Fuji Electric

Innovating Energy Technology

High-Performance Inverter

FRENIC-Ace (E3) Series

User's Manual

⚠CAUTION

Thank you for purchasing our FRENIC-Ace series of high-performance standard inverters.

- This product is designed to drive a three-phase motor under variable speed control. Read through this user's manual and become familiar with the handling procedure for correct use.
- Incorrect handling may hinder normal operation, or result in a shortening of the product life or failure.
- Deliver this manual to the end user of this product.
- Keep this manual in a safe place until this product is discarded.
- For how to use an optional device, refer to the instruction and installation manuals for that optional device.

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https://www.fujielectric.co.jp/products/drive-download/

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24A7-E-0174

Preface

Thank you for purchasing our “FRENIC-Ace” series of high-performance, standard inverters. This product is designed to drive a three-phase motor under variable speed control.

This manual provides all the information on the FRENIC-Ace series of inverters including its operating procedure and selection of peripheral equipment. Read this User's Manual carefully beforehand to ensure correct use. Incorrect handling may hinder normal operation, or result in a shortening of the product life or failure.

FRENIC-Ace related documents are listed in the following table. Please refer to these documents based on the purpose.

Name	Document No.	Description
Catalog	24A1-E-0174☐	Product overview, features, specifications, outline drawings, options, etc.
Instruction Manual (incl. with the product) (Basic/ EMC filter built-in/ Finless type)	INR-SI47-2546☐	Instruction manual packaged with the product (Quick Guide)
Instruction Manual (incl. with the product) (Ethernet built-in type)	INR-SI47-2548☐	
Instruction Manual (Detailed version) (Basic/ EMC filter built-in/ Finless type)	INR-SI47-2547☐	Instruction Manual for completed documents (Option)
Instruction Manual (Detailed version) (Ethernet built-in type)	INR-SI47-2549☐	
RS-485 Communications User’s Manual	24A7-J-0082☐	Overview of functions implemented by using FRENIC-series RS-485 communications facility, its communications specifications, Modbus RTU/Fuji general-purpose inverter protocol, function codes and related data formats

Revisions are made to the above documents whenever required, and therefore the latest version should be obtained before use.

How this manual is organized

This manual is configured as follows.

Chapter 1 BEFORE USE

This chapter describes the items to be checked before the use of the inverter.

Chapter 2 INSTALLATION AND WIRING

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

Chapter 3 OPERATION USING THE KEYPAD

This chapter describes inverter keypad operation.

Chapter 4 TEST RUN PROCEDURE

This chapter describes basic settings required for making a test run.

Chapter 5 FUNCTION CODES

This chapter explains the table of function codes used by FRENIC-Ace, indexed per purpose, and the details of each function code.

Chapter 6 TROUBLESHOOTING

This chapter describes troubleshooting procedures to be followed when the inverter malfunctions or detects an alarm or a warning condition. Firstly, check whether any alarm code or the " warning" indication is displayed or not, and then proceed to the troubleshooting items.

Chapter 7 MAINTENANCE AND INSPECTION

This chapter describes the maintenance and inspection items of the inverter.

Chapter 8 BLOCK DIAGRAMS FOR CONTROL LOGIC

This chapter describes the main block diagrams of the control section.

Chapter 9 COMMUNICATION FUNCTIONS

This chapter describes an overview of inverter operation through RS-485 communication. For details, refer to the “RS-485 Communications User's Manual (24A7-J-0082□)”.

Chapter 10 SELECTING OPTIMAL MOTOR AND INVERTER CAPACITIES

This chapter provides you with information about the inverter output torque characteristics, capacity selection procedure, and equations for calculating capacities to help you select optimal motor and inverter models. It also helps you select braking resistors, inverter mode (HHD, HND, HD, or ND), and motor drive control.

Chapter 11 SELECTING PERIPHERAL EQUIPMENT

This chapter describes how to use a range of peripheral equipment and options, FRENIC-Ace's configuration with them, and requirements and precautions for selecting wires and crimp terminals.

Chapter 12 SPECIFICATIONS

This chapter describes the inverter output ratings.

Chapter 13 EXTERNAL DIMENSIONS

This chapter gives external dimensions of the inverter.

APPENDICES

CONTENTS

■ Safety precautions

Be sure to read this User's Manual thoroughly prior to installation, wiring (connection), operation, maintenance, or inspection to ensure correct use of the product. Furthermore, ensure a thorough understanding of device knowledge, safety information, as well as all related precautions.

Safety precautions contained in this User's Manual have been categorized as follows.

⚠WARNING	Indicates possible danger, leading to death or serious injury if the product is handled incorrectly.
⚠CAUTION	Indicates possible danger, leading to minor or moderate injury, or physical property damage only if the product is handled incorrectly.

Failure to heed the information contained under the CAUTION title may also result in serious consequences.

All items indicate important content and must therefore be observed.

Application

⚠WARNING

- The FRENIC-Ace is a piece of equipment used to run three-phase induction motors and permanent magnet synchronous motors (hereafter, “PMSM”). It cannot be used for single-phase motors or other applications.
  Failure to observe this could result in fire or an accident.
- The FRENIC-Ace cannot be used as is for applications which may have a direct effect on the human body such as life support machines.
- Strict quality control has been observed in the manufacture of this product, however, safety devices should be installed when the product is used for equipment which may result in a serious accident or loss in the event of failure.
  Failure to observe this could result in an accident.

Installation

⚠WARNING⚠

- Install on non-combustibles such as metal.
- Do not install near combustibles.
  Failure to observe this could result in fire.
- If using an optional DC reactor, there is a possibility of users coming into contact with main circuit terminal block parts (live parts). In such cases, take measures such as installing the product in a location where it will not easily come into contact with people.
  Failure to observe this could result in electric shock or injury.

⚠CAUTION

- Do not hold the surface cover when transporting the product.
  Failure to observe this could result in injury if the product is dropped.
- Take measures to prevent foreign material such as lint, wastepaper, wood shavings, dust, or metal scraps getting into the inverter, or adhering to the cooling fan.
- Use the specified screws for changing the mounting base.
  Failure to observe this could result in fire or an accident.
- Do not install or run inverters with damaged external or internal parts.
  Failure to observe this could result in fire, an accident, or injury.

Wiring

⚠WARNING⚠

- If no zero-phase current (earth leakage current) detective device such as a ground-fault relay is installed in the upstream power supply line in order to avoid the entire power supply system's shutdown undesirable to factory operation, install a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) individually to inverters to break the individual inverter power supply lines only.
- Connect to the power supply via a molded case circuit breaker or earth leakage circuit breaker (with overcurrent protection function) for each inverter. Use the recommended molded case circuit breaker or earth leakage circuit breaker, and do not use devices that exceed the recommended capacity.
- Be sure to use the specified wire size.
- Tighten terminals with the prescribed tightening torque.
- If there are multiple inverter and motor combinations, do not use multi-core cables for the purpose of bundling and storing wiring for multiple combinations.
- Do not install a surge suppressor to the inverter output side (secondary side).
- Be sure to connect an optional DC reactor (DCR) when the capacity of the power supply transformer exceeds 500 kVA, and is at least 10 times the inverter rated capacity.

  Failure to observe this could result in fire.
- Ground the inverter in compliance with the national or local electric code.
- Always connect the ground line to the inverter grounding terminal [⏚G]

  Failure to observe this could result in electric shock or fire.
- Wiring work should be carried out by qualified professionals.
- Carry out wiring work after ensuring that the power has been turned OFF.

  Failure to observe this could result in electric shock.
- Always carry out wiring after installing the unit.

  Failure to observe this could result in electric shock or injury.
- Ensure that the number of phases and rated voltage of the product input power supply matches that for the connected power supply.
- Do not connect the power lines to the inverter output terminals [U], [V], [W].
- When connecting a DC braking resistor (DBR), never connect it to terminals other than terminals [P(+)]-[DB].

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

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

⚠WARNING⚠

- Switch all switches after first waiting 5 minutes after turning OFF the power, ensuring that the LED monitor and charge lamp are OFF, and use a device such as a tester to ensure that the DC intermediate circuit voltage across main circuit terminals [P(+)] and [N(-)] has dropped to a safe level (+25 VDC or less).

  Failure to observe this could result in electric shock.

⚠CAUTION

- The inverter, motor, and wiring generate electric noise, which may cause nearby sensors and devices to malfunction. Employ noise countermeasures to prevent malfunction.

  Failure to observe this could result in an accident.

Operation

⚠WARNING⚠

- Be sure to attach the inverter surface cover before turning the power ON. Do not remove the surface cover while the power is ON.
- Do not operate the unit with wet hands.

  Failure to observe this could result in electric shock.
- If the product stops after being tripped when the retry function is selected, depending on the cause of the trip, the product will restart automatically, and the motor will rotate. Design the machinery in such a way as to ensure the safety of the human body and surrounding area even when operation is resumed.
- There may be times when the stall prevention function (torque limiting) causes the product to run at an acceleration/deceleration time or speed different from the set values. Design the machinery in such a way that safety is ensured even at such times.

  Failure to observe this could result in an accident.
- The keypad (STOP) key is enabled only when keypad operation is selected with function code F02. Please prepare a separate EMERGENCY STOP switch When function code H96 has been set to “0” or “2”, the (STOP) key will be disabled if the operation command method is changed from operation command with the keypad by selecting link operation "LE".
- If any of the protective functions has been activated, first remove the cause. Then, after checking that all run commands are set to OFF, release the alarm. If the alarm is released while any run command is set to ON, the inverter may supply the power to the motor, running the motor.

  Failure to observe this could result in an accident.
- By selecting the momentary power failure resume operation (F14 = 3 to 5), operation will resume automatically following recovery. Design the machinery in such a way as to ensure operator safety even when operation is resumed.
- Set function codes after ensuring a sufficient understanding of this User's Manual. If operation is performed after recklessly changing function code data, the motor may rotate at a torque and speed at which the machine is unable to tolerate.
- When auto tuning is started, the motor rotates. Conduct a sufficient check to ensure that there is no danger even when the motor rotates.

  Failure to observe this could result in an accident or injury.
- Even if the inverter cuts off the supply of power to the motor, if voltage is being applied to main power supply input terminals [L1/R], [L2/S], and [L3/T] or [L1/L] and [L2/N], voltage may be output to inverter output terminals [U], [V] and [W].
- Even if the motor is stopped by DC braking operation or pre-excitation operation, voltage will be output to the inverter output [U], [V] and [W] terminals.

  Failure to observe this could result in electric shock.
- Inverter high-speed operation settings can be specified easily. If settings are changed, use the product after sufficiently checking the motor and machine specification.

  Failure to observe this could result in injury.

⚠CAUTION

- The cooling fans and braking resistors become very hot. Do not touch.

  Failure to observe this could result in burns.
- Mechanical holding is not possible with the inverter brake function.

  Failure to observe this could result in injury.
- The digital input terminals are equipped with a function used to start and stop operation or change the speed command with the "FWD" operation command or "BX" free-run command and so on. Depending on the digital input terminal status, operation may start suddenly, or the speed may change significantly simply by changing the function code settings. Make changes to function code settings after sufficiently ensuring safety.
- With digital input, functions ("SS1, SS2, SS4, SS8", "Hz2/Hz1", "Hz/PID", "IVS", "LE", etc.) used to change the operation procedure for operation commands or command procedure for speed commands can be assigned. Depending on the conditions, changes to these signals may result in operation being started suddenly or the speed changing suddenly.
- 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. Carry out a sufficient safety check beforehand.

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

Speed control mode

⚠CAUTION
• If the control constant for the automatic speed regulator (ASR) used with speed control is not at an appropriate value, even if the operation command is turned OFF, deceleration control may not be performed, and stop conditions may not be met due to such reasons as hunting caused by a high gain setting. As a result, operation may continue. • Hunting due to a high response may occur in the low-speed area when decelerating, the speed detection value may deviate from the zero-speed area before the continuous zero speed control time (F39) has elapsed, the mode may change to low-speed mode again without stop conditions being met, and operation may continue. • If the actual speed deviates from the speed command after adjusting the ASR control constant to an appropriate value and applying the speed mismatch alarm function, an alarm is tripped, allowing the motor to be stopped safely. Furthermore, taking measures such as changing the ASR control constant setting based on the speed, or judging stop speed detection with a speed command value allows the inverter to successfully control the motor. **Failure to observe this could result in an accident or injury.**

Torque control mode

⚠CAUTION
• When performing torque control, in cases such as when the motor is being rotated from the load side with torque greater than that specified with the torque command, there are times when torque conditions are not met, and operation continues even when the operation command is turned OFF. • If wishing to cut the inverter output at such times, take measures such as changing to speed control and bringing the motor to a decelerated stop, or issuing a coast to stop command. **Failure to observe this could result in an accident or injury.**

Maintenance and inspection, and parts replacement

⚠WARNING⚠

- Carry out inspection after waiting 5 minutes or longer after turning OFF the power. Furthermore, ensure that the LED monitor and charge lamp are OFF, and use a device such as a tester to ensure that the DC intermediate circuit voltage across main circuit terminals [P(+)] and [N(-)] has dropped to a safe level (+25 VDC or less).

  Failure to observe this could result in electric shock.
- Be sure to perform the daily inspection and periodic inspection described in the instruction manual. Lengthy use of the product without inspection could result in inverter failure and damage, or accident and fire.
- A periodic inspection cycle of 1 to 2 years is recommended, however, the cycle may be shortened depending on the usage conditions.
- It is recommended that parts for periodic replacement be replaced after the standard number of years indicated in the instruction manual. Lengthy use of the product without replacing parts could result in inverter failure and damage, or accident and fire.
- Contact outputs [30A/B/C] use relays, and may remain ON or OFF, or in an indefinite state when the life is reached. In the interests of safety, equip the product with an external protection function.

  Failure to observe this could result in fire or an accident.
- Maintenance and inspection, and part replacement should only be carried out by the authorized personnel.
- Remove all metal objects (watches, rings, etc.) before beginning work.
- Be sure to use insulated tools.
- Never modify the product.

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

Disposal

⚠CAUTION

- If disposing of the FRENIC-Ace, handle as industrial waste.

  Failure to observe this could result in injury.

General precautions

⚠CAUTION

The drawings in this User's Manual are used to provide detailed descriptions, and therefore some may be drawn with covers or safety shields removed. When running the product, do so only after returning covers or shields to their prescribed original locations, and then run as described in the User's Manual.

Icons

The following icons are used in this instruction manual.

Incorrect handling due to negligence of the description accompanying this icon may undermine the true performance of the FRENIC-Ace, and incorrect operation or settings may result in an accident.

Indicates reference items helpful for operation and data entry for the inverter.

Indicates references.