e-Front runners

USER'S MANUAL

FRENIC MEGA SERIES

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MEH278b

High Performance, Multifunction Inverter

FRENIC-MEGA

User's Manual

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Preface

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

Name	Material No.	Description
Catalog	MEH655	Product scope, features, specifications, external drawings, and options of the product
Instruction Manual	INR-SI47-1183-E INR-SI47-1134-E INR-SI47-1223-E INR-SI47-1135-E	Acceptance inspection, mounting & wiring of the inverter, operation using the keypad, running the motor for a test, troubleshooting, and maintenance and inspection
RS-485 Communication User's Manual	MEH448	Overview of functions implemented by using FRENIC-MEGA RS-485 communications facility, its communications specifications, Modbus RTU/Fuji general-purpose inverter protocol and functions, and related data formats

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

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

Our three-phase, 200 V class series inverters of 3.7 kW or less (FRENIC-MEGA 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.

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Safety precautions

Read this manual and the FRENIC-MEGA Instruction Manual (that comes with the product) 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-MEGA 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.

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How this manual is organized

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

Chapter 1 INTRODUCTION TO FRENIC-MEGA

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

Chapter 2 SPECIFICATIONS

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

Chapter 3 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, HD/MD/LD drive mode, and motor drive control.

Chapter 4 SELECTING PERIPHERAL EQUIPMENT

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

Chapter 5 FUNCTION CODES

This chapter contains overview tables of 12 groups of function codes available for the FRENIC-MEGA series of inverters, function code index by purpose, and details of function codes.

Chapter 6 BLOCK DIAGRAMS FOR CONTROL LOGIC

This chapter provides the main block diagrams for the control logic of the FRENIC-MEGA series of inverters.

Chapter 7 KEYPAD FUNCTIONS (OPERATING WITH THE KEYPAD)

This chapter describes the names and functions of the keypad and 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.

Chapter 8 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 (MEH448) for details.

Chapter 9 TROUBLESHOOTING

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

Appendices

Glossary

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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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Chapter 1

INTRODUCTION TO FRENIC-MEGA

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

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1.1 Features

Best vector control for the general-purpose inverter in the class

■ Ideal for highly accurate control such as positioning

Vector control with speed sensor

Effective for applications requiring highly precise and accurate positioning control such as offset printing

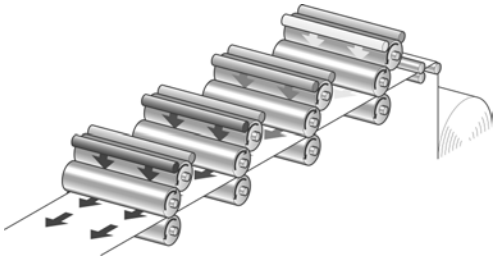
Speed control range: 1:1500

Speed response: 100 Hz

Speed control accuracy: ±0.01%

Current response: 500 Hz

Torque accuracy: ±10%



* The option card is required.

* The above specifications may vary depending on the environment or conditions for use.

■ Maximizing the performance of a general-purpose motor

Vector control without speed sensor

Useful for the application that requires a high starting torque, such as the gondola type multi-level car parking tower

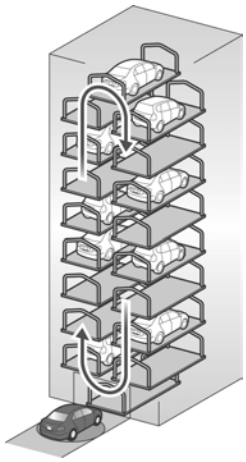
Speed control range: 1:200

Speed response: 20 Hz

Speed control accuracy: ±0.5%

Current response: 500 Hz

Torque accuracy: ±10%



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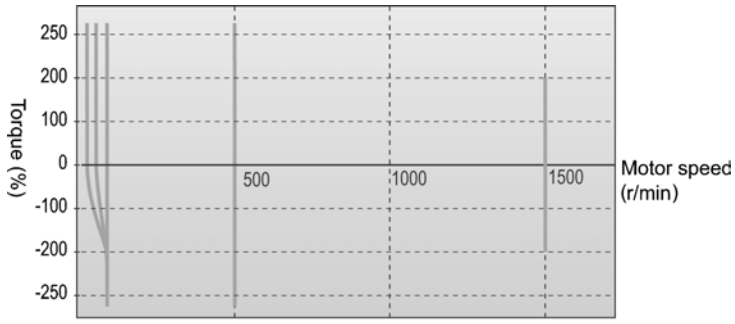
■ Fuji's original dynamic torque vector control has further upgraded.

Besides the dynamic torque vector control, the inverter is equipped with the motor parameter tuning for compensating even a voltage error of the main circuit devices and the magnetic flux observer of a new system. This realizes a high starting torque of 200% even at a low-speed rotation of 0.3 Hz.

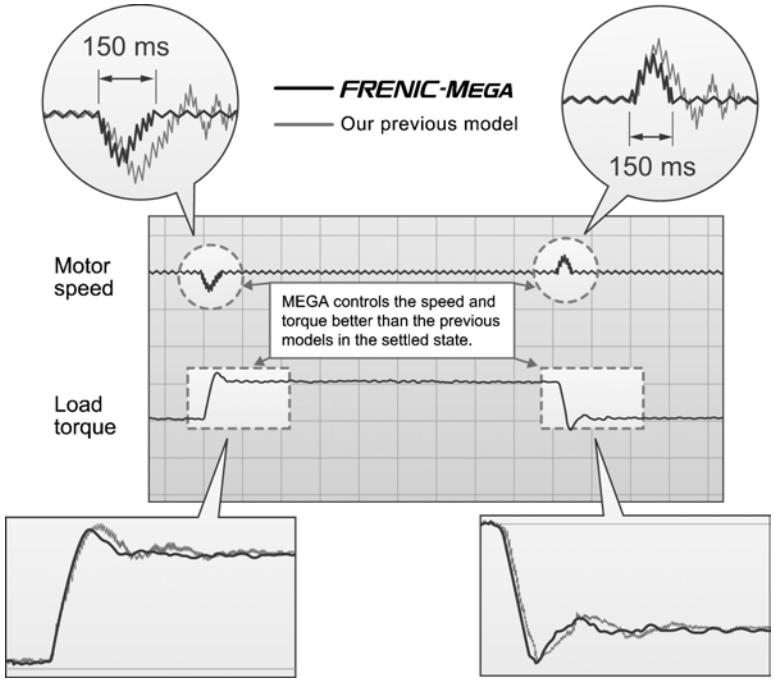


Example torque characteristics [5.5kW]

■ Improved reaction to the fluctuation of impact load

When a remarkable load fluctuation occurs, the inverter provides the torque response in the class-top level. It controls the flux to minimize the fluctuation in the motor speed while suppressing the vibration. This function is best suited for equipment that requires stable speed such as a cutting machine.

Example:



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■ Improved durability in overload operation

Enhancement for extending the current overload durability time of the FRENIC-MEGA longer than that of the Fuji conventional inverters allows the FRENIC-MEGA to run the motor with shorter acceleration/deceleration time. This improves the operation efficiency of machinery such as cutting machines or carrier machines.

Current overload durability: 200% for 3 seconds and 150% for 1 minute.

The standard model is available in the following three drive modes concerning the operation load.

Drive mode	Current overload durability	Major application
HD (High duty) mode	200% for 3 sec, 150% for 1 min	Driving under heavy duty load
MD (Medium duty) mode	150% for 1 min	Driving under medium duty load
LD (Low duty) mode	120% for 1 min	Driving under light duty load

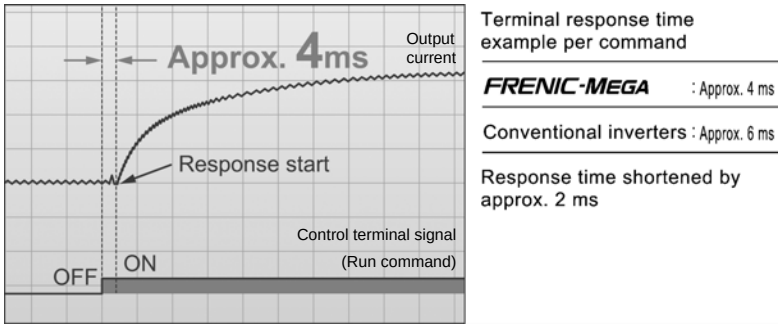
(The MD mode is available only in the 400 V class series of inverters with a capacity of 90 kW or above.)

■ Quicker response to the operation commands

The terminal response to the operation commands has had an established reputation. The FRENIC-MEGA has further shortened this response time, achieving the industry-top response time.

This function is effective in shortening the tact time per cycle and effective for use in the process including frequent repetitions.

Example:



■ Expanded capacity for the brake switching circuit built-in type

A brake switching circuit is built in inverters with a capacity of 22 kW or less as standard. These inverters are applicable to vertical carrier machines and others that run with a certain regenerative load. (Inverters with a capacity of 7.5 kW or less also integrate a braking resistor.)

The brake switching circuit built-in type of inverters with a capacity of 30 to 55 kW in 200 V class series and 30 to 110 kW in 400 V class series is available on request.

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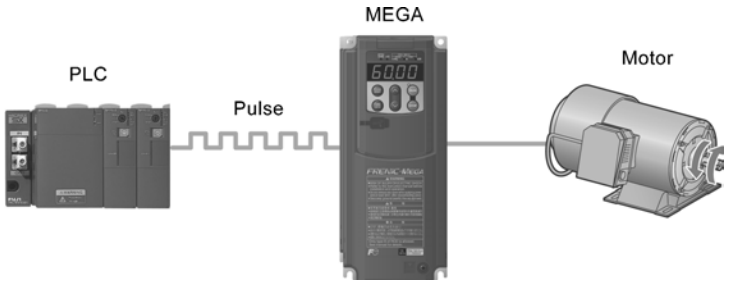
Accommodating various applications

■ Convenient functions for operations at the specified speed

Pulse train input speed command supported as standard

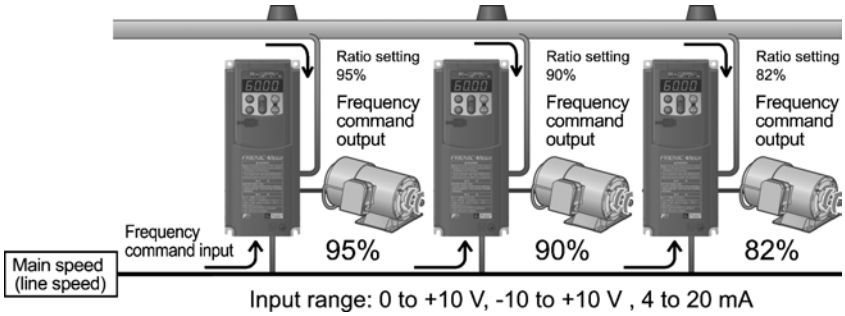
The FRENIC-MEGA can issue a speed command with the pulse train input (single-phase pulse train with sign).

(Maximum pulse input: 100 kHz)



Ratio operation

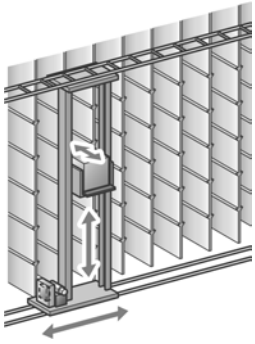
The ratio operation is convenient for synchronous control of two or more carrier machines in a multiline conveyor system. It is possible to specify the ratio of the main speed to other follower motors as a frequency command, so the conveying speed of carrier machines that handle variable loads or loading situations can be synchronously adjusted easily.



$$\text{Frequency command output} = \text{Frequency command input} \times \frac{\text{Analog input (Ratio setting)}}{100\%}$$

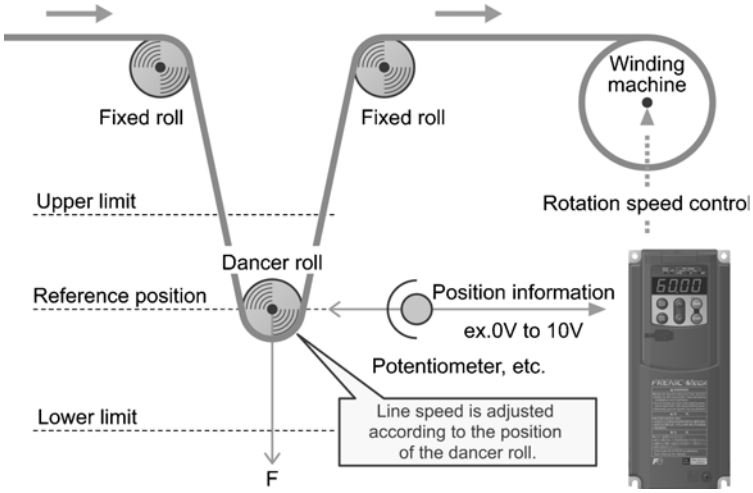
■ Optimum function for preventing an object from slipping down

The reliability of the brake signal was increased for uses such as vertical carrier machines. Conventionally, the current value and the frequency have been monitored when the brake signal is output. By adding a torque value to these two values, the brake timing can be adjusted more easily.



■ Dancer control function optimum for winding control

The PID value, calculated by comparing the feedback value with the speed command value, is added to or subtracted from the reference speed. Since the PID processor gain (in proportional band) can be set low, the inverter can be applied to automatic control systems requiring quick response such as speed control.



■ Thorough protection of the braking circuit

The inverter monitors the braking transistor operation status to protect the braking resistor. **Upon detection of a braking transistor abnormality, the inverter outputs an exclusive signal.** Provide such a circuit that shuts the input power off upon receipt of the exclusive signal, outside the inverter for protecting the braking circuit.

■ More functions are available to meet various requirements

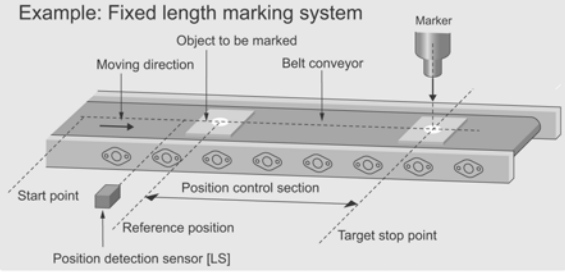
(1) Analog input: Two terminals for voltage input with polarity and one terminal for current input
(2) Slow flowrate level stop function (Pressurized operation is possible before stop of slow flowrate operation.)
(3) Non-linear V/f pattern at 3 points
(4) Mock alarm output function
(5) Selection of up to the 4th motor
(6) S-curve accel./decel. range setting
(7) Detection of a PID feedback wire break

MEGA World Keeps Expanding

PG interface card for positioning control (Available soon)

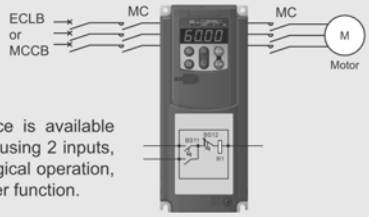
This control function is best suited for the application that requires highly accurate positioning such as that of the conveyance machine. By combined use of the position control device (APR) and PG vector control, the position control accuracy has been remarkably improved. Shortened positioning time by this function will be helpful to reduce the tact time of a cycle.

Example: Fixed length marking system



The customizable logic interface function is adopted in the inverter body. (Available soon)

Logic input/output can be easily created by parameter setting. This makes it possible to simplify the peripheral circuits.



The interface is available in 10 steps using 2 inputs, 1 output, logical operation, and the timer function.

Introducing servo lock function (PG interface card).

This function is effective in adjusting the stop timing or the braking torque when the equipment such as a conveyance machine is stopped by positioning of the motor. This function is helpful when torque is applied externally or holding torque is required during the stop time. The tact time per cycle will be reduced by shortened deceleration time.

Wide model variation meeting the customer needs

■ Wide model variation

1. Basic type

Suitable for the equipment that uses a peripheral device to suppress noise or harmonics.

2. EMC filter built-in type

This type has a built-in EMC filter and is compliant with European EMC Directives.

Objective standard: Category C3 (2nd Env) EN61800-3:2004 compliant

* Use of EMC filter will increase the leakage current.

3. Inverter type designed to the guideline specified by the Ministry of Land, Infrastructure and Transport (available soon)

The inverter employs a DC reactor and complies with "Standard Specifications for Public Building Construction" supervised by the Ministry of Land, Infrastructure and Transport. This inverter suppresses harmonics and noise.

* The inverter incorporates the DC reactor, and the zero-phase reactor is supplied together with the inverter to meet the inverter installation standards stipulated in the Standard Specifications for Public Building Construction (Electric Equipment) 2004 version published under the supervision by Government Buildings Department in Minister/Secretariat of Land, Infrastructure and Transport.

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Supports for simple maintenance

■ The built-in USB port allows use of an inverter support loader (FRENIC loader) for easy information control!

Improved working efficiency in the manufacturing site

- A variety of data about the inverter body can be saved in the keypad memory, allowing you to check the information in any place.

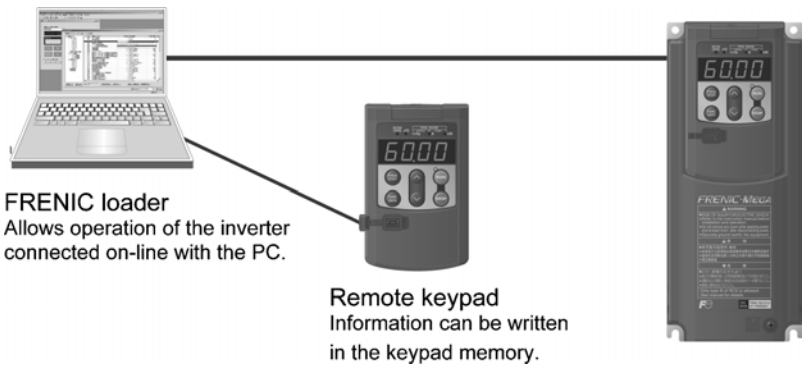
Example of use in the office

Features

1. The keypad can be directly connected to the computer through a commercial USB cable (mini B) without using a converter. The computer can be connected on-line with the inverter.
2. With the FRENIC loader, the inverter can support the following functions (1) to (5).
   (1) Editing, comparing, and copying the function code data
   (2) Operation monitor, real-time trace
   (3) Trouble history (indicating the latest four trouble records)
   (4) Maintenance information
   (5) Historical trace

- Data can be directly transferred from the keypad via the USB port to the computer (FRENIC loader) at the manufacturing site.
- Periodical collection of life information can be carried out efficiently.
- The real-time tracing function permits the operator to check the inverter for abnormality.

Example of use at the manufacturing site



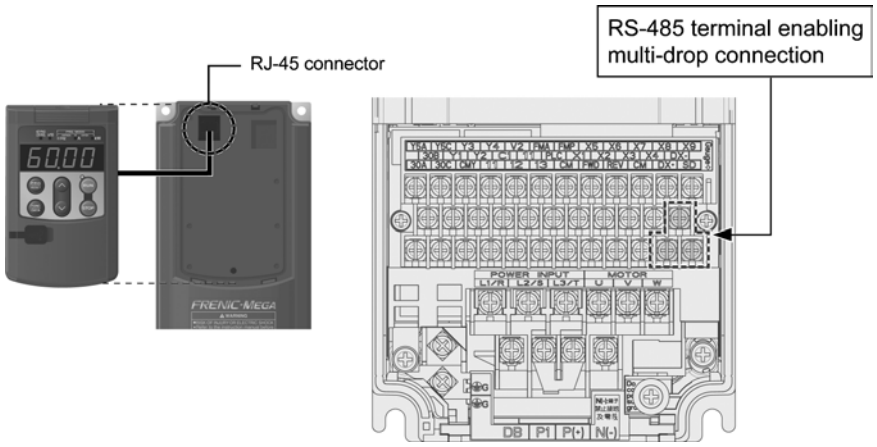
Network connectivity

■ Connectivity to the various FA networks with the following option cards

- SX-bus communications card
- T-Link communications card
- PROFIBUS-DP communications card
- DeviceNet communications card
- CANopen communications card
- CC-Link communications card, etc.

■ RS-485 communication possible as standard (on the terminal block)

Besides the port (RJ-45 connector) shared with the keypad, an RS-485 terminal is provided as standard. With the terminal connection, multi-drop connection can be made easily.



Prolonged service life and improved life judgment function

■ Designed life 10 years

For the various consumable parts inside the inverter, their designed lives have been extended to 10 years, which also extended the equipment maintenance cycles.

Consumable part	Designed life
Main circuit capacitor	10 years
Electrolytic capacitor on PCB	10 years
Cooling fan	10 years
Fuse (90 kW or above)	10 years

The designed lives are based on the following conditions:

- Surrounding temperature: 40ºC
- Load factor: 100% (HD mode) or 80% (MD/LD mode)

* The designed lives are the calculated values and not the guaranteed ones.

■ Full support of life warnings

The inverter has the following functions for facilitating the maintenance of the machinery.

Item	Purpose
Cumulative run time (Unit: h)	Displays the total run time of the inverter by counting the ON time of the main power, by hours.
Cumulative motor run time (Unit: 10 hours)	Displays the total run time of the motor. Used to judge the service life of machinery (load). Even when the motor is driven by commercial power, it is also possible to count the cumulative motor run time using digital input signals.
Cumulative startup count	Displays the number of motor startups. This count can be used as a guide for replacement timing of machinery parts (such as timing belts) that undergo load in ordinary operation.
Equipment maintenance warning Cumulative motor run time (Unit: 10 hours) Cumulative startup count	Makes it possible manage the total run time of the motor and the number of startups. Such data is usable for preparing the maintenance schedule.
Display of inverter lifetime alarm	Displays the following: - Current capacitance of DC link bus capacitor - Total run time of the cooling fan (with ON/OFF compensation) - Total run time of the electrolytic capacitor on the printed circuit board

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Consideration for environment

■ Enhanced resistance to the environmental impacts

Resistance to the environmental impact has been enhanced compared with the conventional inverter.

(1) Enhanced durability of the cooling fan operated under the environmental impact

(2) Adoption of copper bars plated with nickel or tin

In FRENIC-MEGA, resistance to the environmental impact has been increased compared with the conventional model (FRENIC5000 G11S/P11S). However, examine the use of the inverter carefully according to the environment in the following cases:

a. Environment is subject to sulfide gas (at tire manufacturer, paper manufacturer, sewage disposer, or part of the process in textile industry).

b. Environment is subject to conductive dust or foreign matters (in metalworking, operation using extruding machine or printing machine, waste disposal).

c. Others: The inverter is used in the environment of which specification exceeds the specified range.

If you are examining use of the inverter under the above conditions, consult us regarding the models with enhanced durability.

■ Protection against micro surge (optional)

Surge suppression unit SSU (optional)

If the motor drive cable is long, a very thin surge voltage (micro surge) is generated at the motor connection ends. This surge voltage causes deterioration of the motor, dielectric breakdown, or increase in noise. Using the surge suppression unit suppresses this surge voltage.

(1) The surge suppression unit significantly suppresses the surge voltage when simply connected with the motor.

(2) Since no additional work is required, it can be easily mounted on the existing equipment.

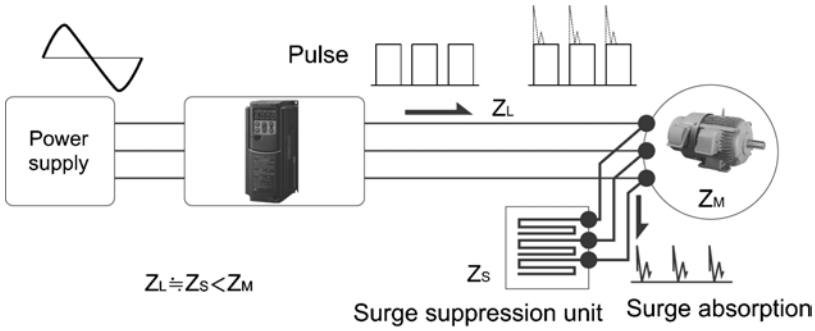
(3) The unit is applicable to the motors regardless of their capacity. (However, consult us for application to the motor with a capacity of 75 kW or over.)

(4) The unit requires no power source and no maintenance.

(5) Two types are available; One for 50 m motor cable and the other for 100 m motor cable.

(6) Compliant with environmental standard and safety standard (Compliant with RoHS Directives).

Structure of surge suppression unit



■ Compliance with RoHS Directives

MEGA complies with European regulations that limit the use of specific hazardous substances (RoHS) as a standard. This inverter is environment-friendly as the use of the following six hazardous substances is restricted.

<Six hazardous substances>

Lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyl (PBB), and polybrominated biphenyl ether (PBDE)

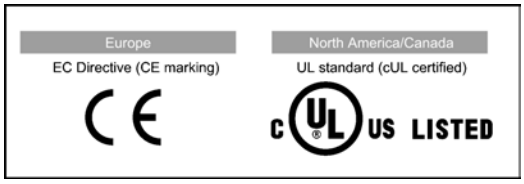
* Except the parts of some inverter models

<About RoHS>

The Directive 2002/96/EC, promulgated by the European Parliament and European Council, limits the use of specific hazardous substances included in electrical and electronic devices.

Global compliance

■ Compliance with global standards



■ SINK/SOURCE switching

■ Wide input voltage range

■ Multilingual display on the multi-function keypad (Japanese, English, German, French, Spanish, Italian, Chinese, and Korean)

* The multi-function keypad is optional and available in two models--"TP-G1-J1" and "TP-G1-C1."

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1.2 Control System

1.2.1 Theory of inverter

As shown in Figure 1.1, the converter section converts the input commercial power to DC power by means of a full-wave rectifier, which charges the DC link bus capacitor (reservoir capacitor). The inverter section modulates the electric energy charged in the DC link bus capacitor by Pulse Width Modulation (PWM) according to the control circuit signals and feeds the output to the motor. (The PWMed frequency is called the "Carrier Frequency.")

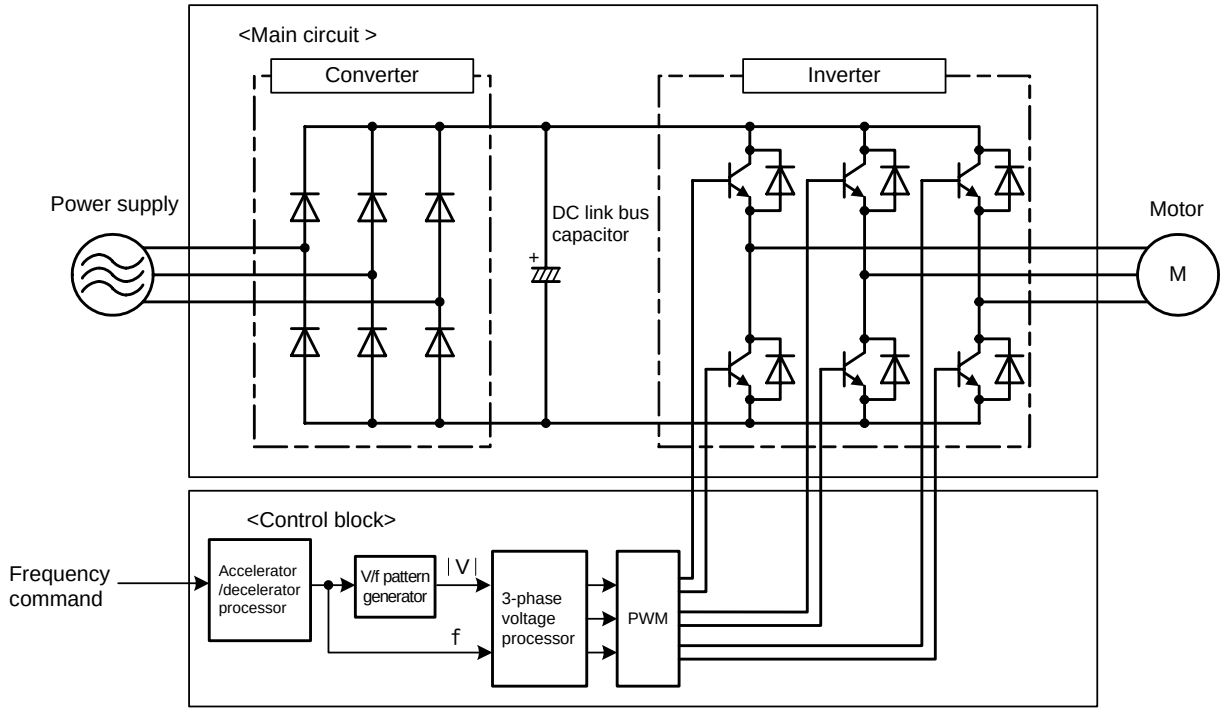

Figure 1.1 Schematic Overview of Theory of Inverter

The voltage applied to the motor has a waveform modulated by the carrier frequency from the dynamic torque vector flux controller that estimates the optimal PWM signal monitoring the inverter output current feedback, as shown on the left-hand side ("PWM voltage waveform") of Figure 1.2. The voltage consists of alternating cycles of positive and negative pulse trains synchronizing with the inverter's output frequency.

The current running through the motor, on the other hand, has a fairly smooth alternating current (AC) waveform shown on the right-hand side ("Current waveform") of Figure 1.2, thanks to the inductance of the motor coil. The control block section controls the PWM so as to bring this current waveform as close to a sinusoidal waveform as possible.

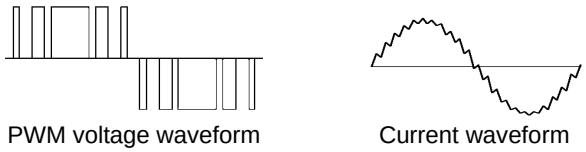

Figure 1.2 Output Voltage and Current Waveform of the Inverter

For the reference frequency given in the control block, the accelerator/decelerator processor calculates the acceleration/deceleration rate required by run/stop control of the motor and transfers the calculated results to the 3-phase voltage processor directly or via the V/f pattern processor, whose output drives the PWM block to switch the power gates.

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1.2.2 Motor drive controls

The FRENIC-MEGA supports the following motor drive controls.

Drive control	Basic control	Speed feedback	Speed control
V/f control with slip compensation inactive	V/f control	Disable	Frequency control
Dynamic torque vector control			Frequency control with slip compensation active
V/f control with slip compensation active			
Vector control without speed sensor	Vector control	Estimated speed	Speed control with automatic speed regulator (ASR)
Vector control with speed sensor*		Enable	

Additionally, the FRENIC-MEGA reserves motor drive controls shown below for future support options.

- V/f control with speed sensor*
- Dynamic torque vector control with speed sensor*

The controls marked with an asterisk (*) require an optional PG (Pulse Generator) interface card.

For the features of the controls, refer to Chapter 3, Section 3.4.1 "Features of motor drive control."

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1.3 External View and Terminal Blocks

(1) External views

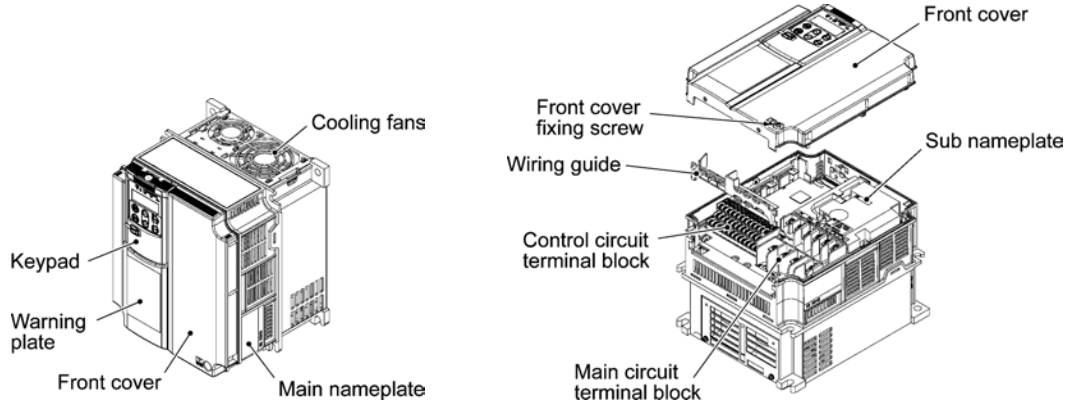


Figure 1.3 FRN11G1S-2☐

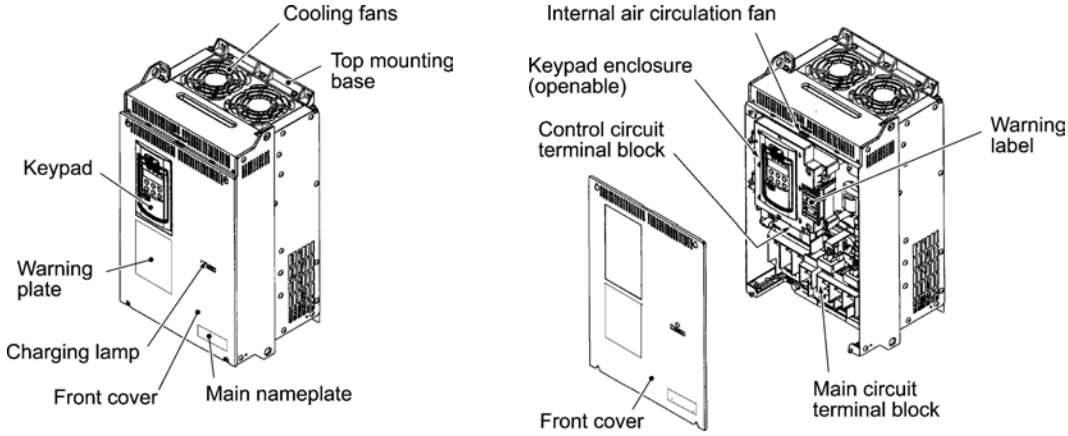
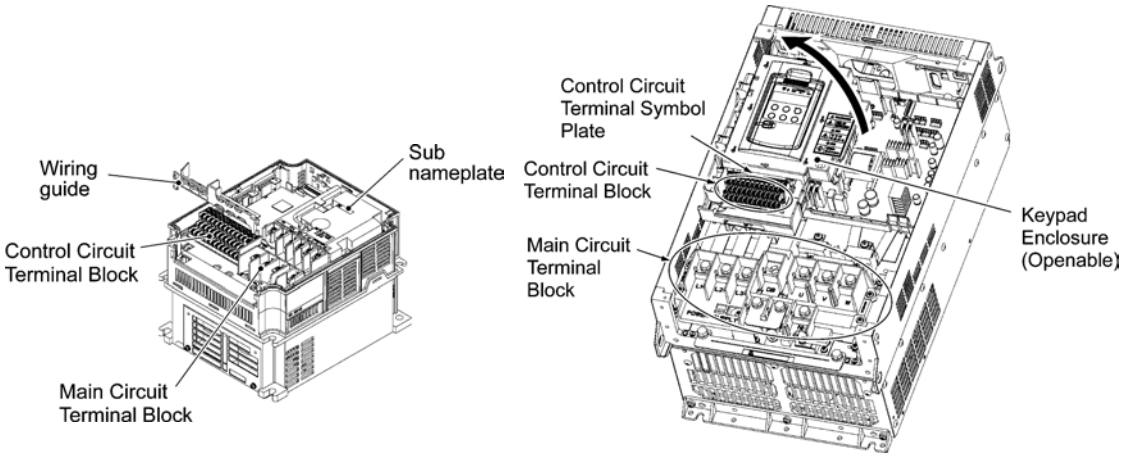


Figure 1.4 FRN30G1S-4☐

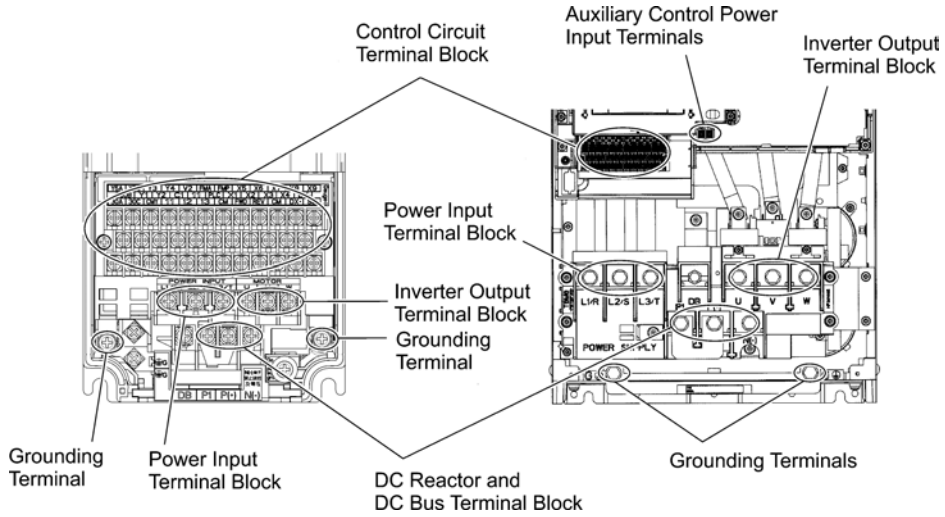
Note: A box (☐) in the above model names replaces A, E, J, or T depending on the shipping destination.

(2) Terminal block location



(a) FRN11G1S-2☐ (b) FRN30G1S-2☐

Figure 1.5 Terminal Blocks and Keypad Enclosure Location



(a) FRN0.75G1S-2☐ (b) FRN30G1S-2☐

Figure 1.6 Enlarged View of the Terminal Blocks

Note: A box (☐) in the above model names replaces A, E, J, or T depending on the shipping destination.

Refer to Chapter 2 "SPECIFICATIONS" for details on terminal functions, arrangement and connection and to Chapter 4, Section 4.2.1 "Recommended wires" when selecting wires.

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1.4 Recommended Configuration

To control a motor with an inverter correctly, you should consider the rated capacity of both the motor and the inverter and ensure that the combination matches the specifications of the machine or system to be used.

Refer to Chapter 3 "SELECTING OPTIMAL MOTOR AND INVERTER CAPACITIES" for details.

After selecting the rated capacities, select appropriate peripheral equipment for the inverter, then connect them to the inverter.

Refer to Chapter 4 "SELECTING PERIPHERAL EQUIPMENT" for details on the selection of peripheral equipment.

Figure 1.7 shows the recommended configuration for an inverter and peripheral equipment.

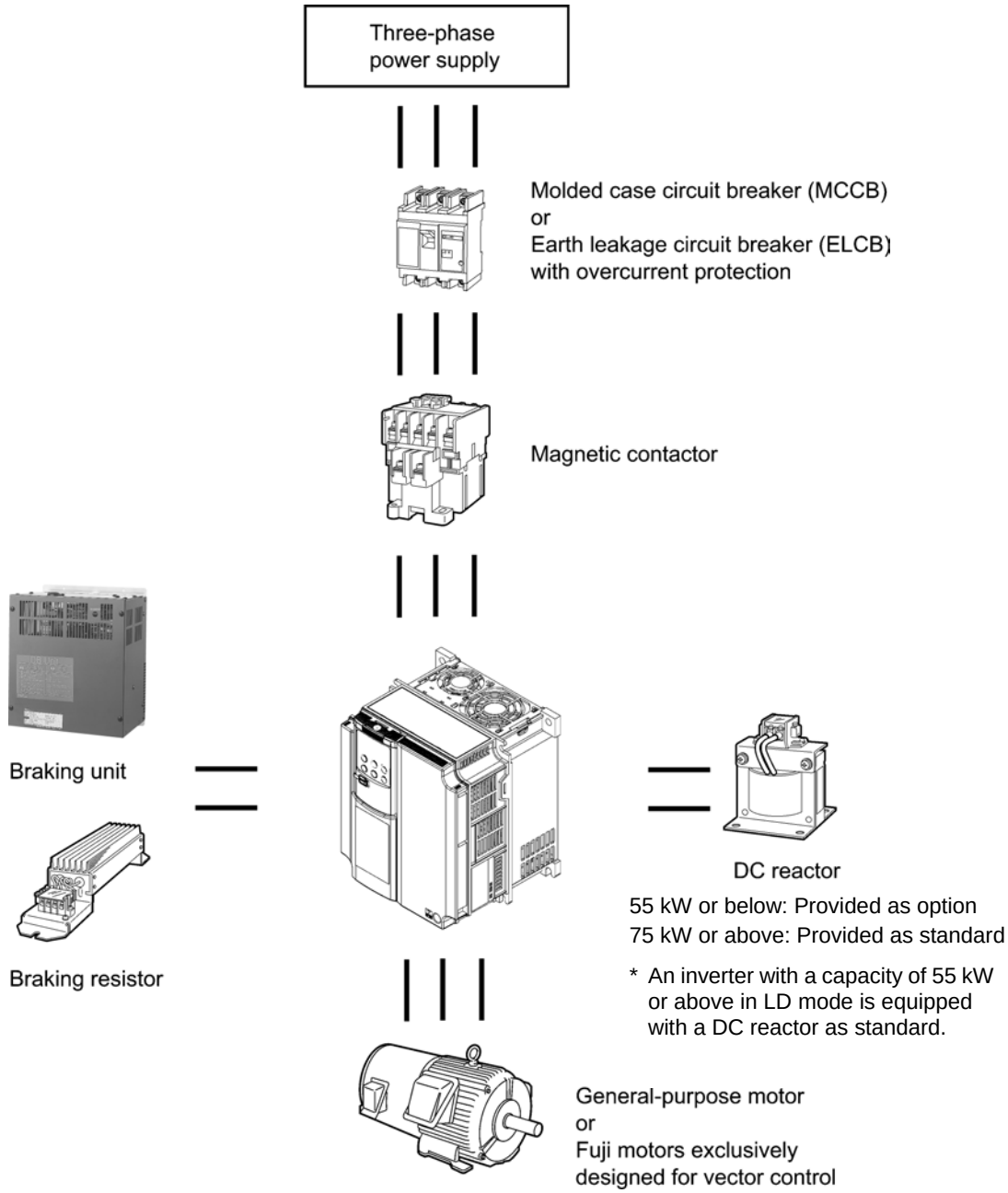

Figure 1.7 Recommended Configuration Diagram

Chapter 2

SPECIFICATIONS

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

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2.1 Standard Model 1 (Basic Type)

2.1.1 Three-phase 200 V class series (HD- and LD-mode inverters)

Item			Specifications														
Type (FRN_ _ _G1S-2□)			0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
HD	Nominal applied motor (kW) *1		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
	Output ratings	Rated capacity (kVA) *2	1.1	1.9	3.0	4.2	6.8	10	14	18	24	28	34	45	55	68	81
		Rated voltage (V) *3	Three-phase 200 to 240 V (with AVR function)											Three-phase 200 to 230 V (with AVR function)			
		Rated current (A)	3	5	8	11	18	27	37	49	63	76	90	119	146	180	215
		Overload capability	150%-1 min, 200%-3.0 s														
	Input power	Voltage, frequency	200 to 240 V, 50/60 Hz											200 to 220 V, 50 Hz, 200 to 230 V, 60 Hz			
		Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *4, Frequency: +5 to -5%														
		Required capacity (with DCR) (kVA) *5	0.6	1.2	2.2	3.1	5.2	7.4	10	15	20	25	30	40	48	58	71
	Braking	Torque (%) *6	150%			100%				20%				10 to 15%			
		Braking transistor	Built-in											--			
		Built-in braking resistor	5 s							--							
		Braking time (s)															
		Duty cycle (%ED)	5	3	5	3	2	3	2	--							
LD	Nominal applied motor (kW) *1		--					7.5	11	15	18.5	22	30	37	45	55	75
	Output ratings	Rated capacity (kVA) *2	--					11	16	20	25	30	43	55	68	81	107
		Rated voltage (V) *3	--					Three-phase 200 to 240 V (with AVR function)						Three-phase 200 to 230 V (with AVR function)			
		Rated current (A) *7	--					31.8 (29)	46.2 (42)	59.4 (55)	74.8 (68)	88 (80)	115 (107)	146	180	215	283
		Overload capability	--					120%-1 min									
	Input power	Voltage, frequency	--					200 to 240 V, 50/60 Hz						200 to 220 V, 50 Hz, 200 to 230 V, 60 Hz			
		Allowable voltage/frequency	--					Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *4, Frequency: +5 to -5%									
		Required capacity (with DCR) (kVA) *5	--					10	15	20	25	30	40	48	58	71	98
	Braking	Torque (%) *6	--					70%		15%				7 to 12%			
		Braking transistor	--					Built-in						--			
		Built-in braking resistor	--					3.7 s	3.4 s	--							
		Braking time (s)															
		Duty cycle (%ED)	--					2.2	1.4	--							
Common	DC reactor (DCR)		Option														*8
	Applicable safety standards		UL508C, C22.2No.14, EN61800-5-1:2003														
	Enclosure (IEC60529)		IP20, UL open type											IP00, UL open type			
	Cooling method		Natural cooling			Fan cooling											
	Weight / Mass (kg)		1.7	2.0	2.8	3.0	3.0	6.5	6.5	5.8	9.5	9.5	10	25	32	42	43

*1 Fuji 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 220 V for 200 V class series and 440 V for 400 V class series.

*3 Output voltage cannot exceed the power supply voltage.

*4 $$\text{Voltage unbalance (\%)} = \frac{\text{Max voltage (V) - Min voltage (V)}}{\text{Three-phase average voltage (V)}} \times 67 \text{ (IEC61800-3)}$$

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

*5 Required when a DC reactor (DCR) is used. A DCR is provided as standard for LD-mode inverters with a capacity of 55 kW and inverters with a capacity of 75 kW or above.

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

*7 To use the inverter with the carrier frequency of 3 kHz or more at the surrounding temperature of 40°C or higher, manage the load so that the current comes to be within the rated ones enclosed in parentheses ( ) in continuous running.

*8 For inverters with a capacity of 55 kW, a DCR is provided as standard or option for LD or HD mode, respectively.

Note: A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

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2.1.2 Three-phase 400 V class series (HD-, LD-, and MD-mode inverters)

Item			Specifications																						
Type (FRN_ _ _G1S-4□)			0.4	0.75	1.5	2.2	3.7 (4.0)*1	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220
HD	Nominal applied motor (kW) *2		0.4	0.75	1.5	2.2	3.7 (4.0)*1	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220
	Output ratings	Rated capacity (kVA) *3	1.1	1.9	2.8	4.1	6.8	10	14	18	24	29	34	45	57	69	85	114	134	160	192	231	287	316
		Rated voltage (V) *4	Three-phase 380 to 480 V (with AVR function)																					
		Rated current (A)	1.5	2.5	4.0	5.5	9.0	13.5	18.5	24.5	32	39	45	60	75	91	112	150	176	210	253	304	377	415
		Overload capability	150%-1 min, 200%-3.0 s																					
	Input power	Voltage, frequency	380 to 480 V, 50/60 Hz															380 to 440 V, 50 Hz 380 to 480 V, 60 Hz						
		Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *5, Frequency: +5 to -5%																					
		Required capacity (with DCR) (kVA) *6	0.6	1.2	2.1	3.2	5.2	7.4	10	15	20	25	30	40	48	58	71	96	114	140	165	199	248	271
	Braking	Torque (%) *7	150%		100%			20%						10 to 15%										
		Braking transistor	Built-in											--										
		Built-in braking resistor	5 s							--														
		Braking time (s)																						
		Duty cycle (%ED)	5	3	5	3	2	3	2	--														
LD	Nominal applied motor (kW) *2		--					7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	280
	Output ratings	Rated capacity (kVA) *3	--					12	17	22	28	33	45	57	69	85	114	134	160	192	231	287	316	396
		Rated voltage (V) *4	--					Three-phase 380 to 480 V (with AVR function)																
		Rated current (A)	--					16.5	23	30.5	37	45	60	75	91	112	150	176	210	253	304	377	415	520
		Overload capability	--					120%-1 min																
	Input power	Voltage, frequency	--					380 to 480 V, 50/60 Hz										380 to 440 V, 50 Hz 380 to 480 V, 60 Hz						
		Allowable voltage/frequency	--					Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *5, Frequency: +5 to -5%																
		Required capacity (with DCR) (kVA) *6	--					10	15	20	25	30	40	48	58	71	96	114	140	165	199	248	271	347
	Braking	Torque (%) *7	--					70%		15%				7 to 12%										
		Braking transistor	--					Built-in						--										
		Built-in braking resistor	--					3.7 s	3.4 s	--														
		Braking time (s)																						
		Duty cycle (%ED)	--					2.2	1.4	--														
MD	Nominal applied motor (kW) *2		--																110	132	160	200	220	250
	Output ratings	Rated capacity (kVA) *3	--																160	192	231	287	316	356
		Rated voltage (V) *4	--																Three-phase 380 to 480 V (with AVR function)					
		Rated current (A)	--																210	253	304	377	415	468
		Overload capability	--																150%-1 min					
	Input power	Voltage, frequency	--																380 to 440 V, 50 Hz 380 to 480 V, 60 Hz					
		Allowable voltage/frequency	--																Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *5, Frequency: +5 to -5%					
		Required capacity (with DCR) (kVA) *6	--																140	165	199	248	271	308
	Braking	Torque (%) *7	--																7 to 12%					
		Braking transistor	--																--					
		Built-in braking resistor	--																--					
		Braking time (s)																						
		Duty cycle (%ED)	--																--					
Common	DC reactor (DCR)		Option														*8	Standard						
	Applicable safety standards		UL508C, C22.2No.14, EN61800-5-1:2003																					
	Enclosure (IEC60529)		IP20, UL open type											IP00, UL open type										
	Cooling method		Natural cooling			Fan cooling																		
	Weight / Mass (kg)		1.7	2.0	2.6	2.7	3.0	6.5	6.5	5.8	9.5	9.5	10	25	26	31	33	42	62	64	94	98	129	140

*1 4.0 kW for the EU. The inverter type is FRN4.0G1S-4E.

*2 Fuji 4-pole standard motor

*3 Rated capacity is calculated assuming the rated output voltage as 220 V for 200 V class series and 440 V for 400 V class series.

*4 Output voltage cannot exceed the power supply voltage.

*5 $$\text{Voltage unbalance (\%)} = \frac{\text{Max voltage (V) - Min voltage (V)}}{\text{Three-phase average voltage (V)}} \times 67 \text{ (IEC61800-3)}$$

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

*6 Required when a DC reactor (DCR) is used. A DCR is provided as standard for LD-mode inverters with a capacity of 55 kW and inverters with a capacity of 75 kW or above.

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

*8 For inverters with a capacity of 55 kW, a DCR is provided as standard or option for LD or HD mode, respectively.

Note: A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

2.2 Standard Model 2 (EMC Filter Built-in Type)

2.2.1 Three-phase 200 V class series (HD- and LD-mode inverters)

Item			Specifications														
Type (FRN_ _ _G1E-2□)			0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
HD	Nominal applied motor (kW) *1		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
	Output ratings	Rated capacity (kVA) *2	1.1	1.9	3.0	4.2	6.8	10	14	18	24	28	34	45	55	68	81
		Rated voltage (V) *3	Three-phase 200 to 240 V (with AVR function)											Three-phase 200 to 230 V (with AVR function)			
		Rated current (A)	3	5	8	11	18	27	37	49	63	76	90	119	146	180	215
		Overload capability	150%-1 min, 200%-3.0 s														
	Input power	Voltage, frequency	200 to 240 V, 50/60 Hz											200 to 220 V, 50 Hz, 200 to 230 V, 60 Hz			
		Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *4, Frequency: +5 to -5%														
		Required capacity (with DCR) (kVA) *5	0.6	1.2	2.2	3.1	5.2	7.4	10	15	20	25	30	40	48	58	71
	Braking	Torque (%) *6	150%			100%				20%				10 to 15%			
		Braking transistor	Built-in											--			
		Built-in braking resistor	5 s							--							
		Braking time (s)															
		Duty cycle (%ED)	5	3	5	3	2	3	2	--							
LD	Nominal applied motor (kW) *1		--					7.5	11	15	18.5	22	30	37	45	55	75
	Output ratings	Rated capacity (kVA) *2	--					11	16	20	25	30	43	55	68	81	107
		Rated voltage (V) *3	--					Three-phase 200 to 240 V (with AVR function)						Three-phase 200 to 230 V (with AVR function)			
		Rated current (A) *7	--					31.8 (29)	46.2 (42)	59.4 (55)	74.8 (68)	88 (80)	115 (107)	146	180	215	283
		Overload capability	--					120%-1 min									
	Input power	Voltage, frequency	--					200 to 240 V, 50/60 Hz						200 to 220 V, 50 Hz, 200 to 230 V, 60 Hz			
		Allowable voltage/frequency	--					Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *4, Frequency: +5 to -5%									
		Required capacity (with DCR) (kVA) *5	--					10	15	20	25	30	40	48	58	71	98
	Braking	Torque (%) *6	--					70%		15%				7 to 12%			
		Braking transistor	--					Built-in						--			
		Built-in braking resistor	--					3.7 s	3.4 s	--							
		Braking time (s)															
		Duty cycle (%ED)	--					2.2	1.4	--							
Common	EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)														
	DC reactor (DCR)		Option														*8
	Applicable safety standards		UL508C, C22.2No.14, EN61800-5-1：2003														
	Enclosure (IEC60529)		IP20, UL open type											IP00, UL open type			
	Cooling method		Natural cooling			Fan cooling											
	Weight / Mass (kg)		1.8	2.1	3.0	3.1	3.2	6.7	7.0	6.4	10.9	10.9	11.0	25	32	42	43

*1 Fuji 4-pole standard motor

*2 Rated capacity is calculated assuming the rated output voltage as 220 V for 200 V class series and 440 V for 400 V class series.

*3 Output voltage cannot exceed the power supply voltage.

*4 $$\text{Voltage unbalance (\%)} = \frac{\text{Max voltage (V) - Min voltage (V)}}{\text{Three-phase average voltage (V)}} \times 67 \text{ (IEC61800-3)}$$

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

*5 Required when a DC reactor (DCR) is used. A DCR is provided as standard for LD-mode inverters with a capacity of 55 kW and inverters with a capacity of 75 kW or above.

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

*7 To use the inverter with the carrier frequency of 3 kHz or more at the surrounding temperature of 40°C or higher, manage the load so that the current comes to be within the rated ones enclosed in parentheses ( ) in continuous running.

*8 For inverters with a capacity of 55 kW, a DCR is provided as standard or option for LD or HD mode, respectively.

Note: A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

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2.2.2 Three-phase 400 V class series (HD-, LD-, and MD-mode inverters)

Item			Specifications																						
Type (FRN_ _ _G1E-4□)			0.4	0.75	1.5	2.2	3.7 (4.0)*1	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220
HD	Nominal applied motor (kW) *2		0.4	0.75	1.5	2.2	3.7 (4.0)*1	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220
	Output ratings	Rated capacity (kVA) *3	1.1	1.9	2.8	4.1	6.8	10	14	18	24	29	34	45	57	69	85	114	134	160	192	231	287	316
		Rated voltage (V) *4	Three-phase 380 to 480 V (with AVR function)																					
		Rated current (A)	1.5	2.5	4.0	5.5	9.0	13.5	18.5	24.5	32	39	45	60	75	91	112	150	176	210	253	304	377	415
		Overload capability	150%-1 min, 200%-3.0 s																					
	Input power	Voltage, frequency	380 to 480 V, 50/60 Hz															380 to 440 V, 50 Hz 380 to 480 V, 60 Hz						
		Allowable voltage/frequency	Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *5, Frequency: +5 to -5%																					
		Required capacity (with DCR) (kVA) *6	0.6	1.2	2.1	3.2	5.2	7.4	10	15	20	25	30	40	48	58	71	96	114	140	165	199	248	271
	Braking	Torque (%) *7	150%		100%					20%				10 to 15%										
		Braking transistor	Built-in											--										
		Built-in braking resistor	5 s							--														
		Braking time (s)																						
		Duty cycle (%ED)	5	3	5	3	2	3	2	--														
LD	Nominal applied motor (kW) *2		--					7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	280
	Output ratings	Rated capacity (kVA) *3	--					12	17	22	28	33	45	57	69	85	114	134	160	192	231	287	316	396
		Rated voltage (V) *4	--					Three-phase 380 to 480 V (with AVR function)																
		Rated current (A)	--					16.5	23	30.5	37	45	60	75	91	112	150	176	210	253	304	377	415	520
		Overload capability	--					120%-1 min																
	Input power	Voltage, frequency	--					380 to 480 V, 50/60 Hz										380 to 440 V, 50 Hz 380 to 480 V, 60 Hz						
		Allowable voltage/frequency	--					Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *5, Frequency: +5 to -5%																
		Required capacity (with DCR) (kVA) *6	--					10	15	20	25	30	40	48	58	71	96	114	140	165	199	248	271	347
	Braking	Torque (%) *7	--					70%		15%				7 to 12%										
		Braking transistor	--					Built-in						--										
		Built-in braking resistor	--					3.7 s	3.4 s	--														
		Braking time (s)																						
		Duty cycle (%ED)	--					2.2	1.4	--														
MD	Nominal applied motor (kW) *2		--															110	132	160	200	220	250
	Output ratings	Rated capacity (kVA) *3	--															160	192	231	287	316	356
		Rated voltage (V) *4	--															Three-phase 380 to 480 V (with AVR function)						
		Rated current (A)	--															210	253	304	377	415	468	
		Overload capability	--															150%-1 min						
	Input power	Voltage, frequency	--															380 to 440 V, 50 Hz 380 to 480 V, 60 Hz						
		Allowable voltage/frequency	--															Voltage: +10 to -15% (Interphase voltage unbalance: 2% or less) *5, Frequency: +5 to -5%						
		Required capacity (with DCR) (kVA) *6	--															140	165	199	248	271	308	
	Braking	Torque (%) *7	--															7 to 12%						
		Braking transistor	--															--						
		Built-in braking resistor	--															--						
		Braking time (s)																						
		Duty cycle (%ED)	--															--						
Common	EMC filter		Compliant with EMC Directives, Emission and Immunity: Category C3 (2nd Env.) (EN61800-3:2004)																					
	DC reactor (DCR)		Option														*8	Standard						
	Applicable safety standards		UL508C, C22.2No.14, EN61800-5-1：2003																					
	Enclosure (IEC60529)		IP20, UL open type											IP00, UL open type										
	Cooling method		Natural cooling			Fan cooling																		
	Weight / Mass (kg)		1.8	2.1	2.7	2.9	3.2	6.8	6.9	6.2	10.5	10.5	11.2	26	27	32	33	42	62	64	94	98	129	140

*1 4.0 kW for the EU. The inverter type is FRN4.0G1S-4E.

*2 Fuji 4-pole standard motor

*3 Rated capacity is calculated assuming the rated output voltage as 220 V for 200 V class series and 440 V for 400 V class series.

*4 Output voltage cannot exceed the power supply voltage.

*5 $$\text{Voltage unbalance (\%)} = \frac{\text{Max voltage (V) - Min voltage (V)}}{\text{Three-phase average voltage (V)}} \times 67 \text{ (IEC61800-3)}$$

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

*6 Required when a DC reactor (DCR) is used. A DCR is provided as standard for LD-mode inverters with a capacity of 55 kW and inverters with a capacity of 75 kW or above.

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

*8 For inverters with a capacity of 55 kW, a DCR is provided as standard or option for LD or HD mode, respectively.

Note: A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

2.3 Common Specifications

Item			Explanation		Remarks
Output frequency	Setting range	Maximum frequency	25 to 500 Hz variable (Up to 120 Hz for MD- and LD-mode inverters) (Up to 120 Hz under vector control without speed sensor, Up to 200 Hz under vector control with speed sensor)		
		Base frequency	25 to 500 Hz variable (in conjunction with the maximum frequency)		
		Starting frequency	0.1 to 60.0 Hz variable (0.0 Hz under vector control with/without speed sensor)		
		Carrier frequency	• 0.75 to 16 kHz variable setting (HD mode: 0.4 to 55 kW, LD mode: 5.5 to 18.5 kW) • 0.75 to 10 kHz variable setting (HD mode: 75 to 400 kW, LD mode: 22 to 55 kW) • 0.75 to 6 kHz variable setting (HD mode: 500 to 630 kW, LD mode: 75 to 500 kW) • 0.75 to 4 kHz variable setting (LD mode: 630 kW) • 0.75 to 2 kHz variable setting (MD mode: 90 to 220 kW) Note: Frequency drops automatically to protect the inverter depending on environmental temperature and output current. (This auto drop function can be canceled.)		
	Output frequency accuracy (Stability)		• Analog setting: ±0.2% of maximum frequency (at 25±10°C) • Keypad setting: ±0.01% of maximum frequency (at -10 to +50°C)		
	Frequency setting resolution		• Analog setting: 1/3000 of maximum frequency (1/1500 with V2 input) The resolution can be set in the function code. (0.01 to 500 Hz) • Keypad setting: 0.01 Hz (99.99 Hz or less), 0.1 Hz (100.0 to 500 Hz) • Link setting: 1/20000 of maximum frequency or 0.01 Hz (fixed)		
	Speed control range		Vector control without speed sensor • 1 : 200 (Minimum speed : Base speed, 4P, 7.5 to 1500 r/min) • 1 : 2 (Constant torque range : Constant output range) Vector control with speed sensor • 1 : 500 (Minimum speed : Base speed, 4P, 1 to 1500 r/min) • 1 : 4 (Constant torque range : Constant output range)		*8
	Speed control accuracy		Vector control without speed sensor • Analog setting: ±0.5% of base speed (at 25 ±10°C) • Digital setting: ±0.5% of base speed (at -10 to +50°C) Vector control with speed sensor • Analog setting: ±0.2% of maximum frequency (at 25 ±10°C) • Digital setting: ±0.01% of maximum frequency (at -10 to +50°C)		*8
Control	Control method		• V/f control • Dynamic torque vector control • V/f control with slip compensation active • V/f control with speed sensor (PG option) • Dynamic torque vector control with speed sensor (PG option) • Vector control without speed sensor • Vector control with speed sensor (PG option)		 *9 *9 *8
	Voltage/frequency characteristic	200 V class series	• Possible to set output voltage at base frequency and at maximum output frequency (80 to 240 V). • The AVR control can be turned ON or OFF. *1, *4 • Non-linear V/f setting (3 points): Free voltage (0 to 240 V) and frequency (0 to 500 Hz) can be set. *1, *4		
		400 V class series	• Possible to set output voltage at base frequency and at maximum output frequency (160 to 500 V). • The AVR control can be turned ON or OFF. *1, *4 • Non-linear V/f setting (3 points): Free voltage (0 to 500 V) and frequency (0 to 500 Hz) can be set. *1, *4		

*1 Available under V/f control.
*4 Available under V/f control with speed sensor. (PG option required)
*8 Available in inverters having a ROM version 0500 or later.
*9 Available soon.

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	Item	Explanation	Remarks
Control	Torque boost	• Auto torque boost (For constant torque load) *1 to *4 • Manual torque boost : Torque boost value can be set between 0.0 and 20.0%. *1, *3, *4 • Select application load with the function code. (Variable torque load or constant torque load) *1, *4	
	Starting torque (HD mode)	• 22 kW or below: 200% or higher, 30 kW or above: 180% or higher, reference frequency 0.3 Hz, base frequency 50 Hz, with slip compensation and auto torque boost active *1 to*4 • 22 kW or below: 200% or higher, 30 kW or above: 180% or higher, reference frequency 0.3 Hz *6	
	Start/stop operation	Keypad: Start and stop with RUN and STOP keys (Standard keypad) Start and stop with FWD / REV and STOP keys (Optional multi-function keypad)	
		External signals (digital inputs): Forward (Reverse) rotation, stop command (capable of 3-wire operation), coast-to-stop command, external alarm, alarm reset, etc.	
		Link operation: Operation through RS-485 or field bus (option) communications	
		Switching operation command: Remote/local switching, link switching	
	Frequency setting	Keypad: Settable with ∧ and ∨ keys	"+1 to +5 VDC" can be adjusted with bias and analog input gain.
		External volume: Can be set with external frequency command potentiometer. (1 to 5 kΩ 1/2 W)	
		Analog input: 0 to ±10 V DC (±5 V DC)/ 0 to ±100% (terminals [12] and [V2]), 0 to +10 V DC (+5 V DC)/ 0 to +100% (terminals [12] and [V2]) : +4 to +20 mA DC/ 0 to 100% (terminal [C1])	
		UP/DOWN operation: Frequency can be increased or decreased while the digital input signal is ON.	
		Multi-frequency: Selectable from 16 different frequencies (step 0 to 15)	
		Link operation: Frequency can be specified through RS-485. (Standard setting)	
		Frequency setting: Two types of frequency settings can be switched with an external signal (digital input). Remote/local switching, link switching	
		Auxiliary frequency setting: Inputs at terminal [12], [C1] or [V2] can be added to the main setting as auxiliary frequency settings.	
		Operation at a specified ratio: The ratio can be set by analog input signal.	
		Inverse operation : Switchable from "0 to +10 VDC/0 to 100%" to "+10 to 0 VDC/0 to 100%" by external command. : Switchable from "4 to +20 mA DC/0 to 100%" to "+20 to 4 mA DC/0 to 100%" by external command.	
		Pulse train input (standard): Pulse input = Terminal [X7], Rotational direction = general terminal Complementary output: Max. 100 kHz, Open collector output: Max. 30 kHz	
		Pulse train input (option): PG interface option CW/CCW pulse, pulse + rotational direction Complementary output: Max. 100 kHz, Open collector output: Max. 25 kHz	
	Acceleration/ deceleration time	Setting range: Between 0.00 and 6000 s	
		Switching: The four types of acceleration/deceleration time can be set or selected individually (switchable during operation).	
		Acceleration/deceleration pattern: Linear acceleration/deceleration, S-shape acceleration/deceleration (weak, free (strong)), curvilinear acceleration/deceleration (acceleration/deceleration max. capacity of constant output)	
		Acceleration/deceleration pattern: Linear acceleration/deceleration, S-shape acceleration/deceleration (weak, free, (strong)), curvilinear acceleration/deceleration (acceleration/deceleration maximum capacity of constant output)	
		Deceleration mode (coast-to-stop): Shutoff of the run command lets the motor coast to a stop.	
		Forcible stop deceleration time: Deceleration stop by the forcible stop ***STOP***.	

*1 Available under V/f control.
*2 Available under dynamic torque vector control.
*3 Available when the slip compensation is made active under V/f control.
*4 Available under V/f control with speed sensor. (PG option required)
*6 Available under vector control without speed sensor.

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	Item	Explanation	Remarks
Control	Frequency limiter (Upper limit and lower limit frequencies)	• Specifies the upper and lower limits in Hz. • It is possible to choose the operation to be performed when the reference frequency drops below the lower limit specified by F16.	
	Bias frequency	• Bias of set frequency and PID command can be independently set (setting range: 0 to ±100%).	
	Analog input	• Gain : Set in the range from 0 to 200% • Off-set : Set in the range from -5.0 to +5.0% • Filter : Set in the range from 0.00s to 5.00 s	
	Jump frequency	• Three operation points and their common jump width (0 to 30.0 Hz) can be set.	
	Jogging operation	• Operation with RUN key (standard keypad), FWD or REV key (multi-function keypad), or digital contact input ***FWD*** or ***REV*** (Exclusive acceleration/deceleration time setting, exclusive frequency setting)	
	Auto-restart after momentary power failure	• Trip at power failure: The inverter trips immediately after power failure. • Trip at power recovery: Coast-to-stop at power failure and trip at power recovery • Deceleration stop: Deceleration stop at power failure, and trip after stoppage • Continue to run: Operation is continued using the load inertia energy. • Start at the frequency selected before momentary power failure: Coast-to-stop at power failure and start after power recovery at the frequency selected before momentary stop. *1 to*3 • Start at starting frequency: Coast-to-stop at power failure and start at the starting frequency after power recovery. *1 to *3	
	Hardware current limiter	Limits the current by hardware to prevent an overcurrent trip from being caused by fast load variation or momentary power failure, which cannot be covered by the software current limiter. This limiter can be canceled.	
	Operation by commercial power supply	• With commercial power selection command, the inverter outputs 50/60 Hz (***SW50***, ***SW60***). *1 to*3 • The inverter has the commercial power supply selection sequence.	
	Slip compensation	Compensates for decrease in speed according to the load. *2, *3	
	Droop control	Decreases the speed according to the load torque.	
	Torque limit	• Switchable between 1st and 2nd torque limit values • Torque limit, torque current limit, and power limit are set for each quadrant. *6, *7 • Analog torque limit input	*9
	Software current limiter	Automatically reduces the frequency so that the output current becomes lower than the preset operation level. *1 to *5	
	PID Control	• PID processor for process control/dancer control • Normal operation/inverse operation • Low liquid level stop function (pressurized operation possible before low liquid level stop) • PID command: Keypad, analog input (from terminals [12], [C1] and [V2]), RS-485 communication • PID feedback value (from terminals [12], [C1] and [V2]) • Alarm output (absolute value alarm, deviation alarm) • PID output limiter • Integration reset/hold • Anti-reset wind-up function	
	Auto search for idling motor speed	The inverter automatically searches for the idling motor speed to be harmonized and starts to drive it without stopping it. (Motor constants need tuning: Auto-tuning (offline) *1 to *3 and *6	

*1 Available under V/f control.
*2 Available under dynamic torque vector control.
*3 Available when the slip compensation is made active under V/f control.
*4 Available under V/f control with speed sensor. (PG option required)
*5 Available under dynamic torque vector control with speed sensor. (PG option required)
*6 Available under vector control without speed sensor.
*7 Available under vector control with speed sensor. (PG option required)
*9 Available soon.

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	Item	Explanation	Remarks
Control	Automatic deceleration	• If the DC link bus voltage or calculated torque exceeds the automatic deceleration level during deceleration, the inverter automatically prolongs the deceleration time to avoid overvoltage trip. (It is possible to select forcible deceleration actuated when the deceleration time becomes three times longer.) • If the calculated torque exceeds automatic deceleration level during constant speed operation, the inverter avoids overvoltage trip by increasing the frequency.	
	Deceleration characteristic (improved braking capacity)	The motor loss is increased during deceleration to reduce the regenerative energy in the inverter to avoid overvoltage trip.	
	Auto energy saving operation	The output voltage is controlled to minimize the total sum of the motor loss and inverter loss at a constant speed. (With digital input signal, auto energy saving mode can be turned ON or OFF by an external device.)	
	Overload prevention control	If the surrounding temperature or IGBT joint temperature increases due to overload, the inverter lowers the output frequency to avoid overload.	
	Auto-tuning (offline)	Tuning the motor while the motor is stopped or running, for setting up motor parameters.	
	Cooling fan ON/OFF control	• Detects inverter internal temperature and stops cooling fan when the temperature is low. • The fan control signal can be output to an external device.	
	2nd to 4th motor settings	• Switchable among the four motors • Code data for four kinds of specific functions can be switched (even during operation). It is possible to set the base frequency, rated current, torque boost, and electronic thermal slip compensation as the data for 1st to 4th motors.	
	Universal DI	The status of external digital signal connected with the universal digital input terminal is transferred to the host controller.	
	Universal DO	Digital command signal from the host controller is output to the universal digital output terminal.	
	Universal AO	The analog command signal from the host controller is output to the analog output terminal.	
	Speed control	• Notch filter for vibration control *7 • Estimates the GD2 value applied to the motor shaft from the load, and automatically controls the ASR system constant. *6 and *7	*9
	Preliminary excitation	Excitation is carried out to create the motor flux before starting the motor. *6 and*7	
	Zero speed control	The motor speed is held to zero by forcibly zeroing the speed command. *7	
	Servo lock	Stops the motor and holds the motor in the stopped position. *7	*8
	Torque control *6, *7	• Analog torque command input • Speed limit function is provided to prevent the motor from becoming out of control.	*9
	Rotational direction control	Select either of reverse or forward rotation prevention.	
	Dew condensation prevention	When the motor is stopped, current is automatically supplied to the motor to keep the motor warm and avoid condensation.	
	Customized logic interface	Available in 10 steps with the functions of 2-input, 1-output, logical operation, and timer function	*9

*1 Available under V/f control.
*2 Available under dynamic torque vector control.
*3 Available when the slip compensation is made active under V/f control.
*4 Available under V/f control with speed sensor. (PG option required)
*5 Available under dynamic torque vector control with speed sensor. (PG option required)
*6 Available under vector control without speed sensor.
*7 Available under vector control with speed sensor (PG option required)
*8 Available in inverters having a ROM version 0500 or later.
*9 Available soon.

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	Item	Explanation	Remarks
Display	Running/Stopping	Speed monitor (reference frequency, output frequency, motor speed, load shaft speed, line speed, and speed indication with percent), output current [A], output voltage [V], calculated torque [%], input power [kW], PID command value, PID feedback value, PID output, load factor [%], motor output [kW], torque current [%] *6 *7, magnetic flux command [%]*6 *7, analog input and input watt-hour	
	Life early warning	• The life early warning of the main circuit capacitors, capacitors on the PC boards and the cooling fan can be displayed. • An external output is issued in a transistor output signal. • Surrounding temperature: 40°C Load factor: Inverter rated current 100% (HD mode) or 80% (MD/LD mode)	
	Cumulative run time	• Displays the inverter cumulative run time, input watt-hour, cumulative motor run time, and the number of startups (of each motor). • Outputs the warning when the maintenance time or the number of start times has exceeded the preset.	
	Trip mode	Displays the cause of trip by codes.	
	Light-alarm	Shows the light-alarm display L-AL.	
	Running or trip mode	• Trip history: Saves and displays the cause of the last four trips (with a code). • Saves and displays the detailed operation status data of the last four trips.	
Protection	Overcurrent protection	The inverter is stopped for protection against overcurrent.	OC1 OC2 OC3
	Short-circuit protection	The inverter is stopped for protection against overcurrent caused by a short circuit in the output circuit.	
	Ground fault protection	The inverter is stopped for protection against overcurrent caused by a ground fault in the output circuit. (200 V 22 kW, 400V 22 kW or below)	
		Detecting zero-phase current of output current, the inverter is stopped for protection against overcurrent caused by a ground fault in the output circuit. (200 V 30 kW, 400 V 30 kW or above)	EF
	Overvoltage protection	An excessive voltage (200 V class series: 400 VDC, 400 V class series: 800 VDC) in the DC link circuit is detected and the inverter is stopped. If an excessive voltage is applied by mistake, the protection cannot be guaranteed.	OU1 OU2 OU3
	Undervoltage protection	The voltage drop (200 V class series: 200 VDC, 400 V class series: 400 VDC) in the DC link circuit is detected to stop the inverter. However, the alarm will not be issued when the re-starting after instantaneous stop is selected.	LU
	Input phase loss protection	• The input phase loss is detected to shut off the inverter output. This function protects the inverter. • When the load is small or a DC reactor is connected, a phase loss may not be detected.	Lin
	Output phase loss protection	Detects breaks in inverter output wining during running, to shut off the inverter output.	OPL
	Overheat protection	Stop the inverter output detecting excess cooling fan temperature in case of a cooling fan fault or overload	OH1
		Stop the inverter output detecting a fault of inner agitating fan. (200 V 45 kW, 400 V 75 kW or above)	
		Stop the inverter output detecting inner temperature of the inverter unit for a cooling fan fault or overload.	OH3
		Protect the braking resistor from over heat by setting the braking resistor electronic thermal function.	dbH
	Overload protection	Stops the inverter output upon detection of the abnormal heat sink temperature and switching element temperature calculated with the output current.	OLU
	External alarm input	With the digital input signal ***THR*** opened, the inverter is stopped with an alarm.	OH2
	Fuse blown	Stop the inverter output detecting the fuse breaking of the main circuit in the inverter. (200 V 75 kW, 400 V 90 kW or above)	FUS
	Charge circuit fault	Stop the inverter output detecting the charge circuit abnormality in the inverter. (200 V 37 kW, 400 V 75 kW or above)	PbF

*6 Available under vector control without speed sensor.
*7 Available under vector control with speed sensor. (PG option required)

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	Item		Explanation	Remarks
Protection	Braking transistor broken		Stop the inverter detecting the brake transistor abnormality. (DB transistor built-in type only	dbA
	Overspeed protection *4 to *7		Stop the inverter when the detected speed exceeds 120% of maximum output frequency.	OS
	PG wire break *4 *5 *7		Stop the inverter detecting the PG braking.	PG
	Motor protection	Electronic thermal	The inverter is stopped with an electronic thermal function set to protect the motor. Protects the general-purpose motor inverter over all frequency range. (The running level and thermal time constant (0.5 to 75.0 min) can be set.)	OL 1 to OL 4
		PTC thermistor	A PTC thermistor input stops the inverter to protect the motor. Connect a PTC thermistor between terminals [V2] and [11] and set the switch on control print board and the function code.	OH4
		NTC thermistor	The NTC thermistor detects a motor temperature. Connect a NTC thermistor between terminals [V2] and [11] and set the switch on control print board and the function code.	
		NTC thermistor breaking	Stop the inverter output detecting the built-in motor NTC breaking.	nrb
		Overload early warning	Warning signal is output at the predetermined level before stopping the inverter with electronic thermal function.	
	Memory error		Data is checked upon power-on and data writing to detect any fault in the memory and to stop the inverter if any.	Er 1
	Keypad communications error		The keypad is used to detect a communication fault between the keypad and inverter main body during operation and to stop the inverter.	Er2
	CPU error		Stop the invert detecting a CPU error or LSI error caused by noise.	Er3
	Option communications error		When each option is used, a fault of communication with the inverter main body is detected to stop the inverter.	Er4
	Option error		When each option is used, the option detects a fault to stop the inverter.	Er5
	Operation protection		STOP key priority: Pressing the STOP key on the keypad or entering the digital input signal will forcibly decelerate and stop the motor even if the operation command through signal input or communication is selected. Er6 will be displayed after the stop.	Er6
			Start check: If the running command is being ordered when switching the running command method from power-on, alarm reset, or the linked operation, the operation starts suddenly. This function bans running and displays Er6.	
	Tuning error		Stop the inverter output when tuning failure, interruption, or any fault as a result of tuning is detected during tuning for motor constant.	Er7
	RS-485 communications error (port 1)		When the connection port of the keypad connected via RS-485 communication port to detect a communication error, the inverter is stopped and displays an error.	Er8
	Speed mismatch or excessive speed deviation *4 to *7		Stop the inverter output when the speed deviation excesses the specified value (difference between speed command and feedback).	ErE
	Data save error upon undervoltage		When the undervoltage protection function works, an alarm is displayed if the data is not properly saved.	ErF
	RS-485 communications error (port 2)		Stop the inverter output detecting the communication error between the inverter main unit and a mate when the RS-485 connection port of the touch panel is used to configure the network.	ErP
	Hardware error		Stop the inverter output detecting the LSI abnormality of the print board for power supply which is mainly caused by noise.	ErH
	Mock alarm		Simulated alarm is output by the keypad operation.	Err
	PID feedback wire break		Stop the inverter output detecting a breaking when the input current is allocated to the PID control feedback. (Select valid/invalid.)	CoF

*4 Available under V/f control with speed sensor. (PG option required)
*5 Available under dynamic torque vector control with speed sensor. (PG option required)
*6 Available under vector control without speed sensor.
*7 Available under vector control with speed sensor. (PG option required)

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	Item	Explanation	Remarks
Protection	Alarm relay output (for any fault)	• The relay signal is output when the inverter stops upon an alarm. • PRG/RESET key or digital input signal ***RST*** is used to reset the alarm stop state.	
	Light-alarm (warning)	The "light-alarm" display is indicated when alarm or warning matters set as minor troubles occurred. The operation is continued. Light alarm object Heat sink overheat (OH1), External alarm(OH2), Inverter internal overheat (OH3), Motor protection (OH4), Braking resistor overheat (dbH), Overload of motor (OL1 to OL4), Keypad communications error (Er-3), Option communications error (Er-4), Option error (Er-5), RS-485 communications error (port 1) (Er-8), Speed mismatch or excessive speed deviation (Er-E), RS-485 communications error (port 2) (Er-P), DC fan locked, Motor overload early warning, Heat sink overheat early warning, Lifetime alarm (DC link bus capacitor, electrolytic capacitors on printed circuit boards or cooling fans), PTC thermistor activated (PTC), Inverter life (Cumulative run time), Inverter life (number of startups)	L-AL
	Stall prevention	Operates when the inverter output goes beyond the instantaneous overcurrent limiting level, and avoids tripping, during acceleration and constant speed operation.	
	Retry function	When the motor is tripped and stopped, this function automatically resets the tripping state and restarts operation.	
	Surge protection	The inverter is protected against surge voltage intruding between the main circuit power line and ground.	
	Command loss detection	A loss (breaking, etc.) of the frequency command is detected to output an alarm and the operation is continued at the preset frequency (set at a ratio to the frequency before detection).	
	Momentary power failure protection	• A protective function (inverter stoppage) is activated upon a momentary power failure for 15 ms or longer. • If restart upon momentary power failure is selected, the inverter restarts upon recovery of the voltage within the set time.	
Environment	Installation location	Shall be free from corrosive gases, flammable gases, oil mist, dusts, and direct sunlight. (Pollution degree 2 (IEC60664-1)). Indoor use only.	
	Surrounding temperature	-10 to +50°C (-10 to +40°C when installed side-by-side without clearance (22 kW or below))	
	Relative humidity	5 to 95% RH (without condensation)	
	Altitude	Lower than 1,000 m	
	Vibration	200 V 55 kW, 400 V 75 kW or below 3 mm: 2 to less than 9 Hz, 9.8m/s^2: 9 to less than 20 Hz 2 m/ s^2: 20 to less than 55 Hz, 1m/ s^2: 55 to less than 200 Hz 200V 75 kW, 400 V 90 kW or above 3 mm: 2 to less than 9 Hz 2 m/s^2: 9 to less than 55 Hz, 1 m/s^2: 55 to less than 200 Hz	
	Storage temperature	-25 to +65°C	
	Storage humidity	5 to 95% RH (without condensation)	

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2.4 Terminal Specifications

2.4.1 Terminal functions

Main circuit and analog input terminals

Classification	Symbol	Name	Functions
Main circuit	L1/R, L2/S, L3/T	Main circuit power inputs	Connect the three-phase input power lines.
	U, V, W	Inverter outputs	Connect a three-phase motor.
	R0, T0	Auxiliary power input for the control circuit	For a backup of the control circuit power supply, connect AC power lines same as that of the main power input. (For inverters with 1.5 kW or above)
	P1, P(+)	DC reactor connection	Connect a DC reactor (DCR) for correcting power factor. • HD-mode inverters: A DCR is provided as option for 0.4 to 55 kW, and as standard for 75 kW or above. • LD-mode inverters: A DCR is provided as option for 5.5 to 45 kW, and as standard for 55 kW or above.
	P(+), DB	Braking resistor	Connect the braking resistor (option).
	P(+), N(-)	DC link bus	Connect a DC link bus of other inverter(s). A high power-factor, regenerative PWM converter is also connectable to these terminals.
	R1, T1	Auxiliary power input for the fans	Normally, no need to use these terminals. Use these terminals for an auxiliary power input of the fans in a power system using a power regenerative PWM converter (RHC series). (For 200 V class series of inverters with 37 kW and 400 V class series with 75 kW or above)
	⏚ G	Grounding for inverter and motor	Grounding terminals for the inverter's chassis (or case) and motor. Earth one of the terminals and connect the grounding terminal of the motor. Inverters provide a pair of grounding terminals that function equivalently.
Analog input	[13]	Power supply for the potentiometer	Power supply (+10 VDC) for frequency command potentiometer (Potentiometer: 1 to 5kΩ) The potentiometer of 1/2 W rating or more should be connected.
	[12]	Analog setting voltage input	(1) The frequency is commanded according to the external analog voltage input. • 0 to ±10 VDC/0 to ±100% (Normal operation) • +10 to 0 VDC/0 to 100% (Inverse operation) (2) In addition to frequency setting, PID command, PID feedback signal, auxiliary frequency command setting, ratio setting, torque limiter level setting, or analog input monitor can be assigned to this terminal. (3) Hardware specifications • Input impedance: 22kΩ • The maximum input is ±15 VDC, however, the voltage higher than ±10 VDC is handled as ±10 VDC. • Inputting a bipolar analog voltage (0 to ±10 VDC) to terminal [12] requires setting function code C35 to "0."

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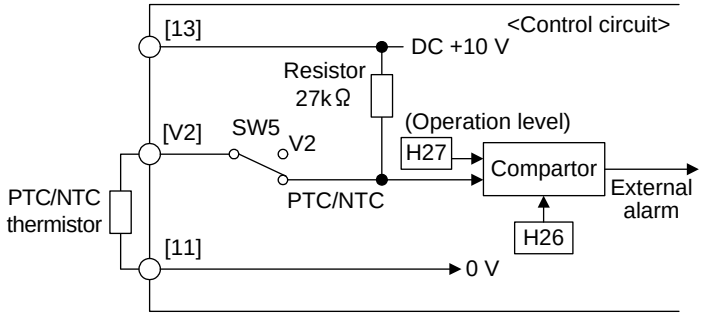
Classification	Symbol	Name	Functions
Analog input	[C1]	Analog setting current input (C1 function)	(1) The frequency is commanded according to the external analog current input. • 4 to 20 mA DC/0 to 100% (Normal operation) • 20 to 4 mA DC/0 to 100 % (Inverse operation) (2) In addition to frequency setting, PID command, PID feedback signal, auxiliary frequency command setting, ratio setting, torque limiter level setting, or analog input monitor can be assigned to this terminal. (3) Hardware specifications • Input impedance: 250Ω • The maximum input is +30 mA DC, however, the current larger than +20 mA DC is handled as +20 mA DC.
	[V2]	Analog setting voltage input (V2 function)	(1) The frequency is commanded according to the external analog voltage input. • 0 to ±10 VDC/0 to ±100 % (Normal operation) • +10 to 0 VDC/0 to 100% (Inverse operation) (2) In addition to frequency setting, PID command, PID feedback signal, auxiliary frequency command setting, ratio setting, torque limiter level setting, or analog input monitor can be assigned to this terminal. (3) Hardware specifications • Input impedance: 22kΩ • The maximum input is ±15 VDC, however, the voltage higher than ±10 VDC is handled as ±10 VDC. • Inputting a bipolar analog voltage (0 to ±10 VDC) to terminal [V2] requires setting function code C45 to "0."
		PTC/NTC thermistor input (PTC/NTC function)	(1) Connects PTC (Positive Temperature Coefficient)/NTC (Negative Temperature Coefficient) thermistor for motor protection. Ensure that the slide switch SW5 on the control PCB is turned to the PTC/NTC position (refer to Section 2.4.2 "Setting up the slide switches"). The figure shown at the right illustrates the internal circuit diagram where SW5 (switching the input of terminal [V2] between V2 and PTC/NTC) is turned to the PTC/NTC position. For details on SW5, refer to Section 2.4.2 "Setting up the slide switches." In this case, you must change data of the function code H26.  Figure 2.1 Internal Circuit Diagram (SW5 Selecting PTC/NTC)
	[11]	Analog common	Common for analog input/output signals ([13], [12], [C1], [V2] and [FMA]). Isolated from terminals [CM]s and [CMY].

Classification	Symbol	Name	Functions	Related function codes
Analog input	Note		- Since low level analog signals are handled, these signals are especially susceptible to the external noise effects. Route the wiring as short as possible (within 20 m) and use shielded wires. In principle, ground the shielded sheath of wires; if effects of external inductive noises are considerable, connection to terminal [11] may be effective. As shown in Figure 2.2, be sure to ground the single end of the shield to enhance the shield effect. - Use a twin-contact relay for low level signals if the relay is used in the control circuit. Do not connect the relay's contact to terminal [11]. - When the inverter is connected to an external device outputting the analog signal, the external device may malfunction due to electric noise generated by the inverter. If this happens, according to the circumstances, connect a ferrite core (a toroidal core or equivalent) to the device outputting the analog signal or connect a capacitor having the good cut-off characteristics for high frequency between control signal wires as shown in Figure 2.3. - Do not apply a voltage of +7.5 VDC or higher to terminal [C1]. Doing so could damage the internal control circuit.	

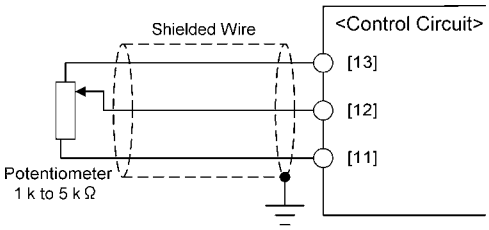


Figure 2.2 Connection of Shielded Wire

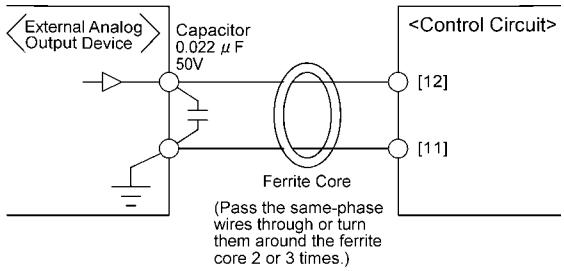


Figure 2.3 Example of Electric Noise Reduction

Digital Input Terminals

Classification	Symbol	Name	Functions
Digital input	[X1]	Digital input 1	(1) Various signals such as "Coast to a stop," "Enable external alarm trip," and "Select multi-frequency" can be assigned to terminals [X1] to [X9], [FWD] and [REV] by setting function codes E01 to E09, E98, and E99. For details, refer to Chapter 5 "FUNCTION CODES." (2) Input mode, i.e. SINK/SOURCE, is changeable by using the slide switch SW1. (Refer to Section 2.4.2 "Setting up the slide switches.") (3) Switches the logic value (1/0) for ON/OFF of the terminals [X1] to [X9], [FWD], or [REV]. 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. (4) Digital input terminal [X7] can be defined as a pulse train input terminal with the function codes. Maximum wiring length 20 m Maximum input pulse 30 kHz: When connected to a pulse generator with open collector transistor output (Needs a pull-up or pull-down resistor. See notes on page 2-17.) 100 kHz: When connected to a pulse generator with complementary transistor output For the settings of the function codes, refer to Chapter 5 "FUNCTION CODES." (Digital input circuit specifications)
	[X2]	Digital input 2	
	[X3]	Digital input 3	
	[X4]	Digital input 4	
	[X5]	Digital input 5	
	[X6]	Digital input 6	
	[X7]	Digital input 7	
	[X8]	Digital input 8	
	[X9]	Digital input 9	
	[FWD]	Run forward command	
	[REV]	Run reverse command	

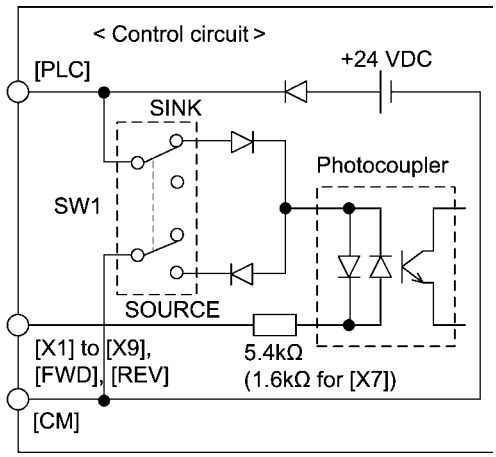


Figure 2.4 Digital Input Circuit

Item		Min.	Max.
Operating voltage (SINK)	ON level	0 V	2 V
	OFF level	22 V	27 V
Operating voltage (SOURCE)	ON level	22 V	27 V
	OFF level	0 V	2 V
Operating current at ON (Input voltage is at 0 V)		2.5 mA	5 mA
(For [X7])		(9.7 mA)	(16 mA)
Allowable leakage current at OFF		–	0.5 mA

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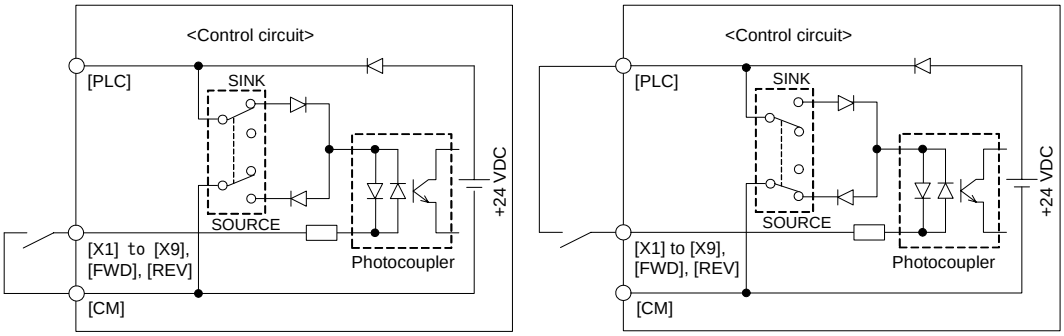
Classification	Symbol	Name	Functions
Digital input	[PLC]	PLC signal power	(1) Connects to PLC output signal power supply. Rated voltage: +24 VDC (Allowable range: +22 to +27 VDC), Maximum 100 mA DC (2) This terminal also supplies a power to the load connected to the transistor output terminals [Y1] and [Y2]. Refer to "Transistor output" described later in this table for more.
	[CM]	Digital input common	Two common terminals for digital input signals These terminals are electrically isolated from the terminals [11]s and [CMY].
	Tip		■ Using a relay contact to turn [X1] to [X9], [FWD], or [REV] ON or OFF Figure 2.5 shows two examples of a circuit that uses a relay contact to turn control signal input [X1] to [X9], [FWD], or [REV] ON or OFF. In circuit (a), the slide switch SW1 has been turned to SINK, whereas in circuit (b) it has been turned to SOURCE. **Note:** To configure this kind of circuit, use a highly reliable relay. (Recommended product: Fuji control relay Model HH54PW.)

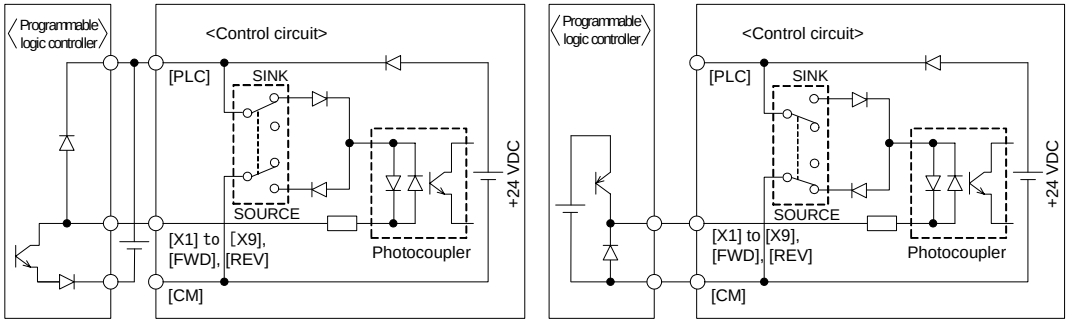


(a) With the switch turned to SINK (b) With the switch turned to SOURCE

Figure 2.5 Circuit Configuration Using a Relay Contact

	Tip		■ Using a programmable logic controller (PLC) to turn [X1] to [X9], [FWD], or [REV] ON or OFF Figure 2.6 shows two examples of a circuit that uses a programmable logic controller (PLC) to turn control signal input [X1] to [X9], [FWD], or [REV] ON or OFF. In circuit (a), the slide switch SW1 has been turned to SINK, whereas in circuit (b) it has been turned to SOURCE. In circuit (a) below, short-circuiting or opening the transistor's open collector circuit in the PLC using an external power supply turns ON or OFF control signal [X1] to [X9], [FWD], or [REV]. When using this type of circuit, observe the following: - Connect the + node of the external power supply (which should be isolated from the PLC's power) to terminal [PLC] of the inverter. - Do not connect terminal [CM] of the inverter to the common terminal of the PLC.

Classification	Symbol	Name	Functions
Digital input			



(a) With the switch turned to SINK (b) With the switch turned to SOURCE

Figure 2.6 Circuit Configuration Using a PLC

For details about the slide switch setting, refer to Section 2.4.2 "Setting up the slide switches.")

Note

■ For inputting a pulse train through the digital input terminal [X7]

• Inputting from a pulse generator with an open collector transistor output

Stray capacity on the wiring between the pulse generator and the inverter may disable transmission of the pulse train. As a countermeasure against this problem, insert a pull-up resistor between the open collector output signal (terminal [X7]) and the power source terminal (terminal [PLC]) if the switch selects the SINK mode input; insert a pull-down resistor between the output signal and the digital common terminal (terminal [CM]) if the switch selects the SOURCE mode input.

A recommended pull-up/down resistor is 1kΩ 2 W. Check if the pulse train is correctly transmitted because stray capacity is significantly affected by the wire types and wiring conditions.

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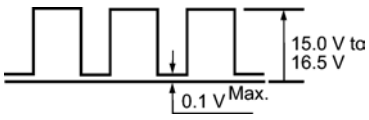
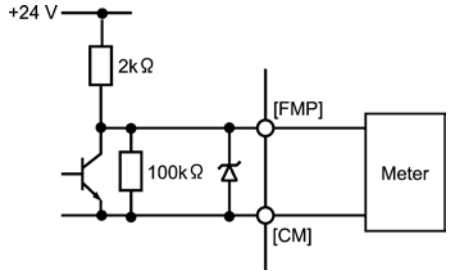
Analog output, pulse output, transistor output, and relay output terminals

Classification	Symbol	Name	Functions
Analog output	[FMA]	Analog monitor (FMA function)	The monitor signal for analog DC voltage (0 to +10 V) or analog DC current (+4 to +20 mA) is output. You can select the output form (VO/IO) by switching the slide switch SW4 on the control PCB and changing data of the function code F29. You can select one of the following signal functions with function code F31. • Output frequency • Output current • Output voltage • Output torque • Load factor • Input power • PID feedback amount • Speed (PG feedback value) • DC link bus voltage • Universal AO • Motor output • Calibration • PID command • PID output * Input impedance of the external device: Min. 5kΩ (at 0 to 10 VDC output) (While the terminal is outputting 0 to 10 VDC, it is capable of driving up to two analog voltmeters with 10 kΩ impedance.) * Input impedance of the external device: Max. 500Ω (at 4 to 20 mA DC output) * Adjustable range of the gain: 0 to 300%
	[11]	Analog common	Two common terminals for analog input and output signals. These terminals are electrically isolated from terminals [CM]s and [CMY].
Pulse output	[FMP]	Pulse monitor (FMP function)	Pulse signal is output. You can also select one of the signal functions listed in the above column for [FMA] using function code F35. * Input impedance of the external device: Min. 5kΩ (While the terminal is outputting 0 to 10 VDC, it is capable of driving up to two analog voltmeters with 10 kΩ impedance.) * Pulse duty: Approx. 50% Pulse rate: 25 to 6000 p/s (at full scale) Voltage waveform • Pulse output waveform  • FMP output circuit 
	[CM]	Digital common	Two common terminals for digital input and [FMP] output signals. These terminals are electrically isolated from other common terminals, [11]s and [CMY]. These are the shared terminals with the digital input terminal [CM]s.

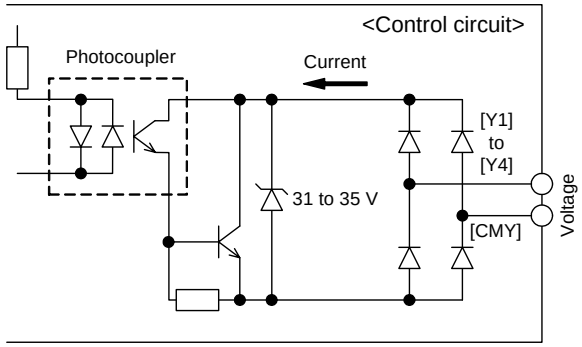
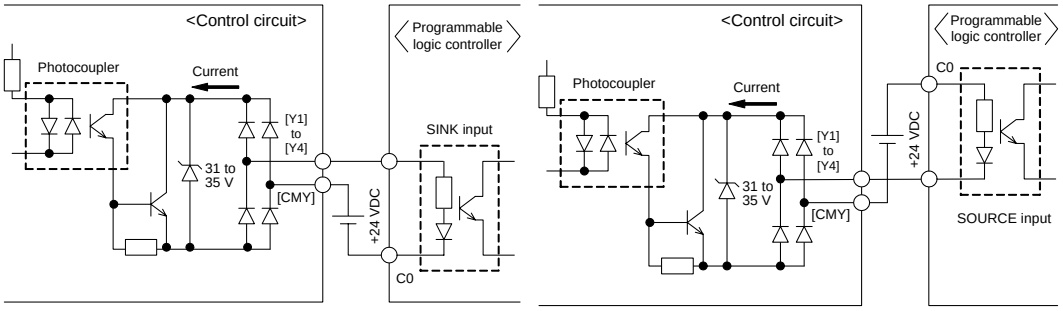
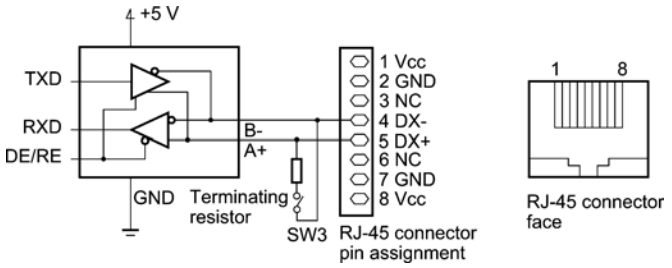
<table>
<tr><th>Classification</th><th>Symbol</th><th>Name</th><th>Functions</th></tr>
<tr><td rowspan="5">Transistor output</td><td>[Y1]</td><td>Transistor output 1</td><td rowspan="4">(1) Various signals such as inverter running, speed/freq. arrival and overload early warning can be assigned to any terminals, [Y1] to [Y4] by setting function code E20 to E24. Refer to Chapter 5 "FUNCTION CODES" for details.
(2) Switches the logic value (1/0) for ON/OFF of the terminals between [Y1] to [Y4], and [CMY]. If the logic value for ON between [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.
(Transistor output circuit specifications)
 

Figure 2.7 Transistor Output Circuit
<table><tr><th colspan="2">Item</th><th>Max.</th></tr><tr><td rowspan="2">Operation voltage</td><td>ON level</td><td>2 V</td></tr><tr><td>OFF level</td><td>27 V</td></tr><tr><td colspan="2">Maximum motor current at ON</td><td>50 mA</td></tr><tr><td colspan="2">Leakage current at OFF</td><td>0.1 mA</td></tr></table>Figure 2.8 shows examples of connection between the control circuit and a PLC.
Note • When a transistor output drives a control relay, connect a surge-absorbing diode across relay's coil terminals.
• When any equipment or device connected to the transistor output needs to be supplied with DC power, feed the power (+24 VDC: allowable range: +22 to +27 VDC, 100 mA max.) through the [PLC] terminal. Short-circuit between the terminals [CMY] and [CM] in this case.</td></tr>
<tr><td>[Y2]</td><td>Transistor output 2</td></tr>
<tr><td>[Y3]</td><td>Transistor output 3</td></tr>
<tr><td>[Y4]</td><td>Transistor output 4</td></tr>
<tr><td>[CMY]</td><td>Transistor output common</td><td>Common terminal for transistor output signals
This terminal is electrically isolated from terminals [CM]s and [11]s.</td></tr>
</table>

Classification	Symbol	Name	Functions	Related function codes
Transistor output			■ Connecting programmable logic controller (PLC) to terminal [Y1], [Y2], [Y3] or [Y4] Figure 2.8 shows two examples of circuit connection between the transistor output of the inverter's control circuit and a PLC. In example (a), the input circuit of the PLC serves as a SINK for the control circuit output, whereas in example (b), it serves as a SOURCE for the output.  (a) PLC serving as SINK (b) PLC serving as SOURCE Figure 2.8 Connecting PLC to Control Circuit	
Relay output	[Y5A/C]	General purpose relay output	(1) A general-purpose relay contact output usable as well as the function of the transistor output terminal [Y1], [Y2], [Y3] or [Y4]. Contact rating: 250 VAC 0.3 A, cos ϕ = 0.3, 48 VDC, 0.5 A (2) Switching of the normal/negative logic output is applicable to the following two contact output modes: "Active ON" (Terminals [Y5A] and [Y5C] are closed (excited) if the signal is active.) and "Active OFF" (Terminals [Y5A] and [Y5C] are opened (non-excited) if the signal is active while they are normally closed.).	
	[30A/B/C]	Alarm relay output (for any error)	(1) Outputs a contact signal (SPDT) when a protective function has been activated to stop the motor. Contact rating: 250 VAC, 0.3A, cos ϕ = 0.3, 48 VDC, 0.5A (2) Any one of output signals assigned to terminals [Y1] to [Y4] can also be assigned to this relay contact to use it for signal output. (3) Switching of the normal/negative logic output is applicable to the following two contact output modes: "Active ON" (Terminals[30A] and [30C] are closed (excited) if the signal is active.) and "Active OFF" (Terminals [30A] and [30C] are opened (non-excited) if the signal is active while they are normally closed.).	

RS-485 communications port

Classification	Connector	Name	Functions
Communication	DX+/DX-/SD	RS-485 communications port 2 (Terminals on control PCB)	A communications port transmits data through the RS-485 multipoint protocol between the inverter and a personal computer or other equipment such as a PLC. (For setting of the terminating resistor, refer to Section 2.4.2 "Setting up the slide switches.")
	RJ-45 connector for the keypad	RS-485 communications port 1 (Standard RJ-45 connector)	(1) Used to connect the inverter with the keypad. The inverter supplies the power to the keypad through the pins specified below. The extension cable for remote operation also uses wires connected to these pins for supplying the keypad power. (2) Remove the keypad from the standard RJ-45 connector and connect the RS-485 communications cable to control the inverter through the PC or PLC (Programmable Logic Controller). For setting of the terminating resistor, refer to Section 2.4.2 "Setting up the slide switches."  Figure 2.9 RJ-45 Connector and its Pin Assignment* * Pins 1, 2, 7, and 8 are exclusively assigned to power lines for the standard keypad and multi-function keypad, so do not use those pins for any other equipment.
	USB connector	USB port (On the keypad)	A USB port connector (mini B) that connects an inverter to a personal computer. FRENIC Loader (software*) running on the computer supports editing the function codes, transferring them to the inverter, verifying them, test-running an inverter and monitoring the inverter running status. * FRENIC Loader is available as a free download from our website at: http://www.fujielectric.co.jp/fcs/eng/product/drive/index_1.shtml On the Fuji website shown above, select "Technical Information" | "Drive Control Equipment" | "Inverters" | "Software libraries." Then download the "FRENIC-MEGA Loader3 (Japan/Taiwan area version)," "FRENIC-MEGA Message Manger (Common for MEGA English Version)," and "FRENIC-MEGA PC Loader3 Instruction Manual." Before downloading, you are requested to register as a member (free of charge).

Note

- Route the wiring of the control circuit terminals as far from the wiring of the main circuit as possible. Otherwise electric noise may cause malfunctions.
- Fix the control circuit wires with a cable tie inside the inverter to keep them away from the live parts of the main circuit (such as the terminal block of the main circuit).

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2.4.2 Setting up the slide switches

⚠WARNING

Before changing the switches or touching the control circuit terminal symbol plate, turn OFF the power and wait at least five minutes for inverters with a capacity of 22 kW or below, or at least ten minutes for inverters with a capacity of 30 kW or above. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P(+) and N(-) has dropped to the safe level (+25 VDC or below).

An electric shock may result if this warning is not heeded as there may be some residual electric charge in the DC bus capacitor even after the power has been turned OFF.

Switching the slide switches located on the control PCB allows you to customize the operation mode of the analog output terminals, digital I/O terminals, and communications ports. The locations of those switches are shown in Figure 2.10.

To access the slide switches, remove the front cover so that you can see the control PCB. For inverters with a capacity of 30 kW or above, open also the keypad enclosure.

For details on how to remove the front cover and how to open and close the keypad enclosure, refer to the FRENIC-MEGA Instruction Manual, Chapter 2, Section 2.3.1 "Removing and mounting the front cover and the wiring guide."

Table 2.1 lists the function of each slide switch.

Table 2.1 Function of Each Slide Switch

<table>
<tr><th>Slide Switch</th><th>Function</th></tr>
<tr><td>SW1</td><td>Switches the service mode of the digital input terminals between SINK and SOURCE.
- This switches the input mode of digital input terminals [X1] to [X9], [FWD] and [REV] to be used as the SINK or SOURCE mode.
- Factory default: SINK</td></tr>
<tr><td>SW2</td><td>Switches the terminating resistor of RS-485 communications port on the inverter ON and OFF. (RS-485 communications port 2, on the control PCB)
- If the inverter is connected to the RS-485 communications network as a terminating device, turn SW2 to ON.</td></tr>
<tr><td>SW3</td><td>Switches the terminating resistor of RS-485 communications port on the inverter ON and OFF. (RS-485 communications port 1, for connecting the keypad)
- To connect a keypad to the inverter, turn SW3 to OFF. (Factory default)
- If the inverter is connected to the RS-485 communications network as a terminating device, turn SW3 to ON.</td></tr>
<tr><td>SW4</td><td>Switches the output mode of the analog output terminal [FMA] between voltage and current.
When changing this switch setting, also change the data of function code F29.
<table>
<tr><th>Output mode</th><th>SW4</th><th>Set data of F29 to:</th></tr>
<tr><td>Voltage output (Factory default)</td><td>VO</td><td>0</td></tr>
<tr><td>Current output</td><td>IO</td><td>1</td></tr>
</table></td></tr>
<tr><td>SW5</td><td>Switches the property of the analog input terminal [V2] between analog setting voltage input, PTC thermistor input, and NTC thermistor input.
When changing this switch setting, also change the data of function code H26.
<table>
<tr><th>Output mode</th><th>SW5</th><th>Set data of H26 to:</th></tr>
<tr><td>Analog setting voltage input (Factory default)</td><td>V2</td><td>0</td></tr>
<tr><td>PTC thermistor input</td><td>PTC/NTC</td><td>1 (alarm) or 2 (warning)</td></tr>
<tr><td>NTC thermistor input</td><td>PTC/NTC</td><td>3</td></tr>
</table></td></tr>
</table>

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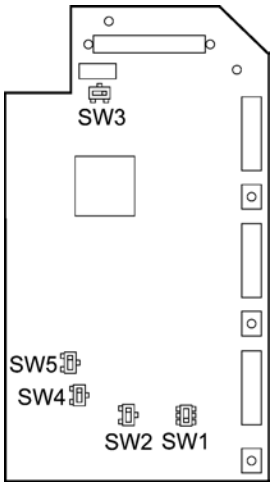
Figure 2.10 shows the location of slide switches on the control PCB for the input/output terminal configuration.



Switching examples and factory default

	SW1	SW2	SW3	SW4	SW5
Factory default	SINK	OFF	OFF	VO	V2
---	SOURCE	ON	ON	IO	PTC/NTC

Figure 2.10 Location of the Slide Switches on the Control PCB

Note To move a switch slider, use a tool with a narrow tip (e.g., tweezers), taking care not to touch other electronic parts on the PCB. 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.

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2.4.3 Terminal arrangement diagram and screw specifications

2.4.3.1 Main circuit terminals

The table and figures given below show the terminal screw sizes, tightening torque and terminal arrangements. Note that the terminal arrangements differ depending on the inverter types. In each of the figures, two grounding terminals (⏚G) are not exclusive to the power supply wiring (primary circuit) or motor wiring (secondary circuit).

Use crimp terminals covered with an insulation sheath or with an insulation tube. The recommended wire sizes for the main circuits are examples of using a single HIV wire (JIS C3317) (for 75°C) at a surrounding temperature of 50°C.

Table 2.2 Screw Specifications and Recommended Wire Sizes

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ LD mode	Refer to:	Screw specifications				Recommended wire size (mm^2)				
					Screw size	Tightening torque (N·m)	Grounding screw size	Tightening torque (N·m)	Main circuit power input (L1/R, L2/S, L3/T) w/ DCR	Main circuit power input (L1/R, L2/S, L3/T) w/o DCR	Grounding [⏚G]	Inverter output [U, V, W]	DCR [P1, P(+)]	Braking resistor [P(+), DB]
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	Figure A	M3.5	1.2	M3.5	1.2	2.0	2.0	2.0	2.0	2.0	2.0
	0.75	FRN0.75G1■-2□												
	1.5	FRN1.5G1■-2□		Figure B	M4	1.8	M4	1.8						
	2.2	FRN2.2G1■-2□												
	3.7	FRN3.7G1■-2□												
	5.5	FRN5.5G1■-2□	HD	Figure C	M5	3.5	M5	3.5		3.5	3.5	3.5	3.5	
	7.5		LD						3.5	5.5			5.5	
		FRN7.5G1■-2□	HD								5.5	5.5		
	11		LD						5.5	14		8.0	8.0	
		FRN11G1■-2□	HD											
	15		LD						14	22	8.0	14	14	
		FRN15G1■-2□	HD	Figure D	M6	5.8	M6	5.8						
	18.5		LD										22	
		FRN18.5G1■-2□	HD											
	22		LD						22	38 *1	14	22		
		FRN22G1■-2□	HD											
	30		LD						38 *1	60 *2		38 *1	38 *1	
		FRN30G1■-2□	HD	Figure E	M8	13.5	M8	13.5					38	
	37		LD						38	60		38	60	
		FRN37G1■-2□	HD	Figure F	M10	27					22			--
	45		LD						60	100		60	100	
		FRN45G1■-2□	HD											
	55		LD						100			100		
		FRN55G1■-2□	HD											
	75		LD						150 *3	--		150 *3	150 *3	
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	Figure A	M3.5	1.2	M3.5	1.2	2.0	2.0	2.0	2.0	2.0	2.0
	0.75	FRN0.75G1■-4□												
	1.5	FRN1.5G1■-4□		Figure B	M4	1.8	M4	1.8						
	2.2	FRN2.2G1■-4□												
	3.7	FRN3.7G1■-4□												
	5.5	FRN5.5G1■-4□	HD	Figure C	M5	3.5	M5	3.5			3.5	3.5		
	7.5		LD											
		FRN7.5G1■-4□	HD											
	11		LD							3.5			3.5	
		FRN11G1■-4□	HD									3.5		
	15		LD						3.5	5.5			5.5	
		FRN15G1■-4□	HD	Figure D	M6	5.8	M6	5.8						
	18.5		LD							8.0 *4		5.5		
		FRN18.5G1■-4□	HD						5.5		5.5			
	22		LD							14		8.0 *4	8.0 *4	
		FRN22G1■-4□	HD											
	30		LD						14	22	8.0	14	14	
		FRN30G1■-4□	HD	Figure E	M8	13.5	M8	13.5						
	37		LD										22	
		FRN37G1■-4□	HD											--
	45		LD						22	38		22		
		FRN45G1■-4□	HD											
	55		LD								14	38	38	
		FRN55G1■-4□	HD											

*1 Use the crimp terminal model No. 38-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*2 Use the crimp terminal model No. 60-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*3 When using 150 mm^2 wires for main circuit terminals of FRN55G1■-2□ (LD mode), use CB150-10 crimp terminals designed for low voltage appliances in JEM1399.

*4 Use the crimp terminal model No. 8-L6 manufactured by JST Mfg. Co., Ltd., or equivalent.

Note: A box (■) in the above table replaces S or E depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Table 2.2 Screw Specifications and Recommended Wire Sizes (Continued)

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD mode	Refer to:	Screw specifications				Recommended wire size (mm^2)				
					Screw size	Tightening torque (N·m)	Grounding screw size	Tightening torque (N·m)	Main circuit power input (L1/R, L2/S, L3/T) w/ DCR	Main circuit power input (L1/R, L2/S, L3/T) w/o DCR	Grounding [⏚G]	Inverter output [U, V, W]	DCR [P1, P(+)]	Braking resistor [P(+), DB]
Three-phase 400 V	75	FRN55G1■-4□	LD	Figure E	M8	13.5	M8	13.5	38	--	14	60	60	--
	90	FRN75G1■-4□	HD	Figure F	M10	27			60				100	
			LD											
	110	FRN90G1■-4□	HD	Figure G					100		22	100		
			MD/ LD											
	132	FRN110G1■-4□	HD										150	
			MD/ LD											
	160	FRN132G1■-4□	HD	Figure H	M12	48	M10	27	150			150		
			MD/ LD											
	200	FRN160G1■-4□	HD								38	200	250	
			MD/ LD											
	220	FRN200G1■-4□	HD	Figure I					200					
			MD/ LD											
	250	FRN220G1■-4□	HD						250			250	325	
			MD											
	280		LD									150×2	200×2	

Note: A box (■) in the above table replaces S or E depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Terminals common to all inverters	Screw specifications		Recommended wire size (mm^2)	Remarks
	Screw size	Tightening torque (N·m)		
Auxiliary control power input terminals R0 and T0	M3.5	1.2	2.0	1.5 kW or above
Auxiliary fan power input terminals R1 and T1	M3.5	1.2	2.0	200 V class series with 37 kW or above and 400 V class series with 75 kW or above

Figure A

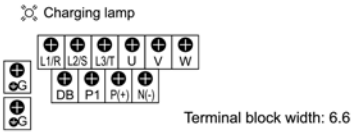


Figure B

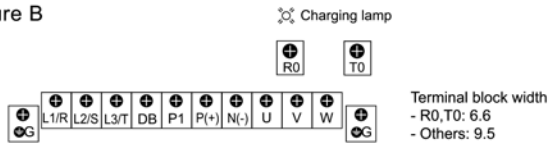


Figure C

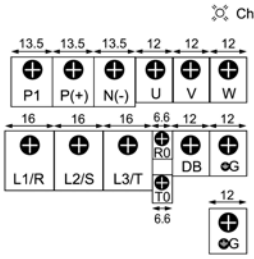


Figure D

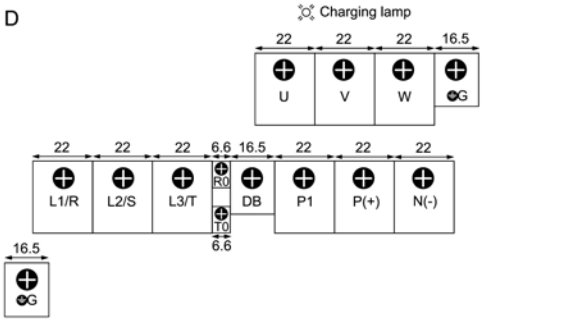


Figure E

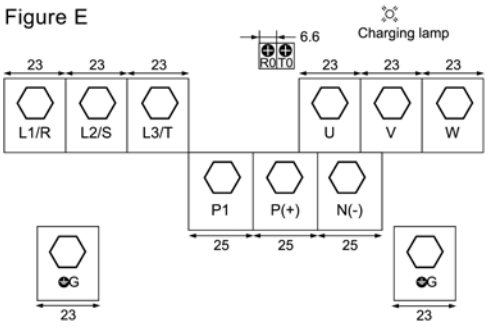


Figure F

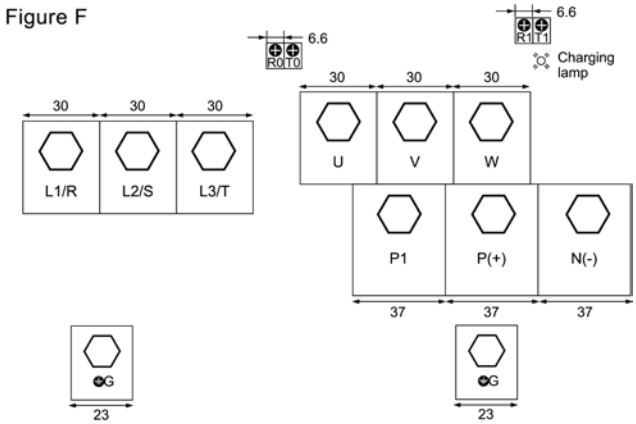


Figure G

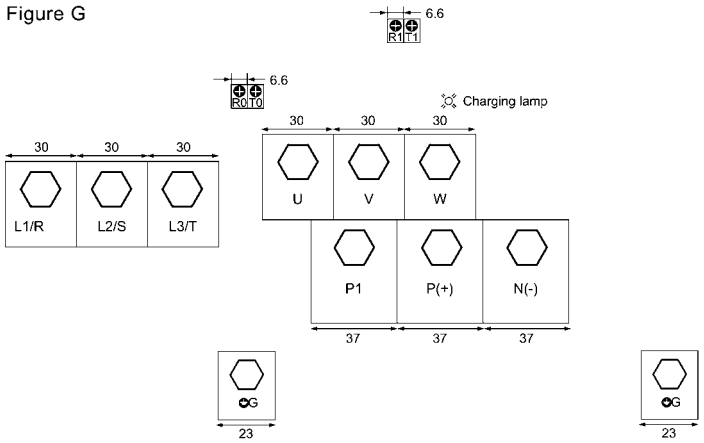


Figure H

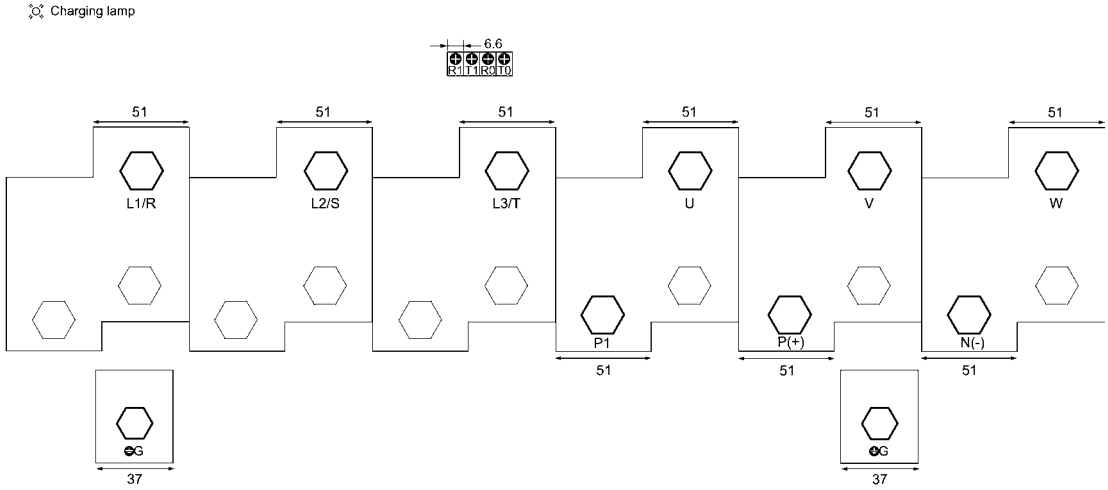
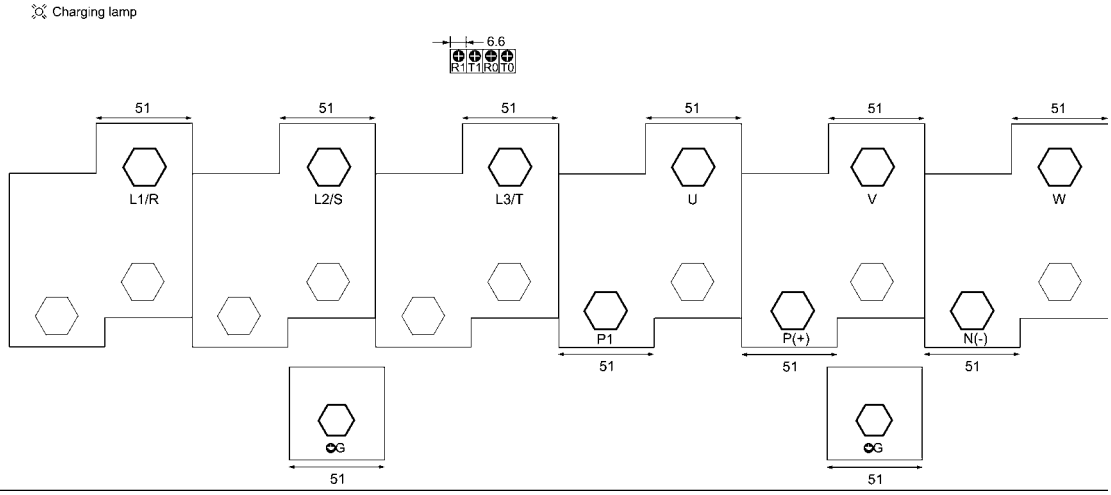


Figure I



2.4.3.2 Control circuit terminals (Common to all inverter types)

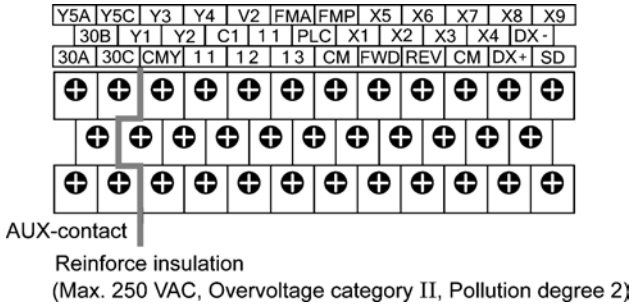
The control circuit terminal arrangement, screw sizes, and tightening torque are shown below.

The control circuit terminals are common to all inverter types regardless of their capacities.

Table 2.3 Screw Specifications and Recommended Wire Size

Terminals common to all inverter types	Screw specifications		Recommended wire size (mm^2)
	Screw size	Tightening torque (N·m)	
Control circuit terminals	M3	0.7	0.75 (Note)

(Note) Using wires exceeding the recommended sizes may lift the front cover depending upon the number of wires used, impeding keypad's normal operation.



2.5 Operating Environment and Storage Environment

2.5.1 Operating environment

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

Table 2.4 Environmental Requirements

Item	Specifications	
Site location	Indoors	
Surrounding temperature	-10 to +50°C **(Note 1)**	
Relative humidity	5 to 95% (No condensation)	
Atmosphere	The inverter must not be exposed to dust, direct sunlight, corrosive gases, flammable gas, oil mist, vapor or water drops. Pollution degree 2 (IEC60664-1) **(Note 2)** The atmosphere can contain a small amount of salt. (0.01 mg/cm2 or less per year) The inverter must not be subjected to sudden changes in temperature that will cause condensation to form.	
Altitude	1000 m max. **(Note 3)**	
Atmospheric pressure	86 to 106 kPa	
Vibration	55 kW or below (200 V class series) 75 kW or below (400 V class series)	75 kW or above (200 V class series) 90 kW or above (400 V class series)
	3 mm (Max. amplitude) : 2 to less than 9 Hz	3 mm (Max. amplitude) : 2 to less than 9 Hz
	9.8 m/s^2 : 9 to less than 20 Hz	2 m/s^2 : 9 to less than 55 Hz
	2 m/s^2 : 20 to less than 55 Hz	1 m/s^2 : 55 to less than 200 Hz
	1 m/s^2 : 55 to less than 200 Hz	

(Note 1) When inverters are mounted side-by-side without any gap between them (22 kW or less), the surrounding temperature should be within the range from -10 to +40°C.

(Note 2) Do not install the inverter in an environment where it may be exposed to cotton waste or moist dust or dirt which will clog the heat sink in the inverter. If the inverter is to be used in such an environment, install it in the panel of your system or other dustproof containers.

(Note 3) If you use the inverter in an altitude above 1000 m, you should apply an output current derating factor as listed in Table 2.5.

Table 2.5 Output Current Derating Factor in Relation to Altitude

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

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2.5.2 Storage environment

2.5.2.1 Temporary storage

Store the inverter in an environment that satisfies the requirements listed below.

Table 2.6 Storage and Transport Environments

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

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

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

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 above, 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 item (2).

2.5.2.2 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. 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 Table 2.6.

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.

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2.6 Precautions for Using Inverters

2.6.1 Precautions in introducing inverters

This section provides precautions in introducing inverters, e.g. precautions for installation environment, power supply lines, wiring, and connection to peripheral equipment. Be sure to observe those precautions.

■ Installation environment

Install the inverter in an environment that satisfies the requirements listed in Table 2.4 in Section 2.5.1.

Fuji Electric strongly recommends installing inverters in a panel for safety reasons, in particular, when installing the ones whose enclosure rating is IP00.

When installing the inverter in a place out of the specified environmental requirements, it is necessary to derate the inverter or consider the panel engineering suitable for the special environment or the panel installation location. For details, refer to the Fuji Electric technical information "Engineering Design of Panels" or consult your Fuji Electric representative.

The special environments listed below require using the specially designed panel or considering the panel installation location

Environments	Possible problems	Sample measures	Applications
Highly concentrated sulfidizing gas or other corrosive gases	Corrosive gases cause parts inside the inverter to corrode, resulting in an inverter malfunction.	Any of the following measures may be necessary. - Mount the inverter in a sealed panel with IP6X or air-purge mechanism. - Place the panel in a room free from influence of the gases.	Paper manufacturing, sewage disposal, sludge treatment, tire manufacturing, metal processing, and a particular process in textile factories.
A lot of conductive dust or foreign material (e.g., metal powders or shavings, carbon fibers, or carbon dust)	Entry of conductive dust into the inverter causes a short circuit.	Any of the following measures may be necessary. - Mount the inverter in a sealed panel. - Place the panel in a room free from influence of the conductive dust.	Wiredrawing machines, metal processing, extruding machines, printing presses, combustors, and industrial waste treatment.
A lot of fibrous or paper dust	Fibrous or paper dust accumulated on the heat sink lowers the cooing effect. Entry of dust into the inverter causes the electronic circuitry to malfunction.	Any of the following measures may be necessary. - Mount the inverter in a sealed panel that shuts out dust. - Ensure a maintenance space for periodical cleaning of the heat sink in panel engineering design. - Employ external cooling when mounting the inverter in a panel for easy maintenance and perform periodical maintenance.	Textile manufacturing and paper manufacturing.
High humidity or dew condensation	In an environment where a humidifier is used or where the air conditioner is not equipped with a dehumidifier, high humidity or dew condensation results, which causes a short-circuiting or malfunction of electronic circuitry inside the inverter.	- Put a heating module such as a space heater in the panel.	Outdoor installation. Film manufacturing line, pumps and food processing.
Vibration or shock exceeding the specified level	If a large vibration or shock exceeding the specified level is applied to the inverter, for example, due to a carrier running on seam joints of rails or blasting at a construction site, the inverter structure gets damaged.	- Insert shock-absorbing materials between the mounting base of the inverter and the panel for safe mounting.	Installation of an inverter panel on a carrier or self-propelled machine. Ventilating fan at a construction site or a press machine.

Environments	Possible problems	Sample measures	Applications
Fumigation for export packaging	Halogen compounds such as methyl bromide used in fumigation corrodes some parts inside the inverter.	- When exporting an inverter built in a panel or equipment, pack them in a previously fumigated wooden crate. When packing an inverter alone for export, use a laminated veneer lumber (LVL).	Exporting.

■ Wiring precautions

(1) Route the wiring of the control circuit terminals as far from the wiring of the main circuit as possible. Otherwise electric noise may cause malfunctions.

(2) Fix the control circuit wires inside the inverter to keep them away from the live parts of the main circuit (such as the terminal block of the main circuit).

(3) 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.

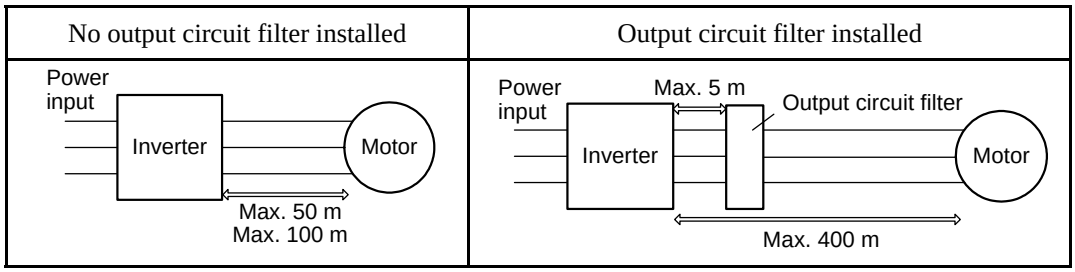
(4) Precautions for high frequency leakage currents

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

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

If the wiring distance longer than the specified above is required, 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).



For an inverter with an output circuit filter installed, the total secondary wiring length should be 400 m or less (100 m or less under the vector control).

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

(5) Precautions for surge voltage in driving a motor by an inverter (especially for 400 V class, general-purpose motors)

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

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

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(6) When an output circuit filter is inserted in the secondary circuit or the wiring between the inverter and the motor is long, a voltage loss occurs due to reactance of the filter or wiring so that the insufficient voltage may cause output current oscillation or a lack of motor output torque. To avoid it, select the constant torque load by setting the function code F37 (Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1) to "1" and keep the inverter output voltage at a higher level by configuring H50/H52 (Non-linear V/f Pattern, Frequency) and H51/H53 (Non-linear V/f Pattern, Voltage).

■ Precautions for connection of peripheral equipment

(1) Phase-advancing capacitors for power factor correction

Do not mount a phase-advancing capacitor for power factor correction in the inverter's input (primary) or output (secondary) circuit. Mounting it in the input (primary) circuit takes no effect. To correct the inverter power factor, use an optional DC reactor (DCR). Mounting it in the output (secondary) circuit causes an overcurrent trip, disabling operation.

An overvoltage trip that occurs when the inverter is stopped or running with a light load is assumed to be due to surge current generated by open/close of phase-advancing capacitors in the power system. An optional DC/AC reactor (DCR/ACR) is recommended as a measure to be taken at the inverter side.

Input current to an inverter contains a harmonic component that may affect other motors and phase-advancing capacitors on the same power supply line. If the harmonic component causes any problems, connect an optional DCR/ACR to the inverter. In some cases, it is necessary to insert a reactor in series with the phase-advancing capacitors.

(2) Power supply lines (Application of a DC/AC reactor)

Use an optional DC reactor (DCR) when the capacity of the power supply transformer is 500 kVA or more and is 10 times or more the inverter rated capacity or when there are thyristor-driven loads. If no DCR is used, the percentage-reactance of the power supply decreases, and harmonic components and their peak levels increase. These factors may break rectifiers or capacitors in the converter section of the inverter, or decrease the capacitance of the capacitors.

If the input voltage unbalance rate is 2% to 3%, use an optional AC reactor (ACR).

$$\text{Voltage unbalance (\%)} = \frac{\text{Max voltage (V) - Min voltage (V)}}{\text{Three-phase average voltage (V)}} \times 67 \text{ (IEC 61800-3)}$$

(3) DC reactor (DCR) for correcting the inverter input power factor (for suppressing harmonics)

To correct the inverter input power factor (to suppress harmonics), use an optional DCR. Using a DCR increases the reactance of inverter's power source so as to decrease harmonic components on the power source lines and correct the power factor of the inverter.

DCR models	Input power factor	Remarks
DCR2/4-□□/□□A/□□B	Approx. 90% to 95%	The last letter identifies the capacitance.
DCR2/4-□□C	Approx. 86% to 90%	Exclusively designed for nominal applied motor of 37 kW or above.

Note Select a DCR matching not the inverter but the nominal applied motor. Therefore, for HD-mode inverters, arrange a DCR with the same capacity as the inverter; for LD-mode inverters, arrange a DCR with one rank higher capacity than the inverter.

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(4) PWM converter for correcting the inverter input power factor

Using a PWM converter (High power-factor, regenerative PWM converter, RHC series) corrects the inverter power factor up to nearly 100%. When combining an inverter with a PWM converter, disable the main power loss detection by setting the function code H72 to "0." If the main power loss detection is enabled (H72 = 1 by factory default), the inverter interprets the main power as being shut down, ignoring an entry of a run command.

(5) Molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB)

Install a recommended MCCB or RCD/ELCB (with overcurrent protection) in the primary circuit of the inverter to protect the wiring. Since using an MCCB or RCD/ELCB with a lager capacity than recommended ones breaks the protective coordination of the power supply system, be sure to select recommended ones. Also select ones with short-circuit breaking capacity suitable for the power source impedance.

⚠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.

Otherwise, a fire could occur.

(6) Magnetic contactor (MC) in the inverter input (primary) circuit

Avoid frequent ON/OFF operation of the magnetic contactor (MC) in the input circuit; otherwise, the inverter failure may result. If frequent start/stop of the motor is required, use FWD/REV terminal signals or the RUN / STOP keys on the inverter's keypad.

The frequency of the MC's ON/OFF should not be more than once per 30 minutes. To assure 10-year or longer service life of the inverter, it should not be more than once per hour.

Tip

- From the system's safety point of view, it is recommended to employ such a sequence that shuts down the magnetic contactor (MC) in the inverter input circuit with an alarm output signal ***ALM*** issued on inverter's programmable output terminals. The sequence minimizes the secondary damage even if the inverter breaks.

  When the sequence is employed, connecting the MC's primary power line to the inverter's auxiliary control power input makes it possible to monitor the inverter's alarm status on the keypad.
- The breakdown of a braking unit or misconnection of an external braking resistor may trigger that of the inverter's internal parts (e.g., charging resistor). To avoid such a breakdown linkage, introduce an MC and configure a sequence that shuts down the MC if a DC link voltage establishment signal is not issued within three seconds after the MC is switched on.
- For the braking transistor built-in type of inverters, assign a transistor error output signal ***DBAL*** on inverter's programmable output terminals to switch off the MC in the input circuit.

(7) Magnetic contactor (MC) in the inverter output (secondary) circuit

If a magnetic contactor (MC) is inserted in the inverter's output (secondary) circuit for switching the motor to a commercial power or for any other purposes, it should be switched on and off when both the inverter and motor are completely stopped. This prevents the contact point from getting rough due to a switching arc of the MC. The MC should not be equipped with any main circuit surge killer (Fuji SZ-ZM□ etc.).

Applying a commercial power to the inverter's output circuit breaks the inverter. To avoid it, interlock the MC on the motor's commercial power line with the one in the inverter output circuit so that they are not switched ON at the same time.

(8) Surge absorber/surge killer

Do not install any surge absorber or surge killer in the inverter's output (secondary) lines.

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■ Noise reduction

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

(1) If noise generated from the inverter affects the other devices through power wires or grounding wires:
- Isolate the grounding terminals of the inverter from those of the other devices.
- Connect a noise filter to the inverter power wires.
- Isolate the power system of the other devices from that of the inverter with an insulated transformer.
- Decrease the inverter's carrier frequency (F26).

(2) If induction or radio noise generated from the inverter affects other devices:
- Isolate the main circuit wires from the control circuit wires and other device wires.
- Put the main circuit wires through a metal conduit pipe, and connect the pipe to the ground near the inverter.
- Install the inverter into the metal panel and connect the whole panel to the ground.
- Connect a noise filter to the inverter's power wires.
- Decrease the inverter's carrier frequency (F26).

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

■ Leakage current

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

Problem	Measures
An earth leakage circuit breaker* that is connected to the input (primary) side has tripped. * With overcurrent protection	1) Decrease the carrier frequency. 2) Make the wires between the inverter and motor shorter. 3) Use an earth leakage circuit breaker with lower sensitivity than the one currently used. 4) Use an earth leakage circuit breaker that features measures against the high frequency current component (Fuji SG and EG series).
An external thermal relay was activated.	1) Decrease the carrier frequency. 2) Increase the setting current of the thermal relay. 3) Use the electronic thermal overload protection built in the inverter, instead of the external thermal relay.

■ Selecting inverter capacity

(1) To drive a general-purpose motor, select an inverter according to the nominal applied motor rating listed in the standard specifications table. When high starting torque is required or quick acceleration or deceleration is required, select an inverter with one rank higher capacity than the standard.

(2) Special motors may have larger rated current than general-purpose ones. In such a case, select an inverter that meets the following condition.

Inverter rated current > Motor rated current

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2.6.2 Precautions in running inverters

Precautions for running inverters to drive motors or motor-driven machinery are described below.

■ Motor temperature

When an inverter is used to run a general-purpose motor, the motor temperature becomes higher than when it is operated with a commercial power supply. In the low-speed range, the motor cooling effect will be weakened, so decrease the output torque of the motor when running the inverter in the low-speed range.

■ Motor noise

When a general-purpose motor is driven by an inverter, the noise level is higher than that when it is driven by a commercial power supply. To reduce noise, raise carrier frequency of the inverter. Operation at 60 Hz or higher can also result in higher noise level.

■ Machine vibration

When an inverter-driven motor is mounted to a machine, resonance may be caused by the natural frequencies of the motor-driven machinery. Driving a 2-pole motor at 60 Hz or higher may cause abnormal vibration. If it happens, do any of the following:

- Consider the use of a rubber coupling or vibration-proof rubber.
- Use the inverter's jump frequency control feature to skip the resonance frequency zone(s).
- Use the vibration suppression related function codes that may be effective. For details, refer to the description of H80 in Chapter 5 "FUNCTION CODES."

2.6.3 Precautions in using special motors

When using special motors, note the followings.

■ 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 larger rated current than general-purpose motors. Select an inverter whose rated output current is greater than that of the motor. These motors differ from general-purpose motors in thermal characteristics. Decrease the thermal time constant of the electronic thermal overload protection to match the motor rating.

■ Brake motors

For motors equipped with parallel-connected brakes, their power supply for braking must be supplied from the inverter input (primary) circuit. If the power supply for braking is mistakenly connected to the inverter's output (secondary) circuit, the brake may not work when the inverter output is shut down. 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 operation at low speed may cause poor lubrication. Avoid such operation.

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■ 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.

■ High-speed motors

If the reference frequency is set to 120 Hz or higher to drive a high-speed motor, test-run the combination of the inverter and motor beforehand to check it for the safe operation.

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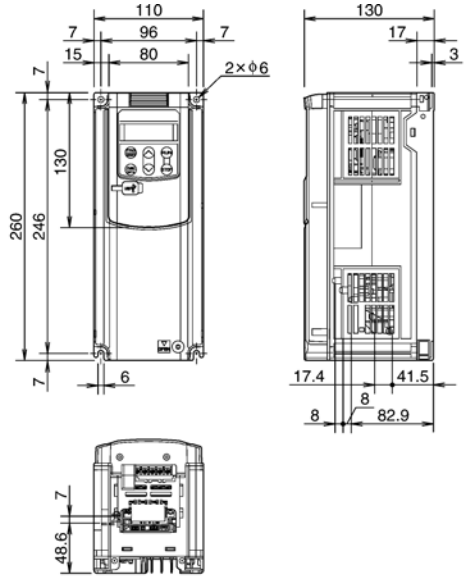
2.7 External Dimensions

2.7.1 Standard models

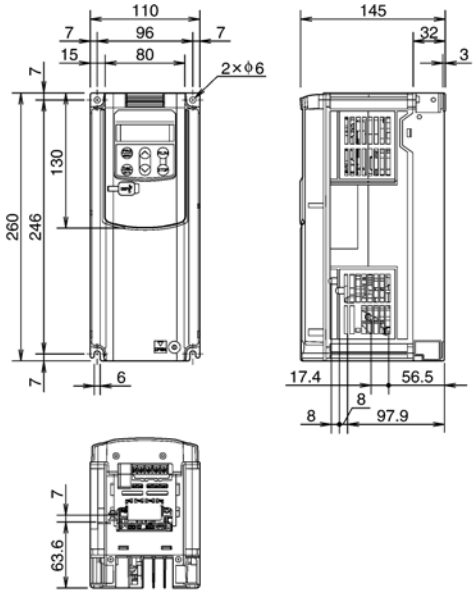
The diagrams below show external dimensions of the FRENIC-MEGA series of inverters according to the inverter capacity. (Three-phase 200 V/ 400 V class series)

Unit: mm

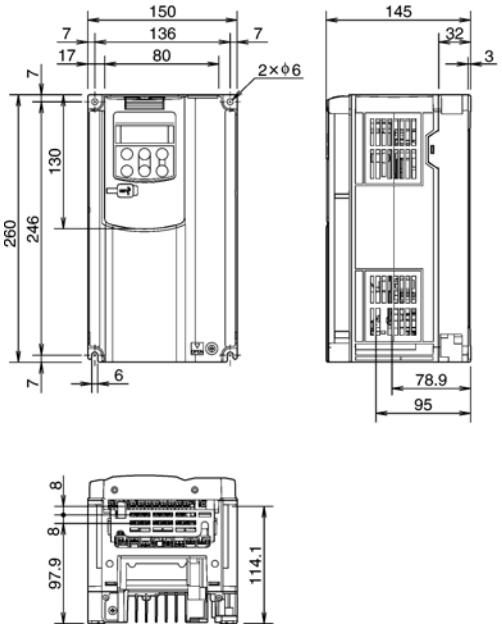
■ FRN0.4G1S-2□/4□



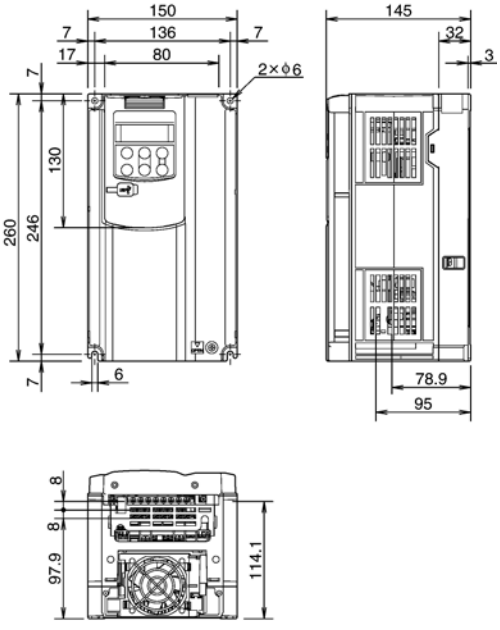
■ FRN0.75G1S-2□/4□



■ FRN1.5G1S-2□/4□



■ FRN2.2G1S-2□/4□, FRN3.7G1S-2□/4□



Note: A box (□) in the above model names replaces A, E, J, or T depending on the shipping destination.

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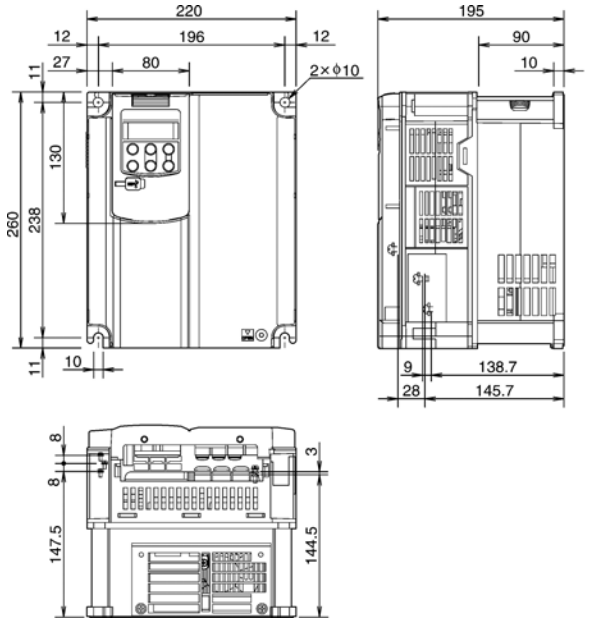
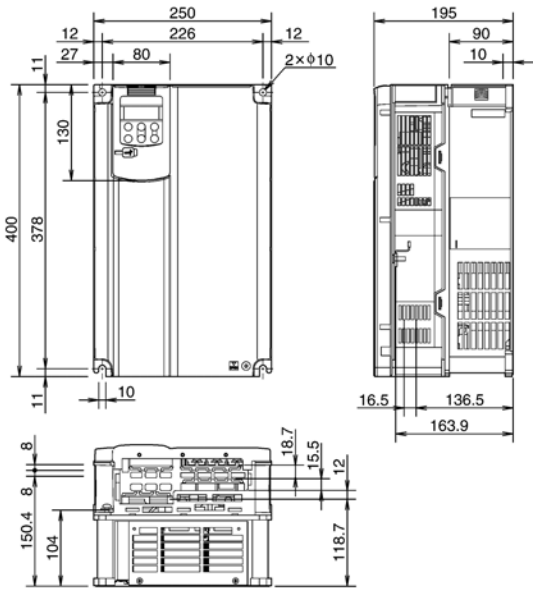
Unit: mm

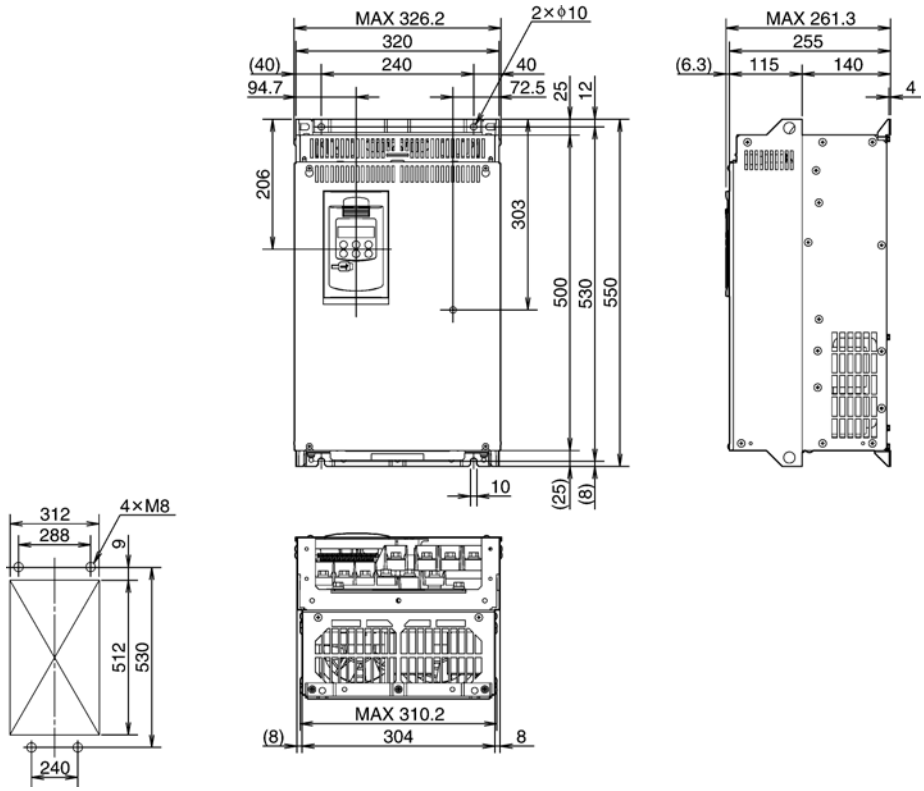
■ FRN5.5G1S-2☐/4☐, FRN7.5G1S-2☐/4☐, FRN11G1S-2☐/4☐



■ FRN15G1S-2☐/4☐, FRN18.5G1S-2☐/4☐, FRN22G1S-2☐/4☐



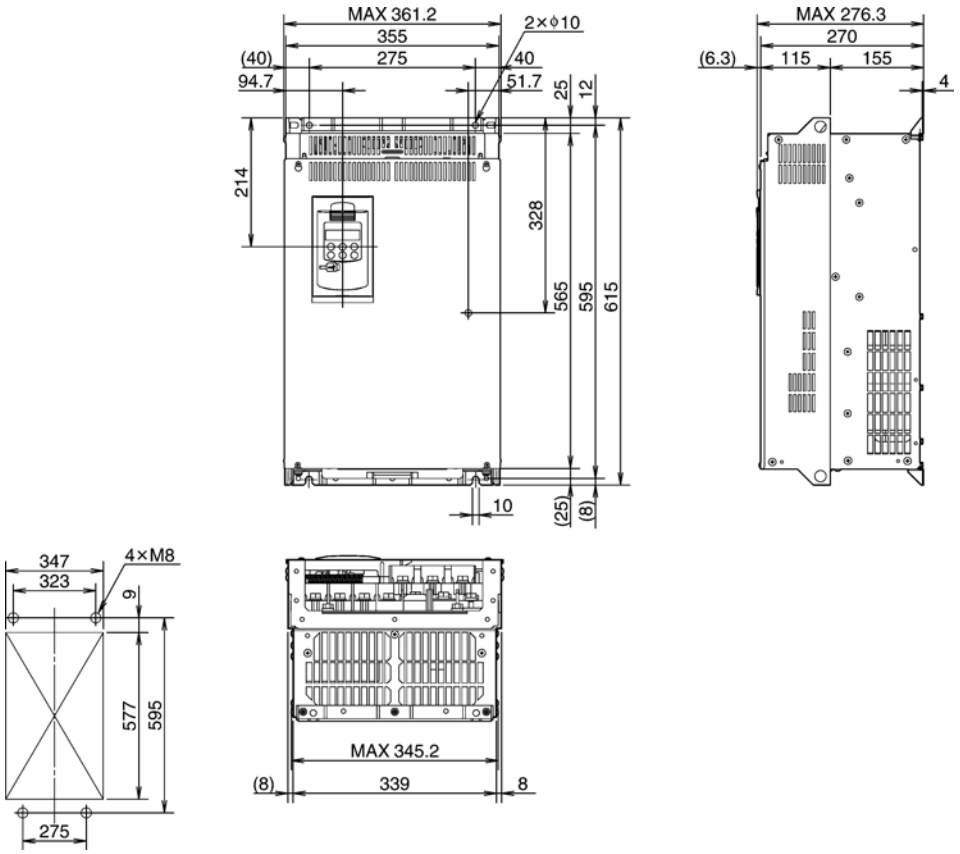
■ FRN30G1S-2☐/4☐, FRN37G1S-4☐



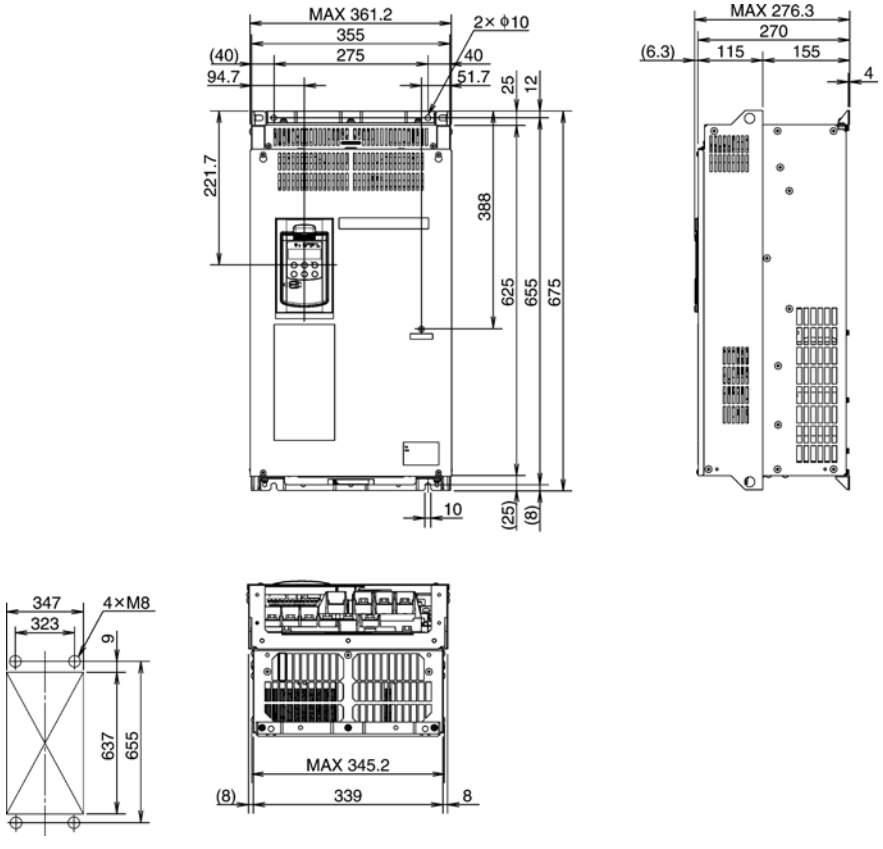
Note: A box (☐) in the above model names replaces A, E, J, or T depending on the shipping destination.

Unit: mm

■ FRN37G1S-2☐, FRN45G1S-4☐



■ FRN55G1S-4☐



Note: A box (☐) in the above model names replaces A, E, J, or T depending on the shipping destination.

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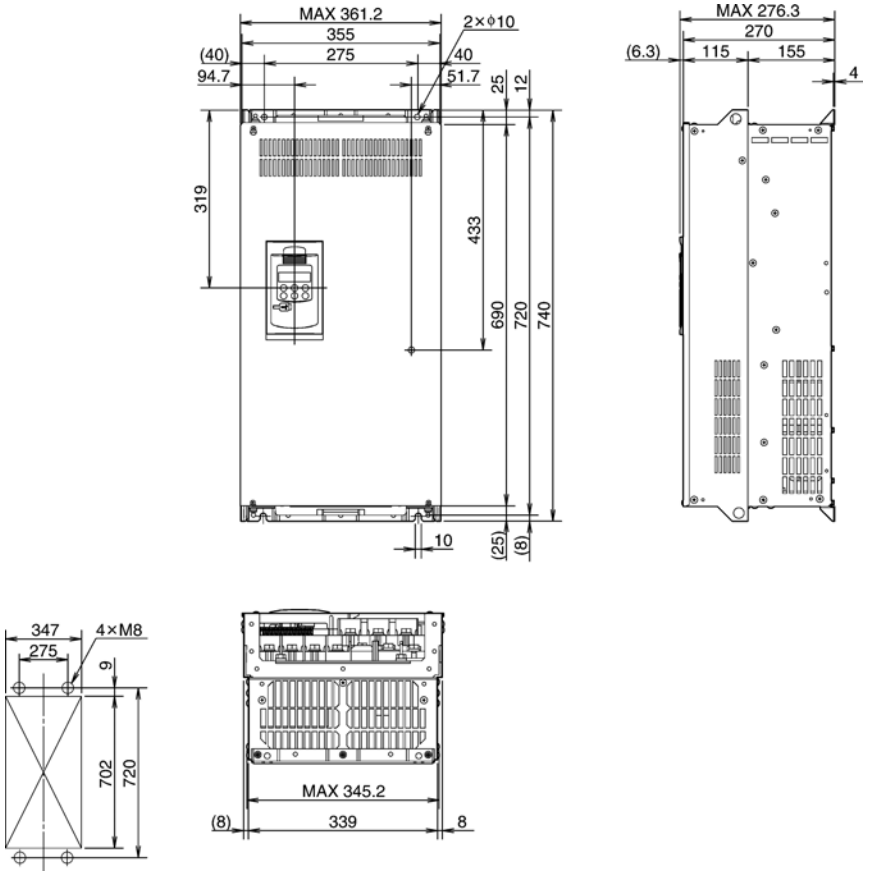
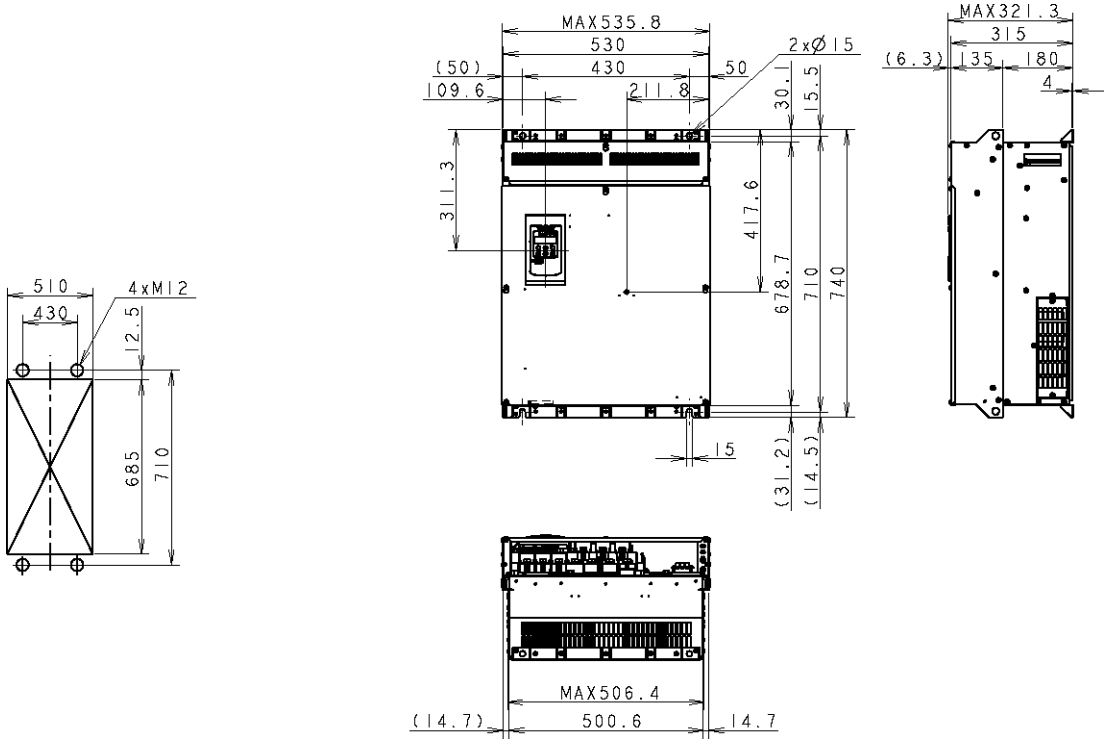
Unit: mm

■ FRN45G1S-2☐, FRN55G1S-2☐, FRN75G1S-4☐



■ FRN90G1S-4☐, FRN110G1S-4☐



Note: A box (☐) in the above model names replaces A, E, J, or T depending on the shipping destination.

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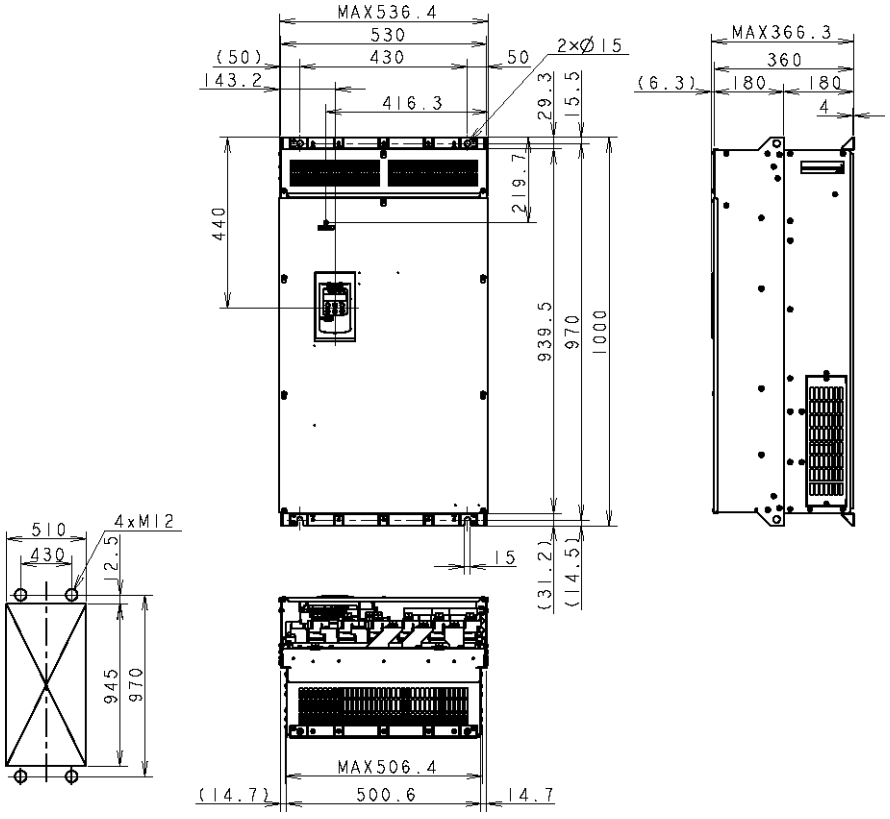
Unit: mm

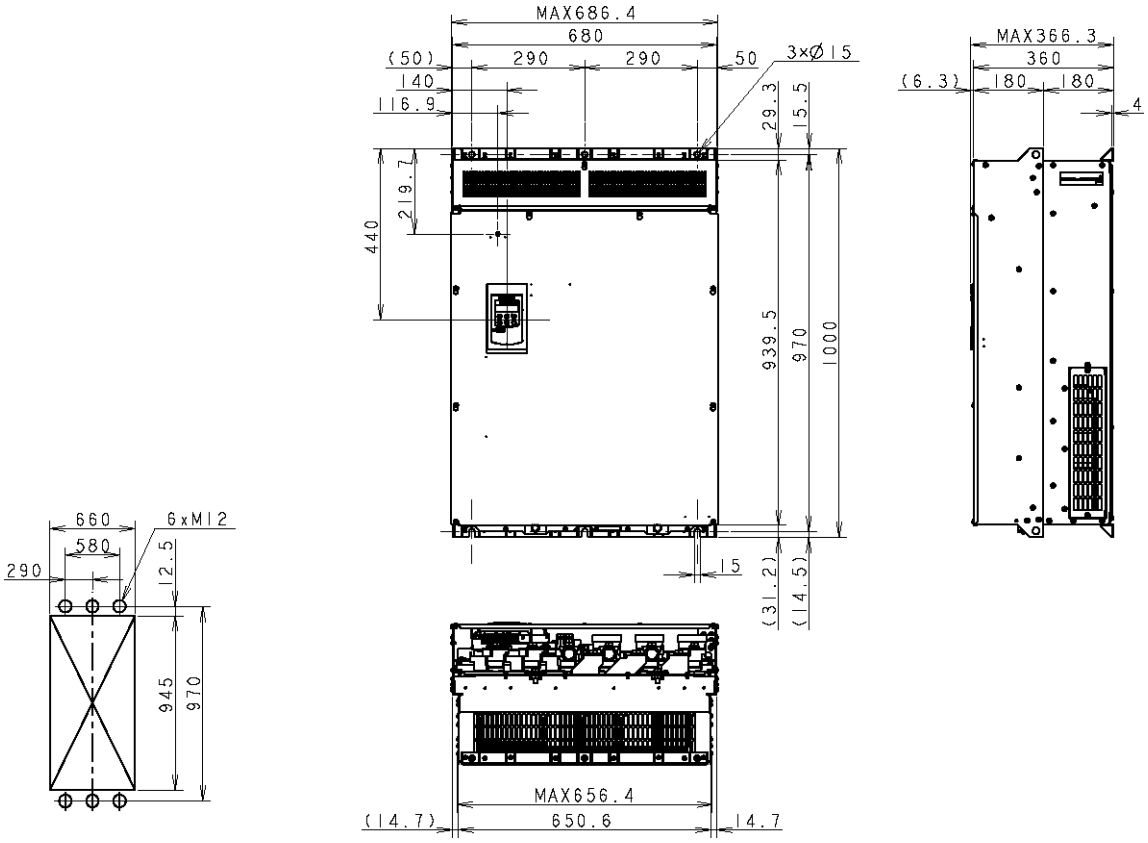
■ FRN132G1S-4□, FRN160G1S-4□



Note: A box (□) in the above model names replaces A, E, J, or T depending on the shipping destination.

Unit: mm

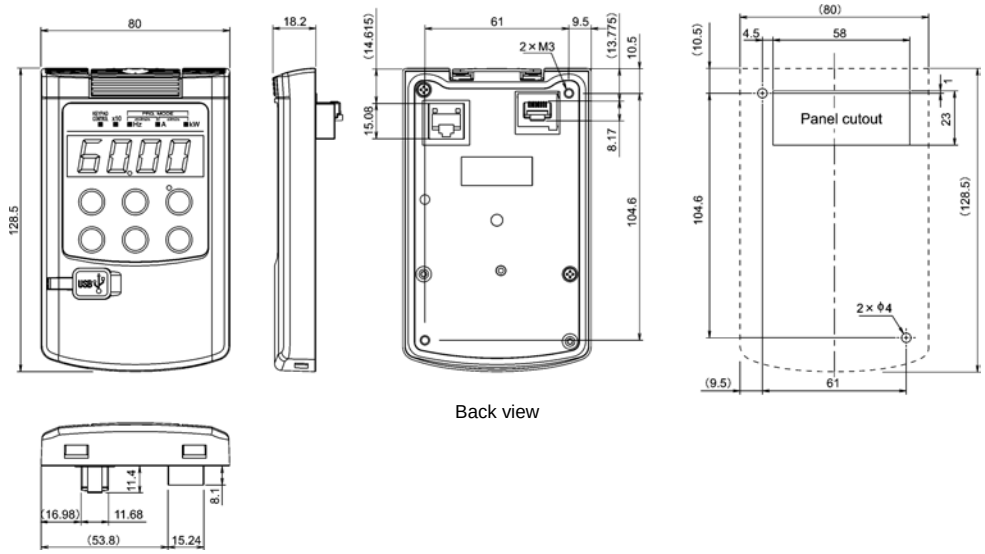
■ FRN200G1S-4□, FRN220G1S-4□



Note: A box (□) in the above model names replaces A, E, J, or T depending on the shipping destination.

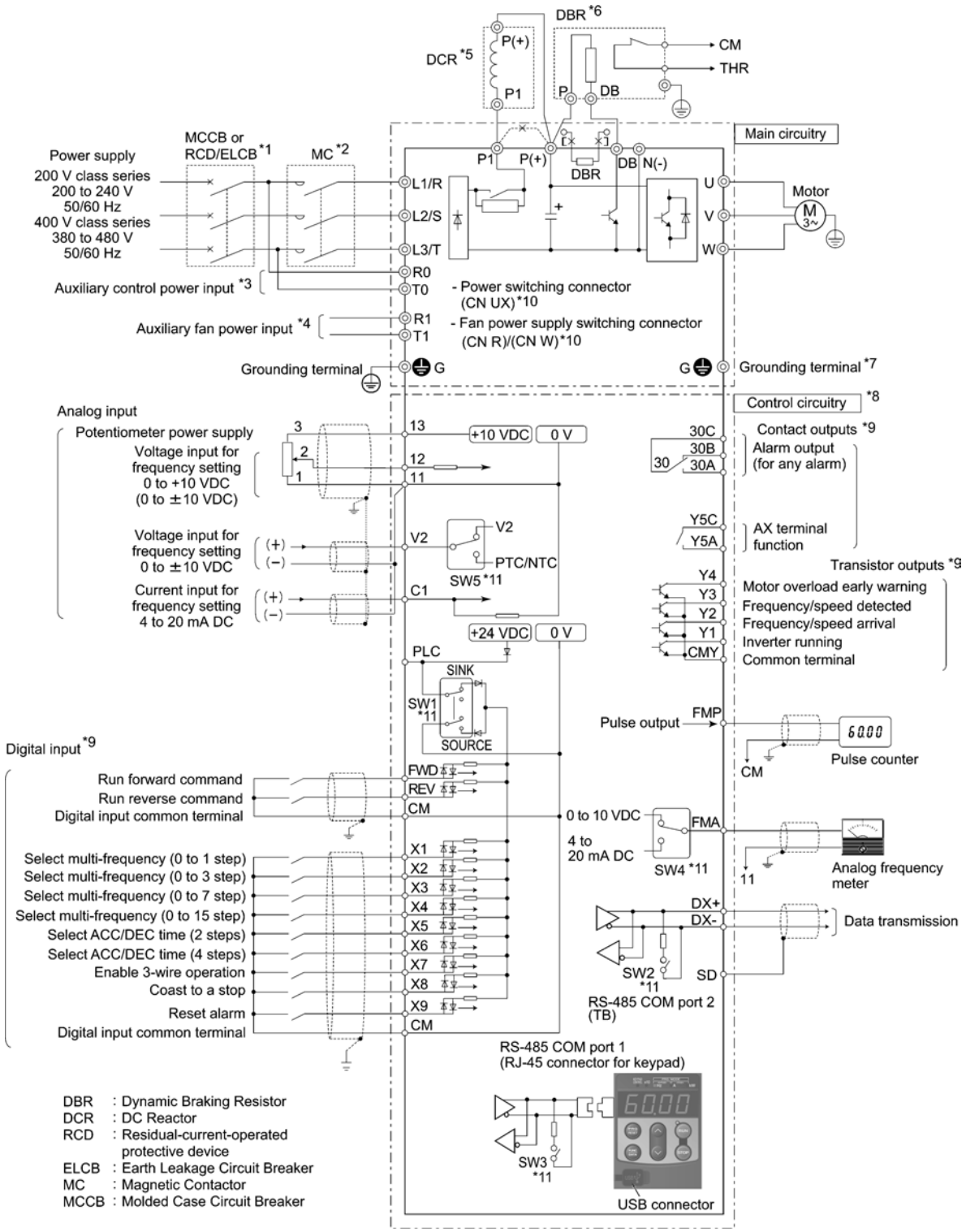
2.7.2 Keypad

Unit: mm



2.8 Connection Diagrams

2.8.1 Running a standard motor



*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 Inverters with a capacity of 1.5 kW or above have terminals R0 and T0.
To retain an alarm output signal ***ALM*** issued on inverter's programmable output terminals by the protective function or to keep the keypad alive even if the main power has shut down, connect these terminals to the power supply lines. Without power supply to these terminals, the inverter can run.

*4 Usually no need to be connected. Use these terminals when the inverter is combined with a high power-factor, regenerative PWM converter RHC series.

*5 When connecting an optional DC reactor (DCR), remove the jumper bar from the inverter main circuit terminals P1 and P(+).
LD-mode inverters with a capacity of 55 kW and inverters with 75 kW or above are equipped with a DC reactor (DCR) as standard. Be sure to connect the DCR.

Use a DCR when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity, or when there are thyristor-driven loads in the same power supply line.

*6 Inverters with a capacity of 7.5 kW or below have a built-in braking resistor (DBR) between the terminals P(+) and DB.

When connecting an external braking resistor (DBR), be sure to remove the built-in one.

*7 A grounding terminal for a motor. Use this terminal if needed.

*8 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, set them at right angles.

*9 The connection diagram shows factory default functions assigned to digital input terminals [X1] to [X9], [FWD] and [REV], transistor output terminals [Y1] to [Y4], and relay contact output terminals [Y5A/C] and [30A/B/C].

*10 Switching connectors in the main circuits. For details, refer to the FRENIC-MEGA Instruction Manual (INR-SI47-1183-E, INR-SI47-1223-E), Chapter 2, Section 2.3.5 "⑥ Switching connectors," or the FRENIC-MEGA Instruction Manual (INR-SI47-1334-E, INR-SI47-1335-E), Chapter 2, Section 2.3.4 "⑥ Switching connectors."

*11 Slide switches on the control printed circuit board (control PCB). Use these switches to customize the inverter operations. For details, refer to Section 2.4.2 "Setting up the slide switches."

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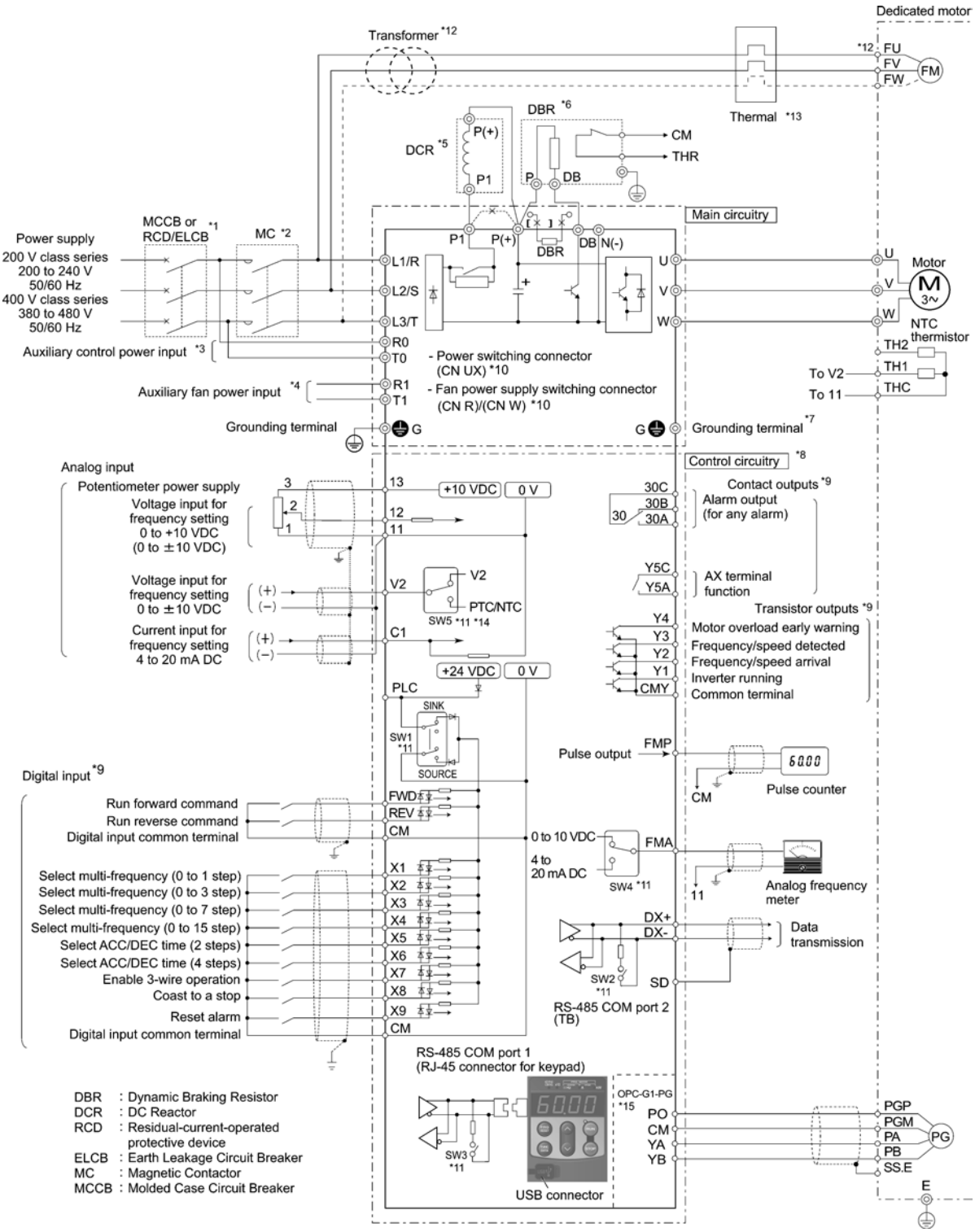
2.8.2 Running a Fuji motor exclusively designed for vector control



*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 Inverters with a capacity of 1.5 kW or above have terminals R0 and T0.
To retain an alarm output signal ***ALM*** issued on inverter's programmable output terminals by the protective function or to keep the keypad alive even if the main power has shut down, connect these terminals to the power supply lines. Without power supply to these terminals, the inverter can run.

*4 Usually no need to be connected. Use these terminals when the inverter is combined with a high power-factor, regenerative PWM converter RHC series.

*5 When connecting an optional DC reactor (DCR), remove the jumper bar from the inverter main circuit terminals P1 and P(+).
LD-mode inverters with a capacity of 55 kW and inverters with 75 kW or above are equipped with a DC reactor (DCR) as standard. Be sure to connect the DCR.

Use a DCR when the capacity of the power supply transformer exceeds 500 kVA and is 10 times or more the inverter rated capacity, or when there are thyristor-driven loads in the same power supply line.

*6 Inverters with a capacity of 7.5 kW or below have a built-in braking resistor (DBR) between the terminals P(+) and DB.

When connecting an external braking resistor (DBR), be sure to remove the built-in one.

*7 A grounding terminal for a motor. Use this terminal if needed.

*8 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, set them at right angles.

*9 The connection diagram shows factory default functions assigned to digital input terminals [X1] to [X9], [FWD] and [REV], transistor output terminals [Y1] to [Y4], and relay contact output terminals [Y5A/C] and [30A/B/C].

*10 Switching connectors in the main circuits. For details, refer to the FRENIC-MEGA Instruction Manual (INR-SI47-1183-E, INR-SI47-1223-E), Chapter 2, Section 2.3.5 "⑥ Switching connectors," or the FRENIC-MEGA Instruction Manual (INR-SI47-1334-E, INR-SI47-1335-E), Chapter 2, Section 2.3.4 "⑥ Switching connectors."

*11 Slide switches on the control printed circuit board (control PCB). Use these switches to customize the inverter operations. For details, refer to Section 2.4.2 "Setting up the slide switches."

*12 The cooling fan power for motors with a capacity of 7.5 kW or below is single-phase. Connect wires to terminals [FU] and [FV].

- For 200 V class series motors with a capacity of 7.5 kW or below:
  The cooling fan rating is 200 VAC/50 Hz, 200 to 230 VAC/60 Hz.
- For 400 V class series motors with a capacity of 11 kW or above:
  The cooling fan rating is 400 to 420 VAC/50 Hz, 400 to 440 VAC/60 Hz.

When applying voltage other than the above, use a voltage step up/down transformer.

*13 Use auxiliary contacts of the thermal relay (manually restorable) to trip the molded case circuit breaker (MCCB) or magnetic contactor (MC).

*14 To connect an NTC thermistor to this terminal, turn SW5 on the control printed circuit board to the PTC/NTC side and set the function code H26 data to "3."

*15 The PG interface card (OPC-G1-PG) is optional.

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2.9 Protective Functions

The table below lists the name of the protective functions, description, alarm codes on the LED monitor, and presence of alarm output at terminals [30A/B/C]. If an alarm code appears on the LED monitor, remove the cause of activation of the alarm function referring to Chapter 9 "TROUBLESHOOTING."

Name	Description		LED monitor displays	Alarm output [30A/B/C] **(Note)**
Overcurrent protection	Stops the inverter output to protect the inverter from an overcurrent resulting from overload.	During acceleration	OC1	Yes
Short-circuit protection	Stops the inverter output to protect the inverter from overcurrent due to a short-circuiting in the output circuit.	During deceleration	OC2	
Ground fault protection	Stops the inverter output to protect the inverter from overcurrent due to a ground fault in the output circuit. (For 200 V class series with 22 kW and 400 V class series with 22 kW or below)	During running at constant speed	OC3	
	Detects a zero-phase current in the output current and stops the inverter output to protect the inverter from overcurrent due to a ground fault in the output circuit. (For 200 V class series with 30 kW and 400 V class series with 30 kW or above)	—	EF	Yes
Overvoltage protection	Stops the inverter output upon detection of an overvoltage condition (400 VDC for 200 V class series, 800 VDC for 400 V class series) in the DC link bus. This protection is not assured if extremely large AC line voltage is applied inadvertently.	During acceleration	OU1	Yes
		During deceleration	OU2	
		During running at constant speed (stopped)	OU3	
Undervoltage protection	Stops the inverter output when the DC link bus voltage drops below the undervoltage level (200 VDC for 200 V class series, 400 VDC for 400 V class series). Note that, if the restart mode after momentary power failure is selected, no alarm is output even if the DC link bus voltage drops.		LU	Yes*
Input phase loss protection	Protects the inverter or stops the inverter output when an input phase loss is detected. If connected load is light or a DC reactor is connected to the inverter, this function may not detect input phase loss if any.		Lin	Yes*
Output phase loss protection	Detects breaks in inverter output wiring during running, stopping the inverter output.		OPL	Yes*

Note: In Alarm output [30A/B/C] column, "Yes*" means that an alarm may not be issued depending upon function code setting.

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Name	Description	LED monitor displays	Alarm output [30A/B/C] **(Note)**
Overheat protection	- Stops the inverter output upon detecting excess heat sink temperature in case of cooling fan failure or overload. - Detects a failure of the internal air circulation DC fan and stops the inverter (For models of 45 kW in 200 V class series and 75 kW or above in 400 V class series)	OH1	Yes
	Stops the inverter output upon detecting an excessively high surrounding temperature inside the inverter caused by a failure or an overload condition of the cooling fan.	OH3	Yes
	The electronic thermal protection for the braking resistor stops the inverter output to prevent the braking resistor from overheating. (For models of 22 kW in 200 V class series and 22 kW or below in 400 V class series) * Function codes must be set according to the braking resistor.	dbH	Yes*
Overload protection	Stops the inverter output upon detection of the abnormal heat sink temperature and switching element temperature calculated with the output current.	OLU	Yes
External alarm input	Places the inverter in alarm-stop state upon receiving digital input signal ***THR***.	OH2	Yes*
Fuse blown	Upon detection of a fuse blown in the inverter's main circuit, this function stops the inverter output. (For models of 75 kW in 200 V class series and 90 kW or above in 400 V class series)	FUS	Yes
Abnormal condition in charger circuit	Upon detection of an abnormal condition in the charger circuit inside the inverter, this function stops the inverter output. (For models of 37 kW in 200 V class series and 75 kW or above in 400 V class series)	PbF	Yes
Braking transistor broken	Stops the inverter output if a breakdown of the braking transistor is detected. (Only for braking transistor built-in type inverters)	dbA	Yes*
Overspeed *1 to *4	Stops the inverter output if the detected speed is 120% or over of the maximum frequency	OS	Yes
PG wire break *1, *2, *4	Stops the inverter output if a PG wire break is detected.	PG	Yes

Note: In Alarm output [30A/B/C] column, "Yes*" means that an alarm may not be issued depending upon function code setting.

*1 Available under V/f control with speed sensor. (PG option required)

*2 Available under dynamic torque vector control with speed sensor. (PG option required)

*3 Available under vector control without speed sensor.

*4 Available under vector control with speed sensor. (PG option required)

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Name		Description	LED monitor displays	Alarm output [30A/B/C] **(Note)**
Motor protection	Electronic thermal overload	In the following cases, the inverter stops running the motor to protect the motor in accordance with the electronic thermal overload protection setting. - Protects general-purpose motors over the entire frequency range (F10 = 1.) - Protects inverter motors over the entire frequency range (F10 = 2.) The operation level and thermal time constant can be set. (0.5 to 75.0 minutes)	OL 1 OL2 OL3 OL4	Yes*
	PTC thermistor	A PTC thermistor input stops the inverter output for motor protection.	OH4	Yes*
		Connect a PTC thermistor between terminals [V2] and [11] and set the function codes and slide switch on the interface PCB accordingly.		
	NTC thermistor	An NTC thermistor input detects the motor temperature.		
		Connect an NTC thermistor between terminals [V2] and [11] and set the function codes and slide switch on the interface PCB accordingly.		
	NTC wire break error	Stops the inverter upon detecting the NTC wire break inside the inverter.	n-b	Yes
	Overload early warning	Outputs a preliminary alarm at a preset level before the inverter is stopped by the electronic thermal overload protection for the motor. (Only for the first motor only)	—	—
Memory error detection		The inverter checks memory data after power-on and when the data is written. If a memory error is detected, the inverter stops.	Er 1	Yes
Keypad communications error detection		Stops the inverter output upon detecting a communications error between the inverter and the keypad during operation using the keypad.	Er2	Yes
CPU error detection		If the inverter detects a CPU error or LSI error caused by noise or some other factors, this function stops the inverter.	Er3	Yes
Option communications error detection		Upon detection of an error in the communication between the inverter and an optional card, stops the inverter output.	Er4	—
Option error detection		When an option card has detected an error, this function stops the inverter output.	Er5	—

Note: In Alarm output [30A/B/C] column, "Yes*" means that an alarm may not be issued depending upon function code setting.

Name	Description		LED monitor displays	Alarm output [30A/B/C] **(Note)**
Operation protection	STOP key priority	Pressing the STOP key on the keypad forces the inverter to decelerate and stop the motor even if the inverter is running by any run commands given via the terminals or communications (link operation). After the motor stops, the inverter issues alarm *Er-5*.	*Er-5*	Yes
	Start check function	To prevent a sudden start, the inverter prohibits any run operations and displays *Er-5* on the 7-segment LED monitor if any run command is present when: - Powering up - An alarm is released (the PRG/RESET key is turned ON or an alarm reset ***RST*** is input.) - "Enable communications link ***LE***" has been activated and the run command is active in the linked source.	*Er-5*	Yes*
Tuning error detection	During tuning of motor parameters, if the tuning has failed or has aborted, or an abnormal condition has been detected in the tuning result, the inverter stops its output.		*Er-7*	Yes
RS-485 communications error detection (COM port 1)	When the inverter is connected to a communications network via the RS-485 port designed for the keypad, detecting a communications error stops the inverter output.		*Er-8*	Yes*
Excessive speed deviation *1 to *4	Stops the inverter output if the speed deviation (difference between the speed command value and the feedback value) exceeds the preset value.		*Er-E*	Yes*
Data save error during under-voltage	If the data could not be saved during activation of the undervoltage protection function, the inverter displays the alarm code.		*Er-F*	Yes
RS-485 communications error detection (COM port 2)	When the inverter is connected to a communications network via the RS-485 port on the control terminals DX+ and DX-, detecting a communications error stops the inverter output.		*Er-P*	Yes*
Hardware error	Stops the inverter output upon detecting a malfunction of LSI on the power printed circuit board.		*Er-H*	Yes
Mock alarm	Mock alarm can be generated with keypad operations.		*Er-r*	Yes
PID feedback wire break	When the PID feedback is assigned to the current input, if a wire break is detected, whether the warning with transistor output or the alarm output can be selected.		*CoF*	Yes*

Note: In Alarm output [30A/B/C] column, "Yes*" means that an alarm may not be issued depending upon function code setting.

*1 Available under V/f control with speed sensor. (PG option required)

*2 Available under dynamic torque vector control with speed sensor. (PG option required)

*3 Available under vector control without speed sensor.

*4 Available under vector control with speed sensor. (PG option required)

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Name	Description	LED monitor displays	Alarm output [30A/B/C] **(Note)**
Alarm relay output (for any fault)	The inverter outputs a relay contact signal when the inverter issues an alarm and stops the inverter output. < Alarm reset > The alarm stop state is reset by pressing the PRG/RESET key or by the digital input signal ***RST***. < Saving the alarm history and detailed data > The information on the previous 4 alarms can be saved and displayed.	—	Yes
Stall prevention	When the output current exceeds the current limiter level (F44) during acceleration/deceleration or constant speed running, this function decreases the output frequency to avoid an overcurrent trip.	—	—
Retry	When the inverter has stopped because of a trip, this function allows the inverter to automatically reset itself and restart. (You can specify the number of retries and the latency between stop and reset.)	—	—
Surge protection	Protects the inverter against surge voltages which might appear between one of the power lines for the main circuit and the ground.	—	—
Command loss detected	Upon detecting a loss of a frequency command (because of a broken wire, etc.), this function issues an alarm and continues the inverter operation at the preset reference frequency (specified as a ratio to the frequency just before the detection).	-Er	—
Protection against momentary power failure	Upon detecting a momentary power failure lasting more than 15 ms, this function stops the inverter output. If restart after momentary power failure is selected, this function invokes a restart process when power has been restored within a predetermined period (allowable momentary power failure time).	—	—
Light alarm (warning)	Upon detecting a failure or warning status that has been registered as a light alarm item, the inverter displays L-AL on the LED monitor without stopping the operation. <u>Light alarm object</u> Heat sink overheat (OH1), External alarm (OH2), Inverter internal overheat (OH3), Motor protection (OH4), Braking resistor overheat (dbH), Overload of motor 1 through 4 (OL1 to OL4), Keypad communications error (Er2), Option communications error (Er4), Option error (Er5), RS-485 communications error (COM port 1) (Er8), Speed mismatch or excessive speed deviation (ErE), RS-485 communications error (COM port 2) (ErP), DC fan locked (FAL), Motor overload early warning (OL), Heat sink overheat early warning (OH), Lifetime alarm (DC link bus capacitor, electrolytic capacitors on printed circuit boards or cooling fans) (L1F), Reference command loss detected (rEF), PID alarm (PID), Low torque output (LUL), PTC thermistor activated (PTC), Inverter life (cumulative run time) (rTE), Inverter life (number of startups) (Cnt)	L-AL	—

Note: In Alarm output [30A/B/C] column, "Yes*" means that an alarm may not be issued depending upon function code setting.

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Chapter 3

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, inverter mode (HD, MD, or LD), and motor drive control.

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3.1 Selecting Motors and Inverters

When selecting a general-purpose inverter, first select a motor and then inverter as follows:

(1) Key point for selecting a motor: Determine what kind of load machine is to be used, calculate its moment of inertia, and then select the appropriate motor capacity.

(2) Key point for selecting an inverter: Taking into account the operation requirements (e.g., acceleration time, deceleration time, and frequency in operation) of the load machine to be driven by the motor selected in (1) above, calculate the acceleration/deceleration/braking torque.

This section describes the selection procedure for (1) and (2) above. First, it explains the output torque characteristics obtained by using the motor driven by the inverter (FRENIC-MEGA).

3.1.1 Motor output torque characteristics

Figures 3.1 and 3.2 graph the output torque characteristics of motors at the rated output frequency individually for 50 Hz and 60 Hz base. The horizontal and vertical axes show the output frequency and output torque (%), respectively. Curves (a) through (f) depend on the running conditions.

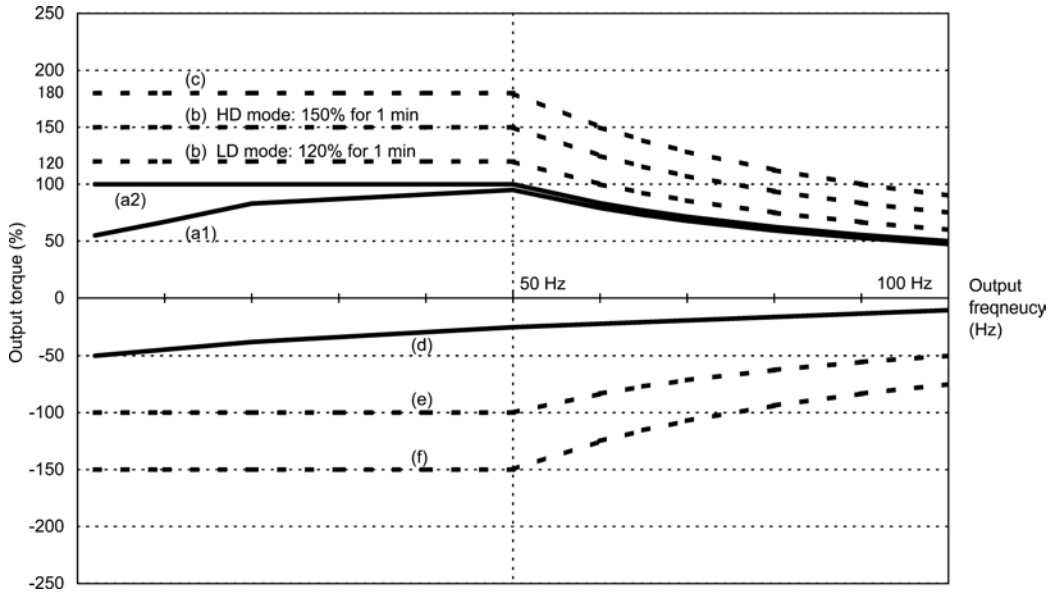

Figure 3.1 Output Torque Characteristics (Base frequency: 50 Hz)

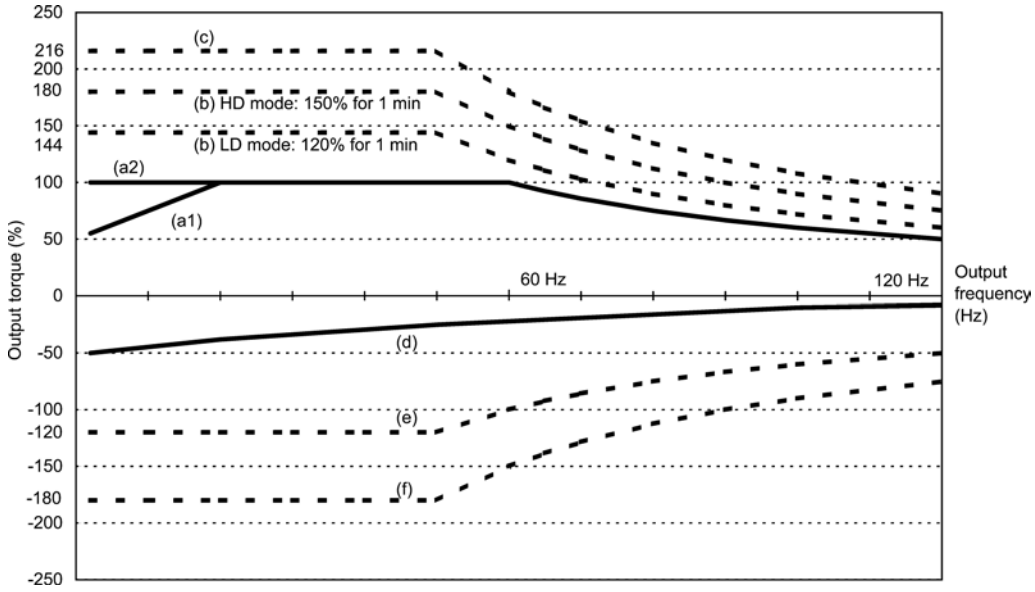

Figure 3.2 Output Torque Characteristics (Base frequency: 60 Hz)

(1) Continuous allowable driving torque

① Standard motor (Curve (a1) in Figures 3.1 and 3.2)

Curve (a1) shows the torque characteristic that can be obtained in the range of the inverter continuous rated current, where the standard motor's cooling characteristic is taken into consideration. When the motor runs at the base frequency of 60 Hz, 100 % output torque can be obtained; at 50 Hz, the output torque is somewhat lower than that in commercial power, and it further lowers at lower frequencies. The reduction of the output torque at 50 Hz is due to increased loss by inverter driving, and that at lower frequencies is mainly due to heat generation caused by the decreased ventilation performance of the motor cooling fan.

② Motor exclusively designed for vector control (Curve (a2) in Figures 3.1 and 3.2)

Curve (a2) shows the torque characteristic that can be obtained in the range of the inverter continuous rated current, where the motor exclusively designed for vector control is connected. In the motor exclusively designed for vector control, the attached forced-cooling fan reduces heat generation from the motor, so that the torque does not drop in the low-speed range, compared to the standard motor.

(2) Maximum driving torque in a short time (Curves (b) and (c) in Figures 3.1 and 3.2)

Curve (b) shows the torque characteristic that can be obtained in the range of the inverter overload capability in a short time (HD mode: output torque is 150% for 1 minute and 200% for 3 seconds, LD mode: output torque is 120% for 1 minute) when torque-vector control is enabled. At that time, the motor cooling characteristics have little effect on the output torque.

Curve (c) shows an example of the torque characteristic when one class higher capacity inverter is used to increase the short-time maximum torque. In this case, the short-time torque is 20 to 30% greater than that when the standard capacity inverter is used.

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(3) Starting torque (around the output frequency 0 Hz in Figures 3.1 and 3.2)

The maximum torque in a short time applies to the starting torque as it is.

(4) Braking torque (Curves (d), (e), and (f) in Figures 3.1 and 3.2)

In braking the motor, kinetic energy is converted to electrical energy and regenerated to the DC link bus capacitor (reservoir capacitor) of the inverter. Discharging this electrical energy to the braking resistor produces a large braking torque as shown in curve (e). If no braking resistor is provided, however, only the motor and inverter losses consume the regenerated braking energy so that the torque becomes smaller as shown in curve (d).

When an optional braking resistor is used, the braking torque is allowable only for a short time. Its time ratings are mainly determined by the braking resistor ratings. This manual and associated catalogs list the allowable values (kW) obtained from the average discharging loss and allowable values (kWs) obtained from the discharging capability that can be discharged at one time.

Note that the torque % value varies according to the inverter capacity.

Selecting an optimal brake unit enables a braking torque value to be selected comparatively freely in the range below the short-time maximum torque in the driving mode, as shown in curve (f).

For braking-related values when the inverter and braking resistor are normally combined, refer to Chapter 4, Section 4.4.1.1 "Braking resistor (DBR) and braking unit."

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3.1.2 Selection procedure

Figure 3.3 shows the general selection procedure for optimal inverters. Items numbered (1) through (5) are described on the following pages.

You may easily select inverter capacity if there are no restrictions on acceleration and deceleration times. If "there are any restrictions on acceleration or deceleration time" or "acceleration and deceleration are frequent," then the selection procedure is more complex.

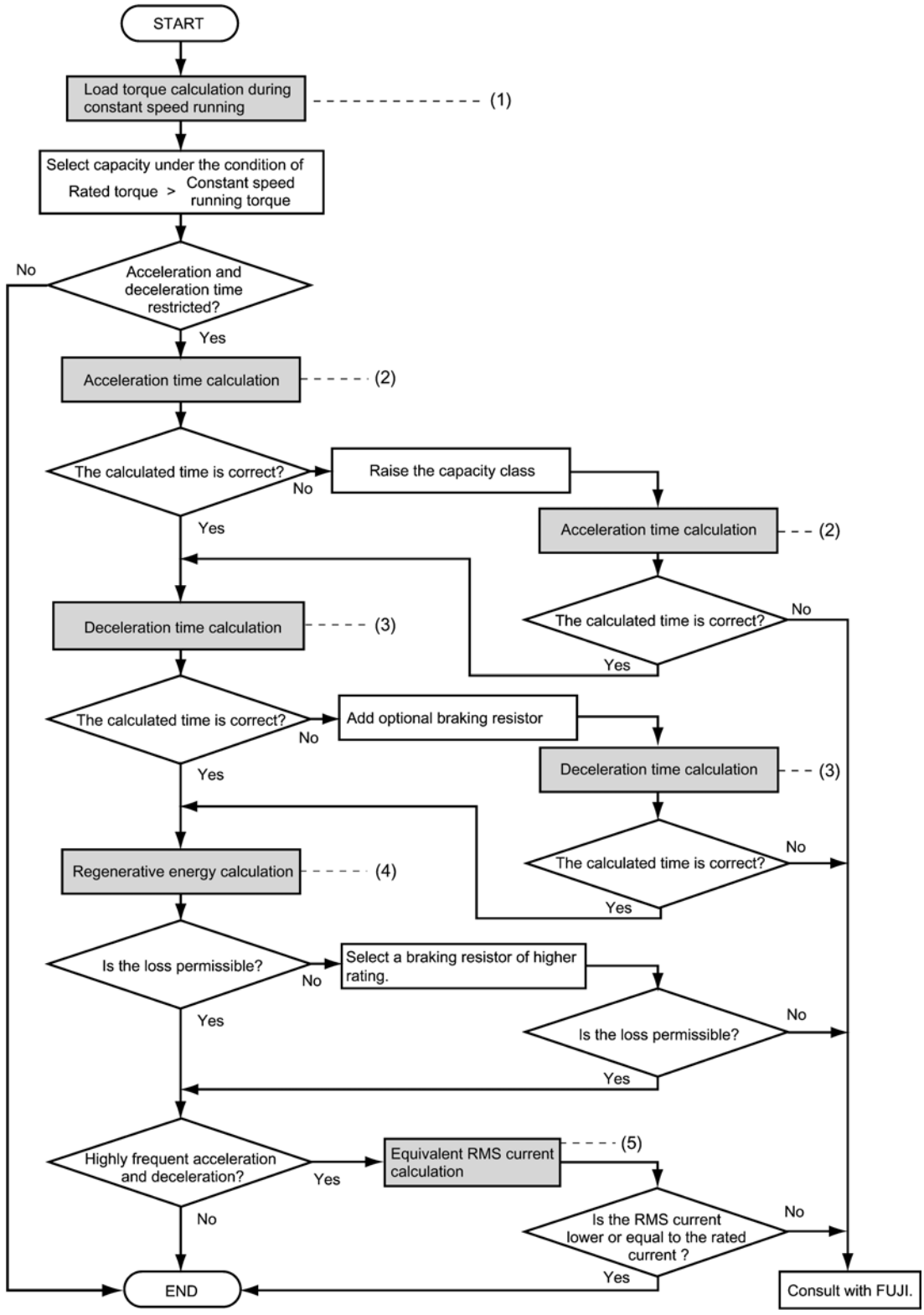


Figure 3.3 Selection Procedure

(1) Calculating the load torque during constant speed running (For detailed calculation, refer to Section 3.1.3.1)

It is essential to calculate the load torque during constant speed running for all loads.

First calculate the load torque of the motor during constant speed running and then select a tentative capacity so that the continuous rated torque of the motor during constant speed running becomes higher than the load torque. To perform capacity selection efficiently, it is necessary to match the rated speeds (base speeds) of the motor and load. To do this, select an appropriate reduction-gear (mechanical transmission) ratio and the number of motor poles.

If the acceleration or deceleration time is not restricted, the tentative capacity can apply as a defined capacity.

(2) Calculating the acceleration time (For detailed calculation, refer to Section 3.1.3.2)

When there are some specified requirements for the acceleration time, calculate it according to the following procedure:

1) Calculate the moment of inertia for the load and motor
   Calculate the moment of inertia for the load, referring to Section 3.1.3.2, "Acceleration and deceleration time calculation." For the motor, refer to the related motor catalogs.
2) Calculate the minimum acceleration torque (See Figure 3.4)
   The acceleration torque is the difference between the motor short-time output torque (base frequency: 60 Hz) explained in Section 3.1.1 (2), "Maximum driving torque in a short time" and the load torque (τ_L / η_G) during constant speed running calculated in the above (1). Calculate the minimum acceleration torque for the whole range of speed.
3) Calculate the acceleration time
   Assign the value calculated above to the equation (3.15) in Section 3.1.3.2, "Acceleration and deceleration time calculation" to calculate the acceleration time. If the calculated acceleration time is longer than the expected time, select the inverter and motor having one class larger capacity and calculate it again.

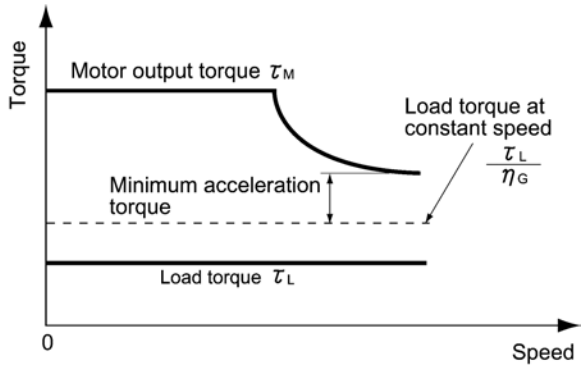


Figure 3.4 Example Study of Minimum Acceleration Torque

(3) Deceleration time (For detailed calculation, refer to Section 3.1.3.2)

To calculate the deceleration time, check the motor deceleration torque characteristics for the whole range of speed in the same way as for the acceleration time.

1) Calculate the moment of inertia for the load and motor
   Same as for the acceleration time.
2) Calculate the minimum deceleration torque (See Figures 3.5 and 3.6.)
   Same as for the deceleration time.
3) Calculate the deceleration time
   Assign the value calculated above to the equation (3.16) to calculate the deceleration time in the same way as for the acceleration time. If the calculated deceleration time is longer than the requested time, select the inverter and motor having one class larger capacity and calculate it again.

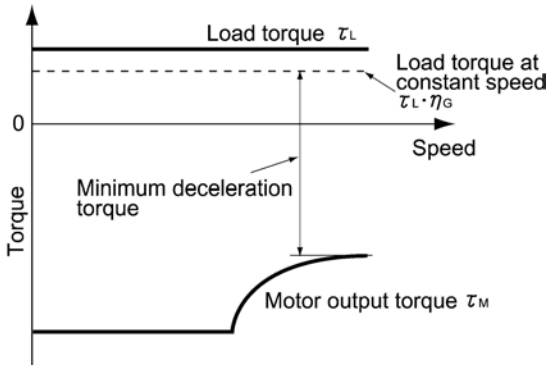


Figure 3.5 Example Study of Minimum Deceleration Torque (1)

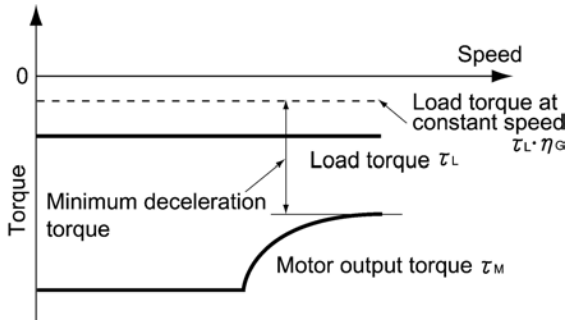


Figure 3.6 Example Study of Minimum Deceleration Torque (2)

(4) Braking resistor rating (For detailed calculation, refer to Section 3.1.3.3)

Braking resistor rating is classified into two types according to the braking periodic duty cycle.

1) When the periodic duty cycle is 100 sec or less:
   Calculate the average loss to determine rated values.
2) When the periodic duty cycle exceeds 100 sec:
   The allowable braking energy depends on the maximum regenerative braking capacity. The allowable values are listed in Chapter 4, Section 4.4.1.1 "Braking resistor (DBR) and braking unit."

(5) Motor RMS current (For detailed calculation, refer to Section 3.1.3.4)

In metal processing machine and materials handling machines requiring positioning control, highly frequent running for a short time is repeated. In this case, calculate the maximum equivalent RMS current value (effective value of current) not to exceed the allowable value (rated current) for the motor.

3.1.3 Equations for selections

3.1.3.1 Load torque during constant speed running

[1] General equation

The frictional force acting on a horizontally moved load must be calculated. Calculation for driving a load along a straight line with the motor is shown below.

Where the force to move a load linearly at constant speed υ (m/s) is F (N) and the motor speed for driving this is N_M (r/min), the required motor output torque τ_M (N·m) is as follows:

$$\tau_M = \frac{60 \cdot \upsilon}{2\pi \cdot N_M} \cdot \frac{F}{\eta_G} \quad (N \cdot m) \tag{3.1}$$

where, η_G is Reduction-gear efficiency.

When the inverter brakes the motor, efficiency works inversely, so the required motor torque should be calculated as follows:

$$\tau_M = \frac{60 \cdot \upsilon}{2\pi \cdot N_M} \cdot F \cdot \eta_G \quad (N \cdot m) \tag{3.2}$$

$(60 \cdot \upsilon) / (2\pi \cdot N_M)$ in the above equation is an equivalent turning radius corresponding to speed υ (m/s) around the motor shaft.

The value F (N) in the above equations depends on the load type.

[2] Obtaining the required force F

■ Moving a load horizontally

A simplified mechanical configuration is assumed as shown in Figure 3.7. If the mass of the carrier table is W_0 (kg), the load is W (kg), and the friction coefficient of the ball screw is μ, then the friction force F (N) is expressed as follows, which is equal to a required force for driving the load:

$$F = (W_0 + W) \cdot g \cdot \mu \quad (N) \tag{3.3}$$

where, g is the gravity acceleration (≈ 9.8 (m/s^2)).

Then, the driving torque around the motor shaft is expressed as follows:

$$\tau_M = \frac{60 \cdot \upsilon}{2\pi \cdot N_M} \cdot \frac{(W_0 + W) \cdot g \cdot \mu}{\eta_G} \quad (N \cdot m) \tag{3.4}$$

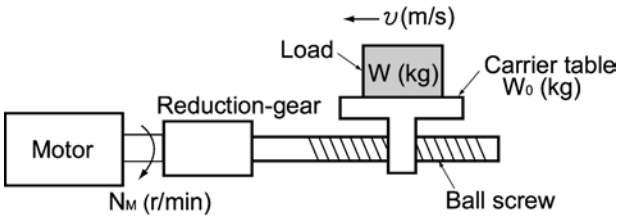


Figure 3.7 Moving a Load Horizontally

■ Vertical Lift Load

A simplified mechanical configuration is assumed as shown in Figure 3.8. If the mass of the cage is W_0 (kg), the load is W (kg), and the balance weight is W_B (kg), then the forces F (N) required for lifting the load up and down are expressed as follows:

$$F = (W_0 + W - W_B) \cdot g \ (N) \qquad \text{(For lifting up)} \qquad (3.5)$$

$$F = (W_0 - W - W_B) \cdot g \ (N) \qquad \text{(For lifting down)} \qquad (3.6)$$

Assuming the maximum load is W_{max}, the mass of the balance weight W_B (kg) is generally obtained with the expression $W_B = W_O + W_{max}/2$. Depending on the mass of load W (kg), the values of F (N) may be negative in both cases of lifting up and down, which means the lift is in braking mode. So, be careful in motor and inverter selection.

For calculation of the required output torque τ around the motor shaft, apply the expression (3.1) or (3.2) depending on the driving or braking mode of the lift, that is, apply the expression (3.1) if the value of F (N) is positive, and the (3.2) if negative.

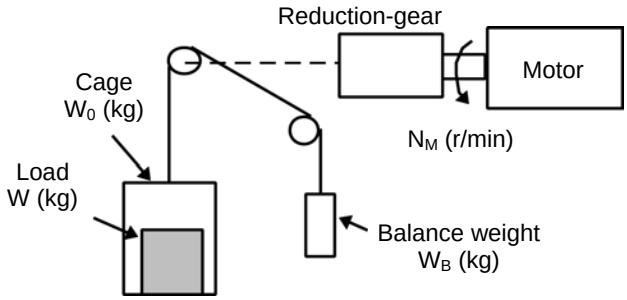


Figure 3.8 Vertical Lift Load

■ Inclined Lift Load

Although the mechanical configuration of an inclined lift load is similar to that of a vertical lift load, unignorable friction force in the inclined lift makes a difference; in an inclined lift load, there is a distinct difference between the expression to calculate the lift force F (N) for lifting up and that for lifting down.

If the incline angle is θ, and the friction coefficient is μ, as shown in the figure 3.9, the driving force F (N) is expressed as follows:

$$F = ((W_0 + W)(\sin\theta + \mu \cdot \cos\theta) - W_B) \cdot g \ (N) \qquad \text{(For lifting up)} \qquad (3.7)$$

$$F = ((W_B - (W_0 + W)(\sin\theta + \mu \cdot \cos\theta)) \cdot g \ (N) \qquad \text{(For lifting down)} \qquad (3.8)$$

The braking mode applies to both lifting up and down as in the vertical lift load. And the calculation of the required output torque τ around the motor shaft is the same as in the vertical lift load; apply the expression (3.1) if the value of F (N) is positive, and the (3.2) if negative.

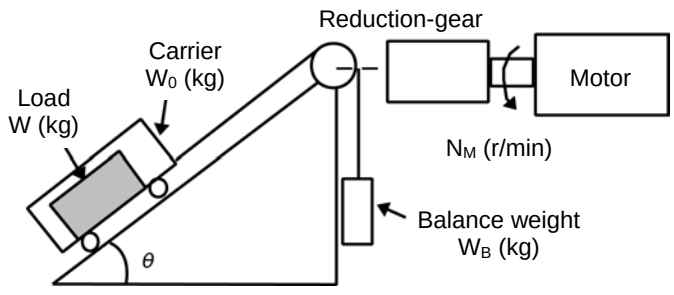


Figure 3.9 Inclined Lift Load

3.1.3.2 Acceleration and deceleration time calculation

When an object whose moment of inertia is J (kg·m^2) rotates at the speed N (r/min), it has the following kinetic energy:

$$E = \frac{J}{2} \cdot (\frac{2\pi \cdot N}{60})^2 \quad (J) \tag{3.9}$$

To accelerate the above rotational object, the kinetic energy will be increased; to decelerate the object, the kinetic energy must be discharged. The torque required for acceleration and deceleration can be expressed as follows:

$$\tau = J \cdot \frac{2\pi}{60} (\frac{dN}{dt}) \quad (N \cdot m) \tag{3.10}$$

This way, the mechanical moment of inertia is an important element in the acceleration and deceleration. First, calculation method of moment of inertia is described, then those for acceleration and deceleration time are explained.

[1] Calculation of moment of inertia

For an object that rotates around the shaft, virtually divide the object into small segments and square the distance from the shaft to each segment. Then, sum the squares of the distances and the masses of the segments to calculate the moment of inertia.

$$J = \sum (W_i \cdot r_i^2) \quad (kg \cdot m^2) \tag{3.11}$$

The following describes equations to calculate moment of inertia having different shaped loads or load systems.

(1) Hollow cylinder and solid cylinder

The common shape of a rotating body is hollow cylinder. The moment of inertia J (kg·m^2) around the hollow cylinder center axis can be calculated as follows, where the outer and inner diameters are D_1 and D_2 [m] and total mass is W [kg] in Figure 3.10.

$$J = \frac{W \cdot (D_1^2 + D_2^2)}{8} \quad (kg \cdot m^2) \tag{3.12}$$

For a similar shape, a solid cylinder, calculate the moment of inertia as D_2 is 0.

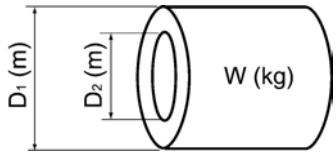
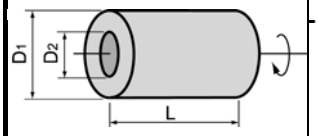
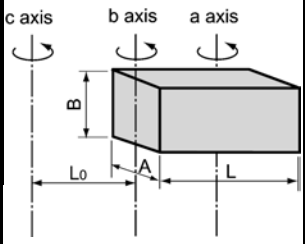
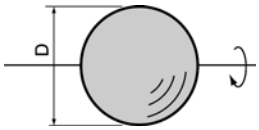
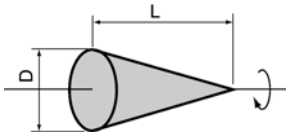
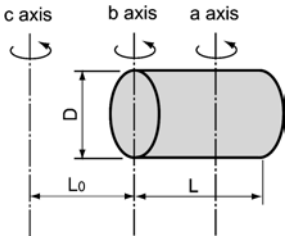
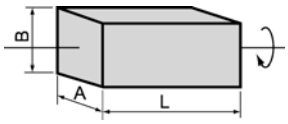
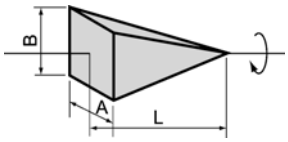
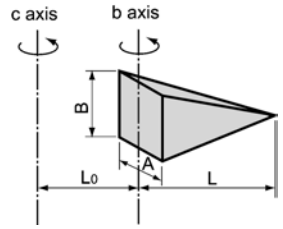
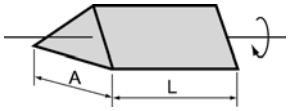
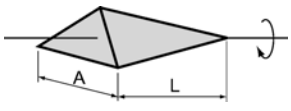
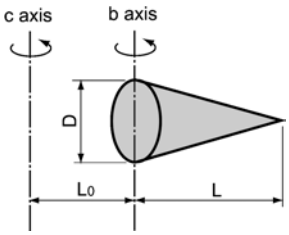


Figure 3.10 Hollow Cylinder

(2) For a general rotating body

Table 3.1 lists the calculation equations of moment of inertia of various rotating bodies including the above cylindrical rotating body.

Table 3.1 Moment of Inertia of Various Rotating Bodies

Shape	Mass: W (kg) Moment of inertia: J (kg·m^2)	Shape	Mass: W (kg) Moment of inertia: J (kg·m^2)
Hollow cylinder 	$W = \frac{\pi}{4} \cdot (D_1^2 - D_2^2) \cdot L \cdot \rho$ $J = \frac{1}{8} \cdot W \cdot (D_1^2 + D_2^2)$		$W = A \cdot B \cdot L \cdot \rho$ $J_a = \frac{1}{12} \cdot W \cdot (L^2 + A^2)$ $J_b = \frac{1}{12} \cdot W \cdot (L^2 + \frac{1}{4} \cdot A^2)$ $J_c \approx W \cdot (L_0^2 + L_0 \cdot L + \frac{1}{3} \cdot L^2)$
Sphere 	$W = \frac{\pi}{6} \cdot D^3 \cdot \rho$ $J = \frac{1}{10} \cdot W \cdot D^2$		
Cone 	$W = \frac{\pi}{12} \cdot D^2 \cdot L \cdot \rho$ $J = \frac{3}{40} \cdot W \cdot D^2$		$W = \frac{\pi}{4} \cdot D^2 \cdot L \cdot \rho$ $J_a = \frac{1}{12} \cdot W \cdot (L^2 + \frac{3}{4} \cdot D^2)$ $J_b = \frac{1}{3} \cdot W \cdot (L^2 + \frac{3}{16} \cdot D^2)$ $J_c \approx W \cdot (L_0^2 + L_0 \cdot L + \frac{1}{3} \cdot L^2)$
Rectangular prism 	$W = A \cdot B \cdot L \cdot \rho$ $J = \frac{1}{12} \cdot W \cdot (A^2 + B^2)$		
Square cone (Pyramid, rectangular base) 	$W = \frac{1}{3} \cdot A \cdot B \cdot L \cdot \rho$ $J = \frac{1}{20} \cdot W \cdot (A^2 + B^2)$		$W = \frac{1}{3} \cdot A \cdot B \cdot L \cdot \rho$ $J_b = \frac{1}{10} \cdot W \cdot (L^2 + \frac{1}{4} \cdot A^2)$ $J_c \approx W \cdot (L_0^2 + \frac{3}{2} \cdot L_0 \cdot L + \frac{3}{5} \cdot L^2)$
Triangular prism 	$W = \frac{\sqrt{3}}{4} \cdot A^2 \cdot L \cdot \rho$ $J = \frac{1}{3} \cdot W \cdot A^2$		
Tetrahedron with an equilateral triangular base 	$W = \frac{\sqrt{3}}{12} \cdot A^2 \cdot L \cdot \rho$ $J = \frac{1}{5} \cdot W \cdot A^2$		$W = \frac{\pi}{12} \cdot D^2 \cdot L \cdot \rho$ $J_b = \frac{1}{10} \cdot W \cdot (L^2 + \frac{3}{8} \cdot D^2)$ $J_c \approx W \cdot (L_0^2 + \frac{3}{2} \cdot L_0 \cdot L + \frac{3}{5} \cdot L^2)$
Main metal density (at 20°C) ρ(kg/m^3) Iron: 7860, Copper: 8940, Aluminum: 2700			

(3) For a load running horizontally

Assume a carrier table driven by a motor as shown in Figure 3.7. If the table speed is υ (m/s) when the motor speed is N_M (r/min), then an equivalent distance from the shaft is equal to $60 \cdot \upsilon / (2\pi \cdot N_M)$ (m). The moment of inertia of the table and load to the shaft is calculated as follows:

$$J = \left(\frac{60 \bullet \upsilon}{2\pi \bullet N_M}\right)^2 \bullet (W_0 + W) \quad (kg \bullet m^2) \tag{3.13}$$

(4) For a vertical or inclined lift load

The moment of inertia J ($kg \cdot m^2$) of the loads connected with a rope as shown in Figures 3.8 and 3.9 is calculated with the following equation using the mass of all moving objects, although the motion directions of those loads are different.

$$J = \left(\frac{60 \bullet \upsilon}{2\pi \bullet N_M}\right)^2 \bullet (W_0 + W + W_B) \quad (kg \bullet m^2) \tag{3.14}$$

[2] Calculation of the acceleration time

Figure 3.11 shows a general load model. Assume that a motor drives a load via a reduction-gear with efficiency η_G. The time required to accelerate this load in stop state to a speed of N_M (r/min) is calculated with the following equation:

$$t_{ACC} = \frac{J_1 + J_2/\eta_G}{\tau_M - \tau_L/\eta_G} \bullet \frac{2\pi \bullet (N_M - 0)}{60} \quad (s) \tag{3.15}$$

where,

J_1: Motor shaft moment of inertia ($kg \cdot m^2$)
J_2: Load shaft moment of inertia converted to motor shaft ($kg \cdot m^2$)
τ_M: Minimum motor output torque in driving motor (N·m)
τ_L: Maximum load torque converted to motor shaft (N·m)
η_G: Reduction-gear efficiency.

As clarified in the above equation, the equivalent moment of inertia becomes (J_1+J_2/η_G) by considering the reduction-gear efficiency.

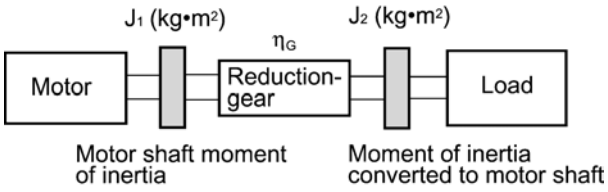


Figure 3.11 Load Model Including Reduction-gear

[3] Calculation of the deceleration time

In a load system shown in Figure 3.11, the time needed to stop the motor rotating at a speed of N_M (r/min) is calculated with the following equation:

$$t_{DEC} = \frac{J_1 + J_2 \cdot \eta_G}{\tau_M - \tau_L \cdot \eta_G} \cdot \frac{2\pi \cdot (0 - N_M)}{60} \quad (s) \qquad (3.16)$$

where,

J_1: Motor shaft moment of inertia (kg·m^2)
J_2: Load shaft moment of inertia converted to motor shaft (kg·m^2)
τ_M: Minimum motor output torque in braking (or decelerating) motor (N·m)
τ_L: Maximum load torque converted to motor shaft (N·m)
η_G: Reduction-gear efficiency

In the above equation, generally output torque τ_M is negative and load torque τ_L is positive. So, deceleration time becomes shorter.

Tip For lift applications, calculate the deceleration time using the negative value of τ_L (maximum load torque converted to motor shaft).

[4] Calculating non-linear acceleration/deceleration time

In applications requiring frequent acceleration/deceleration, the inverter can accelerate/decelerate the motor in the shortest time utilizing all torque margin. The inverter in a vector control mode can easily perform this type of operation.

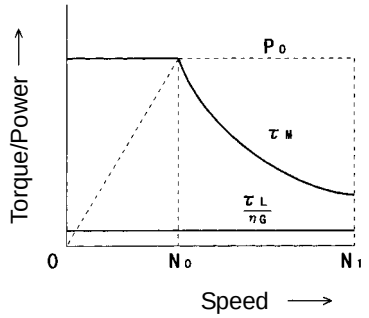


Figure 3.12 An Example of Driving Characteristics with a Constant Output Range

In this case, the acceleration/deceleration vs. speed curve will form a non-linear figure, and the acceleration/deceleration time cannot be calculated by a single expression.

Generally, the acceleration/deceleration time is obtained by calculating the acceleration/deceleration time of ΔN that is a difference of speed N broken into small parts, and then integrating it to obtain the total acceleration/deceleration time from start to end. Because the smaller ΔN provides higher accuracy, this numerical calculation needs an aid of a computer program.

The following is a guide for the numerical calculation method using a computer program.

Figure 3.12 illustrates an example of driving characteristics with a constant output range. In the figure, the range under N_0 is of constant torque characteristics, and the range between N_0 and N_1 is of a constant output with the non-linear acceleration/deceleration characteristics.

[4-1] Calculating non-linear acceleration time

The expression (3.17) gives an acceleration time Δt_{ACC} within a ΔN speed thread.

$$\Delta t_{ACC} = \frac{J_1 + J_2 / \eta_G}{\tau_M - \tau_L / \eta_G} \cdot \frac{2\pi \cdot \Delta N}{60} \quad (s) \tag{3.17}$$

Before proceeding this calculation, obtain the motor shaft moment of inertia J_1, the load shaft moment of inertia converted to motor shaft J_2, maximum load torque converted to motor shaft τ_L, and the reduction-gear efficiency η_G. Apply the maximum motor output torque τ_M according to an actual speed thread ΔN as follows.

[τ_M in $N \leq N_0$] Constant output torque range

$$\tau_M = \frac{60 \cdot P_O}{2\pi \cdot N_0} \quad (N \cdot m) \tag{3.18}$$

[τ_M in $N_0 \leq N \leq N_1$] Constant output power range
(The motor output torque is inversely proportional to the motor speed)

$$\tau_M = \frac{60 \cdot P_O}{2\pi \cdot N} \quad (N \cdot m) \tag{3.19}$$

If the result obtained by the above calculation does not satisfy the target value, select an inverter with one rank higher capacity.

[4-2] Calculating non-linear deceleration time

Use the following expression to obtain the non-linear deceleration time as well as for the acceleration time shown in [4-1].

$$\Delta t_{DEC} = \frac{J_1 + J_2 \cdot \eta_G}{\tau_M - \tau_L \cdot \eta_G} \cdot \frac{2\pi \cdot \Delta N}{60} \quad (s) \tag{3.20}$$

In this expression, both τ_M, and ΔN are generally negative values so that the load torque τ_L serves to assist the deceleration operation. For a lift load, however, the load torque τ_L is a negative value in some modes. In this case, the τ_M, and τ_L will take polarity opposite to each other and the τ_L will serve to prevent the deceleration operation of the lift.

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3.1.3.3 Heat energy calculation of braking resistor

If the inverter brakes the motor, the kinetic energy of mechanical load is converted to electric energy to be regenerated into the inverter circuit. This regenerative energy is often consumed in so-called braking resistors as heat. The following explains the braking resistor rating.

[1] Calculation of regenerative energy

In the inverter operation, one of the regenerative energy sources is the kinetic energy that is generated at the time an object is moved by an inertial force.

(1) Kinetic energy of a moving object

When an object with moment of inertia J ($kg \cdot m^2$) rotates at a speed N_2 (r/min), its kinetic energy is as follows:

$$E = \frac{J}{2} \bullet \left(\frac{2\pi \bullet N_2}{60}\right)^2 \quad (J = Ws) \tag{3.21}$$

$$\approx \frac{1}{182.4} \cdot J \cdot N_2{}^2 \quad (J) \tag{3.21)'}$$

When this object is decelerated to a speed N_1 (r/min), the output energy is as follows:

$$E = \frac{J}{2} \cdot \left[\left(\frac{2\pi \cdot N_2}{60}\right)^2 - \left(\frac{2\pi \cdot N_1}{60}\right)^2\right] \quad (J) \tag{3.22}$$

$$\approx \frac{1}{182.4} \cdot J \cdot (N_2{}^2 - N_1{}^2) \quad (J) \tag{3.22)'}$$

The energy regenerated to the inverter as shown in Figure 3.11 is calculated from the reduction-gear efficiency η_G and motor efficiency η_M as follows:

$$E \approx \frac{1}{182.4} \cdot \left(J_1 + J_2 \cdot \eta_G\right) \cdot \eta_M \cdot \left(N_2{}^2 - N_1{}^2\right) \quad (J) \tag{3.23}$$

(2) Potential energy of a lift

When an object whose mass is W (kg) falls from the height h_2 (m) to the height h_1 (m), the output energy is as follows:

$$E = W \cdot g \cdot (h_2 - h_1) \ (J=Ws) \tag{3.24}$$
$$g \approx 9.8065 \ (m/s^2)$$

The energy regenerated to the inverter is calculated from the reduction-gear efficiency η_G and motor efficiency η_M as follows:

$$E = W \cdot g \cdot (h_2 - h_1) \cdot \eta_G \cdot \eta_M \ (J) \tag{3.25}$$

3.1.3.4 Calculating the RMS rating of the motor

In case of the load which is repeatedly and very frequently driven by a motor, the motor current fluctuates largely and enters the short-time rating range of the motor repeatedly. Therefore, you have to review the allowable thermal rating of the motor. The heat value is assumed to be approximately proportional to the square of the motor current.

If an inverter drives a motor in duty cycles that are much shorter than the thermal time constant of the motor, calculate the "equivalent RMS current" as mentioned below, and select the motor so that this RMS current will not exceed the rated current of the motor.

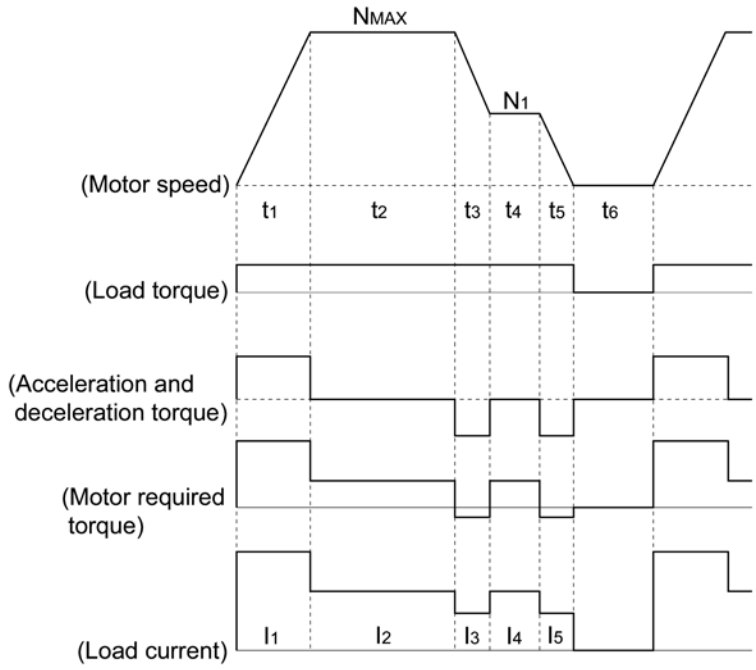

Figure 3.13 Sample of the Repetitive Operation

First, calculate the required torque of each part based on the speed pattern. Then using the torque-current curve of the motor, convert the torque to the motor current. The "equivalent RMS current, I_{eq}" can be finally calculated by the following equation:

$$I_{eq} = \sqrt{\frac{I_1^2 \cdot t_1 + I_2^2 \cdot t_2 + I_3^2 \cdot t_3 + I_4^2 \cdot t_4 + I_5^2 \cdot t_5}{t_1 + t_2 + t_3 + t_4 + t_5 + t_6}} \quad (A) \qquad (3.26)$$

The torque-current curve for the dedicated motor is not available for actual calculation. Therefore, calculate the motor current I from the load torque τ_1 using the following equation (3.27). Then, calculate the equivalent current I_{eq}:

$$I = \sqrt{\left(\frac{\tau_1}{100} \times I_{t100}\right)^2 + I_{m100}^2} \quad (A) \qquad (3.27)$$

Where, τ_1 is the load torque (%), I_{t100} is the torque current, and I_{m100} is exciting current.

3.2 Selecting a Braking Resistor

3.2.1 Selection procedure

Depending on the cyclic period, the following requirements must be satisfied.

① If the cyclic period is 100 s or less: Requirements 1) and 3) below
② If the cyclic period exceeds 100 s: Requirements 1) and 2) below

1) The maximum braking torque should not exceed values listed in Tables 4.6 to 4.9 in Chapter 4, Section 4.4.1.1 "Braking resistor (DBR) and braking unit." To use the maximum braking torque exceeding values in those tables, select the braking resistor having one class larger capacity.
2) The discharge energy for a single braking action should not exceed the discharging capability (kWs) listed in Tables 4.6 to 4.9 in Chapter 4, Section 4.4.1.1 "Braking resistor (DBR) and braking unit." For detailed calculation, refer to Section 3.1.3.3 "Heat energy calculation of braking resistor."
3) The average loss that is calculated by dividing the discharge energy by the cyclic period must not exceed the average allowable loss (kW) listed in Tables 4.6 to 4.9 in Chapter 4, Section 4.4.1.1 "Braking resistor (DBR) and braking unit."

3.2.2 Notes on selection

The braking time T_1, cyclic period T_0, and duty cycle %ED are converted under deceleration braking conditions based on the rated torque as shown below. However, you do not need to consider these values when selecting the braking resistor capacity.

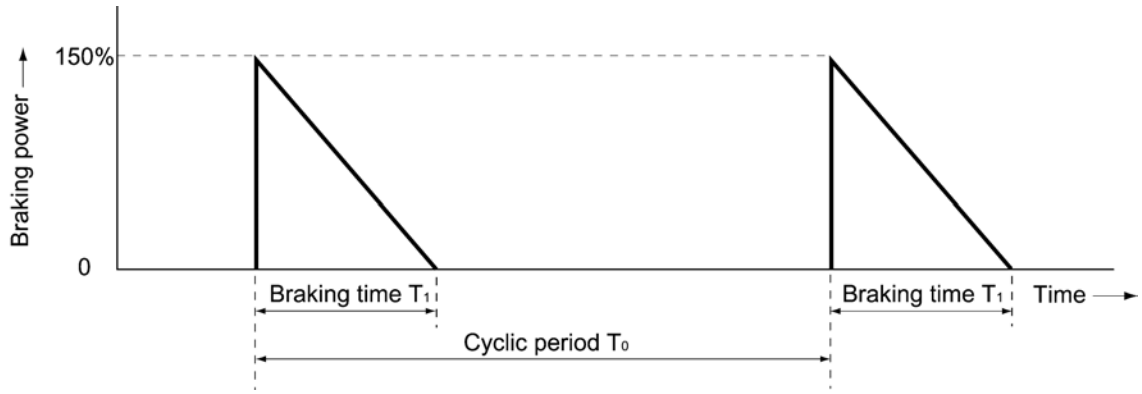

Figure 3.14 Duty Cycle

$$\text{Duty cycle \%ED} = \frac{T1}{T0} \times 100\ (\%)$$

3.3 Selecting an Inverter Drive Mode

3.3.1 Precaution in selecting the inverter drive mode between HD, MD, and LD modes

A FRENIC-MEGA inverter is available in three different drive modes--HD (High Duty: for heavy duty load applications) , MD (Medium Duty: for medium duty load applications), and LD (Low Duty: for light duty load applications), which allows users to switch the drive modes on site.

Select the inverter drive mode appropriate to the user application, considering the motor capacity, overload characteristics, and HD/MD/LD mode referring to Section 3.3.2 "Guideline for selecting inverter drive mode and capacity."

HD mode designed for heavy duty load applications

Apply to general-purpose equipment where the inverter's load current in normal operations is less than the inverter rated current, and the load current in overcurrent operation is less than 150% of the rated current for 1 minute and 200% for 3 seconds.

MD mode designed for medium duty load applications

Apply to equipment where the inverter's load current in normal operations is less than the inverter rated current, and the load current in overcurrent operation is less than 150% of the rated current for 1 minute.

LD mode designed for light duty load applications

Apply to variable load equipment such as fans, pumps, and centrifugal machines where the inverter's load current in normal operations is less than the inverter rated current, and the load current in overcurrent operation is less than 120% of the rated current for 1 minute.

The LD mode is available only in inverters with a capacity of 5.5 kW or above, and the MD mode, in the 400 V class series of inverters with 90 kW or above.

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3.3.2 Guideline for selecting inverter drive mode and capacity

Table 3.2 lists the differences between HD, MD, and LD modes.

If the MD/LD mode specifications satisfy the requirements in your application in view of the overload capability and functionality, you can select the inverter one or two ranks lower in capacity than that of the motor rating.

Table 3.2 Differences between HD, MD, and LD modes

Function	HD mode	MD mode	LD mode (Applies to 5.5 kW or above)	Remarks
Application	Heavy duty load	Medium duty load	Light duty load	—
Function code data setting (Switching between HD, MD, and LD modes)	F80 = 0, Factory default	F80 = 2	F80 = 1	—
Continuous current rating level (inverter rated current level)	Capable of driving a motor whose capacity is the same as the inverter's one.	Capable of driving a motor whose capacity is one rank higher than the inverter's one.	Capable of driving a motor whose capacity is one or two ranks higher than the inverter's one.	The MD-/LD-mode inverter brings out the continuous current rating level which enables the inverter to drive a motor with one or two ranks higher capacity, but its overload capability (%) against the continuous current level decreases. For the rated current level, refer to Chapter 2 "SPECIFICATIONS."
Overload capability	150% for 1 min. 200% for 3 s	150% 1 min	120% 1 min	
Maximum frequency	Setting range: 25 to 500 Hz Upper limit: 500 Hz	Setting range: 25 to 500 Hz Upper limit: 120 Hz		In the MD/LD mode, if the maximum frequency exceeds 120 Hz, the actual output frequency is internally limited to 120 Hz.
DC braking (Braking level)	Setting range: 0 to 100%	Setting range: 0 to 80%		In the MD/LD mode, a value out of the range, if specified, automatically changes to the maximum value allowable in the MD/LD mode.
Motor sound (Carrier frequency)	Setting range: 0.75 to 16 kHz (0.4 to 55 kW) 0.75 to 10 kHz (75 to 220 kW)	Setting range: 0.75 to 2 kHz (90 to 220 kW)	Setting range: 0.75 to 16 kHz (5.5 to 18.5 kW) 0.75 to 10 kHz (22 to 55 kW) 0.75 to 6 kHz (75 to 220 kW)	
Current limiter (Level)	Initial value: 160%	Initial value: 145%	Initial value: 130%	Switching the drive mode between HD, MD, and LD with function code F80 automatically initializes the F44 data to the value specified at left.
Current indication and output	Based on the rated current level for HD mode	Based on the rated current level for MD mode	Based on the rated current level for LD mode	—

3.4 Selecting a Motor Drive Control

3.4.1 Features of motor drive controls

The FRENIC-MEGA supports the following motor drive controls.

This section shows their basic configurations and describes their features.

Drive control	Basic control	Speed feedback	Speed control
V/f control with slip compensation inactive	V/f control	Disable	Frequency control
Dynamic torque vector control			Frequency control with slip compensation
V/f control with slip compensation active			
Vector control without speed sensor	Vector control	Estimated speed	Speed control with automatic speed regulator (ASR)
Vector control with speed sensor*		Enable	

Additionally, the FRENIC-MEGA reserves the following motor drive controls for future support options.

- V/f control with speed sensor*
- Dynamic torque vector control with speed sensor*

Note that the controls marked with an asterisk (*) require an optional PG (Pulse Generator) interface card.

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■ V/f control with slip compensation inactive

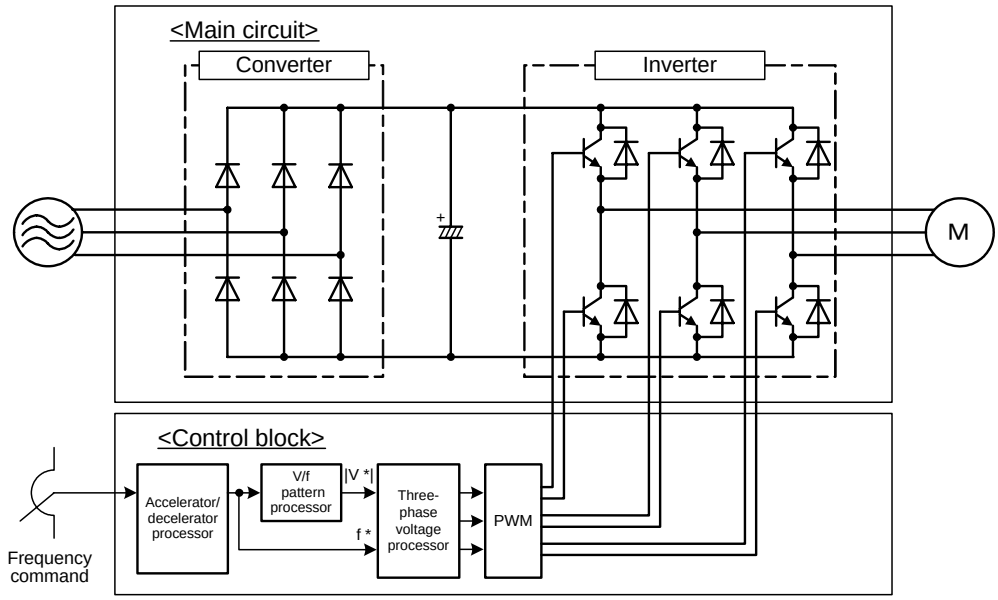

Figure 3.15 Schematic Block Diagram of
V/f Control with Slip Compensation Inactive

As shown in the above configuration, the inverter does not receive any speed information feedback from the target machinery being controlled and it controls the load shaft speed only with a frequency command given by the frequency setting device (open-loop control). The inverter outputs the voltage/frequency following the V/f pattern processor's output to drive a motor. This control disables all automatically controlled features (such as the slip compensation), causing no unpredictable output fluctuation and enabling stable operation with constant output frequency.

This control is suitable for applications that do not need quick speed change such as variable torque load equipment, fans and pumps.

■ Dynamic torque vector control

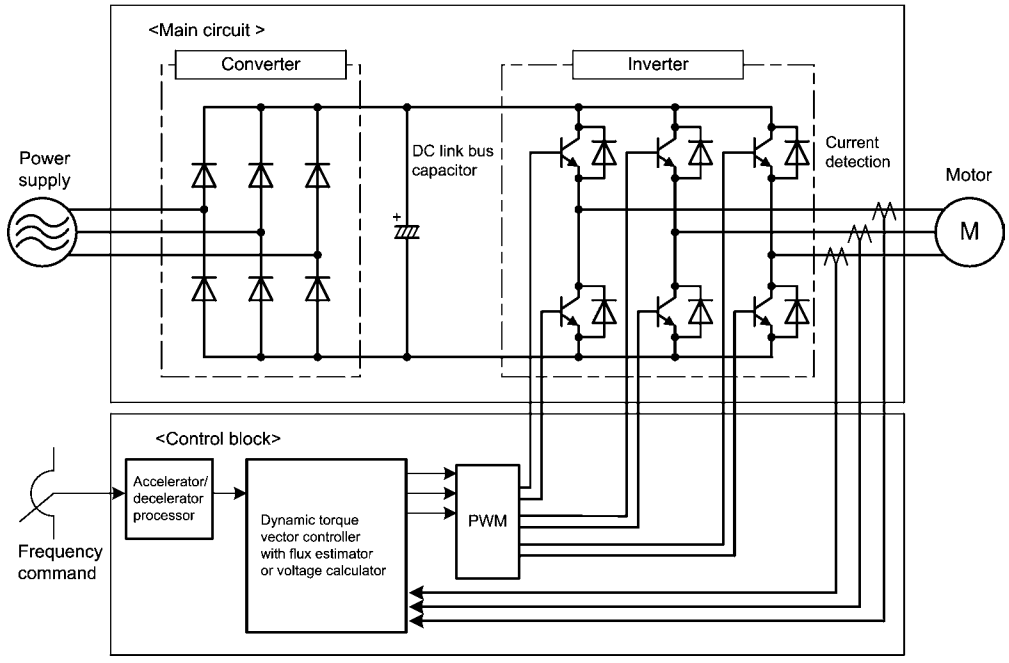

Figure 3.16 Schematic Block Diagram of
Dynamic Torque Vector Control

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The FRENIC-MEGA features the dynamic torque vector controller with the flux estimator, which is always correcting the magnetic flux phase while monitoring the inverter output current as the feedback. This feature allows the inverter to always apply the drive power with an optimal voltage and current and consequently respond to quick load variation or speed change.
The feature also estimates the generated torque of the motor from the estimated flux data and output current to the motor to improve the motor efficiency for matching the current operation situation.

This control mode is effective for applications that need large torque in low speed range or that have quick load fluctuations. Selecting the dynamic torque vector control automatically enables the auto-torque boost and slip compensation.

■ V/f control with slip compensation active

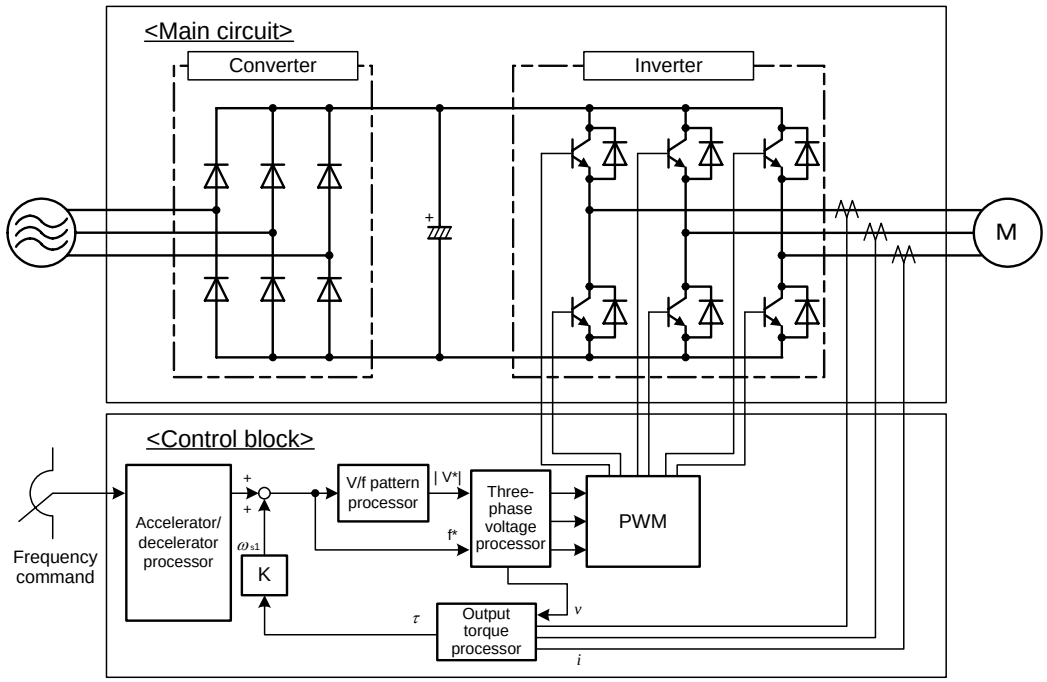

Figure 3.17 Schematic Block Diagram of
V/f Control with Slip Compensation Active

Applying any load to an induction motor causes a rotational slip due to the motor characteristics, decreasing the motor rotation. The inverter's slip compensation function first presumes the slip value of the motor based on the motor torque generated and raises the output frequency to compensate for the decrease in motor rotation. This prevents the motor from decreasing the rotation due to the slip.

That is, this function is effective for improving the motor speed control accuracy.

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■ Vector control without speed sensor

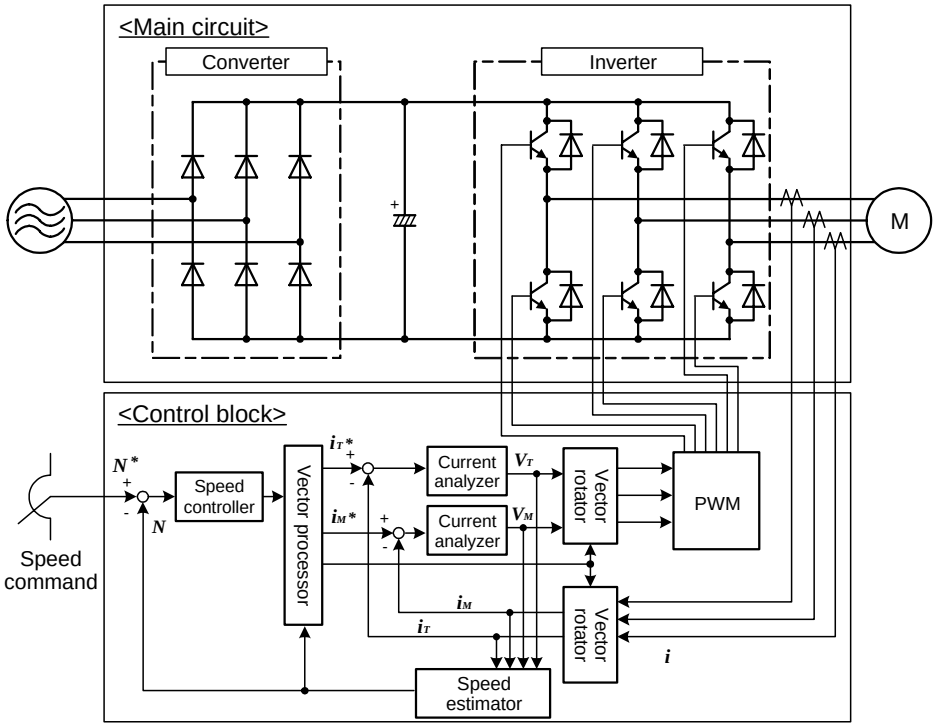

Figure 3.18 Schematic Block Diagram of Vector Control without Speed Sensor

This control estimates the motor speed based on the inverter's output voltage and current to use the estimated speed for speed control. In addition, it decomposes the motor drive current into the exciting and torque current components, and controls each of those components in vector. No PG (pulse generator) interface card is required. It is possible to obtain the desired response by adjusting the control constants (PI constants) using the speed regulator (PI controller).

The vector control without speed sensor in the FRENIC-MEGA series has adopted the magnetic flux observer system, improving the control performance in the low speed domain.

Since this control controls the motor current, it is necessary to secure some voltage margin between the voltage that the inverter can output and the induced voltage of the motor, by keeping the former lower than the latter. Usually the voltage of the general-purpose motor has been adjusted to match the commercial power, however, in order to secure the voltage margin, it is necessary to keep the motor terminal voltage low.

If the motor is driven under this control with the motor terminal voltage being low, the rated torque cannot be obtained even when the rated current originally specified for the motor is applied. To secure the rated torque, therefore, it is necessary to use a motor with higher rated current. (This also applies to the vector control with speed sensor.)

This control is not available for MD-mode inverters, so do not set F42 data to "5" for those inverters.

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■ Vector control with speed sensor

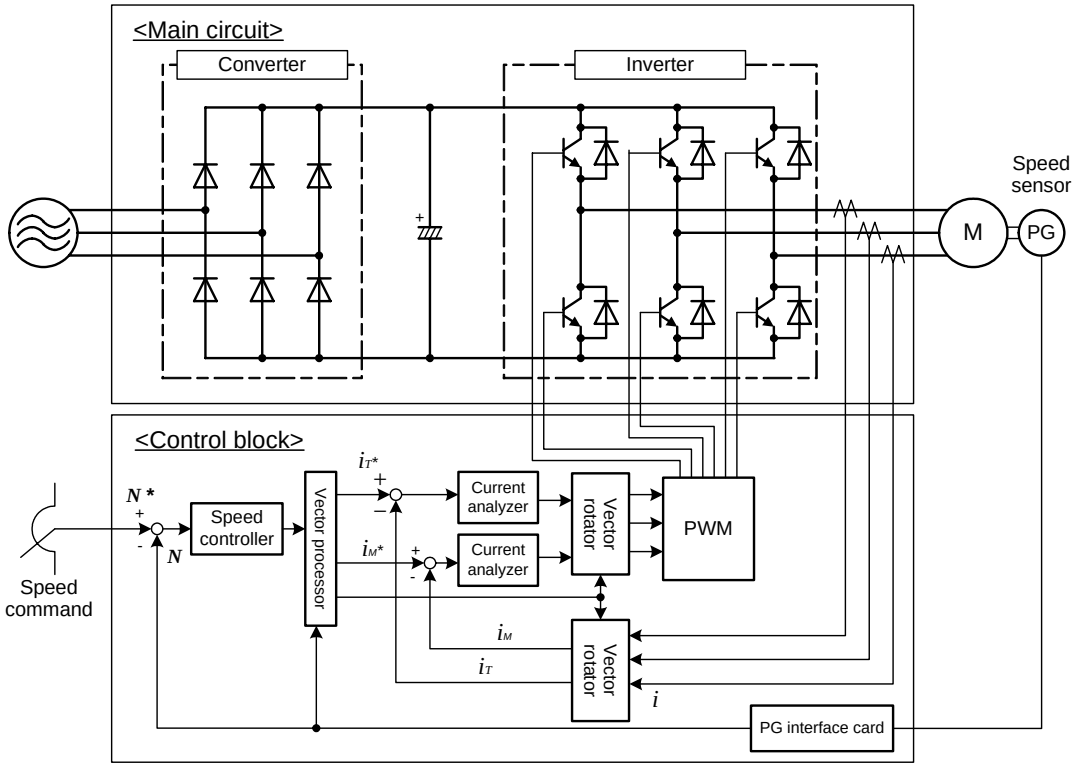

Figure 3.19 Schematic Block Diagram of Vector Control with Speed Sensor

As shown in the above configuration, the inverter is equipped with an optional PG (Pulse Generator) interface card and receives the feedback signals from the PG to detect the motor rotational position and speed. This enables rapid-response control of the motor speed with high accuracy. (It is recommended to use Fuji motors exclusively designed for vector control.)

By dividing the current flowing across the motor into the exciting current and torque current to control them separately, the inverter can control an induction motor with as high controllability as a DC motor.

This control is suitable for:

- Applications that need to minimize the speed fluctuation over quick load variations
- Applications that need highly precise positioning
- Applications that need the servo-lock function to generate a holding torque negating external disturbances even while the motor is stopping
- Applications that need large torque output in low speed operation
- Applications that need to protect the equipment from an unexpectedly outputted large torque, because the torque limiting/controlling function is available

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3.4.2 Selecting a Motor Drive Control by Purpose

Listed below is a general guide for selecting a motor drive control by purpose. Use this guide just for reference. In individual cases, selection should be made carefully after a technical consultation regarding the detailed specifications of your system.

Table 3.3 Motor Drive Control by Purpose

Drive control abbreviation: "V/f" (V/f control), "Torque vector" (Dynamic torque vector control), "w/o PG" (Vector control without speed sensor), "w/ PG" (Vector control with speed sensor)

Type of industry	Applications	Segment	Drive control			
			V/f	Torque vector	w/o PG	w/ PG
Delivery equipment	Crane (Hoisting)	Large crane	N	N	N	Y
		Overhead crane	N	N	N	Y
		Compact hoist-type crane	N	Y	Y	Y
	(Traveling)	1 : 1	Y*	Y*	Y*	Y
	(Traveling)	1 : N	Y	N	N	N
	(Traversing)		N	Y*	Y*	Y
	(Traversing)	With anti-sway control	N	N	N	Y
	Traveling dolly	Single motor	Y	Y	Y	Y
		Multiple motors	Y	Y	N	Y*
	Roller table		N	N	N	Y
	Parking tower (Elevator type)	Less than 50 m/min	Y*	Y	Y	Y
		50m/min or above	Y*	Y*	Y*	Y
		50m/min or above, zero speed required	N	N	N	Y*
	Parking tower (Circulation type)		Y*	Y	Y	Y
	Multistory warehouse (Stacker crane)	With position compensation	N	N	Y*	Y
		Without position compensation	Y	Y	Y	Y
	Variable speed escalator		Y*	Y	Y	Y
Plastic	Extruding machine	Low precision	N	Y	N	Y
		High precision	N	N	N	Y
Metalworking	Wire drawing machine	Straight type with dancer	N	N	N	Y
		Storage type	Y*	Y	Y	Y
	Drawbench		Y*	Y	Y	Y
	Twisting machine	Main unit	N	N	N	Y
		Auxiliary machine	N	N	N	Y
	Press main engine driving	Standard type	Y	Y	Y	Y
		High-speed press	Y*	Y	Y	Y
	Winder/unwinder for iron and steel		N	N	N	Y*
Printing and binding	Cut-sheet printer		N	N	N	Y
	Offset printer		N	N	N	Y
	Continuous feed printer (Rotary press)	Line shaft	N	N	N	Y
Textile	Synthetic fiber spinning	Winder	N	N	N	Y
		Traverser	N	N	N	Y
		Various rolls, gear pump	Y	Y	Y	Y
	Preparing machine	Taking-up	N	N	N	Y*
		Feeding	N	N	N	Y*
Others	Winder without dancer	Center drive (winding off)	N	N	N	Y*
		Surface drive	N	N	N	Y
	Winder with dancer	Center drive (winding off)	Y*	Y	Y	Y
		Center drive (taking up)	Y*	Y	Y	Y
	(Cement) kiln		Y*	Y	Y	Y
	Centrifuge		Y*	Y	Y	Y
	Agitator		Y*	Y	Y	Y
	Crusher		Y*	Y	Y*	Y
	Vibration exciter		N	N	N	Y*
	Straightening machine		N	N	N	Y
	Grinder		N	N	N	Y
	Machine tool (large)		N	N	N	Y
	Automotive test equipment	Mission tester	N	N	N	Y*

Y: Applicable (Examination required), Y*: Examination required, N: Not applicable

Chapter 4

SELECTING PERIPHERAL EQUIPMENT

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

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4.1 Configuring the FRENIC-MEGA

This section lists the names and features of peripheral equipment and options for the FRENIC-MEGA series of inverters and includes a configuration example for reference. Refer to Figure 4.1 for a quick overview of available options.

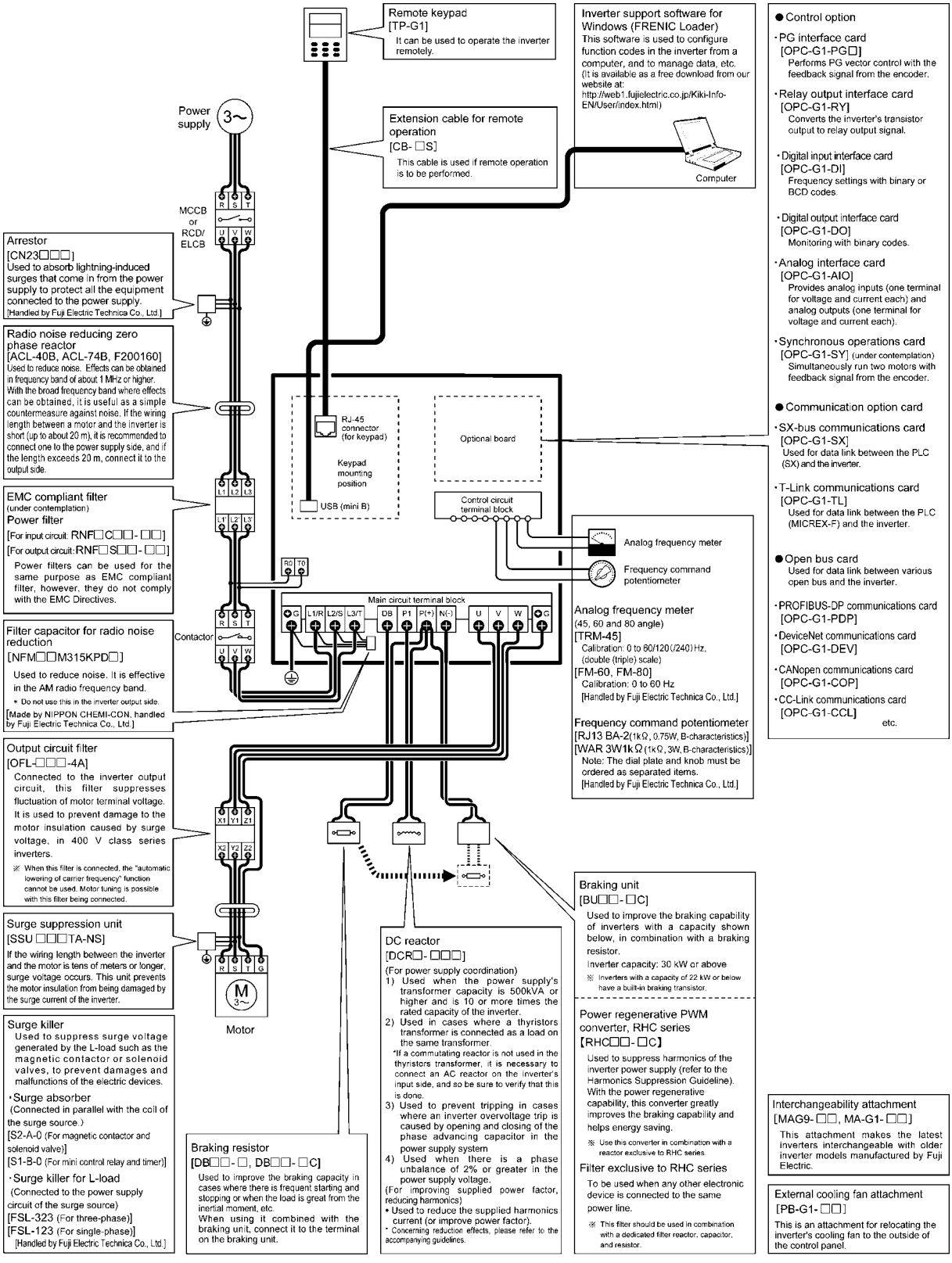

Figure 4.1 Quick Overview of Options

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4.2 Selecting Wires and Crimp Terminals

This section contains information needed to select wires for connecting the inverter to commercial power lines, motor or any of the optional/peripheral equipment. The level of electric noise issued from the inverter or received by the inverter from external sources may vary depending upon wiring and routing. To solve such noise-related problems, refer to Appendix A "Advantageous Use of Inverters (Notes on electrical noise)."

Select wires that satisfy the following requirements:

- Sufficient capacity to flow the rated average current (allowable current capacity).
- Protective coordination with an MCCB or RCD/ELCB with overcurrent protection in the overcurrent zone.
- Voltage loss due to the wire length is within the allowable range.
- Suitable for the type and size of terminals of the optional equipment to be used.

Recommended wires are listed below. Use these wires unless otherwise specified.

■ 600 V class of vinyl-insulated wires (IV wires)

Use this class of wire for the power circuits. This class of wire is hard to twist, so using it for the control signal circuits is not recommended. Maximum surrounding temperature for this wire is 60°C.

■ 600 V grade heat-resistant PVC insulated wires or 600 V polyethylene insulated wires (HIV wires)

As wires in this class are smaller in diameter and more flexible than IV wires and can be used at a higher surrounding temperature (75°C), they can be used for both of the main power and control signal circuits. To use this class of wire for the control circuits, you need to correctly twist the wires and keep the wiring length for equipment being connected as short as possible.

■ 600 V cross-linked polyethylene-insulated wires

Use this class of wire mainly for power and grounding circuits. These wires are smaller in diameter and more flexible than those of the IV and HIV classes of wires, meaning that these wires can be used to save on space and increase operation efficiency of your power system, even in high temperature environments. The maximum allowable surrounding temperature for this class of wires is 90°C. The (Boardlex) wire range available from Furukawa Electric Co., Ltd. satisfies these requirements.

■ Shielded-Twisted cables for internal wiring of electronic/electric equipment

Use this category of cables for the control circuits of the inverter so as to prevent the signal lines from being affected by noise from external sources, including the power input/output lines of the inverter themselves. Even if the signal lines are inside the power control panel, always use this category of cables when the length of wiring is longer than normal. Cables satisfying these requirements are the Furukawa's BEAMEX S shielded cables of the XEBV and XEWV ranges.

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Currents Flowing across the Inverter Terminals

Table 4.1 summarizes average (effective) electric currents flowing across the terminals of each inverter model for ease of reference when selecting peripheral equipment, options and electric wires for each inverter--including supplied power voltage and applicable motor rating.

Table 4.1 Currents Flowing through Inverter

HD (High Duty) mode: Heavy duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	HD/LD	Nominal applied motor (kW)	Inverter type	200 V, 50 Hz			220 V, 60 Hz			Braking resistor circuit current (A)
				Input RMS current (A) DC reactor (DCR)		DC link bus current (A)	Input RMS current (A) DC reactor (DCR)		DC link bus current (A)	
				w/ DCR	w/o DCR		w/ DCR	w/o DCR		
Three-phase 200 V	HD	0.4	FRN0.4G1■-2□	1.6	3.1	2.0	1.5	3.0	1.8	1.2
	HD	0.75	FRN0.75G1■-2□	3.2	5.3	4.0	3.0	4.9	3.7	1.6
	HD	1.5	FRN1.5G1■-2□	6.1	9.5	7.5	5.6	8.7	6.9	3.6
	HD	2.2	FRN2.2G1■-2□	8.9	13.2	11.0	8.1	12.0	10.0	3.5
	HD	3.7	FRN3.7G1■-2□	15.0	22.2	18.4	13.6	20.0	16.7	4.1
	HD	5.5	FRN5.5G1■-2□	21.1	31.5	25.9	19.0	28.4	23.3	6.4
	LD	7.5		28.8	42.7	35.3	26.0	38.5	31.9	6.4
	HD	7.5	FRN7.5G1■-2□	28.8	42.7	35.3	26.0	38.5	31.9	6.1
	LD	11		42.2	60.7	51.7	38.0	54.7	46.6	6.1
	HD	11	FRN11G1■-2□	42.2	60.7	51.7	38.0	54.7	46.6	9.1
	LD	15		57.6	80.1	70.6	52.0	72.2	63.7	9.1
	HD	15	FRN15G1■-2□	57.6	80.1	70.6	52.0	72.2	63.7	11
	LD	18.5		71.0	97.0	87.0	64.0	87.4	78.4	11
	HD	18.5	FRN18.5G1■-2□	71.0	97.0	87.0	64.0	87.4	78.4	14
	LD	22		84.4	112	103	76.0	101	93.1	14
	HD	22	FRN22G1■-2□	84.4	112	103	76.0	101	93.1	15
	LD	30		114	151	140	103	136	126	15
	HD	30	FRN30G1■-2□	114	151	140	103	136	126	19
	LD	37		138	185	169	124	167	152	19
	HD	37	FRN37G1■-2□	138	185	169	124	167	152	25
	LD	45		167	225	205	150	203	184	25
	HD	45	FRN45G1■-2□	167	225	205	150	203	184	30
	LD	55		203	270	249	183	243	224	30
	HD	55	FRN55G1■-2□	203	270	249	183	243	224	37
	LD	75		282		345	254		311	37
	HD	75	FRN75G1■-2□	282		345	254		311	49
	LD	90		334	-	409	301	-	368	49
	HD	90	FRN90G1■-2□	334		409	301		368	62
	LD	110		410		502	369		452	62

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

- Inverter efficiency is calculated using values suitable for each inverter model. The input route mean square (RMS) current is calculated according to the following conditions:

  22 kW or below: Power supply capacity 500 kVA, Power supply impedance 5%

  30 kW or above: Power supply capacity and power supply impedance which are calculated using values matching the inverter capacity recommended by Fuji Electric Systems.

- The input RMS current listed in the above table will vary in inverse proportion to the power supply voltage, such as 230 VAC.
- The braking current is always constant, independent of braking resistor specifications, including built-in, standard and 10%ED models.

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Table 4.1 Currents Flowing through Inverter (continued)

HD (High Duty) mode: Heavy duty load applications
MD (Medium Duty) mode: Medium duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	HD/ MD/ LD	Nominal applied motor (kW)	Inverter type	400 V, 50 Hz			440 V, 60 Hz			Braking resistor circuit current (A)
				Input RMS current (A)		DC link bus current (A)	Input RMS current (A)		DC link bus current (A)	
				DC reactor (DCR)			DC reactor (DCR)			
				w/ DCR	w/o DCR		w/ DCR	w/o DCR		
Three-phase 400 V	HD	0.4	FRN0.4G1■-4□	0.85	1.7	1	0.74	1.7	0.99	0.8
	HD	0.75	FRN0.75G1■-4□	1.6	3.1	2.0	1.5	2.9	1.9	1.1
	HD	1.5	FRN1.5G1■-4□	3.0	5.9	3.7	2.8	5.4	3.5	1.8
	HD	2.2	FRN2.2G1■-4□	4.5	8.2	5.6	4.1	7.5	5.1	1.8
	HD	3.7	FRN3.7G1■-4□	7.5	13	9.2	6.9	11.8	8.5	2.1
	HD	5.5	FRN5.5G1■-4□	10.6	17.3	13.0	9.6	15.7	11.8	3.2
	LD	7.5		14.4	23.2	17.7	13.0	21.0	16.0	3.2
	HD	7.5	FRN7.5G1■-4□	14.4	23.2	17.7	13.0	21.0	16.0	3.1
	LD	11		21.1	33.0	25.9	19.0	29.8	23.3	3.1
	HD	11	FRN11G1■-4□	21.1	33.0	25.9	19.0	29.8	23.3	4.5
	LD	15		28.8	43.8	35.3	26.0	39.5	31.9	4.5
	HD	15	FRN15G1■-4□	28.8	43.8	35.3	26.0	39.5	31.9	5.7
	LD	18.5		35.5	52.3	43.5	32.0	47.1	39.2	5.7
	HD	18.5	FRN18.5G1■-4□	35.5	52.3	43.5	32.0	47.1	39.2	7.2
	LD	22		42.2	60.6	51.7	38.0	54.6	46.6	7.2
	HD	22	FRN22G1■-4□	42.2	60.6	51.7	38.0	54.6	46.6	7.7
	LD	30		57.0	77.9	69.9	51.4	70.2	63.0	7.7
	HD	30	FRN30G1■-4□	57.0	77.9	69.9	51.4	70.2	63.0	10
	LD	37		68.5	94.3	83.9	61.8	85.0	75.7	10
	HD	37	FRN37G1■-4□	68.5	94.3	83.9	61.8	85.0	75.7	12
	LD	45		83.2	114	102	75.0	103	91.9	12
	HD	45	FRN45G1■-4□	83.2	114	102	75.0	103	91.9	15
	LD	55		102	140	125	91.9	126	113	15
	HD	55	FRN55G1■-4□	102	140	125	91.9	126	113	19
	LD	75		138		169	124		152	19
	HD	75	FRN75G1■-4□	138		169	124		152	24
	LD	90		164		201	148		181	24
	HD	90	FRN90G1■-4□	164		201	148		181	31
	MD/LD	110		201		246	181		222	35/31
	HD	110	FRN110G1■-4□	201		246	181		222	35
	MD/LD	132		238	-	292	214	-	263	42/35
	HD	132	FRN132G1■-4□	238		292	214		263	42
	MD/LD	160		286		350	258		315	50/42
	HD	160	FRN160G1■-4□	286		350	258		315	50
	MD/LD	200		357		437	321		394	62/50
	HD	200	FRN200G1■-4□	357		437	321		394	62
	MD/LD	220		390		478	351		430	71/62

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

- Inverter efficiency is calculated using values suitable for each inverter model. The input route mean square (RMS) current is calculated according to the following conditions:

  22 kW or below: Power supply capacity 500 kVA, Power supply impedance 5%

  30 kW or above: Power supply capacity and power supply impedance which are calculated using values matching the inverter capacity recommended by Fuji Electric Systems.

- The input RMS current listed in the above table will vary in inverse proportion to the power supply voltage, such as 380 VAC.
- The braking current is always constant, independent of braking resistor specifications, including built-in, standard and 10%ED models.

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Table 4.1 Currents Flowing through Inverter (continued)

HD (High Duty) mode: Heavy duty load applications
MD (Medium Duty) mode: Medium duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	HD/ MD/ LD	Nominal applied motor (kW)	Inverter type	400 V, 50 Hz			440 V, 60 Hz			Braking resistor circuit current (A)
				Input RMS current (A) DC reactor (DCR)		DC link bus current (A)	Input RMS current (A) DC reactor (DCR)		DC link bus current (A)	
				w/ DCR	w/o DCR		w/ DCR	w/o DCR		
Three-phase 400 V	HD	220	FRN220G1■-4□	390		478	351		430	71
	MD	250		443		543	399		489	100
	LD	280		500		613	450		552	71
	HD	280	FRN280G1■-4□	500		613	450		552	100
	MD	315		559		685	503		617	100
	LD	355		628		770	565		693	100
	HD	315	FRN315G1■-4□	559		685	503		617	100
	MD	355		628		770	565		693	124
	LD	400		705		864	635		778	124
	HD	355	FRN355G1■-4□	628	-	770	565	-	693	124
	MD	400		705		864	635		778	124
	LD	450		789		967	710		870	124
	HD	400	FRN400G1■-4□	705		864	635		778	124
	MD	450		789		967	710		870	150
	LD	500		881		1080	793		972	124
	HD	500	FRN500G1■-4□	881		1080	793		972	186
	LD	630		1115		1367	1004		1230	186
	HD	630	FRN630G1■-4□	1115		1367	1004		1230	212
	LD	710		1256		1539	1130		1385	212

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

- Inverter efficiency is calculated using values suitable for each inverter model. The input route mean square (RMS) current is calculated according to the following conditions:

  22 kW or below: Power supply capacity 500 kVA, Power supply impedance 5%

  30 kW or above: Power supply capacity and power supply impedance which are calculated using values matching the inverter capacity recommended by Fuji Electric Systems.

- The input RMS current listed in the above table will vary in inverse proportion to the power supply voltage, such as 380 VAC.
- The braking current is always constant, independent of braking resistor specifications, including built-in, standard and 10%ED models.

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4.2.1 Recommended wires

Tables 4.2 and 4.3 list the recommended wires according to the internal temperature of your power control panel.

■ If the internal temperature of your power control panel is 50°C or below

Table 4.2 Wire Size (for main circuit power input and inverter output)

HD (High Duty) mode: Heavy duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	Recommended wire size (mm^2)																			
				Main circuit power input [L1/R, L2/S, L3/T]								Inverter output [U, V, W]											
				w/ DC reactor (DCR)				w/o DC reactor (DCR)				HD				MD				LD			
				Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current
				60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	2.0	2.0	2.0	1.6	2.0	2.0	2.0	3.1	2.0	2.0	2.0	3	-	-	-	-	-	-	-	-
	0.75	FRN0.75G1■-2□		2.0	2.0	2.0	3.2	2.0	2.0	2.0	5.3	2.0	2.0	2.0	5	-	-	-	-	-	-	-	-
	1.5	FRN1.5G1■-2□		2.0	2.0	2.0	6.1	2.0	2.0	2.0	9.5	2.0	2.0	2.0	8	-	-	-	-	-	-	-	-
	2.2	FRN2.2G1■-2□		2.0	2.0	2.0	8.9	2.0	2.0	2.0	13.2	2.0	2.0	2.0	11	-	-	-	-	-	-	-	-
	3.7	FRN3.7G1■-2□		2.0	2.0	2.0	15.0	5.5	2.0	2.0	22.2	3.5	2.0	2.0	18	-	-	-	-	-	-	-	-
	5.5	FRN5.5G1■-2□	HD	5.5	2.0	2.0	21.1	8.0	3.5	3.5	31.5	5.5	3.5	2.0	27	-	-	-	-	-	-	-	-
	7.5		LD	8.0	3.5	2.0	28.8	14	5.5	5.5	42.7	-	-	-	-	-	-	-	-	8.0	3.5	3.5	31.8
		FRN7.5G1■-2□	HD									14	5.5	3.5	37					-	-	-	-
	11		LD	14	5.5	5.5	42.2	22	14	8.0	60.7	-	-	-	-	-	-	-	-	14	8.0	5.5	46.2
		FRN11G1■-2□	HD									14	8.0	5.5	49					-	-	-	-
	15		LD	22	14	8.0	57.6	38 *4)	22	14	80.1	-	-	-	-	-	-	-	-	22 *5)	14	8.0	59.4
		FRN15G1■-2□	HD									22 *5)	14	8.0	63					-	-	-	-
	18.5		LD	38 *1)	14	14	71.0	60 *2)	22	14	97.0	-	-	-	-	-	-	-	-	38 *1)	14	14	74.8
		FRN18.5G1■-2□	HD									38 *1)	14	14	76					-	-	-	-
	22		LD	38 *1)	22	14	84.4	60 *2)	38 *1)	22	112	-	-	-	-	-	-	-	-	38 *1)	22	14	88
		FRN22G1■-2□	HD									38 *1)	22	14	90					-	-	-	-
	30		LD	60 *2)	38 *1)	22	114	100 *6)	60 *2)	38 *1)	151	-	-	-	-	-	-	-	-	60 *2)	38 *1)	22	115
		FRN30G1■-2□	HD	60	38			-	60	38		60	38	22	119					-	-	-	-
	37		LD	-	38	38	138	-	60	38	185	-	-	-	-	-	-	-	-	-	38	38	146
		FRN37G1■-2□	HD	100								100	38	38	146					-	-	-	-
	45		LD	100	60	38	167	-	100	60	225	-	-	-	-	-	-	-	-	-	60	38	180
		FRN45G1■-2□	HD									-	60	38	180					-	-	-	-
	55		LD	-	100	60	203	-	100	100	270	-	-	-	-	-	-	-	-	-	100	60	215
		FRN55G1■-2□	HD									-	100	60	215					-	-	-	-
	75		LD	-	150 *7)	100	282	-	-	-	-	-	-	-	-	-	-	-	-	-	150 *7)	100	283
		FRN75G1■-2□	HD									-	150	100	283					-	-	-	-
	90		LD	-	150	100	334	-	-	-	-	-	-	-	-	-	-	-	-	-	150	150	346
		FRN90G1■-2□	HD									-	150	150	346					-	-	-	-
	110		LD	-	200	150	410	-	-	-	-	-	-	-	-	-	-	-	-	-	200	150	415

Note 1: Assuming the use of aerial wiring (without rack or duct): 600 V class of vinyl-insulated IV wires for 60°C, 600 V class of polyethylene-insulated HIV wires for 75°C, and 600 V cross-linked polyethylene insulated wires for 90°C.

Note 2: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

*1 Use the crimp terminal model No. 38-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*2 Use the crimp terminal model No. 60-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*4 Use the crimp terminal model No. 38-S5 manufactured by JST Mfg. Co., Ltd., or equivalent.

*5 Use the crimp terminal model No. 22-S5 manufactured by JST Mfg. Co., Ltd., or equivalent.

*6 Use the crimp terminal model No. CB100-S8 manufactured by JST Mfg. Co., Ltd., or equivalent.

*7 Use CB150-10 crimp terminals designed for low voltage appliances in JEM1399.

*3 (Not applicable.)

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Table 4.2 Wire Size (for main circuit power input and inverter output) (continued)

HD (High Duty) mode: Heavy duty load applications
MD (Medium Duty) mode: Medium duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD	Recommended wire size (mm²)																							
				Main circuit power input [L1/R, L2/S, L3/T]								Inverter output [U, V, W]															
				w/ DC reactor (DCR)				w/o DC reactor (DCR)				HD				MD				LD							
				Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current				
				60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)				
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	2.0	2.0	2.0	0.85	2.0	2.0	2.0	1.7	2.0	2.0	2.0	1.5	-	-	-	-	-	-	-	-				
	0.75	FRN0.75G1■-4□		2.0	2.0	2.0	1.6	2.0	2.0	2.0	3.1	2.0	2.0	2.0	2.5	-	-	-	-	-	-	-	-				
	1.5	FRN1.5G1■-4□		2.0	2.0	2.0	3.0	2.0	2.0	2.0	5.9	2.0	2.0	2.0	4	-	-	-	-	-	-	-	-				
	2.2	FRN2.2G1■-4□		2.0	2.0	2.0	4.5	2.0	2.0	2.0	8.2	2.0	2.0	2.0	5.5	-	-	-	-	-	-	-	-				
	3.7	FRN3.7G1■-4□		2.0	2.0	2.0	7.5	2.0	2.0	2.0	13.0	2.0	2.0	2.0	9	-	-	-	-	-	-	-	-				
	5.5	FRN5.5G1■-4□	HD	2.0	2.0	2.0	10.6	3.5	2.0	2.0	17.3	2.0	2.0	2.0	13.5	-	-	-	-	-	-	-	-				
	7.5		LD	2.0	2.0	2.0	14.4	5.5	2.0	2.0	23.2	-	-	-	-	-	-	-	-	3.5	2.0	2.0	16.5				
		FRN7.5G1■-4□	HD									3.5	2.0	2.0	18.5					-	-	-	-				
	11		LD	8.0	2.0	2.0	21.1	8.0	3.5	3.5	33	-	-	-	-	-	-	-	-	5.5	2.0	2.0	23				
		FRN11G1■-4□	HD									5.5	3.5	2.0	24.5					-	-	-	-				
	15		LD	8.0	3.5	2.0	28.8	14	5.5	5.5	43.8	-	-	-	-	-	-	-	-	8.0	3.5	2.0	30.5				
		FRN15G1■-4□	HD									8.0	3.5	3.5	32					-	-	-	-				
	18.5		LD	14	5.5	3.5	35.5	22	8.0 *3)	5.5	52.3	-	-	-	-	-	-	-	-	14	5.5	3.5	37				
		FRN18.5G1■-4□	HD									14	5.5	3.5	39					-	-	-	-				
	22		LD	14	5.5	5.5	42.2	22	14	8.0 *3)	60.6	-	-	-	-	-	-	-	-	14	8.0 *3)	5.5	45				
		FRN22G1■-4□	HD									14	8.0 *3)	5.5	45					-	-	-	-				
	30		LD	22	14	8.0 *3)	57.0	38 *1)	14	14	77.9	-	-	-	-	-	-	-	-	22	14	8.0 *3)	60				
		FRN30G1■-4□	HD			8.0		38				22	14	8.0	60					-	-	-	-				
	37		LD	38	14	8.0	68.5	60	22	14	94.3	-	-	-	-	-	-	-	-	38	14	14	75				
		FRN37G1■-4□	HD									38	14	14	75					-	-	-	-				
	45		LD	38	22	14	83.2	60	38	22	114	-	-	-	-	-	-	-	-	38	22	14	91				
		FRN45G1■-4□	HD									38	22	14	91					-	-	-	-				
	55		LD	60	22	22	102	-	38	38	140	-	-	-	-	-	-	-	-	60	38	22	112				
		FRN55G1■-4□	HD									60	38	22	112					-	-	-	-				
	75		LD	-	38	38	138	-	-	-	-	-	-	-	-	-	-	-	-	-	60	38	150				
		FRN75G1■-4□	HD	100								100	60	38	150					-	-	-	-				
	90		LD	100	60	38	164	-	-	-	-	-	-	-	-	-	-	-	-	-	60	38	176				
		FRN90G1■-4□	HD									-	60	38	176					-	-	-	-				
	110		MD/LD	-	100	60	201	-	-	-	-	-	-	-	-	-	100	60	210	-	100	60	210				
		FRN110G1■-4□	HD									-	100	60	210	-	-	-	-	-	-	-	-				
	132		MD/LD	-	100	60	238	-	-	-	-	-	-	-	-	-	100	100	253	-	100	100	253				
		FRN132G1■-4□	HD									-	100	100	253	-	-	-	-	-	-	-	-				
	160		MD/LD	-	150	100	286	-	-	-	-	-	-	-	-	-	150	100	304	-	150	100	304				
		FRN160G1■-4□	HD									-	150	100	304	-	-	-	-	-	-	-	-				
	200		MD/LD	-	150	150	357	-	-	-	-	-	-	-	-	-	200	150	377	-	200	150	377				
		FRN200G1■-4□	HD									-	200	150	377	-	-	-	-	-	-	-	-				
	220		MD/LD	-	200	150	390	-	-	-	-	-	-	-	-	-	200	150	415	-	200	150	415				
		FRN220G1■-4□	HD									-	200	150	415	-	-	-	-	-	-	-	-				
	250		MD	-	250	150	443	-	-	-	-	-	-	-	-	-	250	200	468	-	-	-	-				
	280		LD	-	250	200	500	-	-	-	-	-	-	-	-	-	-	-	-	-	325	200	520				
		FRN280G1■-4□	HD									-	325	200	520					-	-	-	-				
	315		MD	-	2x150	250	559	-	-	-	-	-	-	-	-	-	325	250	585	-	-	-	-				
	355		LD	-	2x200	250	628	-	-	-	-	-	-	-	-	-	-	-	-	-	2x200	325	650				
	315		HD	-	2x150	250	559	-	-	-	-	-	325	250	585	-	-	-	-	-	-	-	-				
	355	FRN315G1■-4□	MD	-	2x200	250	628	-	-	-	-	-	-	-	-	-	2x200	325	650	-	-	-	-				
	400		LD	-	2x200	325	705	-	-	-	-	-	-	-	-	-	-	-	-	-	2x250	325	740				
	355		HD	-	2x200	250	628	-	-	-	-	-	2x200	325	650	-	-	-	-	-	-	-	-				
	400	FRN355G1■-4□	MD	-	2x200	325	705	-	-	-	-	-	-	-	-	-	2x250	325	740	-	-	-	-				
	450		LD		2x250	2x200	789	-	-	-	-	-	-	-	-	-	-	-	-	-	2x250	2x200	840				
	400		HD	-	2x200	325	705	-	-	-	-	-	2x250	325	740	-	-	-	-	-	-	-	-				
	450	FRN400G1■-4□	MD		2x250	2x200	789	-	-	-	-	-	-	-	-	-	2x250	2x200	840	-	-	-	-				
	500		LD	-	2x325	2x200	881	-	-	-	-	-	-	-	-	-	-	-	-	-	2x325	2x250	960				
		FRN500G1■-4□	HD									-	2x325	2x250	960					-	-	-	-				
	630		LD	-	3x325	2x325	1115	-	-	-	-	-	-	-	-	-	-	-	-	-	3x325	2x325	1170				
		FRN630G1■-4□	HD									-	3x325	2x325	1170					-	-	-	-				
	710		LD	-	4x250	2x325	1256	-	-	-	-	-	-	-	-	-	-	-	-	-	4x325	3x325	1370				

Note 1: Assuming the use of aerial wiring (without rack or duct): 600 V class of vinyl-insulated IV wires for 60°C, 600 V class of polyethylene-insulated HIV wires for 75°C, and 600 V cross-linked polyethylene insulated wires for 90°C.

Note 2: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

*1 Use the crimp terminal model No. 38-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*3 Use the crimp terminal model No. 8-L6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*2, *4 to *7 (Not applicable.)

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Table 4.2 Wire Size (for DC reactor, braking resistor, control circuits, and inverter grounding) (continued)

HD (High Duty) mode: Heavy duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	Recommended wire size (mm^2)																							
				DC reactor [P1, P(+)]				Braking resistor [P(+), DB]												Control circuit			Auxiliary control power input [R0, T0]			Auxiliary fan power input [R1, T1]			Inverter grounding [⏚G]		
								HD				MD				LD													
				Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Allowable temp. (Note 1)			Allowable temp. (Note 1)			Allowable temp. (Note 1)		
				60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.2	-	-	-	-	-	-	-	-	0.75			2.0			-			2.0		
	0.75	FRN0.75G1■-2□		2.0	2.0	2.0	4.0	2.0	2.0	2.0	1.6	-	-	-	-	-	-	-	-												
	1.5	FRN1.5G1■-2□		2.0	2.0	2.0	7.5	2.0	2.0	2.0	3.6	-	-	-	-	-	-	-	-												
	2.2	FRN2.2G1■-2□		2.0	2.0	2.0	11.0	2.0	2.0	2.0	3.5	-	-	-	-	-	-	-	-												
	3.7	FRN3.7G1■-2□		3.5	2.0	2.0	18.4	2.0	2.0	2.0	4.1	-	-	-	-	-	-	-	-												
	5.5	FRN5.5G1■-2□	HD	5.5	3.5	2.0	25.9	2.0	2.0	2.0	6.4	-	-	-	-	-	-	-	-												3.5
	7.5		LD	14	5.5	3.5	35.3	-	-	-	-	-	-	-	-	2.0	2.0	2.0	6.4												
		FRN7.5G1■-2□	HD					2.0	2.0	2.0	6.1	-	-	-	-	-	-	-	-												5.5
	11		LD	22 *5)	8.0	5.5	51.7	-	-	-	-	-	-	-	-	2.0	2.0	2.0	6.1							-					
		FRN11G1■-2□	HD					2.0	2.0	2.0	9.1	-	-	-	-	-	-	-	-												
	15		LD	38 *4)	14	14	70.6	-	-	-	-	-	-	-	-	2.0	2.0	2.0	9.1												
		FRN15G1■-2□	HD					2.0	2.0	2.0	11	-	-	-	-	-	-	-	-												8.0
	18.5		LD	38 *1)	22	14	87.0	-	-	-	-	-	-	-	-	2.0	2.0	2.0	11												
		FRN18.5G1■-2□	HD					2.0	2.0	2.0	14	-	-	-	-	-	-	-	-												
	22		LD	60 *2)	22	22	103	-	-	-	-	-	-	-	-	2.0	2.0	2.0	14												
		FRN22G1■-2□	HD					2.0	2.0	2.0	15	-	-	-	-	-	-	-	-												14
	30		LD	100 *6)	38 *1)	38 *1)	140	-	-	-	-	-	-	-	-	2.0	2.0	2.0	15												
		FRN30G1■-2□	HD	-	38	38		3.5	2.0	2.0	19	-	-	-	-	-	-	-	-												
	37		LD	-	60	38	169	-	-	-	-	-	-	-	-	3.5	2.0	2.0	19												
		FRN37G1■-2□	HD	100				5.5	3.5	2.0	25	-	-	-	-	-	-	-	-												
	45		LD	-	100	60	205	-	-	-	-	-	-	-	-	5.5	3.5	2.0	25												
		FRN45G1■-2□	HD					8.0	3.5	2.0	30	-	-	-	-	-	-	-	-												
	55		LD	-	100	60	249	-	-	-	-	-	-	-	-	8.0	3.5	2.0	30							2.0 (37 kW or above)					22
		FRN55G1■-2□	HD					14	5.5	3.5	37	-	-	-	-	-	-	-	-												
	75		LD	-	150 *7	150 *7	345	-	-	-	-	-	-	-	-	14	5.5	3.5	37												
		FRN75G1■-2□	HD		150	150		14	8.0	5.5	48	-	-	-	-	-	-	-	-												
	90		LD	-	200	150	409	-	-	-	-	-	-	-	-	14	8.0	5.5	48												
		FRN90G1■-2□	HD					22	14.0	8.0	61	-	-	-	-	-	-	-	-												
	110		LD	-	250	200	502	-	-	-	-	-	-	-	-	22	14.0	8.0	61												38

Note 1: Assuming the use of aerial wiring (without rack or duct): 600 V class of vinyl-insulated IV wires for 60°C, 600 V class of polyethylene-insulated HIV wires for 75°C, and 600 V cross-linked polyethylene insulated wires for 90°C.

Note 2: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

*1 Use the crimp terminal model No. 38-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*2 Use the crimp terminal model No. 60-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*4 Use the crimp terminal model No. 38-S5 manufactured by JST Mfg. Co., Ltd., or equivalent.

*5 Use the crimp terminal model No. 22-S5 manufactured by JST Mfg. Co., Ltd., or equivalent.

*6 Use the crimp terminal model No. CB100-S8 manufactured by JST Mfg. Co., Ltd., or equivalent.

*7 Use CB150-10 crimp terminals designed for low voltage appliances in JEM1399.

*3 (Not applicable.)

If environmental requirements such as power supply voltage and surrounding temperature differ from those listed above, select wires suitable for your system by referring to Table 4.1 and Appendices, App. F "Allowable Current of Insulated Wires."

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Table 4.2 Wire Size (for DC reactor, braking resistor, control circuits, and inverter grounding) (continued)

HD (High Duty) mode: Heavy duty load applications
MD (Medium Duty) mode: Medium duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD	Recommended wire size (mm²)																									
				DC reactor [P1, P(+)]				Braking resistor [P(+), DB]												Control circuit			Auxiliary control power input [R0, T0]			Auxiliary fan power input [R1, T1]			Inverter grounding [⏚]		
								HD				MD				LD														
				Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Allowable temp. (Note 1)			Allowable temp. (Note 1)			Allowable temp. (Note 1)		
				60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	2.0	2.0	2.0	1.0	2.0	2.0	2.0	0.8	-	-	-	-	-	-	-	-	0.75			2.0			-			2.0		
	0.75	FRN0.75G1■-4□		2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.1	-	-	-	-	-	-	-	-												
	1.5	FRN1.5G1■-4□		2.0	2.0	2.0	3.7	2.0	2.0	2.0	1.8	-	-	-	-	-	-	-	-												
	2.2	FRN2.2G1■-4□		2.0	2.0	2.0	5.6	2.0	2.0	2.0	1.8	-	-	-	-	-	-	-	-												
	3.7	FRN3.7G1■-4□		2.0	2.0	2.0	9.2	2.0	2.0	2.0	2.1	-	-	-	-	-	-	-	-												
	5.5	FRN5.5G1■-4□	HD	2.0	2.0	2.0	13.0	2.0	2.0	2.0	3.2	-	-	-	-	-	-	-	-												
	7.5	FRN7.5G1■-4□	LD	3.5	2.0	2.0	17.7	-	-	-	-	-	-	-	-	2.0	2.0	2.0	3.2												
			HD					2.0	2.0	2.0	3.1	-	-	-	-	-	-	-	-												
	11	FRN11G1■-4□	LD	5.5	3.5	2.0	25.9	-	-	-	-	-	-	-	-	2.0	2.0	2.0	3.1												
			HD					2.0	2.0	2.0	4.5	-	-	-	-	-	-	-	-												
	15	FRN15G1■-4□	LD	14	5.5	3.5	35.3	-	-	-	-	-	-	-	-	2.0	2.0	2.0	4.5												
			HD					2.0	2.0	2.0	5.7	-	-	-	-	-	-	-	-												
	18.5	FRN18.5G1■-4□	LD	14	5.5	5.5	43.5	-	-	-	-	-	-	-	-	2.0	2.0	2.0	5.7												
			HD					2.0	2.0	2.0	7.2	-	-	-	-	-	-	-	-												
	22	FRN22G1■-4□	LD	22	8.0 *3)	5.5	51.7	-	-	-	-	-	-	-	-	2.0	2.0	2.0	7.2												
			HD					2.0	2.0	2.0	7.7	-	-	-	-	-	-	-	-												
	30	FRN30G1■-4□	LD	38 *1)	14	8.0 *3)	69.9	-	-	-	-	-	-	-	-	2.0	2.0	2.0	7.7												
			HD	38		8.0		2.0	2.0	2.0	10	-	-	-	-	-	-	-	-												
	37	FRN37G1■-4□	LD	38	22	14	83.9	-	-	-	-	-	-	-	-	2.0	2.0	2.0	10												
			HD					2.0	2.0	2.0	12	-	-	-	-	-	-	-	-												
	45	FRN45G1■-4□	LD	60	22	22	102	-	-	-	-	-	-	-	-	2.0	2.0	2.0	12												
			HD					2.0	2.0	2.0	15	-	-	-	-	-	-	-	-												
	55	FRN55G1■-4□	LD	60	38	22	125	-	-	-	-	-	-	-	-	2.0	2.0	2.0	15												
			HD					3.5	2.0	2.0	19	-	-	-	-	-	-	-	-												
	75	FRN75G1■-4□	LD	-	60	38	169	-	-	-	-	-	-	-	-	3.5	2.0	2.0	19												
			HD	100				5.5	2.0	2.0	24	-	-	-	-	-	-	-	-												
	90	FRN90G1■-4□	LD	-	100	60	201	-	-	-	-	-	-	-	-	5.5	2.0	2.0	24												
			HD					8.0	3.5	2.0	31	-	-	-	-	-	-	-	-												
	110	FRN110G1■-4□	MD/LD	-	100	60	246	-	-	-	-	4.0	2.0	2.0	34	8.0	3.5	2.0	31												
			HD					8.0	5.5	3.5	34	-	-	-	-	-	-	-	-												
	132	FRN132G1■-4□	MD/LD	-	150	100	292	-	-	-	-	8.0	5.5	3.5	41	8.0	5.5	3.5	34												
			HD					14	5.5	3.5	41	-	-	-	-	-	-	-	-												
	160	FRN160G1■-4□	MD/LD	-	150	150	350	-	-	-	-	14	5.5	3.5	50	14	5.5	3.5	41												
			HD					14	8.0	5.5	50	-	-	-	-	-	-	-	-												
	200	FRN200G1■-4□	MD/LD	-	250	150	437	-	-	-	-	14	8.0	5.5	62	14	8.0	5.5	50												
			HD					22	14	8.0	62	-	-	-	-	-	-	-	-												
	220	FRN220G1■-4□	MD/LD	-	250	200	478	-	-	-	-	22	14	8.0	71	22	14	8.0	62												
			HD					38	14	14	71	-	-	-	-	-	-	-	-												
	250	FRN220G1■-4□	MD	-	325	250	543	-	-	-	-	22	14	8.0	71	-	-	-	-												
	280	FRN280G1■-4□	LD	-	2x200	250	612	-	-	-	-	-	-	-	-	22	8.0	5.5	71												
			HD					60	22	14	100	-	-	-	-	-	-	-	-												
	315		MD	-	2x200	325	685	-	-	-	-	60	22	14	100	-	-	-	-							2.0 (75 kW or above)					
	355		LD	-	2x250	2x200	769	-	-	-	-	-	-	-	-	38	22	14	100												
	315		HD	-	2x200	325	685	60	22	14	100	-	-	-	-	-	-	-	-												
	355	FRN315G1■-4□	MD	-	2x250	2x200	769	-	-	-	-	60	38	22	124	-	-	-	-												
	400		LD	-	2x325	2x200	864	-	-	-	-	-	-	-	-	38	22	14	124												
	355		HD	-	2x250	2x200	769	60	38	22	124	-	-	-	-	-	-	-	-												
	400	FRN355G1■-4□	MD	-	2x325	2x200	864	-	-	-	-	60	38	22	124	-	-	-	-												
	450		LD	-	2x325	2x250	966	-	-	-	-	-	-	-	-	60	38	22	124												
	400		HD	-	2x325	2x200	864	60	38	22	124	-	-	-	-	-	-	-	-												
	450	FRN400G1■-4□	MD	-	2x325	2x250	966	-	-	-	-	100	60	38	150	-	-	-	-												
	500		LD	-	3x325	2x325	1079	-	-	-	-	-	-	-	-	60	38	22	124												
		FRN500G1■-4□	HD					150	100	38	186	-	-	-	-	-	-	-	-												
	630		LD	-	3x325	3x325	1366	-	-	-	-	-	-	-	-	150	100	38	186												
		FRN630G1■-4□	HD					150	100	60	212	-	-	-	-	-	-	-	-												
	710		LD	-	4x325	3x325	1538	-	-	-	-	-	-	-	-	150	100	60	212												

Note 1: Assuming the use of aerial wiring (without rack or duct): 600 V class of vinyl-insulated IV wires for 60°C, 600 V class of polyethylene-insulated HIV wires for 75°C, and 600 V cross-linked polyethylene insulated wires for 90°C.

Note 2: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

*1 Use the crimp terminal model No. 38-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*3 Use the crimp terminal model No. 8-L6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*2, *4 to *7 (Not applicable.)

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■ If the internal temperature of your power control panel is 40°C or below

Table 4.3 Wire Size (for main circuit power input and inverter output)

HD (High Duty) mode: Heavy duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	Recommended wire size (mm²)																			
				Main circuit power input [L1/R, L2/S, L3/T]								Inverter output [U, V, W]											
				w/ DC reactor (DCR)				w/o DC reactor (DCR)				HD				MD				LD			
				Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current
				60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	2.0	2.0	2.0	1.6	2.0	2.0	2.0	3.1	2.0	2.0	2.0	3	-	-	-	-	-	-	-	-
	0.75	FRN0.75G1■-2□		2.0	2.0	2.0	3.2	2.0	2.0	2.0	5.3	2.0	2.0	2.0	5	-	-	-	-	-	-	-	-
	1.5	FRN1.5G1■-2□		2.0	2.0	2.0	6.1	2.0	2.0	2.0	9.5	2.0	2.0	2.0	8	-	-	-	-	-	-	-	-
	2.2	FRN2.2G1■-2□		2.0	2.0	2.0	8.9	2.0	2.0	2.0	13.2	2.0	2.0	2.0	11	-	-	-	-	-	-	-	-
	3.7	FRN3.7G1■-2□		2.0	2.0	2.0	15	3.5	2.0	2.0	22.2	2.0	2.0	2.0	18	-	-	-	-	-	-	-	-
	5.5	FRN5.5G1■-2□		2.0	2.0	2.0	21.1	5.5	3.5	2.0	31.5	3.5	2.0	2.0	27	-	-	-	-	-	-	-	-
	7.5	FRN7.5G1■-2□	LD	3.5	2.0	2.0	28.8	8.0	5.5	3.5	42.7	-	-	-	-	-	-	-	-	5.5	3.5	2.0	31.8
			HD									5.5	3.5	3.5	37					-	-	-	-
	11	FRN11G1■-2□	LD	8.0	5.5	3.5	42.2	14	8.0	5.5	60.7	-	-	-	-	-	-	-	-	8.0	5.5	3.5	46.2
			HD									8.0	5.5	5.5	49					-	-	-	-
	15	FRN15G1■-2□	LD	14	8.0	5.5	57.6	22	14	14	80.1	-	-	-	-	-	-	-	-	14	8.0	5.5	59.4
			HD									14	8.0	5.5	63					-	-	-	-
	18.5	FRN18.5G1■-2□	LD	14	14	8.0	71.0	38 *1)	22	14	97.0	-	-	-	-	-	-	-	-	22	14	8.0	74.8
			HD									22	14	8.0	76					-	-	-	-
	22	FRN22G1■-2□	LD	22	14	14	84.4	38 *1)	22	14	112	-	-	-	-	-	-	-	-	22	14	14	88
			HD									22	14	14	90					-	-	-	-
	30	FRN30G1■-2□	LD	38 *1)	22	22	114	60 *2)	38 *1)	38 *1)	151	-	-	-	-	-	-	-	-	38 *1)	22	22	115
			HD	38				60	38	38		38	22	22	119					-	-	-	-
	37	FRN37G1■-2□	LD	60	38	22	138	-	60	38	185	-	-	-	-	-	-	-	-	60	38	22	146
			HD					100				60	38	22	146					-	-	-	-
	45	FRN45G1■-2□	LD	60	38	38	167	100	60	60	225	-	-	-	-	-	-	-	-	100	60	38	180
			HD									100	60	38	180					-	-	-	-
	55	FRN55G1■-2□	LD	100	60	38	203	-	100	60	270	-	-	-	-	-	-	-	-	100	60	60	215
			HD									100	60	60	215					-	-	-	-
	75	FRN75G1■-2□	LD	-	100	100	282	-	-	-	-	-	-	-	-	-	-	-	-	-	100	100	283
			HD	150 *7)								150	100	100	283					-	-	-	-
	90	FRN90G1■-2□	LD	-	150	100	334	-	-	-	-	-	-	-	-	-	-	-	-	200	150	100	346
			HD									200	150	100	346					-	-	-	-
	110		LD	-	150	150	410	-	-	-	-	-	-	-	-	-	-	-	-	250	150	150	415

Note 1: Assuming the use of aerial wiring (without rack or duct): 600 V class of vinyl-insulated IV wires for 60°C, 600 V class of polyethylene-insulated HIV wires for 75°C, and 600 V cross-linked polyethylene insulated wires for 90°C.

Note 2: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

*1 Use the crimp terminal model No. 38-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*2 Use the crimp terminal model No. 60-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*7 Use CB150-10 crimp terminals designed for low voltage appliances in JEM1399.

*3 to *6 (Not applicable.)

Table 4.3 Wire Size (for main circuit power input and inverter output) (continued)

HD (High Duty) mode: Heavy duty load applications
MD (Medium Duty) mode: Medium duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD	Recommended wire size (mm²)																			
				Main circuit power input [L1/R, L2/S, L3/T]								Inverter output [U, V, W]											
				w/ DC reactor (DCR)				w/o DC reactor (DCR)				HD				MD				LD			
				Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current	Allowable temp. (Note 1)			Current
				60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)	60°C	75°C	90°C	(A)
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	2.0	2.0	2.0	0.85	2.0	2.0	2.0	1.7	2.0	2.0	2.0	1.5	-	-	-	-	-	-	-	-
	0.75	FRN0.75G1■-4□		2.0	2.0	2.0	1.6	2.0	2.0	2.0	3.1	2.0	2.0	2.0	2.5	-	-	-	-	-	-	-	-
	1.5	FRN1.5G1■-4□		2.0	2.0	2.0	3.0	2.0	2.0	2.0	5.9	2.0	2.0	2.0	4	-	-	-	-	-	-	-	-
	2.2	FRN2.2G1■-4□		2.0	2.0	2.0	4.5	2.0	2.0	2.0	8.2	2.0	2.0	2.0	5.5	-	-	-	-	-	-	-	-
	3.7	FRN3.7G1■-4□		2.0	2.0	2.0	7.5	2.0	2.0	2.0	13.0	2.0	2.0	2.0	9	-	-	-	-	-	-	-	-
	5.5	FRN5.5G1■-4□	HD	2.0	2.0	2.0	10.6	2.0	2.0	2.0	17.3	2.0	2.0	2.0	13.5	-	-	-	-	-	-	-	-
	7.5		LD	2.0	2.0	2.0	14.4	3.5	2.0	2.0	23.2	-	-	-	-	-	-	-	-	2.0	2.0	2.0	16.5
		FRN7.5G1■-4□	HD									2.0	2.0	2.0	18.5					-	-	-	-
	11		LD	2.0	2.0	2.0	21.1	5.5	3.5	2.0	33	-	-	-	-	-	-	-	-	3.5	2.0	2.0	23
		FRN11G1■-4□	HD									3.5	2.0	2.0	24.5					-	-	-	-
	15		LD	3.5	2.0	2.0	28.8	8.0	5.5	3.5	43.8	-	-	-	-	-	-	-	-	5.5	3.5	2.0	30.5
		FRN15G1■-4□	HD									5.5	3.5	2.0	32					-	-	-	-
	18.5		LD	5.5	3.5	3.5	35.5	14	8.0 *3)	5.5	52.3	-	-	-	-	-	-	-	-	5.5	3.5	3.5	37
		FRN18.5G1■-4□	HD									5.5	3.5	3.5	39					-	-	-	-
	22		LD	8.0 *3)	5.5	3.5	42.2	14	8.0 *3)	5.5	60.6	-	-	-	-	-	-	-	-	8.0 *3)	5.5	3.5	45
		FRN22G1■-4□	HD									8.0 *3)	5.5	3.5	45					-	-	-	-
	30		LD	14	8.0 *3)	5.5	57.0	22	14	8.0 *3)	77.9	-	-	-	-	-	-	-	-	14	8.0 *3)	5.5	60
		FRN30G1■-4□	HD		8.0					8.0		14	8.0	5.5	60					-	-	-	-
	37		LD	14	14	8.0	68.5	38	14	14	94.3	-	-	-	-	-	-	-	-	22	14	8.0	75
		FRN37G1■-4□	HD									22	14	8.0	75					-	-	-	-
	45		LD	22	14	14	83.2	38	22	22	114	-	-	-	-	-	-	-	-	22	14	14	91
		FRN45G1■-4□	HD									22	14	14	91					-	-	-	-
	55		LD	38	22	14	102	60	38	22	140	-	-	-	-	-	-	-	-	38	22	14	112
		FRN55G1■-4□	HD									38	22	14	112					-	-	-	-
	75		LD	60	38	22	138	-	-	-	-	-	-	-	-	-	-	-	-	60	38	38	150
		FRN75G1■-4□	HD									60	38	38	150					-	-	-	-
	90		LD	60	38	38	164	-	-	-	-	-	-	-	-	-	-	-	-	60	60	38	176
		FRN90G1■-4□	HD									60	60	38	176					-	-	-	-
	110		MD/LD	100	60	38	201	-	-	-	-	-	-	-	-	100	60	60	210	100	60	60	210
		FRN110G1■-4□	HD									100	60	60	210	-	-	-	-	-	-	-	-
	132		MD/LD	100	100	60	238	-	-	-	-	-	-	-	-	150	100	60	253	150	100	60	253
		FRN132G1■-4□	HD									150	100	60	253	-	-	-	-	-	-	-	-
	160		MD/LD	150	100	100	286	-	-	-	-	-	-	-	-	150	100	100	304	150	100	100	304
		FRN160G1■-4□	HD									150	100	100	304	-	-	-	-	-	-	-	-
	200		MD/LD	200	150	100	357	-	-	-	-	-	-	-	-	200	150	100	377	200	150	100	377
		FRN200G1■-4□	HD									200	150	100	377	-	-	-	-	-	-	-	-
	220		MD/LD	250	150	150	390	-	-	-	-	-	-	-	-	250	150	150	415	250	150	150	415
		FRN220G1■-4□	HD									250	150	150	415	-	-	-	-	-	-	-	-
	250		MD	250	200	150	443	-	-	-	-	-	-	-	-	325	200	150	468	-	-	-	-
	280		LD	325	200	150	500	-	-	-	-	-	-	-	-	-	-	-	-	325	250	200	520
		FRN280G1■-4□	HD									325	250	200	520					-	-	-	-
	315		MD	-	250	200	559	-	-	-	-	-	-	-	-	-	250	200	585	-	-	-	-
	355		LD	-	325	250	628	-	-	-	-	-	-	-	-	-	-	-	-	-	325	250	650
	315		HD	-	250	200	559	-	-	-	-	-	250	200	585	-	-	-	-	-	-	-	-
	355	FRN315G1■-4□	MD	-	325	250	628	-	-	-	-	-	-	-	-	-	325	250	650	-	-	-	-
	400		LD	-	2x150	250	705	-	-	-	-	-	-	-	-	-	-	-	-	-	2x200	325	740
	355		HD	-	325	250	628	-	-	-	-	-	325	250	650	-	-	-	-	-	-	-	-
	400	FRN355G1■-4□	MD	-	2x150	250	705	-	-	-	-	-	-	-	-	-	2x200	325	740	-	-	-	-
	450		LD	-	2x200	325	789	-	-	-	-	-	-	-	-	-	-	-	-	-	2x200	2x150	840
	400		HD	-	2x150	250	705	-	-	-	-	-	2x200	325	740	-	-	-	-	-	-	-	-
	450	FRN400G1■-4□	MD	-	2x200	325	789	-	-	-	-	-	-	-	-	-	2x200	2x150	840	-	-	-	-
	500		LD	-	2x250	2x200	881	-	-	-	-	-	-	-	-	-	-	-	-	-	2x250	2x200	960
		FRN500G1■-4□	HD									-	2x250	2x200	960					-	-	-	-
	630		LD	-	2x325	2x250	1115	-	-	-	-	-	-	-	-	-	-	-	-	-	3x250	2x250	1170
		FRN630G1■-4□	HD									-	3x250	2x250	1170					-	-	-	-
	710		LD	-	3x250	2x325	1256	-	-	-	-	-	-	-	-	-	-	-	-	-	3x325	2x325	1370

Note 1: Assuming the use of aerial wiring (without rack or duct): 600 V class of vinyl-insulated IV wires for 60°C, 600 V class of polyethylene-insulated HIV wires for 75°C, and 600 V cross-linked polyethylene insulated wires for 90°C.

Note 2: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

*3 Use the crimp terminal model No. 8-L6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*1, *2, *4 to *7 (Not applicable.)

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Table 4.3 Wire Size (for DC reactor, braking resistor, control circuit, and inverter grounding) (continued)

HD (High Duty) mode: Heavy duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	Recommended wire size (mm^2)																							
				DC reactor [P1, P(+)]				Braking resistor [P(+), DB]												Control circuit			Auxiliary control power input [R0, T0]			Auxiliary fan power input [R1, T1]			Inverter grounding [⏚G]		
								HD				MD				LD													
				Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Allowable temp. (Note 1)			Allowable temp. (Note 1)			Allowable temp. (Note 1)		
				60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.2	-	-	-	-	-	-	-	-	0.75			2.0			-			2.0		
	0.75	FRN0.75G1■-2□		2.0	2.0	2.0	4.0	2.0	2.0	2.0	1.6	-	-	-	-	-	-	-	-												
	1.5	FRN1.5G1■-2□		2.0	2.0	2.0	7.5	2.0	2.0	2.0	3.6	-	-	-	-	-	-	-	-												
	2.2	FRN2.2G1■-2□		2.0	2.0	2.0	11.0	2.0	2.0	2.0	3.5	-	-	-	-	-	-	-	-												
	3.7	FRN3.7G1■-2□		2.0	2.0	2.0	18.4	2.0	2.0	2.0	4.1	-	-	-	-	-	-	-	-												
	5.5	FRN5.5G1■-2□	HD	3.5	2.0	2.0	25.9	2.0	2.0	2.0	6.4	-	-	-	-	-	-	-	-												
	7.5		LD	5.5	3.5	3.5	35.3	-	-	-	-	-	-	-	-	2.0	2.0	2.0	6.4												
		FRN7.5G1■-2□	HD					2.0	2.0	2.0	6.1	-	-	-	-	-	-	-	-												
	11		LD	14	5.5	5.5	51.7	-	-	-	-	-	-	-	-	2.0	2.0	2.0	6.1												
		FRN11G1■-2□	HD					2.0	2.0	2.0	9.1	-	-	-	-	-	-	-	-												
	15		LD	14	14	8.0	70.6	-	-	-	-	-	-	-	-	2.0	2.0	2.0	9.1												
		FRN15G1■-2□	HD					2.0	2.0	2.0	11	-	-	-	-	-	-	-	-												
	18.5		LD	22	14	14	87.0	-	-	-	-	-	-	-	-	2.0	2.0	2.0	11												
		FRN18.5G1■-2□	HD					2.0	2.0	2.0	14	-	-	-	-	-	-	-	-												
	22		LD	38 *1)	22	14	103	-	-	-	-	-	-	-	-	2.0	2.0	2.0	14												
		FRN22G1■-2□	HD					2.0	2.0	2.0	15	-	-	-	-	-	-	-	-												
	30		LD	60 *2)	38 *1)	22	140	-	-	-	-	-	-	-	-	2.0	2.0	2.0	15												
		FRN30G1■-2□	HD	60	38			2.0	2.0	2.0	19	-	-	-	-	-	-	-	-												
	37		LD	60	38	38	169	-	-	-	-	-	-	-	-	2.0	2.0	2.0	19												
		FRN37G1■-2□	HD					3.5	2.0	2.0	25	-	-	-	-	-	-	-	-												
	45		LD	100	60	38	205	-	-	-	-	-	-	-	-	3.5	2.0	2.0	25												
		FRN45G1■-2□	HD					3.5	3.5	2.0	30	-	-	-	-	-	-	-	-												
	55		LD	150*7)	100	60	249	-	-	-	-	-	-	-	-	3.5	3.5	2.0	30												
		FRN55G1■-2□	HD					5.5	3.5	3.5	37	-	-	-	-	-	-	-	-												
	75		LD	-	150*7)	100	345	-	-	-	-	-	-	-	-	5.5	3.5	3.5	37												
		FRN75G1■-2□	HD		150			8.0	5.5	5.5	48	-	-	-	-	-	-	-	-												
	90		LD	-	150	150	409	-	-	-	-	-	-	-	-	8.0	5.5	5.5	48												
		FRN90G1■-2□	HD					14.0	8.0	5.5	61	-	-	-	-	-	-	-	-												
	110		LD	-	200	150	502	-	-	-	-	-	-	-	-	14	8.0	5.5	61							2.0 (37 kW or above)			38		

Note 1: Assuming the use of aerial wiring (without rack or duct): 600 V class of vinyl-insulated IV wires for 60°C, 600 V class of polyethylene-insulated HIV wires for 75°C, and 600 V cross-linked polyethylene insulated wires for 90°C.

Note 2: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

*1 Use the crimp terminal model No. 38-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*2 Use the crimp terminal model No. 60-6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*7 Use CB150-10 crimp terminals designed for low voltage appliances in JEM1399.

*3 to *6 (Not applicable.)

If environmental requirements such as power supply voltage and surrounding temperature differ from those listed above, select wires suitable for your system by referring to Table 4.1 and Appendices, App. F "Allowable Current of Insulated Wires."

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Table 4.3 Wire Size (for DC reactor, braking resistor, control circuit, and inverter grounding) (continued)

HD (High Duty) mode: Heavy duty load applications
MD (Medium Duty) mode: Medium duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD	Recommended wire size (mm²)																							
				DC reactor [P1, P(+)]				Braking resistor [P(+), DB]												Control circuit			Auxiliary control power input [R0, T0]			Auxiliary fan power input [R1, T1]			Inverter grounding [G]
								HD				MD				LD												
				Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Current (A)	Allowable temp. (Note 1)			Allowable temp. (Note 1)			Allowable temp. (Note 1)			Allowable temp. (Note 1)		
				60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C		60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	2.0	2.0	2.0	1.0	2.0	2.0	2.0	0.8	-	-	-	-	-	-	-	-	0.75			2.0			-			2.0		
	0.75	FRN0.75G1■-4□		2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.1	-	-	-	-	-	-	-	-												
	1.5	FRN1.5G1■-4□		2.0	2.0	2.0	3.7	2.0	2.0	2.0	1.8	-	-	-	-	-	-	-	-												
	2.2	FRN2.2G1■-4□		2.0	2.0	2.0	5.6	2.0	2.0	2.0	1.8	-	-	-	-	-	-	-	-												
	3.7	FRN3.7G1■-4□		2.0	2.0	2.0	9.2	2.0	2.0	2.0	2.1	-	-	-	-	-	-	-	-												
	5.5	FRN5.5G1■-4□	HD	2.0	2.0	2.0	13.0	2.0	2.0	2.0	3.2	-	-	-	-	-	-	-	-												
	7.5	FRN7.5G1■-4□	LD	2.0	2.0	2.0	17.7	-	-	-	-	-	-	-	-	2.0	2.0	2.0	3.2										3.5		
			HD					2.0	2.0	2.0	3.1					-	-	-	-												
	11	FRN11G1■-4□	LD	3.5	2.0	2.0	25.9	-	-	-	-	-	-	-	-	2.0	2.0	2.0	3.1												
			HD					2.0	2.0	2.0	4.5					-	-	-	-												
	15	FRN15G1■-4□	LD	5.5	3.5	3.5	35.3	-	-	-	-	-	-	-	-	2.0	2.0	2.0	4.5												
			HD					2.0	2.0	2.0	5.7					-	-	-	-												
	18.5	FRN18.5G1■-4□	LD	8.0 *3)	5.5	3.5	43.5	-	-	-	-	-	-	-	-	2.0	2.0	2.0	5.7							-			5.5		
			HD					2.0	2.0	2.0	7.2					-	-	-	-												
	22	FRN22G1■-4□	LD	14	5.5	5.5	51.7	-	-	-	-	-	-	-	-	2.0	2.0	2.0	7.2												
			HD					2.0	2.0	2.0	7.7					-	-	-	-												
	30	FRN30G1■-4□	LD	14	14	8.0 *3) 8.0	69.9	-	-	-	-	-	-	-	-	2.0	2.0	2.0	7.7										8.0		
			HD					2.0	2.0	2.0	10					-	-	-	-												
	37	FRN37G1■-4□	LD	22	14	14	83.9	-	-	-	-	-	-	-	-	2.0	2.0	2.0	10												
			HD					2.0	2.0	2.0	12					-	-	-	-												
	45	FRN45G1■-4□	LD	38	22	14	102	-	-	-	-	-	-	-	-	2.0	2.0	2.0	12												
			HD					2.0	2.0	2.0	15					-	-	-	-												
	55	FRN55G1■-4□	LD	38	38	22	125	-	-	-	-	-	-	-	-	2.0	2.0	2.0	15												
			HD					2.0	2.0	2.0	19					-	-	-	-												
	75	FRN75G1■-4□	LD	60	38	38	169	-	-	-	-	-	-	-	-	2.0	2.0	2.0	19										14		
			HD					3.5	2.0	2.0	24					-	-	-	-												
	90	FRN90G1■-4□	LD	100	60	38	201	-	-	-	-	-	-	-	-	3.5	2.0	2.0	24												
			HD					5.5	3.5	2.0	31					-	-	-	-												
	110	FRN110G1■-4□	MD/LD	150	100	60	246	-	-	-	-	5.5	3.5	2.0	34	5.5	3.5	2.0	31												
			HD					5.5	3.5	2.0	34	-	-	-	-	-	-	-	-										22		
	132	FRN132G1■-4□	MD/LD	150	100	100	292	-	-	-	-	8.0	5.5	3.5	41	5.5	3.5	2.0	34												
			HD					8.0	5.5	3.5	41	-	-	-	-	-	-	-	-												
	160	FRN160G1■-4□	MD/LD	200	150	100	350	-	-	-	-	8.0	5.5	5.5	50	8.0	5.5	3.5	41												
			HD					8.0	5.5	5.5	50	-	-	-	-	-	-	-	-												
	200	FRN200G1■-4□	MD/LD	250	200	150	437	-	-	-	-	14	8.0	5.5	62	8.0	5.5	5.5	50												
			HD					14	8.0	5.5	62	-	-	-	-	-	-	-	-												
	220	FRN220G1■-4□	MD/LD	325	200	150	478	-	-	-	-	14	14	8.0	71	14	8.0	5.5	62												
			HD					14	14.0	8.0	71	-	-	-	-	-	-	-	-										38		
	250	FRN220G1■-4□	MD	-	250	200	543	-	-	-	-	38	22	14	100	-	-	-	-												
	280	FRN280G1■-4□	LD	-	325	250	612	-	-	-	-	-	-	-	-	14	14	8.0	71							2.0 (75 kW or above)					
			HD					38	22	14	100	-	-	-	-	-	-	-	-												
	315		MD	-	2x150	250	685	-	-	-	-	38	22	14	100	-	-	-	-												
	355		LD	-	2x200	325	769	-	-	-	-	-	-	-	-	38	22	14.0	100												
	315		HD	-	2x150	250	685	38	22	14	100	-	-	-	-	-	-	-	-												
	355	FRN315G1■-4□	MD	-	2x200	325	769	-	-	-	-	38	22	22	124	-	-	-	-												
	400		LD	-	2x250	2x200	864	-	-	-	-	-	-	-	-	38	22	22	124										60		
	355		HD	-	2x200	325	769	38	22	22	124	-	-	-	-	-	-	-	-												
	400	FRN355G1■-4□	MD	-	2x250	2x200	864	-	-	-	-	38	22	22	124	-	-	-	-												
	450		LD	-	2x250	2x200	966	-	-	-	-	-	-	-	-	38	22	22	124												
	400		HD	-	2x250	2x200	864	38	22	22	124	-	-	-	-	-	-	-	-												
	450	FRN400G1■-4□	MD	-	2x250	2x200	966	-	-	-	-	60	38	38	150	-	-	-	-												
	500		LD	-	2x325	2x250	1079	-	-	-	-	-	-	-	-	38	22	22	124												
		FRN500G1■-4□	HD					60	38	38	186					-	-	-	-												
	630		LD	-	3x325	2x325	1366	-	-	-	-	-	-	-	-	60	38	38	186										100		
		FRN630G1■-4□	HD					100	60	60	212					-	-	-	-												
	710		LD	-	4x325	3x325	1538	-	-	-	-	-	-	-	-	100	60	60	212												

Note 1: Assuming the use of aerial wiring (without rack or duct): 600 V class of vinyl-insulated IV wires for 60°C, 600 V class of polyethylene-insulated HIV wires for 75°C, and 600 V cross-linked polyethylene insulated wires for 90°C.

Note 2: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

*3 Use the crimp terminal model No. 8-L6 manufactured by JST Mfg. Co., Ltd., or equivalent.

*1, *2, *4 to *7 (Not applicable.)

If environmental requirements such as power supply voltage and surrounding temperature differ from those listed above, select wires suitable for your system by referring to Table 4.1 and Appendices, App. F "Allowable Current of Insulated Wires."

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4.3 Peripheral Equipment

4.3.1 Molded case circuit breaker (MCCB), residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) and magnetic contactor (MC)

[1] Functional overview

■ MCCBs and RCDs/ELCBs* * With overcurrent protection

Molded Case Circuit Breakers (MCCBs) are designed to protect the power circuits between the power supply and inverter's main circuit terminals ([L1/R], [L2/S] and [L3/T]) from overload or short-circuit, which in turn prevents secondary accidents caused by the broken inverter.

Residual-Current-Operated Protective Devices (RCDs)/Earth Leakage Circuit Breakers (ELCBs) function in the same way as MCCBs.

Built-in overcurrent/overload protective functions protect the inverter itself from failures related to its input/output lines.

■ MCs

An MC can be used at both the power input and output sides of the inverter. At each side, the MC works as described below. When inserted in the output circuit of the inverter, the MC can also switch the motor drive power supply between the inverter output and commercial power lines.

At the power supply side

Insert an MC in the power supply side of the inverter in order to:

(1) Forcibly cut off the inverter from the power supply (generally, commercial/factory power lines) with the protective function built into the inverter, or with the external signal input.

(2) Stop the inverter operation in an emergency when the inverter cannot interpret the stop command due to internal/external circuit failures.

(3) Cut off the inverter from the power supply when the MCCB inserted in the power supply side cannot cut it off for maintenance or inspection purpose. For the purpose only, it is recommended that you use an MC capable of turning the MC ON/OFF manually.

Note Avoid frequent ON/OFF operation of the magnetic contactor (MC) in the input circuit; otherwise, the inverter failure may result.
The frequency of the MC's ON/OFF should not be more than once per 30 minutes. To assure 10-year or longer service life of the inverter, it should not be more than once per hour.
If frequent start/stop of the motor is required, use ***FWD***/***REV*** terminal signals or the RUN / STOP keys on the inverter's keypad.

At the output side

Insert an MC in the power output side of the inverter in order to:

(1) Prevent externally turned-around current from being applied to the inverter power output terminals ([U], [V], and [W]) unexpectedly. An MC should be used, for example, when a circuit that switches the motor driving power supply between the inverter output and commercial power lines is connected to the inverter.

Tip If a magnetic contactor (MC) is inserted in the inverter's output (secondary) circuit for switching the motor to a commercial power or for any other purposes, it should be switched on and off when both the inverter and motor are completely stopped. This prevents the contact point from getting rough due to a switching arc of the MC. The MC should not be equipped with any main circuit surge killer (Fuji SZ-ZM□, etc.).
Applying a commercial power to the inverter's output circuit breaks the inverter. To avoid it, interlock the MC on the motor's commercial power line with the one in the inverter output circuit so that they are not switched ON at the same time.

(2) Drive more than one motor selectively by a single inverter.

(3) Selectively cut off the motor whose thermal overload relay or equivalent devices have been activated.

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Driving the motor using commercial power lines

MCs can also be used to switch the power supply of the motor driven by the inverter to a commercial power supply.

Select the MC so as to satisfy the rated currents listed in Table 4.1, which are the most critical RMS currents for using the inverter. (Refer to Table 4.4) For switching the motor drive source between the inverter output and commercial power lines, use the MC of class AC3 specified by JIS C8325 in the commercial line side.

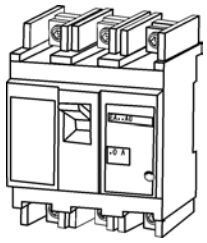
[2] Connection example and criteria for selection of circuit breakers

Figure 4.2 shows a connection example for MCCB or RCD/ELCB (with overcurrent protection) and MC in the inverter input circuit. Table 4.4 lists the rated current for the MCCB and corresponding inverter models. Table 4.5 lists the applicable grades of RCD/ELCB sensitivity.

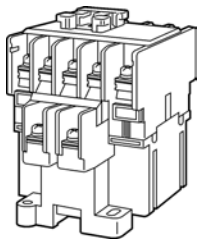
⚠WARNING

Insert an MCCB or RCD/ELCB (with overcurrent protection) recommended for each inverter for its input circuits. Do not use an MCCB or RCD/ELCB of a higher rating than that recommended.

Doing so could result in a fire.



Molded case circuit breaker or
residual-current-operated protective device/
earth leakage circuit breaker



Magnetic contactor

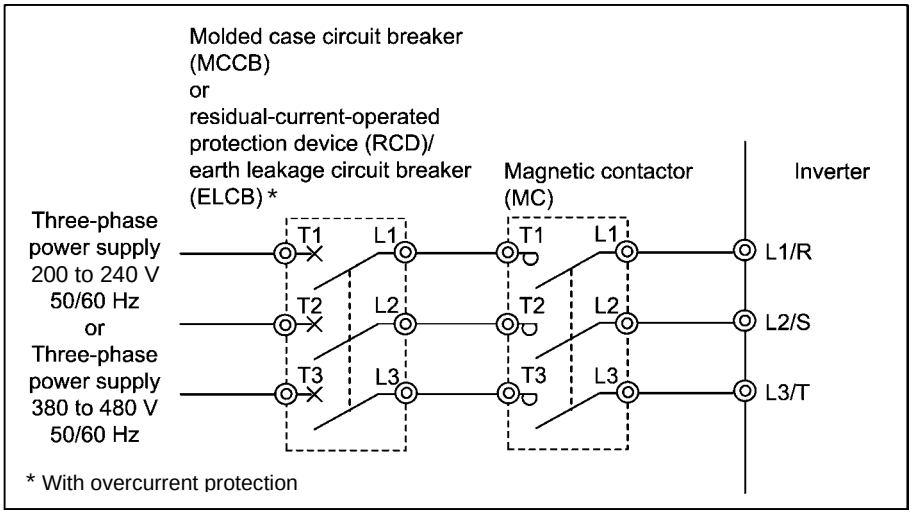


Figure 4.2 External Views of MCCB or RCD/ELCB and MC and Connection Example

Table 4.4 Rated Current of Molded Case Circuit Breaker (MCCB), Residual-Current-Operated Protective Device (RCD)/ Earth Leakage Circuit Breaker (ELCB) and Magnetic Contactor (MC)

HD (High Duty) mode: Heavy duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	MCCB, RCD/ELCB Rated current (A)		MC			
						For input circuit		For output circuit	
				DC reactor (DCR)		DC reactor (DCR)		HD	LD
				w/ DCR	w/o DCR	w/ DCR	w/o DCR		
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	5	5	SC-05	SC-05	SC-05	-
	0.75	FRN0.75G1■-2□			10				
	1.5	FRN1.5G1■-2□		10	15				
	2.2	FRN2.2G1■-2□			20				
	3.7	FRN3.7G1■-2□		20	30		SC-5-1		
	5.5	FRN5.5G1■-2□	HD	30	50		SC-N1	SC-4-0	
	7.5		LD	40	75	SC-5-1	SC-N2	-	SC-5-1
		FRN7.5G1■-2□	HD					SC-N1	-
	11		LD	50	100	SC-N1	SC-N2S	-	SC-N1
		FRN11G1■-2□	HD					SC-N1	-
	15		LD	75	125	SC-N2	SC-N3	-	SC-N2
		FRN15G1■-2□	HD					SC-N2	-
	18.5		LD	100	150	SC-N2S	SC-N4	-	SC-N2S
		FRN18.5G1■-2□	HD					SC-N2S	-
	22		LD		175		SC-N5	-	SC-N2S
		FRN22G1■-2□	HD					SC-N3	-
	30		LD	150	200	SC-N4	SC-N7	-	SC-N4
		FRN30G1■-2□	HD					SC-N4	-
	37		LD	175	250	SC-N5	SC-N8	-	SC-N5
		FRN37G1■-2□	HD					SC-N5	-
	45		LD	200	300	SC-N7		-	SC-N7
		FRN45G1■-2□	HD					SC-N7	-
	55		LD	250	350	SC-N8	SC-N11	-	SC-N8
		FRN55G1■-2□	HD					SC-N8	-
	75		LD	350	-	SC-N11	-	-	SC-N10
		FRN75G1■-2□	HD					SC-N11	-
	90		LD	400				-	SC-N11
		FRN90G1■-2□	HD					SC-N11	-
	110		LD	500		SC-N12		-	SC-N12

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

- Install the MCCB or RCD/ELCB at the input side of the inverter. They cannot be installed at the output side of the inverter.
- The above table lists the rated current of MCCBs and RCD/ELCBs to be used in the power control panel with an internal temperature of lower than 50°C. The rated current is factored by a correction coefficient of 0.85 as the RCDs'/MCCBs' and ELCBs' original rated current is specified when using them in a surrounding temperature of 40°C or lower. Select an MCCB and/or RCD/ELCB suitable for the actual short-circuit breaking capacity needed for your power systems.
- For the selection of the MC type, it is assumed that the **600 V HIV (allowable surrounding temperature: 75°C)** wires for the power input/output of the inverter are used. If an MC type for another class of wires is selected, the wire size suitable for the terminal size of both the inverter and the MC type should be taken into account.
- Use ELCBs with overcurrent protection.
- To protect your power systems from secondary accidents caused by the broken inverter, use an MCCB and/or RCD/ELCB with the rated current listed in the above table. Do not use an MCCB or RCD/ELCB with a rating higher than that listed.

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Table 4.4 Rated Current of Molded Case Circuit Breaker (MCCB), Residual-Current-Operated Protective Device (RCD)/ Earth Leakage Circuit Breaker (ELCB) and Magnetic Contactor (MC) (continued)

HD (High Duty) mode: Heavy duty load applications
MD (Medium Duty) mode: Medium duty load applications
LD (Low Duty) mode: Light duty load applications

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD	MCCB, RCD/ELCB Rated current (A)		MC				
				For input circuit		For output circuit				
				DC reactor (DCR)		DC reactor (DCR)		HD	MD	LD
				w/ DCR	w/o DCR	w/ DCR	w/o DCR			
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	5	5	SC-05	SC-05	SC-05	-	-
	0.75	FRN0.75G1■-4□			10					
	1.5	FRN1.5G1■-4□			15					
	2.2	FRN2.2G1■-4□			20					
	3.7	FRN3.7G1■-4□		10	30		SC-4-0			
	5.5	FRN5.5G1■-4□	HD	15	40		SC-5-1	-		SC-05
			LD	20				SC-05		-
	7.5	FRN7.5G1■-4□	HD		50		SC-N1	-		SC-4-0
			LD	30				SC-4-0		-
	11	FRN11G1■-4□	HD		60	SC-5-1		-		SC-5-1
			LD	40				SC-5-1		-
	15	FRN15G1■-4□	HD		75	SC-N1	SC-N2	-		SC-N1
			LD					SC-N1	-	-
	18.5	FRN18.5G1■-4□	HD		100		SC-N2S	-		SC-N1
			LD	50				SC-N1		-
	22	FRN22G1■-4□	HD		125	SC-N2	SC-N3	-		SC-N2
			LD	75				SC-N2		-
	30	FRN30G1■-4□	HD			SC-N2S	SC-N4	-		SC-N2S
			LD	100				SC-N2S		-
	37	FRN37G1■-4□	HD		150	SC-N3		-		SC-N3
			LD					SC-N3		-
	45	FRN45G1■-4□	HD		200		SC-N5	-		SC-N4
			LD	125				SC-N4		-
	55	FRN55G1■-4□	HD		-	SC-N4	-	-		SC-N5
			LD	175				SC-N5		-
	75	FRN75G1■-4□	HD			SC-N7		-		SC-N7
			LD	200				SC-N7		-
	90	FRN90G1■-4□	HD					-	SC-N8	SC-N8
			MD/LD	250		SC-N8		SC-N8	-	-
	110	FRN110G1■-4□	HD					-	SC-N8	SC-N8
			MD/LD	300				SC-N8	-	-
	132	FRN132G1■-4□	HD					-	SC-N11	SC-N11
			MD/LD	350		SC-N11		SC-N11	-	-
	160	FRN160G1■-4□	HD					-	SC-N12	SC-N12
			MD/LD	500		SC-N12		SC-N12	-	-
	200	FRN200G1■-4□	HD					-	SC-N12	SC-N12
			MD/LD					SC-N12	-	-
	220	FRN220G1■-4□	HD					-	SC-N14	-
	250		MD	600				-	-	SC-N14
			LD			SC-N14		SC-N14	-	-
	280	FRN280G1■-4□	HD					-	SC-N14	-
	315		MD	800				-	-	SC-N14
	355		LD					SC-N14	-	-
	315	FRN315G1■-4□	HD					-	SC-N14	-
	355		MD					-	-	SC-N16
	400		LD	1200		SC-N16		SC-N14	-	-
	355	FRN355G1■-4□	HD	800		SC-N14		-	SC-N16	610CM*
	400		MD	1200		SC-N16		-	-	-
	450		LD					SC-N16	610CM*	610CM*
	400	FRN400G1■-4□	HD					-	-	-
	450		MD					610CM*	-	612CM*
	500		LD			610CM*		-		-
		FRN500G1■-4□	HD					610CM*		612CM*
	630		LD	1400		612CM*		-		-
		FRN630G1■-4□	HD					612CM*		616CM*
	710		LD	1600		616CM*		-		

* 610CM, 612CM and 616CM: Manufactured by Aichi Electric Works Co., Ltd.

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

- Install the MCCB or RCD/ELCB at the input side of the inverter. They cannot be installed at the output side of the inverter.
- The above table lists the rated current of MCCBs and RCD/ELCBs to be used in the power control panel with an internal temperature of lower than 50°C. The rated current is factored by a correction coefficient of 0.85 as the RCDs'/MCCBs' and ELCBs' original rated current is specified when using them in a surrounding temperature of 40°C or lower. Select an MCCB and/or RCD/ELCB suitable for the actual short-circuit breaking capacity needed for your power systems.
- For the selection of the MC type, it is assumed that the **600 V HIV (allowable surrounding temperature: 75°C)** wires for the power input/output of the inverter are used. If an MC type for another class of wires is selected, the wire size suitable for the terminal size of both the inverter and the MC type should be taken into account.
- Use ELCBs with overcurrent protection.
- To protect your power systems from secondary accidents caused by the broken inverter, use an MCCB and/or RCD/ELCB with the rated current listed in the above table. Do not use an MCCB or RCD/ELCB with a rating higher than that listed.

Table 4.5 lists the relationship between the rated leakage current sensitivity of RCDs/ELCBs (with overcurrent protection) and wiring length of the inverter output circuits. Note that the sensitivity levels listed in the table are estimated values based on the results obtained by the test setup in the Fuji laboratory where each inverter drives a single motor.

Table 4.5 Rated Current Sensitivity of Residual-Current-Operated Protective Device (RCD)/ Earth Leakage Circuit Breakers (ELCBs)

Power supply voltage	Nominal applied motor (kW)	Wiring length and current sensitivity					
		10 m	30 m	50 m	100 m	200 m	300 m
Three-phase 200 V	0.4						
	0.75						
	1.5						
	2.2		30 mA				
	3.7						
	5.5						
	7.5				100 mA		
	11						
	15						
	18.5					200 mA	
	22						
	30						
	37						
	45						
	55						
	75						500 mA
	90						
	110						
Three-phase 400 V	0.4						
	0.75						
	1.5						
	2.2						
	3.7	30 mA					
	5.5						
	7.5						
	11			100 mA			
	15						
	18.5						
	22				200 mA		
	30						
	37						
	45					500 mA	
	55						
	75						
	90						
	110						
	132						1000 mA
	160						(Special)
	200						
	220						
	250						
	280						
	315						
	355						3000 mA
	400						(Special)
	450						
	500						

- Values listed above were obtained using Fuji ELCB EG or SG series applied to the test setup.
- The rated current of applicable motor rating indicates values for Fuji standard motor (4 poles, 50 Hz and 200 V three-phase).
- The leakage current is calculated based on grounding of the single wire for 200 V class delta connection and neutral grounding for 400 V class Y-connection power lines.
- Values listed above are calculated based on the static capacitance to the earth when the 600 V class of vinyl-insulated IV wires are used in a wiring through metal conduit pipes.
- Wiring length is the total length of wiring between the inverter and motor. If more than one motor is to be connected to a single inverter, the wiring length should be the total length of wiring between the inverter and motors.

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4.3.2 Surge killers for L-load

A surge killer absorbs surge voltage induced by L-load of an electro magnetic switch or solenoid valve. Use of a surge killer is effective in preventing the electronic equipment, including inverters, from damage or malfunctioning caused by such surges.

Install a surge killer near the power coil of the surge source. Connected to the inverter's power source side, as shown in Figure 4.3, a surge killer absorbs the surge voltage, preventing the electronic equipment, from damage or malfunctioning.

Refer to the catalog "Fuji Surge Killers/Absorbers (HS118: Japanese edition only)" for details. These products are available from Fuji Electric Technica Co., Ltd.

Note: Do not connect the surge killers in the secondary (output) circuit of the inverter.

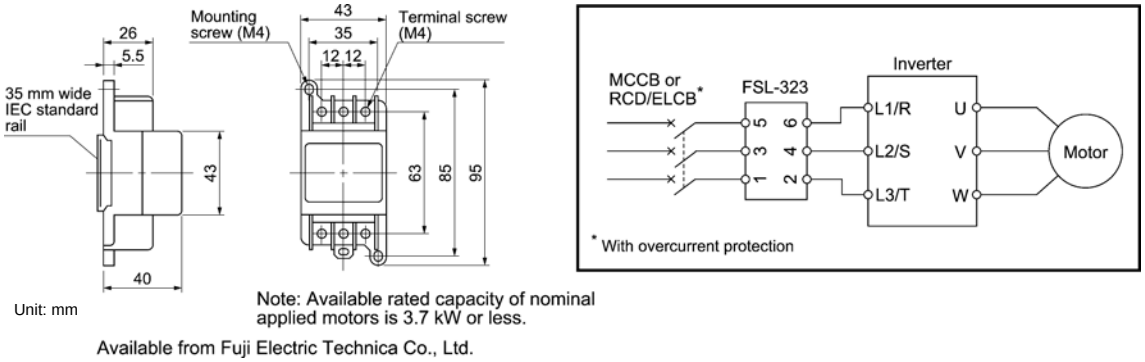

Figure 4.3 Dimensions of Surge Killer and Connection Example

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4.3.3 Arresters

An arrester suppresses surge currents induced by lightning invaded from the power supply lines. Common use of the grounding wire that is used for electric equipment in the panel, with the arrester, is effective in preventing electronic equipment from damage or malfunctioning caused by such surges.

Applicable arrester models are CN23232 for three-phase 200V class series, and CN2324E and CN2324L for three-phase 400V class series. (CN233 series with 20 kA of discharging capability is also available.) Figure 4.4 shows their external dimensions and connection examples. Refer to the catalog "Fuji Surge Killers/Absorbers (HS118: Japanese edition only)" for details. These products are available from Fuji Electric Technica Co., Ltd.

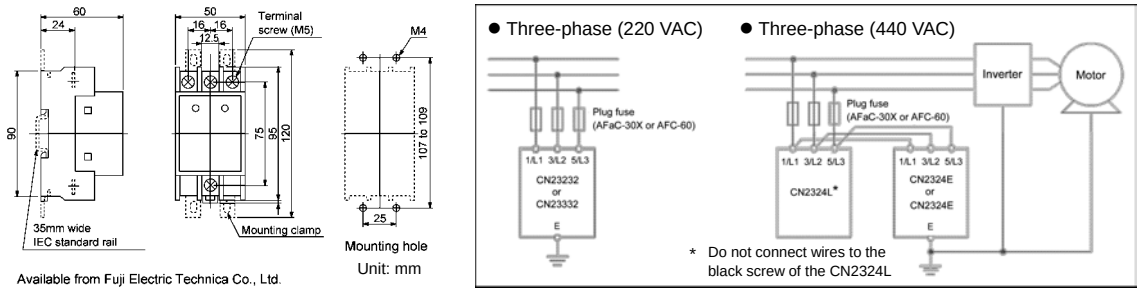

Figure 4.4 Arrester Dimensions and Connection Examples

4.3.4 Surge absorbers

A surge absorber absorbs surges or noises generated by a magnetic contactor (MC) or solenoid valve in the power system to effectively protect electronic equipment in the panel from malfunctions or breakdown. Installed parallel to a coil of an MC, solenoid valve, or L load, a surge absorber absorbs a surge voltage.

Applicable surge absorber models are the S2-A-O and S1-B-O. Figure 4.5 shows their external dimensions.

The surge absorbers are available from Fuji Electric Technica Co., Ltd.

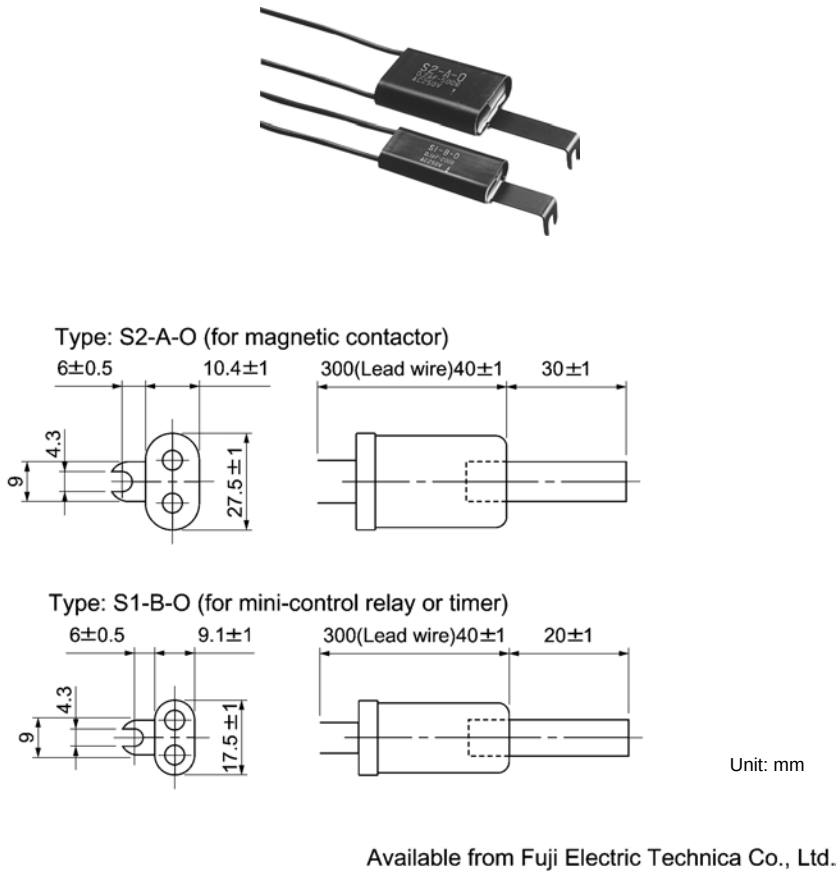

Figure 4.5 Surge Absorber Dimensions

4.3.5 Filtering capacitors suppressing AM radio band noises

These capacitors are effective to suppress AM radio band (less than 1 MHz) noises. Using them with Zero-phase reactors upgrades capability.

Applicable models are NFM25M315KPD1 for 200 V class series inverters and NFM60M315KPD for 400 V class. Use one of them no matter what the inverter capacity. Figure 4.6 shows their external dimensions. These products are available from Fuji Electric Technica Co., Ltd.

Note: Do not use the capacitor in the inverter secondary (output) line.

NFM25M315KPD1 NFM60M315KPD

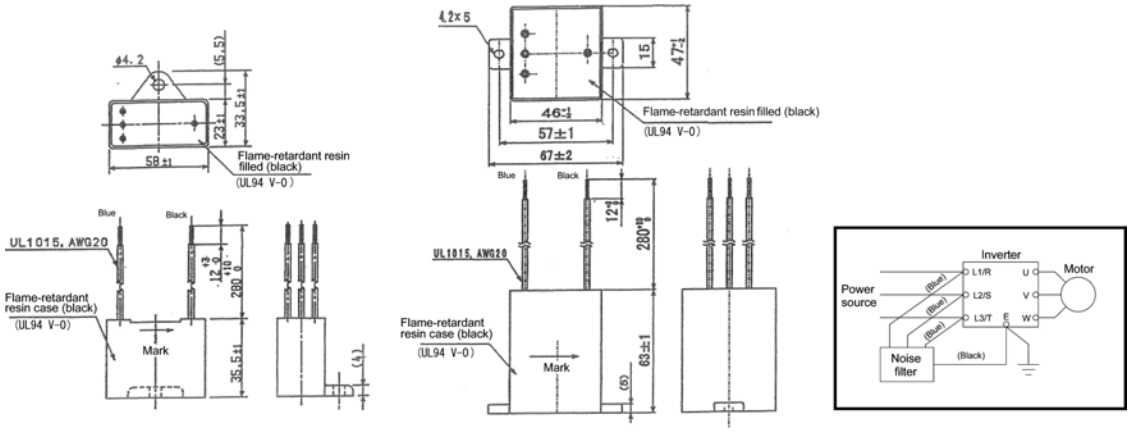

Figure 4.6 Filtering Capacitors Dimensions

4.4 Selecting Options

4.4.1 Peripheral equipment options

4.4.1.1 Braking resistor (DBR) and braking unit

[1] Braking resistor (DBR)

A braking resistor converts regenerative energy generated from deceleration of the motor to heat for consumption. Use of a braking resistor results in improved deceleration performance of the inverter.

Refer to Chapter 3, Section 3.2 "Selecting a Braking Resistor."

[1.1] Standard model

The standard model of a braking resistor integrates a facility that detects the temperature on the heat sink of the resistor and outputs a digital ON/OFF signal if the temperature exceeds the specified level (as an overheating warning signal). To ensure that the signal is recognized at one of the digital input terminals of the FRENIC-MEGA, assign the external alarm ***THR*** to any of terminals [X1] to [X9], [FWD] and [REV]. Connect the assigned terminals to terminals [1] and [2] of the braking resistor. Upon detection of the warning signal (preset detection level: 150°C), the inverter simultaneously transfers to Alarm mode, displays alarm "OH2" on the LED monitor and shuts down its power output.

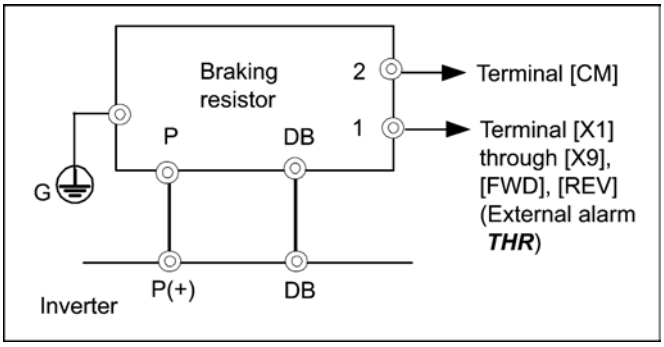

Figure 4.7 Braking Resistor (Standard Model) and Connection Example

[1.2] 10%ED model

The 10%ED braking resistor does not support overheating detection or warning output, so an electronic thermal overload relay needs to be set up using function codes F50 and F51 to protect the braking resistor from overheating.

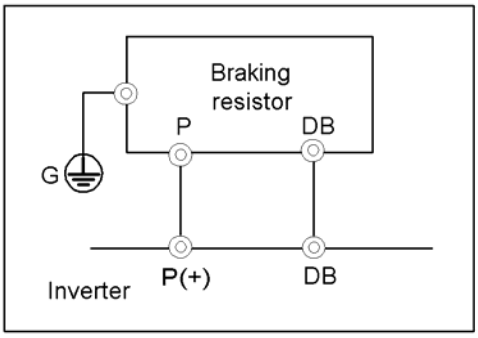

Figure 4.8 Braking Resistor (10%ED Model) and Connection Example

For the specifications and external dimensions of the braking resistors, refer to [3] and [4] in this section.

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[2] Braking unit

Add a braking unit to the braking resistor to upgrade the braking capability of inverters with the following capacity.

HD mode: 30 kW or above

LD mode: 30 kW or above

Inverters with a capacity of 22 kW or below have built-in IGBTs for the braking resistor.

Figure 4.9 Braking Unit

For the specifications and external dimensions of the braking units, refer to [3] and [4] in this Section.

[3] Specifications

Table 4.6 Generated Loss in Braking Unit

Model	Generated loss (W)
BU37-2C	40
BU55-2C	50
BU90-2C	60
BU37-4C	35
BU55-4C	40
BU90-4C	50
BU132-4C	60
BU220-4C	80

*10%ED

Table 4.7 Braking Unit and Braking Resistor (Standard Model) for HD-mode Inverters

Power supply voltage	Nominal applied motor (kW)	Inverter type	Option					Maximum braking torque (%)		Continuous braking (100% braking torque)		Repetitive braking (each cycle is less than 100 (s))	
			Braking unit		Braking resistor								
		HD mode	Type	Q'ty	Type	Q'ty	Resistance (Ω)	50 Hz (N·m)	60 Hz (N·m)	Discharging capability (kWs)	Braking time (s)	Average allowable loss (kW)	Duty cycle (%ED)
Three-phase 200 V	0.4	FRN0.4G1■-2□	-		DB0.75-2	1	100	4.02	3.32	9	45	0.044	22
	0.75	FRN0.75G1■-2□						7.57	6.25	17	45	0.068	18
	1.5	FRN1.5G1■-2□			DB2.2-2	1	40	15	12.4	34	45	0.075	10
	2.2	FRN2.2G1■-2□						22	18.2	33	30	0.077	7
	3.7	FRN3.7G1■-2□			DB3.7-2	1	33	37.1	30.5	37	20	0.093	5
	5.5	FRN5.5G1■-2□			DB5.5-2	1	20	54.3	45	55	20	0.138	5
	7.5	FRN7.5G1■-2□			DB7.5-2	1	15	73.6	61.6	37	10	0.188	5
	11	FRN11G1■-2□			DB11-2	1	10	108	89.5	55	10	0.275	5
	15	FRN15G1■-2□			DB15-2	1	8.6	147	122	75	10	0.375	5
	18.5	FRN18.5G1■-2□			DB18.5-2	1	6.8	182	151	92	10	0.463	5
	22	FRN22G1■-2□			DB22-2	1	5.8	216	179	88	8	0.55	5
	30	FRN30G1■-2□	BU37-2C	1	DB30-2C	1	4	195	162	150	10	1.50	10
	37	FRN37G1■-2□			DB37-2C	1	3	240	200	185	10	1.85	10
	45	FRN45G1■-2□	BU55-2C	1	DB45-2C	1	2.5	292	243	225	10	2.25	10
	55	FRN55G1■-2□			DB55-2C	1	2	359	298	275	10	2.75	10
	75	FRN75G1■-2□	BU90-2C	1	DB75-2C	1	1.6	487	405	375	10	3.75	10
	90	FRN90G1■-2□			DB110-2C	1	1.2	585	486	450	10	4.50	10
Three-phase 400 V	0.4	FRN0.4G1■-4□	-		DB0.75-4	1	200	4.02	3.32	9	45	0.044	22
	0.75	FRN0.75G1■-4□						7.57	6.25	17	45	0.068	18
	1.5	FRN1.5G1■-4□			DB2.2-4	1	160	15	12.4	34	45	0.075	10
	2.2	FRN2.2G1■-4□						22	18.2	33	30	0.077	7
	3.7	FRN3.7G1■-4□			DB3.7-4	1	130	37.1	30.5	37	20	0.093	5
	5.5	FRN5.5G1■-4□			DB5.5-4	1	80	54.3	45	55	20	0.138	5
	7.5	FRN7.5G1■-4□			DB7.5-4	1	60	73.6	61.6	38	10	0.188	5
	11	FRN11G1■-4□			DB11-4	1	40	108	89.5	55	10	0.275	5
	15	FRN15G1■-4□			DB15-4	1	34.4	147	122	75	10	0.375	5
	18.5	FRN18.5G1■-4□			DB18.5-4	1	27	182	151	93	10	0.463	5
	22	FRN22G1■-4□			DB22-4	1	22	216	179	88	8	0.55	5
	30	FRN30G1■-4□	BU37-4C	1	DB30-4C	1	15	195	162	150	10	1.50	10
	37	FRN37G1■-4□			DB37-4C	1	12	240	200	185	10	1.85	10
	45	FRN45G1■-4□	BU55-4C	1	DB45-4C	1	10	292	243	225	10	2.25	10
	55	FRN55G1■-4□			DB55-4C	1	7.5	359	298	275	10	2.75	10
	75	FRN75G1■-4□	BU90-4C	1	DB75-4C	1	6.5	487	405	375	10	3.75	10
	90	FRN90G1■-4□			DB110-4C	1	4.7	585	486	450	10	4.50	10
	110	FRN110G1■-4□	BU132-4C	1				712	592	550	10	5.50	10
	132	FRN132G1■-4□			DB132-4C	1	3.9	855	710	660	10	6.60	10
	160	FRN160G1■-4□	BU220-4C	1	DB160-4C	1	3.2	1036	861	800	10	8.00	10
	200	FRN200G1■-4□			DB200-4C	1	2.6	1295	1076	1000	10	10.0	10
	220	FRN220G1■-4□			DB220-4C	1	2.2	1424	1184	1100	10	11.0	10
	280	FRN280G1■-4□	Under study										
	315	FRN315G1■-4□											
	355	FRN355G1■-4□											
	400	FRN400G1■-4□											
	500	FRN500G1■-4□											
	630	FRN630G1■-4□											

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

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Table 4.8 Braking Unit and Braking Resistor (Standard Model) for LD-mode Inverters

Power supply voltage	Nominal applied motor (kW)	Inverter type	Option					Maximum braking torque (%)			Continuous braking (100% braking torque)		Repetitive braking (each cycle is less than 100 (s))	
			Braking unit		Braking resistor									
		LD mode	Type	Q'ty	Type	Q'ty	Resistance (Ω)		50 Hz (N·m)	60 Hz (N·m)	Discharging capability (kWs)	Braking time (s)	Average allowable loss (kW)	Duty cycle (%ED)
Three-phase 200 V	7.5	FRN5.5G1■-2□	-		DB5.5-2	1	20	100	49.1	41	55	15	0.138	3.5
	11	FRN7.5G1■-2□			DB7.5-2	1	15		72	59.7	37	7	0.188	3.5
	15	FRN11G1■-2□			DB11-2	1	10		98.1	81.4	55	7	0.275	3.5
	18.5	FRN15G1■-2□			DB15-2	1	8.6		121	100	75	8	0.375	4
	22	FRN18.5G1■-2□			DB18.5-2	1	6.8		144	119	92	8	0.463	4
	30	FRN22G1■-2□			DB22-2	1	5.8		216	179	88	6	0.55	3.5
	37	FRN30G1■-2□	BU37-2C	1	DB30-2C	1	4	75	180	150	150	10	1.50	10
	45	FRN37G1■-2□			DB37-2C	1	3		219	182	185	10	1.85	10
	55	FRN45G1■-2□	DB55-2C	1	DB45-2C	1	2.5		269	223	225	10	2.25	10
	75	FRN55G1■-2□			BU55-2C	1	2		365	303	275	10	2.75	10
	90	FRN75G1■-2□	BU90-2C	1	DB75-2C	1	1.6		439	364	375	10	3.75	10
	110	FRN90G1■-2□			DB110-2C	1	1.2		534	444	450	10	4.50	10
Three-phase 400 V	7.5	FRN5.5G1■-4□	-		DB5.5-4	1	80	100	49.6	41	55	15	0.138	3.5
	11	FRN7.5G1■-4□			DB7.5-4	1	60		72	59.7	38	7	0.188	3.5
	15	FRN11G1■-4□			DB11-4	1	40		98.1	81.4	55	7	0.275	3.5
	18.5	FRN15G1■-4□			DB15-4	1	34.4		121	100	75	8	0.375	4
	22	FRN18.5G1■-4□			DB18.5-4	1	27		144	119	93	8	0.463	4
	30	FRN22G1■-4□			DB22-4	1	22		195	162	88	6	0.55	3.5
	37	FRN30G1■-4□	BU37-4C	1	DB30-4C	1	15	75	180	150	150	10	1.50	10
	45	FRN37G1■-4□			DB37-4C	1	12		219	182	185	10	1.85	10
	55	FRN45G1■-4□	BU55-4C	1	DB45-4C	1	10		269	223	225	10	2.25	10
	75	FRN55G1■-4□			DB55-4C	1	7.5		365	303	275	10	2.75	10
	90	FRN75G1■-4□	BU90-4C	1	DB75-4C	1	6.5		439	364	375	10	3.75	10
	110	FRN90G1■-4□			DB110-4C	1	4.7		534	444	450	10	4.50	10
	132	FRN110G1■-4□	BU132-4C	1					641	533	550	10	5.50	10
	160	FRN132G1■-4□			DB132-4C	1	3.9		777	646	660	10	6.60	10
	200	FRN160G1■-4□	BU220-4C	1	DB160-4C	1	3.2		971	807	800	10	8.00	10
	220	FRN200G1■-4□			DB200-4C	1	2.6		1068	888	1000	10	10.0	10
	280	FRN220G1■-4□			DB220-4C	1	2.2		1360	1130	1100	10	11.0	10
	355	FRN280G1■-4□	Under study											
	400	FRN315G1■-4□												
	450	FRN355G1■-4□												
	500	FRN400G1■-4□												
	630	FRN500G1■-4□												
	710	FRN630G1■-4□												

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Table 4.9 Braking Unit and Braking Resistor (Standard Model) for MD-mode Inverters

Power supply voltage	Nominal applied motor (kW)	Inverter type	Options					Maximum braking torque (%)			Continuous braking (100% braking torque)		Repetitive braking (each cycle is less than 100 s)	
			Braking unit		Braking resistor									
		MD mode	Type	Q'ty	Type	Q'ty	Resistance (Ω)		50 Hz (N・m)	60 Hz (N・m)	Discharging capability (kWs)	Braking time (s)	Average allowable loss (kW)	Duty cycle (%ED)
Three-phase 400 V	110	FRN90G1■-4□	BU132-4C	1	DB110-4C	1	4.7	100	712	592	550	10	5.50	10
	132	FRN110G1■-4□			DB132-4C		3.9		855	710	660	10	6.60	10
	160	FRN132G1■-4□	BU220-4C		DB160-4C		3.2		1036	861	800	10	8.00	10
	200	FRN160G1■-4□			DB200-4C		2.6		1295	1078	1000	10	10.0	10
	220	FRN200G1■-4□			DB220-4C		2.2		1424	1184	1100	10	11.0	10
	250	FRN220G1■-4□	BU132-4C	2	DB132-4C	2	1.95		1623	1352	1250	10	12.5	10

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Table 4.10 Braking Resistor (10%ED Model) for HD-mode Inverters

Power supply voltage	Nominal applied motor (kW)	Inverter type	Option			Maximum braking torque (%)		Continuous braking (100% braking torque)		Repetitive braking (each cycle is less than 100 (s))	
			Braking resistor								
		HD mode	Type	Q'ty	Resistance (Ω)	50 Hz (N·m)	60 Hz (N·m)	Discharging capability (kWs)	Braking time (s)	Average allowable loss (kW)	Duty cycle (%ED)
Three-phase 200 V	0.4	FRN0.4G1■-2□	DB0.75-2C	1	100	150	4.02	3.32	9	45	0.02	10
	0.75	FRN0.75G1■-2□					7.57	6.25	17	45	0.0375	
	1.5	FRN1.5G1■-2□	DB2.2-2C	1	40		15	12.4	34	45	0.075	
	2.2	FRN2.2G1■-2□					22	18.2	33	30	0.11	
	3.7	FRN3.7G1■-2□	DB3.7-2C	1	33		37.1	30.5	37	20	0.185	
	5.5	FRN5.5G1■-2□	DB5.5-2C	1	20		54.3	45	55	20	0.275	
	7.5	FRN7.5G1■-2□	DB7.5-2C	1	15		73.6	61.6	37	10	0.375	
	11	FRN11G1■-2□	DB11-2C	1	10		108	89.5	55	10	0.55	
	15	FRN15G1■-2□	DB15-2C	1	8.6		147	122	75	10	0.75	
	18.5	FRN18.5G1■-2□	DB22-2C	1	5.8		182	151	92	10	0.925	
	22	FRN22G1■-2□					216	179	110	10	1.1	
Three-phase 400 V	0.4	FRN0.4G1■-4□	DB0.75-4C	1	200	150	4.02	3.32	9	45	0.02	10
	0.75	FRN0.75G1■-4□					7.57	6.25	17	45	0.0375	
	1.5	FRN1.5G1■-4□	DB2.2-4C	1	160		15	12.4	34	45	0.075	
	2.2	FRN2.2G1■-4□					22	18.2	33	30	0.11	
	3.7	FRN3.7G1■-4□	DB3.7-4C	1	130		37.1	30.5	37	20	0.185	
	5.5	FRN5.5G1■-4□	DB5.5-4C	1	80		54.3	45	55	20	0.275	
	7.5	FRN7.5G1■-4□	DB7.5-4C	1	60		73.6	61.6	37	10	0.375	
	11	FRN11G1■-4□	DB11-4C	1	40		108	89.5	55	10	0.55	
	15	FRN15G1■-4□	DB15-4C	1	34.4		147	122	75	10	0.75	
	18.5	FRN18.5G1■-4□	DB22-4C	1	22		182	151	92	10	0.925	
	22	FRN22G1■-4□					216	179	110	10	1.1	

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Note The 10%ED braking resistor does not support overheating detection or warning output, so an electronic thermal overload relay needs to be set up using function codes F50 and F51 to protect the braking resistor from overheating.

Table 4.11 Braking Resistor (10%ED Model) for LD-mode Inverters

Power supply voltage	Nominal applied motor (kW)	Inverter type	Option			Maximum braking torque (%)		Continuous braking (100% braking torque)		Repetitive braking (each cycle is less than 100 (s))	
			Braking resistor								
		LD mode	Type	Q'ty	Resistance (Ω)	50 Hz (N·m)	60 Hz (N·m)	Discharging capability (kWs)	Braking time (s)	Average allowable loss (kW)	Duty cycle (%ED)
Three-phase 200 V	7.5	FRN5.5G1■-2□	DB5.5-2C	1	20	100	49.6	41	55	15	0.275	10
	11	FRN7.5G1■-2□	DB7.5-2C	1	15		72	59.7	37	7	0.375	10
	15	FRN11G1■-2□	DB11-2C	1	10		98.1	81.4	55	7	0.55	10
	18.5	FRN15G1■-2□	DB15-2C	1	8.6		121	100	75	7	0.75	7
	22	FRN18.5G1■-2□	DB22-2C	1	5.8		144	119	93	7	0.925	7
	30	FRN22G1■-2□					195	162	110	7	1.1	7
Three-phase 400 V	7.5	FRN5.5G1■-4□	DB5.5-4C	1	80	100	49.6	41	55	15	0.275	10
	11	FRN7.5G1■-4□	DB7.5-4C	1	60		72	59.7	38	7	0.375	10
	15	FRN11G1■-4□	DB11-4C	1	40		98.1	81.4	55	7	0.55	10
	18.5	FRN15G1■-4□	DB15-4C	1	34.4		121	100	75	7	0.75	7
	22	FRN18.5G1■-4□	DB22-4C	1	22		144	119	93	7	0.925	7
	30	FRN22G1■-4□					195	162	110	7	1.1	7

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Note The 10%ED braking resistor does not support overheating detection or warning output, so an electronic thermal overload relay needs to be set up using function codes F50 and F51 to protect the braking resistor from overheating.

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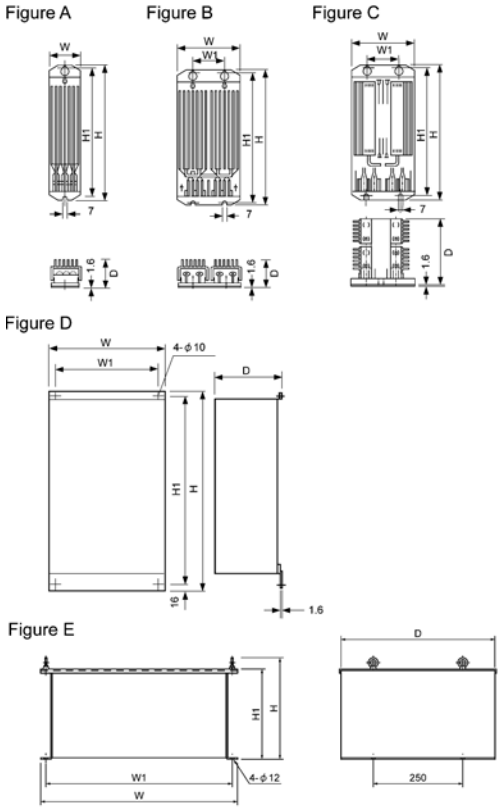
[4] External dimensions

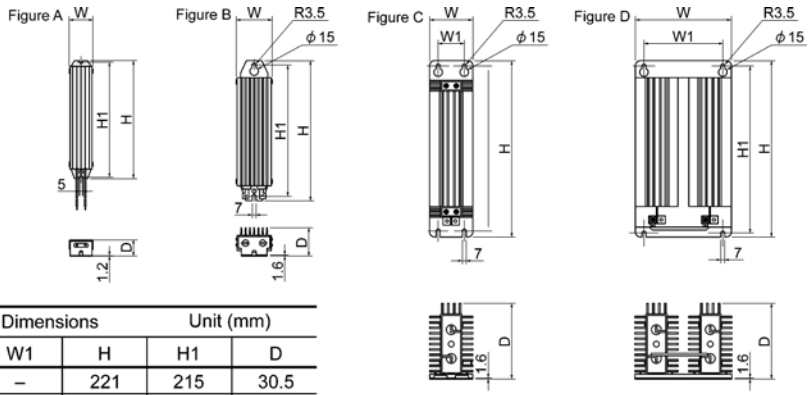
Braking resistors, standard models



Power supply voltage	Type	Figure	Dimensions (mm) W	W1	H	H1	D	Mass (kg)
200 V Class series	DB0.75-2	A	64	–	310	295	67	1.3
	DB2.2-2	A	76		345	332	94	2.0
	DB3.7-2	A	76		345	332	94	2.0
	DB5.5-2	B	142	90	450	430	67.5	4.5
	DB7.5-2	B	156	90	390	370	90	5.0
	DB11-2	C	142	74	430	415	160	6.9
	DB15-2	C	142	74	430	415	160	6.9
	DB18.5-2	C	142	74	510	495	160	8.7
	DB22-2	C	142	74	510	495	160	8.7
	DB30-2C	D	400	368	660	628	140	10
	DB37-2C	D					240	13
	DB45-2C	D						18
	DB55-2C		405		750	718		22
	DB75-2C	E	450	420	283	240	440	35
	DB110-2C		550	520				32
400 V class series	DB0.75-4	A	64	–	310	295	67	1.3
	DB2.2-4		64		470	45	67	2.0
	DB3.7-4		64		470	455	67	1.7
	DB5.5-4	B	142	74	470	455	67	4.5
	DB7.5-4		142	74	520	495	67	5.0
	DB11-4	C	142	74	430	415	160	6.9
	DB15-4	C	142	74	430	415	160	6.9
	DB18.5-4	C	142	74	510	495	160	8.7
	DB22-4	C	142	74	510	495	160	8.7
	DB30-4C	D	420	388	660	628	140	11
	DB37-4C	D					240	14
	DB45-4C	D						19
	DB55-4C		425		750	718		21
	DB75-4C	E	550	520	283	240	440	26
	DB110-4C							30
	DB132-4C		650	620				41
	DB160-4C		750	720				57
	DB200-4C							43
	DB220-4C*		600	570				74

* DB220-4C should be used in pairs. The dimension above is for one unit.

Braking resistors, 10% ED models



Type	Figure	Dimensions W	W1	H	H1	D	Unit (mm)
DB0.75-2C/4C	A	43	–	221	215	30.5	
DB2.2-2C/4C	B	67	–	188	172	55	
DB3.7-2C/4C	B	67	–	328	312	55	
DB5.5-2C/4C	B	80	–	378	362	78	
DB7.5-2C/4C	B	80	–	418	402	78	
DB11-2C/4C	C	80	50	460	440	140	
DB15-2C/4C	C	80	50	580	560	140	
DB22-2C/4C	D	180	144	400	383	145	

Braking units

Figure A

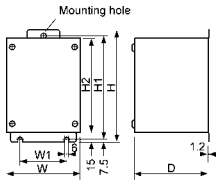
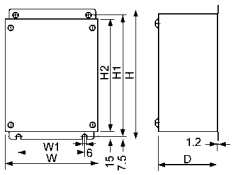


Figure B



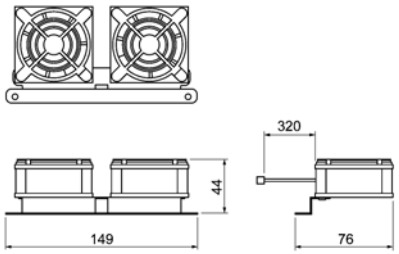
Power supply voltage	Type	Figure	Dimensions (mm) W	W1	H	H1	H2	D	Mass (kg)
200 V class series	BU37-2C	A	150	100	240	225	210	160	4
	BU55-2C	B	230	130	240	225			6
	BU90-2C		250	150	370	355	340		9
400 V class series	BU37-4C	B	150	100	280	265	250	160	4
	BU55-4C		230	130					5.5
	BU90-4C								
	BU132-4C		250	150	370	355	340		9
	BU220-4C				450	435	420		13

Fan units for braking units

Using this option improves the duty cycle [%ED] from 10%ED to 30%ED.

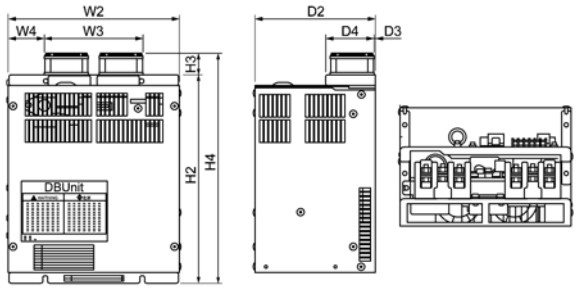
■ Fan unit

● BU-F



■ Braking unit + Fan unit

●BU37 to 220 - 2C/4C + BU-F



[Braking unit + Fan unit]

Power supply voltage	Type	Dimensions W2	W3	W4	H2	H3	H4	D2	D3	D4	Unit (mm)
200 V class series	BU37-2C+BU-F	150	135	7.5	240	30	270	160	1.2	64	
	BU55-2C+BU-F	230		47.5							
	BU90-2C+BU-F	250		57.5	370		400				
400 V class series	BU37-4C+BU-F	150	135	7.5	280	30	310	160	1.2	64	
	BU55-4C+BU-F	230		47.5							
	BU90-4C+BU-F										
	BU132-4C+BU-F	250		57.5	370		400				
	BU220-4C+BU-F				450		480				

4.4.1.2 Power regenerative PWM converter, RHC series

[1] Overview

● Possible to reduce power supply facility capacity
Its power-factor control realizes the same phase current as the power-supply phase-voltage. The equipment, thus, can be operated with the power-factor of almost "1."
This makes it possible to reduce the power transformer capacity and downsize the other devices, compared with those required without the converter.

● Upgraded braking performance
Regenerated energy occurring at highly frequent accelerating and decelerating operation and elevating machine operation is entirely returned to power supply side.
Thus, energy saving during regenerative operation is possible.
As the current waveform is sinusoidal during regenerative operation, no troubles are caused to the power supply system.

Rated continuous regeneration :	100%
Rated regeneration for 1 min	150% (CT use)
	120% (VT use)

● Enhanced maintenance/protective functions
Failure can be easily analyzed with the trace back function (option).

(1) The past 10 alarms can be displayed with the 7-segment LEDs.
This helps you analyze the alarm causes and take countermeasures.

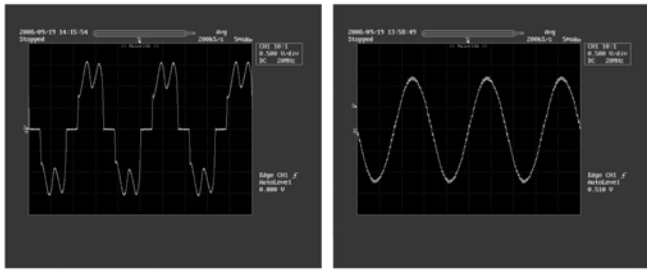
(2) When momentary power failure occurs, the converter shuts out the gate to enable continuous operation after recovery.

(3) The converter can issue warning signals like overload, heat sink overheating, or the end of service life prior to converter tripping.

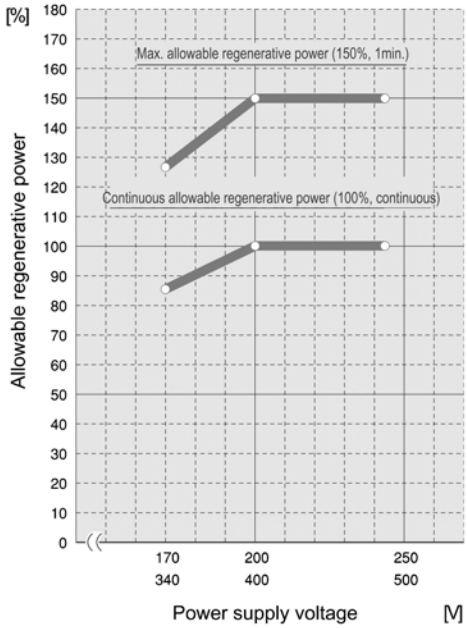
● Enhanced network support
The converter can be connected to MICREX-SX, F series and CC-Link master devices (using option).
The RS-485 interface is provided as standard.

Comparison of Input Current Waveforms

(With PWM converter) (Without PWM converter)



Allowable characteristics of the RHC unit



[2] Specifications

[2.1] Standard specifications

■ 200 V class series

Item			Standard specifications										
Type RHC□□□-2C			200 V class series										
			7.5	11	15	18.5	22	30	37	45	55	75	90
CT mode	Applicable inverter capacity (kW)		7.5	11	15	18.5	22	30	37	45	55	75	90
	Output	Continuous capacity (kW)	8.8	13	18	22	26	36	44	53	65	88	103
		Overload rating	150% of continuous rating for 1 minute										
		Voltage 200 V	320 to 355 VDC (Variable with input power voltage) (*1)										
	Required power supply (kVA)		9.5	14	19	24	29	38	47	57	70	93	111
	Carrier frequency		15 kHz (typical)									10 kHz (typical)	
VT mode	Applicable inverter capacity (kW)		11	15	18.5	22	30	37	45	55	75	90	110
	Output	Continuous capacity (kW)	13	18	22	26	36	44	53	65	88	103	126
		Overload rating	120% of continuous rating for 1 minute										
		Voltage 200 V	320 to 355 VDC (Variable with input power voltage) (*1)										
	Required power supply (kVA)		14	19	24	29	38	47	57	70	93	111	136
	Carrier frequency		10 kHz (typical)									6 kHz (typical)	
Input power	Number of phases, voltage, frequency		Three-phase three lines, 200 to 220 V 50 Hz, 220 to 230 V 50 Hz (*2), 200 to 230 V 60 Hz										
	Voltage/frequency fluctuation		Voltage: –15 to +10%, Frequency: ±5%, Voltage unbalance: 2% or less (*3)										

■ 400 V class series

Item			Standard specifications																				
Type RHC□□□-4C			400 V class series																				
			7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	280	315	355	400	500	630
CT mode	Applicable inverter capacity (kW)		7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	280	315	355	400	500	630
	Output	Continuous capacity (kW)	8.8	13	18	22	26	36	44	53	65	88	103	126	150	182	227	247	314	353	400	448	560	705
		Overload rating	150% of continuous rating for 1 min																				
		Voltage 200 V	640 to 710 V (Variable with input power voltage) (*1)																				
	Required power supply (kVA)		9.5	14	19	24	29	38	47	57	70	93	111	136	161	196	244	267	341	383	433	488	610	762
	Carrier frequency		15 kHz (typical)									10 kHz (typical)											6 kHz (typical)	
VT mode	Applicable inverter capacity (kW)		11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	280	315	355	400	500		
	Output	Continuous capacity (kW)	13	18	22	26	36	44	53	65	88	103	126	150	182	227	247	314	353	400	448	560		
		Overload rating	120% of continuous rating for 1 min																				
		Voltage 200 V	640 to 710 V (Variable with input power voltage) (*1)																				
	Required power supply (kVA)		14	19	24	29	38	47	57	70	93	111	136	161	196	244	267	341	383	433	488	610		
	Carrier frequency		10 kHz (typical)									6 kHz (typical)												
Input power	Number of phases, voltage, frequency		Three-phase three lines, 380 to 440 V 50 Hz, 380 to 460 V 60 Hz (*4)																				
	Voltage/frequency fluctuation		Voltage: –15 to +10%, Frequency: ±5%, Voltage unbalance: 2% or less (*3)																				

(*1) When the power supply voltage is 200/400 V, 220/440 V, or 230/460 V, the output voltage is approximate 320/640 VDC, 343/686 VDC, 355/710 VDC, respectively.

(*2) The 220 to 230 V/50 Hz models are available on request.

(*3) Voltage unbalance (%) = (Max. voltage (V) - Min. voltage (V)) / Three-phase average voltage (V) x 67

(*4) When the power supply voltage is 380 to 398 V/50 Hz and 380 to 430 V/60 Hz, tap-switching is required in the converter.

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[2.2] Common specifications

Item		Specifications
Control	Control method	AVR constant control with DC ACR minor
	Running/Stopping	Starts rectification when the converter is powered ON after connection. Starts boosting when it receives a run signal (terminals [RUN] and [CM] short-circuited or a run command via the communications link). After that, the converter is ready to run.
	Running status signal	Running, power running, regenerative operation, ready-to-run, alarm output (for any alarm), etc.
	CT/VT switching	Switching between CT and VT modes. CT: 150% of overload rating for 1 min VT: 120% of overload rating for 1 min
	Carrier frequency	Fixed to high carrier frequency
	Input power factor	0.99 or above
	Restart after momentary power failure	Shields the gate when the voltage level reaches the undervoltage level if a momentary power failure occurs, and the converter can automatically restart after the power recovers.
	Power limiting control	Controls the power not to exceed the preset limit value.
Indication	Alarm display (Protective functions)	AC fuse blown, AC overvoltage, AC undervoltage, AC overcurrent, AC input current error, input phase loss, synchronous power supply frequency error, DC fuse blown, DC overvoltage, DC undervoltage, charge circuit fault, heat sink overheat, external alarm, converter internal overheat, overload, memory error, keypad communications error, CPU error, network device error, operation procedure error, A/D converter error, optical network error, IPM error
	Alarm history	Saves and displays the most recent 10 alarms. Saves and displays the detailed information of the trip cause for the previous alarm.
	Monitor	Displays input power, input current in RMS, input voltage in RMS, DC link bus voltage and power supply frequency.
	Load factor	Allows the user to measure the load factor with the keypad.
	Language	Allows the user to specify or refer to function codes in any of the three languages--Japanese, English or Chinese.
	Charging lamp	Lights when the DC link bus capacitor is charged.

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[3] Function specifications

■ Terminal functions

Classification	Symbol	Name	Functions
Main circuit	L1/R, L2/S, L3/T	Main circuit power inputs	Connects with the three-phase input power lines through a dedicated reactor.
	P(+), N(-)	Converter outputs	Connects with the power input terminals P(+) and N(-) on an inverter.
	⏚ G	Grounding	Grounding terminal for the converter's chassis (or casing).
	R0, T0	Auxiliary power input for the control circuit	For a backup of the control circuit power supply, connect the power lines same as that of the main power input.
Voltage detection	R1, S1, T1	Synchronous power input for voltage detection	Voltage detection terminals for the internal control of the converter. Connect with the power supply side of the dedicated reactor or filter.
	R2, T2	Inputs for control monitoring	Detection terminal for AC fuse blown.
Input signal	[RUN]	Run command	Short-circuiting terminals [RUN] and [CM] runs the converter; opening them stops the converter.
	[RST]	Reset alarm command	When the converter stops due to an alarm, removing the alarm factor and short-circuiting the terminals [RST] and [CM] cancels the protective function, restarting the converter.
	[X1]	General-purpose transistor input	0: Enable external alarm trip ***THR*** 1: Cancel current limiter ***LMT-CCL*** 2: 73 answerback ***73ANS*** 3: Switch current limiter ***I-LIM*** 4: Option DI ***OPT-DI***
	[CM]	Digital input common	Common terminal for digital input signals.
	[PLC]	PLC signal power	Connects to PLC output signal power supply. (Rated voltage: 24 VDC (22 to 27 VDC)
Output signal	[30A/B/C]	Alarm relay output (for any alarm)	Outputs a signal when the protective function is activated to stop the converter. (Contact: [1C], Terminals [30A] and [30C] are closed: Signal ON) (Contact rating: 250 VAC, max. 50 mA)
	[Y1], [Y2], [Y3], [Y11] to [Y18]	General-purpose transistor output	0: Converter running ***RUN*** 1: Converter ready to run ***RDY*** 2: Power supply current limiting ***IL*** 3: Lifetime alarm ***LIFE*** 4: Heat sink overheat early warning ***PRE-OH*** 5: Overload early warning ***PRE-OL*** 6: Power running ***DRV*** 7: Regenerating ***REG*** 8: Current limiting early warning ***CUR*** 9: Restarting after momentary power failure ***U-RES*** 10: Synchronizing power supply frequency ***SY-HZ*** 11: Alarm content 1 ***AL1*** 12: Alarm content 2 ***AL2*** 13: Alarm content 4 ***AL4*** 14: Option DO ***OPT-DO*** * Mounting the OPC-VG7-DIOA option makes 8 points of DO extended functions available. (DI functions are not available.)
	[CME]	Digital output common	
	[Y5A/C]	Relay output	
	[A01], [A04], [A05]	General-purpose analog output	0: Input power ***PWR*** 1: Input current in RMS ***I-AC*** 2: Input voltage in RMS ***V-AC*** 3: DC link bus voltage ***V-DC*** 4: Power supply frequency ***FREQ*** 5: +10 V test ***P10*** 6: -10 V test ***N10*** * Mounting the OPC-VG7-AIO option makes 2 points of AO extended functions available. (AI functions are not available.)
	[M]	Analog output common	Common terminal for analog output signal.
	[73A], [73C]	Charging resistor input relay outputs	Control output for the input relay of the external charging resistor (73).

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■ Communications specifications

Item		Specifications
General communication specifications		Monitoring the running information, running status and function code data, and controlling (selecting) the terminals [RUN], [RST] and [X1]. * Writing to function codes is not possible.
RS-485 (standard)		Communicating with a PC or PLC. (The converter supports the Fuji general-purpose inverter protocol and Modbus RTU protocol.)
T-Link (option)		Mounting the OPC-VG7-TL option enables communication with a T-Link module of MICREX-F or MICREX-SX via a T-Link network.
SX-bus (option)		Mounting the OPC-VG7-SX option enables communication with a MICREX-SX via an SX bus network.
CC-Link (option)		Mounting the OPC-VG7-CCL option enables communication with a CC-Link master.
Traceback (option)	Hardware	Mounting the OPC-RHC-TR option enables tracing back of the running status data of the converter. WPS-LD-TR software is required.
	Software	Installing the WPS-RHC-TR software enables collecting of traceback data on the PC.

■ Function settings

Function code	Name	Function code	Name
F00	Data protection	H01	Station address
F01	High frequency filter selection	H02	Communications error processing
F02	Restart mode after momentary power failure (Mode selection)	H03	Timer
		H04	Baud rate
F03	Current rating switching	H05	Data length
F04	LED monitor, item selection	H06	Parity bits
F05	LCD monitor, item selection	H07	Stop bits
F06	LCD monitor, language selection	H08	No-response error detection time
F07	LCD monitor, contrast control	H09	Response interval
F08	Carrier frequency	H10	Protocol selection
E01	Terminal [X1] function	H11	TL transmission format
E02 to E13	Terminal [Y1], [Y2], [Y3,], [Y5], [Y11] to [Y18] function	H12	Parallel system
		H13	Number of slave stations in parallel system
E14	I/O function normal open/closed	H14	Clear alarm data
E15	RHC overload early warning level	H15, H16	Power supply current limiter (driving 1/2)
E16	Cooling fan ON/OFF control	H17, H18	Power supply current limiter (braking 1/2)
E17	Under current limiting (Hysteresis width)	H19, H20	Current limiting early warning (level/timer)
E18 to E20	A01, A04 and A05, function selection	M09	Power supply frequency
E21 to E23	A01, A04 and A05, gain setting	M10	Input power
E24 to E26	A01, A04 and A05, bias setting	M11	Input current in RMS
E27	A01, A04 and A05, filter setting	M12	Input voltage in RMS
S01	Operation method	M13	Run command
S02, S03	Power supply current limiting (driving/braking)	M14	Running status
		M15	Output terminals [Y1] to [Y18]

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■ Protective functions

Item	LED monitor displays:	Description	Remarks
AC fuse blown	ACF	Stops the converter output if the AC fuse (R-/T-phase only) is blown.	
AC overvoltage	AOU	Stops the converter output upon detection of an AC overvoltage condition.	
AC undervoltage	ALU	Stops the converter output upon detection of an AC undervoltage condition.	
AC overcurrent	AOC	Stops the converter output if the peak value of the input current exceeds the overcurrent level.	
AC input current error	ACE	Stops the converter output upon detection of the excessive deviation of the AC reactor from the AC input.	
Input phase loss	LPU	Stops the converter output upon detection of an input phase loss.	
Synchronous power frequency error	Fr-E	After the MC for charging circuit (73) is turned on, the converter checks the power frequency. If it detects a power frequency error, this function stops the converter output. An error during converter running (e.g., momentary power failure) triggers no alarm.	
DC fuse blown	dCF	Stops the converter output if the DC fuse (P side) is blown.	18.5 kW or above
DC overvoltage	dOU	Stops the converter output upon detection of a DC overvoltage condition. If a power failure continues for a long time and the control power source is shut down, this alarm is automatically reset.	200 V class series: 400 V ±3 V 400 V class series: 800 V ±5 V
DC undervoltage	dLU	Stops the converter output upon detection of a DC undervoltage condition. If a power failure continues for a long time and the control power source is shut down, this alarm is automatically reset.	200 V class series: Stops at 185 V, restarts at 208 V. 400 V class series: Stops at 371 V, restarts at 417 V.
Charging circuit fault	PbF	Stops the converter output upon detection of a charging circuit fault, provided that the answerback signal from 73 is enabled.	Condition: ***73ANS*** (Answerback from 73) is assigned to terminal [X1].
Heat sink overheat	OH1	Stops the converter output upon detection of a heat sink overheat.	
External alarm	OH2	Stops the converter output upon receipt of an external signal ***THR***.	Condition: ***THR*** (Enable external alarm trip) is assigned to terminal [X1].
Converter internal overheat	OH3	Stops the converter output upon detection of an internal overheat of the converter.	
Converter overload	OLU	Stops the converter output with the inverse-time characteristics due to the input current.	Activate at 105%, 150% for 1 min

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Item	LED monitor displays:	Description	Remarks
Memory error	Er 1	Stops the converter output if a data writing error or any other memory error occurs (when the checksums of the EEPROM and RAM do not match).	
Keypad communications error	Er2	Displays "Er2" upon detection of a wire break in initial communication with the keypad. This does not affect the converter operation.	
CPU error	Er3	Activated if a CPU error occurs.	
Network device error	Er4	Stops the converter output if a fatal error (including no power supply connection) occurs in the master unit in the network.	Applies to T-Link, SX-bus, and CC-Link devices.
Operation procedure error	Er5	Stops the converter output upon detection of an error in the operation procedure.	
A/D converter error	Er8	Stops the converter output upon detection of a failure in the A/D converter circuit.	
Optical network error	Erb	Stops the converter output upon detection of an optical cable break or a fatal error in the optical option.	
IPM error	IPE	Activated when the IPM's self-diagnosis function works due to an overcurrent or overheat.	15 kW or below

■ Required structure and environment

Item		Required structure, environment and standards	Remarks
Structure	Structure	Mounting in a panel or mounting for external cooling	
	Enclosure	IP00	
	Cooling system	Forced air cooling	
	Installation	Vertical installation	
	Coating color	Munsell 5Y3/0.5, eggshell (Same color as our inverter FRENIC 5000VG7S series.)	
	Maintainability	Structure designed for easy parts replacement	
Environment	Site location	Shall be free from corrosive gases, flammable gases, dusts, and direct sunlight. Indoor use only.	
	Surrounding temperature	-10 to 50°C	
	Relative humidity	5 to 95% RH (No condensation)	
	Altitude	3,000 m max. (For use in an altitude between 1,001 m to 3,000 m, the output current should be derated.)	
	Vibration	2 to 9 Hz: Amplitude = 3 mm, 9 to 20 Hz: 9.8 m/s^2, 20 to 55 Hz: 2 m/s^2 (9 to 55 Hz: 2 m/s^2 for 90 kW or above), 55 to 200 Hz: 1 m/s^2	
	Storage temperature	-20 to 55°C	
	Storage humidity	5 to 95% RH	

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[4] Converter configuration

■ List of configurators

CT mode

Power supply	Nominal applied motor (kW)	PWM converter type	MC for charging circuit		MC for power supply		Charging box (*1)						Boosting reactor		Filtering resistor		Filtering reactor		Filtering capacitor		MC for filtering circuit	
									Charging resistor		Fuse											
			(73)	Q'ty	(52)	Q'ty	(CU)	Q'ty	(R0)	Q'ty	(F)	Q'ty	(Lr)	Q'ty	(Rf)	Q'ty	(Lf)	Q'ty	(Cf)	Q'ty	(6F)	Q'ty
200 V class series	7.5	RHC7.5-2C	SC-5-1	1			CU7.5-2C	1	(80W 7.5Ω)	(3)	(CR2LS-50/UL)	(2)	LR2-7.5C	1	GRZG80 0.42Ω	3	LFC2-7.5C	1	CF2-7.5C	1		
	11	RHC11-2C	SC-N1	1			CU11-2C	1	(HF5C5504)		(CR2LS-75/UL)	(2)	LR2-15C	1	GRZG150 0.2Ω	3	LFC2-15C	1	CF2-15C	1		
	15	RHC15-2C	SC-N2	1			CU15-2C	1			(CR2LS-100/UL)	(2)										
	18.5	RHC18.5-2C	SC-N3	1			CU18.5-2C	1	(GRZG120 2Ω)	(3)			LR2-22C	1	GRZG200 0.13Ω	3	LFC2-22C	1	CF2-22C	1		
	22	RHC22-2C					CU22-2C	1			(CR2L-150/UL)	(2)										
	30	RHC30-2C	SC-N4	1			CU30-2C	1			(CR2L-200/UL)	(2)	LR2-37C	1	GRZG400 0.1Ω	3	LFC2-37C	1	CF2-37C	1		
	37	RHC37-2C	SC-N5	1			CU45-2C	1			(CR2L-260/UL)	(2)										
	45	RHC45-2C	SC-N7	1									LR2-55C	1			LFC2-55C	1	CF2-55C	1		
	55	RHC55-2C	SC-N8	1			CU55-2C	1			(CR2L-400/UL)	(2)										
	75	RHC75-2C	SC-N11	1			CU75-2C	1					LR2-75C	1			LFC2-75C	1	CF2-75C	1		
	90	RHC90-2C					CU90-2C	1	(GRZG400 1Ω)	(3)	(A50P600-4)	(2)	LR2-110C	1	GRZG400 0.12Ω (2 pcs in parallel)	6	LFC2-110C	1	CF2-110C	1		
400 V class series	7.5	RHC7.5-4C	SC-05	1			CU7.5-4C	1	(TK50B 30ΩJ)	(3)	(CR6L-30/UL)	(2)	LR4-7.5C	1	GRZG80 1.74Ω	3	LFC4-7.5C	1	CF4-7.5C	1		
	11	RHC11-4C	SC-4-0	1			CU15-4C	1	(HF5B0416)		(CR6L-50/UL)	(2)	LR4-15C	1	GRZG150 0.79Ω	3	LFC4-15C	1	CF4-15C	1		
	15	RHC15-4C	SC-5-1	1																		
	18.5	RHC18.5-4C	SC-N1	1			CU18.5-4C	1	(80W 7.5Ω)	(3)			LR4-22C	1	GRZG200 0.53Ω	3	LFC4-22C	1	CF4-22C	1		
	22	RHC22-4C					CU22-4C	1	(HF5C0416)		(CR6L-75/UL)	(2)										
	30	RHC30-4C	SC-N2	1			CU30-4C	1			(CR6L-100/UL)	(2)	LR4-37C	1	GRZG400 0.38Ω	3	LFC4-37C	1	CF4-37C	1		
	37	RHC37-4C	SC-N2S	1			CU45-4C	1			(CR6L-150/UL)	(2)										
	45	RHC45-4C	SC-N3	1									LR4-55C	1	GRZG400 0.26Ω	3	LFC4-55C	1	CF4-55C	1		
	55	RHC55-4C	SC-N4	1			CU55-4C	1			(CR6L-200/UL)	(2)										
	75	RHC75-4C	SC-N5	1			CU75-4C	1					LR4-75C	1	GRZG400 0.38Ω	3	LFC4-75C	1	CF4-75C	1		
	90	RHC90-4C	SC-N7	1			CU90-4C	1			(CR6L-300/UL)	(2)	LR4-110C	1	GRZG400 0.53Ω (2 pcs in parallel)	6	LFC4-110C	1	CF4-110C	1		
	110	RHC110-4C	SC-N8	1			CU110-4C	1	(GRZG120 2Ω)	(3)												
	132	RHC132-4C					CU132-4C	1			(A50P400-4)	(2)	LR4-160C	1	RF4-160C	1	LFC4-160C	1	CF4-160C	1		
	160	RHC160-4C	SC-N11	1			CU160-4C	1			(A50P600-4)	(2)										
	200	RHC200-4C	SC-N12	1			CU200-4C	1	(GRZG400 1Ω)	(3)			LR4-220C	1	RF4-220C	1	LFC4-220C	1	CF4-220C	1		
	220	RHC220-4C					CU220-4C	1			(A70QS800-4)	(2)										
	280	RHC280-4C	SC-N3	1	SC-N14	1			GRZG400 1Ω (2 pcs in parallel)	6	A70QS800-4	2	LR4-280C	1	RF4-280C	1	LFC4-280C	1	CF4-280C	1	SC-N4	1
	315	RHC315-4C									A70P1600-4TA	2	LR4-315C	1	RF4-315C	1	LFC4-315C	1	CF4-315C	1		
	355	RHC355-4C											LR4-355C	1	RF4-355C	1	LFC4-355C	1	CF4-355C	1		
	400	RHC400-4C			SC-N16	1							LR4-400C	1	RF4-400C	1	LFC4-400C	1	CF4-400C	1		
	500	RHC500-4C			SC-N11	3							LR4-500C	1	RF4-500C	1	LFC4-500C	1	CF4-500C	1(*2)		
	630	RHC630-4C			SC-N12	3					A70P2000-4	2	LR4-630C	1	RF4-630C	1	LFC4-630C	1	CF4-630C	1(*2)	SC-N7	1

VT mode

Power supply	Nominal applied motor (kW)	PWM converter type	MC for charging circuit		MC for power supply		Charging box (*1)						Boosting reactor		Filtering resistor		Filtering reactor		Filtering capacitor		MC for filtering circuit	
									Charging resistor		Fuse											
			(73)	Q'ty	(52)	Q'ty	(CU)	Q'ty	(R0)	Q'ty	(F)	Q'ty	(Lr)	Q'ty	(Rf)	Q'ty	(Lf)	Q'ty	(Cf)	Q'ty	(6F)	Q'ty
200 V class series	11	RHC7.5-2C	SC-N1	1			CU7.5-2C	1	(80W 7.5Ω)	(3)	(CR2LS-50/UL)	(2)	LR2-15C	1	GRZG150 0.2Ω	3	LFC2-15C	1	CF2-15C	1		
	15	RHC11-2C	SC-N2	1			CU11-2C	1	(HF5C5504)		(CR2LS-75/UL)	(2)										
	18.5	RHC15-2C	SC-N3	1			CU15-2C	1			(CR2LS-100/UL)	(2)	LR2-22C	1	GRZG200 0.13Ω	3	LFC2-22C	1	CF2-22C	1		
	22	RHC18.5-2C					CU18.5-2C	1	(GRZG120 2Ω)	(3)												
	30	RHC22-2C	SC-N4	1			CU22-2C	1			(CR2L-150/UL)	(2)	LR2-37C	1	GRZG400 0.1Ω	3	LFC2-37C	1	CF2-37C	1		
	37	RHC30-2C	SC-N5	1			CU30-2C	1			(CR2L-200/UL)	(2)										
	45	RHC37-2C	SC-N7	1			CU45-2C	1			(CR2L-260/UL)	(2)	LR2-55C	1			LFC2-55C	1	CF2-55C	1		
	55	RHC45-2C	SC-N8	1																		
	75	RHC55-2C	SC-N11	1			CU55-2C	1			(CR2L-400/UL)	(2)	LR2-75C	1			LFC2-75C	1	CF2-75C	1		
	90	RHC75-2C					CU75-2C	1					LR2-110C	1	GRZG400 0.12Ω (2 pcs in parallel)	6	LFC2-110C	1	CF2-110C	1		
	110	RHC90-2C	SC-N12	1			CU90-2C	1	(GRZG400 1Ω)	(3)	(A50P600-4)	(2)										
400 V class series	11	RHC7.5-4C	SC-4-0	1			CU7.5-4C	1	(TK50B 30ΩJ)	(3)	(CR6L-30/UL)	(2)	LR4-15C	1	GRZG150 0.79Ω	3	LFC4-15C	1	CF4-15C	1		
	15	RHC11-4C	SC-5-1	1			CU15-4C	1	(HF5B0416)		(CR6L-50/UL)	(2)										
	18.5	RHC15-4C	SC-N1	1									LR4-22C	1	GRZG200 0.53Ω	3	LFC4-22C	1	CF4-22C	1		
	22	RHC18.5-4C					CU18.5-4C	1	(80W 7.5Ω)	(3)												
	30	RHC22-4C	SC-N2	1			CU22-4C	1	(HF5C5504)		(CR6L-75/UL)	(2)	LR4-37C	1	GRZG400 0.38Ω	3	LFC4-37C	1	CF4-37C	1		
	37	RHC30-4C	SC-N2S	1			CU30-4C	1			(CR6L-100/UL)	(2)										
	45	RHC37-4C	SC-N3	1			CU45-4C	1			(CR6L-150/UL)	(2)	LR4-55C	1	GRZG400 0.26Ω	3	LFC4-55C	1	CF4-55C	1		
	55	RHC45-4C	SC-N4	1																		
	75	RHC55-4C	SC-N5	1			CU55-4C	1			(CR6L-200/UL)	(2)	LR4-75C	1	GRZG400 0.38Ω	3	LFC4-75C	1	CF4-75C	1		
	90	RHC75-4C	SC-N7	1			CU75-4C	1					LR4-110C	1	GRZG400 0.53Ω (2 pcs in parallel)	6	LFC4-110C	1	CF4-110C	1		
	110	RHC90-4C	SC-N8	1			CU90-4C	1			(CR6L-300/UL)	(2)										
	132	RHC110-4C					CU110-4C	1	(GRZG120 2Ω)	(3)			LR4-160C	1	RF4-160C	1	LFC4-160C	1	CF4-160C	1		
	160	RHC132-4C	SC-N11	1			CU132-4C	1			(A50P400-4)	(2)										
	200	RHC160-4C	SC-N12	1			CU160-4C	1			(A50P600-4)	(2)	LR4-220C	1	RF4-220C	1	LFC4-220C	1	CF4-220C	1		
	220	RHC200-4C					CU200-4C	1	(GRZG400 1Ω)	(3)												
	280	RHC220-4C	SC-N14	1			CU220-4C	1			(A70QS800-4)	(2)	LR4-280C	1	RF4-280C	1	LFC4-280C	1	CF4-280C	1		
	315	RHC280-4C	SC-N3	1	SC-N14	1			GRZG400 1Ω (2 pcs in parallel)	6	A70QS800-4	2	LR4-315C	1	RF4-315C	1	LFC4-315C	1	CF4-315C	1	SC-N4	1
	355	RHC315-4C									A70P1600-4TA	2	LR4-355C	1	RF4-355C	1	LFC4-355C	1	CF4-355C	1		
	400	RHC355-4C			SC-N16	1							LR4-400C	1	RF4-400C	1	LFC4-400C	1	CF4-400C	1		
	500	RHC400-4C			SC-N11	3							LR4-500C	1	RF4-500C	1	LFC4-500C	1	CF4-500C	1(*2)		

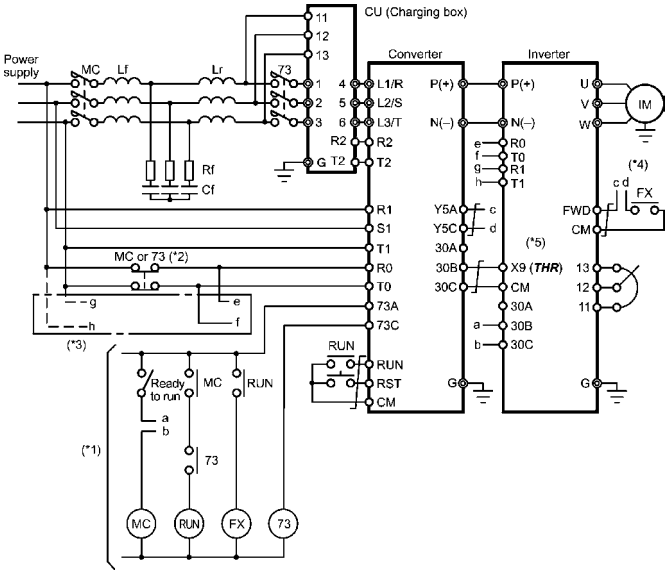
(*1) The charging box (CU) contains a combination of a charging resistor (R0) and a fuse (F). If no CU is used, it is necessary to prepare the charging resistor (R0) and fuse (F) at your end.

(*2) The filtering capacitor consists of two pieces of capacitors. For an order of quantity "1," two pieces of capacitors are to be delivered.

■ Basic connection diagrams

- RHC7.5-2C to RHC90-2C (Applicable inverters: Three-phase 200 V class series, 7.5 to 90 kW)
- RHC7.5-4C to RHC220-4C (Applicable inverters: Three-phase 400 V class series, 7.5 to 220 kW)

*When a charging box is connected



Symbol	Part name
Lr	Boosting reactor
Lf	Filtering reactor
Cf	Filtering capacitor
Rf	Filtering resistor
CU	Charging box
73	Magnetic contactor for charging circuit

(*1) For the 400 V class power supply, connect a stepdown transformer to limit the voltage of the sequence circuit to 220 V or below.

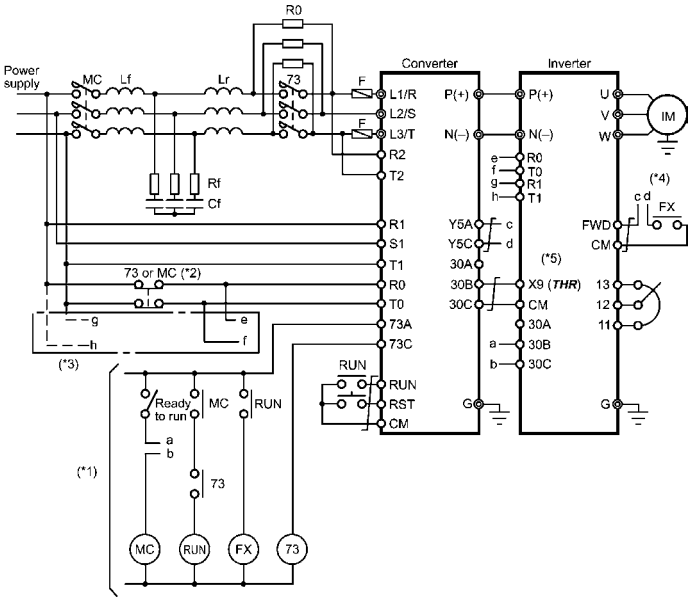
(*2) Be sure to connect the auxiliary power input terminals R0 and T0 of the PWM converter to the main power input lines via B contacts of magnetic contactors of the charging circuit (73 or MC).
If 73 uses SC-05, SC-4-0, or SC-5-1, connect an auxiliary contact unit to the MC's B contact or 73.

(*3) Be sure to connect the auxiliary power input terminals R0 and T0 of the inverter to the main power input lines via B contacts of magnetic contactors of the charging circuit (73 or MC). For 200 V class series of inverters with a capacity of 37 kW or above and 400 V class series with 75 kW or above, connect the fan power input terminals R1 and T1 of the inverter to the main power input lines without going through the MC's B contacts or 73.

(*4) Construct a sequence in which a run command is given to the inverter after the PWM converter becomes ready to run.

(*5) Assign the external alarm ***THR*** to any of terminals [X1] to [X9] on the inverter.

- RHC7.5-2C to RHC90-2C (Applicable inverters: Three-phase 200 V class series, 7.5 to 90 kW)
- RHC7.5-4C to RHC220-4C (Applicable inverters: Three-phase 400 V class series, 7.5 to 220 kW)



Symbol	Part name
Lr	Boosting reactor
Lf	Filtering reactor
Cf	Filtering capacitor
Rf	Filtering resistor
R0	Charging resistor
F	Fuse
73	Magnetic contactor for charging circuit

(*1) For the 400 V class power supply, connect a stepdown transformer to limit the voltage of the sequence circuit to 220 V or below.

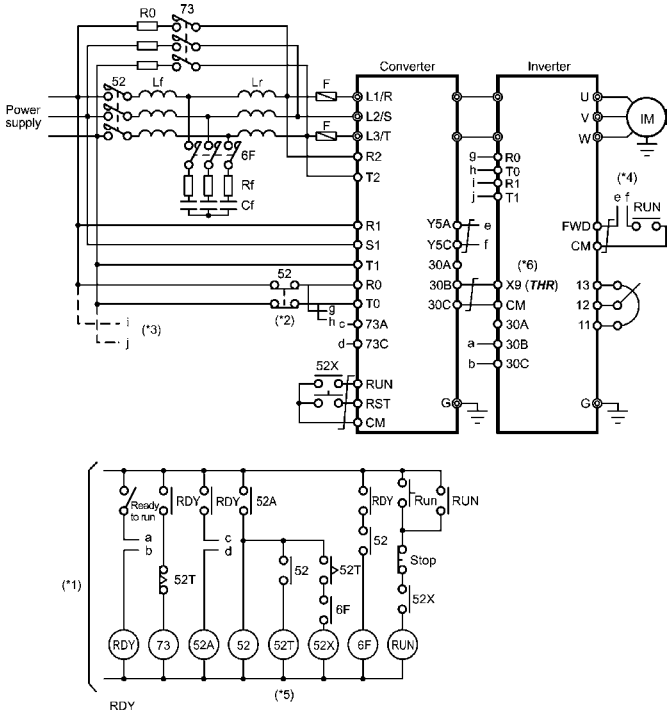
(*2) Be sure to connect the auxiliary power input terminals R0 and T0 of the PWM converter to the main power input lines via B contacts of magnetic contactors of the charging circuit (73 or MC).
If 73 uses SC-05, SC-4-0, or SC-5-1, connect an auxiliary contact unit to the MC's B contact or 73.

(*3) Be sure to connect the auxiliary power input terminals R0 and T0 of the inverter to the main power input lines via B contacts of magnetic contactors of the charging circuit (73 or MC). For 200 V class series of inverters with a capacity of 37 kW or above and 400 V class series with 75 kW or above, connect the fan power input terminals R1 and T1 of the inverter to the main power input lines without going through the MC's B contacts or 73.

(*4) Construct a sequence in which a run command is given to the inverter after the PWM converter becomes ready to run.

(*5) Assign the external alarm ***THR*** to any of terminals [X1] to [X9] on the inverter.

- RHC280-4C to RHC400-4C (Applicable inverters: Three-phase 400 V, 280 to 400 kW)



Symbol	Part name
Lr	Boosting reactor
Lf	Filtering reactor
Cf	Filtering capacitor
Rf	Filtering resistor
R0	Charging resistor
F	Fuse
73	Magnetic contactor for charging circuit
52	Magnetic contactor for power supply
6F	Magnetic contactor for filtering circuit

(*1) Connect a stepdown transformer to limit the voltage of the sequence circuit to 220 V or below.

(*2) Be sure to connect the auxiliary power input terminals R0 and T0 of the PWM converter and the inverter to the main power input lines via B contacts of magnetic contactors of the power supply circuit (52).

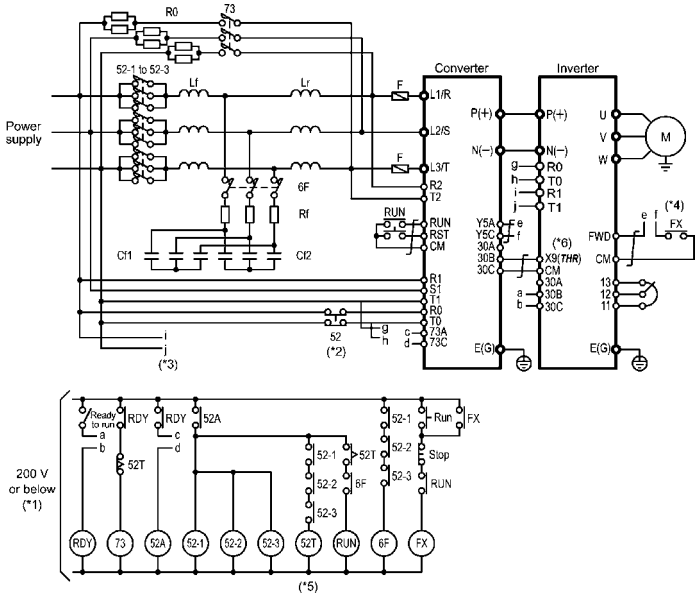
(*3) Connect the fan power input terminals R1 and T1 of the inverter to the main power input lines without going through the B contacts of 52, since the inverter's AC fans are supplied with power from these terminals.

(*4) Construct a sequence in which a run command is given to the inverter after the PWM converter becomes ready to run.

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

(*6) Assign the external alarm ***THR*** to any of terminals [X1] to [X9] on the inverter.

- RHC400-4C in VT mode (Applicable inverters: Three-phase 400 V, 400 kW)
- RHC500-4C and RHC630-4C (Applicable inverters: Three-phase 400 V, 500 and 630 kW)



Symbol	Part name
Lr	Boosting reactor
Lf	Filtering reactor
Cf	Filtering capacitor
Rf	Filtering resistor
R0	Charging resistor
F	Fuse
73	Magnetic contactor for charging circuit
52	Magnetic contactor for power supply
6F	Magnetic contactor for filtering circuit

(*1) Connect a stepdown transformer to limit the voltage of the sequence circuit to 220 V or below.

(*2) Be sure to connect the auxiliary power input terminals R0 and T0 of the PWM converter and the inverter to the main power input lines via B contacts of magnetic contactors of the power supply circuit (52).

(*3) Connect the fan power input terminals R1 and T1 of the inverter to the main power input lines without going through the B contacts of 73 or 52, since the inverter's AC fans are supplied with power from these terminals.

(*4) Construct a sequence in which a run command is given to the inverter after the PWM converter becomes ready to run.

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

(*6) Assign the external alarm ***THR*** to any of terminals [X1] to [X9] on the inverter.

(*7) Wiring for terminals L1/R, L2/S, L3/T, R2, T2, R1, S1, and T1 should match with the phase sequence.

[5] External dimensions

■ PWM converter

Figure A

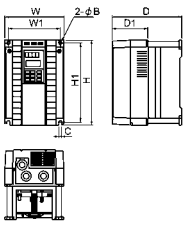


Figure B

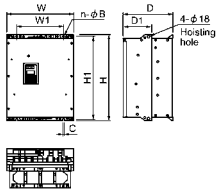


Figure C

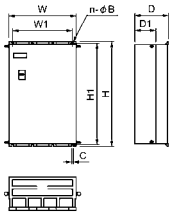
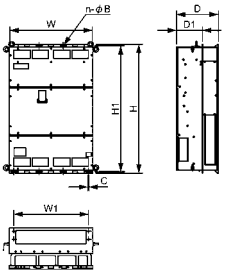


Figure D



PWM converter type		Figure	Dimensions (mm)								Mass (kg)
			W	W1	H	H1	D	D1	n	B	C	
200 V class series	RHC7.5-2C	A	250	226	380	358	245	125	2	10	10	12.5
	RHC11-2C											
	RHC15-2C											
	RHC18.5-2C	B	340	240	480	460	255	145	2	10	10	24
	RHC22-2C											
	RHC30-2C	B	340	240	550	530	255	145	2	10	10	29
	RHC37-2C	B	375	275	615	595	270	145	2	10	10	36
	RHC45-2C	B	375	275	740	720	270	145	2	10	10	42
	RHC55-2C	B	375	275	740	720	270	145	2	10	10	44
	RHC75-2C	C	530	430	750	720	285	145	2	15	15	70
	RHC90-2C	C	680	580	880	850	360	220	3	15	15	115
00 V class series	RHC7.5-4C	A	250	226	380	358	245	125	2	10	10	8
	RHC11-4C											
	RHC15-4C											
	RHC18.5-4C	B	340	240	480	460	255	145	2	10	10	24
	RHC22-4C											
	RHC30-4C	B	340	240	550	530	255	145	2	10	10	29
	RHC37-4C	B	375	275	550	530	270	145	2	10	10	34
	RHC45-4C	B	375	275	675	655	270	145	2	10	10	38
	RHC55-4C											
	RHC75-4C	B	375	275	740	720	270	145	2	10	10	48
	RHC90-4C	C	530	430	740	710	315	175	2	15	15	70
	RHC110-4C											
	RHC132-4C	C	530	430	1000	970	360	220	2	15	15	100
	RHC160-4C											
	RHC200-4C	C	680	580	1000	970	360	220	3	15	15	140
	RHC220-4C											
	RHC280-4C	C	680	580	1400	1370	450	285	3	15	15	320
	RHC315-4C											
	RHC355-4C	C	880	780	1400	1370	450	285	4	15	15	410
	RHC400-4C											
	RHC500-4C	D	999	900	1550	1520	500	313.2	4	15	15	525
	RHC630-4C											

< Boosting reactor >

Figure A

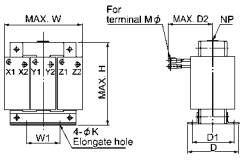


Figure B

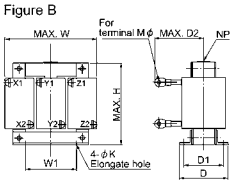


Figure C

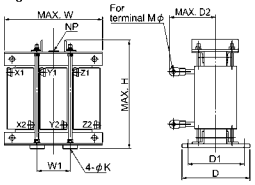
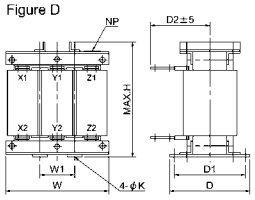


Figure D



Boosting reactor type		figure	Dimensions (mm)								Mass (kg)
			W	W1	H	D	D1	D2	K	M	
200 V class series	LR2-7.5C	A	180	75	205	105	85	95	7	M5	12
	LR2-15C	B	195	75	215	131	110	130	7	M8	18
	LR2-22C	C	240	80	340	215	180	145	10	M8	33
	LR2-37C	C	285	95	420	240	205	150	12	M10	50
	LR2-55C	C	285	95	420	250	215	160	12	M12	58
	LR2-75C	C	330	110	440	255	220	165	12	M12	70
	LR2-110C	C	345	115	500	280	245	185	12	M12	100
400 V class series	LR4-7.5C	B	180	75	205	105	85	90	7	M4	12
	LR4-15C	A	195	75	215	131	110	120	7	M5	18
	LR4-22C	C	240	80	340	215	180	120	10	M6	33
	LR4-37C	C	285	95	405	240	205	130	12	M8	50
	LR4-55C	C	285	95	415	250	215	145	12	M10	58
	LR4-75C	C	330	110	440	255	220	150	12	M10	70
	LR4-110C	C	345	115	490	280	245	170	12	M12	100
	LR4-160C	C	380	125	550	300	260	185	15	M12	140
	LR4-220C	C	450	150	620	330	290	230	15	M12	200
	LR4-280C	C	480	160	740	330	290	240	15	M16	250
	LR4-315C	C	480	160	760	340	300	250	15	M16	270
	LR4-355C	C	480	160	830	355	315	255	15	M16	310
	LR4-400C	C	480	160	890	380	330	260	19	M16	340
	LR4-500C	C	525	175	960	410	360	290	19	M16	420
	LR4-630	D	600	200	640	440	390	285	19	—	450

< Filtering reactor >

Figure A

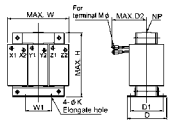


Figure B

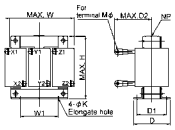


Figure C

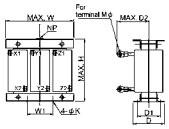


Figure D

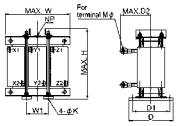
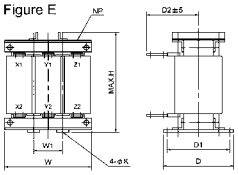


Figure E



Filtering reactor type		Figure	Dimensions (mm)								Mass (kg)
			W	W1	H	D	D1	D2	K	M	
200 V class series	LFC2-7.5C	B	125	40	100	85	67	85	6	M5	2.2
	LFC2-15C	B	125	40	100	93	75	90	6	M8	2.5
	LFC2-22C	B	125	40	100	93	75	105	6	M8	3.0
	LFC2-37C	B	150	60	115	103	85	125	6	M10	5.0
	LFC2-55C	B	175	60	145	110	90	140	6	M12	8.0
	LFC2-75C	B	195	80	200	120	100	150	7	M12	13
	LFC2-110C	C	255	85	230	118	95	165	7	M12	20
400 V class series	LFC4-7.5C	A	125	40	100	85	67	75	6	M4	2.2
	LFC4-15C	A	125	40	100	93	75	90	6	M5	2.5
	LFC4-22C	A	125	40	100	93	75	95	6	M6	3.0
	LFC4-37C	B	150	60	115	108	90	110	6	M8	5.0
	LFC4-55C	B	175	60	145	110	90	120	6	M10	8.0
	LFC4-75C	B	195	80	200	113	93	130	7	M10	12
	LFC4-110C	C	255	85	220	113	90	145	7	M12	19
	LFC4-160C	C	255	85	245	137	110	150	10	M12	22
	LFC4-220C	D	300	100	320	210	180	170	10	M12	35
	LFC4-280C	D	330	110	330	230	195	195	12	M16	43
	LFC4-315C	D	315	105	365	230	195	200	12	M16	48
	LFC4-355C	D	315	105	395	235	200	210	12	M16	53
	LFC4-400C	D	345	115	420	235	200	235	12	M16	60
	LFC4-500C	D	345	115	480	240	205	240	12	M16	72
	LFC4-630C	E	435	145	550	295	255	200	15	--	175

< Filtering capacitor >

Figure A

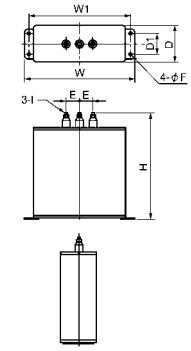
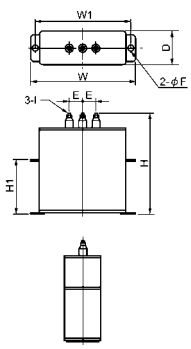


Figure B



Filtering capacitor type		Figure	Dimensions (mm)									Mass (kg)
			W	W1	H	H1	D	D1	E	F	I	
200 V class series	CF2-7.5C	A	165	150	185	--	70	40	30	7	M5	1.9
	CF2-15C	A	205	173	245	--	70	40	30	7	M5	3.5
	CF2-22C	A	280	265	260	--	90	55	80	7	M5	6.0
	CF2-37C	A	280	265	290	--	90	55	80	7	M5	7.0
	CF2-55C	A	280	265	340	--	90	55	80	7	M8	8.5
	CF2-75C	A	280	265	290	--	90	55	80	7	M6	7.0
	CF2-110C	A	280	265	340	--	90	55	80	7	M8	8.5
400 V class series	CF4-7.5C	A	165	150	135	--	70	40	30	7	M5	1.3
	CF4-15C	A	165	150	215	--	70	40	30	7	M5	2.3
	CF4-22C	A	205	190	185	--	70	40	30	7	M5	2.5
	CF4-37C	A	205	190	205	--	70	40	30	7	M5	2.9
	CF4-55C	A	205	190	245	--	70	40	30	7	M5	3.5
	CF4-75C	A	205	190	205	--	70	40	30	7	M5	2.9
	CF4-110C	A	205	190	245	--	70	40	30	7	M5	3.5
	CF4-160C	A	280	265	260	--	90	55	80	7	M6	6.0
	CF4-220C	B	435	400	310	125	100	--	80	15x20 *	M12	13.0
	CF4-280C	B	435	400	350	165	100	--	80	15x20 *	M12	15.0
	CF4-315C	B	435	400	460	275	100	--	80	15x20 *	M12	20.0
	CF4-355C	B	435	400	520	335	100	--	80	15x20 *	M12	23.0
	CF4-400C	B	435	400	610	425	100	--	80	15x20 *	M12	27.0
	CF4-500C	B	435	400	310	125	100	--	80	15x20 *	M12	13.0
	CF4-630C	B	435	400	460	275	100	--	80	15x20 *	M12	20.0

* Elongate hole

< Filtering resistor >

Figure A

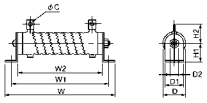


Figure B

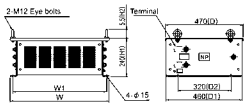
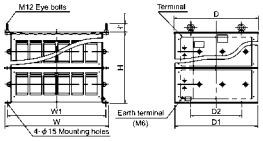


Figure C



Filtering resistor type		Figure	Dimensions (mm)									Mass (kg)	Q'ty
			W	W1	W2	H1	H2	D	D1	D2	C		
200 V class series	GRZG80 0.42Ω	A	167	148	115	22	32	33	26	6	5.5	0.19	3
	GRZG150 0.2Ω	A	247	228	195	22	32	33	26	6	5.5	0.19	3
	GRZG200 0.13Ω	A	306	287	254	22	32	33	26	6	5.5	0.35	3
	GRZG400 0.1Ω	A	411	385	330	40	39	47	40	9.5	5.5	0.85	3
	GRZG400 0.12Ω	A	411	385	330	40	39	47	40	9.5	5.5	0.85	3
400 V class series	GRZG80 1.74Ω	A	167	148	115	22	32	33	26	6	5.5	0.19	3
	GRZG150 0.79Ω	A	247	228	195	22	32	33	26	6	5.5	0.19	3
	GRZG200 0.53Ω	A	306	287	254	22	32	33	26	6	5.5	0.35	3
	GRZG400 0.38Ω	A	411	385	330	40	39	47	40	9.5	5.5	0.85	3
	GRZG400 0.26Ω	A	411	385	330	40	39	47	40	9.5	5.5	0.85	3
	GRZG400 0.53Ω	A	411	385	330	40	39	47	40	9.5	5.5	0.85	6
	RF4-160C	B	400	370	--	240	55	470	460	320	--	22	1
	RF4-220C											25	1
	RF4-280C	C	655	625	--	240	55	470	460	320	--	31	1
	RF4-315C											35	1
	RF4-355C											36	1
	RF4-400C											38	1
	RF4-500C											41	1
	RF4-630C	C	655	625	--	440	55	530	520	320	--	70	1

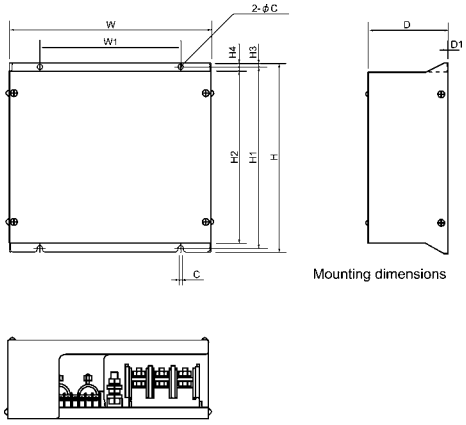
< Charging box >

The charging box contains a combination of a charging resistor and a fuse, which is essential in the configuration of the RHC-C series of PWM converters. Using this charging box eases mounting and wiring jobs.

Capacity range

200 V class series: 7.5 to 90 kW in 10 types,
400 V class series: 7.5 to 220 kW in 14 types, Total 24 types

As for 400 V class series with a capacity of 280 to 400 kW, the charging resistor and the fuse are separately provided as before.



Mounting dimensions

Fuse type		Dimensions (mm)										Mounting bolt	Mass (kg)
		W	W1	H	H1	H2	H3	H4	D	D1	C		
200 V class series	CU7.5-2C	270	170	300	285	270	7.5	15	100	2.4	6	M5	6
	CU11-2C												
	CU15-2C												
	CU18.5-2C												
	CU22-2C												
	CU30-2C	300	200	310	295	280			110				7
	CU45-2C	330	230						130				8
	CU55-2C												
	CU75-2C	430	330	560	536	510	12	25	150	3.2	10	M8	17
	CU90-2C												20
400 V class series	CU7.5-4C	270	170	300	285	270	7.5	15	100	2.4	6	M5	5.5
	CU15-4C												
	CU18.5-4C												6
	CU22-4C												
	CU30-4C	300	200	310	295	280			110				7
	CU45-4C												
	CU55-4C												
	CU75-4C	330	230						130				8
	CU90-4C												
	CU110-4C												
	CU132-4C	430	330	560	536	510	12	25	150	3.2	10	M8	18
	CU160-4C												
	CU200-4C												20
	CU220-4C												

< Charging resistor >

Figure A

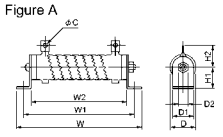


Figure B

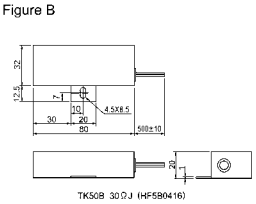
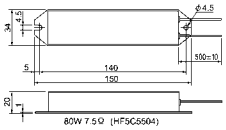


Figure C



Charging resistor type	Figure	Dimensions (mm)									Mass (g)
		W	W1	W2	H1	H2	D	D1	D2	C	
GRZG120 2Ω	A	217	198	165	22	32	33	26	6	5.5	250
GRZG400 1Ω	A	411	385	330	40	39	47	40	9.5	5.5	850
TK50B 30Ω J (HF5B0416)	B	--	--	--	--	--	--	--	--	--	150
80W 7.5Ω (HF5C5504)	C	--	--	--	--	--	--	--	--	--	--

< Fuse >

Figure A

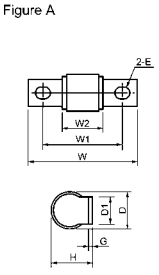


Figure B

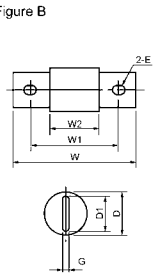
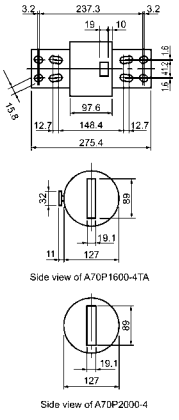


Figure C



Fuse type		Figure	Dimensions (mm)									Mass (g)
			W	W1	W2	H	D	D1	G	E		
200 V class series	CR2LS-50/UL	A	56	42	26	18.5	17.5	12	2	6.5x8.5		28
	CR2LS-75/UL											
	CR2LS-100/UL											
	CR2L-150/UL	A	80	58	29.5	30.5	27	20	3	9x11		100
	CR2L-200/UL	A	85	60	30	33.5	30	25	3.2	11x13		130
	CR2L-260/UL											
	CR2L-400/UL	A	95	70	31	42	37	30	4	11x13		230
	A50P600-4	B	113.5	81.75	56.4	--	50.8	38.1	6.4	10.3x18.2		540
400 V class series	CR6L-30/UL	A	76	62	47	18.5	17.5	12	2	6.5x8.5		42
	CR6L-50/UL											
	CR6L-75/UL	A	95	70	40	34	30	25	3.2	11x13		150
	CR6L-100/UL											
	CR6L-150/UL											
	CR6L-200/UL	A	107	82	43	42	37	30	4	11x13		246
	CR6L-300/UL											
	A50P400-4	B	110	78.6	53.1	--	38.1	25.4	6.4	10.3x18.4		290
	A50P600-4	B	113.5	81.75	56.4	--	50.8	38.1	6.4	10.3x18.4		540
	A70QS800-4	B	180.2	129.4	72.2	--	63.5	50.8	9.5	13.5x18.3		1080
	A70P1600-4TA	C	--	--	--	--	--	--	--	--		7400
	A70P2000-4	C	--	--	--	--	--	--	--	--		8000

■ Generated loss

In CT mode

PWM converter		Boosting reactor		Filtering reactor		Filtering resistor		
Type	Generated loss (W)	Type	Generated loss (W)	Type	Generated loss (W)	Type	Q'ty	Generated loss (W)
RHC7.5-2C	400	LR2-7.5C	95	LFC2-7.5C	10	GRZG80 0.42Ω	3	16
RHC11-2C	500	LR2-15C	150	LFC2-15C	19	GRZG150 0.2Ω	3	48
RHC15-2C	650							
RHC18.5-2C	700	LR2-22C	230	LFC2-22C	26	GRZG200 0.13Ω	3	68
RHC22-2C	800							
RHC30-2C	1000	LR2-37C	330	LFC2-37C	32	GRZG400 0.1Ω	3	107
RHC37-2C	1350							
RHC45-2C	1500	LR2-55C	450	LFC2-55C	43			240
RHC55-2C	1750							
RHC75-2C	2050	LR2-75C	520	LFC2-75C	74			137
RHC90-2C	2450	LR2-110C	720	LR2-110C	115	GRZG400 0.12Ω (2 parts in parallel)	6	374
RHC7.5-4C	400	LR4-7.5C	90	LFC4-7.5C	9	GRZG80 1.74Ω	3	15
RHC11-4C	500	LR4-15C	160	LFC4-15C	20	GRZG150 0.79Ω	3	48
RHC15-4C	600							
RHC18.5-4C	650	LR4-22C	230	LFC4-22C	22	GRZG200 0.53Ω	3	70
RHC22-4C	900							
RHC30-4C	1200	LR4-37C	350	LFC4-37C	36	GRZG400 0.38Ω	3	86
RHC37-4C	1550							
RHC45-4C	1800	LR4-55C	490	LFC4-55C	43	GRZG400 0.26Ω	3	130
RHC55-4C	2050							
RHC75-4C	2150	LR4-75C	520	LFC4-75C	78	GRZG400 0.38Ω	3	112
RHC90-4C	2600	LR4-110C	710	LFC4-110C	90	GRZG400 0.53Ω (2 parts in parallel)	6	405
RHC110-4C	3050							
RHC132-4C	3500	LR4-160C	1000	LFC4-160C	160	RF4-160C	1	568
RHC160-4C	4150							
RHC200-4C	5100	LR4-220C	1240	LFC4-220C	200	RF4-220C	1	751
RHC220-4C	5600							
RHC280-4C	7100	LR4-280C	1430	LFC4-280C	220	RF4-280C	1	1027
RHC315-4C	8000	LR4-315C	1660	LFC4-315C	260	RF4-315C	1	1154
RHC355-4C	8900	LR4-355C	1910	LFC4-355C	300	RF4-355C	1	1286
RHC400-4C	10100	LR4-400C	2160	LFC4-400C	350	RF4-400C	1	1454

In VT mode

PWM converter		Boosting reactor		Filtering reactor		Filtering resistor		
Type	Generated loss (W)	Type	Generated loss (W)	Type	Generated loss (W)	Type	Q'ty	Generated loss (W)
RHC7.5-2C	450	LR2-15C	150	LFC2-15C	19	GRZG150 0.2Ω	3	48
RHC11-2C	550							
RHC15-2C	650	LR2-22C	230	LFC2-22C	26	GRZG200 0.13Ω	3	68
RHC18.5-2C	750							
RHC22-2C	850	LR2-37C	330	LFC2-37C	32	GRZG400 0.1Ω	3	107
RHC30-2C	1200							
RHC37-2C	1500	LR2-55C	450	LFC2-55C	43			240
RHC45-2C	1600							
RHC55-2C	2100	LR2-75C	520	LFC2-75C	74			137
RHC75-2C	2300	LR2-110C	720	LFC2-110C	115	GRZG400 0.12Ω (2 parts in parallel)	6	374
RHC90-2C	2650							
RHC7.5-4C	400	LR4-15C	160	LFC4-15C	20	GRZG150 0.79Ω	3	48
RHC11-4C	500							
RHC15-4C	600	LR4-22C	230	LFC4-22C	22	GRZG200 0.53Ω	3	70
RHC18.5-4C	600							
RHC22-4C	950	LR4-37C	350	LFC4-37C	36	GRZG400 0.38Ω	3	86
RHC30-4C	1200							
RHC37-4C	1450	LR4-55C	490	LFC4-55C	43	GRZG400 0.26Ω	3	130
RHC45-4C	1750							
RHC55-4C	2250	LR4-75C	520	LFC4-75C	78	GRZG400 0.38Ω	3	112
RHC75-4C	1950	LR4-110C	710	LFC4-110C	90	GRZG400 0.53Ω (2 parts in parallel)	6	405
RHC90-4C	2400							
RHC110-4C	2900	LR4-160C	1000	LFC4-160C	160	RF4-160C	1	568
RHC132-4C	3250							
RHC160-4C	4100	LR4-220C	1240	LFC4-220C	200	LFC4-220C	1	751
RHC200-4C	4400							
RHC220-4C	5600	LR4-280C	1430	LFC4-280C	220	LFC4-280C	1	1027
RHC280-4C	6250	LR4-315C	1660	LFC4-315C	260	LFC4-315C	1	1154
RHC315-4C	7000	LR4-355C	1910	LFC4-355C	300	LFC4-355C	1	1286
RHC355-4C	8050	LR4-400C	2160	LFC4-400C	350	LFC4-400C	1	1454
RHC400-4C	8950	LR4-500C	2470	LFC4-500C	450	LFC4-500C	1	1821

Note: Generated losses listed in the above tables are approximate values that are calculated according to the following conditions:

- The power supply is three-phase 200 V/400 V 50 Hz with 0% interphase voltage unbalance ratio.
- The power supply capacity uses the larger of either 500 kVA or 10 times the rated capacity of the inverter.
- The motor is a 4-pole standard model at full load (100%).

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4.4.1.3 DC reactors (DCRs)

A DCR is mainly used for power supply matching and for input power factor correction (for reducing harmonic components).

■ For power supply matching

- Use a DCR when the capacity of a power supply transformer exceeds 500 kVA and is 10 times or more the rated inverter capacity. In this case, the percent reactance of the power supply decreases, and harmonic components and their peak value increase. These factors may break rectifiers or capacitors in the converter section of inverter, or decrease the capacitance of the capacitor (which can shorten the inverter's service life).
- Also use a DCR when there are thyristor-driven loads or when phase-advancing capacitors are being turned ON/OFF.
- Use a DCR when the interphase voltage unbalance ratio of the inverter power supply exceeds 2%.

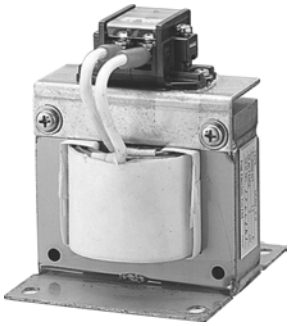
$$\text{Interphase voltage unbalance (\%)} = \frac{\text{Max. voltage (V)} \quad \text{Min. voltage (V)}}{\text{Three - phase average voltage (V)}} \times 67$$

■ For input power factor correction (for suppressing harmonics)

Generally a capacitor is used to improve the power factor of the load, however, it cannot be used in a system that includes an inverter. Using a DCR increases the reactance of inverter's power supply so as to decrease harmonic components on the power supply lines and improve the power factor of inverter. Using a DCR improves the input power factor to approximately 86% to 95%.

Note

- At the time of shipping, a jumper bar is connected across terminals P1 and P (+) on the terminal block. Remove the jumper bar when connecting a DCR.
- If a DCR is not going to be used, do not remove the jumper bar.



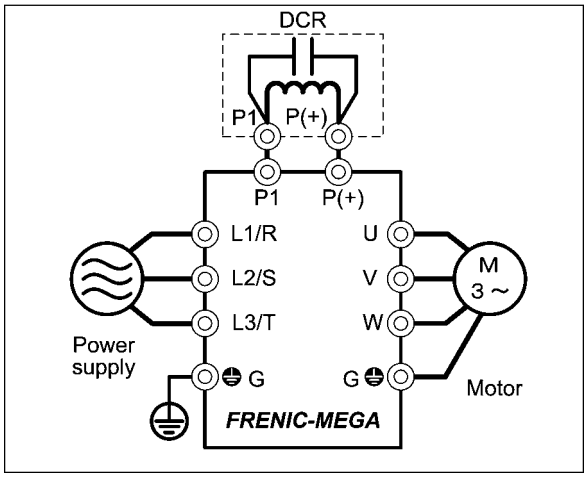


Figure 4.10 External View of a DC Reactor (DCR) and Connection Example

Table 4.12 DC Reactors (DCRs)

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	DC reactor type	Rated current (A)	Inductance (mH)	Generated loss (W)
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	DCR2-0.4	3	12	1.9
	0.75	FRN0.75G1■-2□		DCR2-0.75	5	7	2.8
	1.5	FRN1.5G1■-2□		DCR2-1.5	8	4	4.6
	2.2	FRN2.2G1■-2□		DCR2-2.2	11	3	6.7
	3.7	FRN3.7G1■-2□		DCR2-3.7	18	1.7	8.8
	5.5	FRN5.5G1■-2□	HD	DCR2-5.5	25	1.2	14
	7.5		LD	DCR2-7.5	34	0.8	16
		FRN7.5G1■-2□	HD				
	11		LD	DCR2-11	50	0.6	27
		FRN11G1■-2□	HD				
	15		LD	DCR2-15	67	0.4	27
		FRN15G1■-2□	HD				
	18.5		LD	DCR2-18.5	81	0.35	29
		FRN18.5G1■-2□	HD				
	22		LD	DCR2-22A	98	0.3	38
		FRN22G1■-2□	HD				
	30		LD	DCR2-30B	136	0.23	37
		FRN30G1■-2□	HD				
	37		LD	DCR2-37C	175	0.119	63
		FRN37G1■-2□	HD				
	45		LD	DCR2-45C	213	0.1	68
		FRN45G1■-2□	HD				
	55		LD	DCR2-55C	256	0.08	75
		FRN55G1■-2□	HD				
	75		LD	DCR2-75C	358	0.05	96
		FRN75G1■-2□	HD				
	90		LD	DCR2-90C	431	0.042	100
		FRN90G1■-2□	HD				
	110		LD	DCR2-110C	552	0.034	126

Note 1: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Note 2: Generated losses listed in the above table are approximate values that are calculated according to the following conditions:

- The power supply is three-phase 200 V/400 V 50 Hz with 0% interphase voltage unbalance ratio.
- The power supply capacity uses the larger of either 500 kVA or 10 times the rated capacity of the inverter.
- The motor is a 4-pole standard model at full load (100%).
- An AC reactor (ACR) is not connected.

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Table 4.12 DC Reactors (DCRs) (continued)

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD	DC reactor type	Rated current (A)	Inductance (mH)	Generated loss (W)
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	DCR4-0.4	1.5	50	2
	0.75	FRN0.75G1■-4□		DCR4-0.75	2.5	30	2.5
	1.5	FRN1.5G1■-4□		DCR4-1.5	4	16	4.8
	2.2	FRN2.2G1■-4□		DCR4-2.2	5.5	12	6.8
	3.7	FRN3.7G1■-4□		DCR4-3.7	9	7	8.1
	5.5	FRN5.5G1■-4□	HD	DCR4-5.5	13	4	10
	7.5		LD	DCR4-7.5	18	3.5	15
		FRN7.5G1■-4□	HD				
	11		LD	DCR4-11	25	2.2	21
		FRN11G1■-4□	HD				
	15		LD	DCR4-15	34	1.8	28
		FRN15G1■-4□	HD				
	18.5		LD	DCR4-18.5	41	1.4	29
		FRN18.5G1■-4□	HD				
	22		LD	DCR4-22A	49	1.2	35
		FRN22G1■-4□	HD				
	30		LD	DCR4-30B	71	0.86	35
		FRN30G1■-4□	HD				
	37		LD	DCR4-37C	88	0.483	63
		FRN37G1■-4□	HD				
	45		LD	DCR4-45C	107	0.4	69
		FRN45G1■-4□	HD				
	55		LD	DCR4-55C	131	0.324	78
		FRN55G1■-4□	HD				
	75		LD	DCR4-75C	178	0.23	97
		FRN75G1■-4□	HD				
	90		LD	DCR4-90C	214	0.2	111
		FRN90G1■-4□	HD				
	110		MD/LD	DCR4-110C	261	0.166	122
		FRN110G1■-4□	HD				
	132		MD/LD	DCR4-132C	313	0.148	159
		FRN132G1■-4□	HD				
	160		MD/LD	DCR4-160C	380	0.122	185
		FRN160G1■-4□	HD				
	200		MD/LD	DCR4-200C	475	0.098	218
		FRN200G1■-4□	HD				
	220		MD/LD	DCR4-220C	524	0.087	231
		FRN220G1■-4□	HD				
	250		MD	DCR4-250C	589	0.077	249
	280		LD	DCR4-280C	649	0.069	270
		FRN280G1■-4□	HD				
	315		MD	DCR4-315C	739	0.061	285
	355		LD	DCR4-355C	833	0.054	308
	315	FRN315G1■-4□	HD	DCR4-315C	739	0.061	285
	355		MD	DCR4-355C	833	0.054	308
	400		LD	DCR4-400C	938	0.048	323
	355	FRN355G1■-4□	HD	DCR4-355C	833	0.054	308
	400		MD	DCR4-400C	938	0.048	323
	450		LD	DCR4-450C	1056	0.043	338
	400	FRN400G1■-4□	HD	DCR4-400C	938	0.048	323
	450		MD	DCR4-450C	1056	0.043	338
	500		LD	DCR4-500C	1173	0.039	384
		FRN500G1■-4□	HD				
	630		LD	DCR-630C	1477	0.031	620
		FRN630G1■-4□	HD				
	710		LD	DCR-710C	1666	0.028	600

Note 1: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Note 2: Generated losses listed in the above table are approximate values that are calculated according to the following conditions:

- The power supply is three-phase 200 V/400 V 50 Hz with 0% interphase voltage unbalance ratio.
- The power supply capacity uses the larger of either 500 kVA or 10 times the rated capacity of the inverter.
- The motor is a 4-pole standard model at full load (100%).
- An AC reactor (ACR) is not connected.

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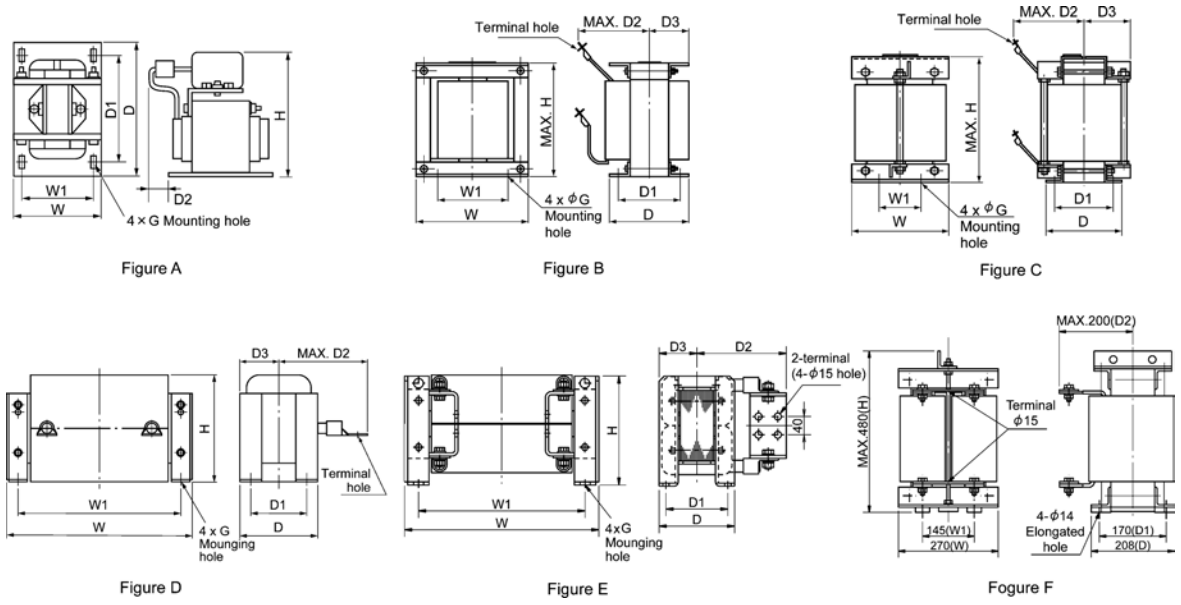

Table 4.13 DC Reactors (DCRs) External Dimensions

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	DC reactor type	Figure	Dimensions (mm)									Mass (kg)
						W	W1	D	D1	D2	D3	H	Mounting hole	Terminal hole	
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	DCR2-0.4	A	66	56	90	72	15	-	94	5.2×8	M4	1.0
	0.75	FRN0.75G1■-2□		DCR2-0.75	A	66	56	90	72	20	-	94	5.2x8	M4	1.4
	1.5	FRN1.5G1■-2□		DCR2-1.5	A	66	56	90	72	20	-	94	5.2x8	M4	1.6
	2.2	FRN2.2G1■-2□		DCR2-2.2	A	86	71	100	80	10	-	110	6x11	M4	1.8
	3.7	FRN3.7G1■-2□		DCR2-3.7	A	86	71	100	80	20	-	110	6x11	M4	2.6
	5.5	FRN5.5G1■-2□	HD	DCR2-5.5	A	111	95	100	80	20	-	130	7x11	M5	3.6
	7.5	FRN7.5G1■-2□	LD	DCR2-7.5	A	111	95	100	80	23	-	130	7x11	M5	3.8
	11	FRN11G1■-2□	HD	DCR2-11	A	111	95	100	80	24	-	137	7x11	M6	4.3
	15	FRN15G1■-2□	LD	DCR2-15	A	146	124	120	96	15	-	180	7x11	M6	5.9
	18.5	FRN18.5G1■-2□	HD	DCR2-18.5	A	146	124	120	96	D2	-	180	7x11	M8	7.4
	22	FRN22G1■-2□	LD	DCR2-22A	A	146	124	120	96	25	-	180	7x11	M8	7.5
	30	FRN30G1■-2□	HD	DCR2-30B	B	152±3	90±1	156±3	116±2	115	78±5	130	8	M8	12
	37	FRN37G1■-2□	LD	DCR2-37C	B	171±3	110±1	151±3	110±2	115	75±5	150	8	M8	14
	45	FRN45G1■-2□	HD	DCR2-45C	B	171±3	110±1	166±3	125±2	120	86±5	150	8	M10	16
	55	FRN55G1■-2□	LD	DCR2-55C	C	190±3	160±1	131±3	90±2	100	65±5	210	8	M12	16
	75	FRN75G1■-2□	HD	DCR2-75C	D	255±10	225	106±2	86	145	53±1	145	M6	M12	11.4
	90	FRN90G1■-2□	LD	DCR2-90C	D	255±10	225	116±2	96	155	58±1	145	M6	M12	14
	110		LD	DCR2-110C	D	300±10	265	116±4	90	185	58±1	160	M8	M12	17

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

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Table 4.13 DC Reactors (DCRs) External Dimensions (continued)

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD	DC reactor type	Figure	Dimensions (mm)									Mass (kg)
						W	W1	D	D1	D2	D3	H	Mounting hole	Terminal hole	
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	DCR4-0.4	A	66	56	90	72	15	-	94	5.2x8	M4	1.0
	0.75	FRN0.75G1■-4□		DCR4-0.75	A	66	56	90	72	20	-	94	5.2x8	M4	1.4
	1.5	FRN1.5G1■-4□		DCR4-1.5	A	66	56	90	72	20	-	94	5.2x8	M4	1.6
	2.2	FRN2.2G1■-4□		DCR4-2.2	A	86	71	100	80	15	-	110	6x9	M4	2
	3.7	FRN3.7G1■-4□		DCR4-3.7	A	86	71	100	80	20	-	110	6x9	M4	2.6
	5.5	FRN5.5G1■-4□	HD	DCR4-5.5	A	86	71	100	80	20	-	110	6x9	M4	2.6
	7.5	FRN7.5G1■-4□	LD	DCR4-7.5	A	111	95	100	80	24	-	130	7x11	M5	4.2
			HD												
	11	FRN11G1■-4□	LD	DCR4-11	A	111	95	100	80	24	-	130	7x11	M5	4.3
			HD												
	15	FRN15G1■-4□	LD	DCR4-15	A	146	124	120	96	15	-	171	7x11	M5	5.9
			HD												
	18.5	FRN18.5G1■-4□	LD	DCR4-18.5	A	146	124	120	96	25	-	171	7x11	M6	7.2
			HD												
	22	FRN22G1■-4□	LD	DCR4-22A	A	146	124	120	96	25	-	171	7x11	M6	7.2
			HD												
	30	FRN30G1■-4□	LD	DCR4-30B	B	152±3	90±1	157±3	115±2	100	78±5	130	8	M8	13
			HD												
	37	FRN37G1■-4□	LD	DCR4-37C	B	171±3	110±1	151±3	110±2	100	75±5	150	8	M8	15
			HD												
	45	FRN45G1■-4□	LD	DCR4-45C	B	171±3	110±1	165±3	125±2	110	82±5	150	8	M8	18
			HD												
	55	FRN55G1■-4□	LD	DCR4-55C	B	171±3	110±1	170±3	130±2	110	82±5	150	8	M8	20
			HD												
	75	FRN75G1■-4□	LD	DCR4-75C	D	255±10	225	106±2	86	125	53±1	145	6	M10	12.4
			HD												
	90	FRN90G1■-4□	LD	DCR4-90C	D	255±10	225	116±2	96	140	58±1	145	M6	M12	14.7
			HD												
	110	FRN110G1■-4□	MD/LD	DCR4-110C	D	300±10	265	116±2	90	175	58±1	155	M8	M12	18.4
			HD												
	132	FRN132G1■-4□	MD/LD	DCR4-132C	D	300±10	265	126±4	100	180	63±2	160	M8	M12	22
			HD												
	160	FRN160G1■-4□	MD/LD	DCR4-160C	D	350±10	310	131±4	103	180	65.5±2	190	M10	M12	25.5
			HD												
	200	FRN200G1■-4□	MD/LD	DCR4-200C	D	350±10	310	141±4	113	185	70.5±2	190	M10	M12	29.5
			HD												
	220	FRN220G1■-4□	MD/LD	DCR4-220C	D	350±10	310	146±4	118	200	73±2	190	M10	M12	32.5
			HD												
	250		MD	DCR4-250C	D	350±10	310	161±4	133	210	80.5±2	190	M10	M12	35
	280	FRN280G1■-4□	LD	DCR4-280C	E	350±10	310	161±4	133	210	80.5±2	190	M10	M16	36
			HD												
	315		MD	DCR4-315C	E	400±10	345	146±4	118	200	73±1	225	M10	M16	40
	355		LD	DCR4-355C	E	400±10	345	156±4	128	200	78±1	225	M10	ϕ15	47
	315	FRN315G1■-4□	HD	DCR4-315C	E	400±10	345	146±4	118	200	73±1	225	M10	M16	40
	355		MD	DCR4-355C	E	400±10	345	156±4	128	200	78±1	225	M10	ϕ15	47
	400		LD	DCR4-400C	E	455±10	385	145±4	117	213	72.5±1	245	M10	ϕ15	52
	355	FRN355G1■-4□	HD	DCR4-355C	E	400±10	345	156±4	128	200	78±1	225	M10	ϕ15	47
	400		MD	DCR4-400C	E	455±10	385	145±4	117	213	72.5±1	245	M10	ϕ15	52
	450		LD	DCR4-450C	E	440±10	385	150±4	122	215	75±2	245	M10	ϕ15	60
	400	FRN400G1■-4□	HD	DCR4-400C	E	455±10	385	145±4	117	213	72.5±1	245	M10	ϕ15	52
	450		MD	DCR4-450C	E	440±10	385	150±4	122	215	75±2	245	M10	ϕ15	60
	500	FRN500G1■-4□	LD	DCR4-500C	E	445±10	390	165±4	137	220	82.5±2	245	M10	ϕ15	70
			HD												
	630	FRN630G1■-4□	LD	DCR4-630C	F	285±10	145	203±4	170	195	104±2	480	M12	ϕ15	75
			HD												
	710		LD	DCR4-710C	F	340±10	160	295±4	255	225	107±2	480	M12	ϕ15	95

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

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4.4.1.4 AC reactors (ACRs)

Use an ACR when the converter part of the inverter should supply very stable DC power, for example, in DC link bus operation (shared PN operation). Generally, ACRs are used for correction of voltage waveform and power factor or for power supply matching, but not for suppressing harmonic components in the power lines. For suppressing harmonic components, use a DCR.

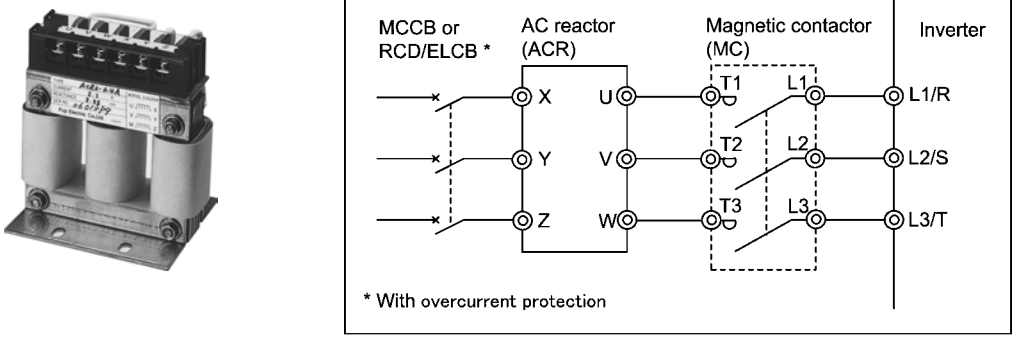

Figure 4.11 External View of AC Reactor (ACR) and Connection Example

Table 4.14 AC Reactor (ACR)

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	AC reactor type	Rated current (A)	Reactance (mΩ/phase)		Coil resistance (mΩ)	Generated loss (W)
						50 Hz	60 Hz		
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	ACR2-0.4A	3	917	1100	-	10
	0.75	FRN0.75G1■-2□		ACR2-0.75A	5	493	592	-	12
	1.5	FRN1.5G1■-2□		ACR2-1.5A	8	295	354	-	14
	2.2	FRN2.2G1■-2□		ACR2-2.2A	11	213	256	-	16
	3.7	FRN3.7G1■-2□		ACR2-3.7A	17	218	153	-	23
	5.5	FRN5.5G1■-2□	HD	ACR2-5.5A	25	87.7	105	-	27
	7.5		LD	ACR2-7.5A	33	65	78	-	30
		FRN7.5G1■-2□	HD						
	11		LD	ACR2-11A	46	45.5	54.7	-	37
		FRN11G1■-2□	HD						
	15		LD	ACR2-15A	59	34.8	41.8	-	43
		FRN15G1■-2□	HD						
	18.5		LD	ACR2-18.5A	74	28.6	34.3	-	51
		FRN18.5G1■-2□	HD						
	22		LD	ACR2-22A	87	24	28.8	-	57
		FRN22G1■-2□	HD						
	30		LD	ACR2-37	200	10.8	13	0.5	28.6
		FRN30G1■-2□	HD						
	37		LD	ACR2-37	200	10.8	13	0.5	40.8
		FRN37G1■-2□	HD						
	45		LD	ACR2-55	270	7.5	9	0.375	47.1
		FRN45G1■-2□	HD						
	55		LD	ACR2-55	270	7.5	9	0.375	66.1
		FRN55G1■-2□	HD						
	75		LD	ACR2-75	390	5.45	6.54	0.25	55.1
		FRN75G1■-2□	HD						
	90		LD	ACR2-90	450	4.73	5.67	0.198	61.5
		FRN90G1■-2□	HD						
	110		LD	ACR2-110	500	4.25	5.1	0.18	83.4

Note 1: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Note 2: Generated losses listed in the above table are approximate values that are calculated according to the following conditions:

- The power supply is three-phase 200 V/400 V 50 Hz with 0% interphase voltage unbalance ratio.
- The power supply capacity uses the larger of either 500 kVA or 10 times the rated capacity of the inverter.
- The motor is a 4-pole standard model at full load (100%).

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Table 4.14 AC Reactor (ACR) (continued)

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	AC reactor type	Rated current (A)	Reactance (mΩ/phase)		Coil resistance (mΩ)	Generated loss (W)
						50 Hz	60 Hz		
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	ACR4-0.75A	2.5	1920	2300	-	5
	0.75	FRN0.75G1■-4□							10
	1.5	FRN1.5G1■-4□		ACR4-1.5A	3.7	1160	1390	-	11
	2.2	FRN2.2G1■-4□		ACR4-2.2A	5.5	851	1020	-	14
	3.7	FRN3.7G1■-4□		ACR4-3.7A	9	512	615	-	17
	5.5	FRN5.5G1■-4□	HD	ACR4-5.5A	13	349	418	-	22
	7.5		LD	ACR4-7.5A	18	256	307	-	27
		FRN7.5G1■-4□	HD						
	11		LD	ACR4-11A	24	183	219	-	40
		FRN11G1■-4□	HD						
	15		LD	ACR4-15A	30	139	167	-	46
		FRN15G1■-4□	HD						
	18.5		LD	ACR4-18.5A	39	114	137	-	57
		FRN18.5G1■-4□	HD						
	22		LD	ACR4-22A	45	95.8	115	-	62
		FRN22G1■-4□	HD						
	30		LD	ACR4-37	100	41.7	50	2.73	38.9
		FRN30G1■-4□	HD						
	37		LD	ACR4-37	100	41.7	50	2.73	55.7
		FRN37G1■-4□	HD						
	45		LD	ACR4-55	135	30.8	37	1.61	50.2
		FRN45G1■-4□	HD						
	55		LD	ACR4-55	135	30.8	37	1.61	70.7
		FRN55G1■-4□	HD						
	75		LD	ACR4-75 *	160	25.8	31	1.16	65.3
		FRN75G1■-4□	HD						
	90		LD	ACR4-110	250	16.7	20	0.523	42.2
		FRN90G1■-4□	HD						
	110		MD/LD	ACR4-110	250	16.7	20	0.523	60.3
		FRN110G1■-4□	HD						
	132		MD/LD	ACR4-132	270	20.8	25	0.741	119
		FRN132G1■-4□	HD						
	160		MD/LD	ACR4-220	561	10	12	0.236	56.4
		FRN160G1■-4□	HD						
	200		MD/LD	ACR4-220	561	10	12	0.236	90.4
		FRN200G1■-4□	HD						
	220		MD/LD	ACR4-220	561	10	12	0.236	107
		FRN220G1■-4□	HD						
	250		MD	ACR4-280	825	6.67	8	0.144	96.4
	280		LD						108
		FRN280G1■-4□	HD	Under study					
	315		MD						
	355		LD						
	315	FRN315G1■-4□	HD						
	355		MD						
	400		LD						
	355	FRN355G1■-4□	HD						
	400		MD						
	450		LD						
	400	FRN400G1■-4□	HD						
	450		MD						
	500		LD						
		FRN500G1■-4□	HD						
	630		LD						
		FRN630G1■-4□	HD						
	710		LD						

* Cool this reactor using a fan with 3 m/s or more WV (Wind Velocity).

Note 1: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Note 2: Generated losses listed in the above table are approximate values that are calculated according to the following conditions:

- The power supply is three-phase 200 V/400 V 50 Hz with 0% interphase voltage unbalance ratio.
- The power supply capacity uses the larger of either 500 kVA or 10 times the rated capacity of the inverter.
- The motor is a 4-pole standard model at full load (100%).

Figure A

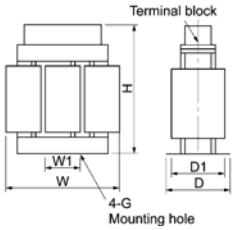

Figure B

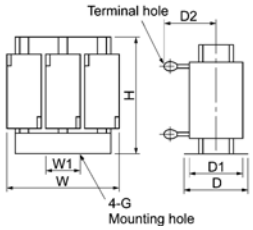

Figure C

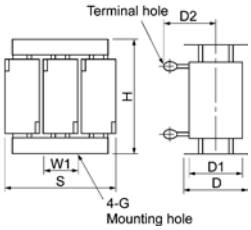

Table 4.15 AC Reactors (ACRs) External Dimensions

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/LD	AC reactor type	Figure	Dimensions (mm)								Mass (kg)
						W	W1	D	D1	D2	G	H	Terminal hole	
Three-phase 200 V	0.4	FRN0.4G1■-2□	HD	ACR2-0.4A	A	120	40	90	65	-	6x10	125	M4	1.5
	0.75	FRN0.75G1■-2□		ACR2-0.75A	A	120	40	100	75	-	6x10	125	M4	2.5
	1.5	FRN1.5G1■-2□		ACR2-1.5A	A	120	40	100	75	-	6x10	125	M4	2.5
	2.2	FRN2.2G1■-2□		ACR2-2.2A	A	120	40	100	75	-	6x10	125	M4	2.5
	3.7	FRN3.7G1■-2□		ACR2-3.7A	A	125	40	100	75	-	6x10	125	M4	2.5
	5.5	FRN5.5G1■-2□	HD	ACR2-5.5A	A	125	40	115	90	-	6x10	125	M4	3.1
	7.5		LD	ACR2-7.5A	B	125	40	115	90	90	6x10	95	M5	3.1
		FRN7.5G1■-2□	HD											
	11		LD	ACR2-11A	B	125	40	125	100	90	6x10	95	M6	3.7
		FRN11G1■-2□	HD											
	15		LD	ACR2-15A	B	180	60	110	85	90	7x11	115	M6	4.8
		FRN15G1■-2□	HD											
	18.5		LD	ACR2-18.5A	B	180	60	110	85	90	7x11	115	M6	5.1
		FRN18.5G1■-2□	HD											
	22		LD	ACR2-22A	B	180	60	110	85	90	7x11	115	M6	5.1
		FRN22G1■-2□	HD											
	30		LD	ACR2-37	B	190	60	120	90	170	7x11	190	8.4	11
		FRN30G1■-2□	HD											
	37		LD	ACR2-37	B	190	60	120	90	170	7x11	190	8.4	11
		FRN37G1■-2□	HD											
	45		LD	ACR2-55	C	190	60	120	90	200	7x10	190	13	12
		FRN45G1■-2□	HD											
	55		LD	ACR2-55	C	190	60	120	90	200	7x10	190	13	12
		FRN55G1■-2□	HD											
	75		LD	ACR2-75	C	250	100	120	90	200	9x14	250	13	25
		FRN75G1■-2□	HD											
	90		LD	ACR2-90	C	285	190	158	120	190	12x20	210	13	26
		FRN90G1■-2□	HD											
	110		LD	ACR2-110	C	280	150	138	110	200	10x20	270	13	30

Note : A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

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Table 4.15 AC Reactors (ACRs) External Dimensions (continued)

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD	AC reactor type	Figure	Dimensions (mm)								Mass (kg)
						W	W1	D	D1	D2	G	H	Terminal hole	
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	ACR4-0.75A	B	120	40	90	65	90	6x10	95	M4	1.1
	0.75	FRN0.75G1■-4□												
	1.5	FRN1.5G1■-4□		ACR4-1.5A	B	125	40	100	75	90	6x10	95	M4	1.9
	2.2	FRN2.2G1■-4□		ACR4-2.2A	B	125	40	100	75	90	6x10	95	M4	2.2
	3.7	FRN3.7G1■-4□		ACR4-3.7A	B	125	40	100	75	90	6x10	95	M4	2.4
	5.5	FRN5.5G1■-4□	HD	ACR4-5.5A	B	125	40	115	90	90	6x10	95	M5	3.1
	7.5		LD	ACR4-7.5A	B	125	40	115	90	90	6x10	95	M5	3.7
		FRN7.5G1■-4□	HD											
	11		LD	ACR4-11A	B	180	60	100	85	90	7x11	115	M6	4.3
		FRN11G1■-4□	HD											
	15		LD	ACR4-15A	B	180	60	110	85	90	7x11	137	M6	5.4
		FRN15G1■-4□	HD											
	18.5		LD	ACR4-18.5A	B	180	60	110	85	90	7x11	137	M6	5.7
		FRN18.5G1■-4□	HD											
	22		LD	ACR4-22A	B	180	60	110	85	90	7x11	137	M6	5.9
		FRN22G1■-4□	HD											
	30		LD	ACR4-37	B	190	60	120	90	170	7x10	190	8.4	11
		FRN30G1■-4□	HD											
	37		LD	ACR4-37	B	190	60	120	90	170	7x10	190	8.4	11
		FRN37G1■-4□	HD											
	45		LD	ACR4-55	C	190	60	120	90	200	7x10	190	10.5	12
		FRN45G1■-4□	HD											
	55		LD	ACR4-55	C	190	60	120	90	200	7x10	190	10.5	12
		FRN55G1■-4□	HD											
	75		LD	ACR4-75 *	C	190	60	126	90	197	7x10	190	11	12
		FRN75G1■-4□	HD											
	90		LD	ACR4-90	C	250	100	136	105	202	9.5x18	245	13	24
		FRN90G1■-4□	HD											
	110		MD/LD	ACR4-110	C	250	100	136	105	202	9.5x18	245	13	24
		FRN110G1■-4□	HD											
	132		MD/LD	ACR4-132	C	250	100	146	115	210	9.5x18	250	13	32
		FRN132G1■-4□	HD											
	160		MD/LD	ACR4-220	C	320	120	150	110	240	12x20	300	13	40
		FRN160G1■-4□	HD											
	200		MD/LD	ACR4-220	C	320	120	150	110	240	12x20	300	13	40
		FRN200G1■-4□	HD											
	220		MD/LD	ACR4-220	C	320	120	150	110	240	12x20	300	13	40
		FRN220G1■-4□	HD											
	250		MD	ACR4-280	C	380	130	150	110	260	12x20	300	13	52
	280		LD											
		FRN280G1■-4□	HD											
	315		MD											
	355		LD											
	315	FRN315G1■-4□	HD											
	355		MD											
	400		LD											
	355	FRN355G1■-4□	HD											
	400		MD											
	450		LD											
	400	FRN400G1■-4□	HD											
	450		MD											
	500		LD											
		FRN500G1■-4□	HD											
	630		LD											
		FRN630G1■-4□	HD											
	710		LD											

Under study

* Cool this reactor using a fan with 3 m/s or more WV (Wind Velocity).

Note : A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.

A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

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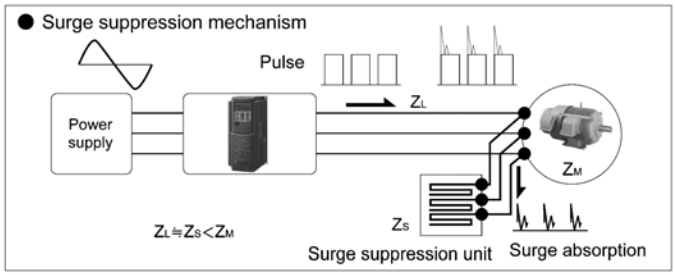
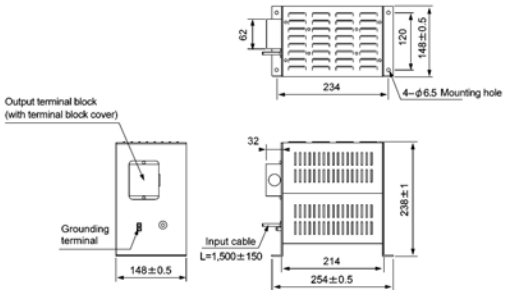
4.4.1.5 Surge suppression unit (SSU)

If the drive wire for the motor is long, an extremely low surge voltage (micro surge) occurs at the wire end connected to the motor. Surge voltage causes motor degradation, insulation breakdown, or increased noises. The surge suppression unit (SSU) suppresses the surge voltage. It features the connectivity for all motor capacities and easy wiring work.

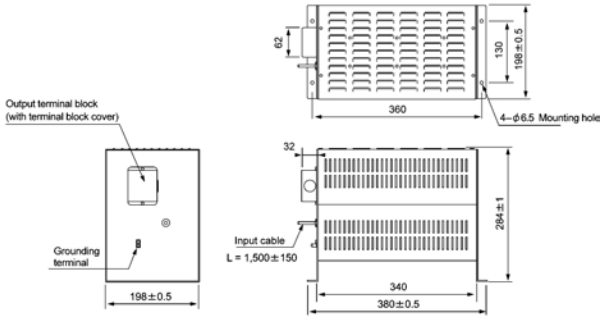


■ Dimensions

• 50 m spec.: SSU 50TA-NS

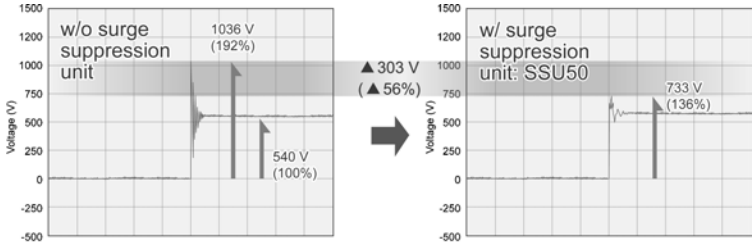


• 100 m spec.: SSU 100TA-NS

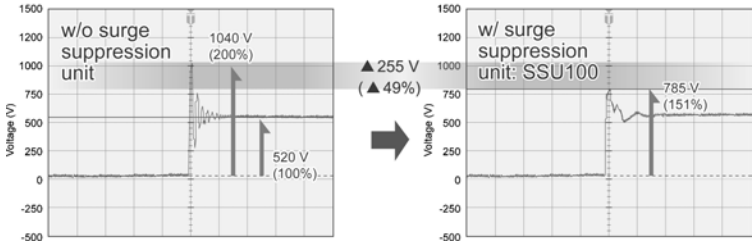


■ Effects of installing the surge suppression units (shown by voltage waveform between motors)

Motor/inverter capacity: 3.7 kW
Wiring length: 50 m
Running status: No-load
Power supply voltage: Three-phase 400 V



Motor/inverter capacity: 75 kW
Wiring length: 100 m
Running status: No-load
Power supply voltage: Three-phase 400 V



■ Basic specifications

Item	Specifications
Type	SSU 50TA-NS SSU100TA-NS
Applicable wiring length	50 m or shorter 100 m or longer
Power supply voltage	200 V and 400 V classes, PWM converter is applicable
Inverter capacity	75 kW or below (For 90 kW or above, individually treated.)
Output frequency	400 Hz or below
Carrier frequency	15 kHz or below (The SSU is not available at 16 kHz.)
Enclosure	IP20
Installation environment	Surrounding temp.: -20 to +40°C, Relative humidity: 85% RH or below, Vibration: 0.7 G or less, Installation: Horizontally
Dielectric strength voltage	2500 VAC, 1 minute

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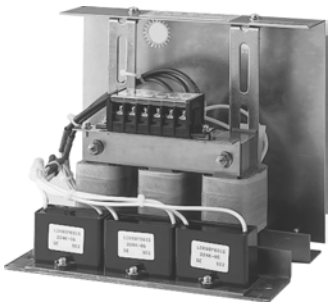
4.4.1.6 Output circuit filters (OFLs)

Insert an OFL in the inverter power output circuit to:

- Suppress the surge voltage at motor terminal
  This protects the motor from insulation damage caused by the application of high voltage surge currents from the 400 V class series of inverters.
- Suppress leakage current (due to higher harmonic components) from the inverter output lines
  This reduces the leakage current when the motor is connected by long power feed lines. Keep the length of the power feed line less than 400 m.
- Minimize radiation and/or induction noise issued from the inverter output lines
  An OFL is an effective noise suppression device for long wiring applications at plants.



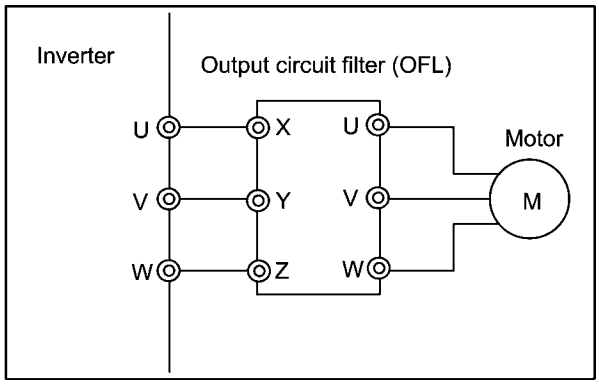


Figure 4.12 External View of Output Circuit Filter (OFL) and Connection Example

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Table 4.16 Output Circuit Filter (OFL)

OFL-□□□-4A

Power supply voltage	Nominal applied motor (kW)	Inverter type	HD/ MD/ LD	Filter type	Rated current (A)	Overload capability	Inverter power input voltage	Carrier frequency-allowable range (kHz)	Maximum frequency (Hz)	Generated loss (W)
Three-phase 400 V	0.4	FRN0.4G1■-4□	HD	OFL-0.4-4A	1.5	HD mode: 150%-1 min 200%-3 s MD mode: 150%-1 min LD mode: 120%-1 min	Three-phase 380 to 480 V 50/60 Hz	0.75 to 16 kHz	HD mode: 400 Hz MD mode: 120 Hz LD mode: 120 Hz	80
	0.75	FRN0.75G1■-4□		OFL-1.5-4A	3.7					105
	1.5	FRN1.5G1■-4□								
	2.2	FRN2.2G1■-4□		OFL-3.7-4A	9					210
	3.7	FRN3.7G1■-4□								
	5.5	FRN5.5G1■-4□	HD	OFL-7.5-4A	18					190
	7.5		LD							
		FRN7.5G1■-4□	HD							
	11		LD	OFL-15-4A	30					320
		FRN11G1■-4□	HD							
	15		LD							
		FRN15G1■-4□	HD							
	18.5		LD	OFL-22-4A	45					350
		FRN18.5G1■-4□	HD							
	22		LD							
		FRN22G1■-4□	HD							
	30		LD	OFL-30-4A	60					570
		FRN30G1■-4□	HD							
	37		LD	OFL-37-4A	75					610
		FRN37G1■-4□	HD							
	45		LD	OFL-45-4A	91					810
		FRN45G1■-4□	HD							
	55		LD	OFL-55-4A	112					910
		FRN55G1■-4□	HD							
	75		LD	OFL-75-4A	150			0.75 to 10 kHz		1200
		FRN75G1■-4□	HD							
	90		LD	OFL-90-4A	176					1360
		FRN90G1■-4□	HD							
	110		MD/LD	OFL-110-4A	210					240
		FRN110G1■-4□	HD							
	132		MD/LD	OFL-132-4A	253					1800
		FRN132G1■-4□	HD							
	160		MD/LD	OFL-160-4A	304					2210
		FRN160G1■-4□	HD							
	200		MD/LD	OFL-200-4A	377					2520
		FRN200G1■-4□	HD							
	220		MD/LD	OFL-220-4A	415					400
		FRN220G1■-4□	HD							
	250		MD	OFL-280-4A	520					3570
	280		LD							
		FRN280G1■-4□	HD	Under study						
	315		MD							
	355		LD							
	315	FRN315G1■-4□	HD							
	355		MD							
	400		LD							
	355	FRN355G1■-4□	HD							
	400		MD							
	450		LD							
	400	FRN400G1■-4□	HD							
	450		MD							
	500		LD							
		FRN500G1■-4□	HD							
	630		LD							
		FRN630G1■-4□	HD							
	710		LD							

Note: A box (■) in the above table replaces S (Basic type) or E (EMC filter built-in type) depending on the enclosure.
A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

Table 4.17 Output Circuit Filter (OFL) Dimensions

OFL-□□□-4A

■ Filter (for 22 kW or below)

Figure A

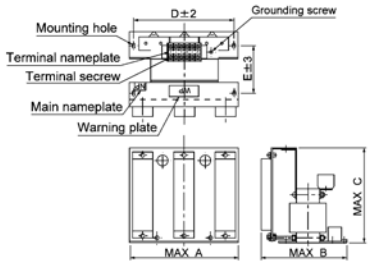
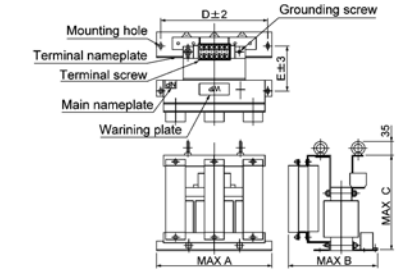


Figure B



■ Reactor (for 30 kW or above)

Figure C

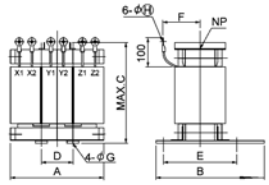


Figure D

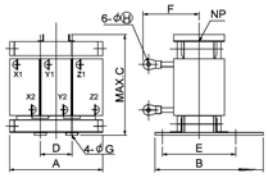
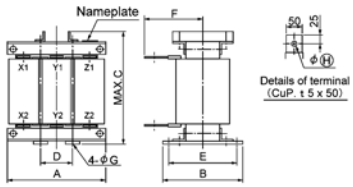
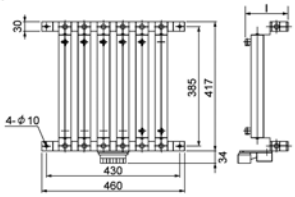


Figure E



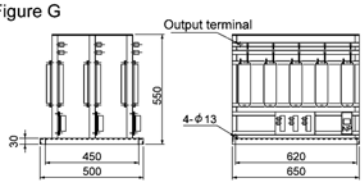
■ Resistor and Capacitor (for 30 kW or above)

Figure F



For filters OFL-30-4A and greater, a reactor, resistor, and capacitor should be installed separately.
(Those parts are not included in the mass of a filter. If ordered with the filter type, the filter is shipped in combination with a reactor, resistor, and capacitor.)

Figure G



Filter type		Fig.	Dimensions (mm)									
			A	B	C	D	E	F	I	Grounding screw	Terminal screw H	Mounting screw H
400 V class series	OFL-0.4-4A	A	220	175	195	200	95	—	—	M4	M4	M5
	OFL-1.5-4A			225	220		115					
	OFL-3.7-4A		290	290	230	260	160			M5	M5	M6
	OFL-7.5-4A	B	330	275	310	300	145			M6	M6	M8
	OFL-15-4A			300	330		170					
	OFL-22-4A	C・F	210	175	210	70	140	90	160	—	6.4	8
	OFL-30-4A		220	190	220	75	150	95				
	OFL-37-4A			195	265	70	155	140			8.4	10
	OFL-45-4A	D・F	260	200	275	85	160	150				
	OFL-55-4A			210	290		170		233		10.5	12
	OFL-75-4A							155				
	OFL-90-4A		300	230	330	100	190	170				
	OFL-110-4A			240	340		200				13	
	OFL-132-4A							180				
	OFL-160-4A		320	270	350	105	220	190	333			15
	OFL-200-4A		340	300	390	115	250					
	OFL-220-4A		350		430			200				
	OFL-280-4A	E・G	440	275	450	150	230	170	333	—	15	15
	OFL-315-4A			290	480		245	175				
	OFL-355-4A			295	510		240	175				
	OFL-400-4A			325	470		270	195	—			
	OFL-450-4A			335	500		280	210				
	OFL-500-4A											

Note: The OFL-□□□-4A models have no restrictions on carrier frequency.

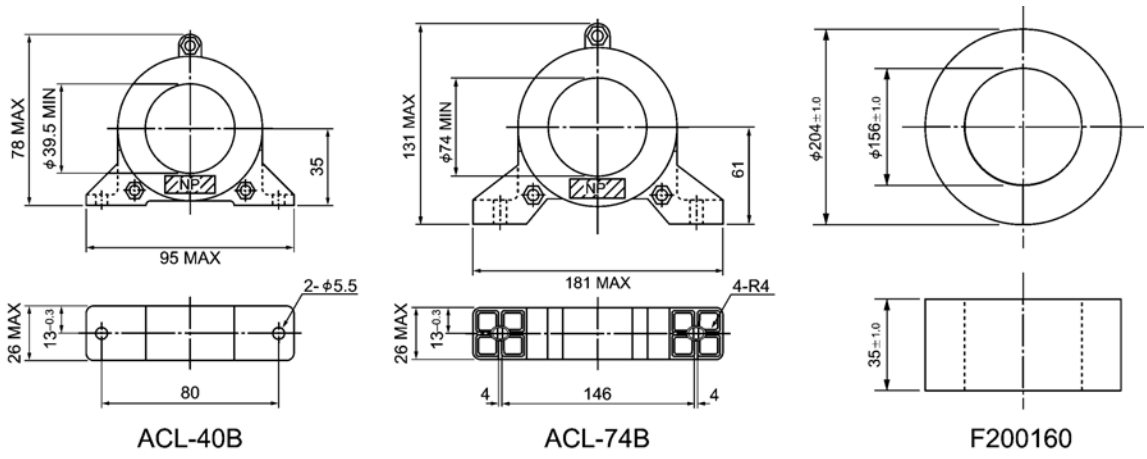
4.4.1.7 Zero-phase reactor for reducing radio noise (ACL)

An ACL is used to reduce radio frequency noise emitted by the inverter.

An ACL suppresses the outflow of high frequency harmonics caused by switching operation for the power supply lines inside the inverter. Pass the power supply lines together through the ACL.

If wiring length between the inverter and motor is less than 20 m, insert an ACL to the power supply lines; if it is more than 20 m, insert it to the power output lines of the inverter.

Wire size is determined depending upon the ACL size (I.D.) and installation requirements.



Unit: mm

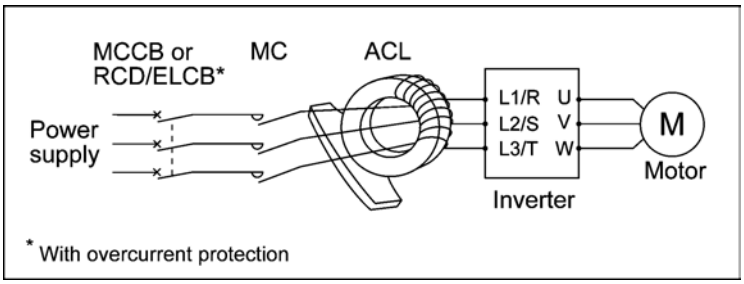


Figure 4.13 Dimensions of Zero-phase Reactor for Reducing Radio Noise (ACL) and Connection Example

Table 4.18 Zero-phase Reactor for Reducing Radio Noise (ACL)

Zero-phase reactor type	Installation requirements		Wire size (mm^2)
	Qty.	Number of turns	
ACL-40B	1	4	2.0, 3.5, 5.5
	2	2	8, 14
ACL-74B	1	4	8, 14
	2	2	22, 38, 60, 5.5×2, 8×2, 14×2, 22×2
	4	1	100, 150, 200, 250, 325, 38×2, 60×2, 100×2, 150×2
F200160	4	1	200×2, 250×2, 325×2

The selected wires are for use with 3-phase input/output lines (3 wires).

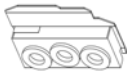
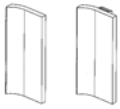
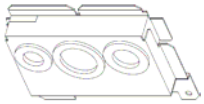
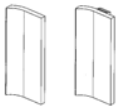
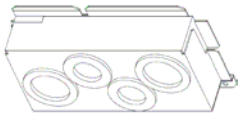
Note: Use the insulated wire of 75°C, 600 V, HIV-insulated.

4.4.1.8 IP40 kit (P40G1-☐☐)

[1] Overview

Mounting the IP40 kit on the FRENIC-MEGA standard model 1 (basic type) enables the inverter's enclosure to conform to the protection rating IP40 (totally enclosed).

[2] Configuration

Type	Configuration				
P40G1-0.75	Small closing plate (for side) × 3 pcs.	Large closing plate (for side) × 1 pc.	Wiring cover × 1 pc.		
P40G1-3.7	Small closing plate (for side) × 3 pcs.	Large closing plate (for side) × 1 pc.	 Wiring cover × 1 pc.		
P40G1-11	Small closing plate (for side) × 3 pcs.	Large closing plate (for side) × 1 pc.	 Closing plate (for right corner) × 1 pc. (for left corner) × 1 pc.	 Wiring cover × 1 pc.	Cross-recessed pan head screw with captive washer × 2 pcs. (M5 × 10)
P40G1-22	Small closing plate (for side) × 3 pcs.	Large closing plate (for side) × 2 pcs.	 Closing plate (for right corner) × 1 pc. (for left corner) × 1 pc.	 Wiring cover × 1 pc.	Cross-recessed pan head screw with captive washer × 2 pcs. (M5 × 10)

[3] Specifications

This kit is applicable only to the FRENIC-MEGA standard model 1 (basic type).

The specifications of the FRENIC-MEGA equipped with this kit differ from those of the standard model 1 (basic type) as listed below. Other specifications are the same as the standard model 1 (basic type).

Applicable inverter

Inverter series	Inverter capacity
FRENIC-MEGA	0.4 to 22 kW

Type and mass

Item	Specifications										
IP40 kit type (P40G1-☐☐)	0.75		3.7			11			22		
Applicable inverter type (FRN☐☐☐G1S-2/4)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22
Mass (kg)	0.1		0.2			0.3			0.4		

Rated output current

The table below shows the rated output current for three-phase, 200 V class series of LD (Low Duty)-mode inverters for light duty load applications.

Item		Specifications					
Applicable inverter type (FRN☐☐☐G1S-2)		5.5	7.5	11	15	18.5	22
Output ratings	Rated current (A)	29	42	55	68	80	107

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Surrounding temperature

-10 to +40°C

Number of option cards (printed circuit boards) mountable on the inverter equipped with the IP40 kit

The inverter equipped with the IP40 kit can accept only one more option card except the relay output interface card (OPC-G1-RY). It can accept two relay output interface cards.

Any type of option cards is compatible with this IP 40 kit. The option connection port(s) to be used differ depending on the specifications of each option card.

[4] Changing the function code setting

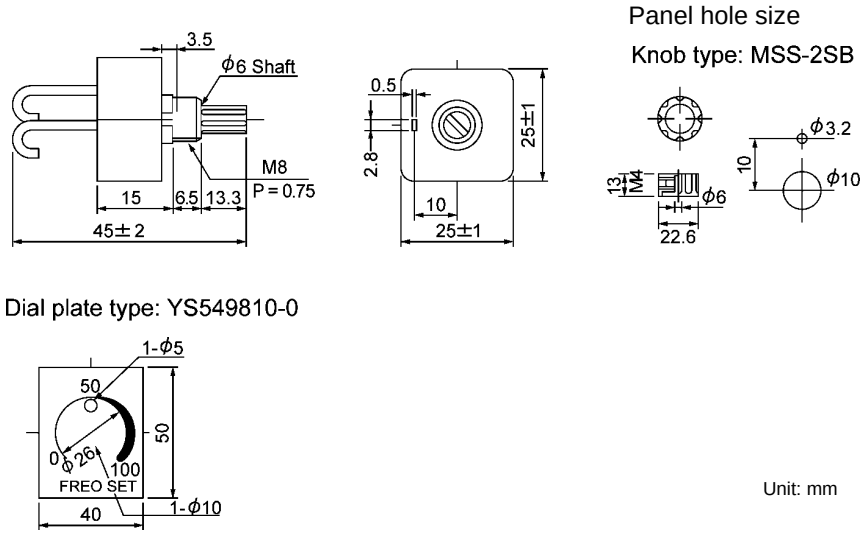
For protection coordination, it is necessary to switch to the protection level suitable for the protection rating IP40 by setting Bit 7 (Switch IP20/IP40 enclosure) of function code H98 (Protection/Maintenance Function (Mode selection)) to "1" (IP40).

4.4.2 Options for operation and communication

4.4.2.1 External frequency command potentiometer

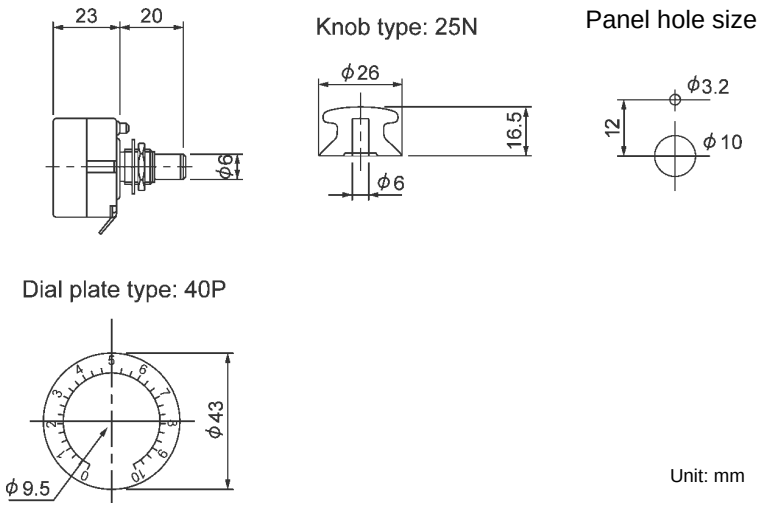
An external frequency command potentiometer may be used to set the drive frequency. Connect the potentiometer to control signal terminals [11] through [13] of the inverter as shown in Figure 4.14.

Model: RJ-13 (BA-2 B-characteristics, 1 kΩ)



Note: The dial plate and knob must be ordered as separated items.
Available from Fuji Electric Technica Co., Ltd.

Model: WAR3W (3W B-characteristics, 1 kΩ)



Note: The dial plate and knob must be ordered as separated items.
Available from Fuji Electric Technica Co., Ltd.

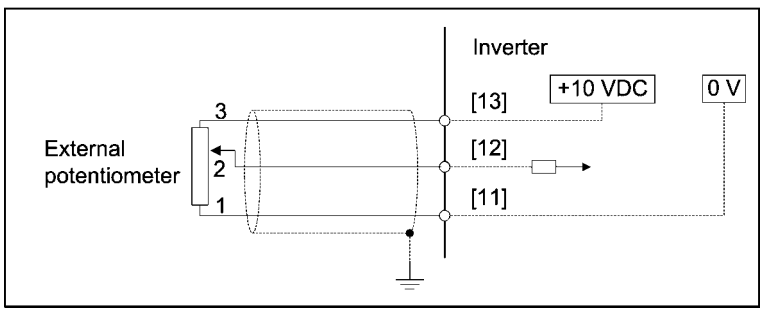


Figure 4.14 External Frequency Command Potentiometer Dimensions and Connection Example

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4.4.2.2 Multi-function keypad (TP-G1-J1, TP-G1-C1)

Replacing the standard keypad with the multi-function keypad enables setting and checking of function code data, and monitoring of the inverter running status, on the LCD monitor.

Specifications

Item		Specifications
Language	TP-G1-J1	Japanese, English, German, French, Spanish, and Italian
	TP-G1-C1	Chinese, English, Japanese, and Korean
Data copying function		Capable of storing and copying function code data of up to three inverters
Applicable inverters		FRENIC-Multi series, FRENIC-Eco series, and FRENIC-MEGA series

External view

4.4.2.3 Extension cable for remote operation

The extension cable connects the inverter with the keypad (standard or multi-function) or USB–RS-485 converter to enable remote operation of the inverter. The cable is a straight type with RJ-45 jacks and its length is selectable from 5, 3, and 1 m.

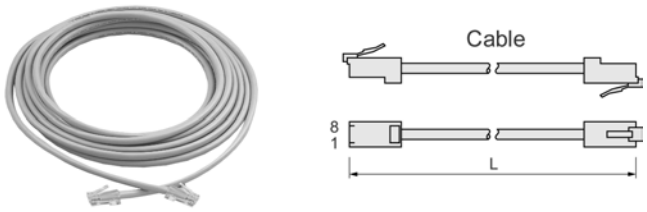

Table 4.19 Extension Cable Length for Remote Operation

Type	Length (m)
CB-5S	5
CB-3S	3
CB-1S	1

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4.4.2.4 Inverter support loader software

FRENIC Loader is support software which enables the inverter to be operated via the RS-485 communications facility. The main functions include the following:

- Easy editing of function code data
- Monitoring the operation statuses of the inverter such as I/O monitor and multi-monitor
- Operation of inverters on a PC screen (Windows-based only)

Refer to Chapter 8 "RUNNING THROUGH RS-485 COMMUNICATION" for details.

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4.4.2.5 PG interface card (OPC-G1-PG)

The PG interface card has a two-shifted pulse train (ABZ phase) input circuit for speed feedback and a power output circuit for feeding power to the connected PG (pulse generator). Mounting this interface card on the FRENIC-MEGA enables the following:

(1) Speed control (vector control with speed sensor) by speed feedback through the PG

(2) Pulse train input frequency command

Furthermore, this option reserves the following features to add in the near future which use speed feedback from the PG:

- Speed control (V/f control with speed sensor),
- Positioning control,
- Servo-lock function, and
- Other similar functions

Note: Using this interface card disables the pulse train frequency command via the digital input terminal [X7] on the inverter.

Ports available for the interface card

This interface card can be connected to the C-port only, out of three option connection ports (A-, B-, and C-ports) provided on the FRENIC-MEGA.

Applicable ROM version

This interface card is applicable to inverters having a ROM version G1S10100 or later.

PG interface specifications

Table 4.20 lists PG specifications of this interface card.

Table 4.20 Specifications of Applicable PG and PG Interface Card

Item	Specifications
Encoder pulse resolution	20 to 3000 P/R, A-, B- and Z-phase pulse trains in incremental format
Pulse output circuit	Open collector (Maximum cable length: 20 m) Complementary (Maximum cable length: 100 m)
Input power requirements	High level ≥ 8 VDC, Low level ≤ 3 VDC (For 12 VDC power source) High level ≥ 10 VDC, Low level ≤ 3 VDC (For 15 VDC power source)
Pulse output current	8 mA or below
PG power supply*	12 VDC ±10%, 120 mA or below, or 15 VDC ±10%. 120 mA or below

* If a power level required by the PG exceeds 120 mA, use an external power source.

Pulse train input interface specifications

Table 4.21 lists pulse train input interface specifications of this interface card.

Table 4.21 Specifications for Pulse Train Inputs

Item	Specifications
PG output pulse frequency	30 kHz max. (Open collector) 100 kHz max. (Complementary)
PG pulse output circuit	Open collector circuit (Maximum cable length: 20 m) Complementary circuit (Maximum cable length: 100 m)
Input pulse threshold	High level ≥ 8 VDC, Low level ≤ 3 VDC (For 12 VDC power source) High level ≥ 10 VDC, Low level ≤ 3 VDC (For 15 VDC power source)
PG pulse input current	8 mA or below

Terminal functions

Terminal	Name	Specification
[P1]	External power input *1	Power input terminal from the external device for PG +12 VDC ±10% or +15 VDC ±10% (Use the power source 150 mA or above which is larger than the PG current consumption.)
[PO]	Power output to PG *2	Power output terminal for PG +12 VDC ±10%, 120 mA or +15 VDC ±10%, 120 mA
[CM]	PG common	Common terminal for power supply to PG (Equipotent with the inverter's terminal [CM])
[XA]	Command input for A-phase pulse train	Input terminal for A-phase command pulse train
[XB]	Command input for B-phase pulse train	Input terminal for B-phase command pulse train
[XZ]	---	Not used.
[YA]	Feedback input for A-phase pulse train	Input terminal for A-phase pulse train fed back from PG
[YB]	Feedback input for B-phase pulse train	Input terminal for B-phase pulse train fed back from PG
[YZ]	Feedback input for Z-phase pulse train	Input terminal for Z-phase pulse train fed back from PG

*1 Use an external power source if the PG current consumption exceeds 120 mA.
*2 Turn the internal switch to the proper position according to the PG power requirement.

Circuit configuration of the PG interface card

Figure 4.15 shows the internal circuit configuration of the optional PG interface card. This figure is of supplying the PG power from the internal +12 VDC source.

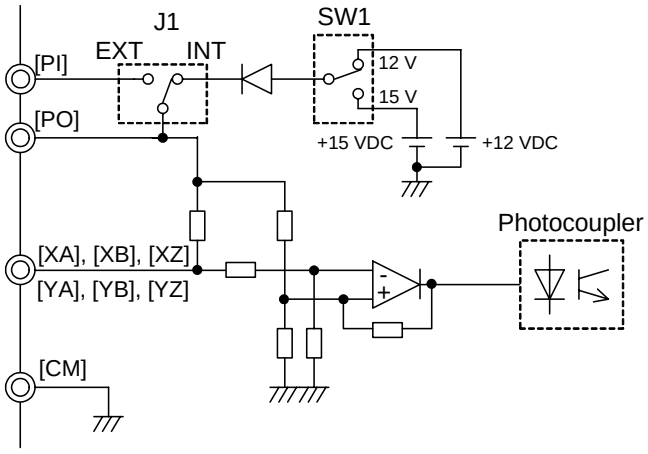

Figure 4.15 Internal Circuit Configuration of the Optional PG Interface Card

Speed control (Vector control with speed sensor)

To control motor speed, the inverter equipped with this interface card uses vector control with speed sensor.

The inverter detects the actual motor speed sensing feedback signals sent from the PG (pulse generator) mounted on the motor output shaft. This control provides high-response speed control.

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

The table below lists inverter specifications under this control.

Item		Specifications	Remarks
Control specifications *1	Maximum frequency	25 to 200 Hz	When a VG motor (1024 P/R) is connected.
	Speed control range	Minimum speed : Base speed = 1 : 1500 (For 4-pole motors, 1 to 1500 r/min)	
	Speed control accuracy	Within ±0.2% of the rated speed (r/min) at 25 ±10°C	

*1 The controllability values specified here greatly vary depending on the pulse resolution, P/R (Pulses/Revolution). The recommended P/R is 1024 or more.

Pulse train input

This function gives a frequency command to the inverter in pulse train format. Available formats are three types of a pulse train input with its sign/pulse train input, run forward/run reverse pulse train, and 90 degree phase shifted A/B pulse trains. Use terminals [XA] and [XB] for the pulse train frequency command input.

Table below summarizes pulse train command input operations of this optional card.

Pulse input format	Operations
Pulse train input with its sign/pulse train	Gives the speed command to the inverter, following the pulse input frequency on the terminal [XB]. Switching the terminal [XA] ON/OFF determines polarity of the speed command. *1
Run forward/run reverse pulse train	Gives the run forward speed command to the inverter, following the pulse input frequency on the terminal [XB], if any. Gives the run reverse speed command to the inverter, following the pulse input frequency on the terminal [XA], if any.*1
90 degree phase shifted A/B pulse trains	Gives the run forward or run reverse speed command to the inverter, following 90 degree phase shift and frequency information of two pulse inputs on terminals [XA] and [XB]. *1

*1 Actual rotation direction of the motor is specified by a combination of the pulse input command polarity and ***FWD***/***REV*** command in the inverter.

For details, refer to the PG Interface Card Instruction Manual (INR-SI47-1283-E).

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4.4.2.6 PG interface (5 V line driver) card (OPC-G1-PG2)

The PG interface (5 V line driver) card has the following circuits:

- Shifted phase pulse train (ABZ phase) input circuit for speed feedback (5 V line driver output type PG)
- Wire break detection circuit (Detection of wire breaks on the Z phase can be cancelled.)
- Power output circuit for feeding power to the connected PG (pulse generator)

Mounting this interface card on the FRENIC-MEGA enables speed control using the feedback signals (vector control with speed sensor).

Ports available for the interface card

This interface card can be connected to the C-port only, out of three option connection ports (A-, B-, and C-ports) provided on the FRENIC-MEGA.

Applicable ROM version

This interface card is applicable to inverters having a ROM version G1S10100 or later.

PG interface specifications

Item		Specifications
Applicable PG	Pulse resolution	20 to 3000 P/R
	Maximum response frequency	100 kHz
	Pulse output system	Line driver (Equivalent to 26C31 or 26LS31) Source current: +20 mA (max.) Sink current: –20 mA (max.)
	Maximum wiring length *1	100 m (when using AWG16)
PG power supply *2		+5 VDC ±10%, 200 mA or below

*1 Table 4.22 shows the relationship between the wiring length and the minimum diameter of wires connectable.

*2 If the PG power current exceeds 200 mA, use an external power supply.

Table 4.22 Relationship Between the Wiring Length and the Minimum Diameter of Wires Connectable

PG power supply specifications	Wiring length (m)				
	Up to 20	Up to 30	Up to 50	Up to 75	Up to 100
5 V ±10%, 200 mA	AWG24 (0.25 mm^2)	AWG22 (0.34 mm^2)	AWG20 (0.50 mm^2)	AWG18 (0.75 mm^2)	AWG16 (1.25 mm^2)

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Terminal functions

Terminal	Name	Specification
[P1]	External power input *1	Power input terminal from the external device for PG +5 VDC ±10% input *2 (Use the power supply 200 mA or above which is larger than the PG current consumption.)
[PO]	Power output to PG	Power output terminal for PG +5 VDC -0% to +10%, 200 mA output
[CM]	PG common	Common terminal for power supply to PG (Equipotent with the inverter's terminal [CM])
[YA]	Feedback input for A(+) phase pulse train	Input terminal for A(+) phase pulse train fed back from PG
[*YA]	Feedback input for A(-) phase pulse train	Input terminal for A(-) phase pulse train fed back from PG
[YB]	Feedback input for B(+) phase pulse train	Input terminal for B(+) phase pulse train fed back from PG
[*YB]	Feedback input for B(-) phase pulse train	Input terminal for B(-) phase pulse train fed back from PG
[YZ]	Feedback input for Z(+) phase pulse train	Input terminal for Z(+) phase pulse train fed back from PG
[*YZ]	Feedback input for Z(-) phase pulse train	Input terminal for Z(-) phase pulse train fed back from PG

*1 If the PG current consumption exceeds 200 mA, use an external power supply.

*2 Use an external power supply whose rating meets the allowable voltage range of the PG. Regulate the external power supply voltage within the PI voltage range (upper limit +10%), taking into account the voltage drop caused by the PG-inverter wiring impedance. Or, use a wire with a larger diameter.

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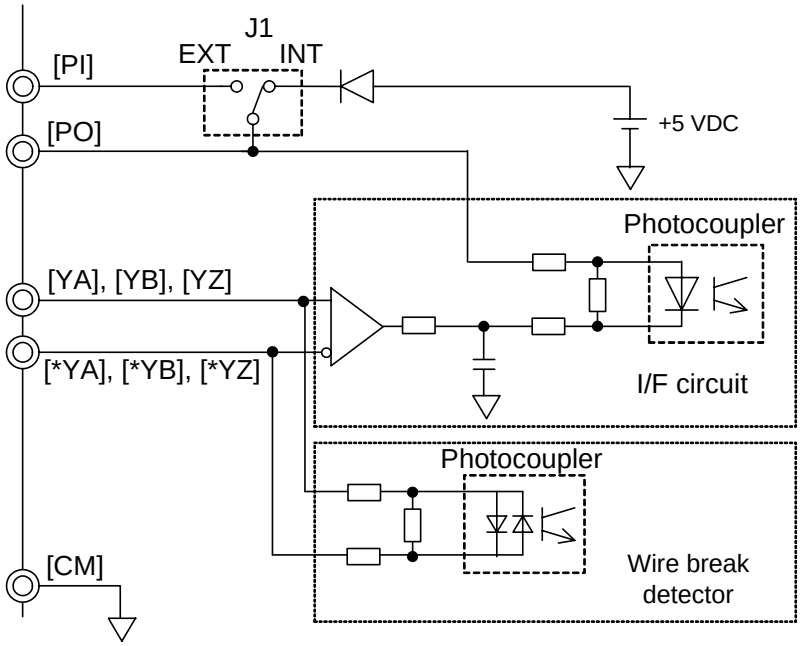
Internal block diagram

Shown below is the internal block diagram example where the internal power source (5 V) supplies power to the PG. (J1 is set to the INT position.)

Each phase input circuit has a wire break detector. The A- and B-phase wire break detectors are always ON. The Z-phase wire break detector toggles ON and OFF by turning SW1 (shown in Figure 4.16) to ON and OFF, respectively. The factory default of SW1 is OFF.



Circuit Diagram

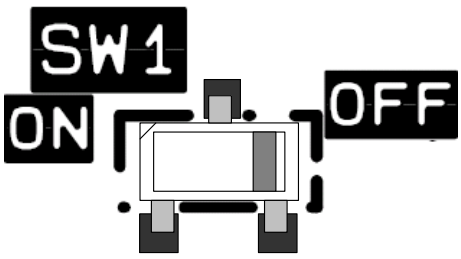


Figure 4.16 Z-phase Wire Break Detector ON/OFF Switch (SW1)

Speed control (Vector control with speed sensor)

To control motor speed, the inverter equipped with this interface card uses vector control with speed sensor.

The inverter detects the actual motor speed sensing feedback signals sent from the PG (pulse generator) mounted on the motor output shaft, decomposes the motor drive current into the exciting and torque current components, and controls each of components in vector.

The vector control enables speed control with high accuracy and high response.

(A recommended motor for the vector control is a Fuji VG motor.)

The table below lists inverter specifications under this control.

Item		Specifications	Remarks
Control specifications *1	Maximum frequency	25 to 200 Hz	When a PG with 1024 P/R is connected.
	Speed control range	Minimum speed : Base speed = 1 : 1500 (For 4-pole motors: 1 to 1500 r/min)	
	Speed control accuracy	Analog setting: ±0.2% or less of maximum frequency (at 25 ±10°C) Digital setting: ±0.01% or less of maximum frequency (at -10 to +50°C)	

*1 The controllability values specified here greatly vary depending on the pulse resolution, P/R (Pulses/Revolution). The recommended P/R is 1024 or more.

For details, refer to the PG2 Interface Card Instruction Manual (INR-SI47-1250-JE).

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4.4.2.7 Relay output interface card (OPC-G1-RY)

The relay output interface card converts an inverter's digital output to a mechanical contact (one transfer contact) output. It has two independent transfer contacts so that using two cards allows the user to activate up to four contact outputs.

A signal to be output to each contact can be defined with function codes E20 to E23. Selecting "Active OFF" for a contact output with the function code enables the contact to be turned ON without relay coil excitation. This is useful for a fail-safe application for the power system.

Ports available for the interface card and functionality assignments

A FRENIC-MEGA inverter has three option connection ports. Note that each port has some limitations as shown below.

Option connection port	Output signal	Assignment	Notes
A-port	Relay contact output 1 Relay contact output 2	Function code E20 (Y1) Function code E21 (Y2)	Do not connect this card to the inverter's terminal [Y1] or [Y2].
B-port	Relay contact output 1 Relay contact output 2	Function code E22 (Y3) Function code E23 (Y4)	Do not connect this card to the inverter's terminal [Y3] or [Y4].
C-port	Not available for the relay output interface card		

Applicable ROM version

This interface card is applicable to inverters having a ROM version G1S10100 or later.

Terminal functions

Symbol	Name	Descriptions
[1A] [1B] [1C]	Relay contact output 1	Relay contacts to output signals selected by function codes E20 and E22, such as Inverter Running, Frequency Arrival and Overload Early Warning. In "active ON", the contact [1A] – [1C] closes and [1B] – [1C] opens while the signal is active.
[2A] [2B] [2C]	Relay contact output 2	Relay contacts to output signals selected by function codes E21 and E23, such as Inverter Running, Frequency Arrival and Overload Early Warning. In "active ON", the contact [1A] – [1C] closes and [1B] – [1C] opens while the signal is active.

Electrical requirements

Item	Specifications
Contact capacity	250 VAC, 0.3A, cosΦ = 0.3, or 48 VDC, 0.5A (resistor load)
Contact life	200,000 times (ON/OFF every 1 second) at 250 VAC, 0.3A 200,000 times (ON/OFF every 1 second) at 48 VDC, 0.5A **Note:** When frequent ON/OFF switching is anticipated (for example, when using the current limit function with the inverter output limiting signal), use the terminals [Y1] to [Y4] (transistor outputs) instead.
Safety Standards/Directives	EN61800-5-1:2003, Overvoltage Category II (Reinforced Insulation) 250 VAC class

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Internal circuits

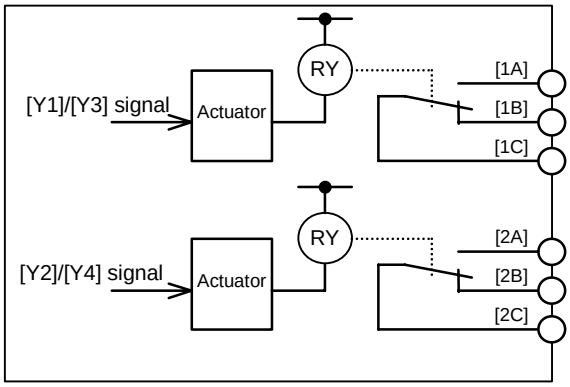

Figure 4.17 Internal Circuits

The relationship between function codes and relay output functions is as follows.

Function code	Functions	Setting range
E20	Terminal [Y1] (Function selection)	0 to 105 (For normal logic), or 1000 to 1105 (For negative logic)
E21	Terminal [Y2] (Function selection)	
E22	Terminal [Y3] (Function selection)	
E23	Terminal [Y4] (Function selection)	

E20 through E23 assign output signals to general-purpose, programmable output terminals [Y1], [Y2], [Y3], and [Y4]. These function codes can also switch the logic system between normal and negative to define the property of those output terminals so that the inverter logic can interpret either the ON or OFF status of each terminal as active.

When a negative logic is employed, all output signals are active (e.g. an alarm would be recognized) while the inverter is powered OFF. To avoid causing system malfunctions by this, interlock these signals to keep them ON using an external power supply. Furthermore, the validity of these output signals is not guaranteed for approximately 1.5 seconds after power ON, so introduce such a mechanism that masks them during the transient period.

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4.4.2.8 Digital input interface card (OPC-G1-DI)

The digital input interface card has 16 digital input terminals (switchable between SINK and SOURCE). Mounting this interface card on the FRENIC-MEGA enables the user to specify frequency commands with binary code (8, 12, 15, or 16 bits) or BCD (4-bit Binary Coded Decimal) code.

Ports available for the interface card

This interface card can be connected to any one of the three option connection ports (A-, B-, and C-ports) on the FRENIC-MEGA.

Applicable ROM version

This interface card is applicable to inverters with a ROM version G1S10500 or later.

Electrical specifications

Terminal symbol	Item		Specifications	
			Min.	Max.
[I1] to [I16]	Operating voltage (SINK)	ON level	0 V	2 V
		OFF level	22 V	27 V
	Operating voltage (SOURCE)	ON level	22 V	27 V
		OFF level	0 V	2 V
	Operating current at ON (Input voltage is at 0 V)		2.5 mA	5 mA
	Allowable leakage current at OFF		-	0.5 mA

Terminal functions

Terminal symbol	Name	Functions
[I1] to [I16]	Digital inputs 1 to 16	(1) These digital inputs specify a frequency command according to the settings made by function codes o19 and o20. For details, refer to the "Configuring inverter's function codes" on the next page. (2) SINK/SOURCE is switchable with the slide switch SW1.
[M1]	External power supply input	Power input terminal from the external device for the interface card (+22 to +27 VDC)
[CM]	Digital common	Common terminal for digital input signals (Equipotent with the inverter's terminal [CM])

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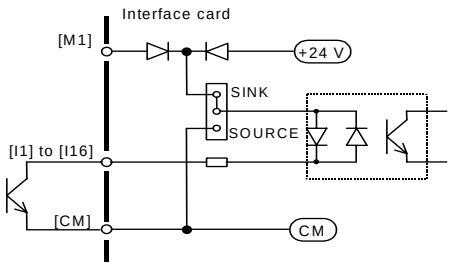
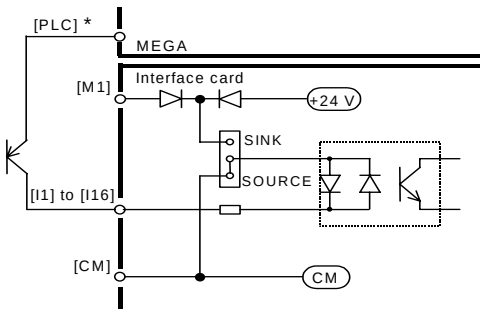
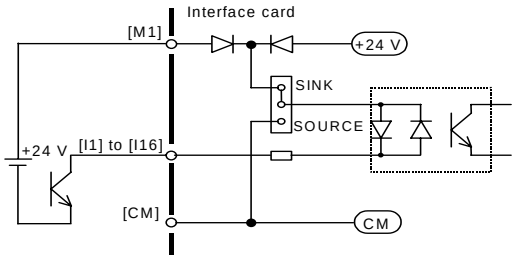
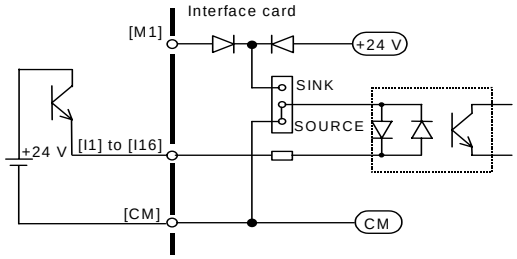
Connection example

<table>
<tr><td rowspan="2">Power supply</td><td colspan="2">Connection example</td></tr>
<tr><td>SINK mode</td><td>SOURCE mode</td></tr>
<tr><td>Internal</td><td> 
</td><td> 

* The maximum allowable current for terminal [PLC] on the FRENIC-MEGA is 100 mA.</td></tr>
<tr><td>External</td><td> 
</td><td> 
</td></tr>
</table>

Configuring inverter's function codes

To enable frequency command inputs from this interface card, it is necessary to set function code F01 (Frequency Command 1) or C30 (Frequency Command 2) to "11" (Digital input interface card). Also specify the polarity and input mode of the frequency command using function codes o19 (DI polarity) and o20 (DI mode) provided for options, respectively.

Turning the terminal input OFF or ON sets each bit data to "0" or "1," respectively.

No.	o19	o20	Input signal name	Terminal function and configuration details
①	0	0	8-bit binary frequency command	Setting resolution = Maximum frequency × (1/255)
②	0	1	12-bit binary frequency command	Setting resolution = Maximum frequency × (1/4095)
③	0	2	15-bit binary frequency command	Setting resolution = Maximum frequency × (1/32767)
④	0	3	16-bit binary frequency command	Setting resolution = Maximum frequency × (1/65535)
⑤	0, 1	4	4-digit BCD frequency command (0 to 99.99 Hz)	Frequency can be specified within the range of 0 to 99.99 Hz (Setting resolution = 0.01 Hz). If a frequency command exceeding the maximum frequency is input, the maximum frequency applies.
⑥	0, 1	5	4-digit BCD frequency command (0 to 500.0 Hz)	Frequency can be specified within the range of 0 to 500.0 Hz (Setting resolution = 0.1 Hz). If a frequency command exceeding the maximum frequency is input, the maximum frequency applies.

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No.	o19	o20	Input signal name	Terminal function and configuration details
⑦	1	0	8-bit binary frequency command	Frequency setting range: -(Maximum frequency) to +(Maximum frequency) = -128 to +127 Setting resolution = Maximum frequency × (1/127)
⑧	1	1	12-bit binary frequency command	Frequency setting range: -(Maximum frequency) to +(Maximum frequency) = -2048 to +2047 Setting resolution = Maximum frequency × (1/2047)
⑨	1	2	15-bit binary frequency command	Frequency setting range: -(Maximum frequency) to +(Maximum frequency) = -16384 to +16383 Setting resolution = Maximum frequency × (1/16383)
⑩	1	3	16-bit binary frequency command	Frequency setting range: -(Maximum frequency) to +(Maximum frequency) = -32768 to +32767 Setting resolution = Maximum frequency × (1/32767)

(Note) "Without polarity" when o20 = 4 or 5 (BCD).

4.4.2.9 Digital output interface card (OPC-G1-DO)

The digital output interface card has eight transistor output terminals (switchable between SINK and SOURCE). Mounting this interface card on the FRENIC-MEGA enables the user to monitor the output frequency and other items with binary code (8 bits).

Ports available for the interface card

This interface card can be connected to any of the three option connection ports (A-, B-, and C-ports) on the FRENIC-MEGA.

Applicable ROM version

This interface card is applicable to inverters with a ROM version G1S10500 or later.

Electrical specifications

Terminal symbol	Item		Specifications
			Max.
[O1] to [O8]	Operating voltage	ON level	2 V
		OFF level	27 V
	Operating current at ON		50 mA
	Allowable leakage current at OFF		0.1 mA

Terminal functions

Terminal symbol	Name	Functions
[O1] to [O8]	Transistor output 1 to 8	These digital terminals output various status signals (e.g., output frequency, output current) specified by function code o21 as an 8-bit parallel signal.
[M2]	Transistor output common	Common terminal for transistor output signals. This terminal is electrically isolated from terminals [CM], [11]s, and [CMY].

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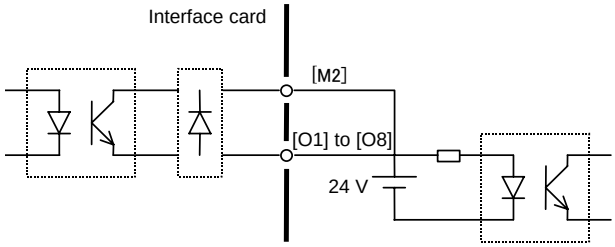
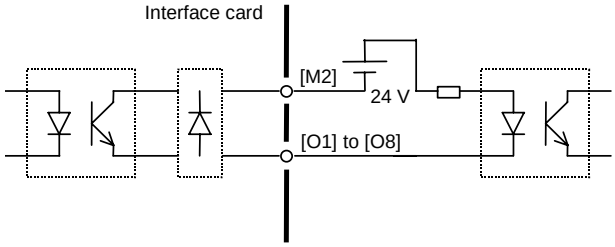
Connection example

SINK mode	
SOURCE mode	

Configuring inverter's function code

Function code o21 (DO mode selection) provided for options specifies the item to be monitored by digital signals of this interface card.

The table below lists the function code and its parameters.

Turning the terminal output OFF or ON sets each bit data to "0" or "1," respectively.

Function code	Data	Output signal name	Terminal function and configuration details
o21	0	Output frequency (before slip compensation)	Terminal output = (Output frequency/Maximum frequency) × 255
	1	Output frequency (after slip compensation)	Terminal output = (Output frequency/Maximum frequency) × 255
	2	Output current	Terminal output = (Output current/(Inverter rated output current × 2)) × 255
	3	Output voltage	Terminal output = (Output voltage/250 V) × 255, for 200 V class series = (Output voltage/500 V) × 255, for 400 V class series
	4	Output torque	Terminal output = (Output torque/(Motor rated torque x 2)) × 255
	5	Load factor	Terminal output = (Load factor/(Motor rated load x 2)) × 255
	6	Input power	Terminal output = (Input power/ (Inverter rated output x 2)) × 255
	7	PID feedback value	Terminal output = (PID feedback amount/100% of feedback value) × 255
	8	PG feedback value	Terminal output = (PG feedback value/100% of synchronous speed at maximum frequency) × 255
	9	DC link bus voltage	Terminal output = (DC link bus voltage/500 V) × 255, for 200 V class series = (DC link bus voltage/1000 V) × 255, for 400 V class series
	13	Motor output	Terminal output = (Motor output/(Motor rated output × 2)) × 255
	15	PID command (SV)	Terminal output = (PID command/100% of feedback value) × 255
	16	PID output (MV)	Terminal output = (PID output/Maximum frequency) × 255

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4.4.2.10 Analog interface card (OPC-G1-AIO)

The analog interface card has the terminals listed below. Mounting this interface card on the FRENIC-MEGA enables analog input and analog output to/from the inverter.

- One analog voltage input point (0 to ±10 V)
- One analog current input point (4 to 20 mA)
- One analog voltage output point (0 to ±10 V)
- One analog current output point (4 to 20 mA)

Ports available for the interface card

This interface card can be connected to any one of the three option connection ports (A-, B-, and C-ports) on the FRENIC-MEGA.

Applicable ROM version

This interface card is applicable to inverters with a ROM version G1S10700 or later.

Terminal functions

Classifi-cations	Symbol	Name	Functions	Remarks
Analog input	[P10]	Power supply for the potentiometer	Power supply for frequency command potentiometer (Variable resistor: 1 to 5 kΩ) (10 VDC, 10 mA DC max.)	
	[32]	Analog voltage input	- Used as analog voltage input from external equipment. 0 to ±10 VDC/0 to ±100% (0 to ±5 VDC/0 to ±100%) - One of the following signals can be assigned to this terminal. - Auxiliary frequency command - PID command - PID feedback amount - Ratio setting - Torque limiter level - Analog input monitor - Resolution: 1/3000	Input impedance: 22kΩ Max. input: ±15 VDC
	[C2]	Analog current input	- Used as analog current input from external equipment. 4 to 20 mA DC/0 to 100% - One of the following signals can be assigned to this terminal. - Auxiliary frequency command - PID command - PID feedback amount - Ratio setting - Torque limiter level - Analog input monitor - Resolution: 1/3000	Input impedance: 250Ω Max. input: 30 mA DC
	[31]	Analog common	- Reference terminal for [P10], [32], [C2].	Equipotent with the inverter's terminal [11]

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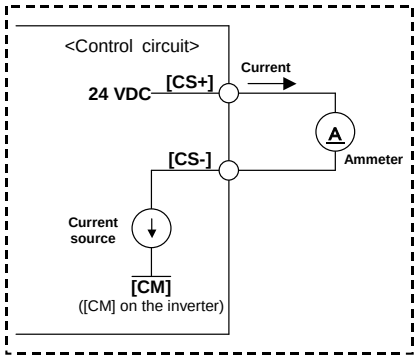
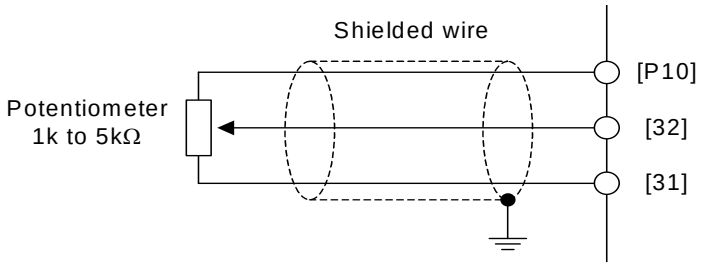
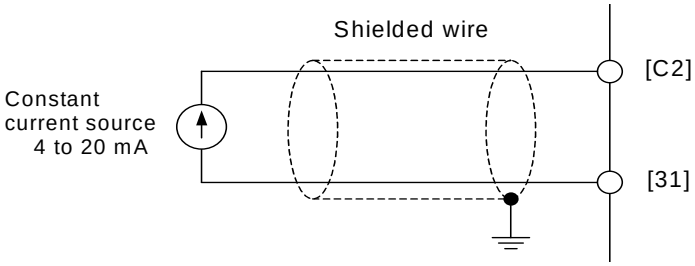
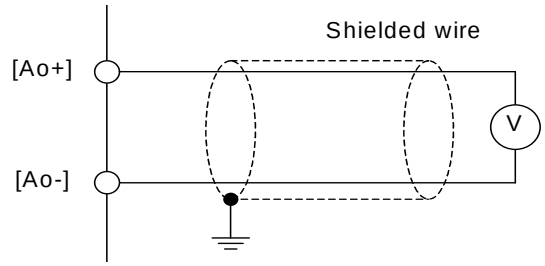
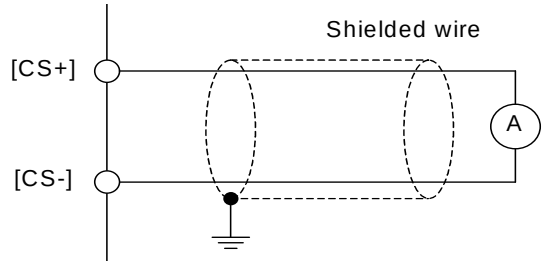
Classifi-cations	Symbol	Name	Functions	Remarks
Analog output	[Ao+]	Analog voltage output (+)	- Outputs the monitor signal of analog DC voltage (0 to ±10 VDC). - One of the following signals can be issued from this terminal. - Output frequency (before or after slip compensation) - Output current - Output voltage - Output torque - Load factor - Input power - PID feedback amount - PG feedback value - DC link bus voltage - Universal AO - Motor output - Analog output test - PID command - PID output - Resolution: 1/3000 * Capable of driving up to two analog voltmeters with 10kΩ impedance.	
	[Ao-]	Analog voltage output (-)	- Reference terminal for [Ao+].	Equipotent with the inverter's terminal [11]
	[CS+]	Analog current output (+)	- Outputs the monitor signal of analog DC current (4 to 20 mA DC) - One of the following signals can be issued from this terminal. - Output frequency (before slip compensation, after slip compensation) - Output current - Output voltage - Output torque - Load factor - Input power - PID feedback amount - PG feedback value - DC link bus voltage - Universal AO - Motor output - Calibration - PID command (SV) - PID output (MV) - Resolution: 1/3000 * Input impedance of the external device: Max. 500Ω	Isolated from terminals [31], [Ao-], and [11]
	[CS-]	Analog current output (-)		



Connection example

Symbol	Connection of shielded wire
[32]	
[C2]	
[Ao]	
[CS]	

Function code settings

Function Codes and Their Parameters for Terminal [32]

Function code	Name	Data	Description	Remarks
o60	Terminal [32] function (Mode selection)	0	No assignment	
		1	Auxiliary frequency command 1	
		2	Auxiliary frequency command 2	
		3	PID command	
		5	PID feedback value	
		6	Ratio setting	
		7	Analog torque limit value A	
		8	Analog torque limit value B	
		20	Analog input monitor	

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Function Codes and Their Parameters for Terminal [32] (Continued)

Function code	Name	Data	Description	Remarks
o61	(Offset adjustment)	-5.0 to +5.0%	Offset adjustment amount	
o62	(Gain adjustment)	0.00 to 200.00%	Gain adjustment amount	
o63	(Filter setting)	0.00 to 5.00 s	Filter constant	
o64	(Gain base point)	0.00 to 100.00%	Gain base point	
o65	(Polarity)	0	Bipolar	
		1	Unipolar	
o66	Terminal [C2] function (Mode selection)	0	No assignment	
		1	Auxiliary frequency command 1	
		2	Auxiliary frequency command 2	
		3	PID command	
		5	PID feedback amount	
		6	Ratio setting	
		7	Analog torque limit value A	
		8	Analog torque limit value B	
		20	Analog input monitor	
o67	(Offset adjustment)	-5.0 to +5.0%	Offset adjustment amount	
o68	(Gain adjustment)	0.00 to 200.00%	Gain adjustment amount	
o69	(Filter setting)	0.00 to 5.00 s	Filter constant	
o70	(Gain base point)	0.00 to 100.00%	Gain base point	

Function Codes and Their Parameters for Terminal [Ao]

Function code	Name	Data	Description	Remarks
o71	Terminal [Ao] function (Mode selection)	0	Output frequency 1 (before slip compensation)	
		1	Output frequency 2 (after slip compensation)	
		2	Output frequency	
		3	Output voltage	
		4	Output torque	
		5	Load factor	
		6	Input power	
		7	PID feedback amount	
		8	PG feedback value (speed)	
		9	DC link bus voltage	
		10	Universal AO	
		13	Motor output	
		14	Calibration (+)	
		15	PID command (SV)	
		16	PID output (MV)	

Function Codes and Their Parameters for Terminal [Ao] (Continued)

Function code	Name	Data	Description	Remarks
o72	(Gain to output voltage)	0 to 300%	-	
o73	(Polarity)	0	Bipolar	
		1	Unipolar	

Function Codes and Their Parameters for Terminal [CS]

Function code	Name	Data	Description	Remarks
o74	Terminal [CS] function (Mode selection)	0	Output frequency 1 (before slip compensation)	
		1	Output frequency 2 (after slip compensation)	
		2	Output frequency	
		3	Output voltage	
		4	Output torque	
		5	Load factor	
		6	Input power	
		7	PID feedback value	
		8	PG feedback value (speed)	
		9	DC link bus voltage	
		10	Universal AO	
		13	Motor output	
		14	Calibration (+)	
		15	PID command (SV)	
		16	PID output (MV)	
o75	(Gain to output voltage)	0 to 300%	-	

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4.4.2.11 T-Link communications card (OPC-G1-TL)

The T-Link communications card is used to connect the FRENIC-MEGA series to a Fuji MICREX series of programmable logic controllers via a T-Link network. Mounting the communications card on the FRENIC-MEGA enables the user to specify and monitor run and frequency commands and configure and check inverter's function codes required for inverter running from the MICREX.

Ports available for the interface card

This communications card can be connected to the A-port only, out of three option connection ports (A-, B-, and C-ports) provided on the FRENIC-MEGA.

Note: Once the inverter is equipped with this communications card, no more communications card (e.g., DeviceNet and SX-bus communications cards) is allowed on the inverter. Mounting more than one card on the inverter causes the Er4 trip that cannot be reset until those cards are removed except a single card.

Applicable ROM version

This communications card is applicable to inverters with a ROM version G1S10500 or later.

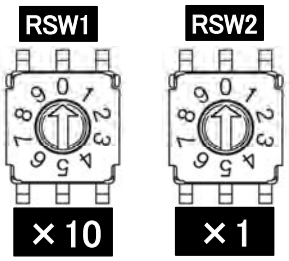
T-Link specifications

Item	Specifications
Applicable controller	MICREX series
Transmission specifications	T-Link slave I/O transmission
Number of words occupied in transmission	Total 8 words (MICREX → Inverter: 4 W, Inverter → MICREX: 4 W)
Number of units connectable	Max. 12 units
Recommended cable	Furukawa Electric twisted pair cable CPEV-SB 0.9 dia. x 1 pair or Furukawa Electric twisted pair cable KPEV-SB 0.5 mm^2 x 1 pair
Max. transmission speed	500 kbps

For the items not contained in the table above, the T-Link specifications apply.

Station address switches (RSW1 and RSW2)

The station address of the communications card on the T-Link should be configured with the station address switches (rotary switches RSW1 and RSW2) on the communications card. The setting range is from 00 to 99 in decimal. RSW1 specifies a 10s digit of the station address and the RSW2, a 1s digit.



RSW1: Upper bit (x10)
RSW2: Lower bit (x1)

* When two or more communications cards are used on the same T-Link network, the same station address should not be double assigned.
* Factory default: RSW1 = 0, RSW2 = 0 (Station address = 00)

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Inverter's function codes dedicated to T-Link communication

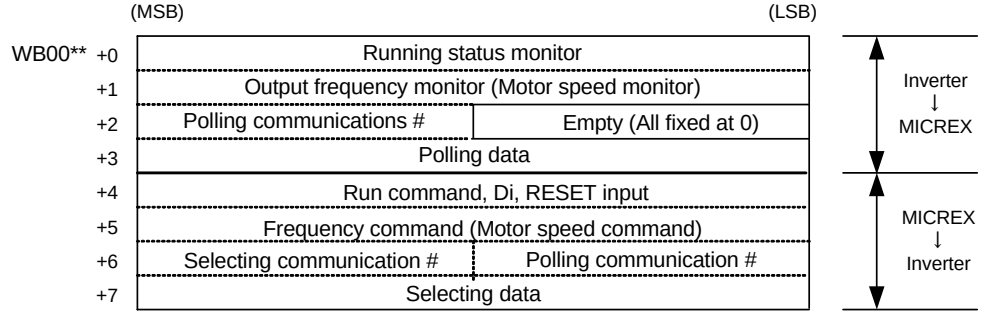
Function code	Function	Data setting range *	Description
y98	Select run/frequency command sources	0 to 3	Select from the following choices: y98 / Frequency command source / Run command source 0 / Inverter / Inverter 1 / T-Link / Inverter 2 / Inverter / T-Link 3 / T-Link / T-Link
o27	Select error processing for T-Link network breaks	0, 4 to 9	Immediately coast to a stop and trip with Er5.
		1	After the time specified by o28, coast to a stop and trip with Er5.
		2	If the communications link is restored within the time specified by o28, ignore the communications error. If a timeout occurs, coast to a stop and trip with Er5.
		3, 13 to 15	Continue to run, ignoring the error (No Er5 trip).
		10	Immediately decelerate to a stop. Issue Er5 after stopping.
		11	After the time specified by o28, decelerate to a stop. Issue Er5 after stopping.
		12	If the communications link is restored within the time specified by o28, ignore the communications error. If a timeout occurs, decelerate to a stop and trip with Er5.
o28	Set the operation timer to be used in error processing for network breaks	0.0 to 60.0 s	Applies when o27 = 1, 2, 11, or 12.
o30	Specify T-Link communications format	0	G11 standard format
		2	G9 compatible format
		1, 3 to 255	Not allowed.

* The underlined values are factory defaults.

Communications format

■ G11 standard format

When the G11 (FRENIC5000G11S) standard format is selected (o30 = 0), an eight-word area per inverter is used in the I/O relay area as shown below. The lower four words are status area for reading out data from the inverter to the MICREX; the upper four words are control area for writing data from the MICREX into the inverter.



(Note) Asterisks (**) denote a T-Link station address configured by the RSW1 and RSW2.

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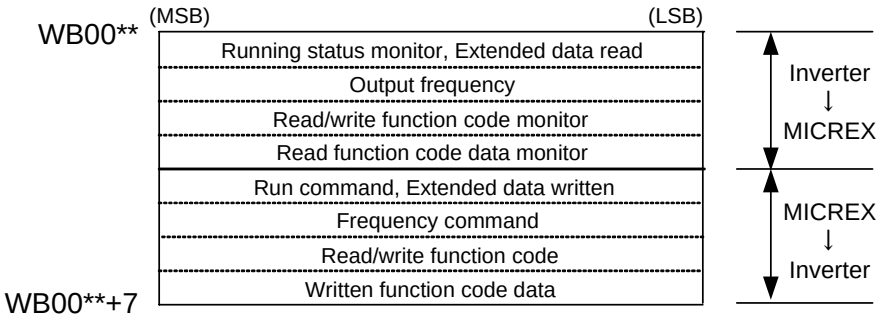
■ G9 compatible format

When the G9 (FRENIC5000 G9) compatible format is selected (o30 = 2), an eight-word area per inverter is used in the I/O relay area as shown below. The lower four words are status area for reading out data from the inverter to the MICREX; the upper four words are control area for writing data from the MICREX into the inverter.

This format has been designed to minimize the program change in the controller when the FRENIC5000 G9 series is replaced with the FRENIC-MEGA series.



(Note) Asterisks (**) denote a T-Link station address configured by the RSW1 and RSW2.

4.4.2.12 SX-bus communications card (OPC-G1-SX)

The SX-bus communications card is used to connect the FRENIC-MEGA series to a Fuji MICREX-SX series of programmable logic controllers via an SX bus. Mounting the communications card on the FRENIC-MEGA enables programmed control and monitoring of the inverter and configuring and checking of function codes required for inverter running, from the MICREX-SX.

Ports available for the interface card

This communications card can be connected to the A-port only, out of three option connection ports (A-, B-, and C-ports) provided on the FRENIC-MEGA.

Note: The SX-bus communications card uses also a part of the B-port function so that the B-port cannot accept any other card except the relay output interface card.

Note: Once the inverter is equipped with the SX-bus communications card, no more communications card (e.g., DeviceNet and PROFIBUS DP cards) is allowed on the inverter. Mounting such a card on the inverter causes the Er4 trip.

Applicable ROM version

This communications card is applicable to inverters with a ROM version G1S11000 or later.

Hardware specifications

Item	Specifications
Name	SX bus communications card
Transmission specifications	SX bus slave, I/O transmission
Transmission speed	25 Mbps
Number of words occupied in transmission	Standard format (16 words, 8W + 8W)
Terminals, Bus cable	IN and OUT, SX bus dedicated cable *NP1C-P3 (0.3 m) to NP1C-25 (25 m)
Rotary switches RSW1 and RSW2	Address switches for configuring an arbitrary station address, from 1 to 238.
Status indicator LEDs (RUN and ERR)	LEDs for indicating the current status (running or error) of the inverter on which the communications card is mounted.

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Inverter's function codes dedicated to SX-bus communication

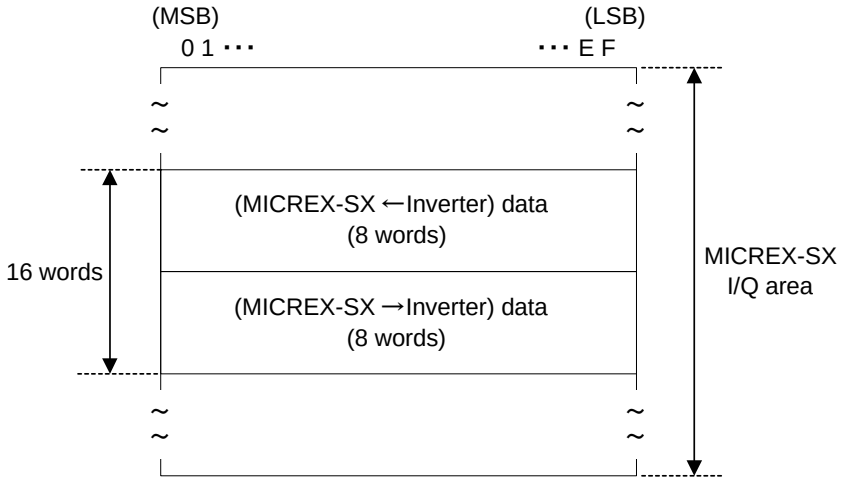
<table>
<tr><th>Function code</th><th>Function</th><th>Data setting range *</th><th>Description</th></tr>
<tr><td>y98</td><td>Select run/frequency command sources</td><td>0 to 3</td><td>Select from the following choices:
<table>
<tr><th>y98</th><th>Frequency command source</th><th>Run command source</th></tr>
<tr><td>0</td><td>Inverter</td><td>Inverter</td></tr>
<tr><td>1</td><td>SX bus</td><td>Inverter</td></tr>
<tr><td>2</td><td>Inverter</td><td>SX bus</td></tr>
<tr><td>3</td><td>SX bus</td><td>SX bus</td></tr>
</table></td></tr>
<tr><td rowspan="7">o27</td><td rowspan="7">Select error processing for SX-bus network breaks</td><td>0, 4 to 9</td><td>Immediately coast to a stop and trip with Er-5.</td></tr>
<tr><td>1</td><td>After the time specified by o28, coast to a stop and trip with Er-5.</td></tr>
<tr><td>2</td><td>If the communications link is restored within the time specified by o28, ignore the communications error. If a timeout occurs, coast to a stop and trip with Er-5.</td></tr>
<tr><td>3, 13 to 15</td><td>Keep the current operation, ignoring the communications error.
(No Er-5 trip)</td></tr>
<tr><td>10</td><td>Immediately decelerate to a stop. Issue Er-5 after stopping.</td></tr>
<tr><td>11</td><td>After the time specified by o28, decelerate to a stop. Issue Er-5 after stopping.</td></tr>
<tr><td>12</td><td>If the communications link is restored within the time specified by o28, ignore the communications error. If a timeout occurs, decelerate to a stop and trip with Er-5.</td></tr>
<tr><td>o28</td><td>Set the operation timer to be used in error processing for network breaks</td><td>0.0 to 60.0 sec</td><td>Applies when o27 = 1, 2, 11, or 12.</td></tr>
<tr><td rowspan="2">o30</td><td rowspan="2">Specify SX-bus communications format</td><td>0</td><td>Standard format</td></tr>
<tr><td>1 to 255</td><td>Specification not allowed</td></tr>
</table>

* The underlined values are factory defaults.

Area occupied in MICREX-SX and data allocation address

■ **Standard Format**

When the standard format is selected (o30 = 0), SX-bus communication uses a 16-word area per inverter in the MICREX-SX I/O area as shown below. (A maximum of 10 inverters can be connected.) The lower 8-word area is used as a status area for reading out data from the inverter to the MICREX-SX, the upper 8-word one, as a control area for writing data from the MICREX-SX to the inverter.



	(MSB)	(LSB)
%IW****.0	Function code group (1) polled	Function code number (1) polled
%IW****.1	Function code group (2) polled	Function code number (2) polled
%IW****.2	Data of function code (1) polled	
%IW****.3	Data of function code (2) polled	
%IW****.4	Empty (Fixed at 0)	
%IW****.5	Empty (Fixed at 0)	
%IW****.6	Output frequency monitor (Motor speed monitor)	
%IW****.7	Running status monitor	
%QW****.8	Selecting function code group (1)	Selecting function code number (1)
%QW****.9	Selecting function code group (2)	Selecting function code number (2)
%QW****.A	Data of function code (1) selected	
%QW****.B	Data of function code (2) selected	
%QW****.C	Frequency command	
%QW****.D	Run command	
%QW****.E	Polling function code group (1)	Polling function code number (1)
%QW****.F	Polling function code group (2)	Polling function code number (2)

INV ↓ MICREX-SX

MICREX-SX ↓ INV

(Note) Asterisks (****) denote a SX bus station address configured by the RSW1 and RSW2.

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4.4.2.13 CC-Link communications card (OPC-G1-CCL)

CC-Link (Control & Communication Link) is an FA open field network system.

The CC-Link communications card connects the inverter to a CC-Link master via CC-Link using a dedicated cable. It supports the transmission speed of 156 kbps to 10 Mbps and the total length of 100 to 1,200 m so that it can be used in wide range of systems requiring a high-speed or long-distance transmission, enabling a flexible system configuration.

Ports available for the communications card

This communications card can be connected to the A-port only, out of three option connection ports (A-, B-, and C-ports) provided on the FRENIC-MEGA.

Note: Once the inverter is equipped with this communications card, no more communications card (e.g., DeviceNet and SX-bus communications cards) is allowed on the inverter. Mounting more than one card on the inverter causes the Er4 trip that cannot be reset until those cards are removed except a single card.

Applicable ROM version

This communications card is applicable to inverters with a ROM version G1S10500 or later.

CC-Link specifications

Item	Specifications				
Applicable controller	Mitsubishi Electric sequencer, etc. (CC-Link master)				
Transmission system	CC-Link version 1.10 and 2.0 (Broadcast polling system)				
Number of inverters connectable	Max. 42 units (one station occupied/unit)				
Number of stations occupied	CC-Link version 1.10: 1 station occupied CC-Link version 2.0: 1 station occupied (Selectable from among 2X, 4X and 8X settings)				
Transmission speed (Baud rate)	10 Mbps/5 Mbps/2.5 Mbps/625 kbps/156 kbps				
Maximum cable length (When using the CC-Link dedicated cable)	10 Mbps	5 Mbps	2.5 Mbps	625 kbps	156 kbps
	100 m	150 m	200 m	600 m	1200 m
Insulation	500 VDC (photocoupler insulation)				
Station type	Remote device station				
Remote device type	Inverter (0x20)				

For items not contained in the above table, the CC-Link specifications apply.

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Inverter's function codes dedicated to CC-Link communication

<table>
<tr><th>Function code</th><th>Function</th><th>Data setting range *1</th><th>Description</th></tr>
<tr><td>y98</td><td>Select run/frequency command sources</td><td><u>0</u> to 3</td><td>Select from the following choices:
<table>
<tr><th>y98</th><th>Frequency command source</th><th>Run command source</th></tr>
<tr><td>0</td><td>Inverter</td><td>Inverter</td></tr>
<tr><td>1</td><td>CC-Link</td><td>Inverter</td></tr>
<tr><td>2</td><td>Inverter</td><td>CC-Link</td></tr>
<tr><td>3</td><td>CC-Link</td><td>CC-Link</td></tr>
</table></td></tr>
<tr><td rowspan="7">o27</td><td rowspan="7">Select error processing for CC-Link network breaks</td><td><u>0</u>, 4 to 9</td><td>Immediately coast to a stop and trip with Er5.</td></tr>
<tr><td>1</td><td>After the time specified by o28, coast to a stop and trip with Er5.</td></tr>
<tr><td>2</td><td>If the communications link is restored within the time specified by o28, ignore the communications error. If a timeout occurs, coast to a stop and trip with Er5.</td></tr>
<tr><td>3, 13 to 15</td><td>Keep the current operation, ignoring the communications error. (No Er5 trip)</td></tr>
<tr><td>10</td><td>Immediately decelerate to a stop. Issue Er5 after stopping.</td></tr>
<tr><td>11</td><td>After the time specified by o28, decelerate to a stop. Issue Er5 after stopping.</td></tr>
<tr><td>12</td><td>If the communications link is restored within the time specified by o28, ignore the communications error. If a timeout occurs, decelerate to a stop and trip with Er5.</td></tr>
<tr><td>o28</td><td>Set the operation timer to be used in error processing for network breaks</td><td><u>0.0</u> to 60.0 sec.</td><td>Applies when o27 = 1, 2, 11, or 12</td></tr>
<tr><td rowspan="5">o30</td><td rowspan="5">CC-Link extension</td><td><u>0</u>, 5 to 255</td><td>No operation</td></tr>
<tr><td>1</td><td>1 station occupied
(CC-Link version 1.10)</td></tr>
<tr><td>2</td><td>1 station occupied, 2X setting
(CC-Link version 2.00)</td></tr>
<tr><td>3</td><td>1 station occupied, 4X setting
(CC-Link version 2.00)</td></tr>
<tr><td>4</td><td>1 station occupied, 8X setting
(CC-Link version 2.00)</td></tr>
<tr><td>o31</td><td>Station address *2</td><td><u>0</u>, 1 to 64</td><td>Any of 1 to 64 should be specified for a slave station.
Specifying any other value causes the L.ERR LED to light.</td></tr>
<tr><td>o32</td><td>Transmission speed *2</td><td><u>0</u> to 4</td><td>0: 156 kbps, 1: 625 kbps, 2: 2.5 Mbps,
3: 5 Mbps, 4: 10 Mbps
Specifying any other value causes the L.ERR LED to light.</td></tr>
</table>

*1 <u>The underlined values</u> are factory defaults.

*2 If the station address (o31) or the transmission speed (o32) is modified when the inverter power is ON, the L.ERR LED flashes and the communications link is lost. Turning the terminal command ***RST*** ON or restarting both the inverter and the communications card validates the new setting.

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4.4.2.14 PROFIBUS-DP communications card (OPC-G1-PDP)

The PROFIBUS-DP communications card is used to connect the FRENIC-MEGA series to a PROFIBUS-DP master via PROFIBUS. Mounting the communications card on the FRENIC-MEGA enables the user to control the FRENIC-MEGA as a slave unit by configuring and monitoring run and frequency commands and accessing inverter's function codes from the PROFIBUS master.

The communications card has the following features:

- PROFIBUS version : DP-V0 compliant
- Transmission speed : 9,600 bps to 12 Mbps
- Applicable profile : PROFIDrive V2
- Able to read and write all function codes supported in the FRENIC-MEGA

Ports available for the communications card

This communications card can be connected to the A-port only, out of three option connection ports (A-, B-, and C-ports) provided on the FRENIC-MEGA.

Note: Once the inverter is equipped with this communications card, no more communications card (e.g., DeviceNet and SX-bus communications cards) is allowed on the inverter. Mounting more than one card on the inverter causes the Er4 trip that cannot be reset until those cards are removed except a single card.

Applicable ROM version

This communications card is applicable to inverters with a ROM version G1S11000 or later.

PROFIBUS-DP specifications

Item		Specifications	Remarks
Transmission section	Lines	RS-485 (insulated cable)	
	Cable length	See the table below.	
	Transmission speed	9.6 kbps to 12 Mbps (auto configuration)	To be specified in the master node
	Protocol	PROFIBUS-DP (DP-V0)	IEC 61158 and 61784
Connector		Pluggable, six-pin terminal block	Manufactured by Phoenix Contact Inc.
Control section	Controller	SPC3 (Siemens)	
	Comm. buffer	1472 bytes (SPC3 built-in memory)	
Addressing		- By on-board node address switches (rotary switches) (0 to 99) or - By inverter's function code o31 (data = 0 to 125)	Setting both node address switches SW1 and SW2 to "0" enables the o31 setting.
Diagnostics		Detection of cable break	Indicated by the OFFL LED
		Detection of the illegal configuration	Indicated by the ERR LED

The maximum cable length per segment for a PROFIBUS-DP specified cable is listed below.

Transmission speed	Maximum cable length (m) per segment
9.6 kbps	1200
19.2 kbps	1200
45.45 kbps	1200
93.75 kbps	1000
187.5 kbps	1000
500 kbps	400
1.5 Mbps	200
3 Mbps	100
6 Mbps	100
12 Mbps	100

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Inverter's function codes dedicated to PROFIBUS-DP communication

The inverter's function codes listed in Table 4.23 should be configured for specifying run and frequency commands via PROFIBUS.

Table 4.23 Inverter's Function Codes Required for Enabling Run and Frequency Commands via PROFIBUS

<table>
<tr><th>Function code</th><th>Description</th><th>Factory default</th><th>Function code data to be set</th><th>Remarks</th></tr>
<tr><td>y98</td><td>Select run/frequency command sources</td><td>0</td><td>3</td><td>Select from the following choices:
<table>
<tr><th>y98</th><th>Frequency command source</th><th>Run command source</th></tr>
<tr><td>0</td><td>Inverter</td><td>Inverter</td></tr>
<tr><td>1</td><td>PROFIBUS</td><td>Inverter</td></tr>
<tr><td>2</td><td>Inverter</td><td>PROFIBUS</td></tr>
<tr><td>3</td><td>PROFIBUS</td><td>PROFIBUS</td></tr>
</table></td></tr>
<tr><td>y99</td><td>Loader Link Function
(Run/frequency commands from Loader)</td><td>0</td><td>0</td><td>No change is required from the factory default.</td></tr>
<tr><td>E01 or above</td><td>Terminal Xn Function
(n: Terminal number)</td><td>--</td><td>Any data except "24 (1024), LE "
(For all terminals Xn)</td><td>Even if LE is selected, LE = ON makes parameter y98 valid, but LE = OFF makes y98 invalid and run/frequency commands in the inverter are valid.</td></tr>
</table>

Table 4.24 lists the other related inverter's function codes.

Table 4.24 Related Inverter's Function Codes

Function code	Description	Factory default	Data setting range	Remarks
o27	Select error processing for PROFIBUS network breaks	0	0 to 15	
o28	Set the operation timer to be used in error processing for network breaks	0.0 s	0.0 to 60.0 s	
o30	Select PPO type	0	0 to 255	For details about o30, refer to the instruction manual of this communications card.
o31	Select PROFIBUS station address	0	0 to 125	Valid when rotary switches SW1 and SW2 are set to "00."
o40 to o43	Assign function code data to be written, 1 to 4	0000	0x0000 to 0xFFFF	Configure function codes for writing to the data mapped I/O. Functionally equivalent to PNU915.
o48 to o51	Assign function code data to be read, 1 to 4	0000	0x0000 to 0xFFFF	Configure function codes for reading from the data mapped I/O. Functionally equivalent to PNU916.

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Node address

(1) Configuring node address switches (SW1 and SW2)

Before the inverter power is turned ON, the node address of the communications card should be specified with rotary switches SW1 and SW2 on the card. The setting range is from 00 to 99 in decimal. SW1 specifies a 10s digit of the node address and the SW2, a 1s digit.

Node address = (SW1 setting x 10) + (SW2 setting x 1)

Note: The node address switches should be accessed with the inverter being OFF. Setting these switches with the inverter being ON requires restarting the inverter to enable the new settings.

Note: To specify a node address exceeding 99, use the function code o31 as described in (2) below.

(2) Configuring the o31 data

The node address can also be specified with the inverter's function code o31. The setting range is from 0 to 125.

With rotary switches SW1 and SW2 being OFF, restarting the inverter validates the setting made with the function code 31. If those switches are set to any value other than 00, the setting made with those switches remains valid.

Setting the o31 data to 126 or greater flashes the ERR LED on the communications card, telling an occurrence of a data setting error.

Selecting the PPO type

This communications card supports PPO types 1 through 4. For details about the PPO, refer to the instruction manual of the PROFIBUS-DP communications card.

The same PPO type should be specified at both the inverter keypad and the PROFIBUS master. If not, the communications card cannot start data exchange with the PROFIBUS master and flashes the ERR LED, telling an occurrence of a data setting error.

■ From the inverter keypad

The PPO type of the communications card can be specified with the inverter's function code o30 that is accessible from the inverter keypad after the communications card is mounted on the inverter.

After the setting of the PPO type is modified, the inverter should be restarted to validate the new setting.

o30	PPO type
0, 1, 6 to 255	PPO 1
2	PPO 2
3	PPO 3
4	PPO 4
5	PPO 2

■ From the PROFIBUS master

The PROFIBUS master sends the definition of the communications card in its configuration frame. The definition is stored in the GSD file. For the configuration procedure, refer to the PROFIBUS master's manual.

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4.4.2.15 DeviceNet communications card (OPC-G1-DEV)

The DeviceNet communications card is used to connect the FRENIC-MEGA series to a DeviceNet master via DeviceNet. Mounting the communications card on the FRENIC-MEGA enables the user to control the FRENIC-MEGA as a slave unit by configuring and monitoring run and frequency commands and accessing inverter's function codes from the DeviceNet master.

Ports available for the communications card

This interface card can be connected to any one of the three option connection ports (A-, B-, and C-ports) provided on the FRENIC-MEGA.

Note: Once the inverter is equipped with this communications card, no more communications card (e.g., CC-Link and SX-bus communications cards) is allowed on the inverter. Mounting more than one card on the inverter causes the Er4 trip that cannot be reset until those cards are removed except a single card.

Applicable ROM version

This communications card is applicable to inverters with a ROM version G1S10500 or later.

DeviceNet specifications

Item	Specifications			
Number of nodes connectable	Max. 64 (including the master)			
MAC ID	0 to 63			
Insulation	500 VDC (photocoupler insulation)			
Transmission rate	500, 250, or 125 kbps			
Maximum cable length (When using thick cables)	Transmission rate	500 kbps	250 kbps	125 kbps
	Trunk line length	100 m	250 m	500 m
	Drop line length	6 m	6 m	6 m
	Total length of drop lines	39 m	78 m	156 m
Messages supported	1. I/O Message (Poll, Change of State) 2. Explicit Message			
Vendor ID	319 (Registered name: Fuji Electric Group)			
Device type	AC drive (code: 2)			
Product code	9219			
Applicable device profile	AC Drive			
Number of input/output bytes	Max. 8 bytes for each of input and output * Depending on the format selected. Refer to "Communications Formats" on page 4-97.			
Applicable DeviceNet Specifications	CIP Specifications Volume 1, Edition 2.2 Japanese version and Volume 3, Edition 1.1 Japanese version			
Node type	Group 2 only server (noncompliant with UCMM)			
Network power consumption	80 mA, 24 VDC (Note) The network power is supplied by an external power source.			

For the items not contained in the table above, the DeviceNet Specifications apply.

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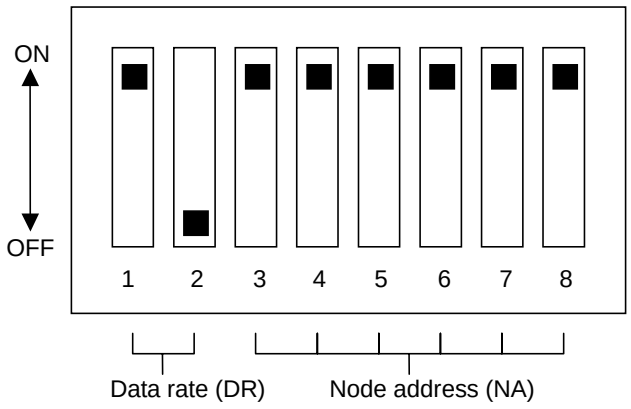
DIP switch configuration

The DIP switch specifies the communication data rate (baud rate) and the node address (MAC ID) on DeviceNet as shown below. It offers a choice of baud rates (125, 250, and 500 kbps) and a choice of node address (MAC ID) ranging from 0 to 63. The DIP switch should be configured before the inverter and the communications card are turned ON. If the switch is configured when they are turned ON, the new configuration does not go into effect until they are restarted.



DR	DIP 1-2
125 kbps	00
250 kbps	01
500 kbps	10
Not allowed	11

NA	DIP 3-8
0	000000
1	000001
2	000010
3	000011
…	…
62	111110
63	111111

DIP Switch Configuration (showing an example of Data Rate = 500 kbps and Node Address = 63

Inverter's function codes dedicated to DeviceNet communication

Function code	Description	Factory default	Function code data	Remarks
y98	Select run/frequency command sources	0	Select from the following choices: y98: 0 = Inverter / Inverter; 1 = DeviceNet / Inverter; 2 = Inverter / DeviceNet; 3 = DeviceNet / DeviceNet (Frequency command source / Run command source)	
o27	Select error processing for DeviceNet breaks	0	Refer to the instruction manual of the DeviceNet communications card.	
o28	Set the operation timer to be used in error processing for network breaks	0.0 s	0.0 to 60.0 s	
o31	Select output assembly instance.	0	See Table 4.26.	Restart the inverter to validate the new settings.
o32	Select input assembly instance	0	See Table 4.26.	
o40 to o43	Assign the function code writing data, 1 to 4.	0000	See Note below.	
o48 to o51	Assign the function code reading data, 1 to 4.	0000	See Note below.	

Note: Configuring o40 to o43 and o48 to o51

Specify the function code group (shown in Table 4.25) and number in a 4-digit hexadecimal notation.

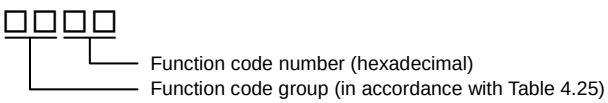


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Table 4.25 Function Code Group

Group	Group code		Group name	Group	Group code		Group name	Group	Group code		Group name
S	2	02h	Command/function data	A	9	09h	Motor 2 parameters	b	19	13h	Motor 3 parameters
M	3	03h	Monitored data	o	10	0Ah	Option functions	r	12	0Ch	Motor 4 parameters
F	4	04h	Fundamental functions	J	14	0Eh	Application functions 1	d	20	14h	Application functions 2
E	5	05h	Extension terminal functions	y	15	0Fh	Link functions				
C	6	06h	Control functions	W	16	10h	Monitored data 2				
P	7	07h	Motor 1 parameters	X	17	11h	Alarm 1				
H	8	08h	High performance functions	Z	18	12h	Alarm 2				

Example: For F26 F ⇒ Group code 04
26 ⇒ 1A (hexadecimal) } "041A"

Communications formats

Table 4.26 lists the communications formats supported. The output formats should be selected by function code o31 and the input formats, by function code o32. Restarting the inverter validates the new settings of o31 and o32.

Table 4.26 List of Communications Formats Supported

Function codes o31, o32	Type	Instance ID	Description	Length (words)
o31 = 20	Output (from master to inverter)	20	Basic Speed Control Output	4
o31 = 21 or 0 (Factory default)		21	Extended Speed Control Output	4
o31 = 100		100	Fuji Drive Assembly Output	4
o31 = 102		102	User Defined Assembly Output	8
o31 = 104 (Note)		104	Request for Access to Function Codes	8
o32 = 70	Input (from inverter to master)	70	Basic Speed Control Input	4
o32 = 71 or 0 (Factory default)		71	Extended Speed Control Input	4
o32 = 101		101	Fuji Drive Assembly Input	4
o32 = 103		103	User Defined Assembly Input	8
o32 = 105 (Note)		105	Response to Function Codes Access Request	8

(Note) When o31 is set at 104 (Request for Access to Function Codes), o32 should be set at 105 (Response to Request for Access to Function Codes). For details, refer to the instruction manual of the DeviceNet communications card.

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4.4.2.16 CANopen communications card (OPC-G1-COP)

The CANopen communications card is used to connect the FRENIC-MEGA series to a CANopen master unit (e.g., PC and PLC) via a CANopen network. Mounting the communications card on the FRENIC-MEGA allows the user to control the FRENIC-MEGA as a slave unit by configuring run and frequency commands and accessing inverter's function codes from the CANopen master unit.

Ports available for the communications card

This communications card can be connected to the A-port only, out of three option connection ports (A-, B-, and C-ports) provided on the FRENIC-MEGA.

Note: Once the inverter is equipped with this communications card, no more communications card (e.g., DeviceNet and SX-bus communications cards) is allowed on the inverter. Mounting more than one card on the inverter causes the Er4 trip that cannot be reset until those cards are removed except a single card.

Applicable ROM version

This communications card is applicable to inverters with a ROM version G1S11000 or later.

CANopen specifications

Item	Specifications	Remarks
Physical layer	CAN (ISO11898)	
Baud rate	20, 50, 125, 250, 500, 800 kbits/s or 1 Mbit/s	Specified by o32
Maximum cable length	2500 m (at 20 kbits/s) to 25 m (at 1 Mbit/s)	
Node ID	1 to 127	Specified by o31
Applicable profile	Compliant with the following profiles; - CiA DS-301 Ver. 4.02 - CiA DS-402 Ver. 2.0 with Velocity Mode	

Inverter's function codes dedicated to CANopen communication

The inverter's function codes listed below should be configured for performing communication between the communications card and CANopen master unit.

Inverter's Function Codes Required for CANopen Communication

Function code	Function code name	Factory default	Data setting range	Description
o31 *1	Node ID setting	0	0 to 255 (Valid range: 0 to 127)	Setting 0 or 128 or greater is regarded as 127
o32 *1	Baud rate setting	0	0 to 255 (Valid range: 0 to 7)	0: 125 kbits/s 1: 20 kbits/s 2: 50 kbits/s 3: 125 kbits/s 4: 250 kbits/s 5: 500 kbits/s 6: 800 kbits/s 7: 1 Mbit/s 8 to 255: 1 Mbit/s

*1 After configuring the function code o31 or o32, restart the inverter or send ResetNode command from the CANopen master to validate the new setting.

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The table below lists the other related inverter's function codes. Configure those function codes if necessary.

Related Inverter's Function Codes

Function code	Function code name	Factory default	Data setting range	Description
o27	Select error processing for CANopen network breaks	0	0 to 15	
o28	Set the operation timer to be used in error processing for network breaks	0	0 to 60.0 s	
o40 to o43 *2	Assign the function code to be written via RPDO 3	0x0000	0x0000 to 0xFFFF	Specify the function code as follows: 0xXX■■ XX: Group (Refer to the table below) ■■: Number ex. F07-> 0x0407
o48 to o51 *2	Assign the function code to be monitored via TPDO 3	0x0000	0x0000 to 0xFFFF	Same as above.
y98	Select run/frequency command sources	0	0 to 3	Select from the following choices: y98: 0 = Frequency command source: Inverter, Run command source: Inverter y98: 1 = Frequency command source: CANopen, Run command source: Inverter y98: 2 = Frequency command source: Inverter, Run command source: CANopen y98: 3 = Frequency command source: CANopen, Run command source: CANopen

*2 After configuring the function code o40 to o43 and o48 to o51, restart the inverter or send Reset Node command from the CANopen master to validate the new setting.

Function Code Group (Function codes o40 to o43 and o48 to o51)

Group	Group code		Group name	Group	Group code		Group name	Group	Group code		Group name
S	2	02h	Command/function data	A	9	09h	Motor 2 parameters	b	19	13h	Motor 3 parameters
M	3	03h	Monitored data	o	10	0Ah	Option functions	r	12	0Ch	Motor 4 parameters
F	4	04h	Fundamental functions	J	14	0Eh	Application functions 1	d	20	14h	Application functions 2
E	5	05h	Extension terminal functions	y	15	0Fh	Link functions				
C	6	06h	Control functions	W	16	10h	Monitored data 2				
P	7	07h	Motor 1 parameters	X	17	11h	Alarm 1				
H	8	08h	High performance functions	Z	18	12h	Alarm 2				

Communication

The communications card is a slave of CANopen and supports the following services.

Item	Services	Remarks
PDO	- 3 RPDOs / 3 TPDOs - Sync, Cyclic and Async (Change of state event) supported for 3 TPDOs	All PDO cannot be remapped by PDO Mapping parameters.
SDO	- Expedited and Segmented protocol supported - Only Default SDO supported	Block protocol not supported
Emergency (EMCY) Object	EMCY Producer	EMCY Consumer not supported
Network Management (NMT)	NMT Slave (DS-301 state machine) Guarding Heartbeat Producer Heartbeat Consumer Boot-up Protocol	NMT master not supported

4.4.3 Option cards for operation and communication

4.4.3.1 About option cards for operation and communication

The table below lists the option cards, option connection ports, and applicable ROM/product versions.

(Function enhancement or version update in the future may provide new options. For options not listed below, contact Fuji Electric or visit our website.)

Option type	Model name	Option connection ports			Applicable FRENIC-MEGA		Remarks
		A-port	B-port	C-port	ROM version	Product version	
Relay output	OPC-G1-RY	√	√	--	0100 or later	*1	Two option cards connectable at a time to A- and B-ports (4 outputs).
PG feedback	OPC-G1-PG	--	--	√	0100 or later	*1	
	OPC-G1-PG2	--	--	√	0100 or later	*1	
I/O	OPC-G1-DI	√	√	√	0500 or later	*2	A single option card connectable at a time to any one of A-, B- and C-ports.
	OPC-G1-DO	√	√	√	0500 or later	*2	A single option card connectable at a time to any one of A-, B- and C-ports.
	OPC-G1-AIO	√	√	√	0700 or later	*2	A single option card connectable at a time to any one of A-, B- and C-ports.
Communication	OPC-G1-DEV	√	√	√	0500 or later	*2	Only one of these communications option cards connectable to the inverter at a time. (e.g. Connection of both OPC-G1-DEV and OPC-G1-TL at a time is not possible.) When the OPC-G1-SX is connected to the A-port, the OPC-G1-RY only can be connected to the B-port.
	OPC-G1-TL	√	--	--	0500 or later	*2	
	OPC-G1-COP	√	--	--	1000 or later	C	
	OPC-G1-PDP	√	--	--	1000 or later	C	
	OPC-G1-CCL	√	--	--	0500 or later	*2	
	OPC-G1-SX	√	--	--	1000 or later	C	

*1 Applicable independent of the product version.

*2 Applicable to the product version C or later. For versions earlier than C, it is necessary to check the ROM version.

Note Mounting an IP40 option limits the number of connectable option cards to one (except that two relay output interface cards (OPC-G1-RY) can be connected at a time).

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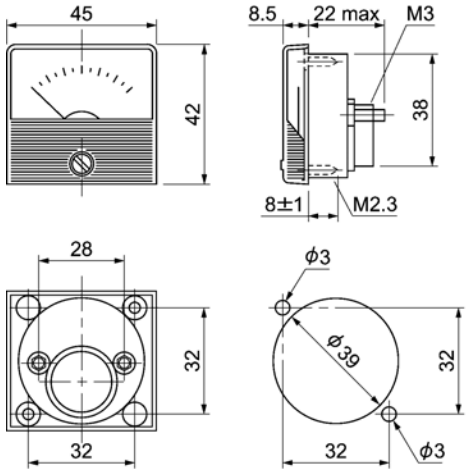
4.4.4 Meter options

4.4.4.1 Frequency meters

Connect a frequency meter to analog signal output terminals [FMA] and [11] of the inverter to measure the frequency component selected by function code F31. Figure 4.17 shows the dimensions of the frequency meter and a connection example.

Model: TRM-45 (10 VDC, 1 mA)

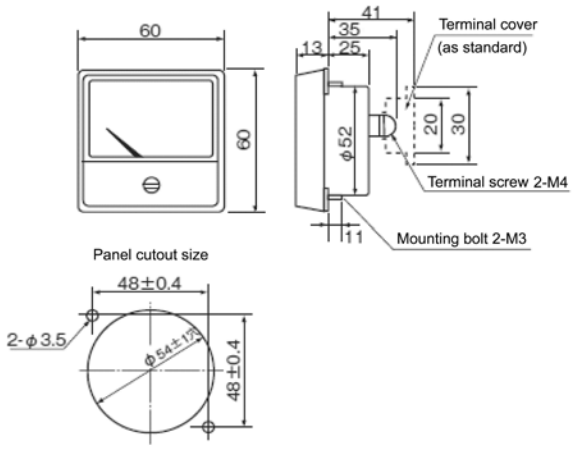
This model has two types of calibration: "0 to 60/120 Hz" and "60/120/240 Hz."



Unit: mm

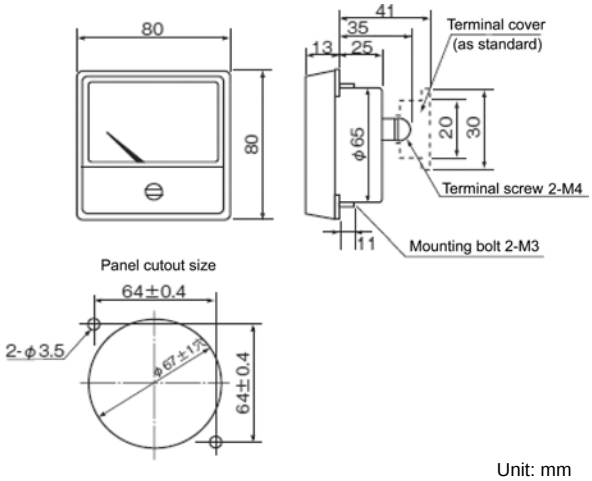
Available from Fuji Electric Technica Co., Ltd.

Model: FM-60 (10 VDC, 1 mA)



(View from the front of the panel)

Model: FM-80 (10 VDC, 1 mA)



(View from the front of the panel)

Unit: mm

Available from Fuji Electric Technica Co., Ltd.

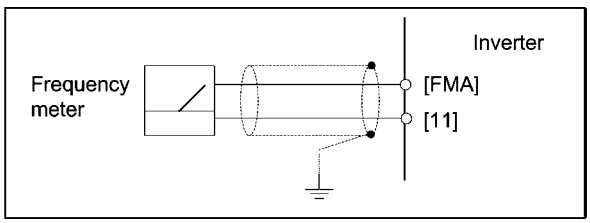


Figure 4.18 Frequency Meter Dimensions and Connection Example

Chapter 5

FUNCTION CODES

This chapter contains overview tables of function codes available for the FRENIC-MEGA series of inverters, function code index by purpose, and details of function codes.

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5.1 Overview of Function Codes

Function codes enable the FRENIC-MEGA series of inverters to be set up to match your system requirements.

Each function code consists of a 3-letter alphanumeric string. The first letter is an alphabet that identifies its group and the following two letters are numerals that identify each individual code in the group. The function codes are classified into 12 groups: Fundamental Functions (F codes), Extension Terminal Functions (E codes), Control Functions (C codes), Motor 1 Parameters (P codes), High Performance Functions (H codes), Motor 2, 3 and 4 Parameters (A, b and r codes), Application Functions 1 and 2 (J and d codes), Link Functions (y codes) and Option Functions (o codes). To determine the property of each function code, set data to the function code.

This manual does not contain the descriptions of Option Functions (o codes). For o codes, refer to the instruction manual for each option.

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5.2 Function Code Tables

The following descriptions supplement those given in the function code tables on page 5-4 and subsequent pages.

■ Changing, validating, and saving function code data when the inverter is running

Function codes are indicated by the following based on whether they can be changed or not when the inverter is running:

Notation	Change when running	Validating and saving function code data
Y*	Possible	If the data of the codes marked with Y* is changed with ∧ and ∨ keys, the change will immediately take effect; however, the change is not saved into the inverter's memory. To save the change, press the FUNC/DATA key. If you press the PRG/RESET key without pressing the FUNC/DATA key to exit the current state, then the changed data will be discarded and the previous data will take effect for the inverter operation.
Y	Possible	Even if the data of the codes marked with Y is changed with ∧ and ∨ keys, the change will not take effect. Pressing the FUNC/DATA key will make the change take effect and save it into the inverter's memory.
N	Impossible	—

■ Copying data

The keypad is capable of copying of the function code data stored in the inverter's memory into the keypad's memory (refer to Menu #7 "Data copying" in Programming mode). With this feature, you can easily transfer the data saved in a source inverter to other destination inverters.

If the specifications of the source and destination inverters differ, some code data may not be copied to ensure safe operation of your power system. Whether data will be copied or not is detailed with the following symbols in the "Data copying" column of the function code tables given on page 5-4 and subsequent pages.

- Y: Will be copied unconditionally.
- Y1: Will not be copied if the rated capacity differs from the source inverter.
- Y2: Will not be copied if the rated input voltage differs from the source inverter.
- N: Will not be copied. (The function code marked with "N" is not subject to the Verify operation, either.)

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■ Using negative logic for programmable I/O terminals

The negative logic signaling system can be used for the programmable, digital input and output terminals by setting the function code data specifying the properties for those terminals. Negative logic refers to the inverted ON/OFF (logical value 1 (true)/0 (false)) state of input or output signal. An active-ON signal (the function takes effect if the terminal is short-circuited.) in the normal logic system is functionally equivalent to active-OFF signal (the function takes effect if the terminal is opened.) in the negative logic system. Active-ON signals can be switched to active-OFF signals, and vice versa, with the function code data setting, except some signals.

To set the negative logic system for an input or output terminal, enter data of 1000s (by adding 1000 to the data for the normal logic) in the corresponding function code.

Example: "Coast to a stop" command ***BX*** assigned to any of digital input terminals [X1] to [X9] using any of function codes E01 through E09

Function code data	Description
7	Turning ***BX*** ON causes the motor to coast to a stop. (Active-ON)
1007	Turning ***BX*** OFF causes the motor to coast to a stop. (Active-OFF)

■ Drive control

The FRENIC-MEGA runs under "V/f control," "vector control without speed sensor," or "vector control with speed sensor."

Some function codes apply exclusively to the specific drive control, which is indicated by letters Y (Applicable) and N (Not applicable) in the "Drive control" column in the function code tables given on the following pages.

The "Drive control" column uses the following abbreviations:

- V/f: V/f control
- w/o PG: Vector control without speed sensor
- w/ PG: Vector control with speed sensor

For details about the drive control, refer to the description of F42 "Drive Control Selection 1."

Note The FRENIC-MEGA is a general-purpose inverter whose operation is customized by frequency-basis function codes, like conventional inverters. Under the speed-basis drive control, however, the control target is a motor speed, not a frequency, so convert the frequency to the motor speed according to the following expression.

Motor speed (r/min) = 120 × Frequency (Hz) ÷ Number of poles

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The following tables list the function codes available for the FRENIC-MEGA series of inverters.

F codes: Fundamental Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
F00	Data Protection	0: Disable both data protection and digital reference protection 1: Enable data protection and disable digital reference protection 2: Disable data protection and enable digital reference protection 3: Enable both data protection and digital reference protection	Y	Y	0	Y	Y	Y	5-52
F01	Frequency Command 1	0: ▲ / ▼ keys on keypad 1: Voltage input to terminal [12] (-10 to +10 VDC) 2: Current input to terminal [C1] (4 to 20 mA DC) 3: Sum of voltage and current inputs to terminals [12] and [C1] 5: Voltage input to terminal [V2] (0 to 10 VDC) 7: Terminal command ***UP/DOWN*** control 8: ▲ / ▼ keys on keypad (balanceless-bumpless switching available) 11: Digital input interface card (option) 12: Pulse train input	N	Y	0	Y	Y	Y	5-53
F02	Operation Method	0: RUN/STOP keys on keypad (Motor rotational direction specified by terminal command ***FWD***/***REV***) 1: Terminal command ***FWD*** or ***REV*** 2: RUN/STOP keys on keypad (forward) 3: RUN/STOP keys on keypad (reverse)	N	Y	2	Y	Y	Y	5-61
F03	Maximum Frequency 1	25.0 to 500.0 Hz	N	Y	60.0	Y	Y	Y	5-62
F04	Base Frequency 1	25.0 to 500.0 Hz	N	Y	50.0	Y	Y	Y	
F05	Rated Voltage at Base Frequency 1	0: Output a voltage in proportion to input voltage 80 to 240 V: Output an AVR-controlled voltage (for 200 V class series) 160 to 500 V: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	200 400	Y	Y	Y	
F06	Maximum Output Voltage 1	80 to 240 V: Output an AVR-controlled voltage (for 200 V class series) 160 to 500 V: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	200 400	Y	N	N	
F07	Acceleration Time 1	0.00 to 6000 s Note: Entering 0.00 cancels the acceleration time, requiring external soft-start.	Y	Y	*1	Y	Y	Y	5-65
F08	Deceleration Time 1		Y	Y	*1	Y	Y	Y	
F09	Torque Boost 1	0.0% to 20.0% (percentage with respect to "Rated Voltage at Base Frequency 1")	Y	Y	*2	Y	N	N	5-68 5-89
F10	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics)	1: For a general-purpose motor with shaft-driven cooling fan 2: For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan	Y	Y	1	Y	Y	Y	5-68
F11	(Overload detection level)	0.00: Disable 1% to 135% of the rated current (allowable continuous drive current) of the motor	Y	Y1 Y2	*3	Y	Y	Y	
F12	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	
F14	Restart Mode after Momentary Power Failure (Mode selection)	0: Trip immediately 1: Trip after a recovery from power failure 2: Trip after decelerate-to-stop 3: Continue to run, for heavy inertia or general loads 4: Restart at the frequency at which the power failure occurred, for general loads 5: Restart at the starting frequency	Y	Y	1	Y	Y	Y	5-72
F15	Frequency Limiter (High)	0.0 to 500.0 Hz	Y	Y	70.0	Y	Y	Y	5-80
F16	(Low)	0.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	
F18	Bias (Frequency command 1)	-100.00% to 100.00%	Y*	Y	0.00	Y	Y	Y	5-53 5-81
F20	DC Braking 1 (Braking starting frequency)	0.0 to 60.0 Hz	Y	Y	0.0	Y	Y	Y	5-81
F21	(Braking level)	0% to 100% (HD mode), 0% to 80% (MD/LD mode)	Y	Y	0	Y	Y	Y	
F22	(Braking time)	0.00 (Disable); 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	
F23	Starting Frequency 1	0.0 to 60.0 Hz	Y	Y	0.5	Y	Y	Y	5-83
F24	(Holding time)	0.00 to 10.00 s	Y	Y	0.00	Y	Y	Y	
F25	Stop Frequency	0.0 to 60.0 Hz	Y	Y	0.2	Y	Y	Y	

The shaded function codes (▭) are applicable to the quick setup.

*1 6.00 s for inverters with a capacity of 22 kW or below; 20.00 s for those with 30 kW or above

*2 The factory default differs depending upon the inverter's capacity. See Table A.

*3 The motor rated current is automatically set. See Table B (function code P03).

*4 5.0 min for inverters with a capacity of 22 kW or below; 10.0 min for those with 30 kW or above

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Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
F26	Motor Sound (Carrier frequency)	0.75 to 16 kHz (HD-mode inverters with 55 kW or below and LD-mode ones with 18.5 kW or below) 0.75 to 10 kHz (HD-mode inverters with 75 to 400 kW and LD-mode ones with 22 to 55 kW) 0.75 to 6 kHz (HD-mode inverters with 500 and 630 kW and LD-mode ones with 75 to 500 kW) 0.75 to 4 kHz (LD-mode inverters with 630 kW) 0.75 to 2 kHz (MD-mode inverters with 90 to 400 kW)	Y	Y	2	Y	Y	Y	5-86
F27	(Tone)	0: Level 0 (Inactive) 1: Level 1 2: Level 2 3: Level 3	Y	Y	0	Y	N	N	
F29	Analog Output [FMA] (Mode selection)	0: Output in voltage (0 to 10 VDC) 1: Output in current (4 to 20 mA DC)	Y	Y	0	Y	Y	Y	5-87
F30	(Voltage adjustment)	0% to 300%	Y*	Y	100	Y	Y	Y	
F31	(Function)	Select a function to be monitored from the followings. 0: Output frequency 1 (before slip compensation) 1: Output frequency 2 (after slip compensation) 2: Output current 3: Output voltage 4: Output torque 5: Load factor 6: Input power 7: PID feedback amount 8: PG feedback value 9: DC link bus voltage 10: Universal AO 13: Motor output 14: Calibration (+) 15: PID command (SV) 16: PID output (MV)	Y	Y	0	Y	Y	Y	
F33	Pulse Output [FMP] (Pulse rate)	25 to 6000 p/s (Pulse rate at 100% output)	Y*	Y	1440	Y	Y	Y	5-88
F34	(Gain to output voltage)	0%: Output pulse rate (Fixed at 50% duty) 1% to 300%: Voltage output adjustment (Pulse rate fixed at 2000 p/s. Adjust the maximum pulse duty.)	Y*	Y	0	Y	Y	Y	
F35	(Function)	Select a function to be monitored from the followings. 0: Output frequency 1 (before slip compensation) 1: Output frequency 2 (after slip compensation) 2: Output current 3: Output voltage 4: Output torque 5: Load factor 6: Input power 7: PID feedback amount 8: PG feedback value 9: DC link bus voltage 10: Universal AO 13: Motor output 14: Calibration 15: PID command (SV) 16: PID output (MV)	Y	Y	0	Y	Y	Y	
F37	Load Selection/ Auto Torque Boost/ Auto Energy Saving Operation 1	0: Variable torque load 1: Constant torque load 2: Auto torque boost 3: Auto energy saving (Variable torque load during ACC/DEC) 4: Auto energy saving (Constant torque load during ACC/DEC) 5: Auto energy saving (Auto torque boost during ACC/DEC)	N	Y	1	Y	N	Y	5-89
F38	Stop Frequency (Detection mode)	0: Detected speed 1: Reference speed	N	Y	0	N	N	Y	5-83
F39	(Holding Time)	0.00 to 10.00 s	Y	Y	0.00	Y	Y	Y	5-92
F40	Torque Limiter 1-1	-300% to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	5-92
F41	1-2	-300% to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	
F42	Drive Control Selection 1	0: V/f control with slip compensation inactive 1: Dynamic torque vector control 2: V/f control with slip compensation active 3: V/f control with speed sensor 4: Dynamic torque vector control with speed sensor 5: Vector control without speed sensor 6: Vector control with speed sensor	N	Y	0	Y	Y	Y	5-95
F43	Current Limiter (Mode selection)	0: Disable (No current limiter works.) 1: Enable at constant speed (Disable during ACC/DEC) 2: Enable during ACC/constant speed operation	Y	Y	2	Y	N	N	5-97
F44	(Level)	20% to 200% (The data is interpreted as the rated output current of the inverter for 100%.)	Y	Y	160	Y	N	N	
F50	Electronic Thermal Overload Protection for Braking Resistor (Discharging capability)	0 (Braking resistor built-in type), 1 to 9000 kWs, OFF (Disable)	Y	Y1 Y2	*5	Y	Y	Y	5-98
F51	(Allowable average loss)	0.001 to 99.99 kW	Y	Y1 Y2	0.001	Y	Y	Y	
F52	(Resistance)	0.01 to 999Ω	Y	Y1 Y2	0.01	Y	Y	Y	
F80	Switching between HD, MD and LD drive modes	0: HD (High Duty) mode 1: LD (Low Duty) mode 2: MD (Medium Duty) mode	N	Y	0	Y	Y	Y	5-100

The shaded function codes ( ) are applicable to the quick setup.

*5 0 for inverters with a capacity of 7.5 kW or below; OFF for those with 11 kW or above

Function Code Tables
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

E codes: Extension Terminal Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
		Selecting function code data assigns the corresponding function to terminals [X1] to [X9] as listed below.							5-102
E01	Terminal [X1] Function	0 (1000): Select multi-frequency (0 to 1 steps) (***SS1***)	N	Y	0	Y	Y	Y	
E02	Terminal [X2] Function	1 (1001): Select multi-frequency (0 to 3 steps) (***SS2***)	N	Y	1	Y	Y	Y	
E03	Terminal [X3] Function	2 (1002): Select multi-frequency (0 to 7 steps) (***SS4***)	N	Y	2	Y	Y	Y	
E04	Terminal [X4] Function	3 (1003): Select multi-frequency (0 to 15 steps) (***SS8***)	N	Y	3	Y	Y	Y	
E05	Terminal [X5] Function	4 (1004): Select ACC/DEC time (2 steps) (***RT1***)	N	Y	4	Y	Y	Y	
E06	Terminal [X6] Function	5 (1005): Select ACC/DEC time (4 steps) (***RT2***)	N	Y	5	Y	Y	Y	
E07	Terminal [X7] Function	6 (1006): Enable 3-wire operation (***HLD***)	N	Y	6	Y	Y	Y	
E08	Terminal [X8] Function	7 (1007): Coast to a stop (***BX***)	N	Y	7	Y	Y	Y	
E09	Terminal [X9] Function	8 (1008): Reset alarm (***RST***)	N	Y	8	Y	Y	Y	
		9 (1009): Enable external alarm trip (***THR***) (9 = Active OFF, 1009 = Active ON)				Y	Y	Y	
		10 (1010): Ready for jogging (***JOG***)				Y	Y	Y	
		11 (1011): Select frequency command 2/1 (***Hz2/Hz1***)				Y	Y	Y	
		12 (1012): Select motor 2 (***M2***)				Y	Y	Y	
		13: Enable DC braking (***DCBRK***)				Y	Y	Y	
		14 (1014): Select torque limiter level 2/1 (***TL2/TL1***)				Y	Y	Y	
		15: Switch to commercial power (50 Hz) (***SW50***)				Y	N	N	
		16: Switch to commercial power (60 Hz) (***SW60***)				Y	N	N	
		17 (1017): UP (Increase output frequency) (***UP***)				Y	Y	Y	
		18 (1018): DOWN (Decrease output frequency) (***DOWN***)				Y	Y	Y	
		19 (1019): Enable data change with keypad (***WE-KP***)				Y	Y	Y	
		20 (1020): Cancel PID control (***Hz/PID***)				Y	Y	Y	
		21 (1021): Switch normal/inverse operation (***IVS***)				Y	Y	Y	
		22 (1022): Interlock (***IL***)				Y	Y	Y	
		23 (1023): Cancel torque control (***Hz/TRQ***)				N	N	N	
		24 (1024): Enable communications link via RS-485 or fieldbus (option) (***LE***)				Y	Y	Y	
		25 (1025): Universal DI (***U-DI***)				Y	Y	Y	
		26 (1026): Enable auto search for idling motor speed at starting (***STM***)				Y	Y	N	
		30 (1030): Force to stop (***STOP***) (30 = Active OFF, 1030 = Active ON)				Y	Y	Y	
		32 (1032): Pre-excitation (***EXITE***)				N	Y	Y	
		33 (1033): Reset PID integral and differential components (***PID-RST***)				Y	Y	Y	
		34 (1034): Hold PID integral component (***PID-HLD***)				Y	Y	Y	
		35 (1035): Select local (keypad) operation (***LOC***)				Y	Y	Y	
		36 (1036): Select motor 3 (***M3***)				Y	Y	Y	
		37 (1037): Select motor 4 (***M4***)				Y	Y	Y	
		39: Protect motor from dew condensation (***DWP***)				Y	Y	Y	
		40: Enable integrated sequence to switch to commercial power (50 Hz) (***ISW50***)				Y	N	N	
		41: Enable integrated sequence to switch to commercial power (60 Hz) (***ISW60***)				Y	N	N	
		47 (1047): Servo-lock command (***LOCK***)				N	N	Y	
		48: Pulse train input (available only on terminal [X7] (E07)) (***PIN***)				Y	Y	Y	
		49 (1049): Pulse train sign (available on terminals except [X7] (E01 to E06, E08 and E09)) (***SIGN***)				Y	Y	Y	
		70 (1070): Cancel constant peripheral speed control (***Hz/LSC***)				Y	Y	Y	
		71 (1071): Hold the constant peripheral speed control frequency in the memory (***LSC-HLD***)				Y	Y	Y	
		72 (1072): Count the run time of commercial power-driven motor 1 (***CRUN-M1***)				Y	N	N	
		73 (1073): Count the run time of commercial power-driven motor 2 (***CRUN-M2***)				Y	N	N	
		74 (1074): Count the run time of commercial power-driven motor 3 (***CRUN-M3***)				Y	N	N	
		75 (1075): Count the run time of commercial power-driven motor 4 (***CRUN-M4***)				Y	N	N	
		76 (1076): Select droop control (***DROOP***)				Y	Y	Y	
		77 (1077): Cancel PG alarm (***PG-CCL***)				N	N	Y	
		80 (1080): Cancel customizable logic (***CLC***)				Y	Y	Y	
		81 (1081): Clear all customizable logic timers (***CLTC***)				Y	Y	Y	
		100: No function assigned (***NONE***)				Y	Y	Y	
		Setting the value in parentheses ( ) shown above assigns a negative logic input to a terminal.							
E10	Acceleration Time 2	0.00 to 6000 s	Y	Y	*1	Y	Y	Y	5-65
E11	Deceleration Time 2	Note: Entering 0.00 cancels the acceleration time, requiring external soft-start and -stop.	Y	Y	*1	Y	Y	Y	5-117
E12	Acceleration Time 3		Y	Y	*1	Y	Y	Y	
E13	Deceleration Time 3		Y	Y	*1	Y	Y	Y	
E14	Acceleration Time 4		Y	Y	*1	Y	Y	Y	
E15	Deceleration Time 4		Y	Y	*1	Y	Y	Y	

*1 6.00 s for inverters with a capacity of 22 kW or below; 20.00 s for those with 30 kW or above

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
E16	Torque Limiter 2-1	-300% to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	5-92
E17	Torque Limiter 2-2	-300% to 300%; 999 (Disable)	Y	Y	999	Y	Y	Y	5-117
		Selecting function code data assigns the corresponding function to terminals [Y1] to [Y5A/C] and [30A/B/C] as listed below.							5-118
E20	Terminal [Y1] Function	0 (1000): Inverter running (***RUN***)	N	Y	0	Y	Y	Y	
E21	Terminal [Y2] Function	1 (1001): Frequency (speed) arrival signal (***FAR***)	N	Y	1	Y	Y	Y	
E22	Terminal [Y3] Function	2 (1002): Frequency (speed) detected (***FDT***)	N	Y	2	Y	Y	Y	
E23	Terminal [Y4] Function	3 (1003): Undervoltage detected (Inverter stopped) (***LU***)	N	Y	7	Y	Y	Y	
E24	Terminal [Y5A/C] Function	4 (1004): Torque polarity detected (***B/D***)	N	Y	15	Y	Y	Y	
E27	Terminal [30A/B/C] Function (Relay output)	5 (1005): Inverter output limiting (***IOL***)	N	Y	99	Y	Y	Y	
		6 (1006): Auto-restarting after momentary power failure (***IPF***)				Y	Y	Y	
		7 (1007): Motor overload early warning (***OL***)				Y	Y	Y	
		8 (1008): Keypad operation enabled (***KP***)				Y	Y	Y	
		10 (1010): Inverter ready to run (***RDY***)				Y	Y	Y	
		11: Switch motor drive source between commercial power and inverter output (For MC on commercial line) (***SW88***)				Y	N	N	
		12: Switch motor drive source between commercial power and inverter output (For secondary side) (***SW52-2***)				Y	N	N	
		13: Switch motor drive source between commercial power and inverter output (For primary side) (***SW52-1***)				Y	N	N	
		15 (1015): Select ***AX*** terminal function (For MC on primary side) (***AX***)				Y	Y	Y	
		22 (1022): Inverter output limiting with delay (***IOL2***)				Y	Y	Y	
		25 (1025): Cooling fan in operation (***FAN***)				Y	Y	Y	
		26 (1026): Auto-resetting (***TRY***)				Y	Y	Y	
		27 (1027): Universal DO (***U-DO***)				Y	Y	Y	
		28 (1028): Heat sink overheat early warning (***OH***)				Y	Y	Y	
		30 (1030): Lifetime alarm (***LIFE***)				Y	Y	Y	
		31 (1031): Frequency (speed) detected 2 (***FDT2***)				Y	Y	Y	
		33 (1033): Reference loss detected (***REF OFF***)				Y	Y	Y	
		35 (1035): Inverter output on (***RUN2***)				Y	Y	Y	
		36 (1036): Overload prevention control (***OLP***)				Y	Y	Y	
		37 (1037): Current detected (***ID***)				Y	Y	Y	
		38 (1038): Current detected 2 (***ID2***)				Y	Y	Y	
		39 (1039): Current detected 3 (***ID3***)				Y	Y	Y	
		41 (1041): Low current detected (***IDL***)				Y	Y	Y	
		42 (1042): PID alarm (***PID-ALM***)				Y	Y	Y	
		43 (1043): Under PID control (***PID-CTL***)				Y	Y	Y	
		44 (1044): Motor stopped due to slow flowrate under PID control (***PID-STP***)				Y	Y	Y	
		45 (1045): Low output torque detected (***U-TL***)				Y	Y	Y	
		46 (1046): Torque detected 1 (***TD1***)				Y	Y	Y	
		47 (1047): Torque detected 2 (***TD2***)				Y	Y	Y	
		48 (1048): Motor 1 selected (***SWM1***)				Y	Y	Y	
		49 (1049): Motor 2 selected (***SWM2***)				Y	Y	Y	
		50 (1050): Motor 3 selected (***SWM3***)				Y	Y	Y	
		51 (1051): Motor 4 selected (***SWM4***)				Y	Y	Y	
		52 (1052): Running forward (***FRUN***)				Y	Y	Y	
		53 (1053): Running reverse (***RRUN***)				Y	Y	Y	
		54 (1054): In remote operation (***RMT***)				Y	Y	Y	
		56 (1056): Motor overheat detected by thermistor (***THM***)				Y	Y	Y	
		57 (1057): Brake signal (***BRKS***)				Y	Y	Y	
		58 (1058): Frequency (speed) detected 3 (***FDT3***)				Y	Y	Y	
		59 (1059): Terminal [C1] wire break (***C1OFF***)				Y	Y	Y	
		70 (1070): Speed valid (***DNZS***)				N	Y	Y	
		71 (1071): Speed agreement (***DSAG***)				N	Y	Y	
		72 (1072): Frequency (speed) arrival signal 3 (***FAR3***)				Y	Y	Y	
		76 (1076): PG error detected (***PG-ERR***)				N	Y	Y	
		82 (1082): Positioning completion signal (***PSET***)				N	N	Y	
		84 (1084): Maintenance timer (***MNT***)				Y	Y	Y	
		98 (1098): Light alarm (***L-ALM***)				Y	Y	Y	
		99 (1099): Alarm output (for any alarm) (***ALM***)				Y	Y	Y	
		105 (1105): Braking transistor broken (***DBAL***)				Y	Y	Y	
		111 (1111): Customizable logic output signal 1 (***CLO1***)				Y	Y	Y	
		112 (1112): Customizable logic output signal 2 (***CLO2***)				Y	Y	Y	
		113 (1113): Customizable logic output signal 3 (***CLO3***)				Y	Y	Y	
		114 (1114): Customizable logic output signal 4 (***CLO4***)				Y	Y	Y	
		115 (1115): Customizable logic output signal 5 (***CLO5***)				Y	Y	Y	
		Setting the value in parentheses ( ) shown above assigns a negative logic output to a terminal.							

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Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
E30	Frequency Arrival (Hysteresis width)	0.0 to 10.0 Hz	Y	Y	2.5	Y	Y	Y	5-127
E31	Frequency Detection 1 (Level)	0.0 to 500.0 Hz	Y	Y	60.0	Y	Y	Y	5-128
E32	(Hysteresis width)	0.0 to 500.0 Hz	Y	Y	1.0	Y	Y	Y	
E34	Overload Early Warning/Current Detection (Level)	0.00 (Disable); Current value of 1% to 200% of the inverter rated current	Y	Y1 Y2	*3	Y	Y	Y	
E35	(Timer)	0.01 to 600.00s	Y	Y	10.00	Y	Y	Y	
E36	Frequency Detection 2 (Level)	0.0 to 500.0 Hz	Y	Y	60.0	Y	Y	Y	5-128 5-129
E37	Current Detection 2/ Low Current Detection (Level)	0.00 (Disable); Current value of 1% to 200% of the inverter rated current	Y	Y1 Y2	*3	Y	Y	Y	
E38	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	
E40	PID Display Coefficient A	-999 to 0.00 to 9990	Y	Y	100	Y	Y	Y	5-130
E41	PID Display Coefficient B	-999 to 0.00 to 9990	Y	Y	0.00	Y	Y	Y	
E42	LED Display Filter	0.0 to 5.0 s	Y	Y	0.5	Y	Y	Y	5-131
E43	LED Monitor (Item selection)	0: Speed monitor (select by E48) 3: Output current 4: Output voltage 8: Calculated torque 9: Input power 10: PID command 12: PID feedback amount 14: PID output 15: Load factor 16: Motor output 17: Analog input 23: Torque current (%) 24: Magnetic flux command (%) 25: Input watt-hour	Y	Y	0	Y	Y	Y	5-132
E44	(Display when stopped)	0: Specified value 1: Output value	Y	Y	0	Y	Y	Y	5-133
E45	LCD Monitor (Item selection)	0: Running status, rotational direction and operation guide 1: Bar charts for output frequency, current and calculated torque	Y	Y	0	Y	Y	Y	
E46	(Language selection)	0: Japanese 1: English 2: German 3: French 4: Spanish 5: Italian	Y	Y	1 (Taiwan) 0 (Japan)	Y	Y	Y	
E47	(Contrast control)	0 (Low) to 10 (High)	Y	Y	5	Y	Y	Y	
E48	LED Monitor (Speed monitor item)	0: Output frequency 1 (Before slip compensation) 1: Output frequency 2 (After slip compensation) 2: Reference frequency 3: Motor speed in r/min 4: Load shaft speed in r/min 5: Line speed in m/min 7: Display speed in %	Y	Y	0	Y	Y	Y	5-132 5-133
E50	Coefficient for Speed Indication	0.01 to 200.00	Y	Y	30.00	Y	Y	Y	5-133
E51	Display Coefficient for Input Watt-hour Data	0.000 (Cancel/reset), 0.001 to 9999	Y	Y	0.010	Y	Y	Y	
E52	Keypad (Menu display mode)	0: Function code data editing mode (Menus #0, #1, and #7) 1: Function code data check mode (Menu #2 and #7) 2: Full-menu mode	Y	Y	0	Y	Y	Y	5-134
E54	Frequency Detection 3 (Level)	0.0 to 500.0 Hz	Y	Y	60.0	Y	Y	Y	5-128 5-135
E55	Current Detection 3 (Level)	0.00 (Disable); Current value of 1% to 200% of the inverter rated current	Y	Y1 Y2	*3	Y	Y	Y	
E56	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	
E61	Terminal [12] Extended Function	0: None 1: Auxiliary frequency command 1 2: Auxiliary frequency command 2 3: PID command 1 5: PID feedback amount 6: Ratio setting 7: Analog torque limit value A 8: Analog torque limit value B 10: Torque command 11: Torque current command 20: Analog input monitor	N	Y	0	Y	Y	Y	5-135
E62	Terminal [C1] Extended Function		N	Y	0	Y	Y	Y	
E63	Terminal [V2] Extended Function		N	Y	0	Y	Y	Y	
E64	Saving of Digital Reference Frequency	0: Automatic saving (when main power is turned OFF) 1: Saving by pressing FUNC/DATA key	Y	Y	1	Y	Y	Y	5-136
E65	Reference Loss Detection (Continuous running frequency)	0: Decelerate to stop, 20% to 120%, 999: Disable	Y	Y	999	Y	Y	Y	
E78	Torque Detection 1 (Level)	0% to 300%	Y	Y	100	Y	Y	Y	5-137
E79	(Timer)	0.01 to 600.00 s	Y	Y	10.00	Y	Y	Y	
E80	Torque Detection 2/ Low Torque Detection (Level)	0% to 300%	Y	Y	20	Y	Y	Y	
E81	(Timer)	0.01 to 600.00 s	Y	Y	20.00	Y	Y	Y	

The shaded function codes ( ) are applicable to the quick setup.

*3 The motor rated current is automatically set. See Table B (function code P03).

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Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
		Selecting function code data assigns the corresponding function to terminals [FWD] and [REV] as listed below.							5-102 5-138
E98	Terminal [FWD] Function	0 (1000): Select multi-frequency (0 to 1 steps) (***SS1***)	N	Y	98	Y	Y	Y	
E99	Terminal [REV] Function	1 (1001): Select multi-frequency (0 to 3 steps) (***SS2***)	N	Y	99	Y	Y	Y	
		2 (1002): Select multi-frequency (0 to 7 steps) (***SS4***)				Y	Y	Y	
		3 (1003): Select multi-frequency (0 to 15 steps) (***SS8***)				Y	Y	Y	
		4 (1004): Select ACC/DEC time (2 steps) (***RT1***)				Y	Y	Y	
		5 (1005): Select ACC/DEC time (4 steps) (***RT2***)				Y	Y	Y	
		6 (1006): Enable 3-wire operation (***HLD***)				Y	Y	Y	
		7 (1007): Coast to a stop (***BX***)				Y	Y	Y	
		8 (1008): Reset alarm (***RST***)				Y	Y	Y	
		9 (1009): Enable external alarm trip (***THR***) (9 = Active OFF, 1009 = Active ON)				Y	Y	Y	
		10 (1010): Ready for jogging (***JOG***)				Y	Y	Y	
		11 (1011): Select frequency command 2/1 (***Hz2/Hz1***)				Y	Y	Y	
		12 (1012): Select motor 2 (***M2***)				Y	Y	Y	
		13: Enable DC braking (***DCBRK***)				Y	Y	Y	
		14 (1014): Select torque limiter level 2/1 (***TL2/TL1***)				Y	Y	Y	
		15: Switch to commercial power (50 Hz) (***SW50***)				Y	N	N	
		16: Switch to commercial power (60 Hz) (***SW60***)				Y	N	N	
		17 (1017): UP (Increase output frequency) (***UP***)				Y	Y	Y	
		18 (1018): DOWN (Decrease output frequency) (***DOWN***)				Y	Y	Y	
		19 (1019): Enable data change with keypad (***WE-KP***)				Y	Y	Y	
		20 (1020): Cancel PID control (***Hz/PID***)				Y	Y	Y	
		21 (1021): Switch normal/inverse operation (***IVS***)				Y	Y	Y	
		22 (1022): Interlock (***IL***)				Y	Y	Y	
		23 (1023): Cancel torque control (***Hz/TRQ***)				N	N	N	
		24 (1024): Enable communications link via RS-485 or fieldbus (***LE***)				Y	Y	Y	
		25 (1025): Universal DI (***U-DI***)				Y	Y	Y	
		26 (1026): Enable auto search for idling motor speed at starting (***STM***)				Y	Y	N	
		30 (1030): Force to stop (***STOP***) (30 = Active OFF, 1030 = Active ON)				Y	Y	Y	
		32 (1032): Pre-excitation (***EXITE***)				N	Y	Y	
		33 (1033): Reset PID integral and differential components (***PID-RST***)				Y	Y	Y	
		34 (1034): Hold PID integral component (***PID-HLD***)				Y	Y	Y	
		35 (1035): Select local (keypad) operation (***LOC***)				Y	Y	Y	
		36 (1036): Select motor 3 (***M3***)				Y	Y	Y	
		37 (1037): Select motor 4 (***M4***)				Y	Y	Y	
		39: Protect motor from dew condensation (***DWP***)				Y	Y	Y	
		40: Enable integrated sequence to switch to commercial power (50 Hz) (***ISW50***)				Y	N	N	
		41: Enable integrated sequence to switch to commercial power (60 Hz) (***ISW60***)				Y	N	N	
		47 (1047): Servo-lock command (***LOCK***)				N	N	Y	
		49 (1049): Pulse train sign (***SIGN***)				Y	Y	Y	
		70 (1070): Cancel constant peripheral speed control (***Hz/LSC***)				Y	Y	Y	
		71 (1071): Hold the constant peripheral speed control frequency in the memory (***LSC-HLD***)				Y	Y	Y	
		72 (1072): Count the run time of commercial power-driven motor 1 (***CRUN-M1***)				Y	N	N	
		73 (1073): Count the run time of commercial power-driven motor 2 (***CRUN-M2***)				Y	N	N	
		74 (1074): Count the run time of commercial power-driven motor 3 (***CRUN-M3***)				Y	N	N	
		75 (1075): Count the run time of commercial power-driven motor 4 (***CRUN-M4***)				Y	N	N	
		76 (1076): Select droop control (***DROOP***)				Y	Y	Y	
		77 (1077): Cancel PG alarm (***PG-CCL***)				N	N	Y	
		80 (1080): Cancel customizable logic (***CLC***)				Y	Y	Y	
		81 (1081): Clear all customizable logic timers (***CLTC***)				Y	Y	Y	
		98: Run forward (***FWD***)				Y	Y	Y	
		99: Run reverse (***REV***)				Y	Y	Y	
		100: No function assigned (***NONE***)				Y	Y	Y	
		Setting the value in parentheses ( ) shown above assigns a negative logic input to a terminal.							

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C codes: Control Functions of Frequency

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
C01	Jump Frequency 1	0.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	5-139
C02	2		Y	Y	0.0	Y	Y	Y	
C03	3		Y	Y	0.0	Y	Y	Y	
C04	(Hysteresis width)	0.0 to 30.0 Hz	Y	Y	3.0	Y	Y	Y	
C05	Multi-frequency 1	0.00 to 500.00 Hz	Y	Y	0.00	Y	Y	Y	
C06	2		Y	Y	0.00	Y	Y	Y	
C07	3		Y	Y	0.00	Y	Y	Y	
C08	4		Y	Y	0.00	Y	Y	Y	
C09	5		Y	Y	0.00	Y	Y	Y	
C10	6		Y	Y	0.00	Y	Y	Y	
C11	7		Y	Y	0.00	Y	Y	Y	
C12	8		Y	Y	0.00	Y	Y	Y	
C13	9		Y	Y	0.00	Y	Y	Y	
C14	10		Y	Y	0.00	Y	Y	Y	
C15	11		Y	Y	0.00	Y	Y	Y	
C16	12		Y	Y	0.00	Y	Y	Y	
C17	13		Y	Y	0.00	Y	Y	Y	
C18	14		Y	Y	0.00	Y	Y	Y	
C19	15		Y	Y	0.00	Y	Y	Y	
C20	Jogging Frequency	0.00 to 500.00 Hz	Y	Y	0.00	Y	Y	Y	5-141
C30	Frequency Command 2	0: Enable ⌃ / ⌄ keys on the keypad 1: Voltage input to terminal [12] (-10 to +10 VDC) 2: Current input to terminal [C1] (4 to 20 mA DC) 3: Sum of voltage and current inputs to terminals [12] and [C1] 5: Voltage input to terminal [V2] (0 to 10 VDC) 7: Terminal command ***UP***/***DOWN*** control 8: Enable ⌃ / ⌄ keys on the keypad (balanceless-bumpless switching available) 11: Digital input interface card (option) 12: Pulse train input	N	Y	2	Y	Y	Y	5-53 5-142
C31	Analog Input Adjustment for [12] (Offset)	-5.0% to 5.0%	Y*	Y	0.0	Y	Y	Y	5-142
C32	(Gain)	0.00% to 200.00%	Y*	Y	100.00	Y	Y	Y	
C33	(Filter time constant)	0.00 to 5.00 s	Y	Y	0.05	Y	Y	Y	
C34	(Gain base point)	0.00% to 100.00%	Y*	Y	100.00	Y	Y	Y	
C35	(Polarity)	0: Bipolar 1: Unipolar	N	Y	1	Y	Y	Y	
C36	Analog Input Adjustment for [C1] (Offset)	-5.0% to 5.0%	Y*	Y	0.0	Y	Y	Y	
C37	(Gain)	0.00% to 200.00%	Y*	Y	100.00	Y	Y	Y	
C38	(Filter time constant)	0.00 to 5.00s	Y	Y	0.05	Y	Y	Y	
C39	(Gain base point)	0.00% to 100.00%	Y*	Y	100.00	Y	Y	Y	
C41	Analog Input Adjustment for [V2] (Offset)	-5.0% to 5.0%	Y*	Y	0.0	Y	Y	Y	
C42	(Gain)	0.00% to 200.00%	Y*	Y	100.00	Y	Y	Y	
C43	(Filter time constant)	0.00 to 5.00 s	Y	Y	0.05	Y	Y	Y	
C44	(Gain base point)	0.00% to 100.00%	Y*	Y	100.00	Y	Y	Y	
C45	(Polarity)	0: Bipolar 1: Unipolar	N	Y	1	Y	Y	Y	
C50	Bias (Frequency command 1) (Bias base point)	0.00% to 100.00%	Y*	Y	0.00	Y	Y	Y	5-53 5-143
C51	Bias (PID command 1) (Bias value)	-100.00% to 100.00%	Y*	Y	0.00	Y	Y	Y	5-143
C52	(Bias base point)	0.00% to 100.00%	Y*	Y	0.00	Y	Y	Y	
C53	Selection of Normal/Inverse Operation (Frequency command 1)	0: Normal operation 1: Inverse operation	Y	Y	0	Y	Y	Y	

P codes: Motor 1 Parameters

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
P01	Motor 1 (No. of poles)	2 to 22 poles	N	Y1 Y2	4	Y	Y	Y	5-144
P02	(Rated capacity)	0.01 to 1000 kW (when P99 = 0, 2, 3 or 4) 0.01 to 1000 HP (when P99 = 1)	N	Y1 Y2	*6	Y	Y	Y	
P03	(Rated current)	0.00 to 2000 A	N	Y1 Y2	*6	Y	Y	Y	
P04	(Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune while the motor is rotating under V/f control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c") 3: Tune while the motor is rotating under vector control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c." Available when the vector control is enabled.)	N	N	0	Y	Y	Y	5-145
P06	(No-load current)	0.00 to 2000 A	N	Y1 Y2	*6	Y	Y	Y	5-146
P07	(%R1)	0.00% to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	
P08	(%X)	0.00% to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	
P09	(Slip compensation gain for driving)	0.0% to 200.0%	Y*	Y	100.0	Y	Y	Y	5-147
P10	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1 Y2	0.12	Y	N	N	
P11	(Slip compensation gain for braking)	0.0% to 200.0%	Y*	Y	100.0	Y	Y	Y	
P12	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1 Y2	*6	Y	Y	Y	
P13	(Iron loss factor 1)	0.00% to 20.00%	Y	Y1 Y2	*6	Y	Y	Y	
P14	(Iron loss factor 2)	0.00% to 20.00%	Y	Y1 Y2	0.00	Y	Y	Y	
P15	(Iron loss factor 3)	0.00% to 20.00%	Y	Y1 Y2	0.00	Y	Y	Y	
P16	(Magnetic saturation factor 1)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
P17	(Magnetic saturation factor 2)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
P18	(Magnetic saturation factor 3)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
P19	(Magnetic saturation factor 4)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
P20	(Magnetic saturation factor 5)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
P21	(Magnetic saturation extension factor "a")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
P22	(Magnetic saturation extension factor "b")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
P23	(Magnetic saturation extension factor "c")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
P53	(%X correction factor 1)	0% to 300%	Y	Y1 Y2	100	Y	Y	Y	5-148
P54	(%X correction factor 2)	0% to 300%	Y	Y1 Y2	100	Y	Y	Y	
P55	(Torque current under vector control)	0.00 to 2000 A	N	Y1 Y2	*6	N	Y	Y	
P56	(Induced voltage factor under vector control)	50% to 100%	N	Y1 Y2	*6	N	Y	Y	
P57	Reserved *9	0.000 to 20.000 s	Y	Y1 Y2	*6	-	-	-	—
P99	Motor 1 Selection	0: Motor characteristics 0 (Fuji standard motors, 8-series) 1: Motor characteristics 1 (HP rating motors) 2: Motor characteristics 2 (Fuji motors exclusively designed for vector control) 3: Motor characteristics 3 (Fuji standard motors, 6-series) 4: Other motors	N	Y1 Y2	0	Y	Y	Y	5-148

H codes: High Performance Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
H03	Data Initialization	0: Disable initialization 1: Initialize all function code data to the factory defaults 2: Initialize motor 1 parameters 3: Initialize motor 2 parameters 4: Initialize motor 3 parameters 5: Initialize motor 4 parameters	N	N	0	Y	Y	Y	5-149
H04	Auto-reset (Times)	0: Disable; 1 to 10	Y	Y	0	Y	Y	Y	5-150
H05	(Reset interval)	0.5 to 20.0 s	Y	Y	5.0	Y	Y	Y	
H06	Cooling Fan ON/OFF Control	0: Disable (Always in operation) 1: Enable (ON/OFF controllable)	Y	Y	0	Y	Y	Y	5-151
H07	Acceleration/Deceleration Pattern	0: Linear 1: S-curve (Weak) 2: S-curve (Arbitrary, according to H57 to H60 data) 3: Curvilinear	Y	Y	0	Y	Y	Y	5-65 5-151
H08	Rotational Direction Limitation	0: Disable 1: Enable (Reverse rotation inhibited) 2: Enable (Forward rotation inhibited)	N	Y	0	Y	Y	Y	5-152

The shaded function codes ( ) are applicable to the quick setup.
*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table B.
*9 These function codes are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

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Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
H09	Starting Mode (Auto search)	0: Disable 1: Enable (At restart after momentary power failure) 2: Enable (At restart after momentary power failure and at normal start)	N	Y	0	Y	N	N	5-152
H11	Deceleration Mode	0: Normal deceleration 1: Coast-to-stop	Y	Y	0	Y	Y	Y	5-154
H12	Instantaneous Overcurrent Limiting (Mode selection)	0: Disable 1: Enable	Y	Y	1	Y	N	N	5-97 5-154
H13	Restart Mode after Momentary Power Failure (Restart time)	0.1 to 10.0 s	Y	Y1 Y2	*2	Y	Y	Y	5-72 5-154
H14	(Frequency fall rate)	0.00: Deceleration time selected by F08, 0.01 to 100.00 Hz/s, 999: Follow the current limit command	Y	Y	999	Y	Y	N	
H15	(Continuous running level)	200 to 300 V for 200 V class series 400 to 600 V for 400 V class series	Y	Y2	235 470	Y	N	N	
H16	(Allowable momentary power failure time)	0.0 to 30.0 s 999: Automatically determined by inverter	Y	Y	999	Y	Y	Y	
H18	Torque Limiter (Mode selection)	0: Disable (Speed control) 2: Enable (Torque current command) 3: Enable (Torque command)	N	Y	0	N	Y	Y	—
H26	Thermistor (for motor) (Mode selection)	0: Disable 1: PTC (The inverter immediately trips with displayed.) 2: PTC (The inverter issues output signal ***THM*** and continues to run.) 3: NTC (When connected)	Y	Y	0	Y	Y	Y	5-155
H27	(Level)	0.00 to 5.00 V	Y	Y	0.35	Y	Y	Y	
H28	Droop Control	-60.0 to 0.0 Hz	Y	Y	0.0	Y	Y	Y	5-156
H30	Communications Link Function (Mode selection)	Frequency command / Run command 0: F01/C30 / F02 1: RS-485 (Port 1) / F02 2: F01/C30 / RS-485 (Port 1) 3: RS-485 (Port 1) / RS-485 (Port 1) 4: RS-485 (Port 2) / F02 5: RS-485 (Port 2) / RS-485 (Port 1) 6: F01/C30 / RS-485 (Port 2) 7: RS-485 (Port 1) / RS-485 (Port 2) 8: RS-485 (Port 2) / RS-485 (Port 2)	Y	Y	0	Y	Y	Y	5-157
H42	Capacitance of DC Link Bus Capacitor	Indication for replacement of DC link bus capacitor 0000 to FFFF (hex.)	Y	N	-	Y	Y	Y	5-159
H43	Cumulative Run Time of Cooling Fan	Indication for replacement of cooling fan (in units of 10 hours)	Y	N	-	Y	Y	Y	
H44	Startup Counter for Motor 1	Indication of cumulative startup count 0000 to FFFF (hex.)	Y	N	-	Y	Y	Y	5-162
H45	Mock Alarm	0: Disable 1: Enable (Once a mock alarm occurs, the data automatically returns to 0.)	Y	N	0	Y	Y	Y	5-163
H46	Starting Mode (Auto search delay time 2)	0.1 to 10.0 s	Y	Y1 Y2	*6	Y	Y	N	5-152 5-163
H47	Initial Capacitance of DC Link Bus Capacitor	Indication for replacement of DC link bus capacitor 0000 to FFFF (hex.)	Y	N	-	Y	Y	Y	5-159 5-163
H48	Cumulative Run Time of Capacitors on Printed Circuit Boards	Indication for replacement of capacitors (The cumulative run time can be modified or reset in units of 10 hours.)	Y	N	-	Y	Y	Y	
H49	Starting Mode (Auto search delay time 1)	0.0 to 10.0 s	Y	Y	0.0	Y	Y	Y	5-152 5-163
H50	Non-linear V/f Pattern 1 (Frequency)	0.0: Cancel, 0.1 to 500.0 Hz	N	Y	*7	Y	N	N	5-62
H51	(Voltage)	0 to 240: Output an AVR-controlled voltage (for 200 V class series) 0 to 500: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	*8	Y	N	N	5-163
H52	Non-linear V/f Pattern 2 (Frequency)	0.0: Cancel, 0.1 to 500.0 Hz	N	Y	0.0	Y	N	N	
H53	(Voltage)	0 to 240: Output an AVR-controlled voltage (for 200 V class series) 0 to 500: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	0	Y	N	N	
H54	Acceleration Time (Jogging)	0.00 to 6000 s	Y	Y	*1	Y	Y	Y	5-65
H55	Deceleration Time (Jogging)	0.00 to 6000 s	Y	Y	*1	Y	Y	Y	5-163
H56	Deceleration Time for Forced Stop	0.00 to 6000 s	Y	Y	*1	Y	Y	Y	
H57	1st S-curve acceleration range (Leading edge)	0% to 100%	Y	Y	10	Y	Y	Y	
H58	2nd S-curve acceleration range (Trailing edge)	0% to 100%	Y	Y	10	Y	Y	Y	
H59	1st S-curve deceleration range (Leading edge)	0% to 100%	Y	Y	10	Y	Y	Y	
H60	2nd S-curve deceleration range (Trailing edge)	0% to 100%	Y	Y	10	Y	Y	Y	

*1 6.00 s for inverters with a capacity of 22 kW or below; 20.00 s for those with 30 kW or above

*2 The factory default differs depending upon the inverter's capacity. See Table A.

*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table B.

*7 0.0 (Cancel) for inverters with a capacity of 22 kW or below; 5.0 Hz for those with 30 kW or above.

*8 0 V for inverters with a capacity of 22 kW or below; 20 V or 40 V for 200 V or 400 V class series of inverters with 30 kW or above, respectively.

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
H61	UP/DOWN Control (Initial frequency setting)	0: 0.00 Hz 1: Last ***UP***/***DOWN*** command value on releasing the run command	N	Y	1	Y	Y	Y	5-53 5-163
H63	Low Limiter (Mode selection)	0: Limit by F16 (Frequency limiter: Low) and continue to run 1: If the output frequency lowers below the one limited by F16 (Frequency limiter: Low), decelerate to stop the motor.	Y	Y	0	Y	Y	Y	5-80 5-164
H64	(Lower limiting frequency)	0.0: Depends on F16 (Frequency limiter, Low) 0.1 to 60.0 Hz	Y	Y	1.6	Y	N	N	5-164
H65	Non-linear V/f Pattern 3 (Frequency)	0.0: Cancel, 0.1 to 500.0 Hz	N	Y	0.0	Y	N	N	5-62
H66	(Voltage)	0 to 240: Output an AVR-controlled voltage (for 200 V class series) 0 to 500: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	0	Y	N	N	5-164
H67	Auto Energy Saving Operation (Mode selection)	0: Enable during running at constant speed 1: Enable in all modes	Y	Y	0	Y	N	Y	5-89 5-164
H68	Slip Compensation 1 (Operating conditions)	0: Enable during ACC/DEC and at base frequency or above 1: Disable during ACC/DEC and enable at base frequency or above 2: Enable during ACC/DEC and disable at base frequency or above 3: Disable during ACC/DEC and at base frequency or above	N	Y	0	Y	N	N	5-95 5-164
H69	Automatic Deceleration (Mode selection)	0: Disable 2: Torque limit control with Force-to-stop if actual deceleration time exceeds three times the specified one 3: DC link bus voltage control with Force-to-stop if actual deceleration time exceeds three times the specified one 4: Torque limit control with Force-to-stop disabled 5: DC link bus voltage control with Force-to-stop disabled	Y	Y	0	Y	Y	Y	5-164
H70	Overload Prevention Control	0.00: Follow the deceleration time selected 0.01 to 100.0 Hz/s 999: Cancel	Y	Y	999	Y	Y	Y	5-165
H71	Deceleration Characteristics	0: Disable 1: Enable	Y	Y	0	Y	N	N	5-166
H72	Main Power Down Detection (Mode selection)	0: Disable 1: Enable	Y	Y	1	Y	Y	Y	
H73	Torque Limiter (Operating conditions)	0: Enable during ACC/DEC and running at constant speed 1: Disable during ACC/DEC and enable during running at constant speed 2: Enable during ACC/DEC and disable during running at constant speed	N	Y	0	Y	Y	Y	5-92 5-166
H74	(Control target)	0: Motor-generating torque limit 1: Torque current limit 2: Output power limit	N	Y	1	N	Y	Y	
H75	(Target quadrants)	0: Drive/brake 1: Same for all four quadrants 2: Upper/lower limits	N	Y	0	N	Y	Y	
H76	(Frequency increment limit for braking)	0.0 to 500.0 Hz	Y	Y	5.0	Y	N	N	5-164 5-166
H77	Service Life of DC Link Bus Capacitor (Remaining time)	0 to 8760 (in units of 10 hours)	Y	N	-	Y	Y	Y	5-166
H78	Maintenance Interval (M1)	0: Disable; 1 to 9999 (in units of 10 hours)	Y	N	8760	Y	Y	Y	5-167
H79	Preset Startup Count for Maintenance (M1)	0000: Disable; 0001 to FFFF (hex.)	Y	N	0	Y	Y	Y	5-168
H80	Output Current Fluctuation Damping Gain for Motor 1	0.00 to 0.40	Y	Y	0.20 *10	Y	N	N	
H81	Light Alarm Selection 1	0000 to FFFF (hex.)	Y	Y	0	Y	Y	Y	5-169
H82	Light Alarm Selection 2	0000 to FFFF (hex.)	Y	Y	0	Y	Y	Y	
H84	Pre-excitation (Initial level)	100% to 400%	Y	Y	100	N	Y	Y	5-171
H85	(Time)	0.00: Disable; 0.01 to 30.00 s	Y	Y	0.00	N	Y	Y	
H86	Reserved *9	0 to 2	Y	Y1Y2	0 *11	-	-	-	5-172
H87	Reserved *9	25.0 to 500.0 Hz	Y	Y	25.0	-	-	-	
H88	Reserved *9	0 to 3; 999	Y	N	0	-	-	-	
H89	Reserved *9	0, 1	Y	Y	0	-	-	-	
H90	Reserved *9	0, 1	Y	Y	0	-	-	-	
H91	PID Feedback Wire Break Detection	0.0: Disable alarm detection 0.1 to 60.0 s	Y	Y	0.0	Y	Y	Y	5-173
H92	Continuity of Running (P)	0.000 to 10.000 times; 999	Y	Y1Y2	999	Y	N	N	5-72
H93	(I)	0.010 to 10.000 s; 999	Y	Y1Y2	999	Y	N	N	5-173
H94	Cumulative Motor Run Time 1	0 to 9999 (The cumulative run time can be modified or reset in units of 10 hours.)	N	N	-	Y	Y	Y	5-167 5-173
H95	DC Braking (Braking response mode)	0: Slow 1: Quick	Y	Y	1	Y	N	N	5-81 5-173
H96	STOP Key Priority/ Start Check Function	Data STOP key priority Start check function 0: Disable Disable 1: Enable Disable 2: Disable Enable 3: Enable Enable	Y	Y	0	Y	Y	Y	5-173

*9 These function codes are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

*10 0.10 for 200 V class series of inverters with a capacity of 37 kW or above.

*11 2 for 200 V class series of inverters with a capacity of 37 kW or above.

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Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
H97	Clear Alarm Data	0: Disable 1: Enable (Setting "1" clears alarm data and then returns to "0.")	Y	N	0	Y	Y	Y	5-174
H98	Protection/Maintenance Function (Mode selection)	0 to 255: Display data in decimal format Bit 0: Lower the carrier frequency automatically (0: Disabled; 1: Enabled) Bit 1: Detect input phase loss (0: Disabled; 1: Enabled) Bit 2: Detect output phase loss (0: Disabled; 1: Enabled) Bit 3: Select life judgment threshold of DC link bus capacitor (0: Factory default level; 1: User setup level) Bit 4: Judge the life of DC link bus capacitor (0: Disabled; 1: Enabled) Bit 5: Detect DC fan lock (0: Enabled; 1: Disabled) Bit 6: Detect braking transistor error (for 22 kW or below) (0: Disabled; 1: Enabled) Bit 7: Switch IP20/IP40 enclosure (0: IP20; 1: IP40)	Y	Y	83	Y	Y	Y	

A codes: Motor 2 Parameters

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
A01	Maximum Frequency 2	25.0 to 500.0 Hz	N	Y	60.0	Y	Y	Y	—
A02	Base Frequency 2	25.0 to 500.0 Hz	N	Y	50.0	Y	Y	Y	
A03	Rated Voltage at Base Frequency 2	0: Output a voltage in proportion to input voltage 80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	200 400	Y	Y	Y	
A04	Maximum Output Voltage 2	80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	200 400	Y	N	N	
A05	Torque Boost 2	0.0% to 20.0% (percentage with respect to "A03: Rated Voltage at Base Frequency 2")	Y	Y	*2	Y	N	N	
A06	Electronic Thermal Overload Protection for Motor 2 (Select motor characteristics)	1: For a general-purpose motor with shaft-driven cooling fan 2: For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan	Y	Y	1	Y	Y	Y	
A07	(Overload detection level)	0.00: Disable 1% to 135% of the rated current (allowable continuous drive current) of the motor	Y	Y1 Y2	*3	Y	Y	Y	
A08	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	
A09	DC Braking 2 (Braking starting frequency)	0.0 to 60.0 Hz	Y	Y	0.0	Y	Y	Y	
A10	(Braking level)	0% to 100% (HD mode), 0% to 80% (MD/LD mode)	Y	Y	0	Y	Y	Y	
A11	(Braking time)	0.00: Disable; 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	
A12	Starting Frequency 2	0.0 to 60.0 Hz	Y	Y	0.5	Y	Y	Y	
A13	Load Selection/ Auto Torque Boost Auto Energy Saving Operation 2	0: Variable torque load 1: Constant torque load 2: Auto-torque boost 3: Auto-energy saving operation (Variable torque load during ACC/DEC) 4: Auto-energy saving operation (Constant torque load during ACC/DEC) 5: Auto-energy saving operation (Auto-torque boost during ACC/DEC)	N	Y	1	Y	N	Y	
A14	Drive Control Selection 2	0: V/f control with slip compensation inactive 1: Dynamic torque vector control 2: V/f control with slip compensation active 3: V/f control with speed sensor 4: Dynamic torque vector control with speed sensor 5: Vector control without speed sensor 6: Vector control with speed sensor	N	Y	0	Y	Y	Y	
A15	Motor 2 (No. of poles)	2 to 22 poles	N	Y1 Y2	4	Y	Y	Y	
A16	(Rated capacity)	0.01 to 1000 kW (when A39 = 0, 2. 3 or 4) 0.01 to 1000 HP (when A39 = 1)	N	Y1 Y2	*6	Y	Y	Y	
A17	(Rated current)	0.00 to 2000 A	N	Y1 Y2	*6	Y	Y	Y	

*2 The factory default differs depending upon the inverter's capacity. See Table A.
*3 The motor rated current is automatically set. See Table B (function code P03).
*4 5.0 min for inverters with a capacity of 22 kW or below; 10.0 min for those with 30 kW or above
*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table B.

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Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
A18	Motor 2 (Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune while the motor is rotating under V/f control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c") 3: Tune while the motor is rotating under vector control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c." Available when the vector control is enabled.)	N	N	0	Y	Y	Y	—
A20	(No-load current)	0.00 to 2000 A	N	Y1 Y2	*6	Y	Y	Y	
A21	(%R1)	0.00% to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	
A22	(%X)	0.00% to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	
A23	(Slip compensation gain for driving)	0.0% to 200.0%	Y*	Y	100.0	Y	Y	Y	
A24	(Slip compensation response time)	0.01 to 10.00s	Y	Y1 Y2	0.12	Y	N	N	
A25	(Slip compensation gain for braking)	0.0% to 200.0%	Y*	Y	100.0	Y	Y	Y	
A26	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1 Y2	*6	Y	Y	Y	
A27	(Iron loss factor 1)	0.00% to 20.00%	Y	Y1 Y2	*6	Y	Y	Y	
A28	(Iron loss factor 2)	0.00% to 20.00%	Y	Y1 Y2	0.00	Y	Y	Y	
A29	(Iron loss factor 3)	0.00% to 20.00%	Y	Y1 Y2	0.00	Y	Y	Y	
A30	(Magnetic saturation factor 1)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
A31	(Magnetic saturation factor 2)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
A32	(Magnetic saturation factor 3)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
A33	(Magnetic saturation factor 4)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
A34	(Magnetic saturation factor 5)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
A35	(Magnetic saturation extension factor "a")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
A36	(Magnetic saturation extension factor "b")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
A37	(Magnetic saturation extension factor "c")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
A39	Motor 2 Selection	0: Motor characteristics 0 (Fuji standard motors, 8-series) 1: Motor characteristics 1 (HP rating motors) 2: Motor characteristics 2 (Fuji motors exclusively designed for vector control) 3: Motor characteristics 3 (Fuji standard motors, 6-series) 4: Other motors	N	Y1 Y2	0	Y	Y	Y	
A40	Slip Compensation 2 (Operating conditions)	0: Enable during ACC/DEC and at base frequency or above 1: Disable during ACC/DEC and enable at base frequency or above 2: Enable during ACC/DEC and disable at base frequency or above 3: Disable during ACC/DEC and at base frequency or above	N	Y	0	Y	N	N	
A41	Output Current Fluctuation Damping Gain for Motor 2	0.00 to 0.40	Y	Y	0.20	Y	N	N	
A42	Motor/Parameter Switching 2 (Mode selection)	0: Motor (Switch to the 2nd motor) 1: Parameter (Switch to particular A codes)	N	Y	0	Y	Y	Y	5-177
A43	Speed Control 2 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	—
A44	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	
A45	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	
A46	I (Integral time)	0.001 to 9.999 s	Y*	Y	0.100	N	Y	Y	
A48	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	
A49	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	Y	
A50	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	Y	
A51	Cumulative Motor Run Time 2	0 to 9999 (The cumulative run time can be modified or reset in units of 10 hours.)	N	N	-	Y	Y	Y	
A52	Startup Counter for Motor 2	Indication of cumulative startup count 0000 to FFFF (hex.)	Y	N	-	Y	Y	Y	
A53	Motor 2 (%X correction factor 1)	0% to 300%	Y	Y1 Y2	100	Y	Y	Y	
A54	(%X correction factor 2)	0% to 300%	Y	Y1 Y2	100	Y	Y	Y	
A55	(Torque current under vector control)	0.00 to 2000 A	N	Y1 Y2	*6	N	Y	Y	
A56	(Induced voltage factor under vector control)	50 to 100	N	Y1 Y2	*6	N	Y	Y	
A57	Reserved *9	0.000 to 20.000 s	Y	Y1 Y2	*6	-	-	-	

*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table B.

*9 These function codes are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

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b codes: Motor 3 Parameters

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
b01	Maximum Frequency 3	25.0 to 500.0 Hz	N	Y	60.0	Y	Y	Y	—
b02	Base Frequency 3	25.0 to 500.0 Hz	N	Y	50.0	Y	Y	Y	
b03	Rated Voltage at Base Frequency 3	0: Output a voltage in proportion to input voltage 80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	200 400	Y	Y	Y	
b04	Maximum Output Voltage 3	80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	200 400	Y	N	N	
b05	Torque Boost 3	0.0% to 20.0% (percentage with respect to "b03: Rated Voltage at Base Frequency 3")	Y	Y	*2	Y	N	N	
b06	Electric Thermal Overload Protection for Motor 3 (Select motor characteristics)	1: For a general-purpose motor with shaft-driven cooling fan 2: For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan	Y	Y	1	Y	Y	Y	
b07	(Overload detection level)	0.00: Disable 1% to 135% of the rated current (allowable continuous drive current) of the motor	Y	Y1 Y2	*3	Y	Y	Y	
b08	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	
b09	DC Braking 3 (Braking starting frequency)	0.0 to 60.0 Hz	Y	Y	0.0	Y	Y	Y	
b10	(Braking level)	0% to 100% (HD mode), 0% to 80% (MD/LD mode)	Y	Y	0	Y	Y	Y	
b11	(Braking time)	0.00: Disable; 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	
b12	Starting Frequency 3	0.0 to 60.0 Hz	Y	Y	0.5	Y	Y	Y	
b13	Load Selection/ Auto Torque Boost/ Auto Energy Saving Operation 3	0: Variable torque load 1: Constant torque load 2: Auto-torque boost 3: Auto-energy saving operation (Variable torque load during ACC/DEC) 4: Auto-energy saving operation (Constant torque load during ACC/DEC) 5: Auto-energy saving operation (Auto-torque boost during ACC/DEC)	N	Y	1	Y	N	Y	
b14	Drive Control Selection 3	0: V/f control with slip compensation inactive 1: Dynamic torque vector control 2: V/f control with slip compensation active 3: V/f control with speed sensor 4: Dynamic torque vector control with speed sensor 5: Vector control without speed sensor 6: Vector control with speed sensor	N	Y	0	Y	Y	Y	
b15	Motor 3 (No. of poles)	2 to 22 poles	N	Y1 Y2	4	Y	Y	Y	
b16	(Rated capacity)	0.01 to 1000 kW (when b39 = 0, 2, 3 or 4) 0.01 to 1000 HP (when b39 = 1)	N	Y1 Y2	*6	Y	Y	Y	
b17	(Rated current)	0.00 to 2000 A	N	Y1 Y2	*6	Y	Y	Y	
b18	(Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune while the motor is rotating under V/f control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c") 3: Tune while the motor is rotating under vector control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c." Available when the vector control is enabled.)	N	N	0	Y	Y	Y	
b20	(No-load current)	0.00 to 2000 A	N	Y1 Y2	*6	Y	Y	Y	
b21	(%R1)	0.00% to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	
b22	(%X)	0.00% to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	
b23	(Slip compensation gain for driving)	0.0% to 200.0%	Y*	Y	100.0	Y	Y	Y	
b24	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1 Y2	0.12	Y	N	N	
b25	(Slip compensation gain for braking)	0.0% to 200.0%	Y*	Y	100.0	Y	Y	Y	
b26	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1 Y2	*6	Y	Y	Y	
b27	(Iron loss factor 1)	0.00% to 20.00%	Y	Y1 Y2	*6	Y	Y	Y	
b28	(Iron loss factor 2)	0.00% to 20.00%	Y	Y1 Y2	0.00	Y	Y	Y	
b29	(Iron loss factor 3)	0.00% to 20.00%	Y	Y1 Y2	0.00	Y	Y	Y	
b30	(Magnetic saturation factor 1)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
b31	(Magnetic saturation factor 2)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
b32	(Magnetic saturation factor 3)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
b33	(Magnetic saturation factor 4)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
b34	(Magnetic saturation factor 5)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	

*2 The factory default differs depending upon the inverter's capacity. See Table A.
*3 The motor rated current is automatically set. See Table B (function code P03).
*4 5.0 min for inverters with a capacity of 22 kW or below; 10.0 min for those with 30 kW or above
*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table B.

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	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
b35	Motor 3 (Magnetic saturation extension factor "a")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	—
b36	(Magnetic saturation extension factor "b")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
b37	(Magnetic saturation extension factor "c")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
b39	Motor 3 Selection	0: Motor characteristics 0 (Fuji standard motors, 8-series) 1: Motor characteristics 1 (HP rating motors) 2: Motor characteristics 2 (Fuji motors exclusively designed for vector control) 3: Motor characteristics 3 (Fuji standard motors, 6-series) 4: Other motors	N	Y1 Y2	0	Y	Y	Y	
b40	Slip Compensation 3 (Operating conditions)	0: Enable during ACC/DEC and at base frequency or above 1: Disable during ACC/DEC and enable at base frequency or above 2: Enable during ACC/DEC and disable at base frequency or above 3: Disable during ACC/DEC and at base frequency or above	N	Y	0	Y	N	N	
b41	Output Current Fluctuation Damping Gain for Motor 3	0.00 to 0.40	Y	Y	0.20	Y	N	N	
b42	Motor/Parameter Switching 3 (Mode selection)	0: Motor (Switch to the 3rd motor) 1: Parameter (Switch to particular b codes)	N	Y	0	Y	Y	Y	5-177
b43	Speed Control 3 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	—
b44	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	
b45	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	
b46	I (Integral time)	0.001 to 9.999 s	Y*	Y	0.100	N	Y	Y	
b48	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	
b49	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	Y	
b50	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	Y	
b51	Cumulative Motor Run Time 3	0 to 9999 (The cumulative run time can be modified or reset in units of 10 hours.)	N	N	-	Y	Y	Y	
b52	Startup Counter for Motor 3	Indication of cumulative startup count 0000 to FFFF (hex.)	Y	N	-	Y	Y	Y	
b53	Motor 3 (%X correction factor 1)	0% to 300%	Y	Y1 Y2	100	Y	Y	Y	
b54	(%X correction factor 2)	0% to 300%	Y	Y1 Y2	100	Y	Y	Y	
b55	(Torque current under vector control)	0.00 to 2000 A	N	Y1 Y2	*6	N	Y	Y	
b56	(Induced voltage factor under vector control)	50 to 100	N	Y1 Y2	*6	N	Y	Y	
b57	Reserved *9	0.000 to 20.000 s	Y	Y1 Y2	*6	-	-	-	

r codes: Motor 4 Parameters

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
r01	Maximum Frequency 4	25.0 to 500.0 Hz	N	Y	60.0	Y	Y	Y	—
r02	Base Frequency 4	25.0 to 500.0 Hz	N	Y	50.0	Y	Y	Y	
r03	Rated Voltage at Base Frequency 4	0: Output a voltage in proportion to input voltage 80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	200 400	Y	Y	Y	
r04	Maximum Output Voltage 4	80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	N	Y2	200 400	Y	N	N	
r05	Torque Boost 4	0.0% to 20.0% (percentage with respect to "r03: Rated Voltage at Base Frequency 4")	Y	Y	*2	Y	N	N	
r06	Electronic Thermal Overload Protection for Motor 4 (Select motor characteristics)	1: For a general-purpose motor with shaft-driven cooling fan 2: For an inverter-driven motor, non-ventilate*d motor, or motor with separately powered cooling fan	Y	Y	1	Y	Y	Y	
r07	(Overload detection level)	0.00: Disable 1% to 135% of the rated current (allowable continuous drive current) of the motor	Y	Y1 Y2	*3	Y	Y	Y	
r08	(Thermal time constant)	0.5 to 75.0 min	Y	Y	*4	Y	Y	Y	

*2 The factory default differs depending upon the inverter's capacity. See Table A.
*3 The motor rated current is automatically set. See Table B (function code P03).
*4 5.0 min for inverters with a capacity of 22 kW or below; 10.0 min for those with 30 kW or above
*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table B.
*9 These function codes are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

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Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
r09	DC Braking 4 (Braking starting frequency)	0.0 to 60.0 Hz	Y	Y	0.0	Y	Y	Y	—
r10	(Braking level)	0% to 100% (HD mode), 0% to 80% (MD/LD mode)	Y	Y	0	Y	Y	Y	
r11	(Braking time)	0.00: Disable; 0.01 to 30.00 s	Y	Y	0.00	Y	Y	Y	
r12	Starting Frequency 4	0.0 to 60.0 Hz	Y	Y	0.5	Y	Y	Y	
r13	Load Selection/ Auto Torque Boost/ Auto Energy Saving Operation 4	0: Variable torque load 1: Constant torque load 2: Auto-torque boost 3: Auto-energy saving operation (Variable torque load during ACC/DEC) 4: Auto-energy saving operation (Constant torque load during ACC/DEC) 5: Auto-energy saving operation (Auto-torque boost during ACC/DEC)	N	Y	1	Y	N	Y	
r14	Drive Control Selection 4	0: V/f control with slip compensation inactive 1: Dynamic torque vector control 2: V/f control with slip compensation active 3: V/f control with speed sensor 4: Dynamic torque vector control with speed sensor 5: Vector control without speed sensor 6: Vector control with speed sensor	N	Y	0	Y	Y	Y	
r15	Motor 4 (No. of poles)	2 to 22 poles	N	Y1 Y2	4	Y	Y	Y	
r16	(Rated capacity)	0.01 to 1000 kW (when r39 = 0, 2, 3 or 4) 0.01 to 1000 HP (when r39 = 1)	N	Y1 Y2	*6	Y	Y	Y	
r17	(Rated current)	0.00 to 2000 A	N	Y1 Y2	*6	Y	Y	Y	
r18	(Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune while the motor is rotating under V/f control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c") 3: Tune while the motor is rotating under vector control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c." Available when the vector control is enabled.)	N	N	0	Y	Y	Y	
r20	(No-load current)	0.00 to 2000 A	N	Y1 Y2	*6	Y	Y	Y	
r21	(%R1)	0.00% to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	
r22	(%X)	0.00% to 50.00%	Y	Y1 Y2	*6	Y	Y	Y	
r23	(Slip compensation gain for driving)	0.0% to 200.0%	Y*	Y	100.0	Y	Y	Y	
r24	(Slip compensation response time)	0.01 to 10.00 s	Y	Y1 Y2	0.12	Y	N	N	
r25	(Slip compensation gain for braking)	0.0% to 200.0%	Y*	Y	100.0	Y	Y	Y	
r26	(Rated slip frequency)	0.00 to 15.00 Hz	N	Y1 Y2	*6	Y	Y	Y	
r27	(Iron loss factor 1)	0.00% to 20.00%	Y	Y1 Y2	*6	Y	Y	Y	
r28	(Iron loss factor 2)	0.00% to 20.00%	Y	Y1 Y2	0.00	Y	Y	Y	
r29	(Iron loss factor 3)	0.00% to 20.00%	Y	Y1 Y2	0.00	Y	Y	Y	
r30	(Magnetic saturation factor 1)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
r31	(Magnetic saturation factor 2)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
r32	(Magnetic saturation factor 3)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
r33	(Magnetic saturation factor 4)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
r34	(Magnetic saturation factor 5)	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
r35	(Magnetic saturation extension factor "a")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
r36	(Magnetic saturation extension factor "b")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
r37	(Magnetic saturation extension factor "c")	0.0% to 300.0%	Y	Y1 Y2	*6	Y	Y	Y	
r39	Motor 4 Selection	0: Motor characteristics 0 (Fuji standard motors, 8-series) 1: Motor characteristics 1 (HP rating motors) 2: Motor characteristics 2 (Fuji motors exclusively designed for vector control) 3: Motor characteristics 3 (Fuji standard motors, 6-series) 4: Other motors	N	Y1 Y2	0	Y	Y	Y	
r40	Slip Compensation 4 (Operating conditions)	0: Enable during ACC/DEC and at base frequency or above 1: Disable during ACC/DEC and enable at base frequency or above 2: Enable during ACC/DEC and disable at base frequency or above 3: Disable during ACC/DEC and at base frequency or above	N	Y	0	Y	N	N	
r41	Output Current Fluctuation Damping Gain for Motor 4	0.00 to 0.40	Y	Y	0.20	Y	N	N	
r42	Motor/Parameter Switching 4 (Mode selection)	0: Motor (Switch to the 4th motor) 1: Parameter (Switch to particular r codes)	N	Y	0	Y	Y	Y	5-177

*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table B.

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Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
r43	Speed Control 4 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	—
r44	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	
r45	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	
r46	I (Integral time)	0.001 to 9.999 s	Y*	Y	0.100	N	Y	Y	
r48	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	
r49	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	Y	
r50	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	Y	
r51	Cumulative Motor Run Time 4	0 to 9999 (The cumulative run time can be modified or reset in units of 10 hours.)	N	N	-	Y	Y	Y	
r52	Startup Counter for Motor 4	Indication of cumulative startup count 0000 to FFFF (hex.)	Y	N	-	Y	Y	Y	
r53	Motor 4 (%X correction factor 1)	0% to 300%	Y	Y1 Y2	100	Y	Y	Y	
r54	(%X correction factor 2)	0% to 300%	Y	Y1 Y2	100	Y	Y	Y	
r55	(Torque current under vector control)	0.00 to 2000 A	N	Y1 Y2	*6	N	Y	Y	
r56	(Induced voltage factor under vector control)	50 to 100	N	Y1 Y2	*6	N	Y	Y	
r57	Reserved *9	0.000 to 20.000 s	Y	Y1 Y2	*6	-	-	-	

J codes: Application Functions 1

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
J01	PID Control (Mode selection)	0: Disable 1: Enable (Process control, normal operation) 2: Enable (Process control, inverse operation) 3: Enable (Dancer control)	N	Y	0	Y	Y	Y	5-180
J02	(Remote command SV)	0: ⌃ / ⌄ keys on keypad 1: PID command 1 (Analog input terminals [12], [C1], and [V2]) 3: UP/DOWN 4: Command via communications link	N	Y	0	Y	Y	Y	5-181
J03	P (Gain)	0.000 to 30.000 times	Y	Y	0.100	Y	Y	Y	5-185
J04	I (Integral time)	0.0 to 3600.0 s	Y	Y	0.0	Y	Y	Y	
J05	D (Differential time)	0.00 to 600.00 s	Y	Y	0.00	Y	Y	Y	
J06	(Feedback filter)	0.0 to 900.0 s	Y	Y	0.5	Y	Y	Y	
J08	(Pressurization starting frequency)	0.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	5-189
J09	(Pressurizing time)	0 to 60 s	Y	Y	0	Y	Y	Y	
J10	(Anti reset windup)	0% to 200%	Y	Y	200	Y	Y	Y	5-191
J11	(Select alarm output)	0: Absolute-value alarm 1: Absolute-value alarm (with Hold) 2: Absolute-value alarm (with Latch) 3: Absolute-value alarm (with Hold and Latch) 4: Deviation alarm 5: Deviation alarm (with Hold) 6: Deviation alarm (with Latch) 7: Deviation alarm (with Hold and Latch)	Y	Y	0	Y	Y	Y	
J12	(Upper level alarm (AH))	-100% to 100%	Y	Y	100	Y	Y	Y	
J13	(Lower level alarm (AL))	-100% to 100%	Y	Y	0	Y	Y	Y	
J15	(Stop frequency for slow flowrate)	0.0: Disable; 1.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	5-189
J16	(Slow flowrate level stop latency)	0 to 60 s	Y	Y	30	Y	Y	Y	5-190
J17	(Starting frequency)	0.0 to 500.0 Hz	Y	Y	0.0	Y	Y	Y	
J18	(Upper limit of PID process output)	-150% to 150%; 999: Depends on setting of F15	Y	Y	999	Y	Y	Y	5-193
J19	(Lower limit of PID process output)	-150% to 150%; 999: Depends on setting of F16	Y	Y	999	Y	Y	Y	
J21	Dew Condensation Prevention (Duty)	1% to 50%	Y	Y	1	Y	Y	Y	
J22	Commercial Power Switching Sequence	0: Keep inverter operation (Stop due to alarm) 1: Automatically switch to commercial-power operation	N	Y	0	Y	N	N	5-102 5-193
J56	PID Control (Speed command filter)	0.00 to 5.00 s	Y	Y	0.10	Y	Y	Y	5-194
J57	(Dancer reference position)	-100% to 0% to 100%	Y	Y	0	Y	Y	Y	
J58	(Detection width of dancer position deviation)	0: Disable switching PID constant 1% to 100% (Manually set value)	Y	Y	0	Y	Y	Y	
J59	P (Gain) 2	0.000 to 30.000 times	Y	Y	0.100	Y	Y	Y	
J60	I (Integral time) 2	0.0 to 3600.0 s	Y	Y	0.0	Y	Y	Y	
J61	D (Differential time) 3	0.00 to 600.00 s	Y	Y	0.00	Y	Y	Y	
J62	(PID control block selection)	0 to 3 bit 0: PID output polarity 0: Plus (add), 1: Minus (subtract) bit 1: Select compensation factor for PID output 0 = Ratio (relative to the main setting) 1 = Speed command (relative to maximum frequency)	N	Y	0	Y	Y	Y	

*6 The motor parameters are automatically set, depending upon the inverter's capacity. See Table B.
*9 These function codes are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

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Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
J68	Brake Signal (Brake-OFF current)	0% to 300%	Y	Y	100	Y	Y	Y	5-195
J69	(Brake-OFF frequency/speed)	0.0 to 25.0 Hz	Y	Y	1.0	Y	N	N	
J70	(Brake-OFF timer)	0.0 to 5.0 s	Y	Y	1.0	Y	Y	Y	
J71	(Brake-ON frequency/speed)	0.0 to 25.0 Hz	Y	Y	1.0	Y	N	N	
J72	(Brake-ON timer)	0.0 to 5.0 s	Y	Y	1.0	Y	Y	Y	
J95	(Brake-OFF torque)	0% to 300%	Y	Y	100	N	Y	Y	
J96	(Speed selection)	0: Detected speed 1: Reference speed	Y	Y	0	N	Y	Y	
J97	Servo-lock (Gain)	0.00 to 10.00 times	Y*	Y	0.10	N	N	Y	5-197
J98	(Completion timer)	0.000 to 1.000 s	Y	Y	0.100	N	N	Y	
J99	(Completion range)	0 to 9999 pulses	Y	Y	10	N	N	Y	

d codes: Application Functions 2

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
d01	Speed Control 1 (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	5-199
d02	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	
d03	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	
d04	I (Integral time)	0.001 to 9.999 s	Y*	Y	0.100	N	Y	Y	
d06	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	
d07	(Notch filter resonance frequency)	1 to 200 Hz	Y	Y	200	N	N	Y	5-200
d08	(Notch filter attenuation level)	0 to 20 dB	Y	Y	0	N	N	Y	
d09	Speed Control (Jogging) (Speed command filter)	0.000 to 5.000 s	Y	Y	0.020	N	Y	Y	5-199 5-200
d10	(Speed detection filter)	0.000 to 0.100 s	Y*	Y	0.005	N	Y	Y	
d11	P (Gain)	0.1 to 200.0 times	Y*	Y	10.0	N	Y	Y	
d12	I (Integral time)	0.001 to 9.999 s	Y*	Y	0.100	N	Y	Y	
d13	(Output filter)	0.000 to 0.100 s	Y	Y	0.002	N	Y	Y	
d14	Feedback Input (Pulse input format)	0: Pulse train sign/Pulse train input 1: Forward rotation pulse/Reverse rotation pulse 2: A/B phase with 90 degree phase shift	N	Y	2	N	N	Y	5-201
d15	(Encoder pulse resolution)	0014 to EA60 (hex.) (20 to 60000 pulses)	N	Y	0400 (1024)	N	N	Y	
d16	(Pulse count factor 1)	1 to 9999	N	Y	1	N	N	Y	
d17	(Pulse count factor 2)	1 to 9999	N	Y	1	N	N	Y	
d21	Speed Agreement/PG Error (Hysteresis width)	0.0% to 50.0%	Y	Y	10.0	N	Y	Y	5-203
d22	(Detection timer)	0.00 to 10.00 s	Y	Y	0.50	N	Y	Y	
d23	PG Error Processing	0: Continue to run 1: Stop running with alarm 1 2: Stop running with alarm 2	N	Y	2	N	Y	Y	
d24	Zero Speed Control	0: Not permit at startup 1: Permit at startup	N	Y	0	N	Y	Y	5-83 5-204
d25	ASR Switching Time	0.000 to 1.000 s	Y	Y	0.000	N	Y	Y	5-177 5-204
d32	Torque Control (Speed limit 1)	0 to 110 %	Y	Y	100	N	Y	Y	5-204
d33	(Speed limit 2)	0 to 110 %	Y	Y	100	N	Y	Y	
d41	Application-defined Control	0: Disable (Ordinary control) 1: Enable（Constant peripheral speed control）	N	Y	0	N	N	N	—
d51	Reserved *9	0 to 500	N	Y	*12	-	-	-	5-204
d52	Reserved *9	0 to 500	N	Y	*12	-	-	-	
d53	Reserved *9	0 to 500	N	Y	*12	-	-	-	
d54	Reserved *9	0 to 500	N	Y	*12	-	-	-	
d55	Reserved *9	0, 1	N	Y	0	-	-	-	
d59	Command (Pulse Rate Input) (Pulse input format)	0: Pulse train sign/Pulse train input 1: Forward rotation pulse/Reverse rotation pulse 2: A/B phase with 90 degree phase shift	N	Y	0	Y	Y	Y	5-53 5-204
d61	(Filter time constant)	0.000 to 5.000 s	Y	Y	0.005	Y	Y	Y	
d62	(Pulse count factor 1)	1 to 9999	N	Y	1	Y	Y	Y	
d63	(Pulse count factor 2)	1 to 9999	N	Y	1	Y	Y	Y	
d67	Starting Mode (Auto search)	0: Disable 1: Enable (At restart after momentary power failure) 2: Enable (At restart after momentary power failure and at normal start)	N	Y	2	N	Y	N	5-152
d68	Reserved *9	0.0 to 10.0 Hz	N	Y	40	-	-	-	5-204
d69	Reserved *9	30.0 to 100.0 Hz	Y	Y	30.0	-	-	-	
d70	Speed Control Limiter	0.00 to 100.00%	Y	Y	100.00	N	N	N	
d99	Reserved *9	0 to 3	Y	Y	0	-	-	-	

*9 These function codes are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

*12 The factory default differs depending upon the inverter's capacity.
5 for inverters with a capacity of 3.7 kW or below; 10 for those with 5.5 kW to 22 kW; 20 for those with 30 kW or above

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y codes: LINK Functions

Code	Name	Data setting range	Change when running	Data copying	Default setting	Drive control			Refer to page:
						V/f	w/o PG	w/ PG	
y01	RS-485 Communication 1 (Station address)	1 to 255	N	Y	1	Y	Y	Y	5-205
y02	(Communications error processing)	0: Immediately trip with alarm Er8 1: Trip with alarm Er8 after running for the period specified by timer y03 2: Retry during the period specified by timer y03. If the retry fails, trip with alarm Er8. If it succeeds, continue to run. 3: Continue to run	Y	Y	0	Y	Y	Y	
y03	(Timer)	0.0 to 60.0 s	Y	Y	2.0	Y	Y	Y	
y04	(Baud rate)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	Y	Y	3	Y	Y	Y	
y05	(Data length)	0: 8 bits 1: 7 bits	Y	Y	0	Y	Y	Y	
y06	(Parity check)	0: None (2 stop bits) 1: Even parity (1 stop bit) 2: Odd parity (1 stop bit) 3: None (1 stop bit)	Y	Y	0	Y	Y	Y	
y07	(Stop bits)	0: 2 bits 1: 1 bit	Y	Y	0	Y	Y	Y	
y08	RS-485 Communication 1 (No-response error detection time)	0: No detection; 1 to 60 s	Y	Y	0	Y	Y	Y	
y09	(Response interval)	0.00 to 1.00 s	Y	Y	0.01	Y	Y	Y	
y10	(Protocol selection)	0: Modbus RTU protocol 1: FRENIC Loader protocol (SX protocol) 2: Fuji general-purpose inverter protocol	Y	Y	1	Y	Y	Y	
y11	RS-485 Communication 2 (Station address)	1 to 255	N	Y	1	Y	Y	Y	
y12	(Communications error processing)	0: Immediately trip with alarm Er8 1: Trip with alarm Er8 after running for the period specified by timer y13 2: Retry during the period specified by timer y13. If the retry fails, trip with alarm Er8. If it succeeds, continue to run. 3: Continue to run	Y	Y	0	Y	Y	Y	
y13	(Timer)	0.0 to 60.0 s	Y	Y	2.0	Y	Y	Y	
y14	(Baud rate)	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	Y	Y	3	Y	Y	Y	
y15	(Data length)	0: 8 bits 1: 7 bits	Y	Y	0	Y	Y	Y	
y16	(Parity check)	0: None (2 stop bits) 1: Even parity (1 stop bit) 2: Odd parity (1 stop bit) 3: None (1 stop bit)	Y	Y	0	Y	Y	Y	
y17	(Stop bits)	0: 2 bits 1: 1 bit	Y	Y	0	Y	Y	Y	
y18	(No-response error detection time)	0: No detection; 1 to 60 s	Y	Y	0	Y	Y	Y	
y19	(Response interval)	0.00 to 1.00 s	Y	Y	0.01	Y	Y	Y	
y20	(Protocol selection)	0: Modbus RTU protocol 2: Fuji general-purpose inverter protocol	Y	Y	0	Y	Y	Y	
y97	Communication Data Storage Selection	0: Save into nonvolatile storage (Rewritable times limited) 1: Write into temporary storage (Rewritable times unlimited) 2: Save all data from temporary storage to nonvolatile one (After saving data, the y97 data automatically returns to "1.")	Y	Y	0	Y	Y	Y	5-208
y98	Bus Link Function (Mode selection)	Frequency command / Run command 0: Follow H30 data / Follow H30 data 1: Via fieldbus option / Follow H30 data 2: Follow H30 data / Via fieldbus option 3: Via fieldbus option / Via fieldbus option	Y	Y	0	Y	Y	Y	5-157 5-208
y99	Loader Link Function (Mode selection)	Frequency command / Run command 0: Follow H30 and y98 data / Follow H30 and y98 data 1: Via RS-485 link (FRENIC Loader) / Follow H30 and y98 data 2: Follow H30 and y98 data / Via RS-485 link (FRENIC Loader) 3: Via RS-485 link (FRENIC Loader) / Via RS-485 link (FRENIC Loader)	Y	N	0	Y	Y	Y	5-209

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Table A Factory Defaults Depending upon Inverter Capacity

Inverter capacity (kW)	Torque boost 1 to 4 F09/A05/b05/r05	Auto-restart after momentary power failure (Restart time) H13	Inverter capacity (kW)	Torque boost 1 to 4 F09/A05/b05/r05	Auto-restart after momentary power failure (Restart time) H13
0.4	7.1	0.5	30	0.0	1.0
0.75	6.8		37		
1.5			45		1.5
2.2			55		
3.7	5.5		75		
5.5	4.9		90		
7.5	4.4		110	0.0	
11	3.5	1.0	132		2.0
15	2.8		160		
18.5	2.2		200		2.5
22			220		

Table B (1) Fuji Standard Motor, 8-series or Other Motor is Selected with Motor Selection (P99/A39/b39/r39 = 0 or 4)

■ 200 V class series

Motor capacity (kW)	Nominal applied motor (kW)	Rated current (A)	No-load current (A)	%R1 (%)	%X (%)	Slip compen-sation gain for driving	Slip compen-sation response time	Slip compen-sation gain for braking	Rated slip frequency	Iron loss factor 1	Iron loss factor 2	Iron loss factor 3	Magnetic saturation factor 1	Magnetic saturation factor 2	Magnetic saturation factor 3	Magnetic saturation factor 4	Magnetic saturation factor 5	Magnetic saturation extension factor "a"	Magnetic saturation extension factor "b"	Magnetic saturation extension factor "c"	%X correction factor 1	%X correction factor 2	Torque current under vector control	Induced voltage factor under vector control	For particular manufac-turers	Starting mode (Auto search delay time 2) H46 *
P02/A16 b16/r16		P03/A17 b17/r17	P06/A20 b20/r20	P07/A21 b21/r21	P08/A22 b22/r22	P09/A23 b23/r23	P10/A24 b24/r24	P11/A25 b25/r25	P12/A26 b26/r26	P13/A27 b27/r27	P14/A28 b28/r28	P15/A29 b29/r29	P16/A30 b30/r30	P17/A31 b31/r31	P18/A32 b32/r32	P19/A33 b33/r33	P20/A34 b34/r34	P21/A35 b35/r35	P22/A36 b36/r36	P23/A37 b37/r37	P53/A53 b53/r53	P54/A54 b54/r54	P55/A55 b55/r55	P56/A56 b56/r56	P57/A57 b57/r57	
0.01 to 0.09	0.06	0.44	0.40	13.79	11.75	100.0	0.12	100.0	1.77	14.00	0.00	0.00	93.8	87.5	75.0	62.5	50.0	106.3	112.5	118.8	100.0	100.0	0.20	85	0.027	0.5
0.10 to 0.19	0.1	0.68	0.55	12.96	12.67				1.77	14.00			93.3	86.1	74.4	63.6	50.7	108.8	118.7	129.6			0.34		0.024	
0.20 to 0.39	0.2	1.30	1.06	12.95	12.92				2.33	12.60			89.7	81.9	66.9	54.5	43.3	111.0	129.3	148.4			0.68		0.023	
0.40 to 0.74	0.4	2.30	1.66	10.20	13.66				2.40	9.88			88.7	81.3	67.0	55.2	43.8	112.1	126.5	144.3			1.36		0.027	
0.75 to 1.49	0.75	3.60	2.30	8.67	10.76				2.33	7.40			88.3	77.7	62.6	51.8	41.1	112.4	129.2	148.4			2.55		0.033	
1.50 to 2.19	1.5	6.10	3.01	6.55	11.21				2.00	5.85			92.1	82.8	71.1	58.1	46.2	111.4	126.1	143.9			5.09		0.061	
2.20 to 3.69	2.2	9.20	4.85	6.48	10.97				1.80	5.91			85.1	74.6	61.7	50.3	39.8	115.7	133.5	150.6			7.47		0.051	0.6
3.70 to 5.49	3.7	15.00	7.67	5.79	11.25				1.93	5.24			86.0	76.9	61.3	49.5	39.1	115.6	133.2	154.1			12.57		0.063	0.8
5.50 to 7.49	5.5	22.50	11.00	5.28	14.31				1.40	4.75			88.6	79.2	64.9	52.7	41.8	114.3	133.1	155.6			18.68		0.082	1.0
7.50 to 10.99	7.5	29.00	12.50	4.50	14.68				1.57	4.03			87.7	80.0	67.1	56.1	45.6	111.7	128.4	149.2			25.47		0.095	1.2
11.00 to 14.99	11	42.00	17.70	3.78	15.09				1.07	3.92			91.3	83.3	69.9	58.0	47.0	114.1	130.2	147.9			37.36		0.133	1.3
15.00 to 18.49	15	55.00	20.00	3.25	16.37				1.13	3.32			90.5	83.5	72.1	60.7	49.5	109.0	121.3	137.8			50.94		0.151	2.0
18.50 to 21.99	18.5	67.00	21.40	2.92	16.58				0.87	3.34			90.7	83.0	70.7	59.9	48.7	112.1	127.9	147.5			62.83		0.22	
22.00 to 29.99	22	78.00	25.10	2.70	16.00				0.90	3.28			89.7	81.3	68.9	59.1	48.4	114.1	130.2	151.8			74.72		0.228	
30.00 to 36.99	30	107.0	38.90	2.64	14.96				0.80	3.10			90.2	81.6	68.7	57.2	45.8	114.8	132.3	153.9			101.9		0.202	2.3
37.00 to 44.99	37	130.0	41.50	2.76	16.41				0.80	2.30			88.7	78.9	65.4	54.2	43.4	112.2	126.4	143.6			125.7		0.25	2.5
45.00 to 54.99	45	156.0	47.50	2.53	16.16				0.80	2.18			89.0	79.7	66.8	55.4	44.4	112.3	126.0	141.8			152.8		0.272	
55.00 to 74.99	55	190.0	58.60	2.35	16.20				0.94	2.45			89.2	79.3	64.7	53.6	43.1	117.2	136.2	157.8			186.8		0.267	2.6
75.00 to 89.99	75	260.0	83.20	1.98	16.89				0.80	2.33			88.1	78.0	64.3	54.2	42.9	114.9	129.8	144.6			254.7		0.292	2.8
90.00 to 109.9	90	310.0	99.20	1.73	16.03				0.80	2.31			88.8	79.0	65.0	54.0	44.0	115.0	130.0	145.0			305.7		0.31	3.2
110.0 or above	110	376.0	91.20	1.99	20.86				0.66	1.73			90.5	82.6	70.7	58.7	47.8	112.2	126.1	142.4			373.6		0.378	3.5

* H46 is available for motor 1 only.

Motor capacity (kW) P02/A16 b16/r16	Nominal applied motor (kW)	Rated current (A) P03/A17 b17/r17	No-load current (A) P06/A20 b20/r20	%R1 (%) P07/A21 b21/r21	%X (%) P08/A22 b22/r22	Slip compen-sation gain for driving P09/A23 b23/r23	Slip compen-sation response time P10/A24 b24/r24	Slip compen-sation gain for braking P11/A25 b25/r25	Rated slip frequency P12/A26 b26/r26	Iron loss factor 1 P13/A27 b27/r27	Iron loss factor 2 P14/A28 b28/r28	Iron loss factor 3 P15/A29 b29/r29	Magnetic saturation factor 1 P16/A30 b30/r30	Magnetic saturation factor 2 P17/A31 b31/r31	Magnetic saturation factor 3 P18/A32 b32/r32	Magnetic saturation factor 4 P19/A33 b33/r33	Magnetic saturation factor 5 P20/A34 b34/r34	Magnetic saturation extension factor "a" P21/A35 b35/r35	Magnetic saturation extension factor "b" P22/A36 b36/r36	Magnetic saturation extension factor "c" P23/A37 b37/r37	%X correction factor 1 P53/A53 b53/r53	%X correction factor 2 P54/A54 b54/r54	Torque current under vector control P55/A55 b55/r55	Induced voltage factor under vector control P56/A56 b56/r56	For particular manufac-turers P57/A57 b57/r57	Starting mode (Auto search delay time 2) H46 *
0.01 to 0.09	0.06	0.22	0.20	13.79	11.75				1.77	14.00			93.8	87.5	75.0	62.5	50.0	106.3	112.5	118.8			0.10		0.027	
0.10 to 0.19	0.1	0.35	0.27	12.96	12.67				1.77	14.00			93.3	86.1	74.4	63.6	50.7	108.8	118.7	129.6			0.17		0.024	
0.20 to 0.39	0.2	0.65	0.53	12.95	12.92				2.33	12.60			89.7	81.9	66.9	54.5	43.3	111.0	129.3	148.4			0.34		0.023	0.5
0.40 to 0.74	0.4	1.15	0.83	10.20	13.66				2.40	9.88			88.7	81.3	67.0	55.2	43.8	112.1	126.5	144.3			0.68		0.027	
0.75 to 1.49	0.75	1.80	1.15	8.67	10.76				2.33	7.40			88.3	77.7	62.6	51.8	41.1	112.4	129.2	148.4			1.27		0.033	
1.50 to 2.19	1.5	3.10	1.51	6.55	11.21				2.00	5.85			92.1	82.8	71.1	58.1	46.2	111.4	126.1	143.9			2.55		0.061	
2.20 to 3.69	2.2	4.60	2.43	6.48	10.97				1.80	5.91			85.1	74.6	61.7	50.3	39.8	115.7	133.5	150.6			3.74		0.051	0.6
3.70 to 5.49	3.7	7.50	3.84	5.79	11.25				1.93	5.24			86.0	76.9	61.3	49.5	39.1	115.6	133.2	154.1			6.28		0.063	0.8
5.50 to 7.49	5.5	11.50	5.50	5.28	14.31				1.40	4.75			88.6	79.2	64.9	52.7	41.8	114.3	133.1	155.6			9.34		0.082	1.0
7.50 to 10.99	7.5	14.50	6.25	4.50	14.68				1.57	4.03			87.7	80.0	67.1	56.1	45.6	111.7	128.4	149.2			12.74		0.095	1.2
11.00 to 14.99	11	21.00	8.85	3.78	15.09				1.07	3.92			91.3	83.3	69.9	58.0	47.0	114.1	130.2	147.9			18.68	85	0.133	1.3
15.00 to 18.49	15	27.50	10.00	3.25	16.37				1.13	3.32			90.5	83.5	72.1	60.7	49.5	109.0	121.3	137.8			25.47		0.151	
18.50 to 21.99	18.5	34.00	10.70	2.92	16.58				0.87	3.34			90.7	83.0	70.7	59.9	48.7	112.1	127.9	147.5			31.41		0.22	2.0
22.00 to 29.99	22	39.00	12.60	2.70	16.00	100.0	0.12	100.0	0.90	3.28	0.00	0.00	89.7	81.3	68.9	59.1	48.4	114.1	130.2	151.8	100.0	100.0	37.36		0.228	
30.00 to 36.99	30	54.00	19.50	2.64	14.96				0.80	3.10			90.2	81.6	68.7	57.2	45.8	114.8	132.3	153.9			50.94		0.202	2.3
37.00 to 44.99	37	65.00	20.80	2.76	16.41				0.80	2.30			88.7	78.9	65.4	54.2	43.4	112.2	126.4	143.6			62.83		0.25	2.5
45.00 to 54.99	45	78.00	23.80	2.53	16.16				0.80	2.18			89.0	79.7	66.8	55.4	44.4	112.3	126.0	141.8			76.41		0.272	
55.00 to 74.99	55	95.00	29.30	2.35	16.20				0.94	2.45			89.2	79.3	64.7	53.6	43.1	117.2	136.2	157.8			93.39		0.267	2.6
75.00 to 89.99	75	130.0	41.60	1.98	16.89				0.80	2.33			88.1	78.0	64.3	54.2	42.9	114.9	129.8	144.6			127.4		0.292	2.8
90.00 to 109.9	90	155.0	49.60	1.73	16.03				0.80	2.31			88.8	79.0	65.0	54.0	44.0	115.0	130.0	145.0			152.8		0.31	3.2
110.0 to 131.9	110	188.0	45.60	1.99	20.86				0.66	1.73			90.5	82.6	70.7	58.7	47.8	112.2	126.1	142.4			186.8		0.378	3.5
132.0 to 159.9	132	224.0	57.60	1.75	18.90				0.66	1.80			90.3	81.9	69.8	57.8	46.6	112.9	127.6	144.8			211.7		0.394	4.1
160.0 to 199.9	160	272.0	64.50	1.68	19.73				0.66	1.50			92.2	84.8	71.1	58.6	46.9	114.6	130.5	148.0			256.6		0.482	4.5
200.0 to 219.9	200	335.0	71.50	1.57	20.02				0.66	1.36			91.9	85.5	72.3	60.0	47.6	109.8	122.7	136.4			320.8	90	0.534	4.7
220.0 to 249.9	220	365.0	71.80	1.60	20.90				0.58	1.25			93.1	86.1	72.9	60.8	48.6	108.7	118.8	130.9			352.8		0.561	
250.0 to 279.9	250	415.0	87.90	1.39	18.88				0.54	1.33			92.2	84.9	72.7	60.5	48.9	109.9	122.2	137.8			400.9		0.571	5.0
280.0 or avobe	280	462.0	93.70	1.36	19.18				0.54	1.27			92.7	85.6	72.9	60.9	48.9	109.3	120.2	133.5			449.1		0.589	5.5

* H46 is available for motor 1 only.

Table B (2) Fuji Standard Motor, 6-series is Selected with Motor Selection (P99/A39/b39/r39 = 3)

■ 200 V class series

Motor capacity (kW)	Nominal applied motor (kW)	Rated current (A)	No-load current (A)	%R1 (%)	%X (%)	Slip compen-sation gain for driving	Slip compen-sation response time	Slip compen-sation gain for braking	Rated slip frequency	Iron loss factor 1	Iron loss factor 2	Iron loss factor 3	Magnetic saturation factor 1	Magnetic saturation factor 2	Magnetic saturation factor 3	Magnetic saturation factor 4	Magnetic saturation factor 5	Magnetic saturation extension factor "a"	Magnetic saturation extension factor "b"	Magnetic saturation extension factor "c"	%X correction factor 1	%X correction factor 2	Torque current under vector control	Induced voltage factor under vector control	For particular manufac-turers	Starting mode (Auto search delay time 2)
P02/A16 b16/r16		P03/A17 b17/r17	P06/A20 b20/r20	P07/A21 b21/r21	P08/A22 b22/r22	P09/A23 b23/r23	P10/A24 b24/r24	P11/A25 b25/r25	P12/A26 b26/r26	P13/A27 b27/r27	P14/A28 b28/r28	P15/A29 b29/r29	P16/A30 b30/r30	P17/A31 b31/r31	P18/A32 b32/r32	P19/A33 b33/r33	P20/A34 b34/r34	P21/A35 b35/r35	P22/A36 b36/r36	P23/A37 b37/r37	P53/A53 b53/r53	P54/A54 b54/r54	P55/A55 b55/r55	P56/A56 b56/r56	P57/A57 b57/r57	H46 *
0.01 to 0.09	0.06	0.44	0.40	13.79	11.75				1.77	14.00			93.8	87.5	75.0	62.5	50.0	106.3	112.5	118.8			0.20		0.027	
0.10 to 0.19	0.1	0.68	0.55	12.96	12.67				1.77	14.00			93.3	86.1	74.4	63.6	50.7	108.8	118.7	129.6			0.34		0.024	
0.20 to 0.39	0.2	1.30	1.00	12.61	13.63				2.33	12.60			90.0	81.3	67.9	56.6	45.0	112.4	126.6	145.1			0.68		0.026	0.5
0.40 to 0.74	0.4	2.30	1.56	10.20	14.91				2.40	9.88			88.7	81.3	67.0	55.2	43.8	112.1	126.5	144.3			1.36		0.029	
0.75 to 1.49	0.75	3.60	2.35	8.67	10.66				2.33	7.40			88.3	77.7	62.6	51.8	41.1	112.4	129.2	148.4			2.55		0.032	
1.50 to 2.19	1.5	6.10	3.00	6.55	11.26				2.00	5.85			92.1	82.8	71.1	58.1	46.2	111.4	126.1	143.9			5.09		0.061	
2.20 to 3.69	2.2	9.20	4.85	6.48	10.97				1.80	5.91			85.1	74.6	61.7	50.3	39.8	115.7	133.5	150.6			7.47		0.051	0.6
3.70 to 5.49	3.7	15.00	7.70	5.79	11.22				1.93	5.24			86.0	76.9	61.3	49.5	39.1	115.6	133.2	154.1			12.57		0.063	0.8
5.50 to 7.49	5.5	22.00	10.70	5.09	13.66				1.40	4.75			87.2	78.2	65.5	54.2	44.1	111.7	129.1	150.9			18.68		0.088	1.0
7.50 to 10.99	7.5	29.00	12.50	4.50	14.70				1.57	4.03			87.7	80.0	67.1	56.1	45.6	111.7	128.4	149.2			25.47		0.095	1.2
11.00 to 14.99	11	42.00	17.60	3.78	15.12	100.0	0.12	100.0	1.07	3.92	0.00	0.00	91.3	83.3	69.9	58.0	47.0	114.1	130.2	147.9	100.0	100.0	37.36	85	0.132	1.3
15.00 to 18.49	15	55.00	20.00	3.24	16.37				1.13	3.32			90.5	83.5	72.1	60.7	49.5	109.0	121.3	137.8			50.94		0.151	
18.50 to 21.99	18.5	67.00	21.90	2.90	17.00				0.87	3.34			90.7	83.0	70.7	59.9	48.7	112.1	127.9	147.5			62.83		0.243	2.0
22.00 to 29.99	22	78.00	25.10	2.70	16.05				0.90	3.28			89.7	81.3	68.9	59.1	48.4	114.1	130.2	151.8			74.72		0.228	
30.00 to 36.99	30	107.0	38.90	2.69	15.00				0.80	3.10			90.2	81.6	68.7	57.2	45.8	114.8	132.3	153.9			101.9		0.202	2.3
37.00 to 44.99	37	130.0	41.50	2.76	16.42				0.80	2.30			88.7	78.9	65.4	54.2	43.4	112.2	126.4	143.6			125.7		0.25	2.5
45.00 to 54.99	45	156.0	47.50	2.53	16.16				0.80	2.18			89.0	79.7	66.8	55.4	44.4	112.3	126.0	141.8			152.8		0.272	
55.00 to 74.99	55	190.0	58.60	2.35	16.20				0.94	2.45			89.2	79.3	64.7	53.6	43.1	117.2	136.2	157.8			186.8		0.267	2.6
75.00 to 89.99	75	260.0	83.20	1.98	16.89				0.80	2.33			88.1	78.0	64.3	54.2	42.9	114.9	129.8	144.6			254.7		0.292	2.8
90.00 to 109.9	90	310.0	99.20	1.73	16.03				0.80	2.31			88.8	79.0	65.0	54.0	44.0	115.0	130.0	145.0			305.7		0.31	3.2
110.0 or above	110	376.0	91.20	1.99	20.86				0.66	1.73			90.5	82.6	70.7	58.7	47.8	112.2	126.1	142.4			373.6		0.378	3.5

* H46 is available for motor 1 only.

Motor capacity (kW) P02/A16 b16/r16	Nominal applied motor (kW)	Rated current (A) P03/A17 b17/r17	No-load current (A) P06/A20 b20/r20	%R1 (%) P07/A21 b21/r21	%X (%) P08/A22 b22/r22	Slip compen-sation gain for driving P09/A23 b23/r23	Slip compen-sation response time P10/A24 b24/r24	Slip compen-sation gain for braking P11/A25 b25/r25	Rated slip frequency P12/A26 b26/r26	Iron loss factor 1 P13/A27 b27/r27	Iron loss factor 2 P14/A28 b28/r28	Iron loss factor 3 P15/A29 b29/r29	Magnetic saturation factor 1 P16/A30 b30/r30	Magnetic saturation factor 2 P17/A31 b31/r31	Magnetic saturation factor 3 P18/A32 b32/r32	Magnetic saturation factor 4 P19/A33 b33/r33	Magnetic saturation factor 5 P20/A34 b34/r34	Magnetic saturation extension factor "a" P21/A35 b35/r35	Magnetic saturation extension factor "b" P22/A36 b36/r36	Magnetic saturation extension factor "c" P23/A37 b37/r37	%X correction factor 1 P53/A53 b53/r53	%X correction factor 2 P54/A54 b54/r54	Torque current under vector control P55/A55 b55/r55	Induced voltage factor under vector control P56/A56 b56/r56	For particular manufac-turers P57/A57 b57/r57	Starting mode (Auto search delay time 2) H46 *
0.01 to 0.09	0.06	0.22	0.20	13.79	11.75				1.77	14.00			93.8	87.5	75.0	62.5	50.0	106.3	112.5	118.8			0.10		0.027	
0.10 to 0.19	0.1	0.35	0.27	12.96	12.67				1.77	14.00			93.3	86.1	74.4	63.6	50.7	108.8	118.7	129.6			0.17		0.024	
0.20 to 0.39	0.2	0.65	0.50	12.61	13.63				2.33	12.60			90.0	81.3	67.9	56.6	45.0	112.4	126.6	145.1			0.34		0.026	0.5
0.40 to 0.74	0.4	1.20	0.78	10.20	14.91				2.40	9.88			88.7	81.3	67.0	55.2	43.8	112.1	126.5	144.3			0.68		0.029	
0.75 to 1.49	0.75	1.80	1.18	8.67	10.66				2.33	7.40			88.3	77.7	62.6	51.8	41.1	112.4	129.2	148.4			1.27		0.032	
1.50 to 2.19	1.5	3.10	1.50	6.55	11.26				2.00	5.85			92.1	82.8	71.1	58.1	46.2	111.4	126.1	143.9			2.55		0.061	
2.20 to 3.69	2.2	4.60	2.43	6.48	10.97				1.80	5.91			85.1	74.6	61.7	50.3	39.8	115.7	133.5	150.6			3.74		0.051	0.6
3.70 to 5.49	3.7	7.50	3.85	5.79	11.22				1.93	5.24			86.0	76.9	61.3	49.5	39.1	115.6	133.2	154.1			6.28		0.063	0.8
5.50 to 7.49	5.5	11.00	5.35	5.09	13.66				1.40	4.75			87.2	78.2	65.5	54.2	44.1	111.7	129.1	150.9			9.34		0.088	1.0
7.50 to 10.99	7.5	14.50	6.25	4.50	14.70				1.57	4.03			87.7	80.0	67.1	56.1	45.6	111.7	128.4	149.2			12.74		0.095	1.2
11.00 to 14.99	11	21.00	8.80	3.78	15.12				1.07	3.92			91.3	83.3	69.9	58.0	47.0	114.1	130.2	147.9			18.68	85	0.132	1.3
15.00 to 18.49	15	27.50	10.00	3.24	16.37				1.13	3.32			90.5	83.5	72.1	60.7	49.5	109.0	121.3	137.8			25.47		0.151	
18.50 to 21.99	18.5	34.00	11.00	2.90	17.00				0.87	3.34			90.7	83.0	70.7	59.9	48.7	112.1	127.9	147.5			31.41		0.243	2.0
22.00 to 29.99	22	39.00	12.60	2.70	16.05	100.0	0.12	100.0	0.90	3.28	0.00	0.00	89.7	81.3	68.9	59.1	48.4	114.1	130.2	151.8	100.0	100.0	37.36		0.228	
30.00 to 36.99	30	54.00	19.50	2.69	15.00				0.80	3.10			90.2	81.6	68.7	57.2	45.8	114.8	132.3	153.9			50.94		0.202	2.3
37.00 to 44.99	37	65.00	20.80	2.76	16.42				0.80	2.30			88.7	78.9	65.4	54.2	43.4	112.2	126.4	143.6			62.83		0.25	2.5
45.00 to 54.99	45	78.00	23.80	2.53	16.16				0.80	2.18			89.0	79.7	66.8	55.4	44.4	112.3	126.0	141.8			76.41		0.272	
55.00 to 74.99	55	95.00	29.30	2.35	16.20				0.94	2.45			89.2	79.3	64.7	53.6	43.1	117.2	136.2	157.8			93.39		0.267	2.6
75.00 to 89.99	75	130.0	41.60	1.98	16.89				0.80	2.33			88.1	78.0	64.3	54.2	42.9	114.9	129.8	144.6			127.4		0.292	2.8
90.00 to 109.9	90	155.0	49.60	1.73	16.03				0.80	2.31			88.8	79.0	65.0	54.0	44.0	115.0	130.0	145.0			152.8		0.31	3.2
110.0 to 131.9	110	188.0	45.60	1.99	20.86				0.66	1.73			90.5	82.6	70.7	58.7	47.8	112.2	126.1	142.4			186.8		0.378	3.5
132.0 to 159.9	132	224.0	57.60	1.75	18.90				0.66	1.80			90.3	81.9	69.8	57.8	46.6	112.9	127.6	144.8			211.7		0.394	4.1
160.0 to 199.9	160	272.0	64.50	1.68	19.73				0.66	1.50			92.2	84.8	71.1	58.6	46.9	114.6	130.5	148.0			256.6		0.482	4.5
200.0 to 219.9	200	335.0	71.50	1.57	20.02				0.66	1.36			91.9	85.5	72.3	60.0	47.6	109.8	122.7	136.4			320.8	90	0.534	4.7
220.0 to 249.9	220	365.0	71.80	1.60	20.90				0.58	1.25			93.1	86.1	72.9	60.8	48.6	108.7	118.8	130.9			352.8		0.561	
250.0 to 279.9	250	415.0	87.90	1.39	18.88				0.54	1.33			92.2	84.9	72.7	60.5	48.9	109.9	122.2	137.8			400.9		0.571	5.0
280.0 or above	280	462.0	93.70	1.36	19.18				0.54	1.27			92.7	85.6	72.9	60.9	48.9	109.3	120.2	133.5			449.1		0.589	5.5

* H46 is available for motor 1 only.

Table B (3) Fuji Motor Exclusively Designed for Vector Control is Selected with Motor Selection (P99/A39/b39/r39 = 2)

■ 200 V class series

Motor capacity (kW)	Nominal applied motor (kW)	Rated voltage at base frequency (V)	Rated current (A)	No-load current (A)	%R1 (%)	%X (%)	Slip compen-sation gain for driving	Slip compen-sation response time	Slip compen-sation gain for braking	Rated slip frequency	Iron loss factor 1	Iron loss factor 2	Iron loss factor 3	Magnetic saturation factor 1	Magnetic saturation factor 2	Magnetic saturation factor 3	Magnetic saturation factor 4	Magnetic saturation factor 5	Magnetic saturation extension factor "a"	Magnetic saturation extension factor "b"	Magnetic saturation extension factor "c"	%X correction factor 1	%X correction factor 2	Torque current under vector control	Induced voltage factor under vector control	For particular manufac-turers	Starting mode (Auto search delay time 2)
P02/A16 b16/r16		F05	P03/A17 b17/r17	P06/A20 b20/r20	P07/A21 b21/r21	P08/A22 b22/r22	P09/A23 b23/r23	P10/A24 b24/r24	P11/A25 b25/r25	P12/A26 b26/r26	P13/A27 b27/r27	P14/A28 b28/r28	P15/A29 b29/r29	P16/A30 b30/r30	P17/A31 b31/r31	P18/A32 b32/r32	P19/A33 b33/r33	P20/A34 b34/r34	P21/A35 b35/r35	P22/A36 b36/r36	P23/A37 b37/r37	P53/A53 b53/r53	P54/A54 b54/r54	P55/A55 b55/r55	P56/A56 b56/r56	P57/A57 b57/r57	H46 *
0.01 to 0.09	0.06	200	0.44	0.40	13.79	11.75	100.0	0.12	100.0	1.77	14.00	0.00	0.00	93.8	87.5	75.0	62.5	50.0	106.3	112.5	118.8	100.0	100.0	0.20	85	0.027	0.5
0.10 to 0.19	0.1	200	0.68	0.55	12.96	12.67				1.77	14.00			93.3	86.1	74.4	63.6	50.7	108.8	118.7	129.6			0.34		0.024	
0.20 to 0.39	0.2	200	1.30	1.06	12.95	12.92				2.33	12.60			89.7	81.9	66.9	54.5	43.3	111.0	129.3	148.4			0.68		0.023	
0.40 to 0.74	0.4	200	2.30	1.66	10.20	13.66				2.40	9.88			88.7	81.3	67.0	55.2	43.8	112.1	126.5	144.3			1.36		0.027	
0.75 to 1.49	0.75	188	4.30	3.21	4.34	9.07			89.8	1.32	7.60	7.60	10.00	93.0	85.8	72.6	60.0	47.6	109.6	121.4	136.2			2.92	79	0.054	
1.50 to 2.19	1.5	188	7.00	3.21	7.06	14.76			89.8	2.64	3.80	3.80	5.00	93.0	85.8	72.6	60.0	47.6	109.6	121.4	136.2			5.83	79	0.054	
2.20 to 3.69	2.2	188	11.00	3.81	8.27	12.95			116.7	2.62	3.00	4.00	1.00	85.2	73.7	59.1	47.6	37.4	112.3	131.1	150.0			9.75	74	0.026	0.6
3.70 to 5.49	3.7	188	18.00	8.11	6.86	12.69			94.8	2.50	3.00	2.95	2.50	88.4	80.1	66.4	54.1	43.0	113.1	130.9	158.0			15.69	78	0.042	0.8
5.50 to 7.49	5.5	188	30.0	12.98	6.05	13.44			96.6	1.49	3.00	2.50	3.00	88.3	79.5	66.0	54.1	43.0	114.0	132.0	155.1			21.92	79	0.045	1.0
7.50 to 10.99	7.5	188	37.0	15.82	6.70	12.45			105.6	1.77	2.32	1.76	3.00	85.3	70.7	53.8	43.7	34.4	117.6	140.7	176.4			30.66	82	0.035	1.2
11.00 to 14.99	11	188	50.0	24.79	4.26	11.64			83.4	0.99	4.53	1.88	0.22	84.9	75.0	61.6	50.0	39.4	115.0	137.9	171.9			40.30	93	0.044	1.3
15.00 to 18.49	15	188	65.0	26.99	4.47	12.25			100.0	1.07	0.00	1.50	1.00	88.7	80.7	67.2	55.2	44.0	110.4	125.0	142.7			53.96	85	0.067	2.0
18.50 to 21.99	18.5	188	74.0	30.58	3.22	10.68			99.7	0.93	3.50	0.50	0.50	90.7	83.2	69.5	56.8	44.4	110.0	121.4	139.6			72.83	85	0.12	
22.00 to 29.99	22	188	90.0	34.17	3.59	11.78			141.1	0.61	1.30	0.77	2.00	91.1	83.2	69.1	56.8	44.6	114.2	134.2	159.7			83.43	85	0.194	
30.00 to 36.99	30	188	116.0	53.42	2.53	12.13			106.9	0.61	2.50	3.50	5.00	84.4	74.0	59.5	48.9	38.0	119.5	146.7	183.4			108.1	88	0.193	2.3
37.00 to 44.99	37	188	143.0	60.09	2.47	14.69			107.8	0.50	1.80	3.00	5.00	85.4	75.7	62.3	50.5	39.9	120.1	147.3	186.4			133.2	89	0.092	2.5
45.00 to 54.99	45	188	170.0	56.71	2.73	15.26			95.1	0.95	1.00	0.00	0.15	89.2	81.6	67.6	56.2	43.4	112.7	133.2	163.3			169.7	87	0.148	
55.00 to 74.99	55	185	216.0	66.22	2.08	12.36			95.8	0.62	3.00	0.83	0.21	91.5	83.8	70.6	57.8	45.6	109.8	122.8	146.2			197.9	91	0.272	2.6
75.00 to 89.99	75	183	276.0	99.34	1.70	15.29			104.2	0.64	2.00	2.00	0.00	90.4	83.0	68.4	57.4	46.4	110.1	121.4	135.8			261.6	90	0.278	2.8
90.00 to 109.9	90	183	345.0	89.30	2.28	20.12			81.6	0.67	0.00	5.00	0.00	91.1	85.1	70.9	59.2	48.7	109.8	121.7	137.6			332.3	99	0.275	3.2

* H46 is available for motor 1 only.

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Motor capacity (kW) P02/A16 b16/r16	Nominal applied motor (kW)	Rated voltage at base frequency (V) F05	Rated current (A) P03/A17 b17/r17	No-load current (A) P06/A20 b20/r20	%R1 (%) P07/A21 b21/r21	%X (%) P08/A22 b22/r22	Slip compen-sation gain for driving P09/A23 b23/r23	Slip compen-sation response time P10/A24 b24/r24	Slip compen-sation gain for braking P11/A25 b25/r25	Rated slip frequency P12/A26 b26/r26	Iron loss factor 1 P13/A27 b27/r27	Iron loss factor 2 P14/A28 b28/r28	Iron loss factor 3 P15/A29 b29/r29	Magnetic saturation factor 1 P16/A30 b30/r30	Magnetic saturation factor 2 P17/A31 b31/r31	Magnetic saturation factor 3 P18/A32 b32/r32	Magnetic saturation factor 4 P19/A33 b33/r33	Magnetic saturation factor 5 P20/A34 b34/r34	Magnetic saturation extension factor "a" P21/A35 b35/r35	Magnetic saturation extension factor "b" P22/A36 b36/r36	Magnetic saturation extension factor "c" P23/A37 b37/r37	%X correction factor 1 P53/A53 b53/r53	%X correction factor 2 P54/A54 b54/r54	Torque current under vector control P55/A55 b55/r55	Induced voltage factor under vector control P56/A56 b56/r56	For particular manufac-turers P57/A57 b57/r57	Starting mode (Auto search delay time 2) H46 *
0.01 to 0.09	0.06	400	0.22	0.20	13.79	11.75				1.77	14.00	0.00	0.00	93.8	87.5	75.0	62.5	50.0	106.3	112.5	118.8			0.10		0.027	
0.10 to 0.19	0.1	400	0.35	0.27	12.96	12.67				1.77	14.00	0.00	0.00	93.3	86.1	74.4	63.6	50.7	108.8	118.7	129.6			0.17		0.024	
0.20 to 0.39	0.2	400	0.65	0.53	12.95	12.92				2.33	12.60	0.00	0.00	89.7	81.9	66.9	54.5	43.3	111.0	129.3	148.4			0.34		0.023	0.5
0.40 to 0.74	0.4	400	1.15	0.83	10.20	13.66			100.0	2.40	9.88	0.00	0.00	88.7	81.3	67.0	55.2	43.8	112.1	126.5	144.3			0.68	85	0.027	
0.75 to 1.49	0.75	400	1.80	1.15	8.67	10.76				2.33	7.40	0.00	0.00	88.3	77.7	62.6	51.8	41.1	112.4	129.2	148.4			1.27		0.033	
1.50 to 2.19	1.5	400	3.10	1.51	6.55	11.21				2.00	5.85	0.00	0.00	92.1	82.8	71.1	58.1	46.2	111.4	126.1	143.9			2.55		0.061	
2.20 to 3.69	2.2	400	4.60	2.43	6.48	10.97				1.80	5.91	0.00	0.00	85.1	74.6	61.7	50.3	39.8	115.7	133.5	150.6			3.74		0.051	0.6
3.70 to 5.49	3.7	376	9.00	3.93	6.86	13.94			93.2	2.51	2.35	2.55	1.20	90.5	82.4	68.7	57.0	45.3	113.1	130.9	158.0			7.78	78	0.052	0.8
5.50 to 7.49	5.5	376	15.00	7.15	5.50	12.78			104.5	1.31	2.00	5.00	7.00	88.0	79.2	65.6	53.6	42.2	114.0	132.0	155.1			10.74	80	0.039	1.0
7.50 to 10.99	7.5	376	18.50	7.81	4.37	13.72			115.1	1.47	7.61	2.00	1.00	85.9	76.9	63.4	51.6	40.5	117.6	140.7	176.4			15.33	82	0.032	1.2
11.00 to 14.99	11	376	25.00	12.39	4.27	11.67			83.4	0.99	4.53	1.88	0.22	84.9	75.0	61.6	50.0	39.4	115.0	137.9	171.9			20.15	93	0.044	1.3
15.00 to 18.49	15	376	31.70	14.47	4.48	13.69			98.4	1.29	1.00	0.50	1.00	88.7	81.7	67.2	55.2	44.0	110.4	125.0	142.7			28.63	81	0.067	
18.50 to 21.99	18.5	376	37.00	14.02	2.66	12.45	100.0	0.12	100.0	0.88	1.00	3.00	3.00	92.5	84.3	70.3	57.1	45.1	110.0	121.4	139.6	100.0	100.0	36.06	85	0.148	2.0
22.00 to 29.99	22	376	45.00	16.81	3.61	14.06			98.7	0.90	1.50	1.50	3.00	91.1	83.2	69.1	56.5	44.6	114.2	134.2	159.7			41.72	85	0.194	
30.00 to 36.99	30	376	58.00	25.74	2.55	12.16			97.3	0.67	2.50	3.50	9.50	84.4	74.0	59.5	48.9	38.0	119.5	146.7	183.4			52.52	88	0.193	2.3
37.00 to 44.99	37	376	71.00	30.07	2.49	14.11			100.2	0.50	1.79	1.80	5.00	85.4	75.7	62.3	50.5	39.9	120.1	147.3	186.4			65.54	89	0.092	2.5
45.00 to 54.99	45	376	85.00	28.36	2.73	15.30			98.9	0.95	0.50	1.50	1.85	89.2	81.6	67.6	56.2	43.4	112.7	133.2	163.3			84.85	87	0.148	
55.00 to 74.99	55	376	108.0	33.11	2.05	12.20			95.8	0.62	3.00	0.83	0.21	91.5	83.8	70.6	57.8	45.6	109.8	122.8	146.2			98.98	89	0.266	2.6
75.00 to 89.99	75	365	138.0	49.67	1.71	15.39			104.2	0.64	2.00	2.00	0.00	90.4	83.0	68.4	57.4	46.4	110.1	121.4	135.8			130.8	90	0.314	2.8
90.00 to 109.9	90	370	173.0	44.37	2.23	18.47			94.5	0.69	0.00	2.00	0.00	90.7	83.7	69.0	57.1	44.9	109.8	121.7	137.6			164.1	94	0.311	3.2
110.0 to 131.9	110	375	206.0	53.03	2.14	16.83			108.8	0.56	0.44	0.00	0.00	90.1	82.6	67.7	56.3	44.2	109.0	119.9	133.1			195.8	93	0.412	3.5
132.0 to 159.9	132	375	248.0	62.05	1.56	17.21			110.4	0.48	0.00	0.39	0.00	90.1	81.2	67.7	56.2	45.9	112.5	125.6	148.2			237.3	90	0.438	4.1
160.0 to 199.9	160	375	297.0	70.71	1.15	17.47			100.0	0.52	0.00	0.00	0.00	91.0	84.3	71.8	59.1	47.7	108.4	120.6	136.5			286.3	88	0.474	4.5
200.0 to 219.9	200	369	369.0	107.7	1.15	14.98			93.8	0.47	0.00	2.50	0.00	93.8	87.6	74.8	60.6	48.2	108.3	117.9	131.2			341.5	93	0.447	4.7
220.0 or above	220	370	409.0	98.64	1.63	14.54			102.5	0.45	1.00	1.00	0.00	95.1	88.5	75.0	63.1	51.3	108.3	118.8	130.5			385.3	98	0.468	

* H46 is available for motor 1 only.

Table B (4) HP Rating Motor is Selected with Motor Selection (P99/A39/b39/r39 = 1)

■ 200 V class series

Motor capacity (kW)	Nominal applied motor (kW)	Rated current (A)	No-load current (A)	%R1 (%)	%X (%)	Slip compen-sation gain for driving	Slip compen-sation response time	Slip compen-sation gain for braking	Rated slip frequency	Iron loss factor 1	Iron loss factor 2	Iron loss factor 3	Magnetic saturation factor 1	Magnetic saturation factor 2	Magnetic saturation factor 3	Magnetic saturation factor 4	Magnetic saturation factor 5	Magnetic saturation extension factor "a"	Magnetic saturation extension factor "b"	Magnetic saturation extension factor "c"	%X correction factor 1	%X correction factor 2	Torque current under vector control	Induced voltage factor under vector control	For particular manufac-turers	Starting mode (Auto search delay time 2)
P02/A16 b16/r16		P03/A17 b17/r17	P06/A20 b20/r20	P07/A21 b21/r21	P08/A22 b22/r22	P09/A23 b23/r23	P10/A24 b24/r24	P11/A25 b25/r25	P12/A26 b26/r26	P13/A27 b27/r27	P14/A28 b28/r28	P15/A29 b29/r29	P16/A30 b30/r30	P17/A31 b31/r31	P18/A32 b32/r32	P19/A33 b33/r33	P20/A34 b34/r34	P21/A35 b35/r35	P22/A36 b36/r36	P23/A37 b37/r37	P53/A53 b53/r53	P54/A54 b54/r54	P55/A55 b55/r55	P56/A56 b56/r56	P57/A57 b57/r57	H46 *
0.01 to 0.11	0.1	0.44	0.40	13.79	11.75	100.0	0.12	100.0	2.50	14.00	0.00	0.00	93.8	87.5	75.0	62.5	50.0	106.3	112.5	118.8	100.0	100.0	0.21	85	0.027	0.5
0.12 to 0.24	0.12	0.68	0.55	12.96	12.67				2.50	14.00			93.3	86.1	74.4	63.6	50.7	108.8	118.7	129.6			0.27		0.024	
0.25 to 0.49	0.25	1.40	1.12	11.02	13.84				2.50	12.60			89.7	81.9	66.9	54.5	43.3	111.0	129.3	148.4			0.53		0.014	
0.50 to 0.99	0.5	2.00	1.22	6.15	8.80				2.50	9.88			88.7	81.3	67.0	55.2	43.8	112.1	126.5	144.3			1.09		0.019	
1.00 to 1.99	1	3.00	1.54	3.96	8.86				2.50	7.40			88.3	77.7	62.6	51.8	41.1	112.4	129.2	148.4			2.21		0.036	
2.00 to 2.99	2	5.80	2.80	4.29	7.74				2.50	5.85			92.1	82.8	71.1	58.1	46.2	111.4	126.1	143.9			4.43		0.035	
3.00 to 4.99	3	7.90	3.57	3.15	20.81				1.17	5.91			85.1	74.6	61.7	50.3	39.8	115.7	133.5	150.6			6.64		0.152	0.6
5.00 to 7.49	5	12.6	4.78	3.34	23.57				1.50	5.24			86.0	76.9	61.3	49.5	39.1	115.6	133.2	154.1			11.07		0.153	0.8
7.50 to 9.99	7.5	18.6	6.23	2.65	28.91				1.17	4.75			88.6	79.2	64.9	52.7	41.8	114.3	133.1	155.6			16.60		0.234	1.0
10.00 to 14.99	10	25.3	8.75	2.43	30.78				1.17	4.03			87.7	80.0	67.1	56.1	45.6	111.7	128.4	149.2			22.15		0.209	1.2
15.00 to 19.99	15	37.3	12.7	2.07	29.13				1.00	3.92			91.3	83.3	69.9	58.0	47.0	114.1	130.2	147.9			33.22		0.256	1.3
20.00 to 24.99	20	49.1	9.20	2.09	29.53				1.00	3.32			90.5	83.5	72.1	60.7	49.5	109.0	121.3	137.8			44.30		0.262	2.0
25.00 to 29.99	25	60.0	16.70	1.75	31.49				1.00	3.34			90.7	83.0	70.7	59.9	48.7	112.1	127.9	147.5			55.37		0.348	
30.00 to 39.99	30	72.4	19.80	1.90	32.55				1.00	3.28			89.7	81.3	68.9	59.1	48.4	114.1	130.2	151.8			66.45		0.33	
40.00 to 49.99	40	91.0	13.60	1.82	25.32				0.47	3.10			90.2	81.6	68.7	57.2	45.8	114.8	132.3	153.9			88.60		0.497	2.3
50.00 to 59.99	50	115.0	18.70	1.92	24.87				0.58	2.30			88.7	78.9	65.4	54.2	43.4	112.2	126.4	143.6			110.7		0.419	2.5
37.00 to 44.99	60	137.0	20.80	1.29	26.99				0.35	2.18			89.0	79.7	66.8	55.4	44.4	112.3	126.0	141.8			132.9		0.757	
75.00 to 99.99	75	174.0	28.60	1.37	27.09				0.35	2.45			89.2	79.3	64.7	53.6	43.1	117.2	136.2	157.8			166.1		0.66	2.6
100.0 tp 124.9	100	226.0	37.40	1.08	23.80				0.23	2.33			88.1	78.0	64.3	54.2	42.9	114.9	129.8	144.6			221.5		0.796	2.8
125.0 to 149.9	125	268.0	29.80	1.05	22.90				0.35	2.31			88.8	79.0	65.0	54.0	44.0	115.0	130.0	145.0			276.9		0.996	3.2
150.0 or above	150	337.0	90.40	0.96	21.61				0.39	1.73			90.5	82.6	70.7	58.7	47.8	112.2	126.1	142.4			332.2		0.851	3.5

* H46 is available for motor 1 only.

■ 400 V class series

Motor capacity (kW)	Nominal applied motor (kW)	Rated current (A)	No-load current (A)	%R1 (%)	%X (%)	Slip compen-sation gain for driving	Slip compen-sation response time	Slip compen-sation gain for braking	Rated slip frequency	Iron loss factor 1	Iron loss factor 2	Iron loss factor 3	Magnetic saturation factor 1	Magnetic saturation factor 2	Magnetic saturation factor 3	Magnetic saturation factor 4	Magnetic saturation factor 5	Magnetic saturation extension factor "a"	Magnetic saturation extension factor "b"	Magnetic saturation extension factor "c"	%X correction factor 1	%X correction factor 2	Torque current under vector control	Induced voltage factor under vector control	For particular manufac-turers	Starting mode (Auto search delay time 2)
P02/A16 b16/r16		P03/A17 b17/r17	P06/A20 b20/r20	P07/A21 b21/r21	P08/A22 b22/r22	P09/A23 b23/r23	P10/A24 b24/r24	P11/A25 b25/r25	P12/A26 b26/r26	P13/A27 b27/r27	P14/A28 b28/r28	P15/A29 b29/r29	P16/A30 b30/r30	P17/A31 b31/r31	P18/A32 b32/r32	P19/A33 b33/r33	P20/A34 b34/r34	P21/A35 b35/r35	P22/A36 b36/r36	P23/A37 b37/r37	P53/A53 b53/r53	P54/A54 b54/r54	P55/A55 b55/r55	P56/A56 b56/r56	P57/A57 b57/r57	H46 *
0.01 to 0.11	0.1	0.22	0.20	13.79	11.75				2.50	14.00			93.8	87.5	75.0	62.5	50.0	106.3	112.5	118.8			0.10		0.027	
0.12 to 0.24	0.12	0.34	0.27	12.96	12.67				2.50	14.00			93.3	86.1	74.4	63.6	50.7	108.8	118.7	129.6			0.13		0.024	
0.25 to 0.49	0.25	0.70	0.56	11.02	13.84				2.50	12.60			89.7	81.9	66.9	54.5	43.3	111.0	129.3	148.4			0.27		0.014	
0.50 to 0.99	0.5	1.00	0.61	6.15	8.80				2.50	9.88			88.7	81.3	67.0	55.2	43.8	112.1	126.5	144.3			0.55		0.019	0.5
1.00 to 1.99	1	1.50	0.77	3.96	8.86				2.50	7.40			88.3	77.7	62.6	51.8	41.1	112.4	129.2	148.4			1.11		0.036	
2.00 to 2.99	2	2.90	1.40	4.29	7.74				2.50	5.85			92.1	82.8	71.1	58.1	46.2	111.4	126.1	143.9			2.21		0.035	
3.00 to 4.99	3	4.00	1.79	3.15	20.81				1.17	5.91			85.1	74.6	61.7	50.3	39.8	115.7	133.5	150.6			3.32		0.152	
5.00 to 7.49	5	6.30	2.39	3.34	23.57				1.50	5.24			86.0	76.9	61.3	49.5	39.1	115.6	133.2	154.1			5.54		0.153	0.8
7.50 to 9.99	7.5	9.30	3.12	2.65	28.91				1.17	4.75			88.6	79.2	64.9	52.7	41.8	114.3	133.1	155.6			8.30		0.234	1.0
10.00 to 14.99	10	12.7	4.37	2.43	30.78				1.17	4.03			87.7	80.0	67.1	56.1	45.6	111.7	128.4	149.2			11.07		0.209	1.2
15.00 to 19.99	15	18.7	6.36	2.07	29.13				1.00	3.92			91.3	83.3	69.9	58.0	47.0	114.1	130.2	147.9			16.61	85	0.256	1.3
20.00 to 24.99	20	24.6	4.60	2.09	29.53				1.00	3.32			90.5	83.5	72.1	60.7	49.5	109.0	121.3	137.8			22.15		0.262	2.0
25.00 to 29.99	25	30.0	8.33	1.75	31.49				1.00	3.34			90.7	83.0	70.7	59.9	48.7	112.1	127.9	147.5			27.69		0.348	
30.00 to 39.99	30	36.2	9.88	1.90	32.55	100.0	0.12	100.0	1.00	3.28	0.00	0.00	89.7	81.3	68.9	59.1	48.4	114.1	130.2	151.8	100.0	100.0	33.22		0.33	
40.00 to 49.99	40	45.5	6.80	1.82	25.32				0.47	3.10			90.2	81.6	68.7	57.2	45.8	114.8	132.3	153.9			44.30		0.497	2.3
50.00 to 59.99	50	57.5	9.33	1.92	24.87				0.58	2.30			88.7	78.9	65.4	54.2	43.4	112.2	126.4	143.6			55.37		0.419	2.5
60.00 to 74.99	60	68.7	10.4	1.29	26.99				0.35	2.18			89.0	79.7	66.8	55.4	44.4	112.3	126.0	141.8			66.45		0.757	
75.00 to 99.99	75	86.9	14.3	1.37	27.09				0.35	2.45			89.2	79.3	64.7	53.6	43.1	117.2	136.2	157.8			83.06		0.66	2.6
100.0 to 124.9	100	113.0	18.7	1.08	23.80				0.23	2.33			88.1	78.0	64.3	54.2	42.9	114.9	129.8	144.6			110.7		0.796	2.8
125.0 to 149.9	125	134.0	14.9	1.05	22.90				0.35	2.31			88.8	79.0	65.0	54.0	44.0	115.0	130.0	145.0			138.4		0.996	3.2
150.0 to 174.9	150	169.0	45.2	0.96	21.61				0.39	1.73			90.5	82.6	70.7	58.7	47.8	112.2	126.1	142.4			166.1		0.851	3.5
175.0 to 199.9	175	169.0	45.2	0.96	21.61				0.39	1.80			90.3	81.9	69.8	57.8	46.6	112.9	127.6	144.8			183.0		0.851	4.1
200.0 to 249.9	200	231.0	81.8	0.72	20.84				0.23	1.50			92.2	84.8	71.1	58.6	46.9	114.6	130.5	148.0			209.2		1.71	4.5
250.0 to 299.9	250	272.0	41.1	0.71	18.72				0.35	1.36			91.9	85.5	72.3	60.0	47.6	109.8	122.7	136.4			261.5	90	0.994	4.7
300.0 to 324.9	300	323.0	45.1	0.53	18.44				0.23	1.25			93.1	86.1	72.9	60.8	48.6	108.7	118.8	130.9			313.8		1.151	
325.0 to 349.9	325	323.0	45.1	0.53	18.44				0.23	1.33			92.2	84.9	72.7	60.5	48.9	109.9	122.2	137.8			339.9		1.151	5.0
350.0 or above	350	375.0	68.3	0.99	19.24				0.46	1.27			92.7	85.6	72.9	60.9	48.9	109.3	120.2	133.5			366.1		1.126	5.5

* H46 is available for motor 1 only.

5.3 Function Code Index by Purpose

5.3.1 Configuring the minimal requirements for the inverter to just run the motor

To run the motor simply with constant torque load under V/f control, the following function codes should be configured as minimal requirements. These function codes are displayed in the quick setup (Menu #0).

To	Function code	Name	Refer to page:
Set the command source that specifies reference frequency 1.	F01	Frequency Command 1	5-53
Select the source that specifies a run command that runs or stops the motor.	F02	Operation Method	5-61
Specify the maximum frequency to limit the output frequency (motor rotation).	F03	Maximum Frequency 1	5-62
Limit the reference frequency.	F16	Frequency Limiter (Low)	5-80
Enter the motor ratings printed on its nameplate to run the motor properly.	F04 F05 F06	Base Frequency 1 Rated Voltage at Base Frequency 1 Maximum Output Voltage 1	5-62
Specify the acceleration/deceleration time.	F07 F08	Acceleration Time 1 Deceleration Time 1	5-65
Adjust the output voltage with the torque boost to secure a sufficient starting torque.	F09	Torque Boost 1	5-68
Protect the motor.	 F10 F11	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics) (Overload detection level)	5-68
Select the restart mode to apply after momentary power failure.	F14	Restart Mode after Momentary Power Failure (Mode selection)	5-72
Reduce an audible noise generated by the motor.	F26	Motor Sound (Carrier frequency)	5-86
Select the full-menu mode to use various checking functions on the keypad.	E52	Keypad (Menu display mode)	5-134
Specify the motor parameters.	 P02 P03 P04 P99	Motor 1 (Rated capacity) (Rated current) (Auto-tuning) Motor 1 Selection	 5-144 5-145 5-148

5.3.2 Setting up the frequency

5.3.2.1 Frequency setting from the keypad

To	Function code	Name	Refer to page:
Set up the reference frequency from the keypad.	F01	Frequency Command 1	5-53
	E64	Saving of Digital Reference Frequency	5-136

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5.3.2.2 Frequency setting by analog input

To	Function code	Name	Refer to page:
Set up the reference frequency using analog input (voltage or current) applied to terminal [12], [C1], or [V2] from external equipment (analog frequency command source).	F01	Frequency Command 1	5-53
Apply bias and gain (e.g., 1 to 5V) to the analog frequency setting to configure an arbitrary relationship between the analog input and frequency setting.	F18 C50	Bias (Frequency command 1) Bias (Frequency command 1) (Bias base point)	5-53
	C32 C34 C37 C39 C42 C44	Analog Input Adjustment for: [12] (Gain) [12] (Gain base point) [C1] (Gain) [C1] (Gain base point) [V2] (Gain) [V2] (Gain base point)	5-142
Select the polarity for terminal [12] or [V2]--bipolar (e.g., ±10 V) or unipolar (e.g., -10 V).	C35 C45	Analog Input Adjustment for: [12] (Polarity) [V2] (Polarity)	5-142
Cancel the offset of external equipment which analog input (voltage or current) comes from.	C31 C36 C41	Analog Input Adjustment for: [12] (Offset) [C1] (Offset) [V2] (Offset)	5-142
Suppress noise superimposed on analog input with the filter.	C33 C38 C43	Analog Input Adjustment for: [12] (Filter time constant) [C1] (Filter time constant) [V2] (Filter time constant)	5-142
Combine the normal/inverse operation for analog frequency command and the normal/inverse switching terminal command, e.g., for air-conditioners that require switching between cooling and heating.	C53 E01-E09	Selection of Normal/Inverse Operation (Frequency command 1) Terminal [X1] to [X9] Functions (***IVS***)	5-143 5-102
Detect an external frequency command source failure or wire break to issue a warning signal and continue running the motor with the specified running frequency.	E65 E20-E24	Reference Loss Detection (Continuous running frequency) Terminal [Y1] to [Y5A/C] Functions (***REF OFF***)	5-136 5-118

5.3.2.3 Other frequency settings

To		Function code	Name	Refer to page:
UP/***DOWN***	Set up the reference frequency with the terminal command ***UP*** or ***DOWN***.	F01	Frequency Command 1	5-53
		E01-E09	Terminal [X1] to [X9] Functions (***UP, DOWN***)	5-102
	Reset the initial values of terminal commands ***UP*** and ***DOWN*** to 0 Hz at the start of running.	H61	***UP***/***DOWN*** Control (Initial frequency setting)	5-53
Multi-frequency	Define different frequency settings beforehand and switch them with the combination of the ON/OFF states of the frequency selection terminal commands.	F01	Frequency Command 1	5-53
		E01-E09	Terminal [X1] to [X9] Functions (***SS1, 2, 4, 8***)	5-102
		C05-C19	Multi-frequency 1 to 15	5-139

To		Function code	Name	Refer to page:
Pulse train input	Set up the reference frequency with pulse train input.	F01	Frequency Command 1	5-53
	Receive pulses from other motor's PG to perform ratio operation.		Command (Pulse Rate Input)	5-204
		d59	(Pulse input format)	
		d61	(Filter time constant)	
		d62	(Pulse count factor 1)	
		d63	(Pulse count factor 2)	
		E01-E09	Terminal [X1] to [X9] Functions (Pulse train input ***PIN***, available only on terminal [X7]) (Pulse train sign ***SIGN***, available on terminals except [X7])	5-102
Switching between remote and proximal command sources	Switch the frequency command source between analog current (4 to 20 mA) supplied from a remote electric room and analog voltage (0 to 10 V) specified from an operation device.	F01 C30 E01-E09	Frequency Command 1 Frequency Command 2 Terminal [X1] to [X9] Functions (***Hz2/Hz1***)	5-53 5-102
Auxiliary frequency setting	Add auxiliary frequency setting to the reference frequency, using analog input.	E61 E62 E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-135
Ratio setting	Apply the ratio setting using analog input to multiply the reference frequency by the ratio for override control.			
Digital input interface card (option) *	Specify frequency commands with binary code (8, 12, 15, or 16 bits) or BCD (4-bit Binary Coded Decimal) code. (For details, refer to the Digital Input Interface Card Instruction Manual.)	F01	Frequency Command 1	5-53

* Available for inverters with ROM version 0500 or later.

5.3.3 Entering a run command

To		Function code	Name	Refer to page:
Keypad	Run or stop the motor with the keys on the keypad.	F02	Operation Method	5-61
		E98	Terminal [FWD] Function	5-102
		E99	Terminal [REV] Function	
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***KP***)	5-118
External signals	Run or stop the motor with terminal commands ***FWD*** and ***REV*** assigned to terminals [FWD] and [REV] (2-wire operation).	F02	Operation Method	5-61
		E98	Terminal [FWD] Function	5-102
		E99	Terminal [REV] Function	
	Run or stop the motor with terminal commands ***FWD***, ***REV***, and ***HOLD*** assigned to terminals [FWD], [REV], and [X1] to [X9] (3-wire operation).	F02	Operation Method	5-61
		E98	Terminal [FWD] Function	5-102
		E99	Terminal [REV] Function	
		E01-E09	Terminal [X1] to [X9] Functions (***HLD***)	

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5.3.4 Starting/stopping the motor

To		Function code	Name	Refer to page:
Starting frequency	Start the motor smoothly.	F23 F24	Starting Frequency 1 Starting Frequency 1 (Holding time)	5-83
Auto search	Search for the idling motor speed to restart the motor without stopping and shock.	H09 H49 H46 E01-E09	Starting Mode (Auto search) (Auto search delay time 1) (Auto search delay time 2) Terminal [X1] to [X9] Functions (***STM***)	5-152 5-102
Pre-excitation	Compensate for insufficient torque (due to magnetic flux lag) at startup to accelerate the motor promptly.	H84 H85 E01-E09	Pre-excitation (Initial level) (Time) Terminal [X1] to [X9] Functions (***EXITE***)	5-171 5-102
Stopping the motor	Stop the motor smoothly.	F25 F38 F39	Stop Frequency Stop Frequency (Detection mode) Stop Frequency (Holding time)	5-83
	Prevent torque from being insufficient in a low speed zone when stopping the motor.			
DC braking	Prevent the motor from running by inertia during decelerate-to-stop operation with DC braking.	F20 F21 F22 H95	DC Braking 1 (Braking starting frequency) (Braking level) (Braking time) DC Braking (Braking response mode)	5-81
	Apply DC braking with a terminal command sent from external equipment.	E01-E09	Terminal [X1] to [X9] Functions (***DCBRK***)	5-102
Forced stop	Forcedly stop the motor for safety.	H56 E01-E09	Deceleration Time for Forced Stop Terminal [X1] to [X9] Functions (***STOP***)	5-65 5-102
Coast to a stop	Use coast-to-stop for safety.	E01-E09	Terminal [X1] to [X9] Functions (***BX***)	5-102

5.3.5 Specifying the acceleration/deceleration (time, mode, and pattern)

To		Function code	Name	Refer to page:
Acceleration/ deceleration time	Accelerate or decelerate the motor within the specified time.	F07 F08	Acceleration Time 1 Deceleration Time 1	5-65
Switch between ACC/DEC times	Switch the acceleration or deceleration time.	E01-E09 E10 E11 E12 E13 E14 E15	Terminal [X1] to [X9] Functions (***RT1***, ***RT2***) Acceleration Time 2 Deceleration Time 2 Acceleration Time 3 Deceleration Time 3 Acceleration Time 4 Deceleration Time 4	5-102 5-65

To		Function code	Name	Refer to page:
Coast-to-stop	Allow the motor to coast to a stop when the run command is turned OFF in order to minimize the variation of deceleration torque.	H11	Deceleration Mode	5-154
	Allow the motor to coast to a stop in order to prevent conflict with the mechanical brake.			
S-curve acceleration/ deceleration	Apply S-curve to the acceleration/deceleration pattern to gradually accelerates/decelerates the motor to reduce an impact that acceleration/deceleration would make on the machinery.	H07 H57 H58 H59 H60	Acceleration/Deceleration Pattern 1st S-curve acceleration range (Leading edge) 2nd S-curve acceleration range (Trailing edge) 1st S-curve deceleration range (Leading edge) 2nd S-curve deceleration range (Trailing edge)	5-65
Curvilinear acceleration/ deceleration	Select the curvilinear acceleration/ deceleration pattern to accelerate or decelerate the motor with its maximum performance.	H07	Acceleration/Deceleration Pattern	5-65
Acceleration/ deceleration with the torque limiter	Enable the torque limiter during acceleration/ deceleration to run the motor with its maximum performance or arbitrary performance.	F40 F41 E16 E17 H73 H76 E01-E09 E20-E24	Torque Limiter 1-1 Torque Limiter 1-2 Torque Limiter 2-1 Torque Limiter 2-2 Torque Limiter (Operating conditions) Torque Limiter (Frequency increment limit for braking) Terminal [X1] to [X9] Functions (***TL2/TL1***) Terminals [Y1] to [Y5A/C] Functions (***IOL***, ***IOL2***)	5-92 5-102 5-118

5.3.6 Adjusting the running performance

To		Function code	Name	Refer to page:
V/f control	Select V/f control pattern suited for the machinery (load).	F37	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1	5-89
	Configure V/f control pattern suited for the machinery (load) by specifying frequency or voltage components at arbitrary points.	H50 H51 H52 H53 H65 H66	Non-linear V/f Pattern 1 (Frequency) (Voltage) Non-linear V/f Pattern 2 (Frequency) (Voltage) Non-linear V/f Pattern 3 (Frequency) (Voltage)	5-62
Torque boost	Ensure a sufficient starting torque.	F09	Torque Boost 1	5-89
	Prevent the motor from over-excitation while assuring a sufficient starting torque.	F37	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1	5-89
Jump frequency	Skip resonance caused by the motor speed and natural frequency of the machinery (load) in running the motor.	C01-C04	Jump Frequency 1 to 4	5-139

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To		Function code	Name	Refer to page:
Suppression of output current fluctuation	Suppress the fluctuation of the inverter output current.	H80	Output Current Fluctuation Damping Gain for Motor 1	5-168
Motor sound	Reduce an audible noise generated by the motor.	F26 F27	Motor Sound (Carrier frequency) (Tone)	5-86

5.3.7 Controlling the motor

5.3.7.1 Motor drive control to be selected

To		Function code	Name	Refer to page:
Drive control	Select the motor drive control (e.g., V/f or vector control) suited for the characteristics of the machinery (load).	F42	Drive Control Selection 1	5-95
Slip compensation	Improve the motor speed control accuracy by compensating for the decrease (slip) in motor rotation.	H68	Slip Compensation 1 (Operating conditions)	5-95
Speed control under vector control	Control the speed control sequence in normal operation.	d01 d02 d03 d04 d06	Speed Control 1 (Speed command filter) (Speed detection filter) P (Gain) I (Integral time) (Output filter)	5-199 5-200
	Apply a speed zero command.	d24	Zero Speed Control	5-85
	Apply a servo-lock command. * (Available only under vector control with speed sensor.)	E01-E09 E20-E24 J97 J98 J99	Terminal [X1] to [X9] Functions (***LOCK***) Terminals [Y1] to [Y5A/C] Functions (***PSET***) Servo-lock (Gain) (Completion timer) (Completion range)	5-102 5-118 5-197
	Control the speed control sequence for jogging operations to obtain higher speed response than that of normal operations.	d09 d10 d11 d12 d13	Speed control (Jogging) (Speed command filter) (Speed detection filter) P (Gain) I (Integral time) (Output filter)	5-200
	Customize the speed feedback input. (Available only under vector control with speed sensor.)	d14 d15 d16 d17	Feedback Input (Pulse input format) (Encoder pulse resolution) (Pulse count factor 1) (Pulse count factor 2)	5-201

* Available for inverters with ROM version 0500 or later.

To		Function code	Name	Refer to page:
Speed control under vector control	Switch the gain and other speed control parameters between two control modes.	A42	Motor/Parameter Switching 2	5-177
		d25	ASR Switching Time	
		E01-E09	Terminals [X1] to [X9] Functions (***M2***)	5-102
			Speed Control 1	5-199
		d01	(Speed command filter)	
		d02	(Speed detection filter)	
		d03	P (Gain)	
		d04	I (Integral time)	
		d06	(Output filter)	
			Speed Control 2	-
		A43	(Speed command filter)	
		A44	(Speed detection filter)	
		A45	P (Gain)	
		A46	I (Integral time)	
		A48	(Output filter)	

5.3.7.2 Motor parameters to be set up

To	Function code	Name	Refer to page:
Use Fuji standard motors (6- or 8-series, 4P, 50 Hz) or Fuji motors exclusively designed for vector control.	P99	Motor 1 Selection	5-148
	P02	Motor 1 (Rated capacity)	5-144
	H03	Data Initialization	5-149
Check the motor nameplate and specify the motor parameters.	P99	Motor 1 Selection	5-148
	F04	Base Frequency 1	5-62
	F05	Rated Voltage at Base Frequency 1	
	F06	Maximum Output Voltage 1	
	F03	Maximum Frequency 1	
		Motor 1	5-144
	P01	(No. of poles)	
	P02	(Rated capacity)	
	P03	(Rated current)	
Perform motor parameter tuning (offline).	P04	Motor 1 (Auto-tuning)	5-145
Set up motor parameters according to tuning or the motor manufacturer's data sheet. (To use the data sheet, conversion is required.)		Motor 1	5-146
	P06	(No-load current)	
	P07	(%R1)	
	P08	(%X)	
	P53, P54	(%X correction factor 1, 2)	5-148
	P09	(Slip compensation gain for driving)	5-147
	P10	(Slip compensation response time)	
	P11	(Slip compensation gain for braking)	
	P12	(Rated slip frequency)	
	P13-P15	(Iron loss factor 1 to 3)	
	P16-P20	(Magnetic saturation factor 1 to 5)	
	P21-P23	(Magnetic saturation extension factor "a" to "c")	
		Motor 1	5-148
	P55	(Torque current under vector control)	
	P56	(Induced voltage factor under vector control)	

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5.3.8 Setting up I/O terminals

To		Function code	Name	Refer to page:
Assignment of functions to general-purpose input terminals	Assign functions (commands) to the digital input terminals to control the inverter.	E01-E09	Terminal [X1] to [X9] Functions	5-102
Assignment of functions to general-purpose output terminals	Output inverter or motor running status to the transistor or contact output signals.	E20-E24	Terminal [Y1] to [Y5A/C] Functions	5-118
Negative logic signaling system for general-purpose I/O terminals	Switch active-ON I/O signals to active-OFF ones, and vice versa.	E01-E09 E20-E24	Terminal [X1] to [X9] Functions Terminal [Y1] to [Y5A/C] Functions	5-102 5-118

5.3.9 Outputting monitored data

To		Function code	Name	Refer to page:
Analog output	Output various monitored data for meters in an analog DC voltage or current via terminal [FMA].	F29 Slide switch SW4 F30 F31	Analog Output [FMA] (Mode selection) Voltage/current output switch for terminal [FMA] (Voltage adjustment) (Function)	5-87 2-22
Pulse output	Output various monitored data for meters in a pulse train via terminal [FMP].	F33 F34 F35	Pulse Output [FMP] (Pulse rate) (Gain to output voltage) (Function)	5-88

5.3.10 Keeping on running the motor

To		Function code	Name	Refer to page:
Reset	Enable the auto-reset function that makes the inverter automatically attempt to reset the tripped state and restart even if an alarm occurs.	H04 H05 E20-E24	Auto-reset (Times) (Reset interval) Terminal [Y1] to [Y5A/C] Functions (***TRY***)	5-150 5-118
Restart after momentary power failure	Continue to run the motor even if a momentary power failure occurs.	F14 H13 H14 H15 H16 H92 H93 E20-E24 E01-E09	Restart Mode after Momentary Power Failure (Mode selection) (Restart time) (Frequency fall rate) (Continuous running level) (Allowable momentary power failure time) Continuity of Running (P) Continuity of Running (I) Terminal [Y1] to [Y5A/C] Functions (***LU***) Terminal [X1] to [X9] Functions (***IL***)	5-72 5-118 5-102
	Restart the inverter at the frequency at which a power failure occurred.			
	Restart the inverter at the starting frequency if a power failure occurs.			
	Search for the idling motor speed to restart the motor without stopping and shock after a momentary power failure.	H09 H46 d67	Starting Mode (Auto search) (Auto search delay time 2) (Auto search)	5-152
Automatic deceleration (Anti-regenerative control)	Prevent the inverter from tripping due to activation of the overvoltage protection in the system not equipped with a DB resistor.	H69 H76 E20-E24	Automatic Deceleration (Mode selection) Torque Limiter (Frequency increment limit for braking) Terminal [Y1] to [Y5A/C] Functions (***IOL***, ***IOL2***)	5-164 5-118
Improvement of the braking capability		H71	Deceleration Characteristics	5-166
Overload prevention control	Decelerate the output frequency in order to decrease the load before the inverter trips due to an overload (heat sink overheat or inverter overload).	H70 E20-E24	Overload Prevention Control Terminal [Y1] to [Y5A/C] Functions (***OLP***)	5-165 5-118
Detection of reference loss	Detect an external frequency command potentiometer failure or a potentiometer wire break, output an alarm, and continue the inverter operation.	E65 E20-E24	Reference Loss Detection (Continuous running frequency) Terminal [Y1] to [Y5A/C] Functions (***REF OFF***)	5-136 5-118
Light alarm	Let the inverter continue the current operation without tripping even if a particular minor alarm occurs.	H81 H82 E20-E24	Light Alarm Selection 1 Light Alarm Selection 2 Terminal [Y1] to [Y5A/C] Functions (***L-ALM***)	5-169 5-118

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5.3.11 Outputting status signals

To		Function code	Name	Refer to page:
Detection of frequency	Detect the motor running speed level.	E31 E32 E36 E54 E20-E24	Frequency Detection 1 (Level) (Hysteresis width) Frequency Detection 2 (Level) Frequency Detection 3 (Level) Terminal [Y1] to [Y5A/C] Functions (***FDT***, ***FDT2***, ***FDT3***)	5-128 5-118
Frequency arrival	Judge whether the motor speed arrives at the target value.	E30 E20-E24	Frequency Arrival (Hysteresis width) Terminal [Y1] to [Y5A/C] Functions (***FAR***, ***FAR3***)	5-127 5-118
Torque detection	Check that the output torque reaches the predetermined level and is not excessively large.	E78 E79 E20-E24	Torque Detection 1 (Level) (Timer) Terminal [Y1] to [Y5A/C] Functions (***B/D***, ***TD1***)	5-137 5-118
Low torque detection	Detect low torque (no-load state) to signal a belt break or other problems in the driven machinery.	E80 E81 E20-E24	Torque Detection 2/Low Torque Detection (Level) (Timer) Terminal [Y1] to [Y5A/C] Functions (***B/D***, ***U-TL***, ***TD2***)	5-137 5-118
Current detection	Check that the current more than the predetermined level flows and excessive current does not flow.	E34 E35 E55 E56 E20-E24	Overload Early Warning/Current Detection (Level) (Timer) Frequency Detection 3 (Level) (Timer) Terminal [Y1] to [Y5A/C] Functions (***ID***, ***ID3***, ***OL***)	5-128 5-128 5-118
Low output current detection	Detect low torque (no-load state) to signal a belt break or other problems in the driven machinery.	E37 E38 E20-E24	Current Detection 2/Low Current Detection (Level) (Timer) Terminal [Y1] to [Y5A/C] Functions (***ID2***, ***ITL***, ***IDL***)	5-128 5-118
Low voltage	Output low voltage status.	E20-E24	Terminal [Y1] to [Y5A/C] Functions (***LU***)	5-118

5.3.12 Running in various operation modes

To		Function code	Name	Refer to page:
Jogging	Jog (inch) the motor with the keys on the keypad.	C20	Jogging Frequency	5-141
		H54	Acceleration Time (Jogging)	5-65
		H55	Deceleration Time (Jogging)	
	Jog (inch) the motor with input signals to terminal [FWD] or [REV].	E01-E09	Terminal [X1] to [X9] Functions (***JOG***)	5-102
Auto energy saving operation	Enable auto energy saving operation.	F37	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1	5-89
		H67	Auto Energy Saving Operation (Mode selection)	
	Manage energy.	E51	Display Coefficient for Input Watt-hour Data	5-133
		E01-E09	Terminal [X1] to [X9] Functions (***SW50***, ***SW60***)	5-102
Commercial power switching sequence	Switch to commercial-power operation for energy saving or backup power supply to be used when an alarm occurs in the inverter.	J22	Commercial Power Switching Sequence	5-115
		H13	Restart Mode after Momentary Power Failure (Restart time)	5-78
		E01-E09	Terminal [X1] to [X9] Functions (***ISW50***, ***ISW60***)	5-102
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***SW88***, ***SW52-1***, ***SW52-2***)	5-118
Switching between motors	Drive two or more motors with a single inverter by switching between those motors.	A42 b42 r42	Motor/Parameter Switching 2 to 4 (Mode selection)	5-177
		E01-E09	Terminal [X1] to [X9] Functions (***M2***, ***M3***, ***M4***)	5-102
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***SWM1, 2, 3, 4***)	5-118
Brake signal	Use brake signals available for vertical carrier machines.		Brake Signal	5-195
		J68	(Brake-OFF current)	
		J69	(Brake-OFF frequency/speed)	
		J70	(Brake-OFF timer)	
		J71	(Brake-ON frequency/speed)	
		J72	(Brake-ON timer)	
		J95	(Brake-OFF torque)	
		J96	(Speed selection)	
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***BRKS***)	5-118
Switching between control parameters	Run the motor with control parameters suited for variable conditions (e.g., inertia) of the machinery equipped with gear change.	A42 b42 r42	Motor/Parameter Switching 2 to 4 (Mode selection)	5-177
		E01-E09	Terminal [X1] to [X9] Functions (***M2***, ***M3***, ***M4***)	5-102
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***SWM1, 2, 3, 4***)	5-118
		d25	ASR Switching Time	5-179

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5.3.13 Setting up controls suited for individual applications

5.3.13.1 Droop control

To	Function code	Name	Refer to page:
Eliminate load unbalance using the droop control.	H28 E01-E09	Droop Control Terminals [X1] to [X9] Functions (***DROOP***)	5-156 5-102

5.3.13.2 PID process control

To		Code	Name	Refer to page:
Exercise the process control for pressure, flow, temperature, etc.		J01	PID Control (Mode selection)	5-180
Normal/inverse operation	Switch between normal/reverse operation for the PID output in cooling and heating.	J01 E01-E09	PID Control (Mode selection) Terminal [X1] to [X9] Functions (***IVS***)	5-180 5-102
PID command	Specify a PID command using the keypad.	J02	PID Control (Remote command ***SV***)	5-181
	Specify a PID command with analog input.	J02 E61 E62 E63	PID Control (Remote command ***SV***) Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-181 5-135
		C51 C52	Bias (PID command 1) (Bias value) (Bias base point)	5-143
		C32 C34 C37 C39 C42 C44	Analog Input Adjustment for: [12] (Gain) [12] (Gain base point) [C1] (Gain) [C1] (Gain base point) [V2] (Gain) [V2] (Gain base point)	5-142
		C31 C36 C41	Analog Input Adjustment for: [12] (Offset) [C1] (Offset) [V2] (Offset)	5-142
		C33 C38 C43	Analog Input Adjustment for: [12] (Filter time constant) [C1] (Filter time constant) [V2] (Filter time constant)	5-142
		C35 C45	Analog Input Adjustment for: [12] (Polarity) [V2] (Polarity)	5-142
	Specify a PID command with ***UP*** or ***DOWN*** command.	J02 E01-E09 H61	PID Control (Remote command ***SV***) Terminal [X1] to [X9] Functions (***UP***, ***DOWN***) ***UP***/***DOWN*** Control (Initial frequency setting)	5-181 5-102 5-58
	Specify a PID command via a communications link.	J02	PID Control (Remote command ***SV***)	5-181

To		Code	Name	Refer to page:
PID command	Define two or more PID commands beforehand and switch between them with "Select multi-frequency" terminal commands.	J02	PID Control (Remote command ***SV***)	5-181
		E01-E09	Terminal [X1] to [X9] Functions (***SS4***, ***SS8***)	5-102
		C08	Multi-frequency 4	5-139
		C12	Multi-frequency 8	
		C16	Multi-frequency 12	
PID feedback	Set up analog input feedback for PID control.	E61	Terminal [12] Extended Function	5-135
		E62	Terminal [C1] Extended Function	
		E63	Terminal [V2] Extended Function	
		C32	Analog Input Adjustment for: [12] (Gain)	5-142
		C34	[12] (Gain base point)	
		C37	[C1] (Gain)	
		C39	[C1] (Gain base point)	
		C42	[V2] (Gain)	
		C44	[V2] (Gain base point)	
		C31	Analog Input Adjustment for: [12] (Offset)	5-142
		C36	[C1] (Offset)	
		C41	[V2] (Offset)	
		C33	Analog Input Adjustment for: [12] (Filter time constant)	5-142
		C38	[C1] (Filter time constant)	
		C43	[V2] (Filter time constant)	
PID optimization	Optimize the PID processor.		PID Control	5-185
		J03	P (Gain)	
		J04	I (Integral time)	
		J05	D (Differential time)	
		J06	(Feedback filter)	
		J56	(Speed command filter)	5-194
Anti reset windup	Suppress overshoot in control with the PID processor.	J10	PID Control (Anti reset windup)	5-191
Alarm output	Output an alarm signal associated with PID control (e.g., deviation alarm and absolute-value alarm).		PID Control	5-191
		J11	(Select alarm output)	
		J12	(Upper level alarm (AH))	
		J13	(Lower level alarm (AL))	
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***PID-ALM***)	5-118
	Detect a wire break for PID feedback.	H91	PID Feedback Wire Break Detection	5-173
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***C1OFF***)	5-118
Slow flowrate stop feature	Use the slow flowrate stop feature, enabling energy saving operation.		PID Control	5-192
		J15	(Stop frequency for slow flowrate)	
		J16	(Slow flowrate level stop latency)	
		J17	(Starting frequency)	
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***PID-STP***)	5-118
		J08	PID Control (Pressurization starting frequency)	5-189
		J09	PID Control (Pressurizing time)	
Output limiter	Limit the PID output with the upper and lower limiters.		PID Control	5-193
		J18	(Upper limit of PID process output)	
		J19	(Lower limit of PID process output)	
PID control	Hold/reset the PID processor or cancel PID control from external equipment.	E01-E09	Terminal [X1] to [X9] Functions (***PID-HLD***, ***Hz/PID***, ***PID-RST***)	5-102

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To		Code	Name	Refer to page:
"Under PID control" signal output	Output the "Under PID control" signal from the specified output terminal.	E20-E24	Terminal [Y1] to [Y5A/C] Functions (***PID-CTL***)	5-118
Display of process value	Convert a control amount into a physical quantity of the process and display it on the keypad.	E40 E41	PID Display Coefficient A PID Display Coefficient B	5-130

5.3.13.3 PID dancer control

To		Function code	Name	Refer to page:
Exercise the speed control for dancer positioning, etc.		J01 J62	PID Control (Mode selection) (PID control block selection)	 5-180 5-194
PID command	Specify a PID command using the keypad.	J02 J57	PID Control (Remote command ***SV***) (Dancer reference position)	 5-181 5-194
	Specify a PID command with analog input.	J02 E61 E62 E63	PID Control (Remote command ***SV***) Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-181 5-135
		C51 C52	Bias (PID command 1) (Bias value) (Bias base point)	 5-143
		C32 C34 C37 C39 C42 C44	Analog Input Adjustment for: [12] (Gain) [12] (Gain base point) [C1] (Gain) [C1] (Gain base point) [V2] (Gain) [V2] (Gain base point)	 5-142
		C31 C36 C41	Analog Input Adjustment for: [12] (Offset) [C1] (Offset) [V2] (Offset)	 5-142
		C33 C38 C43	Analog Input Adjustment for: [12] (Filter time constant) [C1] (Filter time constant) [V2] (Filter time constant)	 5-142
		C35 C45	Analog Input Adjustment for: [12] (Polarity) [V2] (Polarity)	 5-142
	Specify a PID command with ***UP*** or ***DOWN*** command.	J02 E01-E09 H61	PID Control (Remote command ***SV***) Terminal [X1] to [X9] Functions (***UP***, ***DOWN***) ***UP***/***DOWN*** Control (Initial frequency setting)	5-181 5-102 5-58
	Specify a PID command via a communications link.	J02	PID Control (Remote command ***SV***)	5-181

To		Function code	Name	Refer to page:
PID command	Define two or more PID commands beforehand and switch between them with "Select multi-frequency" terminal commands.	J02	PID Control (Remote command ***SV***)	5-181
		E01-E09	Terminal [X1] to [X9] Functions (***SS4***, ***SS8***)	5-102
		C08	Multi-frequency 4	5-139
		C12	Multi-frequency 8	
		C16	Multi-frequency 12	
PID feedback	Set up analog input feedback for PID control.	E61	Terminal [12] Extended Function	5-135
		E62	Terminal [C1] Extended Function	
		E63	Terminal [V2] Extended Function	
			Analog Input Adjustment for:	5-142
		C32	[12] (Gain)	
		C34	[12] (Gain base point)	
		C37	[C1] (Gain)	
		C39	[C1] (Gain base point)	
		C42	[V2] (Gain)	
		C44	[V2] (Gain base point)	
			Analog Input Adjustment for:	5-142
		C31	[12] (Offset)	
		C36	[C1] (Offset)	
		C41	[V2] (Offset)	
			Analog Input Adjustment for:	5-142
		C33	[12] (Filter time constant)	
		C38	[C1] (Filter time constant)	
		C43	[V2] (Filter time constant)	
PID optimization	Optimize the PID processor.		PID Control	5-185
		J03	P (Gain)	
		J04	I (Integral time)	
		J05	D (Differential time)	
		J06	(Feedback filter)	
		J56	(Speed command filter)	5-194
	Switch the PID processor constants if the dancer roll comes into the vicinity of the target position.		PID Control	5-194
		J58	(Detection width of dancer position deviation)	
		J59	P (Gain) 2	
		J60	I (Integral time) 2	
		J61	D (Differential time) 2	
Anti reset windup	Suppress overshoot in control with the PID processor.	J10	PID Control (Anti reset windup)	5-191
Alarm output	Output an alarm signal associated with PID control (e.g., deviation alarm and absolute-value alarm).		PID Control	5-191
		J11	(Select alarm output)	
		J12	(Upper level alarm (AH))	
		J13	(Lower level alarm (AL))	
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***PID-ALM***)	5-118
	Detect a wire break for PID feedback.	H91	PID Feedback Wire Break Detection	5-173
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***C1OFF***)	5-118
Output limiter	Limit the PID output with the upper and lower limiters.		PID Control	5-193
		J18	(Upper limit of PID process output)	
		J19	(Lower limit of PID process output)	
PID control	Hold/reset the PID processor or cancel PID control from external equipment.	E01-E09	Terminal [X1] to [X9] Functions (***PID-HLD***, ***Hz/PID***, ***PID-RST***)	5-102
"Under PID control" signal output	Output the "Under PID control" signal from the specified output terminal.	E20-E24	Terminal [Y1] to [Y5A/C] Functions (***PID-CTL***)	5-118

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To		Function code	Name	Refer to page:
Display of process value	Convert a control amount into a physical quantity of the process and display it on the keypad.	E40 E41	PID Display Coefficient A PID Display Coefficient B	5-130

5.3.14 Customizing the keypad

To	Function code	Name	Refer to page:
Protect function code data from accidentally getting changed.	F00 E01-E09	Data Protection Terminal [X1] to [X9] Functions (***WE-KP***)	5-52 5-102
Revert function code data to the initial values.	H03	Data Initialization	5-149
Initialize motor parameters.			
Remove restrictions on the menu display to use various checking functions on the keypad.	E52	Keypad (Menu display mode)	5-134
Suppress fluctuation of unstable, hard-to-read display on the keypad.	E42	LED Display Filter	5-131
Specify the running status item to be monitored and displayed on the LED monitor.	E43 E48	LED Monitor (Item selection) (Speed monitor item)	5-132
Display the output frequency even when the inverter is stopped.	E44	LED Monitor (Display when stopped)	5-133
Set up the display items for the multi-function keypad.	E45 E46 E47	LCD Monitor (Item selection) (Language selection) (Contrast control)	-
Receive external analog sensor signals from sensors and convert their values into physical quantities to display.	E61 E62 E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-135
	E40 E41	PID Display Coefficient A PID Display Coefficient B	5-130
Display the load shaft speed and line speed.	E50	Coefficient for Speed Indication	5-133
Display the input watt-hour data (kWh) multiplied by a display coefficient.	E51	Display Coefficient for Input Watt-hour Data	5-133
Convert a PID command and its feedback into physical quantities to display.	E40 E41	PID Display Coefficient A PID Display Coefficient B	5-130

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5.3.15 Controlling the inverter via communications line

To	Function code	Name	Refer to page:
Specify communications conditions.		RS-485 Communication 1	5-205
	y01	(Station address)	
	y02	(Communications error processing)	
	y03	(Timer)	
	y04	(Baud rate)	
	y05	(Data length)	
	y06	(Parity check)	
	y07	(Stop bits)	
	y08	(No-response error detection time)	
	y09	(Response interval)	
	y10	(Protocol selection)	
	SW3	< Switching the terminating resistor of the RS-485 communications port 1 >	2-22
		RS-485 Communication 2	5-205
	y11	(Station address)	
	y12	(Communications error processing)	
	y13	(Timer)	
	y14	(Baud rate)	
	y15	(Data length)	
	y16	(Parity check)	
	y17	(Stop bits)	
	y18	(No-response error detection time)	
	y19	(Response interval)	
	y20	(Protocol selection)	
	SW2	< Switching the terminating resistor of the RS-485 communications port 2 >	2-22
Specify the sources of run and frequency commands.	H30	Communications Link Function (Mode selection)	5-157
	y98	Bus Link Function (Mode selection)	5-208
	y99	Loader Link Function (Mode selection)	5-209
Change function code data frequently via the communications link.	y97	Communication Data Storage Selection	5-208
Switch between frequency or run commands via the communications link.	E01-E09	Terminal [X1] to [X9] Functions (***LE***)	5-102
Use inverter input/output signals as general-purpose DI/DO.	E01-E09	Terminal [X1] to [X9] Functions (***U-DI***)	5-102
	E20-E24	Terminal [Y1] to [Y5A/C] Functions (***U-DO***)	5-118

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5.3.16 Activating the protective functions

5.3.16.1 Protection of machinery with limiters

To	Function code	Name	Refer to page:
Limit the frequency to protect the machinery.	F15 F16 H63	Frequency Limiter (High) (Low) Low Limiter (Mode selection)	5-80
	F03	Maximum Frequency 1	5-62
	H64	Low Limiter (Lower limiting frequency)	5-164
Limit the motor rotational direction to protect the machinery.	H08	Rotational Direction Limitation	5-152
Limit the motor output torque with the current limiter to protect the machinery.	F43 F44	Current Limiter (Mode selection) (Level)	5-97
	E20-E24	Terminal [Y1] to [Y5A/C] Functions (***IOL***, ***IOL2***)	5-118
Limit the motor output torque with the torque limiter to protect the machinery.	F40 F41 E16 E17	Torque Limiter 1-1 Torque Limiter 1-2 Torque Limiter 2-1 Torque Limiter 2-1	5-92
	E61 E62 E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	5-135
	H73 H74 H75 H76	Torque Limiter (Operating conditions) (Control target) (Target quadrants) (Frequency increment limit for braking)	5-166
	E01-E09	Terminal [X1] to [X9] Functions (***TL2/TL1***)	5-102
	E20-E24	Terminal [Y1] to [Y5A/C] Functions (***IOL***, ***IOL2***)	5-118
Limit the overspeed level with the speed limiter to protect the machinery.	d32 d33	Torque control (Speed limit 1) (Speed limit 2)	5-204

5.3.16.2 Protection of motors

To		Function code	Name	Refer to page:
Electronic thermal overload protection	Protect the motor with the electronic thermal overload protection function.	F10 F11 F12	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics) (Overload detection level) (Thermal time constant)	5-68
Overload early warning	Output an overload early warning before the inverter trips with the electronic thermal overload protection.	F10 F12	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics) (Thermal time constant)	5-68
		E34	Overload Early Warning/Current Detection (Level)	5-128
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***OL***)	5-118

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To		Function code	Name	Refer to page:
Motor overheat	Protect the motor from overheating with the PTC or NTC thermistor embedded in the motor.	H26 H27	Thermistor (for motor) (Mode selection) (Level)	5-155
	Use the Fuji VG motor (exclusively designed for vector control) having a built-in NTC thermistor.	SW5	< Switching the terminal [V2] function between V2 and PTC/NTC >	2-22
Detection with thermistor	Detect the current voltage with the PTC thermistor embedded in the motor and issue an alarm.	H26 H27	Thermistor (for motor) (Mode selection) (Level)	5-155
		SW5	< Switching the terminal [V2] function between V2 and PTC/NTC >	2-22
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***THM***)	5-118
Dew condensation prevention	Prevent the motor being stopped from dew condensation by feeding DC power when the motor is used in cold climates.	J21	Dew Condensation Prevention (Duty)	5-193
		F21 F22	DC Braking 1 (Braking level) (Braking time)	5-81
		E01-E09	Terminal [X1] to [X9] Functions (***DWP***)	5-102

5.3.16.3 Using other protective and safety functions

To		Function code	Name	Refer to page:
Trip after momentary power failure (No restart)	Trip the inverter immediately if a momentary power failure occurs.	F14 H15 H92 H93	Restart Mode after Momentary Power Failure (Mode selection) (Continuous running level) Continuity of Running (P) Continuity of Running (I)	5-72
	Shut down the inverter output immediately to allow the motor to coast to a stop without trip if a momentary power failure occurs. Trip the inverter when the power is restored.			
	Decelerate the motor to a stop immediately if a momentary power failure occurs. Trip the inverter after the frequency drops down to zero.	E20-E24	Terminal [Y1] to [Y5A/C] Functions (***LU***, ***IPF***)	5-118
		E01-E09	Terminal [X1] to [X9] Functions (***IL***)	5-102
External alarm	Shut down the inverter output immediately in the event of an abnormal situation in peripheral equipment.	E01-E09	Terminal [X1] to [X9] Functions (***THR***)	5-102
Protective/ maintenance functions	Enable or disable the following functions. - Automatic lowering of carrier frequency - Input/output phase loss protection - Judgment on the life of DC link bus capacitor - DC fan lock detection - Braking transistor failure detection	H98	Protection/Maintenance Function (Mode selection)	5-174
Braking resistor	Use an external braking resistor and protect it with the electronic thermal overload protection function.	F50 F51 F52	Electronic Thermal Overload Protection for Braking Resistor (Discharging capability) (Allowable average loss) (Resistance)	5-98
Braking transistor	Detect a breakdown of the braking resistor to protect the inverter.	E20-E24	Terminal [Y1] to [Y5A/C] Functions (***DBAL***)	5-118

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To		Function code	Name	Refer to page:
Communications error	Detect a communications error.	y02 y03 y08	RS-485 Communication 1 (Communications error processing) (Timer) (No-response error detection time)	5-205
		y12 y13 y18	RS-485 Communication 2 (Communications error processing) (Timer) (No-response error detection time)	
PID feedback wire break	Stop the system if a PID feedback wire breaks (current input on [C1]).	H91	PID Feedback Wire Break Detection	5-173
Speed deviation out of the specified range	Detect that a deviation between the commanded and detected speeds is out of the specified range.	d21 d22	Speed Agreement/PG Error (Hysteresis width) (Detection timer)	5-203
		d23	PG Error Processing	
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***PG-ERR***)	5-118
PG error (PG wire break)	Detect a PG error such as a PG wire break.	d21 d22	Speed Agreement/PG Error (Hysteresis width) (Detection timer)	5-203
		E20-E24	Terminal [Y1] to [Y5A/C] Functions (***PG-ERR***)	5-118
	Ignore a PG wire break alarm.	E01-E09	Terminal [X1] to [X9] Functions (***PG-CCL***)	5-102
Forced stop	Use the forced stop function for safety.	H56 E01-E09	Deceleration Time for Forced Stop Terminal [X1] to [X9] Functions (***STOP***)	5-65 5-102
Coast to a stop	Use the coast-to-stop function for safety.	E01-E09	Terminal [X1] to [X9] Functions (***BX***)	5-102
STOP key priority	Always enable the STOP key for safety.	H96	STOP Key Priority/Start Check Function	5-173
Start check function	Check in specified situation changes whether any run command has been turned ON for safety. This is to prevent the motor from running suddenly.	H96	STOP Key Priority/Start Check Function	5-173
Heat sink overheat early warning	Issue a heat sink overheat early warning before an overheat trip actually happens.	E20-E24	Terminal [Y1] to [Y5A/C] Functions (***OH***)	5-118
Cancel of current limit processing	Cancel the current limit processing if invoking it drops the motor toque temporarily, causing a problem.	H12	Instantaneous Overcurrent Limiting (Mode selection)	5-154
Alarm	Clear alarm history and relevant information stored in the inverter.	E01-E09 H97 E20-E24	Terminal [X1] to [X9] Functions Clear Alarm Data Terminal [Y1] to [Y5A/C] Functions	5-102 5174 5-118
	Cause the inverter to generate a mock alarm.	H45	Mock Alarm	5-163

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5.3.17 Maintenance

5.3.17.1 Maintenance of inverters

To		Function code	Name	Refer to page:
Service life of DC link bus capacitor	Set up the load conditions that match the actual operating conditions at the user site for measuring the service life of the DC link bus capacitor.	H42 H47	Capacitance of DC Link Bus Capacitor Initial Capacitance of DC Link Bus Capacitor	5-159
Judgment on service life	Disable the judgment on the service life of the DC link bus capacitor, if accurate measurement of the capacitance is not available due to the use of auxiliary input for control power.	H98	Protection/Maintenance Function (Mode selection)	5-174
Cooling fan ON/OFF control	Prolong the service life of the inverter cooling fans and reduce fan noise during the inverter stop.	H06 E20-E24	Cooling Fan ON/OFF Control Terminal [Y1] to [Y5A/C] Functions (***FAN***, ***LIFE***)	5-151 5-118

5.3.17.2 Maintenance of machinery

To		Function code	Name	Refer to page:
Cumulative motor run time	Check the cumulative motor run time.	H94	Cumulative Motor Run Time 1	5-167
	Count the cumulative motor run time even when the motor is driven by commercial power.	E01-E09	Terminal [X1] to [X9] Functions (***CRUN-M1, M2, M3, M4***)	5-102
Startup count for motor	Check the startup count for judging the service life of the drive belt used in the machinery if the belt deteriorates due to the starting torque applied every time of startups.	H44	Startup Counter for Motor 1	5-162
Maintenance timer	Signal the need of the maintenance, based on the cumulative motor run time.	H78 E20-E24	Maintenance Interval (M1) Terminal [Y1] to [Y5A/C] Functions (***MNT***)	5-167 5-118
	Signal the need of the maintenance, based on the inverter startup count.	H79 E20-E24	Preset Startup Count for Maintenance (M1) Terminal [Y1] to [Y5A/C] Functions (***MNT***)	5-168 5-118
Switching between remote and local modes	Separate the inverter from the system and drive it with commands entered from the keypad, for maintenance.	E01-E09 E20-E24	Terminal [X1] to [X9] Functions (***LOC***) Terminal [Y1] to [Y5A/C] Functions (***RMT***)	5-102 5-118

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5.4 Details of Function Codes

This section provides the details of the function codes. The descriptions are, in principle, arranged in the order of function code groups and in numerical order. However, highly relevant function codes are collectively described where one of them first appears.

5.4.1 F codes (Fundamental functions)

F00 **Data Protection**

F00 specifies whether to protect function code data (except F00) and digital reference data (such as frequency command and PID command) from accidentally getting changed by pressing the ⌃ / ⌄ keys on the keypad.

Data for F00	Changing function code data		Changing digital reference data with the ⌃ / ⌄ keys
	From the keypad	Via communications link	
0	Allowed	Allowed	Allowed
1	Not allowed *	Allowed	Allowed
2	Allowed	Allowed	Not allowed
3	Not allowed *	Allowed	Not allowed

*Only F00 data can be modified with the keypad, while all other function codes cannot.

To change F00 data, simultaneous keying of STOP + ⌃ (from 0 to 1) or STOP + ⌄ (from 1 to 0) keys is required.

For similar purposes, ***WE-KP***, a signal enabling editing of function code data from the keypad is provided as a terminal command for digital input terminals. (Refer to the descriptions of E01 through E09. data = 19)

The relationship between the terminal command ***WE-KP*** and F00 data are as shown below.

WE-KP	Changing function code data	
	From the keypad	Via communications link
OFF	Not allowed	Follow the F00 setting
ON	Follow the F00 setting	

Note

- If you mistakenly assign the terminal command ***WE-KP***, you no longer edit or modify function code data. In such a case, temporarily turn this ***WE-KP***-assigned terminal ON and reassign the ***WE-KP*** to a correct command.
- ***WE-KP*** is only a signal that allows you to change function code data, so it does not protect the frequency settings or PID speed command specified by the ⌃ and ⌄ keys.

F01	Frequency Command 1	F18 (Bias, Frequency command 1) C30 (Frequency Command 2) C31 to C35 (Analog Input Adjustment for [12]) C36 to C39 (Analog Input Adjustment for [C1]) C41 to C45 (Analog Input Adjustment for [V2]) C50 (Bias (Frequency command 1), Bias base point) H61 (*UP/DOWN* Control, Initial frequency setting) d59, d61 to d63 (Command (Pulse Rate Input))

F01 or C30 sets the command source that specifies reference frequency 1 or reference frequency 2, respectively.

Data for F01, C30	Function
0	Enable ⌃ / ⌄ keys on the keypad.
1	Enable the voltage input to terminal [12] (0 to ±10 VDC, maximum frequency obtained at ±10 VDC).
2	Enable the current input to terminal [C1] (+4 to +20 mA DC, maximum frequency obtained at +20 mA DC).
3	Enable the sum of voltage (0 to ±10 VDC) and current inputs (+4 to +20 mA DC) given to terminals [12] and [C1], respectively. See the two items listed above for the setting range and the value required for maximum frequencies. Note: If the sum exceeds the maximum frequency (F03), the maximum frequency will apply.
5	Enable the voltage input to terminal [V2] (0 to ±10 VDC, maximum frequency obtained at ±10 VDC). (SW5 on the control circuit board should be turned to the V2 position (factory default).)
7	Enable ***UP*** and ***DOWN*** commands assigned to digital input terminals. The ***UP*** and ***DOWN*** should be assigned to any of digital input terminals [X1] to [X9] beforehand with any of E01 to E09 (data = 17 or 18).
8	Enable ⌃ / ⌄ keys on the keypad (balanceless-bumpless switching available).
11	Enable a digital input interface card (option). (For details, refer to the Digital Input Interface Card Instruction Manual.)
12	Enable the "Pulse train input" ***PIN*** command assigned to digital input terminal [X7] with E07 (data = 48), or the optional PG interface card.

Setting up a reference frequency

[1] Using the keypad (F01 = 0 (factory default) or 8)

(1) Set F01 data to "0" or "8." This can be done only when the inverter is in Running mode.

(2) Press the ⌃ / ⌄ key to display the current reference frequency. The lowest digit on the LED monitor will blink.

(3) To change the reference frequency, press the ⌃ / ⌄ key again. To save the new setting into the inverter's memory, press the FUNC/DATA key (when E64 = 1 (factory default)). When the power is turned ON next time, the new setting will be used as an initial reference frequency.

Tip

- In addition to the saving with the FUNC/DATA key described above, auto-saving is also available (when E64 = 0).
- If you have set F01 data to "0" or "8," but have selected a frequency command source other than frequency command 1 (i.e., frequency command 2, frequency command via communication, or multi-frequency command), then the ⌃ and ⌄ keys are disabled to change the current frequency command even in Running mode. Pressing either of these keys just displays the current reference frequency.

Function Code Details
F00-F01
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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Tip

- When you start specifying the reference frequency or any other parameter with the ⌃ / ⌄ key, the least significant digit on the display blinks; that is, the cursor lies in the least significant digit. Holding down the ⌃ / ⌄ key changes data in the least significant digit and generates a carry, while the cursor remains in the least significant digit.
- While the least significant digit is blinking by pressing the ⌃ / ⌄ key, holding down the PRG/RESET key for more than 1 second moves the cursor from the least significant digit to the most significant digit. Further holding it down moves the cursor to the next lower digit. This cursor movement allows you to easily move the cursor to the desired digit and change the data in higher digits.
- Setting F01 data to "8" enables the balanceless-bumpless switching. When the frequency command source is switched to the keypad from any other source, the inverter inherits the current frequency that has applied before switching, providing smooth switching and shockless running.

[2] Using analog input (F01 = 1 to 3, or 5)

When any analog input (voltage input to terminals [12] and [V2], or current input to terminal [C1]) is selected by F01, it is possible to arbitrarily specify the reference frequency by multiplying the gain and adding the bias. The polarity can be selected and the filter time constant and offset can be adjusted.

Adjustable elements of frequency command 1

Data for F01	Input terminal	Input range	Bias		Gain		Polarity	Filter time constant	Offset
			Bias	Base point	Gain	Base point			
1	[12]	0 to +10 V, -10 to +10V	F18	C50	C32	C34	C35	C33	C31
2	[C1]	4 to 20 mA	F18	C50	C37	C39	-	C38	C36
3	[12] + [C1] (Sum of the two values)	0 to +10 V, -10 to +10 V	F18	C50	C32	C34	C35	C33	C31
		4 to 20 mA	F18	C50	C37	C39	-	C38	C36
5	[V2]	0 to +10 V, -10 to +10 V	F18	C50	C42	C44	C45	C43	C41

■ Offset (C31, C36, C41)

C31, C36 or C41 specifies an offset for analog input voltage or current. The offset also applies to signals sent from the external equipment.

■ Filter time constant (C33, C38, C43)

C33, C38, or C43 specifies a filter time constant for analog input voltage or current. Choose an appropriate value for the time constant taking into account the response speed of the mechanical system since a large time constant slows down the response. When the input voltage fluctuates due to noise, specify a larger time constant.

■ Polarity (C35, C45)

C35 or C45 specifies the input range for analog input voltage.

Data for C35/C45	Terminal input specifications
0	-10 to +10 VDC
1	0 to +10 VDC (negative value of voltage is regarded as 0 V)

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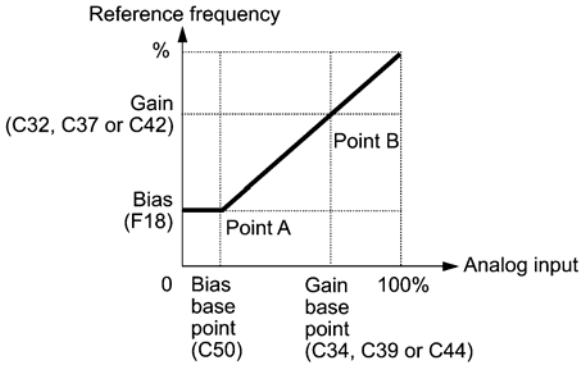
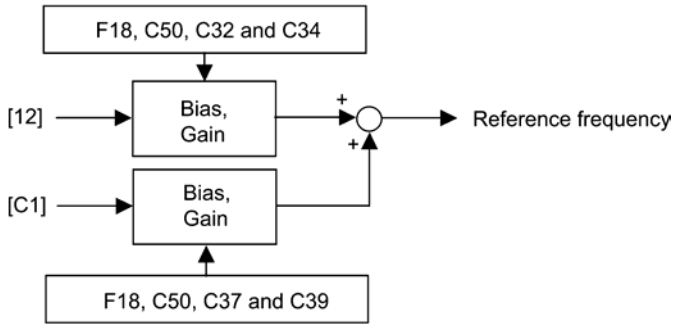
■ Gain and bias



Note If F01 = 3 (the sum of [12] + [C1] is enabled), the bias and gain are independently applied to each of the voltage and current inputs given to terminals [12] and [C1], and the sum of the two values is applied as the reference frequency.



In the case of unipolar input
(terminal [12] with C35 = 1, terminal [C1], terminal [V2] with C45 = 1)

As shown in the graph above, the relationship between the analog input and the reference frequency specified by frequency command 1 is determined by points "A" and "B." Point "A" is defined by the combination of the bias (F18) and its base point (C50); Point "B," by the combination of the gain (C32, C37 or C42) and its base point (C34, C39 or C44).

The combination of C32 and C34 applies to terminal [12], that of C37 and C39, to [C1], and that of C42 and C44, to [V2].

Configure the bias (F18) and gain (C32, C37 or C42), assuming the maximum frequency as 100%, and the bias base point (C50) and gain base point (C34, C39 or C44), assuming the full scale (10 VDC or 20 mA DC) of analog input as 100%.

Note
- The analog input less than the bias base point (C50) is limited by the bias value (F18).
- Specifying that the data of the bias base point (C50) is equal to or greater than that of each gain base point (C34, C39 or C44) will be interpreted as invalid, so the inverter will reset the reference frequency to 0 Hz.

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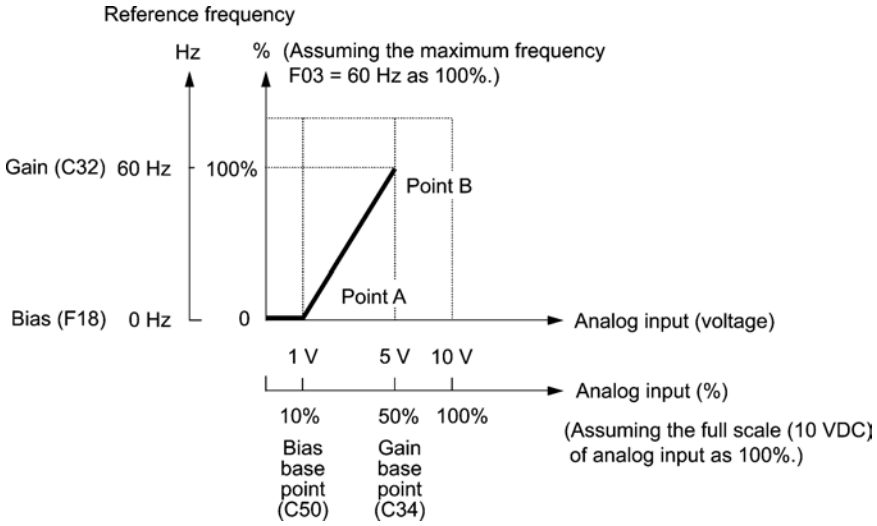
Example: Setting the bias, gain, and their base points when the reference frequency 0 to 60 Hz follows the analog input of 1 to 5 VDC applied on terminal [12] with the maximum frequency 60 Hz (F03)



(Point A)

To set the reference frequency to 0 Hz for an analog input being at 1 V, set the bias to 0% (F18 = 0). Since 1 V is the bias base point and it is equal to 10% of 10 V (full scale of terminal [12]), set the bias base point to 10% (C50 = 10).

(Point B)

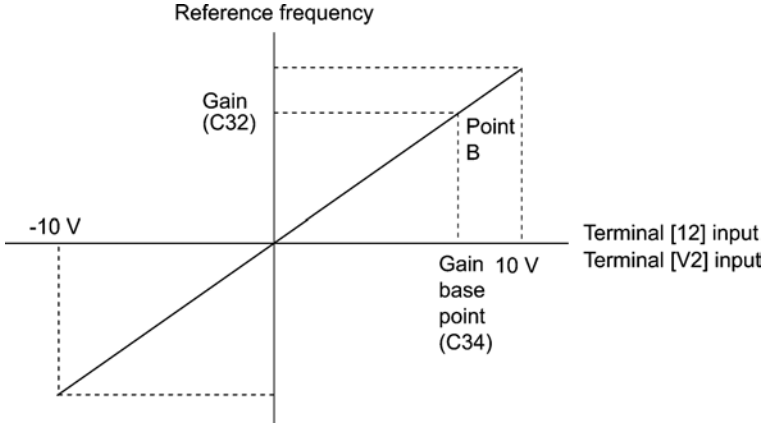
To specify the maximum frequency equal to the reference frequency for an analog input being at 5 V, set the gain to 100% (C32 = 100). Since 5 V is the gain base point and it is equal to 50% of 10 V (full scale of terminal [12]), set the gain base point to 50% (C34 = 50).

Note The setting procedure for specifying a gain or bias alone without changing any base points is the same as that of Fuji conventional inverters of FRENIC5000G11S/P11S series, FVR-E11S series, etc.

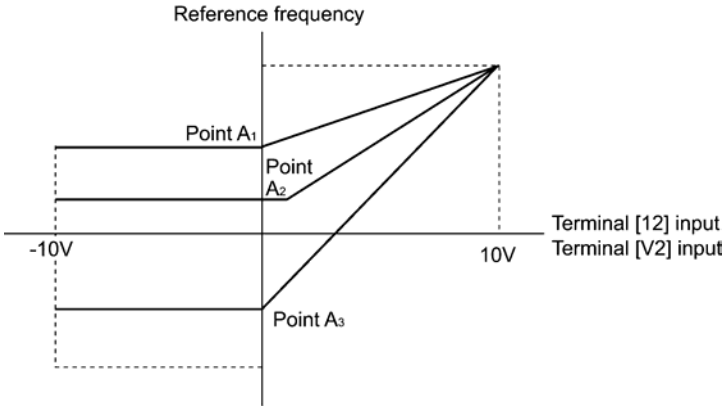
In the case of bipolar input
(terminal [12] with C35 = 0, terminal [V2] with C45 = 0)

Setting C35 and C45 data to "0" enables terminals [12] and [V2] to be used for bipolar input (-10 V to +10 V), respectively.

When both F18 (Bias) and C50 (Bias base point) are set to "0," the negative and positive voltage inputs produce reference frequencies symmetric about the origin point as shown below.



Note • Configuring F18 (Bias) and C50 (Bias base point) to specify an arbitrary value (Points A1, A2, and A3) gives the bias as shown below.



Note • To input bipolar analog voltage (0 to ±10 VDC) to terminals [12] and [V2], set C35 and C45 data to "0." Setting C35 and C45 data to "1" enables the voltage range from 0 to +10 VDC and interprets the negative polarity input from 0 to -10 VDC as 0 V.

• A reference frequency can be specified not only with the frequency (Hz) but also with other menu items, depending on the setting of function code E48 (= 3 to 5, or 7).

[3] Using digital input signals *UP*/*DOWN* (F01 = 7)

When the ***UP/DOWN*** control is selected for frequency setting with a run command ON, turning the terminal command ***UP*** or ***DOWN*** ON causes the output frequency to increase or decrease, respectively, within the range from 0 Hz to the maximum frequency as listed below.

To enable the ***UP/DOWN*** control for frequency setting, it is necessary to set F01 data to "7" and assign the ***UP*** and ***DOWN*** commands to any of digital input terminals [X1] to [X9], [FWD] and [REV] with any of E01 to E09 (data = 17 or 18).

UP	***DOWN***	Function
Data = 17	Data = 18	
OFF	OFF	Keep the current output frequency.
ON	OFF	Increase the output frequency with the acceleration time currently specified.
OFF	ON	Decrease the output frequency with the deceleration time currently specified.
ON	ON	Keep the current output frequency.

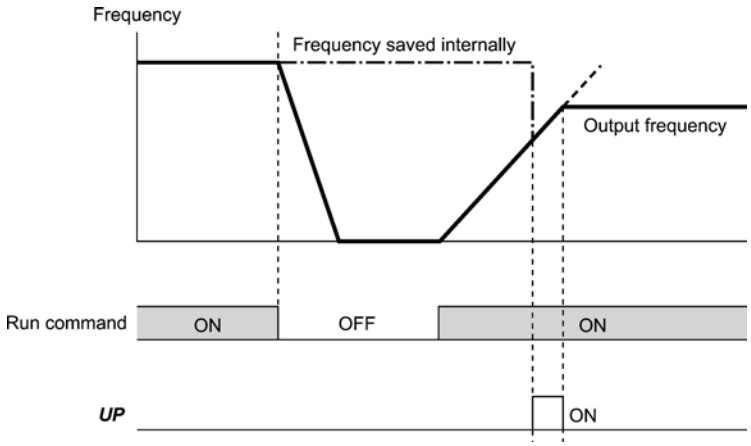
Function Code Details
F01
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

■ Specifying the initial value for the ***UP/DOWN*** control

Specify the initial value to start the ***UP/DOWN*** control.

Data for H61	Initial value to start the ***UP/DOWN*** control
0	Mode fixing the value at "0": The inverter automatically clears the value to "0" when restarted (including powered ON). Speed up by the ***UP*** command.
1	Mode holding the final output frequency in the previous ***UP/DOWN*** control: The inverter internally holds the last output frequency set by the ***UP/DOWN*** control and applies the held frequency at the next restart (including powering ON).

Note At the time of restart, if the terminal command ***UP*** or ***DOWN*** is entered before the internal frequency reaches the output frequency saved in the memory, the inverter saves the current output frequency into the memory and starts the ***UP/DOWN*** control with the new frequency. Pressing one of these keys overwrites the frequency held in the inverter.



<Initial frequency for ***UP/DOWN*** control when the frequency command source is switched>

When the frequency command source is switched to the ***UP/DOWN*** control from other sources, the initial frequency for the ***UP/DOWN*** control is as listed below:

Frequency command source	Switching command	Initial frequency for ***UP/DOWN*** control	
		H61 = 0	H61 = 1
Other than ***UP***/***DOWN*** (F01, C30)	Select frequency command 2/1 (***Hz2***/***Hz1***)	Reference frequency given by the frequency command source used just before switching	
PID control	Cancel PID control (***Hz***/***PID***)	Reference frequency given by PID control (PID processor output)	
Multi- frequency	Select multi-frequency (***SS1***, ***SS2***, ***SS4*** and ***SS8***)	Reference frequency given by the frequency command source used just before switching	Reference frequency at the time of previous ***UP/DOWN*** control
Communications link	Enable communications link via RS-485 or fieldbus (***LE***)		

[4] Using pulse train input (F01 = 12)

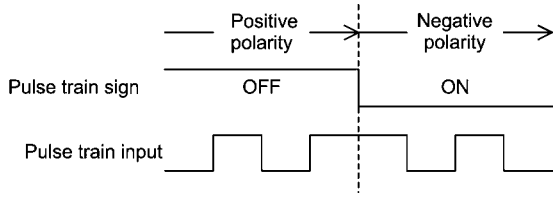
■ Selecting the pulse train input format (d59)

A pulse train in the format selected by the function code d59 can give a frequency command to the inverter. Three types of formats are available; the pulse train sign/pulse train input, the forward rotation pulse/reverse rotation pulse, and the A and B phases with 90 degree phase difference. If no optional PG interface card is mounted, the inverter ignores the setting of the function code d59 and accepts only the pulse train sign/pulse train input.

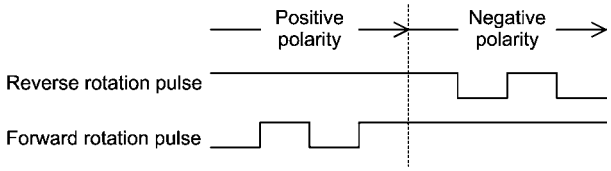
The table below lists pulse train formats and their operations.

Pulse train input format selected by d59	Operation overview
0: Pulse train sign/ Pulse train input	Frequency/speed command according to the pulse train rate is given to the inverter. The pulse train sign specifies the polarity of the frequency/speed command. • For the inverter without an optional PG interface card Pulse train input: ***PIN*** assigned to the digital terminal [X7] (data = 48) Pulse train sign: ***SIGN*** assigned to a digital terminal other than [X7] (data = 49) If no ***SIGN*** is assigned, polarity of any pulse train input is positive.
1: Forward rotation pulse/Reverse rotation pulse	Frequency/speed command according to the pulse train rate is given to the inverter. The forward rotation pulse gives a frequency/speed command with positive polarity, and a reverse rotation pulse, with negative polarity.
2: A and B phases with 90 degree phase difference	Pulse trains generated by A and B phases with 90 degree phase difference give a frequency/speed command based on their pulse rate and the phase difference to an inverter.

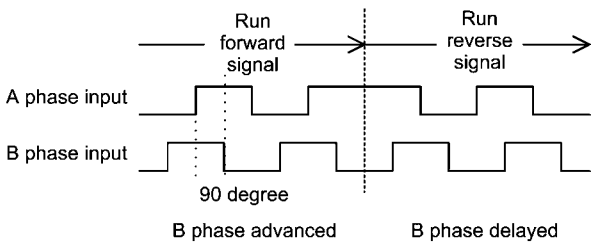
For details of operations using the optional PG interface card, refer to the Instruction Manual for it.



Pulse train sign/Pulse train input



Forward rotation pulse/Reverse rotation pulse



A and B phases with 90 degree phase difference

Function Code Details
F01
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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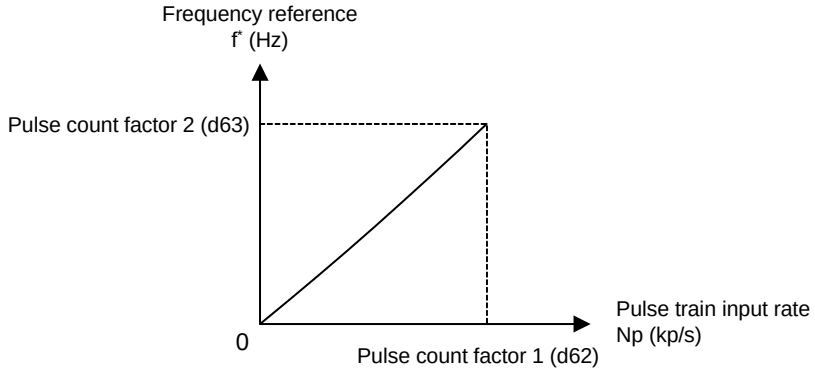
■ Pulse count factor 1 (d62), Pulse count factor 2 (d63)

For the pulse train input, function codes d62 (Command (Pulse rate input), (Pulse count factor 1)) and d63 (Command (Pulse rate input), (Pulse count factor 2)) define the relationship between the input pulse rate and the frequency command (reference).



Relationship between the Pulse Train Input Rate and Frequency Command (Reference)

As shown in the figure above, enter the pulse train input rate into function code d62 (Command (Pulse rate input), (Pulse count factor 1)), and enter the frequency reference defined by d62 into d63 (Command (Pulse rate input), (Pulse count factor 2)). The relationship between the pulse train input rate (kp/s) inputted to the ***PIN*** terminal and the frequency reference f* (Hz) (or speed command) is given by the expression below.

$$f^* \text{ (Hz)} = \text{Np (kp/s)} \times \frac{\text{Pulse count factor 2 (d63)}}{\text{Pulse count factor 1 (d62)}}$$

f^* (Hz) : Frequency reference

Np (kp/s) : Input pulse rate
In the case of A and B phases with 90 degree phase difference, note that the pulse train rate is not the one 4-multiplied.

The pulse train sign, forward/reverse rotation pulse, and A/B phase difference define the polarity of the pulse train input. Combination of the polarity of the pulse train input and the ***FWD***/***REV*** command determines the rotational direction of the motor. The table below shows the relationship between the polarity of the pulse train input and the motor rotational direction.

Pulse Train Polarity	Run command	Motor rotational direction
Positive	***FWD*** (Run forward command)	Forward
Positive	***REV*** (Run reverse command)	Reverse
Negative	***FWD*** (Run forward command)	Reverse
Negative	***REV*** (Run reverse command)	Forward

Note Mounting an optional PG interface card automatically switches the pulse train input source to the card and disables the input from the terminal [X7].

■ Filter time constant (d61)

d61 specifies a filter time constant for pulse train input. Choose an appropriate value for the time constant taking into account the response speed of the mechanical system since a large time constant slows down the response. When the commanded frequency fluctuates due to small number of pulses, specify a larger time constant.

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Switching frequency command

Using the terminal command ***Hz2/Hz1*** assigned to one of the digital input terminals switches between frequency command 1 (F01) and frequency command 2 (C30).

📖 For details about ***Hz2/Hz1***, refer to E01 to E09 (data = 11).

Terminal command ***Hz2/Hz1***	Frequency command source
OFF	Follow F01 (Frequency command 1)
ON	Follow C30 (Frequency command 2)

F02 Operation Method

F02 selects the source that specifies a run command. The table below lists the run command sources and the rotational directions of the motor.

Data for F02	Run Command	Description
0	Keypad (Rotational direction specified by terminal command)	Enables the RUN / STOP keys to run and stop the motor. The rotational direction of the motor is specified by terminal command ***FWD*** or ***REV***.
1	External signals (Digital input terminal commands)	Enables terminal command ***FWD*** or ***REV*** to run the motor.
2	Keypad (Forward rotation)	Enables RUN / STOP keys to run and stop the motor. Note that this run command enables only the forward rotation. There is no need to specify the rotational direction.
3	Keypad (Reverse rotation)	Enables RUN / STOP keys to run and stop the motor. Note that this run command enables only the reverse rotation. There is no need to specify the rotational direction.

Terminal commands ***FWD*** ("Run forward") and ***REV*** ("Run reverse") must be assigned to terminals [FWD] and [REV], respectively.

📖 For details about ***FWD*** and ***REV***, refer to E98 and E99 (data = 98 or 99).

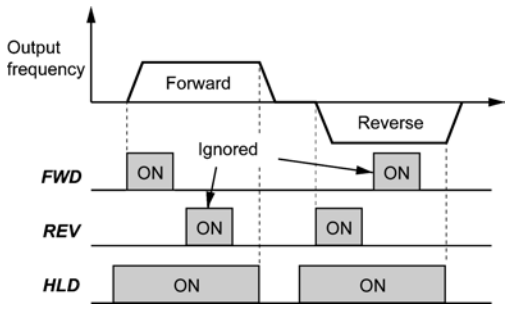
Note
- When the ***FWD*** or ***REV*** is ON, the F02 data cannot be changed.
- When changing terminal command assignments to terminals [FWD] and [REV] from commands other than the ***FWD*** and ***REV*** to the ***FWD*** or ***REV*** with F02 being set to "1," be sure to turn the target terminal OFF beforehand; otherwise, the motor may unintentionally rotate.

■ 3-wire operation with external input signals (digital input terminal commands)

The default setting of the ***FWD*** and ***REV*** are 2-wire. Assigning the terminal command ***HLD*** self-holds the forward ***FWD*** or reverse ***REV*** run command, to enable 3-wire inverter operation.

📖 For details about ***HLD***, refer to E01 to E09 (data = 6).

Short-circuiting the ***HLD***-assigned terminal and [CM] (i.e., when ***HLD*** is ON) self-holds the first ***FWD*** or ***REV*** at its rising edge. Turning the ***HLD*** OFF releases the self-holding. When no ***HLD*** is assigned, 2-wire operation involving only ***FWD*** and ***REV*** takes effect.



In addition to the run command sources described above, higher priority command sources including remote and local modes (see Section 7.3.6) and communications link are provided.

F03 Maximum Frequency 1

F03 specifies the maximum frequency to limit the output frequency. Specifying the maximum frequency exceeding the rating of the equipment driven by the inverter may cause damage or a dangerous situation. Make sure that the maximum frequency setting matches the equipment rating.

- Data setting range: 25.0 to 500.0 (Hz)

Drive mode	Drive control	Maximum setting range	Remarks
HD mode	V/f control	500 Hz	
	Vector control with speed sensor	200 Hz	Internally limited*
MD/LD mode	V/f control	120 Hz	Internally limited*
	Vector control with speed sensor	120 Hz	Internally limited*

* If a setting exceeding the maximum setting range (e.g., 500 Hz) is made, the reference speed and analog output (FMA) will be based on the full scale/reference value (10V/500 Hz); provided, however, that the frequency is internally limited. Even if 10 V is inputted, the frequency 500 Hz will be internally limited to 200 Hz.

Note
- For MD- and LD-mode inverters, set the maximum frequency at 120 Hz or below.
- Under vector control with speed sensor, set the maximum frequency at 200 Hz or below, and under vector control without speed sensor, at 120 Hz or below.

⚠WARNING

The inverter can easily accept high-speed operation settings. When changing the speed setting, carefully check the specifications of motors or equipment beforehand.

Otherwise injuries could occur.

Note Modifying F03 data to apply a higher output frequency requires also changing F15 data specifying a frequency limiter (high).

F04, F05 F06 Base Frequency 1, Rated Voltage at Base Frequency 1, Maximum Output Voltage 1

H50, H51 (Non-linear V/f Pattern 1, Frequency and Voltage)
H52, H53 (Non-linear V/f Pattern 2, Frequency and Voltage)
H65, H66 (Non-linear V/f Pattern 3, Frequency and Voltage)

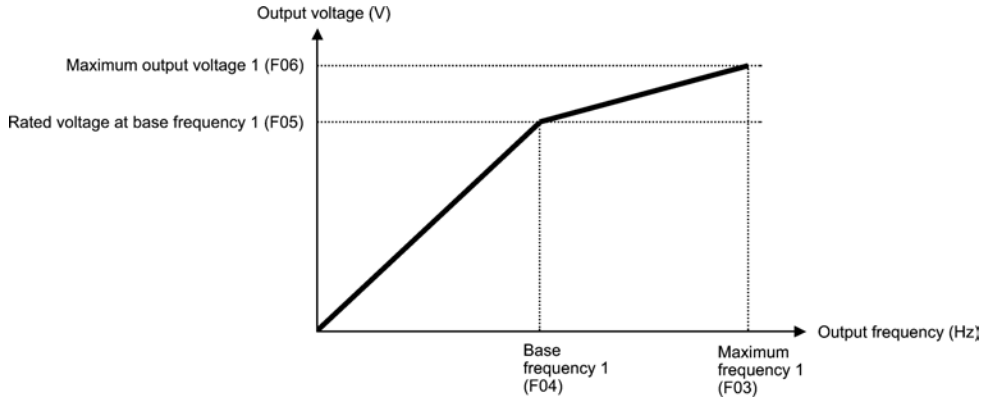
These function codes specify the base frequency and the voltage at the base frequency essentially required for running the motor properly. If combined with the related function codes H50 through H53, H65 and H66, these function codes may profile the non-linear V/f pattern suitable for the load by specifying increase or decrease in voltage at any point on the V/f pattern.

The following descriptions include setups required for the non-linear V/f patterns.

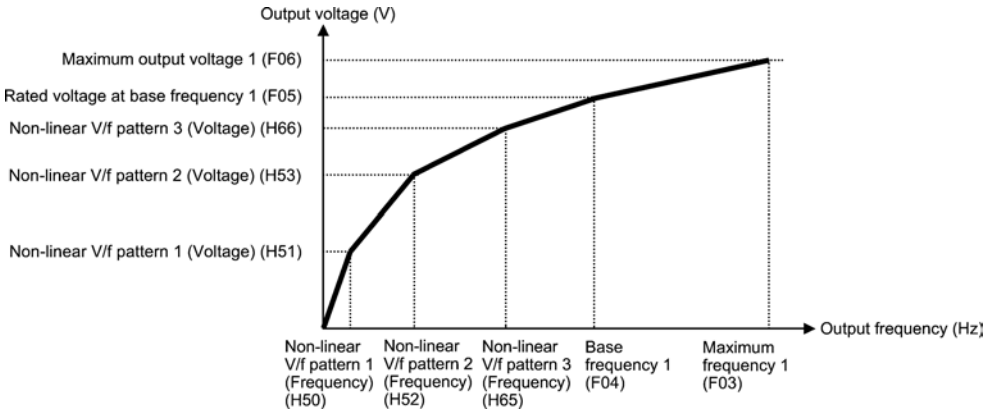
At high frequencies, the motor impedance may increase, resulting in an insufficient output voltage and a decrease in output torque. To prevent this problem, use F06 (Maximum Output Voltage 1) to increase the voltage. Note, however, that the inverter cannot output voltage exceeding its input power voltage.

V/f point	Function code		Remarks
	Frequency	Voltage	
Maximum frequency	F03	F06	The setting of the maximum output voltage is disabled when the auto torque boost, torque vector control, vector control without speed sensor, or vector control with speed sensor is selected.
Base frequency	F04	F05	
Non-linear V/f pattern 3	H65	H66	Disabled when the auto torque boost, torque vector control, vector control without speed sensor, or vector control with speed sensor is selected.
Non-linear V/f pattern 2	H52	H53	
Non-linear V/f pattern 1	H50	H51	

■ Normal (linear) V/f pattern



■ V/f pattern with three non-linear points



■ Base Frequency 1 (F04)

Set F04 data to the rated frequency printed on the nameplate labeled on the motor.

- Data setting range: 25.0 to 500.0 (Hz)

■ Rated Voltage at Base Frequency 1 (F05)

Set F05 data to "0" or the rated voltage printed on the nameplate labeled on the motor.

- Data setting range:

  0 : The Automatic Voltage Regulator (AVR) is disabled
  80 to 240 (V) : Output an AVR-controlled voltage for 200 V class series
  160 to 500 (V) : Output an AVR-controlled voltage for 400 V class series

- If F05 = 0, the rated voltage at base frequency is at the same level as the inverter input voltage. The output voltage will fluctuate in line with the input voltage fluctuation.
- If F05 = an arbitrary value other than 0, the inverter automatically keeps the output voltage constant in line with the setting. When any control function such as auto torque boost, auto energy saving, slip compensation, etc. is enabled, the F05 data should be equal to the rated voltage of the motor (printed on the nameplate of the motor).

Function Code Details
F03-F06
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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Note In vector control, current feedback control is performed. In the current feedback control, the current is controlled with the difference between the motor induced voltage and the inverter output voltage. For a proper control, the inverter output voltage should be sufficiently higher than the motor induced voltage. Generally, the voltage difference is about 20 V for 200 V class series, about 40 V for 400 V class series.

The voltage the inverter can output is at the same level as the inverter input voltage. Configure these voltages correctly in accordance with the motor specifications.

When a Fuji VG motor (exclusively designed for vector control) is used, configuring the inverter for using a VG motor with P02 (Rated capacity) and P99 (Motor 1 selection) automatically configures F04 (Base Frequency 1) and F05 (Rated Voltage at Base Frequency 1).

When enabling the vector control without speed sensor using a general-purpose motor, set the F05 (Rated Voltage at Base Frequency 1) data at the rated voltage of the motor. The voltage difference described above is specified by function code P56 (Induced voltage factor under vector control). Generally, there is no need to modify the initial setting.

■ Non-linear V/f Patterns 1, 2 and 3 for Frequency (H50, H52 and H65)

H50, H52, or H65 specifies the frequency component at an arbitrary point in the non-linear V/f pattern.

- Data setting range: 0.0 (cancel); 0.1 to 500.0 (Hz)

Note Setting "0.0" to H50, H52 or H65 disables the non-linear V/f pattern operation.

■ Non-linear V/f Patterns 1, 2 and 3 for Voltage (H51, H53 and H66)

H51, H53, or H66 specifies the voltage component at an arbitrary point in the non-linear V/f pattern.

- Data setting range:
  0 to 240 (V) : Output an AVR-controlled voltage for 200 V class series
  0 to 500 (V) : Output an AVR-controlled voltage for 400 V class series

Note The factory default values for H50 and H51 differ depending on the inverter capacity. Refer to the following table.

Voltage	200 V class series		400 V class series	
Capacity	22 kW or below	30 kW or above	30 kW or below	37 kW or above
H50	0.0	5.0 (Hz)	0.0	5.0 (Hz)
H51	0	20 (V)	0	40 (V)

■ Maximum Output Voltage 1 (F06)

F06 specifies the voltage for the maximum frequency 1 (F03).

- Data setting range:
  80 to 240 (V) : Output an AVR-controlled voltage for 200 V class series
  160 to 500 (V): Output an AVR-controlled voltage for 400 V class series

Note If F05 (Rated Voltage at Base Frequency 1) is set to "0," settings of H50 through H53, H65, H66 and F06 do not take effect. (When the non-linear point is below the base frequency, the linear V/f pattern applies; when it is above, the output voltage is kept constant.)

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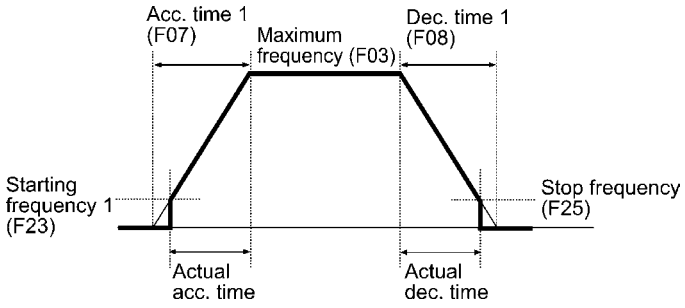
F07, F08	**Acceleration Time 1, Deceleration Time 1** **E10, E12, E14 (Acceleration Time 2, 3 and 4)** **E11, E13, E15 (Deceleration Time 2, 3 and 4)** **H07 (Acceleration/Deceleration Pattern)** **H56 (Deceleration Time for Forced Stop)** **H54, H55 (Acceleration Time/Deceleration Time, Jogging)** **H57 to H60 (1st and 2nd S-curve Acceleration/Deceleration Range)**

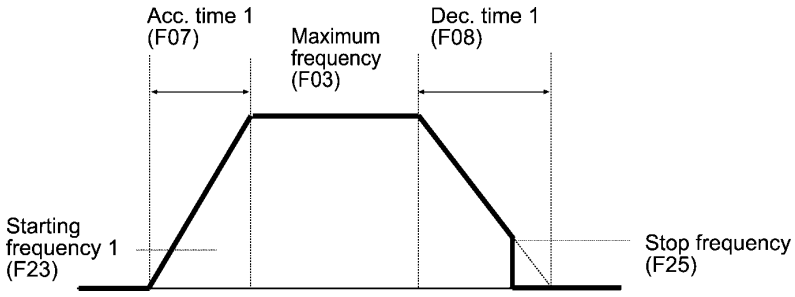
F07 specifies the acceleration time, the length of time the frequency increases from 0 Hz to the maximum frequency. F08 specifies the deceleration time, the length of time the frequency decreases from the maximum frequency down to 0 Hz.

- Data setting range: 0.00 to 6000 (s)

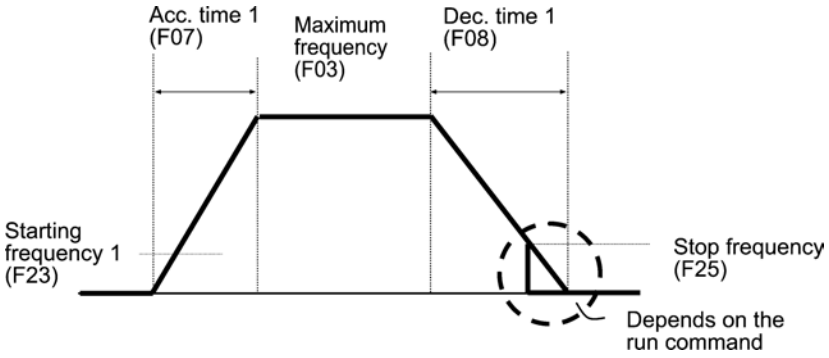
V/f control



Vector control without speed sensor



Vector control with speed sensor



Function Code Details
F04-F08
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

■ Acceleration/deceleration time

<table>
<tr><td rowspan="2">Acceleration/ deceleration time</td><td colspan="2">Function code</td><td colspan="3">Switching factor of acceleration/deceleration time (📖 Refer to the descriptions of E01 to E09.)</td></tr>
<tr><td>ACC time</td><td>DEC time</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Acceleration/ deceleration time 1</td><td rowspan="2">F07</td><td rowspan="2">F08</td><td>RT2</td><td>RT1</td><td rowspan="5">The combinations of ON/OFF states of the two terminal commands RT2 and RT1 offer four choices of acceleration/ deceleration time 1 to 4. (Data = 4, 5)

If no terminal command is assigned, only the acceleration/deceleration time 1 (F07/F08) is effective.</td></tr>
<tr><td>OFF</td><td>OFF</td></tr>
<tr><td>Acceleration/ deceleration time 2</td><td>E10</td><td>E11</td><td>OFF</td><td>ON</td></tr>
<tr><td>Acceleration/ deceleration time 3</td><td>E12</td><td>E13</td><td>ON</td><td>OFF</td></tr>
<tr><td>Acceleration/ deceleration time 4</td><td>E14</td><td>E15</td><td>ON</td><td>ON</td></tr>
<tr><td>At jogging operation</td><td>H54</td><td>H55</td><td colspan="3">When the terminal command JOG is ON, jogging operation is possible. (Data = 10)
(📖 Refer to the description of C20.)</td></tr>
<tr><td>At forced stop</td><td>—</td><td>H56</td><td colspan="3">When the terminal command STOP is OFF, the motor decelerates to a stop in accordance with the deceleration time for forced stop (H56). After the motor stops, the inverter enters the alarm state with the alarm Er6 displayed. (Data = 30)</td></tr>
</table>

■ Acceleration/Deceleration pattern (H07)

H07 specifies the acceleration and deceleration patterns (patterns to control output frequency).

<table>
<tr><td>Data for H07</td><td>Acceleration/ deceleration pattern</td><td colspan="2">Motion</td><td>Function code</td></tr>
<tr><td>0</td><td>Linear</td><td colspan="2">The inverter runs the motor with the constant acceleration and deceleration.</td><td>—</td></tr>
<tr><td>1</td><td>S-curve (Weak)</td><td rowspan="2">To reduce an impact that acceleration/deceleration would make on the machine, the inverter gradually accelerates or decelerates the motor in both the starting and ending zones of acceleration or deceleration.</td><td>Weak:
The acceleration/deceleration rate to be applied to all of the four inflection zones is fixed at 5% of the maximum frequency.</td><td>—</td></tr>
<tr><td>2</td><td>S-curve (Arbitrary)</td><td>Arbitrary:
The acceleration/deceleration rate can be arbitrarily specified for each of the four inflection zones.</td><td>H57
H58
H59
H60</td></tr>
<tr><td>3</td><td>Curvilinear</td><td colspan="2">Acceleration/deceleration is linear below the base frequency (constant torque) but it slows down above the base frequency to maintain a certain level of load factor (constant output).
This acceleration/deceleration pattern allows the motor to accelerate or decelerate with the maximum performance of the motor.</td><td>—</td></tr>
</table>

S-curve acceleration/deceleration

To reduce an impact that acceleration/deceleration would make on the machine, the inverter gradually accelerates or decelerates the motor in both the starting and ending zones of acceleration or deceleration. Two types of S-curve acceleration/deceleration rates are available; applying 5% (weak) of the maximum frequency to all of the four inflection zones, and specifying arbitrary rate for each of the four zones with function codes H57 to H60. The reference acceleration/deceleration time determines the duration of acceleration/deceleration in the linear period; hence, the actual acceleration/deceleration time is longer than the reference acceleration/deceleration time.

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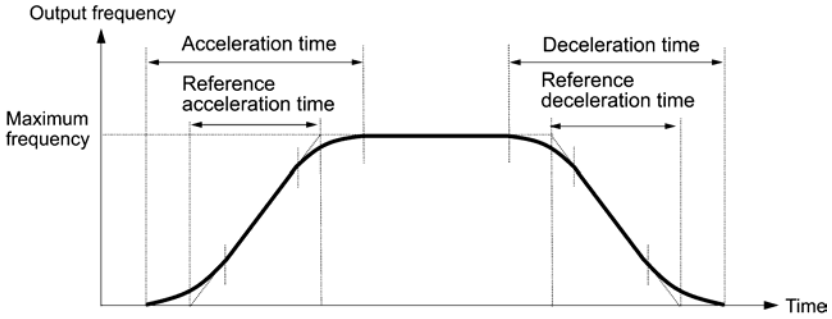

	Acceleration		Deceleration	
	Starting zone	Ending zone	Starting zone	Ending zone
S-curve (Weak)	5%	5%	5%	5%
S-curve (Arbitrary) Setting range: 0 to 100%	H57 Acceleration rate for the 1st S-curve (Leading edge)	H58 Acceleration rate for the 2nd S-curve (Trailing edge)	H59 Deceleration rate for the 1st S-curve (Leading edge)	H60 Deceleration rate for the 2nd S-curve (Trailing edge)

<S-curve acceleration/deceleration (weak): when the frequency change is 10% or more of the maximum frequency>

Acceleration or deceleration time (s) = (2 × 5/100 + 90/100+ 2 × 5/100) × (reference acceleration or deceleration time)
= 1.1 × (reference acceleration or deceleration time)

<S-curve acceleration/deceleration (arbitrary): when the frequency change is 30% or more of the maximum frequency--10% at the leading edge and 20% at the trailing edge>

Acceleration or deceleration time (s) = (2 × 10/100 + 70/100 + 2 × 20/100) × (reference acceleration or deceleration time)
= 1.3 × (reference acceleration or deceleration time)

Function Code Details
F07-F08
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
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y codes

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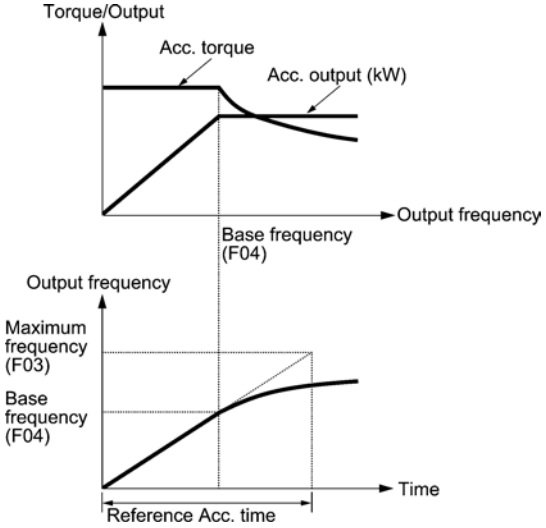
Curvilinear acceleration/deceleration

Acceleration/deceleration is linear below the base frequency (constant torque) but it slows down above the base frequency to maintain a certain level of load factor (constant output).

This acceleration/deceleration pattern allows the motor to accelerate or decelerate with its maximum performance.



The figures at left show the acceleration characteristics. Similar characteristics apply to the deceleration.

Note

- If you choose S-curve acceleration/deceleration or curvilinear acceleration/deceleration in Acceleration/Deceleration Pattern (H07), the actual acceleration/deceleration times are longer than the specified ones.
- Specifying an improperly short acceleration/deceleration time may activate the current limiter, torque limiter, or anti-regenerative control (automatic deceleration), resulting in a longer acceleration/deceleration time than the specified one.

F09	Torque Boost 1 (Refer to F37.)

Refer to the description of F37.

F10 to F12	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics, Overload detection level, Thermal time constant)

F10 through F12 specify the thermal characteristics of the motor for its electronic thermal overload protection that is used to detect overload conditions of the motor inside the inverter.

F10 selects the motor cooling mechanism to specify its characteristics, F11 specifies the overload detection current, and F12 specifies the thermal time constant.

Upon detection of overload conditions of the motor, the inverter shuts down its output and issues a motor overload alarm OL 1 to protect motor 1.

Note

Thermal characteristics of the motor specified by F10 and F12 are also used for the overload early warning. Even if you need only the overload early warning, set these characteristics data to these function codes. (📖 Refer to the description of E34.)
To disable the electronic thermal overload protection, set F11 data to "0.00."

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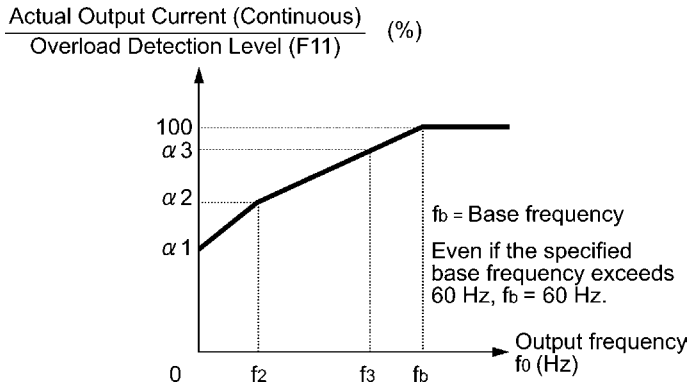
Note For Fuji motors exclusively designed for vector control, you need not specify the electronic thermal overload protection with these function codes, because they are equipped with motor overheat protective function by NTC thermistor. Set F11 data to "0.00" (Disable) and connect the NTC thermistor of the motor to the inverter.
For motors with PTC thermistor, connecting the PTC thermistor to the terminal [V2] enables the motor overheat protective function. For details, refer to the description of H26.

■ Select motor characteristics (F10)

F10 selects the cooling mechanism of the motor--shaft-driven or separately powered cooling fan.

Data for F10	Function
1	For a general-purpose motor with shaft-driven cooling fan (The cooling effect will decrease in low frequency operation.)
2	For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan (The cooling effect will be kept constant regardless of the output frequency.)

The figure below shows operating characteristics of the electronic thermal overload protection when F10 = 1. The characteristic factors α1 through α3 as well as their corresponding output frequencies f2 and f3 differ depending on the characteristics of the motor. The tables below list the factors of the motor selected by P99 (Motor 1 Selection).



Cooling Characteristics of Motor with Shaft-driven Cooling Fan

Nominal Applied Motor and Characteristic Factors when P99 (Motor 1 selection) = 0 or 4

Nominal applied motor (kW)	Thermal time constant τ (Factory default)	Reference current for setting the thermal time constant (Imax)	Output frequency for motor characteristic factor		Characteristic factor (%)		
			f2	f3	α1	α2	α3
0.4, 0.75	5 min	Allowable continuous drive current × 150%	5 Hz	7 Hz	75	85	100
1.5 to 3.7					85	85	100
5.5 to 11				6 Hz	90	95	100
15				7 Hz	85	85	100
18.5, 22				5 Hz	92	100	100
30 to 45	10 min		Base frequency × 33%	Base frequency × 83%	54	85	95
55 to 90					51	95	95
110 or above					53	85	90

Function Code Details
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Nominal Applied Motor and Characteristic Factors when P99 (Motor 1 Selection) = 1 or 3

Nominal applied motor (kW)	Thermal time constant τ (Factory default)	Reference current for setting the thermal time constant (Imax)	Output frequency for motor characteristic factor		Characteristic factor (%)		
			f2	f3	α1	α2	α3
0.2 to 22	5 min	Allowable continuous drive current × 150%	Base frequency × 33%	Base frequency × 33%	69	90	90
30 to 45	10 min			Base frequency × 83%	54	85	95
55 to 90					51	95	95
110 or above					53	85	90

If F10 is set to "2," changes of the output frequency do not affect the cooling effect. Therefore, the overload detection level (F11) remains constant.

■ Overload detection level (F11)

F11 specifies the level at which the electronic thermal overload protection becomes activated.

- Data setting range: 1 to 135% of the rated current (allowable continuous drive current) of the inverter

In general, set the F11 data to the allowable continuous current of motor when driven at the base frequency (i.e. 1.0 to 1.1 times of the rated current of the motor.) To disable the electronic thermal overload protection, set the F11 data to "0.00."

■ Thermal time constant (F12)

F12 specifies the thermal time constant of the motor. If the current of 150% of the overload detection level specified by F11 flows for the time specified by F12, the electronic thermal overload protection becomes activated to detect the motor overload. The thermal time constant for general-purpose motors including Fuji motors is approx. 5 minutes for motors of 22 kW or below and 10 minutes for motors of 30 kW or above by factory default.

- Data setting range: 0.5 to 75.0 (minutes)

(Example) When the F12 data is set at 5 minutes

As shown on the next page, the electronic thermal overload protection is activated to detect an alarm condition (alarm code $\overline{OL}$ 1) when the output current of 150% of the overload detection level (specified by F11) flows for 5 minutes, and 120% for approx. 12.5 minutes.

The actual time required for issuing a motor overload alarm tends to be shorter than the specified value, taking into account the time period from when the output current exceeds the allowable continuous drive current (100%) until it reaches 150% of the overload detection level.

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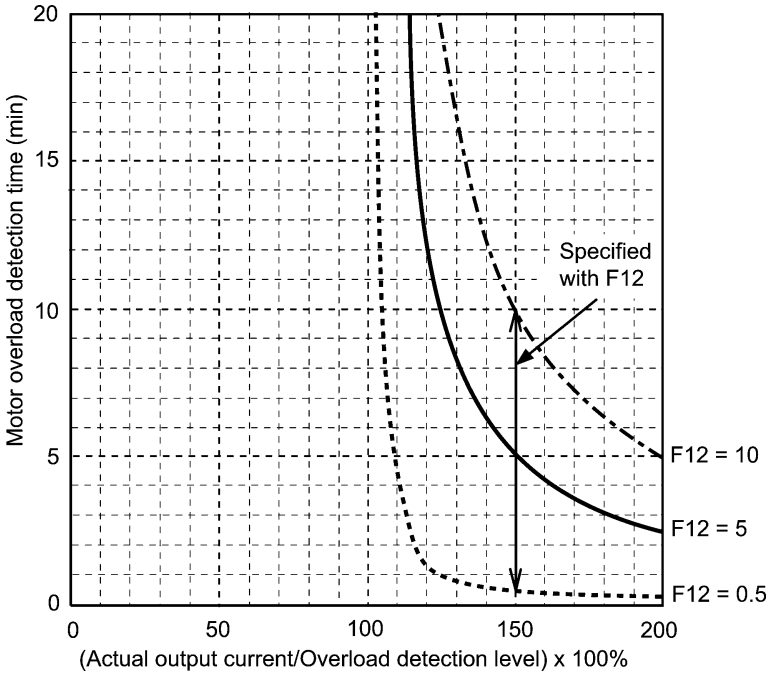
Example of Thermal Overload Detection Characteristics



Function Code Details
F10-F12
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H codes
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r codes
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—
y codes

F14	**Restart Mode after Momentary Power Failure (Mode selection)** **H13 (Restart time)** **H14 (Frequency fall rate)** **H15 (Continuous running level)** **H16 (Allowable momentary power failure time)** **H92 and H93 (Continuity of Running, P and I)**

F14 specifies the action to be taken by the inverter such as trip and restart in the event of a momentary power failure.

■ Restart mode after momentary power failure (Mode selection) (F14)

• **Under V/f control**

<table>
<tr><td rowspan="2">Data for F14</td><td colspan="2">Description</td></tr>
<tr><td>Auto search disabled</td><td>Auto search enabled</td></tr>
<tr><td>0: Trip immediately</td><td colspan="2">As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter issues undervoltage alarm LU and shuts down its output so that the motor enters a coast-to-stop state.</td></tr>
<tr><td>1: Trip after recovery from power failure</td><td colspan="2">As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down its output so that the motor enters a coast-to-stop state, but it does not enter the undervoltage state or issue undervoltage alarm LU.
The moment the power is restored, an undervoltage alarm LU is issued, while the motor remains in a coast-to-stop state.</td></tr>
<tr><td>2: Trip after decelerate-to-stop</td><td colspan="2">As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, decelerate-to-shop control is invoked. Decelerate-to-stop control regenerates kinetic energy from the load's moment of inertia, slowing down the motor and continuing the deceleration operation. After decelerate-to-stop operation, an undervoltage alarm LU is issued.</td></tr>
<tr><td rowspan="3">3: Continue to run (for heavy inertia or general loads)</td><td colspan="2">As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, continuous running control is invoked. Continuous running control regenerates kinetic energy from the load’s moment of inertia, continues running, and waits the recovery of power. When an undervoltage condition is detected due to a lack of energy to be regenerated, the output frequency at that time is saved, the output of the inverter is shut down, and the motor enters a coast-to-stop state.</td></tr>
<tr><td>If a run command has been input, restoring power restarts the inverter at the output frequency saved when undervoltage was detected.</td><td>If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.</td></tr>
<tr><td colspan="2">This setting is ideal for fan applications with a large moment of inertia.</td></tr>
<tr><td rowspan="3">4: Restart at the frequency at which the power failure occurred (for general loads)</td><td colspan="2">As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state.</td></tr>
<tr><td>If a run command has been input, restoring power restarts the inverter at the output frequency saved when undervoltage was detected.</td><td>If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.</td></tr>
<tr><td colspan="2">This setting is ideal for applications with a moment of inertia large enough not to slow down the motor quickly, such as fans, even after the motor enters a coast-to-stop state upon occurrence of a momentary power failure.</td></tr>
</table>

Data for F14	Description	
	Auto search disabled	Auto search enabled
5: Restart at the starting frequency	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state.	
	If a run command has been input, restoring power restarts the inverter at the starting frequency specified by function code F23.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
	This setting is ideal for heavy load applications such as pumps, having a small moment of inertia, in which the motor speed quickly goes down to zero as soon as it enters a coast-to-stop state upon occurrence of a momentary power failure.	
Auto search is enabled by turning ON the digital terminal command ***STM*** ("Enable auto search for idling motor speed at starting") or setting the H09 data to "1" or "2." For details about the digital terminal command ***STM*** and auto search, refer to the description of H09 (Starting Mode, Auto search).		

- **Under vector control without speed sensor**

Data for F14	Description	
	Auto search disabled	Auto search enabled
0: Trip immediately	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter issues undervoltage alarm ⟨⟨⟨ and shuts down its output so that the motor enters a coast-to-stop state.	
1: Trip after recovery from power failure	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down its output so that the motor enters a coast-to-stop state, but it does not enter the undervoltage state or issue undervoltage alarm ⟨⟨⟨. The moment the power is restored, an undervoltage alarm ⟨⟨⟨ is issued, while the motor remains in a coast-to-stop state.	
2: Trip after decelerate-to-stop	As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, decelerate-to-shop control is invoked. Decelerate-to-stop control regenerates kinetic energy from the load's moment of inertia, slowing down the motor and continuing the deceleration operation. After decelerate-to-stop operation, an undervoltage alarm ⟨⟨⟨ is issued.	
3: Continue to run 4: Restart at the frequency at which the power failure occurred	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state. Even if the F14 data is set to "3," the "Continue to run" function is disabled.	
	If a run command has been input, restoring power restarts the inverter at the output frequency saved when undervoltage was detected.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
5: Restart at the starting frequency	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state.	
	If a run command has been input, restoring power restarts the inverter at the starting frequency specified by function code F23.	If a run command has been input, restoring power performs auto search for idling motor speed and restarts running the motor at the frequency calculated based on the searched speed.
	This setting is ideal for heavy load applications such as pumps, having a small moment of inertia, in which the motor speed quickly goes down to zero as soon as it enters a coast-to-stop state upon occurrence of a momentary power failure.	
Auto search is enabled by turning ON the digital terminal command ***STM*** ("Enable auto search for idling motor speed at starting") or setting the d67 data to "1" or "2." For details about the digital terminal command ***STM*** and auto search, refer to the description of d67 (Starting Mode, Auto search).		

• **Under vector control with speed sensor**

Data for F14	Description
0: Trip immediately	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter issues undervoltage alarm LU and shuts down its output so that the motor enters a coast-to-stop state.
1: Trip after recovery from power failure	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down its output so that the motor enters a coast-to-stop state, but it does not enter the undervoltage state or issue undervoltage alarm LU. The moment the power is restored, an undervoltage alarm LU is issued, while the motor remains in a coast-to-stop state.
2: Trip after decelerate-to-stop	As soon as the DC link bus voltage drops below the continuous running level due to a momentary power failure, decelerate-to-shop control is invoked. Decelerate-to-stop control regenerates kinetic energy from the load's moment of inertia, slowing down the motor and continuing the deceleration operation. After decelerate-to-stop operation, an undervoltage alarm LU is issued.
3: Continue to run 4: Restart at the frequency at which the power failure occurred 5: Restart at the starting frequency	As soon as the DC link bus voltage drops below the undervoltage detection level due to a momentary power failure, the inverter shuts down the output so that the motor enters a coast-to-stop state. Even if the F14 data is set to "3," the "Continue to run" function is disabled. If a run command has been input, restoring power restarts the inverter at the motor speed detected by the speed sensor.

⚠WARNING

If you enable the "Restart mode after momentary power failure" (Function code F14 = 3, 4, or 5), the inverter automatically restarts the motor running when the power is recovered. Design the machinery or equipment so that human safety is ensured after restarting.

Otherwise an accident could occur.

■ Restart mode after momentary power failure (Basic operation: Auto search disabled)

The inverter recognizes a momentary power failure upon detecting the condition that DC link bus voltage goes below the undervoltage detection level, while the inverter is running. If the load of the motor is light and the duration of the momentary power failure is extremely short, the voltage drop may not be great enough for a momentary power failure to be recognized, and the motor may continue to run uninterrupted.

Upon recognizing a momentary power failure, the inverter enters the restart mode (after a recovery from momentary power failure) and prepares for restart. When power is restored, the inverter goes through an initial charging stage and enters the ready-to-run state. When a momentary power failure occurs, the power supply voltage for external circuits such as relay sequence circuits may also drop so as to turn the run command OFF. In consideration of such a situation, the inverter waits 2 seconds for a run command input after the inverter enters a ready-to-run state. If a run command is received within 2 seconds, the inverter begins the restart processing in accordance with the F14 data (Mode selection). If no run command has been received within 2-second wait period, the inverter cancels the restart mode (after a recovery from momentary power failure) and needs to be started again from the ordinary starting frequency. Therefore, ensure that a run command is entered within 2 seconds after recovery of power or held with an off-delay timer or a mechanical latch relay.

When run commands are entered via the keypad, the above operation is also necessary for the mode (F02 = 0) in which the rotational direction is determined by the terminal command, ***FWD*** or ***REV***. In the modes where the rotational direction is fixed (F02 = 2 or 3), the run command is retained inside the inverter so that the restart will begin as soon as the inverter enters the ready-to-run state.

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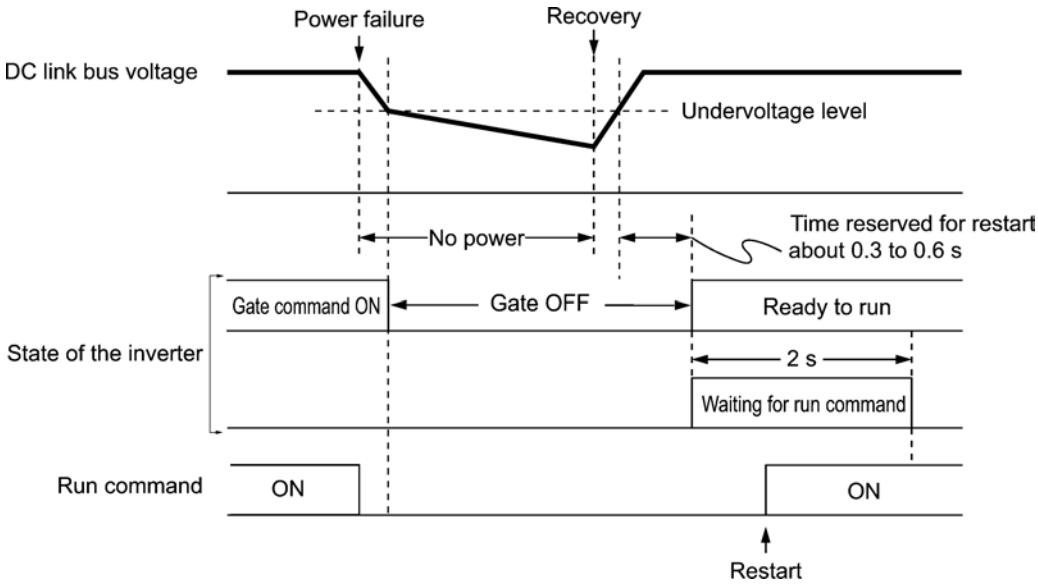

Note

- When the power is restored, the inverter will wait 2 seconds for input of a run command. However, if the allowable momentary power failure time (H16) has elapsed after the power failure was recognized, the inverter will no longer wait 2 seconds for input of a run command and start operation in the normal starting sequence.
- If the terminal command ***BX*** ("Coast to a stop") is entered during the power failure, the inverter gets out of the restart mode and enters the normal running mode. When a run command is entered with power supply applied, the inverter will start from the normal starting frequency.
- The inverter recognizes a momentary power failure by detecting an undervoltage condition when the voltage of the DC link bus goes below the lower limit. In a configuration where a magnetic contactor is installed on the output side of the inverter, the inverter may fail to recognize a momentary power failure because the momentary power failure shuts down the operating power of the magnetic contactor, causing the contactor circuit to open. When the contactor circuit is open, the inverter is cut off from the motor and load so that the voltage drop in the DC link bus may not be great enough to be recognized as a power failure. In such an event, the restart after a recovery from momentary power failure does not work properly as designed. To solve this, connect the auxiliary contact of the magnetic contactor to the inverter terminal which the ***IL*** ("Interlock") is assigned to so that a momentary power failure can sure be detected.

  📖 For details about ***IL***, refer to E01 to E09 (data = 22).

IL	Description
OFF	No momentary power failure has occurred.
ON	A momentary power failure has occurred. (Restart after a momentary power failure enabled)

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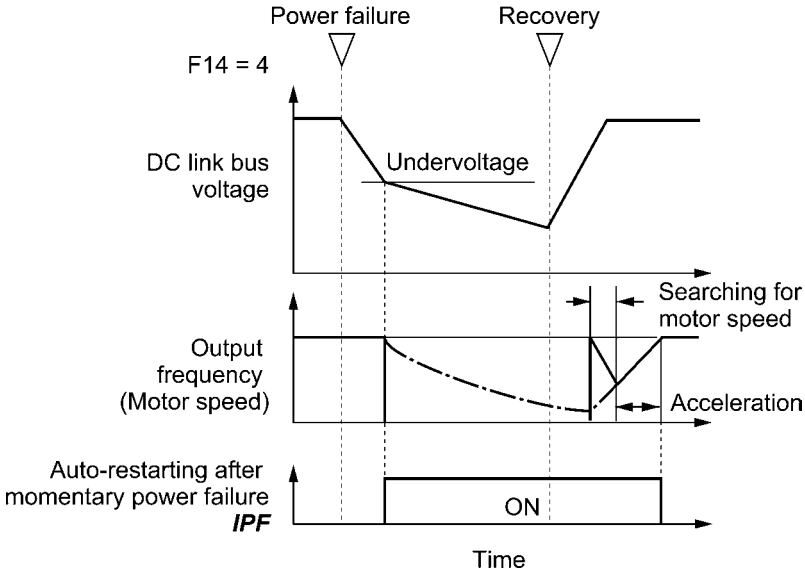
During a momentary power failure, the motor slows down. After power is restored, the inverter restarts at the frequency just before the momentary power failure. Then, the current limiting function works and the output frequency of the inverter automatically decreases. When the output frequency matches the motor speed, the motor accelerates up to the original output frequency. See the figure below. In this case, the instantaneous overcurrent limiting must be enabled (H12 = 1).



• Auto-restarting after momentary power failure ***IPF***

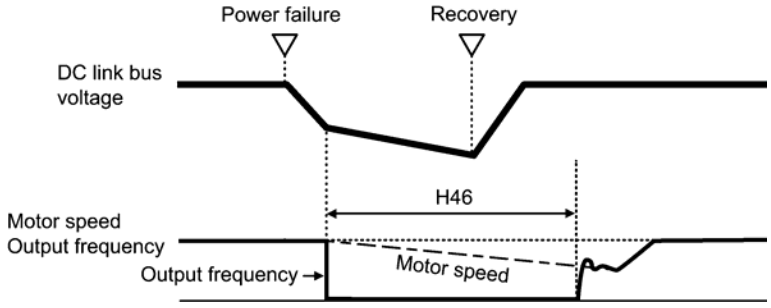
This output signal is ON during the period after the occurrence of momentary power failure until the completion of restart (the output has reached the reference frequency). When the ***IPF*** is ON, the motor slows down, so perform necessary operations.

📖 For details about ***IPF***, refer to E01 through E09 (data = 6).

■ Restart mode after momentary power failure (Basic operation: Auto search enabled)

Auto search for idling motor speed will become unsuccessful if it is done while the motor retains residual voltage. It is, therefore, necessary to leave the motor for the time (auto search delay time) enough to discharge the residual voltage. The delay time is specified by H46 (Starting Mode (Auto search delay time 2)).

The inverter will not start unless the time specified by H46 has elapsed, even if the starting conditions are satisfied. (📖 For details, refer to H09 and d67.)



Note

- To use auto search for idling motor speed, it is necessary to tune the inverter beforehand.
- When the estimated speed exceeds the maximum frequency or the upper limit frequency, the inverter disables auto search and starts running the motor with the maximum frequency or the upper limit frequency, whichever is lower.

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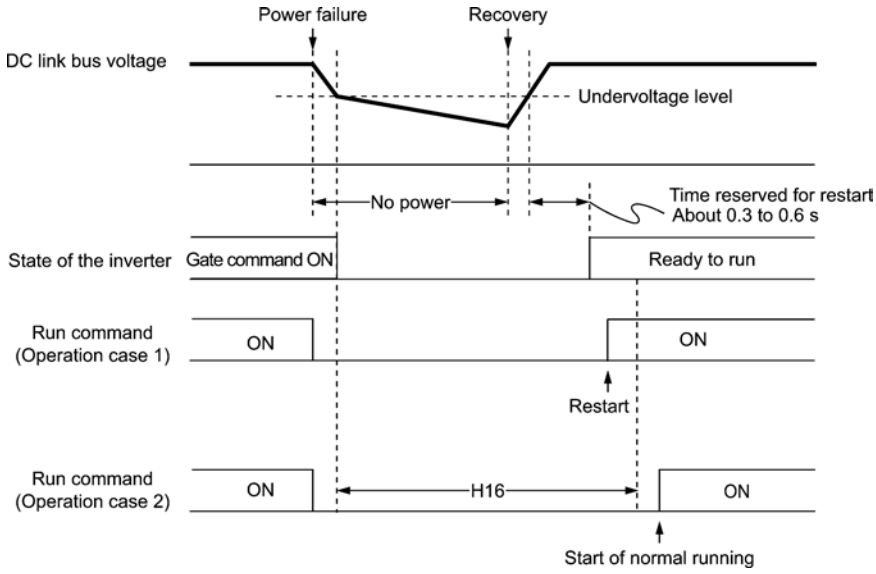
Note

- During auto search, if an overcurrent or overvoltage trip occurs, the inverter restarts the suspended auto search.
- Perform auto search at 60 Hz or below.
- Note that auto search may not fully provide the expected/designed performance depending on conditions including the load, motor parameters, power cable length, and other externally determined events.
- When the inverter is equipped with any of output circuit filters OFL-□□□-2 and -4 in the secondary lines, it cannot perform auto search. Use the filter OFL-□□□-□A instead.

■ Restart mode after momentary power failure (Allowable momentary power failure time) (H16)

H16 specifies the maximum allowable duration (0.0 to 30.0 seconds) from an occurrence of a momentary power failure (undervoltage) until the restart of the inverter. Specify the coast-to-stop time during which the machine system and facility can be tolerated.

If the power is restored within the specified duration, the inverter restarts in the restart mode specified by F14. If not, the inverter recognizes that the power has been shut down so that the inverter does not apply the restart mode and starts normal running.



If H16 (Allowable momentary power failure time) is set to "999," restart will take place until the DC link bus voltage drops down to the allowable voltage for restart after a momentary power failure (50 V for 200 V class series and 100 V for 400 V class series). If the DC link bus voltage drops below the allowable voltage, the inverter recognizes that the power has been shut down so that the inverter does not apply the restart mode and starts normal running.

Power supply voltage	Allowable voltage for restart after momentary power failure
200 V class series	50 V
400 V class series	100 V

Note

The time required from when the DC link bus voltage drops from the threshold of undervoltage until it reaches the allowable voltage for restart after a momentary power failure, greatly varies depending on the inverter capacity, the presence of options, and other factors.

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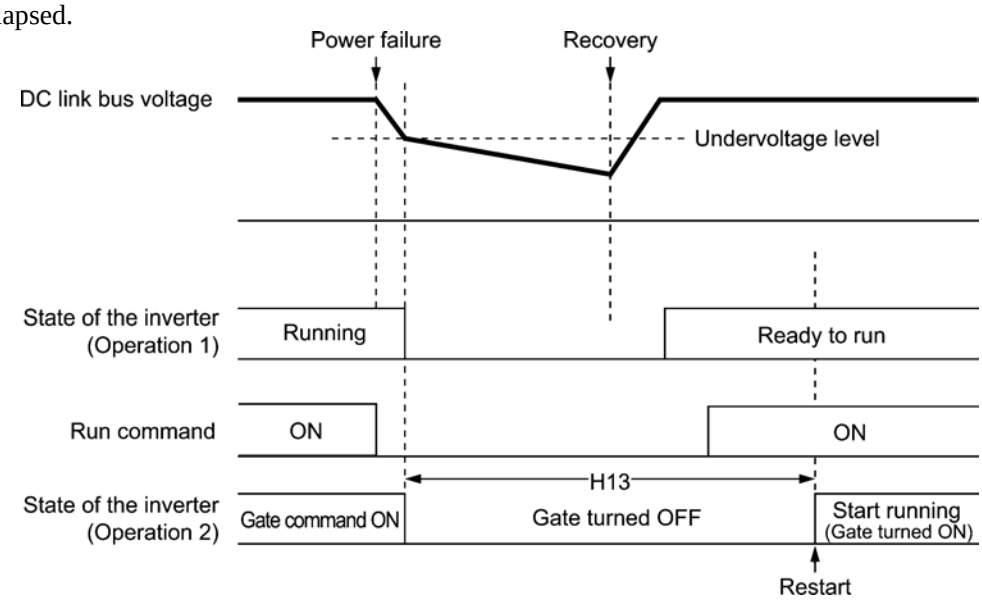
■ Restart mode after momentary power failure (Restart time) (H13)

H13 specifies the time period from an occurrence of a momentary power failure until the restart of the inverter. (When auto search is enabled, H46 (Auto search delay time 2) applies.)

If the inverter starts the motor while motor's residual voltage is still in a high level, a high inrush current may flow or an overvoltage alarm may occur due to an occurrence of temporary regeneration. For safety, therefore, it is advisable to set H13 to a certain level so that the restart will take place only after the residual voltage has dropped to a low level. Note that even when power is restored, restart will not take place until the restart time (H13) has elapsed.



Factory default

By factory default, H13 is set to the value suitable for the standard motor (see Table A given on the last page of the function code tables). Basically, it is not necessary to change H13 data. However, if the long restart time causes the flow rate of the pump to overly decrease or causes any other problem, you might as well reduce the setting to about a half of the default value. In such a case, make sure that no alarm occurs.

Note The restart time specified by H13 also applies to the switching operation (terminal commands ***ISW50***/***ISW60***) between line and inverter. Refer to E01 through E09 (data = 40, 41) for terminals [X1] to [X9].

■ Restart mode after momentary power failure (Frequency fall rate) (H14)

During restart after a momentary power failure, if the inverter output frequency and the idling motor speed cannot be harmonized with each other, an overcurrent will flow, activating the overcurrent limiter. If it happens, the inverter automatically reduces the output frequency to match the idling motor speed according to the reduction rate (Frequency fall rate: Hz/s) specified by H14.

Data for H14	Inverter's action for the output frequency fall
0.00	Follow the specified deceleration time
0.01 to 100.00 (Hz/s)	Follow data specified by H14
999	Follow the setting of the PI processor in the current limiter. (The PI constant is prefixed inside the inverter.)

Note If the frequency fall rate is too high, regeneration may take place at the moment the motor speed matches the inverter output frequency, causing an overvoltage trip. On the contrary, if the frequency fall rate is too low, the time required for the output frequency to match the motor speed (duration of current limiting action) may be prolonged, triggering the inverter overload prevention control.

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■ Restart after momentary power failure (Continuous running level) (H15)
Continuity of running (P and I) (H92, H93)

• Trip after decelerate-to-stop (F14 = 2)

If a momentary power failure occurs when F14 is set to "2" (Trip after decelerate-to-stop), the inverter enters the control sequence of the decelerate-to-stop when the DC link bus voltage drops below the continuous running level specified by H15.

Under the decelerate-to-stop control, the inverter decelerates its output frequency keeping the DC link bus voltage constant using the PI processor. P (proportional) and I (integral) components of the PI processor are specified by H92 and H93, respectively.

For normal inverter operation, it is not necessary to modify data of H15, H92 or H93.

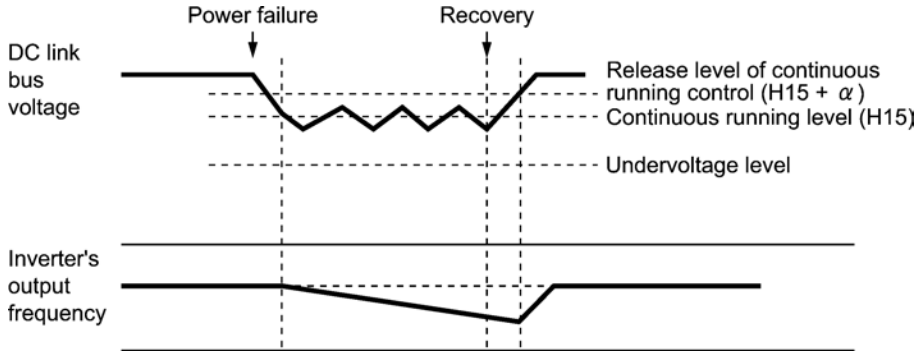
• Continue to run (F14 = 3)

If a momentary power failure occurs when F14 is set to "3" (Continue to run), the inverter enters the control sequence of the continuous running when the DC link bus voltage drops below the continuous running level specified by H15.

Under the continuous running control, the inverter continues to run keeping the DC link bus voltage constant using the PI processor.

P (proportional) and I (integral) components of the PI processor are specified by H92 and H93, respectively.

For normal inverter operation, it is not necessary to modify data of H15, H92 or H93.



Power supply voltage	α	
	22 kW or below	30 kW or above
200 V class series	5 V	10 V
400 V class series	10 V	20 V

Note

Even if you select "Trip after decelerate-to-stop" or "Continue to run," the inverter may not be able to do so when the load's inertia is small or the load is heavy, due to undervoltage caused by a control delay. In such a case, when "Trip after decelerate-to-stop" is selected, the inverter allows the motor to coast to a stop; when "Continue to run" is selected, the inverter saves the output frequency being applied when the undervoltage alarm occurred and restarts at the saved frequency after a recovery from the momentary power failure.

When the input power voltage for the inverter is high, setting the continuous running level high makes the control more stable even if the load's inertia is relatively small. Raising the continuous running level too high, however, might cause the continuous running control activated even during normal operation.

When the input power voltage for the inverter is extremely low, continuous running control might be activated even during normal operation, at the beginning of acceleration or at an abrupt change in load. To avoid this, lower the continuous running level. Lowering it too low, however, might cause undervoltage that results from voltage drop due to a control delay.

Before you change the continuous running level, make sure that the continuous running control will be performed properly, by considering the fluctuations of the load and the input voltage.

Function Code Details
F14
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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■ Frequency Limiter (High and Low) (F15, F16)

F15 and F16 specify the upper and lower limits of the output frequency or reference frequency, respectively. The object to which the limit is applied differs depending on the control system.

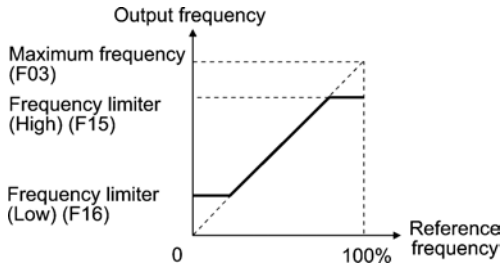
Frequency Limiter		Object to which the limit is applied	
		V/f control	Vector control with/without speed sensor
Frequency Limiter (High)	F15	Output frequency	Commanded speed (reference frequency)
Frequency Limiter (Low)	F16	Reference frequency	Commanded speed (reference frequency)
Note	When the limit is applied to the reference frequency or commanded speed, delayed responses of control may cause an overshoot or undershoot, and the frequency may temporarily go beyond the limit level.		

- Data setting range: 0.0 to 500.0 (Hz)

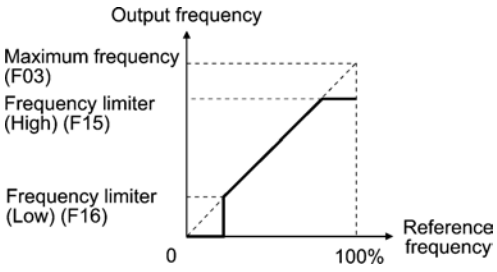
■ Low Limiter (Mode selection) (H63)

H63 specifies the operation to be carried out when the reference frequency drops below the low level specified by F16, as follows:

Data for H63	Operation
0	The output frequency will be held at the low level specified by F16.
1	The inverter decelerates to stop the motor.



(H63 = 0)



(H63 = 1)

Note

- When you change the frequency limiter (High) (F15) in order to raise the reference frequency, be sure to change the maximum frequency (F03) accordingly.
- Maintain the following relationship among the data for frequency control:

  F15 > F16, F15 > F23, and F15 > F25

  F03 > F16

  where, F23 and F25 specify the starting and stop frequencies, respectively.

  If you specify any wrong data for these function codes, the inverter may not run the motor at the desired speed, or cannot start it normally.

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F18	Bias (Frequency command 1)	Refer to F01.

Refer to the description of F01.

F20 to F22 H95	DC Braking 1 (Braking starting frequency, Braking level and Braking time) DC Braking (Braking response mode)

These function codes specify the DC braking that prevents motor 1 from running by inertia during decelerate-to-stop operation.

If the motor enters a decelerate-to-stop operation by turning OFF the run command or by decreasing the reference frequency below the stop frequency, the inverter activates the DC braking by flowing a current at the braking level (F21) for the braking time (F22) when the output frequency goes down to the DC braking starting frequency (F20).

Setting the braking time to "0.0" (F22 = 0) disables the DC braking.

■ Braking starting frequency (F20)

F20 specifies the frequency at which the DC braking starts its operation during motor decelerate-to-stop state.

- Data setting range: 0.0 to 60.0 (Hz)

■ Braking level (F21)

F21 specifies the output current level to be applied when the DC braking is activated. The function code data should be set, assuming the rated output current of the inverter as 100%, in increments of 1%.

- Data setting range: 0 to 100 (%) (For MD-/LD-mode inverter, 0 to 80 (%))

Note The inverter rated output current differs between the HD and MD/LD modes.

■ Braking time (F22)

F22 specifies the braking period that activates DC braking.

- Data setting range: 0.01 to 30.00 (s)
  0.00 (Disable)

■ Braking response mode (H95)

H95 specifies the DC braking response mode. When vector control without speed sensor or vector control with speed sensor is selected, the response is constant.

Data for H95	Characteristics	Note
0	Slow response. Slows the rising edge of the current, thereby preventing reverse rotation at the start of DC braking.	Insufficient braking torque may result at the start of DC braking.
1	Quick response. Quickens the rising edge of the current, thereby accelerating the build-up of the braking torque.	Reverse rotation may result depending on the moment of inertia of the mechanical load and the coupling mechanism.

Function Code Details
F15-F22
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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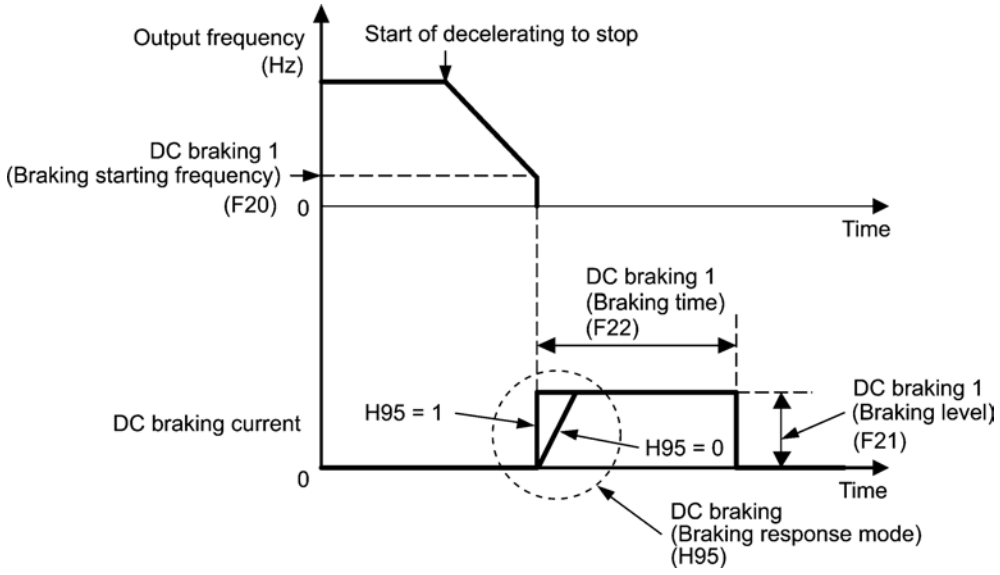


Tip

It is also possible to use an external digital input signal as the terminal command ***DCBRK*** ("Enable DC braking").

As long as the ***DCBRK*** is ON, the inverter performs DC braking, regardless of the braking time specified by F22.

📖 For details about ***DCBRK***, refer to E01 through E09 (data = 13).

Turning the ***DCBRK*** ON even when the inverter is in a stopped state activates the DC braking. This feature allows the motor to be excited before starting, resulting in smoother acceleration (quicker build-up of acceleration torque) (under V/f control).

When vector control without/with speed sensor is selected, use the pre-exciting feature for establishing the magnetic flux. (📖 For details, refer to H84.)

In general, DC braking is used to prevent the motor from running by inertia during the stopping process. Under vector control with speed sensor, however, zero speed control will be more effective for applications where load is applied to the motor even in a stopped state.

Note

In general, specify data of function code F20 at a value close to the rated slip frequency of motor. If you set it at an extremely high value, control may become unstable and an overvoltage alarm may result in some cases.

⚠CAUTION
The DC braking function of the inverter does not provide any holding mechanism. **Injuries could occur.**

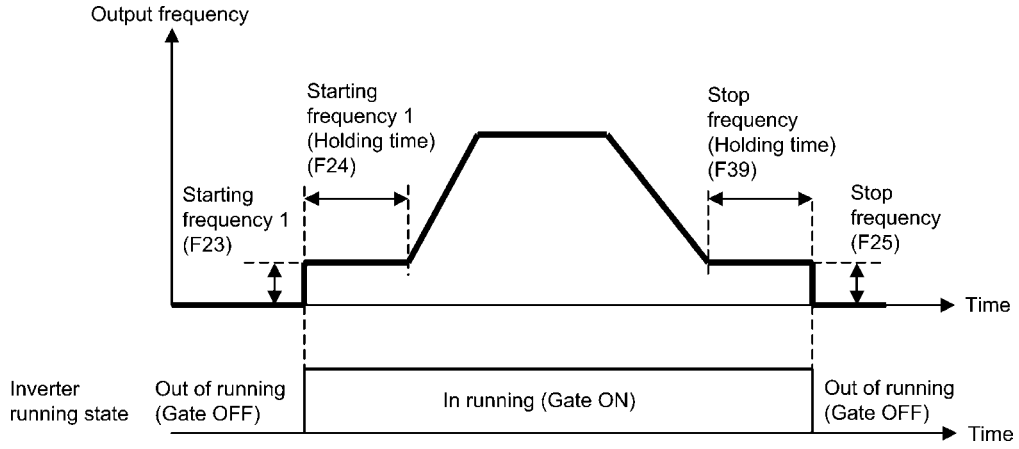
F23 to F25	**Starting Frequency 1, Starting Frequency 1 (Holding time) and Stop Frequency** **F38 and F39 (Stop Frequency, Detection mode and Holding time)** **H92 and H93 (Continuity of Running, P and I)** **d24 (Zero Speed Control)**

V/f control

At the startup of an inverter, the initial output frequency is equal to the starting frequency 1 specified by F23. The inverter stops its output when the output frequency reaches the stop frequency specified by F25.

Set the starting frequency to a level at which the motor can generate enough torque for startup. Generally, set the motor's rated slip frequency as the starting frequency.

In addition, F24 specifies the holding time for the starting frequency 1 in order to compensate for the delay time for the establishment of a magnetic flux in the motor. F39 specifies the holding time for the stop frequency in order to stabilize the motor speed at the stop of the inverter.



■ Starting Frequency 1 (F23)

F23 specifies the starting frequency at the startup of an inverter.

- Data setting range: 0.0 to 60.0 (Hz)

Under V/f control, even if the starting frequency is set at 0.0 Hz, the inverter starts at 0.1 Hz.

■ Starting Frequency 1 (Holding time) (F24)

F24 specifies the holding time for the starting frequency 1.

- Data setting range: 0.00 to 10.00 (s)

■ Stop Frequency (F25)

F25 specifies the stop frequency at the stop of the inverter.

- Data setting range: 0.0 to 60.0 (Hz)

Under V/f control, even if the stop frequency is set at 0.0 Hz, the inverter stops its output at 0.1 Hz.

■ Stop Frequency (Holding time) (F39)

F39 specifies the holding time for the stop frequency.

- Data setting range: 0.00 to 10.00 (s)

Note If the starting frequency is lower than the stop frequency, the inverter will not output any power as long as the reference frequency does not exceed the stop frequency.

Function Code Details
F20-F25
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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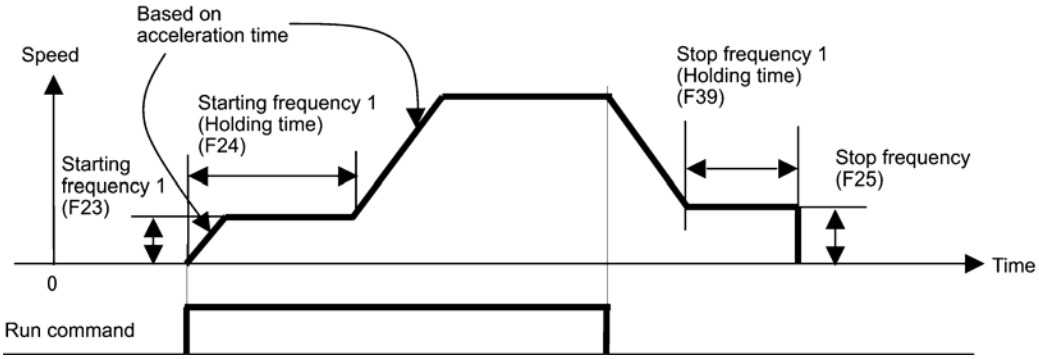
Vector Control without/with Speed Sensor

At the startup, the inverter first starts at the "0" speed and accelerates to the starting frequency according to the specified acceleration time. After holding the starting frequency for the specified period, the inverter again accelerates to the commanded speed according to the specified acceleration time.

The inverter stops its output when the detected speed or commanded speed (specified by F38 under vector control with speed sensor only) reaches the stop frequency specified by F25.

In addition, F24 specifies the holding time for the starting frequency 1 in order to compensate for the delay time for the establishment of a magnetic flux in the motor. F39 specifies the holding time for the stop frequency in order to stabilize the motor speed at the stop of the inverter.



■ Starting Frequency 1 (F23)

F23 specifies the starting frequency at the startup of an inverter.

- Data setting range: 0.0 to 60.0 (Hz)

■ Starting Frequency 1 (Holding time) (F24)

F24 specifies the holding time for the starting frequency 1.

- Data setting range: 0.00 to 10.00 (s)

■ Stop Frequency (F25)

F25 specifies the stop frequency at the stop of the inverter.

- Data setting range: 0.0 to 60.0 (Hz)

■ Stop Frequency (Holding time) (F39)

F39 specifies the holding time for the stop frequency.

- Data setting range: 0.00 to 10.00 (Hz)

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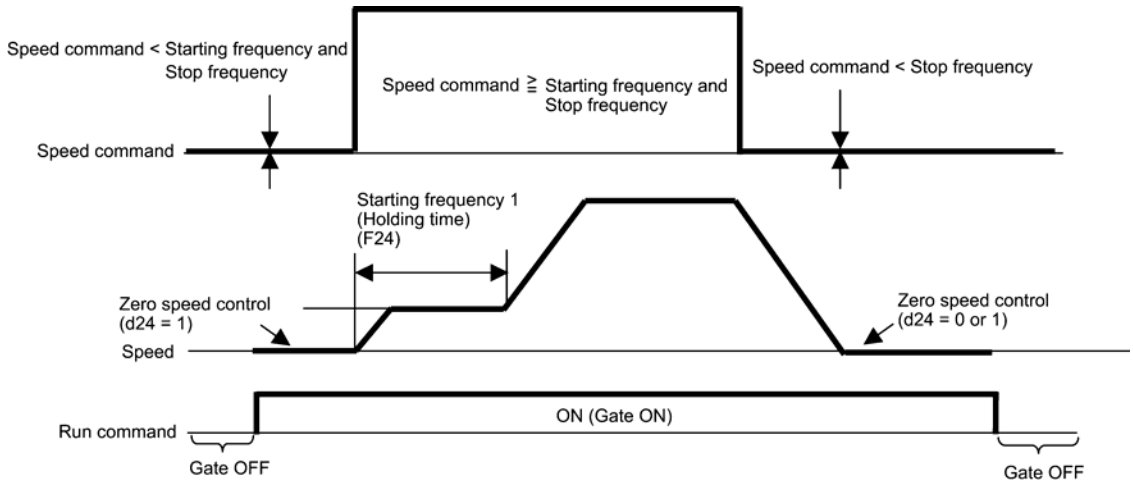
■ Zero Speed Control (d24) (Under vector control with speed sensor only)

To enable zero speed control under vector control with speed sensor, it is necessary to set the speed command (frequency command) at below the starting and stop frequencies. If the starting and stop frequencies are 0.0 Hz, however, the zero speed control is enabled only when the speed command is 0.00 Hz. d24 specifies the operation for the zero speed control at the startup of the inverter.

Data for d24	Zero speed control at startup	Descriptions
0	Not allowed	Even setting the speed command at below the starting and stop frequencies and turning a run command ON does not enable the zero speed control. To enable the zero speed control, set the speed command at above the starting frequency and then start up the inverter again.
1	Allowed	Setting the speed command at below the starting and stop frequencies and turning a run command ON enables the zero speed control.

The table below shows the conditions for zero speed control to be enabled or disabled.

	Speed command	Run command	Data for d24	Operation
At startup	Below the starting and stop frequencies	OFF	—	Stop (Gate OFF)
		ON	0	Stop (Gate OFF)
			1	Zero speed control
At stop	Below the stop frequency	ON	—	Zero speed control
		OFF	—	Stop (Gate OFF)



■ Stop Frequency (Detection mode) (F38) (Under vector control with speed sensor only)

F38 specifies whether the inverter judges when to shutdown its output by the detected speed or commanded speed.

Although the inverter generally judges it by the detected speed, if a load exceeding the inverter capability such as external excess load is applied, the inverter may not stop because the motor may not stop normally and the detected speed may not reach the stop frequency level. If F38 data is set to "1" (commanded speed), the inverter can stop without fail because the commanded speed reaches the stop frequency level even if the detected speed does not.

When such a situation is expected, select the commanded speed for the general fail-safe operation.

- Data setting range: 0 (Detected speed)
  1 (Commanded speed)

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F26, F27	Motor Sound (Carrier frequency and Tone) H98 (Protection/Maintenance Function, Mode selection)

■ Motor Sound (Carrier frequency) (F26)

F26 controls the carrier frequency so as to reduce an audible noise generated by the motor or electromagnetic noise from the inverter itself, and to decrease a leakage current from the main output (secondary) wirings.

Item	Characteristics	Remarks
Carrier frequency	0.75 to 16 kHz	0.4 to 55 kW (HD mode) 5.5 to 18.5 kW (LD mode)
	0.75 to 10 kHz	75 to 220 kW (HD mode) 22 to 55 kW (LD mode)
	0.75 to 6 kHz	75 to 220 kW (LD mode)
	0.75 to 2 kHz	90 to 220 kW (MD mode)
Motor sound noise emission	High ↔ Low	
Motor temperature (due to harmonics components)	High ↔ Low	
Ripples in output current waveform	Large ↔ Small	
Leakage current	Low ↔ High	
Electromagnetic noise emission	Low ↔ High	
Inverter loss	Low ↔ High	

Note Specifying a too low carrier frequency will cause the output current waveform to have a large amount of ripples. As a result, the motor loss increases, causing the motor temperature to rise. Furthermore, the large amount of ripples tends to cause a current limiting alarm. When the carrier frequency is set to 1 kHz or below, therefore, reduce the load so that the inverter output current comes to be 80% or less of the rated current.

When a high carrier frequency is specified, the temperature of the inverter may rise due to an ambient temperature rise or an increase of the load. If it happens, the inverter automatically decreases the carrier frequency to prevent the inverter overload alarm $\mathcal{OL}$. With consideration for motor noise, the automatic reduction of carrier frequency can be disabled. Refer to the description of H98.

It is recommended to set the carrier frequency at 5 kHz or above under vector control without/with speed sensor. DO NOT set it at 1 kHz or below.

■ Motor Sound (Tone) (F27)

F27 changes the motor running sound tone (only for motors under V/f control). This setting is effective when the carrier frequency specified by function code F26 is 7 kHz or lower. Changing the tone level may reduce the high and harsh running noise from the motor.

Data for F27	Function
0	Disable (Tone level 0)
1	Enable (Tone level 1)
2	Enable (Tone level 2)
3	Enable (Tone level 3)

Note If the tone level is set too high, the output current may become unstable, or mechanical vibration and noise may increase. Also, this function code may not be very effective for certain types of motor.

F29 to F31 Analog Output [FMA] (Mode selection, Voltage adjustment, Function)

These function codes allow terminal [FMA] to output monitored data such as the output frequency and the output current in an analog DC voltage or current. The magnitude of such analog voltage or current is adjustable.

■ Mode selection (F29)

F29 specifies the output form of the terminal [FMA]. You need to set switch SW4 on the control printed circuit board (control PCB).

For details of the slide switches on the control PCB, refer to Chapter 2 "SPECIFICATIONS."

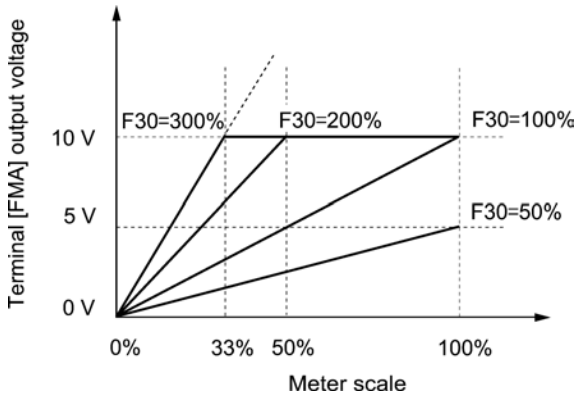
Data for F29	[FMA] output form	Position of slide switch SW4 mounted on the control PCB
0	Voltage (0 to +10 VDC)	VO
1	Current (4 to +20 mA DC)	IO

Note The output current is not isolated from analog input, and does not have an isolated power supply. Therefore, if an electrical potential relationship between the inverter and peripheral equipment has been established, e.g., by connecting an analog, cascade connection of a current output device is not available.

Keep the connection wire length as short as possible.

■ Voltage adjustment (F30)

F30 allows you to adjust the output voltage within the range of 0 to 300%.



Function Code Details
F26-F31
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

■ Function (F31)

F31 specifies what is output to analog output terminal [FMA].

Data for F31	[FMA] output	Function (Monitor the following)	Meter scale (Full scale at 100%)
0	Output frequency 1 (before slip compensation)	Output frequency of the inverter (Equivalent to the motor synchronous speed)	Maximum frequency (F03)
1	Output frequency 2 (after slip compensation)	Output frequency of the inverter	Maximum frequency (F03)
2	Output current	Output current (RMS) of the inverter	Twice the inverter rated current
3	Output voltage	Output voltage (RMS) of the inverter	250 V for 200 V class series, 500 V for 400 V class series
4	Output torque	Motor shaft torque	Twice the rated motor torque
5	Load factor	Load factor (Equivalent to the indication of the load meter)	Twice the rated motor load
6	Input power	Input power of the inverter	Twice the rated output of the inverter
7	PID feedback amount	Feedback amount under PID control	100% of the feedback amount
8	PG feedback value (speed)	Speed detected through the PG interface, or estimated speed (under vector control without speed sensor)	Maximum speed as 100%
9	DC link bus voltage	DC link bus voltage of the inverter	500 V for 200 V class series, 1000 V for 400 V class series
10	Universal AO	Command via communications link (🕮 Refer to the RS-485 Communication User's Manual.)	20000 as 100%
13	Motor output	Motor output (kW)	Twice the rated motor output
14	Calibration	Full scale output for the meter calibration	This always outputs the full-scale (100%).
15	PID command (SV)	Command value under PID control	100% of the feedback amount
16	PID output (MV)	Output level of the PID processor under PID control (Frequency command)	Maximum frequency (F03)

Note If F31 = 16 (PID output), J01 = 3 (Dancer control), and J62 = 2 or 3 (Ratio compensation enabled), the PID output is equivalent to the ratio against the primary reference frequency and may vary within ±300% of the frequency. The monitor displays the PID output in a converted absolute value (%). To indicate the value up to the full-scale of 300%, set F30 data to "33" (%).

F33 to F35 Pulse Output [FMP] (Pulse rate, Gain to output voltage, Function)

These function codes allow terminal [FMP] to output monitored data such as the output frequency and the output current in a variable rate pulse train or a fixed rate pulse train. The fixed rate pulse train (whose pulse duty control produces a variance of an average output voltage of the pulse train) can be used to drive an analog meter.

The output pulse can be specified for each of monitored data items.

To use the terminal [FMP] for pulse train output, set F33 to an appropriate value and set F34 to "0."

To use the terminal for average voltage output, set F34 within the range from 1% to 300%. This setting disables the setting of F33.

[FMP] output form	Data for F33	Data for F34	Pulse duty	Pulse rate
Pulse train	25 to 6000 p/s	0	Around 50%	Variable
Average voltage	—	1 to 300 (%)	Variable	2000 p/s

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■ Pulse rate (F33)

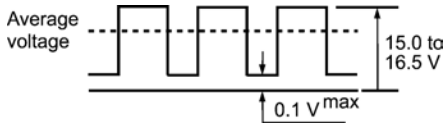
F33 specifies the pulse rate at which the output of the monitored item selected reaches 100%, in accordance with the specifications of the counter to be connected.

- Data setting range: 25 to 6000 (p/s)

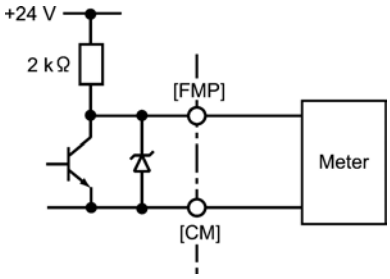
■ Gain to output voltage (F34)

F34 allows you to adjust the output voltage (average voltage) within the range of 0 to 300 (%).

Pulse output waveform



FMP output circuit



■ Function (F35)

F35 specifies what is output to the output terminal [FMP]. Those contents are the same as those for function code F31. Refer to the table in the description of F31.

F37 Load Selection/Auto Torque Boost/Auto Energy Saving Operation 1

F09 (Torque Boost 1)
H67 (Auto Energy Saving Operation, Mode selection)

F09 specifies the torque boost level in order to assure sufficient starting torque.

F37 specifies V/f pattern, torque boost type, and auto energy saving operation in accordance with the characteristics of the load.

Data for F37	V/f pattern	Torque boost	Auto energy saving	Applicable load
0	Variable torque V/f pattern	Torque boost specified by F09	Disable	Variable torque load (General-purpose fans and pumps)
1	Linear V/f pattern			Constant torque load
2		Auto torque boost		Constant torque load (To be selected if a motor may be over-excited at no load.)
3	Variable torque V/f pattern	Torque boost specified by F09	Enable	Variable torque load (General-purpose fans and pumps)
4	Linear V/f pattern			Constant torque load
5		Auto torque boost		Constant torque load (To be selected if a motor may be over-excited at no load.)

Note If a required "load torque + acceleration toque" is more than 50% of the motor rated torque, it is recommended to select the linear V/f pattern (factory default).

Function Code Details
F29-F37
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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Tip

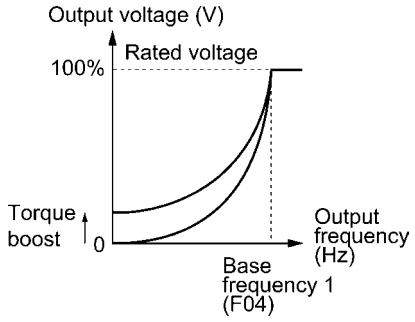
- Under the vector control with speed sensor, F37 is used to specify whether the auto energy saving operation is enabled or disabled. (V/f pattern and torque boost are disabled.)

Data for F37	Operation
0 to 2	Auto energy saving operation OFF
3 to 5	Auto energy saving operation ON

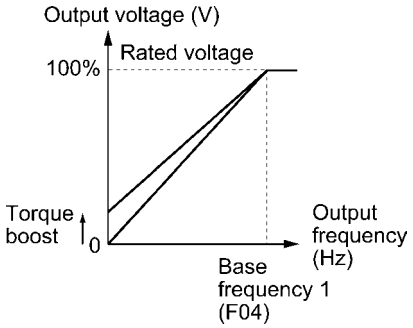
- Under the vector control without speed sensor, both F37 and F09 are disabled. The auto energy saving operation is also disabled.

■ V/f characteristics

The FRENIC-MEGA series of inverters offer a variety of V/f patterns and torque boosts, which include V/f patterns suitable for variable torque load such as general fans and pumps and for constant torque load (including special pumps requiring high starting torque). Two types of torque boosts are available: manual and automatic.



Variable torque V/f pattern (F37 = 0)

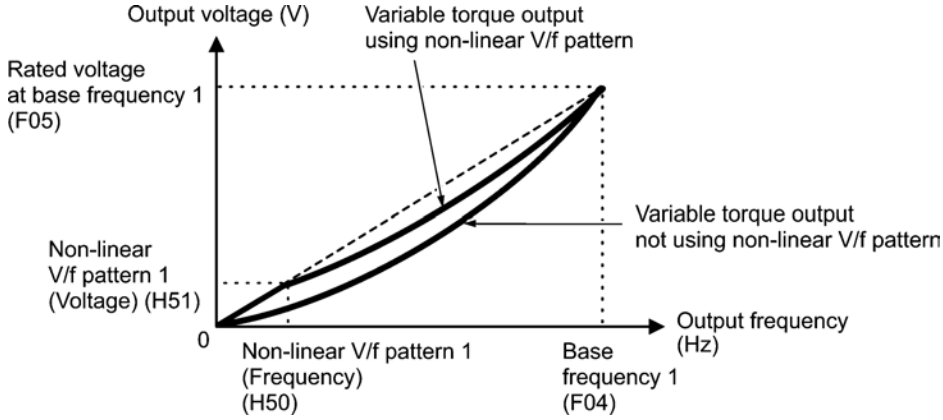


Linear V/f pattern (F37 = 1)

Tip

When the variable torque V/f pattern is selected (F37 = 0 or 3), the output voltage may be low at a low frequency zone, resulting in insufficient output torque, depending on the characteristics of the motor and load. In such a case, it is recommended to increase the output voltage at the low frequency zone using the non-linear V/f pattern.

Recommended value: H50 = 1/10 of the base frequency
H51 = 1/10 of the voltage at base frequency



■ Torque boost

• Manual torque boost (F09)

- Data setting range: 0.0 to 20.0 (%), (100%/Rated voltage at base frequency)

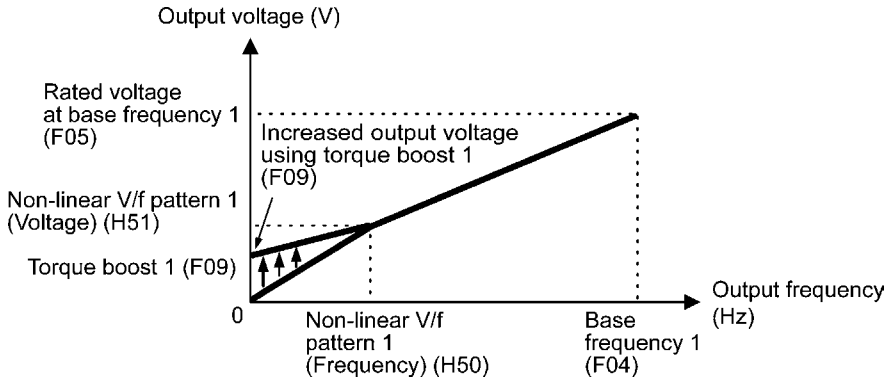
In torque boost using F09, constant voltage is added to the basic V/f pattern, regardless of the load. To secure a sufficient starting torque, manually adjust the output voltage to optimally match the motor and its load by using F09. Specify an appropriate level that guarantees smooth start-up and yet does not cause over-excitation at no or light load.

Torque boost using F09 ensures high driving stability since the output voltage remains constant regardless of the load fluctuation.

Specify the F09 data in percentage to the rated voltage at base frequency 1 (F05). At factory shipment, F09 is preset to a level that assures approx. 100% of starting torque.

Note

- Specifying a high torque boost level will generate a high torque, but may cause overcurrent due to over-excitation at no load. If you continue to drive the motor, it may overheat. To avoid such a situation, adjust torque boost to an appropriate level.
- When the non-linear V/f pattern and the torque boost are used together, the torque boost takes effect below the frequency on the non-linear V/f pattern's point.



• Auto torque boost

This function automatically optimizes the output voltage to fit the motor with its load. Under light load, auto torque boost decreases the output voltage to prevent the motor from over-excitation. Under heavy load, it increases the output voltage to increase the output torque of the motor.

Note

- Since this function relies also on the characteristics of the motor, set the base frequency 1 (F04), the rated voltage at base frequency 1 (F05), and other pertinent motor parameters (P01 through P03 and P06 through P99) in line with the motor capacity and characteristics, or else perform auto-tuning (P04).
- When a special motor is driven or the load does not have sufficient rigidity, the maximum torque might decrease or the motor operation might become unstable. In such cases, do not use auto torque boost but choose manual torque boost using F09 (F37 = 0 or 1).

Function Code Details
F37
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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■ Auto energy saving operation (H67)

This feature automatically controls the supply voltage to the motor to minimize the total power loss of motor and inverter. (Note that this feature may not be effective depending upon the motor or load characteristics. Check the advantage of energy saving before you actually apply this feature to your machinery.) You can select whether applying this feature to constant speed operation only or applying to constant speed operation and accelerating/decelerating operation.

Data for H67	Auto energy saving operation
0	Enable only during running at constant speed (In accelerating/decelerating, the torque boost by F09 or the auto torque boost applies depending on the F37 setting.)
1	Enable during running at constant speed or accelerating/decelerating (Note: For accelerating/decelerating, enable only when the load is light.)

If auto energy saving operation is enabled, the response to a motor speed change from constant speed operation may be slow. Do not use this feature for such machinery that requires quick acceleration/deceleration.

Note

- Use auto energy saving only where the base frequency is 60 Hz or lower. If the base frequency is set at 60 Hz or higher, you may get a little or no energy saving advantage. The auto energy saving operation is designed for use with the frequency lower than the base frequency. If the frequency becomes higher than the base frequency, the auto energy saving operation will be invalid.
- Since this function relies also on the characteristics of the motor, set the base frequency 1 (F04), the rated voltage at base frequency 1 (F05), and other pertinent motor parameters (P01 through P03 and P06 through P99) in line with the motor capacity and characteristics, or else perform auto-tuning (P04).
- Under the vector control without speed sensor, the auto energy saving operation is disabled.

F38, F39 Stop Frequency (Detection mode and Holding time) Refer to F23.

For details about the setting of the stop frequency (detection mode and holding time), refer to the description of F23.

F40, F41 Torque Limiter 1-1, 1-2

E16 and E17 (Torque Limiter 2-1, 2-2)
H73 (Torque Limiter, Operating conditions)
H76 (Torque Limiter, Frequency increment limit for braking)

V/F control

If the inverter's output torque exceeds the specified levels of the torque limiters (F40, F41, E16, and E17), the inverter controls the output frequency and limits the output torque for preventing a stall.

H73 specifies whether the torque limiter is enabled or disabled during acceleration/ deceleration and running at constant speed.

In braking, the inverter increases the output frequency to limit the output torque. Depending on the conditions during operation, the output frequency could dangerously increase. The torque limiter is provided by H76 to limit the increasing frequency component.

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Vector control without/with speed sensor

If the output torque of the inverter exceeds the torque limiter level, this control limits the current command to suppress the output torque within the torque limiter value.

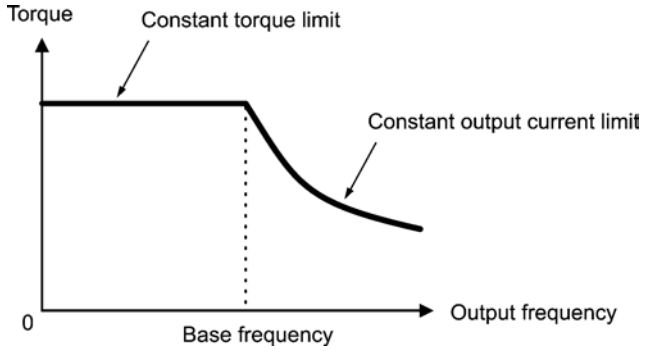
Related function codes

Function code	Name	V/f control	Vector control	Remarks
F40	Torque Limiter 1-1	✓	✓	
F41	Torque Limiter 1-2	✓	✓	
E16	Torque Limiter 2-1	✓	✓	
E17	Torque Limiter 2-2	✓	✓	
H73	Torque Limiter (Operating conditions)	✓	✓	
H76	Torque Limiter (Frequency increment limit for braking)	✓	—	
E61 to E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function	✓	✓	7: Analog torque limit value A 8: Analog torque limit value B

■ Torque limit control mode

Torque limit is performed by limiting torque current flowing across the motor.

The graph below shows relationship between the torque and the output frequency with the constant output current limit.



■ Torque limiter (F40, F41, E16 and E17)

These function codes specify the operation level at which the torque limiters become activated, as the percentage of the motor rated torque.

- Data setting range: -300 to 300 (%), 999 (Disable)

Function code	Name	Torque limit feature
F40	Torque limiter 1-1	Driving torque current limiter 1
F41	Torque limiter 1-2	Braking torque current limiter 1
E16	Torque limiter 2-1	Driving torque current limiter 2
E17	Torque limiter 2-2	Braking torque current limiter 2

Note Although the data setting range for F40, F41, E16, and E17 is from positive to negative values (–300% to +300%), specify positive values in practice. If a negative value is specified, the inverter interprets it as an absolute value.

The torque limiter determined depending on the overload current actually limits the torque current output. Therefore, even if the maximum value of 300% is specified, it will automatically be limited at a lower value.

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■ Analog torque limit values (E61 to E63)

The torque limit values can be specified by analog inputs through terminals [12], [C1], and [V2] (voltage or current). Set E61, E62, and E63 (Terminal [12] Extended Function, Terminal [C1] Extended Function, and Terminal [V2] Extended Function) as listed below.

Data for E61, E62, or E63	Function	Description
7	Analog torque limit value A	Use the analog input as the torque limit value specified by function code data (= 7 or 8). Input specifications: 200% / 10 V or 20 mA
8	Analog torque limit value B	

If the same setting is made for different terminals, the priority order is E61>E62>E63.

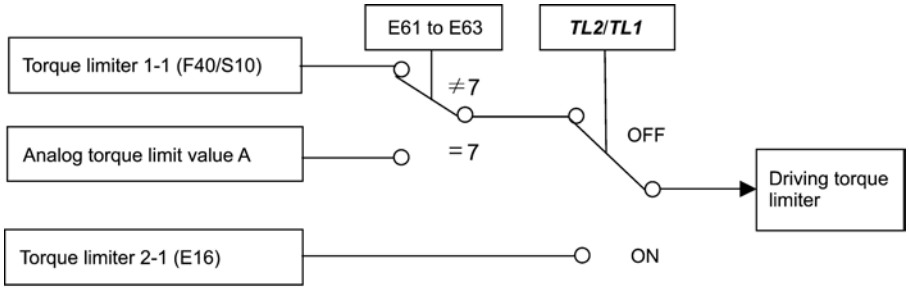
■ Torque limiter levels specified via communications link (S10, S11)

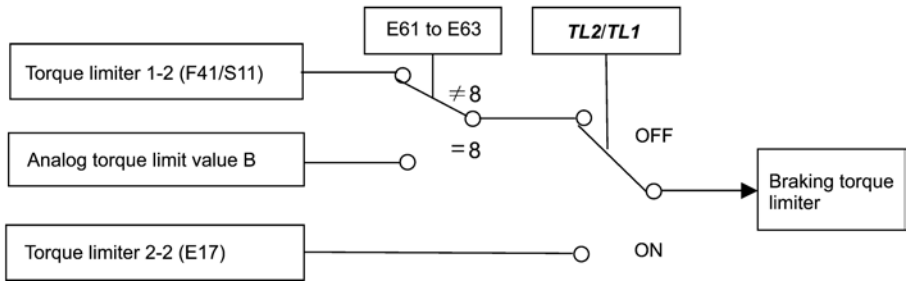
The torque limiter levels can be changed via the communications link. Function codes S10 and S11 exclusively reserved for the communications link respond to function codes F40 and F41.

■ Switching torque limiters

The torque limiters can be switched by the function code setting and the terminal command ***TL2/TL1*** ("Select torque limiter level 2/1") assigned to any of the digital input terminals.

To assign the ***TL2/TL1*** as the terminal function, set any of E01 through E09 to "14." If no ***TL2/TL1*** is assigned, torque limiter levels 1-1 and 1-2 (F40 and F41) take effect by default.





■ Torque limiter (Operating conditions) (H73)

H73 specifies whether the torque limiter is enabled or disabled during acceleration/deceleration and running at constant speed.

Data for H73	During accelerating/decelerating	During running at constant speed
0	Enable	Enable
1	Disable	Enable
2	Enable	Disable

■ Torque limiter (Frequency increment limit for braking) (H76)

H76 specifies the increment limit of the frequency in limiting torque for braking. The factory default is 5.0 Hz. If the increasing frequency during braking reaches the limit value, the torque limiters no longer function, resulting in an overvoltage trip. Such a problem may be avoided by increasing the setting value of H76.

- Data setting range: 0.0 to 500.0 (Hz)

Note The torque limiter and current limiter are very similar functions. If both are activated concurrently, they may conflict with each other and cause hunting (undesirable oscillation of the system). Avoid concurrent activation of these limiters.

F42 Drive Control Selection 1 H68 (Slip Compensation 1, Operating conditions)

F42 specifies the motor drive control.

Data for F42		Basic control	Speed feedback	Speed control
0	V/f control with slip compensation inactive	V/f control	Disable	Frequency control
1	Dynamic torque vector control: (with slip compensation and auto torque boost active)			Frequency control with slip compensation
2	V/f control with slip compensation active			
5	Vector control without speed sensor	Vector control	Estimated speed	Speed control with automatic speed regulator (ASR)
6	Vector control with speed sensor		Enable	

■ V/f control with slip compensation inactive

Under this control, the inverter controls a motor with the voltage and frequency according to the V/f pattern specified by function codes. This control disables all automatically controlled features such as the slip compensation, so no unpredictable output fluctuation occurs, enabling stable operation with constant output frequency.

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■ V/f control with slip compensation active

Applying any load to an induction motor causes a rotational slip due to the motor characteristics, decreasing the motor rotation. The inverter's slip compensation function first presumes the slip value of the motor based on the motor torque generated and raises the output frequency to compensate for the decrease in motor rotation. This prevents the motor from decreasing the rotation due to the slip.

That is, this function is effective for improving the motor speed control accuracy.

Function code		Operation
P12	Rated slip frequency	Specify the rated slip frequency.
P09	Slip compensation gain for driving	Adjust the slip compensation amount for driving. Slip compensation amount for driving = Rated slip x Slip compensation gain for driving
P11	Slip compensation gain for braking	Adjust the slip compensation amount for braking. Slip compensation amount for braking = Rated slip x Slip compensation gain for braking
P10	Slip compensation response time	Specify the slip compensation response time. Basically, there is no need to modify the default setting.

To improve the accuracy of slip compensation, perform auto tuning.

H68 (Slip Compensation 1 (Operating conditions)) specifies whether slip compensation is enabled during acceleration/deceleration and whether it is enabled when the current frequency exceeds the base frequency.

Data for H68	Motor driving conditions		Motor driving frequency zone	
	Accl/Decel	Constant speed	Base frequency or below	Base frequency or above
0	Enable	Enable	Enable	Enable
1	Disable	Enable	Enable	Enable
2	Enable	Enable	Enable	Disable
3	Disable	Enable	Enable	Disable

■ Dynamic torque vector control

To get the maximal torque out of a motor, this control calculates the motor torque for the load applied and uses it to optimize the voltage and current vector output.

Selecting this control automatically enables the auto torque boost and slip compensation function. (The slip compensation functions as in the V/f control with slip compensation enabled.)

This control is effective for improving the system response to external disturbances such as load fluctuations and the motor speed control accuracy.

■ Vector control without speed sensor

This control estimates the motor speed based on the inverter's output voltage and current to use the estimated speed for speed control. In addition, it decomposes the motor drive current into the exciting and torque current components, and controls each of those components in vector. No PG (pulse generator) interface card is required. It is possible to obtain the desired response by adjusting the control constants (PI constants) using the speed regulator (PI controller).

Since this control controls the motor current, it is necessary to secure some voltage margin between the voltage that the inverter can output and the induced voltage of the motor, by keeping the former lower than the latter.

Although the voltage of the general-purpose motor has usually been adjusted to match the commercial power, keeping the motor terminal voltage low is necessary in order to secure the voltage margin. If the motor is driven under this control with the motor terminal voltage being kept low, however, the rated torque cannot be obtained even when the rated current originally specified for the motor is applied. To secure the rated torque, therefore, it is necessary to use a motor with higher rated current. (This also applies to the vector control with speed sensor.)

This control is not available in MD-mode inverters, so do not set F42 data to "5" for those inverters.

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■ Vector control with speed sensor

This control requires an optional PG (pulse generator) and an optional PG interface card to be mounted on a motor shaft and an inverter, respectively. The inverter detects the motor's rotational position and speed from PG feedback signals, decomposes the motor drive current into the exciting and torque current components, and controls each of components in vector.

The vector control enables speed control with high accuracy and high responsiveness.

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

Note

Since slip compensation, dynamic torque vector control, and vector control without/with speed sensor use motor parameters, the following conditions should be satisfied. If they are not satisfied, full control performance may not be obtained.

- A single motor should be controlled.
- Motor parameters P02, P03, P06 to P23, P55 and P56 are properly configured. Or, auto tuning (P04) is performed. (A Fuji VG motor requires no auto tuning, but just requires selecting a Fuji VG motor with function code (P99 = 2).)
- The capacity of the motor to be controlled should be two or more ranks lower than that of the inverter under the dynamic torque vector control; it should be the same as the inverter under the vector control without/with speed sensor. Otherwise, the inverter may not control the motor due to decrease of the current detection resolution.
- The wiring distance between the inverter and motor should be 50 m or less. If it is longer, the inverter may not control the motor due to leakage current flowing through stray capacitance to the ground or between wires. Especially, small capacity inverters whose rated current is also small may be unable to control the motor correctly even when the wiring is less than 50 m. In that case, make the wiring length as short as possible or use a wire with small stray capacitance (e.g., loosely-bundled cable) to minimize the stray capacitance.

F43, F44 Current Limiter (Mode selection and Level)

H12 (Instantaneous Overcurrent Limiting, Mode selection)

When the output current of the inverter exceeds the level specified by the current limiter (F44), the inverter automatically manages its output frequency to prevent a stall and limits the output current.

The default setting is 160%, 145% and 130% for HD-, MD- and LD-mode inverters, respectively. (Once the HD, MD, or LD mode is selected by F80, the current limit for each mode is automatically specified.)

If 160% (145% or 130%) or over of overcurrent instantaneously flows and the output frequency decreases by this current limit that is undesired, consider increasing the current limit level.

If F43 = 1, the current limiter is enabled only during constant speed operation. If F43 = 2, the current limiter is enabled during both of acceleration and constant speed operation. Choose F43 = 1 if you need to run the inverter at full capability during acceleration and to limit the output current during constant speed operation.

■ Mode selection (F43)

F43 selects the motor running state in which the current limiter will be active.

Data for F43	Running states that enable the current limiter		
	During acceleration	During constant speed	During deceleration
0	Disable	Disable	Disable
1	Disable	Enable	Disable
2	Enable	Enable	Disable

■ Level (F44)

F44 specifies the operation level at which the output current limiter becomes activated, in ratio to the inverter rating.

- Data setting range: 20 to 200 (%) (in ratio to the inverter rating)

Function Code Details
F42-F44
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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■ Instantaneous Overcurrent Limiting (Mode selection) (H12)

H12 specifies whether the inverter invokes the current limit processing or enters the overcurrent trip when its output current exceeds the instantaneous overcurrent limiting level. Under the current limit processing, the inverter immediately turns OFF its output gate to suppress the further current increase and continues to control the output frequency.

Data for H12	Function
0	Disable An overcurrent trip occurs at the instantaneous overcurrent limiting level.
1	Enable

If any problem could occur when the motor torque temporarily drops during current limiting processing, it is necessary to cause an overcurrent trip (H12 = 0) and actuate a mechanical brake at the same time.

Note

- Since the current limit operation with F43 and F44 is performed by software, it may cause a delay in control. If you need a quick response current limiting, also enable the instantaneous overcurrent limiting with H12.
- If an excessive load is applied when the current limiter operation level is set extremely low, the inverter will rapidly lower its output frequency. This may cause an overvoltage trip or dangerous turnover of the motor rotation due to undershooting. Depending on the load, extremely short acceleration time may activate the current limiting to suppress the increase of the inverter output frequency, causing hunting (undesirable oscillation of the system) or activating the inverter overvoltage trip (alarm $\mathcal{OU}$). When specifying the acceleration time, therefore, you need to take into account machinery characteristics and moment of inertia of the load.
- The torque limiter and current limiter are very similar in function. If both are activated concurrently, they may conflict with each other and cause hunting. Avoid concurrent activation of these limiters.
- The vector control itself contains the current control system, so it disables the current limiter specified by F43 and F44, as well as automatically disabling the instantaneous overcurrent limiting (specified by H12). Accordingly, the inverter causes an overcurrent trip when its output current exceeds the instantaneous overcurrent limiting level.

F50 to F52 Electronic Thermal Overload Protection for Braking Resistor (Discharging capability, Allowable average loss and Resistance)

These function codes specify the electronic thermal overload protection feature for the braking resistor.

Set the discharging capability, allowable average loss and resistance to F50, F51 and F52, respectively. These values are determined by the inverter and braking resistor models. For the discharging capability, allowable average loss and resistance, refer to [3] "Specifications" in Chapter 4, Section 4.4.1.1 "Braking resistor (DBR) and braking unit." The values listed in the tables are for standard models and 10% ED models of the braking resistors which Fuji Electric provides. If you use a braking resistor of other maker, confirm the corresponding values with the maker, and set the function codes accordingly.

Note Depending on the thermal marginal characteristics of the braking resistor, the electronic thermal overload protection feature may act so that the inverter issues the overheat protection alarm $\mathcal{OH4}$ even if the actual temperature rise is not large enough. If it happens, review the relationship between the performance index of the braking resistor and settings of related function codes.

Tip Using the standard models of braking resistor or using the braking unit and braking resistor together can output temperature detection signal for overheat. Assign terminal command ***THR*** ("Enable external alarm trip") to any of digital input terminals [X1] to [X9], [FWD] and [REV] and connect that terminal and its common terminal to braking resistor's terminals 2 and 1.

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Calculating the discharging capability and allowable average loss of the braking resistor and configuring the function code data

When using any non-Fuji braking resistor, inquire of the resistor manufacturer about the resistor rating and then configure the related function codes.

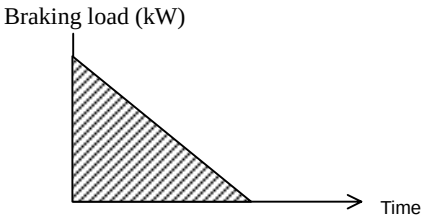
The calculation procedures for the discharging capability and allowable average loss of the braking resistor differ depending on the application of the braking load as shown below.

Applying braking load during deceleration

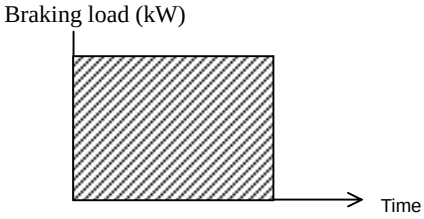
In usual deceleration, the braking load decreases as the speed slows down. In the deceleration with constant torque, the braking load decreases in proportion to the speed. Use Expressions (1) and (3) given below.

Applying braking load during running at a constant speed

Different from during deceleration, in applications where the braking load is externally applied during running at a constant speed, the braking load is constant. Use Expressions (2) and (4) given below.



Applying braking load during deceleration



Applying braking load during running at a constant speed

■ Discharging capability (F50)

The discharging capability refers to kWs allowable for a single braking cycle, which is obtained based on the braking time and the motor rated capacity.

Data for F50	Function
0	For the braking resistor built-in type
1 to 9000	1 to 9000 (kWs)
OFF	Disable the electronic thermal overload protection

During deceleration:

$$\text{Discharging capability (kWs)} = \frac{\text{Braking time (s)} \times \text{Motor rated capacity (kW)}}{2} \qquad \text{Expression (1)}$$

During running at a constant speed:

$$\text{Discharging capability (kWs)} = \text{Braking time (s)} \times \text{Motor rated capacity (kW)} \qquad \text{Expression (2)}$$

Tip When the F50 is set to "0" (For the braking resistor built-in type), no specification of the discharging capability is required.

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■ Allowable average loss (F51)

The allowable average loss refers to a tolerance for motor continuous operation, which is obtained based on the %ED (%) and motor rated capacity (kW).

Data for F51	Function
0.001 to 99.99	0.001 to 99.99 (kW)

During deceleration:

$$\text{Allowable average loss (kWs)} = \frac{\frac{\%ED(\%)}{100} \times \text{Motor rated capacity (kW)}}{2} \qquad \text{Expression (3)}$$

During constant speed operation:

$$\text{Allowable average loss (kWs)} = \frac{\%ED(\%)}{100} \times \text{Motor rated capacity (kW)} \qquad \text{Expression (4)}$$

■ Resistance (F52)

F52 specifies the resistance of the braking resistor.

F80 Switching between HD, MD and LD drive modes

F80 specifies whether to drive the inverter in the high duty (HD), medium duty (MD) or low duty (LD) mode.

To change the F80 data, it is necessary to press the STOP + ∧ keys or STOP + ∨ keys (simultaneous keying).

Data for F80	Drive mode	Application	Continuous current rating level	Overload capability	Maximum frequency
0	HD (High Duty) mode (default)	Heavy load	Capable of driving a motor whose capacity is the same as the inverter's	150% for 1 min. 200% for 3 s	500 Hz
1	LD (Low Duty) mode	Light load	Capable of driving a motor whose capacity is one or two ranks higher than the inverter's.	120% for 1 min.	120 Hz
2	MD (Medium Duty) mode	Medium load	Capable of driving a motor whose capacity is one rank higher than the inverter's.	150% for 1 min.	120 Hz

In the MD/LD mode, the continuous current rating allows the inverter to drive a motor with one or two ranks higher capacity, but the overload capability (%) against the continuous current rating decreases. For the rated current level, see Chapter 2 "SPECIFICATIONS."

The MD-/LD-mode inverter is subject to restrictions on the function code data setting range and internal processing as listed below.

Function codes	Name	HD mode	MD mode	LD mode	Remarks
F21	DC braking 1 (Braking level)	Setting range: 0 to 100%	Setting range: 0 to 80%		In the MD/LD mode, a value out of the range, if specified, automatically changes to the maximum value allowable in the MD/LD mode.
F26	Motor sound (Carrier frequency)	Setting range: 0.75 to 16 kHz (0.4 to 55 kW) 0.75 to 10 kHz (75 to 220 kW)	Setting range: 0.75 to 2 kHz (90 to 220 kW)	Setting range: 0.75 to 16 kHz (5.5 to 18.5 kW) 0.75 to 10 kHz (22 to 55 kW) 0.75 to 6 kHz (75 to 220 kW)	
F44	Current limiter (Level)	Initial value: 160%	Initial value: 145%	Initial value: 130%	Switching the drive mode between HD, MD and LD with function code F80 automatically initializes the F44 data to the value specified at left.
F03	Maximum frequency 1	Setting range: 25 to 500 Hz Upper limit: 500 Hz	Setting range: 25 to 500 Hz Upper limit: 120 Hz		In the MD/LD mode, if the maximum frequency exceeds 120 Hz, the actual output frequency is internally limited to 120 Hz.
—	Current indication and output	Based on the rated current level for HD mode	Based on the rated current level for MD mode	Based on the rated current level for LD mode	—

Switching to the LD mode does not automatically change the motor rated capacity 1 (P02) to the one for the motor with one rank higher capacity, so configure the P02 data to match the applied motor rating as required.

Function Code Details
F50-F80
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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5.4.2 E codes (Extension terminal functions)

E01 to E09 — **Terminal [X1] to [X9] Functions**
E98 and E99 (Terminal [FWD] and [REV] Functions)

Function codes E01 to E09, E98 and E99 allow you to assign commands to terminals [X1] to [X9], [FWD], and [REV] which are general-purpose, programmable, digital input terminals.

These function codes may also switch the logic system between normal and negative to define how the inverter logic interprets either ON or OFF status of each terminal. The default setting is normal logic system "Active ON." So, explanations that follow are given in normal logic system "Active ON." The descriptions are, in principle, arranged in the numerical order of assigned data. However, highly relevant signals are collectively described where one of them first appears. Refer to the function codes in the "Related function codes" column, if any.

The FRENIC-MEGA runs under "V/f control," "vector control without speed sensor," or "vector control with speed sensor." Some function codes apply exclusively to the specific drive control, which is indicated by letters Y (Applicable) and N (Not applicable) in the "Drive control" column in the table below. The "Drive control" column uses the following abbreviations.

- V/f: V/f control
- w/o PG: Vector control without speed sensor
- w/ PG: Vector control with speed sensor

⚠CAUTION

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***, and ***LE***) may cause a sudden motor start or an abrupt change in speed.

An accident or physical injury may result.

Function code data		Terminal commands assigned	Symbol	Drive control			Related function code
Active ON	Active OFF			V/f	w/o PG	w/ PG	
0	1000	Select multi-frequency (0 to 15 steps)	***SS1***	Y	Y	Y	C05 to C19
1	1001		***SS2***	Y	Y	Y	
2	1002		***SS4***	Y	Y	Y	
3	1003		***SS8***	Y	Y	Y	
4	1004	Select ACC/DEC time (2 steps)	***RT1***	Y	Y	Y	F07, F08 E10 to E15
5	1005	Select ACC/DEC time (4 steps)	***RT2***	Y	Y	Y	
6	1006	Enable 3-wire operation	***HLD***	Y	Y	Y	F02
7	1007	Coast to a stop	***BX***	Y	Y	Y	—
8	1008	Reset alarm	***RST***	Y	Y	Y	—
1009	9	Enable external alarm trip	***THR***	Y	Y	Y	—
10	1010	Ready for jogging	***JOG***	Y	Y	Y	C20, H54, H55 d09 to d13
11	1011	Select frequency command 2/1	***Hz2/Hz1***	Y	Y	Y	F01, C30
12	1012	Select motor 2	***M2***	Y	Y	Y	A42
13	—	Enable DC braking	***DCBRK***	Y	Y	Y	F20 to F22
14	1014	Select torque limiter level 2/1	***TL2/TL1***	Y	Y	Y	F40, F41 E16, E17
15	—	Switch to commercial power (50 Hz)	***SW50***	Y	N	N	—
16	—	Switch to commercial power (60 Hz)	***SW60***	Y	N	N	—
17	1017	UP (Increase output frequency)	***UP***	Y	Y	Y	Frequency setting: F01, C30 PID command: J02

Function code data		Terminal commands assigned	Symbol	Drive control			Related function code
Active ON	Active OFF			V/f	w/o PG	w/ PG	
18	1018	DOWN (Decrease output frequency)	***DOWN***	Y	Y	Y	
19	1019	Enable data change with keypad	***WE-KP***	Y	Y	Y	F00
20	1020	Cancel PID control	***Hz/PID***	Y	Y	Y	J01 to J19 J56 to J62
21	1021	Switch normal/inverse operation	***IVS***	Y	Y	Y	C53, J01
22	1022	Interlock	***IL***	Y	Y	Y	F14
24	1024	Enable communications link via RS-485 or fieldbus (option)	***LE***	Y	Y	Y	H30, y98
25	1025	Universal DI	***U-DI***	Y	Y	Y	—
26	1026	Enable auto search for idling motor speed at starting	***STM***	Y	Y	N	H09, d67
1030	30	Force to stop	***STOP***	Y	Y	Y	F07, H56
32	1032	Pre-excitation	***EXITE***	N	Y	Y	H84, H85
33	1033	Reset PID integral and differential components	***PID-RST***	Y	Y	Y	J01 to J19 J56 to J62
34	1034	Hold PID integral component	***PID-HLD***	Y	Y	Y	
35	1035	Select local (keypad) operation	***LOC***	Y	Y	Y	(See Section 7.3.6.)
36	1036	Select motor 3	***M3***	Y	Y	Y	A42, b42
37	1037	Select motor 4	***M4***	Y	Y	Y	A42, r42
39	—	Protect motor from dew condensation	***DWP***	Y	Y	Y	J21
40	—	Enable integrated sequence to switch to commercial power (50 Hz)	***ISW50***	Y	N	N	J22
41	—	Enable integrated sequence to switch to commercial power (60 Hz)	***ISW60***	Y	N	N	
47	1047	Servo-lock command	***LOCK***	N	N	Y	J97 to J99
48	—	Pulse train input (available only on terminal [X7])	***PIN***	Y	Y	Y	F01, C30 d62, d63
49	1049	Pulse train sign (available on terminals except [X7])	***SIGN***	Y	Y	Y	
72	1072	Count the run time of commercial power-driven motor 1	***CRUN-M1***	Y	N	N	H44, H94
73	1073	Count the run time of commercial power-driven motor 2	***CRUN-M2***	Y	N	N	
74	1074	Count the run time of commercial power-driven motor 3	***CRUN-M3***	Y	N	N	
75	1075	Count the run time of commercial power-driven motor 4	***CRUN-M4***	Y	N	N	
76	1076	Select droop control	***DROOP***	Y	Y	Y	H28
77	1077	Cancel PG alarm	***PG-CCL***	N	N	Y	—
98	—	Run forward (Exclusively assigned to [FWD] and [REV] terminals by E98 and E99)	***FWD***	Y	Y	Y	F02
99	—	Run reverse (Exclusively assigned to [FWD] and [REV] terminals by E98 and E99)	***REV***	Y	Y	Y	

Note Any negative logic (Active OFF) command cannot be assigned to the functions marked with "–" in the "Active OFF" column.

The "Enable external alarm trip" and "Force to stop" are fail-safe terminal commands. For example, when data = 9 in "Enable external alarm trip," "Active OFF" (alarm is triggered when OFF); when data = 1009, "Active ON" (alarm is triggered when ON).

Terminal function assignment and data setting

■ Select multi-frequency (0 to 15 steps) -- ***SS1***, ***SS2***, ***SS4***, and ***SS8*** (Function code data = 0, 1, 2, and 3)

The combination of the ON/OFF states of digital input signals ***SS1***, ***SS2***, ***SS4*** and ***SS8*** selects one of 16 different frequency commands defined beforehand by 15 function codes C05 to C19 (Multi-frequency 0 to 15). With this, the inverter can drive the motor at 16 different preset frequencies.

🕮 Refer to C05 through C19.

■ Select ACC/DEC time -- ***RT1*** and ***RT2*** (Function code data = 4 and 5)

These terminal commands switch between ACC/DEC time 1 to 4 (F07, F08 and E10 through E15).

🕮 Refer to F07 and F08.

■ Enable 3-wire operation -- ***HLD*** (Function code data = 6)

Turning this terminal command ON self-holds the forward ***FWD*** or reverse ***REV*** run command, to enable 3-wire inverter operation.

🕮 Refer to F02.

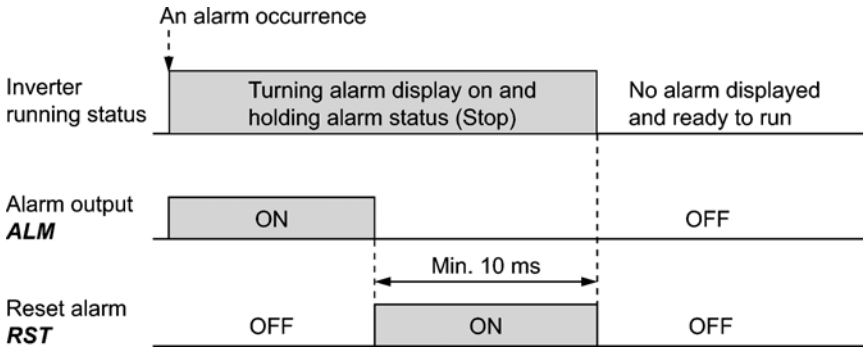
■ Coast to a stop -- ***BX*** (Function code data = 7)

Turning this terminal command ON immediately shuts down the inverter output so that the motor coasts to a stop, without issuing any alarms.

■ Reset alarm -- ***RST*** (Function code data = 8)

Turning this terminal command ON clears the ***ALM*** state--alarm output (for any alarm). Turning it OFF erases the alarm display and clears the alarm hold state.

When you turn the ***RST*** command ON, keep it ON for 10 ms or more. This command should be kept OFF for the normal inverter operation.



■ Enable external alarm trip -- ***THR*** (Function code data = 9)

Turning this terminal command OFF immediately shuts down the inverter output (so that the motor coasts to a stop), displays the alarm ⌈ᴛʜʀ⌋, and issues the alarm output (for any alarm) ***ALM***. The ***THR*** command is self-held, and is reset when an alarm reset takes place.

Tip Use this alarm trip command from external equipment when you have to immediately shut down the inverter output in the event of an abnormal situation in peripheral equipment.

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■ Ready for jogging -- ***JOG*** (Function code data = 10)

This terminal command is used to jog or inch the motor for positioning a workpiece.

Turning this command ON makes the inverter ready for jogging.

🕮 Refer to C20.

■ Select frequency command 2/1 -- ***Hz2***/***Hz1*** (Function code data = 11)

Turning this terminal command ON and OFF switches the frequency command source between frequency command 1 (F01) and frequency command 2 (C30).

🕮 Refer to F01.

■ Select motor 2, 3 and 4 -- ***M2***, ***M3***, ***M4*** (Function code data = 12, 36 and 37)

The combination of digital input terminal commands ***M2***, ***M3*** and ***M4*** switches to any of the 1st to 4th motors. When the motor is switched, the function code group with which the inverter drives the motor is also switched to the one corresponding to the motor.

🕮 Refer to A42.

■ Enable DC braking -- ***DCBRK*** (Function code data = 13)

This terminal command gives the inverter a DC braking command through the inverter's digital input.

(Requirements for DC braking must be satisfied.)

🕮 Refer to F20 through F22.

■ Select torque limiter level 2/1 -- ***TL2***/***TL1*** (Function code data = 14)

This terminal command switches between torque limiter 1 (F40 and F41) and torque limiter 2 (E16 and E17).

🕮 Refer to F40 and F41.

■ Switch to commercial power for 50 Hz or 60 Hz -- ***SW50*** and ***SW60***
(Function code data = 15 and 16)

When an external sequence switches the motor drive power from the commercial line to the inverter, the terminal command ***SW50*** or ***SW60*** enables the inverter to start running the motor with the current commercial power frequency, regardless of settings of the reference/output frequency in the inverter. A running motor driven by commercial power is carried on into inverter operation. This command helps you smoothly switch the motor drive power source from the commercial power to the inverter power.

For details, refer to the table below, the operation scheme and an example of external sequence and its operation time scheme on the following pages.

Assignment	The inverter:	Description
SW50	Starts at 50 Hz.	Do not concurrently assign both ***SW50*** and ***SW60***.
SW60	Starts at 60 Hz.	

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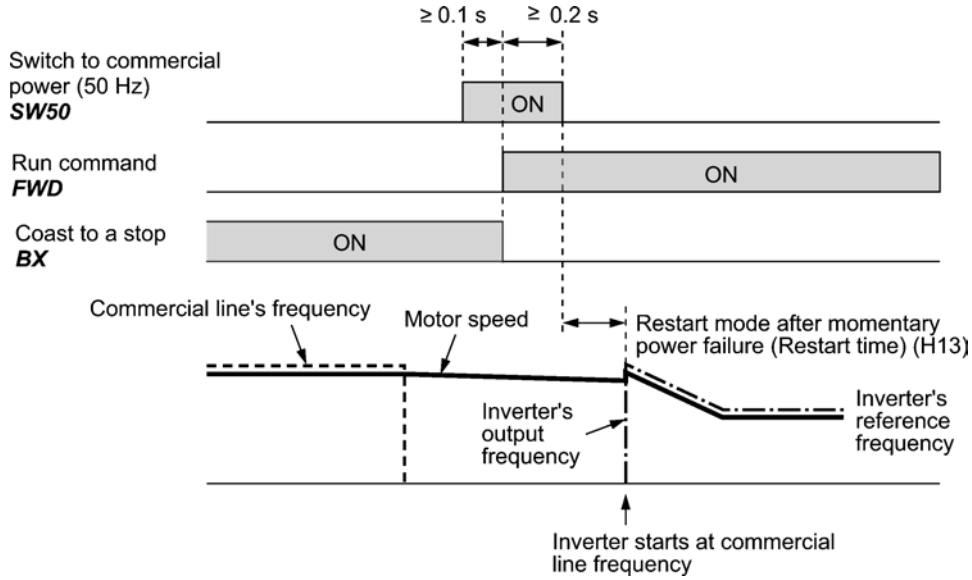
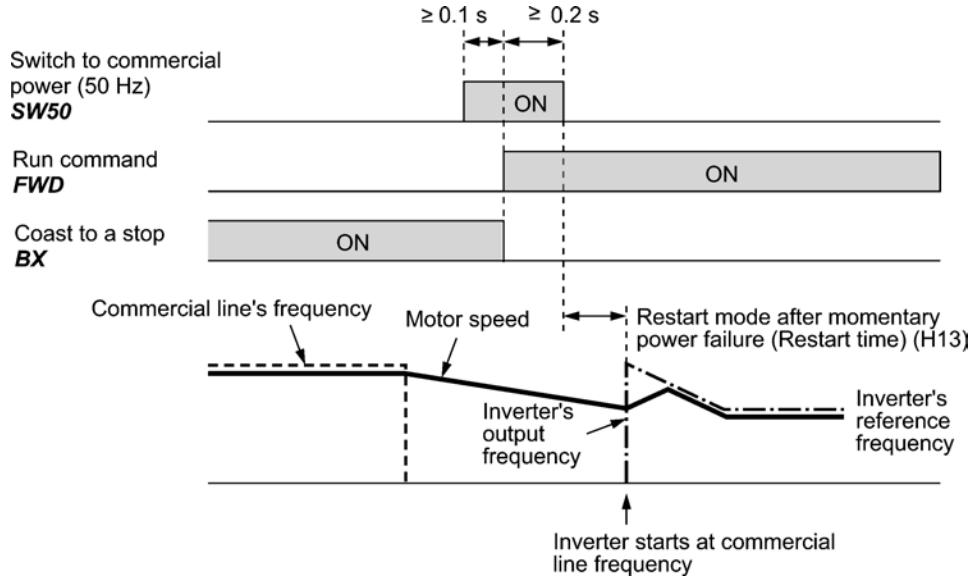
Operation Schemes

- When the motor speed remains almost the same during coast-to-stop:



- When the motor speed decreases significantly during coast-to-stop (with the current limiter activated):



Note

- Secure more than 0.1 second after turning ON the "Switch to commercial power" signal before turning ON a run command.
- Secure more than 0.2 second of an overlapping period with both the "Switch to commercial power" signal and run command being ON.
- If an alarm has been issued or ***BX*** has been ON when the motor drive source is switched from the commercial power to the inverter, the inverter will not be started at the commercial power frequency and will remain OFF. After the alarm has been reset or ***BX*** turned OFF, operation at the frequency of the commercial power will not be continued, and the inverter will be started at the ordinary starting frequency.

  If you wish to switch the motor drive source from the commercial line to the inverter, be sure to turn ***BX*** OFF before the "Switch to commercial power" signal is turned OFF.
- When switching the motor drive source from the inverter to commercial power, adjust the inverter's reference frequency at or slightly higher than that of the commercial power frequency beforehand, taking into consideration the motor speed down during the coast-to-stop period produced by switching.
- Note that when the motor drive source is switched from the inverter to the commercial power, a high inrush current will be generated, because the phase of the commercial power usually does not match the motor speed at the switching. Make sure that the power supply and all the peripheral equipment are capable of withstanding this inrush current.
- If you have enabled "Restart after momentary power failure" (F14 = 3, 4, or 5), keep ***BX*** ON during commercial power driven operation to prevent the inverter from restarting after a momentary power failure.

Function Code Details
F codes
E01-E09
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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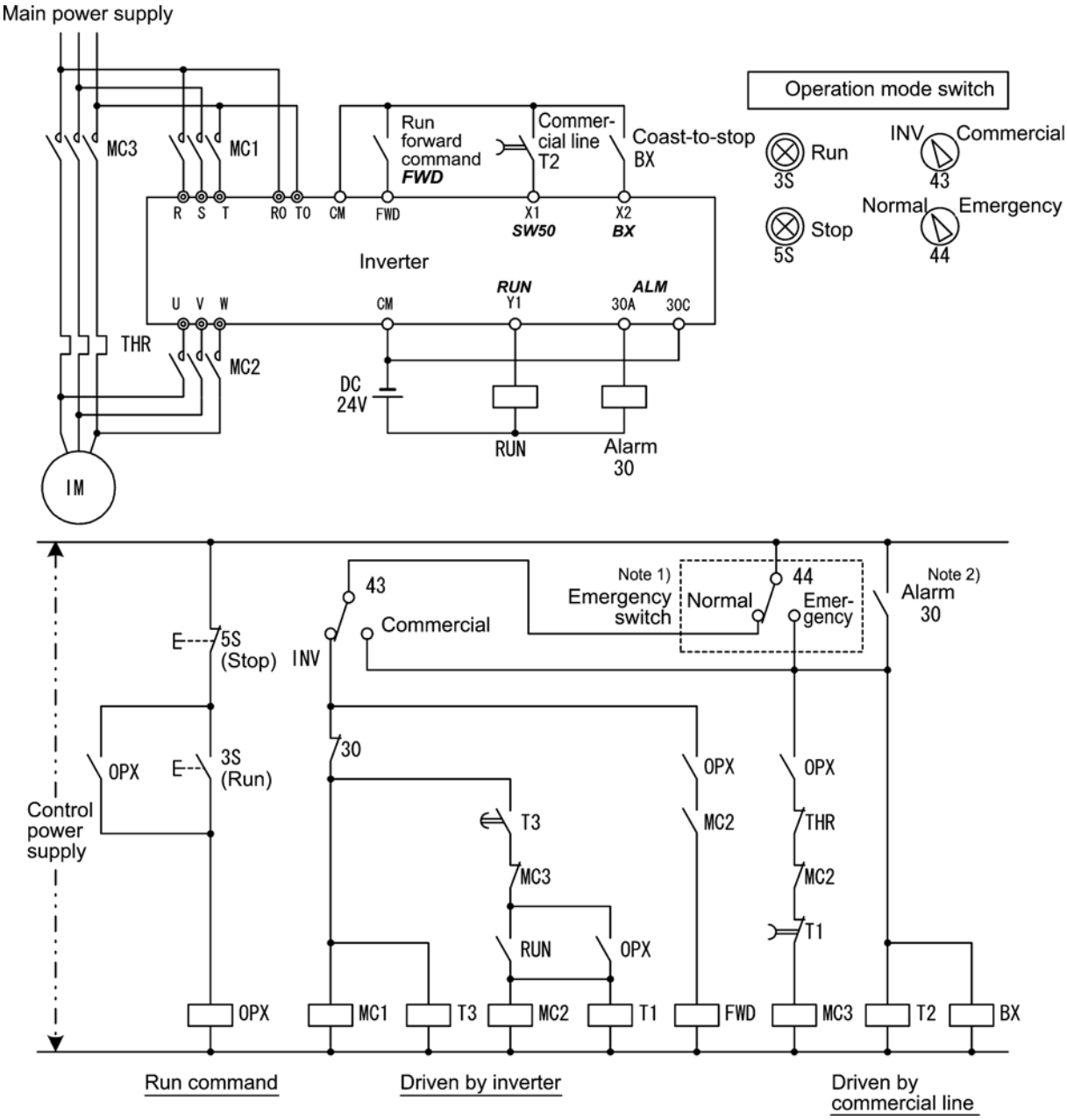
Example of Sequence Circuit

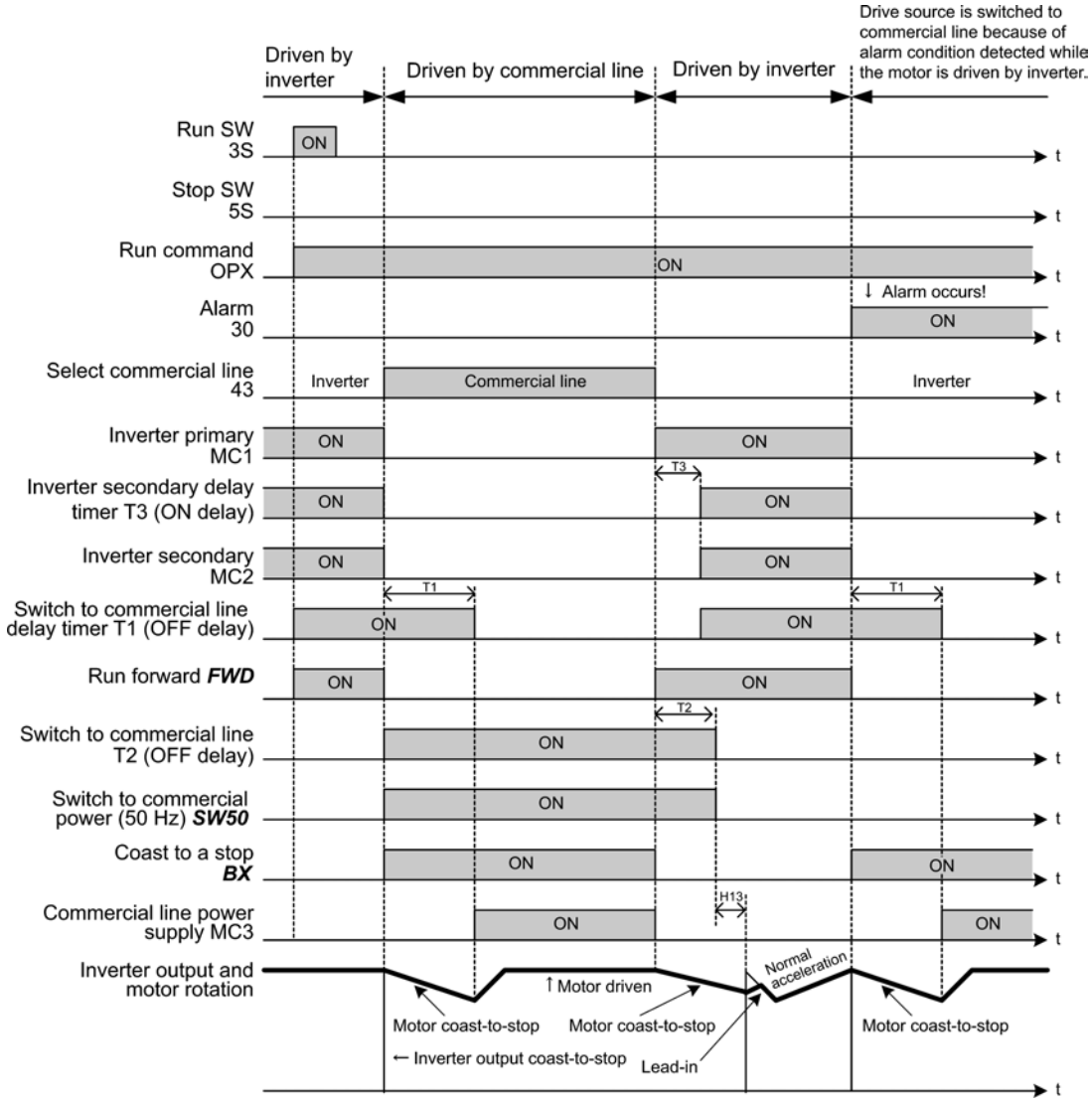


Note 1) Emergency switch

Manual switch provided for the event that the motor drive source cannot be switched normally to the commercial power due to a serious problem of the inverter

Note 2) When any alarm has occurred inside the inverter, the motor drive source will automatically be switched to the commercial power.

Example of Operation Time Scheme



Tip Alternatively, you may use the integrated sequence by which some of the actions above are automatically performed by the inverter itself. For details, refer to the description of ***ISW50*** and ***ISW60***.

■ UP (Increase output frequency) and DOWN (Decrease output frequency) commands -- ***UP*** and ***DOWN*** (Function code data = 17 and 18)

• Frequency setting

Turning the terminal command ***UP*** or ***DOWN*** ON causes the output frequency to increase or decrease, respectively, within the range from 0 Hz to the maximum frequency.
🕮 Refer to F01 (data = 7).

• PID command

Turning the terminal command ***UP*** or ***DOWN*** ON causes the PID command value to increase or decrease, respectively, within the range from 0 to 100%.
🕮 Refer to J02 (data = 3).

■ Enable data change with keypad -- ***WE-KP*** (Function code data = 19)

Turning the terminal command ***WE-KP*** ON protects function code data from accidentally getting changed by pressing the keys on the keypad.

Only when this terminal command is ON, you can change function code data from the keypad.
🕮 Refer to F00.

Function Code Details
F codes
E01-E09
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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■ Cancel PID control -- ***Hz/PID*** (Function code data = 20)

Turning this terminal command ON disables the PID control.

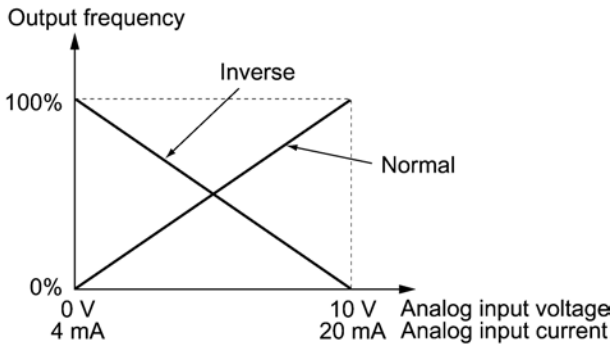
If the PID control is disabled with this command, the inverter runs the motor with the reference frequency manually set by any of the multi-frequency, keypad, analog input, etc.

Terminal command ***Hz/PID***	Function
OFF	Enable PID control
ON	Disable PID control/Enable manual settings

🕮 Refer to J01 through J19 and J56 through J62.

■ Switch normal/inverse operation -- ***IVS*** (Function code data = 21)

This terminal command switches the output frequency control between normal (proportional to the input value) and inverse in analog frequency setting or under PID process control. To select the inverse operation, turn the ***IVS*** ON.



Tip The normal/inverse switching operation is useful for air-conditioners that require switching between cooling and heating. In cooling, the speed of the fan motor (output frequency of the inverter) is increased to lower the temperature. In heating, it is reduced to lower the temperature. This switching is realized by the ***IVS***.

• When the inverter is driven by an external analog frequency command sources (terminals [12], [C1] and [V2]):

Switching normal/inverse operation can apply only to the analog frequency command sources (terminals [12], [C1] and [V2]) in frequency command 1 (F01) and does not affect frequency command 2 (C30) or UP/DOWN control.

As listed below, the combination of the "Selection of normal/inverse operation for frequency command 1" (C53) and the terminal command ***IVS*** determines the final operation.

Combination of C53 and ***IVS***

Data for C53	***IVS***	Final operation
0: Normal operation	OFF	Normal
	ON	Inverse
1: Inverse operation	OFF	Inverse
	ON	Normal

• When the process control is performed by the PID processor integrated in the inverter:

The terminal command ***Hz/PID*** ("Cancel PID control") can switch the PID control between enabled (process is to be controlled by the PID processor) and disabled (process is to be controlled by the manual frequency setting). In either case, the combination of the "PID control" (J01) or "Selection of normal/inverse operation for frequency command 1" (C53) and the terminal command ***IVS*** determines the final operation as listed below.

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When the PID control is enabled:
The normal/inverse operation selection for the PID processor output (reference frequency) is as follows.

PID control (Mode selection) (J01)	***IVS***	Final operation
1: Enable (normal operation)	OFF	Normal
	ON	Inverse
2: Enable (inverse operation)	OFF	Inverse
	ON	Normal

When the PID control is disabled:
The normal/inverse operation selection for the manual reference frequency is as follows.

Selection of normal/inverse operation for frequency command 1 (C53)	***IVS***	Final operation
0: Normal operation	–	Normal
1: Inverse operation	–	Inverse

Note When the process control is performed by the PID control facility integrated in the inverter, the ***IVS*** is used to switch the PID processor output (reference frequency) between normal and inverse, and has no effect on any normal/inverse operation selection of the manual frequency setting.

📖 Refer to the descriptions of J01 through J19 and J56 through J62.

■ Interlock -- ***IL*** (Function code data = 22)

In a configuration where a magnetic contactor (MC) is installed in the power output (secondary) circuit of the inverter, the momentary power failure detection feature provided inside the inverter may not be able to accurately detect a momentary power failure by itself. Using a digital signal input with the interlock command ***IL*** assures the accurate detection.

📖 Refer to F14.

Terminal command ***IL***	Meaning
OFF	No momentary power failure has occurred.
ON	A momentary power failure has occurred. (Restart after a momentary power failure enabled)

■ Enable communications link via RS-485 or fieldbus (option)
-- ***LE*** (Function code data = 24)

Turning this terminal command ON gives priorities to frequency commands or run commands received via the RS-485 communications link (H30) or the fieldbus option (y98).

No ***LE*** assignment is functionally equivalent to the ***LE*** being ON.

📖 Refer to H30 (Communications link function) and y98 (Bus link function).

■ Universal DI -- ***U-DI*** (Function code data = 25)

Using ***U-DI*** enables the inverter to monitor digital signals sent from the peripheral equipment via an RS-485 communications link or a fieldbus option by feeding those signals to the digital input terminals. Signals assigned to the universal DI are simply monitored and do not operate the inverter.

📖 For an access to universal DI via the RS-485 or fieldbus communications link, refer to their respective Instruction Manuals.

■ Enable auto search for idling motor speed at starting -- ***STM*** (Function code data = 26)

This digital terminal command determines, at the start of operation, whether or not to search for idling motor speed and follow it.

📖 Refer to H09 (Starting mode).

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■ Force to stop -- ***STOP*** (Function code data = 30)

Turning this terminal command OFF causes the motor to decelerate to a stop in accordance with the H56 data (Deceleration time for forced stop). After the motor stops, the inverter enters the alarm state with the alarm Er-5 displayed.

🕮 Refer to F07.

■ Pre-excitation -- ***EXITE*** (Function code data = 32)

Turning this terminal command ON activates the pre-exciting feature. Even if this pre-excitation command is not assigned, specifying H85 (Pre-excitation: Time) to other than "0.00" enables the inverter to automatically start pre-exciting of the motor when it is turned ON. (This applies exclusively to the inverters under vector control with speed sensor.)

🕮 Refer to H84 and H85.

■ Reset PID integral and differential components -- ***PID-RST*** (Function code data = 33)

Turning this terminal command ON resets the integral and differential components of the PID processor.

🕮 Refer to J01 through J19 and J56 through J62.

■ Hold PID integral component -- ***PID-HLD*** (Function code data = 34)

Turning this terminal command ON holds the integral components of the PID processor.

🕮 Refer to J01 through J19 and J56 through J62.

■ Select local (keypad) operation -- ***LOC*** (Function code data = 35)

This terminal command switches the sources of run and frequency commands between remote and local.

🕮 For details of switching between remote and local modes, refer to Chapter 7, Section 7.3.6 "Remote and local modes."

■ Protect motor from dew condensation -- ***DWP*** (Function code data = 39)

Turning this terminal command ON supplies a DC current to the motor in a stopped state in order to generate heat, preventing dew condensation.

🕮 Refer to J21.

■ Enable integrated sequence to switch to commercial power for 50 Hz and 60 Hz -- ***ISW50*** and ***ISW60*** (Function code data = 40 and 41)

With the terminal command ***ISW50*** or ***ISW60*** assigned, the inverter controls the magnetic contactor that switches the motor drive source between the commercial power and the inverter output according to the integrated sequence.

This control is effective when not only ***ISW50*** or ***ISW60**** has been assigned to the input terminal but also the ***SW88*** and ***SW52-2*** signals have been assigned to the output terminals. (It is not essential to assign the ***SW52-1*** signal.)

*The ***ISW50*** or ***ISW60*** should be selected depending upon the frequency of the commercial power; the former for 50 Hz and the latter for 60 Hz.

🕮 For details about ***SW88*** and ***SW52-2*** ("Switch motor drive source between commercial power and inverter output"), refer to E20 to E27.

For details of these commands, refer to the circuit diagrams and timing schemes on the following pages.

Terminal command assigned	Operation (Switching from commercial power to inverter)
ISW50 Enable integrated sequence to switch to commercial power (50 Hz)	Start at 50 Hz.
ISW60 Enable integrated sequence to switch to commercial power (60 Hz)	Start at 60 Hz.

Note Do not assign both ***ISW50*** and ***ISW60*** at the same time. Doing so cannot guarantee the result.

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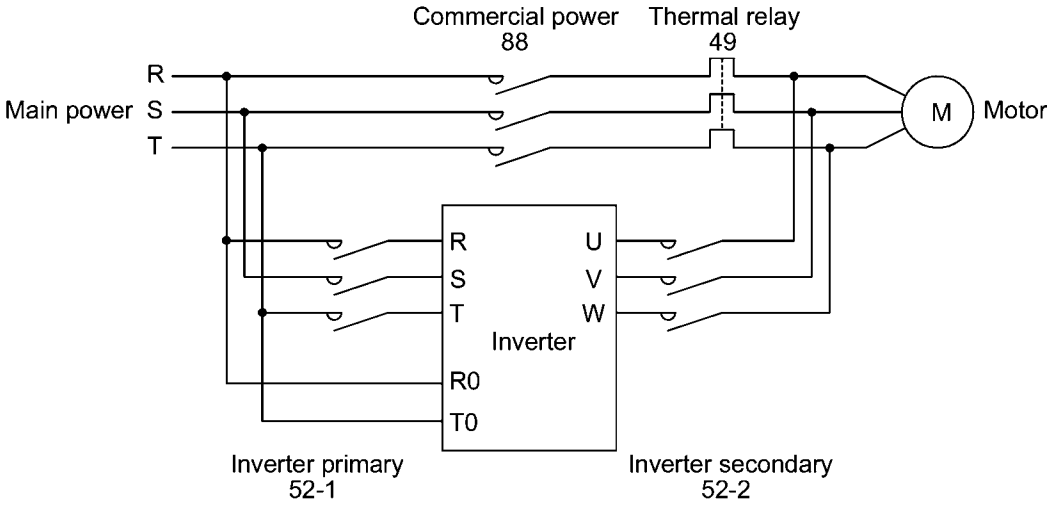
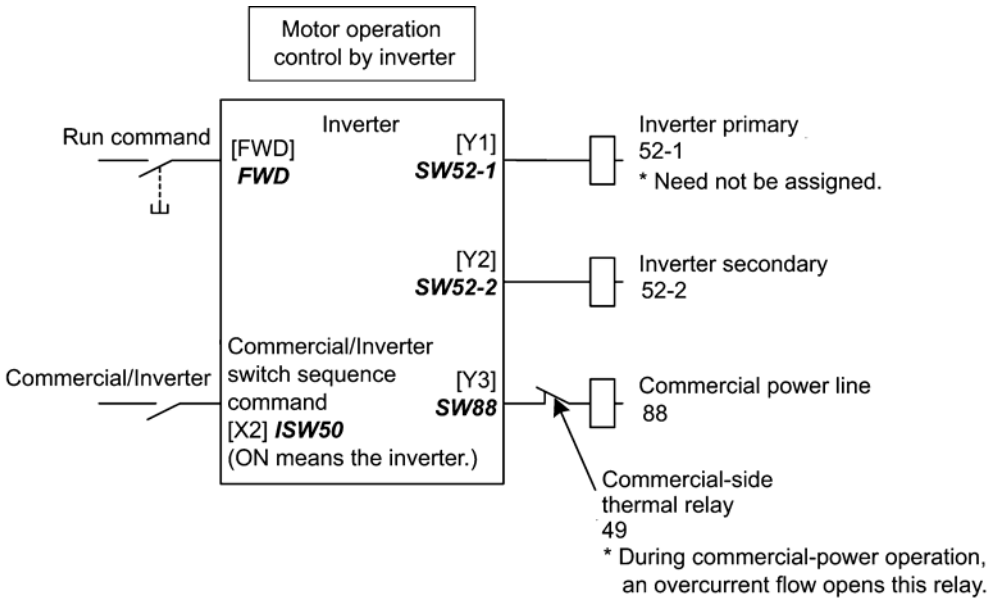
Circuit Diagram and Configuration



Main Circuit



Configuration of Control Circuit

Summary of Operation

Input		Output (Status signal and magnetic contactor)			Inverter operation
ISW50 or ***ISW60***	Run command	***SW52-1*** 52-1	***SW52-2*** 52-2	***SW88*** 88	
OFF (Commercial power)	ON	OFF	OFF	ON	OFF
	OFF			OFF	
ON (Inverter)	ON	ON	ON	OFF	ON
	OFF				OFF

Function Code Details
F codes
E01-E09
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

Timing Scheme

Switching from inverter operation to commercial-power operation
ISW50*/*ISW60: ON → OFF

(1) The inverter output is shut OFF immediately (Power gate IGBT OFF)

(2) The inverter primary circuit ***SW52-1*** and the inverter secondary side ***SW52-2*** are turned OFF immediately.

(3) If a run command is present after an elapse of t1 (0.2 sec + time specified by H13), the commercial power circuit ***SW88*** is turned ON .

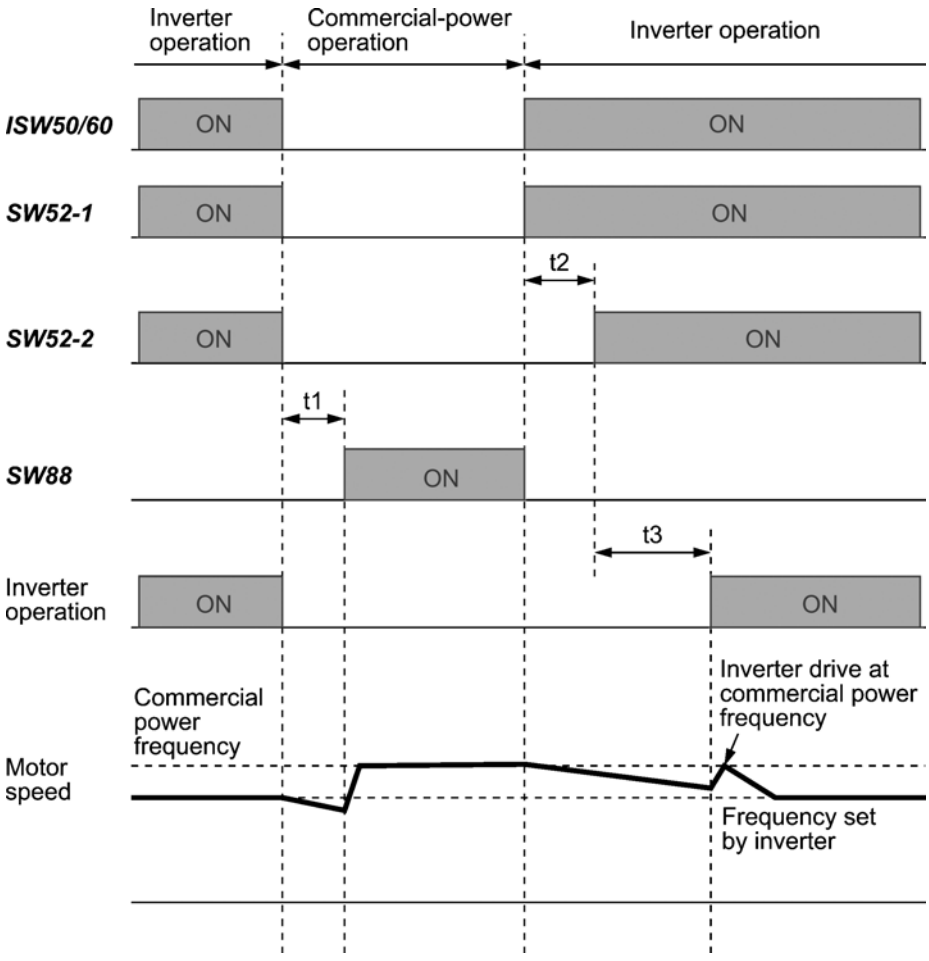
Switching from commercial-power operation to inverter operation
ISW50*/*ISW60: OFF → ON

(1) The inverter primary circuit ***SW52-1*** is turned ON immediately.

(2) The commercial power circuit ***SW88*** is turned OFF immediately.

(3) After an elapse of t2 (0.2 sec + time required for the main circuit to get ready) from when ***SW52-1*** is turned ON, the inverter secondary circuit ***SW52-2*** is turned ON.

(4) After an elapse of t3 (0.2 sec + time specified by H13) from when ***SW52-2*** is turned ON, the inverter harmonizes once the motor that has been freed from the commercial power to the commercial power frequency. Then the motor returns to the operation driven by the inverter.



t1: 0.2 sec + Time specified by H13 (Restart mode after momentary power failure)

t2: 0.2 sec + Time required for the main circuit to get ready

t3: 0.2 sec + Time specified by H13 (Restart mode after momentary power failure)

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Selection of Commercial Power Switching Sequence

J22 specifies whether or not to automatically switch to commercial-power operation when an inverter alarm occurs.

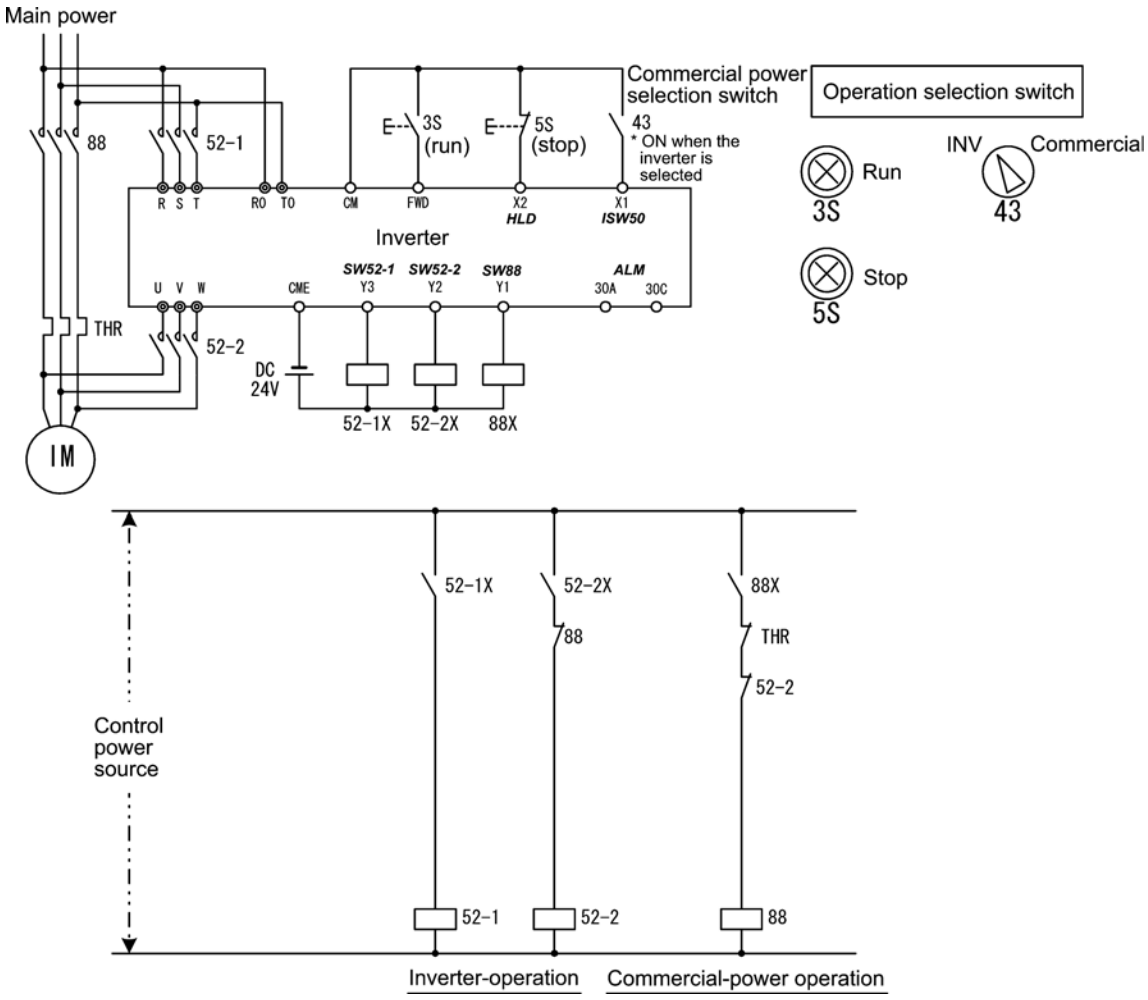
Data for J22	Sequence (upon occurrence of an alarm)
0	Keep inverter-operation (Stop due to alarm.)
1	Automatically switch to commercial-power operation

Note

- The sequence operates normally also even when ***SW52-1*** is not used and the main power of the inverter is supplied at all times.
- Using ***SW52-1*** requires connecting the input terminals [R0] and [T0] for an auxiliary control power. Without the connection, turning ***SW52-1*** OFF loses also the control power.
- The sequence operates normally even if an alarm occurs in the inverter except when the inverter itself is broken. Therefore, for a critical facility, be sure to install an emergency switching circuit outside the inverter.
- Turning ON both the magnetic contactor MC (88) at the commercial-power side and the MC (52-2) at the inverter output side at the same time supplies main power mistakenly from the output (secondary) side of the inverter, which may damage the inverter. To prevent it, be sure to set up an interlocking logic outside the inverter.

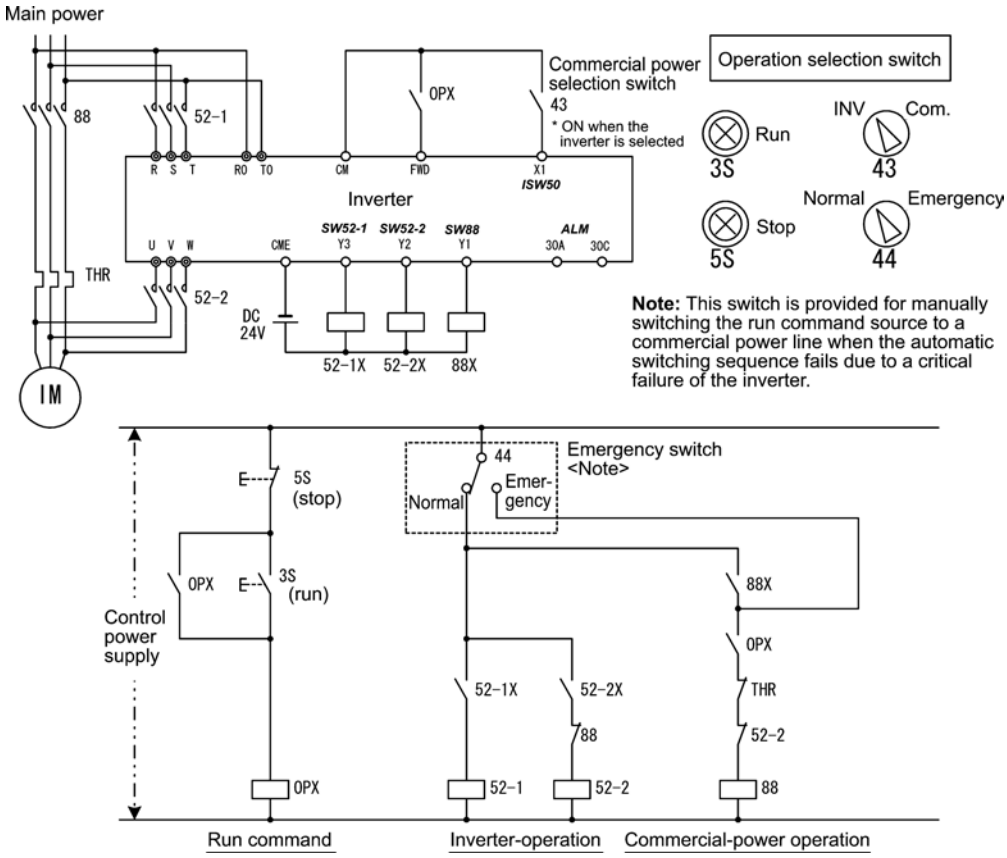
Examples of Sequence Circuits

1) Standard sequence

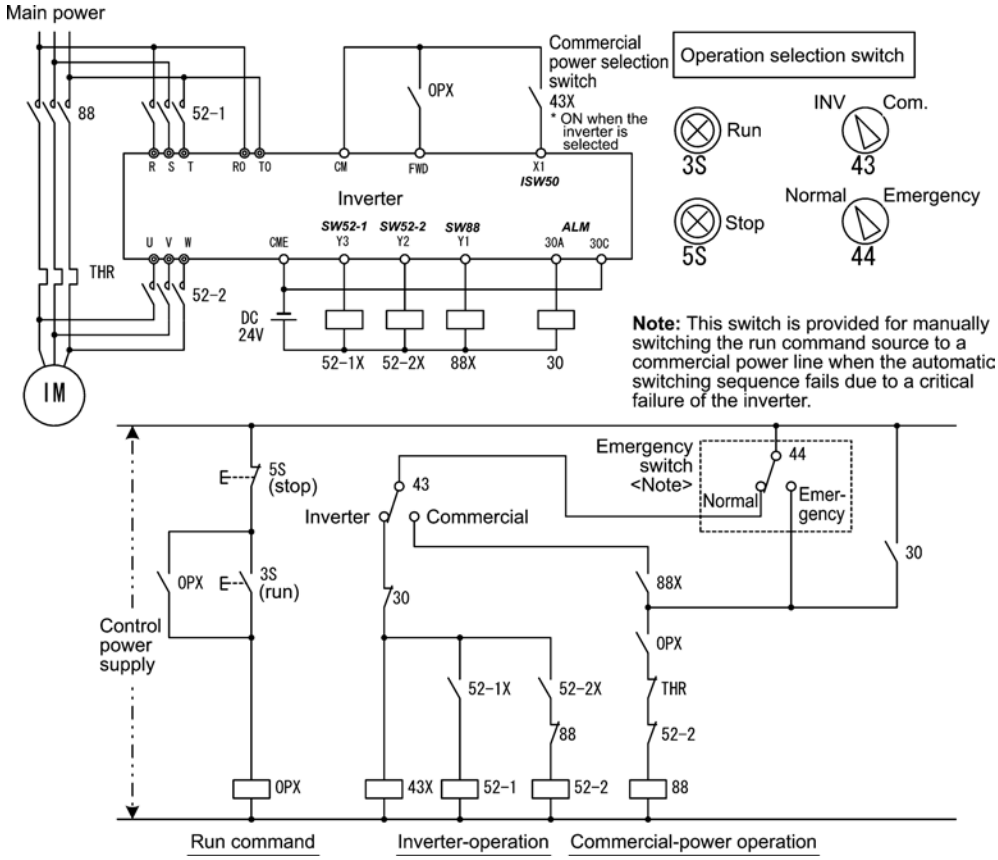


Function Code Details
F codes
E01-E09
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

2) Sequence with an emergency switching function



3) Sequence with an emergency switching function --Part 2 (Automatic switching by the alarm output issued by the inverter)



■ Servo-lock command -- ***LOCK*** (Function code data = 47)

Turning this terminal command ON enables a servo-lock command; turning it OFF disables a servo-lock command.

🕮 Refer to J97 through J99.

■ Pulse train input -- ***PIN*** (available only on terminal [X7]) (Function code data = 48)
Pulse train sign -- ***SIGN*** (available on terminals except [X7]) (Function code data = 49)

Assigning the command ***PIN*** to digital input terminal [X7] enables the frequency command by the pulse train input. Assigning the command ***SIGN*** to one of the digital input terminals except [X7] enables the pulse train sign input to specify the polarity of frequency command.

🕮 Refer to F01.

■ Count the run time of commercial power-driven motors 1 to 4
-- ***CRUN-M1***, ***CRUN-M2***, ***CRUN-M3*** and ***CRUN-M4***
(Function code data = 72, 73, 74 and 75)

These four terminal commands enable the inverter to count the cumulative run time of motors 1 to 4 even when they are driven by commercial power (not by the inverter).

When the ***CRUN-M1***, ***CRUN-M2***, ***CRUN-M3*** or ***CRUN-M4*** is ON, the inverter judges that the motor 1, 2, 3 or 4 is driven by commercial power, respectively, and counts the run time of the corresponding motor.

■ Select droop control -- ***DROOP*** (Function code data = 76)

This terminal command ***DROOP*** is to switch enabling or disabling the droop control.

DROOP	Droop control
ON	Enable
OFF	Disable

🕮 Refer to H28.

■ Cancel PG alarm-- ***PG-CCL*** (Function code data = 77)

When this terminal command is ON, the inverter ignores a PG wire break alarm. Use this terminal command when changing PG wires in switching motors, for example, to prevent it from being interpreted as a wire break.

■ Run forward -- ***FWD*** (Function code data = 98)

Turning this terminal command ON runs the motor in the forward direction; turning it OFF decelerates it to stop.

Tip This terminal command can be assigned only by E98 or E99.

■ Run reverse -- ***REV*** (Function code data = 99)

Turning this terminal command ON runs the motor in the reverse direction; turning it OFF decelerates it to stop.

Tip This terminal command can be assigned only by E98 or E99.

E10 to E15 **Acceleration Time 2 to 4, Deceleration Time 2 to 4** **(Refer to F07)**

Refer to the description of F07.

E16, E17 **Torque Limiter 2-1, 2-2** **(Refer to F40.)**

Refer to the description of F40.

Function Code Details
F codes
E01-E17
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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E20 to E23 E24, E27	**Terminal [Y1] to [Y4] Function** **Terminal [Y5A/C] and [30A/B/C] Function (Relay output)**

E20 through E24 and E27 assign output signals (listed on the following pages) to general-purpose, programmable output terminals [Y1], [Y2], [Y3], [Y4], [Y5A/C] and [30A/B/C]. These function codes can also switch the logic system between normal and negative to define the property of those output terminals so that the inverter logic can interpret either the ON or OFF status of each terminal as active. The factory default settings are "Active ON."

Terminals [Y1], [Y2], [Y3] and [Y4] are transistor outputs and terminals [Y5A/C] and [30A/B/C] are relay contact outputs. In normal logic, if an alarm occurs, the relay will be energized so that [30A] and [30C] will be closed, and [30B] and [30C] opened. In negative logic, the relay will be deenergized so that [30A] and [30C] will be opened, and [30B] and [30C] closed. This may be useful for the implementation of failsafe power systems.

Note

- When a negative logic is employed, all output signals are active (e.g. an alarm would be recognized) while the inverter is powered OFF. To avoid causing system malfunctions by this, interlock these signals to keep them ON using an external power supply. Furthermore, the validity of these output signals is not guaranteed for approximately 1.5 seconds after power-ON, so introduce such a mechanism that masks them during the transient period.
- Terminals [Y5A/C] and [30A/B/C] use mechanical contacts that cannot stand frequent ON/OFF switching. Where frequent ON/OFF switching is anticipated (for example, limiting a current by using signals subjected to inverter output limit control such as switching to commercial power line or direct-on-line starting), use transistor outputs [Y1], [Y2], [Y3] and [Y4] instead. The service life of a relay is approximately 200,000 times if it is switched ON and OFF at one-second intervals.

The tables given on the following pages list functions that can be assigned to terminals [Y1], [Y2], [Y3], [Y4], [Y5A/C], and [30A/B/C].

The descriptions are, in principle, arranged in the numerical order of assigned data. However, highly relevant signals are collectively described where one of them first appears. Refer to the function codes or signals in the "Related function codes/signals (data)" column, if any.

The FRENIC-MEGA runs under "V/f control," "vector control without speed sensor," or "vector control with speed sensor." Some function codes apply exclusively to the specific drive control, which is indicated by letters Y (Applicable) and N (Not applicable) in the "Drive control" column in the tables.

The "Drive control" column uses the following abbreviations.

- V/f: V/f control
- w/o PG: Vector control without speed sensor
- w/ PG: Vector control with speed sensor

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Explanations of each function are given in normal logic system "Active ON."

Function code data		Terminal command assigned	Symbol	Drive control			Related function codes/signals (data)
Active ON	Active OFF			V/f	w/o PG	w/ PG	
0	1000	Inverter running	***RUN***	Y	Y	Y	—
1	1001	Frequency (speed) arrival signal	***FAR***	Y	Y	Y	E30
2	1002	Frequency (speed) detected	***FDT***	Y	Y	Y	E31, E32
3	1003	Undervoltage detected (Inverter stopped)	***LU***	Y	Y	Y	—
4	1004	Torque polarity detected	***B/D***	Y	Y	Y	—
5	1005	Inverter output limiting	***IOL***	Y	Y	Y	—
6	1006	Auto-restarting after momentary power failure	***IPF***	Y	Y	Y	F14
7	1007	Motor overload early warning	***OL***	Y	Y	Y	E34, F10 F12
8	1008	Keypad operation enabled	***KP***	Y	Y	Y	—
10	1010	Inverter ready to run	***RDY***	Y	Y	Y	—
11	—	Switch motor drive source between commercial power and inverter output (For MC on commercial line)	***SW88***	Y	N	N	E01 to E09 ***ISW50*** (40) ***ISW60*** (41) J22
12	—	Switch motor drive source between commercial power and inverter output (For secondary side)	***SW52-2***	Y	N	N	
13	—	Switch motor drive source between commercial power and inverter output (For primary side)	***SW52-1***	Y	N	N	
15	1015	Select AX terminal function (For MC on primary side)	***AX***	Y	N	N	—
22	1022	Inverter output limiting with delay	***IOL2***	Y	Y	Y	***IOL*** (5)
25	1025	Cooling fan in operation	***FAN***	Y	Y	Y	H06
26	1026	Auto-resetting	***TRY***	Y	Y	Y	H04, H05
27	1027	Universal DO	***U-DO***	Y	Y	Y	—
28	1028	Heat sink overheat early warning	***OH***	Y	Y	Y	—
30	1030	Lifetime alarm	***LIFE***	Y	Y	Y	H42
31	1031	Frequency (speed) detected 2	***FDT2***	Y	Y	Y	E32, E36
33	1033	Reference loss detected	***REF OFF***	Y	Y	Y	E65
35	1035	Inverter output on	***RUN2***	Y	Y	Y	***RUN*** (0)
36	1036	Overload prevention control	***OLP***	Y	Y	Y	H70
37	1037	Current detected	***ID***	Y	Y	Y	E34, E35 E37, E38 E55, E56
38	1038	Current detected 2	***ID2***	Y	Y	Y	
39	1039	Current detected 3	***ID3***	Y	Y	Y	
41	1041	Low current detected	***IDL***	Y	Y	Y	
42	1042	PID alarm	***PID-ALM***	Y	Y	Y	J11 to J13

Function code data		Terminal command assigned	Symbol	Drive control			Related function codes/signals (data)
Active ON	Active OFF			V/f	w/o PG	w/ PG	
43	1043	Under PID control	***PID-CTL***	Y	Y	Y	J01
44	1044	Motor stopped due to slow flowrate under PID control	***PID-STP***	Y	Y	Y	J08, J09
45	1045	Low output torque detected	***U-TL***	Y	Y	Y	E78 to E81
46	1046	Torque detected 1	***TD1***	Y	Y	Y	
47	1047	Torque detected 2	***TD2***	Y	Y	Y	
48	1048	Motor 1 selected	***SWM1***	Y	Y	Y	A42, b42, r42
49	1049	Motor 2 selected	***SWM2***	Y	Y	Y	
50	1050	Motor 3 selected	***SWM3***	Y	Y	Y	
51	1051	Motor 4 selected	***SWM4***	Y	Y	Y	
52	1052	Running forward	***FRUN***	Y	Y	Y	—
53	1053	Running reverse	***RRUN***	Y	Y	Y	—
54	1054	In remote operation	***RMT***	Y	Y	Y	(See Section 7.3.6.)
56	1056	Motor overheat detected by thermistor	***THM***	Y	Y	Y	H26, H27
57	1057	Brake signal	***BRKS***	Y	Y	Y	J68 to J72
58	1058	Frequency (speed) detected 3	***FDT3***	Y	Y	Y	E32, E54
59	1059	Terminal [C1] wire break	***C1OFF***	Y	Y	Y	—
70	1070	Speed valid	***DNZS***	N	Y	Y	F25, F38
71	1071	Speed agreement	***DSAG***	N	Y	Y	d21, d22
72	1072	Frequency (speed) arrival signal 3	***FAR3***	Y	Y	Y	E30
76	1076	PG error detected	***PG-ERR***	N	Y	Y	d21 to d23
82	1082	Positioning completion signal	***PSET***	N	N	Y	J97 to J99
84	1084	Maintenance timer	***MNT***	Y	Y	Y	H44, H78, H79
98	1098	Light alarm	***L-ALM***	Y	Y	Y	H81, H82
99	1099	Alarm output (for any alarm)	***ALM***	Y	Y	Y	—
105	1105	Braking transistor broken	***DBAL***	Y	Y	Y	H98

Note Any negative logic (Active OFF) command cannot be assigned to the functions marked with "—" in the "Active OFF" column.

■ Inverter running -- ***RUN*** (Function code data = 0)
Inverter output on -- ***RUN2*** (Function code data = 35)

These output signals tell the external equipment that the inverter is running at a starting frequency or higher.

If assigned in negative logic (Active OFF), these signals can be used to tell the "Inverter being stopped" state.

Output signal	Operating condition 1	Operating condition 2
RUN	Comes ON if the inverter output frequency exceeds the starting frequency, and OFF if it drops below the stop frequency.	Goes OFF even during DC braking.
RUN2		Comes ON even during DC braking.

Under vector control, both ***RUN*** and ***RUN2*** come ON when zero speed control or servo-lock function is enabled.

■ Frequency (speed) arrival signal -- ***FAR*** (Function code data = 1)
Frequency (speed) arrival signal 3 -- ***FAR3*** (Function code data = 72)

These output signals come ON when the difference between the output frequency (detected speed) and reference frequency (commanded speed) comes within the frequency arrival hysteresis width specified by E30.

🕮 Refer to E30.

■ Frequency (speed) detected -- ***FDT*** (Function code data = 2)
Frequency (speed) detected 2 -- ***FDT2*** (Function code data = 31)
Frequency (speed) detected 3 -- ***FDT3*** (Function code data = 58)

The output signal ***FDT***, ***FDT2*** or ***FDT3*** comes ON when the output frequency (detected speed) exceeds the frequency detection level specified by E31, E36 or E54, respectively, and it goes OFF when the output frequency (detected speed) drops below the "Frequency detection level (E31, E36 or E54) - Hysteresis width (E32)."

🕮 Refer to E31 and E32.

■ Undervoltage detected (Inverter stopped) -- ***LU*** (Function code data = 3)

This output signal comes ON when the DC link bus voltage of the inverter drops below the specified undervoltage level, and it goes OFF when the voltage exceeds the level.

When this signal is ON, the inverter cannot run even if a run command is given.

This signal is ON also when the undervoltage protective function is activated so that the motor is in an abnormal stop state (e.g., tripped).

■ Torque polarity detected -- ***B/D*** (Function code data = 4)

The inverter issues the driving or braking polarity signal to this digital output judging from the internally calculated torque or torque command. This signal goes OFF when the detected torque is a driving one, and it goes ON when it is a braking one.

■ Inverter output limiting -- ***IOL*** (Function code data = 5)
Inverter output limiting with delay -- ***IOL2*** (Function code data = 22)

The output signal ***IOL*** comes ON when the inverter is limiting the output frequency by activating any of the following actions (minimum width of the output signal: 100 ms). The output signal ***IOL2*** comes ON when any of the following output limiting operation continues for 20 ms or more.

- Torque limiting (F40, F41, E16 and E17)
- Current limiting by software (F43 and F44)
- Instantaneous overcurrent limiting by hardware (H12 = 1)
- Automatic deceleration (Anti-regenerative control) (H69)

Note When the ***IOL*** is ON, it may mean that the output frequency may have deviated from the commanded frequency because of the limiting functions above.

Function Code Details
F codes
E20-E27
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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■ Auto-restarting after momentary power failure -- ***IPF*** (Function code data = 6)

This output signal is ON either during continuous running after a momentary power failure or during the period after the inverter detects an undervoltage condition and shuts down the output until restart has been completed (the output has reached the reference frequency).

🕮 Refer to F14.

■ Motor overload early warning -- ***OL*** (Function code data = 7)

This output signal is used to issue a motor overload early warning that enables you to take an corrective action before the inverter detects a motor overload alarm and shuts down its output.

🕮 Refer to E34.

■ Keypad operation enabled -- ***KP*** (Function code data = 8)

This output signal comes ON when the RUN / STOP keys are specified as the run command source.

■ Inverter ready to run -- ***RDY*** (Function code data = 10)

This output signal comes ON when the inverter becomes ready to run by completing hardware preparation (such as initial charging of DC link bus capacitors and initialization of the control circuit) and no protective functions are activated.

■ Switch motor drive source between commercial power and inverter output -- ***SW88***, ***SW52-2*** and ***SW52-1*** (Function code data = 11, 12, and 13)

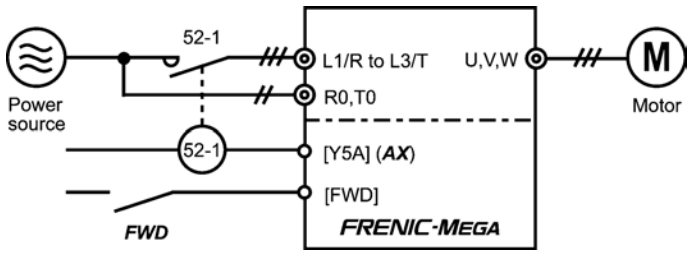
Assigning these output signals to transistor output terminals [Y1], [Y2], [Y3] and [Y4] enables the terminal command ***ISW50*** or ***ISW60*** that controls the magnetic contactor for switching the motor drive source between the commercial power and the inverter output according to the integrated sequence.

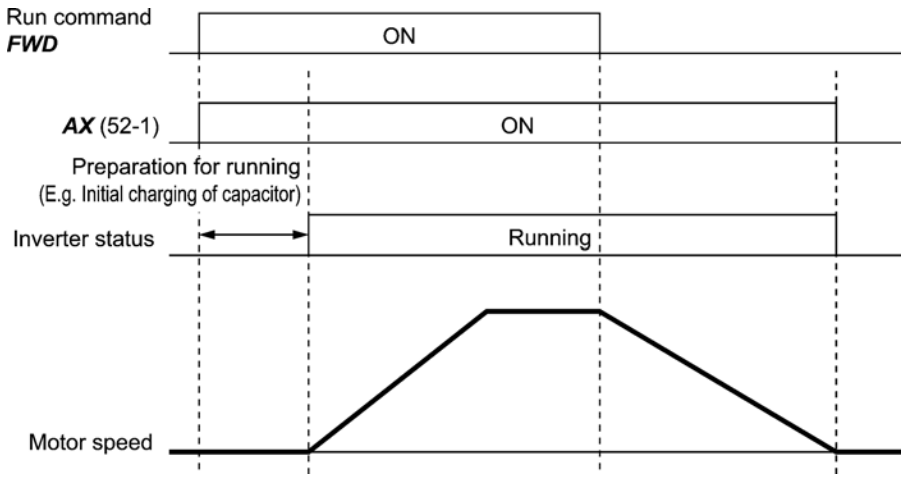
🕮 Refer to E01 through E09 (data = 40 and 41).

■ Select ***AX*** terminal function -- ***AX*** (Function code data = 15)

In response to a run command ***FWD***, this output signal controls the magnetic contactor on the commercial-power supply side. It comes ON when the inverter receives a run command and it goes OFF after the motor decelerates to stop with a stop command received.

This signal immediately goes OFF upon receipt of a coast-to-stop command or when an alarm occurs.





■ Cooling fan in operation -- ***FAN*** (Function code data = 25)

With the cooling fan ON/OFF control enabled (H06 = 1), this output signal is ON when the cooling fan is in operation, and OFF when it is stopped. This signal can be used to make the cooling system of peripheral equipment interlocked for an ON/OFF control.

🕮 Refer to H06.

■ Auto-resetting -- ***TRY*** (Function code data = 26)

This output signal comes ON when auto resetting (resetting alarms automatically) is in progress.

🕮 Refer to H04 and H05.

■ Universal DO -- ***U-DO*** (Function code data = 27)

Assigning this output signal to an inverter's output terminal and connecting the terminal to a digital input terminal of peripheral equipment via the RS-485 communications link or the fieldbus, allows the inverter to send commands to the peripheral equipment.

The universal DO can be used as an output signal independent of the inverter operation.

🕮 For the procedure for access to Universal DO via the RS-485 communications link or fieldbus, refer to the respective instruction manual.

■ Heat sink overheat early warning -- ***OH*** (Function code data = 28)

This output signal is used to issue a heat sink overheat early warning that enables you to take a corrective action before an overheat trip 0H1 actually happens.

This signal comes ON when the temperature of the heat sink exceeds the "overheat trip temperature minus 5°C," and it goes OFF when it drops down to the "overheat trip temperature minus 8°C."

This signal comes ON also when the internal air circulation DC fan (45 kW or above for 200 V class series, 75 kW or above for 400 V class series) has locked.

■ Lifetime alarm -- ***LIFE*** (Function code data = 30)

This output signal comes ON when it is judged that the service life of any one of capacitors (DC link bus capacitors and electrolytic capacitors on the printed circuit boards) and cooling fan has expired.

This signal should be used as a guide for replacement of the capacitors and cooling fan. If this signal comes ON, use the specified maintenance procedure to check the service life of these parts and determine whether the parts should be replaced or not.

🕮 Refer to H42.

This signal comes ON also when the internal air circulation DC fan (45 kW or above for 200 V class series, 75 kW or above for 400 V class series) has locked.

Function Code Details
F codes
E20-E27
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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■ Reference loss detected -- ***REF OFF*** (Function code data = 33)

This output signal comes ON when an analog input used as a frequency command source is in a reference loss state (as specified by E65) due to a wire break or a weak connection. This signal goes OFF when the normal operation under the analog input is resumed.

🕮 Refer to E65.

■ Overload prevention control -- ***OLP*** (Function code data = 36)

This output signal comes ON when the overload prevention control is activated. The minimum ON-duration is 100 ms.

🕮 Refer to H70.

■ Current detected -- ***ID*** (Function code data = 37)
Current detected 2 -- ***ID2*** (Function code data = 38)
Current detected 3 -- ***ID3*** (Function code data = 39)

The output signal ***ID***, ***ID2*** or ***ID3*** comes ON when the output current of the inverter exceeds the level specified by E34, E37 or E55 (Current detection (Level)) for the period specified by E35, E38 or E56 (Current detection (Timer)), respectively. The minimum ON-duration is 100 ms.

🕮 Refer to E34.

■ Low current detected -- ***IDL*** (Function code data = 41)

This output signal comes ON when the output current drops below the low current detection level specified by E37 for the period specified by E38 (Low current detection (Timer)). The minimum ON-duration is 100 ms.

🕮 Refer to E34.

■ PID alarm -- ***PID-ALM*** (Function code data = 42)

Assigning this output signal enables PID control to output absolute-value alarm or deviation alarm.

🕮 Refer to J11 through J13.

■ Under PID control -- ***PID-CTL*** (Function code data = 43)

This output signal comes ON when PID control is enabled ("Cancel PID control" (***Hz/PID***) = OFF) and a run command is ON.

🕮 Refer to J01.

Note When PID control is enabled, the inverter may stop due to the slow flowrate stopping function or other reasons, with the ***PID-CTL*** signal being ON. As long as the ***PID-CTL*** signal is ON, PID control is effective, so the inverter may abruptly resume its operation, depending on the feedback value in PID control.

⚠WARNING

When PID control is enabled, even if the inverter stops its output during operation because of sensor signals or other reasons, operation will resume automatically.

Design your machinery so that safety is ensured even in such cases.

Otherwise, an accident could occur.

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■ Motor stopped due to slow flowrate under PID control -- ***PID-STP***
(Function code data = 44)

This output signal is ON when the inverter is in a stopped state due to the slow flowrate stopping function under PID control.)

🕮 Refer to J08 through J09.

■ Low output torque detected -- ***U-TL*** (Function code data = 45)

This output signal comes ON when the torque value calculated by the inverter or torque command drops below the level specified by E80 (Detect low torque (Level)) for the period specified by E81 (Detect low torque (Timer)). The minimum ON-duration is 100 ms.

🕮 Refer to E78 through E81.

■ Torque detected 1 -- ***TD1*** (Function code data = 46)
Torque detected 2 -- ***TD2*** (Function code data = 47)

This output signal ***TD1*** or ***TD2*** comes ON when the torque value calculated by the inverter or torque command exceeds the level specified by E78 or E80 (Torque detection (Level)) for the period specified by E79 or E81 (Torque detection (Timer)), respectively. The minimum ON-duration is 100 ms.

🕮 Refer to E78 through E81.

■ Motor 1, 2, 3 and 4 selected -- ***SWM1***, ***SWM2***, ***SWM3*** and ***SWM4***
(Function code data = 48, 49, 50 and 51)

The output signal ***SWM1***, ***SWM2***, ***SWM3*** or ***SWM4*** comes ON corresponding to the motor selected by the signals ***M2***, ***M3*** and ***M4*** or the selected function code group.

🕮 Refer to A42.

■ Running forward -- ***FRUN*** (Function code data = 52)
Running reverse -- ***RRUN*** (Function code data = 53)

Output signal	Assigned data	Running forward	Running reverse	Inverter stopped
FRUN	52	ON	OFF	OFF
RRUN	53	OFF	ON	OFF

■ In remote operation -- ***RMT*** (Function code data = 54)

This output signal comes ON when the inverter switches from local to remote mode.

🕮 For details of switching between remote and local modes, refer to Chapter 7, Section 7.3.6 "Remote and local modes."

■ Motor overheat detected by thermistor -- ***THM*** (Function code data = 56)

Even when the PTC thermistor on the motor detects an overheat, the inverter turns this signal ON and continues to run, without entering the alarm 0H4 state. This feature applies only when H26 data is set to "2."

🕮 Refer to H26 and H27.

■ Brake signal -- ***BRKS*** (Function code data = 57)

This signal outputs a brake control command that releases or activates the brake.

🕮 Refer to J68 through J72.

■ Terminal [C1] wire break -- ***C1OFF*** (Function code data = 59)

This output signal comes ON when the inverter detects that the input current to terminal [C1] drops below 2 mA interpreting it as the terminal [C1] wire broken.

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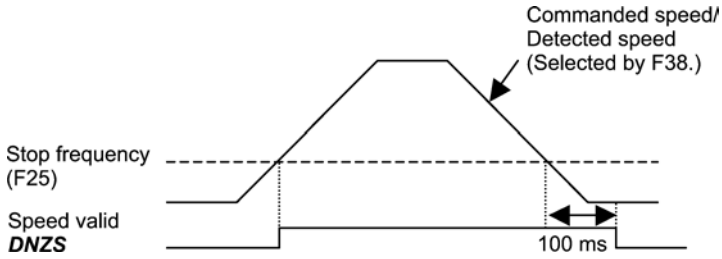
■ Speed valid -- ***DNZS*** (Function code data = 70)

This output signal comes ON when the reference speed or detected one exceeds the stop frequency specified by function code F25. It goes OFF when the speed is below the stop frequency for 100 ms or longer. Under vector control with speed sensor, F38 switches the decision criteria between the reference speed and detected one. Under vector control without speed sensor, the reference speed is used as a decision criteria.

🕮 Refer to F25 and F38.



■ Speed agreement -- ***DSAG*** (Function code data = 71)

This output signal comes ON when the deviation of the detected speed from the speed command output of acceleration/deceleration processor is within the allowable range specified by d21. It goes OFF when the deviation is beyond the range for longer than the period specified by d22. This feature allows you to check whether the speed controller externally installed is working correctly.

🕮 Refer to d21 and d22.

■ PG error detected -- ***PG-ERR*** (Function code data = 76)

This output signal comes ON when the inverter detects a PG error with the d23 (PG error processing) data being set to "0: Continue to run," in which the inverter does not enter the alarm state.

🕮 Refer to d21 through d23.

■ Positioning completion signal -- ***PSET*** (Function code data = 82)

This output signal comes ON as a positioning completion signal.

🕮 Refer to J97 through J99.

■ Maintenance timer -- ***MNT*** (Function code data = 84)

Once the inverter's cumulative run time or the startup times for the motor 1 exceeds the previously specified count, this output signal comes ON.

🕮 Refer to H78 and H79.

■ Light alarm -- ***L-ALM*** (Function code data = 98)

This output signal comes ON when a light alarm occurs.

🕮 Refer to H81 and H82.

■ Alarm output (for any alarm) -- ***ALM*** (Function code data = 99)

This output signal comes ON if any of the protective functions is activated and the inverter enters Alarm mode.

■ Braking transistor broken -- ***DBAL*** (Function code data = 105)

If the inverter detects a breakdown of the braking transistor, it displays the braking transistor alarm (dbA) and also issues the output signal ***DBAL***. Detection of the breakdown of a braking transistor can be cancelled by H98. (200 V class series/ 400 V class series, 22 kW or below)

🕮 Refer to H98.

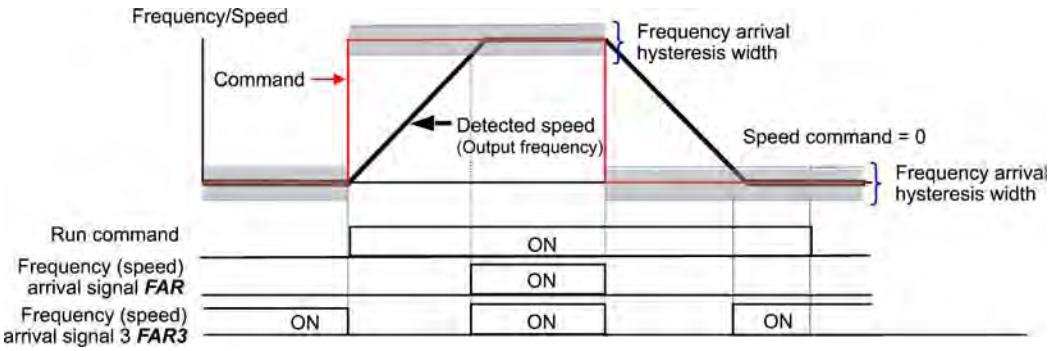
E30 Frequency Arrival (Hysteresis width)

E30 specifies the detection level (hysteresis width) for the frequency (speed) arrival signal ***FAR*** and the frequency (speed) arrival signal 3 ***FAR3***.

Output signal	Assigned data	Operating condition 1	Operating condition 2
FAR	1	Comes ON when difference between the output frequency (detected speed) and the reference frequency (commanded speed) comes within the frequency arrival hysteresis width specified by E30.	Always goes OFF when all the run commands are OFF or speed command value is "0."
FAR3	72		Comes ON even if all the run commands are OFF, interpreting that the speed command is "0," when the output frequency is within "0 ± the frequency arrival hysteresis width specified by E30."

- Data setting range: 0.0 to 10.0 (Hz)

The operation timings of each signal are as shown below.



Function Code Details
F codes
E20-E30
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

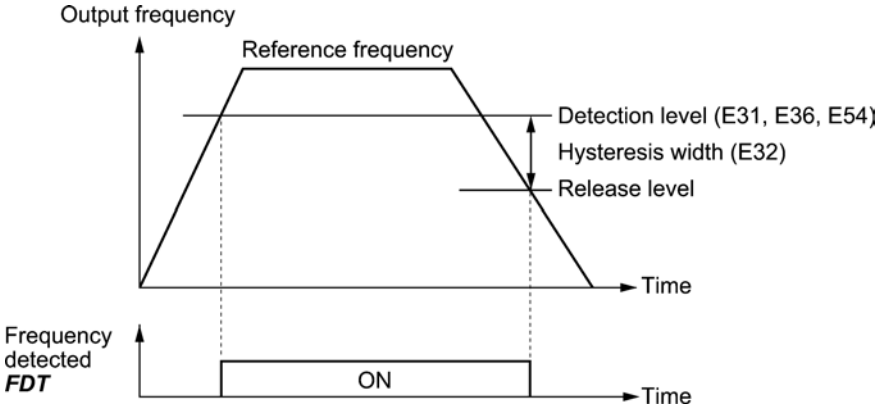
E31, E32 Frequency Detection (Level and Hysteresis width)

E36 (Frequency Detection 2, Level)
E54 (Frequency Detection 3, Level)

When the output frequency exceeds the frequency detection level specified by E31, the ***FDT*** signal comes ON; when it drops below the "Frequency detection level minus Hysteresis width specified by E32," it goes OFF.

Three levels of setting are available with the Frequency Detections 1 to 3.

Name	Output signal	Assigned data	Operation level	Hysteresis width
			Range: 0.0 to 500.0 Hz	Range: 0.0 to 500.0 Hz
Frequency Detection	***FDT***	2	E31	E32
Frequency Detection 2	***FDT2***	31	E36	
Frequency Detection 3	***FDT3***	58	E54	



E34, E35 Overload Early Warning/Current Detection (Level and Timer)

E37, E38 (Current Detection 2/Low Current Detection, Level and Timer)
E55, E56 (Current Detection 3, Level and Timer)

These function codes define the detection level and time for the "Motor overload early warning" ***OL***, "Current detected" ***ID***, "Current detected 2" ***ID2***, "Current detected 3" ***ID3***, and "Low current detected" ***IDL*** output signals.

Output signal	Assigned data	Operation level	Timer	Motor characteristics	Thermal time constant
		Range: See below	Range: 0.01 to 600.00 s	Range: See below	Range: 0.5 to 75.0 min
OL	7	E34	-	F10	F12
ID	37	E34	E35	-	-
ID2	38	E37	E38		
ID3	39	E55	E56		
IDL	41	E37	E38		

- Data setting range

  Operation level: 0.00 (Disable), 1 to 200% of inverter rated current

  Motor characteristics 1: Enable (For a general-purpose motor with shaft-driven cooling fan)
  2: Enable (For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan)

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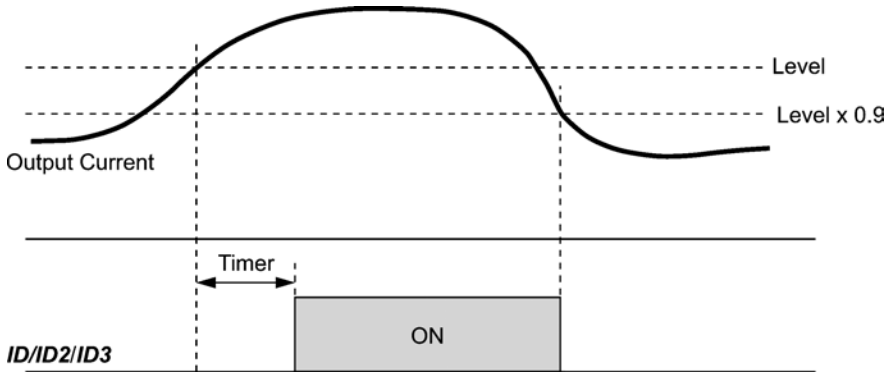
■ Motor overload early warning signal -- ***OL***

The ***OL*** signal is used to detect a symptom of an overload condition (alarm code 7L 1) of the motor so that the user can take an appropriate action before the alarm actually happens.

The ***OL*** signal turns ON when the inverter output current exceeds the level specified by E34. In typical cases, set E34 data to 80 to 90% against F11 data (Electronic thermal overload protection for motor 1, Overload detection level). Specify also the thermal characteristics of the motor with F10 (Select motor characteristics) and F12 (Thermal time constant).

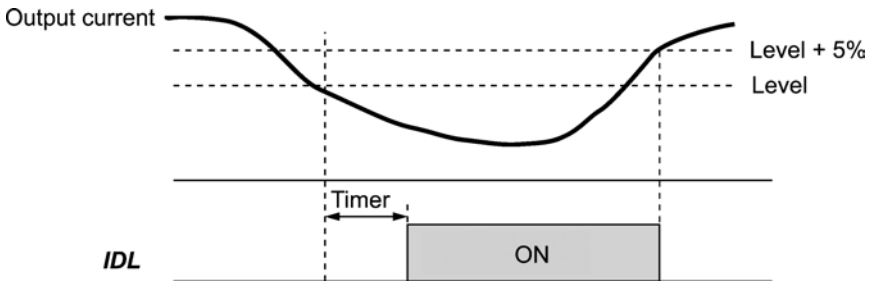
■ Current detected, Current detected 2 and Current detected 3 -- ***ID***, ***ID2*** and ***ID3***

When the inverter output current exceeds the level specified by E34, E37 or E55 for the period specified by E35, E38 or E56, the ***ID***, ***ID2*** or ***ID3*** signal turns ON, respectively. When the output current drops below 90% of the rated operation level, the ***ID***, ***ID2*** or ***ID3*** turns OFF. (The minimum ON-duration is 100 ms.)



■ Low current detected -- ***IDL***

This signal turns ON when the output current drops below the level specified by E37 (Low current detection, Level) for the period specified by E38 (Timer). When the output current exceeds the "Low current detection level plus 5% of the inverter rated current," it goes OFF. (The minimum ON-duration is 100 ms.)



E36	Frequency Detection 2 (Level) (Refer to E31.)

Refer to the description of E31.

E37, E38	Current Detection 2/Low Current Detection (Level and Timer) (Refer to E34.)

Refer to the description of E34.

Function Code Details
F codes
E31-E38
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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E40, E41 PID Display Coefficient A, B

These function codes specify PID display coefficients A and B to convert a PID command (process command or dancer position command) and its feedback into easy-to-understand physical quantities to display.

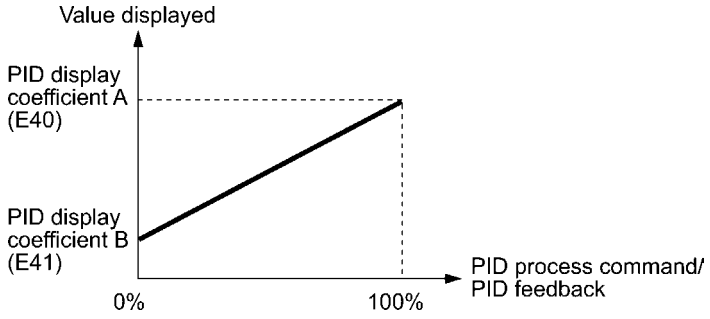
- Data setting range: -999 to 0.00 to 9990 for PID display coefficients A and B

■ Display coefficients for PID process command and its feedback (J01 = 1 or 2)

E40 specifies coefficient A that determines the display value at 100% of the PID process command or its feedback, and E41 specifies coefficient B that determines the display value at 0%.

The display value is determined as follows:

Display value = (PID process command or its feedback (%))/100 × (Display coefficient A - B) + B



Example

Maintaining the pressure around 16 kPa (sensor voltage 3.13 V) while the pressure sensor can detect 0 to 30 kPa over the output voltage range of 1 to 5 V:

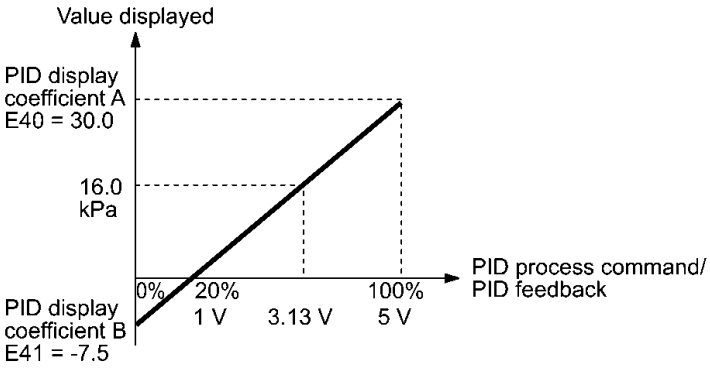
Select terminal [12] as a feedback terminal and set the gain to 200% so that 5 V corresponds to 100%.

The following E40 and E41 settings allow you to monitor or specify the values of the PID process command and its feedback on the keypad as pressure.

PID display coefficient A (E40) = 30.0, that determines the display value at 100% of PID process command or its feedback

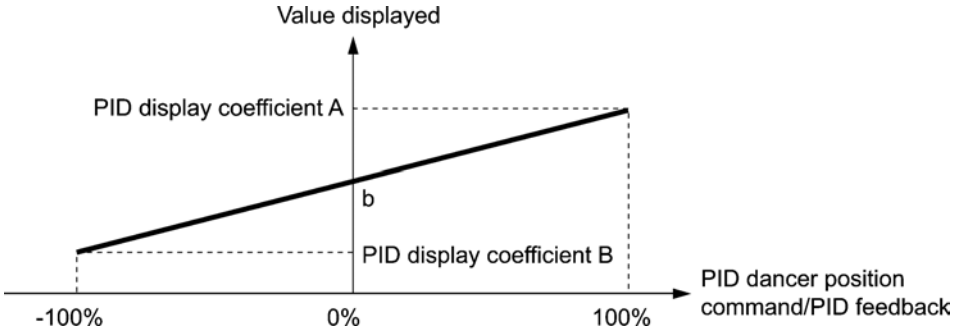
PID display coefficient B (E41) = -7.5, that determines the display value at 0% of PID process command or its feedback

To control the pressure at 16 kPa on the keypad, set the value to 16.0.



■ Display coefficients for PID dancer position command and its feedback (J01 = 3)

Under the PID dancer control, the PID command and its feedback operate within the range ±100%, so specify the value at +100% of the PID dancer position command or its feedback as coefficient A with E40, and the value at -100% as coefficient B with E41.



If the sensor output is unipolar, the PID dancer control operates within the range from 0 to +100%, so virtually specify the value at -100% as coefficient B.

That is, suppose "b" = "Display value at 0%," then:

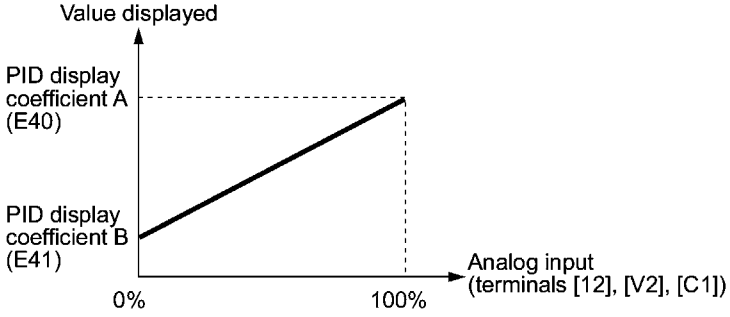
Display coefficient B = 2b - A

📖 For details about the PID control, refer to the description of J01 and later.

📖 For the display method of the PID command and its feedback, refer to the description of E43.

■ Display coefficient for analog input monitor

By inputting analog signals from various sensors such as temperature sensors in air conditioners to the inverter, you can monitor the state of peripheral devices via the communications link. By using an appropriate display coefficient, you can also have various values converted into physical values such as temperature and pressure before they are displayed.



📖 To set up the analog input monitor, use function codes E61 through E63. Use E43 to choose the item to be displayed.

E42 LED Display Filter

E42 specifies a filter time constant to be applied for displaying the output frequency, output current and other running status monitored on the LED monitor on the keypad. If the display varies unstably so as to be hard to read due to load fluctuation or other causes, increase this filter time constant.

- Data setting range: 0.0 to 5.0 (s)

E43 LED Monitor (Item selection) — E48 (LED Monitor, Speed monitor item)

E43 specifies the running status item to be monitored and displayed on the LED monitor.

Specifying the speed monitor with E43 provides a choice of speed-monitoring formats selectable with E48 (LED Monitor).

Monitor item	Display sample on the LED monitor	LED indicator ■: on, □: off	Unit	Meaning of displayed value	Function code data for E43
Speed monitor	Function code E48 specifies what to be displayed on the LED monitor and LED indicators.				0
Output frequency 1 (before slip compensation)	50.00	■Hz □A □kW	Hz	Frequency actually being output	(E48 = 0)
Output frequency 2 (after slip compensation)	50.00	■Hz □A □kW	Hz	Frequency actually being output	(E48 = 1)
Reference frequency	50.00	■Hz □A □kW	Hz	Reference frequency being set	(E48 = 2)
Motor speed	1500	■Hz ■A □kW	r/min	Output frequency (Hz) × 120 / P01	(E48 = 3)
Load shaft speed	300.0	■Hz ■A □kW	r/min	Output frequency (Hz) × E50	(E48 = 4)
Line speed	300.0	□Hz ■A ■kW	m/min	Output frequency (Hz) × E50	(E48 = 5)
Display speed (%)	50.0	□Hz □A □kW	%	Output frequency / Maximum frequency × 100	(E48 = 7)
Output current	12.34	□Hz ■A □kW	A	Current output from the inverter in RMS	3
Output voltage	200.0	□Hz □A □kW	V	Voltage output from the inverter in RMS	4
Calculated torque	50	□Hz □A □kW	%	Motor output torque in % (Calculated value)	8
Input power	10.25	□Hz □A ■kW	kW	Input power to the inverter	9
PID command	10.00	□Hz □A □kW	—	PID command and its feedback converted into physical quantities of the object to be controlled (e.g. temperature) Refer to function codes E40 and E41 for details.	10
PID feedback amount	9.00	□Hz □A □kW	—		12
PID output	100.0	□Hz □A □kW	%	PID output in % as the maximum frequency (F03) being at 100%	14
Load factor	50	□Hz □A □kW	%	Load factor of the motor in % as the rated output being at 100%	15
Motor output	9.85	□Hz □A ■kW	kW	Motor output in kW	16
Analog input	82.00	□Hz □A □kW	—	An analog input to the inverter in a format suitable for a desired scale. Refer to function codes E40 and E41 for details.	17
Torque current	48	□Hz □A □kW	%	Torque current command value or calculated torque current	23
Magnetic flux command	50	□Hz □A □kW	%	Magnetic flux command value (Available only under vector control)	24
Input watt-hour	100.0	□Hz □A □kW	kWh	Input watt-hour (kWh) / 100	25

E44 LED Monitor (Display when stopped)

E44 specifies whether the specified value (data = 0) or the output value (data = 1) to be displayed on the LED monitor of the keypad when the inverter is stopped. The monitored item depends on the E48 (LED monitor, Speed monitor item) setting as shown below.

Data for E48	Monitored item	What to be displayed when the inverter stopped	
		E44 = 0 Specified value	E44 = 1 Output value
0	Output frequency 1 (before slip compensation)	Reference frequency	Output frequency 1 (before slip compensation)
1	Output frequency 2 (after slip compensation)	Reference frequency	Output frequency 2 (after slip compensation)
2	Reference frequency	Reference frequency	Reference frequency
3	Motor speed	Reference motor speed	Motor speed
4	Load shaft speed	Reference load shaft speed	Load shaft speed
5	Line speed	Reference line speed	Line speed
7	Display speed (%)	Reference display speed	Display Speed

E48 LED Monitor (Speed monitor item) Refer to E43.

Refer to the description of E43.

E50 Coefficient for Speed Indication

E50 specifies the coefficient that is used when the load shaft speed or line speed is displayed on the LED monitor. (Refer to the description of E43.)

Load shaft speed [r/min] = (E50: Coefficient for speed indication) × (Output frequency Hz)

Line speed [m/min] = (E50: Coefficient for speed indication) × (Output frequency Hz)

- Data setting range: 0.01 to 200.00

E51 Display Coefficient for Input Watt-hour Data

E51 specifies a display coefficient (multiplication factor) for displaying the input watt-hour data (5_ 17) in a part of maintenance information on the keypad.

Input watt-hour data = Display coefficient (E51 data) × Input watt-hour (kWh)

- Data setting range: 0.000 (cancel/reset); 0.001 to 9999

Note Setting E51 data to 0.000 clears the input watt-hour and its data to "0." After clearing, be sure to restore E51 data to the previous value; otherwise, input watt-hour data will not be accumulated.

Function Code Details
F codes
E43-E51
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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E52 Keypad (Menu display mode)

E52 provides a choice of three menu display modes for the standard keypad as listed below.

Data for E52	Menu display mode	Menus to be displayed
0	Function code data editing mode	Menus #0, #1 and #7
1	Function code data check mode	Menus #2 and #7
2	Full-menu mode	Menus #0 through #7

The menus available on the standard keypad are described below.

Menu #	Menu	LED monitor shows:	Main functions	
0	"Quick Setup"	0.Func	Displays only basic function codes to customize the inverter operation.	
1	"Data Setting"	1.F_ _	F codes (Fundamental functions)	Selecting each of these function codes enables its data to be displayed/ changed.
		1.E_ _	E codes (Extension terminal functions)	
		1.C_ _	C codes (Control functions)	
		1.P_ _	P codes (Motor 1 parameters)	
		1.H_ _	H codes (High performance functions)	
		1.A_ _	A codes (Motor 2 parameters)	
		1.b_ _	b codes (Motor 3 parameters)	
		1.r_ _	r codes (Motor 4 parameters)	
		1.J_ _	J codes (Application functions)	
		1.d_ _	d codes (Application functions 2)	
		1.y_ _	y codes (Link functions)	
		1.o_ _	o codes (Optional function)	
2	"Data Checking"	2.rEP	Displays only function codes that have been changed from their factory defaults. You can refer to or change those function code data.	
3	"Drive Monitoring"	3.dPE	Displays the running information required for maintenance or test running.	
4	"I/O Checking"	4. I_O	Displays external interface information.	
5	"Maintenance Information"	5.CHE	Displays maintenance information including cumulative run time.	
6	"Alarm Information"	6.AL	Displays the recent four alarm codes. You can refer to the running information at the time when the alarm occurred.	
7	"Data Copying"	7.CPy	Allows you to read or write function code data, as well as verifying it.	

For details of each menu item, refer to Chapter 7 "KEYPAD FUNCTIONS."

E54	Frequency Detection 3 (Level)	Refer to E31.

For details, refer to the description of E31.

E55, E56	Current Detection 3 (Level, Timer)	Refer to E34.

For details, refer to the description of E34.

E61 to E63	Terminal [12] Extended Function Terminal [C1] Extended Function Terminal [V2] Extended Function

E61, E62, and E63 define the function of the terminals [12], [C1], and [V2], respectively.

There is no need to set up these terminals if they are to be used for frequency command sources.

Data for E61, E62, or E63	Input assigned to [12], [C1] and [V2]:	Description
0	None	—
1	Auxiliary frequency command 1	Auxiliary frequency input to be added to the reference frequency given by frequency command 1 (F01). Will not be added to any other reference frequency given by frequency command 2 and multi-frequency commands, etc.
2	Auxiliary frequency command 2	Auxiliary frequency input to be added to all reference frequencies given by frequency command 1, frequency command 2, multi-frequency commands, etc.
3	PID command 1	Inputs command sources such as temperature and pressure under PID control. You also need to set function code J02.
5	PID feedback amount	Inputs feedback amounts such as temperature and pressure under PID control.
6	Ratio setting	Multiplies the final frequency command value by this value, for use in the constant line speed control by calculating the winder diameter or in ratio operation with multiple inverters.
7	Analog torque limit value A	Used when analog inputs are used as torque limiters. (🕮 Refer to F40 (Torque Limiter 1-1).)
8	Analog torque limit value B	Used when analog inputs are used as torque limiters. (🕮 Refer to F40 (Torque Limiter 1-1).)
20	Analog signal input monitor	By inputting analog signals from various sensors such as the temperature sensors in air conditioners to the inverter, you can monitor the state of external devices via the communications link. By using an appropriate display coefficient, you can also have various values to be converted into physical quantities such as temperature and pressure before they are displayed.

Note If these terminals have been set up to have the same data, the operation priority is given in the following order:

E61 > E62 > E63

When UP/DOWN control is selected for a frequency command source (F01, C30 = 7), the auxiliary frequency commands 1 and 2 are disabled.

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E64 Saving of Digital Reference Frequency

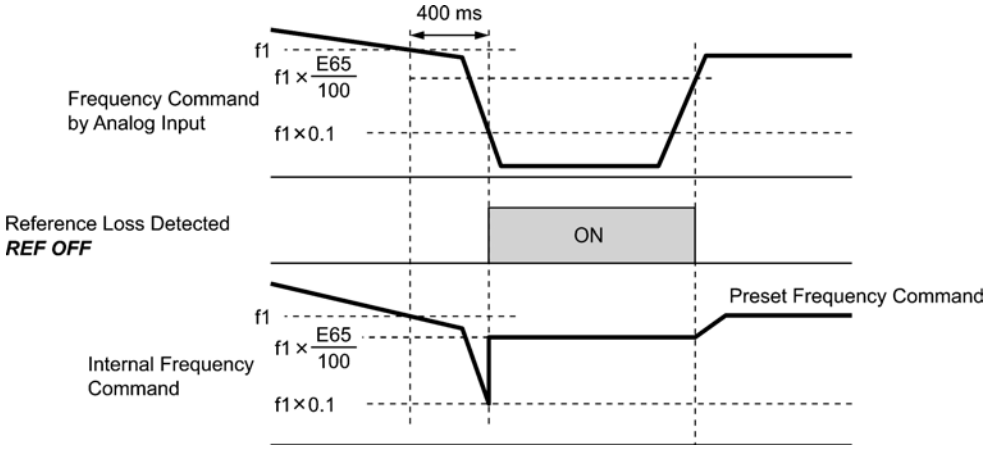
E64 specifies how to save the reference frequency specified in digital formats by the ⌃/⌄ keys on the keypad as shown below.

Data for E64	Function
0	Auto saving when the main power is turned OFF The reference frequency will be automatically saved when the main power is turned OFF. At the next power-on, the reference frequency at the time of the previous power-off applies.
1	Saving by pressing FUNC/DATA key Pressing the FUNC/DATA key saves the reference frequency. If the control power is turned OFF without pressing the FUNC/DATA key, the data will be lost. At the next power-ON, the inverter uses the reference frequency saved when the FUNC/DATA key was pressed last.

E65 Reference Loss Detection (Continuous running frequency)

When the analog frequency command (setting through terminal [12], [C1], or [V2]) has dropped below 10% of the reference frequency within 400 ms, the inverter presumes that the analog frequency command wire has been broken and continues its operation at the frequency determined by the ratio specified by E65 to the reference frequency. 🕮 Refer to E20 through E24 and E27 (data = 33).

When the frequency command level (in voltage or current) returns to a level higher than that specified by E65, the inverter presumes that the broken wire has been fixed and continues to run following the frequency command.



In the diagram above, f1 is the level of the analog frequency command sampled at any given time. The sampling is repeated at regular intervals to continually monitor the wiring connection of the analog frequency command.

- Data setting range: 0 (Decelerate to stop), 20 to 120 %, 999 (Disable)

Note Avoid an abrupt voltage or current change for the analog frequency command. An abrupt change may be interpreted as a wire break.

Setting E65 data at "999" (Disable) allows the ***REF OFF*** signal ("Reference loss detected") to be issued, but does not allow the reference frequency to change (the inverter runs at the analog frequency command as specified).

When E65 = "0" or "999," the reference frequency level at which the broken wire is recognized as fixed is "f1 × 0.2."

When E65 = "100" (%) or higher, the reference frequency level at which the wire is recognized as fixed is "f1 × 1."

The reference loss detection is not affected by the setting of analog input adjustment (filter time constants: C33, C38, and C43).

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E78, E79
E80, E81

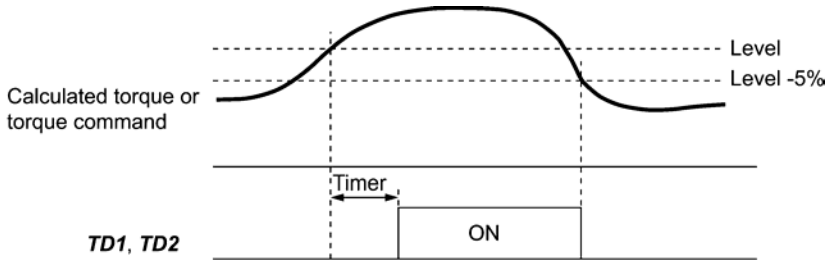
Torque Detection 1 (Level and Timer)
Torque Detection 2/Low Torque Detection (Level and Timer)

E78 specifies the operation level and E79 specifies the timer, for the output signal ***TD1***. E80 specifies the operation level and E81 specifies the timer, for the output signal ***TD2*** or ***U-TL***.

Output signal	Assigned data	Operation level	Timer
		Range: 0 to 300%	Range: 0.01 to 600.00 s
TD1	46	E78	E79
TD2	47	E80	E81
U-TL	45	E80	E81

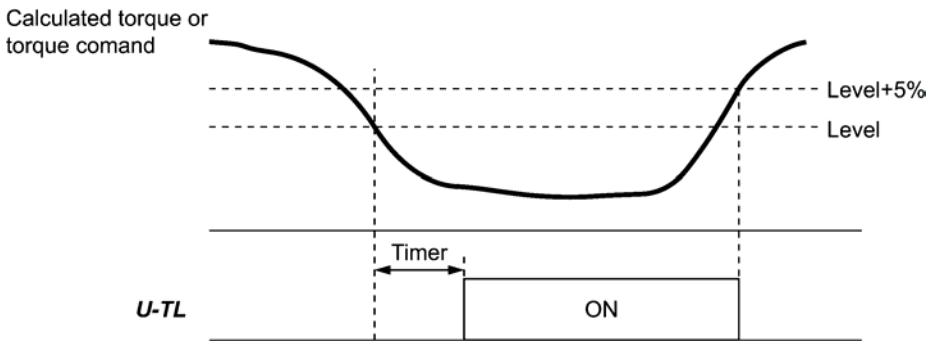
■ Torque detected 1 -- ***TD1***, Torque detected 2 -- ***TD2***

The output signal ***TD1*** or ***TD2*** comes ON when the torque value calculated by the inverter or torque command exceeds the level specified by E78 or E80 (Torque detection (Level)) for the period specified by E79 or E81 (Torque detection (Timer)), respectively. The signal turns OFF when the calculated torque drops below "the level specified by E78 or E80 minus 5% of the motor rated torque." The minimum ON-duration is 100 ms.



■ Low output torque detected--***U-TL***

This output signal comes ON when the torque value calculated by the inverter or torque command drops below the level specified by E80 (Low torque detection (Level)) for the period specified by E81 (Low torque detection (Timer)). The signal turns OFF when the calculated torque exceeds "the level specified by E80 plus 5% of the motor rated torque." The minimum ON-duration is 100 ms.



Function Code Details
F codes
E64-E81
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

In the inverter's low frequency operation, as a substantial error in torque calculation occurs, no low torque can be detected within the operation range at less than 20% of the base frequency (F04). (In this case, the result of recognition before entering this operation range is retained.)

The ***U-TL*** signal goes off when the inverter is stopped..

Since the motor parameters are used in the calculation of torque, it is recommended that auto-tuning be applied by function code P04 to achieve higher accuracy.

E98, E99	**Terminal [FWD] Function** **Terminal [REV] Function** **(Refer to E01 to E09.)**

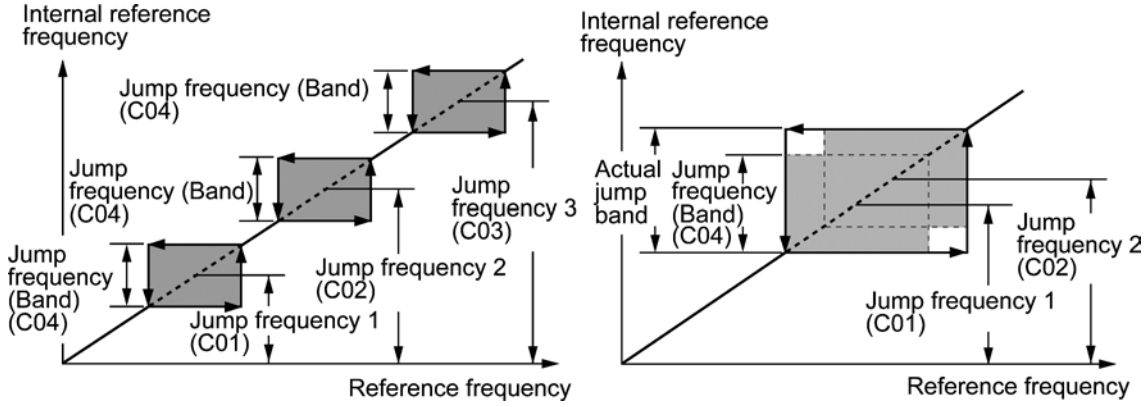
For details, refer to the descriptions of E01 to E09.

5.4.3 C codes (Control functions)

C01 to C03 C04	Jump Frequency 1, 2 and 3 Jump Frequency (Hysteresis width)

These function codes enable the inverter to jump over three different points on the output frequency in order to skip resonance caused by the motor speed and natural frequency of the driven machinery (load).

- While you are increasing the reference frequency, the moment the reference frequency reaches the bottom of the jump frequency band, the inverter keeps the output at that bottom frequency. When the reference frequency exceeds the upper limit of the jump frequency band, the internal reference frequency takes on the value of the reference frequency. When you are decreasing the reference frequency, the situation will be reversed.
- When more than two jump frequency bands overlap, the inverter actually takes the lowest frequency within the overlapped bands as the bottom frequency and the highest as the upper limit. Refer to the figure on the lower right.



■ Jump frequencies 1, 2 and 3 (C01, C02 and C03)

Specify the center of the jump frequency band.

- Data setting range: 0.0 to 500.0 (Hz) (Setting to 0.0 results in no jump frequency band.)

■ Jump frequency hysteresis width (C04)

Specify the jump frequency hysteresis width.

- Data setting range: 0.0 to 30.0 (Hz) (Setting to 0.0 results in no jump frequency band.)

C05 to C19	Multi-frequency 1 to 15

■ These function codes specify 15 frequencies required for driving the motor at frequencies 1 to 15.

Turning terminal commands ***SS1***, ***SS2***, ***SS4*** and ***SS8*** ON/OFF selectively switches the reference frequency of the inverter in 15 steps. To use these features, you need to assign ***SS1***, ***SS2***, ***SS4*** and ***SS8*** ("Select multi-frequency") to the digital input terminals with C05 to C19 (data = 0, 1, 2, and 3).

■ Multi-frequency 1 to 15 (C05 through C19)

- Data setting range: 0.00 to 500.0 (Hz)

Function Code Details
F codes
E78-E99
C01-C19
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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The combination of ***SS1***, ***SS2***, ***SS4*** and ***SS8*** and the selected frequencies are as follows.

SS8	***SS4***	***SS2***	***SS1***	Selected frequency command
OFF	OFF	OFF	OFF	Other than multi-frequency *
OFF	OFF	OFF	ON	C05 (multi-frequency 1)
OFF	OFF	ON	OFF	C06 (multi-frequency 2)
OFF	OFF	ON	ON	C07 (multi-frequency 3)
OFF	ON	OFF	OFF	C08 (multi-frequency 4)
OFF	ON	OFF	ON	C09 (multi-frequency 5)
OFF	ON	ON	OFF	C10 (multi-frequency 6)
OFF	ON	ON	ON	C11 (multi-frequency 7)
ON	OFF	OFF	OFF	C12 (multi-frequency 8)
ON	OFF	OFF	ON	C13 (multi-frequency 9)
ON	OFF	ON	OFF	C14 (multi-frequency 10)
ON	OFF	ON	ON	C15 (multi-frequency 11)
ON	ON	OFF	OFF	C16 (multi-frequency 12)
ON	ON	OFF	ON	C17 (multi-frequency 13)
ON	ON	ON	OFF	C18 (multi-frequency 14)
ON	ON	ON	ON	C19 (multi-frequency 15)

* "Other than multi-frequency" includes frequency command 1 (F01), frequency command 2 (C30) and other command sources except multi-frequency commands.

■ When enabling PID control (J01 = 1, 2, or 3)

Under the PID control, a multi-frequency command can be specified as a preset value (3 different frequencies). It can also be used for a manual speed command even with the PID control being canceled (***Hz***/***PID*** = ON) or for a primary reference frequency under the PID dancer control.

• PID command

SS8	***SS4***	***SS1***, ***SS2***	Command
OFF	OFF	–	Command specified by J02
OFF	ON	–	Multi-frequency by C08
ON	OFF	–	Multi-frequency by C12
ON	ON	–	Multi-frequency by C16

C08, C12, and C16 can be specified in increments of 1 Hz. The following gives the conversion formula between the PID command value and the data to be specified.

$$\text{Data to be specified} = \text{PID command (\%)} \times \text{Maximum frequency (F03)} \div 100$$

$$\text{PID command (\%)} = \frac{\text{Data to be specified (C08, C12, C16)}}{\text{Maximum frequency (F03)}} \times 100$$

• Manual speed command

SS8, *SS4*	*SS2*	*SS1*	Selected frequency command
–	OFF	OFF	Other than multi-frequency
–	OFF	ON	C05 (Multi-frequency 1)
–	ON	OFF	C06 (Multi-frequency 2)
–	ON	ON	C07 (Multi-frequency 3)

C20 Jogging Frequency

H54, H55 (Acceleration/Deceleration Time, Jogging)
d09 to d13 (Speed Control (Jogging))

C20 specifies the operating condition (frequency) to apply in jogging operation.

Function code		Data setting range	Description
C20	Jogging Frequency	0.00 to 500.00 Hz	Reference frequency for jogging operation
H54	Acceleration Time (Jogging)	0.00 to 6000 s	Acceleration time for jogging operation
H55	Deceleration Time (Jogging)	0.00 to 6000 s	Deceleration time for jogging operation
d09	Speed control (Jogging) (Speed command filter)	0.000 to 5.000 s	Modification items related to speed control for jogging operation under vector control without/with speed sensor For adjustments, refer to the descriptions of d01 to d06.
d10	Speed control (Jogging) (Speed detection filter)	0.000 to 0.100 s	
d11	Speed control (Jogging) P (Gain)	0.1 to 200.0 times	
d12	Speed control (Jogging) I (Integral time)	0.001 to 1.000 s	
d13	Speed control (Jogging) (Output filter)	0.000 to 0.100 s	

For details about jogging operation, refer to Chapter 7, Section 7.3.5 "Jogging Operation."

Function Code Details
F codes
E codes
C05-C20
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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C30	Frequency Command 2 (Refer to F01.)

For details of frequency command 2, refer to the description of F01.

C31 to C35 C36 to C39 C41 to C45	Analog Input Adjustment for [12] (Offset, Gain, Filter time constant, Gain base point, Polarity) Analog Input Adjustment for [C1] (Offset, Gain, Filter time constant, Gain base point) Analog Input Adjustment for [V2] (Offset, Gain, Filter time constant, Gain base point, Polarity) F01 (Frequency Command 1)

Setting up a reference frequency using analog input

You can adjust the gain, polarity, filter time constant, and offset which are applied to analog inputs (voltage inputs to terminals [12] and [V2], and current input to terminal [C1]).

Adjustable items for analog inputs

Input terminal	Input range	Gain		Polarity	Filter time constant	Offset
		Gain	Base point			
[12]	0 to +10 V, -10 to +10 V	C32	C34	C35	C33	C31
[C1]	4 to 20 mA	C37	C39	—	C38	C36
[V2]	0 to +10 V, -10 to +10 V	C42	C44	C45	C43	C41

■ Offset (C31, C36, C41)

C31, C36 or C41 configures an offset for an analog voltage/current input. The offset also applies to signals sent from the external equipment.

- Data setting range: -5.0 to +5.0 (%)

■ Filter time constant (C33, C38, C43)

C33, C38 or C43 configures a filter time constant for an analog voltage/current input. The larger the time constant, the slower the response. Specify the proper filter time constant taking into account the response speed of the machine (load). If the input voltage fluctuates due to line noises, increase the time constant.

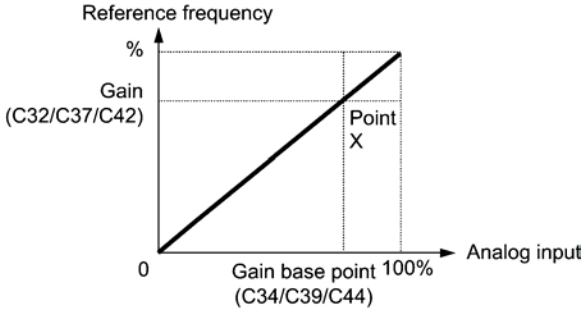
- Data setting range: 0.00 to 5.00 (s)

■ Polarity (C35, C45)

C35 and C45 configure the input range for analog input voltage.

Data for C35 and C45	Specifications for terminal inputs
0	-10 to +10 V
1	0 to +10 V (A minus component of the input will be regarded as 0 VDC.)

■ Gain



Note To input bipolar analog voltage (0 to ±10 VDC) to terminals [12] and [V2], set C35 and C45 data to "0." Setting C35 and C45 data to "1" enables the voltage range from 0 to +10 VDC and interprets the negative polarity input from 0 to -10 VDC as 0 V.

C50	Bias (Frequency command 1) (Bias base point) (Refer to F01.)

For details, refer to the description of F01.

C51, C52	Bias (PID command 1) (Bias value and Bias base point)

These function codes (and the gain-related function codes) specify the gain and bias of the analog PID command 1, enabling it to define arbitrary relationship between the analog input and PID commands.

The actual setting is the same as that of F18. For details, refer to F18 given in the description of F01.

Note Gain-related function codes C32, C34, C37, C39, C42, and C44 are shared by frequency commands.

■ Bias value (C51)

- Data setting range: -100.00 to 100.00 (%)

■ Bias base point (C52)

- Data setting range: 0.00 to 100.00 (%)

C53	Selection of Normal/Inverse Operation (Frequency command 1)

C53 switches the reference frequency sourced by frequency command 1 (F01) between normal and inverse.

For details, refer to E01 through E09 (data = 21) for the terminal command ***IVS*** ("Switch normal/inverse operation").

Function Code Details
F codes
E codes
C30-C53
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

5.4.4 P codes (Motor parameters)

The FRENIC-MEGA drives the motor under "V/f control," "vector control without speed sensor," "vector control with speed sensor," or other drive control, which can be selected with function codes.

To use the integrated automatic control functions such as auto torque boost, torque calculation monitoring, auto energy saving operation, torque limiter, automatic deceleration (anti-regenerative control), auto search for idling motor speed, slip compensation, torque vector control, droop control, and overload stop, it is necessary to build a motor model in the inverter by specifying proper motor parameters including the motor capacity and rated current.

The FRENIC-MEGA provides built-in motor parameters for Fuji standard motors 8-series, 6-series, and Fuji motors exclusively designed for vector control. To use these Fuji motors, it is enough to specify motor parameters for P99 (Motor 1 Selection). If the cabling between the inverter and the motor is long (generally, 20 m or longer) or a reactor is inserted between the motor and the inverter, however, the apparent motor parameters are different from the actual ones, so auto-tuning or other adjustments are necessary. For the auto-tuning procedure, refer to the FRENIC-MEGA Instruction Manual (INR-SI47-1183-E), Chapter 4 " RUNNING THE MOTOR."

When using a motor made by other manufacturers or a Fuji non-standard motor, obtain the datasheet of the motor and specify the motor parameters manually or perform auto-tuning.

P01 Motor 1 (No. of poles)

P01 specifies the number of poles of the motor. Enter the value given on the nameplate of the motor. This setting is used to display the motor speed on the LED monitor and to control the speed (refer to E43). The following expression is used for the conversion.

$$\text{Motor speed (r/min)} = \frac{120}{\text{No. of poles}} \times \text{Frequency (Hz)}$$

- Data setting range: 2 to 22 (poles)

P02 Motor 1 (Rated capacity)

P02 specifies the rated capacity of the motor. Enter the rated value given on the nameplate of the motor.

Data for P02	Unit	Dependency on function code P99
0.01 to 1000	kW	When P99 (Motor 1 Selection) = 0, 2, 3 or 4
	HP	When P99 (Motor 1 Selection) = 1

When accessing P02 with the keypad, take into account that the P02 data automatically updates data of P03, P06 through P23, P53 through P56, and H46.

P03 Motor 1 (Rated current)

P03 specifies the rated current of the motor. Enter the rated value given on the nameplate of the motor.

- Data setting range: 0.00 to 2000 (A)

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P04 Motor 1 (Auto-tuning)

The inverter automatically detects the motor parameters and saves them in its internal memory. Basically, it is not necessary to perform tuning when a Fuji standard motor is used with a standard connection with the inverter.

There are three types of auto tuning as listed below. Select appropriate one considering the limitations in your equipment and control mode.

Data for P04	Auto-tuning	Operation	Motor parameters to be tuned
0	Disable	N/A	N/A
1	Tune the motor while it is stopped	Tunes while the motor is stopped.	Primary resistance (%R1) (P07) Leakage reactance (%X) (P08) Rated slip frequency (P12) %X correction factors 1 and 2 (P53 and P54)
2	Tune the motor while it is rotating under V/f control	After tuning the motor in a stopped state, retunes it running at 50% of the base frequency.	No-load current (P06) Primary resistance (%R1) (P07) Leakage reactance (%X) (P08) Rated slip frequency (P12) Magnetic saturation factors 1 to 5 (P16 through P20) Magnetic saturation extension factors "a" to "c" (P21 through P23) %X correction factors 1 and 2 (P53 and P54)
3	Tune the motor while it is rotating under vector control	After tuning the motor in a stopped state, retunes it running at 50% of the base frequency twice.	No-load current (P06) Primary resistance (%R1) (P07) Leakage reactance (%X) (P08) Rated slip frequency (P12) Magnetic saturation factors 1 to 5 (P16 through P20) Magnetic saturation extension factors "a" to "c" (P21 through P23) %X correction factors 1 and 2 (P53 and P54)

For details of auto tuning, refer to the FRENIC-MEGA Instruction Manual (INR-SI47-1183-E), Chapter 4 " RUNNING THE MOTOR."

Note In any of the following cases, perform auto-tuning since the motor parameters are different from those of Fuji standard motors so that the best performance cannot be obtained under some controls.

- The motor to be driven is a non-Fuji motor or a non-standard motor.
- Cabling between the motor and the inverter is long. (Generally, 20 m or longer)
- A reactor is inserted between the motor and the inverter.

Function Code Details
F codes
E codes
C codes
P01-P04
H codes
A codes
b codes
r codes
J codes
d codes
—
y codes

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■ Functions in which the motor parameters affect the running capability

Function	Related function codes (representative)
Auto torque boost	F37
Output torque monitor	F31, F35
Load factor monitor	F31, F35
Auto energy saving operation	F37
Torque limiter	F40
Anti-regenerative control (Automatic deceleration)	H69
Auto search	H09
Slip compensation	F42
Dynamic torque vector control	F42
Droop control	H28
Torque detection	E78 through E81
Vector control without/with speed sensor	F42
Brake Signal (Brake-OFF torque)	J95

P06 to P08 Motor 1 (No-load current, %R1 and %X)

P06 through P08 specify no-load current, %R1 and %X, respectively. Obtain the appropriate values from the test report of the motor or by calling the manufacturer of the motor.

Performing auto-tuning automatically sets these parameters.

■ No-load current (P06)

Enter the value obtained from the motor manufacturer.

■ %R1 (P07)

Enter the value calculated by the following expression.

$$\%R1 = \frac{R1 + \text{Cable } R1}{V / (\sqrt{3} \times I)} \times 100\ (\%)$$

where,

R1: Primary resistance of the motor (Ω)
Cable R1: Resistance of the output cable (Ω)
V: Rated voltage of the motor (V)
I: Rated current of the motor (A)

■ %X (P08)

Enter the value calculated by the following expression.

$$\%X = \frac{X1 + X2 \times XM / (X2 + XM) + \text{Cable } X}{V / (\sqrt{3} \times I)} \times 100\ (\%)$$

where,

X1: Primary leakage reactance of the motor (Ω)
X2: Secondary leakage reactance of the motor (converted to primary) (Ω)
XM: Exciting reactance of the motor (Ω)
Cable X: Reactance of the output cable (Ω)
V: Rated voltage of the motor (V)
I: Rated current of the motor (A)

Note For reactance, use the value at the base frequency (F04).

P09 to P11 — Motor 1 (Slip compensation gain for driving, Slip compensation response time, and Slip compensation gain for braking)

P09 and P11 determine the slip compensation amount in % for driving and braking individually and adjust the slip amount from internal calculation. Specification of 100% fully compensates for the rated slip of the motor. Excessive compensation (P09, P11 > 100%) may cause hunting (undesirable oscillation of the system), so carefully check the operation on the actual machine.

For Fuji motors exclusively designed for vector control, the rated slip of the motor for driving or braking is compensated by P09 or P11, respectively, to improve output torque accuracy.

P10 determines the response time for slip compensation. Basically, there is no need to modify the default setting. If you need to modify it, consult your Fuji Electric representatives.

Function code		Operation (Slip compensation)
P09	Slip compensation gain for driving	Adjust the slip compensation amount for driving. Slip compensation amount for driving = Rated slip x Slip compensation gain for driving
P11	Slip compensation gain for braking	Adjust the slip compensation amount for braking. Slip compensation amount for braking = Rated slip x Slip compensation gain for braking
P10	Slip compensation response time	Specify the slip compensation response time. Basically, there is no need to modify the default setting.

For details about the slip compensation control, refer to the description of F42.

P12 — Motor 1 (Rated slip frequency)

P12 specifies rated slip frequency. Obtain the appropriate values from the test report of the motor or by calling the manufacturer of the motor. Performing auto-tuning automatically sets these parameters.

- Rated slip frequency: Convert the value obtained from the motor manufacturer to Hz using the following expression and enter the converted value.

(Note: The motor rating given on the nameplate sometimes shows a larger value.)

$$\text{Rated slip frequency (Hz)} = \frac{\text{(Synchronous speed - Rated speed)}}{\text{Synchronous speed}} \times \text{Base frequency}$$

For details about the slip compensation control, refer to the description of F42.

P13 to P15 — Motor 1 (Iron loss factors 1 to 3)

P13 to P15 compensates the iron loss caused inside the motor under vector control with speed sensor, in order to improve the torque control accuracy.

The combination of P99 (Motor 1 selection) and P02 (Motor 1 rated capacity) data determines the standard value. Basically, there is no need to modify the setting.

P16 to P20 P21 to P23 — Motor 1 (Magnetic saturation factors 1 to 5) Motor 1 (Magnetic saturation extension factors "a" to "c")

These function codes specify the characteristics of the exciting current to generate magnetic flux inside the motor and the characteristics of the magnetic flux generated.

The combination of P99 (Motor 1 selection) and P02 (Motor 1 rated capacity) data determines the standard value.

Performing auto-tuning while the motor is rotating (P04 = 2 or 3) specifies these factors automatically.

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P53, P54 Motor 1 (%X correction factors 1 and 2)

P53 and P54 specify the factors to correct fluctuations of leakage reactance (%X).

Basically, there is no need to modify the setting.

P55 Motor 1 (Torque current under vector control)

P55 specifies the rated torque current under vector control without/with speed sensor.

The combination of P99 (Motor 1 selection) and P02 (Motor 1 rated capacity) data determines the standard value.

Basically, there is no need to modify the setting.

P56 Motor 1 (Induced voltage factor under vector control)

P56 specifies the induced voltage factor under vector control without/with speed sensor.

The combination of P99 (Motor 1 selection) and P02 (Motor 1 rated capacity) data determines the standard value.

Basically, there is no need to modify the setting.

P99 Motor 1 Selection

P99 specifies the motor type to be used.

Data for P99	Motor type
0	Motor characteristics 0 (Fuji standard motors, 8-series)
1	Motor characteristics 1 (HP rating motors)
2	Motor characteristics 2 (Fuji motors exclusively designed for vector control)
3	Motor characteristics 3 (Fuji standard motors, 6-series)
4	Other motors

To select the motor drive control or to run the inverter with the integrated automatic control functions such as auto torque boost and torque calculation monitoring, it is necessary to specify the motor parameters correctly. First select the motor type with P99 (Motor 1 selection) from Fuji standard motors 8-series, 6-series, and Fuji motors exclusively designed for vector control, next specify the motor rated capacity with P02, and then initialize the motor parameters with H03. This process automatically configures the related motor parameters (P01, P03, P06 through P23, P53 through P56, and H46).

The data of F09 (Torque boost 1), H13 (Restart Mode after Momentary Power Failure (Restart time)), and F11 (Electronic thermal overload protection for motor 1 (Overload detection level)) depends on the motor capacity, but the process stated above does not change them. Specify and adjust the data during a test run if needed.

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5.4.5 H codes (High performance functions)

H03 **Data Initialization**

H03 initializes the current function code data to the factory defaults or initializes the motor parameters.

To change the H03 data, it is necessary to press the STOP + ∧ keys or STOP + ∨ keys (simultaneous keying).

Data for H03	Function
0	Disable initialization (Settings manually made by the user will be retained.)
1	Initialize all function code data to the factory defaults
2	Initialize motor 1 parameters in accordance with P02 (Rated capacity) and P99 (Motor 1 selection)
3	Initialize motor 2 parameters in accordance with A16 (Rated capacity) and A39 (Motor 2 selection)
4	Initialize motor 3 parameters in accordance with b16 (Rated capacity) and b39 (Motor 3 selection)
5	Initialize motor 4 parameters in accordance with r16 (Rated capacity) and r39 (Motor 4 selection)

- To initialize the motor parameters, set the related function codes as follows.

Step	Item	Action	Function code			
			1st motor	2nd motor	3rd motor	4th motor
(1)	Motor selection	Selects the motor type	P99	A39	b39	r39
(2)	Motor (rated capacity)	Sets the motor capacity (kW)	P02	A16	b16	r16
(3)	Data initialization	Initialize motor parameters	H03 = 2	H03 = 3	H03 = 4	H03 = 5
Function code data to be initialized		If "Data = 0, 1, 3, or 4" in Step (1)	P01, P03, P06 to P23, P53 to P56, H46	A15, A17, A20 to A37, A53 to A56	b15, b17, b20 to b37, b53 to b56	r15, r17, r20 to r37, r53 to r56
		If "Data = 2" in Step (1), function codes listed at the right are also initialized	F04, F05	A02, A03	b02, b03	r02, r03

- Upon completion of the initialization, the H03 data reverts to "0" (factory default).
- If P02, A16, b16 or r16 data is set to a value other than the standard nominal applied motor rating, data initialization with H03 internally converts the specified value forcibly to the standard nominal applied motor rating. (See Table B given on the last page of the function code tables.)
- Motor parameters to be initialized are for motors listed below under V/f control. When the base frequency, rated voltage, and the number of poles are different from those of the listed motors, or when non-Fuji motors or non-standard motors are used, change the rated current data to that printed on the motor nameplate.

Motor selection		V/f control data		
Data = 0 or 4	Fuji standard motors, 8-series	4 poles	200 V/50 Hz,	400 V/50 Hz
Data = 2	Fuji motors exclusively designed for vector control	4 poles	—/50 Hz,	—/50 Hz
Data = 3	Fuji standard motors, 6-series	4 poles	200 V/50 Hz,	400 V/50 Hz
Data = 1	HP rating motors	4 poles	230 V/60 Hz,	460 V/60 Hz

Note When accessing function code P02 with the keypad, take into account that P02 data automatically updates data of function codes P03, P06 through P23, P53 through P56, and H46. Also, when accessing function code A16, b16 or r16, data of related function codes for each are automatically updated.

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H04, H05 Auto-reset (Times and Reset interval)

H04 and H05 specify the auto-reset function that makes the inverter automatically attempt to reset the tripped state and restart without issuing an alarm output (for any alarm) even if any protective function subject to reset is activated and the inverter enters the forced-to-stop state (tripped state).

If the protective function is activated in excess of the times specified by H04, the inverter will issue an alarm output (for any alarm) and not attempt to auto-reset the tripped state.

Listed below are the protective functions subject to auto-reset.

Protective function	LED monitor displays:	Protective function	LED monitor displays:
Overcurrent protection	OC 1, OC2 or OC3	Motor overheat	OH4
Overvoltage protection	OU 1, OU2 or OU3	Braking resistor overheat	dbH
Heat sink overheat	OH 1	Motor overload	OL 1 to OL 4
Inverter internal overheat	OH3	Inverter overload	OLU

■ Number of reset times (H04)

H04 specifies the number of reset times for the inverter to automatically attempt to escape the tripped state. When H04 = 0, the auto-reset function will not be activated.

- Data setting range: 0 (Disable), 1 to 10 (times)

⚠WARNING

If the "auto-reset" function has been specified, the inverter may automatically restart and run the motor stopped due to a trip fault, depending on the cause of the tripping.

Design the machinery so that human body and peripheral equipment safety is ensured even when the auto-resetting succeeds.

Otherwise an accident could occur.

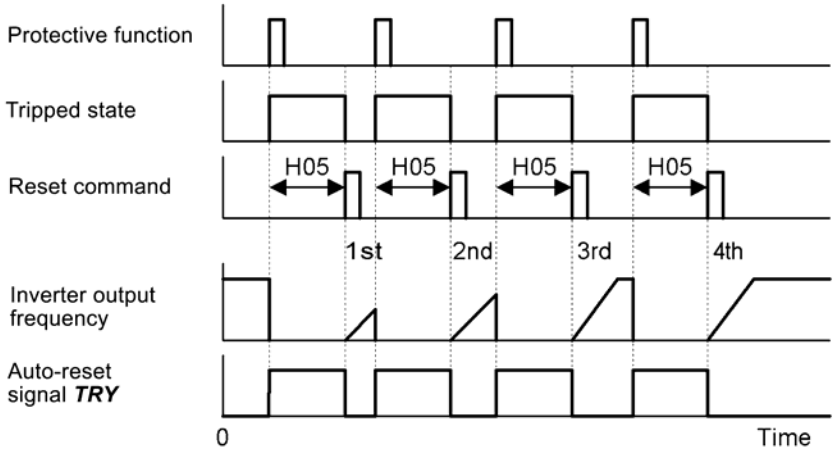
■ Reset interval (H05)

- Data setting range: 0.5 to 20.0 (s)

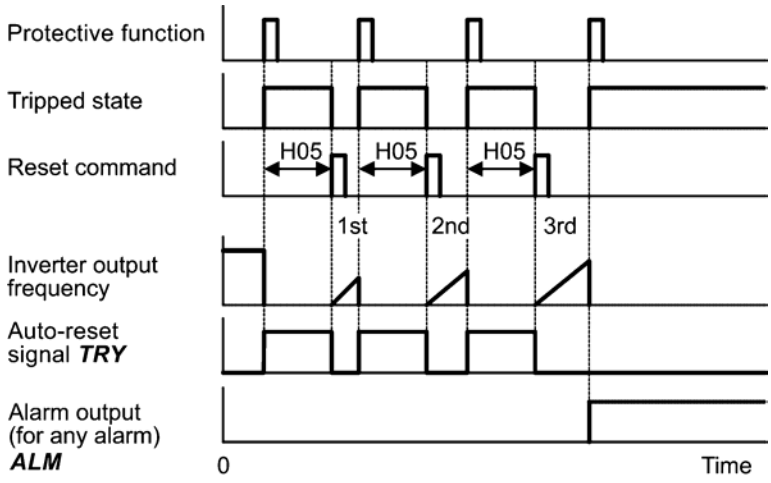
H05 specifies the reset interval time between the time when the inverter enters the tripped state and the time when it issues the reset command to attempt to auto-reset the state. Refer to the timing scheme diagrams below.

<Operation timing scheme>

• In the figure below, normal operation restarts in the 4-th retry.



- In the figure below, the inverter failed to restart normal operation within the number of reset times specified by H04 (in this case, 3 times (H04 = 3)), and issued the alarm output (for any alarm) ***ALM***.



- The auto-reset operation can be monitored from the external equipment by assigning the digital output signal ***TRY*** to any of the programmable, output terminals [Y1] to [Y4], [Y5A/C], and [30A/B/C] with any of E20 through E24 and E27 (data = 26).

H06 Cooling Fan ON/OFF Control

To prolong the service life of the cooling fan and reduce fan noise during running, the cooling fan stops when the temperature inside the inverter drops below a certain level while the inverter stops. However, since frequent switching of the cooling fan shortens its service life, the cooling fan keeps running for 10 minutes once started.

H06 specifies whether to keep running the cooling fan all the time or to control its ON/OFF.

Data for H06	Cooling fan ON/OFF
0	Disable (Always in operation)
1	Enable (ON/OFF controllable)

■ Cooling fan in operation -- ***FAN*** (E20 to E24 and E27, data = 25)

With the cooling fan ON/OFF control enabled (H06 = 1), this output signal is ON when the cooling fan is in operation, and OFF when it is stopped. This signal can be used to make the cooling system of peripheral equipment interlocked for an ON/OFF control

H07 Acceleration/Deceleration Pattern (Refer to F07.)

For details, refer to the description of F07.

H08 Rotational Direction Limitation

H08 inhibits the motor from running in an unexpected rotational direction due to miss-operation of run commands, miss-polarization of frequency commands, or other mistakes.

Data for H08	Function
0	Disable
1	Enable (Reverse rotation inhibited)
2	Enable (Forward rotation inhibited)

Under vector control, some restrictions apply to the speed command. Under vector control without speed sensor, a speed estimation error caused by a motor constant error or other errors may slightly rotate the motor in the direction other than the specified one.

H09 d67 Starting Mode (Auto search)

H49 (Starting Mode, Auto search delay time 1)
H46 (Starting Mode, Auto search delay time 2)

H09 specifies the starting mode--whether to enable the auto search for idling motor speed to run the idling motor without stopping it.

The auto search can apply to the restart of the inverter after a momentary power failure and the normal startup of the inverter individually.

If the terminal command ***STM*** ("Enable auto search for idling motor speed at starting") is assigned to a digital input terminal with any of E01 to E09 (data = 26), the combination of the H09 data and the ***STM*** command status switches the starting modes (whether auto search is enabled or disabled). If no ***STM*** is assigned, the inverter interprets ***STM*** as being OFF by default.

■ H09/d67 (Starting mode, auto search) and terminal command ***STM*** ("Enable auto search for idling motor speed at starting")

The combination of H09/d67 data and the ***STM*** status determines whether to perform the auto search as listed below.

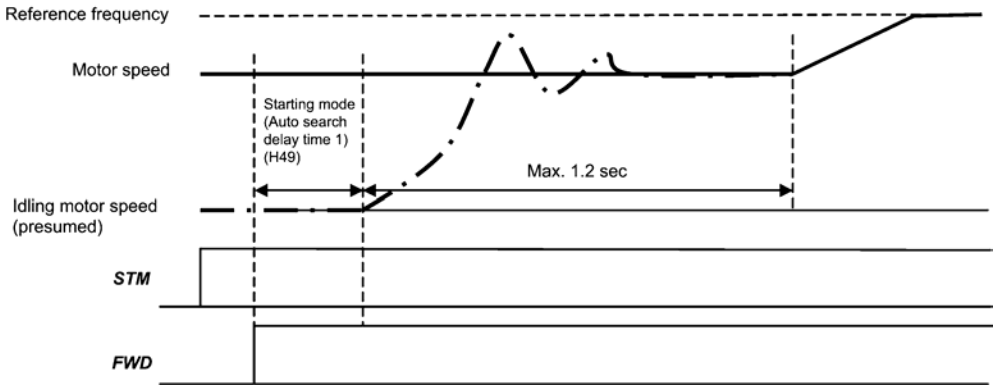
Function code	Drive control	Factory default
H09	V/f control (F42 = 0 to 2)	0: Disable
d67	Vector control without speed sensor (F42 = 5)	2: Enable

Data for H09/d67	***STM***	Auto search for idling motor speed at starting	
		For restart after momentary power failure (F14 = 3 to 5)	For normal startup
0: Disable	OFF	Disable	Disable
1: Enable	OFF	Enable	Disable
2: Enable	OFF	Enable	Enable
—	ON	Enable	Enable

When ***STM*** is ON, auto search for idling motor speed at starting is enabled regardless of the H09/d67 setting. 🕮 Refer to E01 to E09 (data = 26).

Auto search for idling motor speed

Starting the inverter (with a run command ON, ***BX*** OFF, auto-reset, etc.) with ***STM*** being ON searches for the idling motor speed for a maximum of 1.2 seconds to run the idling motor without stopping it. After completion of the auto search, the inverter accelerates the motor up to the reference frequency according to the frequency command and the preset acceleration time.



Auto search for idling motor speed to follow

■ Starting Mode (Auto search delay time 1) (H49)

- Data setting range: 0.0 to 10.0 (s)

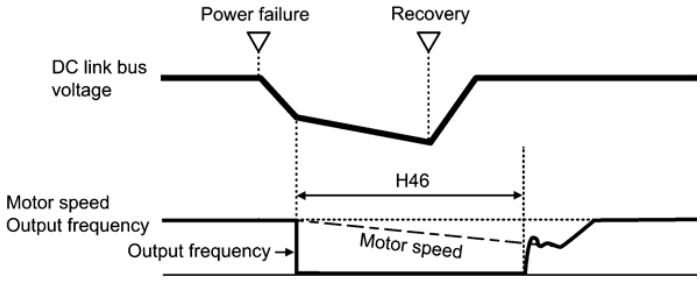
Auto search for the idling motor speed will become unsuccessful if it is done while the motor retains residual voltage. It is, therefore, necessary to leave the motor for an enough time for residual voltage to disappear. H49 specifies that time (0.0 to 10.0 sec.).

At the startup triggered by a run command ON, auto search starts with the delay specified by H49. Using H49, therefore, eliminates the need of the run command timing control when two inverters share a single motor to drive it alternately, allow the motor to coast to a stop, and restart it under auto search control at each time of inverter switching.

■ Starting Mode (Auto search delay time 2) (H46)

- Data setting range: 0.0 to 10.0 (s)

At the restart after a momentary power failure, at the start by turning the terminal command ***BX*** ("Coast to a stop") OFF and ON, or at the restart by auto-reset, the inverter applies the delay time specified by H46. The inverter will not start unless the time specified by H46 has elapsed, even if the starting conditions are satisfied.



Under auto search control, the inverter searches the motor speed with the voltage applied at the motor start and the current flowing in the motor, based on the model built with the motor parameters. Therefore, the search is greatly influenced by the residual voltage in the motor.

H46 is available for motor 1 only.

At factory shipment, H46 data is preset to a correct value according to the motor capacity for the general purpose motor, and basically there is no need to modify the data.

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Depending on the motor characteristics, however, it may take time for residual voltage to disappear (due to the secondary thermal time constant of the motor). In such a case, the inverter starts the motor with the residual voltage remaining, which will cause an error in the speed search and may result in occurrence of an inrush current or an overvoltage alarm.

If it happens, increase the value of H46 data and remove the influence of residual voltage. (If possible, it is recommended to set the value around two times as large as the factory default value allowing a margin.)

Note

- Be sure to auto-tune the inverter preceding the start of auto search for the idling motor speed.
- When the estimated speed exceeds the maximum frequency or the upper limit frequency, the inverter disables auto search and starts running the motor with the maximum frequency or the upper limit frequency, whichever is lower.
- During auto search, if an overcurrent or overvoltage trip occurs, the inverter restarts the suspended auto search.
- Perform auto search at 60 Hz or below.
- Note that auto search may not fully provide the expected/designed performance depending on conditions including the load, motor parameters, power cable length, and other externally determined events.

H11 Deceleration Mode

H11 specifies the deceleration mode to be applied when a run command is turned OFF.

Data for H11	Function
0	Normal deceleration
1	Coast-to-stop The inverter immediately shuts down its output, so the motor stops according to the inertia of the motor and machinery (load) and their kinetic energy losses.

Note When reducing the reference frequency, the inverter decelerates the motor according to the deceleration commands even if H11 = 1 (Coast-to-stop).

H12 Instantaneous Overcurrent Limiting (Mode selection) (Refer to F43.)

Refer to the descriptions of F43 and F44.

H13, H14 H15, H16 Restart Mode after Momentary Power Failure (Restart time, Frequency fall rate, Continuous running level, and Allowable momentary power failure time) (Refer to F14.)

For how to set these function codes (Restart time, Frequency fall rate, Continuous running level and Allowable momentary power failure time), refer to the description of F14.

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H26, H27 Thermistor (for motor) (Mode selection and Level)

These function codes specify the PTC (Positive Temperature Coefficient)/NTC (Negative Temperature Coefficient) thermistor embedded in the motor. The thermistor is used to protect the motor from overheating or output an alarm signal.

■ Thermistor (for motor) (Mode selection) (H26)

H26 selects the function operation mode (protection or alarm) for the PTC/NTC thermistor as shown below.

Data for H26	Action
0	Disable
1	Enable When the voltage sensed by PTC thermistor exceeds the detection level, motor protective function (alarm ⊏ⅡⅡ⊐) is triggered, causing the inverter to enter an alarm stop state.
2	Enable When the voltage sensed by the PTC thermistor exceeds the detection level, a motor alarm signal is output but the inverter continues running. You need to assign the "Motor overheat detected by thermistor" signal (***THM***) to one of the digital output terminals beforehand, by which a temperature alarm condition can be detected by the thermistor (PTC) (E20 to E24 and E27, data = 56).
3	Enable When the inverter is connected with the NTC thermistor built into the Fuji VG motor exclusively designed for vector control, the inverter senses the motor temperature and uses the information for control. If the motor overheats and the temperature exceeds the protection level, the inverter issues the Motor protection alarm ⊏ⅡⅡ⊐ and stops the motor.

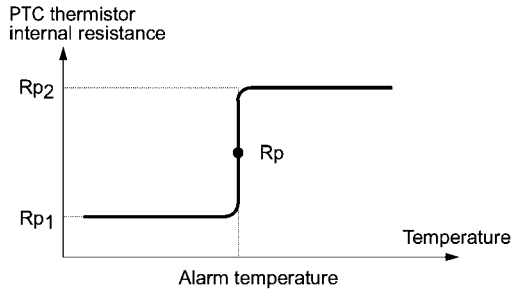
If H26 data is set to "1" or "2" (PTC thermistor), the inverter monitors the voltage sensed by PTC thermistor and protect the motor even when any of the 2nd to 4th motors is selected. If H26 data is set to "3" (NTC thermistor) and any of the 2nd to 4th motors is selected, the inverter does not perform these functions.

■ Thermistor (for motor) (Level) (H27)

H27 specifies the detection level (expressed in voltage) for the temperature sensed by the PTC thermistor.

- Data setting range: 0.00 to 5.00 (V)

The alarm temperature at which the overheat protection becomes activated depends on the characteristics of the PTC thermistor. The internal resistance of the thermistor will significantly change at the alarm temperature. The detection level (voltage) is specified based on the change of the internal resistance.



Suppose that the internal resistance of the PTC thermistor at the alarm temperature is Rp, the detection level (voltage) V_{v2} is calculated by the expression below. Set the result V_{v2} to function code H27.

$$V_{V2} = \frac{R_p}{27000 + Rp} \times 10.5 \text{ (V)}$$

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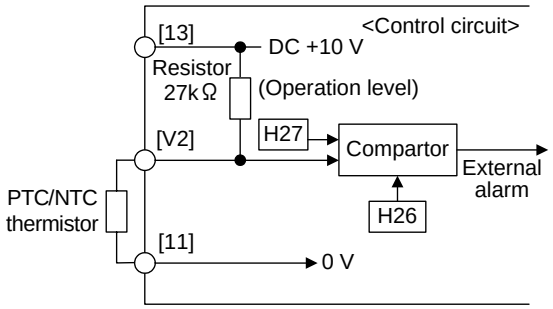
Connect the PTC thermistor as shown below. The voltage obtained by dividing the input voltage on terminal [V2] with a set of internal resistors is compared with the detection level voltage specified by H27.

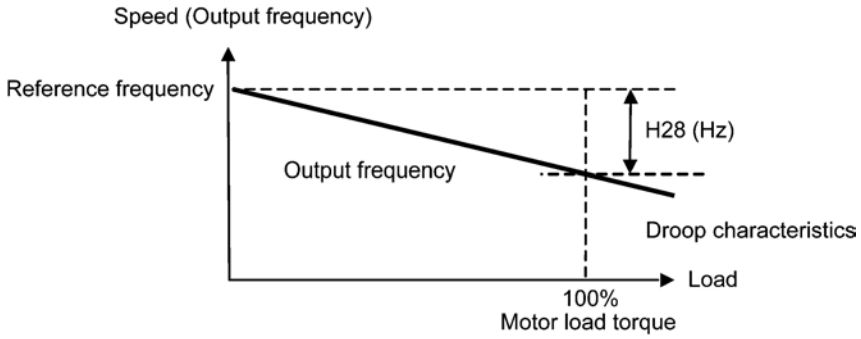


Note When using the terminal [V2] for PTC/NTC thermistor input, also turn SW5 on the control printed circuit board to the PTC/NTC side. For details, refer to Chapter 2, "SPECIFICATIONS."

H28 Droop Control

In a system in which two or more motors drive single machinery, any speed gap between inverter-driven motors results in some load unbalance between motors. The droop control allows each inverter to drive the motor with the speed droop characteristics for increasing its load, eliminating such kind of load unbalance.

- Data setting range: -60.0 to 0.0 (Hz), (0.0: Disable)



■ Select droop control -- ***DROOP*** (E01 to E09, data = 76)

This terminal command ***DROOP*** is to switch enabling or disabling the droop control.

DROOP	Droop control
ON	Enable
OFF	Disable

Note To use droop control, be sure to auto-tune the inverter for the motor.

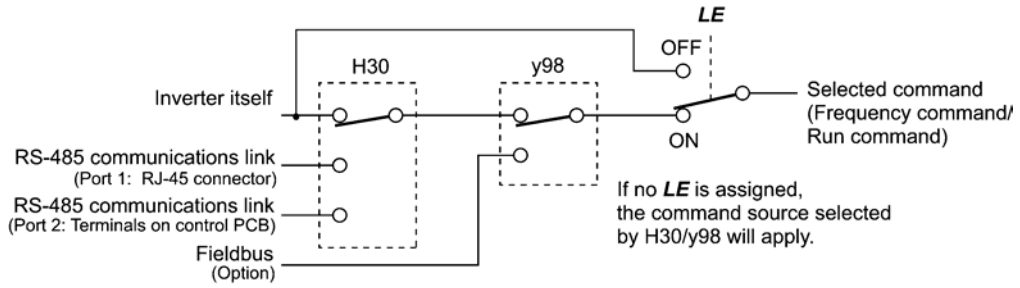
The droop control under V/f control applies the acceleration/deceleration time to the frequency obtained as a result of the droop control to prevent the inverter from tripping even at an abrupt change in load. As a result, reflecting the frequency compensated by the droop control on the motor speed may be delayed due to the influence of the acceleration/deceleration time specified, which may look as if the droop control is disabled.

By contrast, the vector control without/with speed sensor contains the current control system and the inverter does not trip even at an abrupt change in load, so the acceleration/deceleration time does not affect the droop control. It is, therefore, possible to eliminate load unbalance using the droop control even during accelerating/decelerating.

H30	Communications Link Function (Mode selection) y98 (Bus Link Function, Mode selection)

Using the RS-485 communications link (standard/option) or fieldbus (option) allows you to issue frequency commands and run commands from a computer or PLC at a remote location, as well as monitor the inverter running information and the function code data.

H30 and y98 specify the sources of those commands--"inverter itself" or "computers or PLCs via the RS-485 communications link or fieldbus." H30 is for the RS-485 communications link; y98 for the fieldbus.



Command sources selectable

Command sources	Description
Inverter itself	Sources except RS-485 communications link and fieldbus Frequency command source: Specified by F01/C30, or multi-frequency command Run command source: Via the keypad or digital input terminals selected by F02
RS-485 communications link (port 1)	Via the standard RJ-45 port used for connecting a keypad
RS-485 communications link (port 2)	Via the terminals DX+, DX- and SD on the control PCB
Fieldbus (option)	Via fieldbus (option) using FA protocol such as DeviceNet or PROFIBUS DP

Command sources specified by H30 (Communications link function, Mode selection)

Data for H30	Frequency command	Run command
0	Inverter itself (F01/C30)	Inverter itself (F02)
1	RS-485 communications link (port 1)	Inverter itself (F02)
2	Inverter itself (F01/C30)	RS-485 communications link (port 1)
3	RS-485 communications link (port 1)	RS-485 communications link (port 1)
4	RS-485 communications link (port 2)	Inverter itself (F02)
5	RS-485 communications link (port 2)	RS-485 communications link (port 1)
6	Inverter itself (F01/C30)	RS-485 communications link (port 2)
7	RS-485 communications link (port 1)	RS-485 communications link (port 2)
8	RS-485 communications link (port 2)	RS-485 communications link (port 2)

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Command sources specified by y98 (Bus link function, Mode selection)

Data for y98	Frequency command	Run command
0	Follow H30 data	Follow H30 data
1	Via fieldbus (option)	Follow H30 data
2	Follow H30 data	Via fieldbus (option)
3	Via fieldbus (option)	Via fieldbus (option)

Combination of command sources

		Frequency command			
		Inverter itself	Via RS-485 communications link (port 1)	Via RS-485 communications link (port 2)	Via fieldbus (option)
Run command source	Inverter itself	H30 = 0 y98 = 0	H30 = 1 y98 = 0	H30=4 y98=0	H30=0 (1 or 4) y98=1
	Via RS-485 communications link (port 1)	H30 = 2 y98 = 0	H30 = 3 y98 = 0	H30=5 y98=0	H30=2 (3 or 5) y98=1
	Via RS-485 communications link (port 2)	H30 = 6 y98 = 0	H30 = 7 y98 = 0	H30=8 y98=0	H30=6 (7 or 8) y98=1
	Via fieldbus (option)	H30 = 0 (2 or 6) y98 = 2	H30 = 1 (3 or 7) y98 = 2	H30 = 4 (5 or 8) y98 = 2	H30 = 0 (1 to 8) y98 = 3

For details, refer to the RS-485 Communication User's Manual (MEH448) or the Field Bus Option Instruction Manual.

- When the terminal command ***LE*** ("Enable communications link via RS-485 or fieldbus") is assigned to a digital input terminal, turning ***LE*** ON makes the settings of H30 and y98 enabled. When ***LE*** is OFF, those settings are disabled so that both frequency commands and run commands specified from the inverter itself take control.

  (Refer to the descriptions of E01 through E09, data = 24.)

  No ***LE*** assignment is functionally equivalent to the ***LE*** being ON.

H42, H43 H48

Capacitance of DC Link Bus Capacitor, Cumulative Run Time of Cooling Fan Cumulative Run Time of Capacitors on Printed Circuit Boards
H47 (Initial Capacitance of DC Link Bus Capacitor)
H98 (Protection/Maintenance Function)

■ Life prediction function

The inverter has the life prediction function for some parts which measures the discharging time or counts the voltage applied time, etc. The function allows you to monitor the current lifetime state on the LED monitor and judge whether those parts are approaching the end of their service life.

The life prediction function can also issue early warning signals if the lifetime alarm command ***LIFE*** is assigned to any of the digital output terminals by any of E20 through E24 and E27.

The predicted values should be used only as a guide since the actual service life is influenced by the surrounding temperature and other usage environments.

Object of life prediction	Prediction function	End-of-life criteria	Prediction timing	On the LED monitor
DC link bus capacitor	Measurement of discharging time Measures the discharging time of the DC link bus capacitor when the main power is shut down and calculates the capacitance.	85% or lower of the initial capacitance at shipment (See "[1] Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment" on the next page.)	At periodic inspection (H98: Bit 3 = 0)	5_05 (Capacitance)
		85% or lower of the reference capacitance under ordinary operating conditions at the user site (See "[2] Measuring the capacitance of DC link bus capacitor under ordinary operating conditions" on page 5-164.)	During ordinary operation (H98: Bit 3 = 1)	5_05 (Capacitance)
	ON-time counting Counts the time elapsed when the voltage is applied to the DC link bus capacitor, while correcting it according to the capacitance measured above.	Exceeding 87,600 hours (10 years)	During ordinary operation	5_26 (Elapsed time) 5_27 (Time remaining before the end of life)
Electrolytic capacitors on printed circuit boards	Counts the time elapsed when the voltage is applied to the capacitors, while correcting it according to the surrounding temperature.	Exceeding 87,600 hours (10 years)	During ordinary operation	5_06 (Cumulative run time)
Cooling fans	Counts the run time of the cooling fans.	Exceeding 87,600 hours (10 years)	During ordinary operation	5_07 (Cumulative run time)

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■ Capacitance measurement of DC link bus capacitor (H42)

Calculating the capacitance of DC link bus capacitor

- The discharging time of the DC link bus capacitor depends largely on the inverter's internal load conditions, e.g. options attached or ON/OFF of digital I/O signals. If actual load conditions are so different from the ones at which the initial/reference capacitance is measured that the measurement result falls out of the accuracy level required, then the inverter does not perform measuring.
- The capacitance measuring conditions at shipment are extremely restricted, e.g., all input terminals being OFF in order to stabilize the load and measure the capacitance accurately. Those conditions are, therefore, different from the actual operating conditions in almost all cases. If the actual operating conditions are the same as those at shipment, shutting down the inverter power automatically measures the discharging time; however, if they are different, no automatic measurement is performed. To perform it, put those conditions back to the factory default ones and shut down the inverter. For the measuring procedure, see [1] given below.
- To measure the capacitance of the DC link bus capacitor *under ordinary operating conditions* when the power is turned OFF, it is necessary to set up the load conditions for ordinary operation and measure the reference capacitance (initial setting) when the inverter is introduced. For the reference capacitance setup procedure, see [2] on the next page. Performing the setup procedure automatically detects and saves the measuring conditions of the DC link bus capacitor.

  Setting bit 3 of H98 data to 0 restores the inverter to the measurement in comparison with the initial capacitance measured at shipment.

Note When the inverter uses an auxiliary control power input, the load conditions widely differ so that the discharging time cannot be accurately measured. In this case, measuring of the discharging time can be disabled with the function code H98 (Bit 4 = 0) for preventing unintended measuring.

ON-time counting of DC link bus capacitor

- In a machine system where the inverter main power is rarely shut down, the inverter does not measure the discharging time. For such an inverter, the ON-time counting is provided. If the capacitance measurement is made, the inverter corrects the ON-time according to the capacitance measured.

  The ON-time counting result can be represented as "elapsed time" and "remaining time before the end of life."

[1] Measuring the capacitance of DC link bus capacitor in comparison with initial one at shipment

When bit 3 of H98 data is 0, the measuring procedure given below measures the capacitance of DC link bus capacitor in comparison with initial one at shipment when the power is turned OFF. The measuring result can be displayed on the keypad as a ratio (%) to the initial capacitance.

----------Capacitance measuring procedure----------

1) To ensure validity in the comparative measurement, put the condition of the inverter back to the state at factory shipment.
   - Remove the option card (if already in use) from the inverter.
   - In case another inverter is connected via the DC link bus to the P(+) and N(-) terminals of the main circuit, disconnect the wires. (You do not need to disconnect a DC reactor (optional), if any.)
   - Disconnect power wires for the auxiliary input to the control circuit (R0, T0).
   - In case the standard keypad has been replaced with an optional multi-function keypad after the purchase, put back the original standard keypad.
   - Turn OFF all the digital input signals fed to terminals [FWD], [REV], and [X1] through [X9] of the control circuit.
   - If a potentiometer is connected to terminal [13], disconnect it.
   - If an external apparatus is attached to terminal [PLC], disconnect it.

- Ensure that transistor output signals ([Y1] to [Y4]) and relay output signals ([Y5A] - [Y5C], and [30A/B/C]) will not be turned ON.
- Disable the RS-485 communications link.

Note If negative logic is specified for the transistor output and relay output signals, they are considered ON when the inverter is not running. Specify positive logic for them.

- Keep the surrounding temperature within 25 ±10°C.

2) Turn ON the main circuit power.
3) Confirm that the cooling fan is rotating and the inverter is in stopped state.
4) Turn OFF the main circuit power.
5) The inverter automatically starts the measurement of the capacitance of the DC link bus capacitor. Make sure that " . . . . " appears on the LED monitor.

Note If " . . . . " does not appear on the LED monitor, the measurement has not started. Check the conditions listed in 1).

6) After " . . . . " has disappeared from the LED monitor, turn ON the main circuit power again.
7) Select Menu #5 "Maintenance Information" in Programming mode and note the reading (relative capacitance (%) of the DC link bus capacitor).

---

[2] Measuring the capacitance of DC link bus capacitor under ordinary operating conditions

When bit 3 of H98 data is 1, the inverter automatically measures the capacitance of the DC link bus capacitor under ordinary operating conditions when the power is turned OFF. This measurement requires setting up the load conditions for ordinary operation and measuring the reference capacitance when the inverter is introduced to the practical operation, using the setup procedure given below.

Function code	Name	Data
H42	Capacitance of DC link bus capacitor	• Capacitance of DC link bus capacitor (measured value) • Start of initial capacitance measuring mode under ordinary operating conditions (0000) • Measurement failure (0001)
H47	Initial capacitance of DC link bus capacitor	• Initial capacitance of DC link bus capacitor (measured value) • Start of initial capacitance measuring mode under ordinary operating conditions (0000) • Measurement failure (0001)

When replacing parts, clear or modify the H42 and H47 data. For details, refer to the documents for maintenance.

---------- Reference capacitance setup procedure ----------

1) Set function code H98 (Protection/maintenance function) to enable the user to specify the judgment criteria for the service life of the DC link bus capacitor (Bit 3 = 1) (refer to function code H98).
2) Turn OFF all run commands.
3) Make the inverter ready to be turned OFF under ordinary operating conditions.
4) Set both function codes H42 (Capacitance of DC link bus capacitor) and H47 (Initial capacitance of DC link bus capacitor) to "0000."

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5) Turn OFF the inverter, and the following operations are automatically performed.

   The inverter measures the discharging time of the DC link bus capacitor and saves the result in function code H47 (Initial capacitance of DC link bus capacitor).

   The conditions under which the measurement has been conducted will be automatically collected and saved.

   During the measurement, " . . . . " will appear on the LED monitor.

6) Turn ON the inverter again.

   Confirm that H42 (Capacitance of DC link bus capacitor) and H47 (Initial capacitance of DC link bus capacitor) hold right values. Shift to Menu #5 "Maintenance Information" and confirm that the relative capacitance (ratio to full capacitance) is 100%.

Note If the measurement has failed, "0001" is entered into both H42 and H47. Remove the factor of the failure and conduct the measurement again.

Hereafter, each time the inverter is turned OFF, it automatically measures the discharging time of the DC link bus capacitor if the above conditions are met. Periodically check the relative capacitance of the DC link bus capacitor (%) with Menu #5 "Maintenance Information" in Programming mode.

Note The condition given above tends to produce a rather large measurement error. If this mode gives you a lifetime alarm, set H98 (Protection/maintenance function) back to the default setting (Bit 3 (Select life judgment threshold of DC link bus capacitor) = 0) and conduct the measurement under the condition at the time of factory shipment.

■ Cumulative Run Time of Capacitors on Printed Circuit Boards (H48)

Function code	Name	Description
H48	Cumulative run time of capacitors on printed circuit boards	Displays the cumulative run time of capacitor on the printed circuit board in units of ten hours. • Data setting range: 0 to 9999 (0 to 99990 hours)

When replacing capacitors on printed circuit boards, clearing or modifying H48 data is required. For details, refer to the materials for maintenance.

■ Cumulative Run Time of Cooling Fan (H43)

Function code	Name	Description
H43	Cumulative run time of cooling fan	Displays the cumulative run time of cooling fan in units of ten hours. • Data setting range: 0 to 9999 (0 to 99990 hours)

When replacing the cooling fan, clearing or modifying H43 data is required. For details, refer to the maintenance related documents.

H44 Startup Counter for Motor 1

H44 counts the number of inverter startups and displays it in hexadecimal format. Check the displayed number on the maintenance screen of the keypad, and use it as a guide for maintenance timing for parts such as belts. To start the counting over again, e.g. after a belt replacement, set the H44 data to "0000."

H45	Mock Alarm	H97 (Clear Alarm Data)

H45 causes the inverter to generate a mock alarm in order to check whether external sequences function correctly at the time of machine setup.

Setting the H45 data to "1" displays mock alarm Er-1 on the LED monitor. It also issues alarm output (for any alarm) ***ALM*** (if assigned to a digital output terminal by any of E20 to E24 and E27). (Accessing the H45 data requires simultaneous keying of "STOP key + ∧ key.") After that, the H45 data automatically reverts to "0," allowing you to reset the alarm.

Just as data (alarm history and relevant information) of those alarms that could occur in running the inverter, the inverter saves mock alarm data, enabling you to confirm the mock alarm status.

To clear the mock alarm data, use H97. (Accessing the H97 data requires simultaneous keying of "STOP key + ∧ key.") H97 data automatically returns to "0" after clearing the alarm data.

Tip A mock alarm can be issued also by simultaneous keying of "STOP key + FUNC/DATA key" on the keypad for 5 seconds or more.

H46	Starting Mode (Auto search delay time 2)	(Refer to H09.)

For details, refer to the description of H09.

H47, H48	Initial Capacitance of DC Link Bus Capacitor Cumulative Run Time of Capacitors on Printed Circuit Boards	(Refer to H42.)

For details, refer to the description of H42.

H49	Starting Mode (Auto search delay time 1)	(Refer to H09.)

For details, refer to the description of H09.

H50, H51 H52, H53	Non-linear V/f Pattern 1 (Frequency and Voltage) Non-linear V/f Pattern 2 (Frequency and Voltage)	(Refer to F04.)

For details, refer to the description of F04.

H54, H55 H56 H57 to H60	Acceleration Time, Deceleration Time Deceleration Time for Forced Stop 1st/2nd S-curve Acceleration/Deceleration Range	(Refer to F07.)

For details, refer to the description of F07.

H61	*UP/DOWN* Control (Initial frequency setting)	(Refer to F01.)

For details, refer to the description of F01.

Function Code Details
F codes
E codes
C codes
P codes
H42-H61
A codes
b codes
r codes
J codes
d codes
—
y codes

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H63 Low Limiter (Mode selection) (Refer to F15.)

For details, refer to the description of F15.

H64 Low Limiter (Lower limiting frequency)

H64 specifies the lower limit of frequency to be applied when the current limiter, torque limiter, automatic deceleration (anti-regenerative control), or overload prevention control is activated. Normally, it is not necessary to change this data.

- Data setting range: 0.0 to 60.0 (Hz)

H65, H66 Non-linear V/f Pattern 3 (Frequency and Voltage) (Refer to F04.)

For details, refer to the description of F04.

H67 Auto Energy Saving Operation (Mode selection) (Refer to F37.)

For details, refer to the description of F37.

H68 Slip Compensation 1 (Operating conditions) (Refer to F42.)

For details, refer to the description of F42.

H69 Automatic Deceleration (Mode selection)

H76 (Torque Limiter, Frequency increment limit for braking)

H69 enables or disables the anti-regenerative control.

In the inverter not equipped with a PWM converter or braking unit, if the regenerative energy returned exceeds the inverter's braking capability, an overvoltage trip occurs.

To avoid such an overvoltage trip, enable the automatic deceleration (anti-regenerative control) with this function code, and the inverter controls the output frequency to keep the braking torque at around 0 N·m in both the deceleration and constant speed running phases.

Data for H69	Function	
	Control mode	Force-to-stop with actual deceleration time exceeding three times the specified one
0	Disable automatic deceleration	—
2	Torque limit control	Enable
3	DC link bus voltage control	Enable
4	Torque limit control	Disable
5	DC link bus voltage control	Disable

FRENIC-MEGA series of inverters have two braking control modes; torque limit control and DC link bus voltage control. Understand the feature of each control and select the suitable one.

Control mode	Control process	Operation mode	Features
Torque limit control (H69=2 or 4)	Controls the output frequency to keep the braking torque at around "0."	Enabled during acceleration, running at the constant speed, and deceleration.	Quick response. Causes less overvoltage trip with heavy impact load.
DC link bus voltage control (H69=3 or 5)	Control the output frequency to lower the DC link bus voltage if the voltage exceeds the limiting level.	Enabled during deceleration. Disabled during running at the constant speed.	Shorter deceleration time by making good use of the inverter's regenerative capability.

■ Torque Limiter (Frequency increment limit for braking) (H76)

- Data setting range: 0.0 to 500.0 (Hz)

Since increasing the output frequency too much in the torque limit control mode is dangerous, the inverter has a torque limiter (Frequency increment limit for braking) that can be specified by H76. The torque limiter limits the inverter's output frequency to less than "Reference frequency + H76 setting."

Note that the torque limiter activated restrains the anti-regenerative control, resulting in an overvoltage trip in some cases. Increasing the H76 data (0.0 to 500.0 Hz) improves the anti-regenerative control capability.

In addition, during deceleration triggered by turning the run command OFF, the anti-regenerative control increases the output frequency so that the inverter may not stop the load depending on the load state (huge moment of inertia, for example). To avoid that, H69 provides a choice of cancellation of the anti-regenerative control to apply when three times the specified deceleration time is elapsed, thus decelerating the motor forcibly.

Note

- Enabling the automatic deceleration (anti-regenerative control) may automatically increase the deceleration time.
- When a braking unit is connected, disable the anti-regenerative control. The automatic deceleration control may be activated at the same time when a braking unit starts operation, which may make the deceleration time fluctuate.
- If the set deceleration time is too short, the DC link bus voltage of the inverter rises quickly, and consequently, the automatic deceleration may not follow the voltage rise. In such a case, specify a longer deceleration time.

H70 Overload Prevention Control

H70 specifies the decelerating rate of the output frequency to prevent a trip from occurring due to an overload. This control decreases the output frequency of the inverter before the inverter trips due to a heat sink overheat or inverter overload (with an alarm indication of $\mathit{OH1}$ or $\mathit{OL1}$, respectively). It is useful for equipment such as pumps where a decrease in the output frequency leads to a decrease in the load and it is necessary to keep the motor running even when the output frequency drops.

Data for H70	Function
0.00	Decelerate the motor by deceleration time 1 (F08) or 2 (E11)
0.01 to 100.0	Decelerate the motor by deceleration rate from 0.01 to 100.0 (Hz/s)
999	Disable overload prevention control

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■ Overload prevention control -- ***OLP***
(E20 to E24 and E27, data = 36)

This output signal comes ON when the overload prevention control is activated and the output frequency changed.

Note In equipment where a decrease in the output frequency does not lead to a decrease in the load, the overload prevention control is of no use and should not be enabled.

H71 Deceleration Characteristics

Setting the H71 data to "1" enables forced brake control. If regenerative energy produced during the deceleration of the motor and returned to the inverter exceeds the inverter's braking capability, an overvoltage trip will occur. The forced brake control increases the motor energy loss during deceleration, increasing the deceleration torque.

Data for H71	Function
0	Disable
1	Enable

Note This function is aimed at controlling the torque during deceleration; it has no effect if there is a braking load.
Enabling the automatic deceleration (anti-regenerative control, H69 = 2 or 4) in the torque limit control mode disables the deceleration characteristics specified by H71.

H72 Main Power Down Detection (Mode selection)

H72 monitors the inverter alternate-current input power source, and disables the inverter operation if it is not established.

Data for H72	Function
0	Disable
1	Enable

In cases where the power is supplied via a PWM converter or the inverter is connected via the DC link bus, there is no alternate-current input. In such cases, set H72 data to "0," otherwise the inverter cannot operate.

Note If you use a single-phase power supply, contact your Fuji Electric representative.

H73 to H75 Torque Limiter (Operating conditions, Control target, and Target quadrants) (Refer to F40.)

For details about the operating conditions, refer to the description of F40.

H76 Torque Limiter (Frequency increment limit for braking) (Refer to H69.)

For details, refer to the description of H69.

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H77	Service Life of DC Link Bus Capacitor (Remaining time)

H77 displays the remaining time before the service life of DC link bus capacitor expires in units of ten hours.

At the time of a printed circuit board replacement, transfer the service life data of the DC link bus capacitor to the new board.

- Data setting range: 0 to 8760 (in units of ten hours, 0 to 87,600 hours)

H78 H94	Maintenance Interval (M1) Cumulative Motor Run Time 1

H78 (Maintenance interval (M1)) specifies the maintenance interval in units of ten hours.

The maximum setting is 9999 × 10 hours.

- Data setting range: 0 (Disable); 1 to 9999 (in units of ten hours)

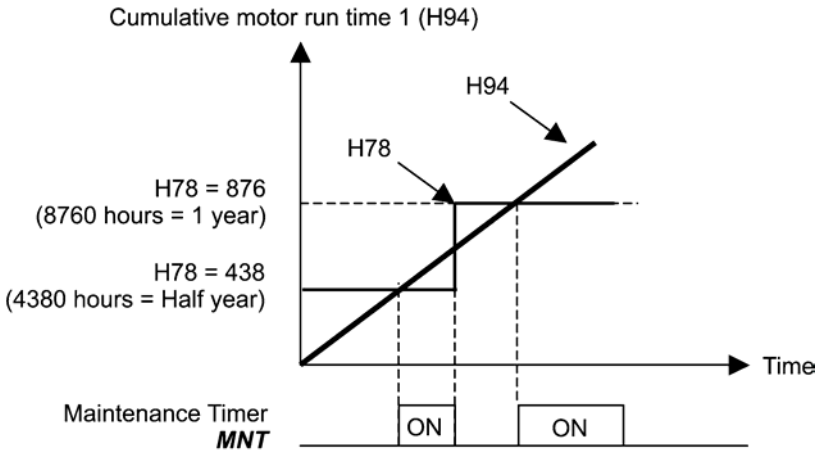
■ Maintenance timer -- ***MNT*** (E20 to E24 and E27, data = 84)

When the cumulative motor run time 1 (H94) reaches the time specified by H78 (Maintenance interval (M1)), the inverter outputs the maintenance timer signal ***MNT*** (if assigned to any digital terminal with any of E20 to E24 and E27) to remind the user of the need of the maintenance of the mechanical system.

■ Cumulative motor run time 1 (H94)

Operating the keypad can display the cumulative run time of motor 1. This feature is useful for management and maintenance of the mechanical system. H94 allows you to set the cumulative run time of the motor to the desired value, which enables setting an arbitrary initial data to determine a parts or inverter replacement timing. Specifying "0" clears the cumulative run time of the motor.

<Biannual maintenance>



Note After the current setting has expired, set a value for the next maintenance in H78 and press the FUNC DATA key so that the output signal is reset and counting restarts.
This function is exclusively applies to the 1st motor.

Function Code Details
F codes
E codes
C codes
P codes
H70-H94
A codes
b codes
r codes
J codes
d codes
—
y codes

■ Count the run time of commercial power-driven motor 1, 2, 3 and 4
-- ***CRUN-M1***, ***CRUN-M2***, ***CRUN-M3*** and ***CRUN-M4***
(E01 to E09, data = 72, 73, 74 and 75)

Even when a motor is driven by commercial power, not by the inverter, it is possible to count the cumulative motor run time 1 to 4 (H94, A51, b51, r51) by detecting the ON/OFF state of the auxiliary contact of the magnetic contactor for switching to the commercial power line.

Note Check the cumulative motor run time with 5_23 on Menu #5 "Maintenance Information" of the keypad.

H79	**Preset Startup Count for Maintenance (M1)** **H44 (Startup Counter for Motor 1)**

H79 specifies the number of inverter startup times to determine the next maintenance timing, e.g., for replacement of a belt.

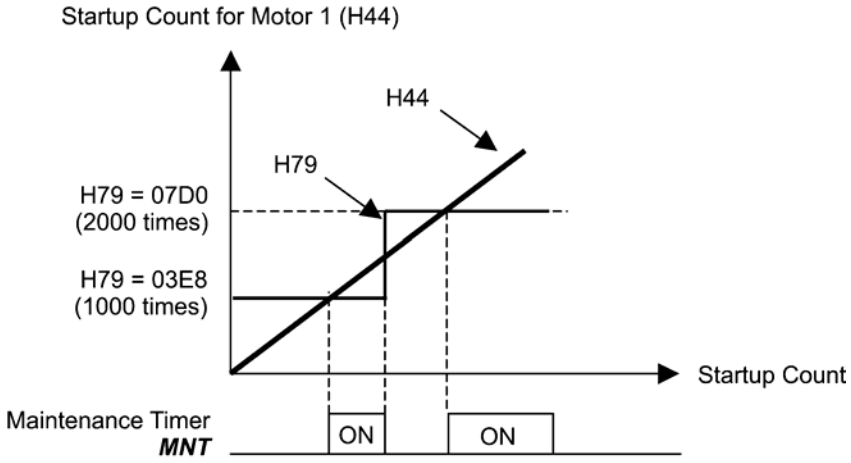
Set the H79 and H44 data in hexadecimal. The maximum setting count is 65,535 (FFFF in hexadecimal.)

- Data setting range: 0000 (Disable); 0001 to FFFF (Hexadecimal)

■ Maintenance timer -- ***MNT*** (E20 to E24 and E27, data = 84)

When the count of the startup counter for motor 1 (H44) reaches the number specified by H79 (Preset startup count for maintenance (M1)), the inverter outputs the maintenance timer signal ***MNT*** (if assigned to any digital terminal with any to E20 to E24 and E27) to remind the user of the need of the maintenance of the mechanical system.

< Maintenance every 1,000 times of startups >



Note After the current setting has expired, set a value for the next maintenance in H79 and press the FUNC DATA key so that the output signal is reset and counting restarts. This function is exclusively applies to the 1st motor.

H80	**Output Current Fluctuation Damping Gain for Motor 1** **A41 (Output Current Fluctuation Damping Gain for Motor 2)**

The inverter output current driving the motor may fluctuate due to the motor characteristics and/or backlash in the machinery (load). Modifying the H80 data adjusts the controls in order to suppress such fluctuation. However, as incorrect setting of this gain may cause larger current fluctuation, do not modify the default setting unless it is necessary.

- Data setting range: 0.00 to 0.40

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H81, H82 Light Alarm Selection 1 and 2

If the inverter detects a minor abnormal state "light alarm", it can continue the current operation without tripping while displaying the "light alarm" indication L-AL on the LED monitor. In addition to the indication L-AL, the inverter blinks the KEYPAD CONTROL LED.

Function codes H81 and H82 specify which alarms should be categorized as "light alarm."

The table below lists alarms selectable as "light alarm."

Code	Name	Description
OH1	Heat sink overheat	Heat sink temperature increased to the trip level.
OH2	External alarm	An error that has occurred in peripheral equipment turned the external alarm signal ***THR*** ON.
OH3	Inverter internal overheat	The temperature inside the inverter abnormally has increased.
dbH	Braking resistor overheat	Estimated temperature of the coil in the braking resistor exceeded the allowable level.
OL1 to OL4	Overload of motor 1 through 4	Motor temperature calculated with the inverter output current reached the trip level.
Er-4	Option communications error	Communications error between the inverter and an option.
Er-5	Option error	An option judged that an error occurred.
Er-8 Er-P	RS-485 communications error (COM port 1) RS-485 communications error (COM port 2)	RS-485 communications error between the COM ports 1 and 2.
Er-E	Speed mismatch or excessive speed deviation	The deviation of the automatic speed regulator (between the commanded speed and the detected speed) is out of the specified range (d21) for the period specified by d22.
CoF	PID feedback wire break	The PID feedback signal wire(s) is broken.
FAL	DC fan locked	Failure of the air circulation DC fan inside the inverter. (200 V class: 45 kW or above. 400 V class: 75 kW or above.)
OL	Motor overload early warning	Early warning before a motor overload
OH	Heat sink overheat early warning	Early warning before a heat sink overheat trip
L-F	Lifetime alarm	It is judged that the service life of any one of the capacitors (DC link bus capacitors and electrolytic capacitors on the printed circuit boards) and cooling fan has expired. Or, failure of the air circulation DC fan inside the inverter. (200 V class: 45 kW or above. 400 V class: 75 kW or above.)
r-EF	Reference command loss detected	Analog frequency command was lost.
P-id	PID alarm	Warning related to PID control (absolute-value alarm or deviation alarm)
U-TL	Low torque output	Output torque drops below the low torque detection level for the specified period.
PTC	PTC thermistor activated	The PTC thermistor on the motor detected a temperature.
rTE	Inverter life (Cumulative run time)	The motor cumulative run time reached the specified level.
Cnt	Inverter life (Number of startups)	Number of startups reached the specified level.

Set data for selecting "light alarms" in hexadecimal. For details on how to select the codes, see the next page.

- Data setting range: 0000 to FFFF (Hexadecimal)

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■ Selecting light alarm factors

To set and display the light alarm factors in hexadecimal format, each light alarm factor has been assigned to bits 0 to 15 as listed in Tables 5.1 and 5.2. Set the bit that corresponds to the desired light alarm factor to "1." Table 5.3 shows the relationship between each of the light alarm factor assignments and the LED monitor display.

Table 5.4 gives the conversion table from 4-bit binary to hexadecimal.

Table 5.1 Light Alarm Selection 1 (H81), Bit Assignment of Selectable Factors

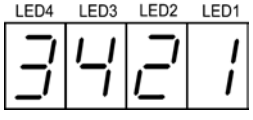
Bit	Code	Content	Bit	Code	Content
15	—	—	7	OL3	Overload of motor 3
14	—	—	6	OL2	Overload of motor 2
13	Er-P	RS-485 communications error (COM port 2)	5	OL 1	Overload of motor 1
12	Er-8	RS-485 communications error (COM port 1)	4	dbH	Braking resistor overheat
11	Er-5	Option error	3	—	—
10	Er-4	Option communications error	2	OH3	Inverter internal overheat
9	—	—	1	OH2	External alarm
8	OL 4	Overload of motor 4	0	OH 1	Heat sink overheat

Table 5.2 Light Alarm Selection 2 (H82), Bit Assignment of Selectable Factors

Bit	Code	Content	Bit	Code	Content
15	—	—	7	L IF	Lifetime alarm
14	—	—	6	OH	Heat sink overheat early warning
13	CnT	Inverter life (Number of startups)	5	OL	Motor overload early warning
12	rTE	Inverter life (Cumulative run time)	4	FAL	DC fan locked
11	PTC	PTC thermistor activated	3	CoF	PID feedback wire break
10	LTL	Low torque output	2	—	—
9	P id	PID alarm	1	—	—
8	rEF	Reference command loss detected	0	Er-E	Speed mismatch or excessive speed deviation

Table 5.3 Display of Light Alarm Factor

(Example) Light alarm factors "RS-485 communications error (COM port 2)," "RS-485 communications error (COM port 1)," "Option communications error," "Overload of motor 1" and "Heat sink overheat" are selected by H81.

LED No.		LED4				LED3				LED2				LED1			
Bit		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Code		—	—	Er-P	Er-8	Er-5	Er-4	—	OL4	OL3	OL2	OL 1	dbH	—	OH3	OH2	OH 1
Example	Binary	0	0	1	1	0	1	0	0	0	0	1	0	0	0	0	1
	Hexa-decimal (See Table 5.4.)	3				4				2				1			
	Hexa-decimal on the LED monitor																

■ Hexadecimal expression

A 4-bit binary number can be expressed in hexadecimal format (1 hexadecimal digit). The table below shows the correspondence between the two notations. The hexadecimals are shown as they appear on the LED monitor.

Table 5.4 Binary and Hexadecimal conversion

Binary				Hexadecimal	Binary				Hexadecimal
0	0	0	0	0	1	0	0	0	8
0	0	0	1	1	1	0	0	1	9
0	0	1	0	2	1	0	1	0	A
0	0	1	1	3	1	0	1	1	b
0	1	0	0	4	1	1	0	0	C
0	1	0	1	5	1	1	0	1	d
0	1	1	0	6	1	1	1	0	E
0	1	1	1	7	1	1	1	1	F

Note When H26 = 1 (PTC (The inverter immediately trips with 0.44 displayed)), if the PTC thermistor is activated, the inverter stops without displaying L-AL, blinking the KEYPAD CONTROL LED, or outputting ***L-ALM*** signal, regardless of the assignment of bit 11 (PTC thermistor activated) by H82 (Light Alarm Selection 2).

■ Light alarm--***L-ALM*** (E20 to E24 and E27, data = 98)

This output signal comes ON when a light alarm occurs.

H84, H85 Pre-excitation (Initial level, Time)

A motor generates torque with magnetic flux and torque current. Lag elements of the rising edge of magnetic flux causes a phenomenon in which enough torque is not generated at the moment of the motor start. To obtain enough torque even at the moment of motor start, enable the pre-excitation with H84 and H85 so that magnetic flux is established before a motor start.

■ Pre-excitation (Initial level) (H84)

H84 specifies the forcing function for the pre-excitation. It is used to shorten the pre-excitation time. Basically, there is no need to modify the default setting.

- Data setting range: 100 to 400 (%)

■ Pre-excitation (Time) (H85)

H85 specifies the pre-excitation time before starting operation.

- Data setting range: 0.00 (Disable), 0.01 to 30.00 (s)

When a run command is inputted, the pre-excitation starts.

After the pre-excitation time specified by H85 has elapsed, the inverter judges magnetic flux to have been established and starts acceleration.

Specify H85 data so that enough time is secured for establishing magnetic flux. The appropriate value for H85 data depends on the motor capacity. Use the default setting value of H13 data as a guide.

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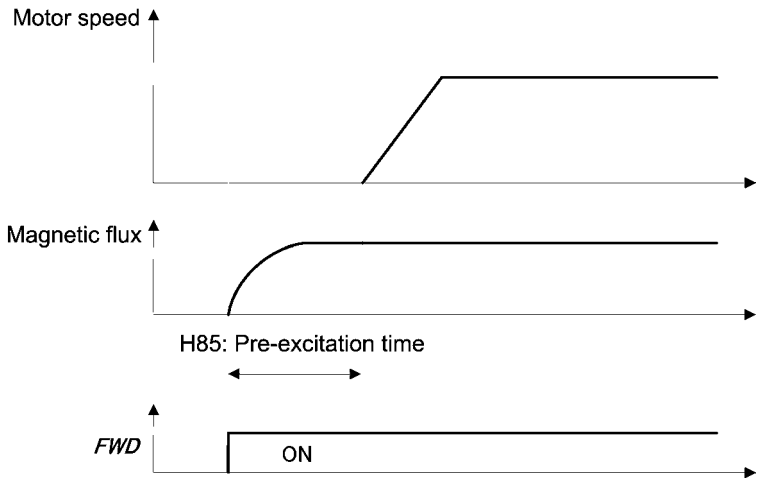
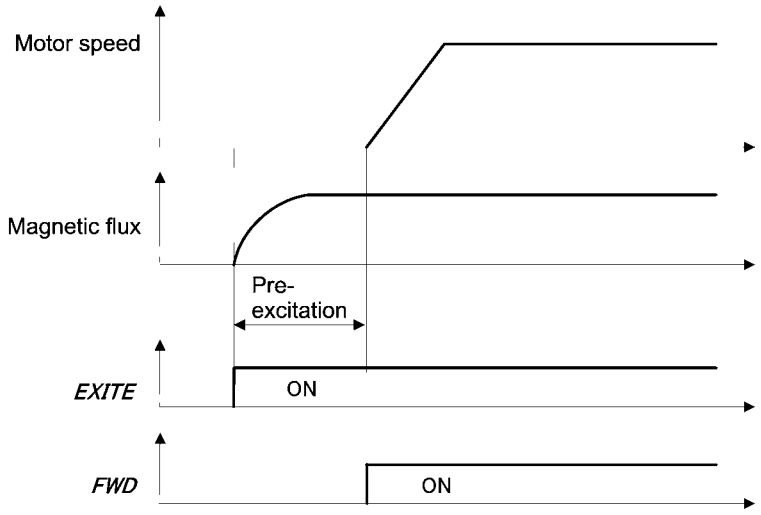


■ Pre-excitation--***EXITE*** (E01 to E09, data = 32)

When this input signal comes ON, pre-excitation starts.

After the delay time for establishing magnetic flux has elapsed, a run command is inputted. When the run command is inputted, the pre-excitation ends and acceleration starts.

Use an external sequence to control the time for establishing magnetic flux.



Note In V/f control (including auto torque boost and torque vector), pre-excitation is disabled. Use the DC braking or the starting frequency instead.

Note A transient phenomenon, which may occur when the loss of the machinery (load) is small, may rotate the motor during pre-excitation. If a motor rotation during pre-excitation is not allowed in your system, install a mechanical brake or other mechanism to stop the motor.

⚠WARNING
Even if the motor is stopped by pre-excitation, voltage is output to inverter's output terminals U, V, and W. **An electric shock may occur.**

H86 to H90	Reserved

H86 to H90 are reserved for particular manufacturers. Do not modify the settings.

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H91 PID Feedback Wire Break Detection

Using the terminal [C1] (current input) for PID feedback signal enables wire break detection and alarm (Er8) issuance. H91 specifies whether the wire break detection is enabled, or the duration of detection. (The inverter judges an input current to the terminal [C1] below 2 mA as a wire break.)

- Data setting range: 0.0 (Disable alarm detection)
  0.1 to 60.0 s (Detect wire break and issue Er8 alarm within the time)

H92, H93 Continuity of Running (P and I) (Refer to F14.)

Refer to the description of F14.

H94 Cumulative Motor Run Time 1 (Refer to H78.)

Refer to the description of H78.

H95 DC Braking (Braking response mode) (Refer to F20 through F22.)

Refer to the descriptions of F20 through F22.

H96 STOP Key Priority/Start Check Function

H96 specifies a functional combination of "STOP key priority" and "Start check function" as listed below.

Data for H96	STOP key priority	Start check function
0	Disable	Disable
1	Enable	Disable
2	Disable	Enable
3	Enable	Enable

■ STOP key priority

Even when run commands are entered from the digital input terminals or via the RS-485 communications link (link operation), pressing the STOP key forces the inverter to decelerate and stop the motor. After that, Er5 appears on the LED monitor.

■ Start check function

For safety, this function checks whether any run command has been turned ON or not in each of the following situations. If one has been turned ON, the inverter does not start up but displays alarm code Er5 on the LED monitor.

- When the power to the inverter is turned ON.
- When the PRG/RESET key is pressed to release an alarm status or when the digital input terminal command ***RST*** ("Reset alarm") is turned ON.
- When the run command source is switched by a digital input terminal command such as ***LE*** ("Enable communications link via RS-485 or fieldbus") or ***LOC*** ("Select local (keypad) operation").

H97 Clear Alarm Data — H45 (Mock Alarm)

H97 clears alarm data (alarm history and relevant information) stored in the inverter. To clear alarm data, simultaneous keying of "STOP key + ∧ key" is required.

Data for H97	Function
0	Disable
1	Enable (Setting "1" clears alarm data and then returns to "0.")

H98 Protection/Maintenance Function (Mode selection)

H98 specifies whether to enable or disable automatic lowering of carrier frequency, input phase loss protection, output phase loss protection, judgment threshold on the life of DC link bus capacitor, judgment on the life of DC link bus capacitor, DC fan lock detection, braking transistor error detection, and IP20/IP40 switching, in combination (Bit 0 to Bit 7).

Automatic lowering of carrier frequency (Bit 0)

This function should be used for important machinery that requires keeping the inverter running.

Even if a heat sink overheat or overload occurs due to excessive load, abnormal ambient temperature, or cooling system failure, enabling this function lowers the carrier frequency to avoid tripping (*OH1*, *OH3* or *OLU*). Note that enabling this function results in increased motor noise.

Input phase loss protection (*LIN*) (Bit 1)

Upon detection of an excessive stress inflicted on the apparatus connected to the main circuit due to phase loss or line-to-line voltage unbalance in the three-phase power supplied to the inverter, this protection feature stops the inverter and displays an alarm *LIN*.

Note In configurations where only a light load is driven or a DC reactor is connected, phase loss or line-to-line voltage unbalance may not be detected because of the relatively small stress on the apparatus connected to the main circuit.

Output phase loss protection (*OPL*) (Bit 2)

Upon detection of output phase loss while the inverter is running, this feature stops the inverter and displays an alarm *OPL*.

Note Where a magnetic contactor is installed in the inverter output circuit, if the magnetic contactor goes OFF during operation, all the phases will be lost. In such a case, this protection feature does not work.

Judgment threshold on the life of DC link bus capacitor (Bit 3)

Bit 3 is used to select the threshold for judging the life of the DC link bus capacitor between the factory default setting and a user-defined setting.

Note Before specifying a user-defined threshold, measure and confirm the reference level in advance. 📖 Refer to H42.

Judgment on the life of DC link bus capacitor (Bit 4)

Whether the DC link bus capacitor has reached its life is judged by measuring the discharging time after power OFF. The discharging time is determined by the capacitance of the DC link bus capacitor and the load inside the inverter. Therefore, if the load inside the inverter fluctuates significantly, the discharging time cannot be accurately measured, and as a result, it may be mistakenly determined that the DC link bus capacitor has reached the end of its life. To avoid such an error, you can disable the judgment based on the discharging time. (Even if it is disabled, the judgment based on the "ON-time counting" while the voltage is applied to the DC link bus capacitor is continued.)

📖 For details about the life prediction function, refer to H42.

Since load may fluctuate significantly in the following cases, disable the judgment on the life during operation. During periodical maintenance, either conduct the measurement with the judgment enabled under appropriate conditions or conduct the measurement under the operating conditions matching the actual ones.

- Auxiliary input for control power is used.
- An option card is used.
- Another inverter or equipment such as a PWM converter is connected to terminals of the DC link bus.

DC fan lock detection (Bit 5)
(200 V class series: 45 kW or above, 400 V class series: 75 kW or above)

An inverter of 45 kW or above (200 V class series), or of 75 kW or above (400 V class series) is equipped with the internal air circulation DC fan. When the inverter detects that the DC fan is locked by a failure or other cause, you can select either continuing the inverter operation or having the inverter enter into the alarm state.

Entering alarm state: The inverter issues the alarm 0H1 and allows the motor to coast to a stop.

Continuing operation: The inverter does not enter the alarm state and continues to run the motor.

Note that, however, the inverter turns ON the ***OH*** and ***LIFE*** signals on the transistor output terminals whenever the DC fan lock is detected regardless of your selection.

Note If the ON/OFF control of the cooling fan is enabled (H06 = 1), the cooling fan may stop depending on the operating condition of the inverter. In this case, the DC fan lock detection feature is considered normal (e.g., the cooling fan is normally stopped by the stop fan command.) so that the inverter may turn OFF the ***LIFE*** or ***OH*** signal output, or enable to cancel the alarm 0H1, even if the internal air circulation DC fan is locked due to a failure etc. (When you start the inverter in this state, it automatically issues the run fan command. Then the inverter detects the DC fan lock state, and turns ON the ***LIFE*** or ***OH*** output or enters the alarm 0H1 state.)

Note that, operating the inverter with the DC fan being locked for a long time may shorten the service life of electrolytic capacitors on the PCBs due to local high temperature inside the inverter. Be sure to check with the ***LIFE*** signal etc., and replace the broken fan as soon as possible.

Braking transistor error detection (Bit 6) (dbA: 22 kW or below)

Upon detection of a built-in braking transistor error, this feature stops the inverter and displays an alarm dbA. Set data of this bit to "0" when the inverter does not use a braking transistor and there is no need of entering an alarm state.

Switch IP20/IP40 enclosure (Bit 7) (for basic type of inverters with a capacity of 22 kW or below)

Mounting an IP40 option to inverters with a capacity of 22 kW or below enables them to conform to IP40. In such a case, switch Bit 7 to "1" for the protection coordination. For details, refer to the instruction manual of the IP40 option.

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To set data of function code H98, assign the setting of each function to each bit and then convert the 8-bit binary to the decimal number.

Refer to the assignment of each function to each bit and a conversion example below.

Bit	Function	Bit data = 0	Bit data = 1	Factory default
0	Lower the carrier frequency automatically	Disable	Enable	1: Enable
1	Detect input phase loss	Continue to run	Enter alarm processing	1: Enter alarm processing
2	Detect output phase loss	Continue to run	Enter alarm processing	0: Continue to run
3	Select life judgment threshold of DC link bus capacitor	Factory default	User-defined setting	0: Factory default
4	Judge the life of DC link bus capacitor	Disable	Enable	1: Enable
5	Detect DC fan lock	Enter alarm processing	Continue to run	0: Enter alarm processing
6	Detect braking transistor error	Continue to run	Enter alarm processing	1: Enter alarm processing
7	Switch IP20/IP40 enclosure	IP20	IP40	0: IP20

An example of conversion from binary to decimal (for the number configured by the factory default setting shown above)

$$\begin{aligned}\text{Decimal} &= \text{Bit } 7 \times 2^7 + \text{Bit } 6 \times 2^6 + \text{Bit } 5 \times 2^5 + \text{Bit } 4 \times 2^4 + \text{Bit } 3 \times 2^3 + \text{Bit } 2 \times 2^2 + \text{Bit } 1 \times 2^1 + \text{Bit } 0 \times 2^0 \\ &= \text{Bit } 7 \times 128 + \text{Bit } 6 \times 64 + \text{Bit } 5 \times 32 + \text{Bit } 4 \times 16 + \text{Bit } 3 \times 8 + \text{Bit } 2 \times 4 + \text{Bit } 1 \times 2 + \text{Bit } 0 \times 1 \\ &= 0 \times 128 + 1 \times 64 + 0 \times 32 + 1 \times 16 + 0 \times 8 + 0 \times 4 + 1 \times 2 + 1 \times 1 \\ &= 64 + 16 + 2 + 1 \\ &= 83\end{aligned}$$

5.4.6 A codes (Motor 2 parameters)
b codes (Motor 3 parameters)
r codes (Motor 4 parameters)

The FRENIC-MEGA can switch control parameters even when it is running so that a single inverter can drive four motors by switching them or turn the energy saving operation ON or OFF for the setup change (e.g., gear switching) that causes the moment of inertia of the machinery to change.

Function code	Motor to drive	Remarks
F/E/P and other codes	Motor 1	Including function codes commonly applied to motors 1 to 4.
A codes	Motor 2	
b codes	Motor 3	
r codes	Motor 4	

Note This manual describes function codes applied to motor 1 only. For ones applied to motors 2 to 4 except A42, b42, and r42 (Motor/Parameter Switching 2 to 4), refer to the corresponding function codes prepared for motor 1 in Table 5.5 on the next page.

A42, b42, r42

Motor/Parameter Switching 2, 3, 4 (Mode selection)
d25 (ASR Switching Time)

A42, b42 or r42 selects whether the combination of terminal commands ***M2***, ***M3*** and ***M4*** switches the actual motors (to the 2nd, 3rd, and 4th motors) or the particular parameters (A codes, b codes, or r codes).

Data for A42, b42 or r42	Function	Switching is possible:
0	Motor (Switch to the 2nd, 3rd or 4th motor)	Only when the inverter is stopped (all run commands are OFF).
1	Parameter (Switch to particular A codes, b codes or r codes)	Even when the inverter is running.

The combination of digital input terminal commands ***M2***, ***M3*** and ***M4*** switches to any of the 1st to 4th motors. When the motor is switched, the function code group with which the inverter drives the motor is also switched to the one corresponding to the motor.

Terminal command			Inverter-driven motor selected (Function code group enabled)	Output signals			
M2	***M3***	***M4***		***SWM1***	***SWM2***	***SWM3***	***SWM4***
OFF	OFF	OFF	1st motor (Default codes)	ON	OFF	OFF	OFF
ON	—	—	2nd motor (A codes)	OFF	ON	OFF	OFF
OFF	ON	—	3rd motor (b codes)	OFF	OFF	ON	OFF
OFF	OFF	ON	4th motor (r codes)	OFF	OFF	OFF	ON

Note From the point of view of signal timing, a combination of ***M2***, ***M3*** and ***M4*** must be determined at least 2 ms before the signal of a run command is established.

If A42, b42 or r42 is set to "0" (Motor (Switch to the 2nd, 3rd or 4th motor)), the combination of ***M2***, ***M3*** and ***M4*** switches the motor to any of the 2nd to 4th motors and also switches the function code group enabled to the one corresponding to the selected motor, as listed in Table 5.5. Note that, however, the functions listed in Table 5.6 are unavailable when any of the 2nd to 4th motors are selected.

If A42, b42 or r42 is set to "1" (Parameter (Switch to particular A codes, b codes or r codes)), the combination of ***M2***, ***M3*** and ***M4*** switches the particular parameters marked with Y in the "Object of parameter switching" column in Table 5.5. For other parameters, ones in the 1st motor column remain effective.

Table 5.5 Function Codes to be Switched

Name	Function code				Object of parameter switching
	1st motor	2nd motor	3rd motor	4th motor	
Maximum frequency	F03	A01	b01	r01	
Base frequency	F04	A02	b02	r02	
Rated voltage at base frequency	F05	A03	b03	r03	
Maximum output voltage	F06	A04	b04	r04	
Torque boost	F09	A05	b05	r05	
Electronic thermal overload protection for motor (Select motor characteristics)	F10	A06	b06	r06	
(Overload detection level)	F11	A07	b07	r07	
(Thermal time constant)	F12	A08	b08	r08	
DC braking (Braking starting frequency)	F20	A09	b09	r09	
(Braking level)	F21	A10	b10	r10	
(Braking time)	F22	A11	b11	r11	
Starting frequency	F23	A12	b12	r12	
Load selection/ Auto torque boost/ Auto energy saving operation	F37	A13	b13	r13	Y
Drive control selection	F42	A14	b14	r14	
Motor (No. of poles)	P01	A15	b15	r15	
(Rated capacity)	P02	A16	b16	r16	
(Rated current)	P03	A17	b17	r17	
(Auto-tuning)	P04	A18	b18	r18	
(No-load current)	P06	A20	b20	r20	
(%R1)	P07	A21	b21	r21	
(%X)	P08	A22	b22	r22	
(Slip compensation gain for driving)	P09	A23	b23	r23	Y
(Slip compensation response time)	P10	A24	b24	r24	Y
(Slip compensation gain for braking)	P11	A25	b25	r25	Y
(Rated slip frequency)	P12	A26	b26	r26	
(Iron loss factor 1)	P13	A27	b27	r27	
(Iron loss factor 2)	P14	A28	b28	r28	
(Iron loss factor 3)	P15	A29	b29	r29	
(Magnetic saturation factor 1)	P16	A30	b30	r30	
(Magnetic saturation factor 2)	P17	A31	b31	r31	
(Magnetic saturation factor 3)	P18	A32	b32	r32	
(Magnetic saturation factor 4)	P19	A33	b33	r33	
(Magnetic saturation factor 5)	P20	A34	b34	r34	
(Magnetic saturation extension factor "a")	P21	A35	b35	r35	
(Magnetic saturation extension factor "b")	P22	A36	b36	r36	
(Magnetic saturation extension factor "c")	P23	A37	b37	r37	

Table 5.5 Function Codes to be Switched (continued)

Name	Function code				Object of parameter switching
	1st motor	2nd motor	3rd motor	4th motor	
Motor selection	P99	A39	b39	r39	
Slip compensation (Operating conditions)	H68	A40	b40	r40	Y
Output current fluctuation damping gain for motor	H80	A41	b41	r41	Y
Speed control (Speed command filter)	d01	A43	b43	r43	Y
(Speed detection filter)	d02	A44	b44	r44	Y
P (Gain)	d03	A45	b45	r45	Y
I (Integral time)	d04	A46	b46	r46	Y
(Output filter)	d06	A48	b48	r48	Y
(Notch filter resonance frequency)	d07	A49	b49	r49	
(Notch filter attenuation level)	d08	A50	b50	r50	
Cumulative motor run time	H94	A51	b51	r51	
Startup counter for motor	H44	A52	b52	r52	
Motor (%X correction factor 1)	P53	A53	b53	r53	
(%X correction factor 2)	P54	A54	b54	r54	
(Torque current under vector control)	P55	A55	b55	r55	
(Induced voltage factor under vector control)	P56	A56	b56	r56	
Reserved for particular manufacturers	d51	d52	d53	d54	
	P57	A57	b57	r57	

Table 5.6 Function Codes Unavailable for the 2nd to 4th Motors

Name	Function codes	Operation in 2nd to 4th motors
Non-linear V/f pattern	H50 to H53, H65, H66	Disabled
Starting frequency 1 (Holding time)	F24	Disabled
Stop frequency (Holding time)	F39	Disabled
Overload early warning/ Current detection	E34 and E35	Disabled
Droop control	H28	Disabled
UP*/*DOWN control	H61	Fixed at the initial setting (0 Hz)
PID control	J01 to J06, J08 to J13, J15 to J19, J56 to J62, E40, E41, H91	Disabled
Dew condensation prevention	J21, F21, F22	Disabled
Brake signal	J68 to J72, J95 and J96	Disabled
Current limiter	F43 and F44	Disabled
Rotational direction limitation	H08	Disabled
Pre-excitation	H84 and H85	Disabled
Maintenance Interval/ Preset Startup Count for Maintenance	H78 and H79	Disabled
NTC thermistor	H26 and H27	Disabled
Starting Mode (Auto search delay time 2)	H46	Disabled

■ ASR Switching Time (d25)

Parameter switching is possible even during operation. For example, speed control P (Gain) and I (Integral time) listed in Table 5.5 can be switched. Switching these parameters during operation may cause an abrupt change of torque and result in a mechanical shock, depending on the driving condition of the load. To reduce such a mechanical shock, the inverter decreases the abrupt torque change using the ramp function of ASR Switching Time (d25).

- Data setting range: 0.000 to 1.000 (s)

5.4.7 J codes (Application functions 1)

J01	PID Control (Mode selection)

Under PID control, the inverter detects the state of a control target object with a sensor or the similar device and compares it with the commanded value (e.g., temperature control command). If there is any deviation between them, the PID control operates so as to minimize it. That is, it is a closed loop feedback system that matches controlled variable (feedback amount). The PID control expands the application area of the inverter to the process control (e.g., flow control, pressure control, and temperature control) and the speed control (e.g., dancer control).

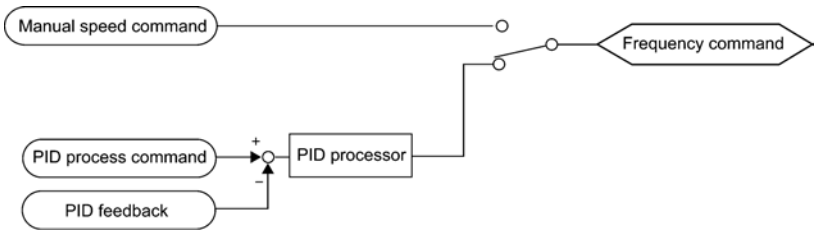
If PID control is enabled (J01 = 1, 2 or 3), the frequency control of the inverter is switched from the drive frequency command generator block to the PID command generator block.

■ Mode Selection (J01)

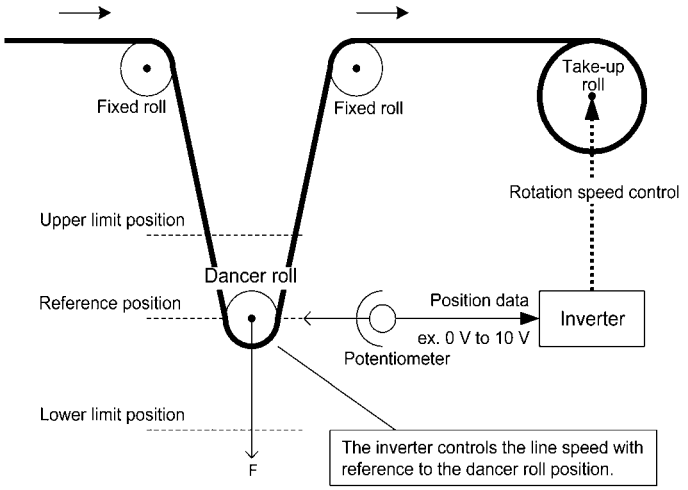
J01 selects the PID control mode.

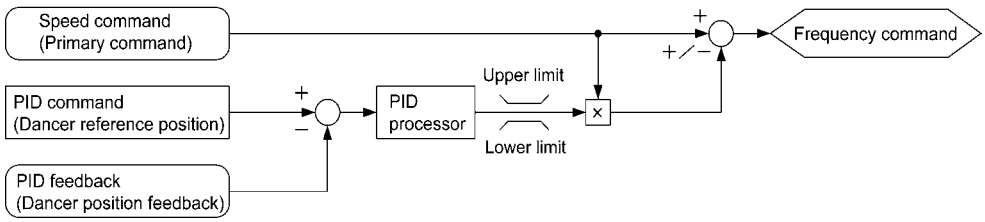
Data for J01	Function
0	Disable
1	Enable (Process control, normal operation)
2	Enable (Process control, inverse operation)
3	Enable (Dancer control)

PID process control block diagram



PID dancer control block diagram





- Using J01 enables switching between normal and inverse operations against the PID control output, so you can specify an increase/decrease of the motor rotating speed to the difference (error component) between the commanded (input) and feedback amounts, making it possible to apply the inverter to air conditioners. The terminal command ***IVS*** can also switch operation between normal and inverse.

For details about the switching of normal/inverse operation, refer to the description of Switch normal/inverse operation ***IVS*** (E01 to E09, data = 21).

J02 PID Control (Remote command *SV*)

J02 sets the source that specifies the command value (***SV***) under PID control.

Data for J02	Function
0	Keypad Specify the PID command by using the ⏶ / ⏷ keys on the keypad.
1	PID command 1 (Analog input: Terminals [12], [C1] and [V2]) Voltage input to the terminal [12] (0 to ±10 VDC, 100% PID command/ ±10 VDC) Current input to the terminal [C1] (4 to 20 mA DC, 100% PID command/ 20 mA DC Voltage input to the terminal [V2] (0 to ±10 VDC, 100% PID command/ ±10 VDC)
3	Terminal command ***UP***/***DOWN*** Using the ***UP*** or ***DOWN*** command in conjunction with PID display coefficients (specified by E40 and E41) with which the command value is converted into a physical quantity, etc., you can specify 0 to 100% of the PID command (± 100% for PID dancer control).
4	Command via communications link Use function code S13 that specifies the communications-linked PID command. The transmission data of 20000 (decimal) is equal to 100% (maximum frequency) of the PID command.

[1] PID command with the ⏶ / ⏷ keys on the keypad (J02 = 0, factory default)

Using the ⏶ / ⏷ keys on the keypad in conjunction with PID display coefficients (specified by E40 and E41), you can specify 0 to 100% of the PID command (±100% for PID dancer control) in an easy-to-understand, converted command format. For details of operation, refer to Chapter 7, Section 7.3.3 "Setting up frequency and PID commands."

[2] PID command by analog inputs (J02 = 1)

When any analog input (voltage input to terminals [12] and [V2], or current input to terminal [C1]) for PID command 1 (J02 = 1) is used, it is possible to arbitrary specify the PID command by multiplying the gain and adding the bias. The polarity can be selected and the filter time constant and offset can be adjusted. In addition to J02 setting, it is necessary to select PID command 1 for analog input (specified by any of E61 to E63, function code data = 3). For details, refer to the descriptions of E61 to E63.

Adjustable elements of PID command

Input terminal	Input range	Bias		Gain		Polarity	Filter time constant	Offset
		Bias	Base point	Gain	Base point			
[12]	0 to +10 V, -10 to +10V	C51	C52	C32	C34	C35	C33	C31
[C1]	4 to 20 mA			C37	C39	-	C38	C36
[V2]	0 to +10 V, -10 to +10 V			C42	C44	C45	C43	C41

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■ Offset (C31, C36, C41)

C31, C36 or C41 configures an offset for an analog voltage/current input. The offset also applies to signals sent from the external equipment.

■ Filter time constant (C33, C38, C43)

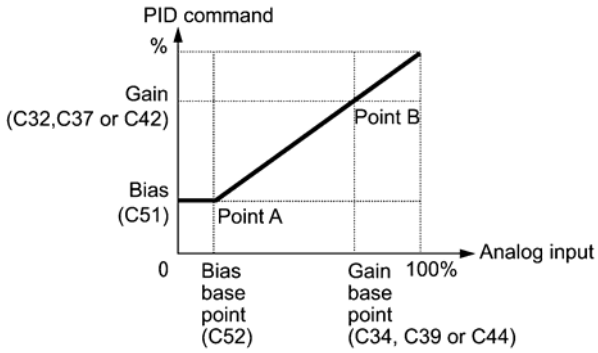
C33, C38, and C43 provide the filter time constants for the voltage and current of the analog input. Choose appropriate values for the time constants considering the response speed of the mechanical system, as large time constants slow down the response. If the input voltage fluctuates because of noise, specify large time constants.

■ Polarity (C35, C45)

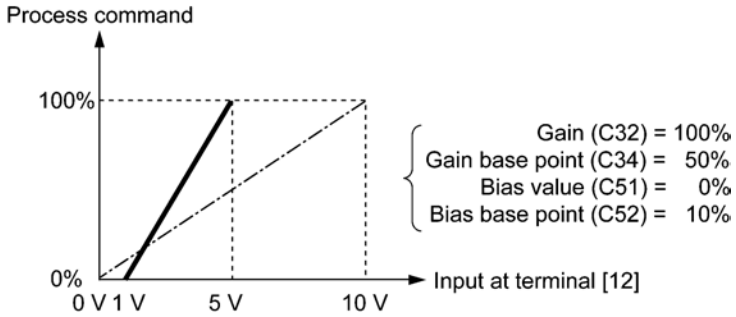
C35 and C45 specify the input range for analog input voltage.

Data for C35 and C45	Terminal input specifications
0	-10 to +10 V
1	0 to +10 V (negative value of voltage is regarded as 0 V)

■ Gain and bias



(Example) Mapping the range of 1 through 5 V at terminal [12] to 0 through 100%



[3] PID command with ***UP/DOWN*** control (J02 = 3)

When the ***UP/DOWN*** control is selected as a PID speed command, turning the terminal command ***UP*** or ***DOWN*** ON causes the PID speed command to change within the range from 0 to 100%.

The PID speed command can be specified in mnemonic physical quantities (such as temperature or pressure) with the PID display coefficients (E40, E41).

To select the ***UP/DOWN*** control as a PID speed command, the ***UP*** and ***DOWN*** should be assigned to the digital input terminals [X1] to [X9]. (🕮 E01 to E09, data = 17, 18)

UP	***DOWN***	Function
Data = 17	Data = 18	
OFF	OFF	Retain PID speed command value.
ON	OFF	Increase PID speed command value at a rate between 0.1%/0.1 s and 1%/0.1 s.
OFF	ON	Decrease PID speed command value at a rate between 0.1%/0.1 s and 1%/0.1 s.
ON	ON	Retain PID speed command value.

Note The inverter internally holds the PID command value set by the ***UP***/***DOWN*** control and applies the held value at the next restart (including powering ON).

[4] PID command via communications link (J02＝4)

Use function code S13 that specifies the communications-linked PID command. The transmission data of 20000 (decimal) is equal to 100% (maximum frequency) of the PID command. For details of the communications format, refer to the RS-485 Communication User's Manual (MEH448).

Note
- Other than the remote command selection by J02, the multi-frequency 4, 8 or 12 (specified by C08, C12 or C16, respectively) specified by terminal commands ***SS4*** and ***SS8*** can also be selected as a preset value for the PID command.

  Calculate the setting data of the PID command using the expression below.

$$\textbf{PID command data (\%)} = \frac{\textbf{Preset multi-frequency}}{\textbf{Maximum frequency}} \times \textbf{100}$$

- In dancer control (J01 = 3), the setting from the keypad interlocks with data of J57 (PID control: Dancer reference position), and is saved as function code data.

Function Code Details
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J02
d codes
—
y codes

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Selecting Feedback Terminals

For feedback control, determine the connection terminal according to the type of the sensor output.

- If the sensor is a current output type, use the current input terminal [C1] of the inverter.
- If the sensor is a voltage output type, use the voltage input terminal [12] of the inverter, or switch over the terminal [V2] to the voltage input terminal and use it.

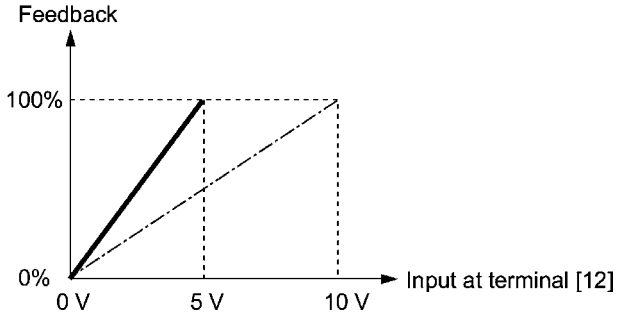
For details, refer to the descriptions of E61 through E63.

Application example: Process control (for air conditioners, fans and pumps)

The operating range for PID process control is internally controlled as 0% through 100%. For the given feedback input, determine the operating range to be controlled by means of gain adjustment.

Example: When the output level of the external sensor is within the range of 1 to 5 V:

- Use terminal [12] designed for voltage input.
- Set the gain (C32 for analog input adjustment) at 200% in order to make the maximum value (5 V) of the external sensor's output correspond to 100%. Note that the input specification for terminal [12] is 0 to 10 V corresponding to 0 to 100%; thus, a gain factor of 200% (= 10 V ÷ 5 V × 100) should be specified. Note also that any bias setting does not apply to feedback control.

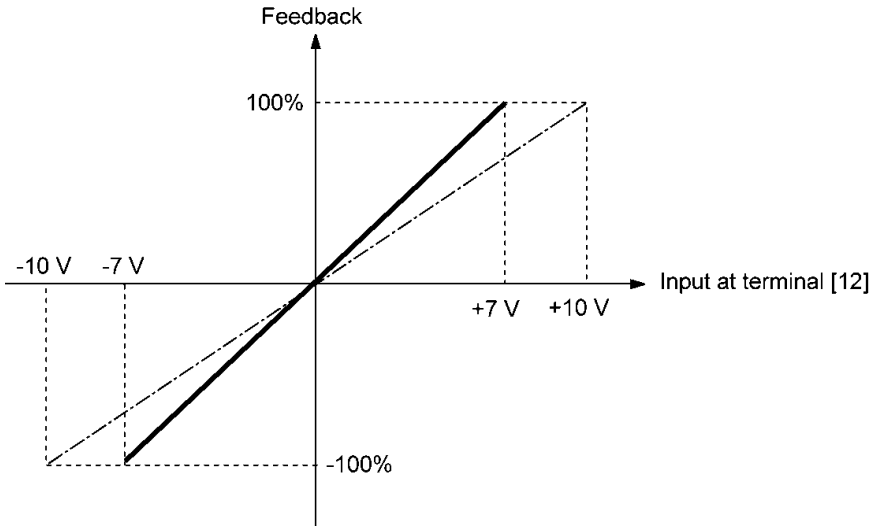


Application examples: Dancer control (for winders)

Example 1. When the output level of the external sensor is ±7 VDC:

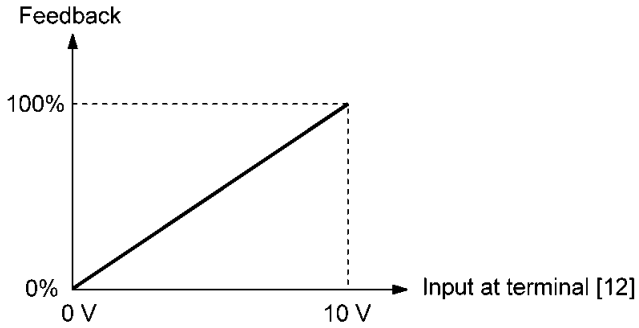
- Use terminal [12] since the voltage input is of bipolar.
- When the external sensor's output is of bipolar, the inverter controls the speed within the range of ±100%. To convert the output ±7 VDC to ±100%, set the gain (C32 for analog input adjustment) at 143% as calculated below.

$$\frac{10\ \text{V}}{7\ \text{V}} \approx 143\%$$



Example 2. When the output level of the external sensor is 0 to 10 VDC:

- Use terminal [12] designed for voltage input.
- When the external sensor's output is of unipolar, the inverter controls the speed within the range of 0 to 100%.



In this example, it is recommended that the dancer reference position be set around the +5 V (50%) point.

PID Display Coefficient and Monitoring

To monitor the PID command and its feedback value, set the display coefficient to convert the values into easy-to-understand physical quantities such as temperature.

Refer to function codes E40 and E41 for details on display coefficients, and to E43 for details on monitoring.

J03 to J06	PID Control (P (Gain), I (Integral time), D (Differential time), Feedback filter)

■ P gain (J03)

J03 specifies the gain for the PID processor.

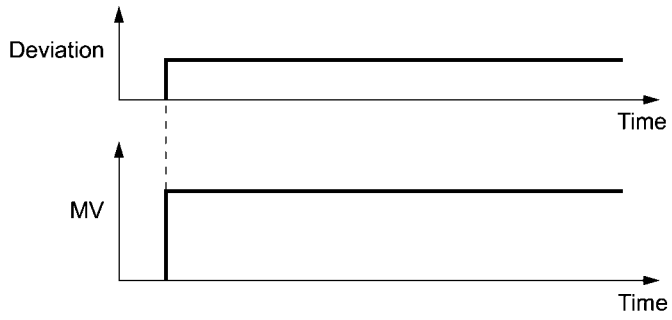
- Data setting range: 0.000 to 30.000 (times)

Function Code Details
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J02-J06
d codes
—
y codes

P (Proportional) action

An operation in which the MV (manipulated value: output frequency) is proportional to the deviation is called P action, which outputs the MV in proportion to deviation. However, the MV alone cannot eliminate deviation.

Gain is data that determines the system response level against the deviation in P action. An increase in gain speeds up response, but an excessive gain may oscillate the inverter output. A decrease in gain delays response, but it stabilizes the inverter output.



■ I integral time (J04)

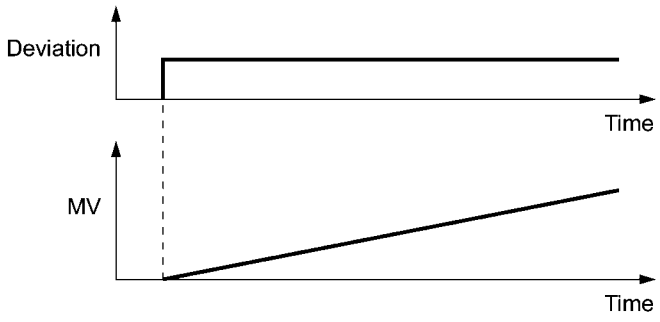
J04 specifies the integral time for the PID processor.

- Data setting range: 0.0 to 3600.0 (s)
  0.0 means that the integral component is ineffective.

I (Integral) action

An operation in which the change rate of the MV (manipulated value: output frequency) is proportional to the integral value of deviation is called I action, which outputs the MV that integrates the deviation. Therefore, I action is effective in bringing the feedback amount close to the commanded value. For the system whose deviation rapidly changes, however, this action cannot make it react quickly.

The effectiveness of I action is expressed by integral time as parameter, that is J04 data. The longer the integral time, the slower the response. The reaction to the external disturbance also becomes slow. The shorter the integral time, the faster the response. Setting too short integral time, however, makes the inverter output tend to oscillate against the external disturbance.



■ D differential time (J05)

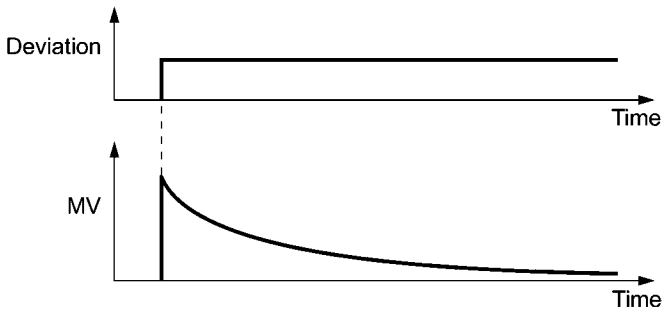
J05 specifies the differential time for the PID processor.

- Data setting range: 0.00 to 600.00 (s)
  0.00 means that the differential component is ineffective.

D (Differential) action

An operation in which the MV (manipulated value: output frequency) is proportional to the differential value of the deviation is called D action, which outputs the MV that differentiates the deviation. D action makes the inverter quickly react to a rapid change of deviation.

The effectiveness of D action is expressed by differential time as parameter, that is J05 data. Setting a long differential time will quickly suppress oscillation caused by P action when a deviation occurs. Too long differential time makes the inverter output oscillation more. Setting short differential time will weakens the suppression effect when the deviation occurs.



The combined uses of P, I, and D actions are described below.

(1) PI control

PI control, which is a combination of P and I actions, is generally used to minimize the remaining deviation caused by P action. PI control always acts to minimize the deviation even if a commanded value changes or external disturbance steadily occurs. However, the longer the integral time, the slower the system response to quick-changed control.

P action can be used alone for loads with very large part of integral components.

(2) PD control

In PD control, the moment that a deviation occurs, the control rapidly generates greater MV (manipulated value) than that generated by D action alone, to suppress the deviation increase. When the deviation becomes small, the behavior of P action becomes small.

A load including the integral component in the controlled system may oscillate due to the action of the integral component if P action alone is applied. In such a case, use PD control to reduce the oscillation caused by P action, for keeping the system stable. That is, PD control is applied to a system that does not contain any damping actions in its process.

(3) PID control

PID control is implemented by combining P action with the deviation suppression of I action and the oscillation suppression of D action. PID control features minimal control deviation, high precision and high stability.

In particular, PID control is effective to a system that has a long response time to the occurrence of deviation.

Follow the procedure below to set data to PID control function codes.

It is highly recommended that you adjust the PID control value while monitoring the system response waveform with an oscilloscope or equivalent. Repeat the following procedure to determine the optimal solution for each system.

- Increase the data of J03 (PID control P (Gain)) within the range where the feedback signal does not oscillate.
- Decrease the data of J04 (PID control I (Integral time)) within the range where the feedback signal does not oscillate.
- Increase the data of J05 (PID control D (Differential time)) within the range where the feedback signal does not oscillate.

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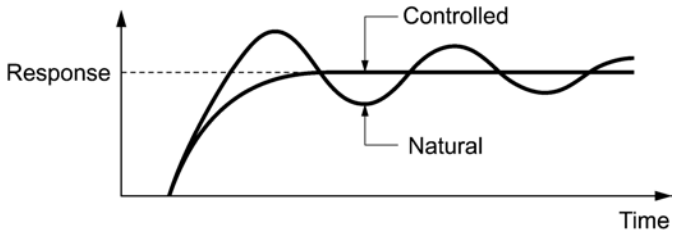
Refining the system response waveforms is shown below.

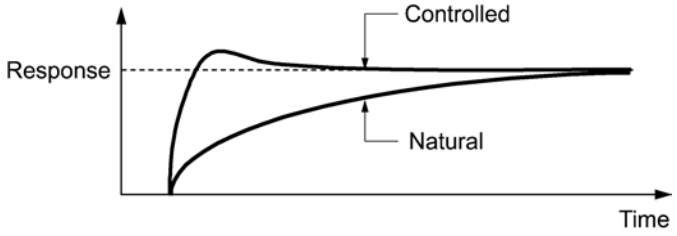
1) Suppressing overshoot

   Increase the data of J04 (Integral time) and decrease that of J05 (Differential time.)



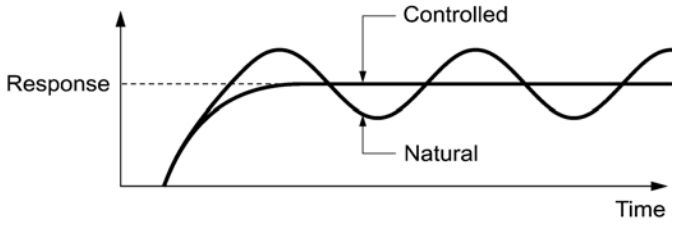
2) Quick stabilizing (moderate overshoot allowable)

   Decrease the data of J03 (Gain) and increase that of J05 (Differential time).



3) Suppressing oscillation whose period is longer than the integral time specified by J04

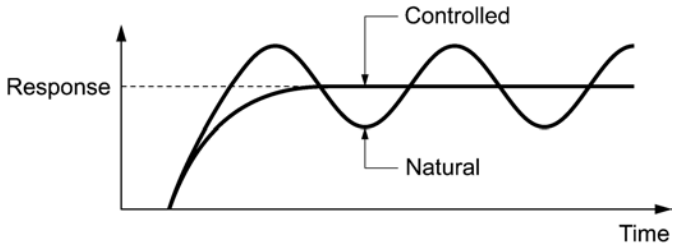
   Increase the data of J04 (Integral time).



4) Suppressing oscillation whose period is approximately the same as the time specified by J05 (Differential time)

   Decrease the data of J05 (Differential time).

   Decrease the data of J03 (Gain), if the oscillation cannot be suppressed even though the differential time is set at 0 sec.



■ Feedback filter (J06)

J06 specifies the time constant of the filter for feedback signals under PID control.

- Data setting range: 0.0 to 900.0 (s)
- This setting is used to stabilize the PID control loop. Setting too long a time constant makes the system response slow.

Note To specify the filter for feedback signals finely under PID dancer control, apply filter time constants for analog input (C33, C38 and C43).

J08, J09	PID Control (Pressurization starting frequency, pressurizing time) J15 (PID Control, Stop frequency for slow flowrate) J16 (PID Control, Slow flowrate level stop latency) J17 (PID Control, Starting frequency)

Slow flowrate stopping function (J15 to J17)

J15 to J17 configure the slow flowrate stopping function in pump control, a function that stops the inverter when the discharge pressure rises, causing the volume of water to decrease.

When the discharge pressure has increased, decreasing the reference frequency (output of the PID processor) below the stop frequency for slow flowrate level (J15) for the period of slow flowrate level stop latency (J16), the inverter decelerates to stop, while PID control itself continues to operate. When the discharge pressure decreases, increasing the reference frequency (output of the PID processor) above the starting frequency (J17), the inverter resumes operation.

■ PID control (Stop frequency for slow flowrate) (J15)

J15 specifies the frequency which triggers slow flowrate stop of inverter.

■ PID control (Slow flowrate level stop latency) (J16)

J16 specifies the period from when the PID output drops below the frequency specified by J15 until the inverter starts deceleration to stop.

■ PID control (Starting frequency) (J17)

J17 specifies the starting frequency. Set J17 to a frequency higher than the stop frequency for slow flowrate (J15). If the specified starting frequency is lower than the stop frequency for slow flowrate, the latter stop frequency is ignored; the slow flowrate stopping function is triggered when the output of the PID processor drops below the specified starting frequency.

■ Assignment of ***PID-STP*** ("Motor stopped due to slow flowrate under PID control") (E20 to E24 and E27, data = 44)

Assigning the digital output signal ***PID-STP*** to any of the programmable, output terminals with any of E20 through E24 and E27 (data = 44) enables the signal to output when the inverter stops due to the slow flowrate stopping function under PID control.

Function Code Details
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J03-J09
d codes
—
y codes

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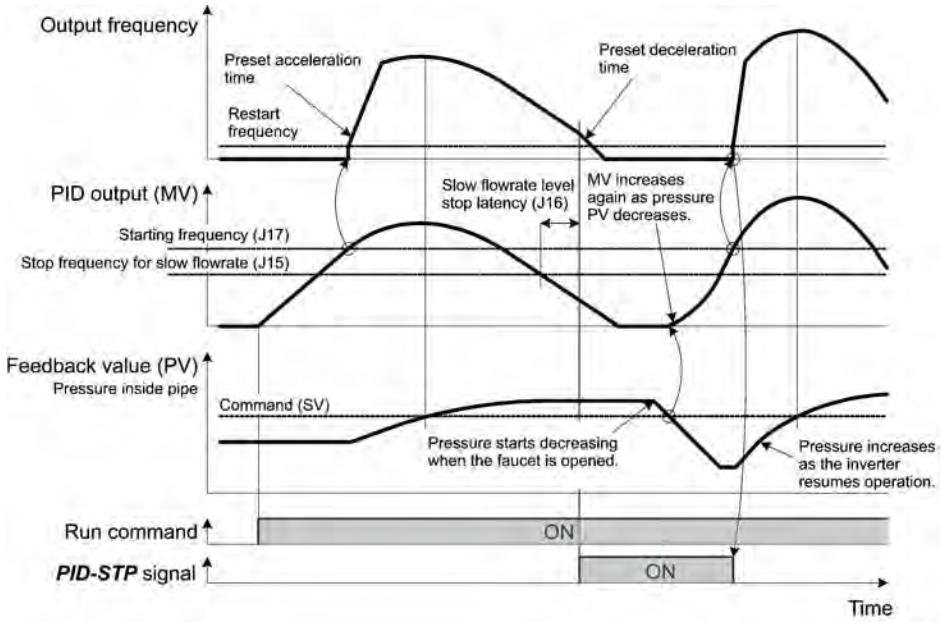
For the slow flowrate stopping function, see the chart below.



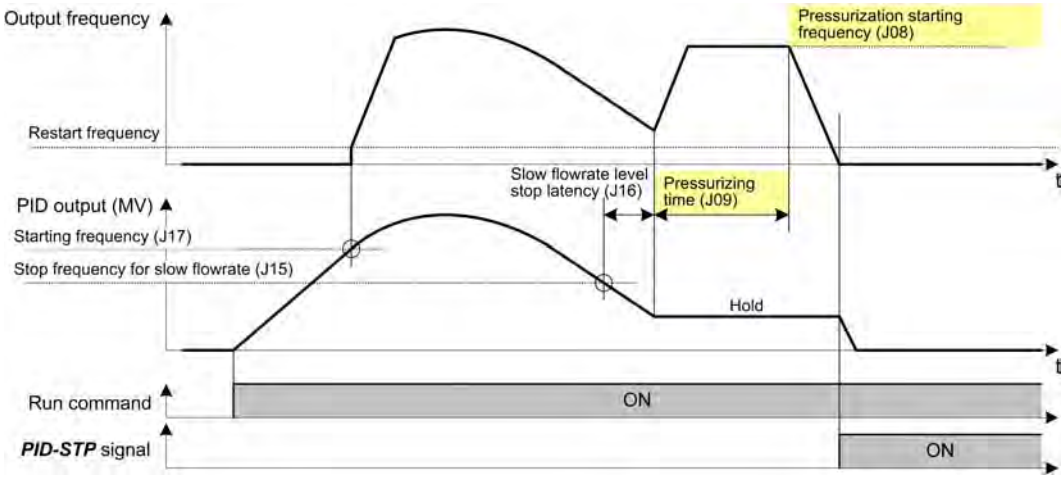
Pressurization before slow flowrate stopping (J08 and J09)

Specifying J08 (Pressurization starting frequency) and J09 (Pressurizing time) enables pressurization control when the frequency drops below the level specified by J15 (Stop frequency for slow flowrate) for the period specified by J16. During the pressurization, the PID control is in the hold state.

This function prolongs the stopping time of equipment with a bladder tank by pressurizing immediately before the frequency drops below the level at which the inverter stops the motor, thus enabling energy saving operation.

Because the pressurization starting frequency (J08) can be specified with a parameter, pressurization setting suitable for the equipment is possible.

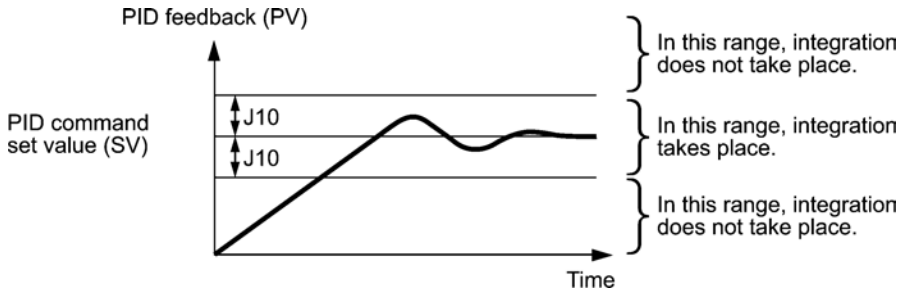
For the pressurization control, see the chart below.



J10 PID Control (Anti reset windup)

J10 suppresses overshoot in control with the PID processor. As long as the deviation between the feedback and the PID command is beyond the preset range, the integrator holds its value and does not perform integration operation.

- Data setting range: 0 to 200 (%)



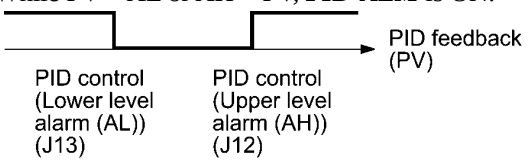
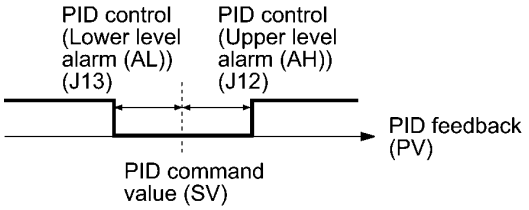
J11 to J13 PID Control (Select alarm output, Upper level alarm (AH) and Lower level alarm (AL))

The inverter can output two types of alarm signals (absolute-value and deviation alarms) associated with PID control if the digital output signal ***PID-ALM*** is assigned to any of the programmable, output terminals with any of E20 through E24 and E27 (data = 42).

J11 specifies the alarm output types. J12 and J13 specify the upper and lower limits for alarms.

■ Select alarm output (J11)

J11 specifies one of the following alarms available.

Data for J11	Alarm	Description
0	Absolute-value alarm	While PV < AL or AH < PV, ***PID-ALM*** is ON. 
1	Absolute-value alarm (with Hold)	Same as above (with Hold)
2	Absolute-value alarm (with Latch)	Same as above (with Latch)
3	Absolute-value alarm (with Hold and Latch)	Same as above (with Hold and Latch)
4	Deviation alarm	While PV < SV - AL or SV + AH < PV, ***PID-ALM*** is ON. 
5	Deviation alarm (with Hold)	Same as above (with Hold)
6	Deviation alarm (with Latch)	Same as above (with Latch)
7	Deviation alarm (with Hold and Latch)	Same as above (with Hold and Latch)

Hold: During the power-on sequence, the alarm output is kept OFF (disabled) even when the monitored quantity is within the alarm range. Once it goes out of the alarm range, and comes into the alarm range again, the alarm is enabled.

Latch: Once the monitored quantity comes into the alarm range and the alarm is turned ON, the alarm will remain ON even if it goes out of the alarm range. To release the latch, perform a reset by using the PRG/RESET key or turning the terminal command ***RST*** ON. Resetting can be done by the same way as resetting an alarm.

■ Upper level alarm (AH) (J12)

J12 specifies the upper limit of the alarm (AH) in percentage (%) of the feedback amount.

■ Lower level alarm (AL) (J13)

J13 specifies the lower limit of the alarm (AL) in percentage (%) of the feedback amount.

Note The value displayed (%) is the ratio of the upper/lower limit to the full scale (10 V or 20 mA) of the feedback amount (in the case of a gain of 100%).

Upper level alarm (AH) and lower level alarm (AL) also apply to the following alarms.

Alarm	Description	How to handle the alarm:	
		Select alarm output (J11)	Parameter setting
Upper limit (absolute)	ON when AH < PV	Absolute-value alarm	J13 (AL) = 0
Lower limit (absolute)	ON when PV < AL		J12 (AH) = 100%
Upper limit (deviation)	ON when SV + AH < PV	Deviation alarm	J13 (AL) = 100%
Lower limit (deviation)	ON when PV < SV - AL		J12 (AH) = 100%
Upper/lower limit (deviation)	ON when |SV - PV| > AL		J13 (AL) = J12 (AH)
Upper/lower range limit (deviation)	ON when SV - AL < PV < SV + AL	Deviation alarm	A negative logic signal should be assigned to ***PID-ALM***.
Upper/lower range limit (absolute)	ON when AL < PV < AH	Absolute-value alarm	
Upper/lower range limit (deviation)	ON when SV - AL < PV < SV + AH	Deviation alarm	

J15 to J17 — PID Control (Stop frequency for slow flowrate, Slow flowrate level stop latency and Starting frequency) (Refer to J08.)

Refer to the description of J08.

J18, J19 — PID Control (Upper limit of PID process output, Lower limit of PID process output)

The upper and lower limiters can be specified to the PID output, exclusively used for PID control. The settings are ignored when PID cancel is enabled and the inverter is operated at the reference frequency previously specified.

(📖 E01 to E09, data = 20)

■ PID Control (Upper limit of PID process output) (J18)

J18 specifies the upper limit of the PID processor output limiter in %. If you specify "999," the setting of the frequency limiter (High) (F15) will serve as the upper limit.

■ PID Control (Lower limit of PID process output) (J19)

J19 specifies the lower limit of the PID processor output limiter in %. If you specify "999," the setting of the frequency limiter (Low) (F16) will serve as the lower limit.

J21 — Dew Condensation Prevention (Duty)

When the inverter is stopped, dew condensation on the motor can be prevented, by feeding DC power to the motor at regular intervals to keep the temperature of the motor above a certain level.

■ Enabling Dew Condensation Prevention

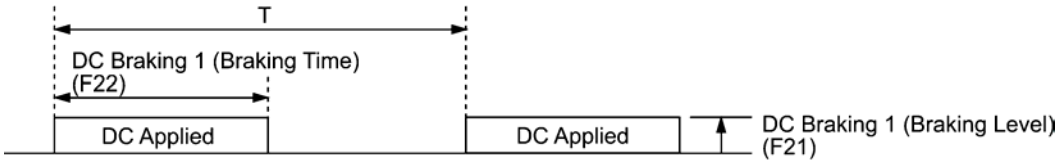
To utilize this feature, you need to assign the terminal command ***DWP*** ("Protect motor from dew condensation") to one of the general-purpose digital input terminals.

(📖 E01 to E09, data = 39)

■ Dew Condensation Prevention (Duty) (J21)

The magnitude of the DC power applied to the motor is the same as the setting of F21 (DC braking 1, Braking level) and its duration of each interval is the same as the setting of F22 (DC braking 1, Braking time). Interval T is determined so that the ratio of the duration of the DC power to T is the value (Duty) set for J21.

$$\text{Duty for condensation prevention (J21)} = \frac{\text{F22}}{\text{T}} \times 100\,(\%)$$



Condensation Prevention Cycle

J22 — Commercial Power Switching Sequence (Refer to E01 through E09.)

Refer to the description of ***ISW50*** and ***ISW60*** (Enable integrated sequence to switch to commercial power) in E01 through E09.

Function Code Details
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J11-J22
d codes
—
y codes

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J56 PID Control (Speed command filter)

Not used.

J57 PID Control (Dancer reference position)

J57 specifies the dancer reference position in the range of -100% to +100% for dancer control.

If J02 = 0 (keypad), this function code is enabled as the dancer reference position.

It is also possible to modify the PID command with the ⌃ / ⌄ keys. If it is modified, the new command value is saved as J57 data.

For the setting procedure of the PID command, refer to Chapter 7, Section 7.3.3 "Setting up frequency and PID commands."

J58, J59 to J61 PID Control (Detection width of dancer position deviation) PID Control (P (Gain) 2, I (Integral time) 2 and D (Differential time) 2)

The moment the feedback value of dancer roll position comes into the range of "the dancer reference position ± detection width of dancer position deviation (J58)," the inverter switches PID constants from the combination of J03, J04 and J05 to that of J59, J60 and J61, respectively in its PID processor. Giving a boost to the system response by raising the P gain may improve the system performance in the dancer roll positioning accuracy.

■ Detection width of dancer position deviation (J58)

J58 specifies the bandwidth in the range of 1 to 100%. Specifying "0" does not switch PID constants.

■ P (Gain) 2 (J59)

■ I (Integral time) 2 (J60)

■ D (Differential time) 2 (J61)

Descriptions for J59, J60, and J61 are the same as those of PID control P (Gain) (J03), I (Integral time) (J04), and D (Differential time) (J05), respectively.

J62 PID Control (PID control block selection)

J62 allows you to select either adding or subtracting the PID dancer processor output to or from the primary speed command. Also, it allows you to select either controlling the PID dancer processor output by the ratio (%) against the primary speed command or compensating the primary speed command by the absolute value (Hz).

Data for J62			Control function	
Decimal	Bit 1	Bit 0	Control value type	Operation for the primary speed command
0	0	0	Ratio (%)	Addition
1	0	1	Ratio (%)	Subtraction
2	1	0	Absolute value (Hz)	Addition
3	1	1	Absolute value (Hz)	Subtraction

J68 to J70 J71, J72 J95, J96	**Brake Signal (Brake-OFF current, Brake-OFF frequency/speed and Brake-OFF timer)** **Brake Signal (Brake-ON frequency/speed and Brake-ON timer)** **Brake Signal (Brake-OFF torque and Speed selection)**

These function codes are for the brake releasing/turning-on signals of vertical carrier machines.

It is possible to set the conditions of the brake releasing/turning-on signals (current, frequency or torque) so that a hoisted load does not fall down at the start or stop of the operation, or so that the load applied to the brake is reduced.

■ Brake signal -- ***BRKS*** (E20 to E24 and E27, data = 57)

This signal outputs a brake control command that releases or activates the brake.

Releasing the Brake

When any of the inverter output current, output frequency, or torque command value exceeds the specified level of the brake signal (J68/J69/J95) for the period specified by J70 (Brake signal (Brake-OFF timer)), the inverter judges that required motor torque is generated and turns the signal ***BRKS*** ON for releasing the brake.

This prevents a hoisted load from falling down due to an insufficient torque when the brake is released.

Function code	Name	Data setting range	Remarks
J68	Brake-OFF current	0 to 300%: Set it putting the inverter rated current at 100%.	
J69	Brake-OFF frequency/speed	0.0 to 25.0 Hz	Available only under V/f control.
J70	Brake-OFF timer	0.0 to 5.0 s	
J95	Brake-OFF torque	0 to 300%	Available only under vector control.

Turning the Brake ON

When the run command is OFF and the output frequency drops below the level specified by J71 (Brake signal (Brake-ON frequency/speed)) for the period specified by J72 (Brake signal (Brake-ON timer)), the inverter judges that the motor rotation is below a certain level and turns the signal ***BRKS*** OFF for activating the brake.

Under vector control, when the commanded speed or detected speed drops below the level of the stop frequency specified by F25 (Stop frequency) for the period specified by J72 (Brake signal (Brake-ON timer)), the inverter judges that the motor rotation is below a certain level and turns the signal ***BRKS*** OFF for activating the brake.

This operation reduces the load applied to the brake, extending lifetime of the brake.

Function code	Name	Data setting range	Remarks
J71	Brake-ON frequency/speed	0.0 to 25.0 Hz	Available only under V/f control.
J72	Brake-ON timer	0.0 to 5.0 s	
J96	Speed selection	0: Detected speed 1: Commanded speed Speed selection under vector control.	Available only under vector control. When vector control without speed sensor is selected, set to "1: Reference speed."

Note

- The brake signal control is only applicable to the 1st motor. If the motor switching function selects any of the 2nd to 4th motor, the brake signal remains ON.
- If the inverter is shut down due to an occurrence of alarm state or by the terminal command ***BX*** ("Coast to a stop"), the brake signal is turned ON immediately.

Function Code Details
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J56-J96
d codes
—
y codes

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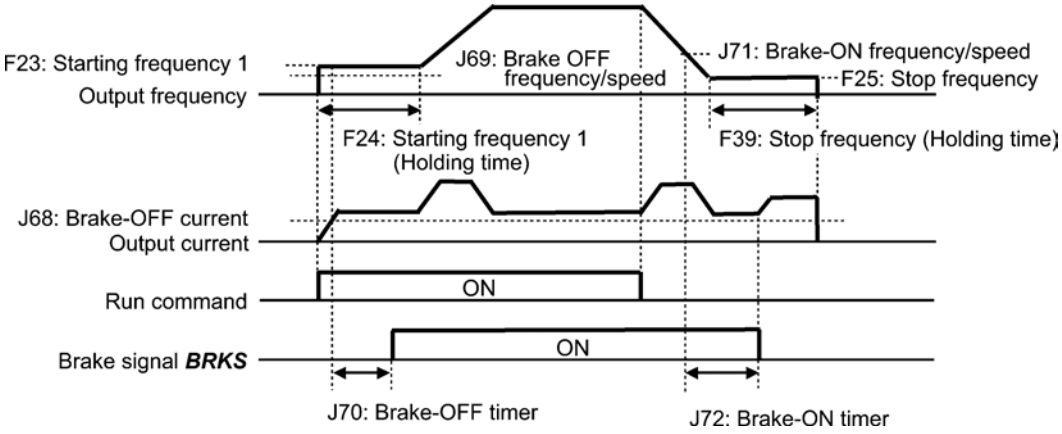
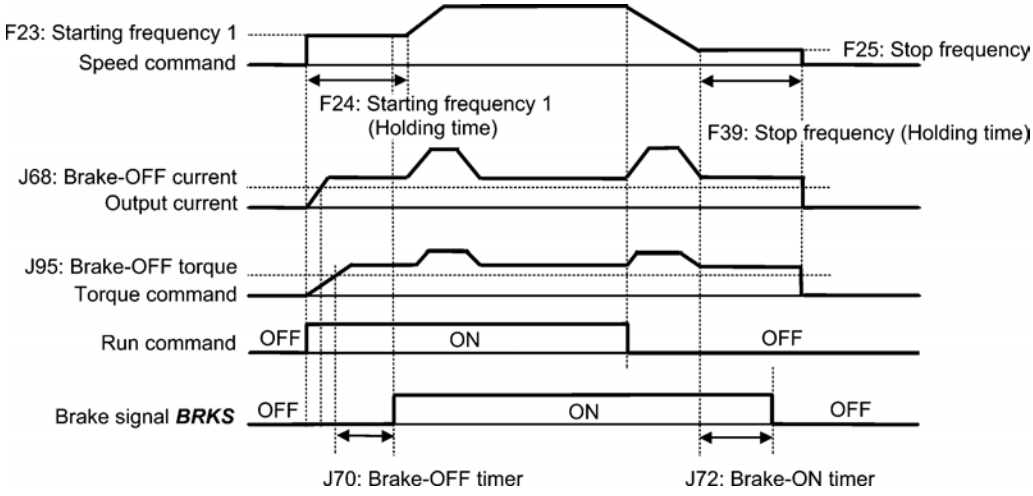
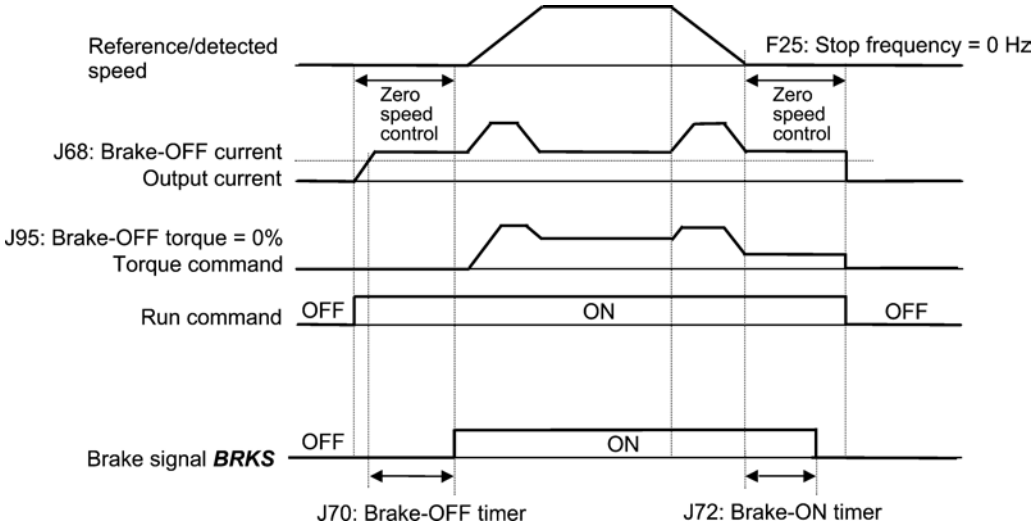
Operation time chart under V/f control



Operation time chart under vector control without speed sensor



Operation time chart under vector control with speed sensor



Note

- If the zero speed control is enabled under vector control with speed sensor, set J95 (Brake-OFF torque) at 0%.
- After releasing the brake (***BRKS*** ON), operating for a while, and then activating the brake (***BRKS*** OFF) to stop the motor, if you want to release the brake (***BRKS*** ON), turn the inverter's run command OFF and then ON.

J97 to J99 Servo-lock (Gain, Completion timer, Completion width)

Servo-lock

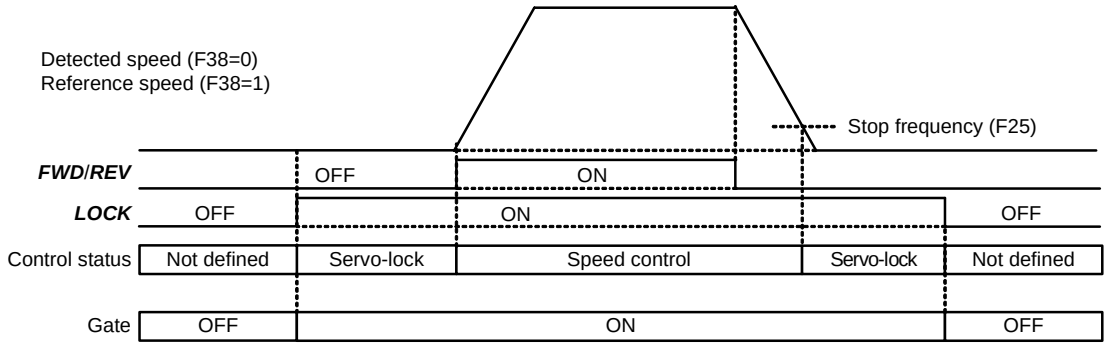
This function servo-locks the inverter to hold the motor within the positioning completion range specified by J99 for the period specified by J98 even if an external force applies to the load.

Note When the inverter is servo-locked, it keeps the output frequency low; therefore, use the inverter under the following specified thermal restriction: Output current within the range of 150% of the rated current for 3 seconds and 80% for continuous operation. (Note that under the restriction, the inverter automatically limits the carrier frequency under 5 kHz.)

Servo-lock starting conditions

	Servo-lock control starts when the following conditions are met:	
	F38 = 0 (Use detected speed as a decision criteria)	F38 = 1 (Use reference speed as a decision criteria)
1	Run command OFF, or Reference frequency < Stop frequency (F25)	
2	***LOCK*** ("Servo-lock command") ON (Assignment of ***LOCK*** (Function code data = 47))	
3	The detected speed is less than stop frequency (F25).	The reference speed is less than stop frequency (F25).

Operation examples



Typical Control Sequence of Servo-lock

⚠WARNING

When the servo-lock command is ON, the inverter keeps on outputting voltage on output terminals [U], [V] and [W] even if a run command is OFF and the motor seems to stop.

An electric shock may occur.

Specifying servo-lock control

■ Positioning completion signal -- ***PSET*** (Function code data = 82), Servo-lock (Completion timer) (J98), and Servo-lock (Completion range) (J99)

This output signal comes ON when the inverter has been servo-locked so that the motor is held within the positioning completion range specified by J99 for the period specified by J98.

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■ Servo-lock (Gain) (J97)

J97 specifies the gain of the servo-lock positioning device to adjust the stop behavior and shaft holding torque.

J97	Small ↔ Large
Stop behavior	Response slow, but smooth ↔ Response quick, but hunting large
Shaft holding torque	Small ↔ Large

Monitor for servo-lock control

Monitor item	LED monitor	Function code	Remarks
Current position	Operation monitor: 3_25 The upper and lower digits appear alternately.	Current position pulse Upper digit: Z90 Lower digit: Z91	Only when the positioning device is in operation (positioning control is active), the LED monitor displays these data. When it is not in operation, the monitor is zero-cleared.
Positioning error	Operation monitor: 3_28 The upper and lower digits appear alternately.	Positioning error pulse Upper digit: Z94 Lower digit: Z95	

The values on the LED monitor appear based on PG pulses 4-multiplied. Under servo-lock, no current positioning pulses or positioning error pulses are displayed on the LED monitor.

Notes for using servo-lock

(1) Positioning control error Er-0

If a positioning error exceeds the value equivalent to four rotations of the motor shaft when the inverter is servo-locked, the inverter issues a positioning control error signal Er-0.

(2) Stop frequency (F25) under servo-lock

Since servo-lock starts when the output frequency is below the stop frequency (F25), it is necessary to specify such F25 data that does not trigger Er-0 (that is, specify the value equivalent to less than 4 rotations of the motor shaft).

Stop frequency (F25) < (4 × Gain (J97) × Maximum frequency)

(Example) When Gain (J97) = 0.01 and Maximum frequency (F03) = 60 Hz, specify F25 data < 2.4 Hz.

(3) Enabling the servo-lock control disables the following:

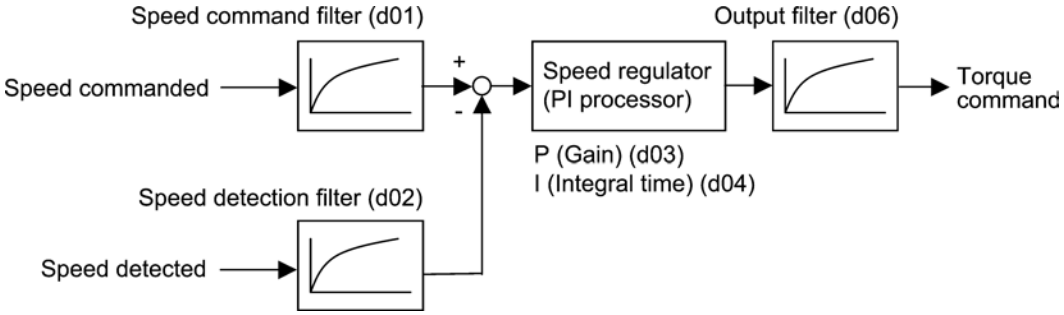
- Operation controlled with a stop frequency
- Rotation direction limitation

5.4.8 d codes (Application functions 2)

d01 to d04	**Speed Control 1 (Speed command filter, Speed detection filter, P (Gain) and I (Integral time))**
d06	**Speed Control 1 (Output filter)**

These function codes control the speed control sequence for normal operations.

Block diagram of the speed control sequence



■ Speed command filter (d01)

d01 specifies a time constant determining the first order delay of the commanded-speed input filter.

- Data setting range: 0.000 to 5.000 (s)

Modify this data when an excessive overshoot occurs against the speed command change.

Increasing the filter time constant stabilizes the speed command and reduces overshoot against the speed command change, but it slows the response speed of the inverter.

■ Speed detection filter (d02)

d02 specifies a time constant determining the first order delay of the detected-speed input filter.

- Data setting range: 0.000 to 0.100 (s)

Modify this data when the control target (machinery) is oscillatory due to deflection of a drive belt or other causes so that ripples (oscillatory components) are superimposed on the detected speed, causing hunting (undesirable oscillation of the system) and blocking the PI processor gain from increasing (resulting in a slow response speed of the inverter). In addition, if the lower encoder (PG) resolution makes the system oscillatory, try to modify this data.

Increasing the time constant stabilizes the detected speed and raises the PI processor gain even with ripples superimposed on the detected speed. However, the detected speed itself delays, resulting in a slower speed response, larger overshoot, or hunting.

■ P gain (d03), I integral time (d04)

d03 and d04 specify the gain and integral time of the speed regulator (PI processor), respectively.

- Data setting range: d03: 0.1 to 200.0 (times)
  d04: 0.001 to 1.000 (s)

Function Code Details
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J97-J99
d01-d06
—
y codes

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P gain

Definition of "P gain = 1.0" is that the torque command is 100% (100% torque output of each inverter capacity) when the speed deviation (commanded speed – actual speed) is 100% (equivalent to the maximum speed).

Determine the P gain according to moment of inertia of machinery loaded to the motor output shaft. Larger moment of inertia needs larger P gain to keep the flat response in whole operations.

Specifying a larger P gain improves the quickness of control response, but may cause a motor speed overshooting or hunting (undesirable oscillation of the system). Moreover, mechanical resonance or vibration sound on the machine or motor could occur due to excessively amplified noises. If it happens, decreasing P gain will reduce the amplitude of the resonance/vibration. A too small P gain results in a slow inverter response and a speed fluctuation in low frequency, which may prolong the time required for stabilizing the motor speed.

Integral time

Specifying a shorter integral time shortens the time needed to compensate the speed deviation, resulting in quick response in speed. Specify a short integral time if quick arrival to the target speed is necessary and a slight overshooting in the control is allowed; specify a long time if any overshooting is not allowed and taking longer time is allowed.

If a mechanical resonance occurs and the motor or gears sound abnormally, setting a longer integral time can transfer the resonance point to the low frequency zone and suppress the resonance in the high frequency zone.

■ Output Filter (d06)

d06 specifies the time constant for the first order delay of the speed controller output filter.

- Data setting range: 0.000 to 0.100 (s)

Use this function code when setting of the P gain and/or integral time cannot control mechanical resonance such as hunting or vibration. Generally, setting a larger value to this time constant decreases the amplitude of resonance; however, a too long time constant may make the system unstable.

d09, d10 d11 to d13	**Speed Control (Jogging) (Speed command filter and Speed detection filter) (P (Gain), I (Integral time) and Output filter)** **(Refer to d01.)**

These function codes control the speed control sequence for jogging operations.

The block diagrams and function codes related to jogging operations are the same as for normal operations.

Since this speed control sequence is exclusive to jogging operations, specify these function codes to obtain higher speed response than that of normal operations for smooth jogging operations.

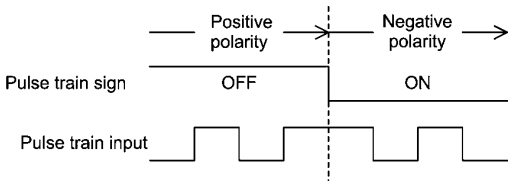
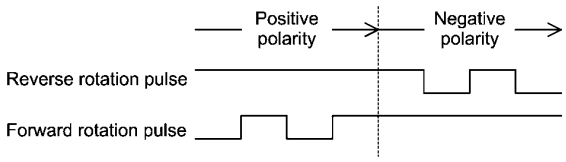
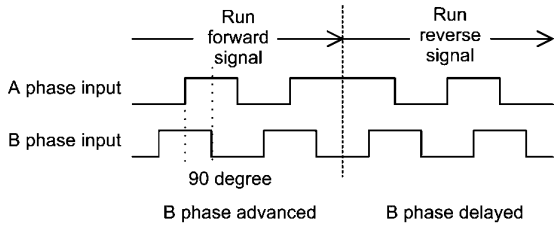
For details, refer to the corresponding descriptions (d01 to d04 and d06) about the speed control sequence for normal operations.

d14 to d17 **Feedback Input (Pulse input format, Encoder pulse resolution, Pulse count factor 1 and Pulse count factor 2)**

These function codes specify the speed feedback input under vector control with speed sensor.

■ Feedback Input, Pulse input format (d14)

d14 specifies the speed feedback input format.

Data for d14	Pulse input mode	Remarks
0	Pulse train sign/ Pulse train input	
1	Forward rotation pulse/Reverse rotation pulse	
2	A and B phases with 90 degree phase difference	Set the d14 data to "2" for Fuji motors exclusively designed for vector control. 

■ Feedback Input, Encoder pulse resolution (d15)

d15 specifies the pulse resolution (P/R) of the speed feedback encoder.

- Data setting range: 0014 to EA60 (in hex.)
  (20 to 60000 P/R in decimal.)

For Fuji motors exclusively designed for vector control, set d15 at "0400 (1024 P/R)."

Function Code Details
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d01-d17
—
y codes

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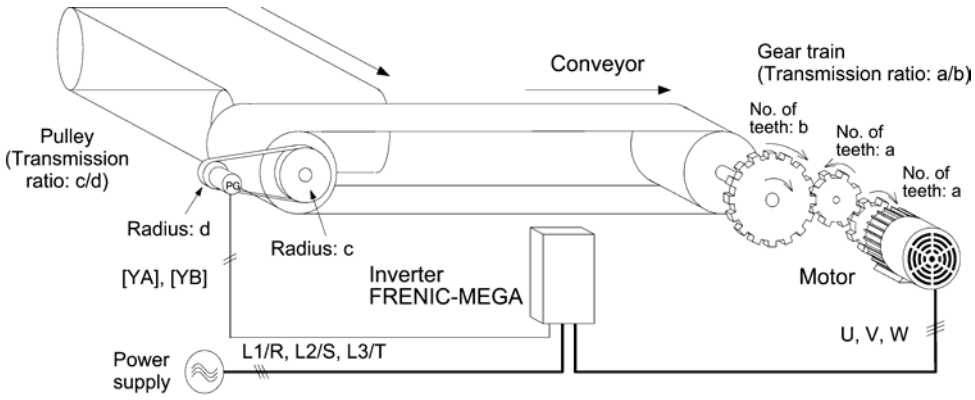
■ Feedback Input, Pulse count factor 1 (d16) and Pulse count factor 2 (d17)

d16 and d17 specify the factors to convert the speed feedback input pulse rate into the motor shaft speed (r/min).

- Data setting range: 1 to 9999

Specify the data according to the transmission ratios of the pulley and gear train as shown below.



An Example of a Closed Loop Speed Control System (Conveyor)

Listed below are expressions for conversion between a speed feedback input pulse rate and motor shaft speed.

$$\text{Motor shaft speed} = \frac{\text{Pulse count factor 2 (d17)}}{\text{Pulse count factor 1 (d16)}} \times \text{Encoder shaft speed}$$

$$\frac{\text{Pulse count factor 2 (d17)}}{\text{Pulse count factor 1 (d16)}} = \frac{b}{a} \times \frac{d}{c}$$

$$\text{Pulse count factor 1 (d16)} = a \times c$$

$$\text{Pulse count factor 2 (d17)} = b \times d$$

Note When enabling the vector control with speed sensor, mount the sensor encoder on the motor output shaft directly, or on a shaft with the rigidity equivalent to the motor output shaft. A backlash or deflection being on the mounting shaft could interfere with normal control.

For using the Fuji VG motor exclusively designed for vector control, the sensor is mounted on the motor shaft directly. Set both the pulse count factor 1 (d16) and pulse count factor 2 (d17) to "1."

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d21, d22 d23	Speed Agreement/PG Error (Hysteresis width and Detection timer) PG Error Processing

These function codes specify the detection levels of the speed agreement signal ***DSAG*** and PG error detected signal ***PG-ERR***.

Speed agreement signal *DSAG* (E20 to E24 and E27, data = 71)

■ Speed Agreement/PG Error (Hysteresis width (d21) and Detection timer (d22))

- Data setting range: d21 = 0.0 to 50.0%, 100% at the maximum speed
  d22 = 0.00 to 10.00 (s)

If the speed regulator's deviation (between the commanded speed and detected speed) is within the specified range (d21), the signal ***DSAG*** turns ON. If the deviation is out of the specified range (d21) for the period specified by d22, the signal turns OFF. This signal allows the user to check whether the speed regulator works properly or not.

PG error detected signal *PG-ERR* (E20 to E24 and E27, data = 76)

■ Speed Agreement/PG Error (Hysteresis width (d21) and Detection timer (d22)) and PG Error Processing (d23)

- Data setting range: d21 = 0.0 to 50.0%, 100% at the maximum speed
  d22 = 0.00 to 10.00 (s)
  d23 = 0, 1, 2

Data of d23	Function
0	Continue to run
1	Stop running with alarm 1 (Er-E)
2	Stop running with alarm 2 (Er-E)

If the deviation (between the commanded and detected speeds) is out of the specified range (d21) for the period specified by d22, the inverter judges it as a PG error.

Data setting for d23, however, defines the detection conditions and the error processing after the error detection.

Data for d23	Detection condition	Processing after error detection
0	When the inverter cannot follow the speed command (even after the soft-starting) due to a heavy overload or the like, and the detected speed is slow against the commanded speed, the inverter does not interpret this situation as a PG error.	The inverter outputs the PG error detected signal ***PG-ERR*** and continues to run.
1		The inverter enters the coast-to-stop state outputting the Er-E alarm, and also outputs the PG error detected signal ***PG-ERR***.
2	The inverter interprets the situation above as a PG error.	

Note Enabling an operation limiting function such as the torque limit and droop control will increase the deviation caused by a huge gap between the commanded speed and actual one. In this case, the inverter may trip interpreting this situation as a PG error, depending on the running status. To avoid this incident, set the d23 data to "0: Continue to run" to prevent the inverter from tripping even if any of those limiting functions is activated.

Function Code Details
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d14-d23
—
y codes

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d24	Zero Speed Control (Refer to F23.)

Refer to the description of F23.

d25	ASR Switching Time (Refer to A42.)

Refer to the description of A42.

Refer to the description of F23.

d32, d33	Torque control (Speed limit 1 and Speed limit 2)

If a regenerative load (which is not generated usually) is generated under droop control, or if function codes are incorrectly configured, the motor may rotate at an unintended high speed. You can specify the overspeed level at any value to protect the mechanical system.

- Forward overspeed level = Maximum frequency 1 (F03) × Speed limit 1 (d32) × 120 (%)
- Reverse overspeed level = Maximum frequency 1 (F03) × Speed limit 2 (d33) × 120 (%)

d51 to d55 d68, d69, d99	Reserved for particular manufacturers

These function codes d51 to d55, d68, d69 and d99 are displayed, but they are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

d59, d61 d62, d63	Command (Pulse Rate Input) (Pulse input format, Filter time constant, Pulse count factor 1 and Pulse count factor 2) (Refer to F01.)

Refer to the description of F01.

5.4.9 y codes (Link functions)

y01 to y20 | **RS-485 Communication 1 and 2**

Up to two ports of RS-485 communications link are available as listed below.

Port	Route	Function code	Applicable equipment
Port 1	RS-485 communications link (via the RJ-45 connector prepared for keypad connection)	y01 through y10	Standard keypad FRENIC Loader Host equipment
Port 2	RS-485 communications link (via terminals DX+, DX- and SD on the control PCB)	y11 through y20	Host equipment

To connect any of the applicable devices, follow the procedures shown below.

(1) Standard keypad

The standard keypad allows you to run and monitor the inverter.

It can be used independent of the y code setting.

(2) FRENIC Loader

Connecting your computer running FRENIC Loader to the inverter via RS-485 communication (port 1), you can monitor the inverter's running status information, edit function codes, and test-run the inverters.

For the setting of y codes, refer to the descriptions of y01 to y10.

Note FRENIC-MEGA series of inverters has a USB port on the keypad.

To use the FRENIC Loader via the USB port, simply set the station address (y01) to "1" (factory default).

(3) Host equipment

The inverter can be managed and monitored by connecting host equipment such as a PC and PLC to the inverter. Modbus RTU* and Fuji general-purpose inverter protocol are available for communications protocols.

*Modbus RTU is a protocol established by Modicon, Inc.

For details, refer to the RS-485 Communication User's Manual (MEH448).

■ Station address (y01 for port 1 and y11 for port 2)

y01 or y11 specifies the station address for the RS-485 communications link. The table below lists the protocols and the station address setting ranges.

Protocol	Station address	Broadcast address
Modbus RTU protocol	1 to 247	0
FRENIC Loader protocol	1 to 255	None
FUJI general-purpose inverter protocol	1 to 31	99

- If any wrong address beyond the above range is specified, no response is returned since the inverter will be unable to receive any enquiries except the broadcast message.
- To use FRENIC Loader via the RS-485 communications link (port 1), set the station address that matches the connected computer.

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■ Communications error processing (y02 for port 1 and y12 for port 2)

y02 or y12 specifies the error processing to be performed if an RS-485 communications error occurs.

RS-485 communications errors include logical errors (such as address error, parity error, framing error), transmission protocol error, and physical errors (such as no-response error specified by y08 and y18). The inverter can recognize such an error only when it is configured with a run or frequency command sourced through the RS-485 communications link and it is running. If none of run and frequency commands is sourced through the RS-485 communications link or the inverter is not running, the inverter does not recognize any error occurrence.

Data for y02, y12	Function
0	Immediately trip, displaying an RS-485 communications error (Er-8 for y02 and Er-P for y12). (The inverter stops with alarm issue.)
1	Run during the period specified by the error processing timer (y03, y13), display an RS-485 communications error (Er-8 for y02 and Er-P for y12), and then stop operation. (The inverter stops with alarm issue.)
2	Retry communication during the period specified by the error processing timer (y03, y13). If a communications link is recovered, continue operation. Otherwise, display an RS-485 communications error (Er-8 for y02 and Er-P for y12) and stop operation. (The inverter stops with alarm issue.)
3	Continue to run even when a communications error occurs.

For details, refer to the RS-485 Communication User's Manual (MEH448).

■ Timer (y03 for port 1 and y13 for port 2)

y03 or y13 specifies an error processing timer.

If the timer count has elapsed due to no response from the other end when a query has been issued, the inverter interprets it as an error occurrence. See the "No-response error detection time (y08, y18)" given on the next page.

- Data setting range: 0.0 to 60.0 (s)

■ Baud rate (y04 for port 1 and y14 for port 2)

y04 or y14 specifies the transmission speed for RS-485 communication.

For FRENIC Loader (via the RS-485 communications link), specify the transmission speed that matches the connected computer.

Data for y04 and y14	Transmission speed (bps)
0	2400
1	4800
2	9600
3	19200
4	38400

■ Data length (y05 for port 1 and y15 for port 2)

y05 or y15 specifies the character length for RS-485 communication.

For FRENIC Loader (via the RS-485 communications link), no setting is required since Loader automatically sets 8 bits. (The same applies to the Modbus RTU protocol.)

Data for y05 and y15	Data length
0	8 bits
1	7 bits

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■ Parity check (y06 for port 1 and y16 for port 2)

y06 or y16 specifies the property of the parity bit.

For FRENIC Loader, no setting is required since Loader automatically sets the even parity.

Data for y06 and y16	Parity
0	None (2 stop bits for Modbus RTU)
1	Even parity (1 stop bit for Modbus RTU)
2	Odd parity (1 stop bit for Modbus RTU)
3	None (1 stop bit for Modbus RTU)

■ Stop bits (y07 for port 1 and y17 for port 2)

y07 or y17 specifies the number of stop bits.

For FRENIC Loader, no setting is required since Loader automatically sets 1 bit.

For the Modbus RTU protocol, no setting is required since the stop bits are automatically determined associated with the property of parity bits.

Data for y07 and y17	Stop bit(s)
0	2 bits
1	1 bit

■ No-response error detection time (y08 for port 1 and y18 for port 2)

y08 or y18 specifies the time interval from when the inverter detects no access until it enters communications error alarm mode due to network failure and processes the communications error. This applies to a mechanical system that always accesses its station within a predetermined interval during communications using the RS-485 communications link.

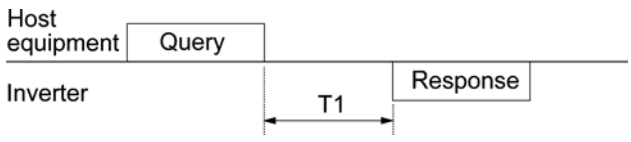
For the processing of communications errors, refer to y02 and y12.

Data for y08 and y18	Function
0	No detection
1 to 60	1 to 60 s

■ Response interval (y09 for port 1 and y19 for port 2)

y09 or y19 specifies the latency time after the end of receiving a query sent from the host equipment (such as a computer or PLC) until the start of sending the response. This function allows using equipment whose response time is slow while a network requires quick response, enabling the inverter to send a response timely by the latency time setting.

- Data setting range: 0.00 to 1.00 (s)



T1 = Response interval + α

where α is the processing time inside the inverter. This time may vary depending on the processing status and the command processed in the inverter.

For details, refer to the RS-485 Communication User's Manual (MEH448).

Note When setting the inverter with FRENIC Loader via the RS-485 communications link, pay sufficient attention to the performance and/or configuration of the PC and protocol converter such as RS-485–RS-232C converter. Note that some protocol converters monitor the communications status and switch the sending/receiving of transmission data by a timer.

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■ Protocol selection (y10 for port 1)

y10 specifies the communications protocol for port 1.

For FRENIC Loader (via the RS-485 communications link), only y10 can be used for protocol selection. Set the y10 data at "1."

Data for y10	Protocol
0	Modbus RTU protocol
1	FRENIC Loader protocol
2	Fuji general-purpose inverter protocol

■ Protocol selection (y20 for port 2)

y20 specifies the communications protocol for port 2.

Data for y20	Protocol
0	Modbus RTU protocol
2	Fuji general-purpose inverter protocol

y97 Communication Data Storage Selection

A nonvolatile storage in the inverter has a limited number of rewritable times (100,000 to 1,000,000 times). Saving data into the storage so many times unnecessarily will no longer allow the storage to save data, causing memory errors.

For frequent data writing via the communications link, therefore, a temporary storage is provided instead of the nonvolatile storage. To use the temporary storage, set the y97 data at "1." Using the temporary storage reduces the number of data writing times into the nonvolatile storage, preventing memory errors.

Setting the y97 data at "2" saves all data written in the temporary storage into the nonvolatile one.

Changing the y97 data requires simultaneous keying of STOP and ∧ / ∨ keys.

Data for y97	Function
0	Save into nonvolatile storage (Rewritable times limited)
1	Write into temporary storage (Rewritable times unlimited)
2	Save all data from temporary storage to nonvolatile one (After saving data, the data automatically returns to "1.")

y98 Bus Link Function (Mode selection) (Refer to H30.)

Refer to the description of H30.

y99 Loader Link Function (Mode selection)

This is a link switching function for FRENIC Loader. Rewriting the data of y99 to enable RS-485 communications from Loader helps Loader send the inverter the frequency and/or run commands. Since the data to be set in the function code of the inverter is automatically set by Loader, no keypad operation is required.

While Loader is selected as the source of the run command, if the computer runs out of control and cannot be stopped by a stop command sent from Loader, disconnect the RS-485 communications cable from the port 1 or the USB cable, connect a keypad instead, and reset the y99 data to "0." This setting "0" in y99 means that the run and frequency command source specified by function code H30 takes place instead of FRENIC Loader.

Note that the inverter cannot save the setting of y99. When power is turned off, the data in y99 is lost (y99 is reset to "0").

Data for y99	Function	
	Frequency command	Run command
0	Follow H30 and y98 data	Follow H30 and y98 data
1	Via RS-485 link (FRENIC Loader)	Follow H30 and y98 data
2	Follow H30 and y98 data	Via RS-485 link (FRENIC Loader)
3	Via RS-485 link (FRENIC Loader)	Via RS-485 link (FRENIC Loader)

Function Code Details
F codes
E codes
C codes
P codes
H codes
A codes
b codes
r codes
J codes
d codes
—
y01-y98

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Chapter 6

BLOCK DIAGRAMS FOR CONTROL LOGIC

This chapter provides the main block diagrams for the control logic of the FRENIC-MEGA series of inverters.

Contents

6.1 Symbols Used in Block Diagrams and their Meanings 6-1
6.2 Drive Frequency Command Block 6-2
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FRENIC-MEGA series of inverters is equipped with a number of function codes to match a variety of motor operations required in your system. Refer to Chapter 5 "FUNCTION CODES" for details of the function codes.

The function codes have functional relationship each other. Several special function codes also work with execution priority each other depending on their functions or data settings.

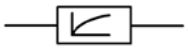
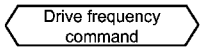
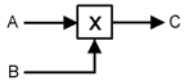
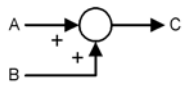
This chapter explains the main block diagrams for control logic in the inverter. You are requested to fully understand the inverter's control logic together with the function codes in order to set the function code data correctly.

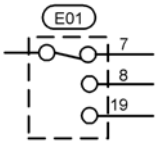
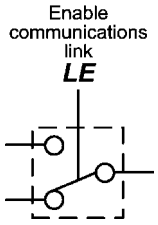
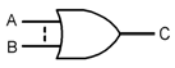
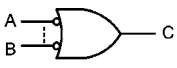
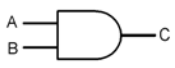
The block diagrams contained in this chapter show only function codes having mutual relationship. For the function codes that work independently and for detailed explanation of each function code, refer to Chapter 5 "FUNCTION CODES."

6.1 Symbols Used in Block Diagrams and their Meanings

Table 6.1 lists symbols commonly used in block diagrams and their meanings with some examples.

Table 6.1 Symbols and Meanings

Symbol	Meaning
[FWD], [Y1] etc.	Programmable, digital inputs/outputs to/from the inverter's control circuit terminal block.
FWD, ***REV*** etc.	Control signals (input) or status signals (output), assigned to control circuit terminals.
	Low-pass filter: Features appropriate characteristics by changing the time constant through the function code data.
	Internal control signal for inverter logic.
	High limiter: Limits the upper value by a constant or data set to a function code.
	Low limiter: Limits the lower value by a constant or data set to a function code.
	Zero limiter: Prevents data from dropping to a negative value.
	Gain multiplier for reference frequencies given by current and/or voltage input or for analog output signals. $C = A \times B$
	Adder for 2 signals or values. C = A + B If B is negative then C = A – B (acting as a subtracter).

Symbol	Meaning
	Function code.
	Switch controlled by a function code. Numbers assigned to the terminals express the function code data.
	Switch controlled by a terminal command. In the example shown on the left, the enable communications link command ***LE*** assigned to one of the digital input terminals from [X1] to [X9] controls the switch.
	OR logic: In normal logic, if any input is ON, then C = ON. Only if all inputs are OFF, then C = OFF.
	NOR (Not-OR) logic: In normal logic, if any input is OFF, then C = ON. If all inputs are ON, C = OFF.
	AND logic: In normal logic, only if A = ON and B = ON, then C = ON. Otherwise, C = OFF.
	NOT logic: In normal logic, if A = ON, then B = OFF, and vice versa.

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6.2 Drive Frequency Command Block

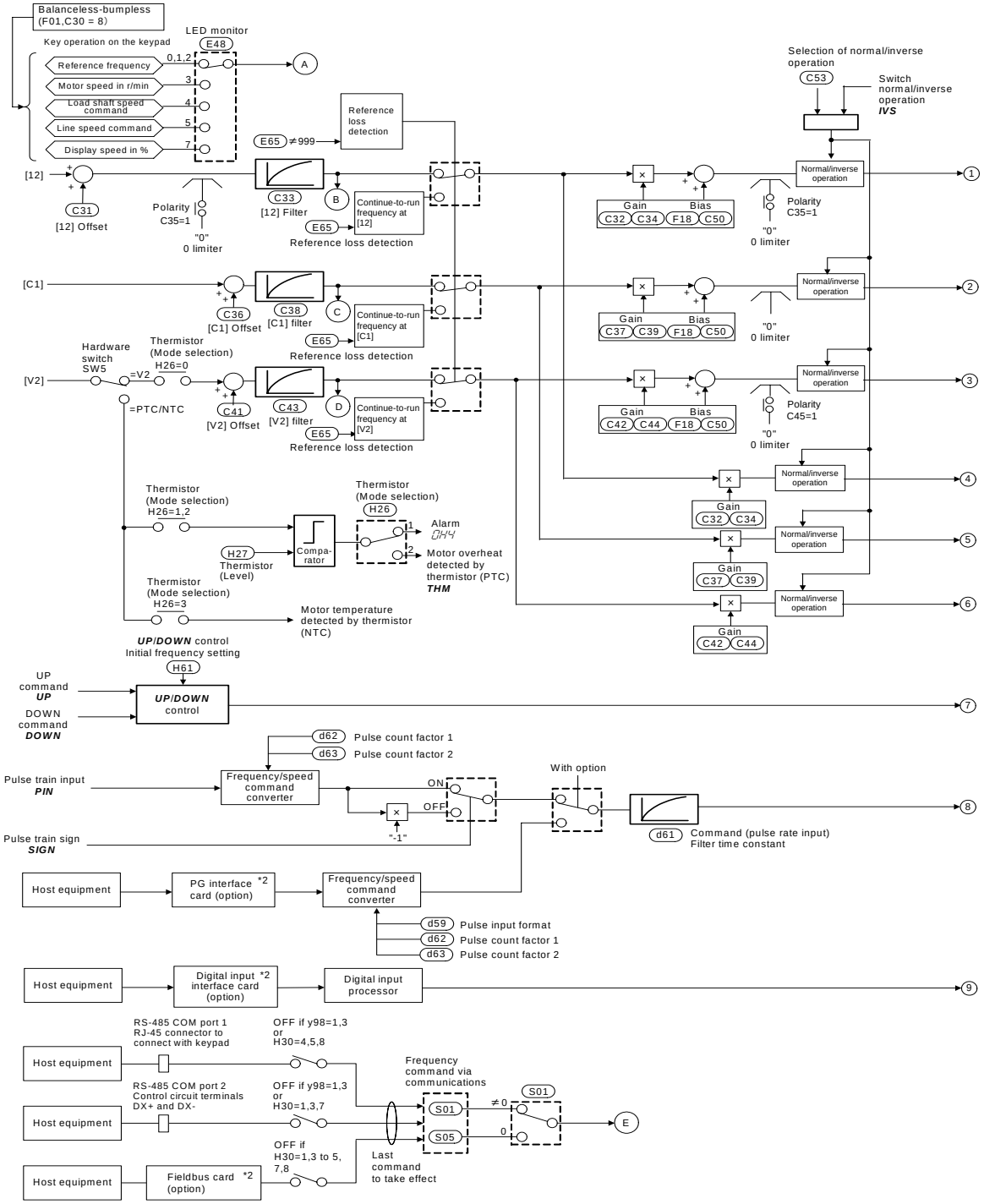
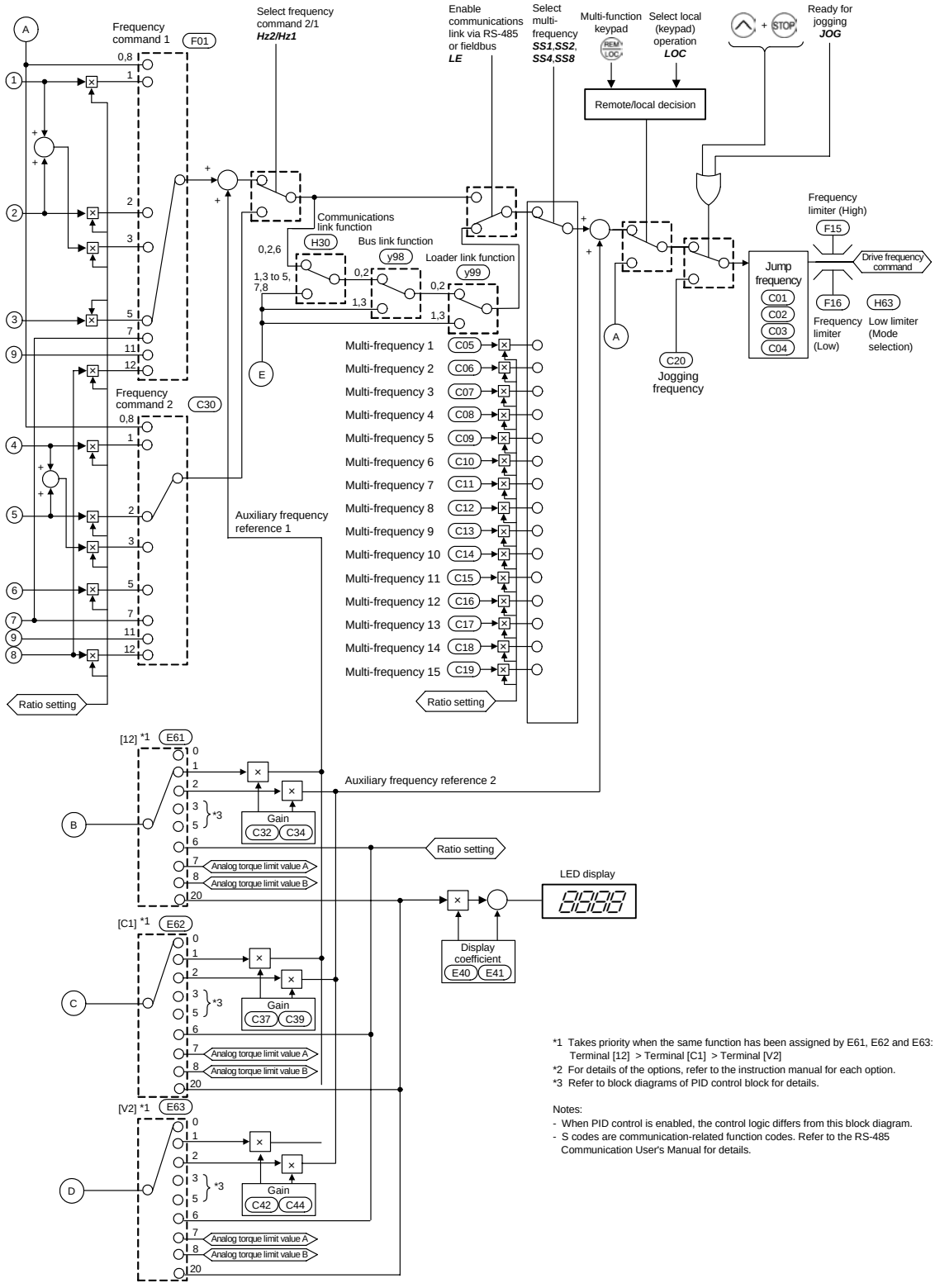


Figure 6.1 (1) Drive Frequency Command Block



*1 Takes priority when the same function has been assigned by E61, E62 and E63: Terminal [12] > Terminal [C1] > Terminal [V2]
*2 For details of the options, refer to the instruction manual for each option.
*3 Refer to block diagrams of PID control block for details.

Notes:
- When PID control is enabled, the control logic differs from this block diagram.
- S codes are communication-related function codes. Refer to the RS-485 Communication User's Manual for details.

Figure 6.1 (2) Drive Frequency Command Block

6.3 Drive Command Block

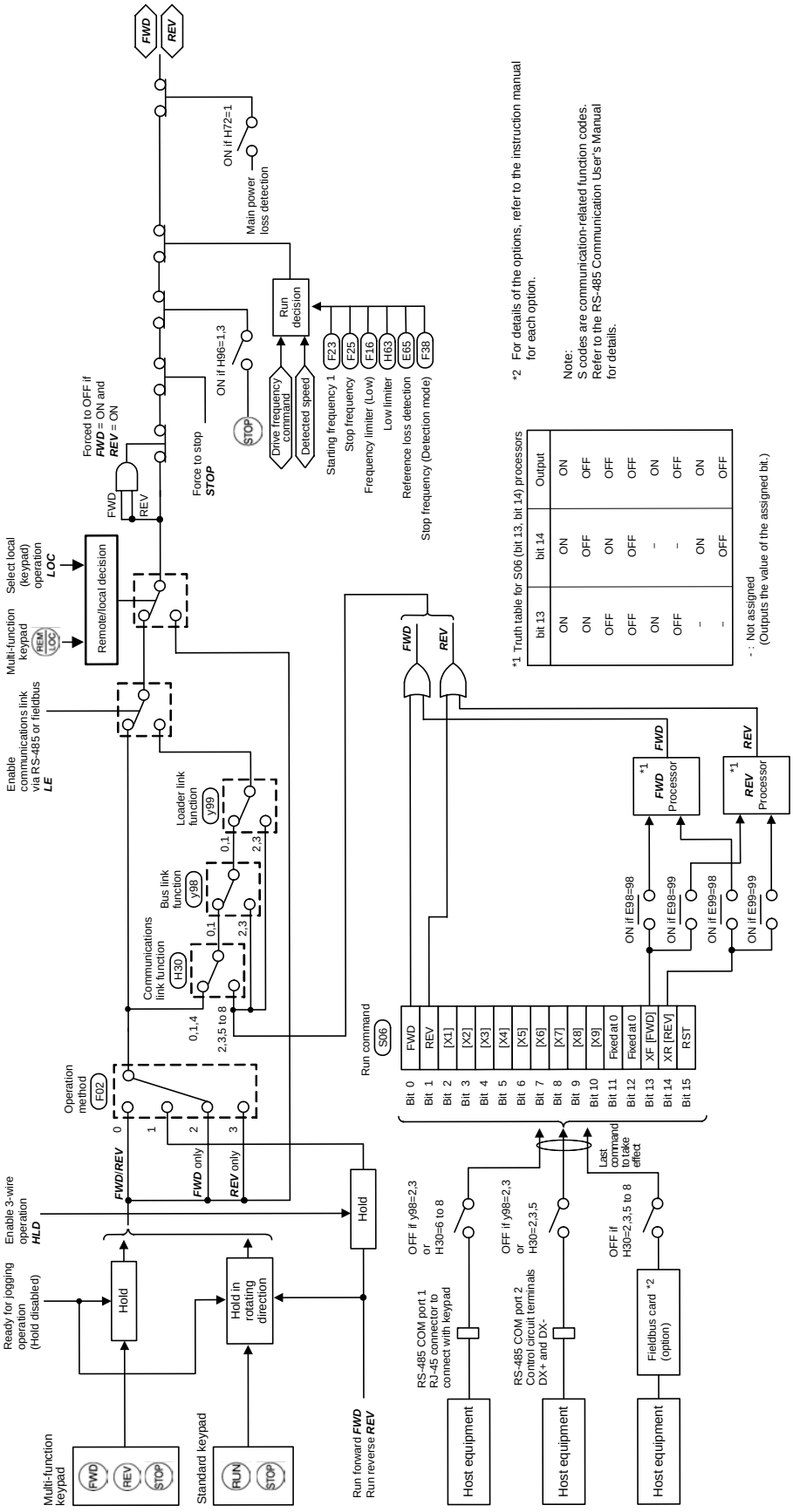


Figure 6.2 Drive Command Block

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6.4 Control Block

6.4.1 V/f control

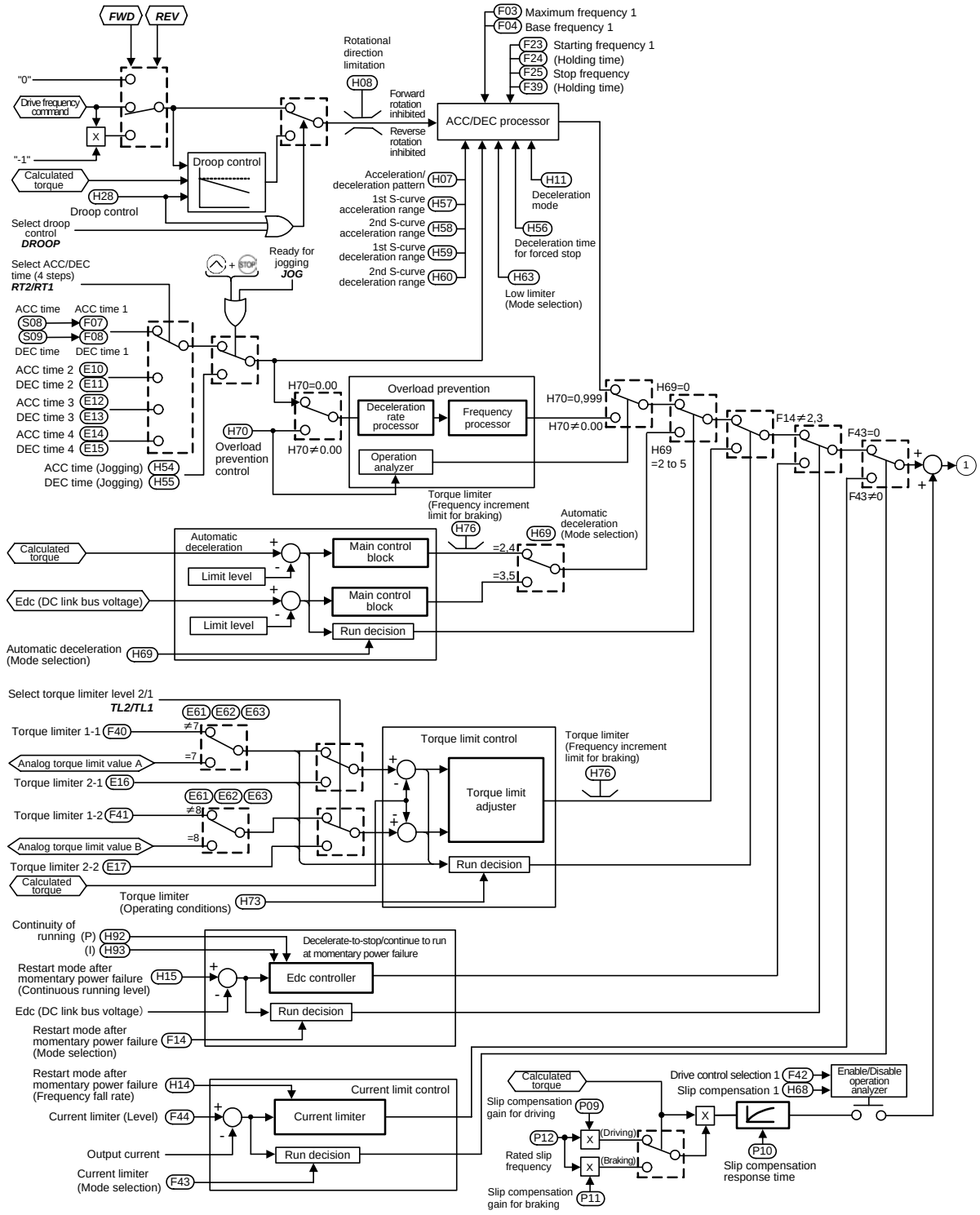


Figure 6.3 (1) V/f Control Block

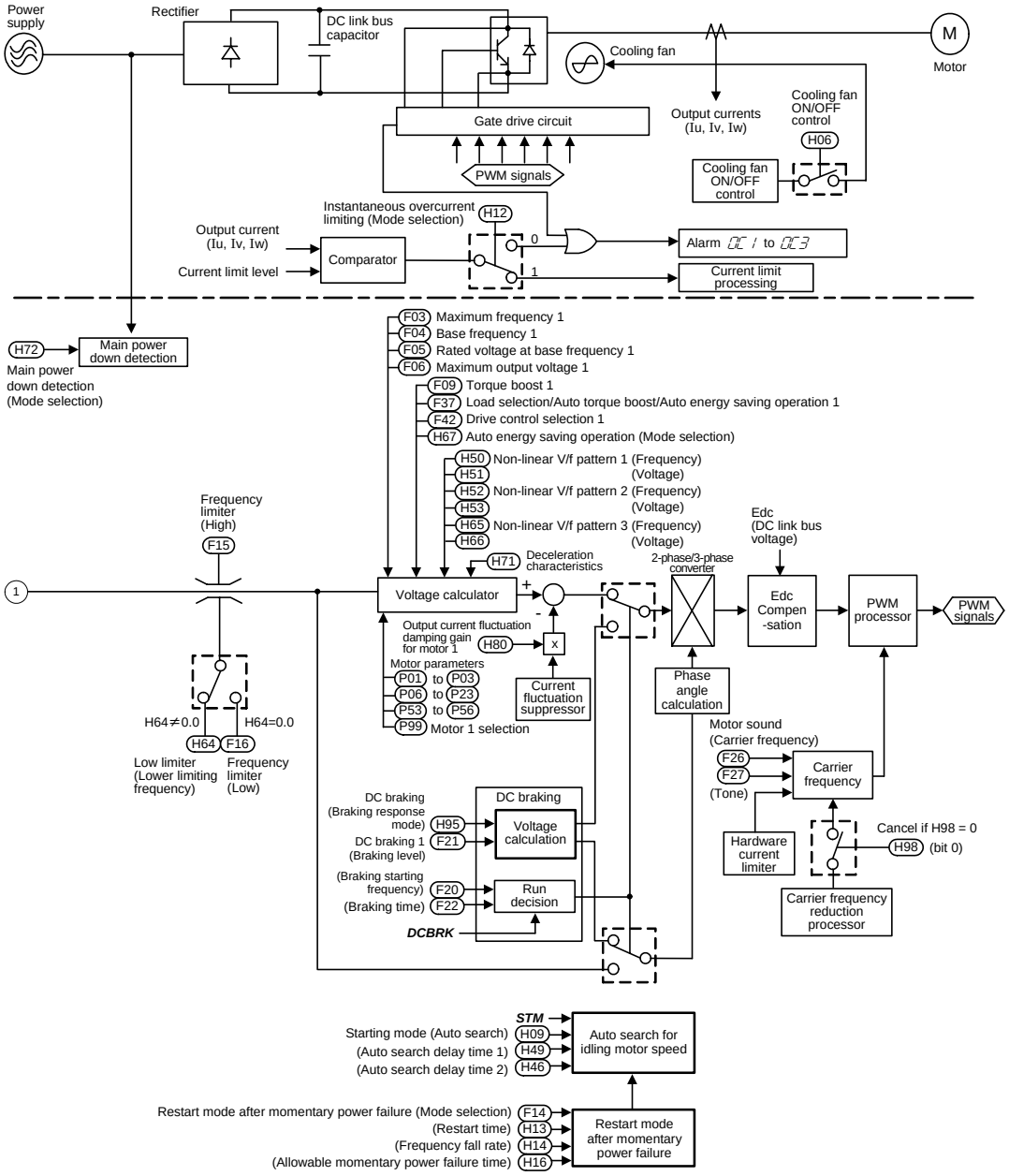


Figure 6.3 (2) V/f Control Block

6.4.2 Vector control with/without speed sensor

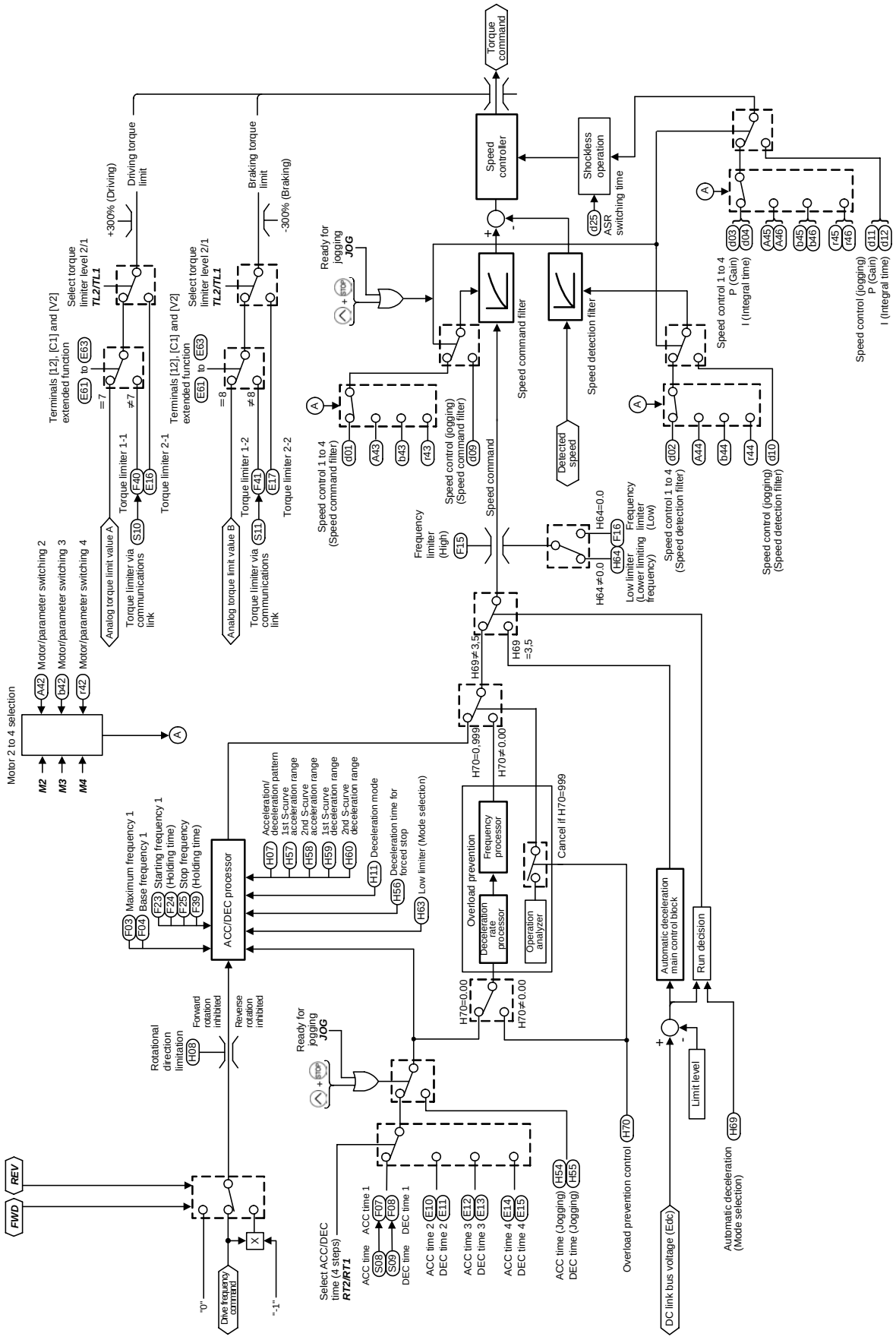


Figure 6.4 (1) Block of Vector Control with/without Speed Sensor

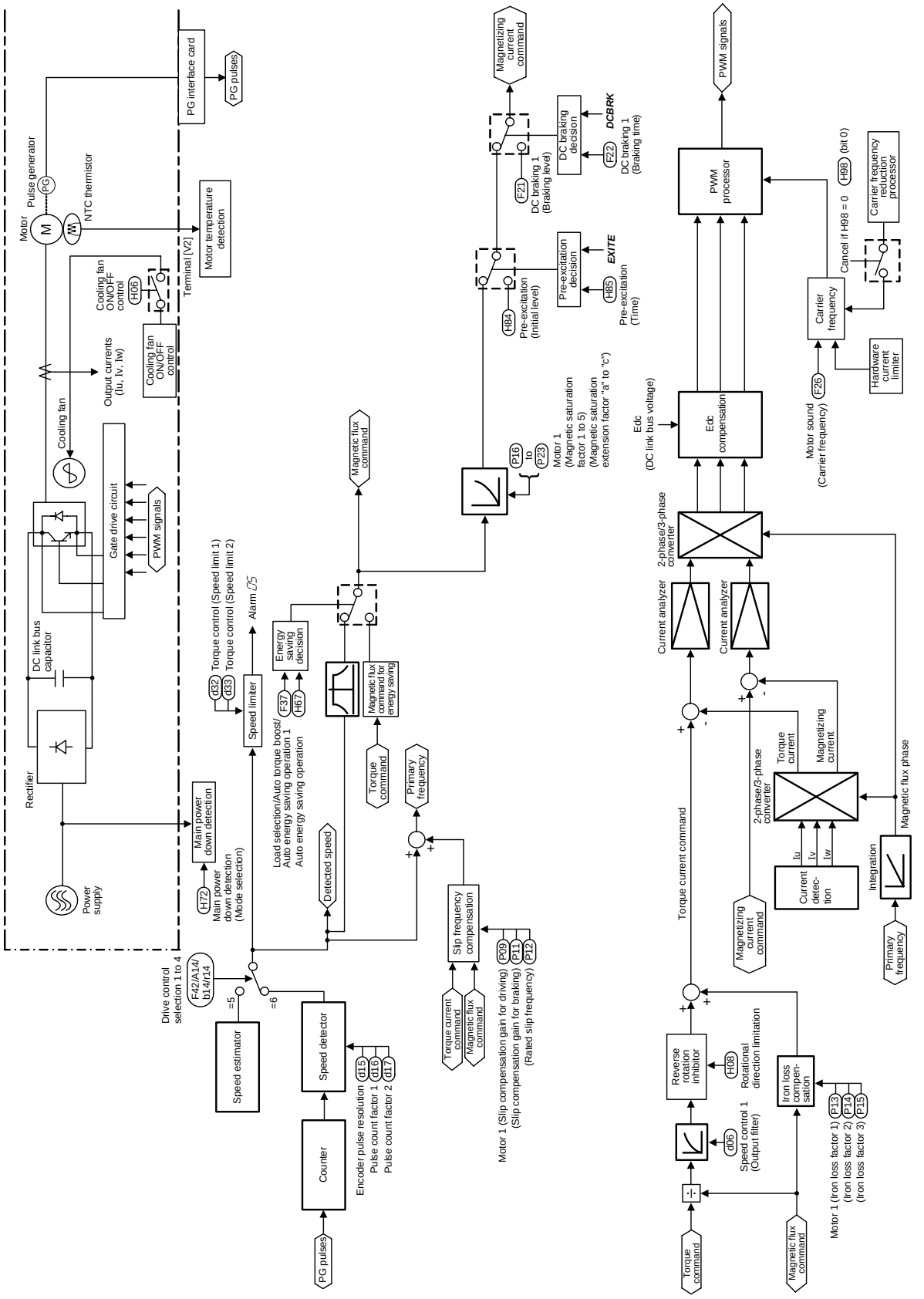


Figure 6.4 (2) Block of Vector Control with/without Speed Sensor

6.5 PID Process Control Block

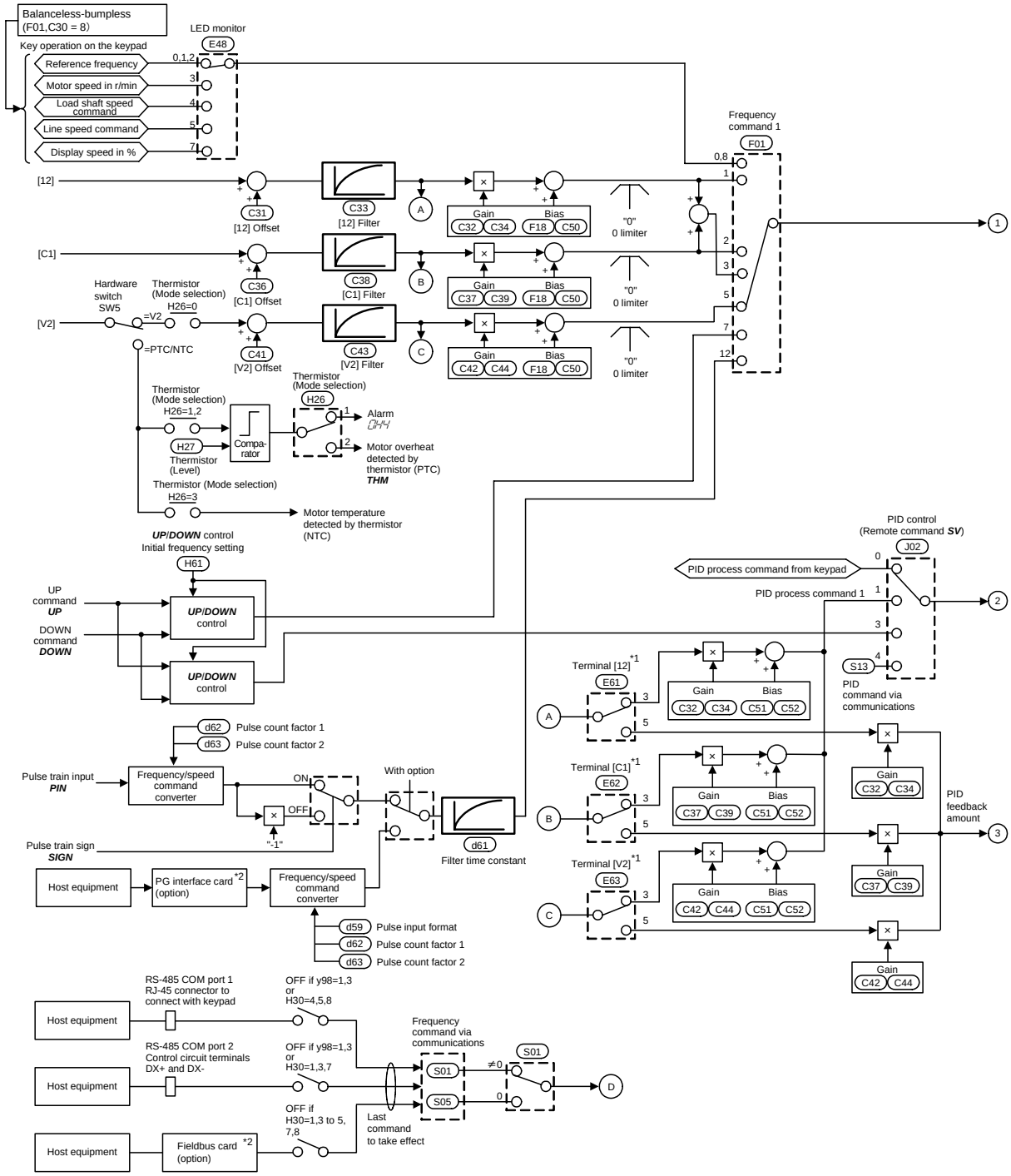
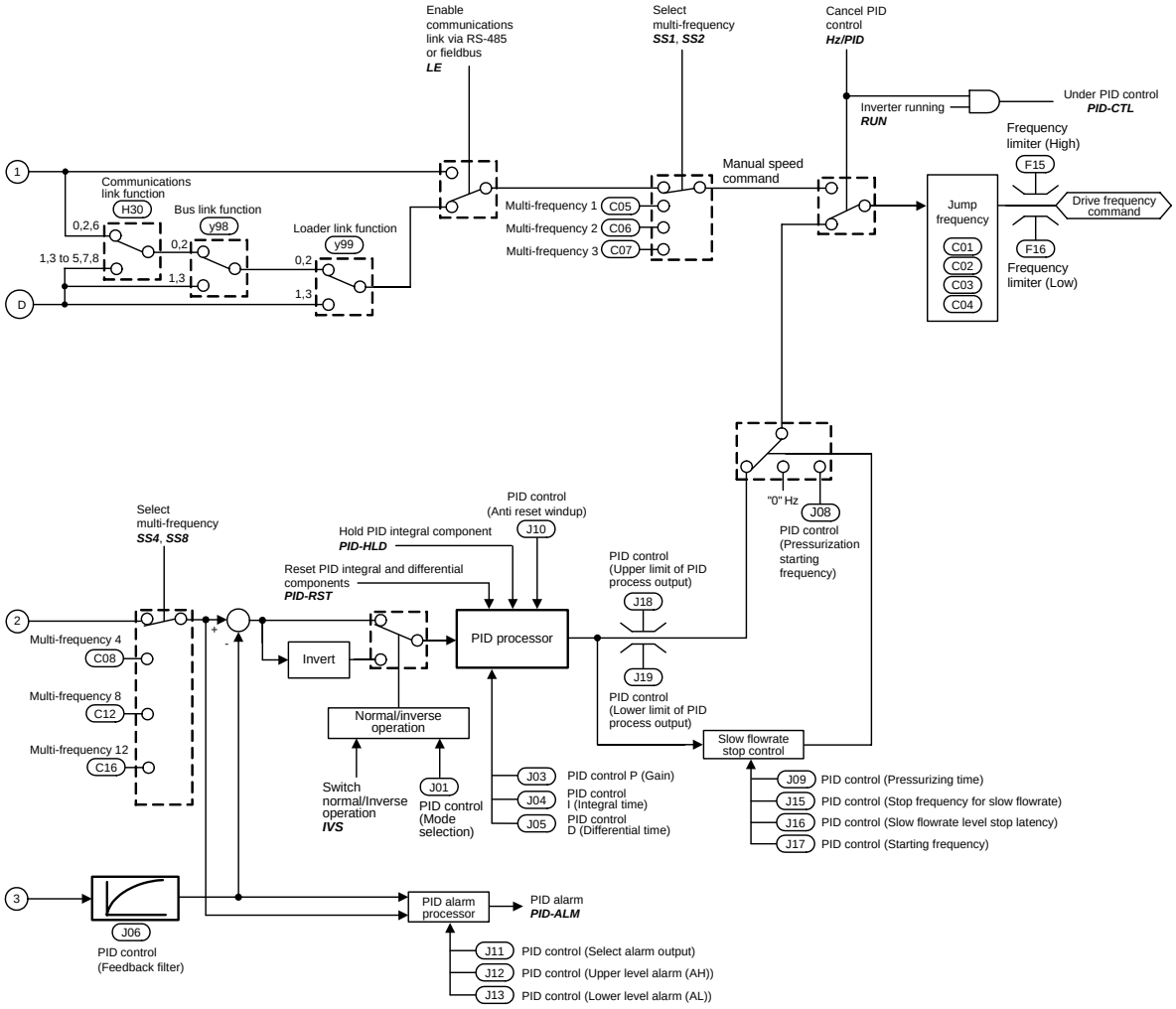


Figure 6.5 (1) PID Process Control Block



*1 Takes priority when the same function has been assigned by E61, E62 and E63:
Terminal [12] > Terminal [C1] > Terminal [V2]

*2 For details of the options, refer to the instruction manual for each option.

Note:
S codes are communication-related function codes. Refer to the RS-485 Communication User's Manual for details.

Figure 6.5 (2) PID Process Control Block

6.6 PID Dancer Control Block

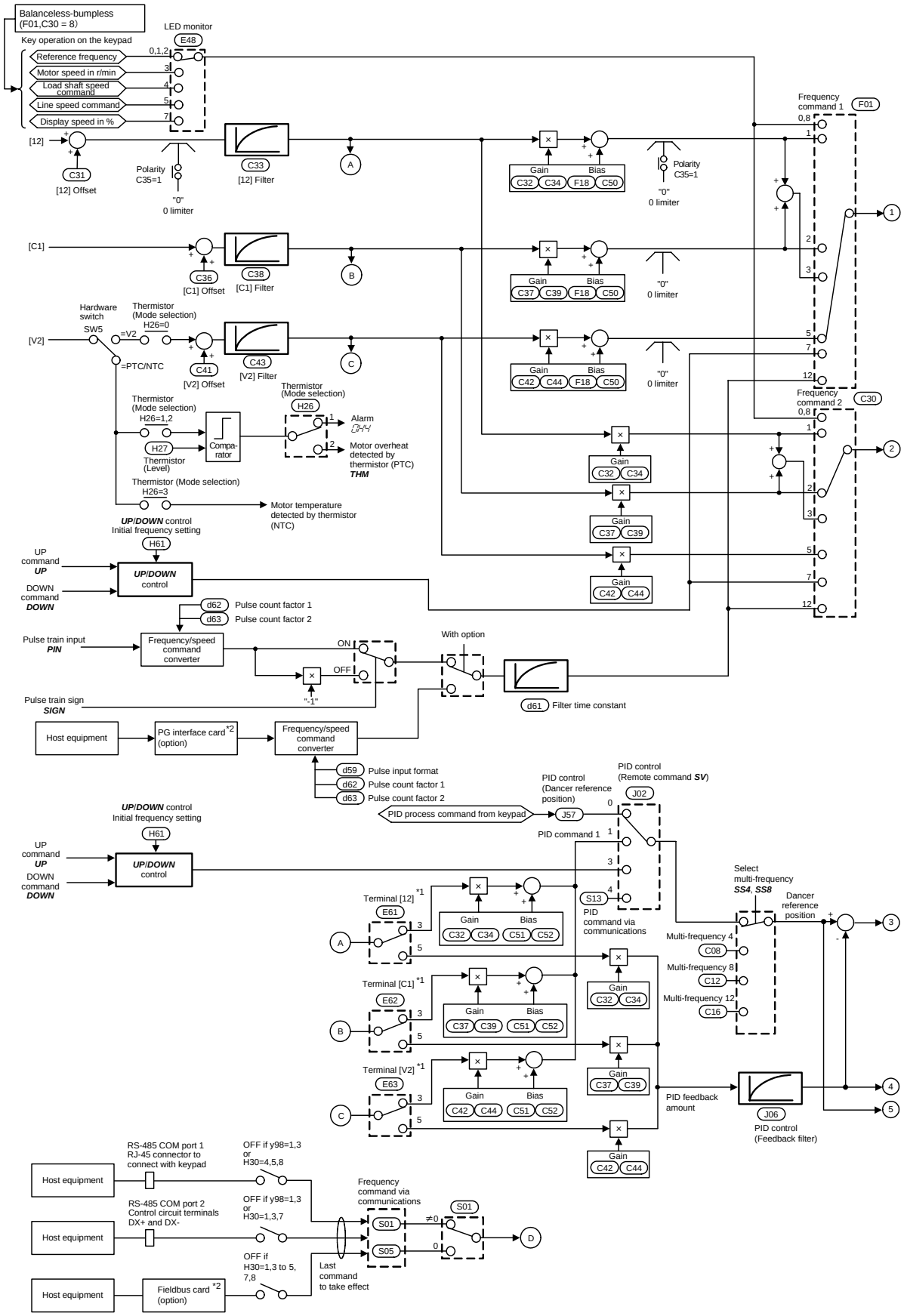
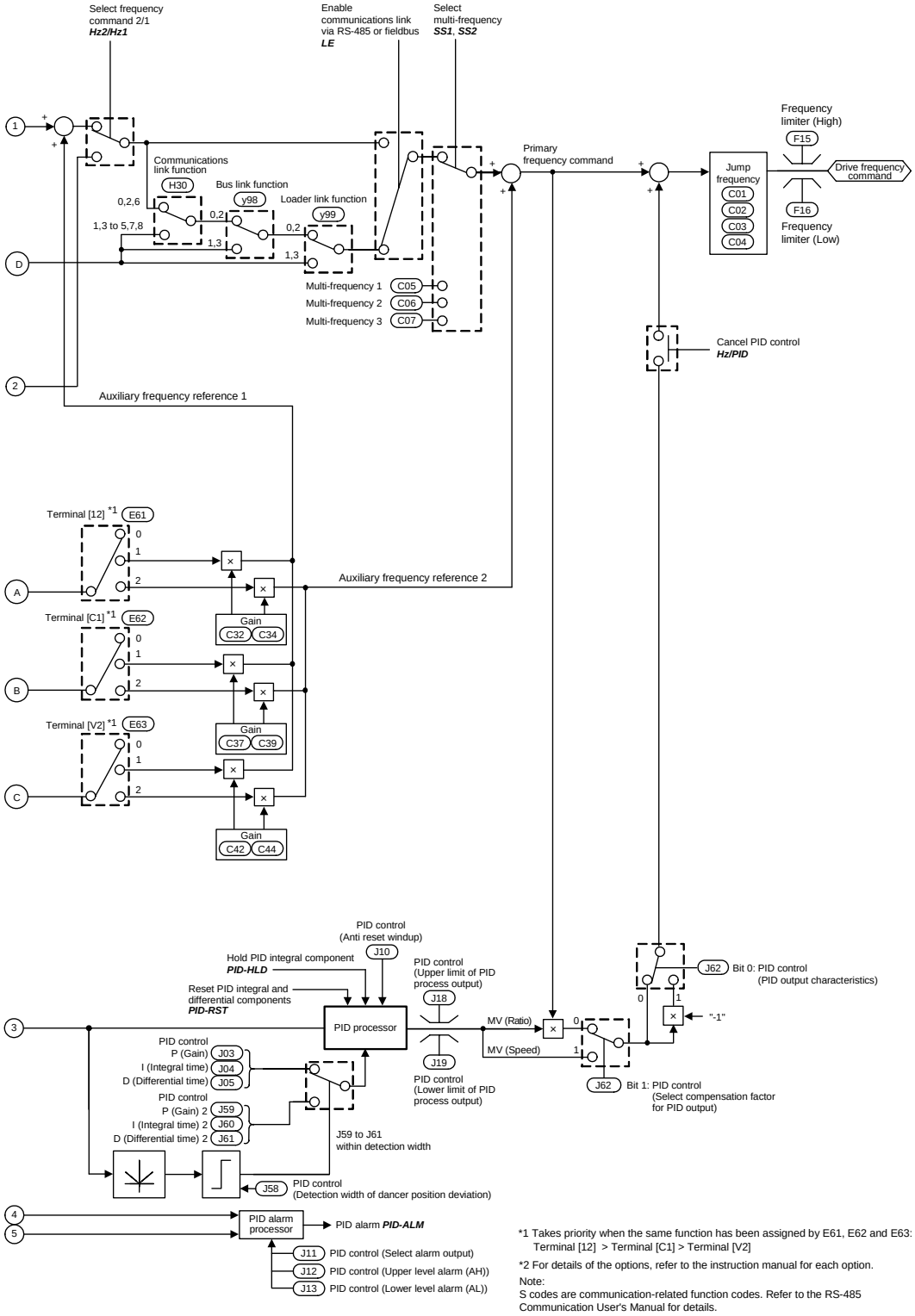


Figure 6.6 (1) PID Dancer Control Block



*1 Takes priority when the same function has been assigned by E61, E62 and E63: Terminal [12] > Terminal [C1] > Terminal [V2]

*2 For details of the options, refer to the instruction manual for each option.

Note:
S codes are communication-related function codes. Refer to the RS-485 Communication User's Manual for details.

Figure 6.6 (2) PID Dancer Control Block

6.7 FMA/FMP Output Selector

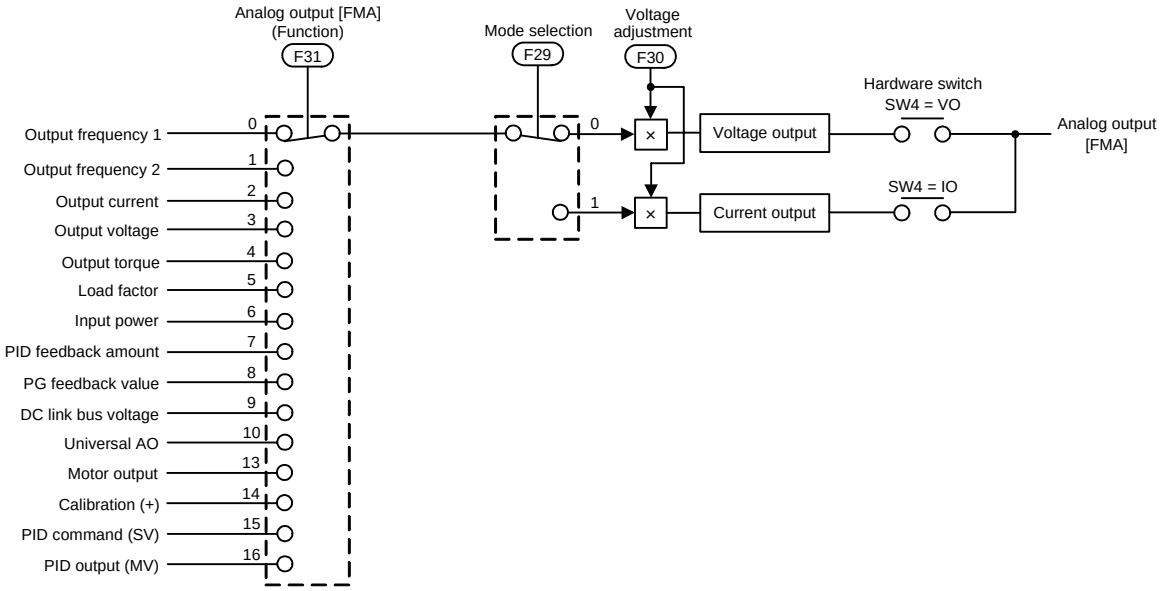


Figure 6.7 Terminal [FMA] Output Selector

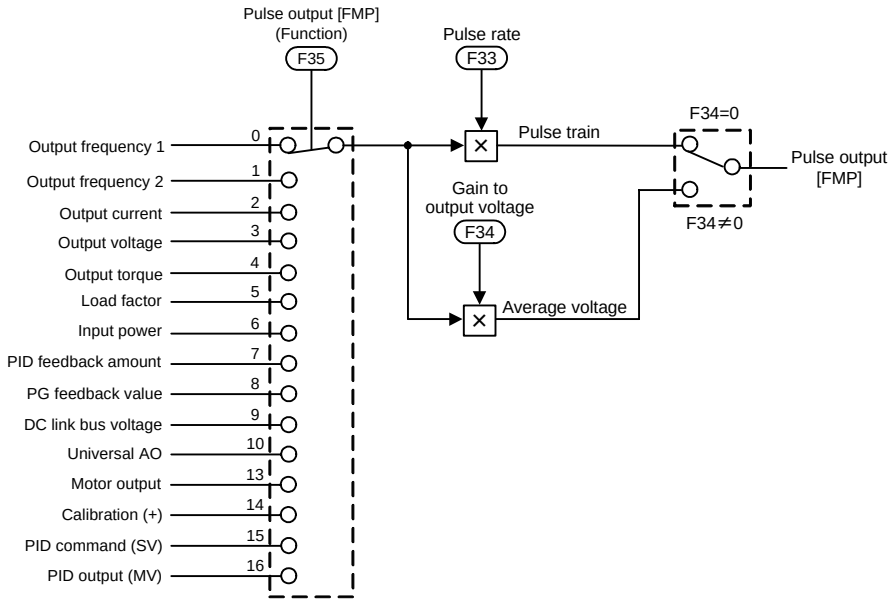


Figure 6.8 Terminal [FMP] Output Selector

Chapter 7

KEYPAD FUNCTIONS
(OPERATING WITH THE KEYPAD)

This chapter describes the names and functions of the keypad and 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.

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7.1 LED Monitor, Keys and LED Indicators on the Keypad

As shown at the right, the keypad consists of a four-digit LED monitor, six keys, and five LED indicators.

The keypad allows you to run and stop the motor, monitor the running status, specify the function code data, and monitor I/O signal states, maintenance information, and alarm information.

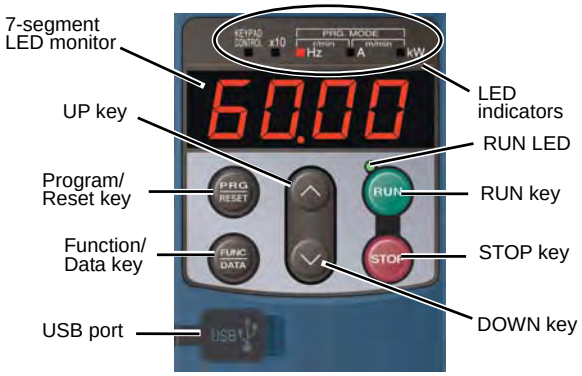

Figure 7.1 Keypad

Table 7.1 Overview of Keypad Functions

Item	LED Monitor, Keys, and LED Indicators	Functions
LED Monitor	60.00	Four-digit, 7-segment LED monitor which displays the followings according to the operation modes. ▪ In Running mode: Running status information (e.g., output frequency, current, and voltage) When a light alarm occurs, L-AL is displayed. ▪ In Programming mode: Menus, function codes and their data ▪ In Alarm mode: Alarm code, which identifies the alarm factor when the protective function is activated.
Operation Keys	PRG RESET	Program/Reset key which switches the operation modes of the inverter. ▪ In Running mode: Pressing this key switches the inverter to Programming mode. ▪ In Programming mode: Pressing this key switches the inverter to Running mode. ▪ In Alarm mode: Pressing this key after removing the alarm factor will switch the inverter to Running mode.
	FUNC DATA	Function/Data key which switches the operations you want to do in each mode as follows: ▪ In Running mode: Pressing this key switches the information to be displayed concerning the status of the inverter (output frequency (Hz), output current (A), output voltage (V), etc.). When a light alarm is displayed, holding down this key resets the light alarm and switches back to Running mode. ▪ In Programming mode: Pressing this key displays the function code or establishes the data entered with ∧ and ∨ keys. ▪ In Alarm mode: Pressing this key displays the details of the problem indicated by the alarm code that has come up on the LED monitor.
	RUN	RUN key. Press this key to run the motor.
	STOP	STOP key. Press this key to stop the motor.
	∧ and ∨	UP and DOWN keys. Press these keys to select the setting items and change the function code data displayed on the LED monitor.
LED Indicators	RUN LED	Lights when running with a run command entered by the RUN key, by terminal command ***FWD*** or ***REV***, or through the communications link.
	KEYPAD CONTROL LED	Lights when the inverter is ready to run with a run command entered by the RUN key (F02 = 0, 2, or 3). In Programming and Alarm modes, however, pressing the RUN key cannot run the inverter even if this indicator lights.

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Table 7.1 Overview of Keypad Functions (continued)

Item	LED Monitor, Keys, and LED Indicators	Functions
LED Indicators	Unit LEDs (3 LEDs)	These three LED indicators identify the unit of numeral displayed on the LED monitor in Running mode by combination of lit and unlit states of them. Unit: Hz, A, kW, r/min and m/min Refer to Section 7.3.1 "Monitoring the running status" for details. While the inverter is in Programming mode, the LEDs of Hz and kW light. ■ Hz □ A ■ kW
	x10 LED	Lights when the data to display exceeds 9999. When this LED lights, the "displayed value x 10" is the actual value. Example: If the LED monitor displays 1234 and the x10 LED lights, it means that the actual value is "1,234 × 10 = 12,340."
USB port		The USB port with a mini B connector enables the inverter to connect with a PC with a USB cable.

■ LED monitor

In Running mode, the LED monitor displays running status information (output frequency, current or voltage); in Programming mode, it displays menus, function codes and their data; and in Alarm mode, it displays an alarm code which identifies the alarm factor if the protective function is activated.

If one of LED4 through LED1 is blinking, it means that the cursor is at this digit, allowing you to change it.

If the decimal point of LED1 is blinking, it means that the currently displayed data is a value of the PID command, not the frequency data usually displayed.

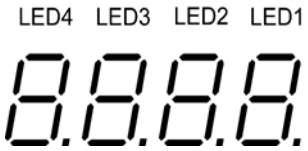

Figure 7.2 7-Segment LED Monitor

Table 7.2 Alphanumeric Characters on the LED Monitor

Character	7-segment	Character	7-segment	Character	7-segment	Character	7-segment
0	0	9	9	i	ı	r	r
1	1	A	A	J	J	S	S
2	2	b	b	K	K	T	t
3	3	C	C	L	L	u	u
4	4	d	d	M	M	V	V
5	5	E	E	n	n	W	W
6	6	F	F	o	o	X	X
7	7	G	G	P	P	y	y
8	8	H	H	q	q	Z	Z
Special characters and symbols (numbers with decimal point, minus and underscore)							
0. - 9.	0. – 9.	-	-	_	_		

■ Simultaneous keying

Simultaneous keying means pressing two keys at the same time. The FRENIC-MEGA supports simultaneous keying as listed below. The simultaneous keying operation is expressed by a "+" letter between the keys throughout this manual.

(For example, the expression "STOP + ⌃ keys" stands for pressing the ⌃ key while holding down the STOP key.)

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7.2 Overview of Operation Modes

FRENIC-MEGA features the following three operation modes:

■ Running mode : After powered ON, the inverter automatically enters this mode.

This mode allows you to specify the reference frequency, PID command value and etc., and run/stop the motor with the RUN / STOP keys.

It is also possible to monitor the running status in real time.

If a light alarm occurs, the L-AL appears on the LED monitor.

■ Programming mode : This mode allows you to configure function code data and check a variety of information relating to the inverter status and maintenance.

■ Alarm mode : If an alarm condition arises, the inverter automatically enters Alarm mode. In this mode, you can view the corresponding alarm code* and its related information on the LED monitor.

* Alarm code: Indicates the cause of the alarm condition. For details, refer to Chapter 2, Section 2.9 "Protective Functions" and Section 7.4.7 "Reading alarm information" in this Chapter.

Figure 7.3 shows the status transition of the inverter between these three operation modes. If the inverter is turned ON, it automatically enters Running mode, making it possible to start or stop the motor.

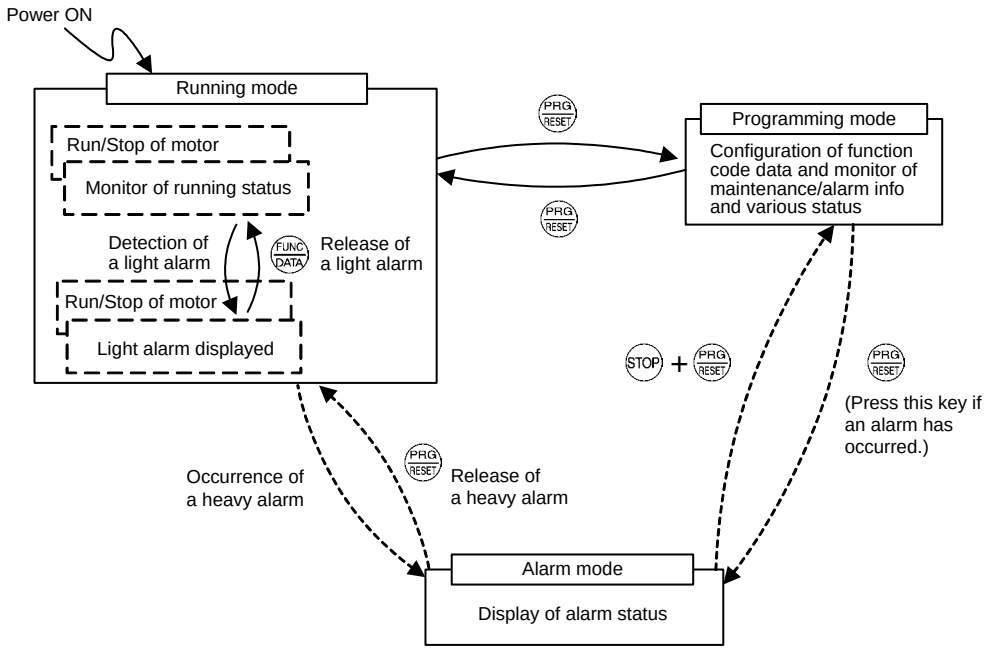
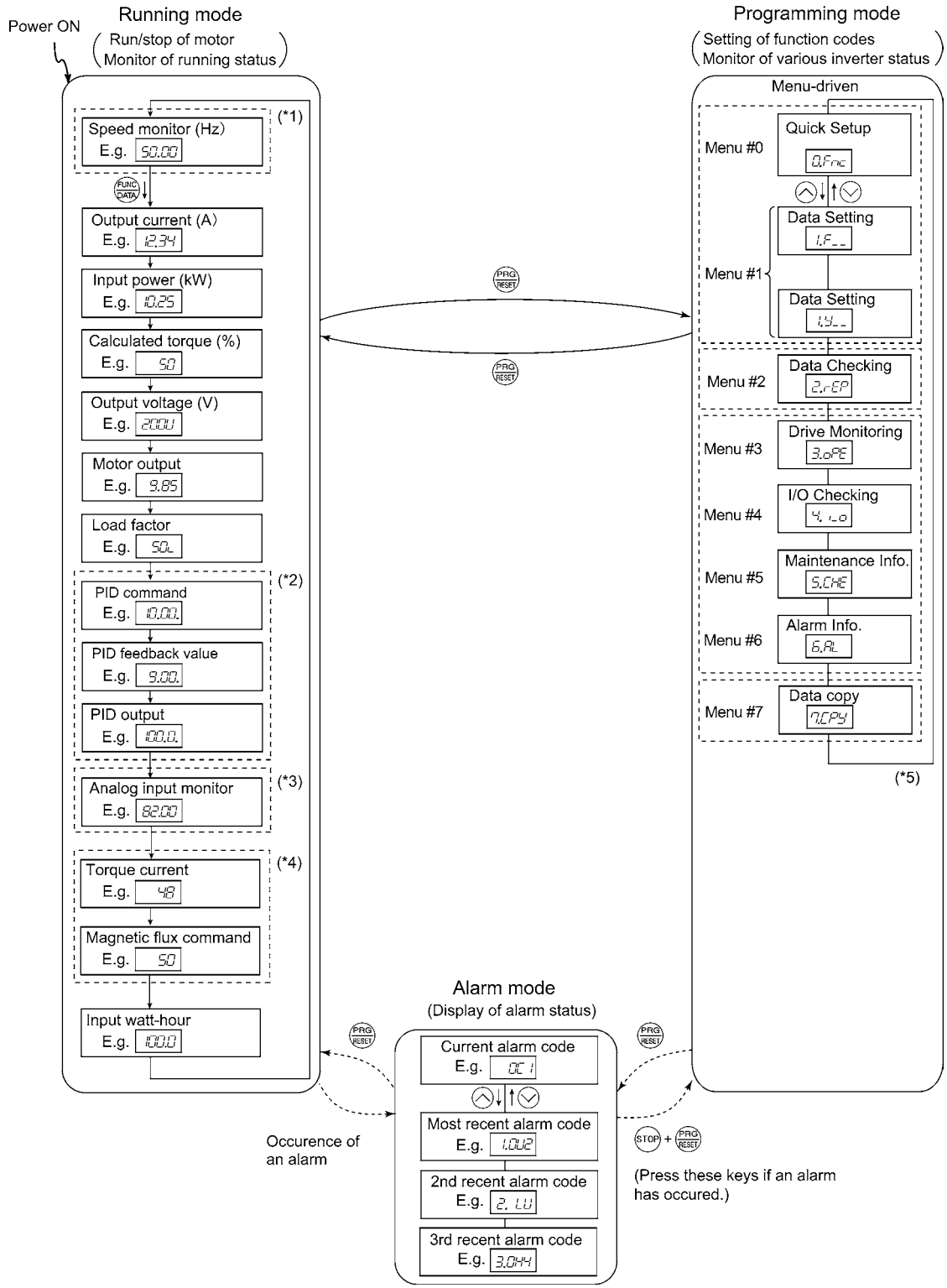


Figure 7.3 Status Transition between Operation Modes

Figure 7.4 illustrates the transition of the LED monitor screen during Running mode, the transition between menu items in Programming mode, and the transition between alarm codes at different occurrences in Alarm mode.



(*1) The speed monitor allows you to select the desired one from the seven speed monitor items by using function code E48.

(*2) Applicable only when PID control is active (J01 = 1, 2 or 3).

(*3) The analog input monitor can appear only when the analog input monitor function is assigned to any of the analog input terminals by any of function codes E61 to E63 (= 20).

(*4) appears under the V/f control.

(*5) Applicable only when the full-menu mode is selected (E52 = 2).

Figure 7.4 Transition between Basic Screens in Individual Operation Mode

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7.3 Running Mode

When the inverter is turned on, it automatically enters Running mode in which you can:

(1) Monitor the running status (e.g., output frequency and output current),
(2) Configure the reference frequency and other settings,
(3) Run/stop the motor,
(4) Jog (inch) the motor,
(5) Switch between remote and local modes, and
(6) Monitor light alarms

7.3.1 Monitoring the running status

In Running mode, the fourteen items listed below can be monitored. Immediately after the inverter is turned on, the monitor item specified by function code E43 is displayed. Press the FUNC/DATA key to switch between monitor items.

Table 7.3 Monitoring Items

Monitor items	Display sample on the LED monitor *1	LED indicator ■: on, □: off	Unit	Meaning of displayed value	Function code data for E43
Speed monitor	Function code E48 specifies what to be displayed on the LED monitor and LED indicators.				0
Output frequency 1 (before slip compensation)	50.00	■Hz □A □kW	Hz	Frequency actually being output	(E48 = 0)
Output frequency 2 (after slip compensation)	50.00	■Hz □A □kW	Hz	Frequency actually being output	(E48 = 1)
Reference frequency	50.00	■Hz □A □kW	Hz	Reference frequency being set	(E48 = 2)
Motor speed	1500	■Hz ■A □kW	r/min	Output frequency (Hz) × 120 / P01	(E48 = 3)
Load shaft speed	300.0	■Hz ■A □kW	r/min	Output frequency (Hz) × E50	(E48 = 4)
Line speed	300.0	□Hz ■A ■kW	m/min	Output frequency (Hz) × E50	(E48 = 5)
Speed (%)	50.0	□Hz □A □kW	%	Output frequency / Maximum frequency x 100	(E48 = 7)
Output current	12.34	□Hz ■A □kW	A	Current output from the inverter in RMS	3
Output voltage *2	200.0	□Hz □A □kW	V	Voltage output from the inverter in RMS	4
Calculated torque	50	□Hz □A □kW	%	Motor output torque in % (Calculated value)	8
Input power	10.25	□Hz □A ■kW	kW	Input power to the inverter	9
PID command *3, *4	10.00.	□Hz □A □kW	—	PID command/feedback amount converted to a physical quantity of the object to be controlled (e.g. temperature) Refer to function codes E40 and E41 for details.	10
PID feedback amount *3, *5	9.00.	□Hz □A □kW	—		12
PID output *3, *4	100.0.	□Hz □A □kW	%	PID output in % as the maximum frequency (F03) being at 100%	14
Load factor *6	50L	□Hz □A □kW	%	Load factor of the motor in % as the rated output being at 100%	15
Motor output *7	9.85	□Hz □A ■kW	kW	Motor output in kW	16
Analog input monitor *8	82.00	□Hz □A □kW	—	An analog input to the inverter in a format suitable for a desired scale. Refer to function codes E40 and E41 for details.	17
Torque current *9	48	□Hz □A □kW	%	Torque current command value or calculated torque current	23
Magnetic flux command	50	□Hz □A □kW	%	Magnetic flux command value (Available only under vector control)	24
Input watt-hour	100.0	□Hz □A □kW	kWh	Input watt-hour (kWh) / 100	25

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*1 A value exceeding 9999 cannot be displayed as is on the 4-digit LED monitor screen, so the LED monitor displays one-tenth of the actual value with the x10 LED lit.

*2 When the LED monitor displays an output voltage, the 7-segment letter "U" in the lowest digit stands for the unit of the voltage "V."

*3 These PID related items appear only when the inverter drives the motor under the PID control specified by function code J01 (= 1, 2 or 3).

*4 When the LED monitor displays a PID command or its output amount, the dot (decimal point) attached to the lowest digit of the 7-segment letter blinks.

*5 When the LED monitor displays a PID feedback amount, the dot (decimal point) attached to the lowest digit of the 7-segment letter lights.

*6 When the LED monitor displays a load factor, the 7-segment letter "L" in the lowest digit stands for "%."

*7 When the LED monitor displays the motor output, the unit LED indicator "kW" blinks.

*8 The analog input monitor can appear only when the analog input monitor function is assigned to any of the analog input terminals by any of function codes E61 to E63 (= 20).

*9 "V" appears under the V/f control.

Function code E42 (LED display filter) allows you to filter the monitoring signals for the monitor items such as output frequency and output current. Increase the E42 data if the monitored values are unstable and unreadable due to fluctuation of load.

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7.3.2 Monitoring light alarms

The FRENIC-MEGA identifies abnormal states in two categories--Heavy alarm and Light alarm. If the former occurs, the inverter immediately trips; if the latter occurs, the inverter shows the L-AL on the LED monitor and blinks the KEYPAD CONTROL LED but it continues to run without tripping.

Which abnormal states are categorized as a light alarm ("Light alarm" object) should be defined with function codes H81 and H82 beforehand.

Assigning the ***LALM*** signal to any one of the digital output terminals with any of function codes E20 to E24 and E27 (= 98) enables the inverter to output the ***LALM*** signal on that terminal upon occurrence of a light alarm.

For details of the light alarm objects, refer to Chapter 2, Section 2.9 "Protective Functions."

■ How to check a light alarm factor

If a light alarm occurs, L-AL appears on the LED monitor. To check the current light alarm factor, enter Programming mode by pressing the PRG/RESET key and select 5_36 on Menu #5 "Maintenance Information."

It is also possible to check the factors of the last three light alarms 5_37 (last) to 5_39 (3rd last).

For details of the menu transition of the maintenance information, refer to Section 7.4.6 "Reading maintenance information."

■ How to reset a light alarm

After checking the current light alarm factor, to switch the LED monitor from the L-AL indication state back to the running status display (e.g., output frequency), press the FUNC/DATA key in Running mode.

If the light alarm factor has been removed, the KEYPAD CONTROL LED stops blinking and the ***LALM*** signal turns OFF. If not (e.g. DC fan lock), the KEYPAD CONTROL LED continues blinking and the ***LALM*** signal remains ON.

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7.3.3 Setting up frequency and PID commands

You can set up the desired frequency and PID commands by using ⌃ and ⌄ keys on the keypad. It is also possible to set up the frequency command as load shaft speed, motor speed or speed (%) by setting function code E48.

■ Setting up a frequency command

Using the keypad (F01 = 0 (factory default) or 8)

(1) Set function code F01 to "0" or "8" (⌃ / ⌄ keys on keypad). This can be done only when the inverter is in Running mode.

(2) Press the ⌃ / ⌄ key to display the current reference frequency. The lowest digit will blink.

(3) To change the reference frequency, press the ⌃ / ⌄ key again. The new setting can be saved into the inverter's internal memory.

Tip

- The reference frequency will be saved either automatically by turning the main power OFF or only by pressing the PRG/RESET key. You can choose either way using function code E64.
- If you have set function code F01 to "0" or "8" (⌃ / ⌄ keys on keypad) but have selected a frequency command source other than frequency command 1 (i.e., frequency command 2, frequency command via communication, or multi-frequency command), then the ⌃ and ⌄ keys are disabled to change the current frequency command even in Running mode. Pressing either of these keys just displays the current reference frequency.
- When you start specifying the reference frequency or any other parameter with the ⌃ / ⌄ key, the least significant digit on the display blinks; that is, the cursor lies in the least significant digit. Holding down the ⌃ / ⌄ key changes data in the least significant digit and generates a carry, while the cursor remains in the least significant digit.
- After the least significant digit blinks by pressing the ⌃ / ⌄ key, holding down the PRG/RESET key for more than 1 second moves the cursor from the least significant digit to the most significant digit. Further holding it down moves the cursor to the next lower digit. This cursor movement allows you to easily move the cursor to the desired digit and change the data in higher digits.
- Setting F01 data to "8" (⌃ / ⌄ keys on keypad) enables the balanceless-bumpless switching. When the frequency command source is switched to the keypad from any other source, the inverter inherits the current frequency that has applied before switching, providing smooth switching and shockless running.

Using analog input (F01 = 1 to 3, or 5)

- Applying the gain and bias to analog inputs (voltage inputs to terminals [12] and [V2], and current input to terminal [C1]) enables the frequency to be set within an arbitrary range (frequency vs. analog input level).

  (Refer to the description of F18.)
- Noise reduction filters are applicable to these analog inputs.

  (Refer to the descriptions of C33, C38 and C43.)
- The normal/inverse operation for the frequency command 1 setting (F01) can be selected with function code C53 and be switched between them with the terminal command IVS assigned to any of the digital input terminals.

  (Refer to the descriptions of E01 through E09.)

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Note

- To input bipolar analog voltage (0 to ±10 VDC) to terminals [12] and [V2], set C35 and C45 data to "0." Setting C35 and C45 data to "1" enables the voltage range from 0 to +10 VDC and interprets the negative polarity input from 0 to -10 VDC as 0 V.
- A reference frequency can be specified not only with the frequency (Hz) but also with other menu items, depending on the setting of function code E48 (= 3 to 5, or 7).

■ Settings under PID process control

To enable the PID process control, you need to set the J01 data to "1" or "2."

Under the PID control, the items that can be specified or checked with ⏶ and ⏷ keys are different from those under regular frequency control, depending upon the current LED monitor setting. If the LED monitor is set to the speed monitor (E43 = 0), you can access manual speed commands (frequency command) with ⏶ and ⏷ keys; if it is set to any other, you can access the PID process command with those keys.

Setting the PID process command with ⏶ and ⏷ keys

(1) Set function code J02 to "0" (⏶ / ⏷ keys on keypad).

(2) Set the LED monitor to something other than the speed monitor (E43=0) when the inverter is in Running mode. When the keypad is in Programming or Alarm mode, you cannot modify the PID process command with the ⏶ / ⏷ key. To enable the PID process command to be modified with the ⏶ / ⏷ key, first switch to Running mode.

(3) Press the ⏶ / ⏷ key to display the PID process command. The lowest digit and its decimal point blink on the LED monitor.

(4) To change the PID process command, press the ⏶ / ⏷ key again. The new setting can be saved into the inverter's internal memory.

Tip

- The PID process command will be saved either automatically by turning the main power OFF or only by pressing the PRG/RESET key. You can choose either way using function code E64.
- Even if multi-frequency is selected as a PID command (***SS4*** or ***SS8*** = ON), it is possible to set a PID command using the keypad.
- When function code J02 is set to any value other than "0," pressing the ⏶ / ⏷ key displays, on the LED monitor, the PID command currently selected, while you cannot change the setting.
- On the LED monitor, the decimal point of the lowest digit is used to discriminate the PID related data from the reference command. The decimal point blinks or lights when a PID command or PID feedback amount is displayed, respectively.

Table 7.4 PID Process Command Manually Set with ⌃ / ⌄ Key and Requirements

PID control (Mode selection) J01	PID control (Remote command SV) J02	LED monitor E43	Multi- frequency ***SS4***, ***SS8***	With ⌃ / ⌄ key
1 or 2	0	Other than 0	ON or OFF	PID process command by keypad
	Other than 0			PID process command currently selected

Setting up the frequency command with ⌃ and ⌄ keys under PID process control

When function code F01 is set to "0" (⌃ / ⌄ keys on keypad) and frequency command 1 is selected as a manual speed command (when disabling the frequency setting command via communications link, multi-frequency command, and PID control), switching the LED monitor to the speed monitor in Running mode enables you to modify the frequency command with the ⌃ / ⌄ keys.

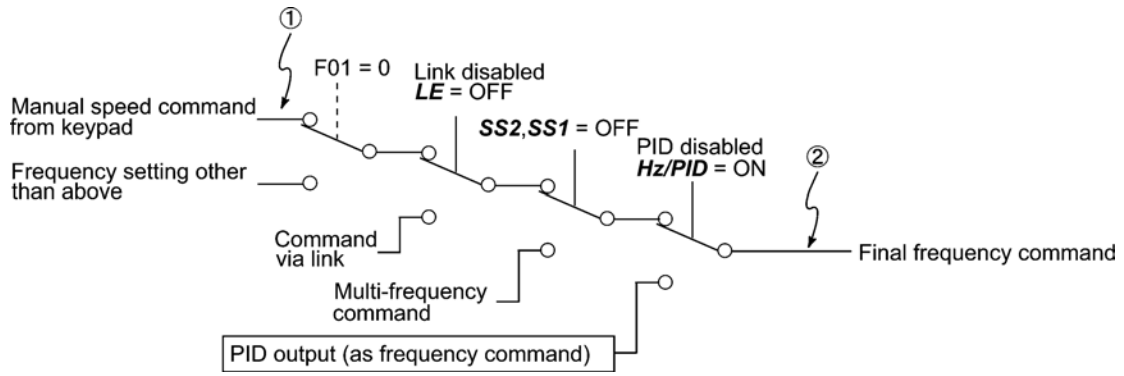
In Programming or Alarm mode, the ⌃ / ⌄ keys are disabled to modify the frequency command. You need to switch to Running mode.

Table 7.5 lists the combinations of the commands and the figure illustrates how the manual speed command ① entered via the keypad is translated to the final frequency command ②.

The setting procedure is the same as that for setting of a usual frequency command.

Table 7.5 Manual Speed (Frequency) Command Specified with ⌃ / ⌄ Keys and Requirements

PID control (Mode selection) J01	LED monitor E43	Frequency command 1 F01	Multi-frequency ***SS2***	Multi-frequency ***SS1***	Communi-cations link operation ***LE***	Cancel PID control ***Hz/PID***	Pressing ⌃ / ⌄ keys controls:
1 or 2	0	0	OFF	OFF	OFF	OFF (PID enabled)	PID output (as final frequency command)
						ON (PID disabled)	Manual speed (frequency) command set by keypad
		Other than the above				OFF (PID enabled)	PID output (as final frequency command)
						ON (PID disabled)	Manual speed (frequency) command currently selected



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■ Settings under PID dancer control

To enable the PID dancer control, you need to set the J01 data to "3."

Under the PID control, the items that can be specified or checked with ⌃ and ⌄ keys are different from those under the regular frequency control, depending upon the current LED monitor setting. If the LED monitor is set to the speed monitor (E43 = 0), the item accessible is the primary frequency command; if it is set to any other data, it is the PID dancer position command.

Setting the PID dancer position command with the ⌃ and ⌄ keys

(1) Set the J02 data to "0" (⌃ / ⌄ keys on keypad).

(2) Set the LED monitor to something other than the speed monitor (E43=0) when the inverter is in Running mode. When the keypad is in Programming or Alarm mode, you cannot modify the PID command with the ⌃ / ⌄ key. To enable the PID dancer position command to be modified with the ⌃ / ⌄ key, first switch to Running mode.

(3) Press the ⌃ / ⌄ key to display the PID dancer position command. The lowest digit blinks on the LED monitor.

(4) To change the PID dancer position command, press the ⌃ / ⌄ key again. The command you have specified will be automatically saved into the inverter's internal memory as function code J57 data. It is retained even if you temporarily switch to another PID command source and then go back to the via-keypad PID command. Furthermore, you can directly configure the command with function code J57.

Tip

- Even if multi-frequency is selected as a PID command (***SS4*** or ***SS8*** = ON), it is possible to set a PID command using the keypad.
- When the J02 data is set to any value other than "0," pressing the ⌃ / ⌄ key displays, on the LED monitor, the PID command currently selected, while you cannot change the setting.
- On the LED monitor, the decimal point of the lowest digit is used to discriminate the PID related data from the reference command. The decimal point blinks or lights when a PID command or PID feedback amount is displayed, respectively.

Table 7.6 PID Command Manually Set with ⌃ / ⌄ Key and Requirements

PID control (Mode selection) J01	PID control (Remote command SV) J02	LED monitor E43	Multi- frequency ***SS4***, ***SS8***	With ⌃ / ⌄ key
3	0	Other than 0	ON or OFF	PID command by keypad
	Other than 0			PID command currently selected

Setting up the primary frequency command with ⌃ and ⌄ keys under PID dancer control

When function code F01 is set to "0" (⌃ / ⌄ keys on keypad) and frequency command 1 is selected as a primary frequency command (when disabling the frequency setting command via communications link, multi-frequency command, and PID control), switching the LED monitor to the speed monitor in Running mode enables you to modify the frequency command with the ⌃ / ⌄ keys.

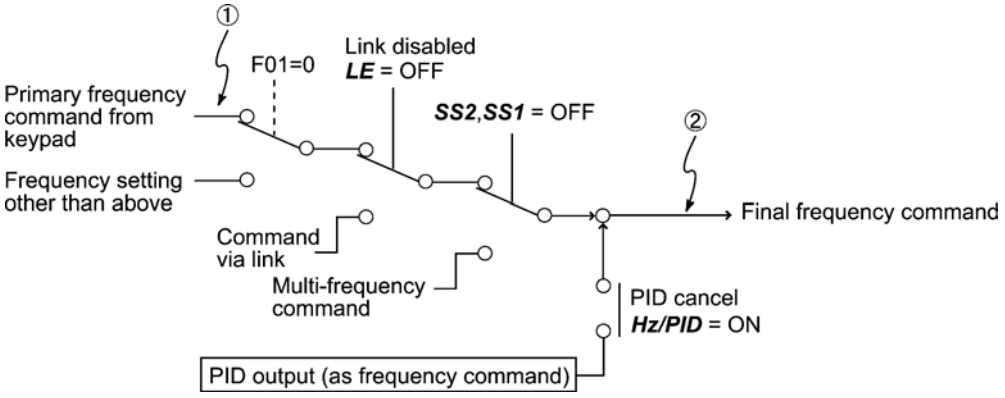
In Programming or Alarm mode, the ⌃ / ⌄ keys are disabled to modify the frequency command. You need to switch to Running mode.

Table 7.7 lists the combinations of the commands and the figure illustrates how the primary frequency command ① entered via the keypad is translated to the final frequency command ②.

The setting procedure is the same as that for setting of a usual frequency command.

Table 7.7 Primary Frequency Command Specified with ⌃ / ⌄ Keys and Requirements

PID control (Mode selection) J01	LED monitor E43	Frequency command 1 F01	Multi-frequency ***SS2***	Multi-frequency ***SS1***	Communi-cations link operation ***LE***	Cancel PID control ***Hz/PID***	Pressing ⌃ / ⌄ keys controls:
3	0	0	OFF	OFF	OFF	OFF (PID enabled)	Final frequency command modified by PID output
						ON (PID disabled)	Keypad primary command (Frequency)
		Other than the above				OFF (PID enabled)	Final frequency command modified by PID output
						ON (PID disabled)	Current primary command (Frequency)



7.3.4 Running/stopping the motor

By factory default, pressing the RUN key starts running the motor in the forward direction and pressing the STOP key decelerates the motor to stop. The RUN key is enabled only in Running mode.

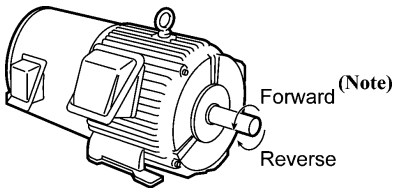
The motor rotational direction can be selected by changing the setting of function code F02.

■ Operational relationship between function code F02 (Operation method) and RUN key

Table 3.6 lists the relationship between function code F02 settings and the RUN key, which determines the motor rotational direction.

Table 7.8 Motor Rotational Direction Specified by F02

Data for F02	Pressing the RUN key runs the motor:
0	In the direction commanded by terminal [FWD] or [REV]
1	RUN key disabled (The motor is driven by terminal [FWD] or [REV] command.)
2	In the forward direction
3	In the reverse direction



(Note) The rotational direction of IEC-compliant motors is opposite to that of the motor shown here.

For the details on operations with function code F02, refer to Chapter 5 "FUNCTION CODES."

7.3.5 Jogging Operation

This section provides the procedure for jogging the motor.

(1) Making the inverter ready to jog with the steps below. The LED monitor should display JOG.

Enter Running mode (see page 7-5) and press the STOP + ∧ keys simultaneously.

The LED monitor displays the jogging frequency for approximately one second and then returns to JOG again.

Tip

- Function codes C20 and H54 specify the jogging frequency and acceleration/deceleration time, respectively. Use these function codes exclusively for the jogging operation with your needs.
- Using the input terminal command "Ready for jogging" ***JOG*** switches between the normal operation state and ready-to-jog state.
- Switching between the normal operation state and read-to-jog state with the STOP + ∧ keys is possible only when the inverter is stopped.

(2) Jogging the motor.

Hold down the RUN key during which the motor continues jogging. To decelerate to stop the motor, release the key.

(3) Exiting the ready-to-jog state and returning to the normal operation state.

- Press the STOP + ∧ keys simultaneously.

For details, refer to the descriptions of function codes E01 to E09 in Chapter 5, Section 5.4.2 "E codes (Extension terminal functions)."

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7.3.6 Remote and local modes

The inverter is available in either remote or local mode. In the remote mode that applies to ordinary operation, the inverter is driven under the control of the data settings stored in the inverter, whereas in the local mode that applies to maintenance operation, it is separated from the control system and is driven manually under the control of the keypad.

- Remote mode: Run and frequency commands are selected by function codes or source switching signals except "Select local (keypad) operation" ***LOC***.
- Local mode: The command source is the keypad, regardless of the settings specified by function codes. The keypad takes precedence over the settings specified by communications link operation signals.

Run commands from the keypad in local mode

The table below shows the input procedures of run commands from the keypad in the local mode.

When Data for F02 (run command) is :	Input Procedures of Run Commands from Keypad
0: Enable (RUN) / (STOP) keys on keypad (Motor rotational direction from digital terminals [FWD]/[REV])	Pressing the (RUN) key runs the motor in the direction specified by command ***FWD*** or ***REV*** assigned to terminal [FWD] or [REV], respectively. Pressing the (STOP) key stops the motor.
1: Enable terminal command ***FWD***/***REV***	Pressing the (RUN) key runs the motor in the forward direction only. Pressing the (STOP) key stops the motor. No specification of the motor rotational direction is required.
2: Enable (RUN) / (STOP) keys on keypad (Forward)	
3: Enable (RUN) / (STOP) keys on keypad (Reverse)	Pressing the (RUN) key runs the motor in the reverse direction only. Pressing the (STOP) key stops the motor. No specification of the motor rotational direction is required.

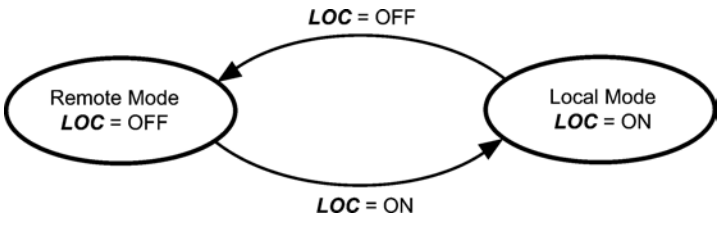
Switching between remote and local modes

The remote and local modes can be switched by a digital input signal provided from the outside of the inverter.

To enable the switching, you need to assign ***LOC*** as a digital input signal to any of terminals [X1] to [X9] by setting "35" to any of E01 to E09, E98 and E99.

Switching from remote to local mode automatically inherits the frequency settings used in remote mode. If the motor is running at the time of the switching from remote to local, the run command will be automatically turned ON so that all the necessary data settings will be carried over. If, however, there is a discrepancy between the settings used in remote mode and ones made on the keypad (e.g., switching from the reverse rotation in remote mode to the forward rotation only in local mode), the inverter automatically stops.

The transition paths between remote and local modes depend on the current mode and the value (ON/OFF) of ***LOC***, as shown in the status transition diagram given below. Also, refer to above table for details



Transition between Remote and Local Modes by ***LOC***

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7.3.7 External run/frequency command

By factory default, run and frequency commands are sourced from the keypad. This section provides other external command source samples--an external potentiometer (variable resistor) as a frequency command source and external run switches as run forward/reverse command sources.

Set up those external sources using the following procedure.

(1) Configure the function codes as listed below.

Function code	Name	Data	Factory default
F01	Frequency command 1	1: Analog voltage input to terminal [12]	0
F02	Operation method	1: External digital input signal	2
E98	Terminal [FWD] function	98: Run forward command ***FWD***	98
E99	Terminal [REV] function	99: Run reverse command ***REV***	99

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

(2) Wire the potentiometer to terminals across [13], [12], and [11].

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

(4) To start running the inverter, rotate the potentiometer to give a voltage to terminal [12] and then turn the run forward or reverse switch ON (short-circuit).

For precautions in wiring, refer to Chapter 2 "SPECIFICATIONS."

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7.4 Programming Mode

The Programming mode provides you with these functions--setting and checking function code data, monitoring maintenance information and checking input/output (I/O) signal status. The functions can be easily selected with the menu-driven system. Table 7.9 lists menus available in Programming mode. The leftmost digit (numerals) of each letter string on the LED monitor indicates the corresponding menu number and the remaining three digits indicate the menu contents.

When the inverter enters Programming mode from the second time on, the menu selected last in Programming mode will be displayed.

Table 7.9 Menus Available in Programming Mode

Menu #	Menu	LED monitor shows:	Main functions		Refer to:
0	"Quick Setup"	0.Func	Displays only basic function codes to customize the inverter operation.		Section 7.4.1
1	"Data Setting"	1.F_ _	F codes (Fundamental functions)	Selecting each of these function codes enables its data to be displayed/ changed.	Section 7.4.2
		1.E_ _	E codes (Extension terminal functions)		
		1.C_ _	C codes (Control functions)		
		1.P_ _	P codes (Motor 1 parameters)		
		1.H_ _	H codes (High performance functions)		
		1.A_ _	A codes (Motor 2 parameters)		
		1.b_ _	b codes (Motor 3 parameters)		
		1.r_ _	r codes (Motor 4 parameters)		
		1.J_ _	J codes (Application functions)		
		1.d_ _	d codes (Application functions 2)		
		1.y_ _	y codes (Link functions)		
		1.o_ _	o codes (Optional function) (Note)		
2	"Data Checking"	2.-CP	Displays only function codes that have been changed from their factory defaults. You can refer to or change those function code data.		Section 7.4.3
3	"Drive Monitoring"	3.dPE	Displays the running information required for maintenance or test running.		Section 7.4.4
4	"I/O Checking"	4. I_O	Displays external interface information.		Section 7.4.5
5	"Maintenance Information"	5.CHE	Displays maintenance information including cumulative run time.		Section 7.4.6
6	"Alarm Information"	6.AL	Displays the recent four alarm codes. You can refer to the running information at the time when the alarm occurred.		Section 7.4.7
7	"Data Copying"	7.CPY	Allows you to read or write function code data, as well as verifying it. Saving the function code data of the currently running inverter into the keypad and connecting it to a PC running FRENIC Loader enables data checking on the PC.		Section 7.4.8

(Note) The o codes are displayed only when the corresponding option is mounted. For details, refer to the Instruction Manual for the corresponding option.

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Figure 7.5 illustrates the menu-driven function code system in Programming mode.

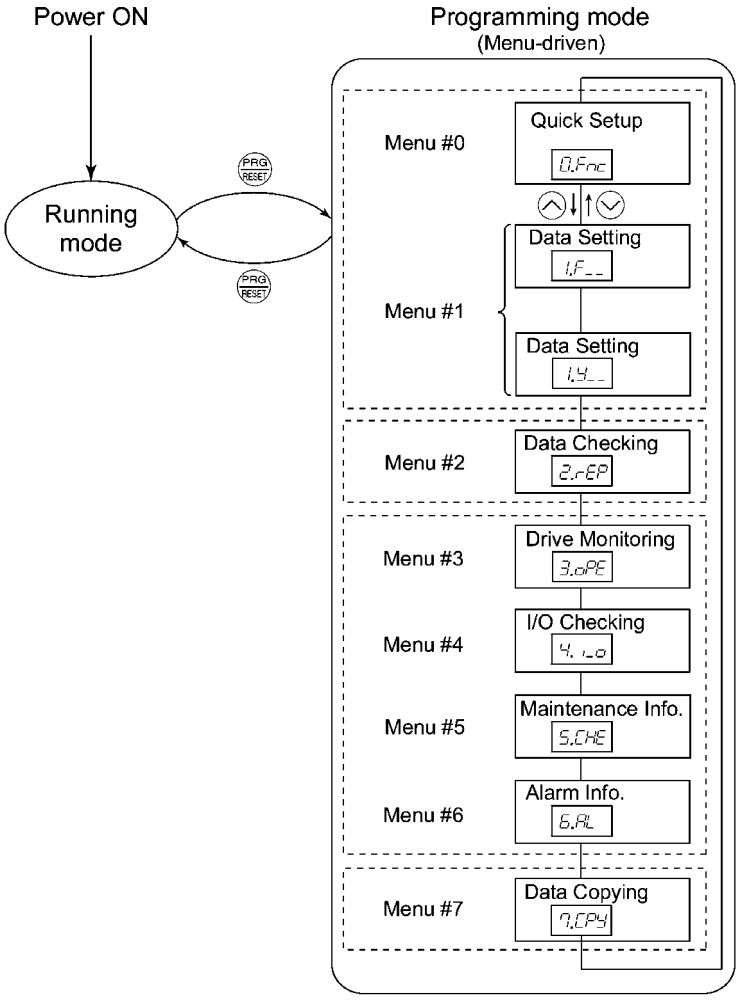

Figure 7.5 Menu Transition in Programming Mode

■ Selecting menus to display

The menu-driven system allows you to cycle through menus. To cycle through necessary menus only for simple operation, use function code E52 that provides a choice of three display modes as listed below.

The factory default (E52 = 0) is to display only three menus--Menu #0 "Quick Setup," Menu #1 "Data Setting" and Menu #7 "Data Copying," allowing no switching to any other menu.

Table 7.10 Keypad Display Mode Selection – Function Code E52

Data for E52	Mode	Menus selectable
0	Function code data editing mode (factory default)	Menu #0 "Quick Setup" Menu #1 "Data Setting" Menu #7 "Data Copying"
1	Function code data check mode	Menu #2 "Data Checking" Menu #7 "Data Copying"
2	Full-menu mode	Menus #0 through #7

Tip Press the PRG/RESET key to enter Programming mode and display menus. While cycling through the menus with the ▲ / ▼ key, select the desired menu item with the FUNC/DATA key. Once the entire menu has been cycled through, the display returns to the first menu item.

7.4.1 Setting up basic function codes quickly
-- Menu #0 "Quick Setup" --

Menu #0 "Quick Setup" in Programming mode allows you to quickly display and set up a basic set of function codes.

To use Menu #0 "Quick Setup," you need to set function code E52 to "0" (Function code data editing mode) or "2" (Full-menu mode).

The predefined set of function codes that are subject to quick setup are held in the inverter.

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Listed below are the function codes (including those not subject to quick setup) available on the FRENIC-MEGA. A function code is displayed on the LED monitor on the keypad in the following format:

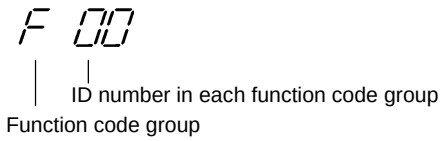

Table 7.11 Function Codes Available on FRENIC-MEGA

Function Code Group	Function Codes	Function	Description
F codes	F00 to F80	Fundamental functions	Functions concerning basic motor running
E codes	E01 to E99	Extension terminal functions	Functions concerning the assignment of control circuit terminals Functions concerning the display of the LED monitor
C codes	C01 to C53	Control functions	Functions associated with frequency settings
P codes	P01 to P99	Motor 1 parameters	Functions for setting up characteristics parameters (such as capacity) of the motor
H codes	H03 to H98	High performance functions	Highly added-value functions Functions for sophisticated control
A codes	A01 to A56	Motor 2 parameters	Functions for setting up characteristics parameters (such as capacity) of the motor
b codes	b01 to b56	Motor 3 parameters	Functions for setting up characteristics parameters (such as capacity) of the motor
r codes	r01 to r56	Motor 4 parameters	Functions for setting up characteristics parameters (such as capacity) of the motor
J codes	J01 to J96	Application functions 1	Functions for applications such as PID control
d codes	d01 to d63	Application functions 2	Functions for applications such as speed control
y codes	y01 to y99	Link functions	Functions for controlling communication
o codes	o27 to o59	Optional functions	Functions for options (Note)

(Note) The o codes are displayed only when the corresponding option is mounted. For details of the o codes, refer to the Instruction Manual for the corresponding option.

For the list of function codes subject to quick setup and their descriptions, refer to Chapter 5 "FUNCTION CODES."

■ Function codes requiring simultaneous keying

To modify the data for function code F00 (Data Protection), H03 (Data Initialization), H45 (Mock Alarm), or H97 (Clear Alarm Data), simultaneous keying is needed, involving the STOP + ⌃ keys or STOP + ⌄ keys.

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■ Changing, validating, and saving function code data when the inverter is running

Some function code data can be changed while the inverter is running, whereas others cannot. Further, depending on the function code, modifications may or may not validate immediately. For details, refer to the "Change when running" column in Chapter 5, Section 5.2 " Function Code Tables."

For details of function codes, refer to Chapter 5, Section 5.2 " Function Code Tables."

Figure 7.6 shows the menu transition in Menu #0 "Quick Setup."

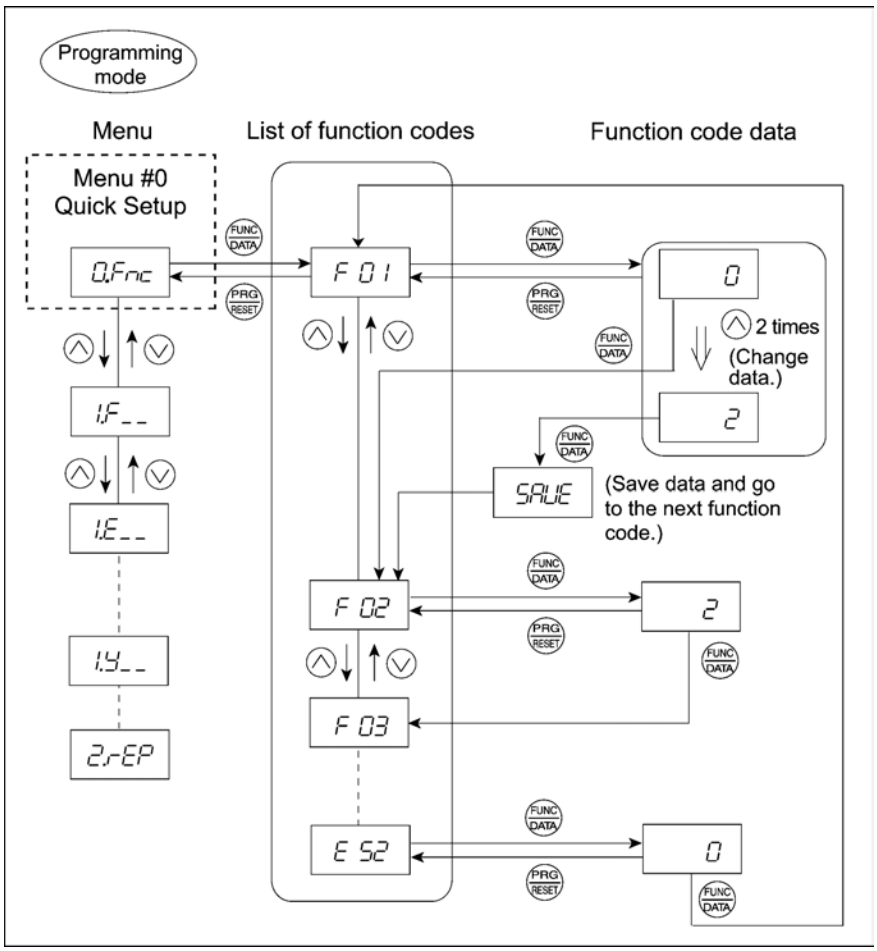

Figure 7.6 Menu Transition in Menu #0 "Quick Setup"

Basic key operation

This section gives a description of the basic key operation in "Quick Setup," following the example of the function code data changing procedure shown in Figure 7.6.

This example shows you how to change function code F01 data (Frequency command source) from the factory default "▲ / ▼ keys on keypad (F01 = 0)" to "Current input to terminal [C1] (C1 function) (4 to 20 mA DC) (F01 = 2)."

(1) Turn the inverter ON. It automatically enters Running mode. In that mode, press the PRG/RESET key to switch to Programming mode. The function selection menu appears. (In this example, 0.Func is displayed.)

(2) If anything other than 0.Func is displayed, use the ▲ and ▼ keys to display 0.Func.

(3) Press the FUNC/DATA key to proceed to the list of function codes.

(4) Use the ▲ and ▼ keys to display the desired function code (F 0 1 in this example), then press the FUNC/DATA key.
The data of this function code appears. (In this example, data 0 of F 0 1 appears.)

(5) Change the function code data using the ▲ and ▼ keys. (In this example, press the ▲ key two times to change data 0 to 2.)

(6) Press the FUNC/DATA key to establish the function code data.
The SAVE appears and the data will be saved in the memory inside the inverter. The display will return to the function code list, then move to the next function code. (In this example, F 02.)
Pressing the PRG/RESET key instead of the FUNC/DATA key cancels the change made to the data. The data reverts to the previous value, the display returns to the function code list, and the original function code reappears.

(7) Press the PRG/RESET key to return to the menu from the function code list.

Tip **Cursor movement**
You can move the cursor when changing function code data by holding down the PRG/RESET key for 1 second or longer in the same way as with the frequency settings. This action is called "Cursor movement."

Tip It is possible to change or add function code items subject to quick setup. For details, consult your Fuji Electric representatives.

7.4.2 Setting up function codes -- Menu #1 "Data Setting" --

Menu #1 "Data Setting" (1.F_ _ through 1.Y_ _) in Programming mode allows you to set up all function codes.

To set function codes in this menu, it is necessary to set function code E52 to "0" (Function code data editing mode) or "2" (Full-menu mode).

Figure 7.7 shows the menu transition in Menu #1 "Data Setting."

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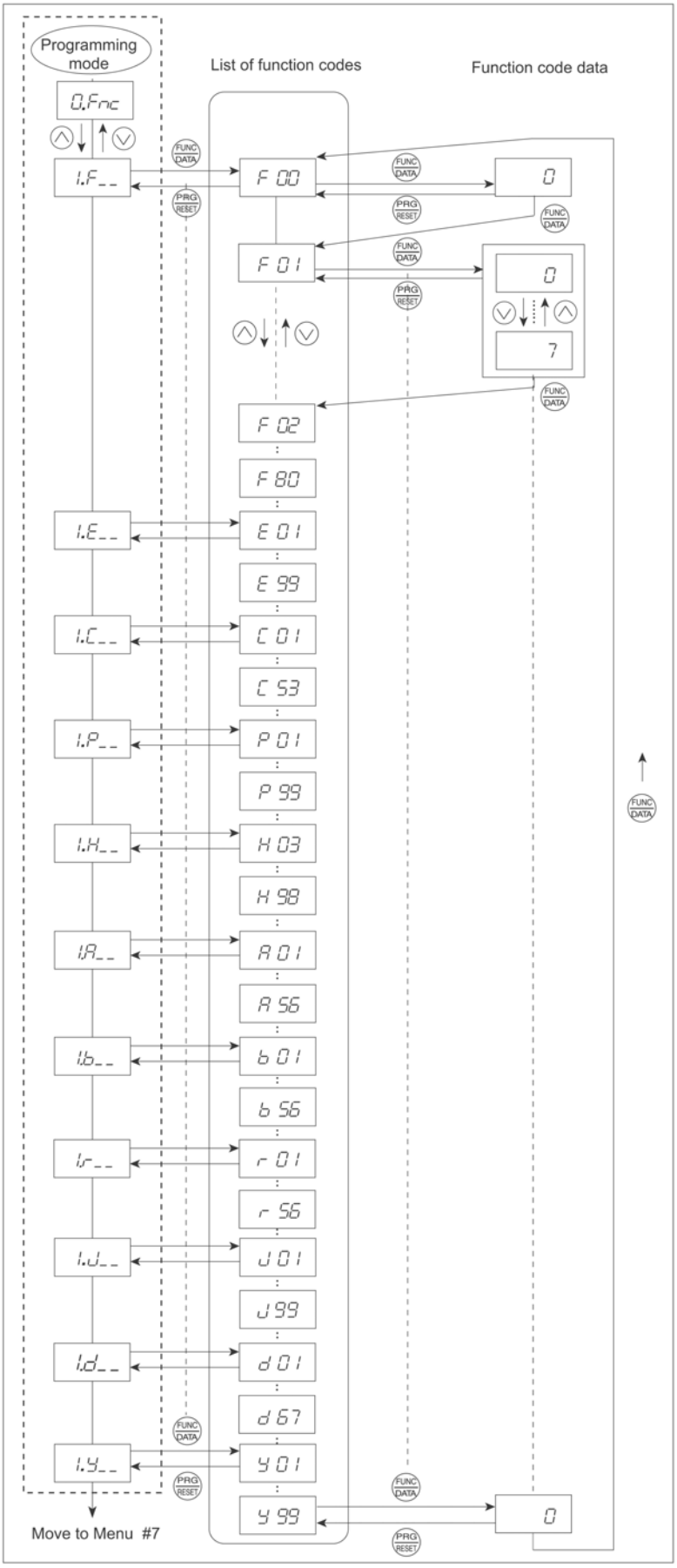

Figure 7.7 Menu Transition in Menu #1 "Data Setting"

Basic key operation

The basic key operation in Menu #1 "Data Setting" is just like that in Menu #0 "Quick Setup."

(1) Turn the inverter ON. It automatically enters Running mode. In that mode, press the PRG/RESET key to switch to Programming mode. The function selection menu appears.

(2) Use the ∧ and ∨ keys to display the desired function code group from the choices 1F__ through 14__.

(3) Press the FUNC/DATA key to proceed to the list of function codes for the selected function code group.

(4) Use the ∧ and ∨ keys to display the desired function code, then press the FUNC/DATA key.
The data of this function code appears.

(5) Change the function code data using the ∧ and ∨ keys.

(6) Press the FUNC/DATA key to establish the function code data.
The SAVE appears and the data will be saved in the memory inside the inverter. The display will return to the function code list, then move to the next function code.
Pressing the PRG/RESET key instead of the FUNC/DATA key cancels the change made to the data. The data reverts to the previous value, the display returns to the function code list, and the original function code reappears.

(7) Press the PRG/RESET key to return to the menu from the function code list.

7.4.3 Checking changed function codes -- Menu #2 "Data Checking" --

Menu #2 "Data Checking" in Programming mode allows you to check function codes that have been changed. Only the function codes whose data has been changed from the factory defaults are displayed on the LED monitor. You can refer to the function code data and change it again if necessary. To check function codes in Menu #2 "Data Checking," it is necessary to set function code E52 to "1" (Function code data check mode) or "2" (Full-menu mode).

Figure 7.8 shows the menu transition in Menu #2 "Data Checking."

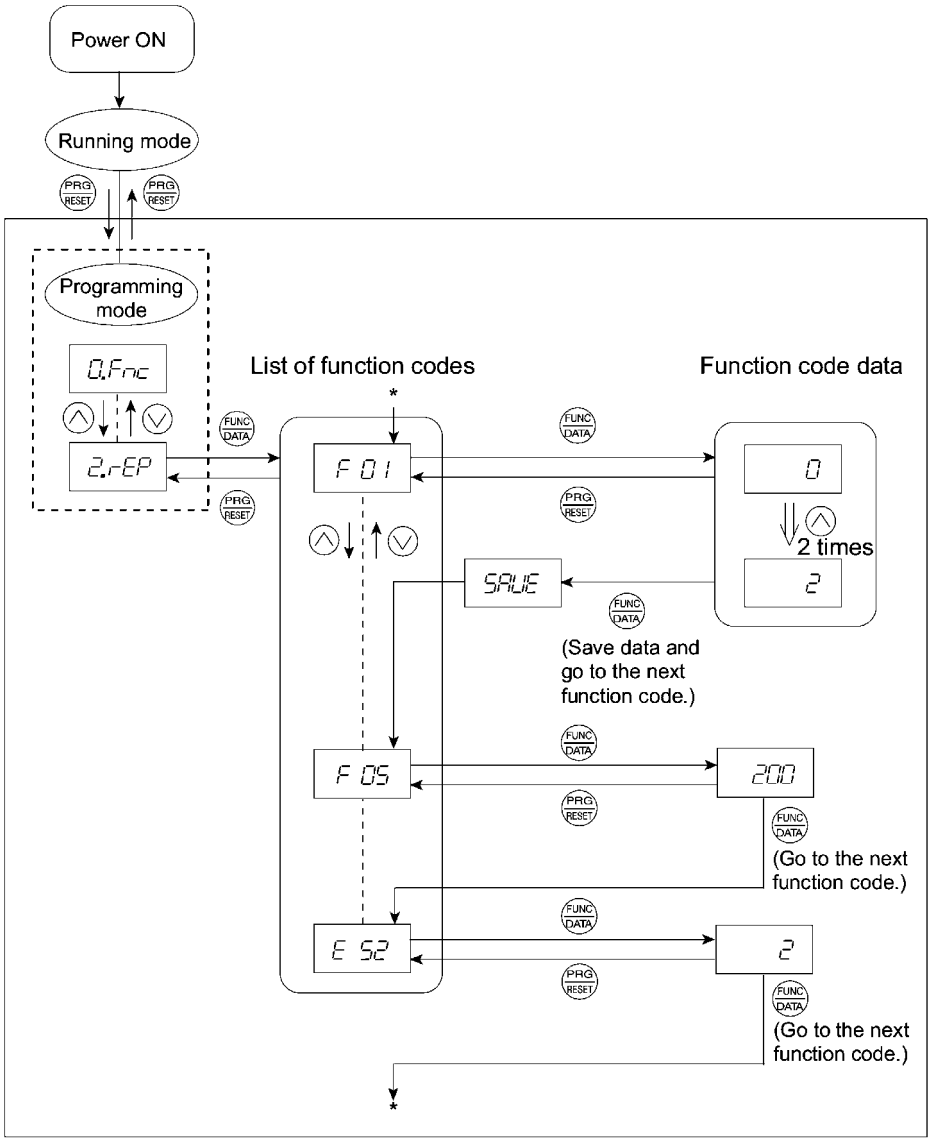

Figure 7.8 Menu Transition in Menu #2 "Data Checking" (Changing F01, F05 and E52 data only)

Basic key operation

For details of the basic key operation, refer to Menu #0 "Quick Setup" in Section 7.4.1.

7.4.4 Monitoring the running status -- Menu #3 "Drive Monitoring" --

Menu #3 "Drive Monitoring" is used to monitor the running status during maintenance and trial running. The display items for "Drive Monitoring" are listed in Table 7.12. Figure 7.9 shows the menu transition in Menu #3 "Drive Monitoring."

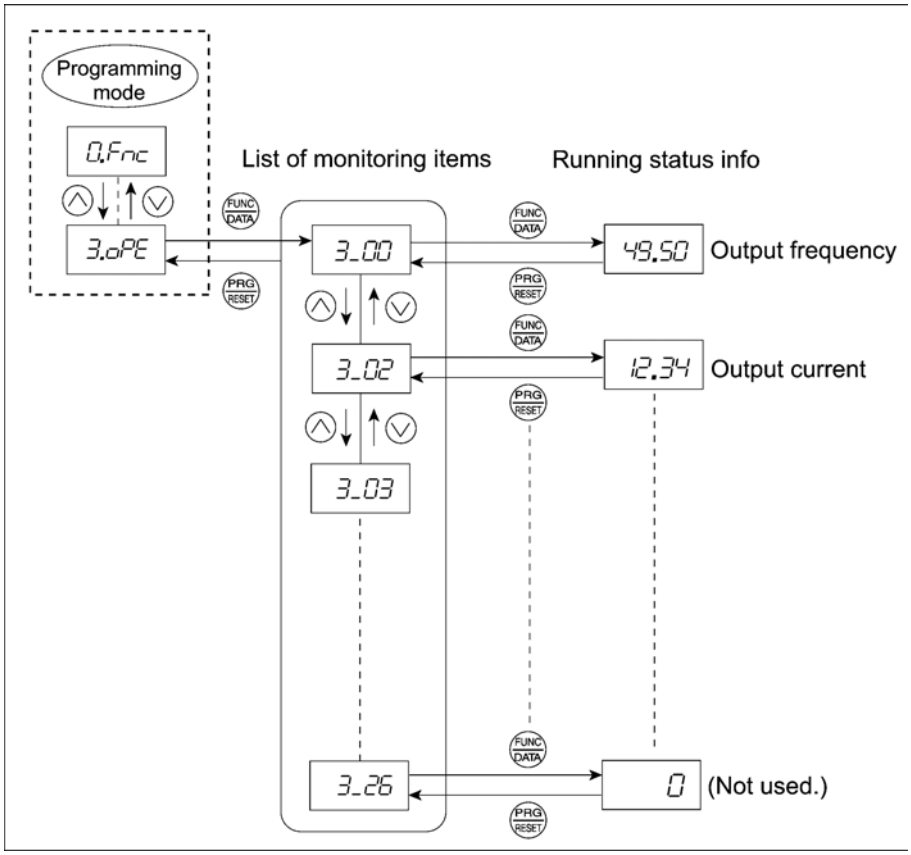

Figure 7.9 Menu Transition in Menu #3 "Drive Monitoring"

Basic key operation

To monitor the running status in "Drive monitoring," set function code E52 to "2" (Full-menu mode) beforehand.

(1) Turn the inverter ON. It automatically enters Running mode. In that mode, press the PRG/RESET key to switch to Programming mode. The function selection menu appears. (In this example, 0.Fnc is displayed.)

(2) Use the ∧ and ∨ keys to display "Drive Monitoring" (3.oPE).

(3) Press the FUNC/DATA key to proceed to a list of monitoring items (e.g. 3_00).

(4) Use the ∧ and ∨ keys to display the desired monitoring item, then press the FUNC/DATA key.
The running status information for the selected item appears.

(5) Press the PRG/RESET key to return to the list of monitoring items. Press the PRG/RESET key again to return to the menu.

Table 7.12 Drive Monitor Display Items

LED monitor shows:	Item	Unit	Description
3_00	Output frequency	Hz	Output frequency before slip compensation
3_01	Output frequency	Hz	Output frequency after slip compensation
3_02	Output current	A	Output current
3_03	Output voltage	V	Output voltage
3_04	Calculated torque	%	Calculated output torque of the motor in %
3_05	Reference frequency	Hz	Frequency specified by a frequency command
3_06	Rotational direction	N/A	Rotational direction being outputted F: forward, r: reverse, ----: stop
3_07	Running status	N/A	Running status in 4-digit hexadecimal format Refer to "■ Displaying running status (3_07) and running status 2 (3_23)" on the next page.
3_08	Motor speed	r/min	Display value = (Output frequency Hz) × $\frac{120}{(\text{No. of poles})}$ If the value is 10000 or lager, the x10 LED turns ON and the LED monitor shows one-tenth of the value.
3_09	Load shaft speed	r/min	Display value = (Output frequency Hz) × (Function code E50: Coefficient for speed indication) If the value is 10000 or lager, the x10 LED turns ON and the LED monitor shows one-tenth of the value.
3_10	PID command value	N/A	Physical quantity (e.g., temperature or pressure) of the object to be controlled, which is converted from the PID command value using function code E40 and E41 data (PID display coefficients A and B) Display value = (PID command value) × (Coefficient A - B) + B If PID control is disabled, "----" appears.
3_11	PID feedback amount	N/A	Physical quantity (e.g., temperature or pressure) of the object to be controlled, which is converted from the PID feedback amount using function code E40 and E41 data (PID display coefficients A and B) Display value = (PID feedback amount) × (Coefficient A - B) + B If PID control is disabled, "----" appears.
3_12	Torque limit value (Level 1)	%	Driving torque limit value A (based on motor rated torque)
3_13	Torque limit value (Level 2)	%	Braking torque limit value B (based on motor rated torque)
3_14	Ratio setting	%	When this setting is 100%, the LED monitor shows 1.00 time of the value to be displayed. If no ratio setting is selected, "----" appears.
3_15	Line speed	m/min	Display value = (Output frequency Hz) × (Function code E50: Coefficient for speed indication) If the value is 10000 or lager, the x10 LED turns ON and the LED monitor shows one-tenth of the value.

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Table 7.12 Drive Monitor Display Items (continued)

LED monitor shows:	Item	Unit	Description
3_16	(Not used.)	—	—
3_17	(Not used.)	—	—
3_18	(Not used.)	—	—
3_19	(Not used.)	—	—
3_20	(Not used.)	—	—
3_21	PID output value	%	PID output value in %. (100% at the maximum frequency) If PID control is disabled, "----" appears.
3_22	Flux command value	%	Flux command value in %.
3_23	Running status 2	N/A	Running status 2 in 4-digit hexadecimal format Refer to "■ Displaying running status (3_07) and running status 2 (3_23)" below.
3_24	Motor temperature	°C	Temperature detected by the NTC thermistor built in the motor (VG motor) If the NTC thermistor connectivity is disabled, "----" appears.
3_25	(Not used.)	—	—
3_26	(Not used.)	—	—

■ Displaying running status (3_07) and running status 2 (3_23)

To display the running status and running status 2 in 4-digit hexadecimal format, each state has been assigned to bits 0 to 15 as listed in Tables 7.13 and 7.14. Table 7.15 shows the relationship between each of the status assignments and the LED monitor display.

Table 7.16 gives the conversion table from 4-bit binary to hexadecimal.

Table 7.13 Running Status (3_07) Bit Assignment

Bit	Notation	Content	Bit	Notation	Content
15	BUSY	"1" when function code data is being written.	7	VL	"1" under voltage limiting control.
14	WR	Always "0."	6	TL	"1" under torque limiting control.
13		Always "0."	5	NUV	"1" when the DC link bus voltage is higher than the undervoltage level.
12	RL	"1" when communication is enabled (when ready for run and frequency commands via communications link).	4	BRK	"1" during braking.
11	ALM	"1" when an alarm has occurred.	3	INT	"1" when the inverter output is shut down.
10	DEC	"1" during deceleration.	2	EXT	"1" during DC braking.
9	ACC	"1" during acceleration.	1	REV	"1" during running in the reverse direction.
8	IL	"1" under current limiting control.	0	FWD	"1" during running in the forward direction.

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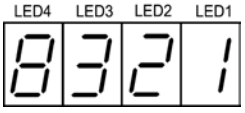
Table 7.14 Running Status 2 (3_23) Bit Assignment

Bit	Notation	Content	Bit	Notation	Content
15	—	(Not used.)	7	—	Speed limiting (under torque control)
14			6	—	(Not used.)
13			5	—	Motor selection
12			4	—	00: Motor 1 01: Motor 2 10: Motor 3 11: Motor 4
11			3	—	Inverter drive control
10			2	—	0000: V/f control with slip compensation inactive
9			1	—	0001: Dynamic torque vector control
8			0	—	0010: V/f control with slip compensation active 0011: V/f control with speed sensor 0100: Dynamic vector control with speed sensor 0101: Vector control without speed sensor 0110: Vector control with speed sensor 1010: Torque control (Vector control without speed sensor) 1011: Torque control (Vector control with speed sensor)

Table 7.15 Running Status Display

LED No.		LED4				LED3				LED2				LED1			
Bit		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Notation		BUSY	WR		RL	ALM	DEC	ACC	IL	VL	TL	NUV	BRK	INT	EXT	REV	FWD
Example	Binary	1	0	0	0	0	0	1	1	0	0	1	0	0	0	0	1
	Hexa-decimal on the LED monitor																

■ Hexadecimal expression

A 4-bit binary number can be expressed in hexadecimal format (1 hexadecimal digit). Table 7.16 shows the correspondence between the two notations. The hexadecimals are shown as they appear on the LED monitor.

Table 7.16 Binary and Hexadecimal Conversion

Binary				Hexadecimal	Binary				Hexadecimal
0	0	0	0	0	1	0	0	0	8
0	0	0	1	1	1	0	0	1	9
0	0	1	0	2	1	0	1	0	A
0	0	1	1	3	1	0	1	1	b
0	1	0	0	4	1	1	0	0	C
0	1	0	1	5	1	1	0	1	d
0	1	1	0	6	1	1	1	0	E
0	1	1	1	7	1	1	1	1	F

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7.4.5 Checking I/O signal status -- Menu #4 "I/O Checking" --

Using Menu #4 "I/O Checking" displays the I/O status of external signals including digital and analog I/O signals without using a measuring instrument. Table 7.17 lists check items available. The menu transition in Menu #4 "I/O Checking" is shown in Figure 7.10.

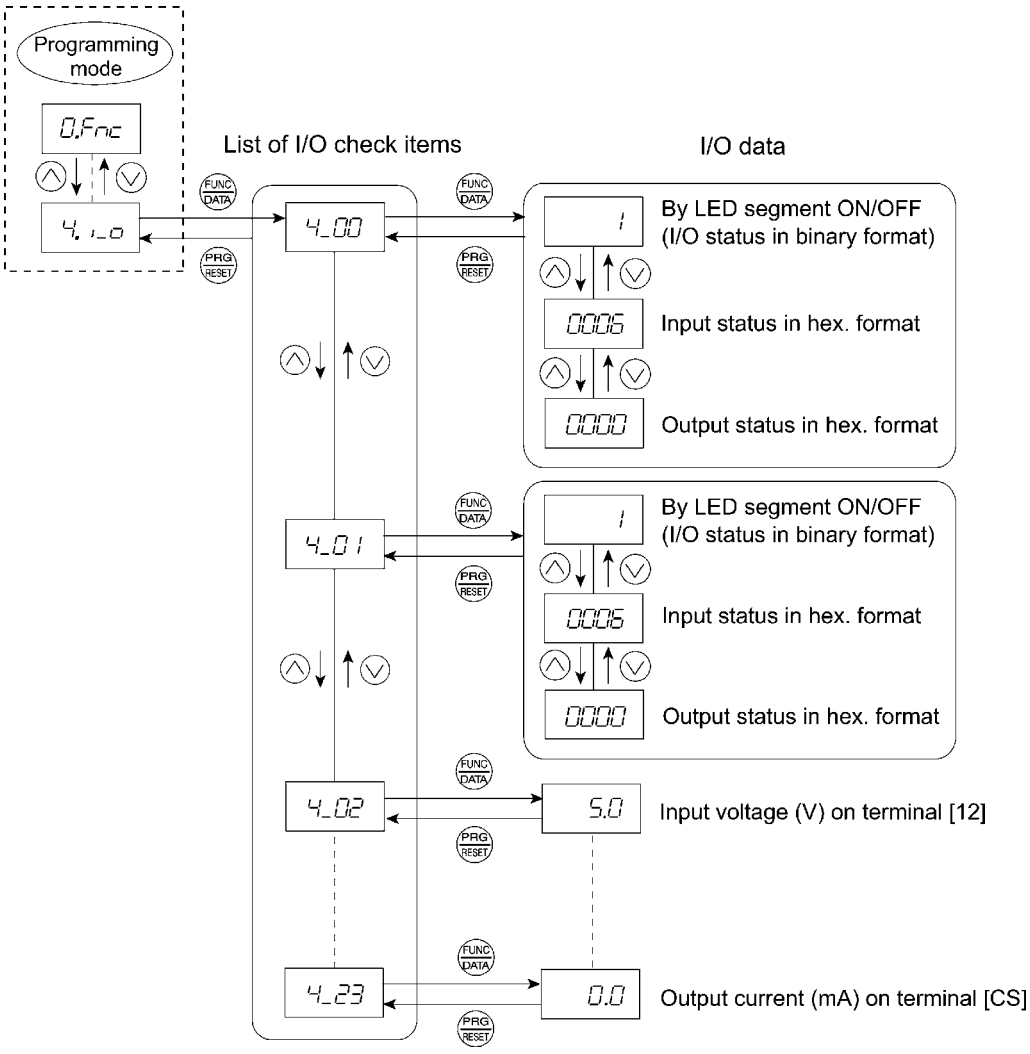


Figure 7.10 Menu Transition in Menu #4 "I/O Checking"

Basic key operation

To check the status of the I/O signals, set function code E52 to "2" (Full-menu mode) beforehand

(1) Turn the inverter ON. It automatically enters Running mode. In that mode, press the PRG/RESET key to switch to Programming mode. The function selection menu appears.

(2) Use the ∧ and ∨ keys to display "I/O Checking" (4. I/O).

(3) Press the FUNC/DATA key to proceed to a list of I/O check items (e.g. 4_00).

(4) Use the ∧ and ∨ keys to display the desired I/O check item, then press the FUNC/DATA key.
The corresponding I/O check data appears. For the item 4_00 or 4_01, using the ∧ and ∨ keys switches the display method between the segment display (for external signal information in Table 7.18) and hexadecimal display (for I/O signal status in Table 7.19).

(5) Press the PRG/RESET key to return to the list of I/O check items. Press the PRG/RESET key again to return to the menu.

Table 7.17 I/O Check Items

LED monitor shows:	Item	Description
4_00	I/O signals on the control circuit terminals	Shows the ON/OFF state of the digital I/O terminals. Refer to "■ Displaying control I/O signal terminals" on the next page for details.
4_01	I/O signals on the control circuit terminals under communications control	Shows the ON/OFF state of the digital I/O terminals that received a command via RS-485 and optional communications. Refer to "■ Displaying control I/O signal terminals" and "■ Displaying control I/O signal terminals under communications control" on the following pages for details.
4_02	Input voltage on terminal [12]	Shows the input voltage on terminal [12] in volts (V).
4_03	Input current on terminal [C1]	Shows the input current on terminal [C1] in milliamperes (mA).
4_04	Output voltage on terminal [FMA]	Shows the output voltage on terminal [FMA] in volts (V).
4_05	Output voltage on terminal [FMP]	Shows the output voltage on terminal [FMP] in volts (V).
4_06	Output frequency on terminal [FMP]	Shows the output pulse rate per unit of time on terminal [FMP] in (p/s).
4_07	Input voltage on terminal [V2]	Shows the input voltage on terminal [V2] in volts (V).
4_08	Output current on terminal [FMA]	Shows the output current on terminal [FMA] in milliamperes (mA).
4_10	Option control circuit terminal (I/O)	Shows the ON/OFF state of the digital I/O terminals on the digital input and output interface cards (options). Refer to "■ Displaying control I/O signal terminals on digital I/O interface option" on page 7-34 for details.
4_11	Terminal [X7] pulse input monitor	Shows the pulse rate of the pulse train signal on terminal [X7].
4_15	PG pulse rate (A/B phase signal from the reference PG)	Shows the pulse rate (kp/s) of the A/B phase signal fed back from the reference PG.
4_16	PG pulse rate (Z phase signal from the reference PG)	Shows the pulse rate (kp/s) of the Z phase signal fed back from the reference PG.

Table 7.17 I/O Check Items (continued)

LED monitor shows:	Item	Description
4_ 17	PG pulse rate (A/B phase signal from the slave PG)	Shows the pulse rate (kp/s) of the A/B phase signal fed back from the slave PG.
4_ 18	PG pulse rate (Z phase signal from the slave PG)	Shows the pulse rate (kp/s) of the Z phase signal fed back from the slave PG.
4_ 19	(Not used.)	—
4_20	Input voltage on terminal [32]	Shows the input voltage on terminal [32] on the analog interface card (option) in volts (V).
4_21	Input current on terminal [C2]	Shows the input current on terminal [C2] on the analog interface card (option) in milliamperes (mA).
4_22	Output voltage on terminal [AO]	Shows the output voltage on terminal [AO] on the analog interface card (option) in volts (V).
4_23	Output current on terminal [CS]	Shows the output current on terminal [CS] on the analog interface card (option) in milliamperes (mA).

■ Displaying control I/O signal terminals

The status of control I/O signal terminals may be displayed with ON/OFF of the LED segment or in hexadecimal.

• Displaying the I/O signal status with ON/OFF of each LED segment

As shown in Table 7.18 and the figure below, each of segments "a" to "dp" on LED1 and LED2 lights when the corresponding digital input terminal circuit ([FWD], [REV], [X1] to [X9]) is closed; it goes OFF when it is open. Each of segments "a" to "e" on LED3 lights when the circuit between output terminal [Y1], [Y2], [Y3] or [Y4] and terminal [CMY] or between terminals [Y5A] and [Y5C] is closed, respectively; it goes OFF when the circuit is open. Segment "a" on LED4 is for terminals [30A/B/C] and lights when the circuit between terminals [30C] and [30A] is short-circuited (ON) and goes OFF when it is open.

Tip If all terminal signals are OFF (open), segments "g" on all of LED1 to LED4 will light ("– – – –"). The segment display indicates the ON/OFF status of the terminals, not the active/inactive status of input/output.

Table 7.18 Segment Display for External Signal Information

Segment	LED4	LED3	LED2	LED1
a	30A/B/C	Y1-CMY	X7	FWD
b	—	Y2-CMY	X8	REV
c	—	Y3-CMY	X9	X1
d	—	Y4-CMY	—	X2
e	—	Y5A-Y5C	—	X3
f	—	—	(XF)*	X4
g	—	—	(XR)*	X5
dp	—	—	(RST)*	X6

—: No corresponding control circuit terminal exists

* (XF), (XR), and (RST) are assigned for communications control. Refer to "■ Displaying control I/O signal terminals under communications control" on the next page.

• Displaying I/O signal status in hexadecimal

Each I/O terminal is assigned to bit 15 through bit 0 as shown in Table 7.19. An unassigned bit is interpreted as "0." Allocated bit data is displayed on the LED monitor as four hexadecimal digits (0 to F each).

On the FRENIC-MEGA, digital input terminals [FWD] and [REV] are assigned to bits 0 and 1, respectively. Terminals [X1] through [X9] are assigned to bits 2 through 10. The bit is set to "1" when the corresponding input terminal is short-circuited (ON), and it is set to "0" when the terminal is open (OFF). For example, when [FWD] and [X1] are ON (short-circuited) and all the others are OFF (open), 0005 is displayed on LED4 to LED1.

Digital output terminals [Y1] through [Y4] are assigned to bits 0 through 3. Each bit is set to "1" when the output terminal [Y1], [Y2], [Y3] or [Y4] is short-circuited with [CMY] (ON), and "0" when it is open (OFF).

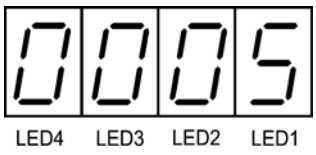
The status of the relay contact output terminal [Y5A/C] is assigned to bit 4. It is set to "1" when the circuit between output terminals [Y5A] and [Y5C] is closed. The status of the relay contact output terminals [30A/B/C] is assigned to bit 8. It is set to "1" when the circuit between output terminals [30A] and [30C] is closed, and "0" when the circuit between [30A] and [30C] is open.

For example, if [Y1] is ON, [Y2] through [Y4] are OFF, the circuit between [Y5A] and [Y5C] is open, and the circuit between [30A] and [30C] is closed, then "0101" is displayed on the LED4 through LED1.

Table 7.19 presents bit assignment and an example of corresponding hexadecimal display on the 7-segment LED.

Tip The segment display indicates the ON/OFF status of the terminals, not the active/inactive status of input/output.

Table 7.19 Segment Display for I/O Signal Status in Hexadecimal Format

LED No.		LED4				LED3				LED2				LED1			
Bit		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input terminal		(RST)*	(XR)*	(XF)*	-	-	X9	X8	X7	X6	X5	X4	X3	X2	X1	REV	FWD
Output terminal		-	-	-	-	-	-	-	30 A/B/C	-	-	-	Y5A/C	Y4	Y3	Y2	Y1
Example	Binary	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
	Hexa-decimal on the LED monitor																

– No corresponding control circuit terminal exists.

* (XF), (XR), and (RST) are assigned for communication. Refer to "■ Displaying control I/O signal terminals under communications control" below.

■ Displaying control I/O signal terminals under communications control

Under communications control, input commands (function code S06) sent via RS-485 or other optional communications can be displayed in two ways: "with ON/OFF of each LED segment" and "in hexadecimal." The content to be displayed is basically the same as that for the control I/O signal terminal status display; however, (XF), (XR), and (RST) are added as inputs. Note that under communications control, the I/O display is in normal logic (using the original signals not inverted).

For details about input commands sent through the communications link, refer to the RS-485 Communication User's Manual and the instruction manual of communication-related options as well.

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■ Displaying control I/O signal terminals on digital input and output interface cards (optional)

The LED monitor can also show the signal status of the terminals on the optional digital input and output interface cards, just like the signal status of the control circuit terminals.

Table 7.20 lists the assignment of digital I/O signals to the LED segments.

Table 7.20 Segment Display for External Signal Information (Digital Input and Output Interface Cards)

Segment	LED4	LED3	LED2	LED1
a	—	O1	I9	I1
b	—	O2	I10	I2
c	—	O3	I11	I3
d	—	O4	I12	I4
e	—	O5	I13	I5
f	—	O6	I14	I6
g	—	O7	I15	I7
dp	—	O8	I16	I8

LED No.	LED4				LED3				LED2				LED1			
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input terminal	I16	I15	I14	I13	I12	I11	I10	I9	I8	I7	I6	I5	I4	I3	I2	I1
Output terminal	-	-	-	-	-	-	-	-	O8	O7	O6	O5	O4	O3	O2	O1

7.4.6 Reading maintenance information

-- Menu #5 "Maintenance Information" --

Menu #5 "Maintenance Information" (5.CHE) contains information necessary for performing maintenance on the inverter. Figure 7.11 shows the menu transition in Menu #5 "Maintenance information."

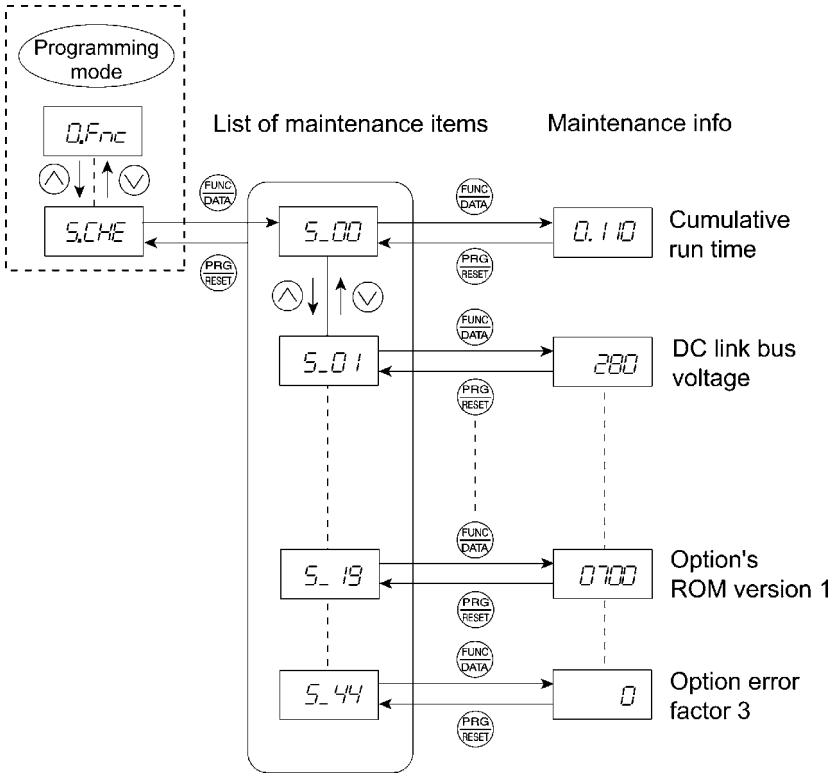

Figure 7.11 Menu Transition in Menu #5 "Maintenance Information"

Basic key operation

To view the maintenance information, set function code E52 to "2" (Full-menu mode) beforehand.

(1) Turn the inverter ON. It automatically enters Running mode. In that mode, press the PRG RESET key to switch to Programming mode. The function selection menu appears.

(2) Use the ∧ and ∨ keys to display "Maintenance Information" (5.CHE).

(3) Press the FUNC DATA key to proceed to the list of maintenance items (e.g. 5_00).

(4) Use the ∧ and ∨ keys to display the desired maintenance item, then press the FUNC DATA key. The data of the corresponding maintenance item appears.

(5) Press the PRG RESET key to return to the list of maintenance items. Press the PRG RESET key again to return to the menu.

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Table 7.21 Display Items for Maintenance Information

LED Monitor shows:	Item	Description
5_00	Cumulative run time	Shows the content of the cumulative power-ON time counter of the inverter. Counter range: 0 to 65,535 hours Display: Upper 2 digits and lower 3 digits are displayed alternately. Example: 0 ⇔ 535H (535 hours) 65 ⇔ 535H (65,535 hours) The lower 3 digits are displayed with H (hour). When the count exceeds 65,535, the counter will be reset to "0" and start over again.
5_01	DC link bus voltage	Shows the DC link bus voltage of the inverter main circuit. Unit: V (volts)
5_02	Max. temperature inside the inverter	Shows the maximum temperature inside the inverter for every hour. Unit: °C (Temperatures below 20°C are displayed as 20°C.)
5_03	Max. temperature of heat sink	Shows the maximum temperature of the heat sink for every hour. Unit: °C (Temperatures below 20°C are displayed as 20°C.)
5_04	Max. effective output current	Shows the maximum current in RMS for every hour. Unit: A (amperes)
5_05	Capacitance of the DC link bus capacitor	Shows the current capacitance of the DC link bus capacitor (reservoir capacitor) in %, based on the capacitance when shipping as 100%. Refer to the FRENIC-MEGA Instruction Manual, Chapter 7 "MAINTENANCE AND INSPECTION" for details. Unit: %
5_06	Cumulative run time of electrolytic capacitors on the printed circuit boards	Shows the content of the cumulative run time counter of the electrolytic capacitors on the printed circuit boards, which is calculated by multiplying the cumulative run time count by the coefficient based on the surrounding temperature condition. Counter range: 0 to 99,990 hours Display range: 0 to 9999 The x10 LED turns ON. Actual cumulative run time of electrolytic capacitors on the printed circuit boards (hours) = Displayed value x 10 When the count exceeds 99,990 the counter stops and the LED monitor sticks to 9999.
5_07	Cumulative run time of the cooling fan	Shows the content of the cumulative run time counter of the cooling fan. This counter does not work when the cooling fan ON/OFF control (function code H06) is enabled and the fan stops. The display method is the same as for 5_05 above.
5_08	Number of startups	Shows the content of the motor 1 startup counter (i.e., the number of run commands issued). Counter range: 0 to 65,530 times Display range: 0 to 9999 If the count exceeds 10,000, the x10 LED turns ON and the LED monitor shows one-tenth of the value. When the count exceeds 65,530, the counter will be reset to "0" and start over again.

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Table 7.21 Display Items for Maintenance Information (continued)

LED Monitor shows:	Item	Description
5_09	Input watt-hour	Shows the input watt-hour of the inverter. Display range: 0.001 to 9999 Input watt-hour = Displayed value × 100 kWh To reset the integrated input watt-hour and its data, set function code E51 to "0.000." When the input watt-hour exceeds 999,900 kWh, the counter will be reset to "0."
5_10	Input watt-hour data	Shows the value expressed by "input watt-hour (kWh) × E51 (whose data range is 0.000 to 9,999)." Unit: None. (Display range: 0.001 to 9999. The data cannot exceed 9999. (It will be fixed at 9,999 once the calculated value exceeds 9999.)) Depending on the value of integrated input watt-hour data, the decimal point on the LED monitor shifts to show it within the LED monitors' resolution. To reset the integrated input watt-hour data, set function code E51 to "0.000."
5_11	Number of RS-485 communications errors (COM port 1)	Shows the total number of errors that have occurred in RS-485 communication (COM port 1, connection to keypad) after the power is turned ON. Once the count exceeds 9999, the counter will be reset to "0."
5_12	Content of RS-485 communications error (COM port 1)	Shows the latest error that has occurred in RS-485 communication (COM port 1) in decimal. For error contents, refer to the RS-485 Communication User's Manual.
5_13	Number of option errors 1	Shows the total number of errors that have occurred in the option being connected to the A-port. Once the count exceeds 9999, the counter will be reset to "0."
5_14	Inverter's ROM version	Shows the inverter's ROM version as a 4-digit code.
5_15	Keypad's ROM version	Shows the keypad's ROM version as a 4-digit code.
5_17	Number of RS-485 communications errors (COM port 2)	Shows the total number of errors that have occurred in RS-485 communication (COM port 2, connection to terminal block) after the power is turned ON. Once the count exceeds 9999, the counter will be reset to "0."
5_18	Content of RS-485 communications error (COM port 2)	Shows the latest error that has occurred in RS-485 communication (COM port 2, connection to terminal block) in decimal. For error contents, refer to the RS-485 Communication User's Manual.
5_19	Option's ROM version 1	Shows the ROM version of the option to be connected to A-port as a 4-digit code. If the option has no ROM, "----" appears on the LED monitor.
5_20	Option's ROM version 2	Shows the ROM version of the option to be connected to B-port as a 4-digit code. If the option has no ROM, "----" appears on the LED monitor.
5_21	Option's ROM version 3	Shows the ROM version of the option to be connected to C-port as a 4-digit code. If the option has no ROM, "----" appears on the LED monitor.

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Table 7.21 Display Items for Maintenance Information (continued)

LED Monitor shows:	Item	Description
5_23	Cumulative motor run time	Shows the content of the cumulative power-ON time counter of motor 1. Counter range: 0 to 99,990 hours Display range: 0 to 9999 The x10 LED turns ON. Actual cumulative motor run time (hours) = Displayed value x 10 When the count exceeds 99,990, the counter will be reset to "0" and start over again.
5_24	Temperature inside the inverter (real-time value)	Shows the current temperature inside the inverter. Unit: °C
5_25	Temperature of heat sink (real-time value)	Shows the current temperature of the heat sink inside the inverter. Unit: °C
5_26	Lifetime of DC link bus capacitor (elapsed hours)	Shows the cumulative time during which a voltage is applied to the DC link bus capacitor. When the main power is shut down, the inverter automatically measures the discharging time of the DC link bus capacitor and corrects the elapsed time. The display method is the same as for 5_05 above.
5_27	Lifetime of DC link bus capacitor (remaining hours)	Shows the remaining lifetime of the DC link bus capacitor, which is estimated by subtracting the elapsed time from the lifetime (10 years). The display method is the same as for 5_06 above.
5_28	Cumulative run time of motor 2	Shows the content of the cumulative power-ON time counter of motor 2. The display method is the same as for 5_23 above.
5_29	Cumulative run time of motor 3	Shows the content of the cumulative power-ON time counter of motor 3. The display method is the same as for 5_23 above.
5_30	Cumulative run time of motor 4	Shows the content of the cumulative power-ON time counter of motor 4. The display method is the same as for 5_23 above.
5_31	Remaining time before the next motor 1 maintenance	Shows the time remaining before the next maintenance, which is estimated by subtracting the cumulative run time of motor 1 from the maintenance interval specified by H78. (This function applies to motor 1 only.) Display range: 0 to 9999 The x10 LED turns ON. Time remaining before the next maintenance (hour) = Displayed value × 10
5_32	Number of startups 2	Shows the content of the motor 2 startup counter (i.e., the number of run commands issued). The display method is the same as for 5_08 above.
5_33	Number of startups 3	Shows the content of the motor 3 startup counter (i.e., the number of run commands issued). The display method is the same as for 5_08 above.
5_34	Number of startups 4	Shows the content of the motor 4 startup counter (i.e., the number of run commands issued). The display method is the same as for 5_08 above.
5_35	Remaining startup times before the next maintenance	Shows the startup times remaining before the next maintenance, which is estimated by subtracting the number of startups from the preset startup count for maintenance specified by H79. (This function applies to motor 1 only.) The display method is the same as for 5_08 above.

Table 7.21 Display Items for Maintenance Information (continued)

LED Monitor shows:	Item	Description
5_36	Light alarm factor (Latest)	Shows the factor of the latest light alarm as an alarm code. For details, refer to the description of H81 in Chapter 5.
5_37	Light alarm factor (Last)	Shows the factor of the last light alarm as an alarm code. For details, refer to the description of H81 in Chapter 5.
5_38	Light alarm factor (2nd last)	Shows the factor of the 2nd last light alarm as an alarm code. For details, refer to the description of H81 in Chapter 5.
5_39	Light alarm factor (3rd last)	Shows the factor of the 3rd last light alarm as an alarm code. For details, refer to the description of H81 in Chapter 5.
5_40	Option error factor 1	Shows the factor of the error that has occurred in the option being connected to the A-port.
5_41	Number of option errors 2	Shows the total number of errors that have occurred in the option being connected to the B-port. Once the count exceeds 9999, the counter will be reset to "0."
5_42	Option error factor 2	Shows the factor of the error that has occurred in the option being connected to the B-port.
5_43	Number of option errors 3	Shows the total number of errors that have occurred in the option being connected to the C-port. Once the count exceeds 9999, the counter will be reset to "0."
5_44	Option error factor 3	Shows the factor of the error that has occurred in the option being connected to the C-port.

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7.4.7 Reading alarm information -- Menu #6 "Alarm Information" --

Menu #6 "Alarm Information" shows the causes of the past 4 alarms in alarm code. Further, it is also possible to display alarm information that indicates the status of the inverter when the alarm occurred. Figure 7.12 shows the menu transition in Menu #6 "Alarm Information" and Table 7.22 lists the details of the alarm information.

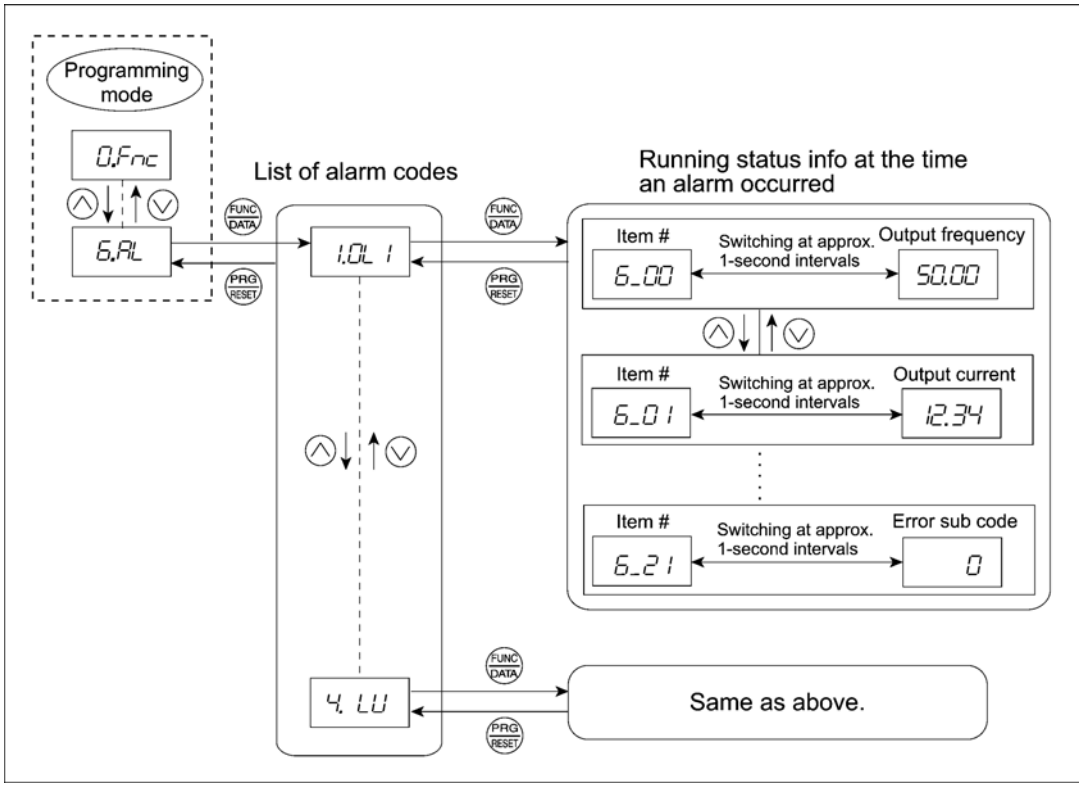


Figure 7.12 Menu Transition in Menu #6 "Alarm Information"

Basic key operation

To view the alarm information, set function code E52 to "2" (Full-menu mode) beforehand.

(1) Turn the inverter ON. It automatically enters Running mode. In that mode, press the PRG/RESET key to switch to Programming mode. The function selection menu appears.

(2) Use the ∧ and ∨ keys to display "Alarm Information" (6.AL).

(3) Press the FUNC/DATA key to proceed to a list of alarm codes (e.g. 1.0L 1).
In the list of alarm codes, the alarm information for the last 4 alarms is saved as an alarm history.

(4) Each time the ∧ or ∨ key is pressed, the last 4 alarms are displayed beginning with the most recent one in the order of 1., 2., 3. and 4.

(5) Press the FUNC/DATA key with an alarm code being displayed.

The item number (e.g. 6_00) and the inverter status information (e.g. Output frequency) at the time of the alarm occurrence alternately appear at approx. 1-second intervals.

Pressing the ∧ and ∨ keys displays other item numbers (e.g. 6_01) and the status information (e.g. Output current) for that alarm code.

(6) Press the PRG/RESET key to return to the list of alarm codes. Press the PRG/RESET key again to return to the menu.

Table 7.22 Alarm Information Displayed

LED monitor shows: (item No.)	Item displayed	Description
6_00	Output frequency	Output frequency before slip compensation
6_01	Output current	Output current
6_02	Output voltage	Output voltage
6_03	Calculated torque	Calculated motor output torque
6_04	Reference frequency	Frequency specified by frequency command
6_05	Rotational direction	This shows the rotational direction being output. F: forward; r: reverse; ---- : stop
6_06	Running status	Running status as four hexadecimal digits. Refer to "■ Displaying running status (3_07) and running status 2 (3_23)" in Section 7.4.4 "Monitoring the running status."
6_07	Cumulative run time	Shows the content of the cumulative power-ON time counter of the inverter. Counter range: 0 to 65,535 hours Display: Upper 2 digits and lower 3 digits are displayed alternately. Example: 0 ⇔ 535H (535 hours) 65 ⇔ 535H (65,535 hours) The lower 3 digits are displayed with H (hour). When the count exceeds 65,535, the counter will be reset to "0" and start over again.
6_08	No. of startups	Shows the content of the startup counter for the motor selected (i.e., the number of run commands issued). Counter range: 0 to 65,530 times Display range: 0 to 9999 If the count exceeds 10,000, the x10 LED turns ON and the LED monitor shows one-tenth of the value. When the count exceeds 65,530, the counter will be reset to "0" and start over again.
6_09	DC link bus voltage	Shows the DC link bus voltage of the inverter main circuit. Unit: V (volts)
6_10	Temperature inside the inverter	Shows the temperature inside the inverter. Unit: °C
6_11	Max. temperature of heat sink	Shows the temperature of the heat sink. Unit: °C
6_12	Terminal I/O signal status (displayed with the ON/OFF of LED segments)	Shows the ON/OFF state of the digital I/O terminals. Refer to "■ Displaying control I/O signal terminals" in Section 7.4.5 "Checking I/O signal status" for details.
6_13	Terminal input signal status (in hexadecimal)	
6_14	Terminal output signal status (in hexadecimal)	

Table 7.22 Alarm Information Displayed (continued)

LED monitor shows: (item No.)	Item displayed	Description
6_15	No. of consecutive occurrences	This is the number of times the same alarm occurs consecutively.
6_16	Multiple alarm 1	Simultaneously occurring alarm codes (1) ("----" is displayed if no alarms have occurred.)
6_17	Multiple alarm 2	Simultaneously occurring alarm codes (2) ("----" is displayed if no alarms have occurred.)
6_18	Terminal I/O signal status under communications control (displayed with the ON/OFF of LED segments)	Shows the ON/OFF status of the digital I/O terminals under RS-485 communications control. Refer to "■ Displaying control I/O signal terminals under communications control" in Section 7.4.5 "Checking I/O signal status" for details.
6_19	Terminal input signal status under communications control (in hexadecimal format)	
6_20	Terminal output signal status under communications control (in hexadecimal format)	
6_21	Error sub code	Secondary error code for the alarm.
6_22	Running status 2	Running status 2 as four hexadecimal digits. Refer to "■ Displaying running status (3_07) and running status 2 (3_23)" in Section 7.4.4 "Monitoring the running status."
6_23	Speed detected value	Speed detected value.

Note When the same alarm occurs repeatedly in succession, the alarm information for the first and the most recent occurrences will be preserved and the information for other occurrences in-between will be discarded. The number of consecutive occurrences will be preserved as the first alarm information.

7.4.8 Copying data -- Menu #7 "Data Copying" --

Menu #7 "Data Copying" is used to read function code data out of an inverter for storing it in the keypad or writing it into another inverter. It is also used to verify the function code data stored in the keypad with the one configured in the inverter. The keypad serves as a temporary storage media.

In addition, using Menu #7 allows you to store the running status information in the keypad, detach the keypad from the inverter, connect it to a PC running FRENIC Loader at an office or off-site place, and check the inverter running status without removing the inverter itself.

To store the inverter running status information into the keypad, use "Read data" (rEAd) or "Read inverter running information" (CHEC) function. For details on how to connect the keypad to a PC and check the inverter running status information stored in the keypad, refer to the FRENIC Loader Instruction Manual.

Figure 7.13 shows the menu transition in Menu #7 "Data Copying." The keypad can hold function code data for a single inverter.

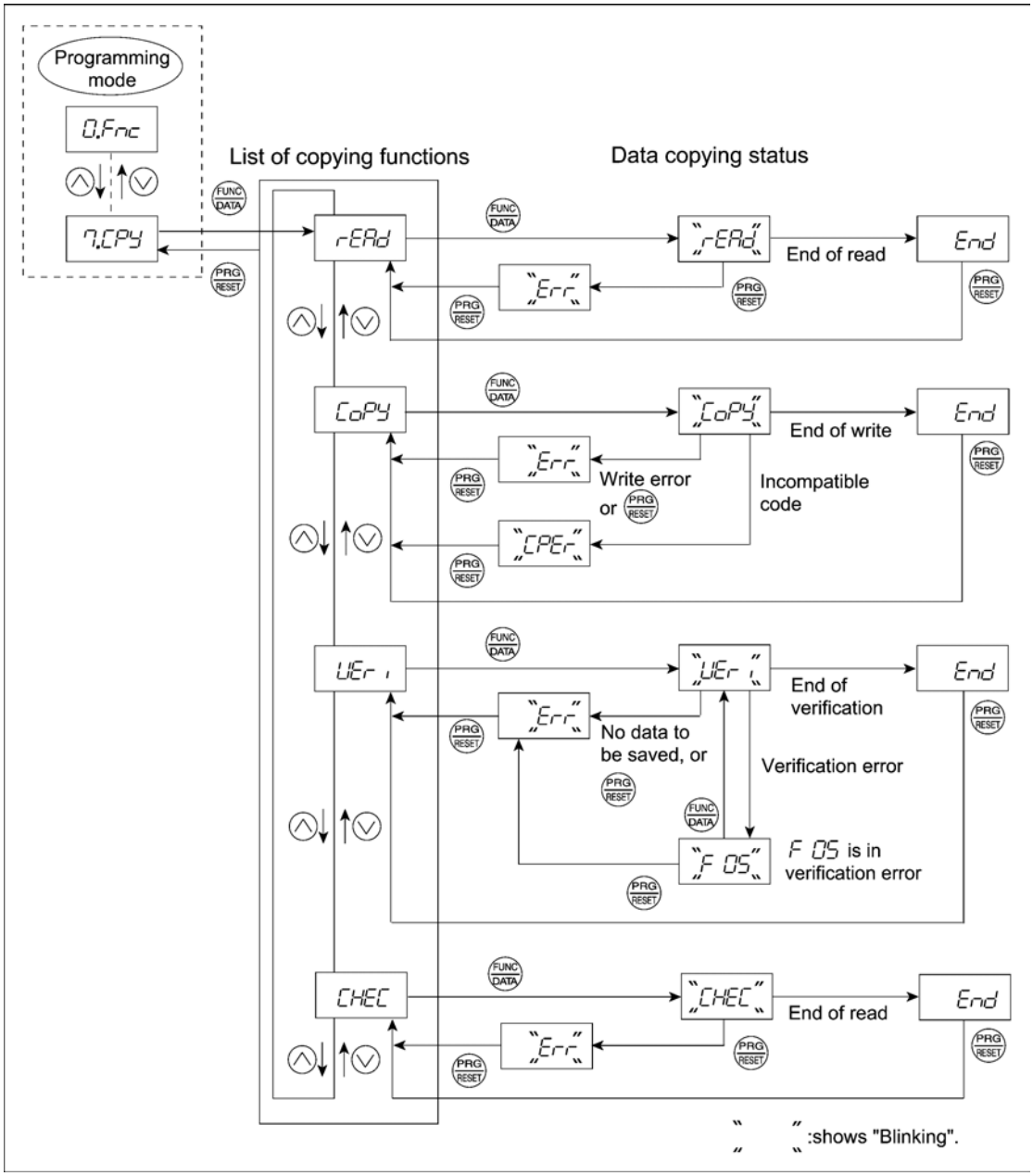


Figure 7.13 Menu Transition in Menu #7 "Data Copying"

Basic key operation

(1) Turn the inverter ON. It automatically enters Running mode. In that mode, press the PRG/RESET key to switch to Programming mode. The function selection menu appears.

(2) Use the ∧ and ∨ keys to display "Data Copying" (7.CPY).

(3) Press the FUNC/DATA key to proceed to the list of data copying functions (e.g. r-rEAd).

(4) Use the ∧ and ∨ keys to select the desired function, then press the FUNC/DATA key to execute the selected function. (e.g. r-rEAd will blink.)

(5) When the selected function has been completed, End appears. Press the PRG/RESET key to return to the list of data copying functions. Press the PRG/RESET key again to return to the menu.

Table 7.23 below lists details of the data copying functions.

Table 7.23 List of Data Copying Functions

Display on LED Monitor	Function	Description
r-rEAd	Read data	Reads the function code data out of the inverter's memory and stores it into the keypad memory. Also reads out inverter's current running status information which can be checked by FRENIC Loader, such as information of I/O, system, alarm, and running status. Pressing the PRG/RESET key during a read operation (when r-rEAd is blinking) immediately aborts the operation and displays Err- (blinking). If this happens, the entire contents of the memory of the keypad will be completely cleared.
CoPY	Write data	Writes data stored in the keypad memory into the inverter's memory. If you press the PRG/RESET key during a write operation (when CoPY is blinking), the write operation that is under way will be aborted and Err- will appear (blinking). If this happens, the contents of the inverter's memory (i.e., function code data) have been partly updated and remain partly old. Therefore, do not operate the inverter. Instead, perform initialization or rewrite the entire data. If this function does not work, refer to "■ If data copying does not work" on page 7-45.
VrF- r	Verify data	Verifies (collates) the data stored in the keypad memory with that in the inverter's memory. If any mismatch is detected, the verify operation will be aborted, with the function code in disagreement displayed blinking. Pressing the FUNC/DATA key again causes the verification to continue from the next function code. Pressing the PRG/RESET key during a verify operation (when VrF- r is blinking) immediately aborts the operation and displays Err- (blinking). Err- appears blinking also when the keypad does not contain any valid data.
Prot	Enable Data protection	Enables the Data protection of data stored in the keypad's memory. In this state, you cannot read any data stored in the inverter's memory, but can write data into the memory and verify data in the memory. Upon pressing the FUNC/DATA key the inverter immediately displays Err-.
CHEC	Read inverter running information	Reads out inverter's current running status information that can be checked by FRENIC Loader, such as information of I/O, system, alarm, and running status, excluding function code data. Use this command when the function code data saved in the PC should not be overwritten and it is necessary to keep the previous data. Pressing the PRG/RESET key during a read operation (CHEC blinking) immediately aborts the operation and displays Err- (blinking).

Tip To get out of the error state indicated by a blinking Err or CPEr, press the PRG/RESET key.

■ Data protection

You can protect data saved in the keypad from unexpected modifications. Enabling the data protection that was disabled changes the display rEAd on the "Data Copying" function list to Prot, and prohibits data reading from the inverter.

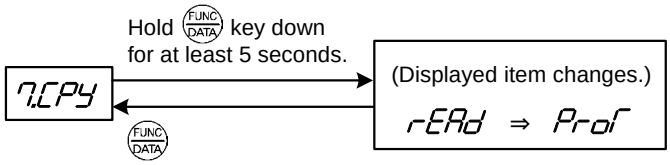
To enable or disable the data protection, follow the steps below.

(1) Select the "Data Copying" (7.CPY) on the function selection menu in Programming mode.

(2) When the 7.CPY is displayed, holding the FUNC/DATA key down for at least 5 seconds alternates data protection status between enabled or disabled.

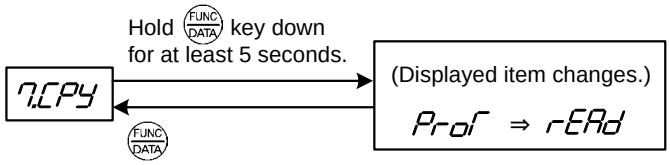
Note For switching the data protection status, be sure to hold the FUNC/DATA key down for at least 5 seconds. Once the key is released within 5 seconds, press the PRG/RESET key to go back to the 7. CPY display and perform the keying operation again.

- Enabling the disabled data protection



While 7.CPY is displayed, holding down the FUNC/DATA key for at least 5 seconds shows rEAd for 5 seconds and then switches to Prot, enabling the data protection.

- Disabling the enabled data protection



While 7.CPY is displayed, holding down the FUNC/DATA key for at least 5 seconds shows Prot for 5 seconds and then switches to rEAd, disabling the data protection.

The followings are restrictions and special notes concerning "Data Copying."

■ If data copying does not work

Check whether Err or CPEr is blinking.

(1) If Err is blinking (a write error), any of the following problems has arisen:

- No data exists in the keypad memory. (No data read operation has been performed since shipment, or a data read operation has been aborted.)
- Data stored in the keypad memory contains any error.
- The models of copy source and destination inverters are different.
- A data write operation has been performed while the inverter is running.
- The copy destination inverter is data-protected. (function code F00 = 1)
- In the copy destination inverter, the "Enable write from keypad" command ***WE-KP*** is OFF.
- A data read operation has been performed for the inverter whose data protection was enabled.

(2) If CPEr is blinking, any of the following problems has arisen:

- The function codes stored in the keypad and ones registered in the inverter are not compatible with each other. (Either of the two may have been revised or upgraded in a non-standard or incompatible manner. Consult your Fuji Electric representative.)

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7.5 Alarm Mode

If an abnormal condition arises, the protective function is invoked and issues an alarm, then the inverter automatically enters Alarm mode. At the same time, an alarm code appears on the LED monitor.

7.5.1 Releasing the alarm and switching to Running mode

Remove the cause of the alarm and press the PRG/RESET key to release the alarm and return to Running mode. The alarm can be removed using the PRG/RESET key only when the alarm code is displayed.

7.5.2 Displaying the alarm history

It is possible to display the most recent 3 alarm codes in addition to the one currently displayed. Previous alarm codes can be displayed by pressing the ▲ / ▼ key while the current alarm code is displayed.

7.5.3 Displaying the status of inverter at the time of alarm

When the alarm code is displayed, you may check various running status information (output frequency and output current, etc.) by pressing the FUNC/DATA key. The item number and data for each running information will be displayed alternately.

Further, you can view various pieces of information on the running status of the inverter using the ▲ / ▼ key. The information displayed is the same as for Menu #6 "Alarm Information" in Programming mode. Refer to Table 7.22 in Section 7.4.7, "Reading alarm information."

Pressing the PRG/RESET key while the running status information is displayed returns to the alarm code display.

Note When the running status information is displayed after removal of the alarm cause, pressing the PRG/RESET key twice returns to the alarm code display and releases the inverter from the alarm state. This means that the motor starts running if a run command has been received by this time.

7.5.4 Switching to Programming mode

You can also switch to Programming mode by pressing STOP + PRG/RESET keys simultaneously with the alarm displayed, and modify the function code data.

Figure 7.14 summarizes the possible transitions between different menu items.

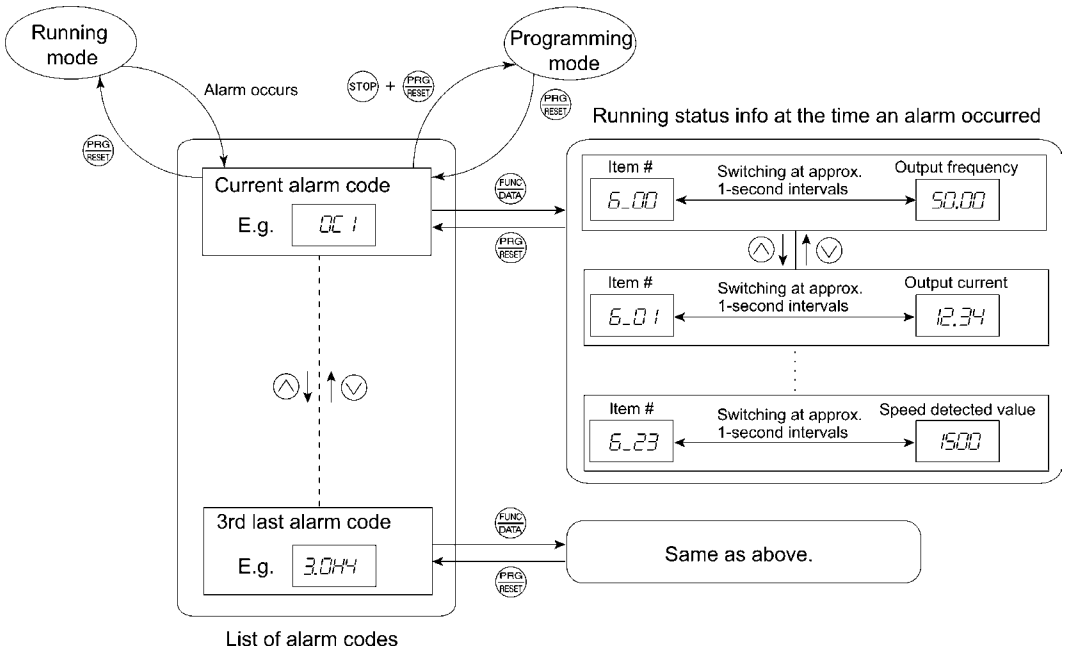

Figure 7.14 Menu Transition in Alarm Mode

7.6 USB Connectivity

The keypad has a USB port (mini B connector) on its face. To connect a USB cable, open the USB port cover as shown below.

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

For the instructions on how to use the FRENIC Loader, refer to the FRENIC Loader Instruction Manual.

In addition, using the keypad as a temporary storage media allows you to store the running status information in the keypad, detach the keypad from the inverter, connect it to a PC running FRENIC Loader at an office or off-site place.

For details on how to store data into the keypad, refer to Section 7.4.8 "Copying Data."

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Chapter 8

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 (MEH448) for details.

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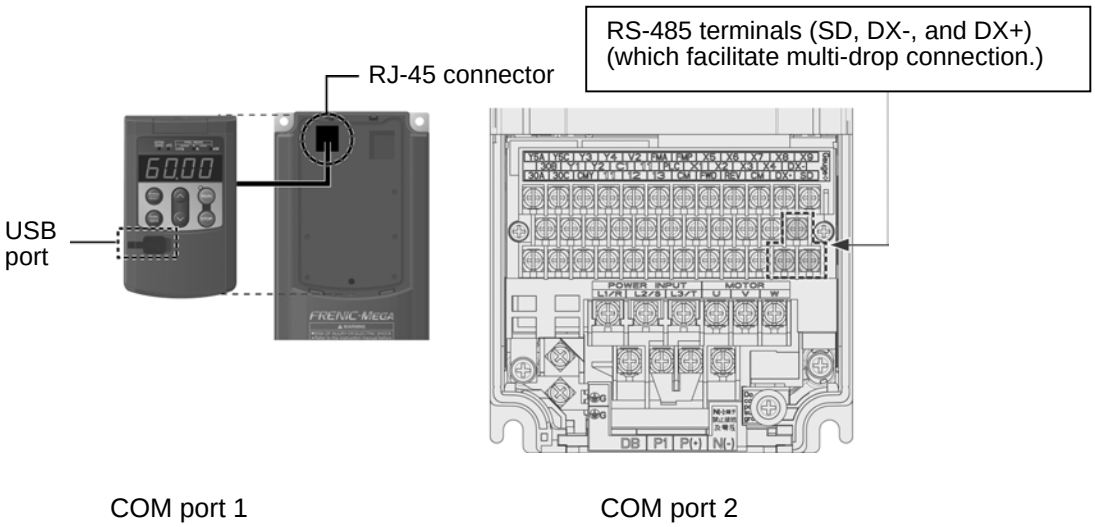
8.1 Overview on RS-485 Communication

The FRENIC-MEGA has two RS-485 communications ports at the locations shown below.

(1) Communications port 1: RJ-45 connector for the keypad

(2) Communications port 2: RS-485 terminals (Control circuit terminals SD, DX-, and DX+)



Using the RS-485 communications ports shown above enables the extended functions listed below.

■ Remote operation from a keypad at the remote location (COM port 1)

Using an extension cable to connect the standard keypad to the RJ-45 port allows you to mount the keypad on a panel located far from the inverter, enabling remote operation. The maximum length of the extension cable is 20 m.

■ Operation by FRENIC Loader (COM port 1)

A Windows-based PC can be connected to the RJ-45 connector (RS-485 communication) or the USB port on the standard keypad. Through the interface, you can run FRENIC Loader (see Section 8.2) on the PC to edit the function code data and monitor the running status of the inverter.

■ Control via host equipment (COM ports 1 and 2)

Connecting the inverter to a PC, PLC, or other host equipment enables you to control the inverter as a subordinate device from the host.

Besides the communications port (RJ-45 connector) shared with the keypad, the FRENIC-MEGA has RS-485 terminals as standard. The connection via terminals facilitates multi-drop connection.

Protocols for managing a network including inverters include the Modbus RTU protocol (compliant to the protocol established by Modicon Inc.) that is widely used in FA markets and the Fuji general-purpose inverter protocol that supports the FRENIC-MEGA and conventional series of inverters.

Note

- Connecting the keypad to the COM port 1 automatically switches to the keypad protocol; there is no need to modify the function code setting.
- When using FRENIC Loader, which requires a special protocol for handling Loader commands, you need to set up some communication function codes accordingly. For details, refer to the FRENIC Loader Instruction Manual.
- The COM port 2 supports only controls from host equipment, and not from the keypad or FRENIC Loader.

For details of RS-485 communication, refer to the RS-485 Communication User's Manual.

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8.1.1 RS-485 common specifications

Items	Specifications		
Protocol	FGI-BUS	Modbus RTU	Loader commands (supported only on the standard version)
Compliance	Fuji general-purpose inverter protocol	Modicon Modbus RTU-compliant (only in RTU mode)	Dedicated protocol (Not disclosed)
No. of supporting stations	Host device: 1 Inverters: Up to 31		
Electrical specifications	EIA RS-485		
Connection to RS-485	RJ-45 connector or terminal block		
Synchronization	Asynchronous start-stop system		
Transmission mode	Half-duplex		
Transmission speed	2400, 4800, 9600 19200 or 38400 bps		
Max. transmission cable length	500 m		
No. of logical station addresses available	1 to 31	1 to 247	1 to 255
Message frame format	FGI-BUS	Modbus RTU	FRENIC Loader
Frame synchronization	SOH (Start Of Header) character detection	Detection of no-data transmission time for 3-byte period	Start code 96H detection
Frame length	Normal transmission: 16 bytes (fixed) High-speed transmission: 8 or 12 bytes	Variable length	Variable length
Max. transfer data	Write: 1 word Read: 1 word	Write: 50 words Read: 50 words	Write: 41 words Read: 41 words
Messaging system	Polling/Selecting/Broadcast		Command message
Transmission character format	ASCII	Binary	Binary
Character length	8 or 7 bits (selectable by the function code)	8 bits (fixed)	8 bits (fixed)
Parity	Even, Odd, or None (selectable by the function code)		Even (fixed)
Stop bit length	1 or 2 bits (selectable by the function code)	No parity: 2 bits/1 bit Even or Odd parity: 1 bit Select by parity setting.	1 bit (fixed)
Error checking	Sum-check	CRC-16	Sum-check

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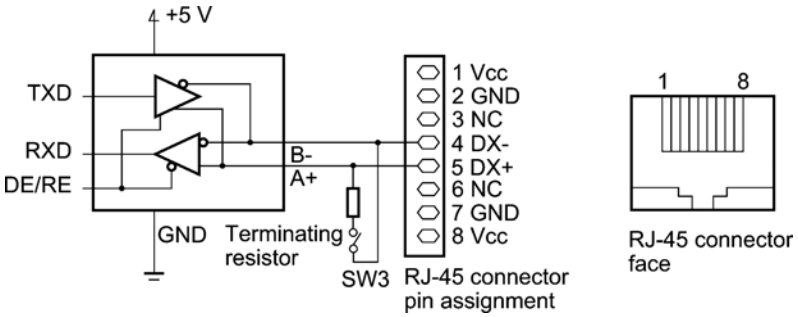
8.1.2 Terminal specifications for RS-485 communications

[1] RS-485 communications port 1 (for connecting the keypad)

The port designed for a standard keypad uses an RJ-45 connector having the following pin assignment:

Pin	Signal name	Function	Remarks
1 and 8	Vcc	Power source for the keypad	5 V power lines
2 and 7	GND	Reference potential	Grounding pins
3 and 6	NC	Not used.	No connection
4	DX-	RS-485 data (-)	Built-in terminating resistor: 112Ω Open/close by SW3*
5	DX+	RS-485 data (+)	

* For details about SW3, refer to Chapter 2, Section 2.4.2 "Setting up the slide switches."



Note Pins 1, 2, 7, and 8 on the RJ-45 connector are exclusively assigned to power supply and grounding for keypads. When connecting other devices to the RJ-45 connector, take care not to use those pins. Failure to do so may cause a short-circuit hazard. Use the pins 4 and 5 only.

[2] RS-485 communications port 2 (control circuit terminals)

The FRENIC-MEGA has terminals for RS-485 communications on the control circuit terminal block. The details of each terminal are shown below.

Signal name	Function	Remarks
SD	Shield terminal	
DX－	RS-485 data (-)	Built-in terminating resistor: 112Ω Open/close by SW2*
DX＋	RS-485 data (+)	

* For details about SW2, refer to Chapter 2, Section 2.4.2 "Setting up the slide switches."

8.1.3 Connection method

- Up to 31 inverters can be connected to one host equipment.
- The protocol is commonly used in the FRENIC series of general-purpose inverters, so programs for similar host equipment can run/stop the inverter.
  (The parameters specifications may differ depending on the equipment.)
- Fixed-length transmission frames facilitate developing communication control programs for hosts.

For details of RS-485 communication, refer to the RS-485 Communication User's Manual (MEH448).

Multi-drop connection using the RS-485 communications port 1 (for connecting the keypad)

For connecting inverters in multi-drop connection, use the branch adapters for multi-drop connection as shown below.

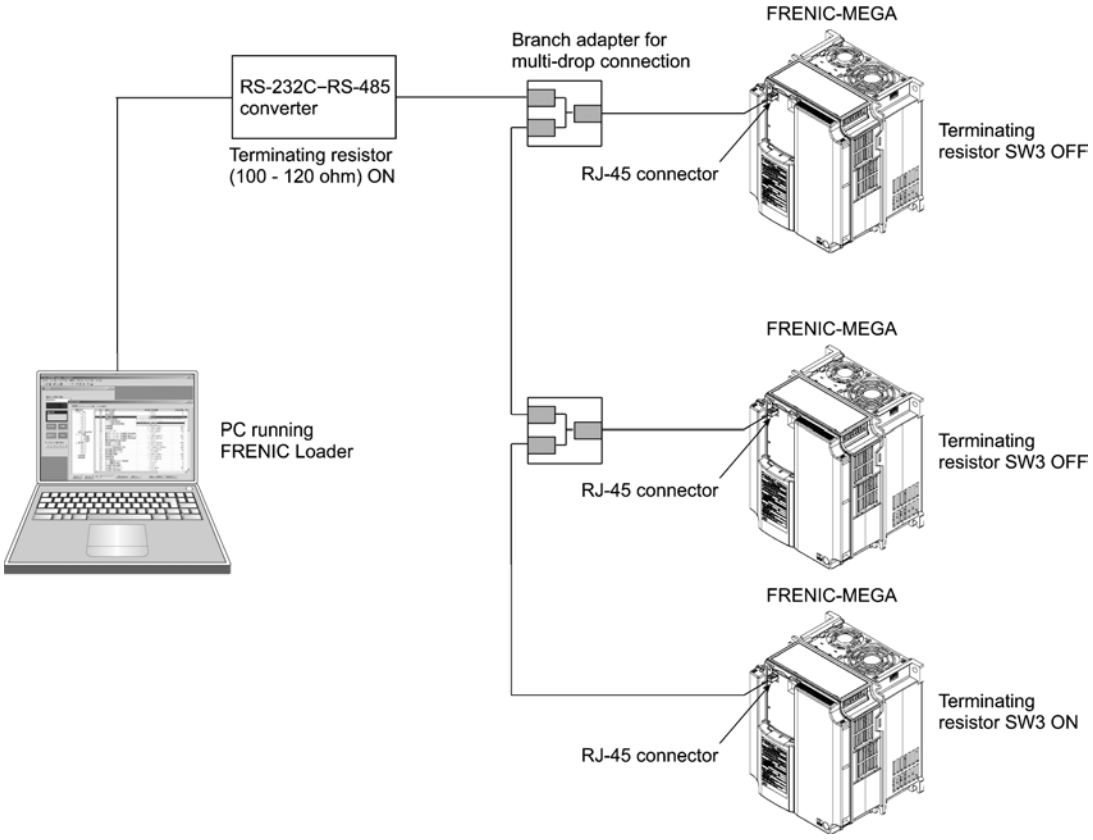


Figure 8.1 Multi-drop Connection (Using the RJ-45 connector)

Note

- Pins 1, 2, 7, and 8 on the RJ-45 connector are exclusively assigned to power supply and grounding for keypads. When connecting other devices to the RJ-45 connector, take care not to use those pins. Failure to do so may cause a short-circuit hazard. Use the pins 4 and 5 only. (For details, refer to Section 8.1.2 "Terminal specifications for RS-485 communications.")
- When selecting additional devices to prevent the damage or malfunction of the control PCB caused by external noises or eliminate the influence of common mode noises, be sure to see section 8.1.4 "Communications support devices."
- The maximum wiring length must be 500 m.
- Use cables and converters meeting the specifications for proper connection. (Refer to [2] "Requirements for the cable (COM port 1: for RJ-45 connector)" in Section 8.1.4 "Communications support devices."

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Multi-drop connection using the RS-485 communications port 2 (on the terminal block)

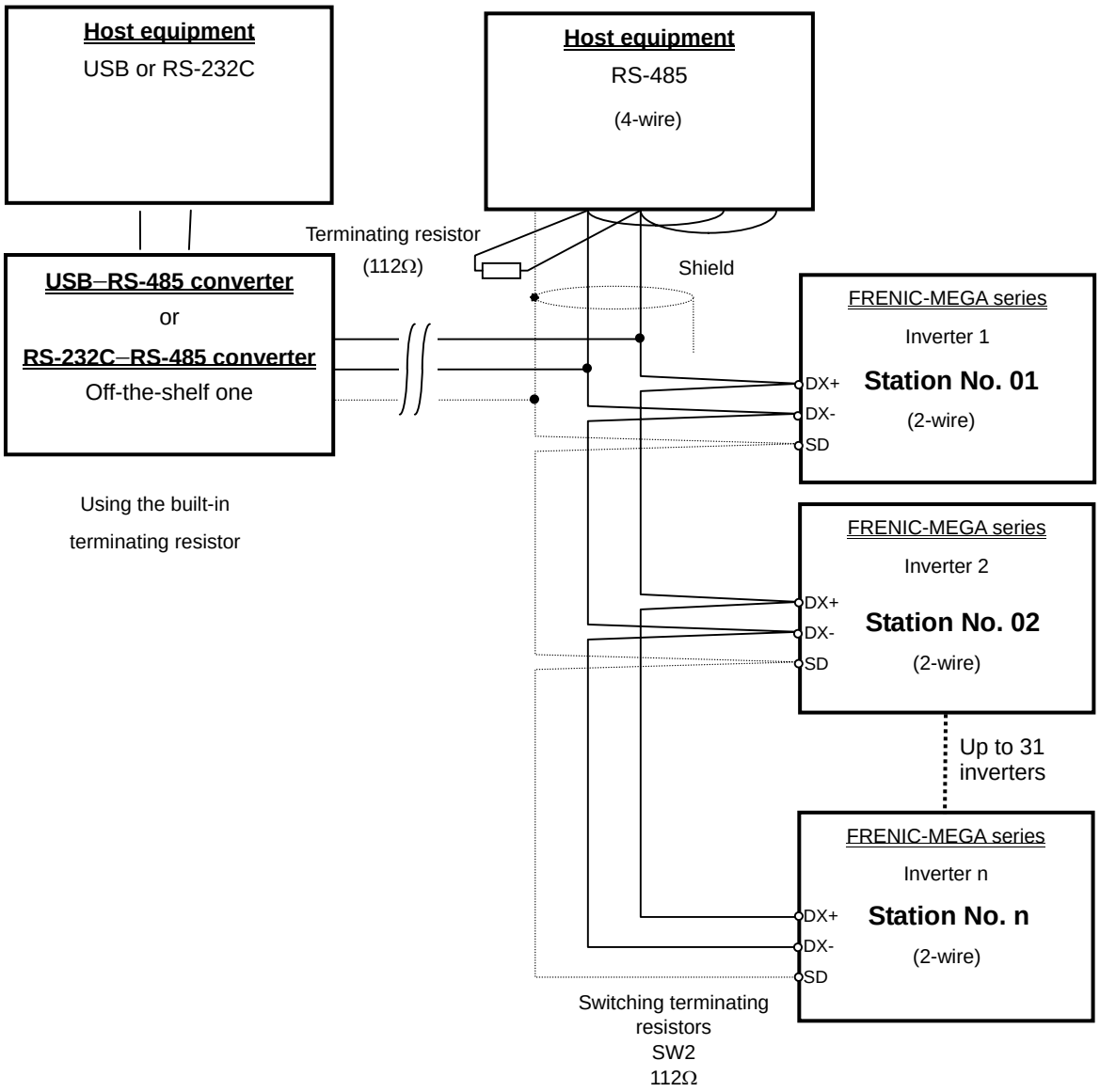

Figure 8.2 Multi-drop Connection Diagram (Connecting to the Terminal Block)

Note Use cables and converters meeting the specifications for proper connection. (Refer to [3] "Requirements for the cable (COM port 2: for RS-485 connector)" in Section 8.1.4 "Communications support devices."

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8.1.4 Communications support devices

This section describes the devices required for connecting the inverter to a PC having no RS-485 interface or for connecting two or more inverters in multi-drop network.

[1] Communications level converters

Usually PCs are not equipped with an RS-485 communications port but with an RS-232C port. To connect inverters to a PC, therefore, you need an RS-232C–RS-485 converter or a USB–RS-485 converter*. To run Loader correctly, use a converter satisfying the requirements given below.

* The USB–RS-485 converter should be a product that is compatible with the conventional COM port by emulation of a virtual COM port device driver.

Requirements for recommended communications level converters

Send/receive switching:	Auto-switching by monitoring of send/receive data status at the PC (RS-232C)
Electric isolation:	Electrically isolated from the RS-485 port
Fail-safe:	Fail-safe facility*
Other requirements:	Superior noise immunity

* The fail-safe facility refers to a feature that ensures the RS-485 receiver's output at "High" (logical value = 0) even if the RS-485 receiver's input is opened or short-circuited or all the RS-485 drivers are inactive. Refer to Figure 8.3.

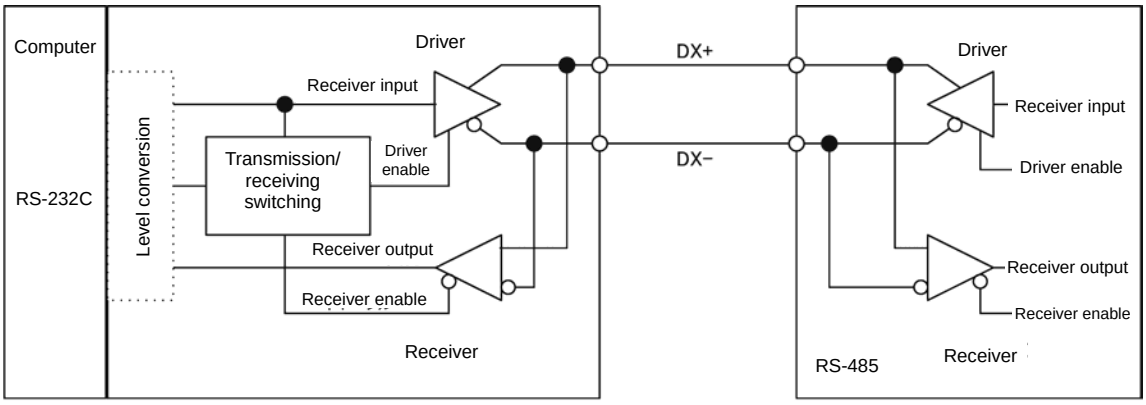
Recommended converters

System Sacom Sales Corporation (Japan) : KS-485PTI (RS-232C–RS-485 converter)
: USB-485I RJ45-T4P (USB–RS-485 converter)

Send/receive switching system

The RS-485 communications system of the inverter acts in half-duplex mode (2-wire) so the converter must feature a send/receive switching circuitry. Generally, the switching system may be either one of the following.

(1) Auto-switching by monitoring of send/receive data
(2) Switching by RS-232C control signal of RTS or DTR (hardware flow control system)



RS-232C–RS-485 converter FRENIC-MEGA (two-wire system)

Figure 8.3 Communications Level Conversion

[2] Requirements for the cable (COM port 1: for RJ-45 connector)

Use a standard 10BASE-T/100BASE-TX LAN cable (US ANSI/TIA/EIA-568A category 5 compliant, straight type).

Note The RJ-45 connector (COM port 1) has power source pins (pins 1, 2, 7 and 8) exclusively assigned to keypads. When connecting other devices to the RJ-45 connector, take care not to use those pins. Using them will cause a short-circuit hazard. Use pins 4 and 5 only.

[3] Requirements for the cable (COM port 2: for RS-485 connector)

To ensure the reliability of connection, use twisted pair shield cables for long distance transmission AWG 16 to 26.

Recommended LAN cable

Manufacturer: FURUKAWA Electric Co., LTD

AWM2789 Cable for long distance connection

Type (Product code): DC23225-2PB

[4] Branch adapter for multi-drop

An RS-485 communications network for inverters utilizes 2-wire 10BASE-T LAN cables fitted with an RJ-45 connector at both ends. To connect those inverters to the network in multi-drop mode, use branch adapters for multi-drop.

Recommended branch adapter

SK Koki (Japan): MS8-BA-JJJ

8.1.5 Noise suppression

Depending on the operating environment, instruments may malfunction due to the noise generated by the inverter. Possible measures to prevent such malfunction are: separating the wiring, use of shielded cable, isolating the power supply, and adding an inductance component. Shown below is an example of adding an inductance component.

Refer to the RS-485 Communication User's Manual, Chapter 2, Section 2.2.4 "Noise suppression" for details.

Adding inductance components

To suppress or eliminate noise for keeping the network in high noise immunity level, insert inductance components such as choke coils in series in the signal circuit, or pass the RS-485 communications cable through a ferrite core ring or wind it around by 2 or 3 turns as shown below to keep the impedance of the signal lines high.

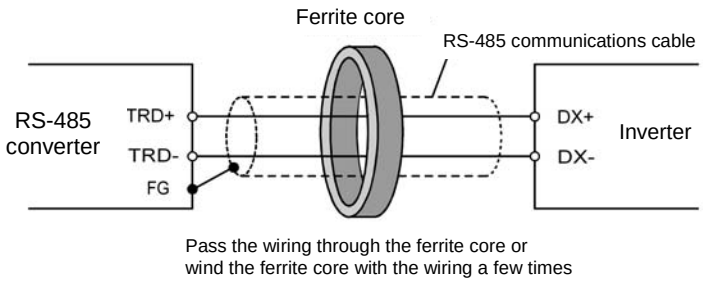


Figure 8.4 Adding an Inductance Component

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8.2 Overview of FRENIC Loader

FRENIC Loader is a software tool that supports the operation of the inverter via an RS-485 communications link. It allows you to remotely run or stop the inverter, edit, set, or manage the function codes, monitor key parameters and values during operation, as well as monitor the running status (including alarm information) of the inverters on the RS-485 communications network.

Note With special order-made inverters, FRENIC Loader may not be able to display some function codes normally.

For details, refer to the FRENIC Loader Instruction Manual.

8.2.1 Specifications

Item		Specifications (White on black indicates factory default)	Remarks
Name of software		FRENIC Loader	
Supported inverter		FRENIC-MEGA	(Note 1)
No. of supported inverters		When connected to USB port: 1 When connected to RS-485 communications ports: Up to 31	
Recommended cable		10BASE-T cable with RJ-45 connectors compliant with EIA568	For the RS-485 interface
Operating environment	CPU	Intel Pentium III 600 MHz or later	(Note 2)
	OS	Microsoft Windows 2000 Microsoft Windows XP	
	Memory	32 MB or more RAM	64 MB or more recommended
	Hard disk	7 MB or more free space	
	COM port	RS-232C (conversion to RS-485 communication required to connect inverters) or USB	
	Monitor resolution	800 x 600 or higher	XGA (1024 x 768), 16-bit color or higher is recommended
Transmission requirements	COM port	COM1 to COM255	PC COM ports assigned to Loader
	Transmission rate	When connected to USB port: Between loader and keypad = fixed at 12 (Mbps) Between keypad and inverter = fixed at 19200 (bps) When connected to RS-485 communications ports: 38400, 19200, 9600, 4800, 2400 (bps)	19200 bps or more is recommended. (Note 3)
	Character length	8 bits	Prefixed
	Stop bit length	1 bit	Prefixed
	Parity	Even	Prefixed
	No. of retries	None or 1 to 10	No. of retry times before detecting communications error
	Timeout setting	(100 ms, 300 ms, 500 ms), (1.0 to 1.5 to 1.9 s), (2.0 to 9.0 s) or (10.0 to 60.0 s)	This setting should be longer than the response interval time set by function code y09 of the inverter.

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(Note 1) FRENIC Loader cannot be used with inverters that do not support SX protocol (protocol for handling Loader commands).

(Note 2) Use a PC with as high a performance as possible, since some slow PCs may not properly refresh the operation status monitor and Test-run windows.

(Note 3) To use FRENIC Loader on a network where a FRENIC-Mini inverter is also configured, choose 19200 bps or below.

8.2.2 Connection

By connecting a number of inverters to one PC, you can control one inverter at a time or a number of inverters simultaneously. You can also simultaneously monitor a number of inverters on the multi monitor.

For how to connect a PC to one or more inverters, refer to the RS-485 Communication User's Manual (MEH448).

8.2.3 Function overview

8.2.3.1 Setting of function code

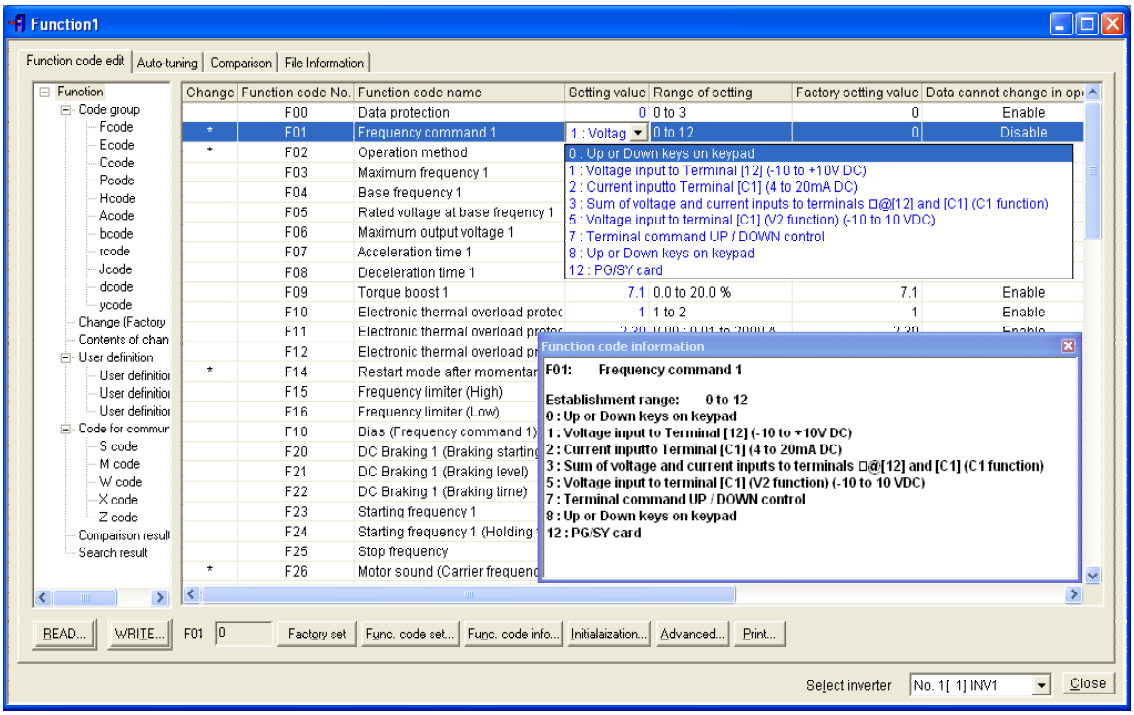
You can set, edit, and check the setting of the inverter's function code data.

List and Edit

In List and edit, you can list and edit function codes with function code No., name, set value, set range, and factory default.

You can also list function codes by any of the following groups according to your needs:

- Function code group
- Function codes that have been modified from their factory defaults
- Result of comparison with the settings of the inverter
- Result of search by function code name
- User-specified function code set



Comparison

You can compare the function code data currently being edited with that saved in a file or stored in the inverter.

To perform a comparison and review the result displayed, click the **Comparison** tab and then click the **Compared with inverter** tab or click the **Compared with file** tab, and specify the file name.

The result of the comparison will be displayed also in the Comparison Result column of the list.

File information

Clicking the **File information** tab displays the property and comments for identifying the function code editing file.

(1) Property

Shows file name, inverter model, inverter's capacity, date of readout, etc.

(2) Comments

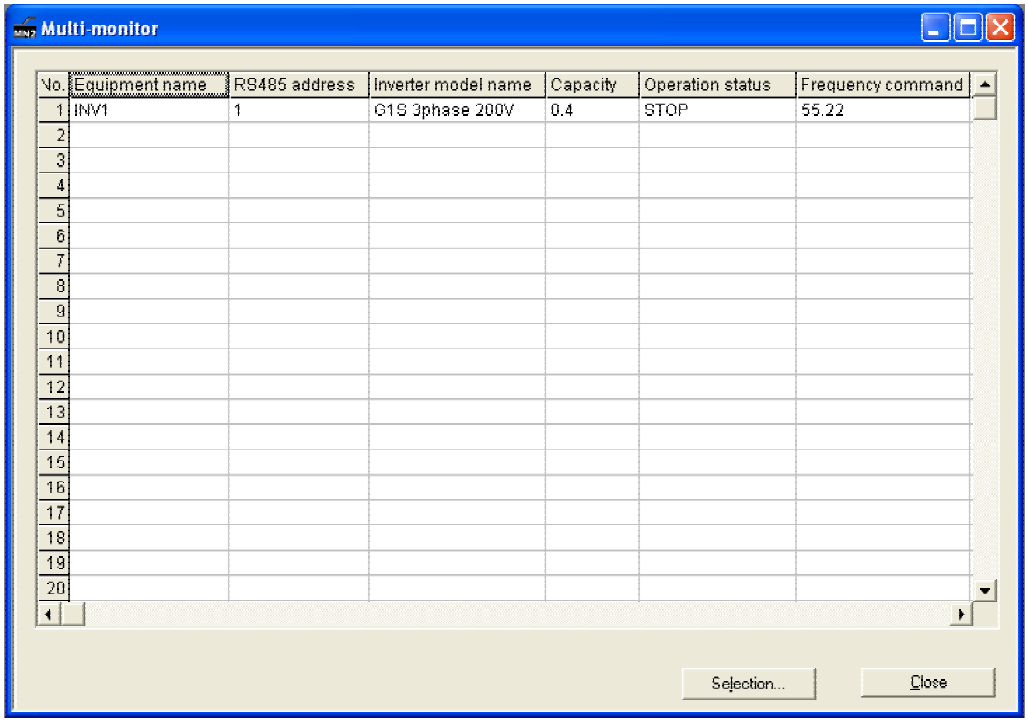
Displays the comments you have entered. You can write any comments necessary for identifying the file.

8.2.3.2 Multi-monitor

This feature lists the status of all the inverters that are marked "connected" in the configuration table.

Multi-monitor

Allows you to monitor the status of more than one inverter in a list format.

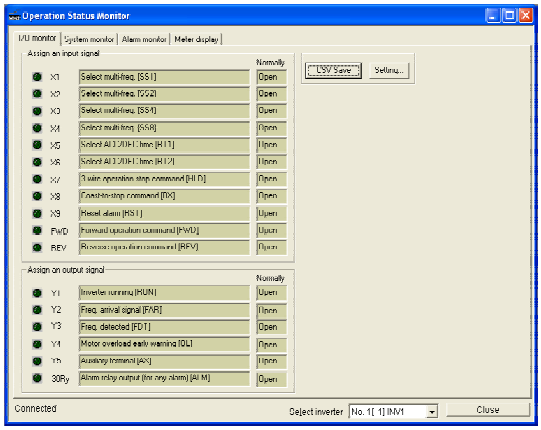


8.2.3.3 Running status monitor

The running status monitor offers four monitor functions: I/O monitor, System monitor, Alarm monitor, and Meter display. You can choose an appropriate monitoring format according to the purpose and situation.

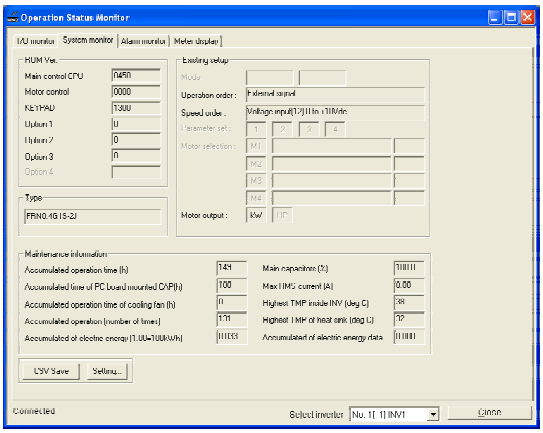
I/O monitor

Allows you to monitor the ON/OFF states of the digital input signals to the inverter and the transistor output signals.



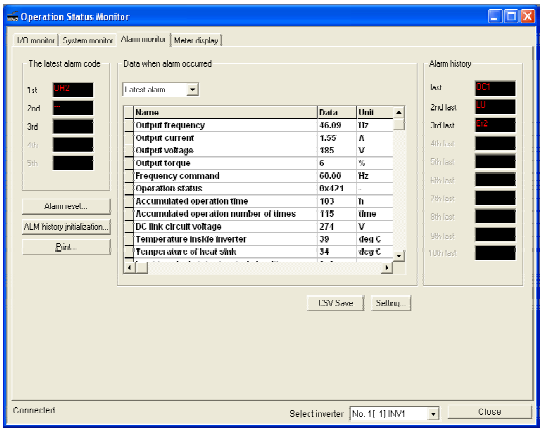
System monitor

Allows you to check the inverter's system information (version, model, maintenance information, etc.).



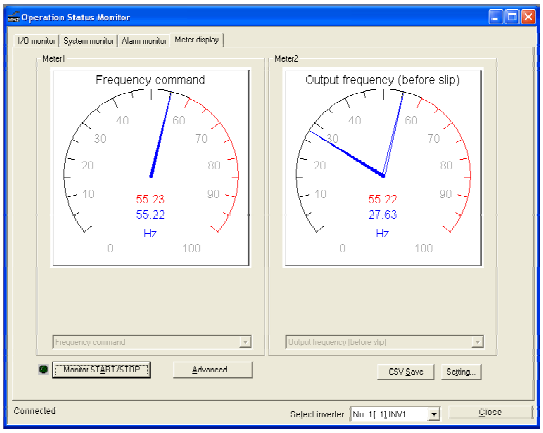
Alarm monitor

The alarm monitor shows the alarm status of the selected inverter. In this window you can check the details of the alarm currently occurs and related information.



Meter display

Displays analog readouts of the selected inverter (such as output frequency) on analog meters. The example on the right displays the reference frequency and the output frequency.



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8.2.3.4 Test-running

The Test-running feature allows you to test-run the motor in the forward or reverse direction while monitoring the running status of the selected inverter.

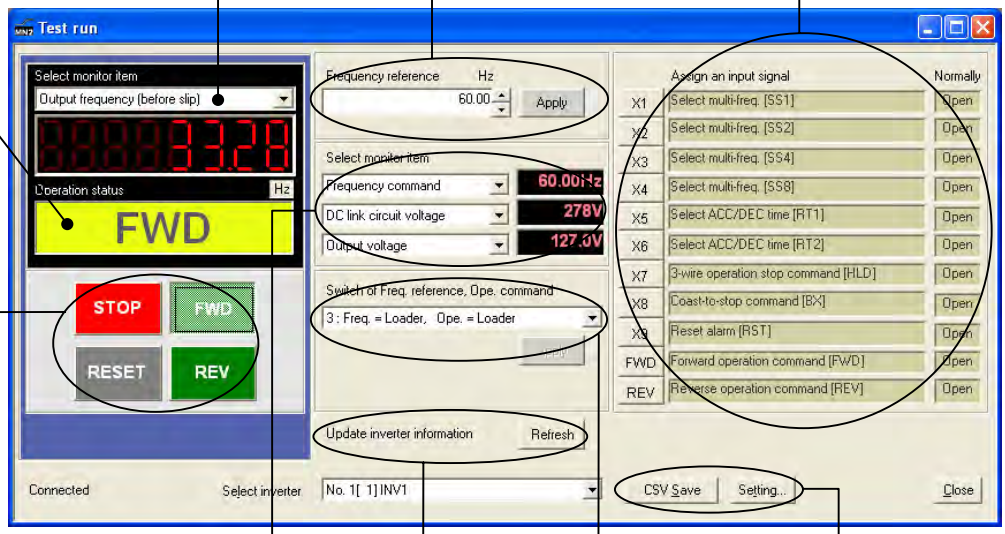
Select monitor item
Select what is to be displayed (e.g., output frequency or current) here using the pull-down menu.

Frequency reference
Enter or select the frequency command to write it into the inverter. Click **Apply** to make it effective.

I/O terminal status
Shows the status of the programmable, digital I/O terminals of the inverter.

Operation status
Shows FWD, REV, STOP and alarm codes.

Operation buttons
(See the table below.)*



Select monitor item
Select the operation status information to be monitored in real-time.

Update inverter information
Click the **Refresh** button to refresh the contents of this window to show the latest inverter status.

Switching of frequency and run command sources
Select the frequency and run command sources and click **Apply**.

CSV Save
Use these buttons to save the displayed data in CSV format.

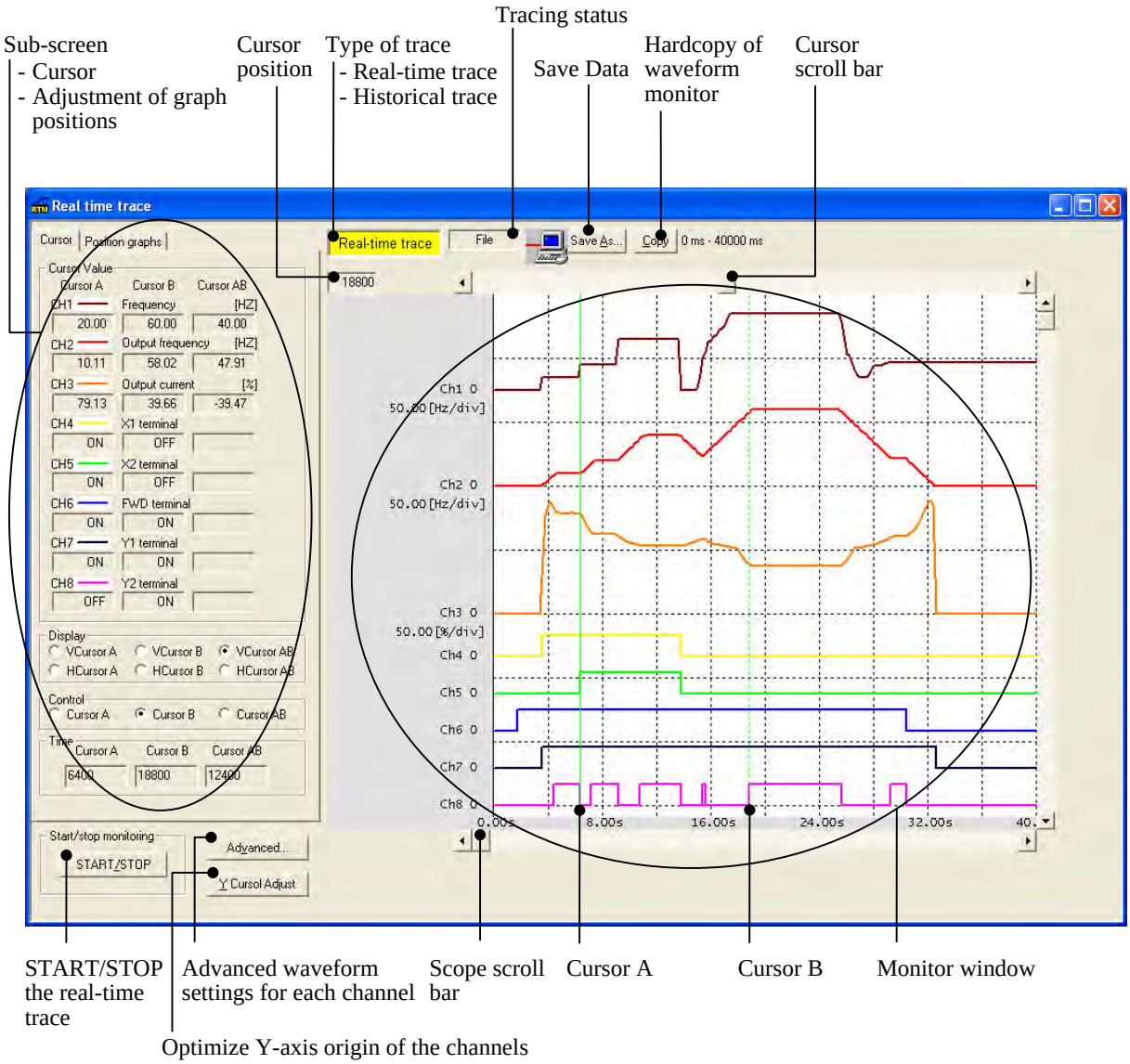
* The details of the operation buttons are described in the table below.

Button	Use to
STOP	Stop the motor.
FWD	Run the motor forward. (The indented appearance of the button indicates that the button is active and the motor is running.)
REV	Run the motor reverse. (The indented appearance of the button indicates that the button is active and the motor is running.)
RESET	Reset all alarm information saved in the selected inverter.

8.2.3.5 Real-time trace

The real-time trace monitors up to 4 analog readouts and up to 8 digital ON/OFF signals to display the running status of a selected inverter in real-time waveforms.

- Sampling interval: Fixed at 200 ms
- Max. 4 channels for analog data and max. 8 channels for digital data (max. 8 channels in total)
- Waveform capturing capability: Max. 15360 samples/channel



Note During the real-time trace in progress you cannot:
- Change the RS-485 station address,
- Change the advanced waveform settings, or
- Scroll the real-time trace screen or move the cursor.

Resizing the real-time trace window automatically changes the monitor window size.

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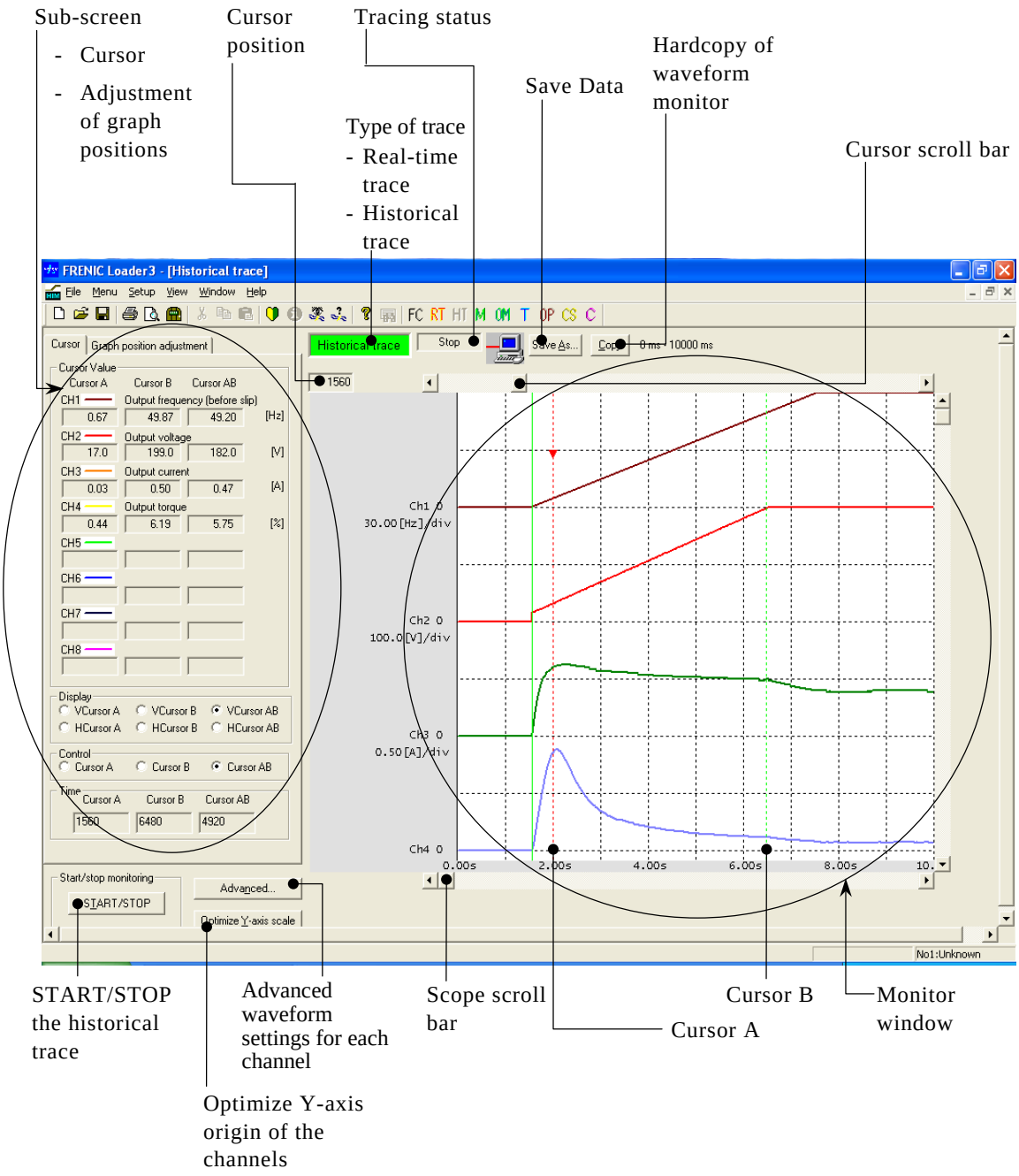
8.2.3.6 Historical trace

The historical trace monitors the running status of a selected inverter in greater detail with more contiguous waveforms than in the real-time trace.

- Sampling interval: 1 to 200 ms
- Size of data saved: 2 kilobytes
- Max. 4 channels for analog data and max. 8 channels for digital data (max. 8 channels in total)
- Waveform capturing capability: Max. 500 samples/channel



Note

During the real-time trace in progress you cannot:
- Change the RS-485 station address, or
- Change the advanced waveform settings.

Resizing the historical trace window automatically changes the monitor window size.

8.2.3.7 USB port on the standard keypad

The USB port on the standard keypad allows you to connect a computer supporting USB connection and use the FRENIC Loader. As described below, various information of the inverter saved in the keypad memory can be monitored and controlled on the computer.

Improved working efficiency in the manufacturing site

- A variety of data about the inverter body can be saved in the keypad memory, allowing you to check the information in any place.

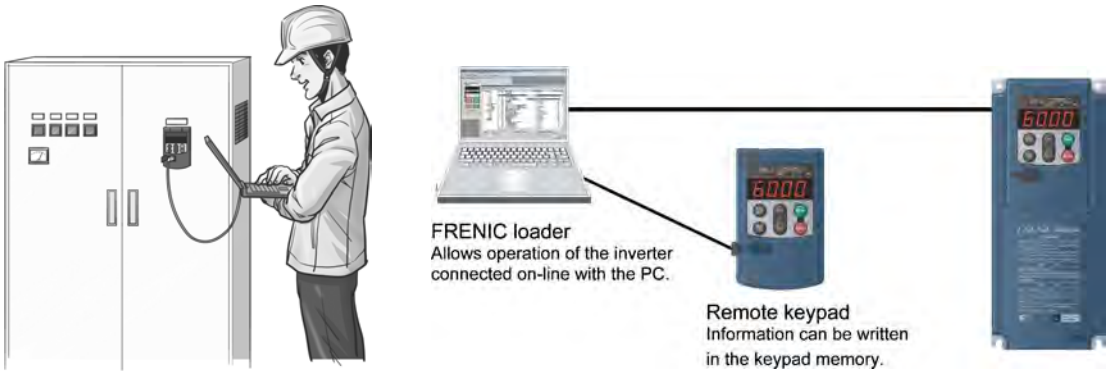
  <Example of use in the office>

Features

1. The keypad can be directly connected to the computer through a commercial USB cable (mini B) without using a converter. The computer can be connected on-line with the inverter.
2. With the personal computer loader, the inverter can support the following functions (1) to (5).
   (1) Editing, comparing, and copying the function code data
   (2) Real-time operation monitor
   (3) Trouble history (indicating the latest four troubles)
   (4) Maintenance information
   (5) Historical trace

- Data can be transferred from the USB port of the keypad directly to the computer (personal computer loader) in the manufacturing site.
- Periodical collection of life information can be carried out efficiently.
- The real-time tracing function permits the operator to check the equipment for abnormality.

<Example of use in the manufacturing site>



Chapter 9

TROUBLESHOOTING

This chapter describes troubleshooting procedures to be followed when the inverter malfunctions or detects an alarm or a light alarm condition. In this chapter, first check whether any alarm code or the "light alarm" indication (L-AL) is displayed or not, and then proceed to the troubleshooting items.

Contents

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9.1 Protective Functions

The FRENIC-MEGA series of inverters has various protective functions as listed below to prevent the system from going down and reduce system downtime. The protective functions marked with an asterisk (*) in the table are disabled by factory default. Enable them according to your needs.

The protective functions include, for example, the "heavy alarm" detection function which, upon detection of an abnormal state, displays the alarm code on the LED monitor and causes the inverter to trip, the "light alarm" detection function which displays the alarm code but lets the inverter continue the current operation, and other warning signal output functions.

If any problem arises, understand the protective functions listed below and follow the procedures given in Sections 9.2 and onwards for troubleshooting.

Protective function	Description	Related function code
"Heavy alarm" detection	This function detects an abnormal state, displays the corresponding alarm code, and causes the inverter to trip. The "heavy alarm" codes are check-marked in the "Heavy alarm" object column in Table 9.1. For details of each alarm code, see the corresponding item in the troubleshooting. The inverter retains the last four alarm codes and their factors together with their running information applied when the alarm occurred, so it can display them.	H98
"Light alarm" detection*	This function detects an abnormal state categorized as a "light alarm," displays L-AL and lets the inverter continue the current operation without tripping. It is possible to define which abnormal states should be categorized as a "light alarm" using function codes H81 and H82. The "light alarm" codes are check-marked in the "Light alarm" object column in Table 9.1. For how to check and release light alarms, see Section 9.5 "If the "Light Alarm" Indication (L-AL) Appears on the LED Monitor."	H81 H82
Stall prevention	When the output current exceeds the current limiter level (F44) during acceleration/ deceleration or constant speed running, this function decreases the output frequency to avoid an overcurrent trip.	F44
Overload prevention control*	Before the inverter trips due to a heat sink overheat (OH1) or inverter overload (OLU), this function decreases the output frequency to reduce the load.	H70
Automatic deceleration* (Anti-regenerative control)	If regenerative energy returned exceeds the inverter's braking capability, this function automatically increases the deceleration time or controls the output frequency to avoid an overvoltage trip.	H69
Deceleration characteristics* (Excessive regenerative energy proof braking capability)	During deceleration, this function increases the motor energy loss and decreases the regenerative energy returned to avoid an overvoltage trip (OLU).	H71
Reference loss detection*	This function detects a reference frequency loss (due to a broken wire, etc.), continues the inverter operation at the specified frequency, and issues the "Command loss detected" signal ***REF OFF***.	E65
Automatic lowering of carrier frequency	Before the inverter trips due to an abnormal surrounding temperature or output current, this function automatically lowers the carrier frequency to avoid a trip.	H98
Dew condensation prevention*	Even when the inverter is in stopped state, this function feeds DC current across the motor at certain intervals to raise the motor temperature for preventing dew condensation.	J21
Motor overload early warning*	When the inverter output current has exceeded the specified level, this function issues the "Motor overload early warning" signal ***OL*** before the thermal overload protection function causes the inverter to trip for motor protection. This function exclusively applies to the 1st motor.	E34 E35
Auto-reset*	When the inverter has stopped because of a trip, this function allows the inverter to automatically reset and restart itself. (The number of retries and the latency between stop and reset can be specified.)	H04 H05
Forced stop*	Upon receipt of the "Force to stop" terminal command ***STOP***, this function interrupts the run and other commands currently applied in order to forcedly decelerate the inverter to a stop.	H56
Surge protection	This function protects the inverter from a surge voltage invaded between main circuit power lines and the ground.	--

Table 9.1 Abnormal States Detectable ("Heavy Alarm" and "Light Alarm" Objects)

Code	Name	"Heavy alarm" objects	"Light alarm" objects	Remarks	Ref. page
OC 1, OC2, OC3	Instantaneous overcurrent	√	--		9-11
EF	Ground fault	√	--	30 kW or above	9-12
OU 1, OU2, OU3	Overvoltage	√	--		9-12
LU	Undervoltage	√	--		9-13
L in	Input phase loss	√	--		9-13
OPL	Output phase loss	√	--		9-14
OH 1	Heat sink overheat	√	√		9-14
OH2	External alarm	√	√		9-14
OH3	Inverter internal overheat	√	√		9-15
OH4	Motor protection (PTC/NTC thermistor)	√	--		9-15
dbH	Braking resistor overheat	√	√	22 kW or below	9-16
FUS	Fuse blown	√	--	200 V class series with 75 kW or above, 400 V class series with 90 kW or above	9-16
PbF	Charger circuit fault	√	--	200 V class series with 37 kW or above, 400 V class series with 75 kW or above	9-16
OL 1 to OL 4	Overload of motors 1 through 4	√	√		9-17
OLU	Inverter overload	√	--		9-17
OS	Overspeed	√	--		9-18
PG	PG wire break	√	--		9-18
Er 1	Memory error	√	--		9-19
Er2	Keypad communications error	√	--		9-19
Er3	CPU error	√	--		9-19
Er4	Option communications error	√	√		9-20
Er5	Option error	√	√		9-20
Er6	Operation protection	√	--		9-20
Er 7	Tuning error	√	--		9-20
Er8 ErP	RS-485 communications error (COM port 1) RS-485 communications error (COM port 2)	√	√		9-21
ErF	Data saving error during undervoltage	√	--		9-22
ErH	Hardware error	√	--	200 V class series with 37 kW or above, 400 V class series with 45 kW or above	9-22
ErE	Speed mismatch or excessive speed deviation	√	√		9-22
nrb	NTC wire break error	√	--		9-23
Err	Mock alarm	√	--		9-23
CoF	PID feedback wire break	√	√		9-24
dbA	Braking transistor broken	√	--		9-24
Ero	Positioning control error	√	--		9-24
L-AL	Light alarm	--	--		--
FAL	DC fan locked	--	√	200 V class series with 45 kW or above, 400 V class series with 75 kW or above	--
OL	Motor overload early warning	--	√		--
OH	Heat sink overheat early warning	--	√		--
L iF	Lifetime alarm	--	√		--
rEF	Reference command loss detected	--	√		--
P id	PID alarm	--	√		--
UTL	Low torque output	--	√		--
PTC	PTC thermistor activated	--	√		--
rTE	Inverter life (Cumulative motor run time)	--	√		--
CnT	Inverter life (Number of startups)	--	√		--

9.2 Before Proceeding with Troubleshooting

⚠WARNING

If any of the protective functions has been activated, first remove the cause. Then, after checking that the all run commands are set to OFF, release the alarm. If the alarm is released while any run commands are set to ON, the inverter may supply the power to the motor, running the motor.

Injury may occur.

- Even though 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.
- Turn OFF the power and wait at least five minutes for inverters with a capacity of 22 kW or below, or at least ten minutes for inverters with a capacity of 30 kW or above. Make sure that the LED monitor and charging lamp are turned OFF. Further, make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P (+) and N (-) has dropped to the safe level (+25 VDC or below).

Electric shock may occur.

Follow the procedure below to solve problems.

(1) First, check that the inverter is correctly wired, referring to Chapter 2, Section 2.8 "Connection Diagrams."

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

- If neither an alarm code nor "light alarm" indication ( ) appears on the LED monitor

Abnormal motor operation → Go to Section 9.3.1.

[1] The motor does not rotate.
[2] The motor rotates, but the speed does not increase.
[3] The motor runs in the opposite direction to the command.
[4] Speed fluctuation or current oscillation (e.g., hunting) occurs during running at constant speed.
[5] Grating sound is heard from the motor or the motor sound fluctuates.
[6] The motor does not accelerate or decelerate within the specified time.
[7] The motor does not restart even after the power recovers from a momentary power failure.
[8] The motor abnormally heats up.
[9] The motor does not run as expected.

Problems with inverter settings → Go to Section 9.3.2.

[1] Nothing appears on the LED monitor.
[2] The desired menu is not displayed.
[3] Data of function codes cannot be changed.

- If an alarm code appears on the LED monitor → Go to Section 9.4.
- If the "light alarm" indication ( ) appears on the LED monitor → Go to Section 9.5.
- If an abnormal pattern appears on the LED monitor while neither an alarm code nor "light alarm" indication ( ) is displayed → Go to Section 9.6.

If any problems persist after the above recovery procedure, contact your Fuji Electric representative.

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

This section describes the troubleshooting procedure based on function codes dedicated to motor 1 which are marked with an asterisk (*). For motors 2 to 4, replace those asterisked function codes with respective motor dedicated ones (refer to Chapter 5, Table 5.8).

For the function codes dedicated to motors 2 to 4, see Chapter 5 "FUNCTION CODES."

9.3.1 Abnormal motor operation

[1] The motor does not rotate.

Possible Causes	What to Check and Suggested Measures
(1) No power supplied to the inverter.	Check the input voltage and interphase voltage unbalance. ➔ Turn ON a molded case circuit breaker (MCCB), a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or a magnetic contactor (MC). ➔ Check for voltage drop, phase loss, poor connections, or poor contacts, and fix them if necessary. ➔ If only the auxiliary control power input is supplied, also supply the main power to the inverter.
(2) No forward/reverse operation command was inputted, or both the commands were inputted simultaneously (external signal operation).	Check the input status of the forward/reverse command with Menu #4 "I/O Checking" using the keypad. ➔ Input a run command. ➔ Set either the forward or reverse operation command to off if both commands are being inputted. ➔ Correct the run command source. (Set F02 data to "1.") ➔ Correct the assignment of commands ***FWD*** and ***REV*** with function codes E98 and E99. ➔ Connect the external circuit wires to control circuit terminals [FWD] and [REV] correctly. ➔ Make sure that the sink/source slide switch (SW1) on the control printed circuit board (control PCB) is properly configured.
(3) No indication of rotation direction (keypad operation).	Check the input status of the forward/reverse rotation direction command with Menu #4 "I/O Checking" using the keypad. ➔ Input the rotation direction (F02 = 0), or select the keypad operation with which the rotation direction is fixed (F02 = 2 or 3).
(4) The inverter could not accept any run commands from the keypad since it was in Programming mode.	Check which operation mode the inverter is in, using the keypad. ➔ Shift the operation mode to Running mode and enter a run command.
(5) A run command with higher priority than the one attempted was active, and the run command was stopped.	Referring to the block diagram of the frequency command block (refer to Chapter 6), check the higher priority run command with Menu #2 "Data Checking" and Menu #4 "I/O Checking" using the keypad. ➔ Correct any incorrect function code data settings (in H30, y98, etc.) or cancel the higher priority run command.
(6) No analog frequency command input.	Check whether the analog frequency command (reference frequency) is correctly inputted, using Menu #4 "I/O Checking" on the keypad. ➔ Connect the external circuit wires to terminals [13], [12], [11], [C1], and [V2] correctly. ➔ When the terminal [V2] is used, check the slider position of the terminal [V2] property switch (SW5) and the setting of the thermistor mode selection (H26).

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Possible Causes	What to Check and Suggested Measures
(7) The reference frequency was below the starting or stop frequency.	Check that a reference frequency has been entered correctly, using Menu #4 "I/O Checking" on the keypad. ➔ Set the reference frequency at the same or higher than that of the starting and stop frequencies (F23* and F25). ➔ Reconsider the starting and stop frequencies (F23* and F25), and if necessary, change them to the lower values. ➔Inspect the external frequency command potentiometers, signal converters, switches, and relay contacts. Replace any ones that are faulty. ➔ Connect the external circuit wires to terminals [13], [12], [11], [C1], and [V2] correctly.
(8) A frequency command with higher priority than the one attempted was active.	Check the higher priority run command with Menu #2 "Data Checking" and Menu #4 "I/O Checking" using the keypad, referring to the block diagram of the frequency command block (refer to Chapter 6). ➔ Correct any incorrect function code data (e.g. cancel the higher priority run command).
(9) The upper and lower frequencies for the frequency limiters were set incorrectly.	Check the data of function codes F15 (Frequency limiter (High)) and F16 (Frequency limiter (Low)). ➔ Change the settings of F15 and F16 to the correct ones.
(10) The coast-to-stop command was effective.	Check the data of function codes E01 through E09, E98, and E99 and the input signal status, using Menu #4 "I/O Checking" on the keypad. ➔ Release the coast-to-stop command setting.
(11) Broken wires, incorrect connection or poor contact with the motor.	Check the wiring (Measure the output current). ➔ Repair the wires to the motor, or replace them.
(12) Overload	Measure the output current. ➔ Reduce the load (In winter, the load tends to increase.)
	Check whether any mechanical brake is activated. ➔ Release the mechanical brake, if any.
(13) Torque generated by the motor was insufficient.	Check that the motor starts running if the value of torque boost (F09*) is increased. ➔ Increase the value of torque boost (F09*) and try to run the motor.
	Check the data of function codes F04*, F05*, H50, H51, H52, H53, H65, and H66. ➔ Change the V/f pattern to match the motor's characteristics.
	Check that the motor switching signal (selecting motor 1, 2, 3 or 4) is correct and the data of function codes matches each motor. ➔ Correct the motor switching signal. ➔ Modify the function code data to match the connected motor.
	Check whether the reference frequency is below the slip-compensated frequency of the motor. ➔ Change the reference frequency so that it becomes higher than the slip-compensated frequency of the motor.
(14) Wrong connection or poor contact of DC reactor (DCR)	Check the wiring. A DCR is provided as standard for LD-mode inverters with a capacity of 55 kW and inverters with a capacity of 75 kW or above. These inverters cannot run without a DCR. ➔ Connect the DCR correctly. Repair or replace DCR wires.

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

Possible Causes	What to Check and Suggested Measures
(1) The maximum frequency currently specified was too low.	Check the data of function code F03* (Maximum frequency). ➔ Correct the F03* data.
(2) The data of frequency limiter (High) currently specified was too low.	Check the data of function code F15 (Frequency limiter (High)). ➔ Correct the F15 data.
(3) The reference frequency currently specified was too low.	Check that the reference frequency has been entered correctly, using Menu #4 "I/O Checking" on the keypad. ➔ Increase the reference frequency. ➔ Inspect the external frequency command potentiometers, signal converters, switches, and relay contacts. Replace any ones that are faulty. ➔ Connect the external circuit wires to terminals [13], [12], [11], [C1], and [V2] correctly.
(4) A frequency command (e.g., multi-frequency or via communications) with higher priority than the one attempted was active and its reference frequency was too low.	Check the data of the relevant function codes and what frequency commands are being received, through Menu #1 "Data Setting," Menu #2 "Data Checking" and Menu #4 "I/O Checking," on the keypad by referring to the block diagram of the frequency command (refer to Chapter 6). ➔ Correct any incorrect data of function codes (e.g. cancel the higher priority frequency command).
(5) The acceleration time was too long or too short.	Check the data of function codes F07, E10, E12, and E14 (Acceleration time). ➔ Change the acceleration time to match the load.
(6) Overload.	Measure the output current. ➔ Reduce the load.
	Check whether any mechanical brake is activated. ➔ Release the mechanical brake.
(7) Function code settings do not agree with the motor characteristics.	If auto-torque boost or auto-energy saving operation is specified, check whether the data of P02*, P03*, P06*, P07*, and P08* agree with the parameters of the motor. ➔ Perform auto-tuning of the inverter for the motor to be used.
(8) The output frequency does not increase due to the current limiter operation.	Make sure that F43 (Current limiter (Mode selection)) is set to "2" and check the data of F44 (Current limiter (Level)). ➔ Correct the F44 data. Or, if the current limiter operation is not needed, set F43 to "0" (disabled).
	Decrease the value of torque boost (F09*), then run the motor again and check if the speed increases. ➔ Adjust the value of the torque boost (F09*).
	Check the data of function codes F04*, F05*, H50, H51, H52, H53, H65, and H66 to ensure that the V/f pattern setting is right. ➔ Match the V/f pattern setting with the motor ratings.
(9) The output frequency does not increase due to the torque limiter operation.	Check whether data of torque limiter related function codes (F40, F41, E16 and E17) is correctly configured and the "Select torque limiter level" terminal command ***TL2***/***TL1*** is correct. ➔ Correct data of F40, F41, E16 and E17 or reset them to the factory defaults (disable). ➔ Set the ***TL2***/***TL1*** correctly.
(10) Bias and gain incorrectly specified.	Check the data of function codes F18, C50, C32, C34, C37, C39, C42, and C44. ➔ Readjust the bias and gain to appropriate values.

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

Possible Causes	What to Check and Suggested Measures
(1) Wiring to the motor is incorrect.	Check the wiring to the motor. ➔ Connect terminals U, V, and W of the inverter to the U, V, and W terminals of the motor, respectively.
(2) Incorrect connection and settings for run commands and rotation direction commands ***FWD*** and ***REV***.	Check the data of function codes E98 and E99 and the connection to terminals [FWD] and [REV]. ➔ Correct the data of the function codes and the connection.
(3) A run command (with fixed rotational direction) from the keypad is active, but the rotational direction setting is incorrect.	Check the data of function code F02 (Run command). ➔ Change the data of function code F02 to "2: RUN / STOP keys on keypad (forward)" or "3: RUN / STOP keys on keypad (reverse)."
(4) The rotation direction specification of the motor is opposite to that of the inverter.	The rotation direction of IEC-compliant motors is opposite to that of incompliant motors. ➔ Switch the ***FWD***/***REV*** signal setting.

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

Possible Causes	What to Check and Suggested Measures
(1) The frequency command fluctuates.	Check the signals for the frequency command with Menu #4 "I/O Checking" using the keypad. ➔ Increase the filter constants (C33, C38, and C43) for the frequency command.
(2) An external frequency command potentiometer is used for frequency setting.	Check that there is no noise in the control signal wires from external sources. ➔ Isolate the control signal wires from the main circuit wires as far as possible. ➔ Use shielded or twisted wires for control signals.
	Check whether the external frequency command potentiometer is malfunctioning due to noise from the inverter. ➔ Connect a capacitor to the output terminal of the potentiometer or set a ferrite core on the signal wire. (Refer to Chapter 2.)
(3) Frequency switching or multi-frequency command was enabled.	Check whether the relay signal for switching the frequency command is chattering. ➔ If the relay contact is defective, replace the relay.
(4) The wiring length between the inverter and the motor is too long.	Check whether auto-torque boost, auto-energy saving operation, or dynamic torque vector control is enabled. ➔ Perform auto-tuning of the inverter for every motor to be used. ➔ Disable the automatic control systems by setting F37* to "1" (Constant torque load) and F42* to "0" (V/f control with slip compensation active), then check that the motor vibration stops. ➔ Make the output wires as short as possible.
(5) The machinery is hunting due to vibration caused by low rigidity of the load. Or the current is irregularly oscillating due to special motor parameters.	Once disable all the automatic control systems such as auto torque boost, auto energy saving operation, overload prevention control, current limiter, torque limiter, automatic deceleration (anti-regenerative control), auto search for idling motor speed, slip compensation, dynamic torque vector control, droop control, overload stop function, speed control, online tuning, notch filter, observer, and then check that the motor vibration comes to a stop. ➔ Disable the functions causing the vibration. ➔ Readjust the output current fluctuation damping gain (H80*). ➔ Readjust the speed control systems. (d01* through d06*)
	Check that the motor vibration is suppressed if you decrease the level of F26 (Motor sound (Carrier frequency)) or set F27 (Motor sound (Tone)) to "0." ➔ Decrease the carrier frequency (F26) or set the tone to "0" (F27 = 0).

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

Possible Causes	What to Check and Suggested Measures
(1) The specified carrier frequency is too low.	Check the data of function codes F26 (Motor sound (Carrier frequency)) and F27 (Motor sound (Tone)). ➔ Increase the carrier frequency (F26). ➔ Change the setting of F27 to appropriate value.
(2) The surrounding temperature of the inverter was too high (when automatic lowering of the carrier frequency was enabled by H98).	Measure the temperature inside the panel where the inverter is mounted. ➔ If it is over 40°C, lower it by improving the ventilation. ➔ Lower the temperature of the inverter by reducing the load. (For fans or pumps, decrease the frequency limiter value (F15).) **Note:** If you disable H98, an *OH1*, *OH3*, or *OLU* alarm may occur.
(3) Resonance with the load.	Check the machinery mounting accuracy or check whether there is resonance with the mounting base. ➔ Disconnect the motor from the machinery and run it alone, then find where the resonance comes from. Upon locating the cause, improve the characteristics of the source of the resonance. ➔ Adjust the settings of C01 (Jump frequency 1) to C04 (Jump frequency (Hysteresis width)) so as to avoid continuous running in the frequency range causing resonance. ➔ Enable the speed control (notch filter) (d07*, d08*) and the observer (d18 to d20) to suppress vibration. (Depending on the characteristics of the load, this may take no effect.)

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

Possible Causes	What to Check and Suggested Measures
(1) The inverter runs the motor with S-curve or curvilinear pattern.	Check the data of function code H07 (Acceleration/deceleration pattern). ➔ Select the linear pattern (H07 = 0). ➔ Shorten the acceleration/deceleration time (F07, F08, E10 through E15).
(2) The current limiting operation prevented the output frequency from increasing (during acceleration).	Make sure that F43 (Current limiter (Mode selection)) is set to "2: Enable during acceleration and at constant speed," then check that the setting of F44 (Current limiter (Level)) is reasonable. ➔ Readjust the setting of F44 to appropriate value, or disable the function of current limiter with F43. ➔ Increase the acceleration/deceleration time (F07, F08, E10 through E15).
(3) The automatic deceleration (Anti-regenerative control) is enabled during deceleration.	Check the data of function code H69 (Automatic deceleration (Mode selection)). ➔ Increase the deceleration time (F08, E11, E13, and E15).
(4) Overload.	Measure the output current. ➔ Reduce the load (For fans or pumps, decrease the frequency limiter value (F15).) (In winter, the load tends to increase.)
(5) Torque generated by the motor was insufficient.	Check that the motor starts running if the value of the torque boost (F09*) is increased. ➔ Increase the value of the torque boost (F09*).
(6) An external frequency command potentiometer is used for frequency setting.	Check that there is no noise in the control signal wires from external sources. ➔ Isolate the control signal wires from the main circuit wires as far as possible. ➔ Use shielded or twisted wires for control signals. ➔ Connect a capacitor to the output terminal of the potentiometer or set a ferrite core on the signal wire. (Refer to Chapter 2.)

Possible Causes	What to Check and Suggested Measures
(7) The output frequency is limited by the torque limiter.	Check whether data of torque limiter related function codes (F40, F41, E16 and E17) is correctly configured and the ***TL2***/***TL1*** terminal command ("Select torque limiter level 2/1") is correct. ➔ Correct the data of F40, F41, E16 and E17 or reset them to the factory defaults. ➔ Set the ***TL2***/***TL1*** correctly. ➔ Increase the acceleration/deceleration time (F07, F08, E10 through E15).
(8) The specified acceleration or deceleration time was incorrect.	Check the terminal commands ***RT1*** and ***RT2*** for acceleration/ deceleration times. ➔ Correct the ***RT1*** and ***RT2*** settings.

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

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

[8] The motor abnormally heats up.

Possible Causes	What to Check and Suggested Measures
(1) Excessive torque boost specified.	Check whether decreasing the torque boost (F09*) decreases the output current but does not stall the motor. ➔ If no stall occurs, decrease the torque boost (F09*).
(2) Continuous running in extremely slow speed.	Check the running speed of the inverter. ➔ Change the speed setting or replace the motor with a motor exclusively designed for inverters.
(3) Overload.	Measure the inverter output current. ➔ Reduce the load (For fans or pumps, decrease the frequency limiter value (F15).) (In winter, the load tends to increase.)

[9] The motor does not run as expected.

Possible Causes	What to Check and Suggested Measures
(1) Incorrect setting of function code data.	Check that function codes are correctly configured and no unnecessary configuration has been done. ➔ Configure all the function codes correctly.
	Make a note of function code data currently configured and then initialize all function code data using H03. ➔ After the above process, reconfigure function codes one by one, checking the running status of the motor.

9.3.2 Problems with inverter settings

[1] Nothing appears on the LED monitor.

Possible Causes	What to Check and Suggested Measures
(1) No power (neither main power nor auxiliary control power) supplied to the inverter.	Check the input voltage and interphase voltage unbalance. ➔ Turn ON a molded case circuit breaker (MCCB), a residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or a magnetic contactor (MC). ➔ Check for voltage drop, phase loss, poor connections, or poor contacts and fix them if necessary.
(2) The power for the control PCB did not reach a sufficiently high level.	Check if the jumper bar has been removed between terminals P1 and P(+) or if there is a poor contact between the jumper bar and those terminals. ➔ Mount a jumper bar or a DC reactor between terminals P1 and P(+). For poor contact, tighten up the screws.
(3) The keypad was not properly connected to the inverter.	Check whether the keypad is properly connected to the inverter. ➔ Remove the keypad, put it back, and see whether the problem recurs. ➔ Replace the keypad with another one and check whether the problem recurs.
	When running the inverter remotely, ensure that the extension cable is securely connected both to the keypad and to the inverter. ➔ Disconnect the cable, reconnect it, and see whether the problem recurs. ➔ Replace the keypad with another one and check whether the problem per recurs.

[2] The desired menu is not displayed.

Possible Causes	Check and Measures
(1) The menu display mode is not selected appropriately.	Check the data of function code E52 (Keypad (Menu display mode)). ➔ Change the E52 data so that the desired menu appears.

[3] Data of function codes cannot be changed.

Possible Causes	What to Check and Suggested Measures
(1) An attempt was made to change function code data that cannot be changed when the inverter is running.	Check if the inverter is running with Menu #3 "Drive Monitoring" using the keypad and then confirm whether the data of the function codes can be changed when the motor is running by referring to the function code tables. ➔ Stop the motor then change the data of the function codes.
(2) The data of the function codes is protected.	Check the data of function code F00 (Data Protection). ➔ Change the F00 data from "Enable data protection" (1 or 3) to "Disable data protection" (0 or 2).
(3) The ***WE-KP*** terminal command ("Enable data change with keypad") is not entered, though it has been assigned to a digital input terminal.	Check the data of function codes E01 through E09, E98 and E99 and the input signal status with Menu #4 "I/O Checking" using the keypad. ➔ Input a ***WE-KP*** command through a digital input terminal.
(4) The FUNC/DATA key was not pressed.	Check whether you have pressed the FUNC/DATA key after changing the function code data. ➔ Press the FUNC/DATA key after changing the function code data. ➔ Check that SAVE is displayed on the LED monitor.
(5) The data of function codes F02, E01 through E09, E98, and E99 cannot be changed.	Either one of the ***FWD*** and ***REV*** terminal commands is turned ON. ➔ Turn OFF both ***FWD*** and ***REV***.

Possible Causes	What to Check and Suggested Measures
(6) The function code(s) to be changed does not appear.	If Menu #0 "Quick Setup" (0.Func) is selected, only the particular function codes appear. ➔ With Menu #0 "Quick Setup" (0.Func) being selected, press the ⌃ key to call up the desired menu from 1.F__ to 1.y__. Then select the desired function code and change its data. For details, refer to Chapter 7, Table 7.9 "Menus Available in Programming Mode."

9.4 If an Alarm Code Appears on the LED Monitor

[1] 0Cn Instantaneous overcurrent

Problem The inverter momentary output current exceeded the overcurrent level.

- 0C 1 Overcurrent occurred during acceleration.
- 0C2 Overcurrent occurred during deceleration.
- 0C3 Overcurrent occurred during running at a constant speed.

Possible Causes	What to Check and Suggested Measures
(1) The inverter output lines were short-circuited.	Disconnect the wiring from the inverter output terminals ([U], [V] and [W]) and measure the interphase resistance of the motor wiring. Check if the resistance is too low. ➔ Remove the short-circuited part (including replacement of the wires, relay terminals and motor).
(2) Ground faults have occurred at the inverter output lines.	Disconnect the wiring from the output terminals ([U], [V] and [W]) and perform a Megger test. ➔ Remove the grounded parts (including replacement of the wires, relay terminals and motor).
(3) Overload.	Measure the motor current with a measuring device to trace the current trend. Then, use this data to judge if the trend is over the calculated load value for your system design. ➔If the load is too heavy, reduce it or increase the inverter capacity.
	Trace the current trend and check if there are any sudden changes in the current. ➔ If there are any sudden changes, make the load fluctuation smaller or increase the inverter capacity. ➔ Enable instantaneous overcurrent limiting (H12 = 1).
(4) Excessive torque boost specified. (when F37* = 0, 1, 3, or 4)	Check whether decreasing the torque boost (F09*) decreases the output current but does not stall the motor. ➔ If no stall occurs, decrease the torque boost (F09*).
(5) The acceleration/ deceleration time was too short.	Check that the motor generates enough torque required during acceleration/deceleration. That torque is calculated from the moment of inertia for the load and the acceleration/deceleration time. ➔ Increase the acceleration/deceleration time (F07, F08, E10 through E15, and H56). ➔ Enable the current limiter (F43) and torque limiter (F40, F41, E16, and E17). ➔ Increase the inverter capacity.
(6) Malfunction caused by noise.	Check if noise control measures are appropriate (e.g., correct grounding and routing of control and main circuit wires). ➔ Implement noise control measures. For details, refer to Appendix A. ➔ Enable the Auto-reset (H04). ➔ Connect a surge absorber to magnetic contactor's coils or other solenoids (if any) causing noise.

[2] EF Ground fault

Problem A ground fault current flew from the output terminal of the inverter.

Possible Causes	What to Check and Suggested Measures
(1) Inverter output terminal(s) grounded (ground fault).	Disconnect the wiring from the output terminals ([U], [V], and [W]) and perform a Megger test. ➔ Remove the grounded parts (including replacement of the wires, relay terminals and motor).

[3] OUn Overvoltage

Problem The DC link bus voltage was over the detection level of overvoltage.

OU1 Overvoltage occurred during acceleration.
OU2 Overvoltage occurred during deceleration.
OU3 Overvoltage occurred during running at constant speed.

Possible Causes	What to Check and Suggested Measures
(1) The power supply voltage exceeded the inverter's specification range.	Measure the input voltage. ➔ Decrease the voltage to within the specified range.
(2) A surge current entered the input power supply.	In the same power line, if a phase-advancing capacitor is turned ON/OFF or a thyristor converter is activated, a surge (momentary large increase in the voltage or current) may be caused in the input power. ➔ Install a DC reactor.
(3) The deceleration time was too short for the moment of inertia for load.	Recalculate the deceleration torque based on the moment of inertia for the load and the deceleration time. ➔ Increase the deceleration time (F08, E11, E13, E15, and H56). ➔ Enable the automatic deceleration (anti-regenerative control) (H69), or deceleration characteristics (H71). ➔ Enable torque limiter (F40, F41, E16, E17, and H73). ➔ Set the rated voltage (at base frequency) (F05*) to "0" to improve the braking capability. ➔ Consider the use of a braking resistor.
(4) The acceleration time was too short.	Check if the overvoltage alarm occurs after rapid acceleration. ➔ Increase the acceleration time (F07, E10, E12, and E14). ➔ Select the S-curve pattern (H07). ➔ Consider the use of a braking resistor.
(5) Braking load was too heavy.	Compare the braking torque of the load with that of the inverter. ➔ Set the rated voltage (at base frequency) (F05*) to "0" to improve the braking capability. ➔ Consider the use of a braking resistor.
(6) Malfunction caused by noise.	Check if the DC link bus voltage was below the protective level when the overvoltage alarm occurred. ➔ Implement noise control measures. For details, refer to Appendix A. ➔ Enable the auto-reset (H04). ➔ Connect a surge absorber to magnetic contactor's coils or other solenoids (if any) causing noise.

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[4] LU Undervoltage

Problem DC link bus voltage has dropped below the undervoltage detection level.

Possible Causes	What to Check and Suggested Measures
(1) A momentary power failure occurred.	➔ Release the alarm. ➔ If you want to restart running the motor without treating this condition as an alarm, set F14 to "3," "4," or "5," depending on the load type.
(2) The power to the inverter was switched back to ON too soon (when F14 = 1).	Check if the power to the inverter was switched back to ON while the control power was still alive. (Check whether the LEDs on the keypad light.) ➔ Turn the power ON again after all LEDs on the keypad go off.
(3) The power supply voltage did not reach the inverter's specification range.	Measure the input voltage. ➔ Increase the voltage to within the specified range.
(4) Peripheral equipment for the power circuit malfunctioned, or the connection was incorrect.	Measure the input voltage to find which peripheral equipment malfunctioned or which connection is incorrect. ➔ Replace any faulty peripheral equipment, or correct any incorrect connections.
(5) Any other loads connected to the same power supply has required a large starting current, causing a temporary voltage drop.	Measure the input voltage and check the voltage fluctuation. ➔ Reconsider the power supply system configuration.
(6) Inverter's inrush current caused the power voltage drop because the power supply transformer capacity was insufficient.	Check if the alarm occurs when a molded case circuit breaker (MCCB), residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) or magnetic contactor (MC) is turned ON. ➔Reconsider the capacity of the power supply transformer.

[5] L IN Input phase loss

Problem Input phase loss occurred, or interphase voltage unbalance rate was large.

Possible Causes	What to Check and Suggested Measures
(1) Breaks in wiring to the main power input terminals.	Measure the input voltage. ➔ Repair or replace the main circuit power input wires or input devices (MCCB, MC, etc.).
(2) The screws on the main power input terminals are loosely tightened.	Check if the screws on the main power input terminals have become loose. ➔ Tighten the terminal screws to the recommended torque.
(3) Interphase voltage unbalance between three phases was too large.	Measure the input voltage. ➔ Connect an AC reactor (ACR) to lower the voltage unbalance between input phases. ➔ Increase the inverter capacity.
(4) Overload cyclically occurred.	Measure the ripple wave of the DC link bus voltage. ➔ If the ripple is large, increase the inverter capacity.
(5) Single-phase voltage was input to the three-phase input inverter.	Check the inverter type. ➔ Apply three-phase power. The FRENIC-MEGA of three-phase input cannot be driven by single-phase power.

Note The input phase loss protection can be disabled with the function code H98 (Protection/Maintenance Function).

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[6] OPL Output phase loss

Problem Output phase loss occurred.

Possible Causes	What to Check and Suggested Measures
(1) Inverter output wires are broken.	Measure the output current. ➔ Replace the output wires.
(2) The motor winding is broken.	Measure the output current. ➔ Replace the motor.
(3) The terminal screws for inverter output were not tight enough.	Check if any screws on the inverter output terminals have become loose. ➔ Tighten the terminal screws to the recommended torque.
(4) A single-phase motor has been connected.	➔ Single-phase motors cannot be used. Note that the FRENIC-MEGA only drives three-phase induction motors.

[7] OH1 Heat sink overheat

Problem Temperature around heat sink has risen abnormally.

Possible Causes	What to Check and Suggested Measures
(1) Temperature around the inverter exceeded the inverter's specification range.	Measure the temperature around the inverter. ➔ Lower the temperature around the inverter (e.g., ventilate the panel where the inverter is mounted).
(2) Ventilation path is blocked.	Check if there is sufficient clearance around the inverter. ➔ Change the mounting place to ensure the clearance.
	Check if the heat sink is not clogged. ➔ Clean the heat sink.
(3) Cooling fan's airflow volume decreased due to the service life expired or failure.	Check the cumulative run time of the cooling fan. Refer to Chapter 7, Section 7.4.6 "Reading maintenance information – Menu #5 "Maintenance Information"." ➔ Replace the cooling fan.
	Visually check whether the cooling fan rotates normally. ➔ Replace the cooling fan.
(4) Overload.	Measure the output current. ➔ Reduce the load (e.g. Use the heat sink overheat early warning (E01 through E09) or the overload early warning (E34) and reduce the load before the overload protection is activated.). ➔ Decease the motor sound (carrier frequency) (F26). ➔ Enable the overload prevention control (H70).

[8] OH2 External alarm

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

Possible Causes	What to Check and Suggested Measures
(1) An alarm function of external equipment was activated.	Check the operation of external equipment. ➔ Remove the cause of the alarm that occurred.
(2) Wrong connection or poor contact in external alarm signal wiring.	Check if the external alarm signal wiring is correctly connected to the terminal to which the "Enable external alarm trip" terminal command ***THR*** has been assigned (Any of E01 through E09, E98, and E99 should be set to "9."). ➔ Connect the external alarm signal wire correctly.

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Possible Causes	What to Check and Suggested Measures
(3) Incorrect setting of function code data.	Check whether the "Enable external alarm trip" terminal command ***THR*** has been assigned to an unavailable terminal (with E01 through E09, E98, or E99). ➔ Correct the assignment.
	Check whether the normal/negative logic of the external signal matches that of the ***THR*** command specified by any of E01 through E09, E98, and E99. ➔ Ensure the matching of the normal/negative logic.

[9] 0H3 Inverter internal overheat

Problem Temperature inside the inverter has exceeded the allowable limit.

Possible Causes	What to Check and Suggested Measures
(1) The surrounding temperature exceeded the inverter's specification limit.	Measure the surrounding temperature. ➔ Lower the temperature around the inverter (e.g., ventilate the panel where the inverter is mounted).

[10] 0H4 Motor protection (PTC/NTC thermistor)

Problem Temperature of the motor has risen abnormally.

Possible Causes	What to Check and Suggested Measures
(1) The temperature around the motor exceeded the motor's specification range.	Measure the temperature around the motor. ➔ Lower the temperature.
(2) Cooling system for the motor defective.	Check if the cooling system of the motor is operating normally. ➔ Repair or replace the cooling system of the motor.
(3) Overload.	Measure the output current. ➔ Reduce the load (e.g. Use the heat sink overheat early warning (E01 through E09) or the overload early warning (E34) and reduce the load before the overload protection is activated.). (In winter, the load tends to increase.) ➔ Lower the temperature around the motor. ➔ Increase the motor sound (Carrier frequency) (F26).
(4) The activation level (H27) of the PTC thermistor for motor overheat protection was set inadequately.	Check the PTC thermistor specifications and recalculate the detection voltage. ➔ Modify the data of function code H27.
(5) Settings for the PTC/NTC thermistor are improper.	Check the setting of the thermistor mode selection (H26) and the slider position of the terminal [V2] property switch SW5. ➔ Change the H26 data in accordance with the thermistor used and set the SW5 to the PTC/NTC position.
(6) Excessive torque boost specified. (F09*)	Check whether decreasing the torque boost (F09*) does not stall the motor. ➔ If no stall occurs, decrease the F09* data.
(7) The V/f pattern did not match the motor.	Check if the base frequency (F04*) and the rated voltage at base frequency (F05*) match the values on the motor's nameplate. ➔ Match the function code data with the values on the motor's nameplate.
(8) Incorrect setting of function code data.	Although no PTC/NTC thermistor is used, the thermistor mode is enabled (H26). ➔ Set the H26 data to "0" (Disable).

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[11] dbH Braking resistor overheated

Problem The electronic thermal protection for the braking resistor has been activated.

Possible Causes	What to Check and Suggested Measures
(1) Braking load is too heavy.	Reconsider the relationship between the braking load estimated and the real load. ➔ Lower the real braking load. ➔ Review the selection of the braking resistor and increase the braking capability (Modification of related function code data (F50, F51, and F52) is also required.)
(2) Specified deceleration time is too short.	Recalculate the deceleration torque and time needed for the load currently applied, based on a moment of inertia for the load and the deceleration time. ➔ Increase the deceleration time (F08, E11, E13, E15, and H56). ➔ Review the selection of the braking resistor and increase the braking capability. (Modification of related function code data (F50, F51, and F52) is also required.)
(3) Incorrect setting of function code data F50, F51, and F52.	Recheck the specifications of the braking resistor. ➔ Review data of function codes F50, F51, and F52, then modify them.

Note: The inverter issues an overheat alarm of the braking resistor by monitoring the magnitude of the braking load, not by measuring its surface temperature.

When the braking resistor is frequently used so as to exceed the settings made by function codes F50, F51, and F52, therefore, the inverter issues an overheat alarm even if the surface temperature of the braking resistor does not rise. To squeeze out full performance of the braking resistor, configure function codes F50, F51, and F52 while actually measuring the surface temperature of the braking resistor.

[12] FUS Fuse blown

Problem The fuse inside the inverter blew.

Possible Causes	What to Check and Suggested Measures
(1) The fuse blew due to short-circuiting inside the inverter.	Check whether there has been any excess surge or noise coming from outside. ➔ Take measures against surges and noise. ➔ Have the inverter repaired.

[13] PbF Charger circuit fault

Problem The magnetic contactor for short-circuiting the charging resistor failed to work.

Possible Causes	What to Check and Suggested Measures
(1) The control power was not supplied to the magnetic contactor intended for short-circuiting the charging resistor.	Check that, in normal connection of the main circuit (not a connection via the DC link bus), the connector (CN R) on the power printed circuit board (power PCB) is not inserted to NC. ➔ Insert the connector (CN R) to FAN.
	Check whether you quickly turned the circuit breaker ON and OFF to confirm safety after cabling/wiring. ➔ Wait until the DC link bus voltage has dropped to a sufficiently low level and then release the current alarm. After that, turn ON the power again. (Do not turn the circuit breaker ON and OFF quickly.) (Turning ON the circuit breaker supplies power to the control circuit to the operation level (lighting the LEDs on the keypad) in a short period. Immediately turning it OFF even retains the control circuit power for a time, while it shuts down the power to the magnetic contactor intended for short-circuiting the charging resistor since the contactor is directly powered from the main power. Under such conditions, the control circuit can issue a turn-on command to the magnetic contactor, but the contactor not powered can produce nothing. This state is regarded as abnormal, causing an alarm.)

[14] OLn Overload of motor 1 through 4

Problem Electronic thermal protection for motor 1, 2, 3, or 4 activated.

OL 1 Motor 1 overload
OL2 Motor 2 overload
OL3 Motor 3 overload
OL4 Motor 4 overload

Possible Causes	What to Check and Suggested Measures
(1) The electronic thermal characteristics do not match the motor overload characteristics.	Check the motor characteristics. ➔ Reconsider the data of function codes (P99*, F10* and F12*). ➔ Use an external thermal relay.
(2) Activation level for the electronic thermal protection was inadequate.	Check the continuous allowable current of the motor. ➔ Reconsider and change the data of function code F11*.
(3) The specified acceleration/ deceleration time was too short.	Recalculate the acceleration/deceleration torque and time needed for the load, based on the moment of inertia for the load and the acceleration/deceleration time. ➔ Increase the acceleration/ deceleration time (F07, F08, E10 through E15, and H56).
(4) Overload.	Measure the output current. ➔ Reduce the load (e.g. Use the overload early warning (E34) and reduce the load before the overload protection is activated.). (In winter, the load tends to increase.)
(5) Excessive torque boost specified (F09*)	Check whether decreasing the torque boost (F09*) does not stall the motor. ➔ If no stall occurs, decrease the F09* data.

[15] OLU Inverter overload

Problem Temperature inside inverter has risen abnormally.

Possible Causes	What to Check and Suggested Measures
(1) Temperature around the inverter exceeded the inverter's specification range.	Measure the temperature around the inverter. ➔ Lower the temperature (e.g., ventilate the panel where the inverter is mounted).
(2) Excessive torque boost specified (F09*)	Check whether decreasing the torque boost (F09*) does not stall the motor. ➔ If no stall occurs, decrease the F09* data.
(3) The specified acceleration/ deceleration time was too short.	Recalculate the acceleration/deceleration torque and time needed for the load, based on the moment of inertia for the load and the acceleration/deceleration time. ➔ Increase the acceleration/deceleration time (F07, F08, E10 through E15, and H56).
(4) Overload.	Measure the output current. ➔ Reduce the load (e.g., Use the overload early warning (E34) and reduce the load before the overload protection is activated.). (In winter, the load tends to increase.). ➔ Decrease the motor sound (Carrier frequency) (F26). ➔ Enable overload prevention control (H70).
(5) Ventilation paths are blocked.	Check if there is sufficient clearance around the inverter. ➔ Change the mounting place to ensure the clearance.
	Check if the heat sink is not clogged. ➔ Clean the heat sink.

Possible Causes	What to Check and Suggested Measures
(6) Cooling fan's airflow volume decreased due to the service life expired or failure.	Check the cumulative run time of the cooling fan. Refer to Chapter 7, Section 7.4.6 "Reading maintenance information – Menu #5 "Maintenance Information"." ➔ Replace the cooling fan.
	Visually check that the cooling fan rotates normally. ➔ Replace the cooling fan.
(7) The wires to the motor are too long, causing a large leakage current from them.	Measure the leakage current. ➔ Insert an output circuit filter (OFL).

[16] 05 Overspeed

Problem The motor rotates in an excessive speed (Motor speed ≥ (F03 data × 1.2)

Possible Causes	What to Check and Suggested Measures
(1) Incorrect setting of function code data.	Check the motor parameter "Number of poles" (P01*). ➔ Specify the P01* data in accordance with the motor to be used.
	Check the maximum frequency setting (F03*). ➔ Specify the F03* data in accordance with the output frequency.
	Check the setting of speed limit function (d32 and d33). ➔ Disable the speed limit function (d32 and d33).
(2) Insufficient gain of the speed controller.	Check whether the actual speed overshoots the commanded one in higher speed operation. ➔ Increase the speed controller gain (d03*.) (Depending on the situations, reconsider the setting of the filter constant or the integral time.)
(3) Noises superimposed on the PG wire.	Check whether appropriate noise control measures have been implemented (e.g., correct grounding and routing of signal wires and main circuit wires). ➔ Implement noise control measures. For details, refer to Appendix A.

[17] PG PG wire break

Problem The pulse generator (PG) wire has been broken somewhere in the circuit.

Possible Causes	What to Check and Suggested Measures
(1) The wire between the pulse generator (PG) and the option card has been broken.	Check whether the pulse generator (PG) is correctly connected to the option card or any wire is broken. ➔ Check whether the PG is connected correctly. Or, tighten up the related terminal screws. ➔ Check whether any joint or connecting part bites the wire sheath. ➔ Replace the wire.
(2) PG related circuit affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of signal wires, communication cables, and main circuit wires). ➔ Implement noise control measures. ➔ Separate the signal wires from the main power wires as far as possible.

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[18] Er 1 Memory error

Problem Error occurred in writing the data to the memory in the inverter.

Possible Causes	What to Check and Suggested Measures
(1) When writing data (especially initializing or copying data), the inverter was shut down so that the voltage to the control PCB has dropped.	Initialize the function code data with H03 (= 1). After initialization, check if pressing the PRG/RESET key releases the alarm. ➔ Revert the initialized function code data to their previous settings, then restart the operation.
(2) Inverter affected by strong electrical noise when writing data (especially initializing or copying data).	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of control and main circuit wires). Also, perform the same check as described in (1) above. ➔ Implement noise control measures. Revert the initialized function code data to their previous settings, then restart the operation.
(3) The control PCB failed.	Initialize the function code data by setting H03 to "1," then reset the alarm by pressing the PRG/RESET key and check that the alarm goes on. ➔ The control PCB (on which the CPU is mounted) is defective. Contact your Fuji Electric representative.

[19] Er2 Keypad communications error

Problem A communications error occurred between the standard keypad or the multi-function keypad and the inverter.

Possible Causes	What to Check and Suggested Measures
(1) Broken communications cable or poor contact.	Check continuity of the cable, contacts and connections. ➔ Re-insert the connector firmly. ➔ Replace the cable.
(2) Connecting many control wires hinders the front cover from being mounted, lifting the keypad.	Check the mounting condition of the front cover. ➔ Use wires of the recommended size (0.75 mm^2) for wiring. ➔ Change the wiring layout inside the unit so that the front cover can be mounted firmly.
(3) Inverter affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of communication cables and main circuit wires). ➔ Implement noise control measures. For details, refer to Appendix A.
(4) A keypad failure occurred.	Replace the keypad with another one and check whether a keypad communications error (Er2) occurs. ➔ Replace the keypad.

[20] Er3 CPU error

Problem A CPU error (e.g. erratic CPU operation) occurred.

Possible Causes	What to Check and Suggested Measures
(1) Inverter affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g. correct grounding and routing of signal wires, communications cables, and main circuit wires). ➔ Implement noise control measures.

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[21] Er-4 Option communications error

Problem A communications error occurred between the option card and the inverter.

Possible Causes	What to Check and Suggested Measures
(1) There was a problem with the connection between the option card and the inverter.	Check whether the connector on the option card is properly engaged with that of the inverter. ➔ Reload the option card into the inverter.
(2) Strong electrical noise.	Check whether appropriate noise control measures have been implemented (e.g. correct grounding and routing of signal wires, communications cables, and main circuit wires). ➔ Implement noise control measures.

[22] Er-5 Option error

An error detected by the option card. Refer to the instruction manual of the option card for details.

[23] Er-6 Operation protection

Problem An incorrect operation was attempted.

Possible Causes	What to Check and Suggested Measures
(1) The STOP key was pressed when H96 = 1 or 3.	Check that the STOP key was pressed when a run command had been entered from the input terminal or through the communications port. ➔ If this was not intended, check the setting of H96.
(2) The start check function was activated when H96 = 2 or 3.	Check that any of the following operations has been performed with a run command being entered. - Turning the power ON - Releasing the alarm - Switching the enable communications link ***LE*** operation ➔ Review the running sequence to avoid input of a Run command when this error occurs. If this was not intended, check the setting of H96. (Turn the run command OFF before releasing the alarm.)
(3) The forced stop digital input ***STOP*** was turned OFF.	Check that turning the ***STOP*** OFF decelerated the inverter to stop. ➔ If this was not intended, check the settings of E01 through E09 for terminals [X1] through [X9].

[24] Er-7 Tuning error

Problem Auto-tuning failed.

Possible Causes	What to Check and Suggested Measures
(1) A phase was missing (There was a phase loss) in the connection between the inverter and the motor.	➔ Properly connect the motor to the inverter.
(2) V/f or the rated current of the motor was not properly set.	Check whether the data of function codes (F04*, F05*, H50 through H53, H65, H66, P02*, and P03*) matches the motor specifications.
(3) The wiring length between the inverter and the motor was too long.	Check whether the wiring length between the inverter and the motor exceeds 50 m. (Inverters with a small capacity are greatly affected by the wiring length.) ➔ Review, and if necessary, change the layout of the inverter and the motor to shorten the connection wire. Alternatively, minimize the wiring length without changing the layout. ➔ Disable both auto-tuning and auto-torque boost (set data of F37* to "1").

Possible Causes	What to Check and Suggested Measures
(4) The rated capacity of the motor was significantly different from that of the inverter.	Check whether the rated capacity of the motor is three or more ranks lower, or two or more ranks higher than that of the inverter. ➔ Replace the inverter with one with an appropriate capacity. ➔ Manually specify the values for the motor parameters P06*, P07*, and P08*. ➔ Disable both auto-tuning and auto-torque boost (set data of F37* to "1").
(5) The motor was a special type such as a high-speed motor.	➔ Disable both auto-tuning and auto-torque boost (set data of F37* to "1").
(6) A tuning operation involving motor rotation (P04* = 2 or 3) was attempted while the brake was applied to the motor.	➔ Specify the tuning that does not involve the motor rotation (P04* = 1). ➔ Release the brake before tuning that involves the motor rotation (P04* = 2 or 3).

For details of tuning errors, refer to the FRENIC-MEGA Instruction Manual, Chapter 4, Section 4.1.7 "Function code basic settings and tuning < 2 >, ■ Tuning errors."

Preparation before running the motor for a test – Setting function code data."

[25] Er8 RS-485 communications error (COM port 1)
Erp RS-485 communications error (COM port 2)

Problem A communications error occurred during RS-485 communications.

Possible Causes	What to Check and Suggested Measures
(1) Communications conditions of the inverter do not match that of the host equipment.	Compare the settings of the y codes (y01 to y10, y11 to y20) with those of the host equipment. ➔ Correct any settings that differ.
(2) Even though no-response error detection time (y08, y18) has been set, communications is not performed within the specified cycle.	Check the host equipment. ➔ Change the settings of host equipment software or disable the no-response error detection (y08, y18 = 0).
(3) The host equipment did not operate due to defective software, settings, or defective hardware.	Check the host equipment (e.g., PLCs and personal computers). ➔ Remove the cause of the equipment error.
(4) The RS-485 converter did not operate due to incorrect connections and settings, or defective hardware.	Check the RS-485 converter (e.g., check for poor contact). ➔ Change the various RS-485 converter settings, reconnect the wires, or replace hardware with recommended devices as appropriate.
(5) Broken communications cable or poor contact.	Check the continuity of the cables, contacts and connections. ➔ Replace the cable.
(6) Inverter affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of communications cables and main circuit wires). ➔ Implement noise control measures. ➔ Implement noise reduction measures on the host side. ➔ Replace the RS-485 converter with a recommended insulated one.
(7) Terminating resistor not properly configured.	Check that the inverter serves as a terminating device in the network. ➔ Configure the terminating resistor switch(es) (SW2/SW3) for RS-485 communication correctly. (That is, turn the switch(es) to ON.)

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[26] Er-F Data saving error during undervoltage

Problem The inverter failed to save data such as the frequency commands and PID commands (which are specified through the keypad), or the output frequencies modified by the ***UP***/***DOWN*** terminal commands when the power was turned OFF.

Possible Causes	What to Check and Suggested Measures
(1) During data saving performed when the power was turned OFF, the voltage fed to the control PCB dropped in an abnormally short period due to the rapid discharge of the DC link bus.	Check how long it takes for the DC link bus voltage to drop to the preset voltage when the power is turned OFF. ➔ Remove whatever is causing the rapid discharge of the DC link bus voltage. After pressing the PRG/RESET key and releasing the alarm, return the data of the relevant function codes (such as the frequency commands and PID commands (specified through the keypad) or the output frequencies modified by the ***UP***/***DOWN*** terminal commands) back to the original values and then restart the operation.
(2) Inverter operation affected by strong electrical noise when the power was turned OFF.	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of control and main circuit wires). ➔ Implement noise control measures. After pressing the PRG/RESET key and releasing the alarm, return the data of the relevant function codes (such as the frequency commands and PID commands (specified through the keypad) or the output frequencies modified by the ***UP***/***DOWN*** terminal commands) back to the original values and then restart the operation.
(3) The control circuit failed.	Check if Er-F occurs each time the power is turned ON. ➔ The control PCB (on which the CPU is mounted) is defective. Contact your Fuji Electric representative.

[27] Er-H Hardware error

Problem The LSI on the power printed circuit board malfunctions.

Possible Causes	What to Check and Suggested Measures
(1) The inverter capacity setting on the control printed circuit board is wrong.	It is necessary to set the inverter capacity correctly. ➔ Contact your Fuji Electric representative.
(2) Data stored in the power printed circuit board memory is corrupted.	It is necessary to replace the power printed circuit board. ➔ Contact your Fuji Electric representative.
(3) The control printed circuit board is misconnected to the power printed circuit board.	It is necessary to replace the power or control printed circuit board. ➔ Contact your Fuji Electric representative.

[28] Er-E Speed mismatch or excessive speed deviation

Problem An excessive deviation appears between the speed command and the detected speed.

Possible Causes	What to Check and Suggested Measures
(1) Incorrect setting of function code data.	Check the following function code data; P01* (Motor (No. of poles)), d15 (Feedback encoder pulse count/rev), and d16 and d17 (Feedback pulse correction factor 1 and 2). ➔ Specify data of function codes P01*, d15, d16, and d17 in accordance with the motor and PG.
(2) Overload.	Measure the inverter output current. ➔ Reduce the load.
	Check whether any mechanical brake is working. ➔ Release the mechanical brake.

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Possible Causes	What to Check and Suggested Measures
(3) The motor speed does not increase due to the current limiter operation.	Check the data of function code F44 (Current limiter (Level)). ➔ Change the F44 data correctly. Or, set the F43 data to "0" (Disable) if the current limiter operation is not needed.
	Check the data of function codes F04*, F05*, and P01* through P12* to ensure that the V/f pattern setting is right. ➔ Match the V/f pattern setting with the motor ratings. ➔ Change the function code data in accordance with the motor parameters.
(4) Function code settings do not match the motor characteristics.	Check whether the data of P01*, P02*, P03*, P06*, P07*, P08*, P09*, P10* and P12* match the parameters of the motor. ➔ Perform auto-tuning of the inverter, using the function code P04*.
(5) Wrong wiring between the pulse generator (PG) and the inverter.	Check the wiring between the PG and the inverter. ➔ Correct the wiring.
	Check that the relationships between the PG feedback signal and the run command are as follows: • For the FWD command: the B phase pulse is in the High level at rising edge of the A phase pulse • For the REV command: the B phase pulse is in the Low level at rising edge of the A phase pulse ➔ If the relationship is wrong, interchange the A and B phase wires.
(6) Wiring to the motor is incorrect.	Check the wiring to the motor. ➔ Connect the inverter output terminals U, V, and W to the motor input terminals U, V, and W, respectively.
(7) The motor speed does not increase due to the torque limiter operation.	Check the data of F40 (Torque limiter 1-1). ➔ Change the F40 data correctly. Or, set the F40 data to "999" (Disable) if the torque limiter operation is not needed.

[29] nrb NTC wire break error

Problem A wire break is found in the NTC thermistor detection circuit.

Possible Causes	What to Check and Suggested Measures
(1) The NTC thermistor cable is broken.	Check whether the motor cable is broken. ➔ Replace the motor cable.
(2) The temperature around the motor is extremely low (lower than -30°C).	Measure the temperature around the motor. ➔ Reconsider the use environment of the motor.
(3) The NTC thermistor is broken.	Measure the resistance of the NTC thermistor. ➔ Replace the motor.

[30] Err Mock alarm

Problem The LED displays the alarm Err.

Possible Causes	What to Check and Suggested Measures
(1) The STOP + FUNC/DATA keys were held down for more than 5 seconds.	➔ To escape from this alarm state, press the FUNC/DATA key.

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[31] CoF PID feedback wire break

Problem: The PID feedback wire is broken.

Possible Causes	What to Check and Suggested Measures
(1) The PID feedback signal wire is broken.	Check whether the PID feedback signal wires are connected correctly. ➔ Check whether the PID feedback signal wires are connected correctly. Or, tighten up the related terminal screws. ➔ Check whether any contact part bites the wire sheath.
(2) PID feedback related circuit affected by strong electrical noise.	Check if appropriate noise control measures have been implemented (e.g., correct grounding and routing of signal wires, communication cables, and main circuit wires). ➔ Implement noise control measures. ➔ Separate the signal wires from the main power wires as far as possible.

[32] dbA Braking transistor error

Problem: A braking transistor error is detected.

Possible Causes	What to Check and Suggested Measures
(1) The braking transistor is broken.	Check whether resistance of the braking resistor is correct or there is a misconnection of the resistor. ➔ Consult your Fuji Electric representative for repair.

[33] Er0 Positioning control error

Problem: An excessive positioning deviation has occurred when the servo-lock function was activated.

Possible Causes	What to Check and Suggested Measures
(1) Insufficient gain in positioning control system	Readjust the settings of J97 (Servo-lock (Gain)) and d03 (Speed control 1 P (Gain)).
(2) Incorrect control completion width	Check whether the setting of J99 (Servo-lock (Completion width)) is correct. ➔ Correct the setting of J99.

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

If the inverter detects a minor abnormal state "light alarm", it can continue the current operation without tripping while displaying the "light alarm" indication L -AL on the LED monitor. In addition to the indication L -AL, the inverter blinks the KEYPAD CONTROL LED and outputs the "light alarm" signal ***L-ALM*** to a digital output terminal to alert the peripheral equipment to the occurrence of a light alarm. (To use the ***L-ALM***, it is necessary to assign the signal to any of the digital output terminals by setting any of function codes E20 through E24 and E27 to "98.")

Function codes H81 and H82 specify which alarms should be categorized as "light alarm." The available "light alarm" codes are check-marked in the "Light alarm" object column in Table 9.1.

To display the "light alarm" factor and escape from the light alarm state, follow the instructions below.

■ Displaying the light alarm factor

1) Press the PRG/RESET key to enter Programming mode.
2) Check the light alarm factor in 5_36 (Light alarm factor (latest)) under Menu #5 "Maintenance Information" in Programming mode. The light alarm factor is displayed in alarm codes. For details about the alarm codes, see Table 9.1 "Abnormal States Detectable ("Heavy alarm" and "Light alarm" objects)."

   For details about the menu transition in Menu #5 "Maintenance Information", see Chapter 7, Section 7.4.6 "Reading maintenance information – Menu #5 "Maintenance Information." It is possible to display the factors of most recent 3 light alarms in 5_37 (Light alarm factor (last)) to 5_39 (Light alarm factor (3rd last)).

■ Switching the LED monitor from the light alarm to normal display

If it is necessary to return the LED monitor to the normal display state (showing the running status such as reference frequency) before removing the light alarm factor because it takes a long time to remove the light alarm factor, for example, follow the steps below.

1) Press the PRG/RESET key to return the LED monitor to the light alarm indication (L -AL).
2) With L -AL being displayed, press the FUNC/DATA key. The LED monitor returns to the normal display state while the KEYPAD CONTROL LED continues blinking.

■ Releasing the light alarm

1) First remove the light alarm factor that has been checked in 5_36 (Light alarm factor (latest)) under Menu #5, in accordance with the troubleshooting procedure. The reference page for the troubleshooting corresponding to each light alarm factor is shown in "Ref. page" column in Table 9.1.
2) To return the LED monitor from the L -AL display to the normal display state (showing the running status such as reference frequency), press the FUNC/DATA key in Running mode.

   If the light alarm factor(s) has been successfully removed in step 1) above, the KEYPAD CONTROL LED stops blinking and the digital output ***L-ALM*** is also turned OFF. (If any light alarm factor persists, e.g., detecting a DC fan lock, the KEYPAD CONTROL LED continues blinking and the ***L-ALM*** remains ON.)

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9.6 If an Abnormal Pattern Appears on the LED Monitor while Neither an Alarm Code nor "Light Alarm" Indication (L -AL) is Displayed

[1] – – – – (center bar) appears

Problem A center bar (– – – –) appeared on the LED monitor.

Possible Causes	What to Check and Suggested Measures
(1) When PID control had been disabled (J01 = 0), you changed E43 (LED Monitor (Item selection)) to 10 or 12. With the PID being enabled (J01 = 1, 2, or 3), you disabled PID control (J01 = 0) when the LED monitor had been set to display the PID command or PID feedback amount by pressing the FUNC/DATA key.	Make sure that when you wish to view other monitor items, E43 is not set to "10: PID command" or "12: PID feedback amount." ➔ Set E43 to a value other than "10" or "12." Make sure that when you wish to view a PID command or a PID feedback amount, J01 (PID control) is not set to "0: Disable." ➔ Set J01 to "1: Enable (Process control normal operation)," "2: Enable (Process control inverse operation)," or "3: Enable (Dancer control)."
(2) The keypad was poorly connected.	Prior to proceed, check that pressing the FUNC/DATA key does not change the display on the LED monitor. Check continuity of the extension cable for the keypad used in remote operation. ➔ Replace the cable.

[2] _ _ _ _ (under bar) appears

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

Possible Causes	What to Check and Suggested Measures
(1) The voltage of the DC link bus was low.	Select 5_07 under Menu #5 "Maintenance Information" in Programming mode on the keypad, then check the voltage of the DC link bus which should be: 200 VDC or below for three-phase 200 V class series, and 400 VDC or below for three-phase 400 V class series. ➔ Connect the inverter to a power supply that meets its input specifications.
(2) The main power is not ON, while the auxiliary input power to the control circuit is supplied.	Check whether the main power is turned ON. ➔ Turn the main power ON.
(3) Although power is supplied not via the commercial power line but via the DC link bus, the main power down detection is enabled (H72 = 1).	Check the connection to the main power and check if the H72 data is set to "1" (factory default). ➔ Correct the H72 data.

[3] ( ) appears

Problem Parentheses ( ) appeared on the LED monitor during speed monitoring on the keypad.

Possible Causes	What to Check and Suggested Measures
(1) The display data overflows the LED monitor.	Check whether the product of the output frequency and the display coefficient (E50) exceeds 99999. ➔ Correct the E50 data.

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App. A Advantageous Use of Inverters (Notes on electrical noise)

- Disclaimer: This document provides you with a summary of the Technical Document of the Japan Electrical Manufacturers' Association (JEMA) (April 1994). It is intended to apply to the domestic market only. It is only for reference for the foreign market. -

A.1 Effect of inverters on other devices

Inverters have been and are rapidly expanding its application fields. This paper describes the effect that inverters have on electronic devices already installed or on devices installed in the same system as inverters, as well as introducing noise prevention measures. (Refer to Section A.3 [3], "Noise prevention examples" for details.)

[1] Effect on AM radios

Phenomenon	If an inverter operates, AM radios may pick up noise radiated from the inverter. (An inverter has almost no effect on FM radios or television sets.)
Probable cause	Radios may receive noise radiated from the inverter.
Measures	Inserting a noise filter on the power supply side of the inverter is effective.

[2] Effect on telephones

Phenomenon	If an inverter operates, nearby telephones may pick up noise radiated from the inverter in conversation so that it may be difficult to hear.
Probable cause	A high-frequency leakage current radiated from the inverter and motors enters shielded telephone cables, causing noise.
Measures	It is effective to commonly connect the grounding terminals of the motors and return the common grounding line to the grounding terminal of the inverter.

[3] Effect on proximity switches

Phenomenon	If an inverter operates, proximity switches (capacitance-type) may malfunction.
Probable cause	The capacitance-type proximity switches may provide inferior noise immunity.
Measures	It is effective to connect a filter to the input terminals of the inverter or change the power supply treatment of the proximity switches. The proximity switches can be replaced with superior noise immunity types such as magnetic types.

[4] Effect on pressure sensors

Phenomenon	If an inverter operates, pressure sensors may malfunction.
Probable cause	Noise may penetrate through a grounding wire into the signal line.
Measures	It is effective to install a noise filter on the power supply side of the inverter or to change the wiring.

[5] Effect on position detectors (pulse encoders)

Phenomenon	If an inverter operates, pulse encoders may produce erroneous pulses that shift the stop position of a machine.
Probable cause	Erroneous pulses are liable to occur when the signal lines of the PG and power lines are bundled together.
Measure	The influence of induction noise and radiation noise can be reduced by separating the PG signal lines and power lines. Providing noise filters at the input and output terminals is also an effective measure.

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A.2 Noise

This section gives a summary of noises generated in inverters and their effects on devices subject to noise.

[1] Inverter noise

Figure A.1 shows an outline of the inverter configuration. The inverter converts AC to DC (rectification) in a converter unit, and converts DC to AC (inversion) with 3-phase variable voltage and variable frequency. The conversion (inversion) is performed by PWM implemented by switching six transistors (IGBT: Insulated Gate Bipolar Transistor, etc), and is used for variable speed motor control.

Switching noise is generated by high-speed on/off switching of the six transistors. Noise current (i) is emitted and at each high-speed on/off switching, the noise current flows through stray capacitance (C) of the inverter, cable and motor to the ground. The amount of the noise current is expressed as follows:

$$i = C \cdot dv/dt$$

It is related to the stray capacitance (C) and dv/dt (switching speed of the transistors). Further, this noise current is related to the carrier frequency since the noise current flows each time the transistors are switched on or off.

In addition to the main circuit of the inverter, the DC-to-DC switching power regulator (DC/DC converter), which is the power source for the control circuit of the inverter, may be a noise source in the same principles as stated above.

The frequency band of this noise is less than approximately 30 to 40 MHz. Therefore, the noise will affect devices such as AM radios using low frequency band, but will not virtually affect FM radios and television sets using higher frequency than this frequency band.

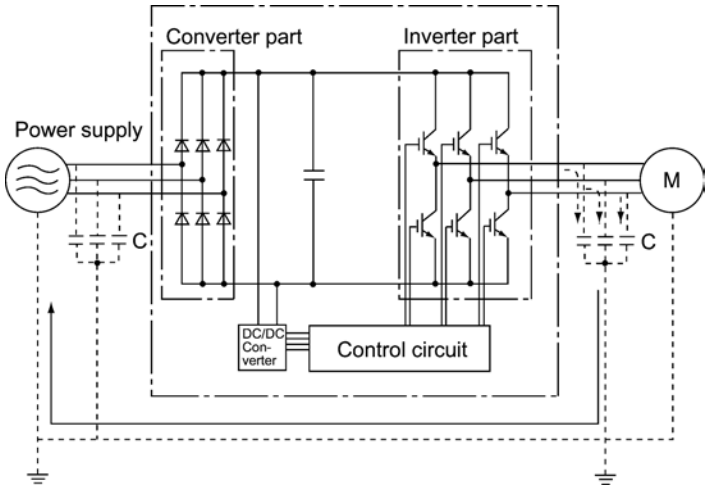

Figure A.1 Outline of Inverter Configuration

[2] Types of noise

Noise generated in an inverter is propagated through the main circuit wiring to the power supply and the motor so as to affect a wide range of applications from the power supply transformer to the motor. The various propagation routes are shown in Figure A.2. According to those routes, noises are roughly classified into three types--conduction noise, induction noise, and radiation noise.

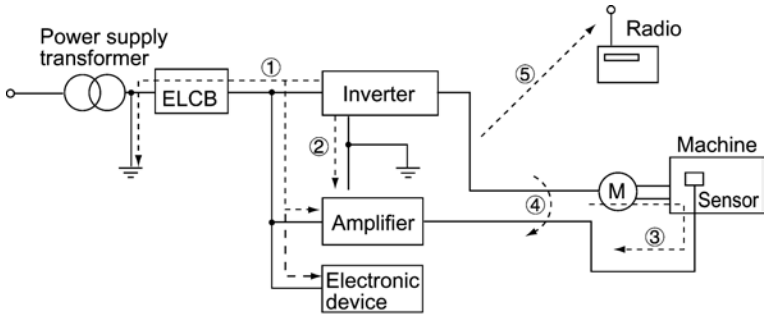

Figure A.2 Noise Propagation Routes

(1) Conduction noise

Noise generated in an inverter may propagate through the conductor and power supply so as to affect peripheral devices of the inverter (Figure A.3). This noise is called "conduction noise." Some conduction noises will propagate through the main circuit ①. If the ground wires are connected to a common ground, conduction noise will propagate through route ②. As shown in route ③, some conduction noises will propagate through signal lines or shielded wires.

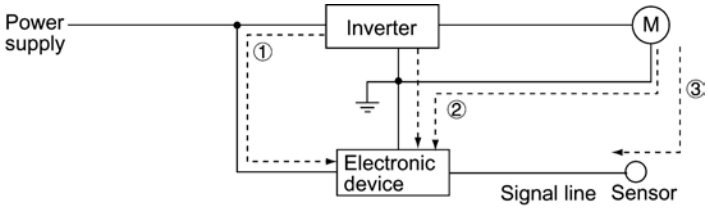

Figure A.3 Conduction Noise

(2) Induction noise

When wires or signal lines of peripheral devices are brought close to the wires on the input and output sides of the inverter through which noise current is flowing, noise will be induced into those wires and signal lines of the devices by electromagnetic induction (Figure A.4) or electrostatic induction (Figure A.5). This is called "induction noise" ④.

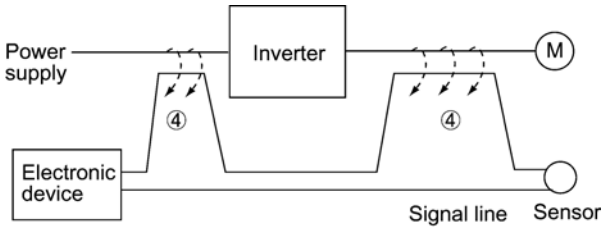

Figure A.4 Electromagnetic Induced Noise

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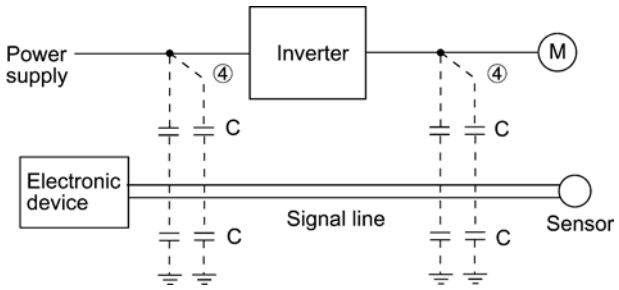

Figure A.5 Electrostatic Induced Noise

(3) Radiation noise

Noise generated in an inverter may be radiated through the air from wires (that act as antennas) at the input and output sides of the inverter so as to affect peripheral devices. This noise is called "radiation noise" ⑤ as shown below. Not only wires but motor frames or control system panels containing inverters may also act as antennas.

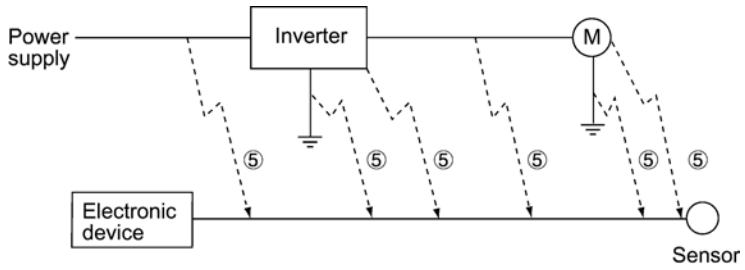

Figure A.6 Radiation Noise

A.3 Noise prevention

The more noise prevention is strengthened, the more effective. However, with the use of appropriate measures, noise problems may be resolved easily. It is necessary to implement economical noise prevention according to the noise level and the equipment conditions.

[1] Noise prevention prior to installation

Before installing an inverter in your control panel or installing an inverter panel, you need to consider noise prevention. Once noise problems occur, it will cost additional materials and time for solving them.

Noise prevention prior to installation includes:

1) Separating the wiring of main circuits and control circuits
2) Putting main circuit wiring into a metal conduit pipe
3) Using shielded wires or twisted shielded wires for control circuits.
4) Implementing appropriate grounding work and grounding wiring.

These noise prevention measures can avoid most noise problems.

[2] Implementation of noise prevention measures

There are two types of noise prevention measures--one for noise propagation routes and the other for noise receiving sides (that are affected by noise).

The basic measures for lessening the effect of noise at the receiving side include:

Separating the main circuit wiring from the control circuit wiring, avoiding noise effect.

The basic measures for lessening the effect of noise at the generating side include:

1) Inserting a noise filter that reduces the noise level.
2) Applying a metal conduit pipe or metal control panel that will confine noise, and
3) Applying an insulated transformer for the power supply that cuts off the noise propagation route.

Table A.1 lists the noise prevention measures, their goals, and propagation routes.

Table A.1 Noise Prevention Measures

Noise prevention method		Goal of noise prevention measures				Conduction route		
		Make it more difficult to receive noise	Cutoff noise conduction	Confine noise	Reduce noise level	Conduction noise	Induction noise	Radiation noise
Wiring and installation	Separate main circuit from control circuit	Y					Y	
	Minimize wiring distance	Y			Y		Y	Y
	Avoid parallel and bundled wiring	Y					Y	
	Use appropriate grounding	Y			Y	Y	Y	
	Use shielded wire and twisted shielded wire	Y					Y	Y
	Use shielded cable in main circuit			Y			Y	Y
	Use metal conduit pipe			Y			Y	Y
Control panel	Appropriate arrangement of devices in panel	Y					Y	Y
	Metal control panel			Y			Y	Y
Anti-noise device	Line filter	Y			Y	Y		Y
	Insulation transformer		Y			Y		Y
Measures at noise receiving sides	Use a passive capacitor for control circuit	Y					Y	Y
	Use ferrite core for control circuit	Y			Y		Y	Y
	Line filter	Y		Y		Y		
Others	Separate power supply systems		Y			Y		
	Lower the carrier frequency				Y*	Y	Y	Y

Y: Effective, Y*: Effective conditionally, Blank: Not effective

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What follows is noise prevention measures for the inverter drive configuration.

(1) Wiring and grounding

As shown in Figure A.7, separate the main circuit wiring from control circuit wiring as far as possible regardless of being located inside or outside the system control panel containing an inverter. Use shielded wires and twisted shielded wires that will block out extraneous noises, and minimize the wiring distance. Also avoid bundled wiring of the main circuit and control circuit or parallel wiring.

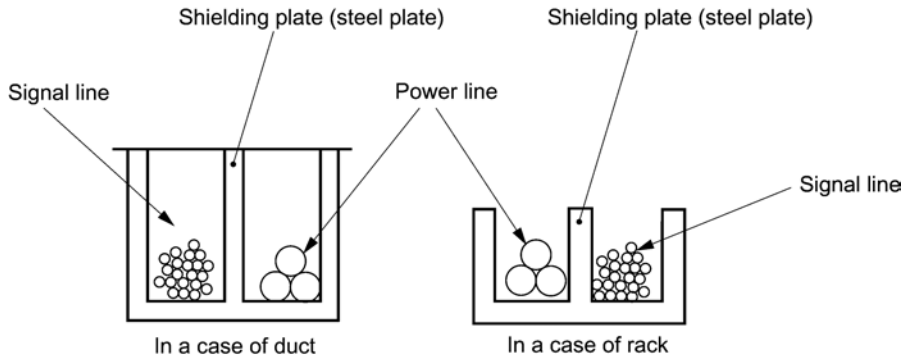

Figure A.7 Separate Wiring

For the main circuit wiring, use a metal conduit pipe and connect its wires to the ground to prevent noise propagation (refer to Figure A.8).

The shield (braided wire) of a shielded wire should be securely connected to the base (common) side of the signal line at only one point to avoid the loop formation resulting from a multi-point connection (refer to Figure A.9).

The grounding is effective not only to reduce the risk of electrical shocks due to leakage current, but also to block noise penetration and radiation. Corresponding to the main circuit voltage, the grounding work should be Class D (300 VAC or less, grounding resistance: 100Ω or less) and Class C (300 to 600 VAC, grounding resistance: 10Ω or less). Each ground wire is to be provided with its own ground or separately wired to a grounding point.

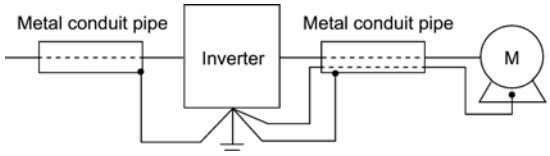

Figure A.8 Grounding of Metal Conduit Pipe

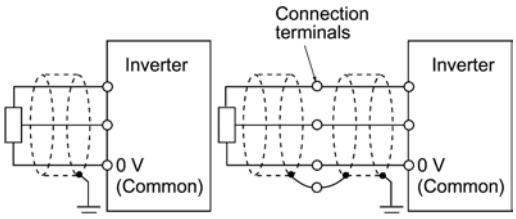

Figure A.9 Treatment of Braided Wire of Shielded Wire

(2) Control panel

The system control panel containing an inverter is generally made of metal, which can shield noise radiated from the inverter itself.

When installing other electronic devices such as a programmable logic controller in the same control panel, be careful with the layout of each device. If necessary, arrange shield plates between the inverter and peripheral devices.

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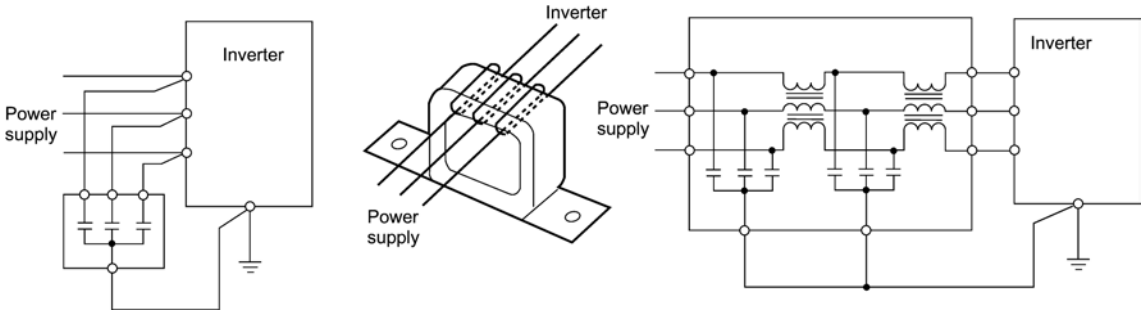
(3) Anti-noise devices

To reduce the noise propagated through the electrical circuits and the noise radiated from the main circuit wiring to the air, a line filter and power supply transformer should be used (refer to Figure A.10).

Line filters are available in these types--the simplified type such as a capacitive filter to be connected in parallel to the power supply line and an inductive filter to be connected in series to the power supply line and the orthodox type such as an LC filter to meet radio noise regulations. Use them according to the targeted effect for reducing noise.

Power supply transformers include common insulated transformers, shielded transformers, and noise-cutting transformers. These transformers have different effectiveness in blocking noise propagation.



(a) Capacitive filter (b) Inductive filter (zero-phase reactor) (c) LC filter

Figure A.10 Various Filters and their Connection

(4) Noise prevention measures at the receiving side

It is important to strengthen the noise immunity of those electronic devices installed in the same control panel as the inverter or located near an inverter. Line filters and shielded or twisted shielded wires are used to block the penetration of noise in the signal lines of these devices. The following treatments are also implemented.

1) Lower the circuit impedance by connecting capacitors or resistors to the input and output terminals of the signal circuit in parallel.
2) Increase the circuit impedance for noise by inserting choke coils in series in the signal circuit or passing signal lines through ferrite core beads. It is also effective to widen the signal base lines (0 V line) or grounding lines.

(5) Other

The level of generating/propagating noise will change with the carrier frequency of the inverter. The higher the carrier frequency, the higher the noise level.

In an inverter whose carrier frequency can be changed, lowering the carrier frequency can reduce the generation of electrical noise and result in a good balance with the audible noise of the motor under driving conditions.

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[3] Noise prevention examples

Table A.2 lists examples of the measures to prevent noise generated by a running inverter.

Table A.2 Examples of Noise Prevention Measures

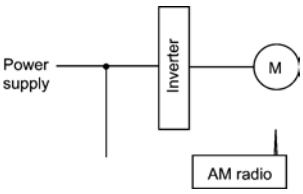
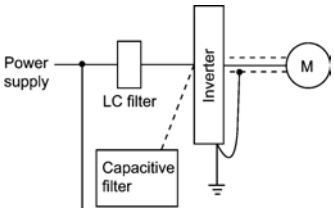
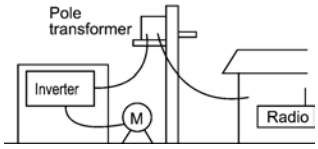
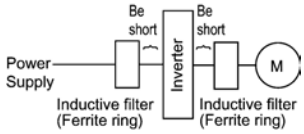
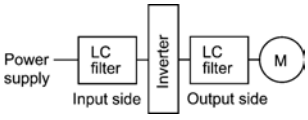
No.	Target device	Phenomena	Noise prevention measures	Notes
1	AM radio	When operating an inverter, noise enters into an AM radio broadcast (500 to 1500 kHz).  <Possible cause> The AM radio may receive noise radiated from wires at the power supply and output sides of the inverter.	1) Install an LC filter at the power supply side of the inverter. (In some cases, a capacitive filter may be used as a simple method.) 2) Install a metal conduit wiring between the motor and inverter.  Note: Minimize the distance between the LC filter and inverter as short as possible (within 1m).	1) The radiation noise of the wiring can be reduced. 2) The conduction noise to the power supply side can be reduced. Note: Sufficient improvement may not be expected in narrow regions such as between mountains.
2	AM radio	When operating an inverter, noise enters into an AM radio broadcast (500 to 1500 kHz).  <Possible cause> The AM radio may receive noise radiated from the power line at the power supply side of the inverter.	1) Install inductive filters at the input and output sides of the inverter.  The number of turns of the zero-phase reactor (or ferrite ring) should be as large as possible. In addition, wiring between the inverter and the zero-phase reactor (or ferrite ring) should be as short as possible. (within 1m) 2) When further improvement is necessary, install LC filters. 	1) The radiation noise of the wiring can be reduced.

Table A.2 Continued

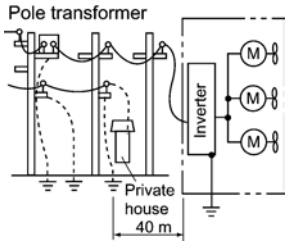
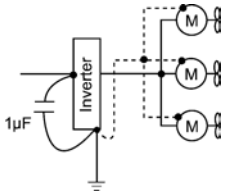
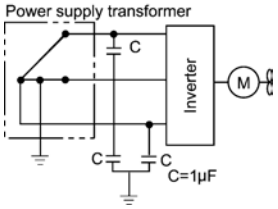
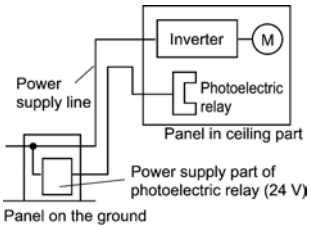
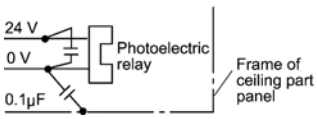
No.	Target device	Phenomena	Noise prevention measures	Notes
3	Tele-phone (in a common private residence at a distance of 40 m)	When driving a ventilation fan with an inverter, noise enters a telephone in a private residence at a distance of 40m.  <Possible cause> A high-frequency leakage current from the inverter and motor flowed to grounded part of the telephone cable shield. During the current's return trip, it flowed through a grounded pole transformer, and noise entered the telephone by electrostatic induction.	1) Connect the ground terminals of the motors in a common connection. Return to the inverter panel, and insert a 1 μF capacitor between the input terminal of the inverter and ground. 	1) The effect of the inductive filter and LC filter may not be expected because of sound frequency component. 2) In the case of a V-connection power supply transformer in a 200V system, it is necessary to connect capacitors as shown in the following figure, because of different potentials to ground. 
4	Photo-electric relay	A photoelectric relay malfunctioned when the inverter runs the motor. [The inverter and motor are installed in the same place (for overhead traveling)]  <Possible cause> It is considered that induction noise entered the photoelectric relay since the inverter's input power supply line and the photoelectric relay's wiring are in parallel separated by approximately 25 mm over a distance of 30 to 40 m. Due to conditions of the installation, these lines cannot be separated.	1) As a temporary measure, Insert a 0.1 μF capacitor between the 0 V terminal of the power supply circuit in the detection unit of the overhead photoelectric relay and a frame of the overhead panel.  2) As a permanent measure, move the 24 V power supply from the ground to the overhead unit so that signals are sent to the ground side with relay contacts in the ceiling part.	1) The wiring is separated by more than 30 cm. 2) When separation is impossible, signals can be received and sent with dry contacts etc. 3) Do not wire low-current signal lines and power lines in parallel.

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Table A.2 Continued

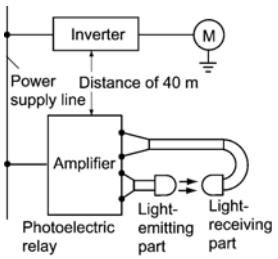
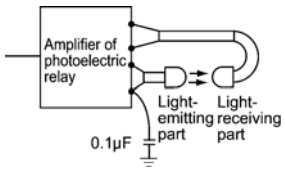
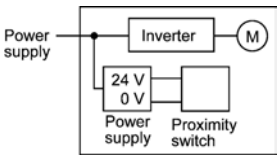
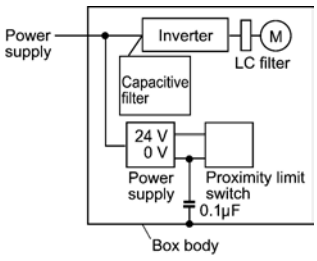
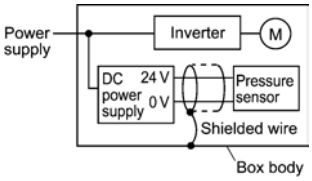
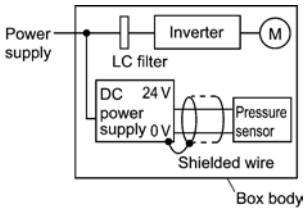
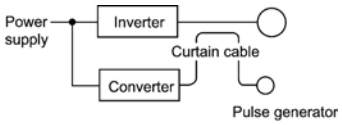
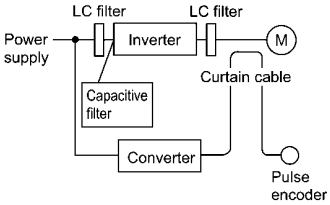
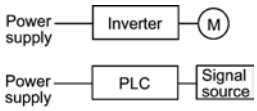
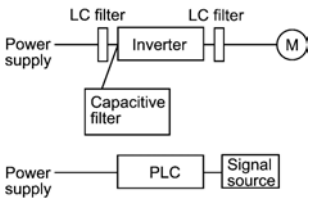
No.	Target device	Phenomena	Noise prevention measures	Notes
5	Photo-electric relay	A photoelectric relay malfunctioned when the inverter was operated.  <Possible cause> Although the inverter and photoelectric relay are separated by a sufficient distance but the power supplies share a common connection, it is considered that conduction noise entered through the power supply line into the photoelectric relay.	1) Insert a 0.1 μF capacitor between the output common terminal of the amplifier of the photoelectric relay and the frame. 	1) If a low-current circuit at the malfunctioning side is observed, the measures may be simple and economical.
6	Prox-imity switch (capaci-tance type)	A proximity switch malfunctioned.  <Possible cause> It is considered that the capacitance type proximity switch is susceptible to conduction and radiation noise because of its low noise immunity.	1) Install an LC filter at the output side of the inverter. 2) Install a capacitive filter at the input side of the inverter. 3) Ground the 0 V (common) line of the DC power supply of the proximity switch through a capacitor to the box body of the machine. 	1) Noise generated in the inverter can be reduced. 2) The switch is superseded by a proximity switch of superior noise immunity (such as a magnetic type).

Table A.2 Continued

No.	Target device	Phenomena	Noise prevention measures	Notes
7	Pressure sensor	A pressure sensor malfunctioned.  <Possible cause> The pressure sensor may malfunction due to noise that came from the box body through the shielded wire.	1) Install an LC filter on the input side of the inverter. 2) Connect the shield of the shielded wire of the pressure sensor to the 0 V line (common) of the pressure sensor, changing the original connection. 	1) The shielded parts of shield wires for sensor signals are connected to a common point in the system. 2) Conduction noise from the inverter can be reduced.
8	Position detector (pulse encoder)	Erroneous-pulse outputs from a pulse converter caused a shift in the stop position of a crane.  <Possible cause> Erroneous pulses may be outputted by induction noise since the power line of the motor and the signal line of the PG are bundled together.	1) Install an LC filter and a capacitive filter at the input side of the inverter. 2) Install an LC filter at the output side of the inverter. 	1) This is an example of a measure where the power line and signal line cannot be separated. 2) Induction noise and radiation noise at the output side of the inverter can be reduced.
9	Program mable logic controller (PLC)	The PLC program sometimes malfunctions.  <Possible cause> Since the power supply system is the same for the PLC and inverter, it is considered that noise enters the PLC through the power supply.	1) Install a capacitive filter and an LC filter on the input side of the inverter. 2) Install an LC filter on the output side of the inverter. 3) Lower the carrier frequency of the inverter. 	1) Total conduction noise and induction noise in the electric line can be reduced.

App.

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

- Disclaimer: This document provides you with a translated summary of the Guideline of the Ministry of Economy, Trade and Industry. It is intended to apply to the domestic market only. It is only for reference for the foreign market. -

Agency of Natural Resource and Energy of Japan published the following two guidelines for suppressing harmonic noise in September 1994.

(1) Guideline for suppressing harmonics in home electric and general-purpose appliances

(2) Guideline for suppressing harmonics by customers receiving high voltage or special high voltage

Assuming that electronic devices generating high harmonics will be increasing, these guidelines are to establish regulations for preventing high frequency noise interference on devices sharing the power source. These guidelines should be applied to all devices that are used on the commercial power lines and generate harmonic current. This section gives a description limited to general-purpose inverters.

B.1 Application to general-purpose inverters

[1] Guideline for suppressing harmonics in home electric and general-purpose appliances

Our three-phase, 200 V class series inverters of 3.7 kW or less (FRENIC-MEGA 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.

[2] Guideline for suppressing harmonics by customers receiving high voltage or special high voltage

Unlike other guidelines, this guideline is not applied to the equipment itself such as a general-purpose inverter, but is applied to each large-scale electric power consumer for total amount of harmonics. The consumer should calculate the harmonics generated from each piece of equipment currently used on the power source transformed and fed from the high or special high voltage source.

(1) Scope of regulation

In principle, the guideline applies to the customers that meet the following two conditions:

- The customer receives high voltage or special high voltage.
- The "equivalent capacity" of the converter load exceeds the standard value for the receiving voltage (50 kVA at a receiving voltage of 6.6 kV).

Appendix B.2 [1] "Calculation of equivalent capacity (Pi)" gives you some supplemental information with regard to estimation for the equivalent capacity of an inverter according to the guideline.

(2) Regulation

The level (calculated value) of the harmonic current that flows from the customer's receiving point out to the system is subjected to the regulation. The regulation value is proportional to the contract demand. The regulation values specified in the guideline are shown in Table B.1.

Appendix B.2 gives you some supplemental information with regard to estimation for the equivalent capacity of the inverter for compliance to "Japanese guideline for suppressing harmonics by customers receiving high voltage or special high voltage."

Table B.1 Upper Limits of Harmonic Outflow Current per kW of Contract Demand (mA/kW)

Receiving voltage	5th	7th	11th	13th	17th	19th	23rd	Over 25th
6.6 kV	3.5	2.5	1.6	1.3	1.0	0.90	0.76	0.70
22 kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36

(3) When the regulation applied

The guideline has been applied. As the application, the estimation for "Voltage distortion factor" required as the indispensable conditions when entering into the consumer's contract of electric power is already expired.

B.2 Compliance to the harmonic suppression for customers receiving high voltage or special high voltage

When calculating the required matters related to inverters according to the guideline, follow the terms listed below. The following descriptions are based on "Technical document for suppressing harmonics" (JEAG 9702-1995) published by the Japan Electrical Manufacturer's Association (JEMA).

[1] Calculation of equivalent capacity (Pi)

The equivalent capacity (Pi) may be calculated using the equation of (input rated capacity) x (conversion factor). However, catalogs of conventional inverters do not contain input rated capacities, so a description of the input rated capacity is shown below:

(1) "Inverter rated capacity" corresponding to "Pi"

- In the guideline, the conversion factor of a 6-pulse converter is used as reference conversion factor 1. It is, therefore, necessary to express the rated input capacity of inverters in a value including harmonic component current equivalent to conversion factor 1.
- Calculate the input fundamental current I_1 from the kW rating and efficiency of the load motor, as well as the efficiency of the inverter. Then, calculate the input rated capacity as shown below:

$$\text{Input rated capacity} = \sqrt{3} \times (\text{power supply voltage}) \times I_1 \times 1.0228/1000 \ \text{(kVA)}$$

  where 1.0228 is the 6-pulse converter's value of (effective current)/(fundamental current).
- When a general-purpose motor or inverter motor is used, the appropriate value shown in Table B.2 can be used. Select a value based on the kW rating of the motor used, irrespective of the inverter type.

Note The input rated capacity shown above is for the dedicated use in the equation to calculate capacity of the inverters, following the guideline. Note that the capacity cannot be applied to the reference for selection of the equipment or wires to be used in the inverter input circuits.

For selection of capacity for the peripheral equipment, refer to the catalogs or technical documents issued from their manufacturers.

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Table B.2 "Input Rated Capacities" of General-purpose Inverters Determined by the Applicable Motor Ratings

Applicable motor rating (kW)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5
Pi (kVA)	200 V	0.57	0.97	1.95	2.81	4.61	6.77	9.07	13.1	17.6	21.8
	400 V	0.57	0.97	1.95	2.81	4.61	6.77	9.07	13.1	17.6	21.8

(2) Values of "Ki (conversion factor)"

Depending on whether an optional ACR (AC reactor) or DCR (DC reactor) is used, apply the appropriate conversion factor specified in the appendix to the guideline. The values of the conversion factor are listed in Table B.3.

Table B.3 "Conversion Factors Ki" for General-purpose Inverters Determined by Reactors

Circuit category	Circuit type		Conversion factor Ki	Main applications
3	3-phase bridge (capacitor smoothing)	w/o reactor	K31=3.4	• General-purpose inverters • Elevators • Refrigerators, air conditioning systems • Other general appliances
		w/- reactor (ACR)	K32=1.8	
		w/- reactor (DCR)	K33=1.8	
		w/- reactors (ACR and DCR)	K34=1.4	

Note Some models are equipped with a reactor as a standard accessory.

[2] Calculation of Harmonic Current

(1) Value of "input fundamental current"

- When you calculate the amount of harmonics according to Table 2 in Appendix of the Guideline, you have to previously know the input fundamental current.
- Apply the appropriate value shown in Table B.4 based on the kW rating of the motor, irrespective of the inverter type or whether a reactor is used.

Note If the input voltage is different, calculate the input fundamental current in inverse proportion to the voltage.

Table B.4 "Input Fundamental Currents" of General-purpose Inverters Determined by the Applicable Motor Ratings

Applicable motor rating (kW)		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5
Input fundamental current (A)	200 V	1.62	2.74	5.50	7.92	13.0	19.1	25.6	36.9	49.8	61.4
	400 V	0.81	1.37	2.75	3.96	6.50	9.55	12.8	18.5	24.9	30.7
6.6 kV converted value (mA)		49	83	167	240	394	579	776	1121	1509	1860

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(2) Calculation of harmonic current

Usually, calculate the harmonic current according to the Sub-table 3 "Three-phase bridge rectifier with the smoothing capacitor" in Table 2 of the Guideline's Appendix. Table B.5 lists the contents of the Sub-table 3.

Table B.5 Generated Harmonic Current (%), 3-phase Bridge Rectifier (Capacitor Smoothing)

Degree	5th	7th	11th	13th	17th	19th	23rd	25th
w/o a reactor	65	41	8.5	7.7	4.3	3.1	2.6	1.8
w/- a reactor (ACR)	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3
w/- a reactor (DCR)	30	13	8.4	5.0	4.7	3.2	3.0	2.2
w/- reactors (ACR and DCR)	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4

- ACR: 3%
- DCR: Accumulated energy equal to 0.08 to 0.15 ms (100% load conversion)
- Smoothing capacitor: Accumulated energy equal to 15 to 30 ms (100% load conversion)
- Load: 100%

Calculate the harmonic current of each degree using the following equation:

$$\text{nth harmonic current (A)} = \text{Fundamental current (A)} \times \frac{\text{Generated nth harmonic current (\%)}}{100}$$

(3) Maximum availability factor

- For a load for elevators, which provides intermittent operation, or a load with a sufficient designed motor rating, reduce the current by multiplying the equation by the "maximum availability factor" of the load.
- The "maximum availability factor of an appliance" means the ratio of the capacity of the harmonic generator in operation at which the availability reaches the maximum, to its total capacity, and the capacity of the generator in operation is an average for 30 minutes.
- In general, the maximum availability factor is calculated according to this definition, but the standard values shown in Table B.6 are recommended for inverters for building equipment.

Table B.6 Availability Factors of Inverters, etc. for Building Equipment (Standard Values)

Equipment type	Inverter capacity category	Single inverter availability
Air conditioning system	200 kW or less	0.55
	Over 200 kW	0.60
Sanitary pump	———	0.30
Elevator	———	0.25
Refrigerator, freezer	50 kW or less	0.60
UPS (6-pulse)	200 kVA	0.60

Correction coefficient according to contract demand level

Since the total availability factor decreases if the scale of a building increases, calculating reduced harmonics with the correction coefficient β defined in Table B.7 is permitted.

Table B.7 Correction Coefficient according to the Building Scale

Contract demand (kW)	Correction coefficient β
300	1.00
500	0.90
1000	0.85
2000	0.80

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Note: If the contract demand is between two specified values listed in Table B.7, calculate the value by interpolation.

Note: The correction coefficient β is to be determined as a matter of consultation between the customer and electric power company for the customers receiving the electric power over 2000 kW or from the special high voltage lines.

(4) Degree of harmonics to be calculated

The higher the degree of harmonics, the lower the current flows. This is the property of harmonics generated by inverters so that the inverters are covered by "The case not causing a special hazard" of the term (3) in the above Appendix for the 9th or higher degrees of the harmonics.

Therefore, "It is sufficient that the 5th and 7th harmonic currents should be calculated."

[3] Examples of calculation

(1) Equivalent capacity

Example of loads	Input capacity and No. of inverters	Conversion factor	Equivalent capacity
[Example 1] 400 V, 3.7 kW, 10 units w/- AC reactor and DC reactor	4.61 kVA × 10 units	K32 = 1.4	4.61 × 10 × 1.4 = 64.54 kVA
[Example 2] 400 V, 1.5 kW, 15 units w/- AC reactor	2.93 kVA × 15 units	K34 = 1.8	2.93 × 15 × 1.8 = 79.11 kVA
	Refer to Table B.2.	Refer to Table B.3.	

(2) Harmonic current every degrees

[Example 1] 400 V, 3.7 kW 10 units, w/- AC reactor, and maximum availability: 0.55

Fundamental current onto 6.6 kV lines (mA)	Harmonic current onto 6.6 kV lines (mA)							
394 × 10 = 3940 3940 × 0.55 = 2167	5th (38%)	7th (14.5%)	11th (7.4%)	13th (3.4%)	17th (3.2%)	19th (1.9%)	23rd (1.7%)	25th (1.3%)
	823.5	314.2						
Refer to Tables B.4 and B.6.	Refer to Table B.5.							

[Example 2] 400 V, 3.7 kW, 15 units, w/- AC reactor and DC reactor, and maximum availability: 0.55

Fundamental current onto 6.6 kV lines (mA)	Harmonic current onto 6.6 kV lines (mA)							
394 × 15 = 5910 5910 × 0.55 = 3250.5	5th (28%)	7th (9.1%)	11th (7.2%)	13th (4.1%)	17th (3.2%)	19th (2.4%)	23rd (1.6%)	25th (1.4%)
	910.1	295.8						
Refer to Tables B.4 and B.6.	Refer to Table B.5.							

App. C Effect on Insulation of General-purpose Motors Driven with 400 V Class Inverters

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Preface

When an inverter drives a motor, surge voltages generated by switching the inverter elements are superimposed on the inverter output voltage and applied to the motor terminals. If the surge voltages are too high they may have an effect on the motor insulation and some cases have resulted in damage.

For preventing such cases this document describes the generating mechanism of the surge voltages and countermeasures against them.

Refer to A.2 [1] "Inverter noise" for details of the principle of inverter operation.

C.1 Generating mechanism of surge voltages

As the inverter rectifies a commercial power source voltage and smoothes into a DC voltage, the magnitude E of the DC voltage becomes about $\sqrt{2}$ times that of the source voltage (about 620 V in case of an input voltage of 440 VAC). The peak value of the output voltage is usually close to this DC voltage value.

But, as there exists inductance (L) and stray capacitance (C) in wiring between the inverter and the motor, the voltage variation due to switching the inverter elements causes a surge voltage originating in LC resonance and results in the addition of high voltage to the motor terminals. (Refer to Figure C.1)

This voltage sometimes reaches up to about twice that of the inverter DC voltage (620 V x 2 = approximately 1,200 V) depending on a switching speed of the inverter elements and wiring conditions.

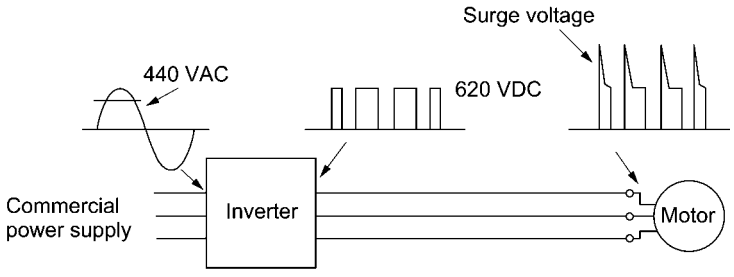

Figure C.1 Voltage Waveform of Individual Portions

A measured example in Figure C.2 illustrates the relation of a peak value of the motor terminal voltage with a wiring length between the inverter and the motor.

From this it can be confirmed that the peak value of the motor terminal voltage ascends as the wiring length increases and becomes saturated at about twice the inverter DC voltage.

The shorter a pulse rise time becomes, the higher the motor terminal voltage rises even in the case of a short wiring length.

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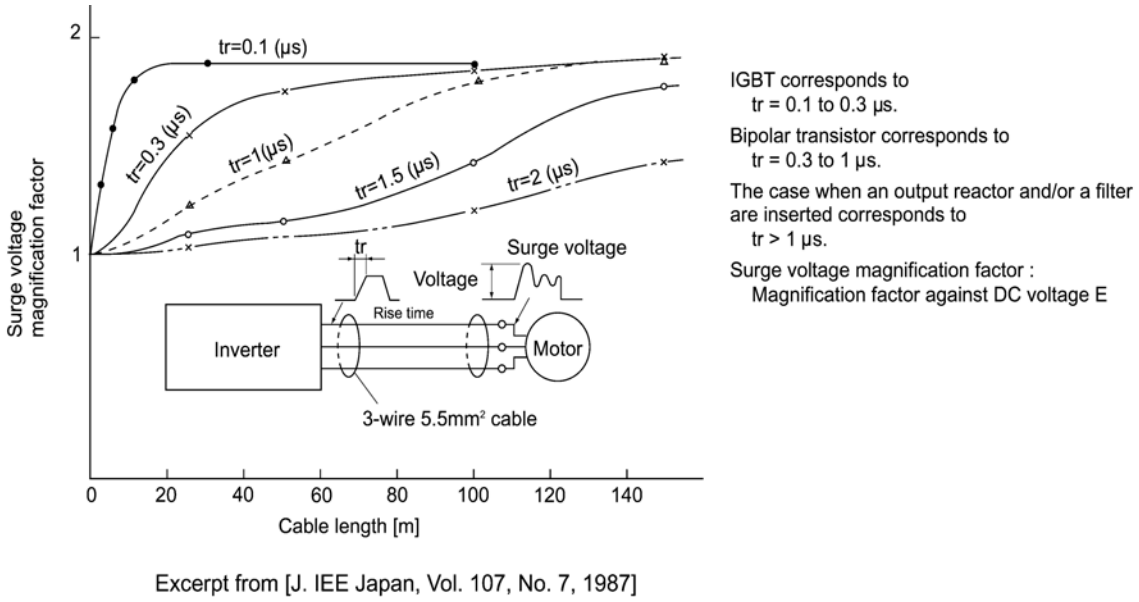


Figure C.2 Measured Example of Wiring Length and Peak Value of Motor Terminal Voltage

C.2 Effect of surge voltages

The surge voltages originating in LC resonance of wiring may be applied to the motor terminals and depending on their magnitude sometimes cause damage to the motor insulation.

When the motor is driven with a 200 V class inverter, the dielectric strength of the insulation is no problem since the peak value at the motor terminal voltage increases twice due to the surge voltages (the DC voltage is only about 300 V).

But in case of a 400 V class inverter, the DC voltage is approximately 600 V and depending on the wiring length, the surge voltages may greatly increase and sometimes result in damage to the insulation.

C.3 Countermeasures against surge voltages

When driving a motor with a 400 V class inverter, the following are countermeasures against damage to the motor insulation by the surge voltages.

[1] Using a surge suppressor unit, SSU (Patent pending)

The surge suppressor unit (SSU) is a newly structured unit using circuits based on the impedance-matching theory of a transmission line. Just connecting the SSU to the surge suppressor cable of the existing equipment can greatly reduce the surge voltage that results in a motor dielectric breakdown.

For 50 m of wiring length: SSU 50TA-NS

For 100 m of wiring length: SSU 100TA-NS

[2] Suppressing surge voltages

There are two ways for suppressing the surge voltages, one is to reduce the voltage rise time and another is to reduce the voltage peak value.

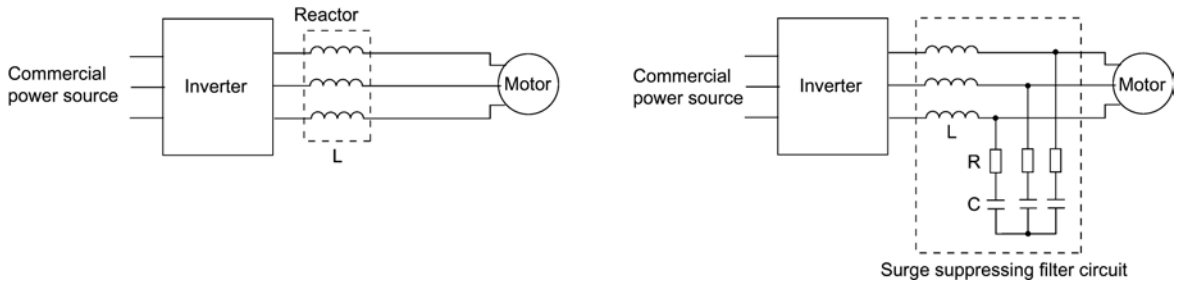
(1) Output reactor

If wiring length is relatively short, the surge voltages can be suppressed by reducing the voltage rise time (dv/dt) with the installation of an AC reactor on the output side of the inverter. (Refer to Figure C.3 (1).)

However, if the wiring length becomes long, suppressing the peak voltage due to surge voltage may be difficult.

(2) Output filter

Installing a filter on the output side of the inverter allows a peak value of the motor terminal voltage to be reduced. (Refer to Figure C.3 (2).)



(1) Output reactor (2) Output filter

Figure C.3 Method to Suppress Surge Voltage

Tip If the wiring length between the inverter and the motor is comparatively long, the crest value of the surge voltage can be suppressed by connecting a surge suppressor unit (SSU) to the motor terminal. For details, refer to Chapter 4, Section 4.4.1.5 "Surge suppression unit (SSU)."

[3] Using motors with enhanced insulation

Enhanced insulation of a motor winding allows its surge withstanding to be improved.

C.4 Regarding existing equipment

[1] In case of a motor being driven with 400 V class inverter

A survey over the last five years on motor insulation damage due to the surge voltages originating from switching of inverter elements shows that the damage incidence is 0.013% under the surge voltage condition of over 1,100 V and most of the damage occurs several months after commissioning the inverter. Therefore there seems to be little probability of occurrence of motor insulation damage after a lapse of several months of commissioning.

[2] In case of an existing motor driven using a newly installed 400 V class inverter

We recommend suppressing the surge voltages with the ways shown in Section C.3.

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App. D Inverter Generating Loss

The table below lists the inverter generating loss.

Power supply voltage	Inverter type	Generating loss (W)					
		HD mode		LD mode		MD mode	
		Low carrier frequency	High carrier frequency	Low carrier frequency	High carrier frequency	Low carrier frequency	High carrier frequency
Three-phase 200 V	FRN0.4G1■-2□	35	45				
	FRN0.75G1■-2□	50	60				
	FRN1.5G1■-2□	80	110				
	FRN2.2G1■-2□	110	140				
	FRN3.7G1■-2□	170	210				
	FRN5.5G1■-2□	240	310	290	370		
	FRN7.5G1■-2□	300	415	410	550		
	FRN11G1■-2□	450	620	500	670		
	FRN15G1■-2□	540	700	630	840		
	FRN18.5G1■-2□	660	860	770	970		
	FRN22G1■-2□	790	1040	1120	1250*3		
	FRN30G1■-2□	1300	1450	1650	1750		
	FRN37G1■-2□	1300	1550	1650	1850		
	FRN45G1■-2□	1450	1600	1850	1950		
	FRN55G1■-2□	1750	1900	2250	2400		
	FRN75G1■-2□	Under contemplation					
	FRN90G1■-2□						
Three-phase 400 V	FRN0.4G1■-4□	35	60				
	FRN0.75G1■-4□	45	80				
	FRN1.5G1■-4□	60	110				
	FRN2.2G1■-4□	80	140				
	FRN3.7G1■-4□	130	230				
	FRN5.5G1■-4□	170	300	210	370		
	FRN7.5G1■-4□	230	400	300	520		
	FRN11G1■-4□	300	520	360	610		
	FRN15G1■-4□	360	610	460	770		
	FRN18.5G1■-4□	440	770	510	870		
	FRN22G1■-4□	510	900	710	1310*3		
	FRN30G1■-4□	800	1150	1000	1250		
	FRN37G1■-4□	1000	1450	1250	1550		
	FRN45G1■-4□	1100	1600	1350	1700		
	FRN55G1■-4□	1350	1950	1950	2400		
	FRN75G1■-4□	1600	2150*1	2000	2250*2		
	FRN90G1■-4□	1900	2600*1	2250	2550*2	2250	
	FRN110G1■-4□	2300	3050*1	2700	3050*2	2700	
	FRN132G1■-4□	2500	3300*1	3050	3400*2	3050	
	FRN160G1■-4□	3100	4000*1	3900	4350*2	3900	
	FRN200G1■-4□	3850	5000*1	4250	4750*2	4250	
	FRN220G1■-4□	4350	5600*1	5600	6200*2	4850	
	FRN280G1■-4□	Under contemplation					
	FRN315G1■-4□						
	FRN355G1■-4□						
	FRN400G1■-4□						
	FRN500G1■-4□						
	FRN630G1■-4□						

Note 1: A box (■) in the above table replaces an alphabetic letter depending on the enclosure.
Note 2: A box (□) in the above table replaces A, E, J, or T depending on the shipping destination.

30 kW or above
Low carrier: 2 kHz
High carrier (HD): 15 kHz (*1: 10 kHz)
High carrier (LD): 10 kHz (*2: 6 kHz)

22 kW or below
Low carrier: 2 kHz
High carrier: 16 kHz (*3: 10 kHz)

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App. E Conversion from SI Units

All expressions given in Chapter 3, "SELECTING OPTIMAL MOTOR AND INVERTER CAPACITIES" are based on SI units (The International System of Units). This section explains how to convert expressions to other units.

[1] Conversion of units

(1) Force

- 1 (kgf) ≈ 9.8 (N)
- 1 (N) ≈ 0.102 (kgf)

(2) Torque

- 1 (kgf·m) ≈ 9.8 (N·m)
- 1 (N·m) ≈ 0.102 (kgf·m)

(3) Work and energy

- 1 (kgf·m) ≈ 9.8 (N·m) = 9.8(J) = 9.8 (W·s)

(4) Power

- 1 (kgf·m/s) ≈ 9.8 (N·m/s) = 9.8 (J/s) = 9.8(W)
- 1 (N·m/s) ≈ 1 (J/s) = 1 (W) ≈ 0.102 (kgf·m/s)

(5) Rotation speed

- $1\,(\mathrm{r/min}) = \frac{2\pi}{60}\,(\mathrm{rad/s}) \approx 0.1047\ (\mathrm{rad/s})$
- $1\,(\mathrm{rad/s}) = \frac{60}{2\pi}\,(\mathrm{r/min}) \approx 9.549\ (\mathrm{r/min})$

(6) Inertia constant

J (kg·m²) : moment of inertia

GD² (kg·m²) : flywheel effect

- $GD^2 = 4\,J$
- $J = \frac{GD^2}{4}$

(7) Pressure and stress

- 1 (mmAq) ≈ 9.8 (Pa) ≈ 9.8 (N/m²)
- 1(Pa) ≈ 1(N/m²) ≈ 0.102 (mmAq)
- 1 (bar) ≈ 100000 (Pa) ≈ 1.02 (kg·cm²)
- 1 (kg·cm²) ≈ 98000 (Pa) ≈ 980 (mbar)
- 1 atmospheric pressure = 1013 (mbar) = 760 (mmHg) = 101300 (Pa) ≈ 1.033 (kg/cm²)

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[2] Calculation formula

(1) Torque, power, and rotation speed

- $P\ (W) \approx \frac{2\pi}{60} \cdot N\ (r/min) \cdot \tau\ (N \cdot m)$
- $P\ (W) \approx 1.026 \cdot N\ (r/min) \cdot T\ (kgf \cdot m)$
- $\tau\ (N \cdot m) \approx 9.55 \cdot \frac{P\ (W)}{N\ (r/min)}$
- $T\ (kgf \cdot m) \approx 0.974 \cdot \frac{P\ (W)}{N\ (r/min)}$

(2) Kinetic energy

- $E\ (J) \approx \frac{1}{182.4} \cdot J\ (kg \cdot m^2) \cdot N^2\ [(r/min)^2]$
- $E\ (J) \approx \frac{1}{730} \cdot GD^2\ (kg \cdot m^2) \cdot N^2\ [(r/min)^2]$

(3) Torque of linear moving load

Driving mode

- $\tau\ (N \cdot m) \approx 0.159 \cdot \frac{V\ (m/min)}{N_M\ (r/min) \cdot \eta_G} \cdot F\ (N)$
- $T\ (kgf \cdot m) \approx 0.159 \cdot \frac{V\ (m/min)}{N_M\ (r/min) \cdot \eta_G} \cdot F\ (kgf)$

Braking mode

- $\tau\ (N \cdot m) \approx 0.159 \cdot \frac{V\ (m/min)}{N_M\ (r/min) / \eta_G} \cdot F\ (N)$
- $T\ (kgf \cdot m) \approx 0.159 \cdot \frac{V\ (m/min)}{N_M\ (r/min) / \eta_G} \cdot F\ (kgf)$

(4) Acceleration torque

Driving mode

- $\tau\ (N \cdot m) \approx \frac{J\ (kg \cdot m^2)}{9.55} \cdot \frac{\Delta N\ (r/min)}{\Delta t\ (s) \cdot \eta_G}$
- $T\ (kgf \cdot m) \approx \frac{GD^2\ (kg \cdot m^2)}{375} \cdot \frac{\Delta N\ (r/min)}{\Delta t\ (s) \cdot \eta_G}$

Braking mode

- $\tau\ (N \cdot m) \approx \frac{J\ (kg \cdot m^2)}{9.55} \cdot \frac{\Delta N\ (r/min) \cdot \eta_G}{\Delta t\ (s)}$
- $T\ (kgf \cdot m) \approx \frac{GD^2\ (kg \cdot m^2)}{375} \cdot \frac{\Delta N\ (r/min) \cdot \eta_G}{\Delta t\ (s)}$

(5) Acceleration time

- $t_{ACC}\ (s) \approx \frac{J_1 + J_2 / \eta_G\ (kg \cdot m^2)}{\tau_M - \tau_L / \eta_G\ (N \cdot m)} \cdot \frac{\Delta N\ (r/min)}{9.55}$
- $t_{ACC}\ (s) \approx \frac{GD_1{}^2 + GD_2{}^2 / \eta_G\ (kg \cdot m^2)}{T_M - T_L / \eta_G\ (kgf \cdot m)} \cdot \frac{\Delta N\ (r/min)}{375}$

(6) Deceleration time

- $t_{DEC}\ (s) \approx \frac{J_1 + J_2 \cdot \eta_G\ (kg \cdot m^2)}{\tau_M - \tau_L \cdot \eta_G\ (N \cdot m)} \cdot \frac{\Delta N\ (r/min)}{9.55}$
- $t_{DEC}\ (s) \approx \frac{GD_1{}^2 + GD_2{}^2 \cdot \eta_G\ (kg \cdot m^2)}{T_M - T_L \cdot \eta_G\ (kgf \cdot m)} \cdot \frac{\Delta N\ (r/min)}{375}$

App. F Allowable Current of Insulated Wires

The tables below list the allowable current of IV wires, HIV wires, and 600 V cross-linked polyethylene insulated wires.

■ IV wires (Maximum allowable temperature: 60°C)

Table F.1 (a) Allowable Current of Insulated Wires

Wire size (mm^2)	Allowable current reference value (up to 30°C) Io (A)	Aerial wiring					Wiring in the duct (Max. 3 wires in one duct)			
		35°C (Io×0.91) (A)	40°C (Io×0.82) (A)	45°C (Io×0.71) (A)	50°C (Io×0.58) (A)	55°C (Io×0.40) (A)	35°C (Io×0.63) (A)	40°C (Io×0.57) (A)	45°C (Io×0.49) (A)	50°C (Io×0.40) (A)
2.0	27	24	22	19	15	11	17	15	13	10
3.5	37	33	30	26	21	15	23	21	18	14
5.5	49	44	40	34	28	20	30	27	24	19
8.0	61	55	50	43	35	25	38	34	29	24
14	88	80	72	62	51	36	55	50	43	35
22	115	104	94	81	66	47	72	65	56	46
38	162	147	132	115	93	66	102	92	79	64
60	217	197	177	154	125	88	136	123	106	86
100	298	271	244	211	172	122	187	169	146	119
150	395	359	323	280	229	161	248	225	193	158
200	469	426	384	332	272	192	295	267	229	187
250	556	505	455	394	322	227	350	316	272	222
325	650	591	533	461	377	266	409	370	318	260
400	745	677	610	528	432	305	469	424	365	298
500	842	766	690	597	488	345	530	479	412	336
2 x 100	497	452	407	352	288	203	313	283	243	198
2 x 150	658	598	539	467	381	269	414	375	322	263
2 x 200	782	711	641	555	453	320	492	445	383	312
2 x 250	927	843	760	658	537	380	584	528	454	370
2 x 325	1083	985	888	768	628	444	682	617	530	433
2 x 400	1242	1130	1018	881	720	509	782	707	608	496
2 x 500	1403	1276	1150	996	813	575	883	799	687	561

■ HIV wires (Maximum allowable temperature: 75°C)

Table F.1 (b) Allowable Current of Insulated Wires

Wire size (mm^2)	Allowable current reference value (up to 30°C) Io (A)	Aerial wiring					Wiring in the duct (Max. 3 wires in one duct)			
		35°C (Io×0.91) (A)	40°C (Io×0.82) (A)	45°C (Io×0.71) (A)	50°C (Io×0.58) (A)	55°C (Io×0.40) (A)	35°C (Io×0.63) (A)	40°C (Io×0.57) (A)	45°C (Io×0.49) (A)	50°C (Io×0.40) (A)
2.0	32	31	29	27	24	22	21	20	18	17
3.5	45	42	39	37	33	30	29	27	25	23
5.5	59	56	52	49	44	40	39	36	34	30
8.0	74	70	65	61	55	50	48	45	42	38
14	107	101	95	88	80	72	70	66	61	55
22	140	132	124	115	104	94	92	86	80	72
38	197	186	174	162	147	132	129	121	113	102
60	264	249	234	217	197	177	173	162	151	136
100	363	342	321	298	271	244	238	223	208	187
150	481	454	426	395	359	323	316	296	276	248
200	572	539	506	469	426	384	375	351	328	295
250	678	639	600	556	505	455	444	417	389	350
325	793	747	702	650	591	533	520	487	455	409
400	908	856	804	745	677	610	596	558	521	469
500	1027	968	909	842	766	690	673	631	589	530
2 x 100	606	571	536	497	452	407	397	372	347	313
2 x 150	802	756	710	658	598	539	526	493	460	414
2 x 200	954	899	844	782	711	641	625	586	547	492
2 x 250	1130	1066	1001	927	843	760	741	695	648	584
2 x 325	1321	1245	1169	1083	985	888	866	812	758	682
2 x 400	1515	1428	1341	1242	1130	1018	993	931	869	782
2 x 500	1711	1613	1515	1403	1276	1150	1122	1052	982	883

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■ 600 V Cross-linked Polyethylene Insulated wires (Maximum allowable temperature: 90°C)

Table F.1 (c) Allowable Current of Insulated Wires

Wire size (mm^2)	Allowable current reference value (up to 30°C) Io (A)	Aerial wiring					Wiring in the duct (Max. 3 wires in one duct)			
		35°C (Io×0.91) (A)	40°C (Io×0.82) (A)	45°C (Io×0.71) (A)	50°C (Io×0.58) (A)	55°C (Io×0.40) (A)	35°C (Io×0.63) (A)	40°C (Io×0.57) (A)	45°C (Io×0.49) (A)	50°C (Io×0.40) (A)
2.0	38	36	34	32	31	29	25	24	22	21
3.5	52	49	47	45	42	39	34	33	31	29
5.5	69	66	63	59	56	52	46	44	41	39
8.0	86	82	78	74	70	65	57	54	51	48
14	124	118	113	107	101	95	82	79	74	70
22	162	155	148	140	132	124	108	103	97	92
38	228	218	208	197	186	174	152	145	137	129
60	305	292	279	264	249	234	203	195	184	173
100	420	402	384	363	342	321	280	268	253	238
150	556	533	509	481	454	426	371	355	335	316
200	661	633	605	572	539	506	440	422	398	375
250	783	750	717	678	639	600	522	500	472	444
325	916	877	838	793	747	702	611	585	552	520
400	1050	1005	961	908	856	804	700	670	633	596
500	1187	1136	1086	1027	968	909	791	757	715	673
2 x 100	700	670	641	606	571	536	467	447	422	397
2 x 150	927	888	848	802	756	710	618	592	559	526
2 x 200	1102	1055	1008	954	899	844	735	703	664	625
2 x 250	1307	1251	1195	1130	1066	1001	871	834	787	741
2 x 325	1527	1462	1397	1321	1245	1169	1018	974	920	866
2 x 400	1751	1676	1602	1515	1428	1341	1167	1117	1055	993
2 x 500	1978	1894	1809	1711	1613	1515	1318	1262	1192	1122

App. G Replacement Information

When replacing Fuji conventional inverter series (FRENIC5000G9S/P9S, FRENIC5000G11S/P11S) with the FRENIC-MEGA series, refer to the replacement information given in this section.

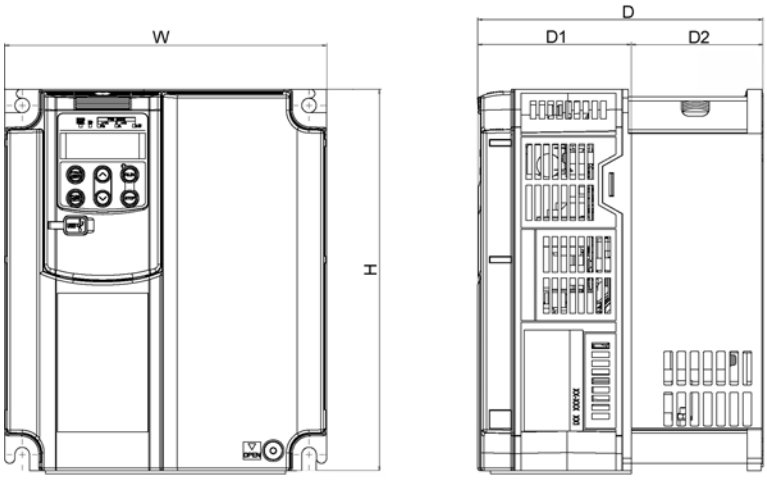
G.1 External dimensions comparison tables

Below is a guide that helps in using the comparison tables on the following pages.

- Mounting area /MEGA (%) — Allows comparing the mounting area required for the FRENIC-MEGA series with that for the conventional inverter series in percentage, assuming the area for the FRENIC-MEGA series to be 100%. If this value is greater than 100%, it means that the mounting area required for the FRENIC-MEGA series is smaller than that of other series.

- Volume/MEGA (%) — Allows comparing the volume of the FRENIC-MEGA series with that of the conventional inverter series in percentage, assuming the volume of the FRENIC-MEGA series to be 100%. If this value is greater than 100%, it means that the volume of the FRENIC-MEGA is smaller than that of other series.

- In the FRENIC-MEGA columns, dimensions in shaded boxes ( ) denote that they are smaller than those of FRENIC5000G9S/P9S and FRENIC5000G11S/P11S series.
- In the FRENIC-MEGA columns, underlined and bolded dimensions denote that they are larger than those of FRENIC5000G11S and FRENIC5000P11S series.



Standard models

FRENIC-MEGA HD mode vs. FRENIC5000G9S

Power supply voltage	Nominal applied motor (kW)	FRENIC-MEGA HD mode							FRENIC5000G9S								
		External dimensions (mm)					Mounting area	Volume	External dimensions (mm)					Mounting area		Volume	
		W	H	D	D1	D2	m^2 ($X10^{-2}$)	m^3 ($X10^{-3}$)	W	H	D	D1	D2	m^2 ($X10^{-2}$)	/MEGA (%)	m^3 ($X10^{-3}$)	/MEGA (%)
Three-phase 200 V	0.4	110	260	**132**	**113**	19	2.9	**3.8**	110	260	115	93	22	2.9	100.0%	3.3	87.1%
	0.75	110	260	**145**	**113**	32	2.9	**4.1**	110	260	130	93	37	2.9	100.0%	3.7	89.7%
	1.5	150	260	145	**113**	32	3.9	5.7	150	260	145	93	52	3.9	100.0%	5.7	100.0%
	2.2	150	260	145	**113**	32	3.9	5.7	150	260	145	93	52	3.9	100.0%	5.7	100.0%
	3.7	150	260	145	**113**	32	3.9	5.7	150	260	145	93	52	3.9	100.0%	5.7	100.0%
	5.5	220	260	195	**105**	90	5.7	11.2	220	260	195	98	97	5.7	100.0%	11.2	100.0%
	7.5	220	260	195	**105**	90	5.7	11.2	220	260	195	98	97	5.7	100.0%	11.2	100.0%
	11	220	260	195	**105**	90	5.7	11.2	250	400	195	99	96	10.0	174.8%	19.5	174.8%
	15	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	18.5	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	22	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	30	320	550	**255**	115	**140**	17.6	44.9	340	550	245	140	105	18.7	106.3%	45.8	102.1%
	37	355	615	**270**	115	**155**	21.8	**58.9**	375	615	245	140	105	23.1	105.6%	56.5	95.9%
	45	355	740	**270**	115	**155**	26.3	**70.9**	375	750	245	140	105	28.1	107.1%	68.9	97.1%
	55	355	740	270	115	**155**	26.3	70.9	375	780	270	155	115	29.3	111.3%	79.0	111.3%
Three-phase 400 V	0.4	110	260	**132**	**113**	19	2.9	**3.8**	110	260	130	93	37	2.9	100.0%	3.7	98.5%
	0.75	110	260	145	**113**	32	2.9	4.1	150	260	145	93	52	3.9	136.4%	5.7	136.4%
	1.5	150	260	145	**113**	32	3.9	5.7	150	260	145	93	52	3.9	100.0%	5.7	100.0%
	2.2	150	260	145	**113**	32	3.9	5.7	150	260	145	93	52	3.9	100.0%	5.7	100.0%
	3.7	150	260	145	**113**	32	3.9	5.7	150	260	145	93	52	3.9	100.0%	5.7	100.0%
	5.5	220	260	195	**105**	90	5.7	11.2	220	260	195	98	97	5.7	100.0%	11.2	100.0%
	7.5	220	260	195	**105**	90	5.7	11.2	220	260	195	98	97	5.7	100.0%	11.2	100.0%
	11	220	260	195	**105**	90	5.7	11.2	250	400	195	99	96	10.0	174.8%	19.5	174.8%
	15	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	18.5	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	22	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	30	320	550	**255**	115	**140**	17.6	44.9	340	550	245	140	105	18.7	106.3%	45.8	102.1%
	37	320	550	**255**	115	**140**	17.6	44.9	375	550	245	140	105	20.6	117.2%	50.5	112.6%
	45	355	615	**270**	115	**155**	21.8	58.9	375	675	245	140	105	25.3	115.9%	62.0	105.2%
	55	355	675	**270**	115	**155**	24.0	**64.7**	375	675	245	140	105	25.3	105.6%	62.0	95.9%
	75	355	740	270	115	**155**	26.3	70.9	375	780	270	155	115	29.3	111.3%	79.0	111.3%
	90	530	740	315	135	**180**	39.2	123.5	530	740	315	190	125	39.2	100.0%	123.5	100.0%
	110	530	740	315	135	**180**	39.2	123.5	530	740	315	190	125	39.2	100.0%	123.5	100.0%
	132	530	1000	360	180	**180**	53.0	190.8	530	1000	360	220	140	53.0	100.0%	190.8	100.0%
	160	530	1000	360	180	**180**	53.0	190.8	530	1000	360	220	140	53.0	100.0%	190.8	100.0%
	200	680	1000	360	180	**180**	68.0	244.8	680	1000	360	245	115	68.0	100.0%	244.8	100.0%
	220	680	1000	360	180	**180**	68.0	244.8	680	1000	360	245	115	68.0	100.0%	244.8	100.0%

FRENIC-MEGA LD mode vs. FRENIC5000P9S

Power supply voltage	Nominal applied motor (kW)	FRENIC-MEGA LD mode							FRENIC5000P9S								
		External dimensions (mm)					Mounting area	Volume	External dimensions (mm)					Mounting area		Volume	
		W	H	D	D1	D2	m^2 ($X10^{-2}$)	m^3 ($X10^{-3}$)	W	H	D	D1	D2	m^2 ($X10^{-2}$)	/MEGA (%)	m^3 ($X10^{-3}$)	/MEGA (%)
Three-phase 200 V	5.5	-	-	-	-	-	-	-	220	260	195	98	97	5.7	-	11.2	-
	7.5	220	260	195	**105**	90	5.7	11.2	220	260	195	98	97	5.7	100.0%	11.2	100.0%
	11	220	260	195	**105**	90	5.7	11.2	220	260	195	98	97	5.7	100.0%	11.2	100.0%
	15	220	260	195	**105**	90	5.7	11.2	250	400	195	99	96	10.0	174.8%	19.5	174.8%
	18.5	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	22	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	30	250	400	195	105	90	10.0	19.5	340	550	245	140	105	18.7	187.0%	45.8	234.9%
	37	320	550	**255**	115	**140**	17.6	44.9	340	550	245	140	105	18.7	106.3%	45.8	102.1%
	45	355	615	**270**	115	**155**	21.8	58.9	375	660	245	140	105	24.8	113.4%	60.6	102.9%
	55	355	740	**270**	115	**155**	26.3	**70.9**	375	750	245	140	105	28.1	107.1%	68.9	97.1%
	75	355	740	270	115	**155**	26.3	70.9	530	750	285	160	125	39.8	151.3%	113.3	159.7%
Three-phase 400 V	5.5	-	-	-	-	-	-	-	220	260	195	98	97	5.7	-	11.2	-
	7.5	220	260	195	**105**	90	5.7	11.2	220	260	195	98	97	5.7	100.0%	11.2	100.0%
	11	220	260	195	**105**	90	5.7	11.2	220	260	195	98	97	5.7	100.0%	11.2	100.0%
	15	220	260	195	**105**	90	5.7	11.2	250	400	195	99	96	10.0	174.8%	19.5	174.8%
	18.5	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	22	250	400	195	**105**	90	10.0	19.5	250	400	195	99	96	10.0	100.0%	19.5	100.0%
	30	250	400	195	105	90	10.0	19.5	340	550	245	140	105	18.7	187.0%	45.8	234.9%
	37	320	550	**255**	115	**140**	17.6	44.9	340	550	245	140	105	18.7	106.3%	45.8	102.1%
	45	320	550	**255**	115	**140**	17.6	44.9	375	550	245	140	105	20.6	117.2%	50.5	112.6%
	55	355	615	**270**	115	**155**	21.8	58.9	375	675	245	140	105	25.3	115.9%	62.0	105.2%
	75	355	675	**270**	115	**155**	24.0	**64.7**	375	675	245	140	105	25.3	105.6%	62.0	95.9%
	90	355	740	270	115	**155**	26.3	70.9	375	780	270	155	115	29.3	111.3%	79.0	111.3%
	110	530	740	315	135	**180**	39.2	123.5	530	740	315	190	125	39.2	100.0%	123.5	100.0%
	132	530	740	315	135	**180**	39.2	123.5	530	740	315	190	125	39.2	100.0%	123.5	100.0%
	160	530	1000	360	180	**180**	53.0	190.8	530	1000	360	220	140	53.0	100.0%	190.8	100.0%
	200	530	1000	360	180	**180**	53.0	190.8	530	1000	360	220	140	53.0	100.0%	190.8	100.0%
	220	680	1000	360	180	**180**	68.0	244.8	680	1000	360	245	115	68.0	100.0%	244.8	100.0%
	280	680	1000	360	180	**180**	68.0	244.8	680	1000	360	245	115	68.0	100.0%	244.8	100.0%

FRENIC-MEGA HD mode vs. FRENIC5000G11S

Power supply voltage	Nominal applied motor (kW)	FRENIC-MEGA HD mode							FRENIC5000G11S								
		External dimensions (mm)					Mounting area	Volume	External dimensions (mm)					Mounting area		Volume	
		W	H	D	D1	D2	m^2 ($X10^{-2}$)	m^3 ($X10^{-3}$)	W	H	D	D1	D2	m^2 ($X10^{-2}$)	/MEGA (%)	m^3 ($X10^{-3}$)	/MEGA (%)
Three-phase 200 V	0.2	–	–	–	–	–	–	–	110	260	130	93.5	36.5	2.9	–	3.7	–
	0.4	110	260	**132**	**113**	19	2.9	**3.8**	110	260	130	93.5	36.5	2.9	100.0%	3.7	98.5%
	0.75	110	260	145	**113**	32	2.9	4.1	110	260	145	93.5	51.5	2.9	100.0%	4.1	100.0%
	1.5	150	260	145	**113**	32	3.9	5.7	150	260	145	83.5	61.5	3.9	100.0%	5.7	100.0%
	2.2	150	260	145	**113**	32	3.9	5.7	150	260	145	83.5	61.5	3.9	100.0%	5.7	100.0%
	3.7	150	260	145	**113**	32	3.9	5.7	150	260	145	83.5	61.5	3.9	100.0%	5.7	100.0%
	5.5	220	260	195	**105**	90	5.7	11.2	220	260	195	91	104	5.7	100.0%	11.2	100.0%
	7.5	220	260	195	**105**	90	5.7	11.2	220	260	195	91	104	5.7	100.0%	11.2	100.0%
	11	220	260	195	**105**	90	5.7	11.2	250	400	195	89	106	10.0	174.8%	19.5	174.8%
	15	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	18.5	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	22	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	30	320	550	255	115	**140**	17.6	44.9	340	550	255	145	110	18.7	106.3%	47.7	106.3%
	37	355	615	270	115	**155**	21.8	58.9	375	615	270	145	125	23.1	105.6%	62.3	105.6%
	45	355	740	270	115	**155**	26.3	70.9	375	740	270	145	125	27.8	105.6%	74.9	105.6%
	55	355	740	270	115	**155**	26.3	70.9	375	740	270	145	125	27.8	105.6%	74.9	105.6%
Three-phase 400 V	0.2	–	–	–	–	–	–	–	110	260	130	93.5	36.5	2.9	–	3.7	–
	0.4	110	260	**132**	**113**	19	2.9	**3.8**	110	260	130	93.5	36.5	2.9	100.0%	3.7	98.5%
	0.75	110	260	145	**113**	32	2.9	4.1	110	260	145	93.5	51.5	2.9	100.0%	4.1	100.0%
	1.5	150	260	145	**113**	32	3.9	5.7	150	260	145	83.5	61.5	3.9	100.0%	5.7	100.0%
	2.2	150	260	145	**113**	32	3.9	5.7	150	260	145	83.5	61.5	3.9	100.0%	5.7	100.0%
	3.7	150	260	145	**113**	32	3.9	5.7	150	260	145	83.5	61.5	3.9	100.0%	5.7	100.0%
	5.5	220	260	195	**105**	90	5.7	11.2	220	260	195	91	104	5.7	100.0%	11.2	100.0%
	7.5	220	260	195	**105**	90	5.7	11.2	220	260	195	91	104	5.7	100.0%	11.2	100.0%
	11	220	260	195	**105**	90	5.7	11.2	250	400	195	89	106	10.0	174.8%	19.5	174.8%
	15	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	18.5	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	22	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	30	320	550	255	115	**140**	17.6	44.9	340	550	255	145	110	18.7	106.3%	47.7	106.3%
	37	320	550	255	115	**140**	17.6	44.9	375	550	270	145	125	20.6	117.2%	55.7	124.1%
	45	355	615	270	115	**155**	21.8	58.9	375	675	270	145	125	25.3	115.9%	68.3	115.9%
	55	355	675	270	115	**155**	24.0	64.7	375	675	270	145	125	25.3	105.6%	68.3	105.6%
	75	355	740	270	115	**155**	26.3	70.9	375	740	270	145	125	27.8	105.6%	74.9	105.6%
	90	530	740	315	135	**180**	39.2	123.5	530	740	315	175	140	39.2	100.0%	123.5	100.0%
	110	530	740	315	135	**180**	39.2	123.5	530	740	315	175	140	39.2	100.0%	123.5	100.0%
	132	530	1000	360	180	**180**	53.0	190.8	530	1000	360	220	140	53.0	100.0%	190.8	100.0%
	160	530	1000	360	180	**180**	53.0	190.8	530	1000	360	220	140	53.0	100.0%	190.8	100.0%
	200	680	1000	360	180	**180**	68.0	244.8	680	1000	360	220	140	68.0	100.0%	244.8	100.0%
	220	680	1000	360	180	**180**	68.0	244.8	680	1000	360	220	140	68.0	100.0%	244.8	100.0%

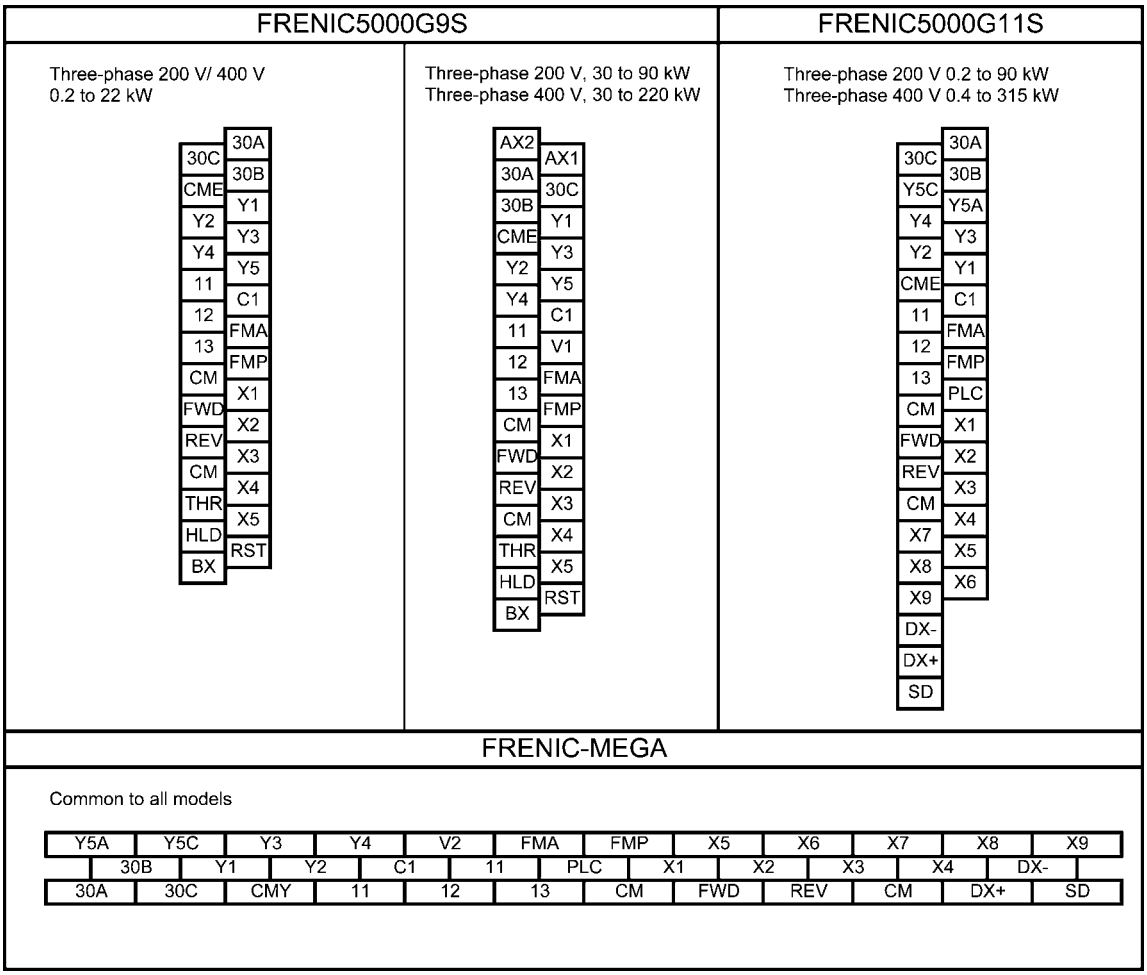
FRENIC-MEGA LD mode vs. FRENIC5000P11S

Power supply voltage	Nominal applied motor (kW)	FRENIC-MEGA LD mode							FRENIC5000P11S								
		External dimensions (mm)					Mounting area	Volume	External dimensions (mm)					Mounting area		Volume	
		W	H	D	D1	D2	m^2 ($X10^{-2}$)	m^3 ($X10^{-3}$)	W	H	D	D1	D2	m^2 ($X10^{-2}$)	/MEGA (%)	m^3 ($X10^{-3}$)	/MEGA (%)
Three-phase 200 V	5.5	–	–	–	–	–	–	–	220	260	195	91	104	5.7	–	11.2	–
	7.5	220	260	195	**105**	90	5.7	11.2	220	260	195	91	104	5.7	100.0%	11.2	100.0%
	11	220	260	195	**105**	90	5.7	11.2	220	260	195	91	104	5.7	100.0%	11.2	100.0%
	15	220	260	195	**105**	90	5.7	11.2	250	400	195	89	106	10.0	174.8%	19.5	174.8%
	18.5	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	22	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	30	250	400	195	105	90	10.0	19.5	340	550	255	145	110	18.7	187.0%	47.7	244.5%
	37	320	550	255	115	**140**	17.6	44.9	340	550	255	145	110	18.7	106.3%	47.7	106.3%
	45	355	615	270	115	**155**	21.8	58.9	375	615	270	145	125	23.1	105.6%	62.3	105.6%
	55	355	740	270	115	**155**	26.3	70.9	375	740	270	145	125	27.8	105.6%	74.9	105.6%
Three-phase 400 V	5.5	–	–	–	–	–	–	–	220	260	195	91	104	5.7	–	11.2	–
	7.5	220	260	195	**105**	90	5.7	11.2	220	260	195	91	104	5.7	100.0%	11.2	100.0%
	11	220	260	195	**105**	90	5.7	11.2	220	260	195	91	104	5.7	100.0%	11.2	100.0%
	15	220	260	195	**105**	90	5.7	11.2	250	400	195	89	106	10.0	174.8%	19.5	174.8%
	18.5	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	22	250	400	195	**105**	90	10.0	19.5	250	400	195	89	106	10.0	100.0%	19.5	100.0%
	30	250	400	195	105	90	10.0	19.5	340	550	255	145	110	18.7	187.0%	47.7	244.5%
	37	320	550	255	115	**140**	17.6	44.9	340	550	255	145	110	18.7	106.3%	47.7	106.3%
	45	320	550	255	115	**140**	17.6	44.9	375	550	270	145	125	20.6	117.2%	55.7	124.1%
	55	355	615	270	115	**155**	21.8	58.9	375	675	270	145	125	25.3	115.9%	68.3	115.9%
	75	355	675	270	115	**155**	24.0	64.7	375	675	270	145	125	25.3	105.6%	68.3	105.6%
	90	355	740	270	115	**155**	26.3	70.9	375	740	270	145	125	27.8	105.6%	74.9	105.6%
	110	530	740	315	135	**180**	39.2	123.5	530	740	315	175	140	39.2	100.0%	123.5	100.0%
	132	530	740	315	135	**180**	39.2	123.5	530	740	315	175	140	39.2	100.0%	123.5	100.0%
	160	530	1000	360	180	**180**	53.0	190.8	530	1000	360	220	140	53.0	100.0%	190.8	100.0%
	200	530	1000	360	180	**180**	53.0	190.8	530	1000	360	220	140	53.0	100.0%	190.8	100.0%
	220	680	1000	360	180	**180**	68.0	244.8	680	1000	360	220	140	68.0	100.0%	244.8	100.0%
	280	680	1000	360	180	**180**	68.0	244.8	680	1000	360	220	140	68.0	100.0%	244.8	100.0%

G.2 Terminal arrangements and symbols

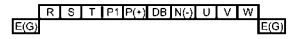
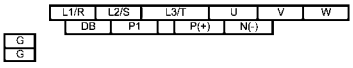
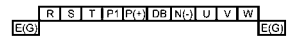
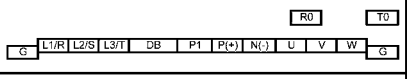
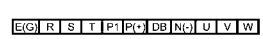
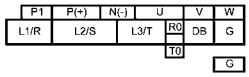
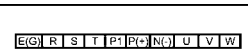
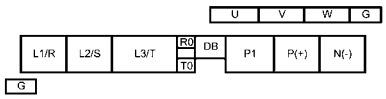
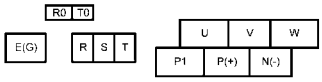
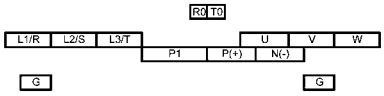
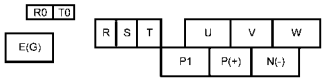
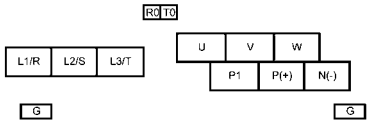
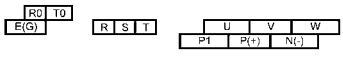
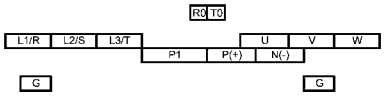
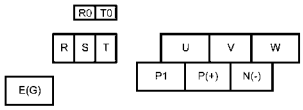
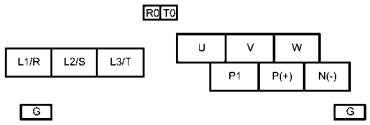
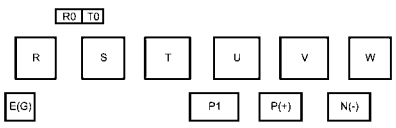
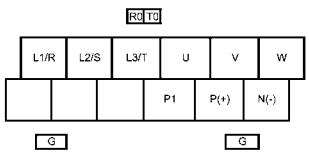
This section shows the difference in the terminal arrangements and their symbols between the FRENIC-MEGA series and the replaceable inverter series.

■ Control circuit terminals arrangement comparison



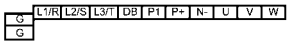
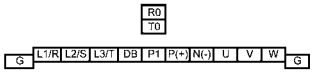
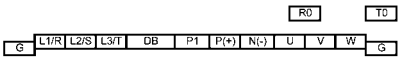
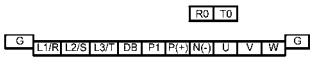
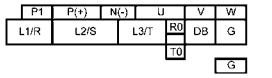
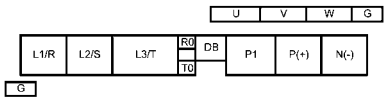
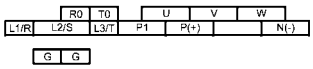
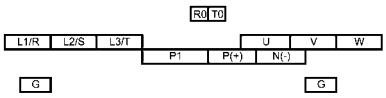
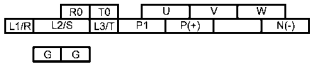
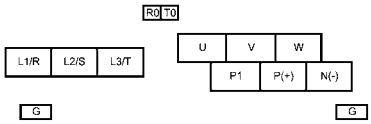
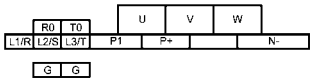
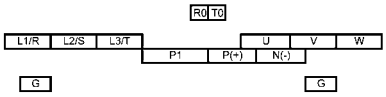
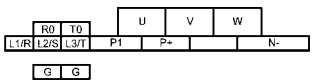
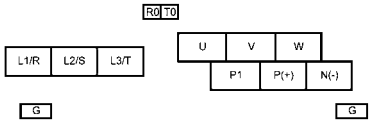
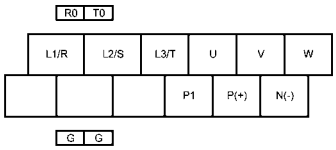
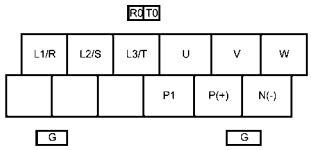
■ Main circuit terminals arrangement and screw sizes comparison

FRENIC5000G9S vs. FRENIC-MEGA

FRENIC5000G9S					FRENIC-MEGA			
Power supply voltage	Capacity (kW)	Main circuit	Other power supply		Capacity (kW)	Main circuit	Other power supply	
Three-phase 200 V/ 400 V	0.2 0.4 0.75	M3.5 M3.5 M3.5	- - -		0.4 0.75	M3.5 M3.5		
	1.5 2.2 3.7	M4 M4 M4	- - -		1.5 2.2 3.7	M4 M4 M4	M3.5 M3.5 M3.5	
	5.5 7.5	M5 M5	- -		5.5 7.5 11	M5 M5 M5	M3.5 M3.5 M3.5	
	11 15 18.5 22	M6 M6 M6 M6	- - - -		15 18.5 22	M6 M6 M6	M3.5 M3.5 M3.5	
Three-phase 200 V	30 37	M8 M8	M4 M4		30	M8	M3.5	
	45 55	M10 M10	M4 M4		37 45 55	M10 M10 M10	M3.5 M3.5 M3.5	
Three-phase 400 V	30 37 45 55	M8 M8 M8 M8	M4 M4 M4 M4		30 37 45 55	M8 M8 M8 M8	M3.5 M3.5 M3.5 M3.5	
	75 90 110 132	M10	M4		75 90 110	M10	M3.5	
	160 200 220	M12	M4		132 160 200 220	M12	M3.5	

App.

FRENIC5000G11S vs. FRENIC-MEGA

FRENIC5000G11S					FRENIC-MEGA			
Power supply voltage	Capacity (kW)	Main circuit	Other power supply		Capacity (kW)	Main circuit	Other power supply	
Three-phase 200 V/ 400 V	0.2 0.4 0.75	M3.5 M3.5 M3.5	— — —		0.4 0.75	M3.5 M3.5		
	1.5 2.2 3.7	M4 M4 M4	M3.5 M3.5 M3.5		1.5 2.2 3.7	M4 M4 M4	M3.5 M3.5 M3.5	
	5.5 7.5	M5 M5	M3.5 M3.5		5.5 7.5 11	M5 M5 M5	M3.5 M3.5 M3.5	
	11 15 18.5 22	M6 M6 M6 M6	M3.5 M3.5 M3.5 M3.5		15 18.5 22	M6 M6 M6	M3.5 M3.5 M3.5	
Three-phase 200 V	30	M8	M4		30	M8	M3.5	
	37 45 55	M10 M10 M10	M4 M4 M4		37 45 55	M10 M10 M10	M3.5 M3.5 M3.5	
Three-phase 400 V	30 37 45 55	M8 M8 M8 M8	M4 M4 M4 M4		30 37 45 55	M8 M8 M8 M8	M3.5 M3.5 M3.5 M3.5	
	75 90 110	M10	M4		75 90 110	M10	M3.5	
	132 160 200 220	M12	M4		132 160 200 220	M12	M3.5	

■ Terminal symbols and functions comparison

FRENIC5000G9S/P9S vs. FRENIC-MEGA

Classification	FRENIC5000G9S/P9S		FRENIC-MEGA	
	Symbols	Name	Symbols	Name
Main circuit	R, S, T	Main circuit power inputs	L1/R, L2/S, L3/T	Main circuit power inputs
	R0, T0	Auxiliary power input for the control circuit (22 kW or below: option)	R0, T0	Auxiliary power input for the control circuit
	U, V, W	Inverter outputs	U, V, W	Inverter outputs
	P1, P(+)	DC reactor connection	P1, P(+)	DC reactor connection
	P(+), N(-)	Braking unit connection	P(+), N(-)	DC link bus
	P(+), DB	Braking resistor connection (7.5 kW or below)	P(+), DB	Braking resistor (22 kW or below)
	⏚G	Grounding for inverter	⏚G	Grounding for inverter
Analog input	13	Power supply for the potentiometer	13	Power supply for the potentiometer
	12	Analog setting voltage input	12	Analog setting voltage input
	C1	Analog setting current input	C1	Analog setting current input
	V1	Voltage input for auxiliary setting (22 kW or below: option)	V2	Analog setting voltage input
	11	Analog common	11 (2 terminals)	Analog common
Digital input	FWD	Run forward command	FWD	Run forward command
	REV	Run reverse command	REV	Run reverse command
	X1 (Digital input 1)	Select multi-frequency (7 steps)	X1 (Digital input 1) ***SS1***	Select multi-frequency
		UP (Increase output frequency)	***UP***	UP (Increase output frequency)
	X2 (Digital input 2)	Select multi-frequency	X2 (Digital input 2) ***SS2***	Select multi-frequency
		DOWN (Decrease output frequency)	***DOWN***	DOWN (Decrease output frequency)
	X3 (Digital input 3)	Select multi-frequency	X3 (Digital input 3) ***SS4***	Select multi-frequency
		Switch to commercial power (50 Hz)	***SW50***	Switch to commercial power (50 Hz)
		Switch to commercial power (60 Hz)	***SW60***	Switch to commercial power (60 Hz)
	X4 (Digital input 4)	Select ACC/DEC time	X4 (Digital input 4) ***RT1***	Select ACC/DEC time (2 steps)
		Select current input	***Hz2/Hz1***	Select frequency command 2/1
		Enable DC braking	***DCBRK***	Enable DC braking
	X5 (Digital input 5)	Select ACC/DEC time	X5 (Digital input 5) ***RT2***	Select ACC/DEC time (4 steps)
		Select 2nd V/f	***M2***	Select motor 2
		Enable data change with keypad	***WE-KP***	Enable data change with keypad
	CM	Digital input common	CM (2 terminals)	Digital input common
	HLD	Enable 3-wire operation	X1 to X9, FWD, REV ***HLD***	Enable 3-wire operation
	BX	Coast to a stop	X1 to X9, FWD, REV ***BX***	Coast to a stop
	RST	Reset alarm	X1 to X9, FWD, REV ***RST***	Reset alarm
	THR	Enable external alarm trip	X1 to X9, FWD, REV ***THR***	Enable external alarm trip
Analog ouptut	FMA	Analog monitor	FMA	Analog monitor
	(11)	(Analog common)	(11)	(Analog common)
Pulse output	FMP	Pulse monitor (Pulse waveform output)	FMP	Pulse monitor
	(CM)	(Digital common)	(CM)	Digital common

App.

Classification	FRENIC5000G9S/P9S		FRENIC-MEGA	
	Symbols	Name	Symbols	Name
Transistor output	Y1	Transistor output 1	Y1	Transistor output 1
	Y2	Transistor output 2	Y2	Transistor output 2
	Y3	Transistor output 3	Y3	Transistor output 3
	Y4	Transistor output 4	Y4	Transistor output 4
	Y5	Transistor output 5	Y5A, Y5C	General purpose relay output
	CME	Transistor output common	CMY	Transistor output common
	(RUN)	Inverter running	***RUN***	Inverter running
	(FAR)	Frequency (speed) arrival signal	***FAR***	Frequency (speed) arrival signal
	(FDT)	Frequency (speed) detected	***FDT***	Frequency (speed) detected
	(LU)	Undervoltage detected (Inverter stopped)	***LU***	Undervoltage detected (Inverter stopped)
	(TL)	Torque limiting	***IOL***	Inverter output limiting
	(RES)	Auto-restarting after momentary power failure	***IPF***	Auto-restarting after momentary power failure
	(OL)	Motor overload early warning	***OL***	Motor overload early warning
	(KP)	Keypad operation enabled	***KP***	Keypad operation enabled
	(STP)	Inverter stopped	***RUN***	Inverter running (negative logic setting)
	(TU)	Time-up signal for pattern operation	—	
	(TO)	Cycle completion signal for pattern operation	—	
	(STG1)	Pattern operation stage No. indication 1	—	
	(STG2)	Pattern operation stage No. indication 2	—	
	(STG4)	Pattern operation stage No. indication 4	—	
	(AL1)	Alarm indication 1	—	
	(AL2)	Alarm indication 2	—	
	(AL4)	Alarm indication 4	—	
	(AL8)	Alarm indication 8	—	
	(TRY)	Auto-resetting	***TRY***	Auto-resetting
Relay output	30A, 30B, 30C	Alarm relay output (for any error)	30A, 30B, 30C	Alarm relay output (for any error)
	AX1, AX2	Power supply side contactor open command (30 kW or above)	(Y5A, Y5C) ***AX***	Select ***AX*** terminal function (For MC on primary side)

FRENIC5000G11S/P11S vs. FRENIC-MEGA

Classification	FRENIC5000G11S/P11S		FRENIC-MEGA	
	Symbols	Name	Symbols	Name
Main circuit	L1/R, L2/S, L3/T	Main circuit power terminal	L1/R, L2/S, L3/T	Main circuit power inputs
	R0, T0	Auxiliary control-power input terminal	R0, T0	Auxiliary power input for the control circuit
	U, V, W	Inverter output terminal	U, V, W	Inverter outputs
	P1, P(+)	DC reactor connecting terminal	P1, P(+)	DC reactor connection
	P(+), N(-)	DC link circuit terminal	P(+), N(-)	DC link bus
	P(+), DB	External braking resistor connecting terminal (Up to 22 kW)	P(+), DB	Braking resistor
	⏚G	Inverter ground terminal	⏚G	Grounding for inverter
Analog input	13	Potentiometer power supply	13	Power supply for the potentiometer
	12	Voltage input	12	Analog setting voltage input
	C1	Current input	C1	Analog setting current input
	11	Analog input common	11 (2 terminals)	Analog common
Digital input	FWD	Forward operation/stop command	FWD	Run forward command
	REV	Reverse operation/stop command	REV	Run reverse command
	X1	Digital input 1	X1	Digital input 1
	X2	Digital input 2	X2	Digital input 2
	X3	Digital input 3	X3	Digital input 3
	X4	Digital input 4	X4	Digital input 4
	X5	Digital input 5	X5	Digital input 5
	X6	Digital input 6	X6	Digital input 6
	X7	Digital input 7	X7	Digital input 7
	X8	Digital input 8	X8	Digital input 8
	X9	Digital input 9	X9	Digital input 9
	CM	Common terminal	CM (2 terminals)	Digital input common
	PLC	PLC signal power	PLC	PLC signal power
	(SS1)	Multistep frequency selection	***SS1***	Select multi-frequency
	(SS2)		***SS2***	
	(SS4)		***SS4***	
	(SS8)		***SS8***	
	(RT1)	Acceleration and deceleration time selection (2 steps)	***RT1***	Select ACC/DEC time (2 steps)
	(RT2)	Acceleration and deceleration time selection (4 steps)	***RT2***	Select ACC/DEC time (4 steps)
	(HLD)	Self-hold selection	***HLD***	Enable 3-wire operation
	(BX)	Coast-to-stop command	***BX***	Coast to a stop
	(RST)	Alarm reset	***RST***	Reset alarm
	(THR)	External alarm	***THR***	Enable external alarm trip
	(JOG)	Jogging	***JOG***	Ready for jogging
	(Hz2/Hz1)	Frequency setting 2/ frequency setting 1	***Hz2/Hz1***	Select frequency command 2/1
	(Hz1/Hz2)	Frequency setting 2/ frequency setting 1	***Hz2/Hz1***	Select frequency command 2/1 (negative logic setting)
	(M2/M1)	Motor 2/motor 1	***M2***	Select motor 2
	(DCBRK)	DC injection brake command	***DCBRK***	Enable DC braking
	(TL2/TL1)	Torque limit 2/torque limit 1	***TL2/TL1***	Select torque limiter level 2/1
	(SW50)	Switching operation from line to inverter (50 Hz)	***SW50***	Switch to commercial power (50 Hz)
	(SW60)	Switching operation from line to inverter (60 Hz)	***SW60***	Switch to commercial power (60 Hz)

Classifi-cation	FRENIC5000G11S/P11S		FRENIC-MEGA	
	Symbols	Name	Symbols	Name
Digital input	(UP)	UP command	***UP***	UP (Increase output frequency)
	(DOWN)	DOWN command	***DOWN***	DOWN (Decrease output frequency)
	(WE-KP)	Edit permission command (data change permission)	***WE-KP***	Enable data change with keypad
	(Hz/PID)	PID control cancellation	***Hz/PID***	Cancel PID control
	(IVS)	Forward/inverse switching	***IVS***	Switch normal/inverse operation
	(IL)	Interlock	***IL***	Interlock
	(Hz/TRQ)	Torque control cancellation	—	
	(LE)	Link operation selection (Standard: RS-485, Option: BUS)	***LE***	Enable communications link via RS-485 or fieldbus (option)
	(U-DI)	Universal DI	***U-DI***	Universal DI
	(STM)	Start characteristics selection	***STM***	Enable auto search for idling motor speed at starting
	(STOP1)	Forced stop command	***STOP***	Force to stop
	(STOP2)	Forced stop with Deceleration time 4		
	(PG/Hz)	SY-PG enable	***PG/Hz***	Switch speed feedback control
	(ZERO)	Zero speed command with PG option	—	
	(EXITE)	Pre-exciting command with PG option	***EXITE***	Pre-excitation
	(Hz/LSC)	Line speed control cancellation	—	
	(LSC-HID)	Line speed frequency memory	—	
Analog output	FMA	Analog monitor	FMA	Analog monitor
	(11)	(Analog input common)	(11)	(Analog common)
Pulse output	FMP	Pulse rate monitor (Pulse waveform output)	FMP	Pulse monitor
	(CM)	(Common terminal)	(CM)	(Digital common)
Transistor output	Y1	Transistor output 1	Y1	Transistor output 1
	Y2	Transistor output 2	Y2	Transistor output 2
	Y3	Transistor output 3	Y3	Transistor output 3
	Y4	Transistor output 4	Y4	Transistor output 4
	CME	Transistor output common	CMY	Transistor output common
	(RUN)	Inverter running	***RUN***	Inverter running
	(FAR)	Frequency equivalence signal	***FAR***	Frequency (speed) arrival signal
	(FDT)	Frequency level detection	***FDT***	Frequency (speed) detected
	(FDT2)	2nd frequency level detection	***FDT2***	Frequency (speed) detected 2
	(LU)	Undervoltage detection signal	***LU***	Undervoltage detected (Inverter stopped)
	(B/D)	Torque polarity	***B/D***	Torque polarity detected
	(TL)	Torque limiting	***IOL***	Inverter output limiting
	(IPF)	Auto-restarting	***IPF***	Auto-restarting after momentary power failure
	(OL)	Overload early warning	***OL***	Motor overload early warning
	(OL2)	2nd overload early warning	—	
	(KP)	KEYPAD operation mode	***KP***	Keypad operation enabled
	(STP)	Inverter stopping	***RUN***	Inverter running (negative logic setting)
	(RDY)	Ready output	***RDY***	Inverter ready to run
	(SW88)	Line/inverter changeover (for 88)	***SW88***	Switch motor drive source between commercial power and inverter output
	(SW52-2)	Line/inverter changeover (for 52-2)	***SW52-2***	Switch motor drive source between commercial power and inverter output

Classification	FRENIC5000G11S/P11S		FRENIC-MEGA	
	Symbols	Name	Symbols	Name
Transistor output	(SW52-1)	Line/inverter changeover (for 52-1)	***SW52-1***	Switch motor drive source between commercial power and inverter output
	(SWM2)	Motor 1/motor 2	***SWM2***	Motor 2 selected
	(AX)	Terminal AX function	***AX***	Select ***AX*** terminal function (For MC on primary side)
	(TU)	Time-up signal for pattern operation	—	
	(TO)	Cycle completion signal for pattern operation	—	
	(STG1)	Pattern operation stage No. indication 1	—	
	(STG2)	Pattern operation stage No. indication 2	—	
	(STG4)	Pattern operation stage No. indication 4	—	
	(AL1)	Alarm indication 1	—	
	(AL2)	Alarm indication 2	—	
	(AL4)	Alarm indication 4	—	
	(AL8)	Alarm indication 8	—	
	(FAN)	Fan operation signal	***FAN***	Cooling fan in operation
	(TRY)	Auto-resetting	***TRY***	Auto-resetting
	(U-DO)	Universal DO	***U-DO***	Universal DO
	(OH)	Overheat early warning	***OH***	Heat sink overheat early warning
	(SY)	Synchronization completed by synchronous operation card	—	
	(LIFE)	Lifetime alarm	***LIFE***	Lifetime alarm
	(C1OFF)	Terminal [C1] off signal	***C1OFF***	Terminal [C1] wire break
	(DNZS)	Speed existence signal	***DNZS***	Speed valid
	(DSAG)	Speed agreement	***DSAG***	Speed agreement
	(PG-ABN)	PG error signal	***PG-ERR***	PG error detected
	(TL2)	Torque limiting (signal with delay)	—	
Relay output	Y5A, Y5C	Multipurpose-signal relay output	Y5A, Y5C	General purpose relay output
	30A, 30B, 30C	Alarm output for any fault	30A, 30B, 30C	Alarm relay output (for any error)
Communication	DX+, DX-, SD	RS-485 communication input-output	DX+, DX-, SD	RS-485 communications port 2

G.3 Function codes

This section describes the replacement information related to function codes that are required when replacing the conventional inverter series (e.g., FRENIC5000G9S/P9S and FRENIC5000G11S/P11S) with the FRENIC-MEGA series. It also provides the conversion table for the torque boost setting.

[1] FRENIC5000G9S vs. FRENIC-MEGA p. A-36
[2] FRENIC5000P9S vs. FRENIC-MEGA p. A-47
[3] FRENIC5000G11S vs. FRENIC-MEGA p. A-48
[4] FRENIC5000P11S vs. FRENIC-MEGA p. A-66

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[1] FRENIC5000G9S vs. FRENIC-MEGA

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
Fundamental functions							
00	Frequency Command	0: ▲ / ▼ keys on keypad	0	F01	Frequency Command 1	0: ▲ / ▼ keys on keypad	0
		1: Voltage input (0 to 10 VDC, Terminals [12] + [V1]), when [V1] is not used.		F01	Frequency Command 1	1: Voltage input to terminal [12] (-10 to +10 VDC)	0
		1: Voltage input (0 to 10 VDC, Terminals [12] + [V1]), when [V1] is used.		F01	Frequency Command 1	1: Voltage input to terminal [12] (-10 to +10 VDC)	0
				E63	Terminal [V2] Extended Function	1: Auxiliary frequency command 1	0
				C45	Analog Input Adjustment for [V2] (Polarity)	0: Bipolar	1
		2: Sum of voltage and current inputs (Terminals [12] + [V1] + [C1]), when [V1] is not used.		F01	Frequency Command 1	3: Sum of voltage and current inputs to terminals [12] and [C1]	0
		2: Sum of voltage and current inputs (Terminals [12] + [V1] + [C1]), when [V1] is used.		F01	Frequency Command 1	3: Sum of voltage and current inputs to terminals [12] and [C1]	0
				E63	Terminal [V2] Extended Function	1: Auxiliary frequency command 1	0
				C45	Analog Input Adjustment for [V2] (Polarity)	0: Bipolar	0
01	Operation Method	0: RUN / STOP keys on keypad	0	F02	Operation Method	0: RUN/STOP keys on keypad (Motor rotational direction specified by terminal command ***FWD***/***REV***)	2
						2: RUN/STOP keys on keypad (forward)	
						3: RUN/STOP keys on keypad (reverse)	
		1: Terminal command ([FWD] or [REV])				1: Terminal command ***FWD*** or ***REV***	
02	Maximum Frequency	G9S: 50 to 400 Hz, P9S: 50 to 120 Hz	60	F03	Maximum Frequency 1	25.0 to 500.0 Hz	60.0
03	Base Frequency 1	G9S: 50 to 400 Hz, P9S: 50 to 120 Hz	50	F04	Base Frequency 1	25.0 to 500.0 Hz	50.0
04	Rated Voltage 1	0: Output a voltage in proportion to input voltage	200 (200 V class series) 400 (400 V class series)	F05	Rated Voltage at Base Frequency 1	0: Output a voltage in proportion to input voltage	200 (200 V class series) 400 (400 V class series)
						80 to 240 V: Output an AVR-controlled voltage (for 200 V class series) 160 to 500 V: Output an AVR-controlled voltage (for 400 V class series)	
	(Maximum Output Voltage 1)	80 to 240 V: (200 V class series), 320 to 480 V: (400 V class series)		F06	Maximum Output Voltage 1	80 to 240 V: Output an AVR-controlled voltage (for 200 V class series) 160 to 500 V: Output an AVR-controlled voltage (for 400 V class series)	200 (200 V class series) 400 (400 V class series)
05	Acceleration Time 1	0.01 to 3600 s	6.0/20.0	F07	Acceleration Time 1	0.00 to 6000 s	6.00/20.00
06	Deceleration Time 1	0.00: Coast-to-stop	6.0/20.0	F08	Deceleration Time 1	0.00	6.00/20.00
		0.01 to 3600 s				0.01 to 6000 s	

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
07	Torque Boost 1	0.0: Auto torque boost 0.1 to 0.9: Variable torque load 1.0 to 1.9: Proportional torque load 2.0 to 20.0: Constant torque load (75 = 0 when the auto-energy saving operation is disabled)		F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	2: Auto torque boost	1
				F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	0: Variable torque load	1
				F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
				F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	1: Constant torque load	1
				F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
		0.0: Auto torque boost 0.1 to 0.9: Variable torque load 1.0 to 1.9: Proportional torque load 2.0 to 20.0: Constant torque load (75 = 1 when the auto-energy saving operation is enabled)		F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	5: Auto energy saving (Auto torque boost during ACC/DEC)	1
				F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	3: Auto energy saving (Variable torque load during ACC/DEC)	1
				F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
				F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	4: Auto energy saving (Constant torque load during ACC/DEC)	1
				F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
08	Electronic Thermal Overload Protection for Motor (Mode selection)	0: Disable	1	F11	Electronic Thermal Overload Protection for Motor 1 (Overload detection level)	0.00: Disable	Motor rated current
		1: For a general-purpose motor		F10	Electronic Thermal Overload Protection for Motor 1 (Select motor characteristics)	1: For a general-purpose motor with shaft-driven cooling fan	1
		2: For an inverter-driven motor				2: For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan	
09	(Overload detection level)	20% to 105% of the rated current (allowable continuous drive current) of the motor	100% of motor rated current	F11	Electronic Thermal Overload Protection for Motor 1 (Overload detection level)	0.01 to 2000 1% to 135% of the rated current (allowable continuous drive current) of the motor	Motor rated current
10	Restart Mode after Momentary Power Failure (Mode selection)	0: Disable (Without restart, trip immediately)	3	F14	Restart Mode after Momentary Power Failure (Mode selection)	0: Trip immediately	1
		1: Disable (Without restart, trip after a recovery from power failure)				1: Trip after a recovery from power failure	
		2: Enable (Continue to run, for heavy inertia or general loads)				3: Continue to run, for heavy inertia or general loads	

* For the torque boost settings, refer to the conversion tables on pages A-67 and onwards.

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
10	Restart Mode after Momentary Power Failure (Mode selection)	3: Enable (Restart at the frequency at which the power failure occurred, for general loads) 4: Enable (Restart at the starting frequency, for low inertia load)	3	F14	Restart Mode after Momentary Power Failure (Mode selection)	4: Restart at the frequency at which the power failure occurred, for general loads 5: Restart at the starting frequency	1
11	Frequency Limiter (High)	G9S: 0 to 400 Hz, P9S: 0 to 120 Hz	70	F15	Frequency Limiter (High)	0.0 to 500.0 Hz	70.0
12	(Low)	G9S: 0 to 400 Hz, P9S: 0 to 120 Hz	0	F16	(Low)	0.0 to 500.0 Hz	0.0
13	Bias Frequency	G9S: 0 to 400 Hz, P9S: 0 to 120 Hz	0	F18	Bias (Frequency command 1)	-100.00% to 100.00%	0.00
14	Gain (Frequency command signal)	0.0% to 200.0%	100.0	C32	Analog Input Adjustment for [12] (Gain)	0.00% to 200.00%	100.00
				C37	Analog Input Adjustment for [C1] (Gain)	0.00% to 200.00%	100.00
15	Torque Limiter (Driving)	20 to 180: The torque is limited to the set value (G9S) 999: Torque limiting disabled	G9S: 180/150	F40	Torque Limiter 1-1	-300% to 300% 999 (Disable)	999
16	(Braking)	20 to 180: The torque is limited to the set value (G9S) 999: Torque limiting disabled 0: Automatic deceleration	G9S: 150/100	F41	Torque Limiter 1-2	-300% to 300% 999 (Disable)	999
				H69	Automatic Deceleration (Mode selection)	4: Torque limit control with Force-to-stop disabled	0
17	DC Braking (Braking starting frequency)	0.0 to 60.0 Hz	0.0	F20	DC Braking 1 (Braking starting frequency)	0.0 to 60.0 Hz	0.0
18	(Braking level)	0% to 100%	0	F21	(Braking level)	0% to 100%	0
19	(Braking time)	0.0: Disable 0.1 to 30.0 s	0.0	F22	(Braking time)	0.00 (Disable) 0.01 to 30.00 s	0.00
20	Multi-frequency 1	G9S: 0.00, 0.20 to 400.0 Hz P9S: 0.00, 0.20 to 120.0 Hz	5.0	C05	Multi-frequency 1	0.00 to 500.00 Hz	0.00
21	Multi-frequency 2		10.0	C06	Multi-frequency 2		0.00
22	Multi-frequency 3		20.0	C07	Multi-frequency 3		0.00
23	Multi-frequency 4		30.0	C08	Multi-frequency 4		0.00
24	Multi-frequency 5		40.0	C09	Multi-frequency 5		0.00
25	Multi-frequency 6		50.0	C10	Multi-frequency 6		0.00
26	Multi-frequency 7		60.0	C11	Multi-frequency 7		0.00
27	Electronic Thermal Overload Protection for Braking Resistor	Only for 7.5 kW or below 0: Disable 1: Enable (built-in braking resistor)	1	F50	Electronic Thermal Overload Protection for Braking Resistor (Discharging capability)	OFF (Disable) 0 (Braking resistor built-in type) 1 to 9000 kWs	7.5 kW or above: 0 11 kW or below: OFF

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
28	Slip Compensation Control	-9.9 to -0.1 0.0 0.1 to 5.0 29 = 0 when the Torque Vector Control is disabled.		F42	Drive Control Selection 1	0: V/f control with slip compensation inactive	0
				H28	Droop Control	-9.9 to -0.1	0.0
				F42	Drive Control Selection 1	0: V/f control with slip compensation inactive	0
				F42	Drive Control Selection 1	2: V/f control with slip compensation active	0
				P12	Motor 1 (Rated slip frequency)	0.1 to -5.0	Depending on inverter capacity
		0.0 0.1 to 5.0 29 = 1 when the Torque Vector Control is enabled.		F42	Drive Control Selection 1	1: Dynamic torque vector control	0
				F42	Drive Control Selection 1	1: Dynamic torque vector control	0
				P12	Motor 1 (Rated slip frequency)	0.1 to -5.0	Depending on inverter capacity
29	Torque Vector Control	Refer to 28, Slip Compensation Control.					
30	Number of Poles of Motor	2 to 14 poles	4	P01	Motor 1 (No. of poles)	2 to 22 poles	4

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
Input terminal functions							
31	Function Block (32 to 41) Selection	0: Do not display the function codes 32 to 41 1: Display the function codes 32 to 41	0				
32	Terminals [X1] to [X5] Functions	Function code 32 data consists of four digits, each of which is assigned a predetermined function and terminal. When replacing the FRENIC5000G9S with the FRENIC-MEGA, it is necessary to replace data assigned to each of those four digits with the corresponding function code data of the FRENIC-MEGA.					
		Data: 0000 to 2222 Most significant digit = [X1] and [X2] 3rd digit = [X3] 2nd digit = [X4] Least significant digit = [X5]	0000			0 to 76（1000 to 1076） Setting the value of 1000 s in parentheses ( ) shown above assigns a negative logic input to a terminal.	
	Terminals [X1] to [X5] Functions : Most significant digit = [X1], [X2]	0###: Select multi-frequency		E01	Terminal [X1] Function	0: Select multi-frequency (0 to 1 steps)	0
				E02	Terminal [X2] Function	1: Select multi-frequency (0 to 3 steps)	1
		1###: UP/DOWN command		E01	Terminal [X1] Function	17: UP (Increase output frequency)	0
				E02	Terminal [X2] Function	18: DOWN (Decrease output frequency)	1
				F01	Frequency Command 1	7: Terminal command ***UP***/***DOWN*** control	0
				H61	***UP***/***DOWN*** Control (Initial frequency setting)	0: 0.00 Hz	1
		2###: UP/DOWN command		E01	Terminal [X1] Function	17: UP (Increase output frequency)	0
				E02	Terminal [X2] Function	18: DOWN (Decrease output frequency)	1
				F01	Frequency Command 1	7: Terminal command ***UP***/***DOWN*** control	0
				H61	***UP***/***DOWN*** Control (Initial frequency setting)	1: Last ***UP***/***DOWN*** command value on releasing the run command	1
	Terminals [X1] to [X5] Functions : 3rd digit = [X3]	#0##: Select multi-frequency		E03	Terminal [X3] Function	2: Select multi-frequency (0 to 7 steps)	2
		#1##: witch to commercial power (50 Hz)				15: Switch to commercial power (50 Hz)	2
		#2##: witch to commercial power (60 Hz)				16: Switch to commercial power (60 Hz)	2
	Terminals [X1] to [X5] Functions : 2nd digit = [X4]	##0#: Select ACC/DEC time (2 steps)		E04	Terminal [X4] Function	4: Select ACC/DEC time (2 steps)	3
		##1#: Select power input		E04	Terminal [X4] Function	11: Select frequency command 2/1	3
				C30	Frequency Command 2	2: Current input to terminal [C1] (4 to 20 mA DC)	2
		##2#: Enable DC braking		E04	Terminal [X4] Function	13: Enable DC braking	3
	Terminals [X1] to [X5] Functions : Least significant digit = [X5]	###0: Select ACC/DEC time (4 steps)		E05	Terminal [X5] Function	5: Select ACC/DEC time (4 steps)	4
		###1: Select 2nd V/f		E05	Terminal [X5] Function	12: Select motor 2	4
				A42	Motor/Parameter Switching 2	0: Motor (Switch to the 2nd motor)	0
		###2: Enable data change with keypad		E05	Terminal [X5] Function	19: Enable data change with keypad	4
33	Acceleration Time 2	0.01 to 3600 s	10.0/100	E10	Acceleration Time 2	0.00 to 6000 s	6.00/20.00

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
34	Deceleration Time 2	0.00: Coast-to-stop 0.01 to 3600 s	10.0/100	E11	Deceleration Time 2	0.00 0.01 to 6000 s	6.00/20.00
35	Acceleration Time 3	0.01 to 3600 s	15.0/100	E12	Acceleration Time 3	0.00 to 6000 s	6.00/20.00
36	Deceleration Time 3	0.00: Coast-to-stop 0.01 to 3600 s	15.0/100	E13	Deceleration Time 3	0.00 0.01 to 6000 s	6.00/20.00
37	Acceleration Time 4	0.01 to 3600 s	3.0/100	E14	Acceleration Time 4	0.00 to 6000 s	6.00/20.00
38	Deceleration Time 4	0.00: Coast-to-stop 0.01 to 3600 s	3.0/100	E15	Deceleration Time 4	0.00 0.01 to 6000 s	6.00/20.00
2nd V/f							
39	Base Frequency 2	G9S: 50 to 400 Hz, P9S: 50 to 120 Hz	50	A02	Base Frequency 2	25.0 to 500.0 Hz	50.0
40	Rated Voltage 2	0: Output a voltage in proportion to input voltage	200 (200 V class series) 400 (400 V class series)	A03	Rated Voltage at Base Frequency 2	0: Output a voltage in proportion to input voltage 80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	200 (200 V class series) 400 (400 V class series)
	(Maximum Output Voltage 2)	80 to 240 V: (200 V class series), 320 to 480 V: (400 V class series		A04	Maximum Output Voltage 2	80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	200 (200 V class series) 400 (400 V class series)
41	Torque Boost 2	0.1 to 0.9: Variable torque load	2.0	A13	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 2	0: Variable torque load	1
				A05	Torque Boost 2	0.0 to 20.0: *	Depending on inverter capacity
		1.0 to 1.9: Proportional torque load					
		2.0 to 20.0: Constant torque load		A13	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 2	1: Constant torque load	1
				A05	Torque Boost 2	0.0 to 20.0: *	Depending on inverter capacity
Terminal [FM] function							
42	Function Block (43 to 51) Selection	0: Do not display the function codes 43 to 51 1: Display the function codes 43 to 51	0				
43	Terminal [FMP] (Pulse rate)	6 to 100	24	F33	Pulse Output [FMP] (Pulse rate)	25 to 6000 p/s	1440
44	(Voltage adjustment)	50 to 120	100	F34	(Gain to output voltage)	0%: Output pulse rate (Fixed at 50% duty) 1 to 300	0
45	Terminal [FMA] (Voltage adjustment)	65 to 200	100	F30	Analog Output [FMA] (Voltage adjustment)	0 to 300	100
46	(Function)	0: Output frequency 1: Output current 2: Output torque 3: Load factor	0	F31	(Function)	0: Output frequency 1 (before slip compensation) 2: Output current 4: Output torque 5: Load factor	0

* For the torque boost settings, refer to the conversion tables on pages A-67 and onwards.

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
Output terminal function							
47	Terminals [Y1] to [Y5] Function	Function code 47 data consists of five digits in hexadecimal, each of which is assigned a predetermined function and one of terminals [Y1] to [Y5], starting from MSD to LSD. When replacing the FRENIC5000G9S with the FRENIC-MEGA, it is necessary to replace data assigned to each of those five digits with the corresponding function code data (E20 to E24) of the FRENIC-MEGA.					
		Data: 00000 to FFFFF	01234			0 to 105 (1000 to 1105) Setting the value of 1000 s in parentheses ( ) shown above assigns a negative logic input to a terminal.	
		Most significant digit = [Y1]		E20	Terminal [Y1] Function		0
		4th digit = [Y2]		E21	Terminal [Y2] Function		1
		3rd digit = [Y3]		E22	Terminal [Y3] Function		2
		2nd digit = [Y4]		E23	Terminal [Y4] Function		7
		Least significant digit = [Y5]		E24	Terminal [Y5A/C] Function		15
		Data that can be assigned to each digit in the FRENIC5000G9S and the corresponding function code data in the FRENIC-MEGA are listed below.					
		0: Inverter running signal				0: Inverter running	
		1: Frequency arrival signal (See function code 48.)				1: Frequency (speed) arrival signal	
		2: Frequency detection signal (See function codes 49 and 50.)				2: Frequency (speed) detected	
		3: Overload early warning (See function code 51.)				7: Motor overload early warning	
		4: Undervoltage detected (Inverter stopped)				3: Undervoltage detected (Inverter stopped)	
		5: Keypad operation enabled				8: Keypad operation enabled	
		6: Torque limiting				5: Inverter output limiting	
		7: Inverter stopped				(1000): Inverter running	
		8: Auto-restarting after momentary power failure				6: Auto-restarting after momentary power failure (Restart timing can be changed.)	
		9: Auto-resetting				26: Auto-resetting	
		A: (Not used.)					
		B: (Not used.)					
		C: When the pattern operation stage changes, outputs a one-shot signal with the pulse of 100 ms.					
		D: When a cycle of pattern operation is completed, outputs a one-shot signal with the pulse of 100 ms.					
		E: Outputs the stage number of the pattern operation with a 3-bit signal by the combination of terminals [Y3] to [Y5].					
		F: Outputs the trip factor with a 4-bit signal by the combination of terminals [Y2] to [Y5].					

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
48	Frequency Arrival (FAR) (Hysteresis width)	0.0 to 10.0 Hz	2.5	E30	Frequency Arrival (Hysteresis width)	0.0 to 10.0 Hz	2.5
49	Frequency Detection (FDT) (Level)	G9S: 0 to 400 Hz, P9S: 0 to 120 Hz	60	E31	Frequency Detection (Level)	0.0 to 500.0 Hz	60.0
50	(Hysteresis width)	0.0 to 30.0 Hz	1.0	E32	(Hysteresis width)	0.0 to 500.0 Hz	1.0
51	Overload Early Warning (Level)	20% to 105% of the inverter rated current	100% of motor rated current	E34	Overload Early Warning/Current Detection (Level)	Current value of 1% to 200% of the inverter rated current	Motor rated current
Frequency control							
52	Function Block (53 to 59) Selection	0: Do not display the function codes 53 to 59 1: Display the function codes 53 to 59	0				
53 to 55	Jump Frequency 1 to 3	G9S: 0 to 400 Hz, P9S: 0 to 120 Hz	0	C01 to C03	Jump Frequency 1 to 3	0.0 to 500.0 Hz	0.0
56	(Hysteresis width)	0 to 30 Hz	3	C04	(Hysteresis width)	0.0 to 30.0 Hz	3.0
57	Starting Frequency (Frequency)	0.2 to 60.0 Hz	0.5	F23	Starting Frequency 1	0.0 to 60.0 Hz	0.5
58	(Holding time)	0.0 to 10.0 s	0.0	F24	(Holding time)	0.00 to 10.00 s	0.00
59	Frequency Command Filter	0.01 to 5.00 s	0.05	C33	Analog Input Adjustment for [12] (Filter time constant)	0.00 to 5.00 s	0.05
				C38	Analog Input Adjustment for [C1] (Filter time constant)	0.00 to 5.00 s	0.05
Display on the LED and LCD							
60	Function Block (61 to 79) Selection	0: Do not display the function codes 61 to 79 1: Display the function codes 61 to 79	0				
61	LED Monitor Switching 1 (Item selection)	0: Output frequency (Hz)	0	E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	
				E48	LED Monitor (Speed monitor item)	0: Output frequency (Before slip compensation)	
		1: Output current (A)		E43	LED Monitor (Item selection)	3: Output current	
		2: Output voltage (command value) (V)		E43	LED Monitor (Item selection)	4: Output voltage	
		3: Synchronous speed (r/min)		E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	
				E48	LED Monitor (Speed monitor item)	3: Motor speed in r/min	
		4: Line speed (m/min)		E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	
				E48	LED Monitor (Speed monitor item)	5: Line speed in m/min	
		5: Load shaft speed (r/min)		E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	
				E48	LED Monitor (Speed monitor item)	4: Load shaft speed in r/min	
		6: Driving torque limit setting value (%)					
		7: Braking torque limit setting value (%)					
		8: Calculated torque (%)		E43	LED Monitor (Item selection)	8: Calculated torque	

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
62	LED Monitor Switching 2 (Display when stopped)	0: Specified value 1: Output value	0	E44	LED Monitor (Display when stopped)	0: Specified value 1: Output value	0
63	Coefficient for Speed Indication (Load speed)	0.01 to 200.00	0.01	E40	PID Display Coefficient A	-999 to 0.00 to 9990	100
				E50	Coefficient for Speed Indication Load shaft speed and line speed	0.01 to 200.00	30.00
64	LCD Monitor (Item selection)	0: Running status, operation guidance 1: Bar graph (Reference frequency/output frequency) 2: Bar graph (Output frequency/output current) 3: Bar graph (Output frequency/output torque)	0	E45	LCD Monitor (Item selection)	0: Running status, rotational direction and operation guide 1: Bar charts for output frequency, current and calculated torque	0
Pattern operation							
65	Pattern Operation (Mode selection)	0: Disable pattern operation. Perform normal operation. 1: Perform a pattern operation cycle, then stop operation. 2: Perform pattern operation repeatedly. 3: Perform a pattern operation cycle, then continue operation with the last frequency set.	0				
66 67 68 69 70 71 72	Timer 1 Timer 2 Timer 3 Timer 4 Timer 5 Timer 6 Timer 7	Timer 0.00 to 6000 s	0.00				
73	Acceleration/Deceleration Pattern (Mode selection)	0: Linear 1: S-curve 2: Curvilinear	0	H07	Acceleration/Deceleration Pattern	0: Linear 1: S-curve (Weak) 2: S-curve (Arbitrary, according to H57 to H60 data) 3: Curvilinear	0

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
Special functions 1							
75	Auto Energy Saving Operation	Refer to 07, Torque Boost 1.					
76	Inhibit Reverse Rotation	0: Disable 1: Enable (Reverse rotation inhibited)	0	H08	Rotational Direction Limitation	0: Disable 1: Enable (Reverse rotation inhibited)	0
77	Data Initialization	0: Disable initialization 1: Initialize all function code data to the factory defaults	0	H03	Data Initialization	0: Disable initialization 1: Initialize all function code data to the factory defaults	0
78	LCD (Japanese/English)	0: Japanese 1: English	0	E46	LCD Monitor (Language selection)	0: Japanese 1: English	0
79	LCD (Contrast control)	0 (Low) to 10 (High)	5	E47	LCD Monitor (Contrast control)	0 (Low) to 10 (High)	5
80	Function Block (81 to 94) Selection	0: Do not display the function codes 81 to 94 1: Display the function codes 81 to 94	0				
81	Motor Sound Adjustment (Carrier frequency) G9 22 kW or below	0: Low carrier frequency (2 kHz) ⋮ 10: High carrier frequency (15 kHz) 11: Extremely low carrier frequency (0.7 kHz)	10	F26	Motor Sound (Carrier frequency) 22 kW or below	2 kHz ⋮ 15 kHz (Up to 16 kHz can be specified.) 0.75 kHz	2
	Motor Sound Adjustment (Carrier frequency) G9 30 to 55 kW	0: Low carrier frequency (2 kHz) ⋮ 10: High carrier frequency (10 kHz) 11: Extremely low carrier frequency (0.7 kHz)			Motor Sound (Carrier frequency) 30 to 55 kW	2 kHz ⋮ 10 kHz (Up to 16 kHz can be specified.) 0.75 kHz	
	Motor Sound Adjustment (Carrier frequency) G9 75 kW or above	0: Low carrier frequency (2 kHz) ⋮ 10: High carrier frequency (6 kHz) 11: Extremely low carrier frequency (0.7 kHz)			Motor Sound (Carrier frequency) 75 kW or below	2 kHz ⋮ 6 kHz (Up to 10 kHz can be specified.) 0.75 kHz	
82	Restart Mode after Momentary Power Failure (Restart time)	0.0 to 0.5 s	0.1	H13	Restart Mode after Momentary Power Failure (Restart time)	0.1 to 10.0 s	Depending on inverter capacity
83	(Frequency fall rate)	0.00: Deceleration time specified 0.01 to 100.00	10.00	H14	(Frequency fall rate)	0.00: Deceleration time selected by F08 0.01 to 100.00	999
84	Auto-reset (Times)	0: Disable 1 to 7: Number of retry times	0	H04	Auto-reset (Times)	0: Disable 1 to 10: Number of retry times	0
85	(Reset interval)	2 to 20 s	5	H05	(Reset interval)	0.5 to 20.0 s	5.0

FRENIC5000G9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
Motor characteristics							
86	Motor 1 (Rated capacity)	0: 1 rank higher capacity than the nominal applied motor 1: Nominal applied motor capacity 2: 1 rank lower capacity than the nominal applied motor 3: 2 ranks lower capacity than the nominal applied motor	1	P02	Motor 1 (Rated capacity)	0.01 to 1000 kW	Depending on inverter capacity
87	Motor 1 (Rated current)	0.00 to 2000 A	Standard rated value	P03	Motor 1 (Rated current)	0.00 to 2000 A	Depending on inverter capacity
88	Motor 1 (No-load current)	0.00 to 2000 A	Standard rated value	P06	Motor 1 (No-load current)	0.00 to 2000 A	Depending on inverter capacity
89	Motor 2 (Rated current)	0.00 to 2000 A	Standard rated value	A17	Motor 2 (Rated current)	0.00 to 2000 A	Depending on inverter capacity
90	Motor 1 (Tuning: %R1, %X)	0: Disable 1: Enable	0	P04	Motor 1 (Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune while the motor is rotating under V/f control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c")	0
91	Motor 1 (%R1)	0.00% to 50.00%	Depending on inverter capacity	P07	Motor 1 (%R1)	0.00% to 50.00%	Depending on inverter capacity
92	Motor 1 (%X)	0.00% to 50.00%	Depending on inverter capacity	P08	Motor 1 (%X)	0.00% to 50.00%	Depending on inverter capacity
Special functions 2							
95	Data Protection	0: Enable data change 1: Enable data protection	0	F00	Data Protection	0: Disable both data protection and digital reference protection 1: Enable data protection and disable digital reference protection	0
The FRENIC5000G9S series of inverters do not support these functions shown at the right. When replacing the FRENIC5000G9S with the FRENIC-MEGA, cancel or disable these function codes in FRENIC-MEGA in order to conform them to the FRENIC5000G9S.				F43	Current Limiter (Mode selection)	0: Disable	2
				H50	Non-linear V/f Pattern 1 (Frequency)	0.0: Cancel (30 kW or above) 0.1 to 500.0 Hz	0.0/5.0
				H51	(Voltage)	0 to 240: Output an AVR-controlled voltage (for 200 V class series) 0 to 500: Output an AVR-controlled voltage	0/20
				H72	Main Power Down Detection (Mode selection)	0: Disable	1

[2] FRENIC5000P9S vs. FRENIC-MEGA

FRENIC5000P9S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
When replacing the FRENIC5000P9S with the FRENIC-MEGA, set the F80 data of the FRENIC-MEGA to "1: LD (Low Duty) mode." The LD-mode inverter brings out the continuous rated current level which enables the inverter to drive a motor with one rank higher capacity, but its overload capability (%) against the continuous current rating level decreases.				F80	Switching between HD, MD, and LD drive modes	1: LD (Low Duty) mode * Function code data out of the range in the LD mode are automatically changed to the upper limits in the LD mode.	0
Replacement of function codes for the FRENIC5000P9S is basically equivalent to that for the FRENIC5000G9S given on pages A-36 to A-46, except for the data setting range of following function codes.							
18	DC Braking (Braking level)		0	F21	DC Braking 1 (Braking level)		0
81	Motor Sound Adjustment (Carrier frequency) P9 22 kW or below	0: Low carrier frequency (2 kHz) ⋮ ⋮ 10: High carrier frequency (15 kHz) 11: Extremely low carrier frequency (0.7 kHz)	10	F26	Motor Sound (Carrier frequency)	2 kHz ⋮ 15 kHz (Up to 16 kHz can be specified.) 0.75 kHz	2
	Motor Sound Adjustment (Carrier frequency) P9 30 to 75 kW	0: Low carrier frequency (2 kHz) ⋮ ⋮ 10: High carrier frequency (6 kHz) 11: Extremely low carrier frequency (0.7 kHz)			Motor Sound (Carrier frequency)	2 kHz ⋮ 6 kHz (Up to 10 kHz can be specified for inverters with a capacity of 5.5 kW or below) 0.75 kHz	
	Motor Sound Adjustment (Carrier frequency) P9 90 kW or above	0: Low carrier frequency (2 kHz) ⋮ ⋮ 10: High carrier frequency (4 kHz) 11: Extremely low carrier frequency (0.7 kHz)			Motor Sound (Carrier frequency)	2 kHz ⋮ 4 kHz (Up to 6 kHz can be specified.) 0.75 kHz	

[3] FRENIC5000G11S vs. FRENIC-MEGA

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
F00	Data Protection	0: The data can be changed	0	F00	Data Protection	0: Disable both data protection and digital reference protection	0
		1: The data cannot be changed				1: Enable data protection and disable digital reference protection	
F01	Frequency Command 1	0: Setting by keypad panel operation (▲ ▼ key)	0	F01	Frequency Command 1	0: ▲ / ▼ keys on keypad	0
		1: Setting by voltage input (terminal [12]) (0 to +10 V)				1: Voltage input to terminal [12] (-10 to +10 VDC)	
		2: Setting by current input (terminal [C1]) (4 to 20 mA)				2: Current input to terminal [C1] (4 to 20 mA DC)	
		3: Setting by voltage input + current input (terminal [12] + terminal [C1])				3: Sum of voltage and current inputs to terminals [12] and [C1]	
		4: Reversible operation with polarity (terminal [12]) (-10 to +10 V)		F01	Frequency Command 1	1: Voltage input to terminal [12] (-10 to +10 VDC)	0
				C35	Analog Input Adjustment for [12] (Polarity)	0: Bipolar	1
		5: Reversible operation with polarity (terminal [12] + AIO frequency auxiliary input)		F01	Frequency Command 1	1: Voltage input to terminal [12] (-10 to +10 VDC)	0
				E63	Terminal [V2] Extended Function	1: Auxiliary frequency command 1	0
				C35	Analog Input Adjustment for [12] (Polarity)	0: Bipolar	1
		6: Inverse mode operation (terminal [12]) (+10 V to 0)		F01	Frequency Command 1	1: Voltage input to terminal [12] (-10 to +10 VDC)	0
				C53	Selection of Normal/Inverse Operation (Frequency command 1)	1: Inverse operation	0
		7: Inverse mode operation (terminal [C1]) (20 to 4 mA)		F01	Frequency Command 1	2: Current input to terminal [C1] (4 to 20 mA DC)	0
				C53	Selection of Normal/Inverse Operation (Frequency command 1)	1: Inverse operation	0
		8: Setting by UP/DOWN control mode 1 (initial value = 0)		F01	Frequency Command 1	7: Terminal command ***UP/DOWN*** control	0
				H61	***UP/DOWN*** Control (Initial frequency setting)	0: 0.00 Hz	1
		9: Setting by UP/DOWN control mode 2 (initial value = last final value)		F01	Frequency Command 1	7: Terminal command ***UP/DOWN*** control	0
				H61	***UP/DOWN*** Control (Initial frequency setting)	1: Last ***UP/DOWN*** command value on releasing the run command	1
		10: Setting by pattern operation					
		11: Setting by digital input or pulse train input		F01	Frequency Command 1	11: Digital input interface card (option)	0
						12: Pulse train input * Max.: 100 kHz/Maximum frequency	

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
F02	Operation Method	0: Keypad operation (FWD, REV, STOP keys)	0	F02	Operation Method	0: RUN/STOP keys on keypad (Motor rotational direction specified by terminal command ***FWD***/***REV***)	2
						2: RUN/STOP keys on keypad (forward)	
						3: RUN/STOP keys on keypad (reverse)	
		1: Operation by external input (terminals [FWD] and [REV])				1: Terminal command ***FWD*** or ***REV***	
F03	Maximum Frequency 1	50 to 400 Hz	60	F03	Maximum Frequency 1	25.0 to 500.0 Hz	60.0
F04	Base Frequency 1	25 to 400 Hz	50	F04	Base Frequency 1	25.0 to 500.0 Hz	50.0
F05	Rated Voltage 1 (at Base frequency 1)	0: (Output voltage proportional to source voltage) 80 to 240 V: (200 V class) 320 to 480 V: (400 V class)	200 (200 V class) 400 (400 V class)	F05	Rated Voltage at Base Frequency 1	0: Output a voltage in proportion to input voltage 80 to 240 V: Output an AVR-controlled voltage (for 200 V class series) 160 to 500 V: Output an AVR-controlled voltage (for 400 V class series)	200 (200 V class series) 400 (400 V class series)
F06	Maximum Voltage 1 (at Maximum frequency 1)	80 to 240 V: (200 V class) 320 to 480 V: (400 V class)	200 (200 V class) 400 (400 V class)	F06	Maximum Output Voltage 1	80 to 240 V: Output an AVR-controlled voltage (for 200 V class series) 160 to 500 V: Output an AVR-controlled voltage (for 400 V class series)	200 (200 V class series) 400 (400 V class series)
F07	Acceleration Time 1	0.01 to 3600 s	6.0/20.0	F07	Acceleration Time 1	0.00 to 6000 s	6.00/20.00
F08	Deceleration Time 1	0.01 to 3600 s	6.0/20.0	F08	Deceleration Time 1	0.00 to 6000 s	6.00/20.00
F09	Torque Boost 1	0.0: Automatic torque boost 0.1 to 0.9: Square law reduction torque 1.0 to 1.9: Proportional torque 2.0 to 20.0: Constant torque (H10 = 0 when the auto-energy saving operation is disabled)	G11S: 0.0	F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	2: Auto torque boost	1
				F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	0: Variable torque load	1
				F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
				F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	1: Constant torque load	1
				F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
		0.0: Automatic torque boost 0.1 to 0.9: Square law reduction torque 1.0 to 1.9: Proportional torque 2.0 to 20.0: Constant torque (H10 = 1 when the auto-energy saving operation is enabled)		F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	5: Auto energy saving (Auto torque boost during ACC/DEC)	1
				F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	3: Auto energy saving (Variable torque load during ACC/DEC)	1
				F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity
				F37	Load Selection/Auto Torque Boost/ Auto Energy Saving Operation 1	4: Auto energy saving (Constant torque load during ACC/DEC)	1
				F09	Torque Boost 1	0.0 to 20.0: *	Depending on inverter capacity

* For the torque boost settings, refer to the conversion tables on pages A-67 and onwards.

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
F10	Electronic Thermal 1 (Select)	0: Inactive	1	F11	Electronic Thermal Overload Protection for Motor 1 (Overload detection level)	0.00: Disable	Motor rated current
		1: Active (for general-purpose motor)		F10	(Select motor characteristics)	1: For a general-purpose motor with shaft-driven cooling fan	1
		2: Active (for inverter motor)				2: For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan	
F11	(Level)	20% to 135% of the rated current of the inverter	Motor rated current	F11	(Overload detection level)	1% to 135% of the rated current (allowable continuous drive current) of the motor	Motor rated current
F12	(Thermal time constant)	0.5 to 75.0 min	5.0/10.0	F12	(Thermal time constant)	0.5 to 75.0 min	5.0/10.0
F13	Electronic Thermal Overload Relay (for braking resistor)	0 to 2 (Up to 7.5 kW) 0: Inactive	1	F50	Electronic Thermal Overload Protection for Braking Resistor (Discharging capability)	0 (Braking resistor built-in type)	7.5 kW or below: 0 11 kW or above: OFF
		1: Active (built-in braking resistor)				1 to 9000	
		2: Active (DB***-2C/4C, external braking resistor)				OFF (Disable)	
		0 (11 kW and above) 0: Inactive	0	F51	(Allowable average loss)	0.001 to 99.99 kW	0.001
				F52	(Resistance)	0.01 to 999Ω	0.01
F14	Restart Mode after Momentary Power Failure (Mode select)	0: Inactive (Immediate inverter trip)	1	F14	Restart Mode after Momentary Power Failure (Mode selection)	0: Trip immediately	1
		1: Inactive (inverter trip at recovery)				1: Trip after a recovery from power failure	
		2: Inactive (inverter trip after deceleration to a stop at power failure)				2: Trip after decelerate-to-stop	
		3: Active (operation continued, for high-inertia loads)				3: Continue to run, for heavy inertia or general loads	
		4: Active (restart with the frequency at power failure)				4: Restart at the frequency at which the power failure occurred, for general loads	
		5: Active (restart with the start frequency, for low-inertia loads)				5: Restart at the starting frequency	
F15	Frequency Limiter (High)	0 to 400 Hz	70	F15	Frequency Limiter (High)	0.0 to 500.0 Hz	70.0
F16	(Low)	0 to 400 Hz	0	F16	(Low)	0.0 to 500.0 Hz	0.0
F17	Gain (for Freq set signal)	0.0% to 200.0%	100.0	C32	Analog Input Adjustment for [12] (Gain)	0.00% to 200.00%	100.00
				C37	Analog Input Adjustment for [C1] (Gain)	0.00% to 200.00%	100.00
F18	Bias Frequency	-400.0 to 400.0 Hz	0.0	F18	Bias (Frequency command 1)	-100.00% to 100.00%	0.00
F20	DC Brake (Starting freq.)	0.0 to 60.0 Hz	0.0	F20	DC Braking 1 (Braking starting frequency)	0.0 to 60.0 Hz	0.0
F21	(Braking level)	0% to 100%	0	F21	(Braking level)	0% to 100%	0
F22	(Braking time)	0.0 to 30.0 s	0.0	F22	(Braking time)	0.01 to 30.00 s	0.00
F23	Starting Frequency (Freq.)	0.1 to 60.0 Hz	0.5	F23	Starting Frequency 1	0.0 to 60.0 Hz	0.5
F24	(Holding time)	0.0 to 10.0 s	0.0	F24	(Holding time)	0.00 to 10.00 s	0.00

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
F25	Stop Frequency	0.1 to 60.0 Hz	0.2	F25	Stop Frequency	0.0 to 60.0 Hz	0.2
F26	Motor Sound (Carrier frequency)	0.75 to 15 kHz: 55 kW or below	2	F26	Motor Sound (Carrier frequency)	0.75 to 15 kHz: 55 kW or below (Up to 16 kHz can be specified.)	2
		0.75 to 10 kHz: 75 kW or above				0.75 to 10 kHz: 75 kW or above	
F27	(Sound tone)	0 to 3	0	F27	(Tone)	0 to 3	0
F30	FMA (Voltage adjust)	0% to 200%	100	F30	Analog Output [FMA] (Voltage adjustment)	0% to 300%	100
F31	(Function)	0: Output frequency 1 (before slip compensation)	0	F31	(Function)	0: Output frequency 1 (before slip compensation)	0
		1: Output frequency 2 (after slip compensation)				1: Output frequency 2 (after slip compensation)	
		2: Output current				2: Output current	
		3: Output voltage				3: Output voltage	
		4: Output torque				4: Output torque	
		5: Load rate				5: Load factor	
		6: Power consumption				6: Input power	
		7: PID feedback amount				7: PID feedback amount	
		8: PG feedback amount				8: PG feedback value	
		9: DC link circuit voltage				9: DC link bus voltage	
		10: Universal AO (Outputs arbitrary value via communications link)				10: Universal AO	
F33	FMP (Pulse rate)	300 to 6000 p/s	1440	F33	Pulse Output [FMP] (Pulse rate)	25 to 6000 p/s	1440
F34	(Voltage adjust)	0: Pulse frequency output (Fixed at 50% duty)	0	F34	(Gain to output voltage)	0%: Output pulse rate (Fixed at 50% duty)	0
		1 to 200				1 to 300	
F35	(Function)	0: Output frequency 1 (before slip compensation)	0	F35	(Function)	0: Output frequency 1 (before slip compensation)	0
		1: Output frequency 2 (after slip compensation)				1: Output frequency 2 (after slip compensation)	
		2: Output current				2: Output current	
		3: Output voltage				3: Output voltage	
		4: Output torque				4: Output torque	
		5: Load rate				5: Load factor	
		6: Power consumption				6: Input power	
		7: PID feedback amount				7: PID feedback amount	
		8: PG feedback amount				8: PG feedback value	
		9: DC link circuit voltage				9: DC link bus voltage	
		10: Universal AO (Outputs arbitrary value via communications link)				10: Universal AO	

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
F36	30RY Operation Mode	0: At normal [30A] - [30C]: OFF At abnormal [30A] - [30C]:ON	0	E27	Terminal [30A/B/C] Function (Relay output)	99: Alarm output (for any alarm) ***ALM*** In normal state, [30A] - [30C]: OFF In abnormal state, [30A] -[30C]: ON	99
		1: At normal [30A] - [30C]: ON At abnormal [30A] - [30C]: OFF				1099: Alarm output (for any alarm) ***ALM*** In normal state, [30A] - [30C]: ON In abnormal state, [30A] -[30C]: OFF	
F40	Torque Limiter 1 (Driving)	20 to 200: The torque is limited to the set value	999	F40	Torque Limiter 1-1	-300 to 300: Torque limiter level	999
		999: Torque limiting inactive				999: Disable	
F41	(Braking)	20 to 200: The torque is limited to the set value	999	F41	Torque Limiter 1-2	-300 to 300: Torque limiter level	999
		999: Torque limiting inactive				999: Disable	
F41	Torque Limiter 1 (Braking)	0: Prevent 0V trip due to power regeneration effect automatically	999	H69	Automatic Deceleration (Mode selection)	2: Torque limit control with Force-to-stop if actual deceleration time exceeds three times the specified one	0
U60	Automatic Deceleration during Deceleration	0: Torque limiting (for high response)	0				
F41	Torque Limiter 1 (Braking)	0: Prevent 0V trip due to power regeneration effect automatically	999	H69	Automatic Deceleration (Mode selection)	3: DC link bus voltage control with Force-to-stop if actual deceleration time exceeds three times the specified one	0
U60	Automatic Deceleration during Deceleration	1: Prevent 0V trip (only during deceleration, for high inertia)	0				
F42	Torque Vector Control 1	0: Inactive	0	F42	Drive Control Selection 1	0: V/f control with slip compensation inactive	0
		1: Active				1: Dynamic torque vector control	
E01	X1 Terminal Function (Function selection)	0 to 35	0	E01	Terminal [X1] Function	0 to 76 (1000 to 1076) Setting the value of 1000 s in parentheses ( ) shown above assigns a negative logic input to a terminal.	0
E02	X2 Terminal Function	0: Multistep frequency selection (1 to 15 steps)	1	E02	Terminal [X2] Function	0: Select multi-frequency (0 to 1 steps)	1
E03	X3 Terminal Function	1: Multistep frequency selection (1 to 15 steps)	2	E03	Terminal [X3] Function	1: Select multi-frequency (0 to 3 steps)	2
E04	X4 Terminal Function	2: Multistep frequency selection (1 to 15 steps)	3	E04	Terminal [X4] Function	2: Select multi-frequency (0 to 7 steps)	3
E05	X5 Terminal Function	3: Multistep frequency selection (1 to 15 steps)	4	E05	Terminal [X5] Function	3: Select multi-frequency (0 to 15 steps)	4
E06	X6 Terminal Function	4: Acceleration and deceleration time selection (3 steps)	5	E06	Terminal [X6] Function	4: Select ACC/DEC time (2 steps)	5
E07	X7 Terminal Function	5: Acceleration and deceleration time selection (3 steps)	6	E07	Terminal [X7] Function	5: Select ACC/DEC time (4 steps)	6
E08	X8 Terminal Function	6: Self-hold selection	7	E08	Terminal [X8] Function	6: Enable 3-wire operation	7
E09	X9 Terminal Function	7: Coast-to-stop command	8	E09	Terminal [X9] Function	7: Coast to a stop	8
		8: Alarm reset				8: Reset alarm	
		9: External alarm				9: Enable external alarm trip	
		10: Jogging				10: Ready for jogging	
		11: Frequency setting 2/frequency setting 1				11: Select frequency command 2/1	
		12: Motor 2/motor 1				12: Select motor 2	
		13: DC injection brake command				13: Enable DC braking	

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
E01 to E09	X1 to X9 Terminal Function (Function selection)	14: Torque limit 2/torque limit 1		E01 to E09	Terminal [X1] to [X9] Function	14: Select torque limiter level 2/1	
		15: Switching operation from line to inverter (50 Hz)				15: Switch to commercial power (50 Hz)	
		16: Switching operation from line to inverter (60 Hz)				16: Switch to commercial power (60 Hz)	
		17: UP command				17: UP (Increase output frequency)	
		18: DOWN command				18: DOWN (Decrease output frequency)	
		19: Edit permission command (data change permission)				19: Enable data change with keypad	
		20: PID control cancellation				20: Cancel PID control	
		21: Forward/inverse switching				21: Switch normal/inverse operation	
		22: Interlock (52-2)				22: Interlock	
		23: Torque control cancellation					
		24: Link operation selection (Standard: RS-485, Option: BUS)				24: Enable communications link via RS-485 or fieldbus (option)	
		25: Universal DI				25: Universal DI	
		26: Start characteristics selection				26: Enable auto search for idling motor speed at starting	
		27: PG-SY enable (option)					
		28: Not used.					
		29: Zero speed command with PG option					
		32: Pre-exciting command with PG option				32: Pre-excitation	
		33: Line speed control cancellation (option)					
		34: Line speed frequency memory (option)					
		35: Frequency setting 2/frequency setting 1				(1011): Select frequency command 2/1	
E01 to E09	X1 to X9 Terminal Function	30: Forced stop command (within the time currently specified)		E01 to E09	Terminal [X1] to [X9] Function	30: Force to stop	0
				H56	Deceleration Time for Forced Stop	0.00 to 6000 s	6.00/20.00
E01 to E09	X1 to X9 Terminal Function	31: Forced stop with Deceleration time 4 (within the time specified by E15, Deceleration Time 4.)	0	E01 to E09	Terminal [X1] to [X9] Function	30: Force to stop	0
E15	Deceleration Time 4	0.01 to 3600 s	6.0/20.0	H56	Deceleration Time for Forced Stop	0.00 to 6000 s	6.00/20.00
E10	Acceleration Time 2	0.01 to 3600 s	6.0/20.0	E10	Acceleration Time 2	0.00 to 6000 s	6.00/20.00
E11	Deceleration Time 2	0.01 to 3600 s	6.0/20.0	E11	Deceleration Time 2	0.00 to 6000 s	6.00/20.00
E12	Acceleration Time 3	0.01 to 3600 s	6.0/20.0	E12	Acceleration Time 3	0.00 to 6000 s	6.00/20.00
E13	Deceleration Time 3	0.01 to 3600 s	6.0/20.0	E13	Deceleration Time 3	0.00 to 6000 s	6.00/20.00
E14	Acceleration Time 4	0.01 to 3600 s	6.0/20.0	E14	Acceleration Time 4	0.00 to 6000 s	6.00/20.00
E15	Deceleration Time 4	0.01 to 3600 s	6.0/20.0	E15	Deceleration Time 4	0.00 to 6000 s	6.00/20.00

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
E16	Torque Limiter 2 (Driving)	20 to 200: The torque is limited to the set value	999	E16	Torque Limiter 2-1	-300 to 300: Torque limiter level	999
		999: Torque limiting inactive				999: Disable	
E17	(Braking)	20 to 200: The torque is limited to the set value	999	E17	Torque Limiter 2-2	300 to 300: Torque limiter level	999
		999: Torque limiting inactive				999: Disable	
E17	Torque Limiter 2 (Braking)	0: Prevent 0V trip due to power regeneration effect automatically	999	H69	Automatic Deceleration (Mode selection)	2: Torque limit control with Force-to-stop if actual deceleration time exceeds three times the specified one	0
U60	Automatic Deceleration during Deceleration	0: Torque limiting (for high response)	0				
E17	Torque Limiter 2 (Braking)	0: Prevent 0V trip due to power regeneration effect automatically	999	H69	Automatic Deceleration (Mode selection)	3: DC link bus voltage control with Force-to-stop if actual deceleration time exceeds three times the specified one	0
U60	Automatic Deceleration during Deceleration	1: Prevent 0V trip (only during deceleration, for high inertia)	0				
E20	Y1 Terminal Function (Function selection)	0 to 37	0	E20	Terminal [Y1] Function	0 to 105 (1000 to 1105) Setting the value of 1000 s in parentheses ( ) shown above assigns a negative logic input to a terminal.	0
E21	Y2 Terminal Function	0: Inverter running	1	E21	Terminal [Y2] Function	0: Inverter running	1
E22	Y3 Terminal Function	1: Frequency equivalence signal	2	E22	Terminal [Y3] Function	1: Frequency (speed) arrival signal	2
E23	Y4 Terminal Function	2: Frequency level detection	7	E23	Terminal [Y4] Function	2: Frequency (speed) detected	7
E24	Y5A and Y5C Terminal Function (Relay output)	3: Undervoltage detection signal	15	E24	Terminal [Y5A/C] Function	3: Undervoltage detected (Inverter stopped)	15
		4: Torque polarity (braking/driving)				4: Torque polarity detected	
		5: Torque limiting				5: Inverter output limiting	
		6: Auto restarting (The output signal comes ON during the period after the power is recovered and before the output reaches the reference frequency.)				6: Auto-restarting after momentary power failure	
		7: Overload early warning (E33 = 0, Thermal calculation)				7: Motor overload early warning	
		7: Overload early warning (E33 = 1, Output current)				37: Current detected	
		8: KEYPAD operation mode				8: Keypad operation enabled	
		9: Inverter stopping				(1000): Inverter running	
		10: Ready output				10: Inverter ready to run	
		11: Line/inverter changeover (for 88)				11: Switch motor drive source between commercial power and inverter output (For MC on commercial line)	
		12: Line/inverter changeover (for 52-2)				12: Switch motor drive source between commercial power and inverter output (For secondary side)	

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
E20 to E24	Y1 to Y4 Terminal function Y5A and Y5C Terminal Function (Relay output) (Function selection)	13: Line/inverter changeover (for 52-1)		E20 to E24	Terminal [Y1] to [Y4] Function Terminal [Y5A/C] Function	13: Switch motor drive source between commercial power and inverter output (For primary side)	
		14: Motor 1/motor 2				49: Motor 2 selected	
		15: Terminal AX function				15: Select ***AX*** terminal function	
		16: Time-up signal for pattern operation					
		17: Cycle completion signal for pattern operation					
		18: Pattern operation stage No. indication 1					
		19: Pattern operation stage No. indication 2					
		20: Pattern operation stage No. indication 4					
		21: Alarm indication 1					
		22: Alarm indication 2					
		23: Alarm indication 4					
		24: Alarm indication 8					
		25: Fan operation signal				25: Cooling fan in operation	
		26: Auto-resetting				26: Auto-resetting	
		27: Universal DO (option)				27: Universal DO	
		28: Overheat early warning				28: Heat sink overheat early warning	
		29: Synchronization completed by synchronous operation card (option)					
		30: Life expectancy detection signal				30: Lifetime alarm	
		31: 2nd frequency level detection				31: Frequency (speed) detected 2	
		32: 2nd OL level early warning				38: Current detected 2	
		33: Terminal C1 off signal				33: Reference loss detected	
						59: Terminal [C1] wire break	
		34: Speed existence signal (option)				70: Speed valid	
		35: Speed agreement signal (option)				71: Speed agreement	
		36: PG error signal (option)				76: PG error detected	
		37: Torque limiting (signal with delay)				22: Inverter output limiting with delay	
E25	Y5 RY Operation Mode	0: At signal OFF, [Y5A] - [Y5C]: OFF At signal ON, [Y5A] -[Y5C]: ON	0	E24	Terminal [Y5A/C] Function	0 to 105: At signal OFF, [Y5A] - [Y5C]: OFF At signal ON, [Y5A] -[Y5C]: ON	—
		1: At signal OFF, [Y5A] - [Y5C]: ON At signal ON, [Y5A] -[Y5C]: OFF				(1000) to (1105): At signal OFF, [Y5A] - [Y5C]: ON At signal ON, [Y5A] -[Y5C]: OFF	
E30	FAR Function (Hysteresis)	0.0 to 10.0 Hz	2.5	E30	Frequency Arrival (Hysteresis width)	0.0 to 10.0 Hz	2.5
E31	FDT Function (Level)	0 to 400 Hz	60	E31	Frequency Detection (Level)	0.0 to 500.0 Hz	60.0
E32	(Hysteresis)	0.0 to 30.0 Hz	1.0	E32	(Hysteresis width)	0.0 to 500.0 Hz	1.0

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
E33	OL1 Function (Mode select)	Refer to E20 to E24, data = 7					
E34	OL1 Function (Level)	5% to 200% of inverter rated current	Motor rated current	E34	Overload Early Warning/Current Detection (Level)	Current value of 1% to 200% of the inverter rated current	Motor rated current
E35	(Timer)	0.0 to 60.0 s	10.0	E35	(Timer)	0.01 to 600.00 s	10.00
E36	FDT2 Function (Level)	0 to 400 Hz	60	E36	Frequency Detection 2 (Level)	0.0 to 500.0 Hz	60.0
E37	OL2 Function (Level)	5% to 200% of inverter rated current	Motor rated current	E37	Current Detection 2/Low Current Detection (Level)	Current value of 1% to 200% of the inverter rated current	Motor rated current
E35	OL1 Function (Timer)	0.0 to 60.0 s	10.0	E38	(Timer)	0.01 to 600.00 s	10.00
E40	Display Coefficient A	-999.00 to 999.00	0.01	E40	PID Display Coefficient A	-999 to 0.00 to 9990	100
				E50	Coefficient for Speed Indication	0.01 to 200.00	30.00
E41	Display Coefficient B	-999.00 to 999.00	0.00	E41	PID Display Coefficient B	-999 to 0.00 to 9990	0.00
E42	LED Display Filter	0.0 to 5.0 s	0.5	E42	LED Display Filter	0.0 to 5.0 s	0.5
E43	LED Monitor (Function)	0: Output frequency 1 (before slip compensation) (Hz)	0	E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	0
				E48	LED Monitor (Speed monitor item)	0: Output frequency (Before slip compensation)	0
		1: Output frequency 2 (after slip compensation) (Hz)		E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	0
				E48	LED Monitor (Speed monitor item)	1: Output frequency (After slip compensation)	0
		2: Set frequency (Hz)		E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	0
				E48	LED Monitor (Speed monitor item)	2: Reference frequency	0
		3: Output current (A)		E43	LED Monitor (Item selection)	3: Output current	0
		4: Output voltage (command value) (V)		E43	LED Monitor (Item selection)	4: Output voltage	0
		5: Motor synchronous speed (r/min)		E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	0
				E48	LED Monitor (Speed monitor item)	3: Motor speed in r/min	0
		6: Line speed (m/min)		E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	0
				E48	LED Monitor (Speed monitor item)	5: Line speed in m/min	0
		7: Load shaft speed (r/min)		E43	LED Monitor (Item selection)	0: Speed monitor (select by E48)	0
				E48	LED Monitor (Speed monitor item)	4: Load shaft speed in r/min	0
		8: Torque calculation value (%)		E43	LED Monitor (Item selection)	8: Calculated torque	0
		9: Consumption (kW)		E43	LED Monitor (Item selection)	9: Input power	0
		10: PID target value 1 (direct input from keypad panel)		E43	LED Monitor (Item selection)	10: PID command	0
		11: PID target value 2 (input from "F02 Frequency 1")					
		12: PID feedback amount		E43	LED Monitor (Item selection)	12: PID feedback amount	0
E44	LED Monitor (Display at STOP mode)	0: Set frequency value	0	E44	LED Monitor (Display when stopped)	0: Specified value	0
		1: Output value				1: Output value	

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
E45	LCD Monitor (Function)	0: Operation status, rotating direction, operation guide	0	E45	LCD Monitor (Item selection)	0: Running status, rotational direction and operation guide	0
		1: Output frequency (before slip compensation), output current, calculated torque value in bar graph				1: Bar charts for output frequency, current and calculated torque	
E46	(Language)	0: Japanese	0	E46	(Language selection)	0: Japanese	0
		1: English				1: English	
		2: German				2: German	
		3: French				3: French	
		4: Spanish				4: Spanish	
		5: Italian				5: Italian	
E47	LCD Monitor (Contrast)	0 (Soft) to 10 (Hard)	5	E47	LCD Monitor (Contrast control)	0 (Low) to 10 (High)	5
C01	Jump Frequency (Jump Freq. 1)	0 to 400 Hz	0	C01	Jump Frequency 1	0.0 to 500.0 Hz	0.0
C02	Jump Frequency (Jump Freq. 2)	0 to 400 Hz	0	C02	Jump Frequency 2	0.0 to 500.0 Hz	0.0
C03	Jump Frequency (Jump Freq. 3)	0 to 400 Hz	0	C03	Jump Frequency 3	0.0 to 500.0 Hz	0.0
C04	(Hysteresis)	0 to 30 Hz	3	C04	(Hysteresis width)	0.0 to 30.0 Hz	3.0
C20	JOG Frequency	0.00 to 400.00 Hz	5.00	C20	Jogging Frequency	0.00 to 500.00 Hz	0.00
				H54	Acceleration Time (Jogging)	0.00 to 6000 s	6.00/20.00
				H55	Deceleration Time (Jogging)	0.00 to 6000 s	6.00/20.00
C21	Pattern Operation (Mode select)	0: Perform a pattern operation cycle, then stop operation	0				
		1: Perform pattern operation repeatedly. Stop operation using a stop command.					
		2: Perform a pattern operation cycle, then continue operation with the last frequency set.					
C22 to C28	Stage 1 to 7	0.00 to 6000 s, F1 to F4, R1 to R4	0.00 F1				
C30	Frequency Command 2	0: Setting by keypad panel operation (▲ ▼ key)	2	C30	Frequency Command 2	0: Enable ▲ / ▼ keys on the keypad	2
		1: Setting by voltage input (terminal [12]) (0 to +10 V)				1: Voltage input to terminal [12] (-10 to +10 VDC)	
		2: Setting by current input (terminal [C1]) (4 to 20 mA)				2: Current input to terminal [C1] (4 to 20 mA DC)	
		3: Setting by voltage input + current input (terminal [12] + terminal [C1])				3: Sum of voltage and current inputs to terminals [12] and [C1]	
		4: Reversible operation with polarity (terminal [12]) (-10 to +10 V)		C30	Frequency Command 2	1: Voltage input to terminal [12] (-10 to +10 VDC)	2
				C35	Analog Input Adjustment for [12] (Polarity)	0: Bipolar	1

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
C30	Frequency Command 2	5: Reversible operation with polarity (terminal [12] + AIO frequency auxiliary input)		C30	Frequency Command 2	1: Voltage input to terminal [12] (-10 to +10 VDC)	2
				E63	Terminal [V2] Extended Function	1: Auxiliary frequency command 1	0
				C35	Analog Input Adjustment for [12] (Polarity)	0: Bipolar	1
		6: Inverse mode operation (terminal [12] (+10 V to 0)		C30	Frequency Command 2	1: Voltage input to terminal [12] (-10 to +10 VDC)	2
				C53	Selection of Normal/Inverse Operation (Frequency command 1)	1: Inverse operation	0
		7: Inverse mode operation (terminal [C1]) (20 to 4 mA)		C30	Frequency Command 2	2: Current input to terminal [C1] (4 to 20 mA DC)	2
				C53	Selection of Normal/Inverse Operation (Frequency command 1)	1: Inverse operation	0
		8: Setting by UP/DOWN control mode 1 (initial value = 0)		C30	Frequency Command 2	7: Terminal command ***UP***/***DOWN*** control	2
				H61	***UP***/***DOWN*** Control (Initial frequency setting)	0: Initial value is 0.00 Hz	1
		9: Setting by UP/DOWN control mode 2 (initial value = last final value)		C30	Frequency Command 2	7: Terminal command ***UP***/***DOWN*** control	2
				H61	***UP***/***DOWN*** Control (Initial frequency setting)	1: Last ***UP***/***DOWN*** command value on releasing the run command	1
		10: Setting by pattern operation					
		11: Setting by digital input or pulse train input		C30	Frequency Command 2	11: Digital input interface card (option) 12: Pulse train input * Max: 100 kHz/Maximum frequency	2
C31	Bias (Terminal [12])	-5.0% to +5.0%	0.0	C31	Analog Input Adjustment for [12] (Offset)	-5.0 to 5.0	0.0
C32	Gain (Terminal [C1])	-5.0% to +5.0%	0.0	C36	Analog Input Adjustment for [C1] (Offset)	-5.0 to 5.0	0.0
C33	Analog Setting Signal Filter	0.00 to 5.00 s	0.05	C33	Analog Input Adjustment for [12] (Filter time constant)	0.00 to 5.00 s	0.05
				C38	Analog Input Adjustment for [C1] (Filter time constant)	0.00 to 5.00 s	0.05
P01	Number of Motor 1 Poles	2 to 14	4	P01	Motor 1 (No. of poles)	2 to 22 poles	4
P02	Motor 1 (Capacity)	0.01 to 45.00 kW: Up to 22 kW	Motor capacity	P02	(Rated capacity)	0.01 to 1000 kW	Depending on inverter capacity
		0.01 to 500 kW: 30 kW and above					
P03	(Rated current)	0.00 to 2000 A	1.30	P03	(Rated current)	0.00 to 2000A	Depending on inverter capacity

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
P04	Motor 1 (Tuning)	0: Inactive 1: Active (Measure the %R1 and %X when the motor stops.) 2: Active (Measure the %R1 and %X when the motor stops, then measure the Io when the motor is rotating.)	0	P04	Motor 1 (Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune while the motor is rotating under V/f control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c")	0
P05	(On-line tuning)	0: Inactive 1: Active	0				
P06	(No-load current)	0.00 to 2000 A	Fuji standard rated value	P06	Motor 1 (No-load current)	0.00 to 2000 A	Depending on inverter capacity
P07	(%R1)	0.00% to 50.00%	Fuji standard rated value	P07	(%R1)	0.00% to 50.00%	Depending on inverter capacity
P08	(%X)	0.00% to 50.00%	Fuji standard rated value	P08	(%X)	0.00% to 50.00%	Depending on inverter capacity
P09	(Slip compensation control 1)	0.00 to 15.00 Hz	0.00	P09	(Slip compensation gain for driving)	0.0% to 200.0% (P09 of G11S) / (P12 of MEGA) × 100% (e.g. If P09 of G11S is 1 Hz and P12 of MEGA is 2, specify 50%.)	100.0
				P11	(Slip compensation gain for braking)	0.00% to 200.0% (P09 of G11S) / (P12 of MEGA) × 100% (e.g. If P09 of G11S is 1 Hz and P12 of MEGA is 2, specify 50%.)	100.0
				P12	(Rated slip frequency)	0.00 to 15.00 Hz Specify the rated slip frequency for the motor. (Obtained also by auto-tuning by P04.)	0.00
H03	Data Initializing	0: Disabled 1: Initializing data	0	H03	Data Initialization	0: Disable initialization 1: Initialize all function code data to the factory defaults	0
H04	Auto-reset (Times)	0: Inactive 1 to 10: Number of retries	0	H04	Auto-reset (Times)	0: Disable 1 to 10: Number of retries	0
H05	(Reset interval)	2 to 20 s	5	H05	(Reset interval)	0.5 to 20.0 s	5.0
H06	Fan Stop Operation	0: ON/OFF control disabled (Always in operation) 1: ON/OFF control enabled	0	H06	Cooling Fan ON/OFF Control	0: Disable (Always in operation) 1: Enable (ON/OFF controllable)	0

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Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
H07	ACC/DEC Pattern (Mode select)	0: Inactive (linear acceleration and deceleration)	0	H07	Acceleration/Deceleration Pattern	0: Linear	0
		1: S-shape acceleration and deceleration (mild)				1: S-curve (Weak)	
		2: S-shape acceleration and deceleration (sharp)				2: S-curve (Arbitrary, according to H57 to H60 data)	
		3: Curvilinear acceleration and deceleration				3: Curvilinear	
H08	Rev. Phase Sequence Lock	0: Inactive	0	H08	Rotational Direction Limitation	0: Disable	0
		1: Active				1: Enable (Reverse rotation inhibited)	
H09	Start Mode	0: Inactive	0	H09	Starting Mode (Auto search)	0: Disable	0
		1: Active (At restart after a momentary power failure or at switching from line to inverter)				1: Enable (At restart after momentary power failure)	
		2: Active (Always)				2: Enable (At restart after momentary power failure and at normal start)	
H10	Energy-saving Operation	Refer to F09, Torque Boost 1.					
H11	DEC Mode	0: Deceleration-to-stop based on data set to "H07 Non-linear Acceleration and Deceleration."	0	H11	Deceleration Mode	0: Normal deceleration	0
		1: Coast-to-stop				1: Coast-to-stop	
H12	Instantaneous OC Limiting	0: Inactive	1	H12	Instantaneous Overcurrent Limiting (Mode selection)	0: Disable	1
		1: Active				1: Enable	
H13	Auto-restart (Restart time)	0.1 to 10.0 s	0.5	H13	Restart Mode after Momentary Power Failure (Restart time)	0.1 to 10.0 s	Depending on inverter capacity
H14	(Freq. fall rate)	0.00: Deceleration time selected by F08	10.00	H14	(Frequency fall rate)	0.00: Deceleration time selected by F08	999
		0.01 to 100.00 Hz/s				0.01 to 100.00 Hz/s	
						999: Follow the current limit command	
H15	(Holding DC voltage)	200 to 300 V: (200 V class)	235	H15	(Continuous running level)	200 to 300 V for 200 V class series	235
		400 to 600 V: (400 V class)	470			400 to 600 V for 400 V class series	470
H16	(OPR command selfhold time)	0.0 to 30.0 s	999	H16	(Allowable momentary power failure time)	0.0 to 30.0s	999
		999: Automatically determined by inverter				999: Automatically determined by inverter	
H18	Torque Control (Mode selection)	0: Inactive (operation by frequency command)	0				
		1: Torque control active (Terminal [12]: 0 to 10 V/0% to 200%)					
		2: Torque control active (Terminal [12]:-10 V to +10 V/-200% to +200%)					
H19	Active Drive	0: Inactive	0				
		1: Active					

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
H20	PID Control (Mode select)	0: No operation	0	J01	PID Control (Mode selection)	0: Disable	0
		1: Forward operation (When the PID output rises, the output frequency rises.)				1: Enable (Process control, normal operation)	
		2: Reverse operation (When the PID output rises, the output frequency drops.)				2: Enable (Process control, inverse operation)	
H21	(Feedback signal)	0: Control terminal [12], forward operation (0 to 10 V voltage input)	1	J02	PID Control (Remote command SV)	1: PID process command 1 (Analog input terminals [12], [C1], and [V2])	0
				E61	Terminal [12] Extended Function	5: PID feedback amount	
		1: Control terminal [C1], forward operation (4 to 20 mA current input)		J02	PID Control (Remote command SV)	1: PID process command 1 (Analog input terminals [12], [C1], and [V2])	
				E62	Terminal [C1] Extended Function	5: PID feedback amount	
		2: Control terminal [12], reverse operation (10 to 0 V voltage input)					
		3: Control terminal [C1], reverse operation (20 to 4 mA current input)					
H22	(P-gain)	0.01 to 10.00 times	0.10	J03	PID Control P (Gain)	0.000 to 30.000 times	0.100
H23	(I-gain)	0.0 to 3600.0 s	0.0	J04	I (Integral time)	0.0 to 3600.0 s	0.0
H24	(D-gain)	0.00 to 10.00 s	0.00	J05	D (Differential time)	0.00 to 600.00 s	0.00
H25	(Feedback filter)	0.0 to 60.0 s	0.5	J06	(Feedback filter)	0.0 to 900.0 s	0.5
H26	PTC Thermistor (Mode select)	0: Inactive	0	H26	Thermistor (for motor) (Mode selection)	0: Disable	0
		1: Active				1: PTC (The inverter immediately trips with ﾌﾟﾀｰ displayed.)	
H27	(Level)	0.00 to 5.00 V	1.60	H27	(Level)	0.00 to 5.00 V	0.35
H28	Droop Operation	-9.9 to 0.0 Hz	0.0	H28	Droop Control	-60.0 to 0.0 Hz	0.0
H30	Serial Link (Function select)	0: Frequency command = Disabled, Operation command = Disabled	0	H30	Communications Link Function (Mode selection)	0: F01/C30 (Frequency command), F02 (Run command)	0
		1: Frequency command = Enabled, Operation command = Disabled				4: RS-485 (Port 2) (Frequency command), F02 (Run command)	
		2: Frequency command = Disabled, Operation command = Enabled				6: F01/C30 (Frequency command), RS-485 (Port 2) (Run command)	
		3: Frequency command = Enabled, Operation command = Enabled				8: RS-485 (Port 2) (Frequency command), RS-485 (Port 2) (Run command)	

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
H31	RS-485 (Address)	1 to 31	1	y11	RS-485 Communication 2 (Station address)	1 to 235	1
H32	(Mode select on no response error)	0: Immediate Er-8 trip	0	y12	(Communications error processing)	0: Immediately trip with alarm Er-P	0
		1: Continue operation within timer time, Er-8 trip after timer time				1: Trip with alarm Er-P after running for the period specified by timer y13	
		2: Continue operation and effect retry within timer time, then invoke an Er-8 trip if a communication error occurs.				2: Retry during the period specified by timer y13. If the retry fails, trip with alarm Er-P. If it succeeds, continue to run.	
		3: Continue operation				3: Continue to run	
H33	(Timer)	0.0 to 60.0 s	2.0	y13	(Timer)	0.0 to 60.0 s	2.0
H34	(Baud rate)	0: 19200 bit/s	1	y14	(Baud rate)	3: 19200 bps	3
		1: 9600 bit/s				2: 9600 bps	
		2: 4800 bit/s				1: 4800 bps	
		3: 2400 bit/s				0: 2400 bps	
		4: 1200 bit/s					
H35	(Data length)	0: 8 bit	0	y15	(Data length)	0: 8 bits	0
		1: 7 bit				1: 7 bits	
H36	(Parity check)	0: None	0	y16	(Parity check)	0: None (2 stop bits)	0
		1: Even				1: Even parity (1 stop bit)	
		2: Odd				2: Odd parity (1 stop bit)	
H37	(Stop bits)	0: 2 bit	0	y17	(Stop bits)	0: 2 bits	0
		1: 1 bit				1: 1 bit	
H38	(No response error detection time)	0: No detection	0	y18	(No-response error detection time)	0: No detection	0
		1 to 60 s				1 to 60 s	
H39	(Response interval)	0.00 to 1.00 s	0.01	y19	(Response interval)	0.00 to 1.00 s	0.01
A01	Maximum Frequency 2	50 to 400 Hz	60	A01	Maximum Frequency 2	25.0 to 500.0 Hz	60.0
A02	Base Frequency 2	25 to 400 Hz	50	A02	Base Frequency 2	25.0 to 500.0 Hz	50.0
A03	Rated Voltage 2 (At base frequency 2)	0: (Output voltage proportional to source voltage)	200 (200 V class)	A03	Rated Voltage at Base Frequency 2	0: Output a voltage in proportion to input voltage	200 (200 V class series)
		80 to 240 V: (200 V class) 320 to 480 V: (400 V class)	400 (400 V class)			80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	400 (400 V class series)
A04	Maximum Voltage 2	80 to 240 V: (200 V class) 320 to 480 V: (400 V class)	200 (200 V class) 400 (400 V class)	A04	Maximum Output Voltage 2	80 to 240: Output an AVR-controlled voltage (for 200 V class series) 160 to 500: Output an AVR-controlled voltage (for 400 V class series)	200 (200 V class series) 400 (400 V class series)

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
A05	Torque Boost 2	0.0: Automatic torque boost 0.1 to 0.9: Square law reduction torque 1.0 to 1.9: Proportional torque 2.0 to 20.0: Constant torque (H10 = 0 when the auto-energy saving operation is inactive)	G11S: 0.0	A13	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 2	2: Auto-torque boost	1
				A13	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 2	0: Variable torque load	1
				A05	Torque Boost 2	0.0 to 20.0: *	Depending on inverter capacity
				A13	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 2	1: Constant torque load	1
				A05	Torque Boost 2	0.0 to 20.0: *	Depending on inverter capacity
		0.0: Automatic torque boost 0.1 to 0.9: Square law reduction torque 1.0 to 1.9: Proportional torque 2.0 to 20.0: Constant torque (H10 = 1 when the auto-energy saving operation is active)		A13	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 2	5: Auto-energy saving operation (Auto-torque boost during ACC/DEC)	1
				A13	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 2	3: Auto-energy saving operation (Variable torque load during ACC/DEC)	1
				A05	Torque Boost 2	0.0 to 20.0: *	Depending on inverter capacity
				A13	Load Selection/Auto Torque Boost/Auto Energy Saving Operation 2	4: Auto-energy saving operation (Constant torque load during ACC/DEC)	1
				A05	Torque Boost 2	0.0 to 20.0: *	Depending on inverter capacity
A06	Electric Thermal Overload Relay for Motor 2 (Select)	0: Inactive	1	A07	Electronic Thermal Overload Protection for Motor 2 (Overload detection level)	0.00: Disable	Motor rated current
		1: Active (for general-purpose motor)		A06	(Select motor characteristics)	1: For a general-purpose motor with shaft-driven cooling fan	1
		2: Active (for inverter motor)				2: For an inverter-driven motor, non-ventilated motor, or motor with separately powered cooling fan	
A07	(Level)	20% to 135% of the rated current of the inverter	Motor rated current	A07	(Overload detection level)	1% to 135% of the rated current (allowable continuous drive current) of the motor	Motor rated current
A08	(Thermal time constant)	0.5 to 75.0 min	5.0/10.0	A08	(Thermal time constant)	0.5 to 75.0 min	5.0/10.0
A09	Torque Vector Control 2	0: Inactive	0	A14	Drive Control Selection 2	0: V/f control with slip compensation inactive	0
		1: Active				1: Dynamic torque vector control	

* For the torque boost settings, refer to the conversion tables on pages A-67 and onwards.

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
A10	Number of Motor-2 Poles	2 to 14 poles	4	A15	Motor 2 (No. of poles)	2 to 22 poles	4
A11	Motor 2 (Capacity)	0.01 to 45.00 kW: Up to 22 kW 0.01 to 500 kW: 30 kW or above	Motor capacity	A16	(Rated capacity)	0.01 to 1000 kW	Depending on inverter capacity
A12	(Rated current)	0.00 to 2000 A	Motor rated current	A17	(Rated current)	0.00 to 2000 A	Depending on inverter capacity
A13	(Tuning)	0: Inactive 1: Active (Measure the %R1 and %X when the motor stops.) 2: Active (Measure the %R1 and %X when the motor stops, then measure the Io when the motor is rotating.)	0	A18	(Auto-tuning)	0: Disable 1: Tune while the motor stops. (%R1, %X and rated slip frequency) 2: Tune while the motor is rotating under V/f control (%R1, %X, rated slip frequency, no-load current, magnetic saturation factors 1 to 5, and magnetic saturation extension factors "a" to "c")	0
A14	(On-line tuning)	0: Inactive 1: Active	0				
A15	(No-load current)	0.00 to 2000 A	Fuji standard rated value	A20	Motor 2 (No-load current)	0.00 to 2000 A	Depending on inverter capacity
A16	(%R1 setting)	0.00% to 50.00%		A21	(%R1)	0.00% to 50.00%	Depending on inverter capacity
A17	(%X setting)	0.00% to 50.00%		A22	(%X)	0.00% to 50.00%	Depending on inverter capacity
A18	(Slip compensation control 2)	0.00 to 15.00 Hz	0.00	A23	(Slip compensation gain for driving)	0.0% to 200.0% (A18 of G11S) / (A26 of MEGA) × 100% (e.g. If A18 of G11S is 1 Hz and A26 of MEGA is 2, specify 50%.)	100.0
				A25	(Slip compensation gain for braking)	0.00% to 200.0% (A18 of G11S) / (A26 of MEGA) × 100% (e.g. If A18 of G11S is 1 Hz and A26 of MEGA is 2, specify 50%.)	100.0
				A26	(Rated slip frequency)	0.00 to 15.00 Hz Specify the rated slip frequency for the motor. (Obtained also by auto-tuning by P04.)	0.00
				* For settings of the 2nd motor, specify the related function codes as needed. For details of those function codes, refer to the description of A42 in Chapter 5 "FUNCTION CODES."			
U01	Maximum Compensation Frequency During Braking Torque Limit	0 to 65535	75	H76	Torque Limiter (Frequency increment limit for braking)	0.0 to 500.0 Hz	5.0
U02	1st S-shape Level at Acceleration	1% to 50%	10	H57	1st S-curve Acceleration Range (Leading edge)	0% to 100%	10

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
U03	2nd S-shape Level at Acceleration	1% to 50%	10	H58	2nd S-curve Acceleration Range (Trailing edge)	0% to 100%	10
U04	1st S-shape Level at Deceleration	1% to 50%	10	H59	1st S-curve Deceleration Range (Leading edge)	0% to 100%	10
U05	2nd S-shape Level at Deceleration	1% to 50%	10	H60	2nd S-curve Deceleration Range (Trailing edge)	0% to 100%	10
U08	Main DC Link Capacitor (Initial value)	0 to 65535	-	H47	Initial Capacitance of DC Link Bus Capacitor	0 to 65535	-
U09	(Measured value)	0 to 65535	0	H42	Capacitance of DC Link Bus Capacitor	0 to 65535	-
U10	PC Board Capacitor Powered on Time	0 to 65535 h	0	H48	Cumulative Run Time of Capacitors on Printed Circuit Boards	0 to 9999 (10h)	-
U11	Cooling Fan Operating Time	0 to 65535 h	0	H43	Cumulative Run Time of Cooling Fan	0 to 9999 (10h)	-
U13	Magnetize Current Vibration Damping Gain	0 to 32767	819/410	H80	Output Current Fluctuation Damping Gain for Motor 1	0.00 to 0.40	0.20
U15	Slip Compensation Filter Time Constant	0 to 32767	556/546	P10	Motor 1 (Slip compensation response time)	0.01 to 10.00 s	0.50
U23	Integral Gain of Continuous Operation at Power Failure	0 to 65535 (Integral time (ms) = 2^{16}/U23 setting data)	1738/1000	H93	Continuity of Running (I)	999: Standard value	999
U24	Proportional Gain of Continuous Operation at Power Failure	0 to 65535 (1.000 time = 4096)	1024/1000	H92	(P)	999: Standard value	999
U48	Input Phase Loss Protection	0, 1: Active	55 kW or below: 0	H98	Protection/Maintenance Function (Mode selection)	Bit 1: Detect input phase loss (0: Disabled; 1: Enabled)	83
		2: Inactive	75 kW or above: 1			Bit 0: Lower the carrier frequency automatically (0: Disabled; 1: Enabled)	
U49	RS-485 Protocol Selection	0: FGI-bus	0	y20	RS-485 Communication 2 (Protocol selection)	2: Fuji general-purpose inverter protocol	0
		1: Modbus-RTU				0: Modbus RTU protocol	
U56	Speed Agreement/PG Error (Detection width)	0% to 50%	10	d21	Speed Agreement/PG Error (Hysteresis width)	0.0% to 50.0%	10.0
U57	(Detection timer)	0.0 to 10.0 s	0.5	d22	(Detection timer)	0.00 to 10.00 s	0.50
U58	PG Error Selection	0: Continue to run (Outputs PG error signal)	1	d23	PG Error Processing	0: Continue to run	2
		1: Stop running (Immediately ﾊﾟﾀﾝ trip)				2: Stop running with alarm 2	
U59	Braking-resistor Function Select	Standard applied resistor (one resistor is used)	00	F50	Electronic Thermal Overload Protection for Braking Resistor (Discharging capability)	Set the value of the discharging capability (kWs), allowable average loss (kW), and resistance (Ω) of the braking resistor currently used to the function codes F50 to F52, respectively.	7.5 kW or below: 0, 11 kW or above: OFF
		1: DB0.75-2C (100Ω 200 W)		F51	(Allowable average loss)		0.001
		2: DB2.2-2C (40Ω 400 W)		F52	(Resistance)		0.01
		3: DB3.7-2C (33Ω 400 W)					
		4: DB5.5-2C (20Ω 800 W)					
		5: DB7.5-2C (15Ω 900 W)					
		6: DB0.75-4C (200Ω 200 W)					
		7: DB2.2-4C (160Ω 400 W)					
		8: DB3.7-4C (130Ω 400 W)					
		9: DB5.5-4C (80Ω 800 W)					

FRENIC5000G11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
U60	Regeneration Avoidance at Deceleration	Refer to F41 and E17, Torque Limiter 1 and 2.					
U61	Voltage Detect Offset and Gain Adjustment	0 (Up to 22 kW) 0: Inactive (fixed)	0				
		0 to 2 (30 kW or above) 0: Inactive	0				
		1: Voltage detect offset adjustment					
		2: Voltage detect gain adjustment					
The FRENIC5000G11S series of inverters do not support these functions shown at the right. When replacing the FRENIC5000G11S with the FRENIC-MEGA, cancel or disable these function codes in FRENIC-MEGA in order to conform them to the FRENIC5000G11S.				F43	Current Limiter (Mode selection)	0: Disable (No current limiter works.)	2
				H50	Non-linear V/f Pattern 1 (Frequency)	0.0: Cancel (30 kW or above)	0.0/5.0
				H51	(Voltage)	0: Cancel (30 kW or above)	0/20
				H72	Main Power Down Detection (Mode selection)	0: Disable	1

[4] FRENIC5000P11S vs. FRENIC-MEGA

FRENIC5000P11S				FRENIC-MEGA			
Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above	Code	Name	Data setting range	Default setting 22 kW or below/ 30 kW or above
When replacing the FRENIC5000P11S with the FRENIC-MEGA, set the F80 data of the FRENIC-MEGA to "1: LD (Low Duty) mode." The LD-mode inverter brings out the continuous rated current level which enables the inverter to drive a motor with one rank higher capacity, but its overload capability (%) against the continuous current rating level decreases.				F80	Switching between HD, MD, and LD drive modes	1: LD (Low Duty) mode	0
Replacement of function codes for the FRENIC5000P11S is basically equivalent to that for the FRENIC5000G11S given on pages A-48 to A-66, except for the data setting range of following function codes.							
F26	Motor Sound (Carrier frequency)	0.75 to 15 kHz: Up to 22 kW	2	F26	Motor Sound (Carrier frequency)	0.75 to 15 kHz: 18.5 kW or below (Up to 16 kHz can be specified.)	2
		0.75 to 10 kHz: 30 to 75 kW				0.75 to 16 kHz: 30 to 55 kW	
		0.75 to 6 kHz: 90 kW or above				0.75 to 10 kHz: 75 kW or above	

■ Torque boost conversion tables

FRENIC5000G9S/P9S (22 kW or below) vs. FRENIC-MEGA

G9S/P9S	FRENIC-MEGA		Remarks
Data for 07	F37	F09	
0.1	0	0.0%	Adjust the torque boost using H50 and H51 as needed.
0.2		2.9%	
0.3		5.8%	
0.4		8.6%	
0.5		11.5%	
0.6		14.4%	
0.7		17.3%	
0.8		20.0%	
0.9		20.0%	
1.0	1	0.0%	Adjust the torque boost using H50 and H51 as needed.
1.1		2.6%	
1.2		5.1%	
1.3		7.7%	
1.4		10.2%	
1.5		12.8%	
1.6		15.3%	
1.7		17.9%	
1.8		20.0%	
1.9		20.0%	
2.0	1	0.0%	*For data values other than those listed at the left, use the expression given below.
3.0		1.3%	
4.0		2.6%	
5.0		3.8%	
6.0		5.1%	
7.0		6.4%	
8.0		7.7%	
9.0		8.9%	
10.0		10.2%	
11.0		11.5%	
12.0		12.8%	
13.0		14.1%	
14.0		15.3%	
15.0		16.6%	
16.0		17.9%	
17.0		19.2%	
17.6		19.9%	
18.0		20.0%	
19.0		20.0%	
20.0		20.0%	

* Expression
If 07 data of G9S or P9S is 2.0 to 20.0,
F09 data (%) of FRENIC-MEGA = 1.278 × ([07 data of G9S or P9S] - 2.0)

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FRENIC5000G9S/P9S (30 kW or above) vs. FRENIC-MEGA

G9S/P9S	FRENIC-MEGA		Remarks
Data for 07	F37	F09	
0.1	0	4.4%	Adjust the torque boost using H50 and H51 as needed.
0.2		4.4%	
0.3		4.4%	
0.4		4.4%	
0.5		5.0%	
0.6		6.3%	
0.7		7.5%	
0.8		8.8%	
0.9		10.0%	
1.0	1	4.4%	Adjust the torque boost using H50 and H51 as needed.
1.1		4.4%	
1.2		4.4%	
1.3		4.4%	
1.4		4.4%	
1.5		5.6%	
1.6		6.7%	
1.7		7.8%	
1.8		8.9%	
1.9		10.0%	
2.0	1	0.0%	*For data values other than those listed at the left, use the expression given below.
3.0		0.6%	
4.0		1.1%	
5.0		1.7%	
6.0		2.2%	
7.0		2.8%	
8.0		3.3%	
9.0		3.9%	
10.0		4.4%	
11.0		5.0%	
12.0		5.6%	
13.0		6.1%	
14.0		6.7%	
15.0		7.2%	
16.0		7.8%	
17.0		8.3%	
18.0		8.9%	
19.0		9.4%	
20.0		10.0%	

* Expression
If 07 data of G9S or P9S is 2.0 to 20.0,
F09 data (%) of FRENIC-MEGA = 0.556 × ([07 data of G9S or P9S] - 2.0)

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FRENIC5000G11S/P11S (22 kW or below) vs. FRENIC-MEGA

G11S/P11S	FRENIC-MEGA		Remarks
Data for F09	F37	F09	
0.1	0	7.0%	Adjust the torque boost using H50 and H51 as needed.
0.2		8.3%	
0.3		9.5%	
0.4		10.8%	
0.5		12.0%	
0.6		13.3%	
0.7		14.5%	
0.8		15.8%	
0.9		17.0%	
1.0	1	7.0%	Adjust the torque boost using H50 and H51 as needed.
1.1		8.1%	
1.2		9.2%	
1.3		10.3%	
1.4		11.5%	
1.5		12.6%	
1.6		13.7%	
1.7		14.8%	
1.8		15.9%	
1.9		17.0%	
2.0	1	0.0%	*For data values other than those listed at the left, use the expression given below.
3.0		1.3%	
4.0		2.6%	
5.0		3.8%	
6.0		5.1%	
7.0		6.4%	
8.0		7.7%	
9.0		8.9%	
10.0		10.2%	
11.0		11.5%	
12.0		12.8%	
13.0		14.1%	
14.0		15.3%	
15.0		16.6%	
16.0		17.9%	
17.0		19.2%	
17.6		19.9%	
18.0		20.0%	
19.0		20.0%	
20.0		20.0%	

* Expression
If F09 data of G11S or P11S is 2.0 to 20.0,
F09 data (%) of FRENIC-MEGA = 1.278 × ([F09 data of G11S or P11S] - 2.0)

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FRENIC5000G11S/P11S (30 kW or above) vs. FRENIC-MEGA

G11S/P11S	FRENIC-MEGA		Remarks
Data for F09	F37	F09	
0.1	0	8.0%	Adjust the torque boost using H50 and H51 as needed.
0.2		9.3%	
0.3		10.5%	
0.4		11.8%	
0.5		13.0%	
0.6		14.3%	
0.7		15.5%	
0.8		16.8%	
0.9		18.0%	
1.0	1	8.0%	Adjust the torque boost using H50 and H51 as needed.
1.1		9.1%	
1.2		10.2%	
1.3		11.3%	
1.4		12.5%	
1.5		13.6%	
1.6		14.7%	
1.7		15.8%	
1.8		16.9%	
1.9		18.0%	
2.0	1	0.0%	*For data values other than those listed at the left, use the expression given below.
3.0		0.6%	
4.0		1.1%	
5.0		1.7%	
6.0		2.2%	
7.0		2.8%	
8.0		3.3%	
9.0		3.9%	
10.0		4.4%	
11.0		5.0%	
12.0		5.6%	
13.0		6.1%	
14.0		6.7%	
15.0		7.2%	
16.0		7.8%	
17.0		8.3%	
18.0		8.9%	
19.0		9.4%	
20.0		10.0%	

* Expression

If F09 data of G11S or P11S is 2.0 to 20.0,

F09 data (%) of FRENIC-MEGA = 0.556 × ([F09 data of G11S or P11S] - 2.0)

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Glossary

This glossary explains the technical terms that are frequently used in this manual.

Acceleration time

A period required for an inverter to increase its output from 0 Hz to the maximum frequency. It should be specified, taking into account the inertia of the machinery (load).

Related function codes: F03, A01, b01, r01, F07, E10, E12, E14 and H54

Alarm output (for any alarm)

A signal issued when any of the protective functions is activated.

Allowable voltage/frequency fluctuation

General-purpose inverters are designed to be supplied with power from commercial power lines. The allowable voltage/frequency fluctuation ranges are specified (see Chapter 2, Section 2.1). Even power supplied by a private power generator should meet the power requirements.

Analog input

An external voltage or current input to give the inverter a frequency command through any of terminals [12], [C1] and [V2]. Assignment of functions to these terminals can be changed using function codes.

Related function codes: E61 to E63

Anti-regenerative control (Automatic deceleration)

A control mode that prevents the inverter from causing an overvoltage trip due to excessive regenerative energy, by automatically controlling the deceleration time and output frequency, even if no braking resistor is used.

Related function codes: H69

Auto energy saving operation

Energy saving operation that automatically controls the output voltage to the motor in order to minimize the total power loss of the motor and the inverter.

Related function codes: F37, A13, b13 and r13

Auto search

Automatically searching for the rotational speed and direction of the motor idling without power supplied in order for the inverter to smoothly drive the idling motor again.

Related function codes: H09, H46 and H49

Auto-reset function

A function that makes the inverter automatically attempt to reset the tripped state and restart even if any protective function is activated. The number of reset times and interval can be specified with function codes.

Related function codes: H04 and H05

Auto-tuning

Automatically tuning up the inverter itself by detecting the constants of the connected motor and saving the motor parameters in the inverter. Auto-tuning is started by the keypad operation.

Related function codes: P04, A18, b18 and r18

Auxiliary power input for the control circuit

A general-purpose inverter usually supplies its control circuit with power from the DC link bus. In a panel that shuts down the power if the inverter trips, therefore, the panel display disappears with the trip. The auxiliary power input is used to keep the panel display.

AVR (Automatic Voltage Regulator)

Voltage regulator that keeps the inverter output voltage constant regardless of input voltage fluctuations.

Balanceless-bumpless switching

To switch the frequency command source to the keypad from any other source, in which the inverter inherits the current frequency that has applied before switching. This switching provides smooth switching and shockless running

Related function codes: F01 and C30

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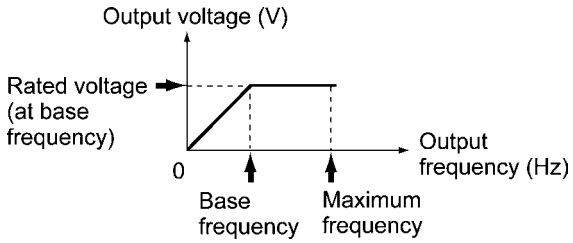
Base frequency

The minimum frequency at which an inverter's output voltage becomes constant.

Related function codes: F04, A02, b02 and r02



Bias

Bias that is a value to be added to an analog frequency command value (e.g., 0 to 10 VDC) to produce the output frequency. It applies to the frequency control signal voltage from the upper level controller.

Related function codes: F18 and C50 to C52

Braking torque

Generally, a motor acts as a generator during a decelerate-to-stop sequence, where the kinetic energy built up in the machinery (load) is transformed into electric power and returned to the inverter. The inverter consumes the returned power to generate a braking torque.

Carrier frequency

Frequency used to determine the modulation period of a pulse width under the inverter's PWM control. The higher the carrier frequency, the closer to the sinusoidal waveform the inverter output current waveform approaches and the quieter the motor sound becomes. However, noise emitted from the inverter increases.

Related function codes: F26

Coast-to-stop command (***BX***)

A digital terminal command input to one of the control circuit terminals, which forces the inverter to immediately shut down its output, causing the motor to coast to a stop. Used to forcibly stop the motor independent of inverter control.

Related function codes: E01 to E09, E98 and E99

Constant torque load

Machinery (load) that requires a constant torque independent of the inverter's output frequency (motor speed). The power consumption increases in proportion to the motor speed. For such machinery (load), e.g., a material conveyer and a lift, the HD-mode inverters are required.

Control circuit terminals

Terminals mainly used to connect to signal lines from a PLC or control relay circuits. Inverters with any capacity have these terminals in common. These terminals include an analog output terminal for a conventional analog meter and a pulse output terminal.

Cooling fan ON/OFF control

A control that automatically turns the cooling fan ON and OFF depending on the temperature detected inside the inverter, saving unnecessary cooling fan operations.

Related function codes: H06

Current limiter

A control that limits the inverter output current to a specified level by varying the output frequency.

Related function codes: F43 and F44

Current response

A performance index under vector control, which indicates how often the inverter can change the direction of current to the motor. If this index is 100 Hz, it means that the current direction change command is applicable 100 times a second.

DC braking

DC current braking that flows a DC current through the motor stator windings to generate a magneto electric loss of the rotor. Used to firmly stop the motor when the load has a large moment of inertia and a low friction torque.

Related function codes: F20, A09, b09, r09, F21, A10, b10, r10, F22, A11, b11 and r11

DC link bus voltage

The voltage of the DC link bus that is an inverter input circuit to convert the input AC power to the DC power. It is approx. 1.4 times the input power voltage and is used as a reference voltage in detecting an undervoltage or overvoltage condition. It can be monitored on the keypad.

Deceleration time

A period required for an inverter to decelerate its output from the maximum frequency to 0 Hz.

Related function codes: F03, A01, b01, r01, F08, E11, E13, E15 and H55

Droop control

A control that reduces the inverter's output frequency depending on the motor's load factor. When the machinery (load) is driven by two or more inverter-driven motors, this control helps the inverters balance their driving forces.

Related function codes: H28

Dynamic torque vector control

A high performance control system in which the inverter calculates the flux and torque vectors based on the real-time voltage and current applied to the motor power terminals. Its basic control is V/f control.

Electronic thermal overload protection

A function that protects the motor from overheating with internal electronic calculation, without using a thermistor or any other thermal sensors on the motor.

Related function codes: F10 to F12

Enable data change with keypad (***WE-KP***)

A digital terminal command input to one of the control circuit terminals, which protects function code data from accidentally getting changed from the keypad when this command is OFF in order to prevent the motor from unexpectedly running.

Turning this command ON enables data change from the keypad.

Related function codes: E01 to E09, E98 and E99

Encoder (PG: pulse generator)

One type of rotational sensor, directly mounted on the output shaft of a vector motor. It generally outputs A and B phase signals. According to these signals, the inverter can detect the motor rotational direction, speed and amount. Using the encoder requires an optional PG interface card (OPC-G1-PG) on the inverter.

Filter

A filter that smoothens and cleans a signal, eliminating unnecessary frequency band. Applying a filter will produce a desirable effect in some cases:

- Suppressing fluctuation of unstable, hard-to-read display on the keypad (F42).
- Suppressing noise superimposed on analog input for frequency command (C33, C38 and C43).
- Stabilizing analog speed command and feedback signal (d01, d02, d09, d10 and d61).

Frequency accuracy

An index that indicates the accuracy of inverter output frequency relative to the commanded frequency. If the frequency command is given digitally from the keypad, the accuracy will be ±0.01% of the maximum frequency.

Frequency command

Reference frequency whose sources can be specified by function code F01. In addition, it can be given by multi-frequency commands and via an RS-485 communications link or other open networks.

Frequency command resolution

Resolution of a frequency command given in an analog input format such as a voltage input. The resolution of terminal [12] input, for example, is 1/3000 of the maximum frequency.

Frequency limiter

A function that determines the upper and lower limits of the inverter output frequency to protect the motor. Accordingly, it protects the machinery (load) from getting unexpected frequency command.

Related function codes: F15 and F16

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HD (High Duty) mode

A mode that applies to the inverter for driving a motor whose capacity is identical to the inverter's one. The HD-mode inverter withstands 150% of the rated current for a minute, and 200% for three seconds.

Related function codes: H80

Interphase (voltage) unbalance

Interphase unbalance of three-phase AC input voltage (supply voltage) that is calculated by the following expression stipulated by the IEC Standard.

$$\text{Interphase voltage unbalance (\%)} = \frac{\text{Max. voltage (V) - Min. voltage (V)}}{\text{Three-phase average voltage (V)}} \times 67$$

The IEC Standard requires variable speed drives such as inverters to withstand up to 2% of interphase voltage unbalance.

Inverse operation

Inverting the scale of the inverter's output frequency to its analog frequency command level. Used for applications such as air-conditioners that require switching between cooling and heating.

Related function codes: C53

Jogging operation

Inching the motor for mechanical positioning in the machinery (load). The frequency command, acceleration/deceleration time and dynamic response during the vector control can be separately specified.

Related function codes: C20

Jump frequencies

Jump frequencies that are used to skip inverter operation in the specified jump frequency bands within the driving frequency band in order to avoid resonance caused by the motor speed and natural frequency of the machinery. In the jump frequency bands, the specified acceleration/ deceleration time applies.

Related function codes: C01 to C04

LD (Low Duty) mode

A mode that applies to the inverter for driving a motor whose capacity is one rank or two ranks higher than the inverter's one. The LD-mode inverter withstands 120% of the rated current for a minute.

Related function codes: H80

Line speed

Traveling speed of a machine (e.g., conveyor) driven by the inverter-driven motor. The unit is meter per minute (m/min). The speed can be displayed on the keypad.

Related function codes: E43 and E50

Link function

A function that starts or stops the inverter through a communications link such as RS-485 interface or other open network, without using the keypad or digital input terminal signals.

Related function codes: H30, y98 and y99

Main circuit terminals

Power input/output terminals mainly used to connect to commercial power lines, braking resistors, DC reactors and motors. The size and other specifications of the terminals differ depending on the inverter capacity.

Maximum frequency

The maximum output frequency of an inverter. It equals to the reference frequency when the +10V input applies on terminal [12] or the 20 mA input applies on terminal [C1] if the gain is set at 100%.

Related function codes: F03, A01, b01 and r01

MD (Medium Duty) mode

A mode that applies to the inverter for driving a motor whose capacity is one rank higher than the inverter's one. The MD-mode inverter withstands 150% of the rated current for a minute.

Related function codes: H80

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Mock alarm

Alarm intentionally caused by activating the inverter protective function in order to check whether external sequences function correctly at the time of machine setup.

Simultaneous keying or using the related function code causes a mock alarm. The mock alarm can be reset by the terminal command ***RST***.

Related function codes: H45

Motor selection

A general-purpose inverter can drive more than one motor by switching. A FRENIC-MEGA inverter can drive up to four motors by switching with terminal commands ***M2***, ***M3*** and ***M4***. It is also possible to register four sets of motor drive data, including base frequencies, drive controls and numbers of poles.

Related function codes: E01 to E09

Multi-frequency selection

Selection from 15 steps of reference frequencies that can be switched by digital terminal command input to the control circuit terminals.

Those 15 steps of frequencies should be preset with function codes C05 to C19.

Related function codes: E01 to E09, E98 and E99

Output circuit filter

An output circuit filter (OFL-□□□-□A) that is used to eliminate noise leakages from the inverter main output cable when the cable length between the inverter and the motor is long or when an inverter drives two or more motors so that the total cable length is long.

Nominal applied motors

Three-phase induction motors (4-pole) that can be normally driven by the inverter. The output ratings are expressed in kW as listed in the specification tables.

Overload capability

Index that indicates how much overload conditions the inverter can tolerate. It is expressed in a combination of the output current level (%) and the period, assuming the rated current as 100%. For instance, it is 150% for 1 minute in HD mode, and 120% for 1 minute in LD mode.

Overload current rating

The overload current that the inverter can tolerate, expressed in percentage of the rated output current level and its permissible period.

Overload prevention control

A function that detects inverter's heat sink overheat or overload and lowers the output frequency before the inverter trips, thus preventing the protective function from being activated. Useful for equipment such as pumps in which a decrease in the output frequency leads to a decrease in the load.

Related function codes: H70

PLC signal power (Terminal [PLC])

Name of an external power input terminal that connects to a PLC (programmable logic controller) output signal power supply. Also used to supply power to the load connected to the transistor output terminals.

Positioning control

Positioning control under which the inverter detects the rotational amount of the encoder to control that of the motor shaft. Under the speed control, the inverter controls the rotational speed of the motor shaft using the speed sensor.

The "Positioning control," implies the traveling distance of machinery (load) driven by the motor.

Pulse train input

Pulse train input that the inverter can use as a frequency command or speed command. It is a digital signal, enabling control with less thermal drift.

Related function codes: d59, d62 and d63

Rated capacity

The rating of an inverter output capacity, or the apparent power obtained by multiplying the rated output voltage by the rated output current.

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Rated output current

An RMS current that flows through the inverter's output terminals under the rated output conditions (that is, when the output voltage, current, frequency and load factor meet the rated conditions).

The 200 V class series of inverters is designed so that the rated output current is higher than that of a 200 V, 6-pole motor; the 400 V class series is designed so that it is higher than that of a 380 V, 50 Hz, 4-pole motor.

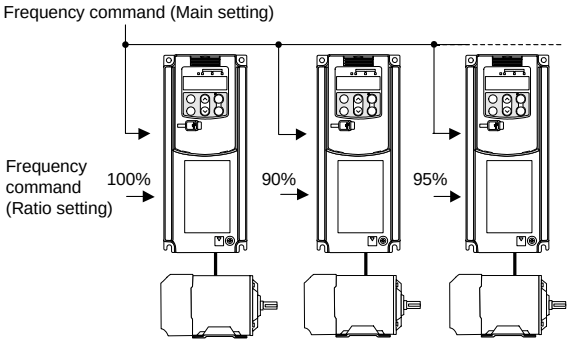
Rated output voltage

An RMS voltage of a fundamental wave that is generated across the inverter’s output terminals when the output frequency is equal to the base frequency.

Ratio operation

Ratio operation in which two or more inverters share a same frequency command (main setting) and an individual inverter multiplies the given frequency command by the ratio (%) specified by one of the analog input terminal extended functions so that individual inverters run at different output frequencies.

Related function codes: E61 to E63



$$\text{Frequency command} = \text{Main setting} \times \frac{\text{Ratio setting}}{100\%}$$

Required power supply capacity

The capacity required of a power supply for an inverter. This is calculated by solving either of the following equations and is stated in kVA.

Required power supply capacity (kVA)

$= \sqrt{3} \times 200 \times$ Input RMS current (200 V, 50 Hz)

Required power supply capacity (kVA)

$= \sqrt{3} \times 400 \times$ Input RMS current (400 V, 50 Hz)

Servo-lock

Holding the current position of the motor shaft at the stopped state in servo system under vector control with speed sensor, even if any external force is applied to the motor shaft.

Simultaneous keying

To simultaneously press two keys on the keypad, which is required for enabling some special keypad operations.

SINK or SOURCE

To switch the digital input modes between SINK and SOURCE with the hardware switch.

SINK mode, in which short-circuiting a digital input terminal with the common [CM] terminal transmits an input signal.

SOURCE mode, in which externally applying voltage signal (24 VDC) to a digital input terminal transmits an input signal.

Slip compensation

To compensate for decrease in motor rotation that is caused by slip of an induction motor, by increasing the inverter's output frequency in proportion to the increase of load torque.

Related function codes: P12

Speed control

Motor drive control that applies to a motor equipped with a speed sensor. The inverter controls the motor speed based on the actual speed detected by the speed sensor mounted on the motor shaft. (Ordinarily, an inverter controls the motor speed at a frequency.)

Related function codes: d01 to d04

Speed control accuracy

An index to show the stability of the motor shaft rotational speed relative to a given speed command under speed control. It is expressed in percentage (%) of the maximum frequency or the rated rotational speed (base speed) of the motor.

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Speed control range

An index to show the controllable speed range relative to the rated motor speed (base speed). It is expressed by a ratio, for example, 1:1500 that means the inverter is able to control the motor speed to 1/1500 of the rated speed.

Speed response

A performance index in speed control, which shows how many times the inverter can change the motor shaft rotational speed with commands in one second. If this index is 100 Hz, for instance, it means that the inverter can respond to up to 100 speed commands per second.

Standard motor

Fuji standard motors (8-, 6- and 9-series) which the inverter can drive by just configuring function codes P99, A39, b39 and r39.

Starting frequency

The initial frequency at which an inverter starts raising its output frequency.

Related function codes: F23, A12, b12 and r12

Starting torque

Torque that a motor produces when it starts rotating (or the drive torque with which the motor can run a load).

Stop frequency

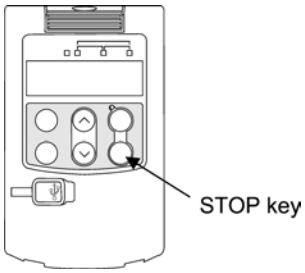
The output frequency at which an inverter stops its output in decelerate-to-stop operation.

Related function codes: F25

STOP key priority

Giving priority to the STOP key on the keypad, which always enables the STOP key during inverter running.

The STOP key priority can be enabled by function code H96 even if the STOP key is disabled by function code F02 or H30.



Switch to commercial power (***SW50***/***SW60***)

To switch the power source for three-phase induction motors between the inverter output and commercial power line. The switching sequence is integrated in the inverter.

Related function codes: E01 to E09, E98 and E99

Thermal time constant

The time needed to activate the electronic thermal overload protection when the preset level of motor current continuously has flowed.

Related function codes: F12, A08, b08 and r08

Thermistor

A kind of thermal sensors, which is classified into two types: PTC (Positive Temperature Coefficient) thermistors and NTC (Negative Temperature Coefficient) thermistors. As the temperature rises, the internal resistance of the PTC thermistors increases, and that of the NTC thermistors decreases.

Some regenerative braking resistors, cooling fans and motors have a built-in thermistor.

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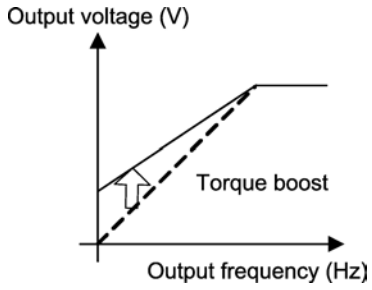
Torque boost

The compensation process for a voltage drop in a low frequency region when an inverter drives a three-phase induction motor.

In a low frequency range, a voltage drop reduces the motor output torque. To compensate for the decrease, this process raises the output voltage.

Related function codes: F09, A05, b05 and r05



Torque control

Controlling the motor output torque in vector control with speed sensor using the option card, in proportion to the analog input given at terminal [12]. It does not control the speed and amount of the motor rotation.

Transistor output

A solid-state digital output (signals), unlike a mechanical contact output such as a relay contact output. These signals output via terminals [Y1] to [Y4] and the reference potential terminal [CMY]. Function codes E20 to E23 assign functions to those terminals.

Trip

An inverter's output shutdown state in which an inverter goes when the protective function is activated due to an overvoltage, overcurrent, or any other unusual event. The inverter cannot run until the trip state is reset. The trip factor is displayed on the keypad.

Universal DI

To relay a digital signal sent from the peripheral equipment to the upper controller (e.g., PLC) using any of the input terminals (if free) on the inverter. The universal DI signal is independent of the inverter operation.

Related function codes: E01 to E09, E98 and E99

Universal DO

To relay a digital command signal sent the upper controller (e.g., PLC) to the peripheral equipment using any of the output terminals (if free) on the inverter. The universal DO signal is independent of the inverter operation.

Related function codes: E20 to E27

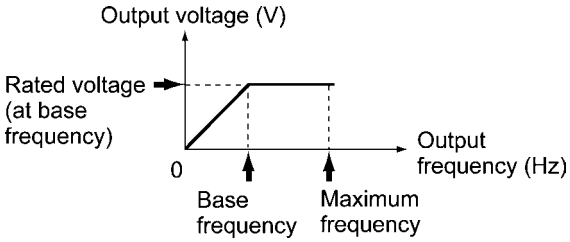
Variable torque load

A load whose torque varies in proportion to the square of the motor shaft rotational speed. Fans and pumps are typical variable torque loads. Using a suitable inverter for them yields energy-saving effect.

V/f characteristics

Characteristics of an inverter output, frequency "f" versus voltage "V." The graph below plots the output frequency along the abscissa, and the output voltage along the ordinate.

Related function codes: F04, F05, A02, A03, b02, b03, r02 and r03



V/f control

The rotational speed of a three-phase induction motor is calculated by the expression given below. A general-purpose inverter controls the motor speed by varying its output frequency (f).

In proportion to the output frequency (f), the V/f control varies the output voltage (V). Select the V/f control to drive more than one motor with a single inverter.

$$N = \frac{120 \times f}{p} \times (1 - s)$$

where,

N: Motor speed (r/min)
f: Output frequency (Hz)
p: Number of poles
s: Slip frequency

Vector control without speed sensor

Introduced in response to a strong demand from the market for a control mode using no speed sensor (PG: pulse generator) in environments where it is difficult to structurally mount a PG near the motor shaft or to suppress inductive noises on the PG signal wiring.

This control provides lower response and accuracy than the control with speed sensor.

Vector control with speed sensor

A high-performance, high-response control mode, in which an inverter processes motor data such as the actual motor speed and motor shaft rotational angle detected by the speed sensor (PG: pulse generator) for optimally controlling the motor rotor flux.

To achieve an optimal control performance, this control mode is usually selected when the inverter drives motors exclusively designed for vector control with the rated voltage of 180 VAC (360 VAC).

Vector motor

A generic term for motors applicable to the vector control. Fuji MVK motors driven by the FRENIC5000VG7 series of inverters are available.

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High Performance, Multifunction Inverter

FRENIC-MEGA

User's Manual

First Edition, June 2007
Third Edition, June 2009

Fuji Electric Systems Co., Ltd.

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

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