

High Performance Compact Inverter
FRENIC-Multi

User's Manual

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Preface

This manual provides all the information on the FRENIC-Multi 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-Multi. Read them in conjunction with this manual as necessary.

Name	Description
Catalog	Product scope, features, specifications, external drawings, and options of the product
Instruction Manual	Acceptance inspection, mounting & wiring of the inverter, operation using the keypad, running the motor for a test, troubleshooting, and maintenance and inspection

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



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-Multi Instruction Manual 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-Multi 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 460 V general-purpose motor	When driving a 460 V 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. If constant torque is required in the low-speed range, use a Fuji inverter motor or a motor equipped with an externally powered ventilating fan.
	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-proof 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	High-speed motors	If the reference frequency is set to 120 Hz or more to drive a high-speed motor, test-run the combination of the inverter and motor beforehand to check for safe operation.
	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 power supply for brake must be supplied from the inverter's primary circuit. If the power supply for brake is connected to the inverter's output circuit by mistake, the brake will not work. Do not use inverters for driving motors with series-connected brake coils.
	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.

Environmental conditions	Installation location	<p>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.</p> <p>Ensure that the installation location meets the environmental conditions specified in Chapter 8, Section 8.4 "Operating Environment and Storage Environment."</p>
Combination with peripheral devices	Installing an MCCB or RCD/GFCI	<p>Install a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/ground-fault circuit interrupter (GFCI) (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.</p>
	Installing an MC in the secondary circuit	<p>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.</p> <p>Remove a surge killer integrated with the magnetic contactor in the inverter's output (secondary) circuit.</p>
	Installing an MC in the primary circuit	<p>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.</p> <p>If frequent starts or stops are required during motor operation, use terminal [FWD]/[REV] signals or the RUN/STOP key.</p>
	Protecting the motor	<p>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.</p> <p>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).</p>
	Discontinuance of power-factor correcting capacitor	<p>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.</p>
	Discontinuance of surge killer	<p>Do not connect a surge killer to the inverter's output (secondary) circuit.</p>
	Reducing noise	<p>Use of a filter and shielded wires is typically recommended to satisfy EMC Directive.</p> <p>Refer to Appendices, App. A "Advantageous Use of Inverters (Notes on electrical noise)" for details.</p>
	Measures against surge currents	<p>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.</p> <p>* Connect a DC reactor to the inverter.</p>
	Megger test	<p>When checking the insulation resistance of the inverter, use a 500 V megger and follow the instructions contained in the FRENIC-Multi Instruction Manual, Chapter 7, Section 7.5 "Insulation Test."</p>

Wiring	Control circuit wiring length	When using remote control, limit the wiring length between the inverter and operator panel 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 nominal applied 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 one rank larger capacity 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-Multi Instruction Manual, 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-Multi

This chapter describes the features and control system of the FRENIC-Multi 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-Multi 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.

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-Multi series of inverters.

Chapter 5 RUNNING THROUGH RS-485 COMMUNICATION

This chapter describes an overview of inverter operation through the RS-485 communications facility. Refer to the RS-485 Communication User's Manual or RS-485 Communications Card "OPC-E1-RS" Installation Manual 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-Multi'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-Multi 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-Multi series of inverters and details of each function code.

Appendices

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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