

# ***FRENIC-HVAC***

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## **CAUTION**

Thank you for purchasing our FRENIC-HVAC series of inverters.

- This product is designed to drive a three-phase induction motor. Read through this manual to become familiar with the handling procedure and correct use.
- Improper handling might result in incorrect operation, short life cycle, or 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 an optional device, refer to the instruction and installation manuals for that optional device.

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## Preface

Thank you for purchasing our FRENIC-HVAC series of inverters. This product is designed to drive a three-phase induction motor.

This instruction manual is Translation of the original instructions and provides only minimum requisite information for wiring and operation of the product. Read through this manual before use.

For details about this product, refer to the FRENIC-HVAC User's Manual that contains the precautions, detailed functions and specifications, wiring, configuration and maintenance.

### Related documentation

- FRENIC-HVAC User's Manual

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



We plan to make the latest edition of the User's Manual available for download from the following URL:

(URL) <https://felib.fujielectric.co.jp/download/login.htm?site=global&lang=en>

## ■ Safety precautions


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

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


|  |   |
|--|---|
|  <b>WARNING</b> | Failure to heed the information indicated by this symbol may lead to dangerous conditions, possibly resulting in death or serious bodily injuries.                                  |
|  <b>CAUTION</b> | 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

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|--|
|  <b>WARNING</b>   |
| <ul style="list-style-type: none"><li>• This product is designed to drive a three-phase induction motor. Do not use it for single-phase motors or for other purposes.<br/><b>Fire or an accident could occur.</b></li><li>• This product may not be used for a life-support system or other purposes directly related to the human safety.</li><li>• Although product 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.<br/><b>An accident could occur.</b></li></ul> |

## Installation


|   |
|---|
|  <b>WARNING</b>  |
| <ul style="list-style-type: none"><li>• Install the inverter on a base made of metal or other non-flammable material.<br/><b>Otherwise, a fire could occur.</b></li><li>• Do not place flammable object nearby.<br/><b>Doing so could cause fire.</b></li></ul> |

## CAUTION

- Do not support the inverter by its front cover during transportation.  
**Doing so could cause a drop of the inverter and injuries.**
- Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the heat sink.
- When changing the positions of the top and bottom mounting bases, use only the specified screws.  
**Otherwise, a fire or an accident might result.**
- Do not install or operate an inverter that is damaged or lacking parts.  
**Doing so could cause fire, an accident or injuries.**

## Wiring

## WARNING

- If there isn't zero-phase current (Earth leakage current) detective device, such as a ground-fault relay-in the upstream power supply line, which is to avoid undesirable system shutdown, install a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) individually to break the individual inverter's power supply line.  
**Otherwise, a fire could occur.**
- When wiring the inverter to the power source, insert a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the path of each pair of power lines to inverters. Use the recommended devices within the recommended current capacity.
- Use wires in the specified size.
- Tighten terminals with specified torque.  
**Otherwise, a fire could occur.**
- When there is more than one combination of an inverter and motor, do not use a multicore cable for the purpose of running their wirings together.
- Do not connect a surge killer to the inverter's output (secondary) circuit.  
**Doing so could cause a fire.**
- Be sure to ground the inverter's grounding terminals G.  
**Otherwise, an electric shock or a fire could occur.**
- Qualified electricians should carry out wiring.
- Be sure to perform wiring after turning the power OFF.  
**Otherwise, an electric shock could occur.**
- Be sure to perform wiring after installing the inverter unit.  
**Otherwise, an electric shock or injuries could occur.**
- Ensure that the number of input phases and the rated voltage of the product match the number of phases and the voltage of the AC power supply to which the product is to be connected.
- When using this product in combination with a PWM converter, refer to the instructions given in the FRENIC-HVAC User's Manual.  
**Otherwise, a fire or an accident could occur.**
- Do not connect the power supply wires to the inverter output terminals (U, V, and W).  
**Doing so could cause fire or an accident.**

## **WARNING**

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

**Doing so could cause an accident or an electric shock.**

## **WARNING**

- Before changing the switches, **turn OFF the power and wait at least 10 minutes**. Make sure that the charging lamp is turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

**Otherwise, an electric shock could occur.**

## **CAUTION**

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

**Otherwise an accident could occur.**

- The leakage current of the EMC filter built-in type of inverters is comparatively large. Be sure to perform protective grounding.

**Otherwise, an accident or an electric shock could occur.**

## Operation

### **WARNING**

- Be sure to mount the front cover before turning the power ON. Do not remove the cover when the inverter power is ON.

**Otherwise, an electric shock could occur.**


- Do not operate switches with wet hands.



**Doing so could cause electric shock.**

- If the auto-reset function has been selected, the inverter may automatically restart and drive the motor depending on the cause of tripping. Design the machinery or equipment so that human safety is ensured at the time of restarting.

**Otherwise, an accident could occur.**

- If the stall prevention function (current limiter), automatic deceleration (anti-regenerative control), or overload prevention control has been selected, the inverter may operate with acceleration/deceleration or frequency different from the commanded ones. Design the machine so that safety is ensured even in such cases.

- The  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  key. To enable the  key for an emergency stop, select the STOP key priority with function code H96 (= 1 or 3).

- If any of the protective functions have been activated, first remove the cause. Then, after checking that all the 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.**

## **WARNING**

- 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 wrong without completely understanding this Instruction Manual and the FRENIC-HVAC User's Manual, the motor may rotate with a torque or at a speed not permitted for the machine.

**An accident or injuries could occur.**

- Even if the inverter has interrupted power to the motor, if the voltage is applied to the main circuit input terminals L1/R, L2/S and L3/T, voltage may be output to inverter output terminals U, V, and W.
- Even if the motor is stopped due to DC braking, 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 the function code settings.  
Run commands (e.g., "Run forward" **FWD**, "FMS is switch to fire mode" **FMS**), stop commands (e.g., "Coast to a stop" **BX**), and frequency change commands can be assigned to digital input terminals. Depending upon the assignment states of those terminals, modifying the function code setting may cause a sudden motor start or an abrupt change in speed.
- When the inverter is controlled with the digital input signals, switching run or frequency command sources with the related terminal commands (e.g., **SS1**, **SS2**, **SS4**, **SS8**, **Hz2/Hz1**, **Hz/PID**, **IVS**, **LE** and **FMS**) may cause a sudden motor start or an abrupt change in speed.
- Ensure safety before modifying customizable logic related function code settings (U codes and related function codes) or turning ON the "Cancel customizable logic" terminal command **CLC**. Depending upon the settings, such modification or cancellation of the customizable logic may change the operation sequence to cause a sudden motor start or an unexpected motor operation.
- If any abnormality is found in the inverter or motor, immediately stop it and perform troubleshooting, referring to the FRENIC-HVAC User's Manual.

**An accident or injuries could occur.**

## Maintenance and inspection, and parts replacement

### **WARNING**

- Before proceeding to maintenance or inspection, **turn OFF the power and wait at least 10 minutes.** Make sure that the charging lamp is turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).  
**Otherwise, an electric shock could occur.**
- Always carry out the daily and periodic inspections described in the 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 carryout 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] [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.
- Continued use of a depleted backup battery may result in loss of data.  
**Otherwise, an accident or fire could occur.**
- Maintenance, inspection, and parts replacement should be made only by qualified persons.
- Take off the watches, rings and other metallic objects before starting work.
- Use insulated tools.  
**Otherwise, an electric shock or injuries could occur.**
- Never modify the inverter.  
**Doing so could cause an electric shock or injuries.**

## Disposal

### **CAUTION**

- Treat the inverter as an industrial waste when disposing of it.  
**Otherwise injuries could occur.**

## GENERAL PRECAUTIONS

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

## Icons

The following icons are used throughout this manual.



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



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



This icon indicates a reference to more detailed information.

## Conformity to the Low Voltage Directive in the EU


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).

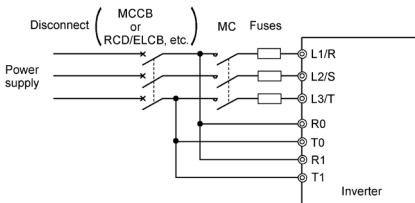
Part 5-1: Safety requirements. Electrical, thermal and energy. IEC/EN 61800-5-1

## ⚠ WARNING ⚠

- 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 of recommended size listed on page vii.  
\*With overcurrent protection.
- To prevent the risk of hazardous accidents that could be caused by damage of the inverter, install the specified fuses in the supply side (primary side) according to the following tables.  
- Breaking capacity: Min. 10 kA  
- Rated voltage: Min. 500 V

### ■ kW rating

| Power supply voltage | Nominal applied motor (kW) | Inverter type                  | Fuse rating (A)     | Power supply voltage | Nominal applied motor (kW) | Inverter type                  | Fuse rating (A)     |
|----------------------|----------------------------|--------------------------------|---------------------|----------------------|----------------------------|--------------------------------|---------------------|
| Three-phase 200 V    | 0.75                       | FRN0.75AR1■-2□                 | 6(IEC/EN 60269-2)   | Three-phase 400 V    | 0.75                       | FRN0.75AR1■-4□                 | 4(IEC/EN 60269-2)   |
|                      | 1.5                        | FRN1.5AR1■-2□                  | 10(IEC/EN 60269-2)  |                      | 1.5                        | FRN1.5AR1■-4□                  | 6(IEC/EN 60269-2)   |
|                      | 2.2                        | FRN2.2AR1■-2□                  | 16(IEC/EN 60269-2)  |                      | 2.2                        | FRN2.2AR1■-4□                  | 10(IEC/EN 60269-2)  |
|                      | 3.7 (4.0)*                 | FRN3.7AR1■-2□<br>FRN4.0AR1■-2E | 25(IEC/EN 60269-2)  |                      | 3.7 (4.0)*                 | FRN3.7AR1■-4□<br>FRN4.0AR1■-4E | 16(IEC/EN 60269-2)  |
|                      | 5.5                        | FRN5.5AR1■-2□                  | 35(IEC/EN 60269-2)  |                      | 5.5                        | FRN5.5AR1■-4□                  | 20(IEC/EN 60269-2)  |
|                      | 7.5                        | FRN7.5AR1■-2□                  | 50(IEC/EN 60269-2)  |                      | 7.5                        | FRN7.5AR1■-4□                  | 25(IEC/EN 60269-2)  |
|                      | 11                         | FRN11AR1■-2□                   | 80(IEC/EN 60269-2)  |                      | 11                         | FRN11AR1■-4□                   | 35(IEC/EN 60269-2)  |
|                      | 15                         | FRN15AR1■-2□                   | 100(IEC/EN 60269-2) |                      | 15                         | FRN15AR1■-4□                   | 50(IEC/EN 60269-2)  |
|                      | 18.5                       | FRN18.5AR1■-2□                 | 125(IEC/EN 60269-2) |                      | 18.5                       | FRN18.5AR1■-4□                 | 63(IEC/EN 60269-2)  |
|                      | 22                         | FRN22AR1■-2□                   | 250(IEC 60269-4)    |                      | 22                         | FRN22AR1■-4□                   | 80(IEC/EN 60269-2)  |
|                      | 30                         | FRN30AR1■-2□                   |                     |                      | 30                         | FRN30AR1■-4□                   | 100(IEC/EN 60269-2) |
|                      | 37                         | FRN37AR1■-2□                   | 350(IEC 60269-4)    |                      | 37                         | FRN37AR1■-4□                   | 125(IEC/EN 60269-2) |
|                      | 45                         | FRN45AR1■-2□                   |                     |                      | 45                         | FRN45AR1■-4□                   | 250(IEC 60269-4)    |
|                      | 55                         | FRN55AR1S-2□                   | 500(IEC 60269-4)    |                      | 55                         | FRN55AR1■-4□                   |                     |
| 75                   | FRN75AR1S-2□               | 75                             |                     | FRN75AR1■-4□         |                            |                                |                     |
| 90                   | FRN90AR1S-2□               | 90                             |                     | FRN90AR1■-4□         | 350(IEC 60269-4)           |                                |                     |
|                      |                            |                                | 110                 | FRN110AR1S-4□        |                            |                                |                     |
|                      |                            |                                | 132                 | FRN132AR1S-4□        | 400 (IEC 60269-4)          |                                |                     |
|                      |                            |                                | 160                 | FRN160AR1S-4□        | 450 (IEC 60269-4)          |                                |                     |
|                      |                            |                                | 200                 | FRN200AR1S-4□        | 500 (IEC 60269-4)          |                                |                     |
|                      |                            |                                | 220                 | FRN220AR1S-4□        | 550 (IEC 60269-4)          |                                |                     |
|                      |                            |                                | 280                 | FRN280AR1S-4□        | 630 (IEC 60269-4)          |                                |                     |
|                      |                            |                                | 315                 | FRN315AR1S-4□        | 900 (IEC 60269-4)          |                                |                     |
|                      |                            |                                | 355                 | FRN355AR1S-4□        |                            |                                |                     |
|                      |                            |                                | 400                 | FRN400AR1S-4□        | 1250 (IEC 60269-4)         |                                |                     |
|                      |                            |                                | 500                 | FRN500AR1S-4□        |                            |                                |                     |
|                      |                            |                                | 630                 | FRN630AR1S-4□        | 2000 (IEC 60269-4)         |                                |                     |
|                      |                            |                                | 710                 | FRN710AR1S-4□        |                            |                                |                     |



\* 4.0 kW for the EU. The inverter type is FRN4.0AR1■-2E or FRN4.0AR1■-4E.

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■ Enclosure: M (IP21) or L (IP55) □ Shipping destination: E (Europe) or A (Asia)

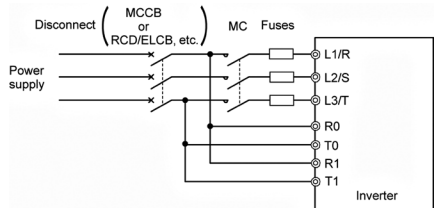


Conformity to the Low Voltage Directive in the EU (Continued)



■HP rating

| Power supply voltage | Nominal applied motor (HP) | Inverter type      | Fuse rating (A)     | Power supply voltage | Nominal applied motor (HP) | Inverter type     | Fuse rating (A)     |
|----------------------|----------------------------|--------------------|---------------------|----------------------|----------------------------|-------------------|---------------------|
| Three-phase 230 V    | 1                          | FRN001AR1■-2U      | 6(IEC/EN 60269-2)   | Three-phase 575 V    | 1                          | FRN001AR1■-5U     | 3(IEC/EN 60269-2)   |
|                      | 2                          | FRN002AR1■-2U      | 10(IEC/EN 60269-2)  |                      | 2                          | FRN002AR1■-5U     | 4(IEC/EN 60269-2)   |
|                      | 3                          | FRN003AR1■-2U      | 16(IEC/EN 60269-2)  |                      | 3                          | FRN003AR1■-5U     | 6(IEC/EN 60269-2)   |
|                      | 5                          | FRN005AR1■-2U      | 25(IEC/EN 60269-2)  |                      | 5                          | FRN005AR1■-5U     | 10(IEC/EN 60269-2)  |
|                      | 7                          | FRN007AR1■-2U      | 35(IEC/EN 60269-2)  |                      | 7                          | FRN007AR1■-5U     | 16(IEC/EN 60269-2)  |
|                      | 10                         | FRN010AR1■-2U      | 50(IEC/EN 60269-2)  |                      | 10                         | FRN010AR1■-5U     | 20(IEC/EN 60269-2)  |
|                      | 15                         | FRN015AR1■-2U      | 80(IEC/EN 60269-2)  |                      | 15                         | FRN015AR1■-5U     | 25(IEC/EN 60269-2)  |
|                      | 20                         | FRN020AR1■-2U      | 100(IEC/EN 60269-2) |                      | 20                         | FRN020AR1■-5U     | 35(IEC/EN 60269-2)  |
|                      | 25                         | FRN025AR1■-2U      | 125(IEC/EN 60269-2) |                      | 25                         | FRN025AR1■-5U     | 40(IEC/EN 60269-2)  |
|                      | 30                         | FRN030AR1■-2U      | 250(IEC 60269-4)    |                      | 30                         | FRN030AR1■-5U     | 50(IEC/EN 60269-2)  |
|                      | 40                         | FRN040AR1■-2U      |                     |                      | 40                         | FRN040AR1■-5U     | 80(IEC/EN 60269-2)  |
|                      | 50                         | FRN050AR1■-2U      | 350(IEC 60269-4)    |                      | 50                         | FRN050AR1■-5U     | 100(IEC/EN 60269-2) |
|                      | 60                         | FRN060AR1■-2U      |                     |                      | 60                         | FRN060AR1■-5U     | 250(IEC 60269-4)    |
|                      | 75                         | FRN075AR1S-2U      | 500(IEC 60269-4)    |                      | 75                         | FRN075AR1■-5U     | 250(IEC 60269-4)    |
| 100                  | FRN100AR1S-2U              | 100                |                     | FRN100AR1■-5U        | 250(IEC 60269-4)           |                   |                     |
| 125                  | FRN125AR1S-2U              | 125                |                     | FRN125AR1■-5U        | 350(IEC 60269-4)           |                   |                     |
|                      |                            | 150                |                     | FRN150AR1■-5U        | 350(IEC 60269-4)           |                   |                     |
| Three-phase 460 V    | 1                          | FRN001AR1■-4U      | 4(IEC/EN 60269-2)   | 200                  | FRN200AR1S-5U              | 400 (IEC 60269-4) |                     |
|                      | 2                          | FRN002AR1■-4U      | 6(IEC/EN 60269-2)   | 250                  | FRN250AR1S-5U              | 450 (IEC 60269-4) |                     |
|                      | 3                          | FRN003AR1■-4U      | 10(IEC/EN 60269-2)  | 300                  | FRN300AR1S-5U              | 500 (IEC 60269-4) |                     |
|                      | 5                          | FRN005AR1■-4U      | 16(IEC/EN 60269-2)  |                      |                            |                   |                     |
|                      | 7                          | FRN007AR1■-4U      | 20(IEC/EN 60269-2)  |                      |                            |                   |                     |
|                      | 10                         | FRN010AR1■-4U      | 25(IEC/EN 60269-2)  |                      |                            |                   |                     |
|                      | 15                         | FRN015AR1■-4U      | 35(IEC/EN 60269-2)  |                      |                            |                   |                     |
|                      | 20                         | FRN020AR1■-4U      | 50(IEC/EN 60269-2)  |                      |                            |                   |                     |
|                      | 25                         | FRN025AR1■-4U      | 63(IEC/EN 60269-2)  |                      |                            |                   |                     |
|                      | 30                         | FRN030AR1■-4U      | 80(IEC/EN 60269-2)  |                      |                            |                   |                     |
|                      | 40                         | FRN040AR1■-4U      | 100(IEC/EN 60269-2) |                      |                            |                   |                     |
|                      | 50                         | FRN050AR1■-4U      | 125(IEC/EN 60269-2) |                      |                            |                   |                     |
|                      | 60                         | FRN060AR1■-4U      | 250(IEC 60269-4)    |                      |                            |                   |                     |
|                      | 75                         | FRN075AR1■-4U      |                     | 75                   | FRN075AR1■-4U              |                   |                     |
|                      | 100                        | FRN100AR1■-4U      | 350(IEC 60269-4)    | 100                  | FRN100AR1■-4U              |                   |                     |
|                      | 125                        | FRN125AR1■-4U      |                     | 125                  | FRN125AR1■-4U              |                   |                     |
|                      | 150                        | FRN150AR1S-4U      |                     | 150                  | FRN150AR1S-4U              |                   |                     |
|                      | 200                        | FRN200AR1S-4U      |                     | 200                  | FRN200AR1S-4U              | 400 (IEC 60269-4) |                     |
|                      | 250                        | FRN250AR1S-4U      | 250 (IEC 60269-4)   | 250                  | FRN250AR1S-4U              | 450 (IEC 60269-4) |                     |
|                      | 300                        | FRN300AR1S-4U      | 500 (IEC 60269-4)   | 300                  | FRN300AR1S-4U              | 500 (IEC 60269-4) |                     |
|                      | 350                        | FRN350AR1S-4U      | 550 (IEC 60269-4)   | 350                  | FRN350AR1S-4U              | 550 (IEC 60269-4) |                     |
|                      | 450                        | FRN450AR1S-4U      | 630 (IEC 60269-4)   | 450                  | FRN450AR1S-4U              | 630 (IEC 60269-4) |                     |
|                      | 500                        | FRN500AR1S-4U      | 900 (IEC 60269-4)   | 500                  | FRN500AR1S-4U              |                   |                     |
|                      | 600                        | FRN600AR1S-4U      |                     | 600                  | FRN600AR1S-4U              |                   |                     |
| 800                  | FRN800AR1S-4U              | 1250 (IEC 60269-4) | 800                 | FRN800AR1S-4U        |                            |                   |                     |
| 900                  | FRN900AR1S-4U              | 2000 (IEC 60269-4) | 900                 | FRN900AR1S-4U        |                            |                   |                     |
| 1000                 | FRN1000AR1S-4U             |                    | 1000                | FRN1000AR1S-4U       |                            |                   |                     |



**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.  
 ■Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

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

# WARNING

3. When used with the inverter, a molded case circuit breaker (MCCB), residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) or magnetic contactor (MC) should conform to the EN or IEC standards.
4. When you use a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) for protection from electric shock in direct or indirect contact power lines or nodes, be sure to install **type B of RCD/ELCB** on the input (primary) of the inverter.
5. The inverter should be used in an environment that does not exceed Pollution Degree 2 requirements.
6. Install the inverter, AC reactor (ACR), 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.  
Note: Does not apply to IP55 model.
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.

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



9. Use wires listed in IEC 60364-5-52.

**■kW rating**

| Power supply voltage | Nominal applied motor (kW) | Inverter type                  | Recommended wire size (mm <sup>2</sup> ) |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|----------------------|----------------------------|--------------------------------|--|-----------------------------|-------------------------------------|---------------------|------------------------------------|--------------------------------|-------------------------------|-----|-------|-----|-------|-------|
|                      |                            |                                | Main terminal                            |                             | DC reactor connection [P1, P(+)] *1 | Control circuit     | Aux. control power supply [R0, T0] | Aux main power supply [R1, T1] |                               |     |       |     |       |       |
|                      |                            |                                | Main power input                         | Inverter's grounding [G] *1 |                                     |                     |                                    |                                | Inverter outputs [U, V, W] *1 |     |       |     |       |       |
|                      |                            |                                | [L1/R, L2/S, L3/T] *1                    |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
| Three-phase 200 V    | 0.75                       | FRN0.75AR1■-2□                 | 2.5                                      | 10                          | 2.5                                 | Built-in DC reactor | 0.75                               | 2.5                            | -                             | 2.5 |       |     |       |       |
|                      | 1.5                        | FRN1.5AR1■-2□                  |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 2.2                        | FRN2.2AR1■-2□                  |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 3.7 (4.0)*                 | FRN3.7AR1■-2□<br>FRN4.0AR1■-2E |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 5.5                        | FRN5.5AR1■-2□                  |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 7.5                        | FRN7.5AR1■-2□                  |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 11                         | FRN11AR1■-2□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 15                         | FRN15AR1■-2□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 18.5                       | FRN18.5AR1■-2□                 |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 22                         | FRN22AR1■-2□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 30                         | FRN30AR1■-2□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 37                         | FRN37AR1■-2□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 45                         | FRN45AR1■-2□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 55                         | FRN55AR1S-2□                   |  |                             |                                     |                     |                                    |                                |                               |     | 50×2  | 95  | 70×2  | 70×2  |
| 75                   | FRN75AR1S-2□               | 95×2                           | 95                                       | 95×2                        | 120×2                               |                     |                                    |                                |                               |     |       |     |       |       |
| 90                   | FRN90AR1S-2□               | 120×2                          | 120                                      | 120×2                       | 150×2                               |                     |                                    |                                |                               |     |       |     |       |       |
| Three-phase 400 V    | 0.75                       | FRN0.75AR1■-4□                 | 2.5                                      | 10                          | 2.5                                 | Built-in DC reactor | 0.75                               | 2.5                            | -                             | 2.5 |       |     |       |       |
|                      | 1.5                        | FRN1.5AR1■-4□                  |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 2.2                        | FRN2.2AR1■-4□                  |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 3.7 (4.0)*                 | FRN3.7AR1■-4□<br>FRN4.0AR1■-4E |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 5.5                        | FRN5.5AR1■-4□                  |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 7.5                        | FRN7.5AR1■-4□                  |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 11                         | FRN11AR1■-4□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 15                         | FRN15AR1■-4□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 18.5                       | FRN18.5AR1■-4□                 |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 22                         | FRN22AR1■-4□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 30                         | FRN30AR1■-4□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 37                         | FRN37AR1■-4□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 45                         | FRN45AR1■-4□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 55                         | FRN55AR1■-4□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 75                         | FRN75AR1■-4□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 90                         | FRN90AR1■-4□                   |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |
|                      | 110                        | FRN110AR1S-4□                  |  |                             |                                     |                     |                                    |                                |                               |     | 50×2  | 95  | 50×2  | 150   |
|                      | 132                        | FRN132AR1S-4□                  |  |                             |                                     |                     |                                    |                                |                               |     | 70×2  | 95  | 70×2  | 95×2  |
|                      | 160                        | FRN160AR1S-4□                  |  |                             |                                     |                     |                                    |                                |                               |     | 185   | 95  | 240   | 300   |
|                      | 200                        | FRN200AR1S-4□                  |  |                             |                                     |                     |                                    |                                |                               |     | 300   | 150 | 300   | 150×2 |
|                      | 220                        | FRN220AR1S-4□                  |  |                             |                                     |                     |                                    |                                |                               |     |       |     | 150×2 | 185×2 |
|                      | 280                        | FRN280AR1S-4□                  |  |                             |                                     |                     |                                    |                                |                               |     | 185×2 | 185 | 240×2 | 300×2 |
|                      | 315                        | FRN315AR1S-4□                  |  |                             |                                     |                     |                                    |                                |                               |     | 240×2 | 240 |       |       |
|                      | 355                        | FRN355AR1S-4□                  |  |                             |                                     |                     |                                    |                                |                               |     | 300×2 | 300 | 300×2 | 300×3 |
| 400                  | FRN400AR1S-4□              | 240×3                          | 185×2                                    | 240×3                       |                                     |                     |                                    |                                |                               |     |       |     |       |       |
| 500                  | FRN500AR1S-4□              | 300×3                          | 240×2                                    | 240×4                       | 300×4                               |                     |                                    |                                |                               |     |       |     |       |       |
| 630                  | FRN630AR1S-4□              | 300×4                          | 300×2                                    | 300×4                       |                                     |                     |                                    |                                |                               |     |       |     |       |       |
| 710                  | FRN710AR1S-4□              |                                |  |                             |                                     |                     |                                    |                                |                               |     |       |     |       |       |

\* 4.0 kW for the EU. The inverter type is FRN4.0AR1■-2E or FRN4.0AR1■-4E.

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■Enclosure: M (IP21) or L (IP55) □Shipping destination: E (Europe) or A (Asia)

\*1 The recommended wire size for main circuits is for the 70°C 600 V PVC wires used at an ambient temperature of 40°C.

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



■HP rating

| Power supply voltage | Nominal applied motor (HP) | Inverter type | Recommended wire size (mm <sup>2</sup> ) |                              |                               |                                     |                 |                                    |                                |       |
|----------------------|----------------------------|---------------|--|------------------------------|-------------------------------|-------------------------------------|-----------------|------------------------------------|--------------------------------|-------|
|                      |                            |               | Main terminal                            |                              |                               | DC reactor connection [P1, P(+)] *1 | Control circuit | Aux. control power supply [R0, T0] | Aux main power supply [R1, T1] |       |
|                      |                            |               | Main power input                         |                              | Inverter outputs [U, V, W] *1 |                                     |                 |                                    |                                |       |
|                      |                            |               | [L1/R, L2/S, L3/T] *1                    | Inverter's grounding [EG] *1 |                               |                                     |                 |                                    |                                |       |
| Three-phase 230 V    | 1                          | FRN001AR1■-2U | 2.5                                      | 10                           | 2.5                           | Built-in DC reactor                 | 0.75            | 2.5                                | -                              |       |
|                      | 2                          | FRN002AR1■-2U |  |                              | 2.5                           |                                     |                 |                                    |                                |       |
|                      | 3                          | FRN003AR1■-2U |  |                              | 2.5                           |                                     |                 |                                    |                                |       |
|                      | 5                          | FRN005AR1■-2U |  |                              | 2.5                           |                                     |                 |                                    |                                |       |
|                      | 7                          | FRN007AR1■-2U | 4  |                              |                               |                                     |                 |                                    |                                |       |
|                      | 10                         | FRN010AR1■-2U | 4  | 6                            |                               |                                     |                 |                                    |                                |       |
|                      | 15                         | FRN015AR1■-2U | 10                                       | 10                           |                               |                                     |                 |                                    |                                |       |
|                      | 20                         | FRN020AR1■-2U | 25                                       | 16                           |                               |                                     |                 |                                    |                                |       |
|                      | 25                         | FRN025AR1■-2U |  | 25                           |                               |                                     |                 |                                    |                                |       |
|                      | 30                         | FRN030AR1■-2U |  | 35                           |                               |                                     |                 |                                    |                                |       |
|                      | 40                         | FRN040AR1■-2U |  | 50                           |                               |                                     |                 |                                    |                                |       |
|                      | 50                         | FRN050AR1■-2U | 70                                       | 70                           |                               |                                     |                 |                                    |                                |       |
|                      | 60                         | FRN060AR1■-2U | 95                                       | 95                           |                               |                                     |                 |                                    |                                |       |
|                      | 75                         | FRN075AR1S-2U | 50×2                                     | 95                           | 70×2                          |                                     |                 |                                    |                                | 70×2  |
| 100                  | FRN100AR1S-2U              | 95×2          | 95                                       | 95×2                         | 120×2                         |                                     |                 |                                    |                                |       |
| 125                  | FRN125AR1S-2U              | 120×2         | 120                                      | 120×2                        | 150×2                         |                                     |                 |                                    |                                |       |
| Three-phase 460 V    | 1                          | FRN001AR1■-4U | 2.5                                      | 10                           | 2.5                           | Built-in DC reactor                 | 0.75            | 2.5                                | -                              |       |
|                      | 2                          | FRN002AR1■-4U |  |                              | 2.5                           |                                     |                 |                                    |                                |       |
|                      | 3                          | FRN003AR1■-4U |  |                              | 2.5                           |                                     |                 |                                    |                                |       |
|                      | 5                          | FRN005AR1■-4U |  |                              | 2.5                           |                                     |                 |                                    |                                |       |
|                      | 7                          | FRN007AR1■-4U | 4  |                              |                               |                                     |                 |                                    |                                |       |
|                      | 10                         | FRN010AR1■-4U | 6  | 6                            |                               |                                     |                 |                                    |                                |       |
|                      | 15                         | FRN015AR1■-4U | 10                                       | 10                           |                               |                                     |                 |                                    |                                |       |
|                      | 20                         | FRN020AR1■-4U | 4  | 16                           |                               |                                     |                 |                                    |                                |       |
|                      | 25                         | FRN025AR1■-4U | 6  | 25                           |                               |                                     |                 |                                    |                                |       |
|                      | 30                         | FRN030AR1■-4U | 10                                       | 35                           |                               |                                     |                 |                                    |                                |       |
|                      | 40                         | FRN040AR1■-4U | 25                                       | 50                           |                               |                                     |                 |                                    |                                |       |
|                      | 50                         | FRN050AR1■-4U |  | 70                           |                               |                                     |                 |                                    |                                |       |
|                      | 60                         | FRN060AR1■-4U |  | 95                           |                               |                                     |                 |                                    |                                |       |
|                      | 75                         | FRN075AR1■-4U |  | 150                          |                               |                                     |                 |                                    |                                |       |
|                      | 100                        | FRN100AR1■-4U | 185                                      | 185                          |                               |                                     |                 |                                    |                                |       |
|                      | 125                        | FRN125AR1■-4U | 240                                      | 240                          |                               |                                     |                 |                                    |                                |       |
|                      | 150                        | FRN150AR1S-4U | 50×2                                     | 95                           | 50×2                          |                                     |                 |                                    |                                | 150   |
|                      | 200                        | FRN200AR1S-4U | 70×2                                     | 95                           | 70×2                          |                                     |                 |                                    |                                | 95×2  |
|                      | 250                        | FRN250AR1S-4U | 185                                      | 95                           | 240                           |                                     |                 |                                    |                                | 300   |
|                      | 300                        | FRN300AR1S-4U | 300                                      | 150                          | 300                           |                                     |                 |                                    |                                | 150×2 |
|                      | 350                        | FRN350AR1S-4U |  | 150×2                        | 185×2                         |                                     |                 |                                    |                                |       |
|                      | 450                        | FRN450AR1S-4U | 185×2                                    | 185                          | 240×2                         |                                     |                 |                                    |                                | 300×2 |
| 500                  | FRN500AR1S-4U              | 300×2         | 300                                      | 300×2                        | 300×3                         |                                     |                 |                                    |                                |       |
| 600                  | FRN600AR1S-4U              | 240×3         | 185×2                                    | 240×3                        |                               |                                     |                 |                                    |                                |       |
| 800                  | FRN800AR1S-4U              | 300×3         | 240×2                                    | 240×4                        | 300×4                         |                                     |                 |                                    |                                |       |
| 900                  | FRN900AR1S-4U              | 300×4         | 300×2                                    | 300×4                        |                               |                                     |                 |                                    |                                |       |
| 1000                 | FRN1000AR1S-4U             |               |  |                              |                               |                                     |                 |                                    |                                |       |

Note: A box (■) replaces an alphabetic letter depending on the enclosure.

■Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

\*1 The recommended wire size for main circuits is for the 70°C 600 V PVC wires used at an ambient temperature of 40°C.

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



| Power supply voltage | Nominal applied motor (HP) | Inverter type | Recommended wire size (mm <sup>2</sup> ) |                              |                               |                                     |                 |                                    |                                |
|----------------------|----------------------------|---------------|--|------------------------------|-------------------------------|-------------------------------------|-----------------|------------------------------------|--------------------------------|
|                      |                            |               | Main terminal                            |                              |                               | DC reactor connection [P1, P(+)] *1 | Control circuit | Aux. control power supply [R0, T0] | Aux main power supply [R1, T1] |
|                      |                            |               | Main power input                         |                              | Inverter outputs [U, V, W] *1 |                                     |                 |                                    |                                |
|                      |                            |               | [L1/R, L2/S, L3/T] *1                    | Inverter's grounding [EG] *1 |                               |                                     |                 |                                    |                                |
| Three-phase 575 V    | 1                          | FRN001AR1■-5U | 2.5                                      | 10                           | 2.5                           | Built-in DC reactor                 | 0.75            | 2.5                                | -                              |
|                      | 2                          | FRN002AR1■-5U |  |                              |                               |                                     |                 |                                    |                                |
|                      | 3                          | FRN003AR1■-5U |  |                              |                               |                                     |                 |                                    |                                |
|                      | 5                          | FRN005AR1■-5U |  |                              |                               |                                     |                 |                                    |                                |
|                      | 7                          | FRN007AR1■-5U |  |                              |                               |                                     |                 |                                    |                                |
|                      | 10                         | FRN010AR1■-5U |  |                              |                               |                                     |                 |                                    |                                |
|                      | 15                         | FRN015AR1■-5U | 4  |                              |                               |                                     |                 |                                    |                                |
|                      | 20                         | FRN020AR1■-5U | 4  | 6                            |                               |                                     |                 |                                    |                                |
|                      | 25                         | FRN025AR1■-5U | 6  | 10                           |                               |                                     |                 |                                    |                                |
|                      | 30                         | FRN030AR1■-5U | 10                                       | 16                           |                               |                                     |                 |                                    |                                |
|                      | 40                         | FRN040AR1■-5U | 25                                       | 25                           | 25                            |                                     |                 |                                    |                                |
|                      | 50                         | FRN050AR1■-5U |  | 25                           | 35                            |                                     |                 |                                    |                                |
|                      | 60                         | FRN060AR1■-5U |  | 35                           | 50                            |                                     |                 |                                    |                                |
|                      | 75                         | FRN075AR1■-5U | 35                                       | 70                           | 70                            |                                     |                 |                                    |                                |
|                      | 100                        | FRN100AR1■-5U | 70                                       | 95                           | 95                            |                                     |                 |                                    |                                |
|                      | 125                        | FRN125AR1■-5U | 95                                       | 120                          | 150                           |                                     |                 |                                    |                                |
|                      | 150                        | FRN150AR1■-5U |  |                              |                               |                                     |                 |                                    |                                |
|                      | 200                        | FRN200AR1S-5U |  |                              |                               |                                     |                 |                                    |                                |
| 250                  | FRN250AR1S-5U              |               |  |                              |                               |                                     |                 |                                    |                                |
| 300                  | FRN300AR1S-5U              | 150           |  |                              |                               | 185                                 | 240             |                                    |                                |
|                      |                            | 185           |  |                              |                               |                                     |                 |                                    |                                |

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

\*1 The recommended wire size for main circuits is for the 70°C 600 V PVC wires used at an ambient temperature of 40°C.

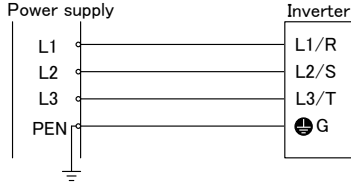
**Conformity to the Low Voltage Directive in the EU (Continued)**

**⚠ WARNING ⚠**

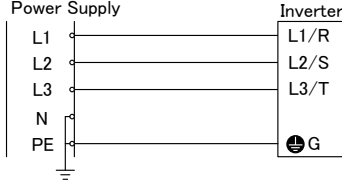
10. The inverter has been tested with IEC/EN 61800-5-1 Short-circuit Test under the following conditions.

- Short-circuit current in the supply: 10,000 A
- 240V or below (200V class series inverters of 18.5 kW (25HP) or below.)
- 230V or below (230V class series inverters of 22 kW (30HP) or above.)
- 480V or below (480V class series inverters)
- 600V or below (575V class series inverters)

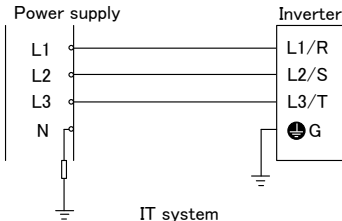
11. Use this inverter at the following power supply system.



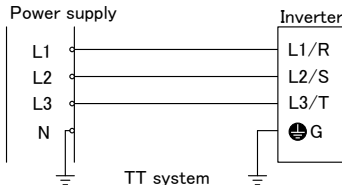
TN-C system



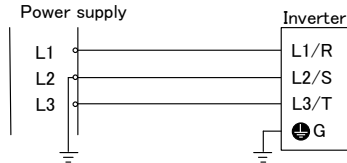
TN-S system



IT system



TT system  
(Earthed neutral)



TT system

200V type inverters can be used at IT or TT system.

Use 400V type inverters at the following IT or TT system.

\*1) EMC filter : on

| Earthed condition   | Can or cannot be used and caution   |
|---|---|
| Non-earthed (isolated from earth) IT system   | Available.<br>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.)<br>Use an earth fault detector able to disconnect the power within 5 s after the earth fault occurs. |
| IT system which earthed neutral by an impedance   |   |
| Corner earthed / Phase-earthed system by an impedance or earthed system of 400V (TT system) | Not available.  |

\*2) EMC filter : off

| Earthed condition   | Can or cannot be used and caution  | note *3)   |
|---|--|--|
| Non-earthed (isolated from earth)<br>IT system  | Available.<br>Restrict the input voltage at 440V+10%<br>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.) | All models of 400V series product.<br>110kW or bigger models of product ver. earlier "G" : Use an earth fault detector able to disconnect the power within 5 s after the earth fault occurs. |
| IT system which earthed neutral by an impedance   |  |  |
| Corner earthed / Phase-earthed system by an impedance or earthed system of 400V (TT system) | Available.<br>Restrict the input voltage at 440V+10%<br>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.) | 90kW or smaller models of 400V series product.<br>110kW or bigger models of product ver. later "H"   |
|   | Not available.   | 110kW or bigger models of product ver. earlier "G"   |

\*1,2)According to chapter 11.1.2.3 of User's manual, turn the EMC filter off.

\*3)"product ver." described in note Colum, means the alphabet symbol of SER.NO.'s end.

Use 575V type inverters at the following IT or TT system.

| Earthed condition   | Can or cannot be used and caution   |
|---|---|
| Non-earthed (isolated from earth)<br>IT system  | Available.<br>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.)<br>Use an earth fault detector able to disconnect the power within 5 s after the earth fault occurs. |
| IT system which earthed neutral by an impedance   |   |
| Corner earthed / Phase-earthed system by an impedance or earthed system of 575V (TT system) | Not available.  |

## Conformity with UL standards and cUL-listed for Canada

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 each model.  
Use function codes F10 to F12 to set the protection level.
2. Use 75°C 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, 240 Volts Maximum for 200V class input 18.5 kW (25HP) or less, 230 Volts Maximum for 200V class input 22 kW (30HP) or above when protected by Class J Fuses or a Circuit Breaker having an interrupting rating not less than 100,000 rms Symmetrical Amperes, 240 Volts Maximum. Models FRN; rated for 200V or 230V class input.

"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. Models FRN; rated for 400V or 460V class input.

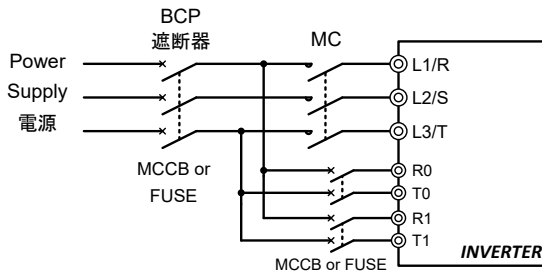
"Suitable For Use On A Circuit Of Delivering Not More Than 100,000 rms Symmetrical Amperes, 600 Volts Maximum when protected by Class J Fuses or a Circuit Breaker having an interrupting rating not less than 100,000 rms Symmetrical Amperes, 600 Volts Maximum. Models FRN; rated for 575V class input.

"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. 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.

Terminals R0, T0 must be protected by Class J Fuses or a Circuit Breakers for all capacity in the figure below.

Terminals R1, T1 must be protected by Class J Fuses or a Circuit Breakers in the figure below. (200V class series 55kW (75HP) only)





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

**⚠ CAUTION**

**7. Environmental rating**

- Maximum Surrounding Air Temperature / Maximum ambient temperature.

The surrounding temperature and ambient temperature shall be lower than the values in the table below.

| Type                            | Temperature |
|---------------------------------|-------------|
| FRN__ _AR1S-□□ / FRN__ _AR1M-□□ | 50 deg C    |
| FRN__ _AR1L-□□ / FRN__ _AR1U-□□ | 40 deg C    |

- Atmosphere

For use in pollution degree 2 environments.

**8. UL enclosure type**

UL enclosed type formats are shown in the table below.

| Enclosure Type  | Type           |
|-----------------|----------------|
| UL Open Type    | FRN__ _AR1S-□□ |
| NEMA/UL Type 1  | FRN__ _AR1M-□□ |
|                 | FRN__ _AR1U-□□ |
| NEMA/UL Type 12 | FRN__ _AR1L-□□ |

**9. Plenum rated drives**

UL Enclosed Type is suitable for installation in a compartment handling conditioned air.

**10. Mounting the wiring plate**

To use inverters with cable gland plate as standard intended for Europe and so on as UL compliant products, attach a separate conduit plate.

Please contact Fuji representative for the conduit plates.

**11. 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]       | Alarm relay output | When the inverter stops with an alarm, output is generated on the relay contact (1C).<br>Contact capacitance: 250 VAC 0.3A cosφ=1.0, 48 VDC 0.5 A |

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

# ⚠ CAUTION

12. Install UL certified fuses or circuit breaker between the power supply and the inverter, referring to the table below. The tightening torque is as follows.

■ kW rating

| Power supply voltage | Nominal applied motor (kW) | Inverter type                  | Class J fuse size (A) *1 | Circuit breaker trip size (A) *1 | Required torque<br>lb-in (N · m) |                 |                           |                        |
|----------------------|----------------------------|--------------------------------|--------------------------|----------------------------------|----------------------------------|-----------------|---------------------------|------------------------|
|                      |                            |                                |                          |                                  | Main terminal                    | Control circuit | Aux. control power supply | Aux. main power supply |
| Three-phase 200V     | 0.75                       | FRN0.75AR1■-2□                 | 10                       | 5                                | 15.9<br>(1.8)                    | 6.1<br>(0.7)    | 10.6<br>(1.2)             | -                      |
|                      | 1.5                        | FRN1.5AR1■-2□                  |                          | 10                               |                                  |                 |                           |                        |
|                      | 2.2                        | FRN2.2AR1■-2□                  |                          | 15                               |                                  |                 |                           |                        |
|                      | 3.7<br>(4.0)*              | FRN3.7AR1■-2□<br>FRN4.0AR1■-2E |                          | 25                               |                                  |                 |                           |                        |
|                      | 5.5                        | FRN5.5AR1■-2□                  | 35                       | 30                               | 51.3<br>(5.8)                    |                 |                           |                        |
|                      | 7.5                        | FRN7.5AR1■-2□                  | 50                       | 40                               |                                  |                 |                           |                        |
|                      | 11                         | FRN11AR1■-2□                   | 70                       | 50                               |                                  |                 |                           |                        |
|                      | 15                         | FRN15AR1■-2□                   | 100                      | 75                               |                                  |                 |                           |                        |
|                      | 18.5                       | FRN18.5AR1■-2□                 | 125                      | 100                              | 119.4<br>(13.5)                  |                 |                           |                        |
|                      | 22                         | FRN22AR1■-2□                   | -                        | 100 (*2)                         |                                  |                 |                           |                        |
|                      | 30                         | FRN30AR1■-2□                   |                          | 150 (*2)                         |                                  |                 |                           |                        |
|                      | 37                         | FRN37AR1■-2□                   |                          | 175 (*2)                         |                                  |                 |                           |                        |
|                      | 45                         | FRN45AR1■-2□                   |                          | 200 (*2)                         |                                  |                 |                           |                        |
|                      | 55                         | FRN55AR1S-2□                   | 350                      | 250                              | 238.9<br>(27)                    |                 |                           |                        |
|                      | 75                         | FRN75AR1S-2□                   | 500                      | 350                              |                                  |                 |                           |                        |
| 90                   | FRN90AR1S-2□               | 600                            | 400                      | 424.7<br>(48)                    | 10.6<br>(1.2)                    |                 |                           |                        |

\* 4.0 kW for the EU. The inverter type is FRN4.0AR1■-2E.

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■ Enclosure: M (IP21) or L (IP55) □ Shipping destination: E (Europe) or A (Asia) or other code except "U"

\*1 Not more than 6 rms Amperes fuses or not more than 5 rms Amperes breakers for aux. control power supply and aux. main power supply.

\*2 Protect the inverter by both a circuit breaker and the fuse tabulated below connected in series.

| Inverter type | Fuse type      |                  |
|---------------|----------------|------------------|
|               | Made by Mersen | Made by Bussmann |
| FRN22AR1■-2□  | A70QS250-4     | FWP-250A         |
| FRN30AR1■-2□  |                |                  |
| FRN37AR1■-2□  | A70QS350-4     | FWP-350A         |
| FRN45AR1■-2□  |                |                  |

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



| Power supply voltage | Nominal applied motor (kW) | Inverter type                  | Class J fuse size (A) *1 | Circuit breaker trip size (A) *1 | Required torque lb-in (N · m) |                 |                           |                        |
|----------------------|----------------------------|--------------------------------|--------------------------|----------------------------------|-------------------------------|-----------------|---------------------------|------------------------|
|                      |                            |                                |                          |                                  | Main terminal                 | Control circuit | Aux. control power supply | Aux. main power supply |
| Three-phase 400V     | 0.75                       | FRN0.75AR1■-4□                 | 3                        | 5                                | 15.9 (1.8)                    | 6.1 (0.7)       | 10.6 (1.2)                | 10.6 (1.2)             |
|                      | 1.5                        | FRN1.5AR1■-4□                  | 6                        |                                  |                               |                 |                           |                        |
|                      | 2.2                        | FRN2.2AR1■-4□                  | 10                       | 10                               |                               |                 |                           |                        |
|                      | 3.7 (4.0)                  | FRN3.7AR1■-4□<br>FRN4.0AR1■-4E | 15                       |                                  |                               |                 |                           |                        |
|                      | 5.5                        | FRN5.5AR1■-4□                  | 20                       | 15                               |                               |                 |                           |                        |
|                      | 7.5                        | FRN7.5AR1■-4□                  | 25                       | 20                               |                               |                 |                           |                        |
|                      | 11                         | FRN11AR1■-4□                   | 35                       | 30                               | 51.3 (5.8)                    |                 |                           |                        |
|                      | 15                         | FRN15AR1■-4□                   | 50                       | 40                               |                               |                 |                           |                        |
|                      | 18.5                       | FRN18.5AR1■-4□                 | 60                       | 50                               |                               |                 |                           |                        |
|                      | 22                         | FRN22AR1■-4□                   | 70                       |                                  |                               |                 |                           |                        |
|                      | 30                         | FRN30AR1■-4□                   | 100                      | 75                               |                               |                 |                           |                        |
|                      | 37                         | FRN37AR1■-4□                   | 125                      | 100                              |                               |                 |                           |                        |
|                      | 45                         | FRN45AR1■-4□                   | -                        | 100 (*2)                         | 119.4 (13.5)                  |                 |                           |                        |
|                      | 55                         | FRN55AR1■-4□                   |                          | 150 (*2)                         |                               |                 |                           |                        |
|                      | 75                         | FRN75AR1■-4□                   |                          | 175 (*2)                         |                               |                 |                           |                        |
|                      | 90                         | FRN90AR1■-4□                   | -                        | 200 (*2)                         | 238.9 (27)                    |                 |                           |                        |
|                      | 110                        | FRN110AR1S-4□                  |                          | 350                              | 250                           |                 |                           |                        |
|                      | 132                        | FRN132AR1S-4□                  |                          | 400                              | 300                           |                 |                           |                        |
|                      | 160                        | FRN160AR1S-4□                  |                          | 500                              | 350                           |                 |                           |                        |
|                      | 200                        | FRN200AR1S-4□                  |                          | 600                              | 500                           |                 |                           |                        |
|                      | 220                        | FRN220AR1S-4□                  |                          | -                                |                               |                 |                           |                        |
|                      | 280                        | FRN280AR1S-4□                  |                          | -                                | 600                           |                 |                           |                        |
|                      | 315                        | FRN315AR1S-4□                  |                          | -                                | 800                           |                 |                           |                        |
| 355                  | FRN355AR1S-4□              | -                              |                          |                                  |                               |                 |                           |                        |
| 400                  | FRN400AR1S-4□              | -                              |                          | 1200                             |                               |                 |                           |                        |
| 500                  | FRN500AR1S-4□              | -                              |                          |                                  |                               |                 |                           |                        |
| 630                  | FRN630AR1S-4□              | -                              | 1400                     |                                  |                               |                 |                           |                        |
| 710                  | FRN710AR1S-4□              | -                              | 1600                     | 424.7 (48)                       |                               |                 |                           |                        |

\* 4.0 kW for the EU. The inverter type is FRN4.0AR1■-4E.

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■ Enclosure: M (IP21) or L (IP55) □ Shipping destination: E (Europe) or A (Asia) or other code except "U"

\*1 Not more than 6 rms Amperes fuses or not more than 5 rms Amperes breakers for aux. control power supply and aux. main power supply.

\*2 Protect the inverter by both circuit breaker and the fuse tabulated below connected in series.

| Inverter type | Fuse type      |                  |
|---------------|----------------|------------------|
|               | Made by Mersen | Made by Bussmann |
| FRN45AR1■-4□  | A70QS250-4     | FWP-250A         |
| FRN55AR1■-4□  |                |                  |
| FRN75AR1■-4□  | A70QS350-4     | FWP-350A         |
| FRN90AR1■-4□  |                |                  |

# ⚠ CAUTION

| Power supply voltage | Nominal applied motor (kW) | Inverter type                  | Wire size AWG (mm <sup>2</sup> ) |                        | Control circuit         | Aux. control power supply | Aux. main power supply |
|----------------------|----------------------------|--------------------------------|----------------------------------|------------------------|-------------------------|---------------------------|------------------------|
|                      |                            |                                | Main terminal                    | Cu wire                |                         |                           |                        |
|                      |                            |                                | L1/R, L2/S, L3/T                 | U, V, W                |                         |                           |                        |
|                      |                            |                                | 75°C<br>Cu<br>wire               | 75°C<br>Cu<br>wire     |                         |                           |                        |
| Three-phase 200V     | 0.75                       | FRN0.75AR1■-2□                 | 14 (2.1) *1                      | 14 (2.1) *1            | 18<br>(0.8)<br>*1<br>*2 | 14<br>(2.1)<br>*1<br>*2   | -                      |
|                      | 1.5                        | FRN1.5AR1■-2□                  |                                  |                        |                         |                           |                        |
|                      | 2.2                        | FRN2.2AR1■-2□                  |                                  |                        |                         |                           |                        |
|                      | 3.7<br>(4.0) *             | FRN3.7AR1■-2□<br>FRN4.0AR1■-2E |                                  |                        |                         |                           |                        |
|                      | 5.5                        | FRN5.5AR1■-2□                  | 10 (5.3) *1                      | 10 (5.3) *1            |                         |                           |                        |
|                      | 7.5                        | FRN7.5AR1■-2□                  |                                  | 8 (8.4)                |                         |                           |                        |
|                      | 11                         | FRN11AR1■-2□                   | 8 (8.4)                          | 6 (13.3)               |                         |                           |                        |
|                      | 15                         | FRN15AR1■-2□                   | 6 (13.3)                         | 2 (33.6)               |                         |                           |                        |
|                      | 18.5                       | FRN18.5AR1■-2□                 | 4 (21.2)                         |                        |                         |                           |                        |
|                      | 22                         | FRN22AR1■-2□                   |                                  |                        |                         |                           |                        |
|                      | 30                         | FRN30AR1■-2□                   | 2 (33.6)                         | 1/0 (53.5)             |                         |                           |                        |
|                      | 37                         | FRN37AR1■-2□                   | 1/0 (53.5)                       | 3/0 (85)               |                         |                           |                        |
|                      | 45                         | FRN45AR1■-2□                   | 2/0 (67.4)                       | 4/0 (107.2) *3         |                         |                           |                        |
|                      | 55                         | FRN55AR1S-2□                   | 4/0 (107.2) *3                   | 3/0 × 2 (85 × 2) *3    |                         |                           |                        |
|                      | 75                         | FRN75AR1S-2□                   | 3/0 × 2 (85 × 2) *3              | 4/0 × 2 (107.2 × 2) *3 |                         |                           |                        |
| 90                   | FRN90AR1S-2□               | 4/0 × 2 (107.2 × 2) *3         | 4/0 × 2 (107.2 × 2) *3           |                        |                         |                           |                        |

\* 4.0 kW for the EU. The inverter type is FRN4.0AR1■-2E.

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■ Enclosure: M (IP21) or L (IP55) □ Shipping destination: E (Europe) or A (Asia) or other code except "U"

**Note:** The inverter's grounding wire size must be provided in accordance with the National Electrical Code.

\*1 No terminal end treatment is required for connection.

\*2 Use 75°C Cu wire only

\*3 The wire size of UL Open Type and NEMA/UL Type 1 are common. Please contact us if UL Open Type exclusive wire is necessary.

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



| Power supply voltage | Nominal applied motor (kW) | Inverter type    | Wire size AWG (mm <sup>2</sup> ) |                   |                   |                 | Control circuit | Aux. control power supply | Aux. main power supply |                           |                        |
|----------------------|----------------------------|------------------|----------------------------------|-------------------|-------------------|-----------------|-----------------|---------------------------|------------------------|---------------------------|------------------------|
|                      |                            |                  | Main terminal                    |                   | U, V, W           | Control circuit |                 |                           |                        | Aux. control power supply | Aux. main power supply |
|                      |                            |                  | L1/R, L2/S, L3/T                 | 75°C Cu wire      |                   |                 |                 |                           |                        |                           |                        |
| Three-phase 400V     | 0.75                       | FRN0.75AR1■-4□   | 14 (2.1) *1                      | 14 (2.1) *1       | 14 (2.1) *1       | 18 (0.8) *1 *2  | 14 (2.1) *1 *2  | 14 (2.1) *1 *2            |                        |                           |                        |
|                      | 1.5                        | FRN1.5AR1■-4□    |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | 2.2                        | FRN2.2AR1■-4□    |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | 3.7                        | FRN3.7AR1■-4□    |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | (4.0) *                    | FRN4.0AR1■-4E    |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | 5.5                        | FRN5.5AR1■-4□    |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | 7.5                        | FRN7.5AR1■-4□    | 10 (5.3) *1                      | 10 (5.3) *1       | 10 (5.3) *1       |                 |                 |                           |                        |                           |                        |
|                      | 11                         | FRN11AR1■-4□     |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | 15                         | FRN15AR1■-4□     |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | 18.5                       | FRN18.5AR1■-4□   | 8 (8.4)                          | 8 (8.4)           | 8 (8.4)           |                 |                 |                           |                        |                           |                        |
|                      | 22                         | FRN22AR1■-4□     |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | 30                         | FRN30AR1■-4□     | 6 (13.3)                         | 6 (13.3)          | 6 (13.3)          |                 |                 |                           |                        |                           |                        |
|                      | 37                         | FRN37AR1■-4□     | 4 (21.2)                         | 2 (33.6)          | 2 (33.6)          |                 |                 |                           |                        |                           |                        |
|                      | 45                         | FRN45AR1■-4□     |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | 55                         | FRN55AR1■-4□     | 2 (33.6)                         | 2 (33.6)          | 2 (33.6)          |                 |                 |                           |                        |                           |                        |
|                      | 75                         | FRN75AR1■-4□     | 1/0 (53.5)                       | 1/0 (53.5)        | 1/0 (53.5)        |                 |                 |                           |                        |                           |                        |
|                      | 90                         | FRN90AR1■-4□     | 2/0 (67.4)                       | 3/0 (85)          | 3/0 (85)          |                 |                 |                           |                        |                           |                        |
|                      | 110                        | FRN110AR1S-4□    | 1/0×2 (53.5×2) *3                | 1/0×2 (53.5×2) *3 | 1/0×2 (53.5×2) *3 |                 |                 |                           |                        |                           |                        |
|                      | 132                        | FRN132AR1S-4□    |                                  |                   |                   |                 |                 |                           |                        |                           |                        |
|                      | 160                        | FRN160AR1S-4□    | 3/0×2 (85×2) *3                  | 3/0×2 (85×2) *3   | 3/0×2 (85×2) *3   |                 |                 |                           |                        |                           |                        |
|                      | 200                        | FRN200AR1S-4□    | 4/0×2 (107.2×2) *3               | 250×2 (127×2) *3  | 250×2 (127×2) *3  |                 |                 |                           |                        |                           |                        |
|                      | 220                        | FRN220AR1S-4□    | 250×2 (127×2) *3                 | 300×2 (152×2) *3  | 300×2 (152×2) *3  |                 |                 |                           |                        |                           |                        |
|                      | 280                        | FRN280AR1S-4□    | 400×2 (203×2) *3                 | 400×2 (203×2) *3  | 400×2 (203×2) *3  |                 |                 |                           |                        |                           |                        |
|                      | 315                        | FRN315AR1S-4□    | 300×2 (152×2) *4                 | 350×2 (177×2) *4  | 350×2 (177×2) *4  |                 |                 |                           |                        |                           |                        |
| 355                  | FRN355AR1S-4□              | 400×2 (203×2) *4 | 400×2 (203×2) *4                 | 400×2 (203×2) *4  |                   |                 |                 |                           |                        |                           |                        |
| 400                  | FRN400AR1S-4□              | 500×2 (253×2) *4 | 500×2 (253×2) *4                 | 500×2 (253×2) *4  |                   |                 |                 |                           |                        |                           |                        |
| 500                  | FRN500AR1S-4□              | 350×3 (177×3) *4 | 400×3 (203×3) *4                 | 400×3 (203×3) *4  |                   |                 |                 |                           |                        |                           |                        |
| 630                  | FRN630AR1S-4□              | 500×3 (253×3) *4 | 600×3 (304×3) *4                 | 600×3 (304×3) *4  |                   |                 |                 |                           |                        |                           |                        |
| 710                  | FRN710AR1S-4□              | 600×3 (304×3) *4 | 500×4 (253×4) *4                 | 500×4 (253×4) *4  |                   |                 |                 |                           |                        |                           |                        |

\* 4.0 kW for the EU. The inverter type is FRN4.0AR1■-4E.

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■Enclosure: M (IP21) or L (IP55) □Shipping destination: E (Europe) or A (Asia) or other code except "U"

**Note:** The inverter's grounding wire size must be provided in accordance with the National Electrical Code.

\*1 No terminal end treatment is required for connection.

\*2 Use 75°C Cu wire only.

\*3 The wire size of UL Open Type and NEMA/UL Type 1 are common. Please contact us if UL Open Type exclusive wire is necessary.

\*4 It is showing the wire size for UL Open Type.

See additional material INR-SI47-1365 for NEMA/UL Type 1 (Pack with TYPE1 kit).

# ⚠ CAUTION

**■HP rating**

| Power supply voltage | Nominal applied motor (HP) | Inverter type | Class J fuse size (A) *1 | Circuit breaker trip size (A) *1 | Required torque lb-in (N · m) |                 |                           |                        |
|----------------------|----------------------------|---------------|--------------------------|----------------------------------|-------------------------------|-----------------|---------------------------|------------------------|
|                      |                            |               |                          |                                  | Main terminal                 | Control circuit | Aux. control power supply | Aux. main power supply |
| Three-phase 230V     | 1                          | FRN001AR1■-2U | 10                       | 5                                | 15.9 (1.8)                    | 6.1 (0.7)       | 10.6 (1.2)                | -                      |
|                      | 2                          | FRN002AR1■-2U |                          | 10                               |                               |                 |                           |                        |
|                      | 3                          | FRN003AR1■-2U | 15                       |                                  |                               |                 |                           |                        |
|                      | 5                          | FRN005AR1■-2U | 25                       | 20                               |                               |                 |                           |                        |
|                      | 7                          | FRN007AR1■-2U | 35                       | 30                               | 51.3 (5.8)                    |                 |                           |                        |
|                      | 10                         | FRN010AR1■-2U | 50                       | 40                               |                               |                 |                           |                        |
|                      | 15                         | FRN015AR1■-2U | 70                       | 50                               |                               |                 |                           |                        |
|                      | 20                         | FRN020AR1■-2U | 100                      | 75                               |                               |                 |                           |                        |
|                      | 25                         | FRN025AR1■-2U | 125                      | 100                              |                               |                 |                           |                        |
|                      | 30                         | FRN030AR1■-2U | -                        | 100 (*2)                         | 119.4 (13.5)                  |                 |                           |                        |
|                      | 40                         | FRN040AR1■-2U |                          | 150 (*2)                         | 238.9 (27)                    |                 |                           |                        |
|                      | 50                         | FRN050AR1■-2U |                          | 175 (*2)                         |                               |                 |                           |                        |
|                      | 60                         | FRN060AR1■-2U |                          | 200 (*2)                         |                               |                 |                           |                        |
|                      | 75                         | FRN075AR1S-2U | 350                      | 250                              | 424.7 (48)                    |                 |                           |                        |
| 100                  | FRN100AR1S-2U              | 500           | 350                      |                                  |                               |                 |                           |                        |
| 125                  | FRN125AR1S-2U              | 600           | 400                      |                                  |                               |                 |                           |                        |

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

■Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

\*1 Not more than 6 rms Amperes fuses or not more than 5 rms Amperes breakers for aux. control power supply and aux. main power supply.

\*2 Protect the inverter by both circuit breaker and the fuse tabulated below connected in series.

| Inverter type | Fuse type      |                  |
|---------------|----------------|------------------|
|               | Made by Mersen | Made by Bussmann |
| FRN030AR1■-2U | A70QS250-4     | FWP-250A         |
| FRN040AR1■-2U |                |                  |
| FRN050AR1■-2U | A70QS350-4     | FWP-350A         |
| FRN060AR1■-2U |                |                  |

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



| Power supply voltage | Nominal applied motor (HP) | Inverter type | Class J fuse size (A) *1 | Circuit breaker trip size (A) *1 | Required torque lb-in (N · m) |                 |                           |                        |
|----------------------|----------------------------|---------------|--------------------------|----------------------------------|-------------------------------|-----------------|---------------------------|------------------------|
|                      |                            |               |                          |                                  | Main terminal                 | Control circuit | Aux. control power supply | Aux. main power supply |
| Three-phase 480V     | 1                          | FRN001AR1■-4U | 3                        | 5                                | 15.9 (1.8)                    | 6.1 (0.7)       | 10.6 (1.2)                | 10.6 (1.2)             |
|                      | 2                          | FRN002AR1■-4U | 6                        |                                  |                               |                 |                           |                        |
|                      | 3                          | FRN003AR1■-4U | 10                       |                                  |                               |                 |                           |                        |
|                      | 5                          | FRN005AR1■-4U | 15                       |                                  |                               |                 |                           |                        |
|                      | 7                          | FRN007AR1■-4U | 20                       | 15                               |                               |                 |                           |                        |
|                      | 10                         | FRN010AR1■-4U | 25                       | 20                               |                               |                 |                           |                        |
|                      | 15                         | FRN015AR1■-4U | 35                       | 30                               | 51.3 (5.8)                    |                 |                           |                        |
|                      | 20                         | FRN020AR1■-4U | 50                       | 40                               |                               |                 |                           |                        |
|                      | 25                         | FRN025AR1■-4U | 60                       | 50                               |                               |                 |                           |                        |
|                      | 30                         | FRN030AR1■-4U | 70                       |                                  |                               |                 |                           |                        |
|                      | 40                         | FRN040AR1■-4U | 100                      | 75                               |                               |                 |                           |                        |
|                      | 50                         | FRN050AR1■-4U | 125                      | 100                              |                               |                 |                           |                        |
|                      | 60                         | FRN060AR1■-4U | -                        | 100 (*2)                         | 119.4 (13.5)                  |                 |                           |                        |
|                      | 75                         | FRN075AR1■-4U |                          | 150 (*2)                         | 238.9 (27)                    |                 |                           |                        |
|                      | 100                        | FRN100AR1■-4U |                          | 175 (*2)                         |                               |                 |                           |                        |
|                      | 125                        | FRN125AR1■-4U |                          | 200 (*2)                         |                               |                 |                           |                        |
|                      | 150                        | FRN150AR1S-4U | 350                      | 250                              | 424.7 (48)                    |                 |                           |                        |
|                      | 200                        | FRN200AR1S-4U | 400                      | 300                              |                               |                 |                           |                        |
|                      | 250                        | FRN250AR1S-4U | 500                      | 350                              |                               |                 |                           |                        |
|                      | 300                        | FRN300AR1S-4U | 600                      | 500                              |                               |                 |                           |                        |
| 350                  | FRN350AR1S-4U              | -             |                          |                                  |                               |                 |                           |                        |
| 450                  | FRN450AR1S-4U              |               | 600                      |                                  |                               |                 |                           |                        |
| 500                  | FRN500AR1S-4U              |               | 800                      |                                  |                               |                 |                           |                        |
| 600                  | FRN600AR1S-4U              |               | 1200                     |                                  |                               |                 |                           |                        |
| 800                  | FRN800AR1S-4U              |               |                          |                                  |                               |                 |                           |                        |
| 900                  | FRN900AR1S-4U              |               |                          |                                  |                               |                 |                           |                        |
| 1000                 | FRN1000AR1S-4U             |               |                          | 1600                             |                               |                 |                           |                        |

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

\*1 Not more than 6 rms Amperes fuses or not more than 5 rms Amperes breakers for aux. control power supply and aux. main power supply.

\*2 Protect the inverter by both circuit breaker and the fuse tabulated below connected in series.

| Inverter type | Fuse type      |                  |
|---------------|----------------|------------------|
|               | Made by Mersen | Made by Bussmann |
| FRN060AR1■-4U | A70QS250-4     | FWP-250A         |
| FRN075AR1■-4U |                |                  |
| FRN100AR1■-4U | A70QS350-4     | FWP-350A         |
| FRN125AR1■-4U |                |                  |

# ⚠ CAUTION

| Power supply voltage | Nominal applied motor (HP) | Inverter type | Class J fuse size (A) *1 | Circuit breaker trip size (A) *1 | Required torque lb-in (N · m) |                 |                           |                        |
|----------------------|----------------------------|---------------|--------------------------|----------------------------------|-------------------------------|-----------------|---------------------------|------------------------|
|                      |                            |               |                          |                                  | Main terminal                 | Control circuit | Aux. control power supply | Aux. main power supply |
| Three-phase 575V     | 1                          | FRN001AR1■-5U | 3                        | 5                                | 15.9<br>(1.8)                 | 6.1<br>(0.7)    | 10.6<br>(1.2)             | -                      |
|                      | 2                          | FRN002AR1■-5U | 6                        |                                  |                               |                 |                           |                        |
|                      | 3                          | FRN003AR1■-5U |                          |                                  |                               |                 |                           |                        |
|                      | 5                          | FRN005AR1■-5U | 10                       | 51.3<br>(5.8)                    |                               |                 |                           |                        |
|                      | 7                          | FRN007AR1■-5U | 15                       |                                  |                               |                 |                           |                        |
|                      | 10                         | FRN010AR1■-5U | 20                       |                                  |                               |                 |                           |                        |
|                      | 15                         | FRN015AR1■-5U | 25                       | 20                               |                               |                 |                           |                        |
|                      | 20                         | FRN020AR1■-5U | 35                       | 30                               |                               |                 |                           |                        |
|                      | 25                         | FRN025AR1■-5U | 40                       |                                  |                               |                 |                           |                        |
|                      | 30                         | FRN030AR1■-5U | 50                       | 40                               |                               |                 |                           |                        |
|                      | 40                         | FRN040AR1■-5U | 70                       | 50                               |                               |                 |                           |                        |
|                      | 50                         | FRN050AR1■-5U | 100                      | 60                               |                               |                 |                           |                        |
|                      | 60                         | FRN060AR1■-5U | -                        | 75 (*2)                          | 119.4<br>(13.5)               |                 |                           |                        |
|                      | 75                         | FRN075AR1■-5U |                          | 100 (*2)                         |                               |                 |                           |                        |
|                      | 100                        | FRN100AR1■-5U |                          | 125 (*2)                         | 238.9<br>(27)                 |                 |                           |                        |
|                      | 125                        | FRN125AR1■-5U |                          | 150 (*2)                         |                               |                 |                           |                        |
|                      | 150                        | FRN150AR1■-5U |                          | 175 (*2)                         |                               |                 |                           |                        |
|                      | 200                        | FRN200AR1S-5U | 350                      | 250                              | 424.7<br>(48)                 |                 |                           |                        |
| 250                  | FRN250AR1S-5U              | 450           | 300                      |                                  |                               |                 |                           |                        |
| 300                  | FRN300AR1S-5U              | 500           | 350                      |                                  |                               |                 |                           |                        |

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

\*1 Not more than 6 rms Amperes fuses or not more than 5 rms Amperes breakers for aux. control power supply and aux. main power supply.

\*2 Protect the inverter by both circuit breaker and the fuse tabulated below connected in series.

| Inverter type | Fuse type      |                  |
|---------------|----------------|------------------|
|               | Made by Mersen | Made by Bussmann |
| FRN060AR1■-5U | A70QS175-4     | FWP-175A         |
| FRN075AR1■-5U |                |                  |
| FRN100AR1■-5U | A70QS250-4     | FWP-250A         |
| FRN125AR1■-5U |                |                  |
| FRN150AR1■-5U |                |                  |



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

# ⚠ CAUTION

| Power supply voltage | Nominal applied motor (HP) | Inverter type          | Wire size AWG (mm <sup>2</sup> ) |                |         | Control circuit | Aux. control power supply | Aux. main power supply |
|----------------------|----------------------------|------------------------|----------------------------------|----------------|---------|-----------------|---------------------------|------------------------|
|                      |                            |                        | Main terminal                    |                | Cu wire |                 |                           |                        |
|                      |                            |                        | L1/R, L2/S, L3/T                 | U, V, W        |         |                 |                           |                        |
|                      |                            |                        | 75°C Cu wire                     | 75°C Cu wire   |         |                 |                           |                        |
| Three-phase 230V     | 1                          | FRN001AR1■-2U          | 14 (2.1) *1                      | 14 (2.1) *1    |         | 18 (0.8) *1 *2  | 14 (2.1) *1 *2            | -                      |
|                      | 2                          | FRN002AR1■-2U          |                                  | 14 (2.1) *1    |         |                 |                           |                        |
|                      | 3                          | FRN003AR1■-2U          |                                  | 14 (2.1) *1    |         |                 |                           |                        |
|                      | 5                          | FRN005AR1■-2U          | 12 (3.3) *1                      |                |         |                 |                           |                        |
|                      | 7                          | FRN007AR1■-2U          | 10 (5.3) *1                      | 10 (5.3) *1    |         |                 |                           |                        |
|                      | 10                         | FRN010AR1■-2U          |                                  | 8 (8.4)        |         |                 |                           |                        |
|                      | 15                         | FRN015AR1■-2U          | 8 (8.4)                          | 8 (8.4)        |         |                 |                           |                        |
|                      | 20                         | FRN020AR1■-2U          | 6 (13.3)                         | 6 (13.3)       |         |                 |                           |                        |
|                      | 25                         | FRN025AR1■-2U          | 4 (21.2)                         | 2 (33.6)       |         |                 |                           |                        |
|                      | 30                         | FRN030AR1■-2U          |                                  | 2 (33.6)       |         |                 |                           |                        |
|                      | 40                         | FRN040AR1■-2U          | 2 (33.6)                         | 2 (33.6)       |         |                 |                           |                        |
|                      | 50                         | FRN050AR1■-2U          | 1/0 (53.5)                       | 1/0 (53.5)     |         |                 |                           |                        |
|                      | 60                         | FRN060AR1■-2U          | 2/0 (67.4)                       | 3/0 (85)       |         |                 |                           |                        |
|                      | 75                         | FRN075AR1S-2U          | 4/0 (107.2) *3                   | 4/0 (107.2) *3 |         |                 |                           |                        |
| 100                  | FRN100AR1S-2U              | 3/0 × 2 (85 × 2) *3    | 3/0 × 2 (85 × 2) *3              |                |         |                 |                           |                        |
| 125                  | FRN125AR1S-2U              | 4/0 × 2 (107.2 × 2) *3 | 4/0 × 2 (107.2 × 2) *3           |                |         |                 |                           |                        |

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

**Note:** The inverter's grounding wire size must be provided in accordance with the National Electrical Code.

\*1 No terminal end treatment is required for connection.

\*2 Use 75°C Cu wire only.

\*3 The wire size of UL Open Type and NEMA/UL Type 1 are common. Please contact us if UL Open Type exclusive wire is necessary.

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



| Power supply voltage | Nominal applied motor (HP) | Inverter type    | Wire size AWG (mm <sup>2</sup> ) |                   |                         | Control circuit         | Aux. control power supply | Aux. main power supply |                    |
|----------------------|----------------------------|------------------|----------------------------------|-------------------|-------------------------|-------------------------|---------------------------|------------------------|--------------------|
|                      |                            |                  | Main terminal                    |                   | 75°C<br>Cu<br>wire      |                         |                           |                        | 75°C<br>Cu<br>wire |
|                      |                            |                  | L1/R, L2/S, L3/T                 | U, V, W           |                         |                         |                           |                        |                    |
|                      |                            |                  |                                  |                   |                         |                         |                           |                        |                    |
| Three-phase 460V     | 1                          | FRN001AR1■-4U    | 14 (2.1) *1                      | 14 (2.1) *1       | 18<br>(0.8)<br>*1<br>*2 | 14<br>(2.1)<br>*1<br>*2 |                           |                        |                    |
|                      | 2                          | FRN002AR1■-4U    |                                  |                   |                         |                         |                           |                        |                    |
|                      | 3                          | FRN003AR1■-4U    |                                  |                   |                         |                         |                           |                        |                    |
|                      | 5                          | FRN005AR1■-4U    |                                  |                   |                         |                         |                           |                        |                    |
|                      | 7                          | FRN007AR1■-4U    |                                  |                   |                         |                         |                           |                        |                    |
|                      | 10                         | FRN010AR1■-4U    |                                  |                   |                         |                         |                           | 12 (3.3) *1            |                    |
|                      | 15                         | FRN015AR1■-4U    | 10 (5.3) *1                      | 10 (5.3) *1       |                         |                         |                           |                        |                    |
|                      | 20                         | FRN020AR1■-4U    |                                  |                   |                         |                         |                           |                        |                    |
|                      | 25                         | FRN025AR1■-4U    | 8 (8.4)                          | 8 (8.4)           |                         |                         |                           |                        |                    |
|                      | 30                         | FRN030AR1■-4U    |                                  |                   |                         |                         |                           |                        |                    |
|                      | 40                         | FRN040AR1■-4U    | 6 (13.3)                         | 6 (13.3)          |                         |                         |                           |                        |                    |
|                      | 50                         | FRN050AR1■-4U    | 4 (21.2)                         | 2 (33.6)          |                         |                         |                           |                        |                    |
|                      | 60                         | FRN060AR1■-4U    |                                  |                   |                         |                         |                           |                        |                    |
|                      | 75                         | FRN075AR1■-4U    | 2 (33.6)                         |                   |                         |                         |                           |                        |                    |
|                      | 100                        | FRN100AR1■-4U    | 1/0 (53.5)                       | 1/0 (53.5)        |                         |                         |                           |                        |                    |
|                      | 125                        | FRN125AR1■-4U    | 2/0 (67.4)                       | 3/0 (85)          |                         |                         |                           |                        |                    |
|                      | 150                        | FRN150AR1S-4U    | 1/0×2 (53.5×2) *3                | 1/0×2 (53.5×2) *3 |                         |                         |                           |                        |                    |
|                      | 200                        | FRN200AR1S-4U    |                                  | 2/0×2 (67.4×2) *3 |                         |                         |                           |                        |                    |
|                      | 250                        | FRN250AR1S-4U    | 3/0×2 (85×2) *3                  | 3/0×2 (85×2) *3   |                         |                         |                           |                        |                    |
|                      | 300                        | FRN300AR1S-4U    | 4/0×2 (107.2×2) *3               | 250×2 (127×2) *3  |                         |                         |                           |                        |                    |
|                      | 350                        | FRN350AR1S-4U    | 250×2 (127×2) *3                 | 300×2 (152×2) *3  |                         |                         |                           |                        |                    |
| 450                  | FRN450AR1S-4U              | 400×2 (203×2) *3 | 400×2 (203×2) *3                 |                   |                         |                         |                           |                        |                    |
| 500                  | FRN500AR1S-4U              | 400×2 (203×2) *4 | 400×2 (203×2) *4                 |                   |                         |                         |                           |                        |                    |
| 600                  | FRN600AR1S-4U              | 500×2 (253×2) *4 | 500×2 (253×2) *4                 |                   |                         |                         |                           |                        |                    |
| 800                  | FRN800AR1S-4U              | 350×3 (177×3) *4 | 400×3 (203×3) *4                 |                   |                         |                         |                           |                        |                    |
| 900                  | FRN900AR1S-4U              | 500×3 (253×3) *4 | 600×3 (304×3) *4                 |                   |                         |                         |                           |                        |                    |
| 1000                 | FRN1000AR1S-4U             | 600×3 (304×3) *4 | 500×4 (253×4) *4                 |                   |                         |                         |                           |                        |                    |

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

**Note:** The inverter's grounding wire size must be provided in accordance with the National Electrical Code.

\*1 No terminal end treatment is required for connection.

\*2 Use 75°C Cu wire only.

\*3 The wire size of UL Open Type and NEMA/UL Type 1 are common. Please contact us if UL Open Type exclusive wire is necessary.

\*4 It is showing the wire size for UL Open Type.

See additional material INR-SI47-1365 for NEMA/UL Type 1 (Pack with TYPE1 kit).

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



| Power supply voltage | Nominal applied motor (HP) | Inverter type    | Wire size AWG (mm <sup>2</sup> ) |                    |                         |                           |                        |
|----------------------|----------------------------|------------------|----------------------------------|--------------------|-------------------------|---------------------------|------------------------|
|                      |                            |                  | Main terminal                    |                    | Control circuit         | Aux. control power supply | Aux. main power supply |
|                      |                            |                  | L1/R, L2/S, L3/T                 | U, V, W            |                         |                           |                        |
|                      |                            |                  | 75°C<br>Cu<br>wire               | 75°C<br>Cu<br>wire |                         |                           |                        |
| Three-phase 575V     | 1                          | FRN001AR1■-5U    | 14 (2.1) *1                      | 14 (2.1) *1        | 18<br>(0.8)<br>*1<br>*2 | 14<br>(2.1)<br>*1<br>*2   | -                      |
|                      | 2                          | FRN002AR1■-5U    |                                  |                    |                         |                           |                        |
|                      | 3                          | FRN003AR1■-5U    |                                  |                    |                         |                           |                        |
|                      | 5                          | FRN005AR1■-5U    |                                  |                    |                         |                           |                        |
|                      | 7                          | FRN007AR1■-5U    |                                  |                    |                         |                           |                        |
|                      | 10                         | FRN010AR1■-5U    |                                  |                    |                         |                           |                        |
|                      | 15                         | FRN015AR1■-5U    |                                  |                    |                         |                           |                        |
|                      | 20                         | FRN020AR1■-5U    | 12 (3.3) *1                      | 12 (3.3) *1        |                         |                           |                        |
|                      | 25                         | FRN025AR1■-5U    | 10 (5.3)                         | 10 (5.3) *1        |                         |                           |                        |
|                      | 30                         | FRN030AR1■-5U    |                                  | 8 (8.4)            |                         |                           |                        |
|                      | 40                         | FRN040AR1■-5U    |                                  | 8 (8.4)            |                         |                           |                        |
|                      | 50                         | FRN050AR1■-5U    | 4(21.2)                          | 6 (13.3)           |                         |                           |                        |
|                      | 60                         | FRN060AR1■-5U    |                                  | 4(21.2)            |                         |                           |                        |
|                      | 75                         | FRN075AR1■-5U    |                                  | 4(21.2)            |                         |                           |                        |
|                      | 100                        | FRN100AR1■-5U    | 1/0(53.5)                        | 1/0(53.5)          |                         |                           |                        |
|                      | 125                        | FRN125AR1■-5U    |                                  |                    |                         |                           |                        |
|                      | 150                        | FRN150AR1■-5U    |                                  |                    |                         |                           |                        |
|                      | 200                        | FRN200AR1S-5U    | 1/0×2(53.5×2) *3                 | 1/0×2(53.5×2) *3   |                         |                           |                        |
| 250                  | FRN250AR1S-5U              | 2/0×2(67.4×2) *3 | 2/0×2(67.4×2) *3                 |                    |                         |                           |                        |
| 300                  | FRN300AR1S-5U              |                  | 3/0×2(85×2) *3                   |                    |                         |                           |                        |
|                      |                            |                  |                                  |                    |                         | 14<br>(2.1)<br>*1<br>*2   |                        |

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

**Note:** The inverter's grounding wire size must be provided in accordance with the National Electrical Code.

\*1 No terminal end treatment is required for connection.

\*2 Use 75°C Cu wire only.

\*3 The wire size of UL Open Type and NEMA/UL Type 1 are common. Please contact us if UL Open Type exclusive wire is necessary.

# Table of Contents

|  |       |
|--|-------|
| Preface .....  | i     |
| ■ Safety precautions.....  | i     |
| Conformity to the Low Voltage Directive in the EU.....   | vi    |
| Conformity with UL standards and cUL-listed for Canada..   | xiv   |
| Product Warranty .....   | xxvii |
| Chapter 1 BEFORE USE .....   | 1-1   |
| 1.1 Acceptance Inspection and<br>Appearance of Product.....  | 1-1   |
| 1.2 Precautions for Using Inverters.....   | 1-2   |
| 1.3 Usage environment and Strage enviroment.....   | 1-3   |
| 1.3.1 Usage environment .....  | 1-3   |
| 1.3.2 Strage environment .....   | 1-5   |
| Chapter 2 MOUNTING AND WIRING THE INVERTER ..  | 2-1   |
| 2.1 Installing the Inverter.....   | 2-1   |
| 2.2 Wiring .....   | 2-1   |
| 2.2.1 Removing and mounting the front cover<br>and the wiring plate.....   | 2-1   |
| 2.2.2 Recommended wire sizes .....   | 2-5   |
| 2.2.3 Terminal arrangement diagrams and screw<br>specifications.....   | 2-5   |
| 2.2.4 Terminal functions and wiring order.....   | 2-12  |
| 2.2.5 Connection diagrams .....  | 2-16  |
| 2.2.6 Switching connectors .....   | 2-20  |
| 2.2.7 Setting the switches .....   | 2-25  |
| 2.2.8 Mounting and connecting the keypad<br>to the panel .....   | 2-25  |
| Chapter 3 NAMES AND FUNCTIONS OF KEYPAD<br>COMPONENTS.....   | 3-1   |
| Chapter 4 RUNNING THE MOTOR FOR A TEST .....   | 4-1   |
| 4.1 Checking Prior to Powering ON.....   | 4-1   |
| 4.2 Powering ON and Checking.....  | 4-1   |
| 4.3 Configuring the Function Code Data<br>Before Test Run .....  | 4-2   |
| 4.4 Running the Inverter for Motor Operation Check ..  | 4-2   |
| 4.5 Preparation for Practical Operation.....   | 4-3   |
| Chapter 5 TROUBLESHOOTING .....  | 5-1   |
| 5.1 Alarm Codes .....  | 5-1   |
| Chapter 6 MAINTENANCE AND INSPECTION .....   | 6-1   |
| 6.1 Daily Inspection .....   | 6-1   |
| 6.2 Periodic Inspection .....  | 6-1   |
| 6.3 List of Periodic Replacement Parts.....  | 6-2   |
| 6.4 Inquiries about Product and Guarantee.....   | 6-3   |
| 6.4.1 When making an inquiry.....  | 6-3   |
| 6.4.2 Product warranty .....   | 6-3   |
| Chapter 7 SPECIFICATIONS.....  | 7-1   |
| 7.1 Standard Model.....  | 7-1   |
| 7.2 External Dimensions.....   | 7-9   |
| Chapter 8 CONFORMITY WITH STANDARDS .....  | 8-1   |
| 8.1 Compliance with European Standards.....  | 8-1   |
| 8.2 Conformity to the Low Voltage Directive<br>in the EU .....   | 8-1   |
| 8.3 Compliance with EMC Standards .....  | 8-2   |
| 8.3.1 General .....  | 8-2   |
| 8.3.2 Recommended installation procedure.....  | 8-2   |
| 8.3.3 Leakage current of the EMC filter.....   | 8-3   |
| 8.4 Harmonic Component Regulation in the EU .....  | 8-7   |
| 8.4.1 General comments .....   | 8-7   |
| 8.4.2 Compliance with IEC/EN 61000-3-2.....  | 8-7   |
| 8.4.3 Compliance with IEC/EN 61000-3-12.....   | 8-7   |
| 8.5 Compliance with UL Standards and<br>cUL-listed for Canada.....   | 8-7   |
| 8.5.1 General .....  | 8-7   |
| 8.5.2 Considerations when using FRENIC-HVAC<br>in systems to be certified by UL and<br>cUL-listed for Canada ..... | 8-7   |

## Product Warranty

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

### Free of charge warranty period and warranty range

#### Free of charge warranty period

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

#### 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 the installation conditions, environment, handling or methods of use, 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 or repairs affected by a party other than Fuji Electric.
  - ⑥ The breakdown was caused by improper maintenance or replacement of replaceable items, etc. specified in the operation manual or catalog, etc.
  - ⑦ The breakdown was caused by a science or technical or other 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 Fuji Electric is not responsible, 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.

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{ RD "HVAC\_IM\_cp04\_E\_d50HP.doc" \f } { RD "HVAC\_IM\_cp05\_E\_d50HP.doc" \f } { RD "HVAC\_IM\_cp06\_E\_d50HP.doc" \f }  
{ RD "HVAC\_IM\_cp07\_E\_d50HP.doc" \f } { RD "HVAC\_IM\_cp08\_E\_d50HP.doc" \f }

# Chapter 1 BEFORE USE

## 1.1 Acceptance Inspection and Appearance of Product

Unpack the package and check the following:

- (1) An inverter and the following accessories are contained in the package.  
Accessories: Instruction manual (this book) and CD-ROM manual
- (2) The inverter has not been damaged during transportation—there should be no dents or parts missing.
- (3) The inverter is the type you ordered. You can check the type and specifications on the main nameplate. (A total of four nameplates and warning plates are attached to the inverter as shown below.)

**Warning plate**

**Sub nameplate**

|         |                |
|---------|----------------|
| TYPE    | FRN37AR1L-4A   |
| SER.No. | W0ZA123A0001AA |

**Main nameplate**

|                                |         |  |
|--------------------------------|---------|--|
|                                |         |  |
| Inverter type                  | TYPE    | FRN37AR1L-4A                                   |
| Input power specifications     | SOURCE  | 3PH 380-480V 50Hz/60Hz<br>69.4A                |
| Inverter output specifications | OUTPUT  | 3PH 380-480V 0.1-120Hz<br>37kVA 75A 110 % 1min |
| Enclosure                      | IP55    |  |
| Product number                 | SER.No. | W0ZA123A0001AA                                 |
|                                |         | 039  |
|                                |         | SCR 100kA                                      |
|                                |         | MASS 23kg                                      |
|                                |         | WF   |

**Production year and week**

|  |
|--|
| 039  |
| Production week<br>The 1st week of January is indicated as "01." |
| Production year: Last digit of year                              |

**Mass of the inverter**

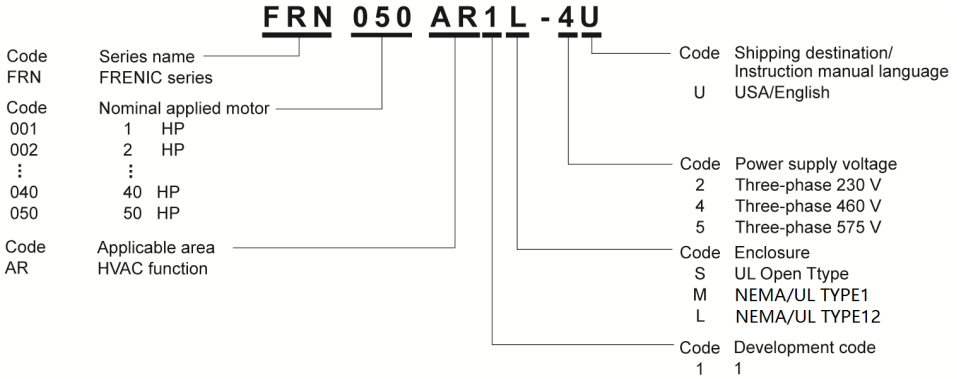
### ■kW rating

**FRN 37 AR1L - 4A**

|   |  |  |   |
|---|--|--|---|
| <p>Code Series name</p> <p>FRN FRENIC series</p><br><p>Code Nominal applied motor</p> <p>0.75 0.75 kW</p> <p>1.5 1.5 kW</p> <p>⋮ ⋮</p> <p>630 630 kW</p> <p>710 710 kW</p><br><p>Code Applicable area</p> <p>AR HVAC function</p> |  |  | <p>Code Shipping destination/<br/>Instruction manual language</p> <p>A Asia/English</p> <p>E EU/English</p><br><p>Code Power supply voltage</p> <p>2 Three-phase 200 V</p> <p>4 Three-phase 400 V</p><br><p>Code Enclosure</p> <p>S IP00</p> <p>M IP21</p> <p>L IP55</p><br><p>Code Development code</p> <p>1 1</p> |
|---|--|--|---|

**Note** In this manual, inverter types are denoted as "FRN\_\_ \_AR1■-4□." The boxes ■ and □ replace alphabetic letters depending on the enclosure and shipping destination, respectively.

**HP rating**



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 Precautions for Using Inverters**

When handling inverters, be sure to observe the wiring precautions given below.

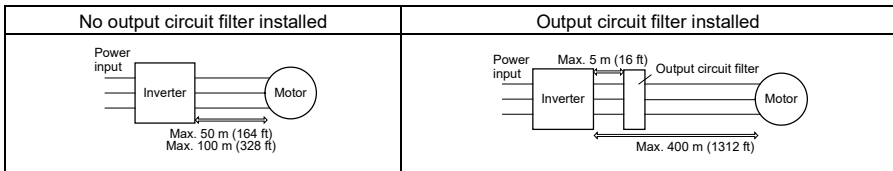
- (1) If more than one motor is to be connected to a single inverter, the wiring length should be the sum of the length of the wires to the motors.
- (2) Precautions for high frequency leakage currents

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 (164 ft) or less for inverters of 3.7 kW (5HP) or below, and 100 m (328 ft) or less for inverters with a higher capacity. Output circuit filters cannot be used with the three-phase 575V class series.

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

When the 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 lower the carrier frequency or insert an output circuit filter (OFL-□□□-□A). Output circuit filters cannot be used with the three-phase 575V class series.



For an inverter with an output circuit filter installed, the total secondary wiring length should be 400 m (1312 ft) or less.

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

### 1.3 Usage environment and Strage enviroment

This section provides precautions in introducing inverters, e.g. precautions for installtion environment and strage environment.

#### 1.3.1 Usage environment

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

Three-phase 200 V class series (kW rating)

0.75 to 90 kW

|                            |                      |   |   |  |   |   |
|----------------------------|----------------------|---|---|--|---|---|
| Environmental Requirements | Ambient temperature  | IP00/IP21   | -10 to +50°C                              |  |   |   |
|                            | Relative humidity    | IP55  | -10 to +40°C                              |  |   |   |
| Environmental Requirements | Atmosphere           | 5 to 95% (No condensation)  |   |  |   |   |
|                            | Altitude             | The inverter must not be exposed to dust, direct sunlight, corrosive gases, flammable gases, oil mist, vapor or water drops. Pollution degree 2 (IEC/EN 60664-1) (*1) Indoor use only<br>The atmosphere can contain a small amount of salt. (0.01 mg/cm <sup>2</sup> or less per year)<br>The inverter must not be subjected to sudden changes in temperature that will cause condensation to form. |   |  |   |   |
|                            | Atmospheric pressure | 1,000 m max. (*2)   |   |  |   |   |
|                            | Vibration            | 86 to 106 kPa   |   |  |   |   |
| Environmental Requirements | Vibration            | 45 kW or less   |   | 55 to 75 kW                              |   | 90kW                                    |
|                            |                      | 3 mm 2 to less than 9 Hz  | 3 mm 2 to less than 9 Hz                  | 3 mm 2 to less than 9 Hz                 | 3 mm 2 to less than 9 Hz                  | 3 mm 2 to less than 9 Hz                |
| Environmental Requirements | Vibration            | 10 m/s <sup>2</sup> 9 to less than 200 Hz   | 9.8 m/s <sup>2</sup> 9 to less than 20 Hz | 2 m/s <sup>2</sup> 20 to less than 55 Hz | 1 m/s <sup>2</sup> 55 to less than 200 Hz | 1 m/s <sup>2</sup> 9 to less than 55 Hz |
|                            |                      |   |   |  |   |   |

Three-phase 400 V class series (kW rating)

0.75 to 710 kW

|                            |                      |   |   |   |                          |                          |
|----------------------------|----------------------|---|---|---|--------------------------|--------------------------|
| Environmental Requirements | Ambient temperature  | IP00/IP21   | -10 to +50°C                            |   |                          |                          |
|                            | Relative humidity    | IP55  | -10 to +40°C                            |   |                          |                          |
| Environmental Requirements | Atmosphere           | 5 to 95% (No condensation)  |   |   |                          |                          |
|                            | Altitude             | The inverter must not be exposed to dust, direct sunlight, corrosive gases, flammable gases, oil mist, vapor or water drops. Pollution degree 2 (IEC/EN 60664-1) (*1) Indoor use only<br>The atmosphere can contain a small amount of salt. (0.01 mg/cm <sup>2</sup> or less per year)<br>The inverter must not be subjected to sudden changes in temperature that will cause condensation to form. |   |   |                          |                          |
|                            | Atmospheric pressure | 1,000 m max. (*2)   |   |   |                          |                          |
|                            | Vibration            | 86 to 106 kPa   |   |   |                          |                          |
| Environmental Requirements | Vibration            | 90 kW or less   |   | 110 to 710 kW                             |                          |                          |
|                            |                      | 3 mm 2 to less than 9 Hz  | 3 mm 2 to less than 9 Hz                | 3 mm 2 to less than 9 Hz                  | 3 mm 2 to less than 9 Hz | 3 mm 2 to less than 9 Hz |
| Environmental Requirements | Vibration            | 10 m/s <sup>2</sup> 9 to less than 200 Hz   | 2 m/s <sup>2</sup> 9 to less than 55 Hz | 1 m/s <sup>2</sup> 55 to less than 200 Hz |                          |                          |
|                            |                      |   |   |   |                          |                          |

(\*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 panel of your system.

(\*2) If you use the inverter in an altitude above 1000 m, you should apply an output current derating factor as listed in the table below.

|                                |                 |                |                |                |                |
|--------------------------------|-----------------|----------------|----------------|----------------|----------------|
| Altitude                       | 1000 m or lower | 1000 to 1500 m | 1500 to 2000 m | 2000 to 2500 m | 2500 to 3000 m |
| Output current derating factor | 1.00            | 0.97           | 0.95           | 0.91           | 0.88           |



### Three-phase 230 V class series (HP rating)

1 to 125 HP

|                            |                      |   |                       |                        |                       |                    |                        |
|----------------------------|----------------------|---|-----------------------|------------------------|-----------------------|--------------------|------------------------|
| Environmental Requirements | Ambient temperature  | UL open type<br>NEMA/UL TYPE1   | 14 to 122 °F          |                        |                       |                    |                        |
|                            |                      | NEMA/UL TYPE12  | 14 to 104 °F          |                        |                       |                    |                        |
|                            | 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 (IEC/EN 60664-1) (*1) Indoor use only<br>The atmosphere can contain a small amount of salt. (0.01 mg/cm <sup>2</sup> or less per year)<br>The inverter must not be subjected to sudden changes in temperature that will cause condensation to form. |                       |                        |                       |                    |                        |
|                            | Altitude             | 3,300 ft max. (*2)  |                       |                        |                       |                    |                        |
|                            | Atmospheric pressure | 86 to 106 kPa   |                       |                        |                       |                    |                        |
|                            | Vibration            | 60 HP or less   |                       | 75 to 100 HP           | 125 HP                |                    |                        |
|                            |                      | 3 mm  | 2 to less than 9 Hz   | 3 mm                   | 2 to less than 9 Hz   | 3 mm               | 2 to less than 9 Hz    |
|                            |                      | 10 m/s <sup>2</sup>   | 9 to less than 200 Hz | 9.8 m/s <sup>2</sup>   | 9 to less than 20 Hz  | 2 m/s <sup>2</sup> | 9 to less than 55 Hz   |
|                            |                      |   |                       | 2 m/s <sup>2</sup>     | 20 to less than 55 Hz | 1 m/s <sup>2</sup> | 55 to less than 200 Hz |
|                            |                      |   | 1 m/s <sup>2</sup>    | 55 to less than 200 Hz |                       |                    |                        |

### Three-phase 460 V class series (HP rating)

1 to 1000 HP

|                            |                      |   |                       |                    |                        |  |
|----------------------------|----------------------|---|-----------------------|--------------------|------------------------|--|
| Environmental Requirements | Ambient temperature  | UL open type<br>NEMA/UL TYPE1   | 14 to 122 °F          |                    |                        |  |
|                            |                      | NEMA/UL TYPE12  | 14 to 104 °F          |                    |                        |  |
|                            | 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 (IEC/EN 60664-1) (*1) Indoor use only<br>The atmosphere can contain a small amount of salt. (0.01 mg/cm <sup>2</sup> or less per year)<br>The inverter must not be subjected to sudden changes in temperature that will cause condensation to form. |                       |                    |                        |  |
|                            | Altitude             | 3,300 ft max. (*2)  |                       |                    |                        |  |
|                            | Atmospheric pressure | 86 to 106 kPa   |                       |                    |                        |  |
|                            | Vibration            | 125 HP or less  |                       | 150 to 1000 HP     |                        |  |
|                            |                      | 3 mm  | 2 to less 9 Hz        | 3 mm               | 2 to less than 9 Hz    |  |
|                            |                      | 10 m/s <sup>2</sup>   | 9 to less than 200 Hz | 2 m/s <sup>2</sup> | 9 to less than 55 Hz   |  |
|                            |                      |   |                       | 1 m/s <sup>2</sup> | 55 to less than 200 Hz |  |

### Three-phase 575 V class series (HP rating)

1 to 300 HP

|                            |                      |   |                       |                    |                        |  |
|----------------------------|----------------------|---|-----------------------|--------------------|------------------------|--|
| Environmental Requirements | Ambient temperature  | UL open type<br>NEMA/UL TYPE1   | 14 to 122 °F          |                    |                        |  |
|                            |                      | NEMA/UL TYPE12  | 14 to 104 °F          |                    |                        |  |
|                            | 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 (IEC/EN 60664-1) (*1) Indoor use only<br>The atmosphere can contain a small amount of salt. (0.01 mg/cm <sup>2</sup> or less per year)<br>The inverter must not be subjected to sudden changes in temperature that will cause condensation to form. |                       |                    |                        |  |
|                            | Altitude             | 3,300 ft max. (*2)  |                       |                    |                        |  |
|                            | Atmospheric pressure | 86 to 106 kPa   |                       |                    |                        |  |
|                            | Vibration            | 150 HP or less  |                       | 200 to 300 HP      |                        |  |
|                            |                      | 3 mm  | 2 to less 9 Hz        | 3 mm               | 2 to less than 9 Hz    |  |
|                            |                      | 10 m/s <sup>2</sup>   | 9 to less than 200 Hz | 2 m/s <sup>2</sup> | 9 to less than 55 Hz   |  |
|                            |                      |   |                       | 1 m/s <sup>2</sup> | 55 to less than 200 Hz |  |

(\*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 panel of your system.

(\*2) If you use the inverter in an altitude above 3300 ft, you should apply an output current derating factor as listed in the table below.

|                                |                  |                 |                 |                 |                 |
|--------------------------------|------------------|-----------------|-----------------|-----------------|-----------------|
| Altitude                       | 3300 ft or lower | 3300 to 4900 ft | 4900 to 6600 ft | 6600 to 8200 ft | 8200 to 9800 ft |
| Output current derating factor | 1.00             | 0.97            | 0.95            | 0.91            | 0.88            |

### 1.3.2 Storage environment

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

#### [ 1 ] Temporary storage

Table1.1 Storage and Transport Environments

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

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

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

#### Precautions for temporary storage

- (1) Do not leave the inverter directly on the floor.
- (2) If the environment does not satisfy the specified requirements listed in Table1.1 wrap the inverter in an airtight vinyl sheet or the like for storage.
- (3) If the inverter is to be stored in a high-humidity environment, put a drying agent (such as silica gel) in the airtight package described in (2) above.

#### [ 2 ] Long-term storage

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

- (1) The storage site must satisfy the requirements specified for temporary storage.  
However, for storage exceeding three months, the surrounding temperature range should be within the range from -10 to +30°C (14 to 86°F). This is to prevent electrolytic capacitors in the inverter from deterioration.
- (2) The package must be airtight to protect the inverter from moisture. Add a drying agent inside the package to maintain the relative humidity inside the package within 70%.
- (3) If the inverter has been installed to the equipment or panel at construction sites where it may be subjected to humidity, dust or dirt, then temporarily remove the inverter and store it in the environment specified in Table1.1.

#### Precautions for storage over 1 year

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

## Chapter 2 MOUNTING AND WIRING THE INVERTER

### 2.1 Installing the Inverter

#### (1) 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.

#### (2) Clearances

Ensure that the minimum clearances indicated in Figure 2.1 and Table 2.1 are maintained at all times. When installing the inverter in the panel of your system, take extra care with ventilation inside the panel as the ambient temperature easily rises. Do not install the inverter in a small panel with poor ventilation.

#### ■ When mounting two or more inverters

When mounting two or more inverters in the same unit or panel, basically lay them out side by side. When mounting them one above the other, be sure to separate them with a partition plate or the like so that any heat radiating from one inverter will not affect the one(s) above.

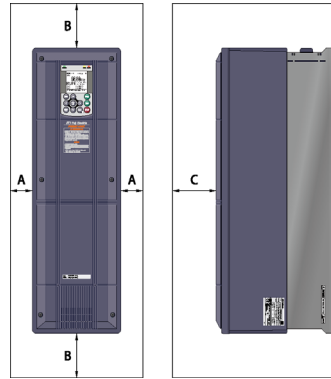


Figure 2.1 Mounting Direction and Required Clearances

Table 2.1 Clearances mm (inch)

| Inverter capacity                                   | A            | B            | C            |
|---|--------------|--------------|--------------|
| 200Vclass series : 0.75 to 45 kW (1 to 60 HP)       | 10<br>(0.39) | 100<br>(3.9) | 100<br>(3.9) |
| 400Vclass series : 0.75 to 90kW (1 to 125 HP)       |              |              |              |
| 575Vclass series : 1 to 150 HP                      | 50<br>(1.97) | 150<br>(5.9) | 150<br>(5.9) |
| 200Vclass series : 55 to 90 kW (75 to 125 HP)       |              |              |              |
| 400Vclass series : 110 to 280kW (150 to 450 HP)     |              |              |              |
| 575Vclass series : 200 to 300HP                     | 150<br>(5.9) | 150<br>(5.9) | 150<br>(5.9) |
| 400Vclass series : 315 to 710 kW<br>(500 to 1000HP) |              |              |              |

C: Space required in front of the inverter unit

### 2.2 Wiring

Before wiring, remove the front cover and wiring plate and then set cable glands or conduits on the wiring plate. After wiring, mount the wiring plate and front cover back into place. (The cable glands or conduits should be prepared by the customer.)

#### 2.2.1 Removing and mounting the front cover and the wiring plate

##### (1) 200V class series 45 kW (60HP), 400V class series 90 kW (125HP), 575V class series 150 HP or less

- ① Loosen the (four or six) screws on the front cover, hold the right and left ends of the front cover, and remove it towards you.
- ② Loosen the four screws on the wiring plate, hold the right and left ends of the wiring plate, and remove it downwards.

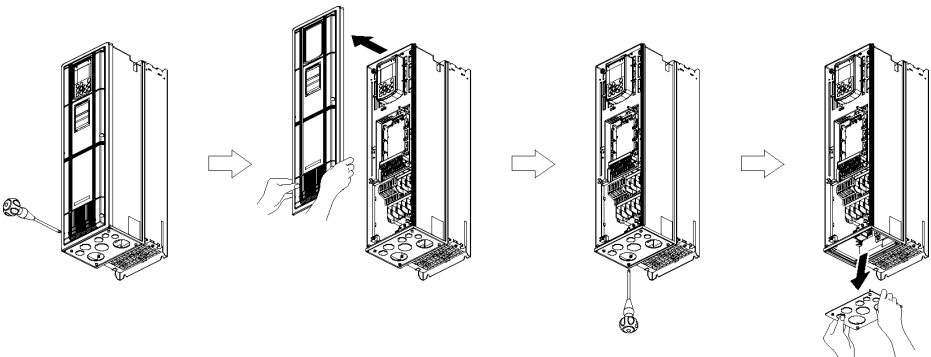


Figure 2.2 Removing the Front Cover and the Wiring Plate (FRN37AR1M-4□/ FRN050AR1M-4U)

- Tip - The wiring plate can be removed even with the front cover being mounted.
- To expose the control printed circuit board (control PCB), remove the front cover.

**(2) 200V class series 55 to 90 kW (75 to 125HP) and 400V class series 110 to 710 kW (150 to 1000HP)  
575V class series 200 to 300 HP**

- ① Loosen the screws on the front cover, hold the right and left ends of the front cover, and slide it up to remove it.
- ② After making the necessary wiring connections, align the top of the front cover with the holes on the unit and reattach the cover by reversing the process illustrated in Figure 2.3.

- Tip - To expose the control printed circuit board (control PCB), open the keypad case.

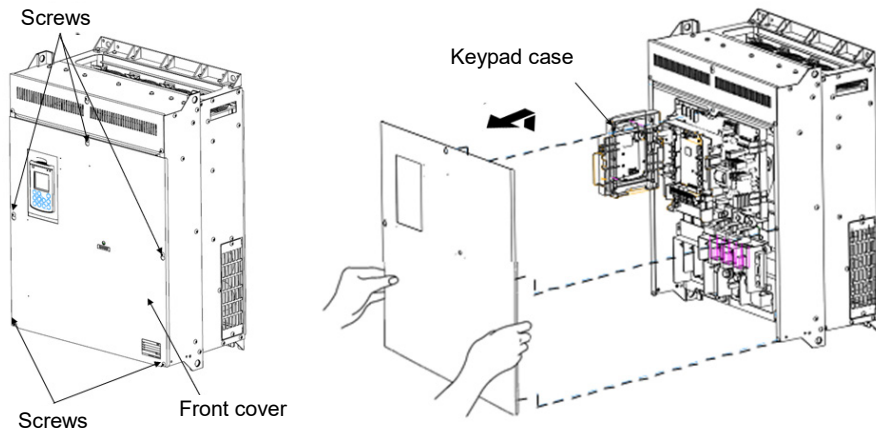


Figure 2.3 Removing the Front Cover and the Wiring Plate (FRN110AR1S-4□)

**(3) Punching out semi-perforated sections in the wiring plate and setting cable glands or conduits**

- ① Lightly tap the semi-perforated sections from the inside of the wiring plate using the hand grip of a screwdriver or the like to punch them out.
- ② Set the cable glands or conduits on the wiring plate and then carry out wiring.

- Note Take care not to get injured by the edge of the parts.

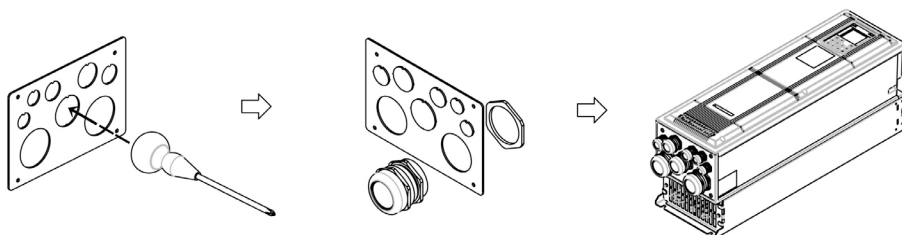
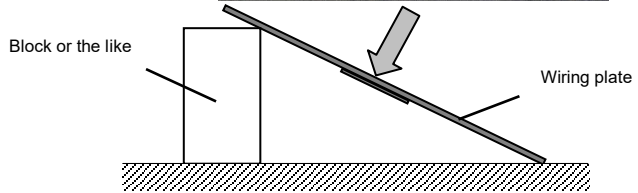
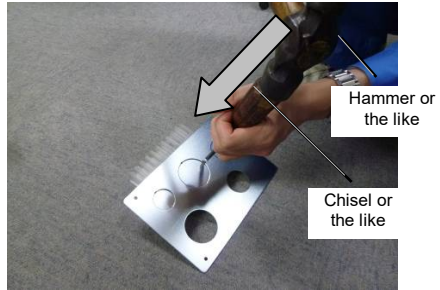
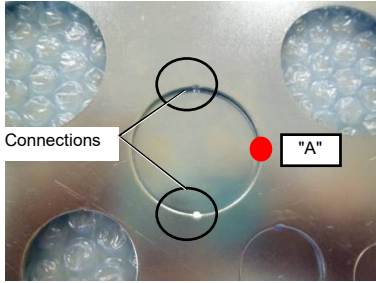


Figure 2.4 Punching Out Semi-perforated Sections in the Wiring Plate and Setting Cable Glands or Conduits

**If it is difficult to punch semi-perforated sections out of the wiring plate**

Apply a rod with a sharp tip (e.g., chisel) to point "A" shown below and tap it using a hammer.

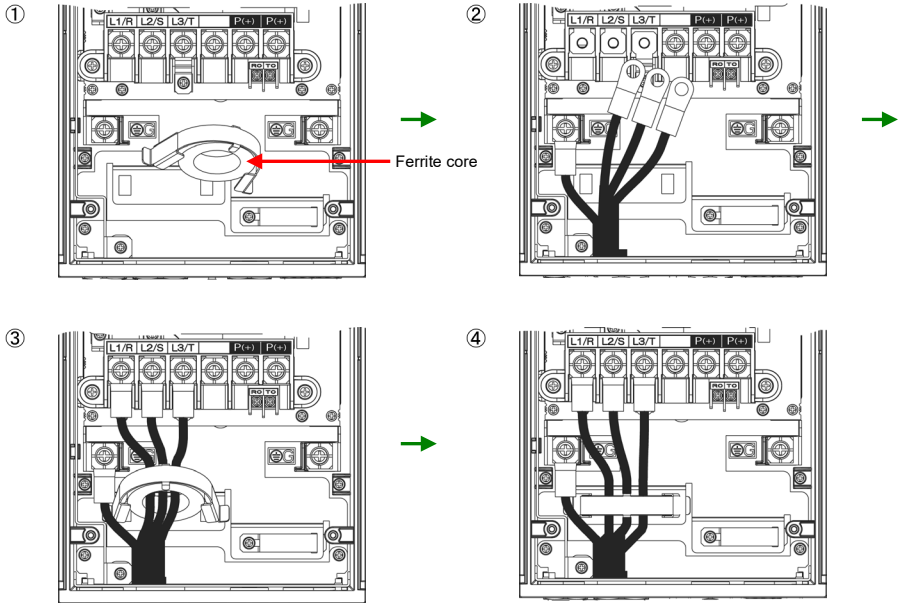


Take care not to deform the wiring plate.

#### (4) Wiring the main circuit power input wires

For 200V class series inverters of 5.5 to 45 kW (7 to 60HP) and 400V ones of 11 to 90 kW (15 to 125HP), follow the wiring procedure given below for smooth wiring. For 575V series, ferrite core is not required.

- ① Remove the screws and press the ends of the ferrite core support inwards to release the ferrite core from the main circuit terminal block.
- ② Connect the inverter grounding wire.
- ③ Pass the main circuit power input wires of the inverter through the ferrite core and then connect those wires to the terminal block.
- ④ Put the ferrite core and its support back into place.



#### (5) Mounting the wiring plate and the front cover

After wiring, mount the wiring plate and front cover back into place.


(Tightening torque: 1.8 N•m (15.9 lb-in) (M4), 3.5 N•m (31.0 lb-in) (M5))

### 2.2.2 Recommended wire sizes

For the recommended wire sizes for the main circuits, refer to the "Conformity to the Low Voltage Directive in the EU" and "Conformity with UL standards and CSA standards (cUL-listed for Canada)" given in Preface. Crimp-style terminals for the main circuits should have insulation, insulation tubes, or similar treatment.

### 2.2.3 Terminal arrangement diagrams and screw specifications

The tables and figures given below show the screw specifications and terminal arrangement diagrams. Note that the terminal arrangements differ depending on the inverter capacity.

 Do not connect wiring to unassigned main circuit terminals that are marked with (※) in the figures given below. Doing so may break the inverter.

#### (1) Main circuit terminals

Table 2.2-1 Main Circuit Terminals (kW rating)

| Power supply voltage | Nominal applied motor (kW) | Inverter type                  | Refer to: | Main circuit terminals |                         | Grounding terminals |                         | Aux. control power supply [R0, T0] |                         | Aux main power supply [R1, T1] |                         |
|----------------------|----------------------------|--------------------------------|-----------|------------------------|-------------------------|---------------------|-------------------------|------------------------------------|-------------------------|--------------------------------|-------------------------|
|                      |                            |                                |           | Screw size             | Tightening torque (N-m) | Screw size          | Tightening torque (N-m) | Screw size                         | Tightening torque (N-m) | Screw size                     | Tightening torque (N-m) |
| Three-phase 200V     | 0.75                       | FRN0.75AR1■-2□                 | Figure A  | M4                     | 1.8                     | M4                  | 1.8                     | M3.5                               | 1.2                     | -                              | -                       |
|                      | 1.5                        | FRN1.5AR1■-2□                  |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 2.2                        | FRN2.2AR1■-2□                  |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 3.7<br>(4.0)*              | FRN3.7AR1■-2□<br>FRN4.0AR1■-2E |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 5.5                        | FRN5.5AR1■-2□                  | Figure B  | M6                     | 5.8                     | M6                  | 5.8                     |                                    |                         |                                |                         |
|                      | 7.5                        | FRN7.5AR1■-2□                  |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 11                         | FRN11AR1■-2□                   |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 15                         | FRN15AR1■-2□                   | Figure C  | M6                     | 5.8                     | M6                  | 5.8                     |                                    |                         |                                |                         |
|                      | 18.5                       | FRN18.5AR1■-2□                 |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 22                         | FRN22AR1■-2□                   | Figure D  | M8                     | 13.5                    | M8                  | 13.5                    |                                    |                         |                                |                         |
|                      | 30                         | FRN30AR1■-2□                   |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 37                         | FRN37AR1■-2□                   | Figure E  | M10                    | 27                      | M10                 | 27                      |                                    |                         |                                |                         |
|                      | 45                         | FRN45AR1■-2□                   |           |                        |                         |                     |                         |                                    |                         |                                |                         |
| 55                   | FRN55AR1S-2□               | Figure F                       | M10       | 27                     | M8                      | 13.5                |                         |                                    |                         |                                |                         |
| 75                   | FRN75AR1S-2□               |                                |           |                        |                         |                     |                         |                                    |                         |                                |                         |
| 90                   | FRN90AR1S-2□               | Figure L                       | M12       | 48                     | M10                     | 27                  |                         |                                    |                         |                                |                         |

\* 4.0 kW for the EU. The inverter type is FRN4.0AR1■-2E

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■Enclosure: M (IP21) or L (IP55)

□Shipping destination: E (Europe) or A (Asia)

Table 2.2-1 Main Circuit Terminals (kW rating) (Continued)

| Power supply voltage | Nominal applied motor (kW) | Inverter type                  | Refer to: | Main circuit terminals |                         | Grounding terminals |                         | Aux. control power supply [R0, T0] |                         | Aux main power supply [R1, T1] |                         |
|----------------------|----------------------------|--------------------------------|-----------|------------------------|-------------------------|---------------------|-------------------------|------------------------------------|-------------------------|--------------------------------|-------------------------|
|                      |                            |                                |           | Screw size             | Tightening torque (N-m) | Screw size          | Tightening torque (N-m) | Screw size                         | Tightening torque (N-m) | Screw size                     | Tightening torque (N-m) |
| Three-phase 400V     | 0.75                       | FRN0.75AR1■-4□                 | Figure A  | M4                     | 1.8                     | M4                  | 1.8                     | M3.5                               | 1.2                     |                                |                         |
|                      | 1.5                        | FRN1.5AR1■-4□                  |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 2.2                        | FRN2.2AR1■-4□                  |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 3.7<br>(4.0)*              | FRN3.7AR1■-4□<br>FRN4.0AR1■-4E |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 5.5                        | FRN5.5AR1■-4□                  |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 7.5                        | FRN7.5AR1■-4□                  |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 11                         | FRN11AR1■-4□                   | Figure B  | M6                     | 5.8                     | M6                  | 5.8                     |                                    |                         |                                |                         |
|                      | 15                         | FRN15AR1■-4□                   |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 18.5                       | FRN18.5AR1■-4□                 |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 22                         | FRN22AR1■-4□                   | Figure C  | M6                     | 5.8                     | M6                  | 5.8                     |                                    |                         |                                |                         |
|                      | 30                         | FRN30AR1■-4□                   |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 37                         | FRN37AR1■-4□                   | Figure D  | M8                     | 13.5                    | M8                  | 13.5                    |                                    |                         |                                |                         |
|                      | 45                         | FRN45AR1■-4□                   |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 55                         | FRN55AR1■-4□                   |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 75                         | FRN75AR1■-4□                   | Figure E  | M10                    | 27                      | M10                 | 27                      |                                    |                         |                                |                         |
|                      | 90                         | FRN90AR1■-4□                   |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 110                        | FRN110AR1S-4□                  | Figure F  | M10                    | 27                      | M8                  | 13.5                    |                                    |                         |                                |                         |
|                      | 132                        | FRN132AR1S-4□                  |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 160                        | FRN160AR1S-4□                  | Figure G  | M12                    | 48                      | M10                 | 27                      |                                    |                         |                                |                         |
|                      | 200                        | FRN200AR1S-4□                  |           |                        |                         |                     |                         |                                    |                         |                                |                         |
|                      | 220                        | FRN220AR1S-4□                  | Figure H  | M12                    | 48                      | M10                 | 27                      |                                    |                         |                                |                         |
| 280                  | FRN280AR1S-4□              |                                |           |                        |                         |                     |                         |                                    |                         |                                |                         |
| 315                  | FRN315AR1S-4□              | Figure I                       | M12       | 48                     | M10                     | 27                  |                         |                                    |                         |                                |                         |
| 355                  | FRN355AR1S-4□              |                                |           |                        |                         |                     |                         |                                    |                         |                                |                         |
| 400                  | FRN400AR1S-4□              | Figure J                       | M12       | 48                     | M10                     | 27                  |                         |                                    |                         |                                |                         |
| 500                  | FRN500AR1S-4□              |                                |           |                        |                         |                     |                         |                                    |                         |                                |                         |
| 630                  | FRN630AR1S-4□              | Figure K                       | M12       | 48                     | M10                     | 27                  |                         |                                    |                         |                                |                         |
| 710                  | FRN710AR1S-4□              |                                |           |                        |                         |                     |                         |                                    |                         |                                |                         |

\* 4.0 kW for the EU. The inverter type is FRN4.0AR1■-4E

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■Enclosure: M (IP21) or L (IP55)

□Shipping destination: E (Europe) or A (Asia)



Table 2.2-2 Main Circuit Terminals (HP rating)

| Power supply voltage | Nominal applied motor (HP) | Inverter type | Refer to: | Main circuit terminals |                           | Grounding terminals |                           | Aux. control power supply [R0, T0] |                           | Aux main power supply [R1, T1] |                           |
|----------------------|----------------------------|---------------|-----------|------------------------|---------------------------|---------------------|---------------------------|------------------------------------|---------------------------|--------------------------------|---------------------------|
|                      |                            |               |           | Screw size             | Tightening torque (lb-in) | Screw size          | Tightening torque (lb-in) | Screw size                         | Tightening torque (lb-in) | Screw size                     | Tightening torque (lb-in) |
| Three-phase 230V     | 1                          | FRN001AR1■-2U | Figure A  | M4                     | 15.9                      | M4                  | 15.9                      | M3.5                               | 10.6                      | -                              | -                         |
|                      | 2                          | FRN002AR1■-2U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 3                          | FRN003AR1■-2U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 5                          | FRN005AR1■-2U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 7                          | FRN007AR1■-2U | Figure B  | M6                     | 51.3                      | M6                  | 51.3                      |                                    |                           |                                |                           |
|                      | 10                         | FRN010AR1■-2U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 15                         | FRN015AR1■-2U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 20                         | FRN020AR1■-2U | Figure C  | M8                     | 119.4                     | M8                  | 119.4                     |                                    |                           |                                |                           |
|                      | 25                         | FRN025AR1■-2U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 30                         | FRN030AR1■-2U | Figure D  | M10                    | 238.9                     | M10                 | 238.9                     |                                    |                           |                                |                           |
|                      | 40                         | FRN040AR1■-2U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 50                         | FRN050AR1■-2U | Figure E  | M10                    | 238.9                     | M8                  | 119.4                     |                                    |                           |                                |                           |
|                      | 60                         | FRN060AR1■-2U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 75                         | FRN075AR1S-2U | Figure F  | M12                    | 424.7                     | M10                 | 238.9                     |                                    |                           |                                |                           |
| 100                  | FRN100AR1S-2U              |               |           |                        |                           |                     |                           |                                    |                           |                                |                           |
| 125                  | FRN125AR1S-2U              | Figure L      |           |                        |                           |                     |                           |                                    |                           |                                |                           |
| Three-phase 460V     | 1                          | FRN001AR1■-4U | Figure A  | M4                     | 15.9                      | M4                  | 15.9                      | M3.5                               | 10.6                      | -                              | -                         |
|                      | 2                          | FRN002AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 3                          | FRN003AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 5                          | FRN005AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 7                          | FRN007AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 10                         | FRN010AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 15                         | FRN015AR1■-4U | Figure B  | M6                     | 51.3                      | M6                  | 51.3                      |                                    |                           |                                |                           |
|                      | 20                         | FRN020AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 25                         | FRN025AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 30                         | FRN030AR1■-4U | Figure C  | M8                     | 119.4                     | M8                  | 119.4                     |                                    |                           |                                |                           |
|                      | 40                         | FRN040AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 50                         | FRN050AR1■-4U | Figure D  | M10                    | 238.9                     | M10                 | 238.9                     |                                    |                           |                                |                           |
|                      | 60                         | FRN060AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 75                         | FRN075AR1■-4U | Figure E  | M10                    | 238.9                     | M8                  | 119.4                     |                                    |                           |                                |                           |
|                      | 100                        | FRN100AR1■-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 125                        | FRN125AR1■-4U | Figure F  | M12                    | 424.7                     | M10                 | 238.9                     |                                    |                           |                                |                           |
|                      | 150                        | FRN150AR1S-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 200                        | FRN200AR1S-4U | Figure G  | M12                    | 424.7                     | M10                 | 238.9                     |                                    |                           |                                |                           |
|                      | 250                        | FRN250AR1S-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 300                        | FRN300AR1S-4U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 350                        | FRN350AR1S-4U | Figure H  | M12                    | 424.7                     | M10                 | 238.9                     |                                    |                           |                                |                           |
| 450                  | FRN450AR1S-4U              |               |           |                        |                           |                     |                           |                                    |                           |                                |                           |
| 500                  | FRN500AR1S-4U              | Figure I      | M12       | 424.7                  | M10                       | 238.9               |                           |                                    |                           |                                |                           |
| 600                  | FRN600AR1S-4U              |               |           |                        |                           |                     |                           |                                    |                           |                                |                           |
| 800                  | FRN800AR1S-4U              | Figure J      | M12       | 424.7                  | M10                       | 238.9               |                           |                                    |                           |                                |                           |
| 900                  | FRN900AR1S-4U              |               |           |                        |                           |                     |                           |                                    |                           |                                |                           |
| 1000                 | FRN1000AR1S-4U             | Figure K      |           |                        |                           |                     |                           |                                    |                           |                                |                           |

Note: A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

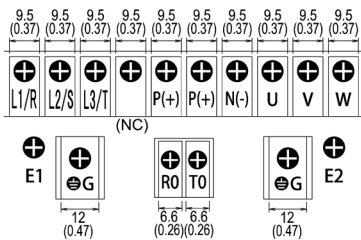
Table 2.2-2 Main Circuit Terminals (HP rating) (Continued)

| Power supply voltage | Nominal applied motor (HP) | Inverter type | Refer to: | Main circuit terminals |                           | Grounding terminals |                           | Aux. control power supply [R0, T0] |                           | Aux main power supply [R1, T1] |                           |
|----------------------|----------------------------|---------------|-----------|------------------------|---------------------------|---------------------|---------------------------|------------------------------------|---------------------------|--------------------------------|---------------------------|
|                      |                            |               |           | Screw size             | Tightening torque (lb-in) | Screw size          | Tightening torque (lb-in) | Screw size                         | Tightening torque (lb-in) | Screw size                     | Tightening torque (lb-in) |
| Three-phase 575V     | 1                          | FRN001AR1■-5U | Figure A  | M4                     | 15.9                      | M4                  | 15.9                      | M3.5                               | 10.6                      | -                              | -                         |
|                      | 2                          | FRN002AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 3                          | FRN003AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 5                          | FRN005AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 7                          | FRN007AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 10                         | FRN010AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 15                         | FRN015AR1■-5U | Figure B  | M6                     | 51.3                      | M6                  | 51.3                      |                                    |                           |                                |                           |
|                      | 20                         | FRN020AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 25                         | FRN025AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 30                         | FRN030AR1■-5U | Figure C  | M8                     | 119.4                     | M8                  | 119.4                     |                                    |                           |                                |                           |
|                      | 40                         | FRN040AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 50                         | FRN050AR1■-5U | Figure D  | M10                    | 238.9                     | M10                 | 238.9                     |                                    |                           |                                |                           |
|                      | 60                         | FRN060AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 75                         | FRN075AR1■-5U | Figure E  | M12                    | 424.7                     | M10                 | 238.9                     |                                    |                           |                                |                           |
|                      | 100                        | FRN100AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
|                      | 125                        | FRN125AR1■-5U |           |                        |                           |                     |                           |                                    |                           |                                |                           |
| 150                  | FRN150AR1■-5U              | Figure G      | M12       | 424.7                  | M10                       | 238.9               |                           |                                    |                           |                                |                           |
| 200                  | FRN200AR1S-5U              |               |           |                        |                           |                     |                           |                                    |                           |                                |                           |
| 250                  | FRN250AR1S-5U              |               |           |                        |                           |                     |                           |                                    |                           |                                |                           |
| 300                  | FRN300AR1S-5U              |               |           |                        |                           |                     |                           |                                    |                           |                                |                           |

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

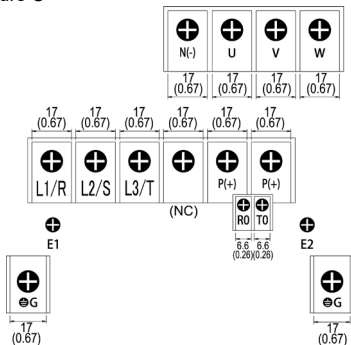
■ Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

Figure A



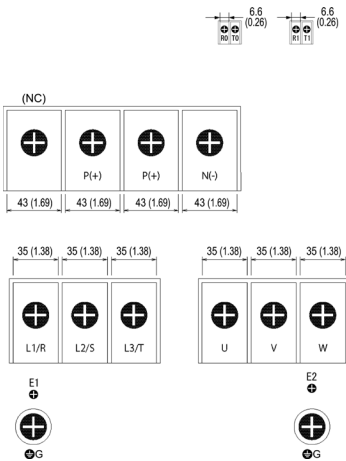
※ : Do not connect.

Figure C



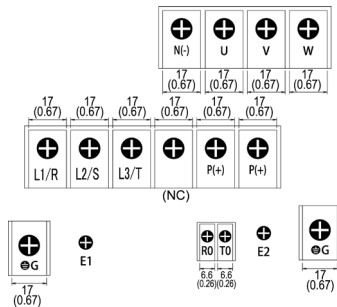
※ : Do not connect.

Figure E



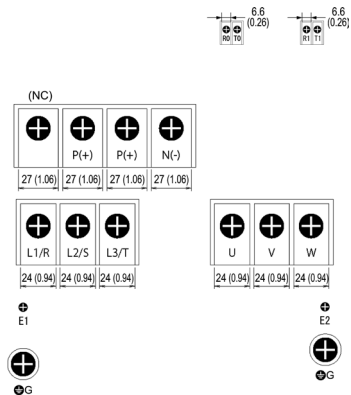
※ : Do not connect.

Figure B



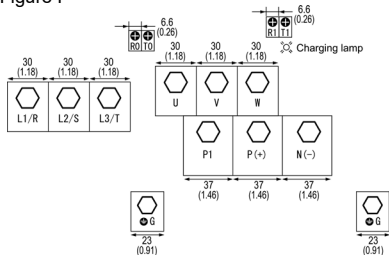
※ : Do not connect.

Figure D



※ : Do not connect.

Figure F



(For Figure F)

Figure G / Figure H

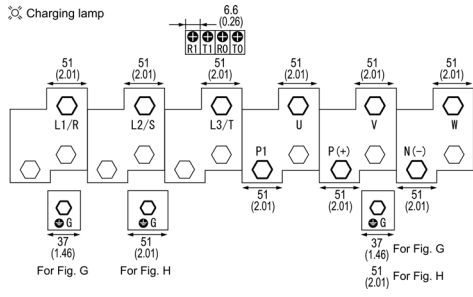


Figure I

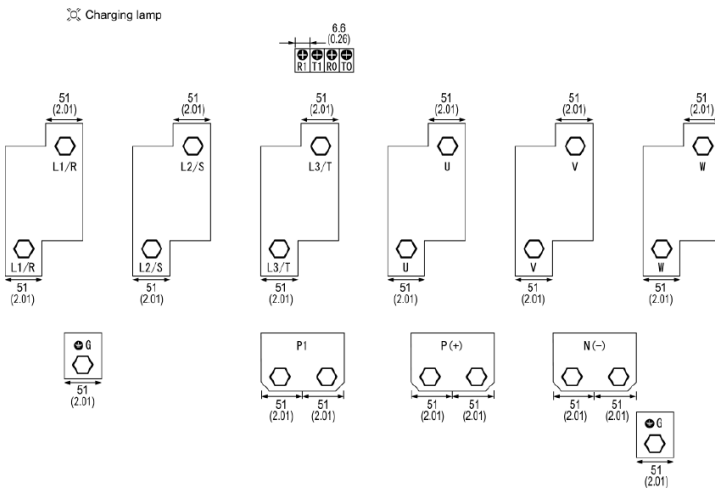


Figure J

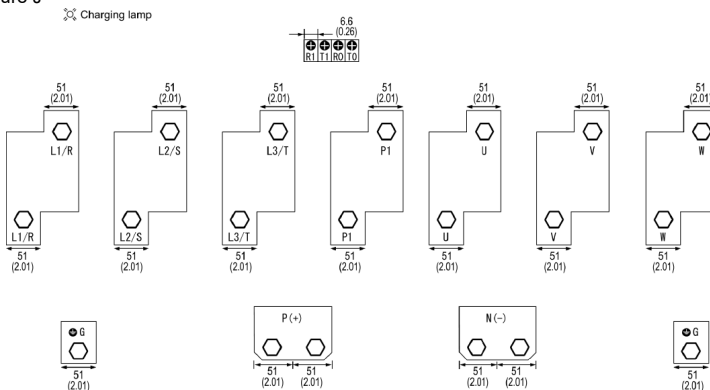


Figure K

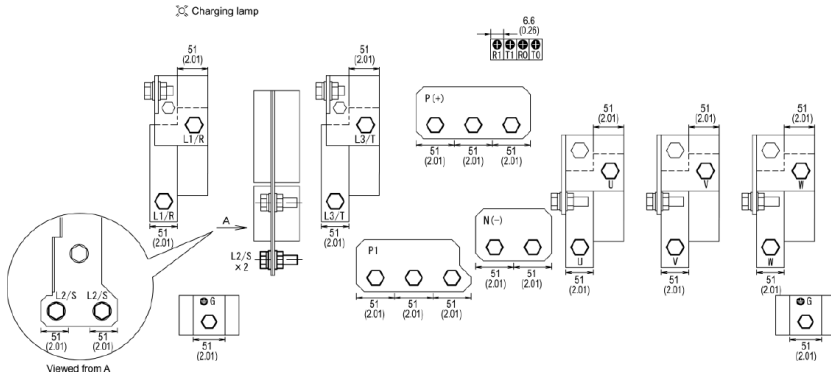
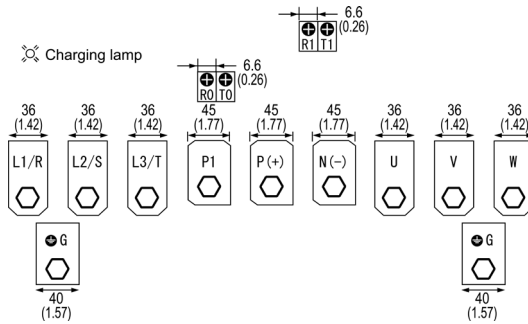
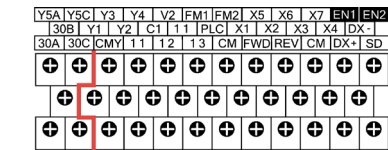


Figure L



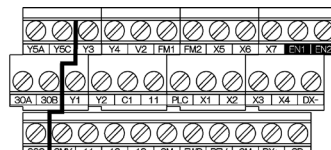
(2) Arrangement of control circuit terminals

■ Screw type of terminal block  
(Shipping destination : A (Asia) or U (USA))




AUX-contact  
Reinforce insulation  
(Max. 250 VAC, Overvoltage category II, Pollution degree 2)

■ Europe type of terminal block  
(Shipping destination : E (Europe))



AUX-contact  
Reinforce insulation  
(Max. 250 VAC, Overvoltage category II, Pollution degree 2)

Table 2.3 Control Circuit Terminals

| Terminal block type | Screw specifications |                                      | Recommended wire size (mm <sup>2</sup> ) | Type of screwdriver (tip shape)                                  | Wire strip length<br> | Gauge No. of wire insertion slot |
|---------------------|----------------------|--------------------------------------|--|--|--|----------------------------------|
|                     | Screw size           | Tightening torque                    |  |  |  |                                  |
| Screw type          | M3                   | 0.7 N·m<br>(6.2 lb·in)               | 0.75 mm <sup>2</sup><br>(AWG18)          | -  | -  | -                                |
| Europe type         |                      | 0.5 to 0.6 N·m<br>(4.4 to 5.3 lb·in) |  | Flat screwdriver<br>(0.6 mm x 3.5 mm)<br>(0.02 inch x 0.14 inch) | 6 mm<br>(0.24 inch)  | A1*                              |





\*In conformity with the IEC/EN 60947-1

## 2.2.4 Terminal functions and wiring order

### Main circuit terminals and grounding terminals

The table below shows the order of wiring and terminal functions. Carry out wiring in the order shown below.

Table 2.4 Order of Wiring and Functions of Main Circuit Terminals

| Classification         | Order of wiring | Name   | Symbol   | Functions  |
|------------------------|-----------------|--|--|--|
| Main circuit<br>(Note) | ①               | Primary grounding terminals for inverter enclosure                   |  G            | Two grounding terminals (  G) are not exclusive to the power supply wiring (primary circuit) or motor wiring (secondary circuit). Be sure to ground either of the two grounding terminals for safety and noise reduction.   |
|                        | ②               | Secondary grounding terminals for motor<br>Inverter output terminals |  G<br>U, V, W | Connect the secondary grounding wire for the motor to the grounding terminal (  G).<br>Connect the three wires of the Three-phase motor to terminals U, V, and W, aligning the phases each other. (*1)  |
|                        | ③               | Auxiliary control power input terminals                              | R0, T0   | Connect the same AC power as for the main circuit to these terminals as a control circuit power backup.  |
|                        | ④               | Auxiliary main power input terminals                                 | R1, T1   | It is not normally necessary to connect anything to these terminals. They are used when connecting to a DC bus. For more information, see FRENIC-HVAC User's Manual section 5.1.6 "Wiring of main circuit terminals and grounding terminals". (on 200V class series inverter of 22kW (30HP) or above, and 400V ones of 45kW (60HP) or above and 575 V ones of 60 HP or above). |
|                        | ⑤               | DC reactor connection terminals                                      | P1, P(+)   | Connect a DC reactor (DCR) to improve the power factor. (on 200V class series inverter of 55 to 90kW (75 to 125HP) or 400V ones of 110 kW (150HP) or above and 575 V ones of 150 HP or above.)   |
|                        | ⑥               | DC link bus terminals  | P(+), N(-)   | A DC link bus is connectable to these terminals. When you need to use the DC link bus terminals P(+) and N(-), consult your Fuji Electric representative.  |
|                        | ⑦               | Main circuit power input terminals                                   | L1/R, L2/S, L3/T   | The three-phase input power lines are connected to these terminals. (*2)<br>If the power wires are connected to other terminals, the inverter will be damaged when the power is turned ON.   |
|                        | ⑧               | Switching connectors   | CN UX, CN R, CN W  | These are the main circuit switching connectors. For more information, see "2.2.6 Switching connectors" in this instruction manual.  |
| Control circuit        | ⑨               | Control circuit terminals  | See Table 2.5.   | Route the wiring of the control circuit as far from that of the main circuit as possible. Otherwise, electric noise may cause malfunctions.<br>When the Enable function is not to be used, short-circuit terminals [EN1] and [PLC] and terminals [EN2] and [PLC] using jumper wires.   |

**(Note)** Do not **connect** wiring to unassigned main circuit terminals (marked with NC). For details about the terminal block, refer to Section 2.2.3 "Terminal arrangement diagrams and screw specifications."

#### Wiring of Auxiliary control power input terminals

Auxiliary control power input terminals R0 and T0.

Terminal rating:

200V class series ; 200 to 240VAC, 50/60Hz, Maximum current 1.0A (18.5kW (25HP) or below)

200V class series ; 200 to 230VAC, 50/60Hz, Maximum current 1.0A(22kW (30HP) or above)

400V class series ; 380 to 480VAC, 50/60Hz, Maximum current 0.5A

575V class series ; 575 to 600VAC, 50/60Hz, Maximum current 0.5A

**Auxiliary main power input terminals R1 and T1**

(on 200V class series inverters of 22 kW (30HP) or above, and 400V/575V class series inverters of 45 kW (60HP) or above)

Terminal rating:

200V class series: 200 to 220 VAC /50 Hz, 200 to 230 VAC/60 Hz: Maximum current 1.0 A

400V class series: 380 to 440 VAC /50 Hz, 380 to 480 VAC/60 Hz

500 kW (800HP) or below : Maximum current 1.0 A

630/710 kW (900/1000HP) : Maximum current 2.0 A

575 V class series: 575 to 600 VAC/50Hz, 575 to 600 VAC/60Hz

Maximum current 1.0 A

**■ Wiring notes**

To make the machinery or equipment compliant with the EMC standards, wire the motor and inverter in accordance with the following.

(\*1) Use shielded wires for the motor cable and route the cable as short as possible. Firmly clamp the shield to the specified point inside the inverter.

(\*2) When wiring the main circuit power input lines of the inverters of 200V class series inverter of 5.5 to 45kW (7 to 60 HP) and 400V ones of 11 to 90 kW (15 to 125 HP), be sure to pass them through a ferrite core. For 575V series, ferrite core is not required.



When shielded wires are not used for the motor cable, remove the motor cable clamps to prevent the cable covering from getting damaged, which makes the machinery or equipment noncompliant with the EMC standards. Wiring the inverter main power input lines without passing them through a ferrite core also makes the machinery or equipment in compliance with the EMC standards due to increase of noise generated by the inverter, but it does not affect inverter basic operation.

For details about wiring, refer to Chapter 8, Section 8.3 "Compliance with EMC Standards."

**Control circuit terminals**

Table 2.5 Names, Symbols and Functions of the Control Circuit Terminals

| Classification | Name   | Symbol             | Functions   |
|----------------|--|--------------------|---|
| Analog input   | Power supply for the potentiometer                   | [13]               | Power supply for an external frequency command potentiometer (Variable resistor: 1 to 5kΩ)  |
|                | Analog setting voltage input                         | [12]               | External voltage input that commands the frequency externally.  |
|                | Analog setting current input<br>PTC thermistor input | [C1]               | External current input that commands the frequency externally.<br>Connection of a PTC (Positive Temperature Coefficient) thermistor for motor protection.   |
|                | Analog setting voltage input                         | [V2]               | External voltage input that commands the frequency externally.  |
|                | Analog common  | [11]               | Common terminal for analog input signals.   |
| Digital input  | Digital input 1 to<br>Digital input 7                | [X1]<br>to<br>[X7] | (1) Various signals such as "Coast to a stop," "Enable external alarm trip," and "Select multi-frequency" can be assigned to terminals [X1] to [X7], [FWD] and [REV] by setting function codes E01 to E07, E98, and E99.<br><br>(2) Input mode, i.e. SINK and SOURCE, is changeable by using the slide switch SW1.<br><br>(3) The logic value (1/0) for ON/OFF of the terminals [X1] to [X7], [FWD], or [REV] can be switched. If the logic value for ON of the terminal [X1] is "1" in the normal logic system, for example, OFF is "1" in the negative logic system and vice versa. |
|                | Run forward command                                  | [FWD]              | Short-circuiting terminals [FWD] and [CM] runs the motor in the forward direction and opening them decelerates the motor to a stop.   |
|                | Run reverse command                                  | [REV]              | Short-circuiting terminals [REV] and [CM] runs the motor in the reverse direction and opening them decelerates the motor to a stop.   |

Table 2.5 Names, Symbols and Functions of the Control Circuit Terminals (continued)

| Classification  | Name  | Symbol             | Functions   |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
|---|---|--------------------|---|------|------|------|-------------------|----------|------|------|-----------|-----|-----|---|--------|------|----------------------------------|---|--------|
| Digital input   | Enable input 1<br>Enable input 2              | [EN1]<br>[EN2]     | <p>(1) Opening the circuit between terminals [EN1] and [PLC] or terminals [EN2] and [PLC] stops the operation of the inverter output transistor.</p> <p>(2) The input mode of terminals [EN1] and [EN2] is fixed at the SOURCE mode. No switching to the SINK mode is possible.</p> <p>(3) If either one of [EN1] and [EN2] is OFF, an alarm occurs. This alarm state can be cleared only by turning the inverter power off and on clears this alarm.</p> <p>&lt;Digital input circuit specifications&gt;</p> <table border="1"> <thead> <tr> <th>Item</th> <th>Min.</th> <th>Max.</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Operating voltage</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>Operating current at ON<br/>(Input voltage is at 27 V)</td> <td>2.5 mA</td> <td>5 mA</td> </tr> <tr> <td>Allowable leakage current at OFF</td> <td>–</td> <td>0.5 mA</td> </tr> </tbody> </table> | Item | Min. | Max. | Operating voltage | ON level | 22 V | 27 V | OFF level | 0 V | 2 V | Operating current at ON<br>(Input voltage is at 27 V) | 2.5 mA | 5 mA | Allowable leakage current at OFF | – | 0.5 mA |
|   | Item  | Min.               | Max.  |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
|   | Operating voltage                             | ON level           | 22 V  | 27 V |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
| OFF level   |   | 0 V                | 2 V   |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
| Operating current at ON<br>(Input voltage is at 27 V) | 2.5 mA  | 5 mA               |   |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
| Allowable leakage current at OFF                      | –   | 0.5 mA             |   |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
|   | PLC signal power                              | [PLC]              | Connects to the output signal power supply of Programmable Logic Controller (PLC).<br>Rated voltage: +24 VDC (Allowable range: +22 to +27 VDC),<br>Maximum 200 mA DC  |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
|   | Digital input common                          | [CM]               | Common terminals for digital input signals  |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
| Analog output   | Analog monitor                                | [FM1]<br>[FM2]     | These terminals output monitor signals for analog DC voltage (0 to +10 V) or analog DC current (4 to 20 mA/0 to 20 mA).   |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
|   | Analog common                                 | [11]               | Common terminal for analog output signals.  |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
| Transistor output                                     | Transistor output 1 to<br>Transistor output 4 | [Y1]<br>to<br>[Y4] | <p>Both the SINK and SOURCE modes are supported.</p> <p>(1) Various signals such as "Inverter running," "Frequency arrival signal," and "Motor overload early warning" can be assigned to terminals [Y1] to [Y4] by setting function code E20 to E23.</p> <p>(2) The logic value (1/0) for ON/OFF of the terminals between one of [Y1] to [Y4] and [CMY] can be switched. If the logic value for ON between one of [Y1] to [Y4] and [CMY] is "1" in the normal logic system, for example, OFF is "1" in the negative logic system and vice versa.</p>   |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |
|   | Transistor output common                      | [CMY]              | Common terminal for transistor output signals   |      |      |      |                   |          |      |      |           |     |     |   |        |      |                                  |   |        |



Table 2.5 Names, Symbols and Functions of the Control Circuit Terminals (continued)

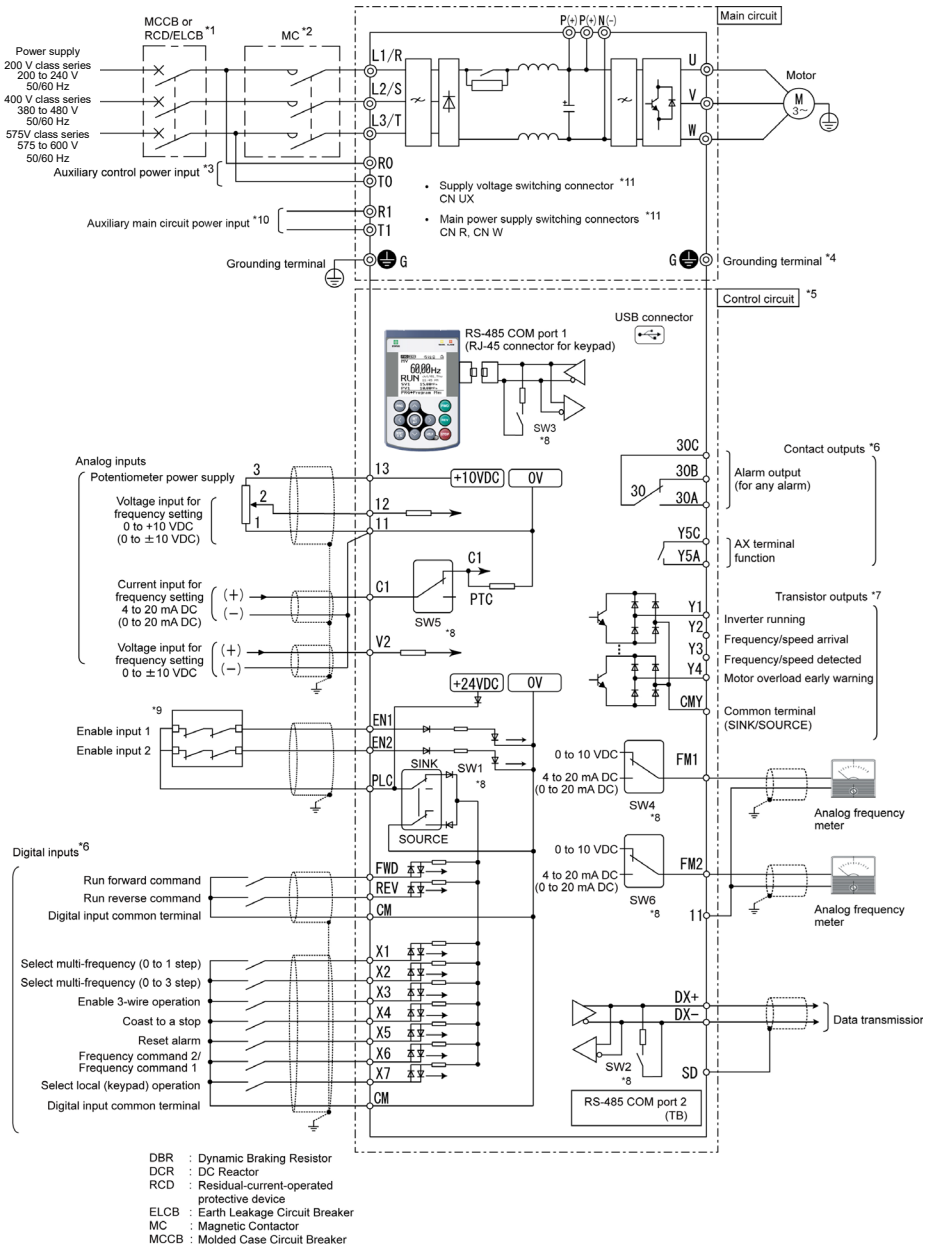
| Classification | Name  | Symbol                   | Functions  |
|----------------|---|--------------------------|--|
| Relay output   | General-purpose relay output                                | [Y5A/C]                  | (1) Any one of output signals that can be assigned to terminals [Y1] to [Y4] can also be assigned to this relay contact, as a general-purpose relay output.<br>(2) Whether excitation or non-excitation causes this terminal to output an alarm can be switched.   |
|                | Alarm relay output (for any error)                          | [30A/B/C]                | (1) When the protective function is activated, this terminal outputs a contact signal (1C) to stop the motor.<br>(2) Any one of output signals that can be assigned to terminals [Y1] to [Y4] can also be assigned to this relay contact as a multipurpose relay output, to use it for signal output.<br>(3) Whether excitation or non-excitation causes this terminal to output an alarm can be switched. |
| Communication  | RS-485 communications port 2 (On the terminal block)        | [DX+]/<br>[DX-]/<br>[SD] | These I/O terminals are used as a communications port that transmits data through the RS-485 multipoint protocol between the inverter and a computer or other equipment such as a PLC.   |
|                | RS-485 communications port 1 (For connection of the keypad) | RJ-45 connector          | Used to connect the keypad to the inverter. The inverter supplies the power to the keypad via the extension cable for remote operation.  |
|                | USB port (On the control printed circuit board)             | CN10                     | Used as a USB port connector (mini B) that connects the inverter to a computer. This connector enables connection with the inverter FRENIC loader program.   |
| Battery        | Battery connection  | CN11                     | Connector for an optional battery.   |

## 2.2.5 Connection diagrams

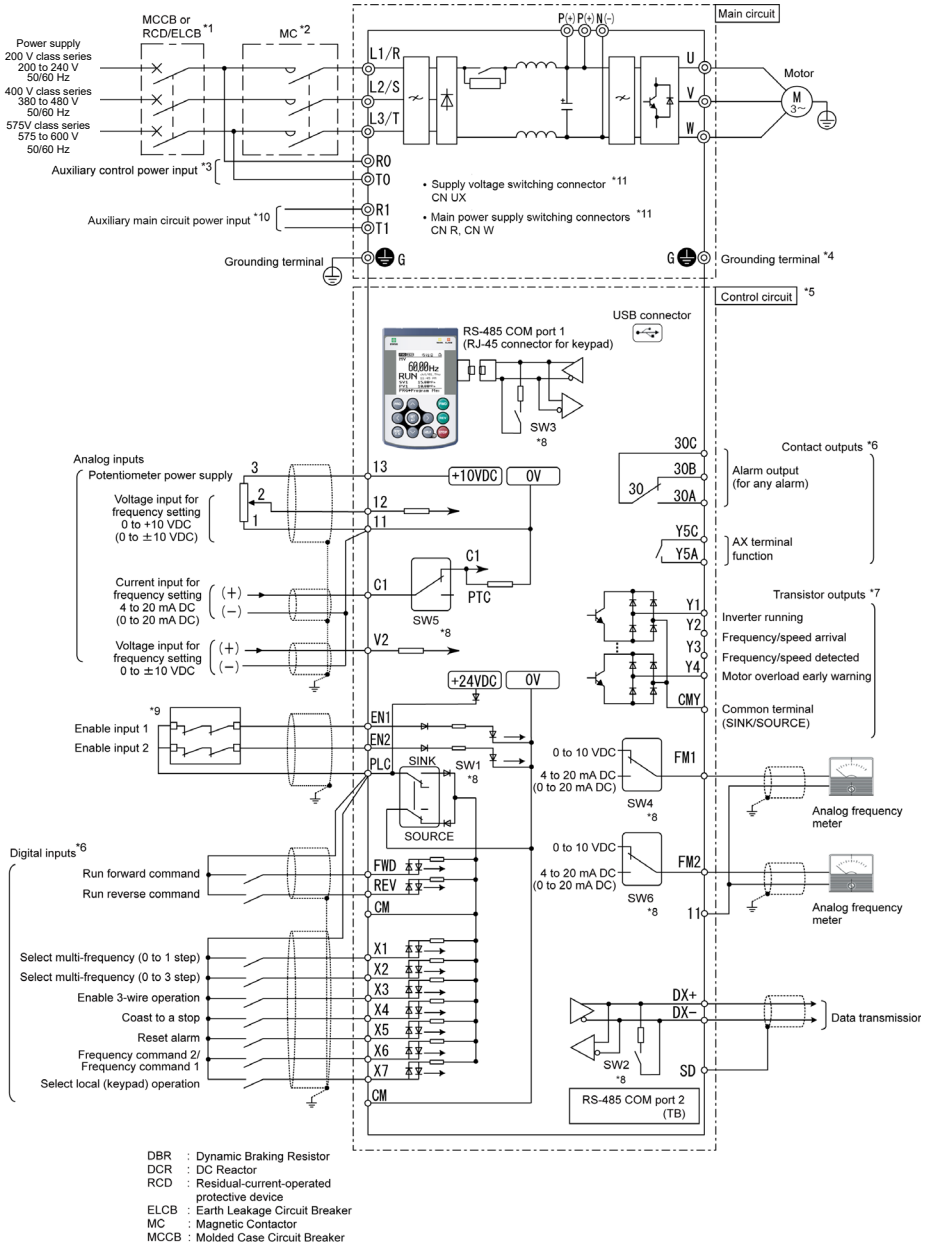
### [ 1 ] 200 V class series inverters of 45 kW (60HP) or below , 400 V ones of 90 kW (125HP) or below and 575 V ones 150HP or below

This section shows connection diagrams with the Enable input function used.

#### SINK mode input by factory default

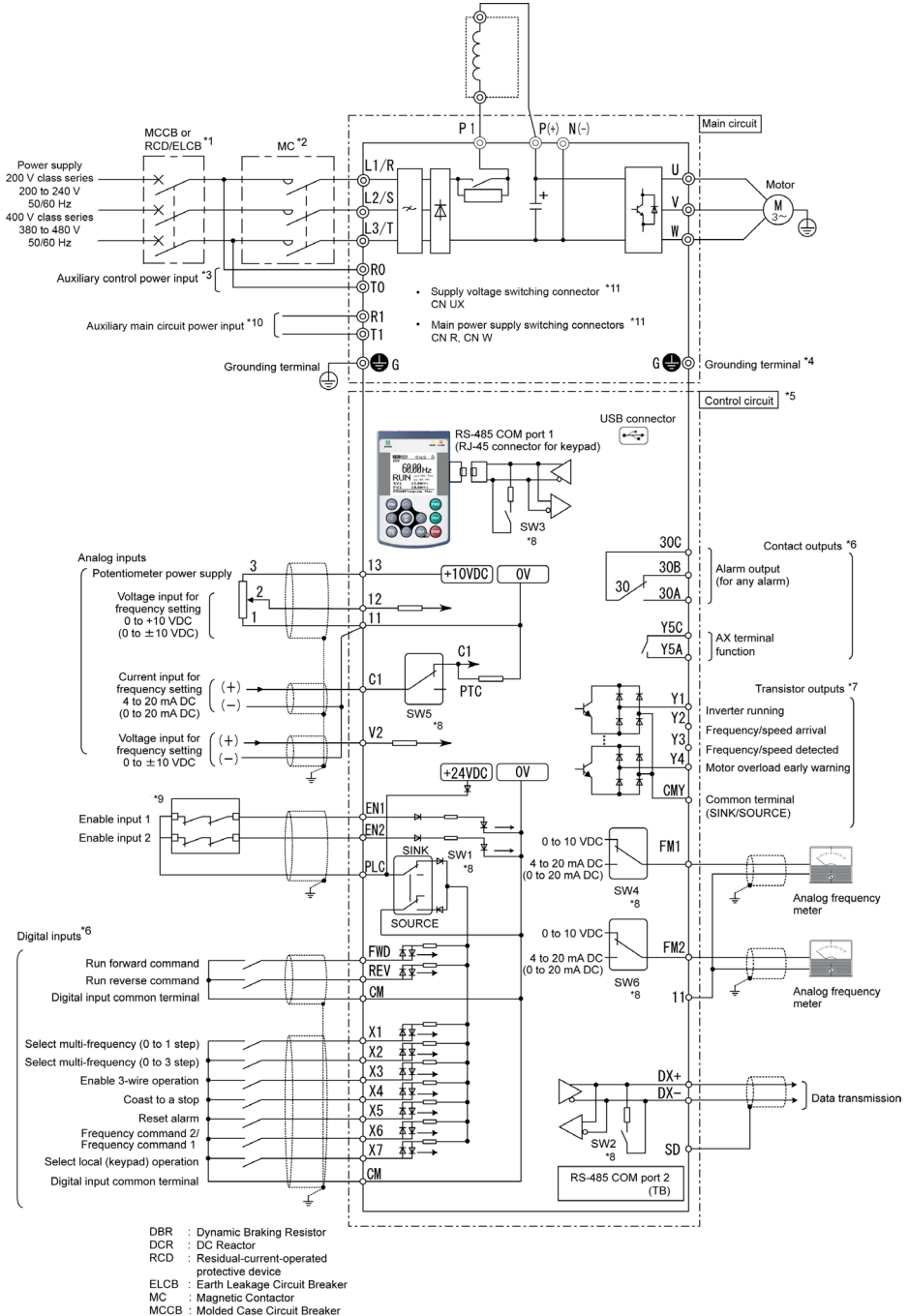


# SOURCE mode input by factory default

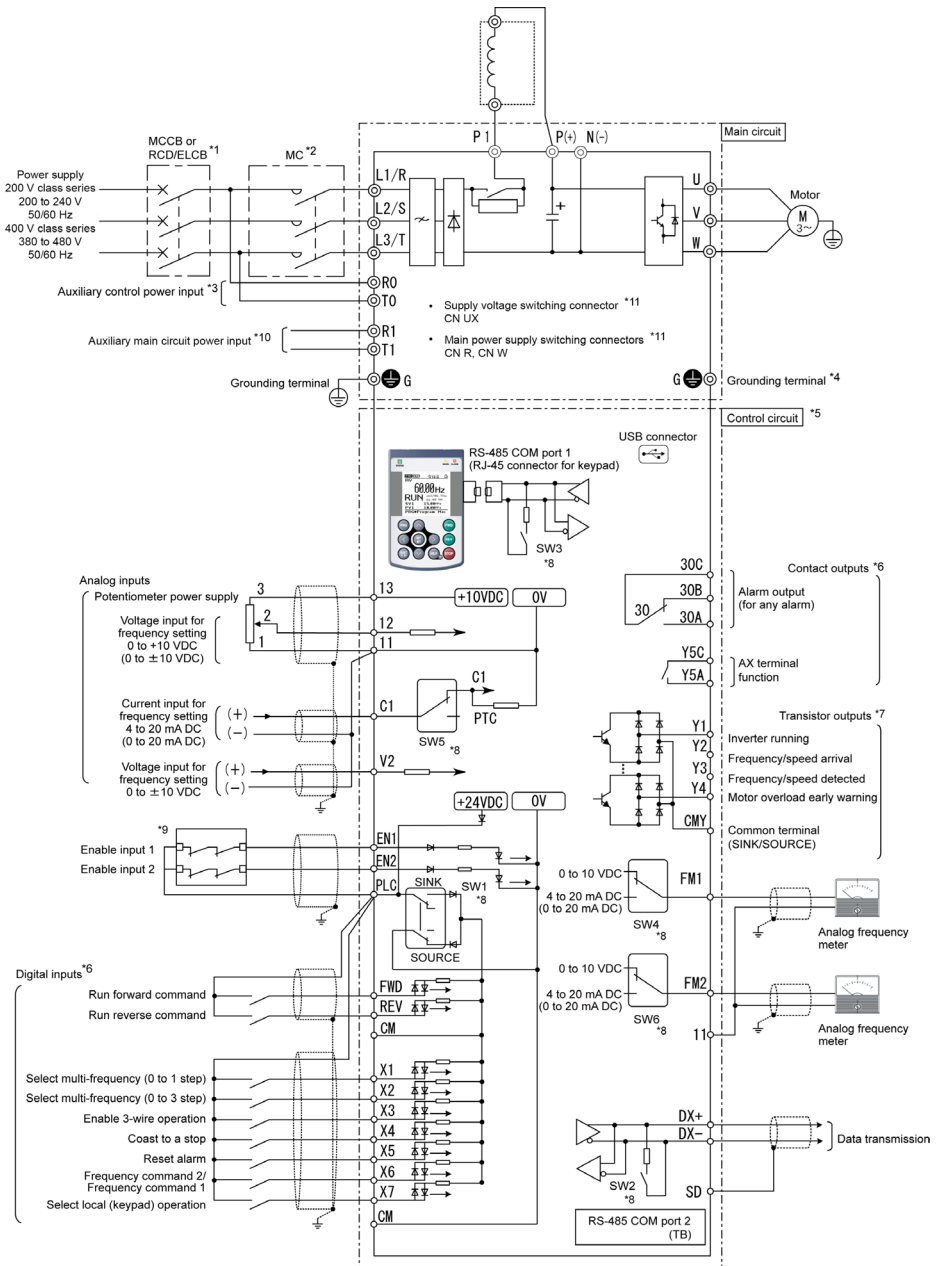


[ 2 ] 200 V class series inverters of 55 kW (75HP) or above and 400 V ones of 110 kW (150HP) or above and 575 V ones of 200HP or above

SINK mode input by factory default

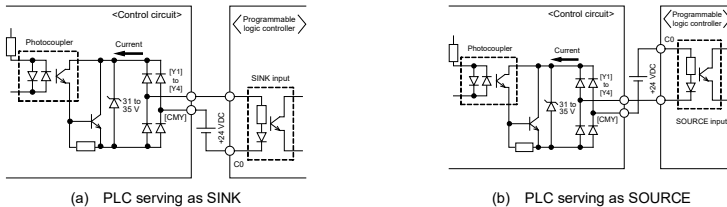


**SOURCE mode input by factory default**



- DBR : Dynamic Braking Resistor
- DCR : DC Reactor
- RCD : Residual-current-operated protective device
- ELCB : Earth Leakage Circuit Breaker
- MC : Magnetic Contactor
- MCCB : Molded Case Circuit Breaker

- \*1 Install a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection function) in the primary circuit of the inverter to protect wiring. Ensure that the circuit breaker capacity is equivalent to or lower than the recommended capacity.
- \*2 Install a magnetic contactor (MC) for each inverter to separate the inverter from the power supply, apart from the MCCB or RCD/ELCB, when necessary.  
Connect a surge absorber in parallel when installing a coil such as the MC or solenoid near the inverter.
- \*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. Even without power supply to these terminals, the inverter can run.  
When these terminals are connected to the power supply lines, shutting down the MC being used for main power ON/OFF cannot power off all live parts. Be sure to shut down all circuits with a disconnecting switch (DS).
- \*4 A grounding terminal for a motor. Use this terminal if needed.
- \*5 For control signal wires, use twisted or shielded-twisted wires. When using shielded-twisted wires, connect the shield of them to the common terminals of the control circuit. To prevent malfunction due to 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, cross them at right angles.
- \*6 The connection diagram shows factory default functions assigned to digital input terminals [X1] to [X7], [FWD] and [REV], transistor output terminals [Y1] to [Y4], and relay contact output terminals [Y5A/C] and [30A/B/C].
- \*7 Terminals [Y1] to [Y4] (transistor outputs) support both SINK and SOURCE modes. The diagrams below show the examples of circuit connection between the transistor output of the inverter's control circuit and a PLC.



- \*8 Slide switches on the control printed circuit board (control PCB). Use these switches to customize the inverter operations. For details, refer to Section 2.2.6 "Setting up the slide switches."
- \*9 When the Enable function is not to be used, short-circuit terminals [EN1] and [PLC] and terminals [EN2] and [PLC] using jumper wires. For opening and closing the hardware circuit between terminals [EN1] and [PLC] and between [EN2] and [PLC], use safety components such as safety relays and safety switches. Be sure to use shielded wires exclusive to terminals [EN1] and [PLC] and terminals [EN2] and [PLC]. (Do not put them together with any other control signal wire in the same shielded core.)
- \*10 It is not normally necessary to connect anything to these terminals. They are used when connecting to a DC bus. (on 200V class series inverters of 22kW (30HP) or above and 400V ones of 45kW (60HP) or above and 575V ones of 60HP or above.)
- \*11 These are the main circuit switching connectors. For more information, see "2.2.5 Switching connectors" in this instruction manual.

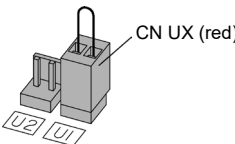
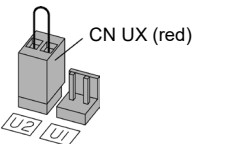
## 2.2.6 Switching connectors

- Supply voltage switching connector (CN UX) (for 400 V class series inverters of 45 kW (60HP) or above)

Inverters with a capacity of 400 V class series inverters of 45 kW (60HP) or above have a supply voltage switching connector (CN UX). If the power supply being connected to the main circuit power input terminals (L1/R, L2/S, L3/T) or auxiliary main circuit power input terminals (R1, T1) satisfies the conditions listed below, change the CN UX connector to the U2 position. Otherwise, use the connector in the factory-default U1 position.

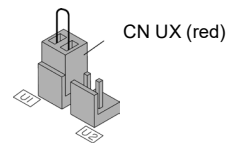
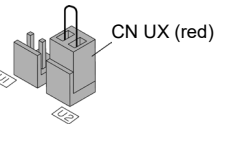
For more detailed switching guidelines, see Figures 2.5 and 2.6 on the following page.

(a) 45 to 132 kW (60 to 200 HP)

|                 |  |  |
|-----------------|--|--|
| Setting         |  |  |
| Applied voltage | 398 to 440 V/50 Hz, 430 to 480 V/60 Hz<br>(Factory default)                      | 380 to 398 V/50 Hz, 380 to 430 V/60 Hz   |

**Note** The allowable voltage fluctuation range is +10% to -15%.

(b) 160 to 710 kW (250 to 1000 HP)

|                 |   |   |
|-----------------|---|---|
| Setting         |  |  |
| Applied voltage | 398 to 440V/50Hz, 430 to 480V/60Hz<br>(Factory default)                           | 380 to 398V/50Hz, 380 to 430V/60Hz  |

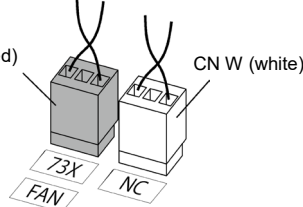
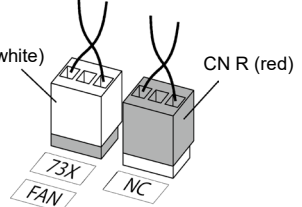
**Note** The allowable voltage fluctuation range is +10% to -15%.

■ Main power supply switching connectors (CN R, CN W) (for 200 V class series inverters of 22 kW (30HP) or above and 400 V/575V ones of 45 kW (60HP) or above)

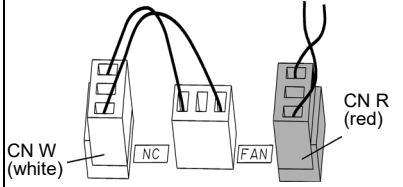
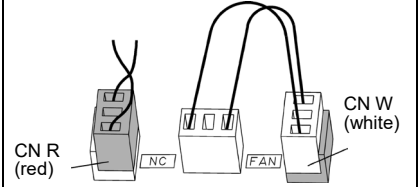
In its standard specifications, the FRENIC-HVAC supports DC power supply input. However, inverters with a capacity of 200 V class series inverters of 22 kW (30HP) or above and 400 V/575 V ones of 45 kW (60HP) or above have components that are driven internally by an AC power supply and therefore require a supply of AC power. Consequently, when using the inverter with a DC power supply, it is necessary to switch the CN R connector to the **NC** position and the CN W connector to the **73X** position (200 V class series inverters of 22 to 45 kW (30 to 60 HP) and 400 V ones of 45 to 90 kW (60 to 125 HP) and 575 V ones of 60 to 150HP or the **FAN** position (200 V class series inverters of 55 kW (75HP) or above, 400 V ones of 110 kW (150HP) or above and 575V ones of 200HP or above), and to connect the designated AC power supply to the auxiliary main circuit power input terminals (R1, T1).

For more detailed switching guidelines, see Figures 2.5 and 2.6 on the following page.

(a) 200 V class series inverters of 22 kW (30 HP) or above and 400 V ones of 45 to 132 kW (60 HP to 200 HP) 575 V ones of 60 HP to 150 HP

|             |   |  |
|-------------|---|--|
| Setting     |  |   |
| Application | When not using the R1 and T1 terminals<br>(Factory default)                         | When using the R1 and T1 terminals<br><ul style="list-style-type: none"> <li>• DC bus input type</li> <li>• Used in combination with a PWM converter.</li> </ul> |

(b) 400 V class series inverters of 160 kW (250HP) or above 575 V ones of 200 HP or above

|             |   |  |
|-------------|---|--|
| Setting     |  |    |
| Application | <p>When not using the R1 and T1 terminals<br/>(Factory default)</p>               | <p>When using the R1 and T1 terminals</p> <ul style="list-style-type: none"> <li>• DC bus input type</li> <li>• Used in combination with a PWM converter.</li> </ul> |

**Note**

- In the factory-default state, the main power supply switching connector CN R is set to 73X (200 V class series inverters of 22 to 45 kW (30 to 60 HP), 400 V ones of 45 to 90 kW (60 to 125 HP) and 575V ones of 60 to 150HP or FAN (200 V class series inverters of 55 kW (75HP) or above and 400V ones of 110 kW (150HP) or above, 575 V ones of 200HP or above), and CN W is set to NC. When not using the inverter with DC power supply input, do not switch the connectors. Use of improper main power supply switching connector settings may result in a malfunction such as a cooling fin overheat (OH1) or charging circuit error (PbF).
- When using this product in combination with a PWM converter, refer to the instructions given in the FRENIC-HVAC User's Manual.



■ Connector locations

The switching connectors can be found in the following locations on the power supply printed circuit board:

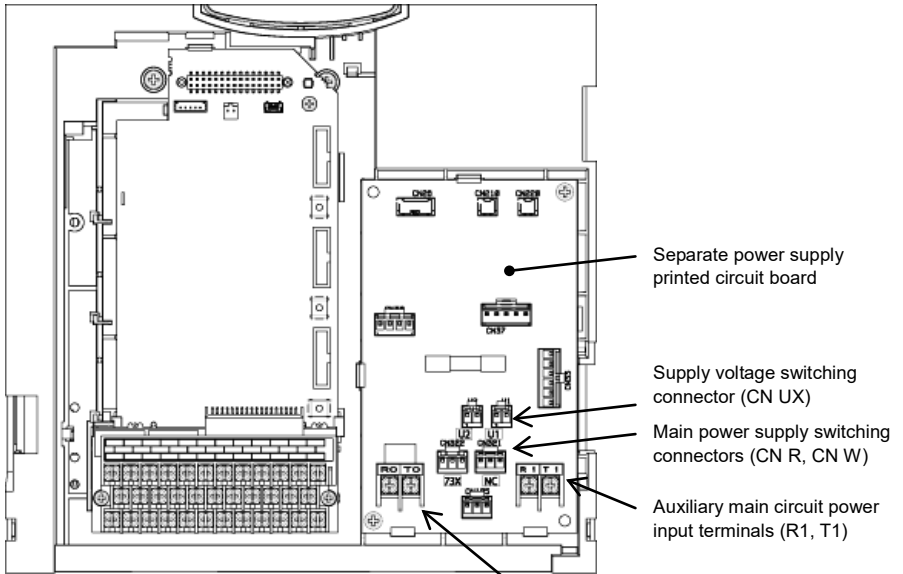


Figure 2.5 Switching Connector Locations  
 (200 V class series inverters of 22 to 45 kW (30 to 60 HP)  
 and 400 V ones of 45 to 90 kW (60 to 125 HP)  
 and 575 V ones of 60 to 150 HP)

Auxiliary control power input terminals (R0, T0)

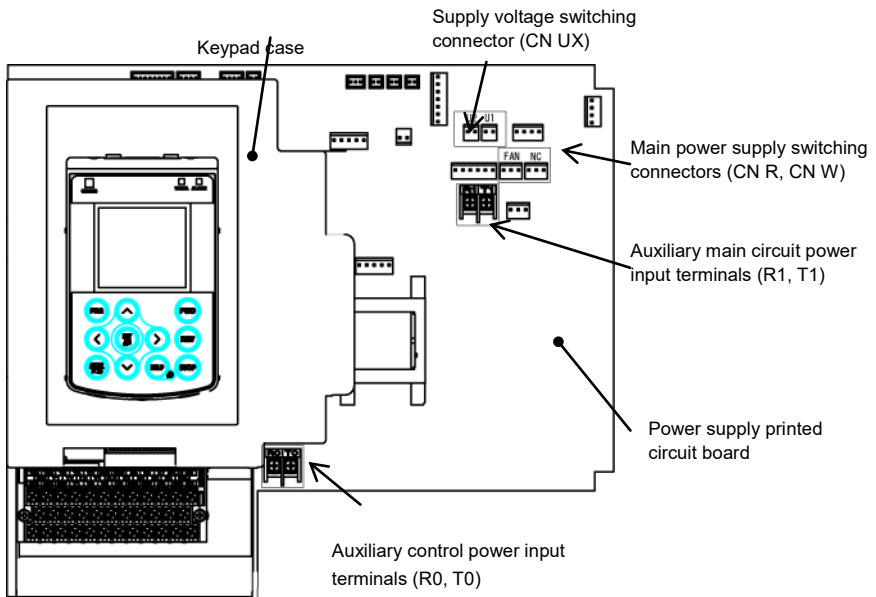


Figure 2.6 Switching Connector Locations  
 (200 V class series inverters of 55 to 90 kW (75 to 125 HP) and 400 V ones of 110 to 132 kW (150 to 200 HP))

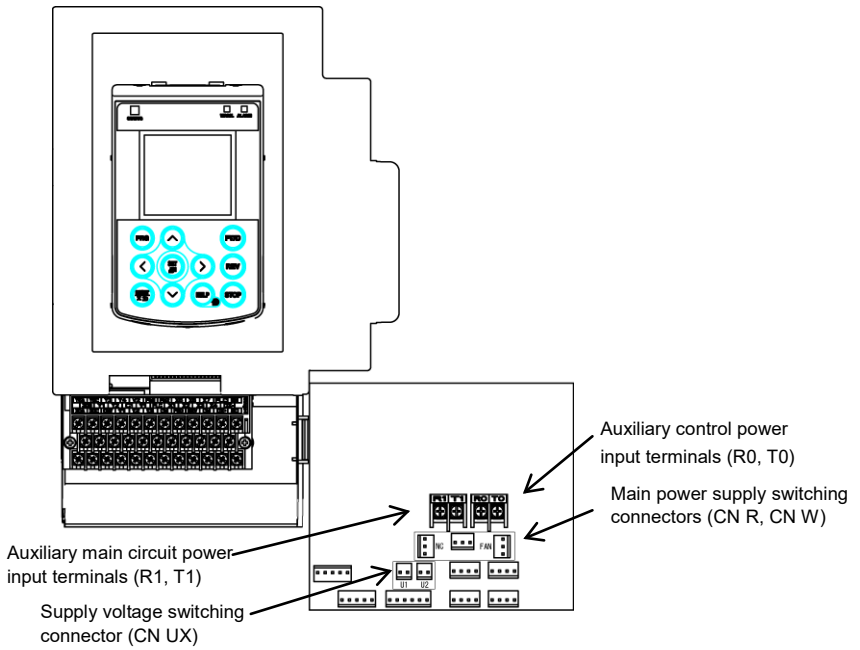
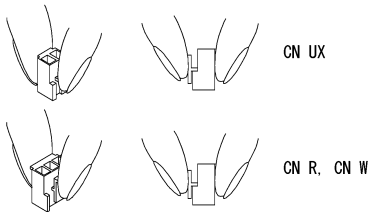


Figure 2.7 Switching Connector Locations (400 V class series inverters of 160 kW (250HP) or above and 575 V ones of 200 to 300 HP)



To remove a connector, squeeze the top of the latch between your fingers to release the fastener and pull off the connector. To attach a connector, push it until it makes a clicking sound to ensure that the fastener is securely seated.

Figure 2.8 Attaching and Removing a Switching Connector  
(200 V class series inverters of 22 kW (30HP) or above and 400 V ones of 45 kW (60HP) or above and 575 V ones of 60HP or above)

## 2.2.7 Setting the switches

Switching the slide switches located on the control PCB (see Figure 2.9) allows you to customize the operation mode of the analog output 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, refer to Section 2.2.1.

Table 2.6 lists function of each slide switch.

Table 2.6 Function of Slide Switches

| Switch | Function   |
|--------|--|
| SW1    | Switches the service mode of the digital input terminals between SINK and SOURCE.  |
| SW2    | Switches the terminating resistor of RS-485 communications port on the inverter ON and OFF. (RS-485 communications port 2 on the terminal block)     |
| SW3    | Switches the terminating resistor of RS-485 communications port on the inverter ON and OFF. (RS-485 communications port 1 for connecting the keypad) |
| SW4    | Switches the function of terminal [FM1] between VO1 and IO1.   |
| SW5    | Switches the function of terminal [C1] between C1 and PTC.   |
| SW6    | Switches the function of terminal [FM2] between VO2 and IO2.   |

Figure 2.9 shows the location of slide switches on the control PCB.

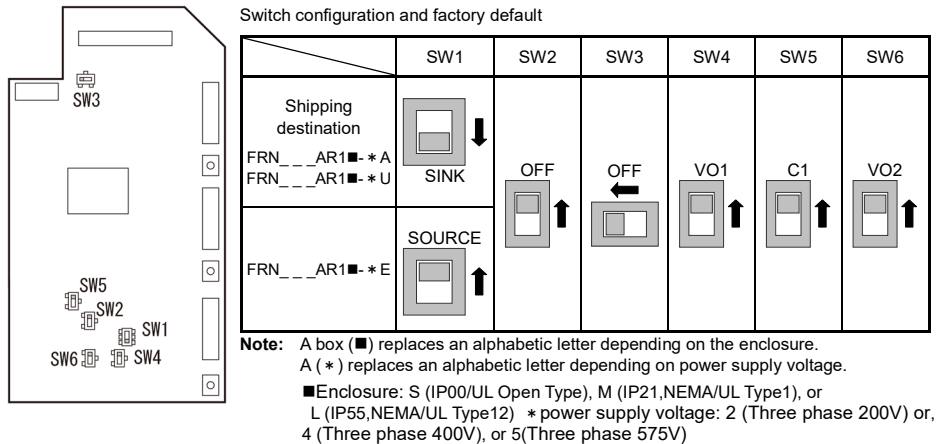

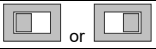





Figure 2.9 Location of the Slide Switches on the Control PCB

 **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.

|                                 |  |
|---------------------------------|--|
| Slider in the correct position  |  or  |
| Slider in an ambiguous position |   |

## 2.2.8 Mounting and connecting the keypad to the panel

You can remove the keypad from the inverter unit to mount it on the panel or install it at a remote site (e.g., for operation on hand). Note that the inverter with the keypad removed is rated IP00 (UL Open Type).

 For detailed instructions on how to mount the keypad on the panel, refer to the FRENIC-HVAC User's Manual, Chapter 5, Section 5.2 "Mounting and Connecting a Keypad to the Panel."

## Chapter 3 NAMES AND FUNCTIONS OF KEYPAD COMPONENTS

### 1 LED Indicators

These indicators show the current running status of the inverter.

STATUS (green): Running state

WARN. (yellow): Light alarm state

ALARM (red): Alarm (heavy alarm) state

### 2 LCD Monitor

This monitor shows the following various information about the inverter according to the operation modes.

- Running status and run command source (e.g., Run/stop and rotation direction)
- Status icons (e.g., timer operation, PID operation, battery state, and password protection state)
- Operation guides for the current screen

### 3 Programming Keys

These keys are used to:

- Switch the operation modes between Running mode/Alarm mode and Programming mode.
- Reset the alarm states, discard the setting being configured, and cancel the screen transition according to the operation modes.
- Move the cursor to the digit of data to be modified, shift the setting item, and switch the screen.
- Call up the HELP screen for the current display state.

### 4 Operation Keys

These keys are used to:

- Start running the motor (in the forward/reverse direction).
- Stop the motor.



## Chapter 4 RUNNING THE MOTOR FOR A TEST

### 4.1 Checking Prior to Powering ON

Check the following before powering on the inverter.

- (1) Check that the wiring is correct.

Especially check the wiring to the inverter input terminals L1/R, L2/S and L3/T and output terminals U, V, and W. Also check that the grounding wires are connected to the grounding terminals (⊕G) correctly. See Figure 4.1.

- (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.

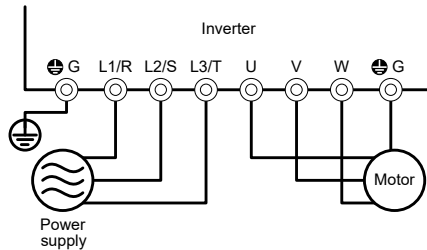


Figure 4.1 Connection of Main Circuit Terminals

### 4.2 Powering ON and Checking

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

Check that the LCD monitor displays 0.00 Hz (indicating that the reference frequency is 0 Hz) that is blinking. (See Figure 4.2.)

If the LCD monitor displays any number except 0.00 Hz, press the

⬆ / ⬇ key to set 0.00 Hz.

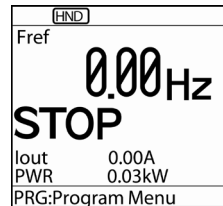


Figure 4.2 Display of the LCD Monitor after Power-ON




The reactor in the inverter may generate noise due to source voltage distortion, which is not abnormal.

### 4.3 Configuring the Function Code Data Before Test Run

Configure the function codes listed below according to the motor ratings and your machinery design values. For the motor ratings, check the ratings printed on the motor's nameplate. For your machinery design values, ask system designers about them.

Table 4.1 Configuring Function Code Data





| Function code | Name                                 | Function code data  | Factory defaults   |
|---------------|--------------------------------------|---|--|
| F04           | Base frequency 1                     | Motor ratings<br>(printed on the nameplate of the motor)  | 200/400/575 V class series<br>Asia: 60.0/50.0/ - (Hz)<br>EU: 50.0/50.0/ - (Hz)<br>USA: 60.0/60.0/60.0 (Hz) |
| F05           | Rated voltage at base frequency 1    |   | 200/400/575 V class series<br>Asia: 220/415/ - (V)<br>EU: 230/400/ - (V)<br>USA: 230/460/575(V)            |
| P02           | Motor 1<br>(Rated capacity)          |   | Nominal applied motor capacity   |
| P03           | Motor 1<br>(Rated current)           |   | Rated current of nominal applied motor   |
| P99           | Motor 1 selection                    | 0: Motor characteristics 0<br>(Fuji standard motors,<br>8-series)<br>1: Motor characteristics 1<br>(HP rating motors)<br>4: Other motors  | Asia/EU: 0<br>USA: 1   |
| F03           | Maximum frequency 1                  | Machinery design values<br><b>(Note)</b> For a test run 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. | 200/400/575 V class series<br>Asia: 60.0/50.0/ - (Hz)<br>EU: 50.0/50.0/ - (Hz)<br>USA: 60.0/60.0/60.0 (Hz) |
| F07           | Acceleration time 1<br><b>(Note)</b> |   | 20.00 (s)  |
| F08           | Deceleration time 1<br><b>(Note)</b> |   | 20.00 (s)  |

 For details about the configuration procedure of function codes, refer to the FRENIC-HVAC User's Manual, Chapter 5, Section 5.6.3.1 "Configuring function codes."

### 4.4 Running the Inverter for Motor Operation Check

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

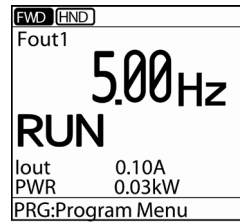
----- **Test Run Procedure** -----

- (1) Turn the power ON and check that the reference frequency 0.00 Hz is blinking on the LCD monitor.
- (2) Set a low reference frequency such as 5 Hz, using  /  keys. (Check that the frequency is blinking on the LCD monitor.)
- (3) Press the  key to start running the motor in the forward direction. (Check that the reference frequency is blinking on the LCD monitor.)
- (4) To stop the motor, press the  key.

**< Check points during a test run >**

- Check that the motor is running in the forward direction.
- Check for smooth rotation without motor humming or excessive vibration.
- Check for smooth acceleration and deceleration.

When no abnormality is found, press the **FWD** key again to start driving the motor, then increase the reference frequency using **▲** / **▼** keys. Check the above points again.



**< Modification of motor control function code data >**

Modifying the current function code data sometimes can solve an insufficient torque or overcurrent incident. The table below lists the major function codes to be accessed. For details, refer to the FRENIC- HVAC User's Manual, Chapter 6 "FUNCTION CODES" or Chapter 9 "TROUBLESHOOTING"

| Function code | Name                | Modification key points  |
|---------------|---------------------|--|
| F07           | Acceleration Time 1 | If the current limiter is activated due to a short acceleration time and large drive current, prolong the acceleration time.               |
| F08           | Deceleration Time 1 | If an overvoltage trip occurs due to a short deceleration time, prolong the deceleration time.   |
| F09           | Torque Boost 1      | If the starting motor torque is deficient, increase the torque boost. If the motor with no load is overexcited, decrease the torque boost. |

**< Remedy to be taken if an alarm ECF (Enable circuit failure) occurs >**

| Possible Causes                                      | What to Check and Suggested Measures  |
|--|---|
| (1) Poor connection of interface PCB                 | Check that the interface printed circuit board (PCB) is firmly connected to the inverter unit.<br>Restarting the inverter releases the alarm.                               |
| (2) Enable circuit logic error                       | Check that the logic states of the output of safety switches match with each other (EN1/EN2 = High/High or Low/Low).<br>Restarting the inverter releases the alarm.         |
| (3) Enable circuit (safety circuit) failure detected | If this error persists after the above procedures have been taken, the inverter is defective.<br>Consult your Fuji Electric representative. (The alarm cannot be released.) |

**4.5 Preparation for Practical Operation**

After verifying normal motor running with the inverter in a test run, proceed to the practical operation. For details, refer to the FRENIC-HVAC User's Manual.

## Chapter 5 TROUBLESHOOTING

### 5.1 Alarm Codes

Table 5.1 Quick List of Alarm Codes

| Code              | Name   | Description  |
|-------------------|--|--|
| OC1<br>OC2<br>OC3 | Instantaneous overcurrent  | The inverter momentary output current exceeded the overcurrent level.<br>OC1: Overcurrent during acceleration<br>OC2: Overcurrent during deceleration<br>OC3: Overcurrent during running at a constant speed |
| EF                | Ground fault   | A ground-fault current flowed from the inverter's output terminals. (on 200V class series inverter of 22kW (30HP) or above and 400V/575V ones of 45kW (60HP) or above)                                       |
| OV1<br>OV2<br>OV3 | Overvoltage  | The DC link bus voltage exceeded the overvoltage detection level.<br>OV1: Overvoltage during acceleration<br>OV2: Overvoltage during deceleration<br>OV3: Overvoltage during running at a constant speed     |
| LV                | Undervoltage   | The DC link bus voltage dropped below the undervoltage detection level.  |
| Lin               | Input phase loss   | An input phase loss occurred or the Interphase voltage unbalance rate was large.   |
| OPL               | Output phase loss  | An output phase loss occurred.   |
| OH1               | Heat sink overheat   | The temperature around the heat sink has risen abnormally.   |
| OH2               | External alarm   | The external alarm <b>THR</b> was entered. (when the <b>THR</b> "Enable external alarm trip" has been assigned to any digital input terminal)  |
| OH3               | Inverter internal overheat   | The temperature inside the inverter has exceeded the allowable limit.  |
| OH4               | Motor protection (PTC thermistor)  | The temperature of the motor has risen abnormally.   |
| FUS               | Fuse trip  | An internal short-circuit tripped a fuse (on 200V class series inverter of 90kW (125HP) or above and 400V ones of 110kW (150HP) or above and 575V ones of 200HP or above)                                    |
| PbF               | Charging circuit malfunction   | No power was supplied to the charging resistance short-circuit electromagnetic contactor (on 200V class series inverter of 22kW (30HP) or above and 400V/575V ones of 45kW (60HP) or above).                 |
| OL1               | Overload of motor 1  | The electronic thermal protection for motor overload detection was activated.  |
| OLU               | Inverter overload  | The temperature inside the inverter has risen abnormally.  |
| Er1               | Memory error   | An error has occurred in writing data to the memory in the inverter.   |
| Er2               | Keypad communications error  | A communications error has occurred between the keypad and the inverter.   |
| Er3               | CPU error  | A CPU error or LSI error has occurred.   |
| Er4               | Option communications error  | A communications error has occurred between the connected option card and the inverter.  |
| Er5               | Option error   | An error was detected by the connected option card (not by the inverter).  |
| Er6               | Operation protection   | An incorrect operation was attempted.  |
| Er7               | Tuning error   | Auto-tuning has failed, resulting in abnormal tuning results.  |
| Er8<br>ErP        | RS-485 communications error (COM port 1)<br>RS-485 communications error (COM port 2) | A communications error has occurred during RS-485 communication.   |
| ErF               | Data saving error during undervoltage  | When the undervoltage protection was activated, the inverter failed to save data, showing this error.  |
| ErH               | Hardware error   | The LSI on the power printed circuit board has malfunctioned due to noise, etc.  |



Table 5.1 Quick List of Alarm Codes (Continued)

| Code                            | Name                          | Description   |
|---------------------------------|-------------------------------|---|
| PV1<br>PV2<br>PVA<br>PVb<br>PVC | PID feedback error            | The PID feedback signal wire is broken under PID control.                             |
| CoF                             | Current input break detection | A break was detected in the current input.  |
| ECF                             | Enable circuit failure        | The Enable circuit was diagnosed as a circuit failure.                                |
| ECL                             | Customizable logic error      | A customizable logic configuration error has caused an alarm.                         |
| rLo                             | Stuck prevention              | The inverter failed to start due to overcurrent.                                      |
| FoL                             | Filter clogging error         | An overload state was detected under PID control.                                     |
| LoK                             | Password protection           | A wrong password has been entered exceeding the predetermined number of times.        |
| Err                             | Mock alarm                    | A mock alarm has been generated intentionally by configuring H45 or keypad operation. |

## Chapter 6 MAINTENANCE AND INSPECTION

Perform daily and periodic inspections to avoid trouble and keep reliable operation of the inverter for a long time.

### 6.1 Daily Inspection

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

- Check that the expected performance (satisfying the standard specifications) is obtained.
- Check that the surrounding environment satisfies the environmental requirements given in Chapter 1, Section 1.3.1 "Usage environment."
- Check that the keypad displays normally.
- Check for abnormal noise, odor, or excessive vibration.
- Check for traces of overheat, discoloration and other defects.

### 6.2 Periodic Inspection

Before starting periodic inspections, be sure to stop the motor, shut down the power, and wait at least 10 minutes. Make sure that the charging lamp is turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the main circuit terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

Table 6.1 List of Periodic Inspections

| Check part                        | Check item  | How to inspect   | Evaluation criteria   |   |
|-----------------------------------|---|--|---|---|
| Environment                       | <ol style="list-style-type: none"> <li>1) Check the ambient temperature, humidity, vibration and atmosphere (dust, gas, oil mist, or water drops).</li> <li>2) Check that tools or other foreign materials or dangerous objects are not left around the equipment.</li> </ol>                   | <ol style="list-style-type: none"> <li>1) Check visually or measure using apparatus.</li> <li>2) Visual inspection</li> </ol>  | <ol style="list-style-type: none"> <li>1) The standard specifications must be satisfied.</li> <li>2) No foreign or dangerous objects are left.</li> </ol> |   |
| Input voltage                     | Check that the input voltages of the main and control circuit are correct.  | Measure the input voltages using a multimeter or the like.   | The standard specifications must be satisfied.  |   |
| Keypad                            | <ol style="list-style-type: none"> <li>1) Check that the display is clear.</li> <li>2) Check that there is no missing part in the displayed characters.</li> </ol>  | <ol style="list-style-type: none"> <li>1), 2)<br/>Visual inspection</li> </ol>   | <ol style="list-style-type: none"> <li>1), 2)<br/>The display can be read and there is no fault.</li> </ol>   |   |
| Structure such as frame and cover | Check for: <ol style="list-style-type: none"> <li>1) Abnormal noise or excessive vibration</li> <li>2) Loose bolts (at clamp sections).</li> <li>3) Deformation and breakage</li> <li>4) Discoloration caused by overheat</li> <li>5) Contamination and accumulation of dust or dirt</li> </ol> | <ol style="list-style-type: none"> <li>1) Visual or auditory inspection</li> <li>2) Retighten.</li> <li>3), 4), 5)<br/>Visual inspection</li> </ol>  | <ol style="list-style-type: none"> <li>1), 2), 3), 4), 5)<br/>No abnormalities</li> </ol>   |   |
| Main circuit                      | Common  | <ol style="list-style-type: none"> <li>1) Check that bolts and screws are tight and not missing.</li> <li>2) Check the devices and insulators for deformation, cracks, breakage and discoloration caused by overheat or deterioration.</li> <li>3) Check for contamination or accumulation of dust or dirt.</li> </ol> | <ol style="list-style-type: none"> <li>1) Retighten.</li> <li>2), 3)<br/>Visual inspection</li> </ol>   | <ol style="list-style-type: none"> <li>1), 2), 3)<br/>No abnormalities</li> </ol> |
|                                   | Conductors and wires  | <ol style="list-style-type: none"> <li>1) Check conductors for discoloration and distortion caused by overheat.</li> <li>2) Check the sheath of the wires for cracks and discoloration.</li> </ol>   | <ol style="list-style-type: none"> <li>1), 2)<br/>Visual inspection</li> </ol>  | <ol style="list-style-type: none"> <li>1), 2)<br/>No abnormalities</li> </ol>     |
|                                   | Terminal blocks   | Check that the terminal blocks are not damaged.  | Visual inspection   | No abnormalities  |

Table 6.1 List of Periodic Inspections (Continued)

| Check part      |                              | Check item  | How to inspect  | Evaluation criteria   |
|-----------------|------------------------------|---|---|---|
| Main circuit    | DC link bus capacitor        | 1) Check for electrolyte leakage, discoloration, cracks and swelling of the casing.<br>2) Check that the safety valve is not protruding remarkably.<br>3) Measure the capacitance if necessary.             | 1), 2)<br>Visual inspection<br><br>3) Measure the discharge time with capacitance probe.                                      | 1), 2)<br>No abnormalities<br><br>3) The discharge time should not be shorter than the one specified by the replacement manual. |
|                 | Transformer and reactor      | Check for abnormal roaring noise and odor.  | Auditory, visual, and olfactory inspection  | No abnormalities  |
|                 | Magnetic contactor and relay | 1) Check for chatters during operation.<br>2) Check that contact surface is not rough.  | 1) Auditory inspection<br>2) Visual inspection  | 1), 2)<br>No abnormalities  |
| Control circuit | Printed circuit board        | 1) Check for loose screws and connectors.<br>2) Check for odor and discoloration.<br>3) Check for cracks, breakage, deformation and rust.<br>4) Check the capacitors for electrolyte leaks and deformation. | 1) Retighten.<br>2) Olfactory and visual inspection<br>3), 4)<br>Visual inspection  | 1), 2), 3), 4)<br>No abnormalities  |
| Cooling system  | Cooling fan                  | 1) Check for abnormal noise and excessive vibration.<br><br>2) Check for loose bolts.<br>3) Check for discoloration caused by overheat.   | 1) Auditory and visual inspection, or turn manually (be sure to turn the power OFF).<br>2) Retighten.<br>3) Visual inspection | 1) Smooth rotation<br><br>2), 3)<br>No abnormalities  |
|                 | Ventilation path             | Check the heat sink, intake and exhaust ports for clogging and foreign materials.   | Visual inspection   | No abnormalities  |

Remove dust accumulating on the inverter with a vacuum cleaner. If the inverter is stained, wipe it off with a chemically neutral cloth.

### 6.3 List of Periodic Replacement Parts

The inverter consists of many electronic parts including semiconductor devices. Table 6.2 lists replacement parts that should be periodically replaced for preventive maintenance (Use the lifetime judgment function as a guide). These parts are likely to deteriorate with age due to their construction and properties, leading to the decreased performance or failure of the inverter.

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

Table 6.2 Replacement Parts

| Part name   | Standard replacement intervals (See Notes below.)  |  |
|---|--|--|
|   | 200Vclass series<br>0.75 to 45 kW (1 to 60 HP)<br>400Vclass series<br>0.75 to 90kW (1 to 125 HP)<br>575Vclass series 1 to 150 HP | 200Vclass series<br>55 to 90 kW (75 to 125 HP)<br>400Vclass series<br>110 to 710kW (150 to 1000HP)<br>575Vclass series 200 to 300 HP |
| DC link bus capacitor                             | 5 years  | 10 years   |
| Electrolytic capacitors on printed circuit boards | 5 years  | 10 years   |
| Cooling fans                                      | 5 years  | 10 years   |
| Fuse  | -  | 10 years   |

- (Notes) • These replacement intervals are based on the inverter's service life estimated at an ambient temperature of 30 °C (86°F) (AR1L) or 40 °C (104°F) (AR1M/AR1S), and with a load factor of 100% (AR1L/AR1M) or 80% (AR1S). Replacement intervals may be shorter when the ambient temperature exceeds 30 °C (86°F) (AR1L) or 40 °C (104°F) (AR1M/AR1S), or when the inverter is used in an excessively dusty environment.
- Standard replacement intervals mentioned above are only a guide for replacement, and not a guaranteed service life.

## 6.4 Inquiries about Product and Guarantee

### 6.4.1 When making an inquiry

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

- 1) Inverter type (Refer to Chapter 1, Section 1.1.)
- 2) SER No. (serial number of the product) (Refer to Chapter 1, Section 1.1.)
- 3) Function codes and their data that you changed (Refer to the FRENIC-HVAC User's Manual, Chapter 5, Section 5.6.3.2.)
- 4) ROM version (Refer to FRENIC-HVAC User's Manual, Chapter 5, Section 5.6.4.4.)
- 5) Date of purchase
- 6) Inquiries (for example, point and extent of breakage, uncertainties, failure phenomena and other circumstances)

### 6.4.2 Product warranty

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

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

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

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

Furthermore, regarding purchased products and delivered products, we request that you inspect the product at the time of delivery. Also, prepare the area for installation of the inverter.

[ 1 ] Free of charge warranty period and warranty range

(1) Free of charge warranty period

- 1) The product warranty period is "1 year from the date of purchase" or 24 months from the manufacturing date imprinted on the name plate, whichever date is earlier.
- 2) However, in cases where the installation environment, conditions of use, frequency or use and times used, etc., have an effect on product life, this warranty period may not apply.
- 3) Furthermore, the warranty period for parts repaired 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 the installation conditions, environment, handling or methods of use, 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 or repairs affected by a party other than Fuji Electric.
  - ⑥ The breakdown was caused by improper maintenance or replacement of replaceable items, etc. specified in the operation manual or catalog, etc.
  - ⑦ The breakdown was caused by a science or technical or other 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 Fuji Electric is not responsible, 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 in the country where you purchased the products.

Consult your local supplier or Fuji Electric representative for details.

# Chapter 7 SPECIFICATIONS

## 7.1 Standard Model

### Three-phase 200 V class series (kW rating)

(0.75 to 90kW)

| Item  |   | Specifications  |     |     |                       |      |      |      |      |      |      |  |          |     |  |     |     |
|---|---|---|-----|-----|-----------------------|------|------|------|------|------|------|--|----------|-----|--|-----|-----|
| Type<br>(FRN__AR1■□2□) (*1)                       |   | 0.75  | 1.5 | 2.2 | 3.7<br>(4.0)<br>(*10) | 5.5  | 7.5  | 11   | 15   | 18.5 | 22   | 30   | 37       | 45  | 55                                     | 75  | 90  |
| Nominal applied motor (kW) (*2)<br>(Rated output) |   | 0.75  | 1.5 | 2.2 | 3.7<br>(4.0)<br>(*10) | 5.5  | 7.5  | 11   | 15   | 18.5 | 22   | 30   | 37       | 45  | 55                                     | 75  | 90  |
| Output<br>ratings                                 | Rated capacity (kVA) (*3)   | 1.9   | 3.0 | 4.1 | 6.8                   | 10   | 12   | 17   | 22   | 28   | 33   | 43   | 55       | 68  | 81                                     | 107 | 131 |
|   | Voltage (V) (*4)  | Three-phase, 200 to 240 V (with AVR function)   |     |     |                       |      |      |      |      |      |      | Three-phase, 200 to 230 V (with AVR function)                          |          |     |  |     |     |
|   | Rated current (A) (*5)  | 5   | 8   | 11  | 18                    | 27   | 31.8 | 46.2 | 59.4 | 74.8 | 88   | 115  | 146      | 180 | 215                                    | 283 | 346 |
|   | Overload capability   | 110%-1 min (Overload interval: Compliant with IEC 61800-2)  |     |     |                       |      |      |      |      |      |      |  |          |     |  |     |     |
| Input power                                       | Main power supply (number of phases, voltage, frequency)                | Three-phase, 200 to 240 V, 50/60 Hz   |     |     |                       |      |      |      |      |      |      | Three-phase, 200 to 220 V, 50 Hz<br>Three-phase, 200 to 230 V, 60 Hz   |          |     |  |     |     |
|   | Auxiliary control power supply (number of phases, voltage, frequency)   | Single-phase, 200 to 240 V, 50/60 Hz  |     |     |                       |      |      |      |      |      |      | Single-phase, 200 to 230 V, 50/60 Hz                                   |          |     |  |     |     |
|   | Auxiliary main power supply (number of phases, voltage, frequency) (*6) | -   |     |     |                       |      |      |      |      |      |      | Single-phase, 200 to 220 V, 50 Hz<br>Single-phase, 200 to 230 V, 60 Hz |          |     |  |     |     |
|   | Allowable voltage/frequency   | Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) (*11),<br>Frequency: +5 to -5%          |     |     |                       |      |      |      |      |      |      |  |          |     |  |     |     |
|   | Rated current (A) (*7)  | 3.2   | 6.0 | 8.6 | 14.8                  | 20.6 | 27.8 | 41.4 | 55.8 | 69.0 | 82.2 | 112  | 139      | 167 | 203                                    | 282 | 334 |
|   | Required capacity (kVA)   | 1.2   | 2.1 | 3.0 | 5.2                   | 7.2  | 9.7  | 15   | 20   | 24   | 29   | 39   | 49       | 58  | 71                                     | 98  | 116 |
| Brake<br>[kg]                                     | Braking torque [%] (*8)   | 20  |     |     |                       |      |      |      |      |      |      |  | 10 to 15 |     |  |     |     |
|   | DC braking  | Braking start frequency: 0.0 to 60.0 Hz; Braking time: 0.0 to 30.0 s; Braking operation level: 0 to 60% |     |     |                       |      |      |      |      |      |      |  |          |     |  |     |     |
| EMC filter (IEC/EN 61800-3)                       |   | EMC standards compliance : Category C2 (emission) / 2nd Env. (Immunity)                                 |     |     |                       |      |      |      |      |      |      |  |          |     | C3/2nd                                 |     |     |
| DC reactor (DCR) (*9)                             |   | Built-in(IEC/EN 61000-3-2, IEC/EN 61000-3-12)   |     |     |                       |      |      |      |      |      |      |  |          |     | Standard accessory (IEC/EN 61000-3-12) |     |     |
| Power factor<br>(at the rated load)               | Fundamental wave power factor   | > 0.98  |     |     |                       |      |      |      |      |      |      |  |          |     |  |     |     |
|   | Total power factor  | ≥ 0.90  |     |     |                       |      |      |      |      |      |      |  |          |     |  |     |     |
| Efficiency (at the rated load) (%)                |   | 97  | 97  | 97  | 97                    | 97   | 98   | 98   | 98   | 98   | 98   | 98   | 98       | 98  | 98                                     | 98  | 98  |
| Applicable (safety) standards                     |   | UL 508C, C22.2 No. 14, IEC/EN 61800-5-1, SEMI F47-0706  |     |     |                       |      |      |      |      |      |      |  |          |     |  |     |     |
| Enclosure   | IEC/EN 60529  | IP21/IP55 (*12)   |     |     |                       |      |      |      |      |      |      |  |          |     | IP00                                   |     |     |
|   | NEMA/UL 50  | NEMA/UL TYPE 1 / NEMA/UL TYPE 12  |     |     |                       |      |      |      |      |      |      |  |          |     | UL open type                           |     |     |
| Cooling method                                    |   | Fan cooling   |     |     |                       |      |      |      |      |      |      |  |          |     |  |     |     |
| Weight / Mass<br>(kg)                             | IP21  | 10  | 10  | 10  | 10                    | 18   | 18   | 18   | 23   | 23   | 50   | 50   | 70       | 70  | -                                      |     |     |
|   | IP55  | 10  | 10  | 10  | 10                    | 18   | 18   | 18   | 23   | 23   | 50   | 50   | 70       | 70  | -                                      |     |     |
|   | IP00  | -   |     |     |                       |      |      |      |      |      |      |  |          |     | 42                                     | 43  | 62  |

(\*1) A box (■) replaces an alphabetic letter depending on the enclosure. A box (□) replaces an alphabetic letter depending on the shipping destination.

■Enclosure: M (IP21), L (IP55) or S (IP00) □Shipping destination: E (Europe) or, A (Asia)

(\*2) Fuji 4-pole standard motor

(\*3) Applies to inverters with a rated capacity of 220 V.

(\*4) The inverter cannot output a voltage higher than the supply voltage.

(\*5) When running the inverter at the carrier frequency 4 kHz or above, it is necessary to derate the current rating.

(\*6) If using inverters with DC power input, supply AC power to the internal circuits. Inverters with DC power input are not normally used.

(\*7) When the inverter is connected to the power supply of 200 V, 50 Hz, Rsc = 120.

(\*8) Indicates average braking torque value for motor alone (varies with motor efficiency).

(\*9) Inverters of 45kW or less are equipped with a built-in DC reactor (DCR). An external DCR is provided as standard for inverters of 55kW and above.

(\*10) 4.0 kW for the EU.

(\*11) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V] x 67 (See IEC/EN 61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR). \*Applies to all models, regardless of capacity.

Even if the voltage drops down to -20%, the inverter can run (operation guaranteed) provided that the load current is within the inverter rated current range. \*Applies only to models with a capacity of 37 kW or less.

(\*12) IP55 offers protection for short water jets. Do not use outdoors or in places where long-term waterproofing is required.

### Three-phase 400 V class series (kW rating)

(0.75 to 37 kW)

| Item  |   | Specifications  |     |     |                               |      |      |      |      |      |      |      |          |
|---|---|---|-----|-----|-------------------------------|------|------|------|------|------|------|------|----------|
| Type (FRN)  | AR1■-4□ (*1)  | 0.75  | 1.5 | 2.2 | 3.7<br>(4.0) <sup>(*10)</sup> | 5.5  | 7.5  | 11   | 15   | 18.5 | 22   | 30   | 37       |
| Nominal applied motor (kW) (*2)<br>(Rated output) |   | 0.75  | 1.5 | 2.2 | 3.7<br>(4.0) <sup>(*10)</sup> | 5.5  | 7.5  | 11   | 15   | 18.5 | 22   | 30   | 37       |
| Output ratings                                    | Rated capacity (kVA) (*3)   | 1.9   | 3.1 | 4.1 | 6.8                           | 10   | 14   | 18   | 24   | 29   | 34   | 45   | 57       |
|   | Voltage (V) (*4)  | Three-phase, 380 to 480 V (with AVR function)   |     |     |                               |      |      |      |      |      |      |      |          |
|   | Rated current (A) (*5)  | 2.5   | 4.1 | 5.5 | 9.0                           | 13.5 | 18.5 | 24.5 | 32   | 39   | 45   | 60   | 75       |
| Overload capability                               |   | 110%-1 min (Overload interval: Compliant with IEC 61800-2)  |     |     |                               |      |      |      |      |      |      |      |          |
| Input power                                       | Main power supply (number of phases, voltage, frequency)              | Three-phase, 380 to 480 V, 50/60 Hz   |     |     |                               |      |      |      |      |      |      |      |          |
|   | Auxiliary control power supply (number of phases, voltage, frequency) | Single-phase, 380 to 480 V, 50/60 Hz  |     |     |                               |      |      |      |      |      |      |      |          |
|   | Allowable voltage/frequency   | Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) (*11),<br>Frequency: +5 to -5%          |     |     |                               |      |      |      |      |      |      |      |          |
|   | Rated current (A) (*7)  | 1.6   | 3.0 | 4.3 | 7.4                           | 10.3 | 13.9 | 20.7 | 27.9 | 34.5 | 41.1 | 55.7 | 69.4     |
| Required capacity (kVA)                           |   | 1.2   | 2.1 | 3.0 | 5.2                           | 7.2  | 9.7  | 15   | 20   | 24   | 29   | 39   | 49       |
| Braking   | Braking torque [%] (*8)   | 20  |     |     |                               |      |      |      |      |      |      |      | 10 to 15 |
|   | DC braking  | Braking start frequency: 0.0 to 60.0 Hz; Braking time: 0.0 to 30.0 s; Braking operation level: 0 to 60% |     |     |                               |      |      |      |      |      |      |      |          |
| EMC filter (IEC/EN 61800-3)                       |   | EMC standards compliance : Category C2 (emission) / 2nd Env. (Immunity)                                 |     |     |                               |      |      |      |      |      |      |      |          |
| DC reactor (DCR) (*9)                             |   | Built-in (IEC/EN 61000-3-2, IEC/EN 61000-3-12)  |     |     |                               |      |      |      |      |      |      |      |          |
| Power factor (at the rated load)                  | Fundamental wave power factor   | > 0.98  |     |     |                               |      |      |      |      |      |      |      |          |
|   | Total power factor  | ≥ 0.90  |     |     |                               |      |      |      |      |      |      |      |          |
| Efficiency (at the rated load) (%)                |   | 95  | 96  | 97  | 97                            | 97   | 97   | 97   | 97   | 98   | 98   | 98   | 98       |
| Applicable (safety) standards                     |   | UL 508C, C22.2 No. 14, IEC/EN 61800-5-1, SEMI F47-0706  |     |     |                               |      |      |      |      |      |      |      |          |
| Enclosure   | IEC/EN 60529  | IP21/IP55 (*12).  |     |     |                               |      |      |      |      |      |      |      |          |
|   | NEMA/UL 50  | NEMA/UL TYPE 1 / NEMA/UL TYPE 12  |     |     |                               |      |      |      |      |      |      |      |          |
| Cooling method                                    |   | Fan cooling   |     |     |                               |      |      |      |      |      |      |      |          |
| Weight / Mass (kg)                                | IP21  | 10  | 10  | 10  | 10                            | 10   | 10   | 18   | 18   | 18   | 18   | 23   | 23       |
|   | IP55  | 10  | 10  | 10  | 10                            | 10   | 10   | 18   | 18   | 18   | 18   | 23   | 23       |

(\*1) A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■Enclosure: M (IP21), L (IP55) or S (IP00) □Shipping destination: E (Europe) or A (Asia)

(\*2) Fuji 4-pole standard motor

(\*3) Applies to inverters with a rated capacity of 440 V.

(\*4) The inverter cannot output a voltage higher than the supply voltage.

(\*5) When running the inverter at the carrier frequency 4 kHz or above, it is necessary to derate the current rating.

(\*7) When the inverter is connected to the power supply of 400 V, 50 Hz, Rsc = 120.

(\*8) Indicates average braking torque value for motor alone (varies with motor efficiency).

(\*9) Inverters in this class are equipped with a built-in DC reactor (DCR).

(\*10) 4.0 kW for the EU.

(\*11) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V] x 67 (See IEC/EN61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR). \*Applies to all models, regardless of capacity.

Even if the voltage drops down to -20%, the inverter can run (operation guaranteed) provided that the load current is within the inverter rated current range. \*Applies only to models with a capacity of 37 kW or less.

(\*12) IP55 offers protection for short water jets. Do not use outdoors or in places where long-term waterproofing is required.

**(45 to 710 kW)**

| Item   |   | Specifications  |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
|--|---|---|-----|-----|-----|-----|-----|---|-----|-----|-----|-----|-----|-----|-----|------|------|
| Type (FRN AR1- <input type="checkbox"/> -4 <input type="checkbox"/> ) (*1) |   | 45  | 55  | 75  | 90  | 110 | 132 | 160   | 200 | 220 | 280 | 315 | 355 | 400 | 500 | 630  | 710  |
| Nominal applied motor (kW) (*2)<br>(Rated output)                          |   | 45  | 55  | 75  | 90  | 110 | 132 | 160   | 200 | 220 | 280 | 315 | 355 | 400 | 500 | 630  | 710  |
| Output ratings   | Rated capacity (kVA) (*3)   | 69  | 85  | 114 | 134 | 160 | 192 | 231   | 287 | 316 | 396 | 445 | 495 | 563 | 731 | 891  | 1044 |
|  | Voltage (V) (*4)  | Three-phase, 380 to 480 V (with AVR function)   |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
|  | Rated current (A) (*5)  | 91  | 112 | 150 | 176 | 210 | 253 | 304   | 377 | 415 | 520 | 585 | 650 | 740 | 960 | 1170 | 1370 |
| Overload capability  |   | 110%-1 min (Overload interval: Compliant with IEC 61800-2)  |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
| Input power  | Main power supply (number of phases, voltage, frequency)                | Three-phase, 380 to 440 V, 50 Hz<br>Three-phase, 380 to 480 V, 60 Hz                                    |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
|  | Auxiliary control power supply (number of phases, voltage, frequency)   | Single-phase, 380 to 480 V, 50/60 Hz  |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
|  | Auxiliary main power supply (number of phases, voltage, frequency) (*6) | Single -phase, 380 to 440 V, 50 Hz<br>Single -phase, 380 to 480 V, 60 Hz                                |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
|  | Allowable voltage/frequency   | Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) (*11),<br>Frequency: +5 to -5%          |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
| Rated current (A) (*7)   |   | 83.1  | 102 | 136 | 162 | 201 | 238 | 286   | 357 | 390 | 500 | 559 | 628 | 705 | 881 | 1115 | 1256 |
| Required capacity (kVA)  |   | 58  | 71  | 95  | 113 | 140 | 165 | 199   | 248 | 271 | 347 | 388 | 436 | 489 | 611 | 773  | 871  |
| Braking  | Braking torque [%] (*8)   | 10 to 15  |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
|  | DC braking  | Braking start frequency: 0.0 to 60.0 Hz; Braking time: 0.0 to 30.0 s; Braking operation level: 0 to 60% |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
| EMC filter (IEC/EN 61800-3)  |   | C2/2nd.   |     |     |     |     |     | EMC standards compliance : Category C3 (emission) / 2nd Env. (Immunity) |     |     |     |     |     |     |     |      |      |
| DC reactor (DCR) (*9)  |   | Built-in IEC/EN 61000-3-2, IEC/EN 61000-3-12  |     |     |     |     |     | Standard accessory (IEC/EN 61000-3-12)                                  |     |     |     |     |     |     |     |      |      |
| Power factor (at the rated load)   | Fundamental wave power factor   | > 0.98  |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
|  | Total power factor  | ≥ 0.90  |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
| Efficiency (at the rated load) (%)   |   | 98  | 98  | 98  | 98  | 98  | 98  | 98  | 98  | 98  | 98  | 98  | 98  | 98  | 98  | 98   | 98   |
| Applicable (safety) standards  |   | UL 508C, C22.2 No. 14 , IEC/EN 61800-5-1 , SEMI F47-0706  |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
| Enclosure  | IEC/EN 60529  | IP21/IP55 (*12)   |     |     |     |     |     | IP00  |     |     |     |     |     |     |     |      |      |
|  | NEMA/UL 50  | NEMA/UL TYPE 1/<br>NEMA/UL TYPE 12  |     |     |     |     |     | UL open type  |     |     |     |     |     |     |     |      |      |
| Cooling method   |   | Fan cooling   |     |     |     |     |     |   |     |     |     |     |     |     |     |      |      |
| Weight / Mass (kg)   | IP21  | 50  | 50  | 70  | 70  | -   |     |   |     |     |     |     |     |     |     |      |      |
|  | IP55  | 50  | 50  | 70  | 70  | -   |     |   |     |     |     |     |     |     |     |      |      |
|  | IP00  | -   |     |     |     | 62  | 64  | 94  | 98  | 129 | 140 | 245 | 245 | 245 | 330 | 530  | 530  |

(\*1) A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■Enclosure: M (IP21), L (IP55) or S (IP00) □Shipping destination: E (Europe) or A (Asia)

(\*2) Fuji 4-pole standard motor

(\*3) Applies to inverters with a rated capacity of 440 V.

(\*4) The inverter cannot output a voltage higher than the supply voltage.

(\*5) When running the inverter at the carrier frequency 4 kHz or above (5 kHz or above for inverters of 110 kW or above), it is necessary to derate the current rating.

(\*6) If using inverters with DC power input, supply AC power to the internal circuits. Inverters with DC power input are not normally used.

(\*7) When the inverter is connected to the power supply of 400 V, 50 Hz, Rscε = 120.

(\*8) Indicates average braking torque value for motor alone (varies with motor efficiency).

(\*9) Inverters of 90kW or less are equipped with a built-in DC reactor (DCR). An external DCR is provided as standard for inverters of 110kW and above.

(\*11) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V] x 67 (See IEC/EN 61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(\*12) IP55 offers protection for short water jets. Do not use outdoors or in places where long-term waterproofing is required.



### Three-phase 230 V class series (HP rating)

(001 to 125 HP)

| Item  |                               |   | Specifications  |     |     |      |      |      |      |      |  |  |      |              |          |  |     |     |
|---|-------------------------------|---|---|-----|-----|------|------|------|------|------|--|--|------|--------------|----------|--|-----|-----|
| Type (FRN)  | AR1■-2U) (*1)                 |   | 001   | 002 | 003 | 005  | 007  | 010  | 015  | 020  | 025  | 030  | 040  | 050          | 060      | 075                                    | 100 | 125 |
| Nominal applied motor [HP] (*2)<br>(Rated output)                           | Three phase input             | AC208V motor  | 1   | 2   | 3   | 5    | 7.5  | 10   | 15   | 20   | 25   | 30   | 40   | 50           | 60       | 75                                     | 100 | 125 |
|   |                               | AC230 motor   | -   | 1/2 | 3/4 | 1.5  | 2    | 3    | 5    | 5    | 7.5  | 10   | 10   | 10           | 15       | 20                                     | 30  | 30  |
|   | Single phase input            | AC208V motor  | -   | 1/2 | 1   | 2    | 3    | 3    | 5    | 7.5  | 10   | 10   | 15   | 20           | 25       | 30                                     | 30  | 50  |
|   |                               | AC230 motor   | -   | 1/2 | 1   | 2    | 3    | 3    | 5    | 7.5  | 10   | 10   | 15   | 20           | 25       | 30                                     | 30  | 50  |
| Output ratings  | Three phase input             | Rated capacity (kVA) (*3)   | 1.9   | 3.1 | 4.3 | 7.1  | 10   | 12   | 18   | 23   | 29   | 35   | 45   | 58           | 71       | 85                                     | 112 | 137 |
|   |                               | Rated current (A)   | 5   | 8   | 11  | 18   | 27   | 31.8 | 46.2 | 59.4 | 74.8   | 88   | 115  | 146          | 180      | 215                                    | 283 | 346 |
|   | Single phase input            | Rated capacity (kVA) (*3)   | 0.7   | 1.2 | 1.6 | 2.7  | 4.1  | 4.9  | 7.1  | 9.2  | 11   | 13   | 17   | 22           | 27       | 37                                     | 40  | 52  |
|   |                               | Rated current (A)   | 1.9   | 3.1 | 4.2 | 7    | 10.5 | 12.4 | 18   | 23.1 | 29.1   | 34.3   | 44.8 | 56.9         | 70.2     | 95                                     | 102 | 131 |
|   | Rated voltage (V) (*4)        |   | Three-phase, 200 to 240 V (with AVR function)   |     |     |      |      |      |      |      |  | Three-phase, 200 to 230 V (with AVR function)                          |      |              |          |  |     |     |
| Overload capability   |                               |   | 110%-1 min (Overload interval: Compliant with IEC 61800-2)  |     |     |      |      |      |      |      |  |  |      |              |          |  |     |     |
| Input power   | Three phase input             | Main power supply (number of phases, voltage, frequency)                                    | Three-phase, 200 to 240 V, 50/60 Hz   |     |     |      |      |      |      |      |  | Three-phase, 200 to 220 V, 50 Hz<br>Three-phase, 200 to 230 V, 60 Hz   |      |              |          |  |     |     |
|   |                               | Rated current (A) (*5)  | 2.8   | 5.3 | 7.5 | 12.9 | 18.0 | 24.2 | 36.0 | 48.6 | 60.0   | 71.5   | 96.9 | 121          | 145      | 177                                    | 246 | 291 |
|   |                               | Required power supply capacity [kVA]  | 1.2   | 2.2 | 3.0 | 5.2  | 7.2  | 10   | 15   | 20   | 24   | 29   | 39   | 49           | 58       | 71                                     | 98  | 116 |
|   | Single phase input            | Main power supply (number of phases, voltage, frequency)                                    | Single-phase, 200 to 240 V, 50/60 Hz  |     |     |      |      |      |      |      |  | Single-phase, 200 to 220 V, 50 Hz<br>Single-phase, 200 to 230 V, 60 Hz |      |              |          |  |     |     |
|   |                               | Rated current [A] (*5)  | 2.8   | 5.3 | 7.5 | 12.9 | 18.0 | 24.2 | 36.0 | 48.6 | 60.0   | 71.5   | 96.9 | 121          | 145      | 177                                    | 246 | 291 |
|   |                               | Required power supply capacity [kVA]  | 0.7   | 1.3 | 1.8 | 3.0  | 4.2  | 5.6  | 8.3  | 12   | 14   | 17   | 23   | 28           | 34       | 41                                     | 57  | 67  |
| Auxiliary control power supply: (number of phases, voltage, frequency) (*6) |                               | Single-phase, 200 to 240 V, 50/60 Hz  |   |     |     |      |      |      |      |      | Single-phase, 200 to 230 V, 50/60 Hz                                   |  |      |              |          |  |     |     |
| Auxiliary main power supply (number of phases, voltage, frequency) (*6)     |                               | -   |   |     |     |      |      |      |      |      | Single-phase, 200 to 220 V, 50 Hz<br>Single-phase, 200 to 230 V, 60 Hz |  |      |              |          |  |     |     |
| Voltage, frequency variations   |                               | Voltage: +10 to -15% (Interphase voltage unbalance : 2% or less) (*9), Frequency: +5 to -5% |   |     |     |      |      |      |      |      |  |  |      |              |          |  |     |     |
| Braking   | Braking torque [%] (*7)       |   | 20  |     |     |      |      |      |      |      |  |  |      |              | 10 to 15 |  |     |     |
|   | DC injection braking          |   | Braking start frequency: 0.0 to 60.0 Hz; Braking time: 0.0 to 30.0 s; Braking operation level: 0 to 60% |     |     |      |      |      |      |      |  |  |      |              |          |  |     |     |
| EMC filter (IEC/EN 61800-3) (*8)  |                               | EMC standards compliance : Category C2 (emission) / 2nd Env. (Immunity)                     |   |     |     |      |      |      |      |      |  |  |      |              |          |  |     |     |
| DC reactor (DCR) (*8)   |                               | Built-in (IEC/EN 61000-3-2(*10), IEC/EN 61000-3-12)   |   |     |     |      |      |      |      |      |  |  |      |              |          | Standard accessory (IEC/EN 61000-3-12) |     |     |
| Power factor (at the rated load)  | Fundamental wave power factor |   | > 0.98  |     |     |      |      |      |      |      |  |  |      |              |          |  |     |     |
|   | Total power factor            |   | ≥ 0.90  |     |     |      |      |      |      |      |  |  |      |              |          |  |     |     |
| Efficiency (at the rated load) (%)  |                               |   | 97  | 97  | 97  | 97   | 97   | 98   | 98   | 98   | 98   | 98   | 98   | 98           | 98       | 98                                     | 98  | 98  |
| Applicable (safety) standards   |                               |   | UL 508C, C22.2 No. 14, IEC/EN 61800-5-1 SEMI F47-0706   |     |     |      |      |      |      |      |  |  |      |              |          |  |     |     |
| Enclosure   |                               | NEMA/UL TYPE 1/ NEMA/UL TYPE 12(*11)  |   |     |     |      |      |      |      |      |  |  |      | UL open type |          |  |     |     |
| Cooling method  |                               |   | Fan cooling   |     |     |      |      |      |      |      |  |  |      |              |          |  |     |     |
| Weight / Mass (lbs)   | NEMA/UL TYPE 1                |   | 22  | 22  | 22  | 22   | 40   | 40   | 40   | 51   | 51   | 110  | 110  | 154          | 154      | -                                      |     |     |
|   | NEMA/UL TYPE 12               |   | 22  | 22  | 22  | 22   | 40   | 40   | 40   | 51   | 51   | 110  | 110  | 154          | 154      | -                                      |     |     |
|   | UL open type                  |   | -   |     |     |      |      |      |      |      |  |  |      |              |          |  | 93  | 95  |

(\*1) A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1), L (NEMA/UL Type12) or S (UL Open Type)

(\*2) US 4-pole standard induction motor.

(\*3) Rated capacity is calculated by assuming the output rated voltage as 230 V.

(\*4) Output voltage cannot exceed the power supply voltage. At single-phase input use, the output voltage may be lower than three-phase input.

(\*5) The value is calculated on assumption that the inverter is connected with a power supply 230V, 50Hz and Rsc=120.

(\*6) The auxiliary power input is used as an AC power input when combining the unit to DC power supply such as high power factor PWM converter with power regenerative function. (Generally not to be used.)

(\*7) Average braking torque for the motor running alone. (It varies with the efficiency of the motor.)

(\*8) EMC filters and DCR does not conform to each corresponding standards when single phase input use.

(\*9) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V] x 67 (See IEC/EN61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(\*10) It is applicable when the power supply is supplied from Three-phase 200V series transformer which is through Three-phase 400V series transformer.

(\*11) NEMA/UL TYPE 12 offers protection for short water jets. Do not use outdoors or in places where long-term waterproofing is required.

### Three-phase 460 V class series (HP rating)

(001 to 075 HP)

| Item  |  |   | Specifications  |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
|---|--|---|---|-----|-----|-----|------|------|------|------|------|------|------|------|--|--|--|
| Type (FRN AR1■-4U) (*1)   |  |   | 001   | 002 | 003 | 005 | 007  | 010  | 015  | 020  | 025  | 030  | 040  | 050  | 060  | 075  |  |
| Nominal applied motor [HP] (*2)<br>(Rated output)                       | Three phase input  | AC460V motor  | 1   | 2   | 3   | 5   | 7.5  | 10   | 15   | 20   | 25   | 30   | 40   | 50   | 60   | 75   |  |
|   | Single phase input   |   | -   | 1/2 | 1   | 2   | 3    | 3    | 5    | 7.5  | 10   | 10   | 15   | 20   | 25   | 30   |  |
| Output ratings  | Three phase input  | Rated capacity (kVA) (*3)   | 1.9   | 3.2 | 4.3 | 7.1 | 10   | 14   | 19   | 25   | 31   | 35   | 47   | 59   | 72   | 89   |  |
|   |  | Rated current (A)   | 2.5   | 4.1 | 5.5 | 9.0 | 13.5 | 18.5 | 24.5 | 32   | 39   | 45   | 60   | 75   | 91   | 112  |  |
|   | Single phase input   | Rated capacity (kVA) (*3)   | -   | 1.1 | 1.6 | 2.7 | 4.1  | 5.7  | 7.5  | 9.8  | 12   | 13   | 18   | 23   | 28   | 34   |  |
|   |  | Rated current (A)   | -   | 1.5 | 2.1 | 3.5 | 5.2  | 7.2  | 9.5  | 12.4 | 15.2 | 17.5 | 23.4 | 29.2 | 35.4   | 43.6   |  |
| Rated voltage (V) (*4)  |  | Three-phase, 380 to 480 V (with AVR function)   |   |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| Overload capability   |  | 110%-1 min (Overload interval: Compliant with IEC 61800-2)                                  |   |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| Input power   | Three phase input  | Main power supply (number of phases, voltage, frequency)                                    | Three-phase, 380 to 480 V, 50/60 Hz   |     |     |     |      |      |      |      |      |      |      |      |  | Three-phase, 380 to 440 V, 50 Hz<br>Three-phase, 380 to 480 V, 60 Hz   |  |
|   |  | Rated current (A) (*5)  | 1.4   | 2.7 | 3.8 | 6.5 | 9.0  | 12.1 | 18.0 | 24.3 | 30.0 | 35.8 | 48.5 | 60.4 | 72.3   | 88.7   |  |
|   |  | Required power supply capacity [kVA]  | 1.2   | 2.2 | 3.1 | 5.2 | 7.2  | 10   | 15   | 20   | 24   | 29   | 39   | 49   | 58   | 71   |  |
|   | Single phase input   | Main power supply (number of phases, voltage, frequency)                                    | Single-phase, 380 to 480 V, 50/60 Hz  |     |     |     |      |      |      |      |      |      |      |      |  | Single-phase, 380 to 440 V, 50 Hz<br>Single-phase, 380 to 480 V, 60 Hz |  |
|   |  | Rated current [A] (*5)  | -   | 2.7 | 3.8 | 6.5 | 9.0  | 12.1 | 18.0 | 24.3 | 30.0 | 35.8 | 48.5 | 60.4 | 72.3   | 88.7   |  |
|   |  | Required power supply capacity [kVA]  | -   | 1.3 | 1.8 | 3.0 | 4.2  | 5.6  | 8.3  | 12   | 14   | 17   | 23   | 28   | 34   | 41   |  |
|   | Auxiliary control power supply: (number of phases, voltage, frequency) |   | Single-phase, 380 to 480 V, 50/60 Hz  |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| Auxiliary main power supply (number of phases, voltage, frequency) (*6) |  | -   |   |     |     |     |      |      |      |      |      |      |      |      | Single-phase, 380 to 440 V, 50 Hz<br>Single-phase, 380 to 480 V, 60 Hz |  |  |
| Voltage, frequency variations   |  | Voltage: +10 to -15% (Interphase voltage unbalance : 2% or less) (*9), Frequency: +5 to -5% |   |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| Braking   | Braking torque [%] (*7)  |   | 20  |     |     |     |      |      |      |      |      |      |      |      | 10 to 15   |  |  |
|   | DC injection braking   |   | Braking start frequency: 0.0 to 60.0 Hz; Braking time: 0.0 to 30.0 s; Braking operation level: 0 to 60% |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| EMC filter (IEC/EN 61800-3) (*8)  |  | EMC standards compliance : Category C2 (emission) / 2nd Env. (Immunity)                     |   |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| DC reactor (DCR) (*8)   |  | Built-in (IEC/EN 61000-3-2(*10), IEC/EN 61000-3-12)   |   |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| Power factor (at the rated load)  | Fundamental wave power factor  |   | > 0.98  |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
|   | Total power factor   |   | ≥ 0.90  |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| Efficiency (at the rated load) (%)                                      |  | 95  | 96  | 97  | 97  | 97  | 97   | 97   | 97   | 97   | 98   | 98   | 98   | 98   | 98   | 98   |  |
| Applicable (safety) standards   |  | UL 508C, C22.2 No. 14, IEC/EN 61800-5-1, SEMI F47-0706                                      |   |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| Enclosure   |  | NEMA/UL TYPE 1/ NEMA/UL TYPE 12(*11)  |   |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| Cooling method  |  | Fan cooling   |   |     |     |     |      |      |      |      |      |      |      |      |  |  |  |
| Weight / Mass (lbs)   | NEMA/UL TYPE 1   |   | 22  | 22  | 22  | 22  | 22   | 22   | 40   | 40   | 40   | 40   | 51   | 51   | 110  | 110  |  |
|   | NEMA/UL TYPE 12  |   | 22  | 22  | 22  | 22  | 22   | 22   | 40   | 40   | 40   | 40   | 51   | 51   | 110  | 110  |  |
|   | UL open type   |   | -   |     |     |     |      |      |      |      |      |      |      |      |  |  |  |

**(100 to 1000 HP)**

| Item  |                               |   | Specifications  |      |      |      |     |     |     |     |     |     |      |      |      |
|---|-------------------------------|---|---|------|------|------|-----|-----|-----|-----|-----|-----|------|------|------|
| Type (FRN AR1■-4U) (*1)   |                               |   | 100   | 125  | 150  | 200  | 250 | 300 | 350 | 450 | 500 | 600 | 800  | 900  | 1000 |
| Nominal applied motor (HP) (*2)<br>(Rated output)                       | Three phase input             | AC460V motor  | 100   | 125  | 150  | 200  | 250 | 300 | 350 | 450 | 500 | 600 | 800  | 900  | 1000 |
|   | Single phase input            |   | 40  | 50   | 60   | 75   | 75  | 100 | 125 | 150 | 200 | 200 | 300  | 350  | 450  |
| Output ratings  | Three phase input             | Rated capacity (kVA) (*3)   | 119   | 140  | 167  | 201  | 242 | 300 | 330 | 414 | 517 | 589 | 764  | 932  | 1091 |
|   |                               | Rated current (A)   | 150   | 176  | 210  | 253  | 304 | 377 | 415 | 520 | 650 | 740 | 960  | 1170 | 1370 |
|   | Single phase input            | Rated capacity (kVA) (*3)   | 46  | 54   | 65   | 78   | 94  | 117 | 128 | 160 | 201 | 229 | 297  | 363  | 425  |
|   |                               | Rated current (A)   | 58.5  | 68.6 | 81.9 | 98.6 | 118 | 147 | 161 | 202 | 253 | 288 | 374  | 456  | 534  |
| Rated voltage (V) (*4)  |                               | Three-phase, 380 to 480 V (with AVR function)   |   |      |      |      |     |     |     |     |     |     |      |      |      |
| Overload capability   |                               | 110%-1 min (Overload interval: Compliant with IEC 61800-2)                                  |   |      |      |      |     |     |     |     |     |     |      |      |      |
| Input power   | Three phase input             | Main power supply (number of phases, voltage, frequency)                                    | Three-phase, 380 to 440 V, 50 Hz<br>Three-phase, 380 to 480 V, 60 Hz                                    |      |      |      |     |     |     |     |     |     |      |      |      |
|   |                               | Rated current (A) (*5)  | 119   | 141  | 175  | 207  | 249 | 311 | 340 | 435 | 547 | 614 | 767  | 970  | 1093 |
|   |                               | Required power supply capacity [kVA]  | 95  | 113  | 140  | 165  | 199 | 248 | 271 | 347 | 436 | 490 | 612  | 773  | 871  |
|   | Single phase input            | Main power supply (number of phases, voltage, frequency)                                    | Single-phase, 380 to 440 V, 50 Hz<br>Single-phase, 380 to 480 V, 60 Hz                                  |      |      |      |     |     |     |     |     |     |      |      |      |
|   |                               | Rated current [A] (*5)  | 119   | 141  | 175  | 207  | 249 | 311 | 340 | 435 | 547 | 614 | 767  | 970  | 1093 |
|   |                               | Required power supply capacity [kVA]  | 55  | 65   | 81   | 96   | 115 | 144 | 157 | 201 | 252 | 238 | 353  | 447  | 503  |
| Auxiliary control power supply: (number of phases, voltage, frequency)  |                               | Single-phase, 380 to 480 V, 50/60 Hz  |   |      |      |      |     |     |     |     |     |     |      |      |      |
| Auxiliary main power supply (number of phases, voltage, frequency) (*6) |                               | Single-phase, 380 to 440 V, 50 Hz<br>Single-phase, 380 to 480 V, 60 Hz                      |   |      |      |      |     |     |     |     |     |     |      |      |      |
| Voltage, frequency variations   |                               | Voltage: +10 to -15% (Interphase voltage unbalance : 2% or less) (*9), Frequency: +5 to -5% |   |      |      |      |     |     |     |     |     |     |      |      |      |
| Braking   | Braking torque [%] (*7)       |   | 10 to 15  |      |      |      |     |     |     |     |     |     |      |      |      |
|   | DC injection braking          |   | Braking start frequency: 0.0 to 60.0 Hz; Braking time: 0.0 to 30.0 s; Braking operation level: 0 to 60% |      |      |      |     |     |     |     |     |     |      |      |      |
| EMC filter (IEC/EN 61800-3) (*8)  |                               | C2/2nd  | EMC standards compliance: Category C3 (emission) / 2nd Env. (Immunity)                                  |      |      |      |     |     |     |     |     |     |      |      |      |
| DC reactor (DCR) (*8)   |                               | Built-in (IEC/EN 61000-3-2(*10), IEC/EN 61000-3-12)   | Standard accessory (IEC/EN 61000-3-12)  |      |      |      |     |     |     |     |     |     |      |      |      |
| Power factor (at the rated load)  | Fundamental wave power factor |   | > 0.98  |      |      |      |     |     |     |     |     |     |      |      |      |
|   | Total power factor            |   | ≥ 0.90  |      |      |      |     |     |     |     |     |     |      |      |      |
| Efficiency (at the rated load) (%)                                      |                               | 98  | 98  | 98   | 98   | 98   | 98  | 98  | 98  | 98  | 98  | 98  | 98   | 98   | 98   |
| Safety standard compliance  |                               | UL 508C, C22.2 No. 14 , IEC/EN 61800-5-1, SEMI F47-0706                                     |   |      |      |      |     |     |     |     |     |     |      |      |      |
| Enclosure   | NEMA/UL 50                    | NEMA/UL TYPE 1/ NEMA/UL TYPE 12(*11)  | UL open type  |      |      |      |     |     |     |     |     |     |      |      |      |
|   |                               |   |   |      |      |      |     |     |     |     |     |     |      |      |      |
| Cooling method  |                               | Fan cooling   |   |      |      |      |     |     |     |     |     |     |      |      |      |
| Weight / Mass (lbs)   | NEMA/UL TYPE 1                | 154   | 154   |      |      |      |     |     |     |     |     |     |      |      |      |
|   | NEMA/UL TYPE 12               | 154   | 154   |      |      |      |     |     |     |     |     |     |      |      |      |
|   | UL open type                  | -   |   | 137  | 141  | 207  | 216 | 284 | 309 | 540 | 540 | 728 | 1168 | 1168 |      |

(\*1) A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1), L (NEMA/UL Type12) or S (UL Open Type)

(\*2) US 4-pole standard induction motor.

(\*3) Rated capacity is calculated by assuming the output rated voltage as 460 V.

(\*4) Output voltage cannot exceed the power supply voltage. At single-phase input use, the output voltage may be lower than three-phase input.

(\*5) The value is calculated on assumption that the inverter is connected with a power supply 460V, 50Hz and Rsc=120.

(\*6) The auxiliary power input is used as an AC power input when combining the unit to DC power supply such as high power factor PWM converter with power regenerative function. (Generally not to be used.)

(\*7) Average braking torque for the motor running alone. (It varies with the efficiency of the motor.)

(\*8) EMC filters and DCR does not conform to each corresponding standards when single phase input use.

(\*9) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V] x 67 (See IEC/EN 61800-3.)

If this value is 2 to 3%, use an optional AC reactor (ACR).

(\*10) It is applicable when the power supply is supplied from Three-phase 200V series transformer which is through Three-phase 400V series transformer.

(\*11) NEMA/UL TYPE 12 offers protection for short water jets. Do not use outdoors or in places where long-term waterproofing is required.

**Three-phase 575 V class series (HP rating)**

**(001 to 050 HP)**

| Item  |  |   | Specifications  |     |     |     |     |     |      |      |      |      |      |          |  |
|---|--|---|---|-----|-----|-----|-----|-----|------|------|------|------|------|----------|--|
| Type (FRN AR1■-5U) (*1)   |  |   | 001   | 002 | 003 | 005 | 007 | 010 | 015  | 020  | 025  | 030  | 040  | 050      |  |
| Nominal applied motor [HP] (*2)<br>(Rated output)                       | Three phase input  | AC575V motor  | 1   | 2   | 3   | 5   | 7.5 | 10  | 15   | 20   | 25   | 30   | 40   | 50       |  |
|   | Single phase input   |   | -   | 1/2 | 3/4 | 1.5 | 2   | 3   | 5    | 5    | 7.5  | 10   | 10   | 15       |  |
| Output ratings  | Three phase input  | Rated capacity (kVA) (*3)   | 1.6   | 2.7 | 3.8 | 6.1 | 9.2 | 11  | 16   | 21   | 26   | 31   | 40   | 51       |  |
|   |  | Rated current (A)   | 1.7   | 2.8 | 3.9 | 6.2 | 9.3 | 12  | 17   | 22   | 27   | 32   | 41   | 52       |  |
|   | Single phase input   | Rated capacity (kVA) (*3)   | -   | 0.9 | 1.4 | 2.3 | 3.5 | 4.5 | 6.5  | 8.4  | 10   | 12   | 15   | 20       |  |
|   |  | Rated current (A)   | -   | 1.0 | 1.5 | 2.4 | 3.6 | 4.6 | 6.6  | 8.5  | 10.5 | 12.4 | 15.9 | 20.2     |  |
| Rated voltage (V) (*4)  |  | Three-phase, 575 to 600 V (with AVR function)   |   |     |     |     |     |     |      |      |      |      |      |          |  |
| Overload capability   |  | 110%-1 min (Overload interval: Compliant with IEC 61800-2)                                  |   |     |     |     |     |     |      |      |      |      |      |          |  |
| Input power   | Three phase input  | Main power supply (number of phases, voltage, frequency)                                    | Three-phase, 575 to 600 V, 50/60 Hz   |     |     |     |     |     |      |      |      |      |      |          |  |
|   |  | Rated current (A) (*5)  | 1.2   | 2.1 | 3.0 | 5.2 | 7.2 | 9.7 | 14.4 | 19.5 | 24.0 | 28.6 | 38.8 | 48.3     |  |
|   |  | Required power supply capacity [kVA]  | 1.2   | 2.1 | 3.0 | 5.2 | 7.2 | 10  | 15   | 20   | 24   | 29   | 39   | 49       |  |
|   | Single phase input   | Main power supply (number of phases, voltage, frequency)                                    | Single-phase, 575 to 600 V, 50/60 Hz  |     |     |     |     |     |      |      |      |      |      |          |  |
|   |  | Rated current [A] (*5)  | -   | 2.1 | 3.0 | 5.2 | 7.2 | 9.7 | 14.4 | 19.5 | 24.0 | 28.6 | 38.8 | 48.3     |  |
|   |  | Required power supply capacity [kVA]  | -   | 1.3 | 1.8 | 3.0 | 4.2 | 5.6 | 8.3  | 12   | 14   | 17   | 23   | 28       |  |
|   | Auxiliary control power supply: (number of phases, voltage, frequency) |   | Single-phase, 575 to 600 V, 50/60 Hz  |     |     |     |     |     |      |      |      |      |      |          |  |
| Auxiliary main power supply (number of phases, voltage, frequency) (*6) |  | -   |   |     |     |     |     |     |      |      |      |      |      |          |  |
| Voltage, frequency variations   |  | Voltage: +10 to -15% (Interphase voltage unbalance : 2% or less) (*9), Frequency: +5 to -5% |   |     |     |     |     |     |      |      |      |      |      |          |  |
| Braking   | Braking torque [%] (*7)  |   | 20  |     |     |     |     |     |      |      |      |      |      | 10 to 15 |  |
|   | DC injection braking   |   | Braking start frequency: 0.0 to 60.0 Hz; Braking time: 0.0 to 30.0 s; Braking operation level: 0 to 60% |     |     |     |     |     |      |      |      |      |      |          |  |
| EMC filter (IEC/EN 61800-3) (*8)  |  | EMC standards compliance : Category C3 (emission) / 2nd Env. (Immunity)                     |   |     |     |     |     |     |      |      |      |      |      |          |  |
| DC reactor (DCR) (*8)   |  | Built-in (IEC/EN 61000-3-2(*10), IEC/EN 61000-3-12)   |   |     |     |     |     |     |      |      |      |      |      |          |  |
| Power factor (at the rated load)  | Fundamental wave power factor  |   | > 0.98  |     |     |     |     |     |      |      |      |      |      |          |  |
|   | Total power factor   |   | ≥ 0.90  |     |     |     |     |     |      |      |      |      |      |          |  |
| Efficiency (at the rated load) (%)                                      |  | 95  | 96  | 97  | 97  | 97  | 97  | 97  | 97   | 97   | 98   | 98   | 98   | 98       |  |
| Applicable (safety) standards   |  | UL 508C, C22.2 No. 14, IEC/EN 61800-5-1   |   |     |     |     |     |     |      |      |      |      |      |          |  |
| Enclosure   |  | NEMA/UL TYPE 1/ NEMA/UL TYPE 12(*11)  |   |     |     |     |     |     |      |      |      |      |      |          |  |
| Cooling method  |  | Fan cooling   |   |     |     |     |     |     |      |      |      |      |      |          |  |
| Weight / Mass (lbs)   | NEMA/UL TYPE 1   |   | 22  | 22  | 22  | 22  | 22  | 22  | 40   | 40   | 40   | 40   | 51   | 51       |  |
|   | NEMA/UL TYPE 12  |   | 22  | 22  | 22  | 22  | 22  | 22  | 40   | 40   | 40   | 40   | 51   | 51       |  |
|   | UL open type   |   | -   |     |     |     |     |     |      |      |      |      |      |          |  |

### Three-phase 575 V class series (HP rating)

(060to 300HP)

| Item  |  |   | Specifications  |      |      |      |      |              |     |     |  |
|---|--|---|---|------|------|------|------|--------------|-----|-----|--|
| Type (FRN AR1 ■-5U) (*1)  |  |   | 060   | 075  | 100  | 125  | 150  | 200          | 250 | 300 |  |
| Nominal applied motor [HP] (*2)<br>(Rated output)                       | Three phase input  | AC575V motor  | 60  | 75   | 100  | 125  | 150  | 200          | 250 | 300 |  |
|   | Single phase input   |   | 20  | 25   | 30   | 40   | 50   | 75           | 100 | 100 |  |
| Output ratings  | Three phase input  | Rated capacity (kVA) (*3)   | 62  | 76   | 103  | 124  | 145  | 210          | 260 | 287 |  |
|   |  | Rated current (A)   | 63  | 77   | 104  | 125  | 146  | 211          | 262 | 289 |  |
|   | Single phase input   | Rated capacity (kVA) (*3)   | 24  | 29   | 40   | 48   | 56   | 81           | 101 | 111 |  |
|   |  | Rated current (A)   | 24.5  | 30.0 | 40.5 | 48.7 | 56.9 | 82.2         | 102 | 112 |  |
| Rated voltage (V) (*4)  |  | Three-phase, 575 to 600 V (with AVR function)   |   |      |      |      |      |              |     |     |  |
| Overload capability   |  | 110%-1 min (Overload interval: Compliant with IEC 61800-2)                                  |   |      |      |      |      |              |     |     |  |
| Input power   | Three phase input  | Main power supply (number of phases, voltage, frequency)                                    | Three-phase, 575 to 600 V, 50/60 Hz   |      |      |      |      |              |     |     |  |
|   |  | Rated current (A) (*5)  | 57.9  | 71.0 | 94.7 | 113  | 140  | 199          | 249 | 272 |  |
|   |  | Required power supply capacity [kVA]  | 58  | 71   | 95   | 113  | 140  | 199          | 248 | 271 |  |
|   | Single phase input   | Main power supply (number of phases, voltage, frequency)                                    | Single-phase, 575 to 600 V, 50/60 Hz  |      |      |      |      |              |     |     |  |
|   |  | Rated current [A] (*5)  | 57.9  | 71.0 | 94.7 | 113  | 140  | 199          | 249 | 272 |  |
|   |  | Required power supply capacity [kVA]  | 34  | 41   | 55   | 65   | 81   | 115          | 144 | 157 |  |
|   | Auxiliary control power supply: (number of phases, voltage, frequency) |   | Single-phase, 575 to 600 V, 50/60 Hz  |      |      |      |      |              |     |     |  |
| Auxiliary main power supply (number of phases, voltage, frequency) (*6) |  | Single-phase, 575 to 600 V, 50/60 Hz  |   |      |      |      |      |              |     |     |  |
| Voltage, frequency variations   |  | Voltage: +10 to -15% (Interphase voltage unbalance : 2% or less) (*9), Frequency: +5 to -5% |   |      |      |      |      |              |     |     |  |
| Brak- ing   | Braking torque [%] (*7)  |   | 10 to 15  |      |      |      |      |              |     |     |  |
|   | DC injection braking   |   | Braking start frequency: 0.0 to 60.0 Hz; Braking time: 0.0 to 30.0 s; Braking operation level: 0 to 60% |      |      |      |      |              |     |     |  |
| EMC filter (IEC/EN 61800-3) (*8)  |  | EMC standards compliance : Category C3 (emission) / 2nd Env. (Immunity)                     |   |      |      |      |      |              |     |     |  |
| DC reactor (DCR) (*8)   |  | Built-in (IEC/EN 61000-3-2(*10), IEC/EN 61000-3-12)   |   |      |      |      |      |              |     |     |  |
| Power factor (at the rated load)  | Fundamental wave power factor  |   | > 0.98  |      |      |      |      |              |     |     |  |
|   | Total power factor   |   | ≥ 0.90  |      |      |      |      |              |     |     |  |
| Efficiency (at the rated load) (%)                                      |  | 98  | 98  | 98   | 98   | 98   | 98   | 98           | 98  | 98  |  |
| Applicable (safety) standards   |  | UL 508C, C22.2 No. 14, IEC/EN 61800-5-1   |   |      |      |      |      |              |     |     |  |
| Enclosure   | NEMA/UL 50   | NEMA/UL TYPE 1<br>NEMA/UL TYPE 12(*11)  |   |      |      |      |      | UL open type |     |     |  |
| Cooling method  |  | Fan cooling   |   |      |      |      |      |              |     |     |  |
| Weight / Mass (lbs)   | NEMA/UL TYPE 1   | 110   | 110   | 154  | 154  | 154  |      |              |     |     |  |
|   | NEMA/UL TYPE 12  | 110   | 110   | 154  | 154  | 154  |      |              |     |     |  |
|   | UL open type   | -   |   |      |      |      | 207  | 216          | 216 |     |  |

(\*1) A box (■) replaces an alphabetic letter depending on the enclosure.

■ Enclosure: M (NEMA/UL Type1), L (NEMA/UL Type12) or S (UL Open Type)

(\*2) US 4-pole standard induction motor.

(\*3) Rated capacity is calculated by assuming the output rated voltage as 575 V.

(\*4) Output voltage cannot exceed the power supply voltage. At single-phase input use, the output voltage may be lower than three-phase input.

(\*5) The value is calculated on assumption that the inverter is connected with a power supply 575V, 50Hz and Rsc=120.

(\*6) The auxiliary power input is used as an AC power input when combining the unit to DC power supply such as high power factor PWM converter with power regenerative function. (Generally not to be used.)

(\*7) Average braking torque for the motor running alone. (It varies with the efficiency of the motor.) If this value is 2 to 3%, use an optional AC reactor (ACR).

(\*8) EMC filters and DCR does not conform to each corresponding standards when single phase input use.

(\*9) Voltage unbalance [%] = (Max. voltage [V] - Min. voltage [V])/Three-phase average voltage [V] x 67 (See IEC/EN 61800-3.)  
If this value is 2 to 3%, use an optional AC reactor (ACR).

(\*10) It is applicable when the power supply is supplied from Three-phase 200V series transformer which is through Three-phase 400V series transformer.

(\*11) NEMA/UL TYPE 12 offers protection for short water jets. Do not use outdoors or in places where long-term waterproofing is required.

## 7.2 External Dimensions

### kW rating

| Rated voltage       | Inverter type  | Refer to: | Dimensions (mm) |       |       |       |       |      |      |      |       |       |       |       |    |
|---------------------|----------------|-----------|-----------------|-------|-------|-------|-------|------|------|------|-------|-------|-------|-------|----|
|                     |                |           | W               | H     | D     | D1    | D2    | W1   | W2   | H1   | H2    | H3    | M     | N     |    |
| Three-phase<br>200V | FRN0.75AR1■-□  | Figure 1  | 150             | 465   | 262   | 162   | 100   | 115  | 17.5 | 451  | 7     | -     | 2×φ8  | 8     |    |
|                     | FRN1.5AR1■-2□  |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN2.2AR1■-2□  |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN3.7AR1■-2□  |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN4.0AR1■-2E* |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN5.5AR1■-2□  |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN7.5AR1■-2□  |           | 203             | 585   | 262   | 162   | 100   | 158  | 22.5 | 571  | 7     | -     | 2×φ8  | 8     |    |
|                     | FRN11AR1■-2□   |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN15AR1■-2□   |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN18.5AR1■-2□ |           | Figure 2        | 265   | 736   | 284   | 184.5 | 99.5 | 180  | 42.5 | 716   | 12    | 8     | 2×φ10 | 10 |
|                     | FRN22AR1■-2□   |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN30AR1■-2□   |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN37AR1■-2□   |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
|                     | FRN45AR1■-2□   |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN55AR1S-2□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN75AR1S-2□        | Figure 3       | 355       | 740             | 270   | 115   | 155   | 275   | 40   | 720  | 12   | 8     | 2×φ10 | 10    |       |    |
| FRN90AR1S-2□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN90AR1S-2□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN0.75AR1■-4□      | Figure 1       | 150       | 465             | 262   | 162   | 100   | 115   | 17.5 | 451  | 7    | -     | 2×φ8  | 8     |       |    |
| FRN1.5AR1■-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN2.2AR1■-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN3.7AR1■-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN4.0AR1■-4E*      |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN5.5AR1■-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN7.5AR1■-4□       |                | 203       | 585             | 262   | 162   | 100   | 158   | 22.5 | 571  | 7    | -     | 2×φ8  | 8     |       |    |
| FRN11AR1■-4□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN15AR1■-4□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN18.5AR1■-4□      |                | Figure 2  | 265             | 736   | 284   | 184.5 | 99.5  | 180  | 42.5 | 716  | 12    | 8     | 2×φ10 | 10    |    |
| FRN22AR1■-4□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN30AR1■-4□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN37AR1■-4□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN45AR1■-4□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN55AR1■-4□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN75AR1■-4□        | Figure 3       | 300       | 885             | 367.9 | 240.8 | 127.1 | 215   | 855  | 15.5 | 14.5 | 2×φ15 | 15    |       |       |    |
| FRN90AR1■-4□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN90AR1■-4□        |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN110AR1S-4□       | Figure 4       | 530       | 740             | 315   | 135   | 180   | 430   | 50   | 710  | 15.5 | 14.5  | 2×φ15 | 15    |       |    |
| FRN132AR1S-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN160AR1S-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN200AR1S-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN220AR1S-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN280AR1S-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN315AR1S-4□       | Figure 5       | 680       | 1000            | 360   | 180   | 290   | 1370  | 970  | 15.5 | 14.5 | 3×φ15 | 15    |       |       |    |
| FRN355AR1S-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN400AR1S-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN500AR1S-4□       | Figure 5       | 880       | 1400            | 440   | 260   | 260   | 300   | 49.5 | 1520 | 15.5 | 14.5  | 4×φ15 | 15    |       |    |
| FRN630AR1S-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |
| FRN710AR1S-4□       |                |           |                 |       |       |       |       |      |      |      |       |       |       |       |    |

\* 4.0 kW for the EU. The inverter type is FRN4.0AR1■-2E or FRN4.0AR1■-4E.

**Note** A box (■) replaces an alphabetic letter depending on the enclosure.

A box (□) replaces an alphabetic letter depending on the shipping destination.

■Enclosure: M (IP21) or L (IP55) □Shipping destination: E (Europe) or A (Asia)

**HP rating**

| Rated voltage       | Inverter type | Refer to: | Dimensions (inch) |       |       |       |       |         |         |         |         |      |         |      |       |
|---------------------|---------------|-----------|-------------------|-------|-------|-------|-------|---------|---------|---------|---------|------|---------|------|-------|
|                     |               |           | W                 | H     | D     | D1    | D2    | W1      | W2      | H1      | H2      | H3   | M       | N    |       |
| Three-phase<br>230V | FRN001AR1-2U  | Figure 1  | 5.91              | 18.31 | 10.31 | 6.38  | 3.94  | 4.53    | 0.69    | 17.76   | 0.28    | -    | 2×φ0.31 | 0.31 |       |
|                     | FRN002AR1-2U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN003AR1-2U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN005AR1-2U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN007AR1-2U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN010AR1-2U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN015AR1-2U  | 7.99      | 23.03             | 25.39 | 6.22  | 0.89  | 22.48 | 24.84   |         |         |         |      |         |      |       |
|                     | FRN020AR1-2U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN025AR1-2U  | Figure 2  | 10.43             | 28.98 | 11.18 | 7.26  | 3.92  | 7.09    | 1.67    | 28.19   | 0.47    | 0.31 | 2×φ0.39 | 0.39 |       |
|                     | FRN040AR1-2U  |           | 11.81             | 34.84 | 14.48 | 9.48  | 5.00  | 8.46    |         | 33.66   | 0.61    | 0.57 | 2×φ0.59 | 0.59 |       |
|                     | FRN050AR1-2U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN060AR1-2U  | Figure 3  | 13.98             | 29.13 | 10.63 | 4.53  | 6.10  | 10.83   | 1.57    | 28.35   | 0.47    | 0.31 | 2×φ0.39 | 0.39 |       |
| FRN075AR1S-2U       | 20.87         |           | 29.53             | 11.22 | 5.71  | 5.51  | 16.93 | 1.97    | 0.61    |         |         |      |         |      | 0.57  |
| FRN100AR1S-2U       |               |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
| FRN125AR1S-2U       |               |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
| Three-phase<br>460V | FRN001AR1-4U  | Figure 1  | 5.91              | 18.31 | 10.31 | 6.38  | 3.94  | 4.53    | 0.69    | 17.76   | 0.28    | -    | 2×φ0.31 | 0.31 |       |
|                     | FRN002AR1-4U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN003AR1-4U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN005AR1-4U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN007AR1-4U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN010AR1-4U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN015AR1-4U  | 7.99      | 23.03             | 25.39 | 6.22  | 0.89  | 22.48 | 24.84   |         |         |         |      |         |      |       |
|                     | FRN020AR1-4U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN025AR1-4U  | Figure 2  | 10.43             | 28.98 | 11.18 | 7.26  | 3.92  | 7.09    | 1.67    | 28.19   | 0.47    | 0.31 | 2×φ0.39 | 0.39 |       |
|                     | FRN040AR1-4U  |           | 11.81             | 34.84 | 14.48 | 9.48  | 5.00  | 8.46    |         | 33.66   | 0.61    | 0.57 | 2×φ0.59 | 0.59 |       |
|                     | FRN050AR1-4U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN060AR1-4U  | Figure 3  | 20.87             | 29.13 | 12.40 | 5.32  | 7.09  | 16.93   | 1.97    | 27.95   | 0.61    | 0.57 | 2×φ0.59 | 0.59 |       |
|                     | FRN075AR1S-4U |           | 26.77             | 39.37 | 14.17 | 7.09  |       |         |         |         |         |      |         |      | 11.42 |
|                     | FRN100AR1S-4U |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN125AR1S-4U |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN150AR1S-4U | Figure 4  | 26.77             | 55.12 | 17.32 | 10.24 | 10.24 | 53.94   | 3×φ0.59 |         |         |      |         |      |       |
|                     | FRN200AR1S-4U |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN250AR1S-4U | Figure 5  | 34.65             | 61.02 | 19.69 | 12.33 | 7.35  | 11.81   | 1.95    | 59.84   | 4×φ0.59 |      |         |      |       |
|                     | FRN300AR1S-4U |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN350AR1S-4U |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
| FRN450AR1S-4U       | Figure 4      | 26.77     | 55.12             | 17.32 | 10.24 | 10.24 | 53.94 | 3×φ0.59 |         |         |         |      |         |      |       |
| FRN500AR1S-4U       |               |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
| FRN600AR1S-4U       | Figure 5      | 39.37     | 61.02             | 19.69 | 12.33 | 7.35  | 11.81 | 1.95    | 59.84   | 4×φ0.59 |         |      |         |      |       |
| FRN800AR1S-4U       |               |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
| FRN900AR1S-4U       |               |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
| FRN1000AR1S-4U      |               |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
| Three-phase<br>575V | FRN001AR1-5U  | Figure 1  | 5.91              | 18.31 | 10.31 | 6.38  | 3.94  | 4.53    | 0.69    | 17.76   | 0.28    | -    | 2×φ0.31 | 0.31 |       |
|                     | FRN002AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN003AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN005AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN007AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN010AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN015AR1-5U  | 7.99      | 23.03             | 25.39 | 6.22  | 0.89  | 22.48 | 24.84   |         |         |         |      |         |      |       |
|                     | FRN020AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN025AR1-5U  | Figure 2  | 10.43             | 28.98 | 11.18 | 7.26  | 3.92  | 7.09    | 1.67    | 28.19   | 0.47    | 0.31 | 2×φ0.39 | 0.39 |       |
|                     | FRN040AR1-5U  |           | 11.81             | 34.84 | 14.48 | 9.48  | 5.00  | 8.46    |         | 33.66   | 0.61    | 0.57 | 2×φ0.59 | 0.59 |       |
|                     | FRN050AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN060AR1-5U  | Figure 3  | 20.87             | 39.37 | 14.17 | 7.09  | 7.09  | 16.93   | 1.97    | 38.19   | 0.61    | 0.57 | 2×φ0.59 | 0.59 |       |
|                     | FRN075AR1-5U  |           | 26.77             | 55.12 | 17.32 | 10.24 |       |         |         |         |         |      |         |      | 10.24 |
|                     | FRN100AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN125AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN150AR1-5U  | Figure 4  | 26.77             | 55.12 | 17.32 | 10.24 | 10.24 | 53.94   | 3×φ0.59 |         |         |      |         |      |       |
|                     | FRN200AR1-5U  |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
|                     | FRN250AR1-5U  | Figure 5  | 39.37             | 61.02 | 19.69 | 12.33 | 7.35  | 11.81   | 1.95    | 59.84   | 4×φ0.59 |      |         |      |       |
| FRN300AR1-5U        |               |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |
| FRN300AR1-5U        |               |           |                   |       |       |       |       |         |         |         |         |      |         |      |       |

**Note** A box (■) replaces an alphabetic letter depending on the enclosure.  
 ■Enclosure: M (NEMA/UL Type1) or L (NEMA/UL Type12)

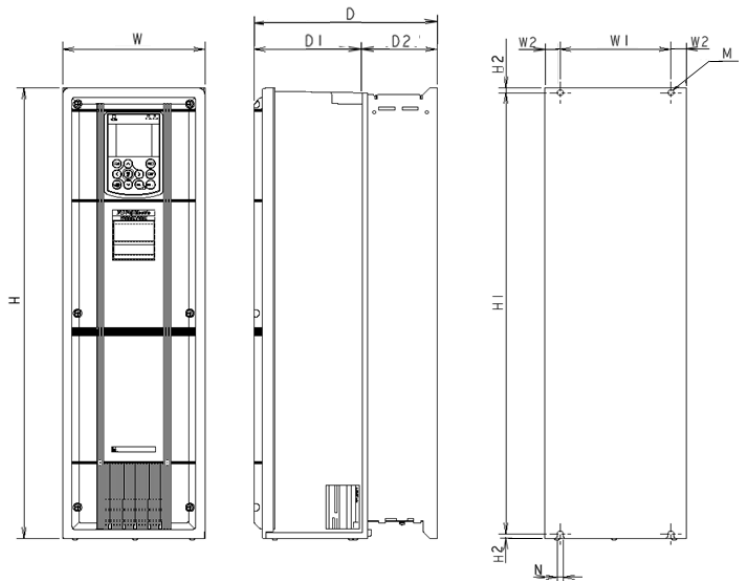


Figure 1 External Dimensions of the Inverter

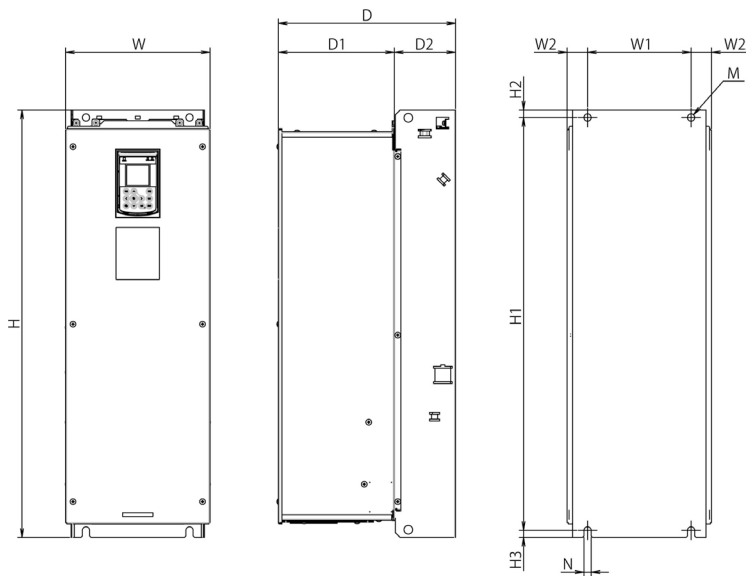


Figure 2 External Dimensions of the Inverter



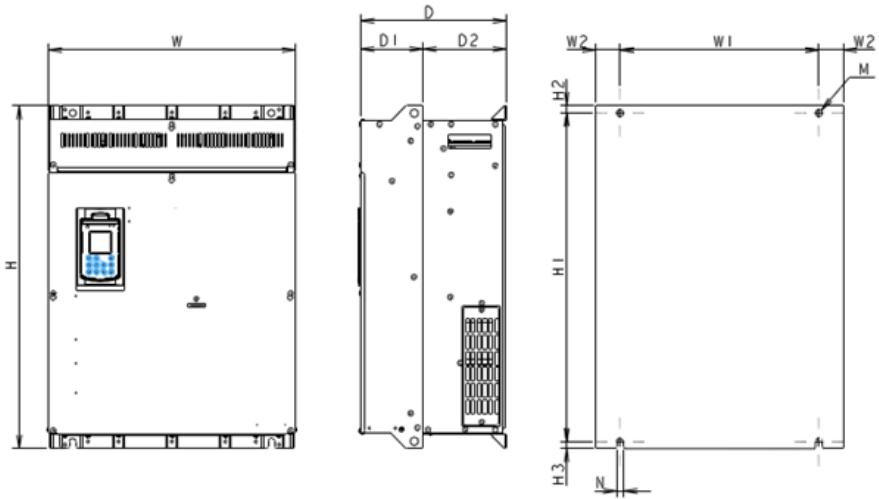


Figure 3 External Dimensions of the Inverter

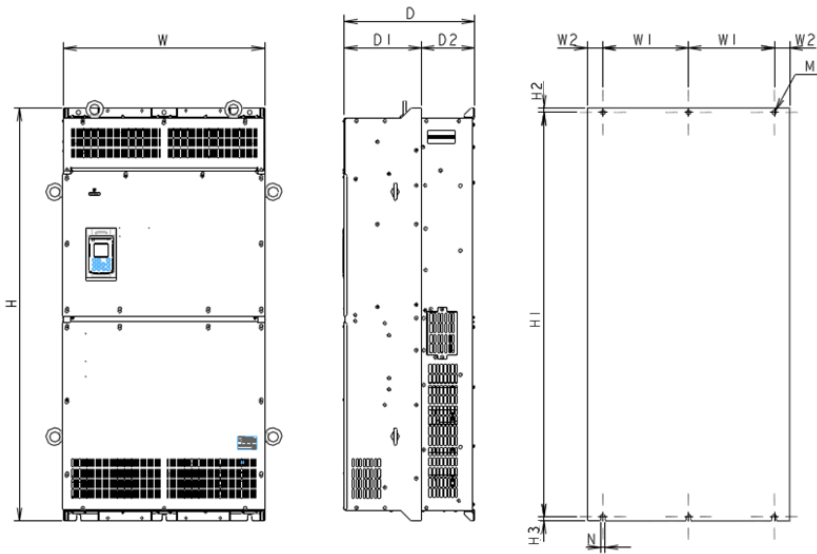


Figure 4 External Dimensions of the Inverter

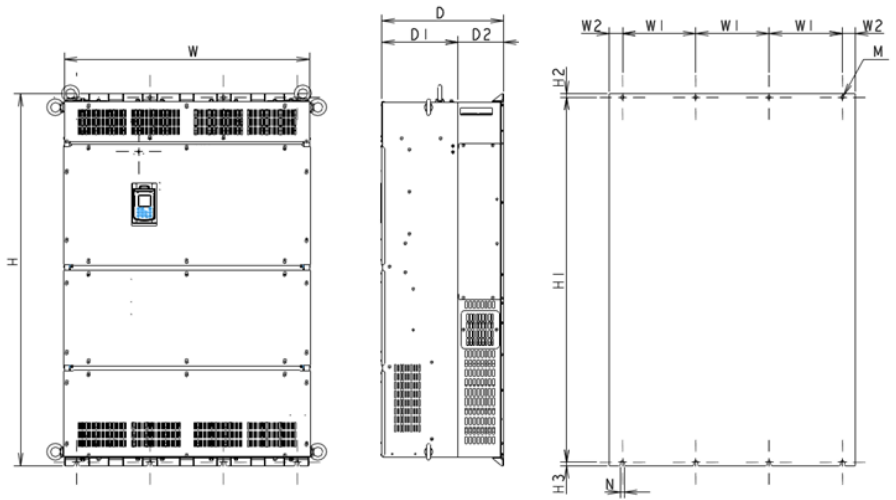




Figure 5 External Dimensions of the Inverter


## Chapter 8 CONFORMITY WITH STANDARDS


### 8.1 Compliance with European Standards

The CE marking on Fuji products indicates that they comply with the essential requirements of the Electromagnetic Compatibility (EMC) Directive and Low Voltage Directive which are issued by the Council of the European Communities.

 **Tip** By installing an external EMC-compatible filter to the input side for 200 V class series inverters of 55kW (75HP) or above and 460V ones of 110kW (150HP) or above, the EMC directive emission category can be changed from C3 to C2.

 Refer to "11.1 European Standards Compliance" in Chapter 11 of the FRENIC-HVAC User's Manual for details if installing an external EMC-compatible filter.

 **Note** The amount of current leaked or when an external EMC-compatible filter is installed is significantly large, and therefore a check should be performed to determine whether the power supply system is affected.

 Refer to "11.1 European Standards Compliance" in Chapter 11 of the FRENIC-HVAC User's Manual for details on EMC filter leakage current values.

The products comply with the following standards

**Table 8.1 Standalone Standard Compliance**

|                       |  |   |
|-----------------------|--|---|
| Inverter Type         | FRN0.75AR1■-2□ to FRN45AR1■-2□<br>FRN001AR1■-2U to FRN060AR1■-2U<br>FRN0.75AR1■-4□ to FRN90AR1■-4□<br>FRN001AR1■-4U to FRN125AR1■-4U | FRN55AR1S-2□ to FRN90AR1S-2□<br>FRN075AR1S-2U to FRN125AR1S-2U<br>FRN110AR1S-4□ to FRN710AR1S-4□<br>FRN150AR1S-4U to FRN1000AR1S-4U<br>FRN001AR1■-5U to FRN150AR1■-5U<br>FRN200AR1S-5U to FRN300AR1S-5U |
| Low Voltage Directive | IEC/EN 61800-5-1   |   |
| EMC Directives        | IEC/EN 61800-3   |   |
| Immunity              | Second environment (Industrial)  |   |
| Emission              | Category C2  | Category C3   |

**Table 8.2 Standalone Standard Compliance (Continued)**

|                          |  |   |
|--------------------------|--|---|
| Inverter Type            | FRN0.75AR1■-2□ to FRN18.5AR1■-2□<br>FRN001AR1■-2U to FRN025AR1■-2U<br>FRN0.75AR1■-4□ to FRN37AR1■-4□<br>FRN001AR1■-4U to FRN050AR1■-4U<br>*1 | FRN22AR1■-2□ to FRN45AR1■-2□<br>FRN030AR1■-2U to FRN060AR1■-2U<br>FRN55AR1S-2□ to FRN90AR1S-2□<br>FRN075AR1S-2U to FRN125AR1S-2U<br>FRN45AR1■-4□ to FRN90AR1■-4□<br>FRN060AR1■-4U to FRN125AR1■-4U<br>FRN110AR1S-4□ to FRN710AR1S-4□<br>FRN150AR1S-4U to FRN1000AR1S-4U<br>*2 |
| Functional Safety        | IEC/EN61800-5-2 SIL 2, EN ISO 13849-1  |   |
| Stop function            | Safe torque off (STO: according to EN61800-5-2)  |   |
| Response time            | 50 ms or less (delay time to "Safe torque off" from turning off either terminal [EN1] or [EN2])  |   |
| Safety integrity level   | SIL 2  |   |
| Safety related subsystem | Type B   |   |
| Hardware Fault Tolerance | HFT 1  |   |
| PFH                      | 3.15E-9 (Probability of a dangerous random hardware failure per hour)  |   |
| DC                       | ≥ 60%  |   |
| SFF                      | ≥ 60%  |   |
| Proof test interval      | 20 years   |   |
| Category                 | Cat 3 (EN ISO 13849-1)   |   |
| Performance level        | d (EN ISO 13849-1)   |   |

**Note** \*1>About target models, products are conformable to functional safety from product ver. "N □ " or later.  
\*2>About target models, products are conformable to functional safety from product ver. "NI" or later.  
"Product ver." described in above note, means the alphabet symbol of SER.NO.'s last two letters. The last letter means hardware version, and the second letter means software version. □: This means any hardware version is available.

**Table 8.3 Standard Compliance When Used with an EMC Filter**

|                       |  |   |
|-----------------------|--|---|
| Inverter Type         | FRN55AR1S-2□ to FRN90AR1S-2□<br>FRN075AR1S-2U to FRN125AR1S-2U<br>FRN110AR1S-4□ to FRN280AR1S-4□<br>FRN150AR1S-4U to FRN450AR1S-4U | FRN315AR1S-4□ to FRN710AR1S-4□<br>FRN500AR1S-4U to FRN1000AR1S-4U |
| EMC filter            | FS or FN series (optional; see Table 8.4)  |   |
| Low Voltage Directive | IEC/EN 61800-5-1   |   |
| EMC Directives        | IEC/EN 61800-3   |   |
| Immunity              | Second environment (Industrial)  |   |
| Emission              | Category C2  | Category C3   |

**Note** A box (■) replaces an alphabetic letter depending on the enclosure.  
A box (□) replaces an alphabetic letter depending on the shipping destination.  
■Enclosure: M (IP21, NEMA/UL Type1) or L (IP55, NEMA/UL Type12) □Shipping destination: E (Europe) or A (Asia)

## 8.2 Conformity to the Low Voltage Directive in the EU

To use Fuji inverters as a product conforming to the Low Voltage Directive in the EU, refer to guidelines given on pages vi to xii.

## 8.3 Compliance with EMC Standards

### 8.3.1 General

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.




Our EMC compliance test is performed with the following wiring length (of the shielded cable) between the inverter and motor under the specified inverter usage conditions.

|   |          |
|---|----------|
| • FRN0.75AR1■-2□ to FRN45AR1■-2□                  | : 75 m   |
| FRN001AR1■-2U to FRN060AR1■-2U                    | : 246 ft |
| • FRN55AR1S-2□ to FRN90AR1S-2□ (inverter alone)   | : 10 m   |
| FRN075AR1S-2U to FRN125AR1S-2U (inverter alone)   | : 33 ft  |
| • FRN55AR1S-2□ to FRN90AR1S-2□ (with filter)      | : 20 m   |
| FRN075AR1S-2U to FRN125AR1S-2U (with filter)      | : 66 ft  |
| • FRN0.75AR1■-4□ to FRN90AR1■-4□                  | : 75 m   |
| FRN001AR1■-4U to FRN125AR1■-4U                    | : 246 ft |
| • FRN110AR1S-4□ to FRN710AR1S-4□ (inverter alone) | : 10 m   |
| FRN150AR1S-4U to FRN1000AR1S-4U(inverter alone)   | : 33 ft  |
| • FRN110AR1S-4□ to FRN710AR1S-4□ (with filter)    | : 20 m   |
| FRN150AR1S-4U to FRN1000AR1S-4U(with filter)      | : 66 ft  |
| • FRN001AR1■-5U to FRN150AR1■-5U                  | : 246 ft |
| • FRN200AR1S-5U to FRN300AR1S-5U                  | : 33 ft  |

### 8.3.2 Recommended installation procedure

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

- 1) Use shielded wires for the motor cable and route the cable as short as possible. Firmly clamp the shield to the specified point or the grounded metal plate inside the inverter. Further, connect the shielding layer electrically to the grounding terminal of the motor.
- 2) For the inverters of 200V class series 5.5 to 45 kW (7 to 60HP) and 400V ones of 11 to 90 kW (15 to 125HP), be sure to pass the main circuit power input lines of the inverter through a ferrite core in wiring. For 575V series, ferrite core is not required.

 For wiring of the main circuit power input lines, refer to Chapter 2, Section 2.2.1 "(4) Wiring the main circuit power input wires."

- 3) Connect the grounding wires to the grounding terminals without passing them through the ferrite core.

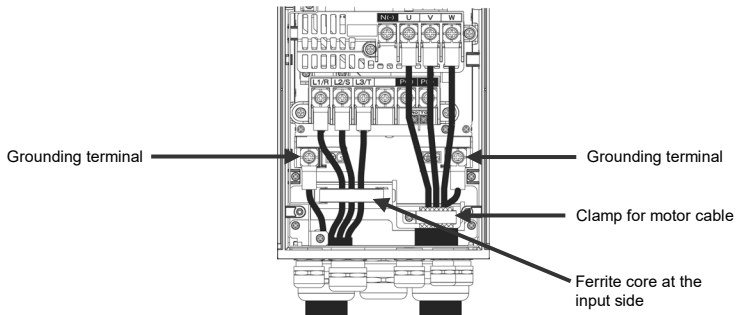


Figure 8.1 Wiring to Main Circuit Terminals

- 4) For connection to inverter's control terminals and for connection of the RS-485 communication signal cable, use shielded wires. As with the motor, clamp the shields firmly to the specified point or the grounded metal plate inside the inverter.

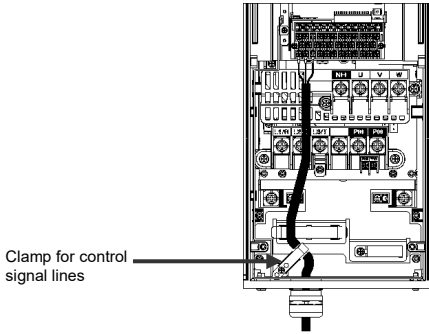


Figure 8.2 Wiring to Control Circuit Terminals

- 5) When using an externally connected EMC filter (optional), place the inverter and filter on a grounded metal plate such as the surface of a panel, as shown in Figure 8.3. If noise emissions exceed the standard, place the inverter and any peripheral equipment inside a metal panel. For more information about how to use the inverter in combination with a filter, see Table 8.5.

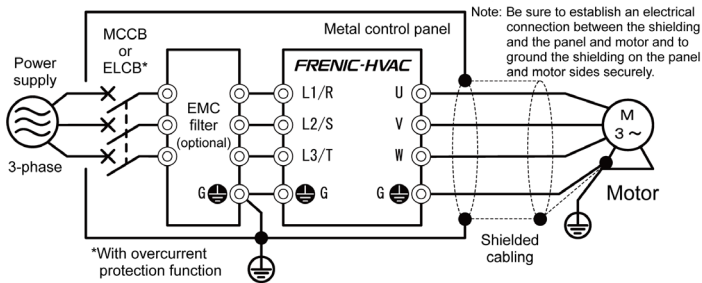


Figure 8.3 Installation inside a Panel

### 8.3.3 Leakage current of the EMC filter

This product uses grounding capacitors for noise suppression which increase the leakage current. Check whether there is no problem with electrical systems. When using an EMC filter, the leakage current listed in Table 8.5 is added. Before adding the filter, consider whether the additional leakage current is allowable in the context of the overall system design.

Table 8.4 Leakage Current of EMC-compliant Filter

| Input power          | Inverter type                                   | Leakage current (mA) |                       | Input power          | Inverter type   | Leakage current (mA) |                       |
|----------------------|---|----------------------|-----------------------|----------------------|---|----------------------|-----------------------|
|                      |   | Normal Conditions    | Worst-case Conditions |                      |   | Normal Conditions    | Worst-case Conditions |
| Three-phase<br>200 V | FRN0.75AR1■-2□<br>FRN001AR1■-2U                 | 86                   | 140                   | Three-phase<br>400 V | FRN0.75AR1■-4□<br>FRN001AR1■-4U   | 55                   | 164                   |
|                      | FRN1.5AR1■-2□<br>FRN002AR1■-2U                  |                      |                       |                      | FRN1.5AR1■-4□<br>FRN002AR1■-4U  |                      |                       |
|                      | FRN2.2AR1■-2□<br>FRN003AR1■-2U                  |                      |                       |                      | FRN2.2AR1■-4□<br>FRN003AR1■-4U  |                      |                       |
|                      | FRN3.7AR1■-2□<br>FRN4.0AR1■-2E<br>FRN005AR1■-2U |                      |                       |                      | FRN3.7AR1■-4□<br>FRN4.0AR1■-4E<br>FRN005AR1■-4U   |                      |                       |
|                      | FRN5.5AR1■-2□<br>FRN007AR1■-2U                  |                      |                       |                      | FRN5.5AR1■-4□<br>FRN007AR1■-4U  |                      |                       |
|                      | FRN7.5AR1■-2□<br>FRN010AR1■-2U                  | 224                  | 357                   |                      | FRN7.5AR1■-4□<br>FRN010AR1■-4U  |                      |                       |
|                      | FRN11AR1■-2□<br>FRN015AR1■-2U                   |                      |                       |                      | FRN11AR1■-4□<br>FRN015AR1■-4U   |                      |                       |
|                      | FRN15AR1■-2□<br>FRN020AR1■-2U                   | 180                  | 291                   |                      | FRN15AR1■-4□<br>FRN020AR1■-4U   | 135                  | 417                   |
|                      | FRN18.5AR1■-2□<br>FRN025AR1■-2U                 |                      |                       |                      | FRN18.5AR1■-4□<br>FRN025AR1■-4U   |                      |                       |
|                      | FRN22AR1■-2□<br>FRN030AR1■-2U                   | 198                  | 314                   |                      | FRN22AR1■-4□<br>FRN030AR1■-4U   |                      |                       |
|                      | FRN30AR1■-2□<br>FRN040AR1■-2U                   |                      |                       |                      | FRN30AR1■-4□<br>FRN040AR1■-4U   | 111                  | 381                   |
|                      | FRN37AR1■-2□<br>FRN050AR1■-2U                   | 204                  | 322                   |                      | FRN37AR1■-4□<br>FRN050AR1■-4U   |                      |                       |
|                      | FRN45AR1■-2□<br>FRN060AR1■-2U                   |                      |                       |                      | FRN45AR1■-4□<br>FRN060AR1■-4U   | 119                  | 367                   |
|                      | FRN55AR1S-2□<br>FRN075AR1S-2U                   | 18                   | 23                    |                      | FRN55AR1■-4□<br>FRN075AR1■-4U   |                      |                       |
|                      | FRN75AR1S-2□<br>FRN100AR1S-2U                   |                      |                       |                      | FRN75AR1■-4□<br>FRN100AR1■-4U   | 148                  | 440                   |
|                      | FRN90AR1S-2□<br>FRN125AR1S-2U                   |                      |                       |                      | FRN90AR1■-4□<br>FRN125AR1■-4U   |                      |                       |
|                      |   |                      |                       |                      | FRN110AR1S-4□<br>FRN150AR1S-4U<br>FRN132AR1S-4□<br>FRN200AR1S-4U<br>FRN160AR1S-4□<br>FRN250AR1S-4U<br>FRN200AR1S-4□<br>FRN300AR1S-4U<br>FRN220AR1S-4□<br>FRN350AR1S-4U<br>FRN280AR1S-4□<br>FRN450AR1S-4U<br>FRN315AR1S-4□<br>-<br>FRN355AR1S-4□<br>FRN500AR1S-4U<br>FRN400AR1S-4□<br>FRN600AR1S-4U<br>FRN500AR1S-4□<br>FRN800AR1S-4U<br>FRN630AR1S-4□<br>FRN900AR1S-4U<br>FRN710AR1S-4□<br>FRN1000AR1S-4U | 3                    | 34                    |

\*1 Calculated based on these measuring conditions: 200 V/ 50 Hz, grounding of a single wire in delta-connection, interphase voltage unbalance ratio 2%.

\*2 Calculated based on these measuring conditions: 400 V/ 50 Hz, neutral grounding in Y-connection, interphase voltage unbalance ratio 2%.

**Note:** The worst-case conditions include input phase loss.

Table 8.4 Leakage Current of EMC-compliant Filter (continue)

| Input power          | Inverter type | Leakage current (mA) |                       | Input power          | Inverter type | Leakage current (mA) |                       |
|----------------------|---------------|----------------------|-----------------------|----------------------|---------------|----------------------|-----------------------|
|                      |               | Normal Conditions    | Worst-case Conditions |                      |               | Normal Conditions    | Worst-case Conditions |
| Three-phase<br>575 V | FRN001AR1■-5U | 68                   | 119                   | Three-phase<br>575 V | FRN040AR1■-5U | 56                   | 149                   |
|                      | FRN002AR1■-5U |                      |                       |                      | FRN050AR1■-5U |                      |                       |
|                      | FRN003AR1■-5U |                      |                       |                      | 98            | 375                  |                       |
|                      | FRN005AR1■-5U |                      |                       |                      |               |                      |                       |
|                      | FRN007AR1■-5U |                      |                       |                      |               |                      |                       |
|                      | FRN010AR1■-5U |                      |                       |                      | 34            | 113                  | FRN100AR1■-5U         |
|                      | FRN015AR1■-5U | FRN125AR1■-5U        |                       |                      |               |                      |                       |
|                      | FRN020AR1■-5U | 18                   | 79                    |                      |               |                      |                       |
|                      | FRN025AR1■-5U |                      |                       |                      |               |                      |                       |
| FRN030AR1■-5U        | FRN150AR1■-5U |                      |                       |                      |               |                      |                       |
|                      |               |                      |                       | FRN200AR1S-5U        |               |                      |                       |
|                      |               |                      |                       | FRN250AR1S-5U        |               |                      |                       |
|                      |               |                      |                       | FRN300AR1S-5U        |               |                      |                       |

\* Calculated based on these measuring conditions: 575 V, 60 Hz, neutral grounding in Y-connection, interphase voltage unbalance ratio of 2%.

**Note:** A box (■) replaces an alphabetic letter depending on the enclosure.

■Enclosure: M (IP21, NEMA/UL Type1) or L (IP55, NEMA/UL Type12)

**Note:** The worst-case conditions include input phase loss.



Table 8.5 EMC Filter (Optional) Use and Leakage Currents

| Input power          | Inverter type                   | Filter model    | EMC filter leakage current (mA) |                       |
|----------------------|---------------------------------|-----------------|---------------------------------|-----------------------|
|                      |                                 |                 | Normal Conditions               | Worst-case Conditions |
| Three-phase<br>200 V | FRN55AR1S-2□<br>FRN075AR1S-2U   | FS5536-400-99-1 | 265                             | 381                   |
|                      | FRN75AR1S-2□<br>FRN100AR1S-2U   |                 |                                 |                       |
|                      | FRN90AR1S-2□<br>FRN125AR1S-2U   |                 |                                 |                       |
| Three-phase<br>400 V | FRN110AR1S-4□<br>FRN150AR1S-4U  | FS5536-250-99-1 | 59                              | 364                   |
|                      | FRN132AR1S-4□<br>FRN200AR1S-4U  | FS5536-400-99-1 | 78                              | 439                   |
|                      | FRN160AR1S-4□<br>FRN250AR1S-4U  |                 |                                 |                       |
|                      | FRN200AR1S-4□<br>FRN300AR1S-4U  |                 |                                 |                       |
|                      | FRN220AR1S-4□<br>FRN350AR1S-4U  | FN3359-600-99   | 38                              | 227                   |
|                      | FRN280AR1S-4□<br>FRN450AR1S-4U  |                 |                                 |                       |
|                      | FRN315AR1S-4□<br>-              | FN3359-800-99   | 38                              | 227                   |
|                      | FRN355AR1S-4□<br>FRN500AR1S-4U  |                 |                                 |                       |
|                      | FRN400AR1S-4□<br>FRN600AR1S-4U  |                 |                                 |                       |
|                      | FRN500AR1S-4□<br>FRN800AR1S-4U  | FN3359-1000-99  | 39                              | 233                   |
|                      | FRN630AR1S-4□<br>FRN900AR1S-4U  | FN3359-1600-99  | 38                              | 227                   |
|                      | FRN710AR1S-4□<br>FRN1000AR1S-4U |                 |                                 |                       |

\* Calculated based on these measuring conditions: 200 V, 50 Hz with single-phase grounding, 400 V, 50Hz with neutral grounding, and an interphase voltage unbalance ratio of 2%.

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

□Shipping destination: E (Europe) or A (Asia)

## 8.4 Harmonic Component Regulation in the EU

### 8.4.1 General comments

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

If an inverter whose rated input is 1 kW or less is connected to the public low-voltage power supply, it is regulated by the harmonics emission regulation IEC/EN 61000-3-2. If an inverter whose input current is 16 A or above and 75 A or below is connected to the public low-voltage power supply, it is regulated by the harmonics emission regulation IEC/EN 61000-3-12.

Note that connection to the industrial low-voltage power lines is an exception. (See Figure 8.3.)

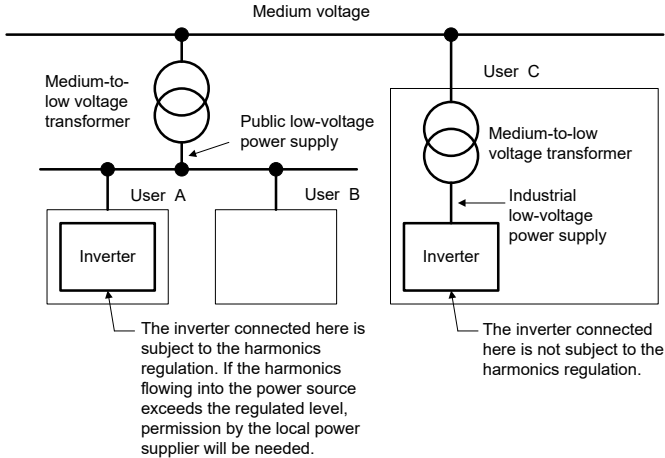


Figure 8.4 Power Source and Regulation

### 8.4.2 Compliance with IEC/EN 61000-3-2

The FRN0.75AR1■-4□ (FRN001AR1■-4U) satisfies the IEC/EN 61000-3-2, so it can be connected to the public low-voltage power supply.

### 8.4.3 Compliance with IEC/EN 61000-3-12

To bring the FRN0.75AR1■-2□ (FRN001AR1■-2U) to FRN18.5AR1■-2□ (FRN025AR1■-2U) and FRN0.75AR1■-4□ (FRN001AR1■-4U/5U) to FRN37AR1■-4□ (FRN050AR1■-4U/5U), FRN060AR1■-5U into compliance with the IEC/EN 61000-3-12, connect them to the power supply whose short-circuit ratio  $R_{sc}$  is 120 or above.

## 8.5 Functional Safety Function description

### 8.5.1 General

In FRENIC-HVAC and FRENIC-AQUA series of inverters, opening the hardware circuit between terminals [EN1]-[PLC] or between terminals [EN2]-[PLC] 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 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 IEC61800-5-2 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. Therefore, before starting wiring or maintenance jobs, be sure to disconnect the input power to the inverter and wait at least five minutes for inverters with a capacity of 22 kW of 400 V series and 11 kW of 200 V series or below, or at least ten minutes for inverters with a capacity of 30 kW of 400 V series and 15 kW of 200 V series or above.
- The functional safety function integrity is ensured only if the inverter is operating in an environment that satisfies the requirements described in the instruction manual (chapter 8.5.2).

## Enable terminals and peripheral circuit, and internal circuit configuration

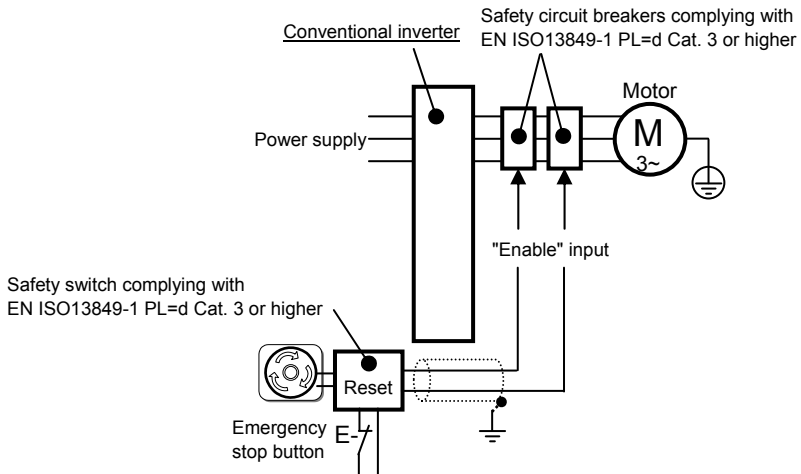
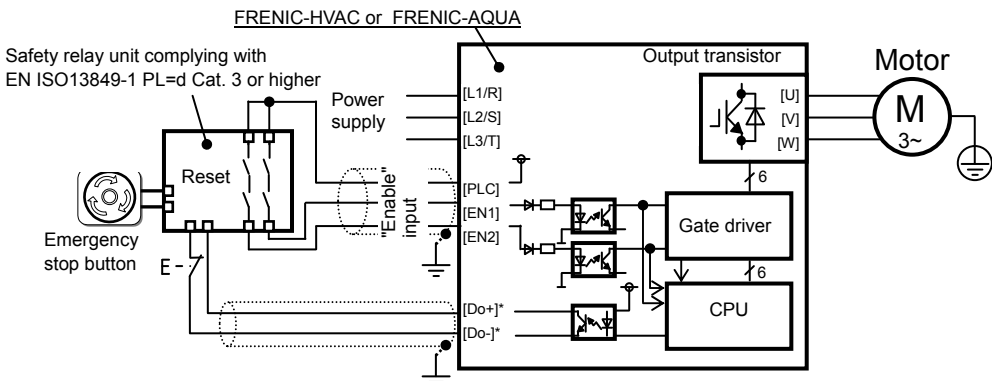
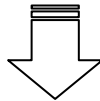


Figure 8.5 Conventional Inverters



\*Transistor output terminals (e.g., [Y1]-[CMY], **DEC**F (Function code data=1101), Refer to Section 8.5.6)

Figure 8.6 FRN\_\_AR1-□□, FRN\_\_AQ1-□□

## 8.5.2 Notes for compliance to Functional Safety Standard

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

- [EN1]/[EN2] and [PLC] 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.
- For opening and closing the hardware circuit between terminals [EN1]/[EN2] and [PLC], use safety approved components such as safety relays that comply with EN ISO13849-1 PL=d Cat. 3 or higher to ensure a complete shut off.
- 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 [PLC].

#### Fault examples:

- Terminals [EN1]/[EN2] and [PLC] are short-circuited due to the wiring being caught in the door of the control 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.

### 2) Notes for Safe Torque Off (STO) functional safety function

- 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, because it is required by the machine directive that the whole system conforms to the safety requirements under the machine manufacturer's responsibility.

In addition, as preventive maintenance, the machinery manufacturer must perform periodical inspections to check that the product safety system properly functions.

- The inverter has been designed according to pollution degree 2 requirements. Therefore, in order 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 EN61800-5-1 and 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]-[PLC] and [EN2]-[PLC] states being ON, as well as outputting an alarm to external equipment. Note that the alarm output function is not guaranteed to all 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 and wait at least 5 minutes.

### 3) Test of Safe Torque Off (STO) functional safety function

- In application where no regular activation of the Safe Torque Off (STO) function is guaranteed, check at least once a year that the Safe Torque Off (STO) function works correctly.

### 4) At power up

- At power up ensure that the terminals [EN1] and [EN2] are not short circuited to PLC (or +24VDC). This allows executing a diagnostic of the functional safety function circuit.

### 8.5.3 EN ISO13849-1 PL=d

European Standard EN ISO13849-1 PL=d (Safety of machinery–Safety related parts of control systems) prescribes the basic safety requirements for machinery categorized according to the requirement level. Category 3 represents the requirements that the machinery shall be designed with redundancy so that a single fault does not lead to the loss of the safety function. Table 8.6 shows an outline of the category levels and their safety requirements. For detailed requirements, refer to EN ISO13849-1 PL=d.

Table 8.6

| Category | Summary of requirements  | System behavior  |
|----------|--|--|
| B        | SRP/CS and/or their protective equipment, as well as their components, shall be designed, constructed, selected, assembled and combined in accordance with relevant standards so that they can withstand the expected influences. Basic safety principles shall be used.   | The occurrence of a fault can lead to the loss of the safety function.   |
| 1        | Requirements of Category B shall apply. Well-tried components and well-tried safety principles shall be used.  | The occurrence of a fault can lead to the loss of the safety function but the probability of occurrence is lower than for Category B.  |
| 2        | Requirements of Category B and the use of well-tried safety principles shall apply. Safety function shall be checked at suitable intervals by the machine control system.  | The occurrence of a fault can lead to the loss of the safety function between the checks. The loss of safety function is detected by the check.  |
| 3        | Requirements of Category B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed, so that <ul style="list-style-type: none"> <li>- a single fault in any of these parts does not lead to the loss of the safety function, and</li> <li>- whenever reasonably practicable, the single fault is detected.</li> </ul>   | When a single fault occurs, the safety function is always performed. Some, but not all, faults will be detected. Accumulation of undetected faults can lead to the loss of the safety function.  |
| 4        | Requirements of Category B and the use of well-tried safety principles shall apply. Safety-related parts shall be designed, so that <ul style="list-style-type: none"> <li>- a single fault in any of these parts does not lead to a loss of the safety function, and</li> <li>- the single fault is detected at or before the next demand upon the safety function, but if this detection is not possible, an accumulation of undetected faults shall not lead to the loss of the safety function.</li> </ul> | When a single fault occurs, the safety function is always performed. Detection of accumulated faults reduces the probability of the loss of the safety function (high DC). The faults will be detected in time to prevent the loss of the safety function. |

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

Turning the emergency stop button ON, switches OFF EN1 and EN2 inputs, bringing the inverter into the Safe Torque Off (STO). This activates a waiting time provided by the H16 parameter; this time can be modified using the standard keypad: AUTO (100 ms as default mode), from 0.0 (equivalent to 0.1s) to 30.0 seconds. Once the H16 waiting time has elapsed, the STO diagnosis is executed. The STO diagnosis requires less than one second to be completed.

Figure 8.7 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.

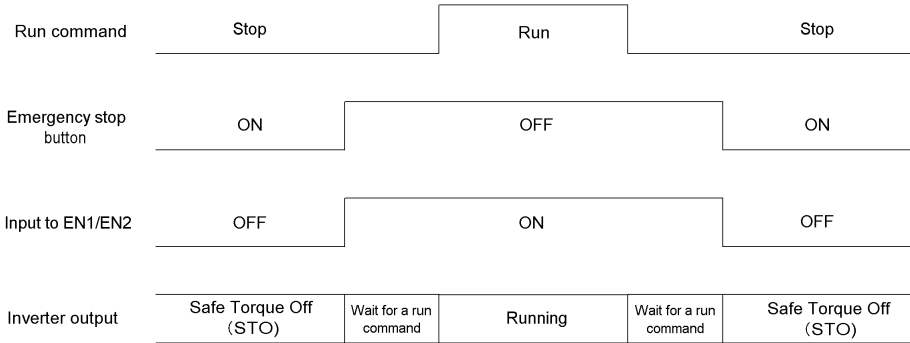


Figure 8.7 Inverter Output State when the Emergency Stop Button is Turned OFF with the Inverter being Stopped

Figure 8.8 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.

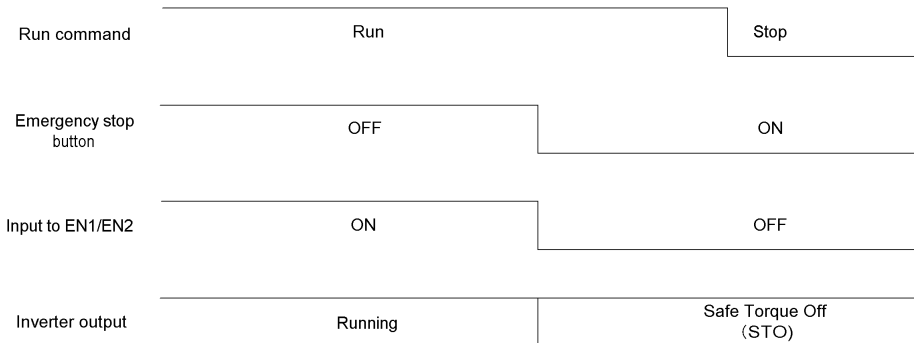


Figure 8.8 Inverter Output State when the Emergency Stop Button is Turned ON with the Inverter Running

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

Turning the emergency stop button ON turns EN1 and EN2 inputs OFF and brings the inverter into the Safe Torque Off (STO) state. When a discrepancy of EN1 and EN2 inputs occurs during a time longer than 50 ms, the inverter interprets it as a logic discrepancy outputting an **ECF** alarm on the screen of the standard keypad; if it is shorter than 50 ms, no alarm occurs. The alarm can be reset by removing power of the inverter.

Figure 8.9 shows the timing scheme when the signals of EN1 and EN2 inputs are not simultaneous so that an alarm **ECF** occurs.

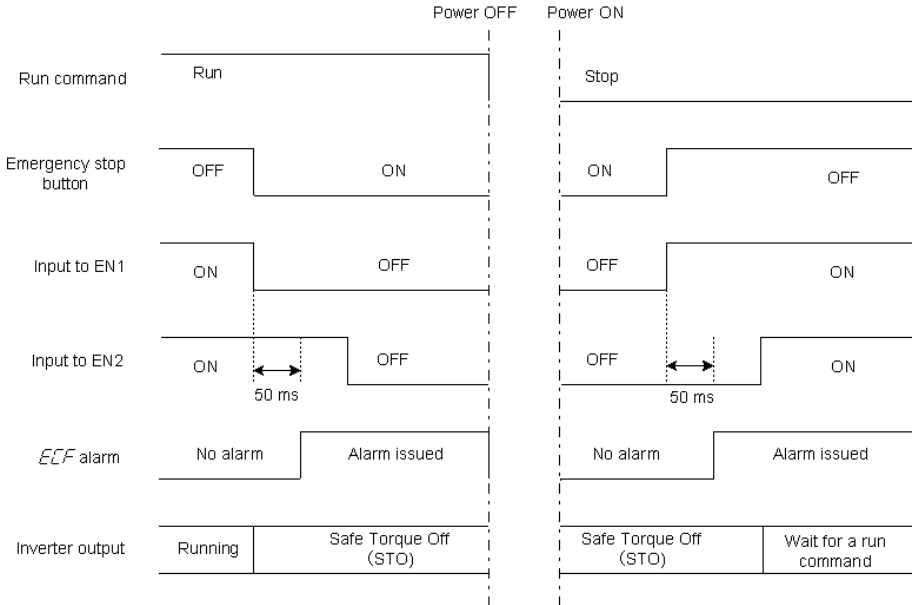


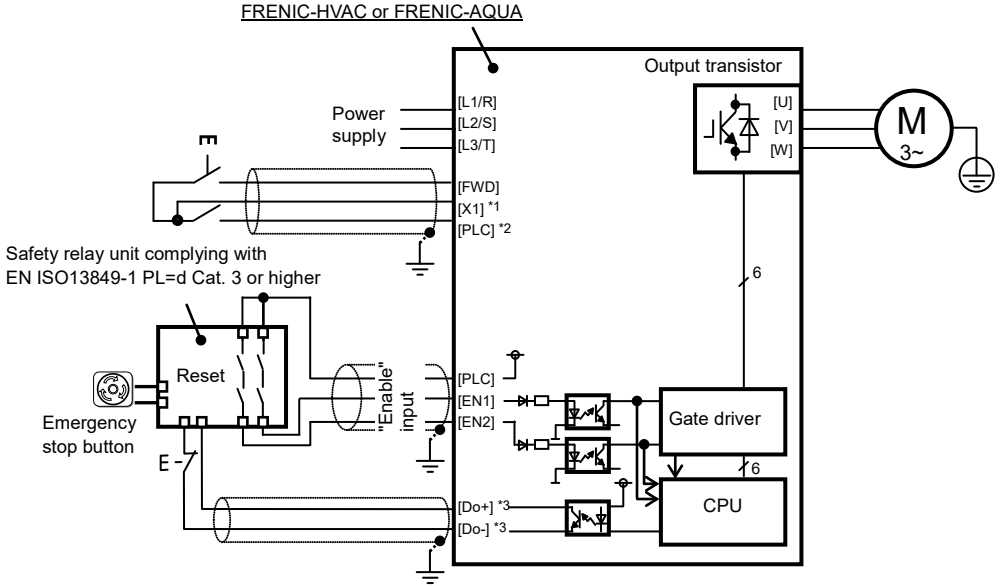
Figure 8.9 **ECF** Alarm (Caused by Logic Discrepancy) and Inverter Output State

### 8.5.6 Prevention of restarting

To prevent the inverter from restarting just by turning the emergency stop button OFF, configure the Enable input circuit as shown in Figure 8.10. Figure 8.11 shows the timing scheme for prevention of restarting.

**HLD** ("Enable 3-wire operation") must be assigned to any digital input terminal; for example, setting the E01 data to "6" sets up the **HLD** function at the [X1] terminal.

After the **FWD** comes ON with the **HLD** function being ON, even turning the **FWD** OFF keeps the inverter running due to the **HLD** function. 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 SOURCE mode, [PLC] applies; if in the SINK mode, [CM] applies

\*3 Transistor output terminals (e.g., [Y1]-[CMY], **DECF** (Function code data=1101))

Figure 8.10 Connection Diagram and Internal Circuit Configuration



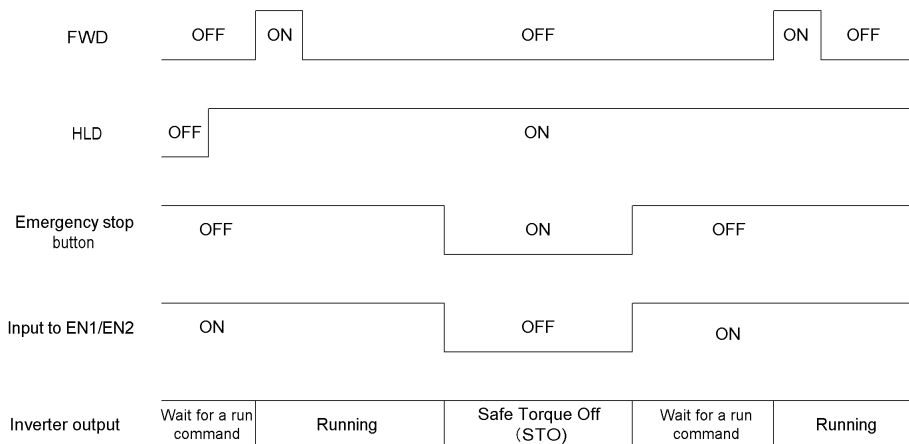


Figure 8.11 Prevention of Restarting

## 8.6 Compatibility with Revised EMC Directive and Low Voltage Directive

In the revised EMC Directive and Low Voltage Directive, 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.

## 8.7 Compliance with UL Standards and cUL-listed for Canada

### 8.7.1 General

Originally, the UL standards were established by Underwriters Laboratories, Inc. as private criteria for inspections/investigations pertaining to fire/accident insurance in the USA. The UL marking on Fuji products is related to the UL Standard UL508C.

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. The cUL marking on Fuji products is related to the CSA Standard C22.2 No. 14.

### 8.7.2 Considerations when using FRENIC-HVAC in systems to be certified by UL and cUL-listed for Canada

If you want to use the FRENIC-HVAC series of inverters as a part of UL Standards or CSA Standards (cUL certified) certified product, refer to the related guidelines described on pages xiii to xxiv.



# ***FRENIC-HVAC***

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## **Instruction Manual**

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