						○	○	○	○	
					04, 05: ASR, acceleration and deceleration selection (4 speeds) [4: RT1, 5: RT2]						○	○	○	○	
					06: Self-holding selection [HLD]						○	○	○	○	
					07: Coast to a stop [BX]						○	○	○	○	
					08: Failure reset [RST]						○	○	○	○	
					09: External alarm [THR]						○	○	○	○	
					10: Jogging operation [JOG]						○	○	○	○	
					11: Speed setting N2/Speed setting N1 [N2/N1]						○	○	○	○	
					12: Motor M2 selection [M-CH2]						○	○	○	○	
					13: Motor M3 selection [M-CH3]						○	○	○	○	
					14: Direct current brake command [DCBRK]						○	○	○	×	
					15: ACC/DEC zero clear command [CLR]						○	○	○	○	
					16: UP/DOWN specification creep speed switching [CRP-N2/N1]						○	○	○	○	
					17: UP/DOWN specification UP command [UP]						○	○	○	○	
					18: UP/DOWN specification DOWN command [DOWN]						○	○	○	○	
					19: Keypad edit permission command (data change allowed) [WE-KP]						○	○	○	○	
					20: PID control cancel [KP/PID]						○	○	○	○	
					21: Normal and reverse operation switching [IVS]						○	○	○	○	
					22: Interlock (52-2) IL]						○	○	○	○	
					23: Link edit permission command [WE-LK]						○	○	○	○	
					24: Linked operation selection [LE]						○	○	○	○	
					25: Universal DI [U-DI]						○	○	○	○	
					26: Starting characteristic selection [STM]						○	○	○	○	
					27: Synchronous operation command (PG (PR) option function) [SYC]						○	×	×	○	
					28: Zero speed lock command [LOCK]						○	×	×	○	
					29: Pre-excitation command [EXITE]						○	○	×	×	
					30: Limitation of speed command value cancel (Related codes: F76, F77, F78) [N-LIM]						○	○	○	○	
					31: H41 [Torque command] cancel [H41-CCL]						○	○	×	○	
					32: H42 [Torque current command] cancel [H42-CCL]						○	○	×	○	
					33: H43 [Magnetic flux command] cancel [H43-CCL]						○	×	×	×	
					34: F40 [Torque limited mode 1] cancel [F40-CCL]						○	○	×	○	
					35: Torque limit (Level 1, Level 2 selection) [TL2/TL1]						○	○	○	○	
					36: Bypass [BPS]						○	○	○	○	
					37, 38: Torque bypass command 1/2 [37: TB1, 38: TB2]						○	○	×	○	
					39: Droop selection [DROOP]						○	○	×	○	
					40: Ai1 zero hold [ZH-AI1]						○	○	○	○	
					41: Ai2 zero hold [ZH-AI2]						○	○	○	○	
					42: Ai3 zero hold (AIO option function) [ZH-AI3]						○	○	○	○	
					43: Ai4 zero hold (AIO option function) [ZH-AI4]						○	○	○	○	
					44: Ai1 polarity reversal [REV-AI1]						○	○	○	○	
					45: Ai2 polarity reversal [REV-AI2]						○	○	○	○	
					46: Ai3 polarity reversal (AIO option function) [REV-AI3]						○	○	○	○	
					47: Ai4 polarity reversal (AIO option function) [REV-AI4]						○	○	○	○	
					48: PID command value reverse operation selection [PID-INV]						○	○	○	○	
					49: PG alarm cancel [PG-CCL]						○	×	×	○	
					50: Insufficient voltage cancel [LU-CCL]						○	○	○	○	
					51: Ai torque bias hold [H-TB]						○	○	×	○	
					52: STOP1 (decelerate to stop in normal deceleration time) [STOP1]						○	○	○	○	
					53: STOP2 (decelerate to stop in “deceleration time 4”) [STOP2]						○	○	○	○	
					54: STOP3 (Ignore deceleration time specification, and decelerate to stop using maximum output torque)						○	○	○	○	
					55: DIA data latch (DIA option function) [DIA]						○	○	○	○	
					56: DIB data latch (DIB option function) [DIB]						○	○	○	○	
					57: Multiple system cancel [MT-CCL]						○	×	○	×	
					58-67: Custom Di1-Di10 [C-DI1 to C-DI10]						○	○	○	○	
					68: Load weighting parameter selection (To be supported soon) [AN-P2/1]						○	×	×	○	
					69: PID clear [PID-CCL]						○	○	○	○	
					70: PID FF item enable [PID-FF]						○	○	○	○	
					71: Speed limit calculation complete reset signal (To be supported soon) [NL-RST]						○	×	×	○	
					72: Toggle signal 1 [TGL1]						○	○	○	○	
					73: Toggle signal 2 [TGL2]						○	○	○	○	
					74: External mock alarm [FTB]						○	○	○	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
E01	101h	78h	X1 Function selection	13	75: NTC thermistor alarm cancel [NTC-CCL]	×	0	O	O	57	O	O	O	O	
					76: Life early warning cancel [LF-CCL]						O	O	O	O	
					77: - [SPG-AP]						-	-	-	-	
					78: PID feedback switching signal [PID-1/2]						O	O	O	O	
					79: PID torque bias selection [TB-PID]						O	O	×	O	
E02	102h	79h	X2 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	1	O	O	57	O	O	O	O	
E03	103h	7Ah	X3 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	2	O	O	57	O	O	O	O	
E04	104h	7Bh	X4 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	3	O	O	57	O	O	O	O	
E05	105h	7Ch	X5 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	4	O	O	57	O	O	O	O	
E06	106h	7Dh	X6 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	5	O	O	57	O	O	O	O	
E07	107h	7Eh	X7 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	7	O	O	57	O	O	O	O	
E08	108h	7Fh	X8 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	8	O	O	57	O	O	O	O	
E09	109h	80h	X9 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	9	O	O	57	O	O	O	O	
E10	10Ah	81h	X11 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	25	O	O	57	O	O	O	O	
E11	10Bh	82h	X12 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	25	O	O	57	O	O	O	O	
E12	10Ch	83h	X13 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	25	O	O	57	O	O	O	O	
E13	10Dh	84h	X14 Function selection	1	0 to 79 (Refer to Terminal [X1] Function.)	×	25	O	O	57	O	O	O	O	
E14	10Eh	h	X Function Normal open/close	0	0000 to 01FF 0: Normal open 1: Normal close Specifies whether to open or close the contact for terminals [X1] to [X9].	×	0000	O	O	35	O	O	O	O	
E15	10Fh	85h	Y1 Function selection	13	0 to 84	×	1	O	O	58					
					00: In operation [RUN]						O	O	O	O	
					01: Speed available [N-EX]						O	O	O	O	
					02: Speed agreement [N-AG1]						O	O	×	O	
					03: Speed achieved [N-AR]						O	O	O	O	
					04: Speed detection 1 [N-DT1]						O	O	O	O	
					05: Speed detection 2 [N-DT2]						O	O	O	O	
					06: Speed detection 3 [N-DT3]						O	O	O	O	
					07: Stopped due to insufficient voltage [LU]						O	O	O	O	
					08: Torque polarity detected (brake/drive) [B/D]						O	O	×	O	
					09: Torque limited TL]						O	O	O	O	
					10: Torque detect 1 [T-DT1]						O	O	O	O	
					11: Torque detect 2 [T-DT2]						O	O	O	O	
					12: Keypad operation [KP]						O	O	O	O	
					13: Stopped [STOP]						O	O	O	O	
					14: Preparation for operation complete [RDY]						O	O	O	O	
					15: Magnetic flux detect signal [MF-DT]						O	O	×	×	
					16: Motor M2 selected [SW-M2]						O	O	O	O	
					17: Motor M3 selected [SW-M3]						O	O	O	O	
					18: Brake release signal [BRK]						O	O	×	O	
					19: Alarm contents [AL1]						O	O	O	O	
					20: Alarm contents [AL2]						O	O	O	O	
					21: Alarm contents [AL4]						O	O	O	O	
					22: Alarm contents [AL8]						O	O	O	O	
					23: Cooling fan in operation [FAN]						O	O	O	O	
					24: Retry function in operation [TRY]						O	O	O	O	
					25: Universal DO [U-DO]						O	O	O	O	
					26: Cooling fin overheat early warning [INV-OH]						O	O	O	O	
					27: Synchronization control complete [SY-C]						O	×	×	O	
					28: Life early warning [LIFE]						O	O	O	O	
					29: Accelerating [U-ACC]						O	O	O	O	
					30: Decelerating [U-DEC]						O	O	O	O	
					31: Inverter overload early warning [INV-OL]						O	O	O	O	
					32: Motor temperature overheat early warning [M-OH]						O	O	O	O	
					33: Motor overload early warning [M-OL]						O	O	O	O	
					* Invalid for use in stack type ⇒ 34: DB overload early warning [DB-OL]						O	O	×	O	
					35: Transmission failure [LK-ERR]						O	O	O	O	
					36: Load weighting control limited [ANL]						O	×	×	O	
					37: Load weighting control in calculation [ANC]						O	×	×	O	
					38: Analog torque bias on hold [TBH]						O	O	×	O	
					39 to 48: Custom Do1-Do10 [C-DO1 to C-DO10]						O	O	O	O	
					49: -						-	-	-	-	
					50: -						O	×	×	O	
					51: Establishing multiple system communication [MTS]						O	×	×	O	
					52: Multiple system cancel response [MEC-AB]						O	×	×	O	
					53: Multiple system master selection [MSS]						O	×	×	O	
					54: Multiple system self error [AL-SF]						O	×	×	O	
					55: Stopped due to communication failure [LES]						O	O	O	O	
					56: Alarm output (for any alarm) [ALM]						O	O	O	O	
					57: Light alarm [L-ALM]						O	O	O	O	
					58: Maintenance early warning [MNT]						O	O	O	O	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
			* Invalid for use in stack type ⇒												
					60: DC fan lock signal [DCFL]						○	○	○	○	
					61: Speed agreement 2 [N-AG2]						○	○	○	○	
					62: Speed agreement 3 [N-AG3]						○	○	×	○	
					63: Axial fan stop signal [MFAN]						○	○	×	○	
					64: Free assignment RDY (***1**) [AS-RDY]						○	○	○	○	
					65: -						-	-	-	-	
					66: Droop selection response [DSAB]						-	-	-	-	
					67: Torque command/Torque current command cancel response [TCL-C]						○	○	×	○	
					68: Torque limited mode 1 cancel response [F40-AB]						○	○	×	○	
					71: 73 input command [PRT-73]						○	○	○	○	
					72: Y terminal test output ON [Y-ON]						○	○	○	○	
					73: Y terminal test output OFF [Y-OFF]						○	○	○	○	
					74: -						-	-	-	-	
					75: Life of battery for clock [BATT]						○	○	○	○	
					76: -						×	×	×	○	
					77: SPGT battery warning (To be supported soon) [SPGT-B]						○	○	○	○	
					78: -						-	-	-	-	
					79: -						-	-	-	-	
				(***2**)	80: EN terminal detection circuit failure [DECF]						○	○	○	○	
					81: EN terminal OFF [ENOFF]						○	○	○	○	
					82: Safety function in operation [SF-RUN]						○	○	○	○	
					83: -						-	-	-	-	
					84: STO diagnosis in progress [SF-TST]						○	○	○	○	
E16	110h	86h	Y2 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	2	○	○	58	○	○	○	○	
E17	111h	87h	Y3 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	3	○	○	58	○	○	○	○	
E18	112h	88h	Y4 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	4	○	○	58	○	○	○	○	
E19	113h	89h	Y5 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	14	○	○	58	○	○	○	○	
E20	114h	8Ah	Y11 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	26	○	○	58	○	○	○	○	
E21	115h	8Bh	Y12 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	26	○	○	58	○	○	○	○	
E22	116h	8Ch	Y13 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	26	○	○	58	○	○	○	○	
E23	117h	8Dh	Y14 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	26	○	○	58	○	○	○	○	
E24	118h	8Eh	Y15 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	26	○	○	58	○	○	○	○	
E25	119h	8Fh	Y16 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	26	○	○	58	○	○	○	○	
E26	11Ah	90h	Y17 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	26	○	○	58	○	○	○	○	
E27	11Bh	91h	Y18 Function selection	1	0 to 84 (Refer to Terminal [Y1] Function.)	×	26	○	○	58	○	○	○	○	
E28	11Ch	h	Y Function Normal open/close	0	0000 to 001F 0: Normal open 1: Normal close Specifies the normal condition of Y1 to Y5.	×	0000	○	○	36	○	○	○	○	
E29	11Dh	92h	PG Pulse output selection	0	0 to 10 0: No division 1: 1/2 2: 1/4 3: 1/8 4: 1/16 5: 1/32 6: 1/64 0 to 6: Internal PG input is divided and output. 7: Internal speed command: Pulse oscillation mode 8: PG (PD): Pulse detection input oscillation mode 9: PG (PR): Pulse command input oscillation mode 10: Internal PG/PG (SD): Speed detection pulse input oscillation mode 7 to 10: Input pulse is divided arbitrarily and output. (AB 90° phase difference signal)	×	0	○	○	92	○	×	×	○	
E30	11Eh	h	Motor overheat protection (Temperature)	8	50 to 200°C	○	150	○	○	0	○	○	○	○	
E31	11Fh	h	Motor overheat early warning (Temperature)	1	50 to 200°C	○	75	○	○	0	○	○	○	○	
E32	120h	CDh	M1-M3 PTC activation level	1	0.00 to 5.00 V The PTC is activated if the input voltage of the PTC terminal exceeds this activation level when the PTC thermistor is selected.	×	1.60	○	○	3	○	○	○	○	
E33	121h	h	Inverter overload early warning	1	25 to 100%	○	90	○	○	0	○	○	○	○	
E34	122h	h	Motor overload early warning	1	25 to 100%	○	90	○	○	0	○	○	○	○	

*1 Availble in the ROM version H1/2 02□□, which supports PROFINET-IRT.
*2 Available when the ROM version is H1/2 0020 or later.

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
E35	123h	h	DB Overload protection * E35 to E37 Invalid for use in stack type	1	0 to 100% Specifies %ED of the braking resistor relative to the inverter capacity. When E35 = 0, the overheat protection function (dbH) is disabled.	○	0	○	○	0	○	○	×	○	
E36	124h	h	DB Overload early warning	1	0 to 100%	○	80	○	○	0	○	○	×	○	
E37	125h	h	DB Thermal time constant	1	0 to 1000 s	○	300	○	○	0	○	○	×	○	
E38	126h	93h	Speed detection mode	8	000 to 111 Detection mode of 0 x E39/E40/E41 0: Speed detection 1: Speed setting Under V/f control, only the specified reference speed is valid.	○	000	○	○	9	○	○	×	○	
E39	127h	94h	Speed detection level 1	1	0 to 30000 r/min If N-FB1± (Detected speed 1) or N-REF4 (Speed setting 4) exceeds this speed detection level 1, the inverter issues the detection signal.	○	1500	○	○	0	○	○	○	○	
E40	128h	95h	Speed detection level 2	1	-30000 to 30000 r/min	○	1500	○	○	5	○	○	○	○	
E41	129h	96h	Speed detection level 3	1	-30000 to 30000 r/min	○	1500	○	○	5	○	○	○	○	
E42	12Ah	97h	Speed arrival (Detection width)	1	1.0 to 20.0% If the detected speed comes within the range of N-REF2 (Speed setting 2) ± detection width, the inverter issues the detection signal.	○	3.0	○	○	2	○	○	×	○	
E43	12Bh	98h	Speed agreement (Detection width)	1	1.0 to 20.0% If N-FB2± (Detected speed 2) is within the range of N-REF4 (Speed setting 4) ± detection width, the inverter issues the detection signal.	○	3.0	○	○	2	○	○	×	○	
E44	12Ch	99h	Speed agreement (Off-delay timer)	1	0.000 to 5.000 s	○	0.100	○	○	4	○	○	×	○	
E45	12Dh	9Ah	Speed disagreement Alarm use and disuse	1	00 to 21 Digit of 1: Speed disagreement alarm (Er-5) 0: Disuse 1: Use Digit of 10: Lin open phase detection (L in) 0: Standard level 1: For manufacturer use 2: Cancel	×	00	○	○	9	○	○	×	○	
E46	12Eh	9Bh	Torque detection level 1	3	0 to 300% Calculated value under V/f control. If the torque command value exceeds this setting value, the inverter issues the detection signal.	○	30	○	○	16	○	○	○	○	
E47	12Fh	9Ch	Torque detection level 2	1	0 to 300%	○	30	○	○	16	○	○	○	○	
E48	130h	9Dh	Magnetic flux detection level	1	10 to 100% Detection signal is output when the magnetic flux calculation value exceeds the specified value.	×	100	○	○	16	○	○	×	×	
E49	131h	h	Terminal [Ai1] Function	4	0 to 27	×	0	○	○	59					
					00: Input signal cut off [OFF] -						○	○	○	○	
					01: Speed auxiliary setting 1 [AUX-N1] ±10 V/± Nmax						○	○	○	○	
					02: Speed auxiliary setting 2 [AUX-N2] ±10 V/± Nmax						○	○	○	○	
					03: Torque limit (Level 1) [TL-REF1] ±10 V/±150%						○	○	○	○	
					04: Torque limit (Level 2) [TL-REF2] ±10 V/±150%						○	○	○	○	
					05: Torque bias [TB-REF] ±10 V/±150%						○	○	×	○	
					06: Torque command [T-REF] ±10 V/±150%						○	○	×	○	
					07: Torque current command [IT-REF] ±10 V/±150%						○	○	×	○	
					08: When UP/DOWN is set, creep speed 1 [CRP-N1] ±10 V/± Nmax						○	○	○	○	
					09: When UP/DOWN is set, creep speed 2 [CRP-N2] ±10 V/± Nmax						○	○	○	○	
					10: Magnetic-flux command [MF-REF] +10 V/+100%						○	×	×	×	
					11: Line speed detection [LINE-N] ±10 V/± Nmax						○	○	○	○	
					12: Motor temperature [M-TMP] +10 V/200°C						○	○	○	○	
					13: Speed override [N-OR] ±10 V/±50%						○	○	○	○	
					14: Universal Ai [U-AI] ±10 V/±4000 (h)						○	○	○	○	
					15: Amount of PID feedback 1 [PID-FB1] ±10 V/±20000 (d)						○	○	○	○	
					16: Amount of PID command [PID-REF] ±10 V/±20000 (d)						○	○	○	○	
					17: PID correction gain [PID-G] ±10 V/±4000 (h)						○	○	○	○	
					18 to 24: Custom Ai 1 to 7 [C-AI1 to C-AI7]						○	○	○	○	
					25: Speed main setting [N-REFV] ±10 V/± Nmax						○	○	○	○	
					26: Current input speed setting (4-20 mADC) [N-REFC] 4-20 mADC/Nmax (26: Current input speed setting can be used only on Ai2.)						○	○	○	○	
					27: Amount of PID feedback 2 [PID-FB2] ±10 V/±20000 (d)						○	○	○	○	
E50	132h	h	Terminal [Ai2] Function	1	0 to 27 (Refer to Terminal [Ai1] Function.)	×	0	○	○	59	○	○	○	○	
E51	133h	h	Terminal [Ai3] Function	1	0 to 27 (Refer to Terminal [Ai1] Function.) (26: Current input speed setting can be used only on Ai2.)	×	0	○	○	59	○	○	○	○	
E52	134h	h	Terminal [Ai4] Function	1	0 to 27 (Refer to Terminal [Ai1] Function.) (26: Current input speed setting can be used only on Ai2.)	×	0	○	○	59	○	○	○	○	
E53	135h	h	Ai1 Gain	4	-10.000 to 10.000 times	○	1.000	○	○	8	○	○	○	○	
E54	136h	h	Ai2 Gain	1	-10.000 to 10.000 times	○	1.000	○	○	8	○	○	○	○	
E55	137h	h	Ai3 Gain	1	-10.000 to 10.000 times (displayed when AIO option is installed)	○	1.000	○	○	8	○	○	○	○	
E56	138h	h	Ai4 Gain	1	-10.000 to 10.000 times (displayed when AIO option is installed)	○	1.000	○	○	8	○	○	○	○	
E57	139h	h	Ai1 Bias	4	-100.0 to 100.0%	○	0.0	○	○	6	○	○	○	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
E58	13Ah	h	Ai2 Bias	1	-100.0 to 100.0%	○	0.0	○	○	6	○	○	○	○	
E59	13Bh	h	Ai3 Bias	1	-100.0 to 100.0% (displayed when AIO option is installed)	○	0.0	○	○	6	○	○	○	○	
E60	13Ch	h	Ai4 Bias	1	-100.0 to 100.0% (displayed when AIO option is installed)	○	0.0	○	○	6	○	○	○	○	
E61	13Dh	h	Ai1 Filter	4	0.000 to 0.500 s	○	0.010	○	○	4	○	○	○	○	
E62	13Eh	h	Ai2 Filter	1	0.000 to 0.500 s	○	0.010	○	○	4	○	○	○	○	
E63	13Fh	h	Ai3 Filter	1	0.000 to 0.500 s	○	0.010	○	○	4	○	○	○	○	
E64	140h	h	Ai4 Filter	1	0.000 to 0.500 s	○	0.010	○	○	4	○	○	○	○	
E65	141h	h	Up/Down limiter (Ai1)	4	0.00 to 60.00 s Specifies the duration required when the inverter internal data changes from 0 V to 10 V if the voltage on analog input terminal changes from 0 V to 10 V.	○	0.00	○	○	3	○	○	○	○	
E66	142h	h	Up/Down limiter (Ai2)	1	0.00 to 60.00 s	○	0.00	○	○	3	○	○	○	○	
E67	143h	h	Up/Down limiter (Ai3)	1	0.00 to 60.00 s	○	0.00	○	○	3	○	○	○	○	
E68	144h	h	Up/Down limiter (Ai4)	1	0.00 to 60.00 s	○	0.00	○	○	3	○	○	○	○	
E69	145h	h	AO1 Function selection	5	0 to 40	○	1	○	○	60					
					00: Speed detection 1 (Speed meter, one way swing) [N-FB1+] ± Nmax/10 V						○	○	×	○	
					01: Speed detection 1 (Speed meter, two way swing) [N-FB1±] ± Nmax/±10 V						○	○	×	○	
					02: Speed setting 2 (before calculation of acceleration/deceleration) [N-REF2] ± Nmax/±10 V						○	○	○	○	
					03: Speed setting 4 (ASR input) [N-REF4] ± Nmax/±10 V						○	○	○	○	
					04: Speed detection 2 (ASR input) [N-FB2±] ± Nmax/±10 V						○	○	×	○	
					05: Line speed detection [LINE-N±] ± Nmax/±10 V						○	○	○	○	
					06: Torque current command (Torque ampere meter, two way swing) [IT-REF±] ±150%/±10 V						○	○	×	○	
					07: Torque current command (Torque ampere meter, one side swing) [IT-REF+] ±150%/10 V						○	○	×	○	
					08: Torque command (Torque meter, two way swing) [T-REF±] ±150%/±10 V						○	○	×	○	
					09: Torque command (Torque meter, one way swing) [T-REF+] ±150%/10 V						○	○	×	○	
					10: Motor current [I-AC] 200%/10 V						○	○	○	○	
					11: Motor voltage [V-AC] 200%/10 V						○	○	○	○	
					12: Power consumption (Motor output) [PWR] 200%/10 V						○	○	○	○	
					13: DC link bus voltage [V-DC] 800 V/10 V						○	○	○	○	
					14: +10 V output test [P10] Output equivalent to +10 V						○	○	○	○	
					15: -10 V output test [N10] Output equivalent to -10 V						○	○	○	○	
					16: Motor temperature [TMP-M] ±200°C/±10 V						○	○	○	○	
					30: Universal AO [U-AO] -						○	○	○	○	
					31-37: Custom Ao1-Ao7 [C-AO1 to C-AO7]						○	○	○	○	
					38: Input power [PWR-IN] 200%/10 V						○	○	○	○	
					39: Magnetic pole position signal [SMP] TOP/5 V						×	×	×	○	
					40: PID output value [PID-OUT] ±200%/±10 V						○	○	○	○	
E70	146h	h	AO2 Function selection	1	0 to 40 (Refer to Terminal [Ao1] function.)	○	6	○	○	60	○	○	○	○	
E71	147h	h	AO3 Function selection	1	0 to 40 (Refer to Terminal [Ao1] function.)	○	3	○	○	60	○	○	○	○	
E72	148h	h	AO4 Function selection	1	0 to 40 (Refer to Terminal [Ao1] function.)	○	0	○	○	60	○	○	○	○	
E73	149h	h	AO5 Function selection	1	0 to 40 (Refer to Terminal [Ao1] function.)	○	0	○	○	60	○	○	○	○	
E74	14Ah	h	AO1 Gain	5	-100.00 to 100.00 times	○	1.00	○	○	7	○	○	○	○	
E75	14Bh	h	AO2 Gain	1	-100.00 to 100.00 times	○	1.00	○	○	7	○	○	○	○	
E76	14Ch	h	AO3 Gain	1	-100.00 to 100.00 times	○	1.00	○	○	7	○	○	○	○	
E77	14Dh	h	AO4 Gain	1	-100.00 to 100.00 times (displayed when AIO option is installed)	○	1.00	○	○	7	○	○	○	○	
E78	14Eh	h	AO5 Gain	1	-100.00 to 100.00 times (displayed when AIO option is installed)	○	1.00	○	○	7	○	○	○	○	
E79	14Fh	h	AO1 Bias	5	-100.0 to 100.0%	○	0.0	○	○	6	○	○	○	○	
E80	150h	h	AO2 Bias	1	-100.0 to 100.0%	○	0.0	○	○	6	○	○	○	○	
E81	151h	h	AO3 Bias	1	-100.0 to 100.0%	○	0.0	○	○	6	○	○	○	○	
E82	152h	h	AO4 Bias	1	-100.0 to 100.0% (displayed when AIO option is installed)	○	0.0	○	○	6	○	○	○	○	
E83	153h	h	AO5 Bias	1	-100.0 to 100.0% (displayed when AIO option is installed)	○	0.0	○	○	6	○	○	○	○	
E84	154h	h	AO1-5 Filter	0	0.000 to 0.500 s	○	0.010	○	○	4	○	○	○	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
E90	15Ah	h	Link command function selection 1 (To be supported soon)	2	00 to 13	○	0	○	○	231					
					00: Input signal cut off [OFF]						○	○	○	○	
					01: Speed auxiliary setting 1 [AUX-N1]						○	○	○	○	
					02: Speed auxiliary setting 2 [AUX-N2]						○	○	○	○	
					03: Torque bias [TB-REF]						○	○	×	○	
					04: When UP/DOWN is set, creep speed 1 [CRP-N1]						○	○	○	○	
					05: When UP/DOWN is set, creep speed 2 [CRP-N2]						○	○	○	○	
					06: Line speed detection [LINE-N]						○	○	○	○	
					07: Motor temperature [M-TMP]						○	○	○	○	
					08: Speed override [N-OR]						○	○	○	○	
					09: Amount of PID feedback 1 [PID-FB1]						○	○	○	○	
					10: Amount of PID commands [PID-REF]						○	○	○	○	
					11: PID correction gain [PID-G]						○	○	○	○	
					12: Amount of PID feedback 2 [PID-FB2]						○	○	○	○	
					13: Observer torque FB [OBS-TFB]						○	○	×	○	
E91	15Bh	h	Link command function selection 2 (To be supported soon)	1	00 to 12 When E91 is except 0 [OFF], analog setting via the communications link (S17) has priority over Ai input specified by Ai function selection. (Refer to the Link command function selection 1.)	○	0	○	○	231	○	○	○	○	
E101	1E01h	h	Ai1 Offset	4	-100.00 to 100.00%	○	0.00	○	○	7	○	○	○	○	
E102	1E02h	h	Ai2 Offset	1	-100.00 to 100.00%	○	0.00	○	○	7	○	○	○	○	
E103	1E03h	h	Ai3 Offset	1	-100.00 to 100.00% (displayed when AIO option is installed)	○	0.00	○	○	7	○	○	○	○	
E104	1E04h	h	Ai4 Offset	1	-100.00 to 100.00% (displayed when AIO option is installed)	○	0.00	○	○	7	○	○	○	○	
E105	1E05h	h	Ai1 Dead zone	4	0.00 to 10.00% Limits all command values below input values to 0 V.	○	0.00	○	○	3	○	○	○	○	
E106	1E06h	h	Ai2 Dead zone	1	0.00 to 10.00%	○	0.00	○	○	3	○	○	○	○	
E107	1E07h	h	Ai3 Dead one	1	0.00 to 10.00% (displayed when AIO option is installed)	○	0.00	○	○	3	○	○	○	○	
E108	1E08h	h	Ai4 Dead zone	1	0.00 to 10.00% (displayed when AIO option is installed)	○	0.00	○	○	3	○	○	○	○	
E109	1E09h	h	Dividing ratio for FA, FB pulse output (Numerator)	2	1 to 65535 Specifies numerator of the dividing ratio for FA, FB, and pulse output.	×	1000	○	○	0	○	×	×	○	
E110	1E0Ah	h	Dividing ratio for FA, FB pulse output (Denominator)	1	1 to 65535 Specifies the denominator of the dividing ratio for FA and FB pulse output.	×	1000	○	○	0	○	×	×	○	
E114	1E0Eh	h	Speed agreement 2 (Detection width)	4	1.0 to 20.0% If N-FB2± (Detected speed 2) is within the range of N-REF4 (Speed setting 4) ± detection width, the inverter issues the speed agreement signal N-AG2.	○	3.0	○	○	2	○	○	×	○	
E115	1E0Fh	h	Speed agreement 2 (Off delay timer)	1	0.000 to 5.000 s Specifies the off-delay timer of the speed agreement signal N-AG2.	○	0.100	○	○	4	○	○	×	○	
E116	1E10h	h	Speed agreement 3 (Detection width)	1	1.0 to 20.0% If N-FB2± (Detected speed 2) is within the range of N-REF4 (Speed setting 4) ± detection width, the inverter issues the speed agreement signal N-AG3.	○	3.0	○	○	2	○	○	×	○	
E117	1E11h	h	Speed agreement 3 (Off delay timer)	1	0.000 to 5.000 s Specifies the off-delay timer of the speed agreement signal N-AG3.	○	0.100	○	○	4	○	○	×	○	
E118	1E12h	h	Temperature for axial fan stop signal	0	0 to 200°C If the NTC detection temperature of the motor having an NTC thermistor drops below this setting value, the inverter turns ON the axial fan (Motor cooling fan) stop signal MFAN.	○	0	○	○	0	○	○	○	○	

5.3.3 C codes (Control Functions)

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
C01	201h	h	Jump speed 1	4	0 to 30000 r/min Enables the inverter to jump over a point on the reference speed in order to skip a resonance point of the driven machinery (load) and the motor speed. Up to three different jump points can be specified.	○	0	○	○	0	○	○	○	○	
C02	202h	h	Jump speed 2	1	0 to 30000 r/min	○	0	○	○	0	○	○	○	○	
C03	203h	h	Jump speed 3	1	0 to 30000 r/min	○	0	○	○	0	○	○	○	○	
C04	204h	h	Jump width	1	0 to 1000 r/min	○	0	○	○	0	○	○	○	○	
C05	205h	9Eh	Multistep speed 1	17	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21) Multistep speeds 1 to 15 can be switched by turning terminal commands SS1, SS2, SS4 and SS8 ON/OFF.	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C06	206h	9Fh	Multistep speed 2	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C07	207h	A0h	Multistep speed 3	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C08	208h	A1h	Multistep speed 4	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C09	209h	A2h	Multistep speed 5	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C10	20Ah	A3h	Multistep speed 6	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C11	20Bh	A4h	Multistep speed 7	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C12	20Ch	h	Multistep speed 8	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C13	20Dh	h	Multistep speed 9	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C14	20Eh	h	Multistep speed 10	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C15	20Fh	h	Multistep speed 11	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C16	210h	h	Multistep speed 12	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C17	211h	h	Multistep speed 13	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C18	212h	h	Multistep speed 14/Creeping speed 1	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21) C18 and C19 apply also to the creep speed under UP/DOWN control.	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C19	213h	h	Multistep speed 15/Creeping speed 2	1	0 to 30000 r/min / 0.00 to 100.00% / 0.0 to 999.9 m/min (switch with C21)	○	0/0.00/ 0.0	○	○	0	○	○	○	○	
C20	214h	h	Multistep speed agreement timer	1	0.000 to 0.100 s When SS1, SS2, SS4 and SS8 are kept at the same status for the duration specified by this function code, the inverter switches the speed setting value.	○	0.000	○	○	4	○	○	○	○	
C21	215h	h	Multistep speed setting definition	1	0 to 2 0: 0 to 30000 r/min 1: 0.00 to 100.00% 2: 0.0 to 999.9 m/min Defines the unit of multistep speed specified by C05 to C19. When C21 = 1, the percentage of the maximum speed (F03/A06/A106) of the selected motor applies.	×	0	○	○	93	○	○	○	○	
C25	219h	h	Speed setting N2	0	0 to 9 0: Keypad (◇/◇ keys) 1: Analog 12 input (0 to ±10 V) 2: Analog 12 input (0 to +10 V) 3: UP/DOWN (initial value 0) 4: UP/DOWN (initial value: previous value) 5: UP/DOWN (initial value: creep velocity 1, 2) 6: DIA card input 7: DIB card input 8: Ai (N-REFV) input 9: Ai2 (N-REFC) input The speed command specified by this function code takes effect when X terminal function N2/N1 is turned ON.	×	0	○	○	41	○	○	○	○	
C29	21Dh	h	Jogging speed	0	0 to 30000 r/min Specifies the speed to be applied when the motor jogs.	○	50	○	○	0	○	○	○	○	
C30	21Eh	h	ASR-P (Gain) JOG	9	0.1 to 500.0 times	○	10.0	○	○	2	○	○	×	○	
C31	21Fh	h	ASR-I (Integral constant) JOG	1	0.000 to 10.000 s P control when set to 0.000	○	0.200	○	○	4	○	○	×	○	
C32	220h	h	ASR-JOG (Input filter)	1	0.000 to 5.000 s	○	0.040	○	○	4	○	○	○	○	
C33	221h	h	ASR-JOG (Detection filter)	1	0.000 to 0.100 s	○	0.005	○	○	4	○	○	×	○	
C34	222h	h	ASR-JOG (Output filter)	1	0.000 to 0.100 s	×	0.002	○	○	4	○	○	×	○	
C35	223h	h	Acceleration time JOG	1	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
C36	224h	h	Deceleration time JOG	1	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
C37	225h	h	S-curve JOG (Start side)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
C38	226h	h	S-curve JOG (End side)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
C40	228h	h	ASR2-P (Gain)	10	0.1 to 500.0 times	○	10.0	○	○	2	○	○	×	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
C41	229h	h	ASR2-I (Integral constant)	1	0.000 to 10.000 s P control when set to 0.000	○	0.200	○	○	4	○	○	×	○	
C42	22Ah	h	ASR2-FF (Gain)	1	0.000 to 9.999 s	○	0.000	○	○	4	○	○	×	○	
C43	22Bh	h	ASR2 Input filter	1	0.000 to 5.000 s	○	0.040	○	○	4	○	○	○	○	
C44	22Ch	h	ASR2 Detection filter	1	0.000 to 0.100 s	○	0.005	○	○	4	○	○	×	○	
C45	22Dh	h	ASR2 Output filter	1	0.000 to 0.100 s	×	0.002	○	○	4	○	○	×	○	
C46	22Eh	h	Acceleration time 2	1	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
C47	22Fh	h	Deceleration time 2	1	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
C48	230h	h	S-curve 2 (Start side)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
C49	231h	h	S-curve 2 (End side)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
C50	232h	h	ASR3-P (Gain)	10	0.1 to 500.0 times	○	10.0	○	○	2	○	○	×	○	
C51	233h	h	ASR3-I (Integral constant)	1	0.000 to 10.000 s P control when set to 0.000	○	0.200	○	○	4	○	○	×	○	
C52	234h	h	ASR3-FF (Gain)	1	0.000 to 9.999 s	○	0.000	○	○	4	○	○	×	○	
C53	235h	h	ASR3 Input filter	1	0.000 to 5.000 s	○	0.040	○	○	4	○	○	○	○	
C54	236h	h	ASR3 Detection filter	1	0.000 to 0.100 s	○	0.005	○	○	4	○	○	×	○	
C55	237h	h	ASR3 Output filter	1	0.000 to 0.100 s	×	0.002	○	○	4	○	○	×	○	
C56	238h	h	Acceleration time 3	1	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
C57	239h	h	Deceleration time 3	1	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
C58	23Ah	h	S-curve 3 (Start side)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
C59	23Bh	h	S-curve 3 (End side)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
C60	23Ch	h	ASR4-P (Gain)	10	0.1 to 500.0 times	○	10.0	○	○	2	○	○	×	○	
C61	23Dh	h	ASR4-I (Integral constant)	1	0.000 to 10.000 s P control when set to 0.000	○	0.200	○	○	4	○	○	×	○	
C62	23Eh	h	ASR4-FF (Gain)	1	0.000 to 9.999 s	○	0.000	○	○	4	○	○	×	○	
C63	23Fh	h	ASR4 Input filter	1	0.000 to 5.000 s	○	0.040	○	○	4	○	○	○	○	
C64	240h	h	ASR4 Detection filter	1	0.000 to 0.100 s	○	0.005	○	○	4	○	○	×	○	
C65	241h	h	ASR4 Output filter	1	0.000 to 0.100 s	×	0.002	○	○	4	○	○	×	○	
C66	242h	h	Acceleration time 4	1	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
C67	243h	h	Deceleration time 4	1	0.01 to 99.99 s 100.0 to 999.9 s 1000 to 3600 s	○	5.00	○	○	13	○	○	○	○	
C68	244h	h	S-curve 4 (Start side)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
C69	245h	h	S-curve 4 (End side)	1	0 to 50%	○	0	○	○	0	○	○	○	○	
C70	246h	h	ASR Switching time	0	0.00 to 2.55 s	○	1.00	○	○	3	○	○	×	○	
C71	247h	A5h	Acceleration/deceleration time switching speed	0	0.00 to 100.00%	○	0.00	○	○	3	○	○	○	○	
C72	248h	A6h	ASR Switching speed	0	0.00 to 100.00%	○	0.00	○	○	3	○	○	×	○	
C73	249h	h	Creep speed switching (under UP/DOWN control)	0	00 to 11 (Creep speed 1) (Creep speed 2) 0: Code (C18, C19) 1: Ai (CRP1, CRP2)	×	00	○	○	9	○	○	○	○	

5.3.4 P codes (Motor Parameter Functions M1)

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
P01	301h	h	M1 Drive control	0	0 to 5 0: Vector control (Induction motor) 1: Sensor-less vector control (Induction motor) 2: Simulated operation mode 3: Vector control (PMSM) 4: - 5: V/f control (Induction motor)	×	0	○	×	55	○	○	○	○	
P02	302h	h	M1 Motor selection	26	0 to 50 Display (kW, HP) changes by setting F60 = 0, 1. 00 to 35: FRENIC-VG dedicated motor setup Data at F04, F05, and P03 to P27 are automatically set. Data at F04, F05, and P03 to P27 are automatically set and write-protected. 36: P-OTHER (keypad display is P-OTR) Data at F04, F05, and P03 to P27 are write-protected and cannot be overwritten. Data at F04, F05, and P03 to P27 are automatically set and write-protected. 37: OTHER Data at F04, F05, and P03 to P27 are write-protected and cannot be overwritten. Write protection of F04, F05, and P03 to P27 is not performed. 38 to 50: FRENIC-VG dedicated setup (type 8) Data at F04, F05, and P03 to P27 are automatically set. Data at F04, F05, and P03 to P27 are automatically set and write-protected. For the relationship between the setting data and the motor type, refer to "List of applicable motors" in Section 4.3.3.2, [82] codes.	×	Depends on capacity	○	×	82	○	○	○	○	
P03	303h	A7h	M1 Rated capacity	1	For inverters of 400 kW or less 0.00 to 500.00 kW when F60 = 0 0.00 to 600.00 HP when F60 = 1 For inverters of 500 kW or more 0.00 to 1200 kW when F60 = 0 0.00 to 1600 HP when F60 = 1 For multiwinding motors, set the motor capacity per wiring.	×	Depends on capacity	○	×	3 13	○	○	○	○	
P04	304h	A8h	M1 Rated current	1	0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A	×	Depends on capacity	○	×	13	○	○	○	○	
P05	305h	A9h	M1 Number of poles	1	2 to 100 poles	×	4	○	×	1	○	○	○	○	
P06	306h	AAh	M1 %R1	1	0.00 to 30.00%	○	Depends on capacity	○	×	3	○	○	○	○	
P07	307h	ABh	M1 %X	1	0.00 to 200.00%	○	Depends on capacity	○	×	3	○	○	○	○	
P08	308h	ACh	M1 Exciting current/Magnetic flux weakening current (-Id)	1	0.01 to 99.99 A 100.0 to 999.9 A 1000 to 2000 A	○	Depends on capacity	○	×	13	○	○	○	○	
P09	309h	ADh	M1 Torque current	1	0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A	○	Depends on capacity	○	×	13	○	○	×	○	
P10	30Ah	AEh	M1 Slip frequency (For driving)	1	0.001 to 10.000 Hz	○	Depends on capacity	○	×	4	○	○	×	×	
P11	30Bh	AFh	M1 Slip frequency (For braking)	1	0.001 to 10.000 Hz	○	Depends on capacity	○	×	4	○	○	×	×	
P12	30Ch	B0h	M1 Iron loss factor 1	1	0.00 to 10.00%	○	Depends on capacity	○	×	3	○	○	×	○	
P13	30Dh	B1h	M1 Iron loss factor 2	1	0.00 to 10.00%	○	Depends on capacity	○	×	3	○	○	×	○	
P14	30Eh	B2h	M1 Iron loss factor 3	1	0.00 to 10.00%	○	Depends on capacity	○	×	3	○	○	×	○	
P15	30Fh	B3h	M1 Magnetic saturation factor 1	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 93.75%.	○	Depends on capacity	○	×	2	○	○	×	×	
P16	310h	B4h	M1 Magnetic saturation factor 2	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 87.5%.	○	Depends on capacity	○	×	2	○	○	×	×	
P17	311h	B5h	M1 Magnetic saturation factor 3	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 75%.	○	Depends on capacity	○	×	2	○	○	×	×	
P18	312h	B6h	M1 Magnetic saturation factor 4	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 62.5%.	○	Depends on capacity	○	×	2	○	○	×	×	
P19	313h	B7h	M1 Magnetic saturation factor 5	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 50%.	○	Depends on capacity	○	×	2	○	○	×	×	
P20	314h	B8h	M1 Secondary time constant	1	0.001 to 9.999 s	○	Depends on capacity	○	×	4	○	○	×	×	
P21	315h	B9h	M1 Induced voltage factor	1	0 to 999 V	○	Depends on capacity	○	×	0	○	○	×	○	
P22	316h	BAh	M1 R2 Correction factor 1	1	0.500 to 5.000	○	Depends on capacity	○	×	4	○	○	×	○	
P23	317h	BBh	M1 R2 Correction factor 2	1	0.500 to 5.000	○	Depends on capacity	○	×	4	○	○	×	×	
P24	318h	BCh	M1 R2 Correction factor 3	1	0.010 to 5.000	○	Depends on capacity	○	×	4	○	○	×	×	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
P25	319h	BDh	M1 Exciting current correction factor	1	0.000 to 5.000	○	Depends on capacity	○	×	4	○	○	×	×	
P26	31Ah	BEh	M1 ACR-P (Gain)	1	0.1 to 20.0	○	1.0	○	×	2	○	○	×	○	
P27	31Bh	BFh	M1 ACR-I (I-time)	1	0.1 to 100.0 ms	○	1.0	○	×	2	○	○	×	○	
P28	31Ch	C0h	M1 PG Pulse resolution	0	100 to 60000 * Set P28 to 32768 when using the option card OPC-VG1-SPGT.	×	1024	○	×	0	○	×	×	○	
P29	31Dh	D6h	M1 External PG correction factor	0	0000 to 4FFF	×	4000	○	×	9	○	×	×	○	
P30	31Eh	C1h	M1 Thermistor selection	0	0 to 3 0: No thermistor 1: NTC thermistor selected 2: PTC thermistor selected 3: Ai [M-TMP] The protection level of the motor protective functions should be specified by E30 to E32.	×	1	○	×	84	○	○	○	○	
P32	320h	h	M1 Online Auto tuning	0	0 to 1 0: Disable 1: Enable Selects the compensation function for the resistance change caused by the temperature rise of the motor running.	○	0	○	×	0	○	○	×	×	
P33	321h	h	M1 Maximum output voltage/Maximum voltage limit value	0	80 to 999 V	×	220/ 440	○	×	0	×	×	○	○	
P34	322h	h	M1 Slip compensation	3	-20.000 to 5.000 Hz	○	0.000	○	×	8	×	×	○	×	
P35	323h	h	M1 Torque boost	1	0.0 to 20.0 Function specific to V/f control. The following selections are possible. 0.0: Automatic torque boost (for fixed torque characteristic load) 0.1 to 0.9: For squared torque characteristic load 1.0 to 1.9: For proportional torque characteristic load 2.0 to 20.0: For fixed torque characteristic load	○	0.0	○	×	2	×	×	○	×	
P36	324h	h	M1 Current fluctuation damping gain	1	0.00 to 1.00	○	0.20	○	×	3	×	×	○	×	
P42	32Ah	h	M1 q axis inductance magnetic saturation coefficient	10	0.0 to 100.0%	○	100.0	○	×	2	×	×	×	○	
P43	32Bh	h	M1 Magnetic flux limiting value	1	50.0 to 150.0%	○	Depends on capacity	○	×	2	×	×	×	○	
P44	32Ch	h	M1 Overcurrent protection level	1	0.00: No operation 0.01 to 99.99A 100.0 to 999.9A 1000 to 2000A Specifies the allowable current value to prevent the permanent magnet of a PMSM from getting demagnetized. If the current exceeding this setting value flows, an overcurrent alarm (OC) occurs.	×	0.00	○	×	13	×	×	×	○	
P45	32Dh	h	M1 Torque correction gain 1	1	0.00 to 10.00	○	Depends on capacity	○	×	3	×	×	×	○	
P46	32Eh	h	M1 Torque correction gain 2	1	0.00 to 10.00	○	Depends on capacity	○	×	3	×	×	×	○	
P47	32Fh	h	M1 Torque correction gain 3	1	-1.000 to 1.000	○	Depends on capacity	○	×	8	×	×	×	○	
P48	330h	h	M1 Torque correction gain 4	1	-1.000 to 1.000	○	Depends on capacity	○	×	8	×	×	×	○	
P49	331h	h	M1 Torque correction gain 5	1	-50.00 to 50.00	○	Depends on capacity	○	×	7	×	×	×	○	
P50	332h	h	M1 Torque correction gain 6	1	-50.00 to 50.00	○	Depends on capacity	○	×	7	×	×	×	○	
P51	333h	h	M1 Torque correction gain 7	1	-1.000 to 1.000	○	Depends on capacity	○	×	8	×	×	×	○	

5.3.5 H codes (High Performance Functions)

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
H01	401h	h	Tuning operation selection	0	0 to 4 0: No operation	×	0	×	×	61	○	○	○	○	
					1: ASR auto tuning (To be supported soon)						○	○	×	○	
					2: Motor constant auto tuning: R1, Lσ						○	○	○	×	
					3: Motor stop auto tuning						○	○	○	×	
					4: Motor rotation auto tuning After writing the data, this function's data code automatically returns to 0. To save the tuned data, perform the Full save function (H02).						○	○	○	×	
H02	402h	Eh	Full save function	0	0 to 1 When auto tuning is executed at H01, or when the data is written by way of the link system (T-Link, field bus, and RS-485, etc.), the data goes out when the power supply of the inverter is turned off. This function must operate when preservation is necessary. After writing the data, this function's data code automatically returns to 0.	○	0	×	×	11	○	○	○	○	
H03	403h	h	Data initialization	0	0 to 1 Setting H03 to "1" reverts the function code data modified by the customer to the factory defaults. Initialization targets include all fields of F, E, C, H, o, L and U codes except motor parameter fields (P, A) and F04, F05, F10 to F12, and F58. Upon completion of the initialization, the H03 data automatically reverts to "0."	×	0	×	×	11	○	○	○	○	
H04	404h	h	Auto-reset (Times)	0	0 to 10 0: No operation 1 to 10 times The auto-resetting signal can be output to the output terminal.	×	0	○	○	0	○	○	○	○	
H05	405h	h	Auto-reset (Reset interval)	0	0.01 to 20.00 s	×	5.00	○	○	3	○	○	○	○	
H06	406h	h	Cooling fan ON/OFF control	0	0 to 1 0: No operation 1: Operation It is possible to output the FAN (cooling fan in operation) signal in conjunction with this function. This control detects the temperature of the heat sink in the inverter unit and turns the cooling fan ON/OFF automatically.	×	0	○	○	68	○	○	○	○	
H08	408h	h	Rev. phase sequence lock	0	0 to 1 0: Disable 1: Enable	○	0	○	○	68	○	○	×	○	
H09	409h	C2h	Starting mode (Auto search)	0	0 to 2 0: No operation 1: Operation (only when restarting from momentary power failure) 2: Operation Auto search detects the idling motor speed at starting and drives the motor at the same speed.	○	2	○	○	0	×	○	○	×	
H10	40Ah	C3h	Energy-saving operation	0	0 to 1 0: Disable 1: Enable	×	0	○	○	68	○	×	×	×	
H11	40Bh	h	Automatic operation OFF function	0	0 to 4 0: Decelerate to stop when OFF between FWD-CM and REV-CM 1: Operation OFF when below stop speed in F37 even if ON between FWD-CM and REV-CM 2: Coast to a stop when OFF between FWD-CM and REV-CM 3: ASR deceleration to stop when OFF between FWD-CM and REV-CM (under torque control) 4: Coast to a stop when OFF between FWD-CM and REV-CM (under torque control)	○	0	○	○	0	○	○	○	○	
H13	40Dh	C4h	Restart mode after momentary power failure setting (Wait time)	5	0.1 to 5.0 s	×	0.5	○	○	2	○	○	○	○	
H14	40Eh	h	Momentary power failure restart setting (Speed reduction rate)	1	1 to 3600 r/min/s	○	500	○	○	0	×	×	○	×	
H15	40Fh	h	Momentary power failure restart setting (Operation continuation level)	1	3-phase 200 V: 200 to 300 V 3-phase 400 V: 400 to 600 V This setting applies when F14 (Operation selection) = 2 (Trip after recovery from power failure) or F14 = 3 (Continue to run).	○	235/ 470	○	○	0	○	○	○	○	
H16	410h	h	Momentary power failure restart setting (Self-holding specification of operation command)	1	0 to 1 0: Specified in H17 1: Max. time (operating commands are retained by the inverter while the control power supply is established inside the inverter, or while the DC intermediate circuit voltage is approximately zero)	×	1	○	○	94	○	○	○	○	
H17	411h	h	Momentary power failure restart setting (Self-holding time in operation command)	1	0.0 to 30.0 s	×	30.0	○	○	2	○	○	○	○	
H19	413h	C5h	Active drive	0	0 to 1 0: Disable 1: Enable Under vector control, this function automatically limits the output torque to avoid an overload trip, etc.	×	0	○	○	68	○	○	○	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
H20	414h	C6h	PID Control (Operation selection)	8	0 to 3 0: No operation 1: Operation 2: Reverse operation 1 3: Reverse operation 2	×	0	○	○	69	○	○	○	○	
H21	415h	C7h	PID Control (Command selection)	1	0 to 1 0: Keypad or 12 input 1: Analog input [PID-REF]	○	0	○	○	70	○	○	○	○	
H22	416h	C9h	PID Control (P-action)	1	0.000 to 10.000 times	○	1.000	○	○	4	○	○	○	○	
H23	417h	CAh	PID Control (I-action)	1	0.00 to 100.00 s	○	1.00	○	○	3	○	○	○	○	
H24	418h	CBh	PID Control (D-action)	1	0.000 to 10.000 s	○	0.000	○	○	4	○	○	○	○	
H25	419h	C8h	PID Control (Upper limit value)	1	-300 to 300%	×	100	○	○	5	○	○	○	○	
H26	41Ah	CCh	PID Control (Lower limit value)	1	-300 to 300%	×	-100	○	○	5	○	○	○	○	
H27	41Bh	CEh	PID Control (Speed command selection)	1	0 to 2 0: Disable 1: PID selection 2: Speed adjustment selection	×	0	○	○	95	○	○	○	○	
H28	41Ch	CFh	Droop control	0	0.0 to 25.0%	○	0.0	○	○	2	○	○	×	○	
H29	41Dh	h	Link function (Code protection)	2	0 to 1 0: Writing code from link allowed 1: Write-protects code from link Setting H29 to "1" protects function code data from getting changed mistakenly via the link (T-Link, RS-485, etc.). Via the link, data can be written to the "normal code fields" (given above) or "command data fields" (S fields). The S fields are defined by H30.	○	0	○	○	40	○	○	○	○	
H30	41Eh	D0h	Link function (Linked operation)	1	0 to 3 Monitor / Command data / Operation (FWD, REV) 0: ○ / × / × 1: ○ / ○ / × 2: ○ / × / ○ 3: ○ / ○ / ○	○	0	○	○	72	○	○	○	○	
H31	41Fh	h	RS-485 Setup (Station address)	10	0 to 255 Broadcast: 0: RTU), (99: Fuji) address: 1 to 255 Specifies the station address of RS-485.	×	1	○	×	0	○	○	○	○	
H32	420h	h	RS-485 Setup (Selection of operation when error occurs)	1	0 to 3 0: Forced stop (Er5) 1: Stop after continuing operation for timer operating time (H33) (Er5) 2: Stop if transmission failure continues longer than timer operating time (H33) (Er5) 3: Continue operation	○	3	○	○	73	○	○	○	○	
H33	421h	h	RS-485 Setup (Timer operating time)	1	0.01 to 20.00 s	○	2.00	○	○	3	○	○	○	○	
H34	422h	h	RS-485 Setup (Transmission speed)	1	0 to 4 0: 38400bps 1: 19200bps 2: 9600bps 3: 4800bps 4: 2400bps	○	0	○	×	74	○	○	○	○	
H35	423h	h	RS-485 Setup (Data length)	1	0 to 1 0: 8bit 1: 7bit	○	0	○	×	75	○	○	○	○	
H36	424h	h	RS-485 Setup (Selection of parity bit)	1	0 to 2 0: None 1: Even parity 2: Odd parity	○	1	○	×	76	○	○	○	○	
H37	425h	h	RS-485 Setup (Selection of stop bit)	1	0 to 1 0: 2bit 1: 1bit	○	1	○	×	77	○	○	○	○	
H38	426h	h	RS-485 Setup (Communication interrupt time)	1	0.0 to 60.0 s 0.0: Interrupt detection disable 0.1 to 60.0: Interrupt detection enable	○	60.0	○	○	2	○	○	○	○	
H39	427h	h	RS-485 Setup (Response interval time)	1	0.00 to 1.00 s	○	0.01	○	○	3	○	○	○	○	
H40	428h	h	RS-485 Setup (Protocol selection)	1	0 to 2 0: Fuji general purpose inverter protocol 1: SX protocol (Loader protocol) 2: Modbus RTU protocol When using FRENIC-VG loader, specify “1: SX protocol”.	×	1	○	×	78	○	○	○	○	
H41	429h	D1h	Torque command selection	4	0 to 5 0: Internal ASR enable 1: Ai (T-REF) enable 2: DIA card enable 3: DIB card enable 4: Link enable 5: PID enable	×	0	○	○	64	○	○	×	○	
H42	42Ah	D2h	Torque current command selection	1	0 to 4 0: Internal ASR enable 1: Ai (IT-REF) enable 2: DIA card enable 3: DIB card enable 4: Link enable	×	0	○	○	65	○	○	×	○	
H43	42Bh	D3h	Magnetic flux command selection	1	0 to 3 0: Internal calculation enable 1: Ai (MF-REF) enable 2: Function code H44 enable 3: Link enable	×	0	○	○	66	○	×	×	×	
H44	42Ch	D4h	Magnetic-flux command value	1	10 to 100%	×	100	○	○	16	○	×	×	×	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
H46	42Eh	D7h	Observer (Mode selection)	7	0 to 2 0: Observer not operational 1: Load disturbance observer 2: Oscillation suppression observer	×	0	○	○	79	○	○	×	○	
H47	42Fh	D8h	Observer (M1 Compensation gain)	1	0.00 to 1.00 times	○	0.00	○	○	3	○	○	×	○	
H48	430h	h	Observer (M2 Compensation gain)	1	0.00 to 1.00 times	○	0.00	○	○	3	○	○	×	○	
H49	431h	D9h	Observer (M1 I-time)	1	0.005 to 1.000 s	○	0.100	○	○	4	○	○	×	○	
H50	432h	h	Observer (M2 I-time)	1	0.005 to 1.000 s	○	0.100	○	○	4	○	○	×	○	
H51	433h	DAh	Observer (M1 load inertia)	1	0.001 to 50.000 kg·m^2 The magnification is switchable by H228.	○	Depends on capacity	○	×	4	○	○	×	○	
H52	434h	h	Observer (M2 load inertia)	1	0.001 to 50.000 kg·m^2 The magnification is switchable by H228.	○	0.001	○	×	4	○	○	×	○	
H53	435h	D5h	Line speed feedback selection	0	0 to 3 0: Line speed disable (internal PG enable) However, higher value is selected between Ai input and PG (LD) on UPAC. 1: Analog line speed detect (AI-LINE) 2: Digital line speed detect (PG (LD)) 3: High selector (selects the higher level between motor speed and line speed)	○	0	○	○	67	○	○	○	○	
H55	437h	h	Zero speed control (Gain)	2	0 to 100 times For details, refer to terminal X function LOCK assigned by any of E01 to E13.	○	5	○	○	0	○	×	×	○	
H56	438h	h	Zero speed control (Completion range)	1	0 to 100 pulses	○	100	○	○	0	○	×	×	○	
H57	439h	h	Overvoltage suppression	2	0 to 1 0: No operation 1: Operation	×	0	○	○	68	○	○	○	○	
H58	43Ah	h	Overcurrent suppression	1	0 to 1 0: No operation 1: Operation	×	0	○	○	68	○	○	○	○	
H60	43Ch	h	Load weighting control (Definition 1 of load weighting control function)	7	0 to 3 0: Disable 1: Method 1 2: Method 2 3: Method 3	×	0	○	○	80	○	×	×	○	
H61	43Dh	h	Load weighting control (Definition 2 of load weighting control function)	1	0 to 1 0: Hoisting with motor rotating normally 1: Lowering with motor rotating normally	×	0	○	○	81	○	×	×	○	
H62	43Eh	h	Load weighting control (Hoisting speed)	1	0.0 to 999.9 m/min	×	0.0	○	○	2	○	×	×	○	
H63	43Fh	h	Load weighting control (Counter weight mass)	1	0.00 to 600.00 t	×	0.00	○	○	3	○	×	×	○	
H64	440h	h	Load weighting control (Safety factor)	1	0.50 to 1.20	×	1.00	○	○	3	○	×	×	○	
H65	441h	h	Load weighting control (Machine efficiency)	1	0.500 to 1.000	×	0.500	○	○	4	○	×	×	○	
H66	442h	h	Load weighting control (Rated load)	1	0.00 to 600.00 t	×	0.00	○	○	3	○	×	×	○	
H68	444h	h	Alarm data deletion	0	0 to 1 After writing the data, this function's data code automatically returns to 0. Setting H68 to "1" deletes all of the alarm history, alarm causes and alarm information held in the inverter memory.	○	0	×	×	11	○	○	○	○	
H70	446h	h	For manufacturer 1	2	0 to 9999 Reserved. (Do not access this function code.)	×	0	○	×	0	○	○	×	○	
H71	447h	h	For manufacturer 2	1	0 to 10 Reserved. (Do not access this function code.)	×	0	×	×	62	○	○	○	○	
H74	44Ah	h	PG detection circuit self-diagnosis selection	0	0 to 1 0: Disable 1: Enable This function activates the inverter's function for self-diagnosis of the speed detection circuit by PG (Pulse generator) signal input (PA, PB).	×	0	○	○	225	○	×	×	×	
H75	44Bh	h	Phase sequence configuration of main circuit output wires	0	0 to 1 0: Normal phase U-V-W 1: Reverse phase U-W-V Switches the phase sequence of the inverter main circuit.	×	0	○	○	197	○	○	○	×	
H76	44Ch	h	Main power down detection * Invalid for use in stack type	0	0 to 1 0: No operation 1: Operation Set this function to "Operation" to enable the AC power monitoring function. Set this function to "No operation" when DC power is supplied, e.g., connecting with a power regenerative converter but the inverter AC input power is not supplied.	○	0	○	○	0	○	○	○	○	
H77	44Dh	h	Cooling fan ON-OFF control continuation timer	0	0 to 600 s Specifies the condition of the cooling fan ON/OFF control by H06.	○	600	○	○	0	○	○	○	○	
H78	44Eh	h	Initialization of startup counter/total run time	6	0 to 6 0: No operation 1: M1 Number of startups 2: M2 Number of startups 3: M3 Number of startups 4: M1 Cumulative run time 5: M2 Cumulative run time 6: M3 Cumulative run time Initializes the number of startups and cumulative run time for each of M1 to M3.	×	0	×	×	0	○	○	○	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
H79	44Fh	h	Cooling fan operation cumulative time initialization setting	1	0 to 65535 (in units of 10 hours) Initializes the cumulative run time when the cooling fan is replaced. Usually, write “0” after replacement.	×	0	×	×	0	O	O	O	O	
H80	450h	h	Capacity of main circuit capacitor initial value measurement * Invalid for use in stack type	1	0 to 32767 When the capacitance measurement is user mode (H104), setting this function code to "0" and shutting down the inverter power starts measuring the initial value of the capacitance and writes the measurement result to this function code.	×	0	×	O	0	O	O	O	O	
H81	451h	h	Initialization of cumulative life of main circuit capacitor	1	0 to 65535 (in units of 10 hours) Initializes the elapsed time of the main circuit capacitor.	×	0	×	O	0	O	O	O	O	
H82	452h	h	Number of startups for maintenance	1	0 to 65535 Specifies the number of startups for performing maintenance of the machinery.	O	0	×	O	0	O	O	O	O	
H83	453h	h	Maintenance Interval	1	0 to 65535 (in units of 10 hours) Specifies the maintenance interval for performing maintenance of the machinery.	O	8760	×	O	0	O	O	O	O	
H84 *1	454h	h	Speed calculation period when extremely low speed (for maker)	0	0.0 to 200.0ms The sampling period setting of the encoder pulse in extremely low speed region. This is a function code for maker. Do not access this function code.	N	0.0	Y	Y	2	Y	N	N	Y	
H85	455h	h	Calendar clock (Year/month)	4	0000 to FFFF Upper 2 digits: Year, Lower 2 digits: Month	O	0001	×	O	143	O	O	O	O	
H86	456h	h	Calendar clock (Day/hour)	1	0000 to FFFF Upper 2 digits: Day, Lower 2 digits: Hour	O	0100	×	O	144	O	O	O	O	
H87	457h	h	Calendar clock (Minute/second)	1	0000 to FFFF Upper 2 digits: Minute, Lower 2 digits: Second	O	0000	×	O	145	O	O	O	O	
H88	458h	h	Calendar clock (Setting up clock)	1	0 to 1 0: No operation 1: Setting up clock Setting H88 to "1" sets up the calendar clock in accordance with the settings of H85 to H87. After that, the H88 data automatically reverts to "0."	O	0	×	×	11	O	O	O	O	
H90	45Ah	h	Overspeed alarm detection level	0	100 to 160%	O	120	O	O	0	O	O	×	O	
H96 *1	460h	h	ASR operation selecting	0	o to 3 0: P priority (VG1) 1: I priority (compatible with VM5) 2: P priority (compatible with VM5) 3: For maker (Do not select this)	N	0	Y	Y	201	Y	Y	N	Y	
H101	1F01h	h	PID command filter time constant	0	0 to 5000ms Specifies the time constant of the PID command filter (after switched by H21).	O	0	O	O	0	O	O	O	O	
H103	1F03h	h	Protective/Maintenance function selection 1 * Invalid for use in stack type ⇒	9	0000 to 1111 Selects the protective functions individually. [0: Disable, 1: Enable] Thousands digit: Start delay alarm (LdAL) Hundreds digit: Ground fault alarm (EF) Tenths digit: Output phase loss alarm (OPL) Units digit: Braking transistor broken (dbAL)	O	0101	O	O	9	O	O	O	O	
H104	1F04h	h	Protective/Maintenance function selection 2 * Invalid for use in stack type ⇒	1	0000 to 1111 Selects the protective/other functions individually. [0: Disable, 1: Enable] Thousands digit: PG wire break alarm (PG) Hundreds digit: Lower the carrier frequency Tenths digit: Judge the life of main circuit capacitor Units digit: Select capacitance measurement of main circuit (0: Referenced on factory default value, 1: Referenced on user measurement)	O	1110	O	O	9	O	O	O	O	
H105	1F05h	h	Protective/Maintenance Function Selection 3	1	0000 to 1111 Selects the protective/maintenance functions individually. (0: Disable, 1: Enable) Thousands digit: -- Hundreds digit: Speed disaccord alarm Er-3 operation 1 Tenths digit: Speed disaccord alarm Er-3 operation 2 Units digit: Save the integrated value of motor electronic thermal	O *1 *1	0000	O	O	9	O	O	O	O	
H106	1F06h	h	Light alarm object definition 1	1	0000 to 1111 [0: Heavy alarm (Er-r), 1: Light alarm (L-AL)] Digit of 1000: OH4 “motor overheat” Digit of 100: OL1-OL3 “motor overload” (common for M1-M3) Digit of 10: nrb “NTC thermistor disconnected” Digit of 1: OH2 “external failure”	O	0000	O	O	9	O	O	O	O	
H107	1F07h	h	Light alarm object definition 2	1	0000 to 1111 [0: Heavy alarm (Er-r), 1: Light alarm (L-AL)] Digit of 1000: Er5 “RS-485 failure” Digit of 100: Er4 “network failure” Digit of 10: Reserved Digit of 1: ArF “toggle failure error”	O	0000	O	O	9	O	O	O	O	
H108	1F08h	h	Light alarm object definition 3	1	0000 to 1111 [0: Heavy alarm (Er-r), 1: Light alarm (L-AL)] Digit of 1000: Err “mock alarm” Digit of 100: dFA “DC fan lock” Digit of 10: Er9 “speed disagreement” LOC "Start delay" Digit of 1: ArE “E-SX bus tact synchronization error”	O	0000	O	O	9	O	O	O	O	

(*1) Available when ROM version is newer than H1/2 0067.

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
H109	1F09h	h	Light alarm object definition 4	1	0000 to 1111 [0: Heavy alarm (Er-r), 1: Light alarm (L-AL)] Digit of 1000: Reserved Digit of 100: Reserved Digit of 10: Reserved Digit of 1: Reserved	○	0000	○	○	9	○	○	○	○	
H110	1F0Ah	h	Light alarm object definition 5	1	0000 to 1111 [0: Light alarm cancel, 1: Light alarm (L-AL)] Digit of 1000: MOH "Motor overheat early warning" MOL "Motor overload early warning" Digit of 100: BaT "Battery life" Digit of 10: LiF "Life early warning" Digit of 1: OH/OL "Fin overheat early warning/Overload early warning"	○	0000	○	○	9	○	○	○	○	
H111	1F0Bh	h	Light alarm object definition 6	1	0 to 1 0: Disable (L-AL no indication) 1: Enable (L-AL indicated) Specifies whether or not to display L-AL on the LED monitor when a light alarm occurs.	○	1	○	○	68	○	○	○	○	
H112	1F0Ch	h	M1 Magnetic saturation extension coefficient 6	7	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 43.75%.	○	43.8	○	×	2	○	×	×	×	
H113	1F0Dh	h	M1 Magnetic saturation extension coefficient 7	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 37.5%.	○	37.5	○	×	2	○	×	×	×	
H114	1F0Eh	h	M1 Magnetic saturation extension coefficient 8	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 31.25%.	○	31.3	○	×	2	○	×	×	×	
H115	1F0Fh	h	M1 Magnetic saturation extension coefficient 9	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 25%.	○	25.0	○	×	2	○	×	×	×	
H116	1F10h	h	M1 Magnetic saturation extension coefficient 10	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 18.75%.	○	18.8	○	×	2	○	×	×	×	
H117	1F11h	h	M1 Magnetic saturation extension coefficient 11	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 12.5%.	○	12.5	○	×	2	○	×	×	×	
H118	1F12h	h	M1 Magnetic saturation extension coefficient 12	1	0.0 to 100.0% Compensation factor for exciting current when the magnetic flux command is 6.25%.	○	6.3	○	×	2	○	×	×	×	
H125	1F19h	h	Observer (M3 compensation gain)	3	0.00 to 1.00 times	○	0.00	○	○	3	○	○	×	○	
H126	1F1Ah	h	Observer (M3 I-time)	1	0.005 to 1.000 s	○	0.100	○	○	4	○	○	×	○	
H127	1F1Bh	h	Observer (M3 load inertia)	1	0.001 to 50.000 kg·m^2 The magnification is switchable by H228.	○	0.001	○	○	4	○	○	×	○	
H134	1F22h	h	Speed drop detection delay timer	5	0.000: No operation 0.001 to 10.000 s	×	0.000	○	○	4	○	○	×	○	
H135	1F23h	h	Speed command detection level (FWD)	1	0.0: No operation 0.1 to 150.0 r/min	×	0.0	○	○	2	○	○	×	○	
H136	1F24h	h	Speed command detection level (REV)	1	0.0: No operation 0.1 to 150.0 r/min	×	0.0	○	○	2	○	○	×	○	
H137	1F25h	h	Speed drop detection level	1	0.0: No operation 0.1 to 150.0 r/min	×	0.0	○	○	2	○	○	×	○	
H138	1F26h	h	Speed drop detection delay timer	1	0.000 to 10.000 s	×	0.000	○	○	4	○	○	×	○	
H140	1F28h	h	Start delay detection (Detection level)	2	0.0 to 300.0 %	○	150.0	○	○	2	○	○	×	○	
H141	1F29h	h	Start delay detection (Detection timer)	1	0.000 to 10.000 s	○	1.000	○	○	4	○	○	×	○	
H142	1F2Ah	h	Mock alarm	0	0 to 1 0: No operation 1: A mock alarm occurs When H108 does not define a mock alarm as a light alarm, a heavy alarm (Er-r) occurs; when it defines a mock alarm as a light alarm, a light alarm (L-AL) occurs. Depressing the STOP + RUN keys on the keypad for 3 seconds will also cause the alarm.	○	0	×	×	11	○	○	○	○	
H144	1F2Ch	h	Toggle data error timer	0	0.01 to 20.00 s Specifies the toggle signal error detection time.	○	0.10	○	○	3	○	○	○	○	
H145	1F2Dh	h	Reverse rotation prevention for sensor-less control (Selection of lower limit frequency operation)	3	0 to 3 0: Disable 1: Enable for FWD polarity operation 2: Enable for REV polarity operation 3: Enable for both FWD/REV polarities	×	0	○	○	202	×	○	×	×	
H146	1F2Eh	h	Reverse rotation prevention for sensor-less control (Lower limit frequency (FWD))	1	0.000 to 10.000 Hz	×	0.000	○	○	4	×	○	×	×	
H147	1F2Fh	h	Reverse rotation prevention for sensor-less control (Lower limit frequency (REV))	1	0.000 to 10.000 Hz	×	0.000	○	○	4	×	○	×	×	
H148	1F30h	h	First order frequency filter	0	0 to 100 ms Increase this setting if the speed fluctuation is large under sensor-less vector control.	×	0	○	○	0	×	○	×	×	
H149	1F31h	h	Machine runaway detection speed setting	0	0.0 to 20.0% 0.0: Disable 0.1 to 20.0% Assuming the maximum speed as 100%.	×	0.0	○	○	2	○	○	×	○	
H160	1F3Ch	h	M1 Initial magnetic polarity position detection method	3	0 to 3 0: Pull-in by current for IPMSM (Interior Permanent Magnet Synchronous Motor) 1-3: -	×	0	○	×	0	×	×	×	○	
H161	1F3Dh	h	M1 Draw current command	1	10 to 200 % 100%/Motor rated current	×	80	○	×	0	×	×	×	○	
H162	1F3Eh	h	M1 Pull-in frequency	1	0.1 to 10.0 Hz	×	1.0	○	×	2	×	×	×	○	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
H170	1F46h	h	M2 Initial magnetic polarity position detection method	3	0 to 3 0: Pull-in by current for IPMSM (Interior Permanent Magnet Synchronous Motor) 1-3: -	×	0	O	×	0	×	×	×	O	
H171	1F47h	h	M2 Draw current command	1	10 to 200 % 100%/Motor rated current	×	80	O	×	0	×	×	×	O	
H172	1F48h	h	M2 Pull-in frequency	1	0.1 to 10.0 Hz	×	1.0	O	×	2	×	×	×	O	
H180	1F50h	h	M3 Initial magnetic polarity position detection method	3	0 to 3 0: Pull-in by current for IPMSM (Interior Permanent Magnet Synchronous Motor) 1-3: -	×	0	O	×	0	×	×	×	O	
H181	1F51h	h	M3 Draw current command	1	10 to 200% 100%/Motor rated current	×	80	O	×	0	×	×	×	O	
H182	1F52h	h	M3 Pull-in frequency	1	0.1 to 10.0 Hz	×	1.0	O	×	2	×	×	×	O	
H201	2001h	h	Load weighting control (Switching of load weighting control parameters) (To be supported soon)	13	0 to 1 0: H51, H64, H65 enable, H202-H213 disable 1: H51, H64, H65 disable, H202-H213 enable	×	0	O	O	0	O	×	×	O	
H202	2002h	h	Load weighting control (Load inertia (hoisting 1)) (To be supported soon)	1	0.001 to 50.000 kg･m^2 Applies to winding-up operation when AN-P2/1 is OFF. The magnification is switchable by H228.	×	0.001	O	O	4	O	×	×	O	
H203	2003h	h	Load weighting control (Safety factor (hoisting 1)) (To be supported soon)	1	0.50 to 1.20 Applies to winding-up operation when AN-P2/1 is OFF.	×	1.00	O	O	3	O	×	×	O	
H204	2004h	h	Load weighting control (Mechanical efficiency (hoisting 1)) (To be supported soon)	1	0.500 to 1.000 Applies to winding-up operation when AN-P2/1 is OFF.	×	0.500	O	O	4	O	×	×	O	
H205	2005h	h	Load weighting control (Load inertia (hoisting 2)) (To be supported soon)	1	0.001 to 50.000 kg･m^2 Applies to winding-up operation when AN-P2/1 is ON. The magnification is switchable by H228.	×	0.001	O	O	4	O	×	×	O	
H206	2006h	h	Load weighting control (Safety factor (hoisting 2)) (To be supported soon)	1	0.50 to 1.20 Applies to winding-up operation when AN-P2/1 is ON.	×	1.00	O	O	3	O	×	×	O	
H207	2007h	h	Load weighting control (Mechanical efficiency (hoisting 2)) (To be supported soon)	1	0.500 to 1.000 Applies to winding-up operation when AN-P2/1 is ON.	×	0.500	O	O	4	O	×	×	O	
H208	2008h	h	Load weighting control (Load inertia (lowering 1)) (To be supported soon)	1	0.001 to 50.000 kg･m^2 Applies to winding-down operation when AN-P2/1 is OFF. The magnification is switchable by H228.	×	0.001	O	O	4	O	×	×	O	
H209	2009h	h	Load weighting control (Safety factor (lowering 1)) (To be supported soon)	1	0.50 to 1.20 Applies to winding-down operation when AN-P2/1 is OFF.	×	1.00	O	O	3	O	×	×	O	
H210	200Ah	h	Load weighting control (Mechanical efficiency (lowering 1)) (To be supported soon)	1	0.500 to 1.000 Applies to winding-down operation when AN-P2/1 is OFF.	×	0.500	O	O	4	O	×	×	O	
H211	200Bh	h	Load weighting control (Load inertia (lowering 2)) (To be supported soon)	1	0.001 to 50.000 kg･m^2 Applies to winding-down operation when AN-P2/1 is ON. The magnification is switchable by H228.	×	0.001	O	O	4	O	×	×	O	
H212	200Ch	h	Load weighting control (Safety factor (lowering 2)) (To be supported soon)	1	0.50 to 1.20 Applies to winding-down operation when AN-P2/1 is ON.	×	1.00	O	O	3	O	×	×	O	
H213	200Dh	h	Load weighting control (Mechanical efficiency (lowering 2)) (To be supported soon)	1	0.500 to 1.000 Applies to winding-down operation when AN-P2/1 is ON.	×	0.500	O	O	4	O	×	×	O	
H214	200Eh	h	Load weighting control (Multi limit speed pattern function selection) (To be supported soon)	14	0 to 1 0: H60 definition enable, H215-H224 disable 1: H60 definition disable, H215-H224 enable	×	0	O	O	0	O	×	×	O	
H215	200Fh	h	Load weighting control (Multi limit speed pattern (maximum speed)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the maximum speed.	×	50.0	O	O	2	O	×	×	O	
H216	2010h	h	Load weighting control (Multi limit speed pattern (rated speed)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the rated speed.	×	100.0	O	O	2	O	×	×	O	
H217	2011h	h	Load weighting control (Multi limit speed pattern (rated speed x 1.1)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the rated speed*1.1.	×	90.9	O	O	2	O	×	×	O	
H218	2012h	h	Load weighting control (Multi limit speed pattern (rated speed x 1.2)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the rated speed*1.2.	×	83.3	O	O	2	O	×	×	O	
H219	2013h	h	Load weighting control (Multi limit speed pattern (rated speed x 1.4)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the rated speed*1.4.	×	71.4	O	O	2	O	×	×	O	
H220	2014h	h	Load weighting control (Multi limit speed pattern (rated speed x 1.6)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the rated speed*1.6.	×	62.5	O	O	2	O	×	×	O	
H221	2015h	h	Load weighting control (Multi limit speed pattern (rated speed x 1.8)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the rated speed*1.8.	×	55.5	O	O	2	O	×	×	O	
H222	2016h	h	Load weighting control (Multi limit speed pattern (rated speed x 2.0)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the rated speed*2.0.	×	50.0	O	O	2	O	×	×	O	

Function codes	Communications address		Name	Dir	Data setting range	Change when running	Factory default value	Data copying	Initialization	Classification	Control method: Enable/ Disable				Remarks
	485 No.	Link No.									PG	LES	VF	SM	
H223	2017h	h	Load weighting control (Multi limit speed pattern (rated speed x 2.5)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the rated speed*2.5.	×	40.0	○	○	2	○	×	×	○	
H224	2018h	h	Load weighting control (Multi limit speed pattern (rated speed x 3.0)) (To be supported soon)	1	0.1 to 100.0% Specifies the torque level at the rated speed*3.0.	×	33.3	○	○	2	○	×	×	○	
H225	2019h	h	Load weighting control (Speed limit determination section (start speed)) (To be supported soon)	1	0.1 to 100.0% Specifies the starting speed of the determination section. The rated speed is assumed as 100%.	×	75.0	○	○	2	○	×	×	○	
H226	201Ah	h	Load weighting control (Speed limit determination section (ending speed)) (To be supported soon)	1	0.1 to 100.0% Specifies the end speed of the determination section. The rated speed is assumed as 100%.	×	93.7	○	○	2	○	×	×	○	
H227	201Bh	h	Load weighting control (Functional definition 3) (To be supported soon)	1	0 to 2 0: Calculation of hoisting and lowering speed limit individually 1: Drive lowering using speed limit of previous hoisting Enable the winding-down speed limit calculation under specific conditions 2: Drive lowering using speed limit of previous hoisting Limit the winding-down speed with the rated speed under specific conditions	×	0	○	○	0	○	×	×	○	
H228	201Ch	h	Load inertia magnification setting	0	0 to 2 0: Multiplied by 1 (0.001 to 50.000 kg·m^2) 1: Multiplied by 10 (0.01 to 500.00 kg·m^2) 2: Multiplied by 100 (0.1 to 5000.0 kg·m^2) H51, H52, H202, H205, H208, H211 Switch the specified scaling factor for the “load inertia”.	×	630 kW or less 0 710 kW, 800 kW 1 1000 kW 2	○	○	193	○	×	×	○	
H322	2116h	h	Notch filter 1 (Resonance frequency)	6	10 to 2000 Hz	○	1000	○	○	0	○	○	×	○	
H323	2117h	h	Notch filter 1 (Attenuation level)	1	0 to 40 dB	○	0	○	○	0	○	○	×	○	
H324	2118h	h	Notch filter 1 (Frequency range)	1	0 to 3	○	2	○	○	0	○	○	×	○	
H325	2119h	h	Notch filter 2 (Resonance frequency)	1	10 to 2000 Hz	○	1000	○	○	0	○	○	×	○	
H326	211Ah	h	Notch filter 2 (Attenuation level)	1	0 to 40 dB	○	0	○	○	0	○	○	×	○	
H327	211Bh	h	Notch filter 2 (Frequency range)	1	0 to 3	○	2	○	○	0	○	○	×	○	

5.3.6 A codes (Alternative Motor Parameter Functions M2/M3)

5.3.7 o codes (Option Functions)

5.3.8 L codes (Lift Functions)

5.3.9 SF codes (Safety Functions)

📖 For a list of the above function codes and the detailed description of them, refer to the FRENIC-VG User's Manual, Chapter 4, Section 4.2 "Function Codes Tables" and Section 4.3 "Details of Function Codes," respectively.

Chapter 6 TROUBLESHOOTING

6.1 Protective Functions

The FRENIC-VG series of inverters has various protective functions as listed below to prevent the system from going down and reduce system downtime. The protective functions marked with an asterisk (*) in the table are disabled by 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 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 Section 6.2 and onwards for troubleshooting.

Protective function	Description
"Heavy alarm" detection	This function detects an abnormal state, displays the corresponding alarm code, and causes the inverter to trip. The "heavy alarm" codes are check-marked in the "Heavy alarm" object column in Table 6.3-1. For details of each alarm code, see the corresponding item in the troubleshooting. The inverter retains the latest and the last 10 alarm codes (see Section 3.4.9) and the latest and the last three pieces of alarm information (see Section 3.4.8). It can also display them.
"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. It is possible to define which abnormal states should be categorized as a "light alarm" using function codes H81 and H82. The "light alarm" codes are check-marked in the "Light alarm" object column in Table 6.3-1. For instructions on how to check and release light alarms, see Section 3.3.5 "Monitoring light alarms, ■ How to remove the current light alarm."
Stall prevention	When the torque command exceeds the torque limiter level (F44, F45) during acceleration/ deceleration or constant speed running, this function limits the motor torque generated in order to avoid an overcurrent trip.
Motor overload early warning*	When the inverter output current has exceeded the specified level, this function issues the "Motor overload early warning" signal ***M-OL*** before the thermal overload protection function causes the inverter to trip for motor protection.
Auto-reset*	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.)
Surge protection	This function protects the inverter from a surge voltage invaded between main circuit power lines and the ground.

Notes When the DC link bus voltage drops below the undervoltage detection level, alarm information is not saved.

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 if the inverter has interrupted power to the motor, if the voltage is applied to the main DC input terminals P(+) and N(-), voltage may be output to inverter output terminals U, V, and W.
- **Turn the power OFF, wait at least ten minutes,** and 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.

Follow the procedure below to solve problems.

(1) First, check that the inverter is correctly wired, referring to Chapter 2, Section 2.3.5 "Wiring of main circuit terminals and grounding terminals."

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

- If an alarm code appears on the LED monitor → Go to Section 6.3.
- If the "light alarm" indication (L-AL) appears on the LED monitor → Go to Section 6.4.
- If neither an alarm code nor "light alarm" indication (L-AL) appears on the LED monitor

  Abnormal motor operation → Go to Section 6.5.1.

  [1] The motor does not rotate.
  [2] The motor rotates, but the speed does not change.
  [3] The motor runs in the opposite direction to the command.
  [4] Speed fluctuation or current oscillation (e.g., hunting) occurs during running at constant speed.
  [5] Grating sound is heard from the motor or the motor sound fluctuates.
  [6] The motor does not accelerate or decelerate within the specified time.
  [7] The motor does not restart even after the power recovers from a momentary power failure.
  [8] The motor abnormally heats up.
  [9] The motor does not run as expected.
  [10] When the motor accelerates or decelerates, the speed is not stable.
  [11] The motor stalls during acceleration.
  [12] When the T-Link communications option is in use, neither a run command nor a speed command takes effect.
  [13] When the SX-bus communications option is in use, neither a run command nor a speed command takes effect.
  [14] When the CC-Link communications option is in use, neither a run command nor a speed command takes effect.
  [15] _ _ _ _ (under bars) appears.

  Problems with inverter settings → Go to Section 6.5.2.

  [1] Nothing appears on the monitors.
  [2] The desired function code does not appear.
  [3] Data of function codes cannot be changed from the keypad.
  [4] Data of function codes cannot be changed via the communications link.

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 List of alarm codes

If the inverter detects an alarm, check whether any alarm code appears on the 7-segment LED monitor of the keypad.

As listed below, some alarm codes are followed by alarm sub codes that denote the detailed error causes. For alarm codes not followed by alarm sub codes, "--" is written in the table below.

Table 6.3-1 Abnormal States Detectable ("Heavy Alarm" and "Light Alarm" Objects)

*1 For the alarm sub code checking procedure, refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.3.8 "Reading alarm information--Menu #7 ALM INF."

*2 For alarm codes followed by alarm sub codes listed as "For particular manufacturers," inform your Fuji Electric representative of the alarm sub code also when contacting or asking him/her to repair the inverter.

*3 For numbers marked with *3, refer to Section 6.3.2 "Possible causes of alarms, checks and measures" that provides the error details. For others, refer to the FRENIC-VG User's Manual, Chapter 13 "Troubleshooting."

Num.	LED monitor displays	Name	Description	Alarm sub code *1	Detailed error cause *2	Related function code
[3]	dCF	DC fuse blown	If a fuse in the main DC circuit blows to open the microswitch of the fuse due to a short circuit in the IGBT circuit, then this protective function displays the error to prevent the secondary damage. The inverter could be broken, so immediately contact your Fuji Electric representative.	--	--	
[4]	dFA	DC fan locked	This function is activated if the DC fan is stopped.	--	--	H108
[5]	dO	Excessive positioning deviation	This function is activated when the positioning deviation between the command and the detected values exceeds the setting of Function code o18 (Excessive deviation value) in synchronous operation. Mounting an option makes the option codes "o" effective and displays them on the keypad.	--	--	o18
[6]	EC	PG communication error	This function is activated if a PG communication error occurs when the 17-bit high resolution ABS interface (OPC-VG1-SPGT) is used.	0001-2000	For particular manufacturers *2	
[7] *3	ECF	Functional safety circuit fault	This function detects a functional safety circuit fault and stops the inverter. The alarm cannot be removed by the inverter's reset function.	0001	Input mismatch between terminals [EN1] and [EN2]	
				0002	Printed circuit board failure	
				0005-0008	CPU error	
[8]	EF	Ground fault	This function is activated when a ground fault is detected in the inverter output circuit. If the ground-fault current is large, the overcurrent protection may be activated. This protective function is to protect the inverter. For the sake of prevention of accidents such as human damage and fire, connect a separate earth-leakage protective relay or an earth-leakage circuit breaker (ELCB).	--	--	H103
[9]	Er 1	Memory error	This function is activated when a memory error such as a data write error occurs. **Note:** The inverter memory uses a nonvolatile memory that has a limited number of rewritable times (100,000 to 1,000,000 times). Saving data into the memory with the Save All function so many times unnecessarily will no longer allow the memory to save data, causing a memory error.	0001-0008	For particular manufacturers*2	

Num.	LED monitor displays	Name	Description	Alarm sub code *1	Detailed error cause *2	Related function code
[10]	Er-2	Keypad communications error	This function is activated if a communications error occurs between the keypad and the inverter control circuit when the start/stop command given from the keypad is valid (Function code F02=0). **Note:** Even if a keypad communications error occurs when the inverter is being driven via the control circuit terminals or the communications link, the inverter continues running without displaying any alarm or issuing an alarm output (for any alarm).	0001	Wire break detected	F02
				0002	Wire break detected (during keypad operation)	
[11]	Er-3	CPU error	This function is activated if a CPU error occurs.	0001-0008	For particular manufacturers *2	
[12]	Er-4	Network error	This function is activated: - if a communications error occurs due to noise when the inverter is being driven via the T-Link, SX-bus, E-SX bus, or CC-Link.	0001-0004	See the FRENIC-VG User's Manual, Chapter 6.	o30, o31, H107, E01 to E14, E15 to E28
[13]	Er-5	RS-485 communications error	This function is activated: - if an RS-485 communications error occurs when the inverter is being driven via the RS-485 and Function code H32 is set to any of "0" through "2." - if Function code H38 is set within the range of 0.1 to 60.0 (s) and the communications link breaks for the specified period or longer.	0001	Communications error (timeout)	H32, H33, H38, H107
				0002	Communications error (transmission error)	
[14]	Er-6	Operation error	This function is activated: - if two or more network options (T-Link, SX-bus, E-SX bus, and CC-Link) are mounted. - if the SW configuration is the same on two or more PG options. (More than one PG option can be mounted.) - if auto tuning (Function code H01) is attempted when any of the digital input signals **BX**, ***STOP1***, ***STOP2*** and ***STOP3*** is ON. - if auto tuning is selected with Function code H01 but the (FWD) key on the keypad is not pressed within 20 seconds.	0001	Option mounting error	H01
				0002	Auto-tuning failed	
				0008-8000	For particular manufacturers *2	
[15]	Er-7	Output wiring fault	This function is activated if the wires in the inverter output circuit are not connected during auto-tuning.	0001	Output wiring fault during tuning	H01
				0002	Speed not arrived during tuning with the motor running	
				0004-0040	For particular manufacturers *2	
[16]	Er-8	A/D converter error	This function is activated if an error occurs in the A/D converter circuit.	0001-0004	For particular manufacturers *2	
[17]	Er-9	Speed not agreed	This function is activated if the deviation between the speed command (reference speed) and the motor speed (detected or estimated speed) becomes excessive. The detection level and detection time can be specified with function codes.	0001	Motor 1 speed not agreed	E43, E44, E45, H108, H149
				0002	Motor 2 speed not agreed	
				0004	Motor 3 speed not agreed	
				0008	Machine runaway detected (by H149)	

Num.	LED monitor displays	Name	Description	Alarm sub code *1	Detailed error cause *2	Related function code
[18]	Er-A	UPAC error	Activated on a hardware fault in the UPAC option or a communication error between the inverter control circuit and the UPAC option.	0001-0004	See the related option manual.	H108
[19]	Er-b	Inter-inverter communications link error	This function is activated if a communications error occurs in the inverter-to-inverter communications link using a high-speed serial communication terminal block (option).	0002-0400	For particular manufacturers *2	H107
[20]	Er-H	Hardware error	Upon detection of an LSI failure on the printed circuit board, this function stops the inverter output.	0001-1000	For particular manufacturers *2	
[21]	Er-r	Mock alarm	This can be caused with keypad operation or FRENIC-VG Loader.	--	--	H108, H142
[22]	Et 1	PG failure	This function is activated if a PG data error or PG failure is detected when the 17-bit high resolution ABS interface (OPC-VG1-SPGT) is used.	--	--	
[24]	LOC	Start delay	This function is activated when the reference torque current (F44, F45) exceeds the specified level (H140) and the detected speed or reference one drops below the specified stop speed (F37) and the state is kept for the specified duration (H141).	--	--	H108, H140, H141
[25]	LU	Undervoltage	This function is activated when the DC link bus voltage drops below the undervoltage detection level (360 VDC for 400 V series). Note that, if the restart mode after momentary power failure is selected (F14 = 3, ,4 or 5), no alarm is output even if the DC link bus voltage drops.	--	--	F14
[26]	rH-b	NTC wire break error	This function is activated if the thermistor wire breaks when the NTC thermistor is selected with Function code P30/A31/A131 for motor M1/M2/M3. This function works even at extremely low temperatures (approx. -30°C or below).	--	--	P30, A31, A131, H106
[27] *3	OC	Overcurrent	This function stops the inverter output when the output current to the motor exceeds the overcurrent level of the inverter.	0001-0004	For particular manufacturers *2	
				0100	Demagnetizing limit current for PMSM	P44, A64, A164
[28] *3	OH 1	Heat sink overheat	This function is activated if the temperature surrounding the heat sink (that cools down the rectifier diodes and the IGBTs) increases due to stopped cooling fans.	0001-0008	Protection by thermistor	
				0010-0200	For particular manufacturers *2	
[29] *3	OH2	External alarm	This function is activated by digital input signal ***THR*** ("Enable external alarm trip"). Connecting an alarm contact of external equipment such as a braking unit or braking resistor to the control circuit terminal (to which the ***THR*** is assigned) activates this function according to the contact signal status.	0001	Protection by ***THR*** signal	E01 to E14, H106
[30]	OH3	Inverter internal overheat	This function is activated if the temperature surrounding the control printed circuit board increases due to poor ventilation inside the inverter.	0001-0008	Protection by thermistor	
				0010	For particular manufacturers *2	
[31]	OH4	Motor overheat	This function is activated if the temperature detected by the NTC thermistor integrated in a dedicated motor for motor temperature detection exceeds the motor overheat protection level (E30).	--	--	E30, H106

Num.	LED monitor displays	Name	Description	Alarm sub code *1	Detailed error cause *2	Related function code
[32]	OL 1	Motor 1 overload	This function is activated by the electronic thermal overload protection if the motor 1 current (inverter output current) exceeds the operation level specified by Function code F11.	--	--	F11, H106
[33]	OL2	Motor 2 overload	This function is activated by the electronic thermal overload protection if the motor 2 current (inverter output current) exceeds the operation level specified by Function code A33.	--	--	A33, H106
[34]	OL3	Motor 3 overload	This function is activated by the electronic thermal overload protection if the motor 3 current (inverter output current) exceeds the operation level specified by Function code A133.	--	--	A133, H106
[35] *3	OLU	Inverter overload	This function is activated if the output current exceeds the overload characteristic of the inverse time characteristic. It stops the inverter output depending upon the heat sink temperature and switching element temperature calculated from the output current.	0001-0010	For particular manufacturers *2	F80
[36]	OPL	Output phase loss	This function detects a break in inverter output wiring during running and stops the inverter output. (Available under vector control for IM with speed sensor.)	0001	Loss of one or more phases	H103, P01, A01, A101
				0002	Loss of two or more phases	
[37]	OS	Overspeed	This function Stops the inverter output if the detected speed is 120% or over of the maximum speed. This function is activated if the motor speed (detected or estimated speed) exceeds 120% (adjustable with Function code H90) of the maximum speed (F03/A06/A106).	--	--	H90
[38] *3	OU	Overvoltage	This function is activated if the DC link bus voltage exceeds the overvoltage detection level (405 VDC for 200 V series, 820 VDC for 400 V series) due to an increase of supply voltage or regenerative braking current from the motor. Note that the inverter cannot be protected from excessive voltage (high voltage, for example) supplied by mistake.	0001	For particular manufacturers *2	
[39]	PG	PG wire break	This function is activated if a wire breaks in the PA/PB circuit on the PG terminal or in the power supply circuit. It does not work under vector control without speed sensor or under V/f control.	0001	Wire break detected (inverter unit, PA and PB)	H104
				0002	Wire break detected (option)	
				0004	Power shutdown detected (inverter unit)	
				0010-0400	PG wiring fault for PMSM	
[41]	Er-E	E-SX bus tact synchronization error	This error occurs when the E-SX tact cycle and inverter control cycle are out of synchronization with each other.	--	--	H108
[42]	Er-F	Toggle data error	The inverter monitors 2-bit signals of toggle signal 1 ***TGL1*** and toggle signal 2 ***TGL2*** which are sent from the PLC. When the inverter receives no prescribed change pattern within the time specified by H144, this error occurs.	--	--	H107

Num.	LED monitor displays	Name	Description	Alarm sub code *1	Detailed error cause *2	Related function code
[43]	SnF	Functional safety card fault	Refer to the Functional Safety Card instruction manual for details.	--	See the Functional Safety Card (OPC-VG1-SAFE) instruction manual.	
[44]	Sn-F		This alarm cannot be removed by the inverter's reset function. For details, refer to the Functional Safety Card instruction manual.	--		
[45]	L-AL	Light alarm (warning)	This function displays L-AL on the LED monitor if a failure or warning registered as a light alarm occurs. It outputs the ***L-ALM*** signal on the Y terminal but it does not issue an alarm relay output ([30A], [30B], [30C]), so the inverter continues to run. <u>Light alarm objects (selectable)</u> Motor overheat (OH4), Motor overload (OL 1 to OL 3), NTC wire break error (rH-b), External failure (OH2), RS-485 communications error (Er5), Network error (Er4), Toggle data error (PI-E), Mock alarm (Err), DC fan locked (dFA), Speed mismatch (Er9), E-SX bus tact synchronization error (PI-E), Motor overheat early warning (MOH), Motor overload early warning (MOL), Lifetime alarm (LiF), Heat sink overheat early warning (OH), Inverter overload early warning (OL), Battery life expired (BAT), Start delay (LOC) Functional safety card light alarms (SnAF):Alarms that could occur in the functional safety card. An individual alarm is not selectable as a light alarm object. Light alarm objects can be checked on the keypad.	--	--	H106 to H108, H110, H111 SF25 to SF27 (Only SnF)
[46]	–	Surge protection	This function protects the inverter against surge voltages which might appear between one of the power lines, using surge absorbers connected to the control power terminals (R0, T0).	--	--	

Notes
- All protective functions are automatically reset if the control power voltage decreases until the inverter control circuit no longer operates.
- The inverter retains the latest and the last 10 alarm codes and the latest and the last three pieces of alarm information.
- Stoppage due to a protective function can be reset by the RST key on the keypad or turning OFF and then ON between the X terminal (to which RST is assigned) and the CM. This action is invalid if the cause of an alarm is not removed.
- The inverter cannot reset until the causes of all alarms are removed. (The causes of alarms not removed can be checked on the keypad.)
- If an abnormal state is categorized as a light alarm, the 30A/B/C does not operate.

6.3.2 Possible causes of alarms, checks and measures

[7] ECF Functional safety circuit fault

① Alarm sub code: 0001

Problem An error occurred in Enable input circuit.

Possible Causes	What to Check and Suggested Measures
(1) Poor contact of the control circuit terminal block	Check that the control circuit terminal block is secured to the inverter.
(2) Enable input circuit logic error	Check the ON/OFF timings of [EN1] and [EN2] with Menu #4 "I/O CHECK." ➔ Check that jumper bars are mounted between terminals [EN1] and [PS] and between [EN2] and [PS]. ➔ Operate the relay so that the ON/OFF timings of [EN1] and [EN2] are synchronized. ➔ Check whether the relay(s) are not welded. If welded, replace the relay. ➔ Check the gap between the ON/OFF timings of [EN1] and [EN2]. Keep the gap within 50 ms.
(3) Enable input circuit fault	Take the measures given in (2) above. ➔ If the error persists, ask your Fuji Electric representative to repair the inverter. Inform the representative of the alarm sub code displayed.

② Alarm sub code: 0002, 0005 to 0008

Problem The printed circuit board(s) or CPU is faulty.

Possible Causes	What to Check and Suggested Measures
(1) Inverter affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g. correct grounding and routing of signal wires, communications cables, and main circuit wires). ➔ Implement noise control measures.
(2) Short circuit on the printed circuit board(s). [Sub code: 0001 to 0008]	Check the printed circuit board(s) for short circuits, accumulation of dust or dirt. ➔ Ask your Fuji Electric representative to repair the inverter. Inform the representative of the alarm sub code displayed.

Note To remove the Er-3 CPU error, turn the power to the inverter OFF and then ON. The error cannot be removed by pressing the RESET key.

[27] OC Overcurrent

Problem The inverter momentary output current exceeded the overcurrent level.

Possible Causes	What to Check and Suggested Measures
(1) The inverter output lines were short-circuited.	Disconnect the wiring from the inverter output terminals ([U], [V] and [W]) and measure the interphase resistance of the motor wiring. Check if the resistance is too low. ➔ Remove the short-circuited part (including replacement of the wires, relay terminals and motor).
(2) Ground faults have occurred at the inverter output lines.	Disconnect the wiring from the output terminals [U], [V] and [W] and perform a Megger test for the inverter and the motor. (Refer to Section 7.6 "Insulation Test.") ➔ Remove the grounded parts (including replacement of the wires, relay terminals and motor).
(3) Overload.	Measure the motor current with a measuring device to trace the current trend. Then, use this data to judge if the trend is over the calculated load value for your system design. ➔ If the load is too heavy, reduce it or increase the inverter capacity. Trace the current trend and check if there are any sudden changes in the current. ➔ If there are any sudden changes, make the load fluctuation smaller or increase the inverter capacity. ➔ Under V/f control Enable overcurrent limiting (H58 = 1).
Under V/f control (4) Excessive torque boost specified (in the case of manual torque boost)	Check whether decreasing the torque boost (P35, A55, A155) decreases the output current but does not stall the motor. ➔ If no stall occurs, decrease the torque boost (P35, A55, A155).

Possible Causes	What to Check and Suggested Measures
Under V/f control (5) The acceleration/deceleration time was too short.	Check that the motor generates enough torque required during acceleration/deceleration. That torque is calculated from the moment of inertia for the load and the acceleration/deceleration time. ➔ Increase the acceleration/deceleration time (F07, F08, C46, C47, C56, C57, C66, C67). ➔ Increase the inverter capacity. ➔ Review the braking method.
(6) Malfunction caused by noise.	Check if noise control measures are appropriate (e.g., correct grounding and routing of control and main circuit wires). ➔ Implement noise control measures. For details, refer to the FRENIC-VG User's Manual, "Appendix A." ➔ Enable the Auto-reset (H04). ➔ Connect a surge absorber to magnetic contactor's coils or other solenoids (if any) causing noise.
Under vector control with/without speed sensor (7) Exciting current was too small during auto-tuning.	Check whether it happens during auto-tuning. ➔ Increase the exciting current (P08, A10, A110) and then perform auto-tuning.
Under vector control with speed sensor (8) Mismatch between the PG's pulse resolution and the function code setting.	Check the function code setting (P28, A30, A130). ➔ Match the function code settings with the PG specifications.
Under vector control with speed sensor (9) Wrong wiring of the PG.	Check the wiring between the PG and the inverter for the phase sequence, wire breaks, shielding and twisting. ➔ Correct the wiring.
Under vector control with speed sensor (10) PG defective.	Check whether the inverter internal control circuit (PG input circuit) is faulty, using the self-diagnosis function of the PG detection circuit (H74). ➔ If the result is "Normal," replace the PG; if it is "Abnormal," contact your Fuji Electric representative. Check the PG waveform using an oscilloscope. ➔ Replace the PG.

[28] 0H1 Heat sink overheat

Problem Temperature around heat sink has risen abnormally.

Possible Causes	What to Check and Suggested Measures
(1) The ambient temperature exceeded the range of the inverter specification. [Sub code: 0001 to 0008]	Measure the temperature around the inverter. ➔ Lower the temperature around the inverter (e.g., ventilate the cabinet where the inverter is mounted).
(2) Ventilation path is blocked. [Sub code: 0001 to 0008]	Check if there is sufficient clearance around the inverter. ➔ Change the mounting place to ensure the clearance.
	Check if the heat sink is not clogged. ➔ Clean the heat sink. (For the cleaning procedure, contact your Fuji Electric representative.)
(3) Cooling fan's airflow volume decreased due to the service life expired or failure. [Sub code: 0001 to 0008] [Sub code: 0010 to 0200]	Check the cumulative run time of the cooling fan. Refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.6 "Reading maintenance information – Menu #5 MAINTENANCE." ➔ Replace the cooling fan. (Contact your Fuji Electric representative.)
	Visually check whether the cooling fan rotates normally. ➔ Replace the cooling fan. (Contact your Fuji Electric representative.)
(4) Overload. [Sub code: 0001 to 0008]	Measure the output current. ➔ Reduce the load (Use the heat sink overheat early warning ***INV-OH*** (E15 through E27) or the inverter overload early warning ***INV-OL*** (E15 through E27) to reduce the load before the overload protection is activated.).

[29] OH2 External alarm

Problem External alarm was inputted (*THR*).
(when the "Enable external alarm trip" *THR* has been assigned to any of digital input terminals)

Possible Causes	What to Check and Suggested Measures
(1) An alarm function of external equipment was activated.	Check the operation of external equipment. ➔ Remove the cause of the alarm that occurred.
(2) Wrong connection or poor contact in external alarm signal wiring.	Check if the external alarm signal wiring is correctly connected to the terminal to which the "Enable external alarm trip" terminal command ***THR*** has been assigned (Any of E01 through E09 should be set to "9."). ➔ Connect the external alarm signal wire correctly.
(3) Incorrect setting of function code data.	Check whether the normal/negative logic of the external signal matches that of the ***THR*** command specified by E14. ➔ Ensure the matching of the normal/negative logic.
(4) The ambient temperature exceeded the range of the braking resistor specification.	Measure the temperature around the braking resistor. ➔ Lower the temperature (e.g., ventilate the inverter).
(5) The capacity of the braking resistor is insufficient.	Reconsider the capacity and %ED of the braking resistor. ➔ Review the braking resistor.

[35] OLU Inverter overload

Problem Electronic thermal overload protection for inverter activated.

Possible Causes	What to Check and Suggested Measures
(1) The ambient temperature exceeded the range of the inverter specification.	Measure the temperature around the inverter. ➔ Lower the temperature (e.g., ventilate the cabinet where the inverter is mounted).
(2) Excessive torque boost specified.	Check whether decreasing the torque boost (P35, A55, A155) does not stall the motor. ➔ If no stall occurs, decrease the torque boost (P35, A55, A155).
(3) The specified acceleration/ deceleration time was too short.	Recalculate the acceleration/deceleration torque and time needed for the load, based on the moment of inertia for the load and the acceleration/deceleration time. ➔ Increase the acceleration/deceleration time (F07, C35, C46, C56, C66).
(4) Overload.	Measure the load factor to see that it does not exceed 100%. (Refer to Section 3.4.7 "Measuring load factor -- Menu #6 "LOAD FCTR." ➔ Reduce the load (e.g., Use the overload early warning (E33) and reduce the load before the overload protection is activated.).
(5) Ventilation paths are blocked.	Check if there is sufficient clearance around the inverter. ➔ Change the mounting place to ensure the clearance. (For details, refer to Chapter 2, Section 2.2 "Installing the Inverter."
	Check if the heat sink is not clogged. ➔ Clean the heat sink. (For the cleaning procedure, contact your Fuji Electric representative.)
(6) Cooling fan's airflow volume decreased due to the service life expired or failure.	Check the cumulative run time of the cooling fan. ➔ Replace the cooling fan. (Contact your Fuji Electric representative.)
	Visually check that the cooling fan rotates normally. ➔ Replace the cooling fan. (Contact your Fuji Electric representative.)
(7) The wires to the motor are too long, causing a large leakage current from them.	Measure the leakage current. ➔ Insert an output circuit filter (OFL).
Under vector control with/without speed sensor (8) Reference speed fluctuating	Check whether the reference speed is fluctuating. ➔ Increase the ASR input filter setting (F64, C43, C53, C63).
Under vector control with/without speed sensor (9) The control constants of the automatic speed regulator (ASR) are inadequate.	Check whether the actual speed overshoots or undershoots the commanded one. ➔ Readjust the ASR (ASR gain, constant of integration, etc.).

Possible Causes	What to Check and Suggested Measures
(10) Wrong wiring to the PG.	Check the wiring to the PG. ➔ Correct the wiring. (Refer to Section 4.2.2 "Mounting direction of a pulse generator (PG) and PG signals.")
(11) Wrong wiring to the motor.	Check the wiring to the motor. ➔ Correct the wiring. It is also possible to use H75 (Phase sequence configuration of main circuit output wires).
(12) The magnetic pole position of the permanent magnet synchronous motor (PMSM) is out of place.	Check the magnetic pole position. ➔ Adjust the magnetic pole position (o10, A60, A160). (Refer to Section 4.3.3 "Vector control for PMSM with speed sensor and magnetic pole position sensor," ■ Adjusting the magnetic pole position.")

[38] 0U Overvoltage

Problem The DC link bus voltage exceeded the overvoltage detection level.

Possible Causes	What to Check and Suggested Measures
(1) The power supply voltage exceeded the range of the inverter specification.	Measure the input voltage. ➔ Decrease the voltage to within the specified range.
(2) The deceleration time was too short for the moment of inertia of the load.	Recalculate the deceleration torque based on the moment of inertia of the load and the deceleration time. ➔ Increase the deceleration time (F08, C36, C47, C57, C67). ➔ Consider the use of a braking resistor or PWM converter. ➔ Decrease the moment of inertia of the load. ➔ Enable the overvoltage trip prevention (H57). ➔ Select the power limit function (F40 = 2). ➔ Under vector control with speed sensor Enable the torque limiter (F40 to F45).
(3) The acceleration time was too short.	Check if an overvoltage alarm occurs after rapid acceleration. ➔ Increase the acceleration time (F07, C35, C46, C56, C66). ➔ Select the S-curve acceleration/deceleration (F67 to F70). ➔ Consider the use of a braking resistor or PWM converter. ➔ Decrease the moment of inertia of the load.
(4) Braking load was too heavy.	Compare the braking torque of the load with that of the inverter. ➔ Consider the use of a braking resistor or PWM converter.
(5) Malfunction caused by noise.	Check if the DC link bus voltage was below the protective level when the overvoltage alarm occurred. ➔ Implement noise control measures. For details, refer to the FRENIC-VG User's Manual, "Appendix A." ➔ Enable the auto-reset (H04). ➔ Connect a surge absorber to magnetic contactor's coils or other solenoids (if any) causing noise.
(6) The inverter output lines were short-circuited.	Disconnect the wiring from the inverter output terminals ([U], [V] and [W]) and measure the interphase resistance of the motor wiring. Check if the resistance is too low. ➔ Remove the short-circuited part (including replacement of the wires, relay terminals and motor).
(7) Wrong connection of the braking resistor.	Check the connection. ➔ Correct the connection.
(8) Large, rapid decrease of the load.	Check whether the inverter runs at the time of rapid decrease of the load. ➔ Consider the use of a braking resistor or PWM converter.

6.4 If the "Light Alarm" Indication (L-AL) Appears on the LED Monitor

If the inverter detects a minor abnormal state "light alarm," it can continue the current operation without tripping while displaying the "light alarm" indication L-AL on the LED monitor. In addition to the indication L-AL, the inverter blinks the KEYPAD CONTROL LED and outputs the "light alarm" signal ***L-ALM*** to a general-purpose digital output terminal to alert the peripheral equipment to the occurrence of a light alarm. (To use the ***L-ALM***, it is necessary to assign the signal to any of the digital output terminals by setting any of function codes E15 through E19 to "57.")

Function codes H106 through H110 specify which alarms should be categorized as "light alarm." The available "light alarm" codes are check-marked in the "Light alarm" object column in Table 6.3-1.

For the "light alarm" factors and the alarm removal procedure, refer to Chapter 3, Section 3.3.5 "Monitoring light alarms."

Note that light alarms SnF that could occur in the functional safety card OPC-VG1-SAFE cannot be selected by function codes H106 through H110. For details about SnF, refer to the Functional Safety Card instruction manual.

6.5 If Neither an Alarm Code Nor "Light Alarm" Indication (L-AL) Appears on the LED Monitor

6.5.1 Abnormal motor operation

[1] The motor does not rotate.

Possible Causes	What to Check and Suggested Measures
(1) No power supplied to the inverter.	Check the input voltage and interphase voltage unbalance. ➔ Turn ON a molded case circuit breaker (MCCB), a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or a magnetic contactor (MC). ➔ Check for voltage drop, phase loss, poor connections, or poor contacts, and fix them if necessary. ➔ If only the auxiliary control power input is supplied, also supply the main power to the inverter.
(2) No run forward/reverse command was inputted, or both the commands were inputted simultaneously (external signal operation).	Check the input status of the forward/reverse command with Menu #4 "I/O CHECK" using the keypad. ➔ Input a run command. ➔ Set either the forward or reverse operation command to off if both commands are being inputted. ➔ Correct the run command source. (Set the data of F02 to "1.") ➔ Connect the external circuit wires to control circuit terminals [FWD] and [REV] correctly. ➔ Make sure that the sink/source slide switch (SW1) on the control printed circuit board (control PCB) is properly configured. (Refer to Section 2.2.6 "Setting up the slide switches.")
(3) A run command with higher priority than the one attempted was active, and the run command was stopped.	Referring to the run command block diagram given in the FRENIC-VG User's Manual, Chapter 4, check the higher priority run command using Menu #2 "DATA CHECK" and Menu #4 "I/O CHECK" with the keypad. ➔ Correct wrong setting of function code H30 (Communications link function, Mode selection) or cancel the higher priority run command.
(4) No analog speed command input.	Check whether the analog speed command is correctly inputted, using Menu #4 "I/O CHECK" on the keypad. ➔ Connect the external circuit wires to terminals [13], [12], [11], [Ai1] and [Ai2] correctly. ➔ Inspect the external speed command potentiometers, signal converters, switches and relay contacts. Replace any ones that are faulty.
Under V/f control (5) The reference speed was below the starting or stop speed.	Check that a speed command has been entered correctly, using Menu #4 "I/O CHECK" on the keypad. ➔ Set the reference speed at the same or higher than the starting speed (F23). ➔ Reconsider the starting speed (F23), and if necessary, change it to the lower value. ➔ Inspect the external speed command potentiometers, signal converters, switches and relay contacts. Replace any ones that are faulty. ➔ Connect the external circuit wires to terminals [13], [12], [11], [Ai1] and [Ai2] correctly.

Possible Causes	What to Check and Suggested Measures
(6) A run command with higher priority than the one attempted was active.	Referring to the run command block diagram given in the FRENIC-VG User's Manual, Chapter 4, check the higher priority run command using Menu #2 "DATA CHECK" and Menu #4 "I/O CHECK" with the keypad. ➔ Correct the wrong setting of function codes (e.g., cancel the higher priority speed command). ➔ Correct wrong setting of function code H30 (Communications link function, Mode selection) or cancel the higher priority speed command.
(7) The speed limiter settings were made incorrectly.	Check the data of function codes F76 (Speed limiter mode), F77 and F78 (Speed limiter levels 1 and 2). ➔ Correct the data of F76 through F78.
(8) The coast-to-stop command was effective.	Check the data of function codes E01 through E09 and the input signal status of X terminals, using Menu #4 "I/O CHECK" on the keypad. ➔ Release the coast-to-stop command setting. Check the input signal status of terminal [EN], using Menu #4 "I/O CHECK" on the keypad. ➔ Short-circuit the terminal [EN] with terminal [PS].
(9) No input on [EN1] or [EN2].	Check the input status of the EN terminal, using Menu #4 "I/O CHECK" on the keypad. ➔ Short-circuit each of [EN1] and [EN2] with [PS]. (Refer to Chapter 2, Section 2.2.5 "[3] Detailed functions of control circuit terminals."
(10) Broken wires, incorrect connection or poor contact with the motor. Or the motor defective.	Check the wiring and the motor. (Measure the output current). ➔ Repair the wires to the motor, or replace them. ➔ Repair the motor or replace it.
(11) Overload	Measure the output current. ➔ Reduce the load (In winter, the load tends to increase.) ➔ Increase the inverter and motor capacities.
	Check whether any mechanical brake is activated. ➔ Release the mechanical brake, if any.
(12) Torque generated by the motor was insufficient.	Check that the motor switching signal (selecting motor 1, 2 or 3) is correct using Menu #4 "I/O CHECK" on the keypad and that the data of function codes matches each motor. ➔ Correct the motor switching signal. ➔ Modify the function code data to match the connected motor.
<u>Under V/f control</u> (13) Torque generated by the motor was insufficient.	Check whether the reference speed is below the slip-compensated speed of the motor (Function codes P10 and P11 for M1, A12 and A13 for M2, and A112 and A113 for M3). ➔ Change the reference speed so that it becomes higher than the slip-compensated speed of the motor. Check whether increasing the toque boost (Function code P35, A55, A155) starts rotating the motor. ➔ Increase the data of P35, A55 or A155. Check the data of function code F04, A05 or A105. ➔ Change the V/f pattern setting to match each motor.
(14) No reference speed setting (keypad operation).	Check the reference speed setting made on the keypad. ➔ Modify the reference speed setting by pressing [↑] key.
(15) The inverter could not accept any run commands from the keypad since it was in Programming mode.	Check which operation mode the inverter is in, using the keypad. ➔ Shift the operation mode to Running mode and enter a run command.
<u>Under vector control with speed sensor</u> (16) Incorrect setting of the number of poles of the motor	Check whether the setting of function code P05, A07 or A107 (No. of poles) matches the number of poles of the actual motor. ➔ Set the data of P05, A07 or A107 to the correct number of poles.

Possible Causes	What to Check and Suggested Measures
Under vector control with speed sensor (17) Wrong wiring between the motor and pulse generator (PG).	Check the motor wiring (phase sequence) and the polarity of the PG. ➔ Correct the wiring. (Refer to Chapter 4, Section 4.2.2 "Mounting direction of a PG (pulse generator) and PG signals.")
Under vector control with/without speed sensor (18) Incorrect setting of the torque limiter level.	Check whether the torque limiter level (Function code F44, F45) is set to zero (0). ➔ Modify the data of F44 or F45 to the appropriate value.
Under vector control with/without speed sensor (19) Incorrect setting of the torque command.	Check whether the torque command of terminal [Ai1]/[Ai2] is zero (0) under torque control mode. ➔ Modify the torque command to the appropriate value.
Under vector control with speed sensor (20) Mismatch between the PG's pulse resolution and the function code setting.	Check whether the setting of function code P28, A30 or A130 matches the pulse resolution of the actual PG.. ➔ Modify the data of P28, A30 or A130 to the appropriate value. Check whether the voltage setting of terminal [PGP] (SW6) matches the voltage specification of the actual PG. ➔ Set SW6 to the appropriate position.
(21) The magnetic pole position of the permanent magnet synchronous motor (PMSM) is out of place.	Check the magnetic pole position. ➔ Adjust the magnetic pole position (o10, A60, A160). (Refer to Chapter 4, Section 4.3.3 "Vector control for PMSM with speed sensor and magnetic pole position sensor," ■ Adjusting the magnetic pole position.")

[2] The motor rotates, but the speed does not change.

Possible Causes	What to Check and Suggested Measures
(1) The setting of the maximum speed was too low.	Check the data of function code F03, A06 or A106 (Maximum speed). ➔ Modify the data of F03, A06 or A106 to the appropriate value.
(2) The setting of the speed limiter was too low.	Check the setting of the speed limiter (F76 to F78). ➔ Modify the data of F76 to F78 to the appropriate value.
(3) The reference speed (analog setting) did not change.	Check whether the reference speed has been entered correctly, using Menu #4 "I/O CHECK" on the keypad. ➔ Increase the reference speed. ➔ Inspect the external speed command potentiometers, signal converters, switches, and relay contacts. Replace any ones that are faulty. ➔ Connect the external circuit wires to terminals [13], [12], [11], [Ai1] and [Ai2] correctly.
(4) The external circuit wiring to terminals [X1] to [X9] or signal assignment to those terminals is wrong.	Check whether the reference speed has been entered correctly, using Menu #4 "I/O CHECK" on the keypad. ➔ Connect the external circuit wires to terminals [X1] through [X9]. ➔ Correct the data of E01 to E14. ➔ Correct the data of C05 to C21 (Multistep speed settings).
(5) A reference speed (e.g., multistep speed or via communications link) with higher priority than the one attempted was active and the reference speed was too low.	Referring to the speed command block diagram given in the FRENIC-VG User's Manual, Chapter 4, check the data of the relevant function codes and what speed commands are being received, using Menu #2 "DATA CHECK" and Menu #4 "I/O CHECK" with the keypad. ➔ Correct any incorrect data of function codes (e.g. cancel the higher priority reference speed).
(6) The acceleration or deceleration time was too long or too short.	Check the settings of the acceleration time and deceleration time (function codes F07, F08, C35, C36, C46, C47, C56, C57, C66 and C67). ➔ Change the acceleration/deceleration time to match the load.
(7) Overload.	Measure the output current. ➔ Reduce the load. Check whether any mechanical brake is activated. ➔ Release the mechanical brake.
Under V/f control (8) Function code settings do not agree with the motor characteristics.	If auto-torque boost (Function code P35, A55, A155) is enabled, check whether the data of P03, P04, P06, P07 and P08 for M1, A02, A03, A08, A09 and A10 for M2, A102, A103, A108, A109 and A110 for M3 matches the parameters of the motor. ➔ Perform auto-tuning of the inverter for the motor to be used.

Possible Causes	What to Check and Suggested Measures
Under V/f control (9) The output frequency does not increase due to the current limiter operation.	Decrease the value of the torque boost (Function code P35, A55, A155), then run the motor again and check if the speed increases. ➔ Adjust the value of the torque boost (P35, A55, A155). Check the data of function codes F04, A05 and A105 to ensure that the V/f pattern setting is right. ➔ Match the V/f pattern setting with the motor ratings.
(10) The motor speed does not increase due to the torque limiter operation.	Check whether the data of torque limiter related function codes F40 through F45 is correctly configured and the ***TL2***/***TL1*** terminal command ("Select torque limiter level") is correct. ➔ Correct the data of F44 or F45 or enter the ***F40-CCL*** terminal command ("Cancel F40 (Torque limiter mode 1)").
(11) Incorrect settings of bias and gain for analog input.	Check the data of function codes F17, F18 and E53 to E60. ➔ Correct the bias and gain settings.
(12) The reference speed did not change. (Keypad operation)	Check whether modifying the reference speed setting from the keypad changes the reference speed. ➔ Modify the reference speed setting by pressing the [↑] and [↓] keys.
Under vector control with speed sensor (13) Wrong wiring of the PG.	Check the wiring between the PG and the inverter for the phase sequence, wire breaks, shielding and twisting. ➔ Correct the wiring. (Refer to Section 4.2.2 "Mounting direction of a pulse generator (PG) and PG signals.")
Under vector control with speed sensor (14) Wrong wiring between the inverter and the motor.	Check the phase sequence (U, V, and W) of the main circuit wires between the inverter and the motor. ➔ Connect the inverter output terminals U, V, and W to the motor input terminals U, V, and W, respectively.
Under vector control with/without speed sensor (15) Function code settings do not agree with the motor characteristics.	For exclusive motors for the FRENIC-VG: Check whether the data of function code P02 matches the specification of the connected motor. ➔ Correct the data of P02. For other motors: ➔ Perform auto-tuning.

[3] The motor runs in the opposite direction to the command.

Possible Causes	What to Check and Suggested Measures
Under V/f control Under vector control without speed sensor (1) Wrong wiring to the motor.	Check the wiring to the motor. ➔ Connect the inverter output terminals U, V, and W to the motor input terminals U, V, and W, respectively.
(2) The rotation direction specification of the motor is opposite to that of the inverter.	The rotation direction of IEC-compliant motors is opposite to that of incompliant motors. ➔ Switch the ***FWD***/***REV*** signal setting.
(3) Incorrect setting of speed command related function code data.	Check the data of the speed command related function codes, referring to the speed command block diagram given in the FRENIC-VG User's Manual, Chapter 4. ➔ Correct the data of the related function codes.
Under vector control with speed sensor (4) Wrong wiring of the PG.	Check the wiring to the motor. ➔ Correct the wiring. (Refer to Section 4.2.2 "Mounting direction of a pulse generator (PG) and PG signals.")

[4] Speed fluctuation or current oscillation (e.g., hunting) occurs during running at constant speed.

Possible Causes	What to Check and Suggested Measures
(1) The analog speed command fluctuates.	Check the signal status for the speed command with Menu #4 "I/O CHECK" using the keypad. (Refer to Section 3.4.5.) ➔ Increase the filter constants (F83, E61 to E64) for the speed command. ➔ Take measures to keep the speed command constant.

Possible Causes	What to Check and Suggested Measures
(2) An external potentiometer is used for speed setting.	Check that there is no noise on the control signal wires connecting to external sources. ➔ Isolate the control signal wires from the main circuit wires as far as possible. ➔ Use shielded or twisted wires for control signals. Check whether the external speed command potentiometer is malfunctioning due to noise from the inverter. ➔ Connect a capacitor to the output terminal of the potentiometer or set a ferrite core on the signal wire. (Refer to Chapter 2.)
(3) Speed switching or multistep speed command was enabled.	Check whether the relay signal for switching the speed command is chattering. ➔ If the relay contact is defective, replace the relay.
(4) The wiring length between the inverter and the motor is too long.	Check whether auto-torque boost is enabled (P35, A55, A155). ➔ Perform auto-tuning. ➔ Under V/f control, disable the automatic control system (select manual torque boost), then check that the motor vibration stops. ➔ Make the output wires as short as possible.
(5) The machinery is hunting due to vibration caused by low rigidity of the load. Or the current is irregularly oscillating due to special motor parameters.	Once disable all the automatic control systems (speed control, auto torque boost, current limiter, torque limiter and droop control), then check that the motor vibration comes to a stop. ➔ Under vector control with/without speed sensor, readjust the speed control system. (F61 through F66, C40 through C45, C50 through C55) ➔ Disable the automatic control system(s) causing the vibration.
(6) Function code settings do not agree with the motor characteristics.	For exclusive motors for the FRENIC-VG: Check whether the setting of function code P02 matches the specification of the connected motor. ➔ Correct the data of P02. For other motors: ➔ Perform auto-tuning.
(7) Load is fluctuating.	Under vector control with/without speed sensor Check whether automatic speed regulator (ASR) is properly configured. (F61 through F66, C40 through C45, C50 through C55) ➔ Readjust the ASR setting.

[5] Grating sound is heard from the motor or the motor sound fluctuates.

Possible Causes	What to Check and Suggested Measures
(1) The ambient temperature of the inverter was too high.	Measure the temperature inside the cabinet where the inverter is mounted. ➔ If it is over 40°C, lower it by improving the ventilation. ➔ Lower the temperature of the inverter by reducing the load.
(2) Resonance with the load.	Check the machinery mounting accuracy or check whether there is resonance with the mounting base. ➔ Disconnect the motor from the machinery and run it alone to find where the resonance comes from. Upon locating the cause, improve the characteristics of the source of the resonance. ➔ Adjust the jump speed (C01 through C04) to avoid continuous running in the frequency range causing resonance. ➔ Specify the observer (H47 through H52, H125 through H127) to suppress vibration. (Depending on the characteristics of the load, this may take no effect.) ➔ Decrease the P gain of the auto speed regulator (ASR). (F61, C40, C50, C60)

[6] The motor does not accelerate or decelerate within the specified time.

Possible Causes	What to Check and Suggested Measures
(1) The inverter runs the motor with S-curve acceleration/ deceleration.	Check the data of function codes F67 through F70 (S-curve acceleration/ deceleration pattern). ➔ Select the linear pattern (F67 through F70 = 0). ➔ Decrease the acceleration/deceleration time (F07, F08, C46, C47, C56, C57, C66, C67).

Possible Causes	What to Check and Suggested Measures
Under V/f control (2) The current limiting operation prevented the output frequency from increasing (during acceleration).	Check whether the acceleration time and torque boost are properly specified. ➔ Increase the data of F07, C35, C46, C56 or C66 (acceleration time). ➔ Decrease the torque boost (P35, A55, A155) and restart the inverter to check that the speed increases.
(3) Overload.	Measure the output current. ➔ Reduce the load.
Under V/f control (4) Torque generated by the motor was insufficient.	Check that increasing the torque boost (P35, A55, A155) starts the motor. ➔ Increase the value of the torque boost (P35, A55, A155).
(5) An external potentiometer is used for speed setting.	Check that there is no noise on the control signal wires connecting to external sources. ➔ Isolate the control signal wires from the main circuit wires as far as possible. ➔ Use shielded or twisted wires for control signals. Check whether the external speed command potentiometer is malfunctioning due to noise from the inverter. ➔ Connect a capacitor to the output terminal of the potentiometer or set a ferrite core on the signal wire. (Refer to the notes for analog input in Table 2.2-5 "Symbols, Names and Functions of the Control Circuit Terminals.")
(6) Motor torque generated is limited by the torque limiter.	Check whether data of torque limiter related function codes (F40 through F45) is correctly configured and the ***TL2***/***TL1*** terminal command ("Select torque limiter level 2/1") is correct. ➔ Correct the data of F40 through F45 or reset them to the factory defaults. Check whether the speed command potentiometer is malfunctioning due to noise from the inverter. ➔ Set the ***TL2***/***TL1*** correctly. ➔ Increase the acceleration/deceleration time (F07, F08, C35, C36, C46, C47, C56, C57, C66, C67).
(7) The specified acceleration or deceleration time was incorrect.	Check the terminal commands ***RT1*** and ***RT2*** for acceleration/deceleration times. ➔ Correct the ***RT1*** and ***RT2*** settings.

[7] The motor does not restart even after the power recovers from a momentary power failure.

Possible Causes	What to Check and Suggested Measures
(1) The data of function code F14 is either "0," "1," or "2."	Check if an undervoltage trip (*ﾚﾋﾌ*) occurs. ➔ Change the data of F14 (Restart mode after momentary power failure, Mode selection) to "3," "4," or "5."
(2) The run command remains OFF even after the power has been restored.	Check the input signal with Menu #4 "I/O CHECK" using the keypad. (Refer to Section 3.4.5.) ➔ Check the power recovery sequence with an external circuit. If necessary, consider the use of a relay that can keep the run command ON.
	In 3-wire operation, the power to the control printed circuit board (control PCB) has been shut down once because of a long momentary power failure time, or the ***HOLD*** signal ("Enable 3-wire operation") has been turned OFF once. ➔ Change the design or the setting so that a run command can be issued again within 2 seconds after the power has been restored.

[8] The motor abnormally heats up.

Possible Causes	What to Check and Suggested Measures
(1) Airflow volume of the motor's cooling fan decreased due to the service life expired or failure	Visually check whether the cooling fan rotates normally. ➔ Ask your Fuji Electric representative to repair the motor's cooling fan.
Under V/f control (2) Excessive torque boost specified.	Check whether decreasing the torque boost (P35, A55, A155) decreases the output current but does not stall the motor. ➔ If no stall occurs, decrease the torque boost (P35, A55, A155).

Possible Causes	What to Check and Suggested Measures
Under V/f control (3) Continuous running in extremely slow speed.	Check the running speed of the inverter. ➔ Change the speed setting or replace the motor with an exclusive motor for inverters (motor with separately powered cooling fan).
(4) Overload.	Measure the inverter output current. ➔ Reduce the load. ➔ Increase the inverter capacity and motor capacity.
Under vector control with/without speed sensor (5) Function code settings do not agree with the motor characteristics.	For exclusive motors for the FRENIC-VG: Check whether the setting of function code P02 matches the connected motor. ➔ Correct the data of P02. For other motors: ➔ Perform auto-tuning.
(6) Motor defective.	Check whether the inverter output voltages (U, V and W) are well-balanced. ➔ Repair or replace the motor.

[9] The motor does not run as expected.

Possible Causes	What to Check and Suggested Measures
(1) Incorrect setting of function code data.	Check that function codes are correctly configured and no unnecessary configuration has been done. ➔ Configure all the function codes correctly.
	Make a note of function code data currently configured and then initialize all function code data using H03. ➔ After the above process, reconfigure function codes one by one, checking the running status of the motor.
(2) Under torque control, the inverter keeps output although the run command is OFF.	Check the setting of the automatic operation OFF function (H11). ➔ Set the data of H11 to "2" ("Coast to a stop when a run command is turned OFF") or "4" ("Coast to a stop when a run command is turned OFF" under torque control).

[10] When the motor accelerates or decelerates, the speed is not stable.

Possible Causes	What to Check and Suggested Measures
Under vector control with/without speed sensor (1) The control constants of the automatic speed regulator (ASR) are inadequate.	Check whether the automatic speed regulator (ASR) is properly adjusted under speed control. ➔ Readjust the ASR (F61 to F66, C40 to C45, C50 to C55).

[11] The motor stalls during acceleration.

Possible Causes	What to Check and Suggested Measures
Under vector control with/without speed sensor (1) Function code settings do not agree with the motor characteristics.	For exclusive motors for the FRENIC-VG: Check whether the setting of function code P02 matches the connected motor. ➔ Correct the data of P02. For other motors: ➔ Perform auto-tuning.
Under V/f control (2) The specified acceleration time is too short.	Check the data of F07, C35, C46, C56 or C66 (acceleration time). ➔ Increase the acceleration time.
Under V/f control (3) The moment of inertia of the load is large.	Measure the inverter output current. ➔ Decrease the moment of inertia of the load. ➔ Increase the inverter capacity.
Under V/f control (4) Large voltage drop on wires.	Check the terminal voltage of the motor. ➔ Use larger size wires between the inverter and motor or make the wiring distance shorter.
Under V/f control (5) The torque of the load is large.	Measure the output current. ➔ Decrease the torque of the load. ➔ Increase the inverter capacity.

Possible Causes	What to Check and Suggested Measures
Under V/f control (6) Torque generated by the motor was insufficient.	Check that increasing the torque boost (P35, A55, A155) starts the motor. ➔ Increase the value of the torque boost (P35, A55, A155).

[12] When the T-Link communications option is in use, neither a run command nor a speed command takes effect.

Possible Causes	What to Check and Suggested Measures
(1) Incorrect setting of the communications link operation (H30).	Check whether the setting of the communications link operation is correct (H30). ➔ Correct the data of H30. ➔ Check the status of the X terminal to which the ***LE*** command ("Enable communications link") is assigned.
(2) Incorrect setting of the transmission format (o32).	Check whether the setting of the transmission format is correct (o32). ➔ Correct the data of o32 (4W + 4W or 8W + 8W).
(3) Incorrect setting of the link number.	Check the current setting of the link number (that should be configured in hexadecimal). ➔ Review the function code list.
(4) Data not written to the I/O relay area as assigned.	Check the data held in the I/O relay area, using the MICREX loader. ➔ Investigate writing into the I/O relay area.

[13] When the SX-bus communications option is in use, neither a run command nor a speed command takes effect.

Possible Causes	What to Check and Suggested Measures
(1) Incorrect setting of the communications link operation (H30).	Check whether the setting of the communications link operation is correct (H30). ➔ Correct the data of H30.
(2) Terminal command ***LE*** is assigned to an X terminal, but the terminal is OFF.	Check the status of the X terminal to which the ***LE*** command ("Enable communications link") is assigned. ➔ Turn the corresponding X terminal ON.
(3) Incorrect setting of the transmission format (U11).	Check whether the transmission format selected by U11 is identical with the one selected in the system configuration definition. ➔ Correct the setting of the transmission format.
(4) Incorrect setting of the link number.	Check the current setting of the link number (that should be configured in hexadecimal). ➔ Review the function code list.
(5) Data not written to the I/O relay area as assigned.	Check the data in application programs, using the SX loader. ➔ Investigate writing into the I/O memory area.

[14] When the CC-Link communications option is in use, neither a run command nor a speed command takes effect.

Possible Causes	What to Check and Suggested Measures
(1) Incorrect setting of the communications link operation (H30).	Check whether the setting of the communications link operation is correct (H30). ➔ Correct the data of H30.
(2) Terminal command ***LE*** is assigned to an X terminal, but the terminal is OFF.	Check the status of the X terminal to which the ***LE*** command ("Enable communications link") is assigned. ➔ Turn the corresponding X terminal ON.
(3) Incorrect setting of the transmission format (o32).	Check whether the transmission format selected by o32 is identical with the one selected in the system configuration definition. ➔ Correct the setting of the transmission format.
(4) Incorrect setting of the link number.	Check the current setting of the link number (that should be configured in hexadecimal). ➔ Review the function code list.
(5) Data not written to the I/O memory area as assigned.	Check the data in application programs, using the PLC loader. ➔ Investigate writing into the I/O memory area.

[15] _ _ _ _ (under bar) appears.

Problem Although you pressed the FWD or REV key or entered a run forward command ***FWD*** or a run reverse command ***REV***, the motor did not start and an under bar (_ _ _ _) appeared on the LED monitor.

Possible Causes	What to Check and Suggested Measures
(1) The DC link bus voltage was low.	Select Menu #5 "MAINTENANCE" in Programming mode on the keypad and check the DC link bus voltage which should be 400 VDC or below. (Refer to the FRENIC-VG User's Manual(Unit Type / Function Codes Edition), Chapter 3, Section 3.4.4.6 "Reading maintenance information – Menu #5 MAINTENANCE.") ➔ Connect the inverter to a power supply that meets the input specifications. ➔ Check that the converter works normally.
(2) The main power is not ON, while the auxiliary input power to the control circuit is supplied.	Check whether the main power is turned ON. ➔ Turn the main power ON.
(3) Breaks in wiring to the main power input terminals.	Measure the input voltage. ➔ Repair or replace the main circuit power input wires or input devices (MCCB, MC, etc.).

6.5.2 Problems with inverter settings

[1] Nothing appears on the monitors.

Possible Causes	What to Check and Suggested Measures
(1) No power (neither main power nor auxiliary control power) supplied to the inverter.	Check the input voltage and interphase voltage unbalance. ➔ Turn ON a molded case circuit breaker (MCCB), a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or a magnetic contactor (MC). ➔ Check for voltage drop, phase loss, poor connections, or poor contacts and fix them if necessary.
(2) The keypad was not properly connected to the inverter.	Check whether the keypad is properly connected to the inverter. ➔ Remove the keypad, put it back, and see whether the problem recurs. ➔ Replace the keypad with another one and check whether the problem recurs.
	When running the inverter remotely, ensure that the extension cable is securely connected both to the keypad and to the inverter. ➔ Disconnect the cable, reconnect it, and see whether the problem recurs. ➔ Replace the keypad with another one and check whether the problem per recurs.

[2] The desired function code does not appear.

Possible Causes	Check and Measures
(1) The function code is not located in the current directory.	Check whether the function code is located in a different directory. ➔ Display the function codes in the directory, referring to Chapter 3, Section 3.4 "Programming Mode." If o codes do not appear, check whether an option board is mounted. ➔ Display the function codes in the directory, referring to Chapter 3, Section 3.4 "Programming Mode." **Note:** No o codes appear unless an option board is mounted.

[3] Data of function codes cannot be changed from the keypad.

Possible Causes	What to Check and Suggested Measures
(1) An attempt was made to change function code data that cannot be changed when the inverter is running.	Check if the inverter is running with Menu #3 "OPR MNTR" using the keypad and then confirm whether the data of the function codes can be changed when the motor is running, referring to the function code tables. ➔ Stop the motor and then change the data of the function codes.
(2) The data of the function codes is protected.	Check the data of function code F00 (Data Protection). ➔ Change the data of F00 from "Enable data protection" (F00 = 1) to "Disable data protection" (F00 = 0).
(3) The ***WE-KP*** terminal command ("Enable data change with keypad") is not entered, though it has been assigned to a digital input terminal.	Check the data of function codes E01 through E09 and the input signal status with Menu #4 "I/O CHECK" using the keypad. ➔ Input a ***WE-KP*** command through a digital input terminal.
(4) The FUNC/DATA key was not pressed.	Check whether you have pressed the FUNC/DATA key after changing the function code data. ➔ Press the FUNC/DATA key after changing the function code data. ➔ Check that "STORING…" is displayed on the LCD monitor.
(5) The data of function codes F02 and E01 through E09 cannot be changed.	Either one of the ***FWD*** and ***REV*** terminal commands is turned ON. ➔ Turn OFF both ***FWD*** and ***REV***.

[4] Data of function codes cannot be changed via the communications link.

Possible Causes	What to Check and Suggested Measures
(1) An attempt was made to change function code data that cannot be changed when the inverter is running.	Check if the inverter is running with Menu #3 "OPR MNTR" using the keypad and then confirm whether the data of the function codes can be changed when the motor is running, referring to the function code tables. ➔ Stop the motor and then change the data of the function codes.
(2) The data of the function codes is protected.	Check the data of function code F00 (Data Protection). ➔ Change the data of F00 from "Enable data protection" (F00 = 1) to "Disable data protection" (F00 = 0).
(3) The ***WE-LK*** terminal command ("Enable data change via communications link") is not entered, though it has been assigned to a digital input terminal.	Check the data of function codes E01 through E09 and the input signal status with Menu #4 "I/O CHECK" using the keypad. ➔ Input a ***WE-LK*** command through a digital input terminal.
(4) The "Save All function" (H02) was not executed.	Check that the "Save All function" was executed (H02 = 1). ➔ If data of function codes is changed via the communications link, execute the "Save All function"; otherwise, turning the power OFF loses the changed data.
(5) The data of function code F02 cannot be changed.	Either one of the ***FWD*** and ***REV*** terminal commands is turned ON. ➔ Turn OFF both ***FWD*** and ***REV***.

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 OFF, wait at least ten minutes,** and 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	Replacement of cooling fans ***2** Replacement of DC link bus capacitors and close checks Replacement of fuses

*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 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 stack type's service life estimated at an ambient temperature of 30°C at 100% (MD mode) or 80% (LD mode) 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.

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 ambient 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 installation 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. 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 for safety 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
Structural components such as chassis and covers of the cabinet and inverter		Check for: 1) Loose bolts (at clamp sections). 2) Deformation and breakage (warped cabinet) 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
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" (Refer to the FRENIC-VG User's Manual(Unit Type / Function Codes Edition), Chapter 3, Section 3.4.4.6.)	1), 2), 3), 4) No abnormalities
Cooling system	Cooling fan	1) Check for any abnormality. 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" (Refer to the FRENIC-VG User's Manual(Unit Type / Function Codes Edition), Chapter 3, Section 3.4.4.6.)	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] Periodical 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

Additional notes

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

[3] Checking the functional safety circuit

In applications where no regular activation of the Safe Torque Off (STO) function with terminals [EN1] and [EN2] is guaranteed, check at least once a year that the Safe Torque Off (STO) function works correctly.

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
Electrolytic capacitors on printed circuit boards	10 years
Cooling fans	10 years
Fuses	10 years
Battery	5 years (Battery ambient temperature 60°C, Inverter not powered)

Note These replacement intervals are based on the inverter's service life estimated at an ambient temperature of 30°C at 100% (MD-mode inverters) or 80% (LD-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 in a well-ventilated, cool and dark place and energized approximately once a year.

(3) Cooling fans and battery 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 battery and the request for replacement of other parts, contact the sales agent where you purchased the product or your nearest Fuji Electric representative.

7.4.1 Judgment on service life

Table 7.4-2 lists the parts whose service life can be predicted and details the life prediction function. The predicted values should be used only as a guide since the actual service life is influenced by the ambient temperature and other usage environments. (Refer to the FRENIC-VG User's Manual, Chapter 3, Section 3.4.4.6 "Reading maintenance information -- Menu #5 MAINTENANCE.")

Table 7.4-2 Life Prediction

Object of life prediction	Prediction function	End-of-life criteria	Prediction timing	"5: MAINTENANCE" on the LCD monitor
DC link bus capacitor	ON-time counting Counts the time elapsed when the voltage is applied to the DC link bus capacitor.	Exceeding 87,600 hours (10 years)	During ordinary operation	LCD page 8 CAPEH (Elapsed time) CAPRH (Time remaining before the end of life)
Electrolytic capacitors on printed circuit boards	Counts the time elapsed when the voltage is applied to the capacitors.	Exceeding 87,600 hours (10 years)	During ordinary operation	LCD page 3 TCAP (Cumulative run time)
Cooling fans	Counts the run time of the cooling fans.	Exceeding 87,600 hours (10 years)	During ordinary operation	LCD page 3 TFAN (Cumulative run time)

(Note) In the stack type, the CAP (Capacitance of DC link bus capacitor) on LCD page 2 in "5: MAINTENANCE" is invalid.

Early warning of lifetime alarm

For the components listed in Table 7.4-2, the inverter can issue an early warning of lifetime alarm ***LIFE*** at one of the transistor output terminals ([Y1] to [Y4]) and Relay output terminals ([Y5A/C]) as soon as any of the levels specified in Table 7.4-2 has been exceeded.

The early warning signal is also turned ON when a lock condition on the internal air circulation DC fan is detected.

7.4.2 Battery

[1] Outline

The battery is used to back up the traceback memory and the calendar clock when no power is applied to the inverter.

Model	OPK-BP
Battery voltage/capacity	3.6 V/1100 mAh
Type	Lithium-thionyl chloride battery
Replacement interval (as a guide)	5 years (Battery ambient temperature 60°C, Inverter not powered)

Unit: mm

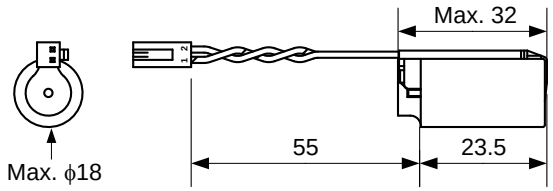


Figure 7.4-1 Outside View and Dimensions

⚠WARNING

Safety Precautions

The lithium thionyl chloride battery, which contains lithium (dangerous material) and thionyl chloride (deleterious material), is a hermetically sealed, high-energy density battery. Improper use of the battery could cause deformation, leakage of battery fluid (Liquid inside the battery leaks out), heat generation, battery-rupture or fire, or produce irritant and corrosive gas. This could result in bodily injury or inverter fault. Be sure to observe the following precautions.

- Take care not to swallow the battery.
- Do not apply excessive force to the positive terminal of the battery.
- Do not drop the battery.
- Do not short-circuit the battery terminals.
- Do not charge the battery.
- Do not discharge the battery forcedly.
- Never heat the battery.
- Never put the battery into fire.
- Never disassemble the battery.
- Do not deform the battery by pressure.
- When loading the battery into the inverter, take care not to insert it in wrong direction.
- Do not touch the fluid leaked from the battery.
- Do not leave a damaged battery in the inverter.

⚠CAUTION

When storing the battery, keep it away from direct sunlight, high temperature, high humidity, and rainwater.

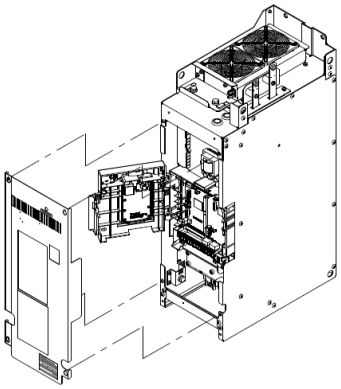
The battery used in this product is a so-called primary battery. When disposing of it, comply with local codes and regulations.

[2] Loading the battery

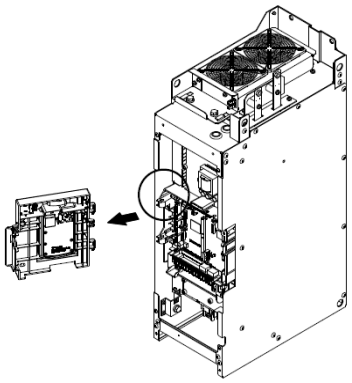
⚠CAUTION
Before proceeding to the loading procedure, be sure to shut down the power. **Fire or an accident could occur.**

* For the calendar clock setting, refer to Section 3.2.1 "Setting the calendar clock."

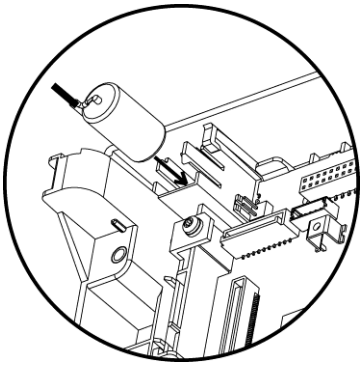
1) Remove the front cover.
   Open the keypad and disconnect it from connectors CN5 and CN8 on the control printed circuit board.



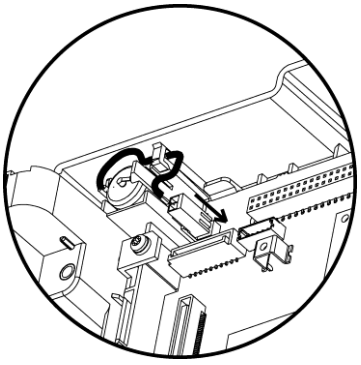
2) Remove the keypad.



3) Load the battery to the location shown below.



4) Fully insert the battery connector into the connector CN7 on the control printed circuit board.



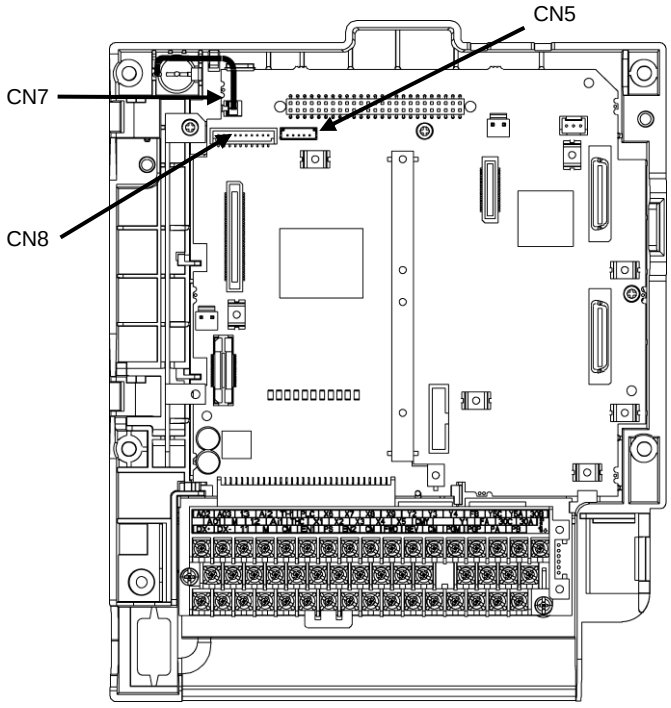


Figure 7.4-2 Battery Loaded

To replace the battery, remove it from the inverter in the reverse order of loading and then load a new battery.

⚠CAUTION
Before proceeding to the loading procedure, be sure to shut down the power. **Fire or an accident could occur.**

* For the calendar clock setting, refer to Section 3.2.1 "Setting the calendar clock."

[3] About marine or air transport of a lithium-metal battery

When transporting a lithium-metal battery by itself, by packing it in a package of the inverter, or by incorporating it in the inverter, observe the following notes.

(1) To transport a lithium-metal battery incorporated in the inverter

When transporting a cabinet holding five or more inverters with a built-in battery, it is necessary to attach the label shown in Figure 7.4-3 and prepare the transportation documents.

(2) To transport a lithium-metal battery packed with the inverter

It is necessary to attach the label shown in Figure 7.4-3 and issue a drop test certificate together with the transportation documents.

To transport a lithium-metal battery by air, the number of batteries that can be contained in a package of the inverter is limited to the number of batteries required for device operation plus 2 batteries.

120 x 110 mm

Figure 7.4-3 Label to be Attached to Outer Wrapping

For details, contact your shipping company.

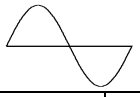
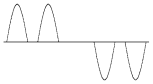
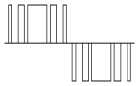
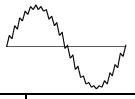
7.5 Measurement of Electrical Amounts in Main Circuit

Because the voltage and current of the main circuit power supply (input) of the converter connected to the inverter and those of the inverter output (to the motor) 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.

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

Table 7.5-1 Meters for Measurement of Main Circuit

Item	Input (converter power supply) side			Output (motor) side			DC link bus voltage (between P(+) and N(-))
	Voltage 	Current 		Voltage 	Current 		
Name of meter	Ammeter $A_{R, S, T}$	Voltmeter $V_{R, S, T}$	Wattmeter $W_{R, S, T}$	Ammeter $A_{U, V, W}$	Voltmeter $V_{U, V, W}$	Wattmeter $W_{U, W}$	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.

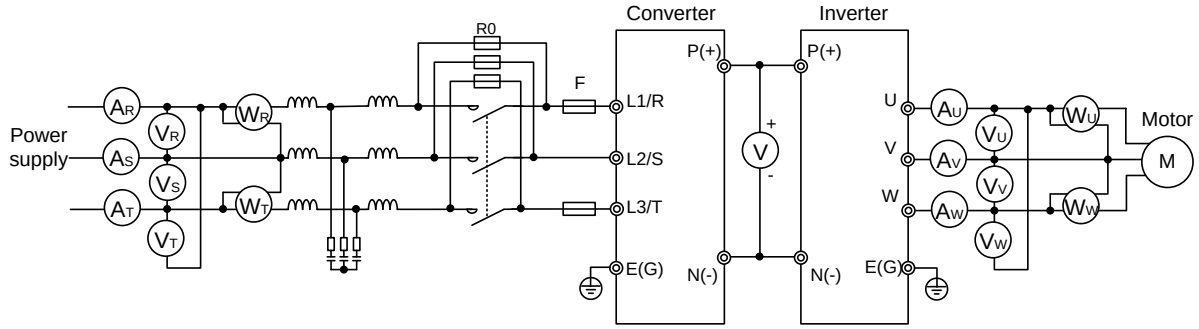


Figure 7.5-1 Connection of Meters

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.)

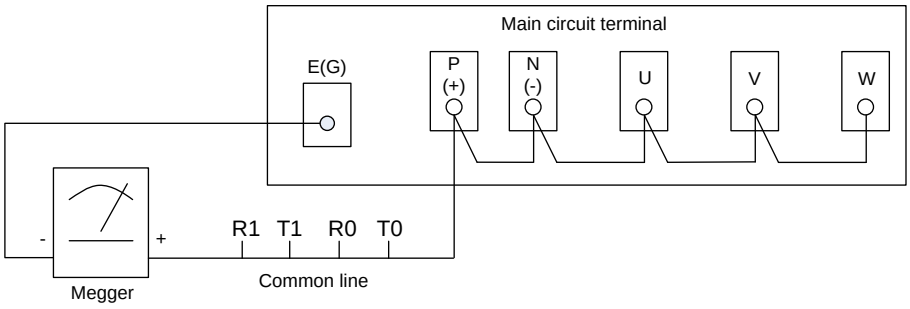


Figure 7.6-1 Main Circuit Terminal Connection for Megger Test

(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.

Chapter 8 SPECIFICATIONS

MD (Medium Duty)-mode inverters for medium load

Item			Specifications													
Inverter	Type (FRN□VG1S-4E)		30S	37S	45S	55S	75S	90S	110S	132S	160S	200S	220S	250S	280S	315S
	Nominal applied motor (kW)		30	37	45	55	75	90	110	132	160	200	220	250	280	315
	Rated capacity (kVA) ***1**		45	57	69	85	114	134	160	192	231	287	316	356	396	445
	Rated current (A)		60	75	91	112	150	176	210	253	304	377	415	468	520	585
	Overload capability		150% of the rated current for 1 minute ***2**													
	Input power	Main power input	Refer to the PWM converter or Diode rectifier specifications.													
		Auxiliary control power input: Phase, voltage, frequency	Single-phase, 380 to 480V, 50/60 Hz													
		Auxiliary fan power input: Phase, voltage, frequency	-					Single-phase, 380 to 440 V/50 Hz, 380 to 480 V/60 Hz ***3**								
		Allowable voltage/frequency	Voltage: +10 to -15%, Frequency: +5 to -5%													
	Carrier frequency (kHz) ***4**		2 kHz													
	Approx. mass (kg)		30	30	30	37	37	45	45	95	95	95	125	135	135	135
	Enclosure		IP00, UL open type													

Item			Specifications			
Inverter	Type (FRN□VG1S-4E) ***5**		630B	710B	800B	
	Nominal applied motor (kW)		630	710	800	
	Rated capacity (kVA) ***1**		891	1044	1127	
	Rated current (A)		1170	1370	1480	
	Overload capability		150% of the rated current for 1 minute ***2**			
	Input power	Main power input	Refer to the PWM converter or Diode rectifier specifications.			
		Auxiliary control power input: Phase, voltage, frequency	Single-phase, 380 to 480V, 50/60 Hz			
		Auxiliary fan power input: Phase, voltage, frequency	Single-phase, 380 to 440 V/50 Hz, 380 to 480 V/60 Hz ***3**			
		Allowable voltage/frequency	Voltage: +10 to -15%, Frequency: +5 to -5%			
	Carrier frequency (kHz) ***4**		2 kHz			
	Approx. mass (kg)		135×3			
	Enclosure		IP00, UL open type			

The above specifications apply when Function code F80 = 3 (MD mode).

*1 This specification applies when the rated output voltage is 440 V.

*2 When the inverter output frequency converted is less than 1 Hz, the inverter may trip earlier due to overload depending on the ambient temperature and other conditions.

*3 For 380 to 398 V/50 Hz or 380 to 430 V/60 Hz, connector switching is required inside the inverter.

*4 Running a permanent magnet synchronous motor (PMSM) except Fuji standard PMSM (GNF2 series) at low carrier frequency may overheat the permanent magnet due to the output current harmonics, resulting in demagnetization. Be sure to check the allowable carrier frequency of the motor.

*5 A set of three phase-specific stacks for U, V and W phases constitutes a single inverter unit.

LD (Low Duty)-mode inverters for light load

Item			Specifications													
Inverter	Type (FRN□VG1S-4E)		30S	37S	45S	55S	75S	90S	110S	132S	160S	200S	220S	250S	280S	315S
	Nominal applied motor (kW)		37	45	55	75	90	110	132	160	200	220	250	280	315	355
	Rated capacity (kVA) ***1**		57	69	85	114	134	160	192	231	287	316	356	396	445	495
	Rated current (A)		75	91	112	150	176	210	253	304	377	415	468	520	585	650
	Overload capability		110% of the rated current for 1 minute ***2**													
	Input power	Main power input	Refer to the PWM converter or Diode rectifier specifications.													
		Auxiliary control power input: Phase, voltage, frequency	Single-phase, 380 to 480V, 50/60 Hz													
		Auxiliary fan power input: Phase, voltage, frequency	–					Single-phase, 380 to 440 V/50 Hz, 380 to 480 V/60 Hz ***3**								
		Allowable voltage/frequency	Voltage: +10 to -15%, Frequency: +5 to -5%													
	Carrier frequency (kHz) ***4**		2 kHz													
	Approx. mass (kg)		30	30	30	37	37	45	45	95	95	95	125	135	135	135
	Enclosure		IP00, UL open type													

Item			Specifications			
Inverter	Type (FRN□VG1S-4E) ***5**		630B	710B	800B	
	Nominal applied motor (kW)		710	800	1000	
	Rated capacity (kVA) ***1**		1044	1127	1409	
	Rated current (A)		1370	1480	1850	
	Overload capability		110% of the rated current for 1 minute ***2**			
	Input power	Main power input	Refer to the PWM converter or Diode rectifier specifications.			
		Auxiliary control power input: Phase, voltage, frequency	Single-phase, 380 to 480V, 50/60 Hz			
		Auxiliary fan power input: Phase, voltage, frequency	Single-phase, 380 to 440 V/50 Hz, 380 to 480 V/60 Hz ***3**			
		Allowable voltage/frequency	Voltage: +10 to -15%, Frequency: +5 to -5%			
	Carrier frequency (kHz) ***4**		2 kHz			
	Approx. mass (kg)		135×3			
	Enclosure		IP00, UL open type			

The above specifications apply when Function code F80 = 1 (LD mode).

*1 This specification applies when the rated output voltage is 440 V.

*2 When the inverter output frequency converted is less than 1 Hz, the inverter may trip earlier due to overload depending on the ambient temperature and other conditions

*3 For 380 to 398 V/50 Hz or 380 to 430 V/60 Hz, connector switching is required inside the inverter.

*4 Running a permanent magnet synchronous motor (PMSM) except Fuji standard PMSM (GNF2 series) at low carrier frequency may overheat the permanent magnet due to the output current harmonics, resulting in demagnetization. Be sure to check the allowable carrier frequency of the motor.

*5 A set of three phase-specific stacks for U, V and W phases constitutes a single inverter unit.

Chapter 9 CONFORMITY WITH STANDARDS

9.1 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, Low Voltage Directive, and Machinery Directive which are issued by the Council of the European Communities.

Table 9.1-1 Conformity with Standards

	Standards	
Combination	Diode rectifier : RHD200S-4D□, RHD315S-D□ Inverter : FRN30SVG1S-4□ to FRN315SVG1S-4□ FRN630BVG1S-4□ to FRN800BVG1S-4□	PWM converter : RHC132S-4D□ to RHC315S-4D□ RHC630B-4D□ to RHC800B-4D□ Inverter : FRN30SVG1S-4□ to FRN315SVG1S-4□ FRN630BVG1S-4□ to FRN800BVG1S-4□
EMC Directives	IEC/EN61800-3 Immunity : Second environment (Industrial) Emission : Category C3 IEC/EN61326-3-1	
Low Voltage Directive	IEC/EN61800-5-1	
Machinery Directive	EN ISO13849-1 : PL-d, Category 3 IEC/EN 60204-1 : Stop category 0	
Functional Safety Standard	IEC/EN 61800-5-2: SIL2 IEC/EN 62061 : SIL2	

9.1.1 Compatibility with Revised EMC Directive and Low Voltage Directive

In the revised EMC Directive (2014/30/EU) and Low Voltage Directive (2014/35/EU), it is necessary to clearly state the name and the address of manufacturers and importers to enhance traceability. Importers shall be indicated as follows when exporting products from Fuji Electric to Europe.

(Manufacturer)

Fuji Electric Co., Ltd
5520, Minami Tamagaki-cho, Suzuka-city, Mie 513-8633, Japan

(Importer in Europe)

Fuji Electric Europe GmbH
Goethering 58, 63067 Offenbach / Main, Germany

<Precaution when exporting to Europe>

- Not all Fuji Electric products in Europe are necessarily imported by the above importer. If any Fuji Electric products are exported to Europe via another importer, please ensure that the importer is clearly stated by the customer.

9.1.2 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.

Power supply voltage	PWM converter type	Diode rectifier type	MD/LD mode	Filter			Remarks
				type	Leakage current *1		
					Under normal conditions	Under worst-case conditions	
Three-phase 400V	RHC132S-4D□	-	MD	FS5536-400-99-1	78	439	
			LD				
	RHC160S-4D□	-	MD				
			LD				
	RHC200S-4D□	RHD200S-4D□	MD				
			LD				
	RHC220S-4D□	-	MD	FN3359-800-99	38	227	
			LD				
	RHC280S-4D□	-	MD				
			LD				
	RHC315S-4D□	RHD315S-4D□	MD				
			LD				
	RHC630B-4D□	-	MD	FN3359-1600-99	38	227	
			LD				
	RHC710B-4D□	-	MD				
			LD				
	RHC800B-4D□	-	MD				
			LD	FN3359-2500-99	38	227	

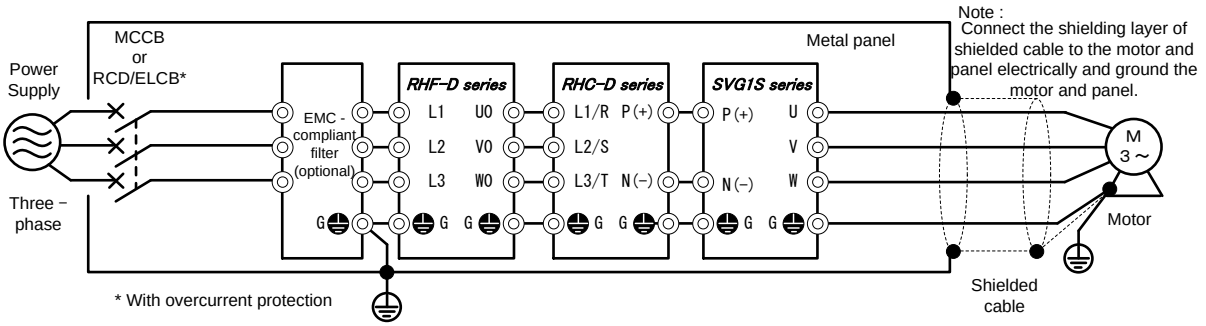
*1 Calculated based on these measuring conditions: 400V, 50 Hz, interphase voltage unbalance ratio 2%.

■ Recommended installation procedure

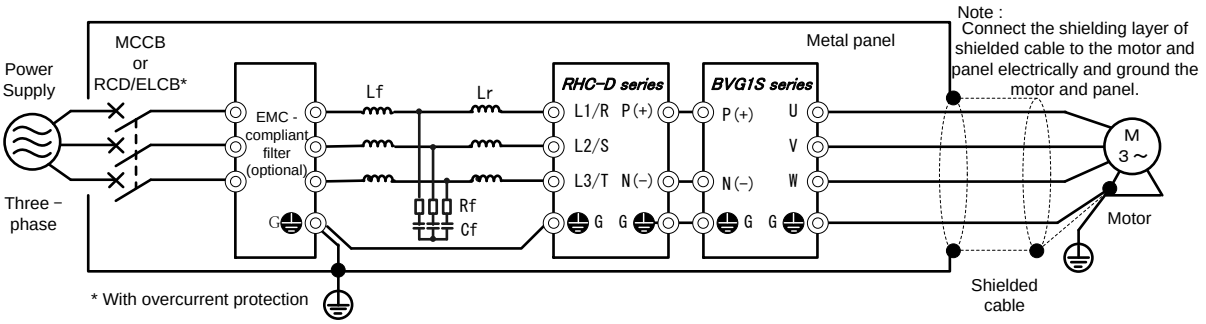
To make the machinery or equipment fully compliant with the EMC Directive, have certified technicians wire the filter stack, the PWM converter, the diode rectifier, the inverter and the motor and in strict accordance with the procedure described below.

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

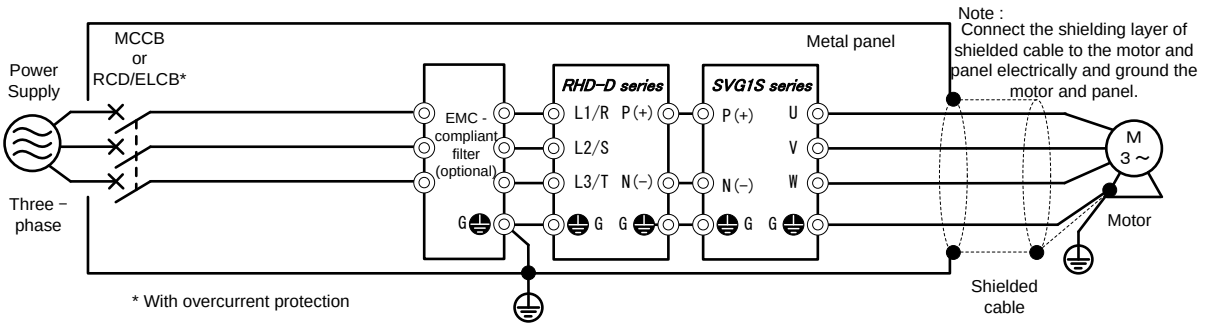
1) Mount the filter stack, the PWM converter, the diode rectifier, the inverter and the filter on a grounded panel or metal plate. Use shielded wires for the motor cable and route the cable as short as possible. Firmly clamp the shields to the metal plate to ground them. Further, connect the shielding layers electrically to the grounding terminal of the motor.
2) For connection to control terminals of the filter stack, the PWM converter, the diode rectifier and the inverter 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.



In the case of the combination of the PWM converter with RHF and the inverter.



In the case of the combination of the PWM converter and the inverter.



In the case of the combination of the diode rectifier and the inverter.

Figure 9.1-1 Mounting an EMC-compliant Filter (option) in a Metal Panel

9.1.3 Harmonic component regulation in the EU

When you use general-purpose industrial inverters in the EU, the harmonics emitted from the inverter to power lines are strictly regulated as stated below.

If an inverter is connected to public low-voltage power supply, it is regulated by the harmonics emission regulations from inverters to power lines (with the exception of industrial low-voltage power lines). Refer to Figure 9.1-2 below for details.

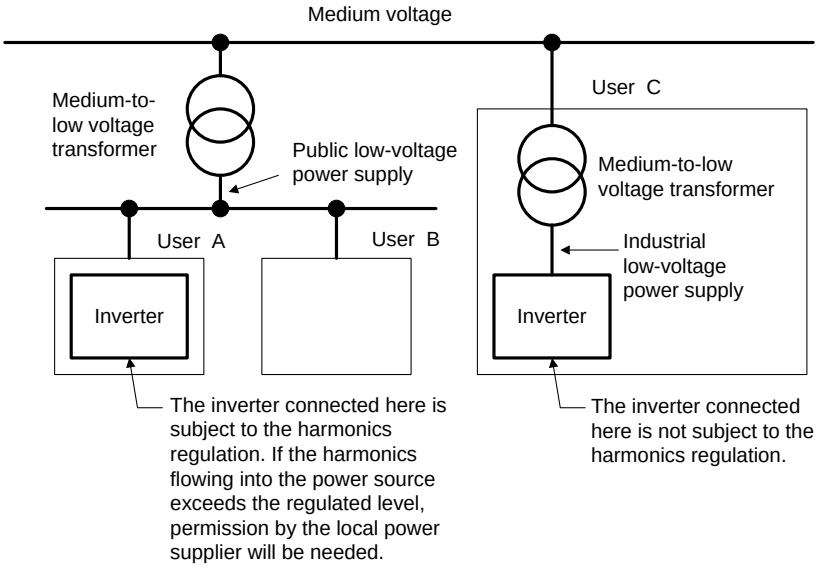


Figure 9.1-2 Power Source and Regulation

Compliance with IEC/EN 61000-3-2

Power supply voltage	Diode rectifier / PWM converter type	Conformity
Three-phase 400 V	RHD200S-4D□, RHD315S-D□ RHC132S-4D□ to RHC315S-4D□ RHC630B-4D□ to RHC800B-4D□	○ *1

To obtain the data with the harmonics current data, contact your Fuji Electric representative.

Use the inverter applied by combination within the limits of each diode rectifier or PWM converter.

*1 To conform to the diode rectifier or the PWM converter compliance with the IEC/EN 61000-3-12, connect them to the power supply whose short-circuit ratio Rsce is 120 or above.

9.1.4 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.

Compliance with European Standards

Adjustable speed electrical power drive systems (PDS).

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

⚠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.

   AC fuse : Breaking capacity: Min. 10 kA, Rated voltage: Min. 500 V

   DC fuse : Breaking capacity: Min. 10 kA, Rated voltage: Min. 800 V

RHD□S-4D series

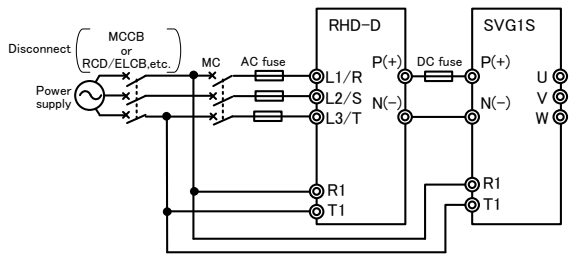
Power supply voltage	Diode rectifier type	MD/LD mode	AC Fuse rating (A)
Three-phase 400V	RHD200S-4D□	MD	630(IEC60269-4)
		LD	630(IEC60269-4)
	RHD315S-4D□	MD	900(IEC60269-4)
		LD	1000(IEC60269-4)

RHC□S-4D series

Power supply voltage	PWM converter type	MD/LD mode	AC Fuse rating (A)
Three-phase 400V	RHC132S-4D□	MD	400(IEC60269-4)
		LD	450(IEC60269-4)
	RHC160S-4D□	MD	450(IEC60269-4)
		LD	630(IEC60269-4)
	RHC200S-4D□	MD	630(IEC60269-4)
		LD	700(IEC60269-4)
	RHC220S-4D□	MD	700(IEC60269-4)
	RHC280S-4D□	MD	800(IEC60269-4)
		LD	900(IEC60269-4)
	RHC315S-4D□	MD	900(IEC60269-4)
		LD	1000(IEC60269-4)
	RHC630B-4D□	MD	1800(IEC60269-4)
		LD	2000(IEC60269-4)
	RHC710B-4D□	MD	2000(IEC60269-4)
		LD	2500(IEC60269-4)
	RHC800B-4D□	MD	2500(IEC60269-4)
		LD	3000(IEC60269-4)

Note: A box (□) replaces an alphabetic letter depending on the enclose and the shipping destination.

RHD□S-4D series



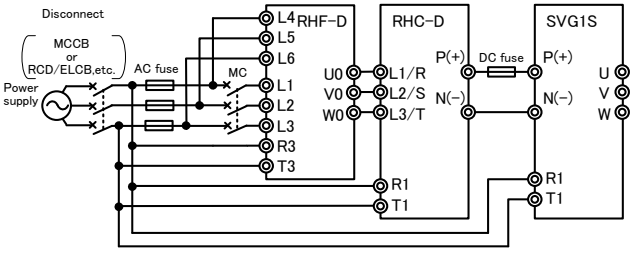
SVG1 series

Power supply voltage	Nominal applied motor (kW)	Inverter type	MD/ LD mode	DC Fuse rating (A)
Three-phase 400V	30	FRN30SVG1S-4□	MD	200(IEC60269-4)
			LD	200(IEC60269-4)
	37	FRN37SVG1S-4□	MD	200(IEC60269-4)
			LD	200(IEC60269-4)
	45	FRN45SVG1S-4□	MD	250(IEC60269-4)
			LD	250(IEC60269-4)
	55	FRN55SVG1S-4□	MD	250(IEC60269-4)
			LD	315(IEC60269-4)
	75	FRN75SVG1S-4□	MD	315(IEC60269-4)
			LD	400(IEC60269-4)
	90	FRN90SVG1S-4□	MD	400(IEC60269-4)
			LD	400(IEC60269-4)
	110	FRN110SVG1S-4□	MD	400(IEC60269-4)
			LD	500(IEC60269-4)
	132	FRN132SVG1S-4□	MD	500(IEC60269-4)
			LD	630(IEC60269-4)
	160	FRN160SVG1S-4□	MD	630(IEC60269-4)
			LD	800(IEC60269-4)
	200	FRN200SVG1S-4□	MD	800(IEC60269-4)
			LD	800(IEC60269-4)
	220	FRN220SVG1S-4□	MD	800(IEC60269-4)
			LD	900(IEC60269-4)
	250	FRN250SVG1S-4□	MD	900(IEC60269-4)
			LD	1000(IEC60269-4)
	280	FRN280SVG1S-4□	MD	1000(IEC60269-4)
			LD	1250(IEC60269-4)
	315	FRN315SVG1S-4□	MD	1250(IEC60269-4)
			LD	1250(IEC60269-4)
	355	FRN630BVG1S-4□	MD	1800(IEC60269-4)
			LD	1800(IEC60269-4)
	630	FRN710BVG1S-4□	MD	2000(IEC60269-4)
			LD	2000(IEC60269-4)
	710	FRN800BVG1S-4□	MD	2000(IEC60269-4)
			LD	2500(IEC60269-4)
	800			
	1000			

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

⚠WARNING⚠

RHC□S-4D series



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 if the power supply is three-phase 400 V.
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 listed in IEC60364-5-52.

RHD□S-4D series

Power supply voltage	Diode rectifier type	MD/LD mode	MCCB or RCD/ELCB *1 Rated current	Recommended wire/copper bar size (mm^2)						
				Main circuit					Control circuit	Fan power supply [R1, T1]
				Main power input *2 [L1/R, L2/S, L3/T]		Diode rectifier output [P(+),N(-)] *2		Ground terminal [⏚G]		
				Copper bar	Wire	Copper bar	Wire			
Three phase 400 V	RHD200S-4D□	MD	500	t5×30 (150)	240	t4×40 (160)	300	120	0.75	2.5
		LD	500		240		150×2	120		
	RHD315S-4D□	MD	700	t10×30 (300)	185×2	t8×50 (400)	300×2	185		
		LD	800		240×2		300×2	240		

RHC□S-4D series

Power supply voltage	PWM converter type	MD/LD mode	MCCB or RCD/ELCB *1 Rated current	Recommended wire/copper bar size (mm^2)							
				Main circuit						Control circuit	R0,T0 R1,S1,T1 R2,T2 R3,T3 73A,73C
				Main power input *2 [L1/R, L2/S, L3/T]		PWM converter output [P(+),N(-)] *2,*3		Ground terminal [⏚G]	Charging circuit [L4,L5,L6]		
				Copper bar	Wire	Copper bar	Wire				
Three phase 400 V	RHC132S-4D□	MD	300	t5×30 (150)	120	t4×40 (160)	120	70	2.5	0.75	2.5
		LD	350		150		150	95			
	RHC160S-4D□	MD	350		150		150	95			
		LD	500		240		240	120			
	RHC200S-4D□	MD	500		240		240	120			
		LD	500		240		300	150			
	RHC220S-4D□	MD	500	t10×30 (300)	240	t8×50 (400)	300	150			
	RHC280S-4D□	MD	600		150×2		185×2	185			
		LD	700		185×2		185×2	185			
	RHC315S-4D□	MD	700		185×2		185×2	185			
		LD	800		240×2		240×2	120×2			
	RHC630B-4D□	MD	1400	t10×125 (1250)	240×4	t8×50 (400)	-	185			
		LD	1600		300×4			120×2			
	RHC710B-4D□	MD	1600		300×4			120×2			
		LD	1800		240×5			120×2			
	RHC800B-4D□	MD	1800		240×5			120×2			
		LD	2200		300×6			150×2			

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

⚠ WARNING ⚠

SVG1 series

Power supply voltage	Nominal applied motor (kW)	Inverter type	MD/LD mode	Recommended wire/ copper bar size (mm^2)						
				Main circuit					Control circuit	Aux. control power supply [R0, T0]	Fan power supply [R1, T1]
				DC input [P(+),N(-)] *2		Inverter output [U,V,W] *2		Ground terminal [⏚G]			
				Copper bar	Wire	Copper bar	Wire				
Three phase 400 V	30	FRN30SVG1S-4□	MD	t3×25 (75)	16		16	16	0.75	2.5	-
	37		LD		25		25	16			
		FRN37SVG1S-4□	MD		25		25	16			
	45		LD		35		35	16			
		FRN45SVG1S-4□	MD		35		25	16			
	55		LD		35		35	16			
		FRN55SVG1S-4□	MD	t3×30 (90)	35	t5×30 (150)	35	16			
	75		LD		70		70	35			
		FRN75SVG1S-4□	MD		70		70	35			
	90		LD		95		70	50			
		FRN90SVG1S-4□	MD		95		70	50			2.5
	110		LD		120		95	70			
		FRN110SVG1S-4□	MD		120		95	70			
	132		LD		150		120	95			
		FRN132SVG1S-4□	MD	t4×40 (160)	150		120	95			
	160		LD		240		185	120			
		FRN160SVG1S-4□	MD		240		185	120			
	200		LD		300		240	150			
		FRN200SVG1S-4□	MD		300		240	150			
	220		LD		150×2		300	150			
		FRN220SVG1S-4□	MD	t8×50 (400)	150×2	t10×30 (300)	300	150			
	250		LD		185×2		150×2	185			
		FRN250SVG1S-4□	MD		185×2		150×2	185			
	280		LD		240×2		185×2	240			
		FRN280SVG1S-4□	MD		240×2		185×2	240			
	315		LD		300×2		240×2	300			
		FRN315SVG1S-4□	MD		300×2		240×2	300			
	355		LD		300×2		240×2	300			
	630	FRN630BVG1S-4□	MD	t8×50 (400) *3	-	t10×125 (1250) *3	240×4	185 *3			
	710		LD				300×4	120×2 *3			
		FRN710BVG1S-4□	MD				300×4	120×2 *3			
	800		LD				300×5	150×2 *3			
		FRN800BVG1S-4□	MD				300×5	150×2 *3			
			LD				300×6	150×2 *3			

Note: A box (□) replaces an alphabetic letter depending on the enclosure or the shipping destination.

*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.

*2 The recommended wire size for main circuits is for the 70°C 600 V PVC wires used at a surrounding temperature of 40°C.

*3 The size of wire or copper bar of stack by phase is a part for 1 phase (1 stack).

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

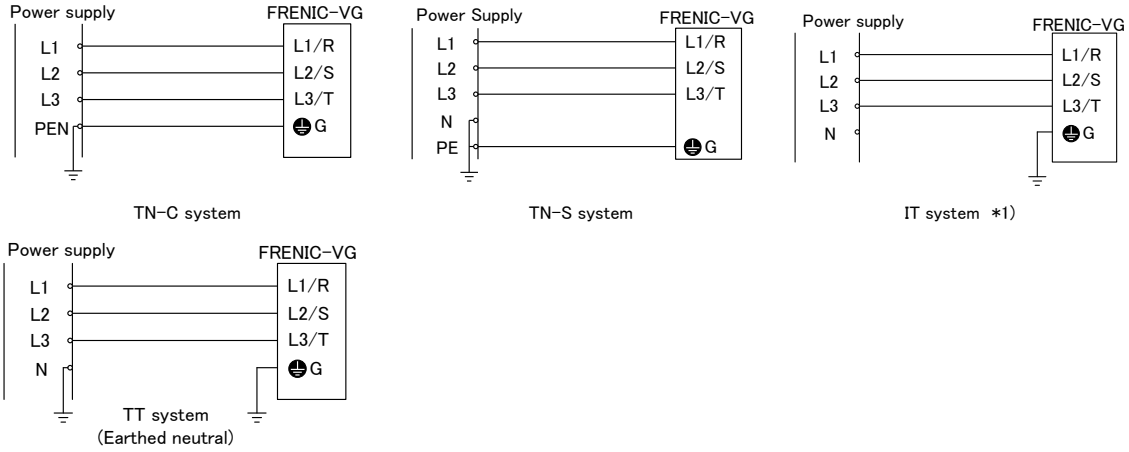
⚠WARNING⚠

10. The inverter has been tested with IEC/EN61800-5-1 5.2.3.6.3 Short-circuit Current Test under the following conditions.

    Short-circuit current in the supply: 10,000 A

    Maximum 480 V for 400 V class series

11. Use this inverter at the following power supply system.



*1 Use this inverter at the following IT system.

Non-earthed (isolated from earth) IT system	Can be used. In this case the insulation between the control interface and the main circuit of the inverter is basic insulation. Thus do not connect SELV circuit from external controller directly (make connection using a supplementary insulation.). Use an earth fault detector able to disconnect the power within 5s after the earth fault occurs.
IT system which earthed neutral by an impedance	

12. As the touch current (leakage current) of inverters is relatively high, it is of essential importance to always assure a reliable connection to Protective Earth (PE). The minimum cross sectional area of the PE-conductor should be:

    - 10 mm^2 (Cu-conductors) - 16 mm^2 (Al-conductors)

    Three Phase PDS (Power Drive System) with touch currents ≥ 3.5 mA AC or ≥ 10 mA DC

    An electric shock could occur.

9.2 Compliance with Functional Safety Standard

9.2.1 General

In FRENIC-VG series of inverters, opening the hardware circuit between terminals [EN1]-[PS] or between terminals [EN2]-[PS] stops the output transistor, coasting the motor to a stop. (EN1: Enable input 1, EN2: Enable input 2) This is the Safe Torque Off (STO) function prescribed in IEC/EN60204-1, Category 0 (Uncontrolled stop) and compliant with Functional Safety Standard.

Using the Safe Torque Off (STO) function eliminates the need of external safety circuit breakers while conventional inverters need those breakers to configure the Functional Safety Standard compliant safety system.

⚠WARNING⚠

- The output shutdown function of this inverter uses the Safe Torque Off (STO) function prescribed in IEC/EN61800-5-2 so that it does not completely shut off the power supply to the motor electrically. Depending upon applications, therefore, additional measures are necessary for safety of end-users, e.g., brake function that locks the machinery and motor terminal protection that prevents possible electrical hazard(s).
- The output shutdown function does not completely shut off the power supply to the motor electrically. Before starting wiring or maintenance jobs, turn OFF the power and wait at least ten minutes. 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).

Enable terminals and peripheral circuit, and internal circuit configuration

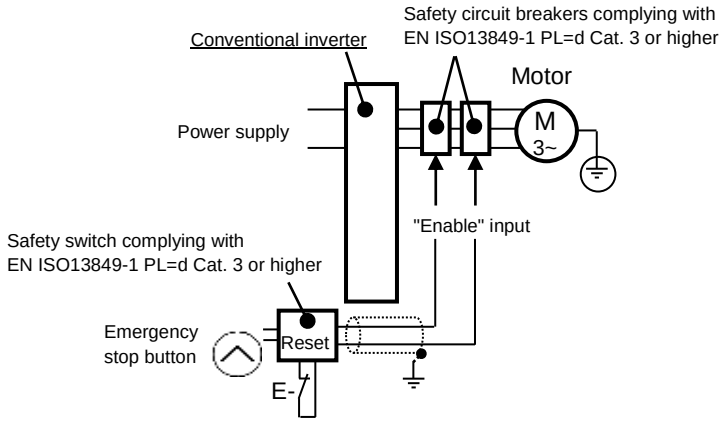
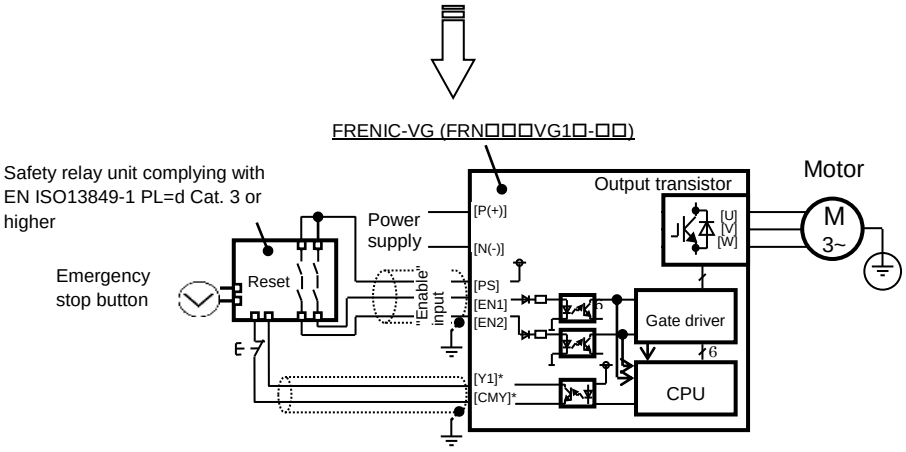


Figure 9.2-1 Conventional Inverters



*Transistor output terminals (e.g., [Y1]-[CMY], ***DECF*** (Function code data=80), Refer to Section 5.3.)

Figure 9.2-2 FRN□□□VG1□-□□

9.2.2 Notes for compliance to Functional Safety Standard

1) Wiring for terminals [EN1] (Enable input 1) and [EN2] (Enable input 2)

- [EN1]/[EN2] and [PS] are terminals prepared for connection of safety related wires; therefore, careful wiring should be performed to ensure that no short-circuit(s) can occur to these terminals.
- Stopping the current flowing through terminal [EN1] or [EN2] activates the safety stop function. For opening and closing the hardware circuit between terminals [EN1]/[EN2] and [PS], use safety approved components such as safety relays that comply with EN ISO13849-1 PL=d Cat. 3 or higher to ensure a complete shutoff.
- It is the responsibility of the machinery manufacturer to guarantee that a short-circuiting or other fault does not occur in wiring of external safety components between terminals [EN1]/[EN2] and [PS].

  Fault examples:
  - Terminals [EN1]/[EN2] and [PS] are short-circuited due to the wiring being caught in the door of the panel so that a current continues to flow in terminal [EN1]/[EN2] although the safety component is OFF and therefore the safety function may NOT operate.
  - The wiring is in contact with any other wire so that a current continues to flow in terminal [EN1]/[EN2] and therefore the safety function may NOT operate.
- To activate the STO function correctly, be sure to keep terminals [EN1] and [EN2] OFF for at least 50 ms.
- When inputting test pulses sent from the safety PLC to terminals [EN1] and [EN2], keep the pulse width of the OFF signal 1 ms or less.
- When using the functional safety card OPC-VG1-SAFE, keep the jumper bars mounted between terminals [EN1]/[EN2] and [PS] since those terminals cannot be used. For the Safe Torque Off (STO) function, use terminals [ST1] and [ST2] on the functional safety card.

2) Note for Safe Torque Off (STO)

- When configuring the product safety system with this Safe Torque Off (STO) function, make a risk assessment of not only the external equipment and wiring connected to terminals [EN1] and [EN2] (Enable input 1 and Enable input 2) but also the whole system including other equipment, devices and wiring against the product safety system required by the machinery manufacturer under the manufacturer's responsibility in order to confirm that the whole system conforms to the product safety system required by the machinery manufacturer.

  In addition, as preventive maintenance, the machinery manufacturer must perform periodical inspections to check that the product safety system properly functions.
- To bring the inverter into compliance with Functional Safety Standard, it is necessary to install the inverter on a control panel with the enclosure rating of IP54 or above.
- To bring the inverter into compliance with Functional Safety Standard, it is necessary to bring it into compliance with European Standards IEC/EN61800-5-1 and IEC/EN61800-3.
- This Safe Torque Off (STO) function coasts the motor to a stop. When a mechanical brake is used to stop or hold the motor for the sake of the product safety system of whole system, do not use the inverter's control signals such as output from terminal [Y]. (Using control signals does not satisfy the safety standards because of software intervention.) Use safety relay units complying with EN ISO13849-1 PL=d Cat. 3 or higher to activate mechanical brakes.
- The safety shutdown circuit between terminal [EN1] and [EN2] input sections and inverter's output shutdown section is dual-configured (redundant circuit) so that an occurrence of a single fault does not detract the Safe Torque Off (STO).

  If a single fault is detected in the safety shutdown circuit, the inverter coasts the motor to a stop even with the [EN1]-[PS] and [EN2]-[PS] states being ON, as well as outputting an alarm to external equipment. (Note that the alarm output function is not guaranteed to all of single faults. It is compliant with EN ISO13849-1 PL=d Cat. 3).
- The Safe Torque Off (STO) function does not completely shut off the power supply to the motor electrically. Before starting wiring or maintenance jobs, be sure to disconnect the input power to the inverter. For details, refer to "wiring" in the safety precautions given on page vi.
- In the case of a permanent magnet synchronous motor (PMSM), a voltage is generated on the motor terminals even during "coast to a stop" caused by the Safe Torque Off (STO) function. When handling the live parts, therefore, be sure to check that the motor is stopped and cut off the input power to the inverter beforehand.

3) Checking wiring

If wiring is changed in the initial start-up or maintenance, be sure to perform the following test with the inverter stopped.

- Turn each of terminals [EN1] and [EN2] OFF (open) and ON (short) and check on the I/O check screen of the keypad that the relevant section turns "signal ON" and "signal OFF," respectively.

9.2.3 Functional safety performance

Table 9.2-1 lists the safety performance values required by the Functional Safety Standard.

Table 9.2-1 Functional Safety Performance

Stop function	Safe Torque Off (STO) (IEC/EN61800-5-2)	
Response time	60 ms or less (From input to the terminal to Safe Torque Off)	
Safety integrity level	SIL 2	(IEC/EN61800-5-2)
PFH	2.00×10^{-9}	(Probability of a dangerous random hardware failure per hour) (IEC/EN61800-5-2)
Category	3	(EN ISO13849-1)
Performance level	PL-d	(EN ISO13849-1)
Mean time to dangerous random hardware failure, MTTFd	150 years	(EN ISO13849-1)
Hardware fault tolerance	HFT1	(IEC/EN61800-5-2)
Safe failure fraction	SFF: 60% or above, Type B	(IEC/EN61800-5-2)
Systematic capability	SC2	(IEC/EN61508)
Proof test interval	10 years	

- The proof test refers to a periodical test to detect safety-related failures.
- The PFH is calculated with the Siemens standard model SN29500.

9.2.4 Inverter output state when Safe Torque Off (STO) is activated

Turning the emergency stop button ON turns EN1 and EN2 OFF, bringing the inverter into the Safe Torque Off (STO) state.

Figure 9.2-3 Inverter Output State when the Emergency Stop Button is Turned OFF with the Inverter being Stopped shows the timing scheme to apply when the emergency stop button is turned OFF with the inverter being stopped. Input to the EN1 and EN2 comes ON, making the inverter ready to run.

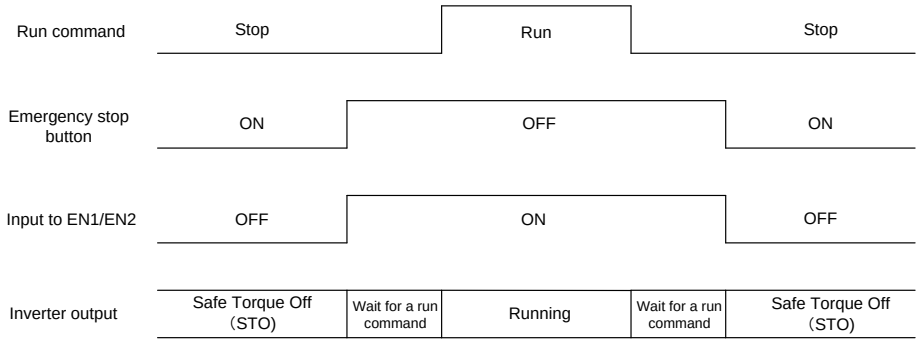


Figure 9.2-3 Inverter Output State when the Emergency Stop Button is Turned OFF with the Inverter being Stopped

Figure 9.2-4 Inverter Output State when the Emergency Stop Button is Turned ON with the Inverter Running shows the timing scheme to apply when the emergency stop button is turned ON with the inverter running. Input to the EN1 and EN2 goes OFF, bringing the inverter into the Safe Torque Off (STO) state and coasting the motor to a stop.

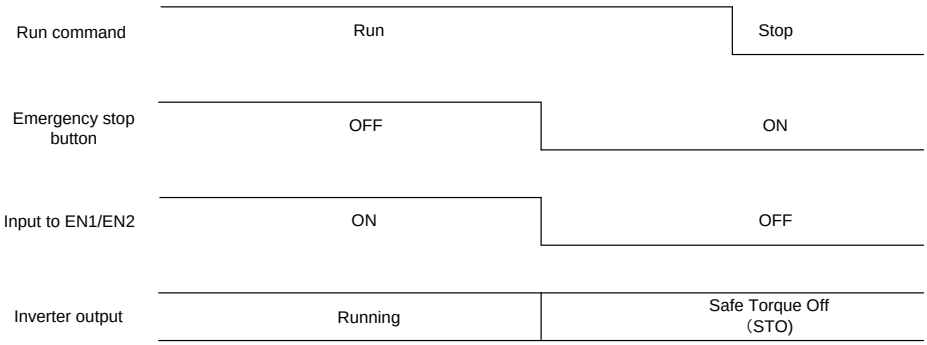


Figure 9.2-4 Inverter Output State when the Emergency Stop Button is Turned ON with the Inverter Running

9.2.5 ECF alarm (caused by logic discrepancy) and inverter output state

Figure 9.2-5 shows the timing scheme to apply when EN1 and EN2 inputs are not aligned so that an alarm ECF occurs.

Turning the emergency stop button ON turns EN1 and EN2 inputs OFF, which usually brings the inverter into the Safe Torque Off (STO) state. If the misalignment of the EN1 and EN2 inputs is within 50 ms, no alarm occurs; if it is more than 50 ms, the inverter interprets it as a logic discrepancy, outputting an alarm ECF The alarm can be cleared by restarting the inverter.

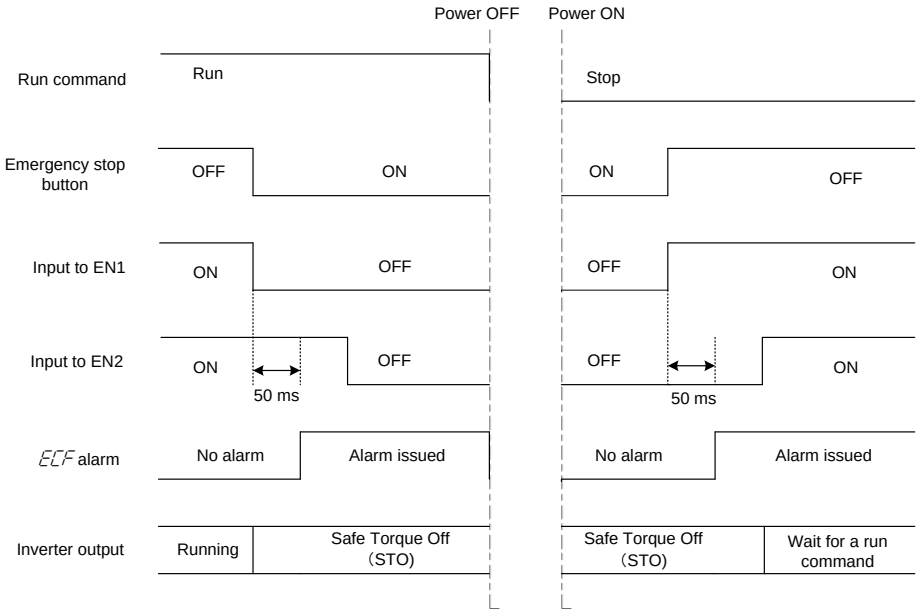


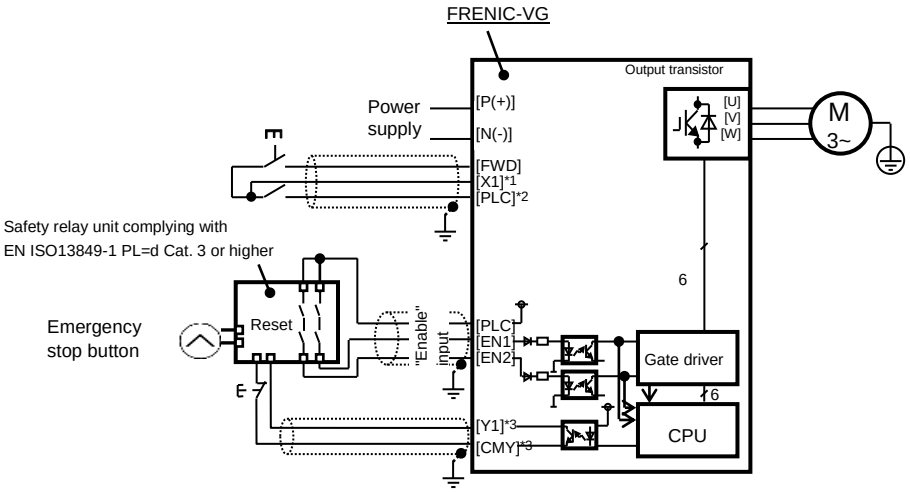
Figure 9.2-5 ECF Alarm (Caused by Logic Discrepancy) and Inverter Output State

9.2.6 Prevention of restarting

To prevent the inverter from restarting just by turning the emergency stop button OFF, configure the Enable input circuit as shown below. Figure 9.2-7 shows the timing scheme for prevention of restarting.

Assigning the ***HLD*** ("Enable 3-wire operation") to any digital input terminal and setting the E01 data to "6" sets up the ***HLD*** function at the [X1] terminal.

After the ***FWD*** comes ON with the ***HLD*** being ON, even turning the ***FWD*** OFF keeps the inverter running due to the ***HLD***. Turning the emergency stop button ON under the condition causes the motor to coast to a stop. After that, turning the emergency stop button OFF no longer starts the inverter to run. To run the inverter, turn the ***FWD*** ON again.



*1 Digital input terminal (e.g., [X1])

*2 If SW1 is in the SINK mode, [CM] applies; if in the SOURCE mode, [PLC] applies.

*3 Transistor output terminals (e.g., [Y1]-[CMY], ***DECF*** (Function code data=80))

Figure 9.2-6 Connection Diagram and Internal Circuit Configuration

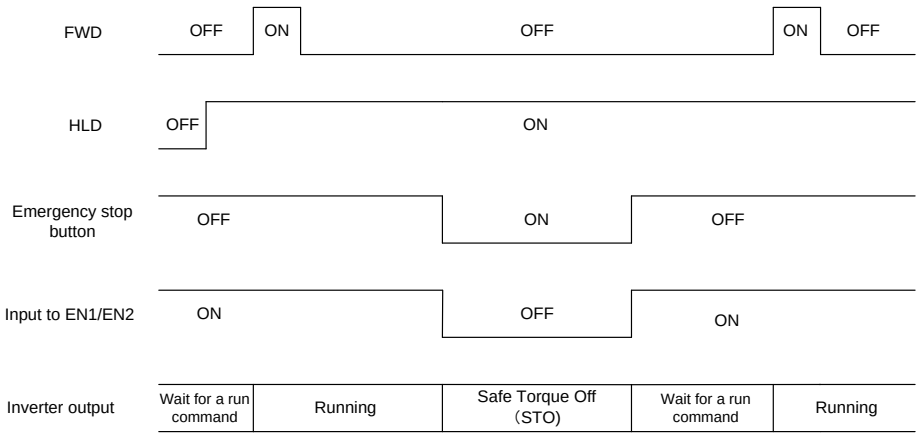


Figure 9.2-7 Prevention of Restarti

9.3 Compliance with UL Standards and Canadian Standards (cUL certification) (c UL us LISTED)

Originally, the UL standards were established by Underwriters Laboratories, Inc. as private criteria for inspections/investigations pertaining to fire/accident insurance in the USA. Later, these standards were authorized as the official standards to protect operators, service personnel and the general populace from fires and other accidents in the USA.

cUL certification means that UL has given certification for products to clear CSA Standards. cUL certified products are equivalent to those compliant with CSA Standards.

■ Notes

UL/cUL-listed inverters are subject to the regulations set forth by the UL standards and CSA standards (cUL-listed for Canada) by installation within precautions listed below.

⚠CAUTION

1. Solid state motor overload protection (motor protection by electronic thermal overload relay) is provided in the inverter (FRN-SVG1S or FRN-BVG1S series).
   Use function codes F10 to F12 to set the protection level.

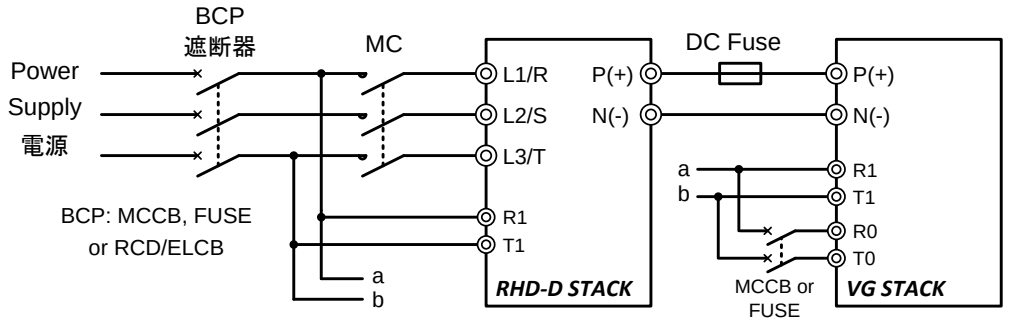
   "WARNING – Operation of this equipment requires detailed operation instructions provided in the Users Manual intended for use with this product. This information is provided on the CD ROM included in the container this device was packaged in. It should be retained with this device at all times. A hard copy of this information may be ordered through your local service representative of Fuji Electric co.,ltd"

2. Use Cu wire only.
3. Use Class 1 wire only for control circuits.
4. Short circuit rating

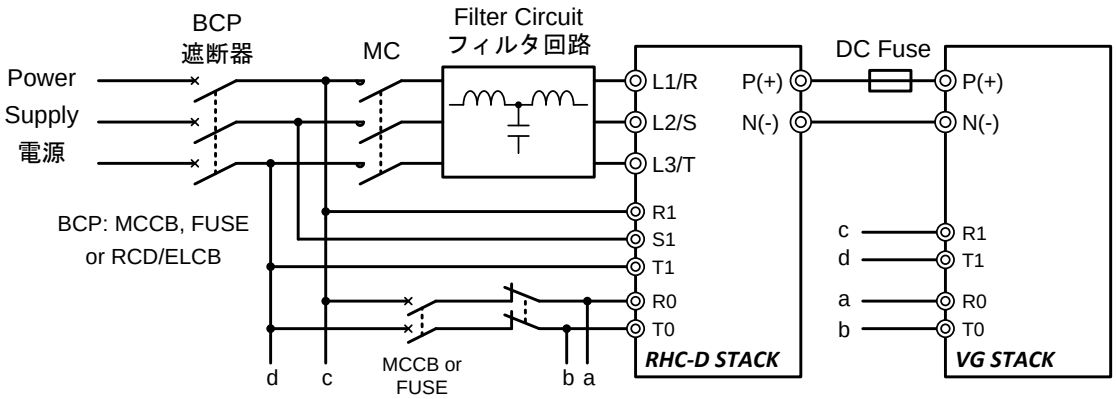
   "Suitable For Use On A Circuit Of Delivering Not More Than 100,000 rms Symmetrical Amperes, 480 Volts Maximum when protected by Class J Fuses or a Circuit Breaker having an interrupting rating not less than 100,000 rms Symmetrical Amperes, 480 Volts Maximum."

   "Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes."

5. When wire is used, field wiring connections must be made by a UL Listed and CSA Certified closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.
6. All circuits with terminals L1/R, L2/S, L3/T, R0, T0, R1, T1 must have a common disconnect and be connected to the same pole of the disconnect if the terminals are connected to the power supply.



In case of the combination of Diode rectifier and Inverter



In case of the combination of PWM converter and Inverter

Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued)

⚠CAUTION

7. Environmental Requirements

- Surrounding temperature
  Maximum Surrounding Air Temperature 40°C
- Atmosphere
  For use in pollution degree 2 environments. (for Open-Type models)

8.Functional Description of Control Circuit Terminals

A power source for connection to the Integrated alarm output (30A, 30B, 30C) should be limited to overvoltage category II such as control circuit or secondary winding of power transformer.

Classification	Terminal Symbol	Terminal Name	Functional description
Contact output	[30A/B/C]	Integrated alarm output	When the inverter stops with an alarm, output is generated on the relay contact (1C). Contact capacitance: AC250 V 0.3A cosφ=1, DC30 V 0.5 A

9. Combinations of Diode rectifier(RHD series) and inverter(SVG1S or BVG1S series) are shown in the table below.

Diode rectifier		Applicable inverter capacity [kW]	Combined conditions
Type	MD/LD mode		
RHD200S-4D□	MD	110 to 200	1.The inverter which may be combined with this converter is made into FRN-SVG1S or FRN-BVG1S series. 2.The total capacity of all inverters shall not exceed the applicable inverter capacity(kW). 3.If it is less than mentioned capacity, two or more sets or a different combination of capacity is possible for the inverter connected to this converter. 4.The number of the maximum connection to the converter of the inverters is not restrained.
	LD	110 to 220	
RHD315S-4D□	MD	180 to 315	
	LD	180 to 355	

10. Combinations of PWM converter(RHC series) and inverter(FRN-SVG1S series or BVG1S series) are shown in the table below

PWM converter		Applicable inverter capacity [kW]	Combined conditions
Type	MD/LD mode		
RHC132S-4D□	MD	132 max	1.The inverter which may be combined with this converter is made into FRN-SVG1S or BVG1S series. 2.The total capacity of all inverters shall not exceed the applicable inverter capacity(kW). 3.If it is less than mentioned capacity, two or more sets or a different combination of capacity is possible for the inverter connected to this converter. 4.The number of the maximum connection to the converter of the inverters is not restrained.
	LD	160 max	
RHC160S-4D□	MD		
	LD	200 max	
RHC200S-4D□	MD		
	LD	220 max	
RHC220S-4D□	MD		
	LD	250 max	
RHC250S-4D□	MD		
	LD	280 max	
RHC280S-4D□	MD		
	LD	315 max	
RHC315S-4D□	MD		
	LD	355 max	

Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued)

⚠CAUTION

11.Install UL certified fuses or circuit breaker between the power supply and the converter, referring to the table below.

RHD series

Power supply voltage	Converter type	MD/LD mode	Class J fuse size *4 (A)	Circuit breaker trip size *5 (A)	Required torque lb-in (N・m)		
					Main terminal/ Grounding	Control circuit	Aux. fan power supply
					L1/R,L2/S,L3/T P,N, ⏚ G		R1,T1
Three-phase 400V	RHD200S-4D□	MD	600	500	424.7 (48)	10.6 (1.2)	10.6 (1.2)
		LD	-				
	RHD315S-4D□	MD	-	700			
		LD	-	800			

Power supply voltage	Converter type	MD/LD mode	Copper bar size (mm^2)		Wire size AWG (mm^2)		
			Main terminal		Grounding	Control circuit	Aux. fan power supply
			L1/R,L2/S, L3/T	P,N	⏚ G		R1,T1
Three-phase 400V	RHD200S-4D□	MD	5 by 30 (150)	4 by 40 (160)	1 (42.4)	16 (1.25) *1 *2	14 (2.1) *2
		LD			1/0 (53.5)		
	RHD315S-4D□	MD	10 by 30 (300)	8 by 50 (400)	2/0 (67.4)		
		LD					

Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued)

⚠CAUTION

RHC series

Power supply voltage	Converter type	MD/LD mode	Class J fuse size *4 (A)	Circuit breaker trip size *5 (A)	Required torque lb-in (N・m)			
					Main terminal/ Grounding	Control circuit	Aux. control power supply	Aux. fan power supply
					L1/R,L2/S,L3/T P,N, ⏚ G		R0,T0	R1,S1,T1
Three-phase 400V	RHC132S-4D□	MD	300	300	424.7 (48)	6.1 (0.7)	10.6 (1.2)	10.6 (1.2)
		LD	400	350				
	RHC160S-4D□	MD						
		LD	600	500				
	RHC200S-4D□	MD						
		LD	-					
	RHC220S-4D□	MD						
	RHC280S-4D□	MD	-	600				
		LD	-	700				
	RHC315S-4D□	MD						
		LD	-	800				
	RHC630B-4D□	MD	-	1400				
		LD	-	1600				
	RHC710B-4D□	MD						
		LD	-	1800				
	RHC800B-4D□	MD						
		LD	-	2200				

Power supply voltage	Converter type	MD/LD mode	Copper bar size (mm^2)		Wire size AWG (mm^2)			
			Main terminal		Grounding	Control circuit	Aux. control power supply	Aux. fan power supply
			L1/R,L2/S L3/T	P,N	⏚ G		R0,T0	R1,T1
Three-phase 400V	RHC132S-4D□	MD	5 by 30 (150)	4 by 40 (160)	4 (21.2)	16 (1.25) *1 *2	14 (2.1) *2	14 (2.1) *2
		LD			3 (26.7)			
	RHC160S-4D□	MD						
		LD			1 (42.4)			
	RHC200S-4D□	MD						
		LD			1/0 (53.5)			
	RHC220S-4D□	MD	10 by 30 (150)	8 by 50 (400)				
	RHC280S-4D□	MD						
		LD			2/0 (67.4)			
	RHC315S-4D□	MD						
		LD						
	RHC630B-4D□	MD	10 by 125 (1250)	8 by 50 (3x400)	2/0×2 (67.4×2)			
		LD						
	RHC710B-4D□	MD						
		LD			4/0×2 (107.2×2)			
	RHC800B-4D□	MD						
		LD						

Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued)

⚠CAUTION

FRN-SVG1S,FRN-BVG1S series

Power supply voltage	Nominal applied motor	Inverter type	MD/LD mode	DC Bus Fuse size *3		Required torque lb-in (N・m)			
						Main terminal/ Grounding	Control circuit	Aux. control power supply	Aux. fan power supply
				Type	Rating (A)	L1/R,L2/S,L3/T P,N, ⏚ G		R0,T0	R1,T1
Three-phase 400V	30	FRN30SVG1S-4□	MD	170M3394 -XA	200	119.4 (13.5)	6.1 (0.7)	10.6 (1.2)	-
	37		LD						
		FRN37SVG1S-4□	MD						
	45		LD						
		FRN45SVG1S-4□	MD	170M3395 -XA	250				
	55		LD						
		FRN55SVG1S-4□	MD						
	75		LD	170M3396 -XA	315				
		FRN75SVG1S-4□	MD						
	90		LD	170M3448 -XA	400	238.9 (27)			10.6 (1.2)
		FRN90SVG1S-4□	MD						
	110		LD						
		FRN110SVG1S-4□	MD						
	132		LD	170M4445 -XA	500				
		FRN132SVG1S-4□	MD			424.7 (48)			
	160		LD	170M5446 -XA	630				
		FRN160SVG1S-4□	MD						
	200		LD	170M6546 -XA	800				
		FRN200SVG1S-4□	MD						
	220		LD						
		FRN220SVG1S-4□	MD						
	250		LD	170M6547 -XA	900				
		FRN250SVG1S-4□	MD						
	280		LD	170M6548 -XA	1000				
		FRN280SVG1S-4□	MD						
	315		LD	170M6500 -XA	1250				
		FRN315SVG1S-4□	MD						
	355		LD						
	630	FRN630BVG1S-4□	MD	170M7532	1800				
	710		LD	170M7633	2000				
		FRN710BVG1S-4□	MD						
	800		LD						
		FRN800BVG1S-4□	MD						
	1000		LD	170M7595	2500				

Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued)

⚠CAUTION

Power supply voltage	Nominal applied motor	Inverter type	MD/LD mode	Copper bar size (mm^2)		Wire size AWG (mm^2)			
				Main terminal			Grounding	Control circuit	Aux. control power supply	Aux. fan power supply
				P,N	U,V,W		⏚ G		R0,T0	R1,T1
Three-phase 400V	30	FRN30SVG1S-4□	MD	3 by 25 (75)	-	6 (13.3) *2	6 (13.3)	16 (1.25) *1 *2	14 (2.1) *1 *2	-
	37		LD			4 (21.2) *2				
		FRN37SVG1S-4□	MD							
	45		LD			3 (26.7) *2				
		FRN45SVG1S-4□	MD			2 (33.6) *2	4 (21.2)			
	55		LD							
		FRN55SVG1S-4□	MD	3 by 30 (90)						
	75		LD			1/0 (53.5) *2	3 (26.7)			
		FRN75SVG1S-4□	MD							
	90		LD			3/0 (85) *2				14 (2.1) *2
		FRN90SVG1S-4□	MD							
	110		LD			4/0 (107.2) *2				
		FRN110SVG1S-4□	MD							
	132		LD			250 (127) *2	2 (33.6)			
		FRN132SVG1S-4□	MD	4 by 40 (160)	5 by 30 (150)	-				
	160		LD				1/0 (53.5)			
		FRN160SVG1S-4□	MD							
	200		LD							
		FRN200SVG1S-4□	MD							
	220		LD							
		FRN220SVG1S-4□	MD	8 by 50 (400)	10 by 30 (300)					
	250		LD				2/0 (67.4)			
		FRN250SVG1S-4□	MD							
	280		LD							
		FRN280SVG1S-4□	MD							
	315		LD				4/0 (107.2)			
		FRN315SVG1S-4□	MD							
	355		LD							
	630	FRN630BVG1S-4□	MD	8 by 50 (400) *6	10 by 125 (1250) *6		2/0×2 (67.4×2) *6			
	710		LD				4/0×2 (107.2×2) *6			
		FRN710BVG1S-4□	MD							
	800		LD							
		FRN800BVG1S-4□	MD							
	1000		LD							

Conformity with UL standards and CSA standards (cUL-listed for Canada) (continued)

⚠CAUTION

*1 No terminal end treatment is required for connection.
*2 Use 75°C Cu wire only.
*3 Supplier: Cooper Bussmann
*4 6 rms Amperes for aux. control power supply.
*5 5 rms Amperes for aux. control power supply.

12. Filter stack(RHF series) and peripheral devices of PWM converter(RHC series) are not contained in UL/cUL authorization range.

13. If the keypad is removed from the inverter and mounts it to the out of the cabinet, it will be out of UL/cUL authorization range.

MEMO

High Performance, Vector Control Inverter (Stack Type)

FRENIC-VG

Instruction Manual

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Fuji Electric Co., Ltd.

The purpose of this instruction manual is to provide accurate information in handling, setting up and operating of the FRENIC-VG 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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