

Designed for Fan and Pump Applications

FRENIC-ECO

User's Manual

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Preface

This manual provides all the information on the FRENIC-Eco series of inverters including its operating procedure, operation modes, and selection of peripheral equipment. Carefully read this manual for proper use. Incorrect handling of the inverter may prevent the inverter and/or related equipment from operating correctly, shorten their lives, or cause problems.

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

Name	Material No.	Description
Catalog	MEH442	Product scope, features, specifications, external drawings, and options of the product
Instruction Manual	INR-SI47-0882-E	Acceptance inspection, mounting & wiring of the inverter, operation using the keypad, running the motor for a test, troubleshooting, and maintenance and inspection
RS485 Communication User's Manual	MEH448	Overview of functions implemented by using FRENIC-Eco RS485 communications facility, its communications specifications, Modbus RTU/Fuji general-purpose inverter protocol and functions, and related data formats
RS485 Communications Card "OPC-F1-RS" Installation Manual	INR-SI47-0872	Items on acceptance checking, and how to install the card option
Relay Output Card "OPC-F1-RY" Instruction Manual	INR-SI47-0873	Items on acceptance checking, how to install the card option, wiring and specifications
Mounting Adapter for External Cooling "PB-F1" Installation Manual	INR-SI47-0880	Items on acceptance checking, what to apply, and how to install the adapter
Panel-mount Adapter "MA-F1" Installation Manual	INR-SI47-0881	Items on acceptance checking, what to apply, and how to install the adapter
Multi-function Keypad "TP-G1" Instruction Manual	INR-SI47-0890-E	Items on acceptance checking, and how to install and wire the Multi-function Keypad, an operation guide of the keypad, and specifications
FRENIC Loader Instruction Manual	INR-SI47-0903-E	Overview, installation, setting-up, functions, troubleshooting, and specifications of FRENIC Loader

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

Documents related to Fuji inverters

Catalogs

FRENIC5000G11S/P11S	MEH403/MEH413
FVR-E11S	MEH404/MEH414
FRENIC-Mini	MEH441/MEH451

User's Manuals and Technical Information

FRENIC5000G11S/P11S & FVR-E11S Technical Information	MEH406
FRENIC-Mini User's Manual	MEH446

Guideline for Suppressing Harmonics in Home Electric and General-purpose Appliances

Our three-phase, 200V series inverters of 3.7 kW or less (FRENIC-Eco series) were the products of which were restricted by the "Guideline for Suppressing Harmonics in Home Electric and General-purpose Appliances" (established in September 1994 and revised in October 1999) issued by the Ministry of Economy, Trade and Industry.

The above restriction, however, was lifted when the Guideline was revised in January 2004. Since then, the inverter makers have individually imposed voluntary restrictions on the harmonics of their products.

We, as before, recommend that you connect a reactor (for suppressing harmonics) to your inverter. As a reactor, select a "DC REACTOR" introduced in this manual. For use of the other reactor, please inquire of us about detailed specifications.

Japanese Guideline for Suppressing Harmonics by Customers Receiving High Voltage or Special High Voltage

Refer to this manual, Appendix B for details on this guideline.

Safety precautions

Read this manual and the FRENIC-Eco Instruction Manual (INR-SI47-0882-E) thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection. Ensure you have sound knowledge of the product and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.

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

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

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

CAUTION

This product is not designed for use in appliances and machinery on which lives depend. Consult your Fuji Electric representative before considering the FRENIC-Eco series of inverters for equipment and machinery related to nuclear power control, aerospace uses, medical uses or transportation. When the product is to be used with any machinery or equipment on which lives depend or with machinery or equipment which could cause serious loss or damage should this product malfunction or fail, ensure that appropriate safety devices and/or equipment are installed.

■ Precautions for Use

In running general-purpose motors	Driving a 400V general-purpose motor	When driving a 400V general-purpose motor with an inverter using extremely long wires, damage to the insulation of the motor may occur. Use an output circuit filter (OFL) if necessary after checking with the motor manufacturer. Fuji motors do not require the use of output circuit filters because of their reinforced insulation.
	Torque characteristics and temperature rise	When the inverter is used to run a general-purpose motor, the temperature of the motor becomes higher than when it is operated using a commercial power supply. In the low-speed range, the cooling effect will be weakened, so decrease the output torque of the motor.
	Vibration	When an inverter-driven motor is mounted to a machine, resonance may be caused by the natural frequencies of the machine system. Note that operation of a 2-pole motor at 60 Hz or higher may cause abnormal vibration. * The use of a rubber coupling or vibration dampening rubber is recommended. * Use the inverter's jump frequency control feature to skip the resonance frequency zone(s).
	Noise	When an inverter is used with a general-purpose motor, the motor noise level is higher than that with a commercial power supply. To reduce noise, raise carrier frequency of the inverter. Operation at 60 Hz or higher can also result in higher level of wind roaring sound.
In running special motors	Explosion-proof motors	When driving an explosion-proof motor with an inverter, use a combination of a motor and an inverter that has been approved in advance.
	Submersible motors and pumps	These motors have a higher rated current than general-purpose motors. Select an inverter whose rated output current is higher than that of the motor. These motors differ from general-purpose motors in thermal characteristics. Set a low value in the thermal time constant of the motor when setting the electronic thermal overcurrent protection (for motor).
	Brake motors	For motors equipped with parallel-connected brakes, their braking power must be supplied from the inverter's primary circuit. If the brake power is connected to the inverter's output circuit by mistake, the brake will not work. Do not use inverters for driving motors equipped with series-connected brakes.
	Geared motors	If the power transmission mechanism uses an oil-lubricated gearbox or speed changer/reducer, then continuous motor operation at low speed may cause poor lubrication. Avoid such operation.
	Synchronous motors	It is necessary to take special measures suitable for this motor type. Contact your Fuji Electric representative for details.
	Single-phase motors	Single-phase motors are not suitable for inverter-driven variable speed operation. Use three-phase motors.

Environ- mental conditions	Installation location	Use the inverter within the ambient temperature range from -10 to +50°C. The heat sink and braking resistor of the inverter may become hot under certain operating conditions, so install the inverter on nonflammable material such as metal. Ensure that the installation location meets the environmental conditions specified in Chapter 8, Section 8.5 "Operating Environment and Storage Environment."
Combina- tion with peripheral devices	Installing an MCCB or RCD/ELCB	Install a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the primary circuit of each inverter to protect the wiring. Ensure that the circuit breaker capacity is equivalent to or lower than the recommended capacity.
	Installing an MC in the secondary circuit	If a magnetic contactor (MC) is installed in the inverter's output (secondary) circuit for switching the motor to commercial power or for any other purpose, ensure that both the inverter and the motor are completely stopped before you turn the MC on or off. Remove a surge killer integrated with the magnet contactor in the inverter's output (secondary) circuit.
	Installing an MC in the primary circuit	Do not turn the magnetic contactor (MC) in the primary circuit on or off more than once an hour as an inverter failure may result. If frequent starts or stops are required during motor operation, use (FWD)/(REV) signals or the RUN/STOP key.
	Protecting the motor	The electronic thermal feature of the inverter can protect the motor. The operation level and the motor type (general-purpose motor, inverter motor) should be set. For high-speed motors or water-cooled motors, set a small value for the thermal time constant. If you connect the motor thermal relay to the motor with a long wire, a high-frequency current may flow into the wiring stray capacitance. This may cause the thermal relay to trip at a current lower than the set value. If this happens, lower the carrier frequency or use the output circuit filter (OFL).
	Discontinuance of power-factor correcting capacitor	Do not connect power-factor correcting capacitors to the inverter's primary circuit. (Use the DC reactor to improve the inverter power factor.) Do not use power-factor correcting capacitors in the inverter's output (secondary) circuit. An overcurrent trip will occur, disabling motor operation.
	Discontinuance of surge killer	Do not connect a surge killer to the inverter's output (secondary) circuit.
	Reducing noise	Use of a filter and shielded wires is typically recommended to satisfy EMC Directives. Refer to Appendices, App. A "Advantageous Use of Inverters (Notes on electrical noise)" for details.
	Measures against surge currents	If an overvoltage trip occurs while the inverter is stopped or operated under light load, it is assumed that the surge current is generated by open/close of the phase-advancing capacitor in the power system. * Connect a DC reactor to the inverter.
	Megger test	When checking the insulation resistance of the inverter, use a 500 V megger and follow the instructions contained in the FRENIC-Eco Instruction Manual (INR-SI47-0882-E), Chapter 7, Section 7.5 "Insulation Test."

Wiring	Control circuit wiring length	When using remote control, limit the wiring length between the inverter and operator box to 20 m or less and use twisted pair or shielded wire.
	Wiring length between inverter and motor	If long wiring is used between the inverter and the motor, the inverter may overheat or trip due to overcurrent because a higher harmonics current flows into the stray capacitance between each phase wire. Ensure that the wiring is shorter than 50 m. If this length must be exceeded, lower the carrier frequency or install an output circuit filter (OFL).
	Wire size	Select wires with a sufficient capacity by referring to the current value or recommended wire size.
	Wire type	Do not share one multi-core cable in order to connect several inverters with motors.
	Grounding	Securely ground the inverter using the grounding terminal.
Selecting inverter capacity	Driving general-purpose motor	Select an inverter according to the applicable motor ratings listed in the standard specifications table for the inverter. When high starting torque is required or quick acceleration or deceleration is required, select an inverter with a capacity one size greater than the standard. Refer to Chapter 7, Section 7.1 "Selecting Motors and Inverters" for details.
	Driving special motors	Select an inverter that meets the following condition: Inverter rated current > Motor rated current
Transportation and storage	When transporting or storing inverters, follow the procedures and select locations that meet the environmental conditions listed in the FRENIC-Eco Instruction Manual (INR-SI47-0882-E), Chapter 1, Section 1.3 "Transportation" and Section 1.4 "Storage Environment."	

How this manual is organized

This manual contains Chapters 1 through 9, Appendices and Glossary.

Part 1 General Information

Chapter 1 INTRODUCTION TO FRENIC-Eco

This chapter describes the features and control system of the FRENIC-Eco series, and the recommended configuration for the inverter and peripheral equipment.

Chapter 2 PARTS NAMES AND FUNCTIONS

This chapter contains external views of the FRENIC-Eco series and an overview of terminal blocks, including a description of the LED display and keys on the keypad.

Chapter 3 OPERATION USING THE KEYPAD

This chapter describes inverter operation using the keypad. The inverter features three operation modes (Running, Programming and Alarm modes) which enable you to run and stop the motor, monitor running status, set function code data, display running information required for maintenance, and display alarm data.

The keypad is available in two types: standard keypad and optional multi-function keypad. For the instructions on how to operate the multi-function keypad, refer to the "Multi-function Keypad Instruction Manual" (INR-SI47-0890-E).

Part 2 Driving the Motor

Chapter 4 BLOCK DIAGRAMS FOR CONTROL LOGIC

This chapter describes the main block diagrams for the control logic of the FRENIC-Eco series of inverters.

Chapter 5 RUNNING THROUGH RS485 COMMUNICATION

This chapter describes an overview of inverter operation through the RS485 communications facility. Refer to the RS485 Communication User's Manual (MEH448a) or RS485 Communications Card "OPC-F1-RS" Installation Manual (INR-SI47-0872) for details.

Part 3 Peripheral Equipment and Options

Chapter 6 SELECTING PERIPHERAL EQUIPMENT

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

Part 4 Selecting Optimal Inverter Model

Chapter 7 SELECTING OPTIMAL MOTOR AND INVERTER CAPACITIES

This chapter provides you with information about the inverter output torque characteristics, selection procedure, and equations for calculating capacities to help you select optimal motor and inverter models. It also helps you select braking resistors.

Chapter 8 SPECIFICATIONS

This chapter describes specifications of the output ratings, control system, and terminal functions for the FRENIC-Eco series of inverters. It also provides descriptions of the operating and storage environment, external dimensions, examples of basic connection diagrams, and details of the protective functions.

Chapter 9 FUNCTION CODES

This chapter contains overview lists of seven groups of function codes available for the FRENIC-Eco series of inverters and details of each function code.

Appendices

- App. A Advantageous Use of Inverters (Notes on electrical noise)
- App. B Japanese Guideline for Suppressing Harmonics by Customers Receiving High Voltage or Special High Voltage
- App. C Effect on Insulation of General-purpose Motors Driven with 400 V Class Inverters
- App. D Inverter Generating Loss
- App. E Conversion from SI Units
- App. F Allowable Current of Insulated Wires

Glossary

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.

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